

**Exploring the responses of municipalities with the advent of rooftop solar  
PV using the approaches to ambidexterity**

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## **ABSTRACT**

Although challenging, successfully combining a dual strategy that simultaneously manages existing operations and supports radical innovation as a means of developing new revenue streams, is crucial for the survival of organisations within rapidly changing environments. Clear guidelines for the achievement of this approach, known as organisational ambidexterity, is not yet apparent from the literature or tacit knowledge systems. This study aimed to explore the extent to which municipalities are aware of the advent of rooftop solar (photovoltaic systems) and their use of ambidexterity, particularly its structural and contextual approaches, in response to the threat which these systems pose to the business models of local authorities.

The research was based on individual studies of three metropolitan municipalities. Semi-structured interviews were conducted with the participants and their responses were analysed from a behavioural viewpoint through an inductive approach.

The results showed that the respondents considered rooftop solar to be a significant threat to municipal revenues. The findings further indicated that the municipalities within the sample are responding to this threat in an incremental manner by increasing their operational efficiencies. Furthermore, two out three of the sample are implementing structural changes to their organisations. Both of these responses have been classified as following an 'intrapreneurship' model as per the proposed typology for ambidexterity. Although the respondents recognised the importance of radical innovation and understood the imperative of ambidexterity, it was apparent that their responses had not yet extended to radical innovation using either a 'laissez faire' or 'solar system' model. It was concluded that radical innovation should be actively pursued, preferably through external entities operating outside the framework of the daily operations and within an environment which allows for flexible and rapid responses to new opportunities.

**KEYWORDS**

Ambidexterity; business sustainability; municipalities; rooftop solar PV

## **DECLARATION**

*I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.*

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1 December 2020

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## **1.0 INTRODUCTION OF RESEARCH PROBLEM AND PURPOSE**

### **1.1 Introduction**

The economy of South Africa is driven by electricity which is largely sourced from Eskom, the South African national producer of electricity. It produces approximately 95 percent of the country's electricity requirements, which is largely supplied from fossil fuel. Municipalities purchase electricity from Eskom and onward sell it to the communities and constituents they serve. Eskom, in combination with municipalities, is also licenced by the National Energy Regulator of South Africa (NERSA) to distribute electricity to customers. Eskom acts on behalf of the municipality who has jurisdiction over the provision of services in that geographic area.

The world energy environment is changing and shifting away from the conventional fossil fuel source of electricity generation towards cleaner forms of electricity production. REN21 (2019) highlight in their latest release of the renewable landscape worldwide, that renewable capacity grew to 2 378 GW in 2018. The major contributors to this growth are from solar photovoltaics (PV) at 55 percent, wind power at 28 percent and hydropower at 11 percent (REN21, 2019). REN21 (2019) further highlights that solar PV and wind power sources have become cheaper than conventional fossil fuel sources. REN21 (2019) reports on certain drivers which encourage renewable energy within Cities around the world, namely, (a) climate change, (b) reduction in air pollution, (c) exploring new forms of job creation, (d) mitigating energy costs and the continuous focus to keep revenues locally, and (e) energy security.

This shift towards cleaner forms of electricity generation have seen the emergence of prosumers. Prosumers are commonly referred to consumers who no longer only consume electricity but now also produce electricity independently as well. The local municipalities and Eskom have always been the providers of electricity however, this reliance is beginning to shift to independent power producers and/or self-producers. REN21 (2019) highlights how local governments in certain countries have capitalised on the opportunity presented by renewable energy by (a) integrating solar PV into their building designs, (b) introducing electrically powered public transport, (c) using

waste and its associate biogases to generate electricity, and (d) diversifying into the sale, installation and maintenance of rooftop solar PV systems.

## 1.2 Research problem

The introduction of rooftop solar is beginning to have a bearing on the electricity distribution industry. Citizens and the community at large are increasingly adopting this new source of electricity (Bonneuil & Boucekkine, 2016; Hyysalo, Juntunan & Martiskainen, 2018; Ingold, Stadelmann-Steffen & Kammermann, 2019). Bonneuil & Boucekkine (2016) and Hyysalo et al. (2018) highlight that citizens adopt small-scale renewable energy technologies such as rooftop photo-voltaic installations due to climate change, costs of conventional power and legislation. In the South African context, a further driver has been Eskom's inability to maintain a reliable and stable supply (Joffe, 2012).

The introduction and adoption of rooftop solar PV poses an interesting challenge for companies responsible for the distribution of electricity (Bolton & Hannon, 2016; Piel, Hamann, Koukal & Breitner, 2017). This challenge emanates from, as exposed by Bolton & Hannon (2016), shrinking revenues as citizens adopt rooftop solar PV and a shift from the conventional to the alternative means of supply. The provision of electricity plays such an important role due to its social and economic development for citizens (Malanima, 2016; Monteiro, 2019; Statistics South Africa, 2017). Revenues from electricity sales serves to cross-subsidise other services for local government (Monteiro, 2019 and Statistics South Africa, 2017).

In order to remain sustainable, municipalities need to innovate (Nowacki & Monk, 2020; Ossenbrink, Hoppmann & Hoffmann, 2019). As clearly stated by Nowacki & Monk (2020), government in its intention to meet its obligations needs to simultaneously improve its performance and find creative solutions. The challenge for municipalities is to improve efficiency and maximise the opportunities which arise through the advent of rooftop solar PV (Ossenbrink et al., 2019). Such ambidextrous approaches will be required for municipalities to remain sustainable (Nowacki & Monk, 2020; Ossenbrink et al., 2019).

### 1.3 Purpose statement

The purpose of this study is to understand the ambidextrous approaches deployed by municipalities with the advent of rooftop solar PV (Nowacki & Monk, 2020; Ossenbrink et al., 2019). Ossenbrink et al. (2019) in their study demonstrated how the changing environment shaped certain organisations' application of ambidexterity approaches related to structure and context. There is limited insight into how organisations combine the different approaches (structural and contextual) in their quest for ambidexterity (Asif, 2017; Fourne, Rosenbusch, Heyden & Jansen, 2019; Ossenbrink et al., 2019). Fourne et al. (2019) confirm that there is value in exploring the joint use of the structural and contextual approaches to ambidexterity.

### 1.4 Document Structure

This research proposal contains seven sections which present the proposed research areas in details. The sections are structured as follows:

- a) **Section 1** focussed on the introduction, which detailed the problem currently impacting the business community and lastly, concluded with a purpose statement.
- b) **Section 2** focusses on a Literature Review – an academic literature review is undertaken to (a) highlight the local government industry, how it is mandated and its constitutional imperative to provide electricity to the local community, (b) highlight the trends in solar PV development worldwide but more specifically the South African uptake and impact, and (c) highlights the mechanisms of ambidexterity and the different approaches to ambidexterity.
- c) **Section 3** focusses on the five research questions which this study sought to explore.
- d) **Section 4** provides an indication of the research methodology and design which this study utilised, through a qualitative explorative individual study approach.
- e) **Section 5** details the analysed results which were undertaken through semi-structured interviews and secondary data from each municipality.
- f) **Section 6** reveals a discussion of the findings of the Research Questions including an inductive development of a proposed typology for ambidexterity.
- g) **Section 7** provides a conclusion to the research study and responds to its relevance to business and theory.

## **2.0 LITERATURE REVIEW**

### **2.1 Introduction**

This section undertakes an academic literature review to (a) highlight the local government industry, how it is mandated and its constitutional imperative to provide electricity to the local community, (b) highlight the trends in solar PV development worldwide but more specifically the South African uptake and impact, and (c) highlights the mechanisms of ambidexterity and the different approaches to ambidexterity.

### **2.2 Local Government**

#### **2.2.1 Constitutional Mandate**

Section 151 of the Constitution of the Republic of South Africa Act 108 (1996) sets out the status and authority of municipalities as the local arm of government. A municipality is given the right, subject to national and provincial legislation, to perform its function without interference from the other spheres of government (Constitution of Republic of South Africa Act 108, 1996). Section 153 of the Constitution of the Republic of South Africa Act 108 (1996), legislates the functions of the provision of the “basic needs of the community, and to promote the social and economic development of the community” (p. 74). The ability to cater for these basic needs is premised on a functional administrative body that is able to appropriately plan and budget for its constituency (Thobejane, 2011). The powers and mandate for the lower tier of government are served through the development of the White Paper on Local Government, 1998 (Christmas & Visser, 2009). The White Paper on Local Government (1998) outlined the fostering of collaborative relationships amongst local stakeholders to cater for the service delivery needs of the community. The improvement of the living conditions and livelihood of its citizens is a fundamental responsibility of local government as outlined in the white paper (Siddle & Koelble, 2017).

#### **2.2.2 Mechanism to fulfil mandate**

The Municipal Systems Act 32 (2000) provides the mechanisms through which municipalities can ensure the fulfilment of their constitutional mandate of catering for

the citizens within their jurisdiction. The entire community should not be prejudiced in any way but treated fairly by the municipality, receiving their basic services (Municipal Systems Act 32, 2000). The provision of the services should be in a responsible manner maintaining financial and environmental prudence (Municipal Systems Act 32, 2000). These services, as outlined in Schedule 4B and 5B of the Constitution of the Republic of South Africa (1996), include but not limited to, the provision of water supply, sanitation, refuse removal and electricity reticulation. Section 156 (1) of the Constitution provides both the legislative and administrative authority to municipalities to undertake this responsibility (Constitution of Republic of South Africa, 1996). These can be classified as essential municipal services which are to maintain the dignity and living conditions of the municipal citizens (Van Rooyen, 2018). Municipalities are expected to adhere to standards and ensure that quality is not compromised during the provision of services to the municipal citizens (Department of Public Service & Administration, 1997).

### 2.2.3 Electricity Provision

A municipality has been mandated with the responsibility for the provision of electricity reticulation however, this service is provided by both Eskom (national electricity producer) and the municipalities. The provision of electricity can be subdivided into three parts, namely generation, transmission and distribution or reticulation. Eskom is responsible for a majority of the generation capacity, solely responsible for the transmission and has joint responsibility with municipalities for the distribution of electricity. Eskom acts solely on behalf of thirty percent of the municipalities, providing electricity supply to their citizens (National Treasury, 2011). In other instances, both Eskom and the municipality provide electricity to the municipal residents, resulting in Eskom having approximately the same number of customers as municipalities (National Treasury, 2011). The provision of electricity is regulated through the Electricity Regulations Act 4 (2006) which is overseen by the NERSA (Electricity Regulations Act 4, 2006). The framework sets out the jurisdiction and conditions for operating a supply licence, the provision of a mandate to NERSA for the approval of electricity tariffs and the authority placed on NERSA to resolve disputes between customers and the licenced authority (Electricity Regulations Act 4, 2006).

#### 2.2.4 Revenue Generation

The income from the levied charges coupled with property rates serve as the main revenue stream of the municipality (Siddle & Koelble, 2017). Section 229 of the Constitution empowers municipalities to levy charges for the services they provide to their citizens (Constitution of Republic of South Africa, 1996). Whilst national government is also expected to provide funding to municipalities via the equitable share, it is not obligated if a municipality does not raise revenue from the services it provides (Section 227 of Constitution of Republic of South Africa, 1996). The White Paper on Local Government (1998) makes the assumption that municipalities are able to finance 90 percent of their expenditure via their own revenue which they generate. Electricity charges for electricity sold to customers is the largest revenue source for the municipalities (Elsasser, Hickman & Stehle, 2018). eThekweni Municipality's revenue from electricity sales accounts for 32.5 percent of the total municipal budget for the fiscal year 2020/2021 (eThekweni Municipality, 2020). Electricity sales serve as the greatest proportion of income of a municipality and it is used to cross-subsidised other municipal functions (Elsasser, et al., 2018).

#### 2.2.5 Municipal Sustainability

Sustaining the provision of electricity is crucial for the municipality to fulfil its service delivery mandate. However, there are certain factors which are impacting on its sustainability which can be summarised as (a) ageing infrastructure which leads to instability, (b) lack funding to perform maintenance, and (c) lack of competent skills to manage its infrastructure (Siddle & Koelble, 2017). Whilst focusing on these factors in order to maintain electricity provision, the municipality should also be projecting for growth and evaluating different supply options (Van Rooyen, 2018). Adequate legislation exists for the municipality to exercise its constitutional mandate when distributing electricity as procured from Eskom. The Municipal Finance Management (MFMA) Act 56 (2003) does not preclude any municipality from producing their own electricity. The MFMA is normally only viewed as a mechanism to ensure sound financial management. However, it can also be viewed in its broader context of ensuring the sustainability of municipal services (Reinecke, Leonard, Kritzing, Bekker & Thilo, 2013). The NERSA oversees the allocation of a generation licence as empowered by the Electricity Act. REN21 (2019) highlights how local governments in certain countries have capitalised on the opportunity



presented by renewable energy by (a) integrating solar PV into their building designs, (b) introducing electrically powered public transport (c) using waste and its associate biogases to generate electricity, and (d) diversifying into the sale, installation and maintenance of rooftop solar systems. Shannon (2016) stated that the electric utility should introduce of a variety of options for customers to choose from in order for customers to take control of their energy needs. The introduction of unbundled rates for tariffs provide greater transparency and flexibility for customers (Shannon, 2016). Dantas, de Castro, Brandao, Rosental, Lafranque (2017) have argued that the customer of the twenty-first century is more exposed to information and technological advancements hence, changing their behaviour and becoming more cognisant of sustainability.

#### 2.2.6 Conclusion

This section has demonstrated the mandate that the lowest tier of government holds which is contained in the Constitution of South Africa and its role of electricity provision. Further the MFMA does not hinder municipal electricity generation but creates a mechanism for sustainability.

### 2.3 Rooftop Solar Photovoltaics (PV)

#### 2.3.1 Worldwide Trends

A shift away from fossil fuels as an energy source to renewable sources is considered a crucial imperative at the moment (Johnson & Oliver, 2019). This is mainly due to climate change considerations and the rising costs of fossil fuel technologies (Dijkgraaf, van Dorp, & Maasland, 2018). International agreements such as the Kyoto Protocol as well as the Paris Agreement have been crucial in nudging this trend over the last few years (Dijkgraaf et al., 2018; Johnson & Oliver, 2019). This has also seen a number of governments review their policy arrangements including the introduction of incentives to steer the industry towards renewable energy source production (Jenner, Chan, Frankenberger, Gable, 2012).

#### 2.3.2 Expansion of Solar PV

Amongst the various renewable energy technology sources, solar PV, is on the increase worldwide (Ntsoane, 2017). The growth of solar PV has outpaced other

known renewable energy sources (such as wind, biomass and geothermal), with an annual average increase of 25 percent, up from 405GW in 2017 to 505GW in 2018 (REN21, 2019). There has been increasing development of research and development in solar PV which has seen significant improvements in the technology (Dijkgraaf et al., 2018). The manufacture and production of solar PV material has also increased, coupled with an establishment of a competitive market which has resulted in a reduction of cost of solar PV systems (Bordigoni & Gilotte, 2017; Dijkgraaf et al., 2018). The growth in production of solar PV materials is due to the advances in technology (Ghandi, Kumar, Rodriguez-Gallegos & Srinivasan, 2020). The cost of solar PV systems is now considered much cheaper than the traditional fossil fuel energy sources (Dijkgraaf et al., 2018). Whilst there has been an increase in solar PV system deployment around the world, this growth is dependent on the potential of the local solar energy source (Enongene, Abandab, Otenec, Obid & Okafore, 2019; REN21, 2019).

According to Enongene et al. (2019), 54% of Nigeria's 2030 renewable energy targets are composed of solar PV. A clear example of how the penetration of solar PV is increasing around the world. The Nigerian authorities argue that these figures are achievable given the radiation levels and location of the country (Enongene et al., 2019). On the other hand, Janko, Arnold & Johnson (2016) highlight that the annual growth rate of solar PV installations with the United States of America is approximately 58 percent with a majority of installations generating in excess of the load requirements. A review of the country's energy policy and strategic goals have driven the growth in the penetration of solar PV (Pacudan, 2018). National and Local government plays a key role in stimulating the growth of solar PV as depicted in existing literature hence, the need for the South African government to create a conducive environment to stimulate its growth in South Africa.

### 2.3.3 Solar PV growth in South Africa

The penetration of solar PV systems within South Africa have been on the increase over the last few years as seen in Figure 1 (AREP, 2019). The main drivers for this increase in penetration have been due to a combination of factors, namely rapid decrease in the cost of PV technology, an increase in the electricity prices and

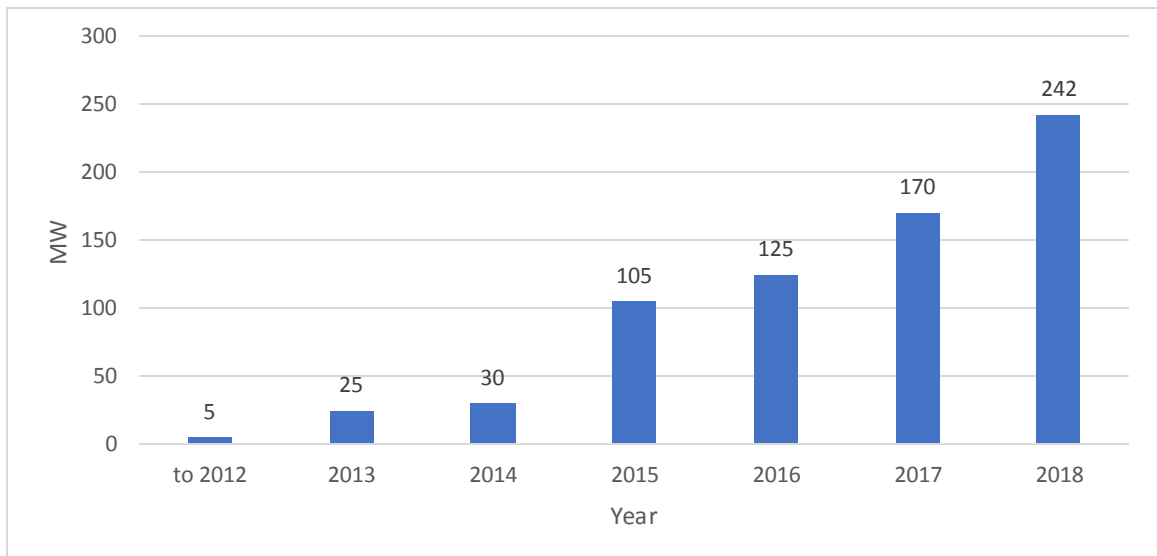
persistent load shedding (Bonneuil & Boucekkine, 2016; Garcez, 2017; Hyysalo et al., 2018; Janko et al., 2016; Joffe, 2012; Korsten, Brent, Sebitosi & Kritzinger, 2017). De Groote, Pepermans & Verboven (2016) argue that the introduction of a net-metering tariff coupled with a surcharge for the use of the grid based on the kWh consumption has improved PV adoption, especially in high income households. Resistance to embrace solar PV in various regions, including South Africa, have been due in the main to, (a) lack of the basic understanding of the entire PV system, (b) inferior product quality, (c) lack of appropriate technical and management expertise for these PV systems, (d) high initial costs for investment in PV systems, and (e) lack of appropriate policies to clarify the regulatory environment to unblock this potential energy source (Karakaya & Sriwannawit, 2015). Sommerfeld, Buys & Vine (2017) argue that policy clarity introduces economic, social and environmental incentives for the adoption of solar PV. Local municipalities have been at the forefront of providing incentives and subsidies to promote the adoption of solar PV (De Groote et al., 2016).

The increase in the installation of solar PV systems lead to a decline in the consumption from the municipal network. Janko et al. (2016) indicates that a one percent increase in solar PV resulted in a proportionate one percent decrease in revenue. A decline in consumption may threaten the revenue of the municipal due to its reliance on electricity sales to support its budget. Literature is varied on the extent to which the municipal revenues will be impacted by the uptake in solar PV. Casteneda, Jimenez, Zapata, Franco & Dyer (2017); Janse van Rensburg, Brent, Musango & De Kock (2018); Korsten, et al. (2017); Korsten, Kritzinger, Scholtz & WWF-SA (2019); Trollip, Walsh, Mahomed & Jones (2012) concur that municipal revenue would be significantly impacted by the uptake of solar PV. Trollip et al. (2012) highlight that the revenue loss could even be between 17 percent and 25 percent. Reinecke et al., (2013) and Walwyn (2015), on the other hand, consider that the revenue loss will be negligible, possibly less than one percent. Satchwell, Mills & Barbose (2015) have observed that the uptake in solar PV is directly proportional to the loss in revenue however, this may not necessarily lead to a death spiral. The most recent view is that the uptake in the solar PV installations will have an impact on municipal consumption (Korsten et al., 2019). Pacudan (2018) has supported this

view that the considerable uptake in solar PV has had a negative impact on the utility due to a reduction in grid consumption.

#### 2.3.4 Challenges in Solar PV

The growth in penetration of solar PV has also had introduced significant challenges (Ghandi et al., 2020). Tarai & Kale (2018) state that a major challenge to the uptake of solar PV within the Indian context had been the rigid and unfavourable existing electricity policy framework. The tenets of this policy did not create a conducive environment for the adoption of solar PV. Technical challenges relating to quality of supply issues such as harmonics, voltage fluctuations, voltage unbalance, grid frequency all negatively impact on the grid (Ghandi et al., 2020). Muslim (2019) has also stressed the fact that technical obstacles are one of the major challenges in the implementation of solar PV. On the other hand, Agostini, Nasirov & Silva (2016), state that the major challenges experienced in Chile related to (a) a lack of institutional capacity – the institutions and systems are not geared for PV deployment, (b) deficiencies in resource management – the available resources are not appropriately skilled and managed, and (c) marginalisation of the indigenous community where PV is to be deployed – lack of involvement from the community. These challenges if inappropriately managed may serve as barriers to the uptake of solar PV or serve as opportunities to unlock the potential of solar PV. The need to review the electricity policy framework seems to be a common challenge around the world justifying the need for the involvement of government.



*Figure 1: Additional Rooftop Solar PV installed in South Africa up to 2018 (Adapted from AREP, 2019)*

#### 2.3.4 Conclusion

This section provided a clear indication of the growth of solar PV and its potential impact on municipal consumption. Municipalities need to adhere to their constitutional mandate and remain sustainable through the alignment of their processes to improve efficiency and maximise on the opportunities presented by the advent of solar PV, which is the focus of organisational ambidexterity (March, 1991).

### 2.4 Ambidexterity

#### 2.4.1 Definition

Organisational ambidexterity can be viewed as the simultaneous focus of the opposing forces of exploitation and exploration (March, 1991). As argued by Kobarg, Wollersheim, Welppe & Spörrle (2017), research work around organisational ambidexterity is quite limited. Hence, a more applicable definition focusing on the local government context is required. Organisational ambidexterity serves as a framework for organisations to simultaneously align their business operations and processes to improve efficiency (incremental change) whilst being adaptive to innovation (rapid innovation) and the changing environment (Birkinshaw & Gibson, 2004). Unlike Birkinshaw & Gibson, however, Nieto-Rodriguez (2014) embraces the idea that organisational ambidexterity is seeing this tension between running the existing business (perspective of exploitation) versus changing to a new business

model (exploration). Previous research has established that these definitions of organisational ambidexterity are useful depending on the sector in which theoretical studies are being undertaken.

#### 2.4.2 Mechanisms of Ambidexterity

The right blend of incremental change and radical innovation is crucial to the success of any organisation (Fourne et al., 2019; O'Reilly & Tushman, 2013). Incremental change is considered as improvements to processes and optimising existing work functions thereby becoming more efficient (March, 1991). Rapid innovation involves flexibility in function, innovation and consideration for different and creative methods for improvement (March, 1991). Ambidexterity within an organisation has since been considered as the ability to undertake exploitation and exploration at the same time (O'Reilly & Tushman, 2013). Lavie, Stettner & Tushman (2010) confirm that much research has been devoted to the constructs of exploitation and exploration. Whilst Lavie et al. confirm that much research has been devoted to the constructs of exploitation and exploration, Kobarg et al. (2017) has taken a different view that not much studies have been given to these constructs within the local government sector. Kobarg et al. (2017) argue that the constructs of exploitation and exploration within local government can be associated with incremental changes in business processes and customer service for exploitation and the introduction of new products and/or services for exploration. Recently, the study of Palm & Lilja (2017), demonstrated that the bureaucratic nature of local government coupled with a functional structure shows the difference in organisational ambidexterity between the private and public sector.

#### 2.4.3 Approaches to Ambidexterity

Ossenbrink et al. (2019) in their study demonstrated how the changing environment shaped certain organisations' use of the structural and contextual approaches to ambidexterity. Much of the research define the structural approach to achieving ambidexterity as the clear separation of the functions of process alignment to achieve efficiency and innovative adaptation (O'Reilly & Tushman, 2013). This would entail the establishment of separate organisational structures to focus on, and achieve, each ambidextrous mechanism (O'Reilly & Tushman, 2013). The separation of function allows for specialisation but also introduces additional systems and perpetuates a silo mentality (Fourne et al., 2019). The contextual approach, on the

other hand, does not focus on any structural separation but rather on a behavioural view of the use of both mechanisms, namely, incremental change and radical innovation (Birkinshaw & Gibson, 2004). The duty of the organisation is to create a conducive environment to allow for employees to understand when and how best to apply the two mechanisms (Ossenbrink et al., 2019). Considerable studies have been undertaken of the structural and contextual approaches to ambidexterity (Fourne et al., 2019).

Literature is mixed in terms of the ambidextrous approach organisations should follow. Nowacki & Monk (2020) argue that radical innovation, a form of ambidexterity, is best achieved through a structural ambidextrous approach. This is supported by the work of Fourne et al. (2019) which stated that organisational ambidexterity is best achieved via a structural approach regardless of the size of the organisation. Marri, Soo & Ali (2019) expanded on this work by highlighting the fact that structural separation is not achievable in resource constrained organisations and have suggested four approaches based on the mechanistic and organic organisational structures. The introduction of the structural approach helps separate the ongoing organisational operations from any innovative work (Jansen, Tempelaar, van den Bosch & Volberda, 2009). Jansen et al. (2009) further argue for need to integrate the two organisational components through a formal separation of function but an informal connectedness of senior management.

On the other hand, Lavikka, Smeds & Jaatinen (2015) argue that organisational ambidexterity can be achieved solely through a contextual approach. This was demonstrated via three developmental interventions, namely, (a) cross inter-organisational knowledge boundaries, (b) creating common understanding of the collaborate process, and (c) co-developing the coordination mechanism for the continuous achievement of ambidexterity (Lavikka et al., 2015). The study by Asif (2017) supports this finding and proposes that the contextual approach is more appropriate as it focuses on the development of processes and systems whilst the structural approach propagates a silo mentality of incremental change and radical innovation.

Organisations are expected to combine the use of both structural and contextual approaches. However, there is limited insight into how organisations combine the

different approaches (structural and contextual) in their quest for ambidexterity (Asif, 2017; Fourne et al., 2019; Ossenbrink et al., 2019). Further to the above, Fourne et al. (2019) confirm that there is value in exploring the joint use of approaches to ambidexterity. Until now, the rich body of knowledge on municipalities response to the advent of solar PV utilising the approach to ambidexterity has not been fully accumulated (Hoon, 2013). This study seeks to add to the body of knowledge by exploring the approaches deployed by municipalities in their quest to be ambidextrous due to the advent of rooftop solar PV.

## 2.5 Conclusion

The academic literature has demonstrated the obligation municipalities hold for the provision of services to its citizens, including electricity. It also has been observed that solar PV is on the increase, driven by industry with certain government incentives. Solar PV does impact on the municipalities however, there is no consensus as to the extent of this impact. Organisational ambidexterity has been introduced as a form of ensuring that municipalities continue to remain sustainable through the combined alignment of its processes and maximising innovative opportunities presented by solar PV. The unanswered question is how this should be undertaken by municipalities within South Africa.



### 3.0 RESEARCH QUESTIONS

#### 3.1 Research Question 1

***RQ1.** Describe how municipalities have responded to the advent of rooftop solar PV?*

The main drivers for this increase in penetration have been due to a combination of factors, namely rapid decrease in the cost of PV technology, an increase in the electricity prices and persistent load shedding (Bonneuil & Boucekkine, 2016; Garcez, 2017; Joffe, 2012; Hyysalo et al., 2018; Korsten et al., 2017).

The aim of this question is to understand if municipalities are aware of the growth of solar PV and the shift of consumers away from conventional grid supply. What, if any, measures are the metro municipalities implementing in response to the advent of solar PV.

#### 3.2 Research Question 2

***RQ2.** What is the understanding of the advent of rooftop solar PV on municipal revenue?*

Casteneda et al. (2017); Janse van Rensburg et al. (2018); Korsten, et al. (2017); Korsten et al. (2019); Trollip et al. (2012) concur that municipal revenue would be significantly impacted by the uptake of solar PV. Trollip et al. (2012) highlight that the revenue loss could even be between 17 percent and 25 percent. Reinecke et al., (2013) and Walwyn (2015) consider that the revenue loss will be negligible possibly less than one percent.

The aim of this question is to understand whether rooftop solar has had any impact on municipal revenue. If so, to what extent and what measures have been introduced by the municipality to mitigate this.

#### 3.3 Research Question 3

***RQ3.** Describe the options available to municipalities given the changes in their core market?*

REN21 (2019) highlights how local governments in certain countries have capitalised on the opportunity presented by renewable energy by (a) integrating solar PV into their building designs, (b) introducing electrically powered public transport (c) using waste and its associate biogases to generate electricity, and (d) diversifying into the sale, installation and maintenance of rooftop solar systems.

The aim of this question is to determine whether municipalities have identified any opportunities outside of their core market to remain sustainable.

#### 3.4 Research Question 4

***RQ4. Describe how the Municipality has attempted to change or has changed its business operations and processes to improve its service delivery in an incremental fashion in response to the advent of rooftop solar PV?***

Ossenbrink et al. (2019) in their study demonstrated how the changing environment shaped certain organisations' use of the structural and contextual approaches to ambidexterity. However, there is limited insight into how organisations combine the different approaches (structural and contextual) in their quest for ambidexterity (Asif, 2017; Fourne et al., 2019; Ossenbrink et al., 2019).

The aim of this question is to understand if municipalities are improving the efficiency of their existing systems.

#### 3.5 Research Question 5

***RQ5. Describe how the Municipality has attempted to radically innovate and adopt new forms of service provision for electricity in response to the advent of rooftop solar PV?***

Ossenbrink et al. (2019) in their study demonstrated how the changing environment shaped certain organisations' use of the structural and contextual approaches to ambidexterity. However, there is limited insight into how organisations combine the different approaches (structural and contextual) in their quest for ambidexterity (Asif, 2017; Fourne et al., 2019; Ossenbrink et al., 2019).

The aim of this question is to understand if municipalities are maximising on the innovative opportunities presented by rooftop solar PV.

## **4.0 RESEARCH METHODOLOGY**

### **4.1 Introduction**

This chapter describes the research methodology and design used for this study in order to respond to the research questions presented in Chapter 3. The study utilised an inductive, qualitative research methodology due to limited knowledge of the approaches to organisational ambidexterity within the public sector. An individual study approach was chosen to assess the management practices of the various municipalities due to the advent of rooftop solar PV.

This study utilised a combination of data collection tools such as semi-structured interviews which were undertaken virtually utilising electronic platforms and the analysis of secondary data from each of the municipalities such as annual reports, strategy documents and business plans. The data was then analysed within each individual study as well as a cross individual study comparison to develop themes which emerged from the data.

Potential concerns relating to data reliability and validity were considered by the researcher during the data collection and analysis. Various strategies such as triangulation were deployed to enhance the quality of the data. Prior to data collection, the researcher acquired ethical clearance and prior consent was obtained from the participants by having the consent forms completed and signed which assured confidentiality.

### **4.2 Choice of Research Methodology and Design**

This study sought to understand the perspective of the individual organisation in relation to organisational ambidexterity within a relatively unexplored context of rooftop solar PV. As stated by Kobarg et al. (2017), research into organisational ambidexterity specifically within the public sector is limited. A qualitative methodology was used due to its ability to assist in discovering a phenomenon when little is known about it (Thornhill, Saunders & Lewis, 2009). The philosophical perspective of interpretivism places significant attention on an individual's interpretation of the social world and both the researcher and research subject's understanding of the

phenomenon under study (Ritchie, Lewis, Nicholls & Ormston, 2013). An interpretivist philosophy was chosen in order for the researcher to wear the shoes of the research subject and walk a distance in them, thereby understanding their perspective (Thornhill, Saunders & Lewis, 2009). The use of an interpretivist qualitative philosophy provided additional benefits for this study. These included the ability of the researcher to gain an in depth understanding of the ambidextrous approaches by municipalities. Further to the above, the results of this study produced thick description, with sufficient detail and the ability to display how municipalities approach rooftop solar PV in an ambidextrous manner.

Easterby-Smith, Golden-Biddle & Locke (2008) suggested that the choice of research approach is critical as it helps choose the research design from a basis of knowledge and allows for clarity of mind in the selection of the strategy. There was limited literature to address the research questions which are crucial for business and the development of theory (Eisenhardt & Graebner, 2007). An inductive approach was chosen for this study which followed on the work of Bonesso, Gerli, & Scapolan (2014) and Aoki & Wilhelm (2017) in support of their choice of design and strategy which ultimately led to the development of theory from the views, perspectives and feelings of their respondents. This study explored the current ambidextrous approaches by municipalities with the advent of rooftop solar PV where the researcher was able to develop theory.

A single data collection and analysis capability was used following the inductive approach hence, a qualitative mono-method is used (Thornhill et al., 2009). The integrity of the research was enhanced through a form of triangulation by the use of multiple data types as well as multiple data sources (Eisenhardt, 1989). The multiple data types included primary data collection via semi-structured interviews as well as secondary data collection via municipal annual reports, documents from municipal websites and organisational strategy documents. The multiple data sources included respondents from the different municipalities.

There was limited insight into how organisations combine the different approaches (structural and contextual) in their quest for ambidexterity (Asif, 2017; Fourne et al., 2019; Ossenbrink et al., 2019). This study sought to explore the ambidextrous approaches deployed by municipalities with the advent of rooftop solar PV (Nowacki

& Monk, 2020; Ossenbrink et al., 2019). The study explored secondary data and conducted interviews hence, an explorative research design was chosen for this study. This was in line with Thornhill et al. (2009) who stated that explorative research design was the ability to search for new understanding, gaining clarity and reviewing theory in a new paradigm.

An individual study approach was chosen to assess the management practices of the various municipalities due to the advent of rooftop solar PV. The interest was understanding the 'how' and 'why' of a particular phenomenon hence, the individual study was applicable (Yin, 2017). In a recent article, Ossenbrink et al. (2019) argued that individual studies offer valuable insights in phenomenon where little research may exist. The Eisenhardt (1989) & Hoon (2013) eight step process for individual study research was adopted for this study due its thorough perspective and ease of application. The eight step process involved the following:

- a) Development of the research question(s) – Chapter 3 highlighted the research questions for this study;
- b) Identification of relevant literature – Chapter 2 provided an exhaustive theoretical background to the study area;
- c) Identification of criteria used to select individual studies – was undertaken within this chapter;
- d) Data collection and coding - this chapter indicated the methods used;
- e) Within case analysis – these results were presented in Chapter 5;
- f) Cross-individual study pattern development – Chapter 5 presented this analysis;
- g) Discuss of findings and theory building – Chapter 6 provided this discussion and comparison with similar and conflicting literature and
- h) Conclusion of study.

The study related how the approaches to ambidexterity were applied within a municipality and why these approaches were deployed. Within individual study as well as cross individual study comparisons were undertaken which followed on the work of Aoki & Wilhelm (2017); Costanzo (2019); Nowacki & Monk (2020); Ossenbrink et al. (2019). Each organisational context was unique whilst operating under similar pressures to deliver and maintain services to the community it serves.

The study developed an understanding at the current point in time, where interviews were conducted once during 2020, and acknowledged the time constraints around the completion of this research. According to Saunders & Lewis (2018), this data collection approach was based on a cross-sectional time horizon. Thornhill et al. (2009) pointed out that the individual study strategy which is based on interviews can be undertaken over a short period of time.

This study utilised semi-structured interviews which were undertaken virtually utilising electronic platforms. The use of semi-structured interviews allowed the researcher to gain in depth insights from the respondents with regard to their ambidextrous approaches within their municipality due to the advent of rooftop solar PV. Interview questions were structured around the research questions. The use of semi-structured interviews in an exploratory study is very useful in gaining deep insights into a phenomenon under study (Thornhill et al., 2009).

The research question in Chapter 3 followed a twostep approach. Firstly, Research Question 1 to Research Question 3 established the existence of rooftop solar PV within municipalities and the extent to which this is impacting the municipalities. Lastly, Research Questions 4 and 5 addressed the approaches deployed by municipalities in their quest for organisational ambidexterity due to the advent of rooftop solar PV.

#### 4.3 Population

Thornhill et al. (2009, p. 212) defines a population as, “the full set of cases from which a sample is taken”. This study sought is to explore the ambidextrous approaches deployed by municipalities with the advent of rooftop solar PV (Nowacki & Monk, 2020; Ossenbrink et al., 2019). As the research focussed specifically within the South African context, the population for this study referred to all municipalities who are licenced by the NERSA to distribute electricity in the country with specific emphasis on the top management and senior management of the electricity municipalities. South Africa consists of 278 municipalities including eight metropolitans (Local Government, 2020). From this number, approximately 174 municipalities and Eskom are licenced by NERSA to distribute electricity (Baker & Phillips, 2019).

#### 4.4 Unit of Analysis

This study explored the characteristics of each municipality with the advent of rooftop solar PV for which the type of characteristics explored were identified in the research questions. Hence, the unit of analysis for this study focused on the municipal level.

#### 4.5 Sampling Method and Size

Purposive sampling was chosen for this particular study which was based on the ability of the researcher to select individual studies which best responded to the research questions (Thornhill et al., 2009). The participants for this research were deliberately chosen due to their ability to fulfil the objectives of the study. Due to their knowledge, experience and being the only service providers within the field of local government having encountered rooftop solar PV, metropolitan municipalities were chosen to respond to the research questions. The choice of these municipalities was useful due to their different approaches to organisational ambidexterity and level of maturity of solar PV management. The selection of multiple individual studies was not chosen at random which also allowed for the findings to be duplicated (Eisenhardt, 1989 & Ossenbrink et al., 2019).

This study was focused on three of the four frontrunner municipalities which have been impacted by the advent of rooftop solar PV within the South African population of municipalities. The researcher was not able to acquire permission from the fourth municipality to undertake the research by the time this study was concluded. These municipalities were ideal for exploring the research questions and also allowed for cross-individual study comparative analysis as well (Costanzo, 2019; Ossenbrink et al., 2019). The non-probability purposive homogenous sample, which included these three municipalities, for this study were chosen based on the following criteria:

- a) Municipalities operating within local government in South Africa;
- b) Category 'A' metropolitan municipalities;
- c) NERSA licenced supplier of electricity;
- d) Amongst the top performing electric municipalities in the country;
- e) Have considered and are responding to rooftop solar PV; and
- f) Each municipality has a heavy hierarchical structure.



Table 1 reflects the sample size and representation of the participants per municipality.

Table 1: Distribution of Sample Size

Municipality	Number of participants
MM01	3
MM02	4
MM03	2

Data should be gathered until the rate at which new codes emerge declines sufficiently to achieve code saturation (Thornhill et al., 2009). For this study, code saturation emerged by the tenth interview with only five new codes being identified. The researcher chose to cease any further data collection due to time constraints. Figure 2 illustrates the number of codes created over the data analysis.

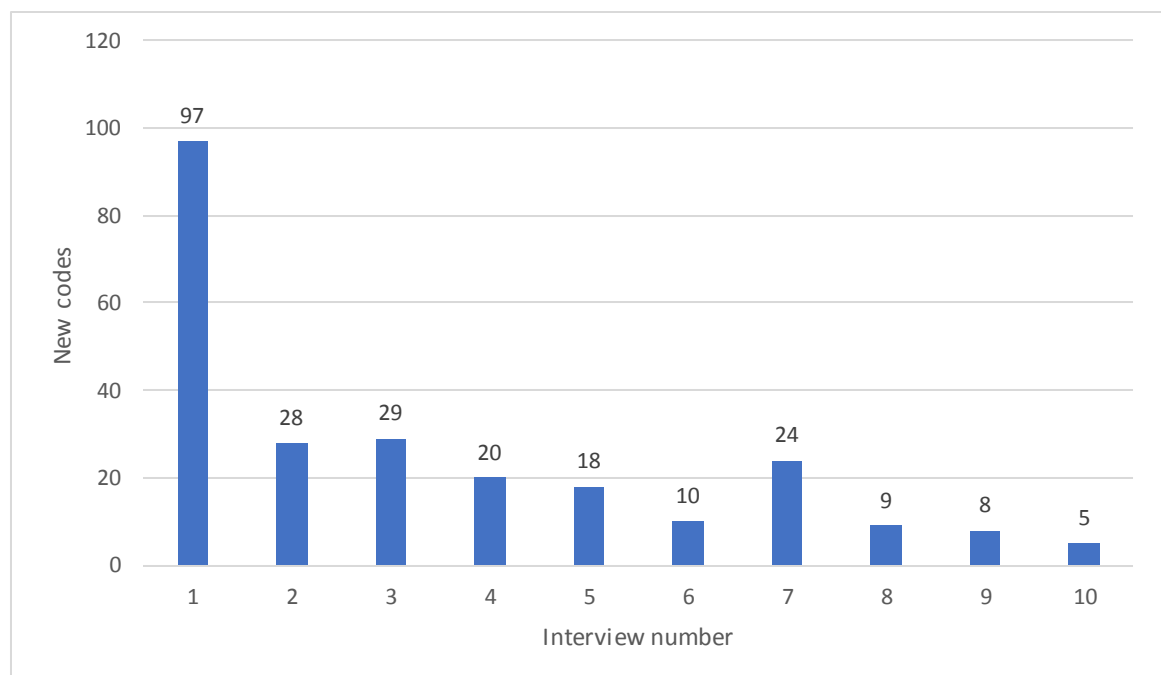


Figure 2: List of new codes

Secondary data was also analysed together with the primary data. An illustration of the code creation referenced from the primary data code creation is shown in Figure 3.

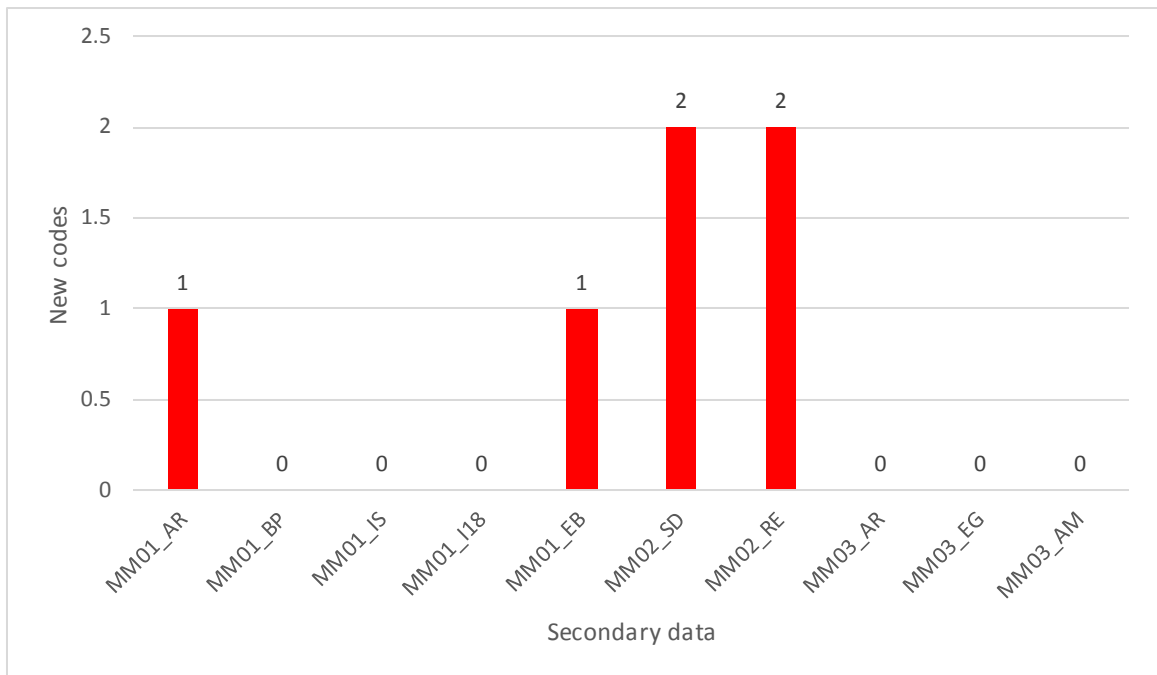


Figure 3: List of secondary data codes

#### 4.6 Measurement Instrument & Data Collection Tool

The researcher developed an interview guide as the structured tool which allowed for consistency in data collection around the theme of each research question. The development of this interview guide (Appendix 4), allowed for flexibility in how the questions were posed to the research participants hence, semi-structured face-to-face interviews were undertaken (Thornhill et al., 2009). The objective of these questions will be to gain insights, personal beliefs and considered opinions into (a) the level of ambidexterity within each organisation (Ossenbrink et al., 2019), (b) identification of the ambidextrous approach applied by each organisation either structured or contextual (Fourne et al., 2019), (c) whether a combination of ambidextrous approaches is applied (Nowacki & Monk, 2020; Ossenbrink et al., 2019;), and (d) how municipalities have responded to the advent of rooftop solar PV.

Following guidelines from Thornhill et al. (2009) and Yin (2017) a vast spectrum of data was collected from different sources. These sources include primary data from semi-structured interviews and an analysis of secondary data from each organisation such as annual reports, organisation strategy, business plans and presentations on relevant topics (Ossenbrink et al., 2019).

In order to mitigate any data quality issues which may have arisen during the interview process, the researcher undertook a pilot of the interview questions with a single participant. The results from this interview was analysed for clarity of questioning and for any ambiguity in the research questions. This interview result was included with the balance of the interviews for data analysis and development of emerging themes. This process allowed the researcher to uncover any problems with the interview questions (Thornhill et al., 2009). The areas of data quality acknowledged by the researcher which may have arisen were reliability of the data, bias and validity. The researcher kept an open mind and allowed the participants to be free to share. All notes pertaining to the research design and strategy choice were recorded and saved. Adequate preparation was followed as provided for with the guidelines stated by Thornhill et al. (2009), namely:

- a) The researcher was knowledgeable about the research topic;
- b) The researcher provided background information as well as definitions of terms used as necessary to each respondent prior the interview;
- c) The researcher ensured that the medium for the interviews was conducive; and
- d) The researcher was open to questions from the respondents.

#### 4.7 Data gathering process

Two separate processes for data collection were undertaken as follows, (a) primary data via semi-structured interviews and (b) secondary data via the collection of all organisational documents. The semi-structured interviews were conducted with highly knowledgeable respondents who have a broad view of the industry, holding diverse perspectives and had the necessary expertise and experience needed to provide key insights into this area of study. All interviews were conducted by the researcher to maintain consistency in type of questioning and process.

The interview guide developed by the researcher detailed the purpose of the interview and overall research objective including how the interview will unfold. Each participant was sent a formal invitation, via email, followed by a telephone call which included a brief on the research topic. All interviews were conducted virtually via the video conferencing platform, Microsoft Teams, at the convenience of each of the participants.

Prior to data collection, the researcher acquired ethical clearance from the Ethics Committee of the Gordon Institute of Business Science (Appendix 2). Prior consent was obtained from the participant by having the consent forms completed and signed (Appendix 3 for sample of Consent Form). The respondents as well as the municipalities were assured confidentiality as they were given pseudonyms in order to protect the identity of each respondent and municipality. All the interviews were conducted by the researcher via the electronic Microsoft Teams video conferencing platform, due to limitations in conducting face to face interviews. The duration of the interviews ranged from 30 minutes (for the shortest interview), to 91 minutes (for the longest interview), with an average interview duration of 56 minutes. All interviews were conducted in English which were recorded and transcribed in order to perform the thematic analysis.

#### 4.8 Data Analysis Approach

As stated, this research identified an inductive approach wherein theory or a framework will emerge from the analysis of the data. As per Braun & Clarke (2013), these stages of thematic analysis were followed by the researcher, which include:

- a) Stage 1 – Transcription (all interviews were transcribed by the researcher for consistency);
- b) Stage 2 – An understanding was obtained by the researcher of the contents of each of the transcripts;
- c) Stage 3 - Performing coding of the data;
- d) Stage 4 – Identification of emerging themes from the data;
- e) Stage 5 – Assessment of the sub-themes per individual study and resultant themes;
- f) Stage 6 - Writing final analysis; and
- g) Stage 7 – Development of a design framework for the approaches to organisational ambidexterity by the municipalities due to the advent of rooftop solar PV.

To support the analysis of the data, the computer aided qualitative data analysis software, ATLAS.ti was utilised. Participant interview transcripts were coded until saturation was achieved. Codes, categories and sub-themes which emerged during

the analysis were reviewed within each individual study and cross-case patterns emerged with the development of themes responding to the research questions (Hoon, 2013).

#### 4.9 Data Quality Controls

Following guidelines from Thornhill et al. (2009) and Yin (2017), a vast spectrum of data should be collected from different sources. This will enhance the quality of the data collected as well as during data analysis through the use of triangulation (Yin, 2017). This study has employed three forms of triangulation to enhance the quality and improve the validity of the data collected and analysed.

##### 4.9.1 Data triangulation

The study deployed multiple data types which included primary data such as semi-structured interviews as well as the analysis of secondary data from each organisation such as annual reports, organisation strategy, business plans and presentations on relevant topics (Ossenbrink et al., 2019).

##### 4.9.2 Respondent triangulation

The integrity of the research was enhanced through a form of triangulation by the use of multiple data sources (Eisenhardt, 1989). The multiple data sources included respondents from the different municipalities throughout South Africa with the knowledge, expertise and experience within this subject area.

##### 4.9.3 Method triangulation

In order to improve the confidence in findings especially within individual study research, the deployment of within individual study analysis and cross individual study analysis is critical (Yin, 2013). Within individual study as well as cross individual study comparisons were undertaken which followed on the work of Aoki & Wilhelm (2017); Costanzo (2019); Nowacki & Monk (2020); Ossenbrink et al. (2019). Each organisational context was unique whilst operating under similar pressures to deliver and maintain services to the community it serves.

All interviews will be conducted in person or virtually and will be electronically recorded with brief notes captured thereafter, the electronic recordings will be transcribed at the end of the day.

#### 4.10 Limitations

The limitations related to this study included the following:

a) Time horizon:

Whilst acceptable as per Thornhill et al. (2009) for the study to be conducted in a cross-sectional time horizon which this study followed, it is of greater benefit to undertake a longitudinal study as per Ossenbrink et al. (2019).

b) Access to other metropolitan municipalities:

The study was able to gather data to produce valuable findings from the expertise of participants from various municipalities however, the researcher was unable to obtain access to participants from two metropolitan municipalities.

c) Access:

Due to the ongoing pandemic, the researcher was impeded from acquiring access to the municipalities sites to conduct observations of their operations.

d) Researcher bias:

Within qualitative research, the risk of researcher bias is introduced. Due to the researcher also employed within the field of this study, this further emphasises the risk. However, the researcher mitigated this by exercising restraint in imparting their knowledge and expertise into the data which was collected and allowed the participants to be free to make their contributions.

## 5.0 RESULTS

### 5.1 Introduction

The previous chapter, Chapter 4, highlighted the methodology undertaken for this research study. This chapter, Chapter 5, presents the key findings with the aim of responding to the research questions and research objectives as presented in Chapter 3. New insights have been uncovered via the use of open-ended semi-structured interviews.

This section commences with an overview of the sample population selected including details of the respondents. Secondly, details pertaining to the interviews such as the medium used for the interviews, transcription, duration of the interviews and information relating to the ensuring the validity and credibility of the data collected are also presented. Lastly, a qualitative data analysis is represented by key themes which have emerged which directly respond to the research questions.

### 5.2 Overview of Sample Population

The researcher conducted ten interviews with respondents from three electrical municipalities from the local government sector within South Africa. The data was organised into each individual study or per municipality hence, considered a stand-alone individual study. The respondents as well as the municipalities have been given pseudonyms in order to protect the identity of each respondent and municipality. The following should be noted about the composition of the three municipalities:

- a) All three municipalities operate within the local government sector of South Africa;
- b) All three municipalities are departments within Category 'A' metropolitan municipalities;
- c) All three municipalities hold a licence as provided by the NERSA for the supply of electricity;
- d) All three municipalities are amongst the top performing electric municipalities in the country; and

- e) All three municipalities have considered and are responding to the advent of rooftop solar PV.

Table 2 provides a detailed list of the respondents and the municipalities they represent. Their details are provided based on the sequence in which the interviews were undertaken.

*Table 2: List of Respondents*

No	Municipality	Respondent	Position	Years of Experience
1	MM01	RTSPV01	General Manager	40 years
2	MM02	RTSPV02	Project Executive	23 years
3	MM02	RTSPV03	Chief Engineer	15 years
4	MM02	RTSPV04	Project Executive	12 years
5	MM03	RTSPV05	Senior Technician	30 years
6	MM03	RTSPV06	Development Advisor	20 years
7	MM02	RTSPV07	Deputy Head: Technical Support	30 years
8	MM01	RTSPV08	Chief Engineer	11 years
9	MM01	RTSPV09	Senior Engineer	6 years
10	MM04	RTSPV10	Head: Electricity & Energy	21 years

All interviews were conducted with highly knowledgeable respondents who have a broad view of the industry, holding diverse perspectives and had the necessary expertise and experience needed to provide key insights into this area of study.

### 5.3 Summary of Interviews and Transcription

All the interviews were conducted by the researcher via the electronic Microsoft Teams video conferencing platform, due to limitations in conducting face to face interviews. The duration of the interviews ranged from 30 minutes (for the shortest



interview), to 91 minutes (for the longest interview), with an average interview duration of 56 minutes. All interviews were conducted in English which were recorded and transcribed in order to perform the thematic analysis.

All interviews were transcribed by the researcher and were undertaken as follows to ensure accuracy and credibility. All interviews were conducted via the video conferencing platform, Microsoft Teams. Post-acquisition of consent from each respondent, the interviews were video and audio recorded. The video recording of each interview was transcribed by the researcher with the assistance of Microsoft Stream. The researcher proof read each transcript and verified it against the video and audio recording to ensure accuracy.

#### 5.4 Sources of Data

As outlined in Chapter 4, two separate processes for data collection was undertaken which included (a) primary data via semi-structured interviews and (b) secondary data via the collection of all organisational documents. Table 3 displays an overview of the data sources utilised during this study.

*Table 3: Overview of Data Sources*

<b>Municipality</b>	<b>Primary Data</b>	<b>Secondary Data</b>
MM01	Semi-structured interviews	Annual report, brochures, strategy document, business model document, business plans
MM02	Semi-structured interviews	Annual report, organisational presentations, strategy document
MM03	Semi-structured interviews	Annual report, brochures, organisational presentation, strategy document, business plans

#### 5.5 Presentation of Results

Analysis of both the primary data as well as the secondary data was performed through the use of the qualitative analysis computer aided software, Atlas.ti. Each

transcript was inductively coded with the development of sub-themes for each individual study. Saturation was achieved when minimal new codes were being created during the analysis. The results of each individual study is presented separated with a consolidated representation of the emerging themes also presented in response to each research question. Hence, the results are presented by research question including the citation of quotations which give a voice to experiences of the respondents.

## 5.6 Results: Research Question 1

***RQ1. Describe how municipalities have responded to the advent of rooftop solar PV?***

The aim of this question was to understand if municipalities were aware of the growth of solar PV and the shift of consumers away from conventional grid supply. What, if any, measures were the metro municipalities implementing in response to the advent of solar PV.

The response to Research Question 1 is categorised into two areas, viz. (a) the awareness by municipalities of the growth of solar PV and (b) measures undertaken in response to the growth. The emerging themes in response to this research question is displayed in Figure 4.

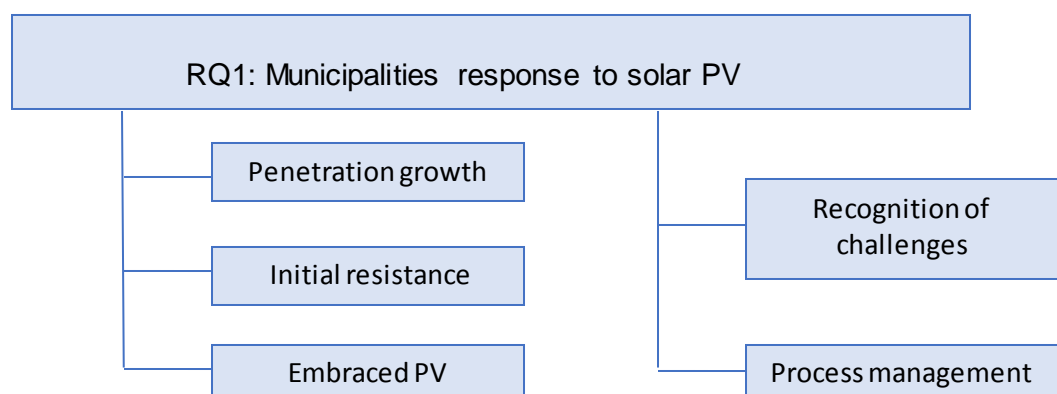


Figure 4: Overview of Results - Research Question 1

It has emerged from the multiple individual studies that there is growth in the penetration of solar PV. There has been resistance to the penetration levels of solar PV however, the municipalities have embraced this growing penetration trend of solar PV. The multiple individual studies have recognised that there are numerous challenges to overcome however, the review of their existing processes have been identified to manage the solar PV installations.

### 5.6.1 Penetration growth

Four sub-themes emerged from the multiple individual studies which contributed to the growth in the penetration of solar PV. These sub-themes are outlined in Table 4 which also highlights the similarities and differences in the responses for each individual study.

Table 4: Overview of Penetration sub-themes

<b>Sub-theme</b>	<b>MM01</b>	<b>MM02</b>	<b>MM03</b>
Drivers of penetration	Yes	Yes	Yes
Public interest	Yes	Yes	
High penetration	Yes		
Rapid uptake	Yes	Yes	Yes

#### 5.6.1.1 Drivers of penetration

All individual studies concurred that there are three main drives to the penetration of solar PV which include a drastic reduction in the costs to install solar PV. These costs have significantly reduced over the last few years making it feasible to install solar PV. In one individual study, the respondent indicated that,

*“What we are aware of obviously is that the cost of solar panels have come down significantly over the past few years. There is even an assembly or manufacturing plant locally that make these parts and actually manufacture panels at very competitive prices. So the technology has grown in leaps and bounds from a point of view of just the cost of production and hence with the costs, decreasing year on year.” (RTSPV07)*

Another response to this question included:

*“At the time, the conclusion was that small-scale embedded generation, although technically feasible, was not financially viable. However, the cost of renewable energy generation decreased considerably in the years following 2008. This, combined with the increase in electricity tariffs, made pursuing small-scale embedded generation an increasingly viable option.” (MM03\_EG)*

Another driver identified is the pressure being exerted by corporates to include environmentally friendly initiatives in their portfolio due to the need to go green.

*“I can tell you. I mean, it's Google. They use data centres within our jurisdiction. Their shareholder says, thou shall purchase X amount of renewable energy for your operations. Which would then meet that requirement of them needing to go green.” (RTSPV01)*

*“There's other benefits in terms of some of the customers, like an example is MAN trucks. They basically went completely carbon neutral meaning that whatever they generate is equal to what they consume over maybe a year or so? So lots of companies are doing it because they also operating in national markets, and people want to see the Greening initiatives. Then there's the carbon tax issue, so people are trying to offset their carbon taxes, then there is the tax incentive for installing solar PV, you can depreciate those PV systems depending on the size, either over one year or either three years.” (RTSPV03)*

#### 5.6.1.2 Public interest

Interest in the installation of solar PV is growing with third party customers, especially within the commercial customer segment, installing solar PV which have been stated by two respondents who commented that,

*“...especially on the commercial side of our customers like Makro for example.”*  
(RTSPV02)

*“So basically we see more of the penetration from the commercial side. I think from the residential point of view, there’s still negligence from our customers.”*  
(RTSPV09)

#### 5.6.1.3 High penetration

It emerged from one individual study that the penetrated is significantly higher than the current recorded installations which are approximately 30MW. Geographic Information System survey photography revealed numerous solar PV installations on rooftops which equate to 30 000 units as compared to the 300 registered installations.

*“...penetration is quite high at the moment we have almost about 30MW that we have already approved coming from the installations.”* (RTSPV08)

#### 5.6.1.4 Rapid uptake

It emerged from all three individual studies that there is a rapid increase in solar PV installation within their municipal areas. This common view amongst a total of five respondents across the three individual studies was that in a short space of time numerous solar PV installations have surfaced on the roofs of residential and commercial buildings within the municipality.

*“Our application process for embedded generation is currently overtaking our three phase applications for our core business and normally these are actually quite big.”* (RTSPV05)

“...so we count, for instance, the 2017 financial year, which was 2016/2017 June, we were sitting at 8MW. Then the following financial year, which was 2017/2018, we are sitting at 15.3 MW. Then the 2018/2019 financial year, which was last year, we were sitting at 32.2 MW. Then this year 2019/2020 we now sitting at 43.9 MW? So in terms of the penetration, we're seeing a large of number of applications that are coming forward.” (RTSPV09)

From the data in Figure 5, there is a clear trend of the rapid increase in the number of solar PV projects encountered by the second individual study. A clear demonstration of the exponential increase in interest to install solar PV.

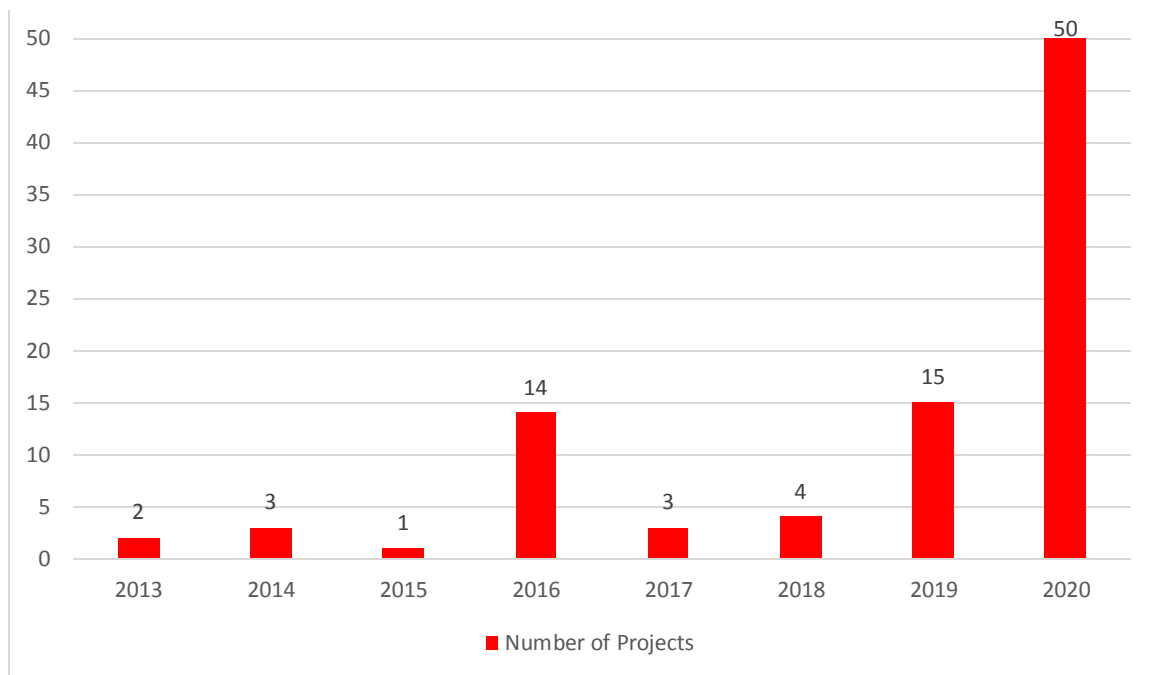


Figure 5: Solar PV Uptake at MM02

### 5.6.2 Initial resistance

It emerged from a single individual study, MM01, that there was initially a poor perception of solar PV as reflected by one of the respondents, “So of course you those municipalities that are sort of against PV see PV as the root cause of the problem” (RTSPV01). The advent of solar PV was viewed as a major disruptor to the current business function.

### 5.6.3 Embraced PV

There was no significant difference between the multiple individual studies with respect to the current view on the advent of solar PV. The municipalities have now embraced its existence and see it as a potential opportunity that can be exploited to further the sustainability of the municipality. A third of the respondents said that their municipality has embraced solar PV,

*“It’s something that came on very quickly. It’s something that we’ve embraced, and we realise that there’s a whole host of advantages when it comes to it. When it comes to renewable energy, I think it has its own advantages, and it can contribute very positively to the municipality.”* (RTSPV04)

*“This PV sector can in fact be an ally to you because it’s the surplus energy it can produce that comes into your network much cheaper than from Eskom certainly in our case.”* (RTSPV01)

### 5.6.4 Recognition of challenges

The data revealed that as the municipalities began to embrace solar PV, they identified numerous challenges. These challenges were expressed across the multiple individual studies as presented in Table 5.

Table 5: Overview of Challenges sub-themes

Sub-theme	MM01	MM02	MM03
Safety issues	Yes	Yes	
System deficiencies	Yes	Yes	Yes
Inflexibility of the MFMA	Yes		
Uncertainty of the regulatory environment	Yes		
Technical issues		Yes	
Lack of an appropriate tariff			Yes
Resource constraints			Yes
Pace of local government processes		Yes	

Four respondents from all the individual studies highlighted a lack of systems, viz. billing systems as well metering systems, in order to effectively manage the advent of solar PV. The lack of the systems leads to incorrect consumption data and load profiles at the customer premises which lead to the creation of inaccurate consumption bills, including potential revenue loss. It further reflects poorly on the image of the municipality which is reflected as inadequately prepared to manage this function. The concerns expressed were,

*“...there is obviously challenges from our side or billing systems tools, I think they're still working to configure it to allow for these tariffs to be implemented and the metering department don't have all of the meters that's required, including the bidirectional meter. I think they still waiting for their metering contract to be approved.”* (RTSPV03)

*“Should we have done the right things like our billing system be in or installing the right meters and also doing the cost reflective tariffs. Then we shouldn't be in this dilemma, but unfortunately we feeling the heat now because we have not done that exercise.”* (RTSPV08)

*“Some of the analogue meters turning backwards resulting in revenue loss as they do not have the capability to record bi-directional energy. Billing system still need to be configured for new embedded generation tariffs.”* (MM02\_RE)

#### 5.6.5 Process management

Respondents from all the three individual studies revealed the need to introduce processes which would support the municipality in managing the rapid growth in solar PV applications and requests by customers to be connected to the municipal grid. Table 6 illustrates the proposition of measures undertaken by the three individual studies in responding to the advent of rooftop solar PV.



Table 6: Overview of Process management sub-themes

Sub-theme	MM01	MM02	MM03
Introduced process to track applications	Yes	Yes	Yes
Review of existing process	Yes	Yes	
Success in management of records	Yes		Yes

#### 5.6.5.1 Introduced process to track applications

Four respondents across all three individual studies revealed urgency that each municipality undertook to introduce processes to track the solar PV applications. This allowed the municipality to be proactive in dealing with the rapid growth in penetration of solar PV. It is also allowed each municipality to identify its own deficiencies in the area and implement mitigating measures. It also allowed the municipality to determine the basic requirements which a customer needed to comply with when applying to be connected to the grid.

*“We recently started to get a bit more processes in place to try and see whether we can start tracking these things and the approach that’s been taken by the organisation was that we integrate. So, yes there is a process in place for us to track the size of the installation, the location of the installation, and all the other technical bits that are important to ensure safe installation.” (RTSPV04)*

*“We had to, you know, craft processes, processes from application. You know face up to, when the customer, gets energy in whichever form. So those processes had to be optimised, because otherwise we were going to lose track of what the customer is doing in their backyard.” (RTSPV08)*

*“We need to adapt. We need to support this section so that we get the processes in place. So there is a data processes department here which assists with the development of the value chain process which directs where we should the applications go.” (RTSPV09)*

#### 5.6.5.2 Success in management of records

Two of the individual studies, MM01 and MM03, have revealed success in the recording and management of the applications for solar PV. One of the respondents reported that they have instituted a database since 2012 in order to successfully log and track all applications. Another respondent commented, *“So it's from that reporting perspective that that I think it works properly. With the big guys at least”* (RTSPV01). A contributing factor to this success, as reported by another respondent, is also the fiscal and legislative mandate that large companies need to satisfy. Another respondent alluded to the notion of an incentive which was introduced by MM03 to encourage registration of applications.

*“I think if I look at the tariffs in South Africa, I think MM03 has a very fair tariff. Actually it is like very beneficial, especially for industry, if you actually have a business. This is quite positive or like quite fair with the tariff, so hopefully most of the people are registering.”* (RTSPV06)

#### 5.6.6 Summary of results: Research Question 1

It has emerged from the multiple individual studies that there is general consensus of the growth in the penetration of solar PV. This was expressed through the exponential growth in applications received and the size of solar PV installations connected to the grid over the last few years. Whilst there has been initial resistance to acknowledge the penetration levels of solar PV however, MM01 and MM03 have since recognised its existence and impact. MM02 has recently embraced the growing penetration of solar PV. The multiple individual studies have recognised that there are numerous challenges to overcome especially relating to the systems needed to support the management of this growing solar PV trend. However, the numerous responses from the three individual studies have revealed the multiple measures being implemented due to the advent of solar PV. These include, as stated by the respondents, the introduction of a process to track applications of the solar PV installations.

## 5.7 Results: Research Question 2

**RQ2.** *What is the understanding of the advent of rooftop solar PV on municipal revenue?*

The aim of this question is to understand whether rooftop solar has had any impact on municipal revenue. If so, to what extent and what measures have been introduced by the municipality to mitigate this.

The results to Research Question 2 are categorised into three areas, viz. (a) recognition of the major contributing factors to municipal revenue, (b) appreciation of the impact on municipal revenue to the advent of rooftop solar PV, and (c) measure identified to mitigate the revenue impact. The emerging themes in response to this research question is displayed in Figure 6.

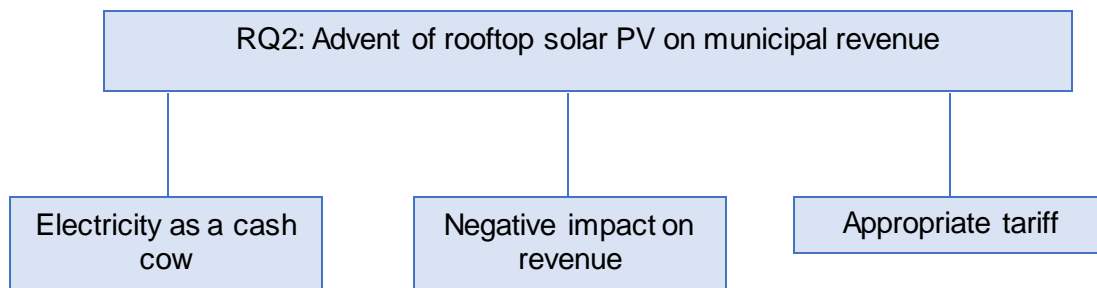


Figure 6: Overview of Results - Research Question 2

The themes identified in the responses from all three individual studies are displayed in Figure 6. A common view amongst respondents from all three individual studies was that electricity sales serve as a major contributor to municipal revenue which is viewed as the cash cow of the municipality. A recurring theme from the interviews was a sense amongst eight of the respondents that there is a definite negative impact on municipal revenue due to the advent of rooftop solar PV. The overwhelming

majority of respondents suggested that in order to mitigate the loss, an appropriate tariff is required.

### 5.7.1 Electricity as a cash cow

Three sub-themes emerged from the respondents of the three individual studies which reflect electricity sales as a cash cow for the municipality. These sub-themes are categorised in Table 7 according to how the respondents from each individual study offered an explanation to the development of this over-arching theme.

*Table 7: Overview of Electricity as a Cash Cow sub-themes*

<b>Sub-theme</b>	<b>MM01</b>	<b>MM02</b>	<b>MM03</b>
Contribution to municipal revenue	Yes	Yes	Yes
Reduction in surplus			Yes
No longer a cash cow	Yes	Yes	Yes

#### 5.7.1.1 Contribution to municipal revenue

An overwhelming majority of the respondents from all the three individual studies commented that electricity sales serve as the major contributor to municipal revenue. A number of respondents argued that the income received from electricity sales serves to sustain the municipality. Figure 7 displays the breakdown of municipal revenue contributor according to seven of the respondents. From the chart, it can be seen that the greatest contributor to municipal revenue is from electricity sales.

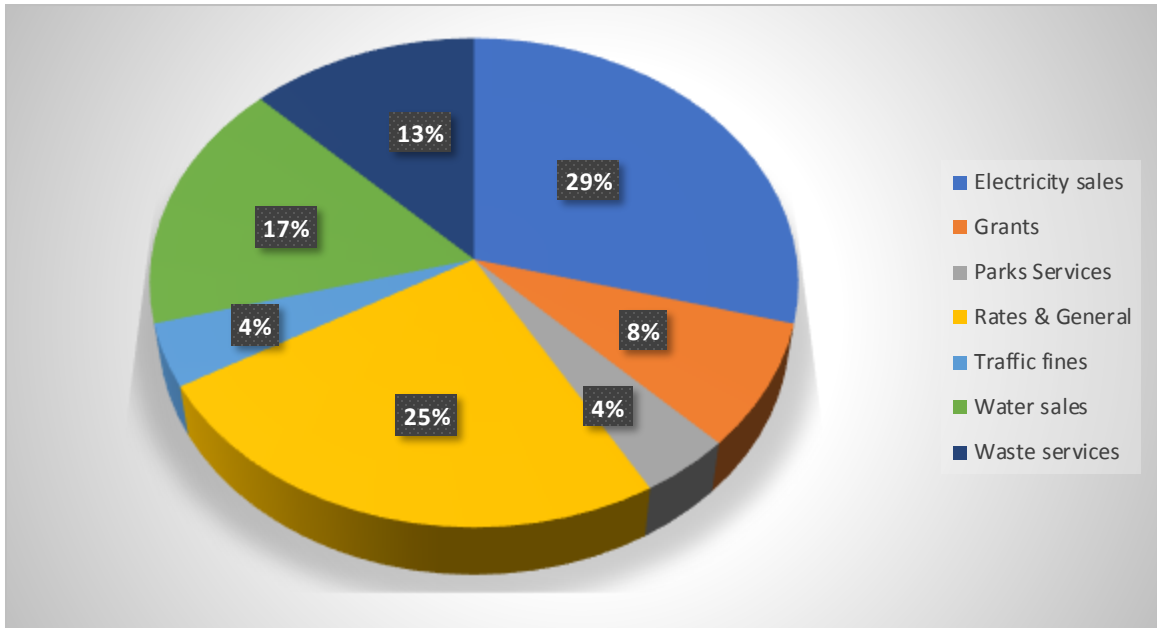


Figure 7: Contributors to Municipal Revenue

#### 5.7.1.2 Reduction in surplus

An important sub-theme which emerged from the respondents from one of the individual studies, MM03, was the reduction in the surplus generated by the electricity department. As one respondent put it: *“I was at a presentation about a week ago, which reflected on the trends in revenue or profit margin from our electricity department over the last three to five years. You looking at about 40 to 50 percent initially and I think it's not just not anymore. For the previous year, I think it shrank to about 12 percent.”* (RTSPV05)

#### 5.7.1.3 No longer a cash cow

It has emerged from respondents across the three individual studies that the electricity business which was once viewed as the cash cow for the municipality is no longer the case. One of the respondents revealed that,

*“I still remember when we had this whole. Let's go to the REDS in 2010. Everybody wanted to hold on to electricity because it was the cash cow. It's completely swapped around and one of the things I think the industry has never*

*realised that fundamental changes that have happened in the last 20 years, yet the tariffs haven't changed accordingly.” (RTSPV01)*

Another respondent stated, *“so with the electricity department is not the golden cow anymore, so whatever, so it becomes actually a serious matter of balancing the books.” (RTSPV05)*

### 5.7.2 Negative impact on revenue

Three sub-themes emerged from the respondents of the three individual studies which revealed that the advent of solar PV has had a negative impact on municipal revenue. These sub-themes are outlined in Table 8 which also highlights the similarities and differences in the responses for each individual study.

*Table 8: Overview of Negative Impact on Revenue sub-themes*

<b>Sub-theme</b>	<b>MM01</b>	<b>MM02</b>	<b>MM03</b>
Impact on revenue	Yes	Yes	Yes
Revenue loss	Yes	Yes	Yes
Downward spiral		Yes	Yes

#### 5.7.2.1 Impact on revenue

Two-thirds of all the respondents across the three individual studies (67 percent) said that the advent of rooftop solar PV has had an impact on municipal revenue. The views emanating from the respondents indicate that solar PV will impact negatively on the revenue of the municipality however, acknowledge that it can be mitigated.

*“Well, the way I look at it, it's definitely going to result in us obtaining much less revenue. Because there's a number of other factors but let's look at it.” (RTSPV03)*

*“...so definitely yes. We know that there will be introduction of revenue loss as solar PV starts to take off.” (RTSPV04)*

*“Definitely by us, definitely. As I say from the last five years from 45 percent to 12 percent. A decrease that's huge, you know, and it's the PV that plays a part but is also the Eskom increases and also the tariff structures, those three and the other things.” (RTSPV05)*

*“It has and it still continues to have. And in this case it's our own wrongdoings because our tariff structure is not cost reflective and the network charges not, you know, implemented in certain case studies.” (RTSPV08)*

#### 5.7.2.2 Revenue loss

The respondents from the three individual studies concur that the advent of solar PV is introducing losses in revenue for the municipality. Some respondents within two of the individual studies, MM02 and MM03, commented that they are unable to express the quantum of the revenue loss experienced by the municipality. In all three individual studies, the respondents expressed that,

*“The last time I checked we were losing about, about more than 100 million per month. You know due to the PV installations because you know our metering system is non-functional.” (RTSPV08)*

*“So we don't know to what extent PV has contributed to a loss, alright, but theoretically we know that for anyone that had a PV system onto their roofs, they will, on average create a revenue loss for the municipality.” (RTSPV04)*

*“As the uptake of rooftop solar increases, it means that for every given house we have been getting back less and less in terms of revenue per connection. That means there's less earn from every customer.” (RTSPV07)*

### 5.7.2.3 Downward spiral

Responses from two of the individual studies, MM02 and MM03, reveal that due to the revenue loss, the municipalities are on a downward spiral. Two respondents indicate that a decline in electricity sales has occurred. Particularly revealing is how the respondents described that the banking institutions are funding private residence and commercial customers to install solar PV. Another respondent alluded to the notion of the costs of solar PV having reached grid parity which makes it enticing to install.

*“The electricity industry you see basically, you increasing customer numbers, so I have more customers on my network, but actually declining electricity sales, so I'm selling less electricity, but I've got less revenue. But I've got actually more costs because I have to connect more people.”* (RTSPV06)

*“I think the four leading banks in South Africa are offering you funding in terms of or capital to install these projects with payback, I mean allows you up to 10 years to pay back, so that's one option.”* (RTSPV03)

*“I'm sure you know the term grid parity with the cost to generate. It is basically matching or equal to that which we purchase power from Eskom as our national generator. So I think we almost all have already hit grid parity making investment in solar viable in the next, perhaps with a return on investment, perhaps of seven to ten years. Some people might find acceptable.”* (RTSPV07)

### 5.7.3 Appropriate tariff

It emerged from all three individual studies that in order to mitigate the revenue loss and negative impact for the municipality due to the advent of solar PV, an appropriate feed-in tariff be implemented. One respondent revealed that the inclusion of a fixed network charge in the tariff structure will ensure that there is consistent revenue for the municipality. Other respondents indicated that,



*“...that would be the case if they were on the wrong tariff. So if they are on the right tariff, that loss becomes less, nothing.” (RTSPV01)*

*“...there is a loss to the municipality at this point in time because we have not correctly structured the way in which we price for electricity services to the end customer.” (RTSPV04)*

#### 5.7.4 Summary of results: Research Question 2

What emerges from the results reported here is that the advent of rooftop solar PV has had a negative impact on municipal revenue. Some respondents from MM01 felt that the impact could be quantified, while others considered that the impact is significant but are not to quantify it. It was clearly revealed by respondents from all three individual studies that the electricity department, once considered the cash cow of the municipality has seen a reduction in its surplus over the years. There is an overwhelming view from the three individual studies that in order to mitigate the impact of the revenue, an introduction of an appropriate feed-in tariff be undertaken.

#### 5.8 Results: Research Question 3

***RQ3. Describe the options available to municipalities given the changes in their core market?***

The aim of this question is to determine whether municipalities have identified any opportunities outside of their core market to remain sustainable.

The results to Research Question 3 are categorised into two areas, viz. (a) confirmation of the core market, and (b) identification of opportunities outside of the core market. The emerging themes in response to this research question is displayed in Figure 8.

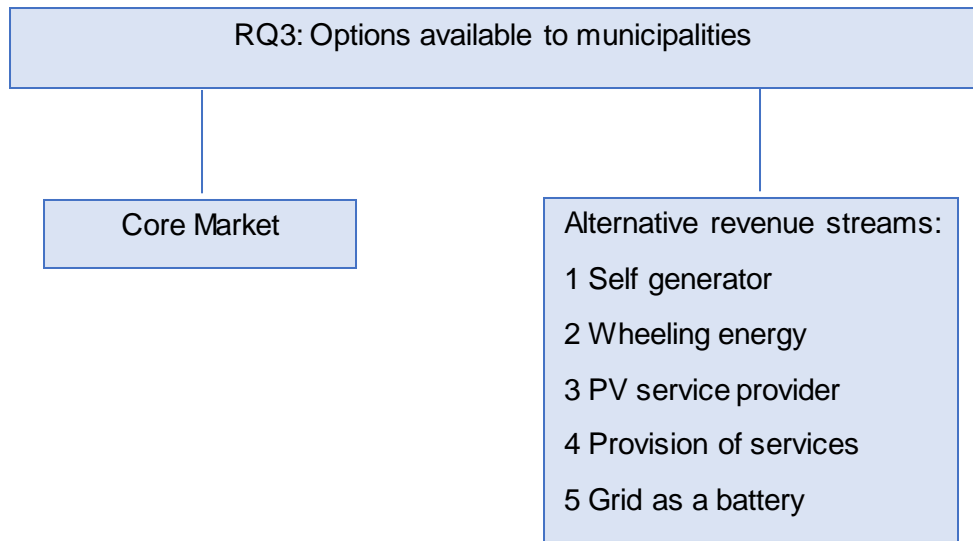


Figure 8: Overview of Results - Research Question 3

### 5.8.1 Core Market

Two sub-themes emerged from the respondents of the three individual studies which revealed the current business model and whether it is sustainable due to the advent of solar PV. These sub-themes are outlined in Table 9 which also highlights the similarities and differences in the responses for each individual study.

Table 9: Overview of Core Market sub-themes

Sub-theme	MM01	MM02	MM03
Power Distribution	Yes	Yes	Yes
Sustainability	Yes	Yes	Yes

#### 5.8.1.1 Power Distribution

The overwhelming majority of the respondents from all individual studies remarked that the municipalities operate a traditional wires business. One of the respondents indicated that the municipalities hold a distribution licence to supply power to the customer. Another respondent highlighted that it had become cheaper to purchase power from the national generator hence, performing a distribution service. Interestingly, there were differences among the three individual studies whether the current business model is still relevant or not. A respondent from MM01 argued that it is no longer relevant as the “...kWh sales business is gone” (RTSPV01) whilst

another respondent from MM02 argues that it is still relevant, *“...because there’s a social sort of dynamic linked to distribution...”* (RTSPV04)

*“But the business model of the unit at the moment is very much a wires business model. The same traditional model that we have used since the past 100, some odd years.”* (RTSPV02)

*“But then I think with coal, we don’t have coal in MM03, so it becomes very expensive. I think it was far cheaper to get rid of it and make it redundant and Eskom start supplying the Metro.”* (RTSPV05)

#### 5.8.1.2 Sustainability

Whilst there were differences among the three individual studies whether the current business model is still relevant or not, it emerged that there was consensus amongst the respondents in the three individual studies that the sustainability of the municipality is at risk. A respondent stated that the electricity business may become redundant if no change is undertaken. Other respondents indicated that it requires out of the box thinking to remain sustainable.

*“While Eskom is likely to remain the dominant supplier, a new path is essential to our sustainability e.g. own IRP, etc.”* (MM01\_EB)

*“So we have to do something outside the box. Otherwise as you say, maybe we’ll be a dead bird by next financial year.”* (RTSPV05)

#### 5.8.2 Alternative revenue streams

Conversations with the respondents from the three individual studies revealed five alternative revenue streams for municipalities to consider in order to remain sustainable. Respondents view these alternative revenue streams as achievable either in the short or medium term. One of the respondents stated that in certain

instances these were missed opportunities. These sub-themes are outlined in Table 10 which also highlights the similarities and differences in the responses for each individual study.

Table 10: Overview of Alternative Revenue Streams sub-themes

<b>Sub-theme</b>	<b>MM01</b>	<b>MM02</b>	<b>MM03</b>
Self-generator	Yes	Yes	Yes
Energy wheeling	Yes	Yes	Yes
PV service provider		Yes	Yes
Provision of services	Yes	Yes	Yes
Grid as a battery	Yes	Yes	Yes

#### 5.8.2.1 Self-generator

All three individual studies have revealed the need for each municipality to consider stepping into the generation space. With the abundance of roof space, whether owned by the municipality or privately owned, respondents state that this is an area which the municipality can easily exploit. Some respondents have indicated that the regulatory environment is changing allowing municipalities to enter this space.

*“There's also opportunities that we can capitalise on in terms of looking at the generation of electricity. You know, we are at the coast. We have opportunities of looking at the ocean in terms of the generation of electricity. We also got reasonably good sunshine. We can look at diversifying into the generation space via solar PV as well.” (RTSPV04)*

*“I've mentioned that other one at 250 MW that we wanted to install. We went out for the request for proposal but unfortunately NERSA stopped us there, which was almost three years ago.” (RTSPV05)*

*“So we want to put PV systems on municipal buildings. Produce our own electricity, so with this bring the demand from MM03 down. So I think there's a there's a big opportunity and also like maybe projects where you actually buy and distributing them.” (RTSPV06)*

### 5.8.2.2 Energy wheeling

It has emerged from all three individual studies that there is huge potential exists for the wheeling of energy. Respondents have revealed that the municipality should explore this option as there is not commitment to own the generating plant or being to the customer who may need the energy.

*“There's also the other alternative, if we can get into the market of wheeling power as well, because lots of customers are looking at that option as well where they've got multiple holdings within the municipality that they want to wheel power from one to the other. So we can sell basically the grid service. We can also look at the option of wheeling electricity from much cheaper sources than Eskom like your wind and solar farms.” (RTSPV03)*

*“OK, yes, to do wheeling. I think wheeling could work for most of the people, and I think it's a good approach to just allow companies to wheel electricity. Basically, you're not really losing money or revenue from that, so this will actually allow somebody to use the grid and you calculate the cost. You put your revenue on top. So you actually making a bit of money from it, and so from that point of view. I think there's opportunity to really look at wheeling allowing the people to be providing the platform for it.” (RTSPV06)*

*“So from that point of view, that's my future business. I'm going to be the transporter of this energy. I don't even have the capital to own my own generating plant to start off. But I have this wonderful grid that could already connect things together. Can make money out of that, you know, and I'm an expert there already.” (RTSPV01)*

### 5.8.2.3 PV service provider

It emerged from two of the individual studies that the municipality could consider venturing into becoming a solar PV service provider. As stated by one of the

respondents, this can be undertaken by becoming the local sales agent of solar PV infrastructure for internationally renowned companies. Another respondent indicated that the municipality could consider the sale of solar cells to customers.

*“So it might be good to get ahead of the curve and actually get into having teams that would then go out and do the installations. You will also then maybe have pre-approved suppliers of these installations so that when your customers decide to move to solar...”* (RTSPV02)

*“We've seen internationally that a lot of the municipalities in some way or the other have actually got to a point of even selling renewable energy devices, playing in the retail space of renewable energy and electricity playing in the space of contracting services to the private sector.”* (RTSPV04)

#### 5.8.2.4 Provision of services

The respondents from all three individual studies concur that the municipality could monopolise on the use of its existing infrastructure for the provision of alternative services. Some respondents indicated that the municipality could acquire revenue from the rental of roof space and/or streetlight poles.

*“I think it was where the one thing they said that we must always leverage. Is the fact that we've built a trust with our customers over 100 years? Remember we are formed in 1897, so in 123 years, 123 year in one 2 three years, we've built a long term relationship. And we're not going to run away. So our wires business will always be there. If Mr. X, whose wife is pushing pressure on him to invest in a solar, decides to want to do so, would he go to Mr. X consulting who he might not know will be around in five years' time? He might fold considering the climate right now. He's got no guarantees. He's got no backup. He's got nothing, you know? Or would you rather come to us as he's trustworthy supplier that says we will? We are here. We will guarantee the product for the next 100 years because we still be around as the municipality.”* (RTSPV07)

*“A new revenue stream that could have been possible where you as a municipality can provide the conduits and the distribution network for fibre and earn revenues from that, but I think we've lost that.” (RTSPV01)*

*“We as a Metro we've got fibres right through the Metro for our substation, so maybe that's also service that we can utilise on that side we've got. Uh, High mast with, uh, with Wi-Fi, where we give this some of the community free Wi-Fi so there are lots of other avenues that we can actually utilise.” (RTSPV05)*

*“Street lighting obviously is one of them, where you know you can rent out. You know your poles, obviously whether you can put cameras there and you know you can rent it out to insurance companies and they can, you know, they can pay you if there's an incident that they want the footage, they will have to pay for it, then you know you generate money.” (RTSPV08)*

#### 5.8.2.5 Grid as a battery

Some of the respondents from all three individual studies argue that the grid can be used as a battery. The respondents state that customers be encouraged to export their excess energy to the grid and purchase from the municipality when in need. The respondents indicate that the municipality will generate revenue via the implementation of a fixed charge tariff for the use of the grid.

*“We basically sell the grid as a large battery in the same sense that we're doing currently, we charge customers a fixed cost because they can store energy when they don't use it and obviously utilise it when they need it. Yeah, so that's where your network access charge is sort of coming in.” (RTSPV03)*

*“So I mean same with PV. If your system, if you got a good backbone on your system and customers install PV and they export excess, then reward. Are you*

*not also benefiting from it? So that's the thing that I say as a municipality, look at it and then obviously make sure your tariff structure is in order before you go.” (RTSPV05)*

### 5.8.3 Summary of results: Research Question 3

What emerges from the results reported here is that the respondents of the three individual studies have revealed the current business model. There is a difference in opinion as to whether the current business model is relevant however, there is consensus that the sustainability of the municipality is at risk due to the advent of solar PV. The respondents from the three individual studies indicated five potential alternative revenue streams that the municipality could consider in order to mitigate the sustainability risk.

### 5.9 Results: Research Question 4

***RQ4. Describe how the Municipality has attempted to change or has changed its business operations and processes to improve its service delivery in an incremental fashion in response to the advent of rooftop solar PV?***

The aim of this question is to understand if municipalities are improving the efficiency of their existing systems.

The results to Research Question 4 are categorised into two areas, viz. (a) identification of the improvement areas for the existing systems, and (b) classification of approach used to undertake improvement. The emerging themes in response to this research question is displayed in Figure 9.



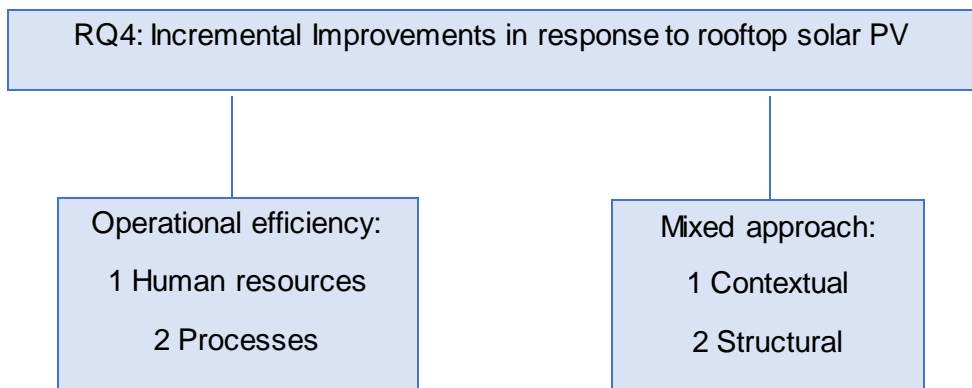


Figure 9: Overview of Results - Research Question 4

### 5.9.1 Operational Efficiency

Two sub-themes emerged from the respondents of the three individual studies which revealed the areas in which the improvement in operational efficiency are being undertaken due to the advent of solar PV. These sub-themes are outlined in Table 11 which also highlights the similarities and differences in the responses for each individual study.

Table 11: Overview of Operational Efficiency sub-themes

Sub-theme	MM01	MM02	MM03
Human resources	Yes	Yes	
Processes	Yes		Yes

#### 5.9.1.1 Human resources

It emerged from the respondents of two of the individual studies, MM01 and MM02, that significant focus is being given to improve the performance of the human resources dedicated to managing the rooftop solar in the municipalities. A respondent indicated that, “...we need to invest our self in training. We do have the learning academy department which assist in training. Solar PV training that is happening.” (RTSPV09) wherein significant investment is placed on skills development in solar PV. Another respondent indicated that recognition was given to the need to acquired additional human resources to oversee the solar PV function which involved the secondment of existing resources.

*“So we were forced to look at, you know, resources you know to do the approvals and to run the processes as well the applications and also the integration of this into our day-to-day billing systems.” (RTSPV08)*

*“So its getting more challenging and I mean to try and deal with it as a small portion of your normal daily job while dealing with ten other things as a side show you not really giving it the full attention that it deserves.” (RTSPV03)*

#### 5.9.1.2 Processes

It emerged from two of the individual studies, MM01 and MM03, that significant improvements were undertaken in the existing processes in order to improve the management of the solar PV applications. A respondent indicated that the business operations were being optimised due to the advent of rooftop solar PV.

*“Technically, we've also managed to get a lot of national standards put into place, so that is also come through quite nicely. We currently trying to get better on the processes that we use internally. We're trying to get better on the prices that we pay for electricity and the tariff approach, and we also then trying to strengthen the application process to make it easier for the customers.” (RTSPV04)*

*“We certainly in terms of the PV application process, it's simply an adaptation of the process to request a supply.” (RTSPV01)*

#### 5.9.2 Mixed approach

Two sub-themes emerged from the respondents of the three individual studies which revealed the approach undertaken to incrementally change due to the advent of solar PV. These sub-themes are outlined in Table 12 which also highlights the similarities and differences in the responses for each individual study.

Table 12: Overview of Mixed Approach sub-themes

Sub-theme	MM01	MM02	MM03
Contextual		Yes	
Structural	Yes		Yes

### 5.9.2.1 Contextual approach

Respondents from the one individual study study, MM02, stated that the improvements in operational efficiency due to the advent of solar PV were being undertaken within the existing departments with the utilisation of existing skills. By undertaking the incremental changes within the existing department with the use of existing skills who continue to perform their other core functions, it lends itself to a contextual approach to ambidexterity. The respondents further indicate that these improvements in operational efficiency are incremental in nature due to the limited skills and focus on other core functions within the organisation.

*“So these are individuals who are working who have day jobs as we’d like to call it within various departments and they are doing it over and above their normal duties.” (RTSPV02)*

*“The applications for renewable energy as a normal application for services, and so we currently using the existing systems that we have to try and track renewable energy.” (RTSPV04)*

*“But in parallel we doing it kind of piece meal and but there’s no real focused team looking at this.” (RTSPV07)*

*“It needs different processes, it needs different structures and needs different cultures to operate. I think can’t be part of the municipality, but still have different cultures, structures and processes. It needs to be a different business altogether.” (RTSPV07)*

#### 5.9.2.2 Structural approach

Respondents from the other two individual studies, MM01 and MM03, stated that the improvements in operational efficiency due to the advent of solar PV were being undertaken within the separate department which was established to oversee the management of renewable energy within the municipality. By undertaking the incremental changes within the separate department which has the sole purpose of dedicating its resources and time to undertake these functions, it lends itself to a structural approach to ambidexterity.

*“There the whole company structure had to change and the executive took a decision that we need this function of renewables and you know then they had to get resources internally, unfortunately within deploy. Obviously with the help of consultants the unit was established with the existing skills that are already in existence internally, so it was just a matter of re-arranging the whole structure”. (RTSPV08)*

#### 5.9.3 Summary of results: Research Question 4

In summary, these results show that all three individual studies have implemented some form of improvements in operational efficiency due to the advent of solar PV. The improvements have been undertaken within the human resources as well as the processes of the municipality. These incremental changes have in the main followed a mixed approach in terms of the department executing these functions. They have been undertaken in either an existing department with the use of existing resources hence, a contextual approach to ambidexterity or a separate department with its sole purpose to focus to manage renewable energy activities hence, a structural approach to ambidexterity.

## 5.10 Results: Research Question 5

**RQ5.** Describe how the Municipality has attempted to radically innovate and adopt new forms of service provision for electricity in response to the advent of rooftop solar PV?

The aim of this question is to understand if municipalities are maximising on the innovative opportunities presented by rooftop solar PV.

The results to Research Question 5 are categorised into two areas, viz. (a) identification of innovative ideas considered by the municipality due to the advent of rooftop solar PV, and (b) classification of approach used to undertake the innovation. The emerging themes in response to this research question is displayed in Figure 10.

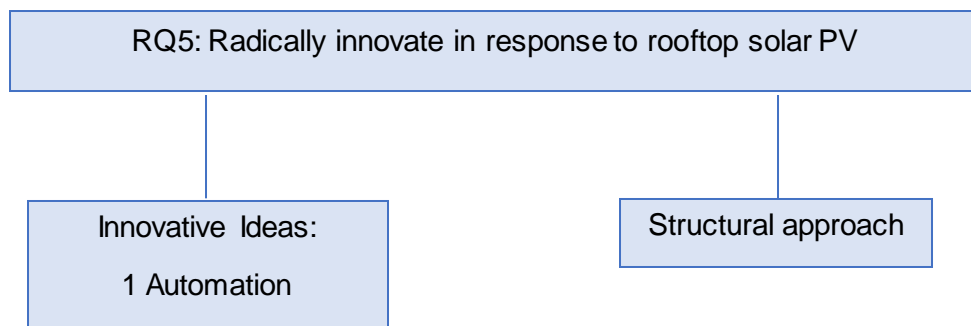


Figure 10: Overview of Results - Research Question 5

### 5.10.1 Automation

The respondents from all three individual studies expressed the need to introduce automation in order to simplify the management functions due to the advent of rooftop solar PV. One respondent stated that any innovative initiative should hold the customer needs at the forefront of all activities. Another respondent indicated that industry and the private sector will not wait for the municipality to deploy innovative ideas.

*“The innovation would have been to make it so easy that you could do this on the Internet. You could log onto the municipal website and inform us where your system is.” (RTSPV01)*

*“So if you have that smart meter and you have rooftop solar PV connected into our network, remotely you are able to verify the consumption on the smart meter.” (RTSPV09)*

#### 5.10.2 Structural approach

Respondents from two of the individual studies, MM01 and MM03, state that a separate department had been established to focus on radical innovation. Respondents from the other individual study, MM02, state that the organisation has recognised the need to establish a separate structure to manage and focus on the strategy of achieving radical innovation. This separate structure would allow for autonomy in function including it to be more agile to undertake research, exploration and implementation of various innovative ideas. This complete separate department solely dedicated to this function lends itself to a structural approach to ambidexterity.

*“...but in doing so we then have to be differently structured. We're going to be a lot more dynamic. We're going to be a lot more business focused. You know we must be able to respond to challenges, be able to make decisions on the on the turn, and be able to provide customers with you, know quick answers and deliver the services they want. You know so. So we got to be extremely responsive and not adopt the culture that unfortunately tends to plague local government where we can take a long time to get things done.” (RTSPV07)*

*“I think the thinking at this point in time, with the little bit of experience in knowing how we operate, I think we need to have a twofold approach. I believe though, that the strategic element needs to be handled by a separate department within the electricity department. A space, or there's an opportunity*

*for us to create a very small, high energy out of the box innovative department that would be looking to capitalise on the opportunities of renewable energy.”*  
(RTSPV04)

#### 5.10.3 Summary of results: Research Question 5

In summary, these results show that all three individual studies have identified a similar innovative initiative to be deployed due to the advent of solar PV. The automation of the processes as well as the management functions will significantly improve the management of this function. However, there is recognition that this function should be managed within a separate department or entity to research and develop all innovative ideas hence, a structural approach to ambidexterity.

## 6.0 DISCUSSION OF RESULTS

### 6.1 Introduction

The previous chapter, Chapter 5, highlighted the key findings for this research study. This chapter, Chapter 6, presents a discussion of these key findings in relation to their response to the research questions and research objectives as presented in Chapter 3. New insights have been uncovered via the use of open-ended semi-structured interviews. The findings are contrasted with existing literature with the view to extending the body of knowledge in solar PV penetration, impact on municipal revenue, alternative revenue streams and the approach to ambidexterity due to the advent of solar PV.

The findings in this chapter have been shared based on the following structure:

- a) The findings to research question 1, which was to understand the municipalities' knowledge of both the existence and the level of penetration of PV, are presented;
- b) The findings to research question 2, which was to understand the impact on municipal revenue, are presented;
- c) The findings to research question 3, which was to understand what alternative revenue streams are available to municipalities, are presented;
- d) The findings to research question 4 and research question 5, which were to designed to understand whether an ambidextrous approach to managing PV had been deployed by the municipalities, are presented;
- e) Lastly, the implications of the findings from research questions 4 and 5 for the theory of ambidexterity are presented.

### 6.2 Discussion: Research Question 1

***RQ1. Describe how municipalities have responded to the advent of rooftop solar PV?***



The aim of this question was to understand if municipalities were aware of the growth of solar PV and the shift of consumers away from conventional grid supply. What, if any, measures were the metro municipalities implementing in response to the advent of solar PV. The main drivers for this increase in penetration have been due to a combination of factors, namely rapid decrease in the cost of PV technology, an increase in the electricity prices and persistent load shedding (Bonneuil & Boucekkine, 2016; Garcez, 2017; Joffe, 2012; Hyysalo et al., 2018; Korsten et al., 2017).

The discussion of this research question is categorised into two broad areas, viz. (a) the awareness by municipalities of the growth of solar PV and (b) measures undertaken in response to the growth. There has been growth in the penetration of solar PV within the industry, whilst there had been initial resistance to the adoption of solar PV, this trend has since changed. Municipalities have identified the need to overcome numerous challenges due to the advent of solar PV and have commenced with the review of existing processes.

#### 6.2.1 Growth of Solar PV

It is apparent that solar PV has grown significantly. This study found that the penetration levels are much higher than the recorded installation information. Geographic Information System survey photography revealed solar PV installations equating to 30 000 on rooftops in comparison to the 300 which are registered. Janko et al. (2016) highlighted a more accurate perspective in terms of recorded installations versus onsite installations.

All three individual studies confirmed the observation of high growth in solar PV with 56 percent of the respondents indicating that over a short period of time, numerous PV installations have surfaced on the roofs of residential and commercial buildings within the municipality. The annual solar PV installation growth rate by one of the individual studies reflect an average annual increase of 79 percent. This is much higher than the annual growth rate of solar PV installations within the United States of America being approximately 58 percent with a majority of the installations generating in excess of the load requirements (Janko et al., 2016).

This study has revealed three drivers for this change. The first driver includes the drastic reduction in the costs to install solar PV, as previously reported by Janko et al. (2016) & Garcez (2017) who also found that the declining costs of the solar PV technology over the last few years has made it feasible to install solar PV. According to Gandhi et al. (2020), developments in solar PV panel technology have increased the performance of the equipment. A further finding indicated that locally manufactured parts at competitive prices have reduced the costs of solar PV.

The second driver is the increase in the electricity tariffs which has made the installation of solar PV a viable option. This finding is consistent with that of Korsten et al. (2017) who stated that the increase in electricity prices contributes to the growth in penetration of solar PV. Over the last decade, the electricity tariffs have been consistently increased by the national electricity producer and these costs have been passed on to the customers of the municipality.

The third driver from this study which is an unexpected finding was the extent to which pressure is being exerted on municipalities by large corporate companies to include environmentally friendly initiatives in their portfolio. Environmentally friendly initiatives are included in the strategic positions of these various organisations. Funding is also channelled to achieve this strategic imperative.

### 6.2.2 Embraced PV

The current study found that one of the individual studies expressed an initial poor perception of solar PV. The introduction of solar PV was viewed as a major disruptor to the existing electricity business model. However, this view has subsequently changed wherein all municipalities have embraced its existence. These findings indicate that municipalities have recognised the potential opportunities that can be explored to further the sustainability of the municipality. The findings indicate that the proliferation of solar PV should be viewed as an ally and municipalities should reap the maximum benefit including the ability to acquire the excess energy at an affordable rate as compared to the rates of the national electricity producer.

This poor perception of solar PV finding is contrary to previous studies which have suggested that the introduction of a net-metering tariff coupled with a surcharge for the use of the grid based on the energy consumption has improved solar PV adoption especially in high income households (De Groote et al., 2016). This rapid adoption has resulted in many countries reviewing these interventions due to the numerous challenges imposed on the municipality (De Groote et al., 2016).

### 6.2.3 Recognition of challenges

The findings of this study show that the adoption of solar PV by the municipalities introduced numerous challenges. These challenges have been expressed across the three individual studies. They include (a) safety issues, (b) system deficiencies, (c) inflexibility of the legislative framework, (d) technical issues, (e) resource constraints, (f) lack of an appropriate tariff, and (g) uncertainty of the regulatory environment. System deficiencies namely, lack of functioning billing systems and metering infrastructure, further hinder the municipality from effectively managing the proliferation of solar PV. The lack of these systems or non-functioning of these systems result in invalid consumption data, the generation of inaccurate bills which may lead to revenue losses and ultimately frustrated consumers.

The finding around technical issues supports the work of other studies in this area linking Gandhi et al. (2020) with Muslim (2019). Gandhi et al. (2020) has identified these technical challenges to include quality of supply issues such as the introduction of harmonics, voltage fluctuations, voltage unbalance and impacts on grid frequency. The impact is greater on the power system due to the severity of the penetration levels (Gandhi et al., 2020). Another important finding is that of regulatory uncertainty which was a common challenge in various countries around the world. According to Tarai & Kale (2018), the major challenge to the adoption of solar PV within the Indian context had been the rigid and unfavourable electricity policy framework. The policy did not create a conducive environment for the adoption of solar PV.

### 6.2.4 Process management

The findings indicate that all three individual studies needed to introduce processes to support the municipality in managing the rapid growth in solar PV applications and

requests by customers to be connected to the grid. The urgent introduction of these processes assisted the municipalities to identify its own deficiencies and that of the customers by implementing mitigating measures. The findings also revealed that the introduction of these processes assisted the municipality in identifying the basic requirements customers needed to satisfy to comply with safety legislation when connecting to the grid.

The findings further stated that the municipalities are now in a position to track the status of each application for solar PV including having a mechanism for customers to come forward to register their solar PV installations. The financial and legislative mandates that each company needs to satisfy have also assisted in organisations coming forward to register their installations. The findings also revealed that one of the individual studies introduced a fair tariff as an incentive for customers to register their installations. This finding is similar to De Groote et al. (2016) that introduced a net-metering tariff coupled with a surcharge for the use of the grid based on the energy consumption had also served as an incentive for customers, especially in high income households to adopt solar PV.

#### 6.2.5 Summary of discussion: Research Question 1

The findings of this study reveal that that the management within each individual study are aware of the growth in penetration of solar PV. Statistics on annual growth rates were presented by the respondents in each individual study. The findings also revealed an initial resistance to adopt solar PV as it was viewed as a disruptor to the current electricity business. However, the individual studies have fully embraced solar PV recognising the opportunities they bring. This was a surprising result given the duration in which solar PV has been in existence.

The results further indicated that municipalities within the individual studies have encountered numerous challenges due to the adoption of solar PV. Uncertainty of the regulatory environment as well as the technical issues have dominated the challenges experienced by the municipalities. In a bid to track and monitor the PV applications, all three individual studies have introduced business processes.

These findings help develop a consolidated view of the response to research question 1 and the corresponding results from each individual study. This is reflected in Table 13.

Table 13: Consolidated Findings RQ1

		Individual studies		
Theme	Sub-theme	MM01	MM02	MM03
Penetration growth	Drivers of penetration	X	X	X
	Public interest	X	X	
	High penetration	X		
	Rapid uptake	X	X	X
Initial resistance			X	
Embraced PV		X		X
Recognition of challenges	Safety issues	X	X	
	System deficiencies	X	X	X
	Inflexibility of the MFMA	X		
	Uncertainty of the regulatory environment	X		
	Technical issues		X	
	Lack of appropriate tariff			X
	Resource constraints			X
	Pace of local government process		X	
Process management		X	X	X

### 6.3 Discussion: Research Question 2

#### ***RQ2.** What is the understanding of the advent of rooftop solar PV on municipal revenue?*

The aim of this question is to understand whether rooftop solar has had any impact on municipal revenue. If so, to what extent and what measures have been introduced by the municipality to mitigate this. Casteneda et al. (2017); Janse van Rensburg et al. (2018); Korsten, et al. (2017); Korsten et al. (2019); Trollip et al. (2012) concur that municipal revenue would be significantly impacted by the uptake of solar PV. Trollip et al. (2012) highlight that the revenue loss could even be between 17 percent and 25 percent. Reinecke et al., (2013) and Walwyn (2015) consider that the revenue loss will be negligible possibly less than one percent.

The discussion of this research question is categorised into three broad areas, viz. (a) recognition of the major contributing factors to municipal revenue, (b) appreciation of the impact on municipal revenue to the advent of rooftop solar PV, and (c) measure identified to mitigate the revenue impact. A common finding from all three individual studies was that electricity sales serve as a major contributor to municipal revenue which is viewed as the cash cow of the municipality. A recurring theme from the interviews was a sense amongst eight of the respondents that there is a definite negative impact on municipal revenue due to the advent of rooftop solar PV. The overwhelming majority of respondents suggested that in order to mitigate the loss, an appropriate tariff is required.

#### 6.3.1 Electricity as a cash cow

The findings of this study indicate that electricity sales serve as a major contributor to municipal revenue. A number of respondents argued that the income received from electricity sales serves to sustain the municipality. The findings further revealed that amongst the contributors to municipal revenue, seven of the respondents concur that electricity sales are the major contributor. This finding is consistent with that of Elsasser et al. (2018) who indicate that electricity charges for electricity sold to customers is the largest revenue source for the municipalities and it is also used to cross-subsidise other municipal functions.

The findings from this study further indicate that there has been a reduction in the surplus generated by the electricity department. One of the findings indicated that the surplus reduced from approximately 50 percent to 12 percent over a five-year period. The findings further revealed that the electricity business which once was viewed as the cash cow of the municipality is no longer viewed in this manner.

### 6.3.2 Negative impact on revenue

An interesting finding which permeated throughout all three individual studies was that the advent of solar PV has had a negative impact on municipal revenue. Whilst the respondents concurred that the advent of solar PV had a negative impact on revenue for the municipality they were unable to confirm the quantum of the revenue loss. One of the respondents ventured to indicate that they observed an approximate loss of R100 million per month which was not solely due to the advent of solar PV.

These results corroborate the findings of a great deal of the previous work in the confirmation that municipal revenue is significantly impacted by the uptake of solar PV (Casteneda et al., 2017; Janse van Rensburg et al., 2018; Korsten, et al., 2017; Korsten et al., 2019; Trollip et al., 2012). Trollip et al. (2012) state that the revenue loss could even be between 17 percent and 25 percent. Janko et al. (2016) has also confirmed that a one percent increase in solar PV penetration resulted in an equivalent reduction in revenue for the municipality.

Satchwell et al. (2015) has further observed that the uptake in solar PV or the growth in PV penetration is directly proportional to the loss in revenue however, this may not necessarily lead to a death spiral. The findings of this study indicate that due to the revenue loss, the municipalities are on a downward spiral. A possible explanation for this might be that the banking institutions are funding private residence and commercial customers to install solar PV. Another possible explanation for this is that the costs of solar PV have reached grid parity which makes it enticing to install solar PV.



### 6.3.3 Appropriate tariff

The findings from this study indicate that in order to mitigate the negative impact on revenue and loss for the municipalities, respondents from all three individual studies concur that an appropriate feed-in tariff be implemented. A further finding revealed that the inclusion of a fixed network charge in the tariff structure will ensure there is consistent revenue for the municipality.

These findings corroborate the ideas of Janko et al. (2016), who suggested that the recovery of revenue losses can be undertaken by an appropriate design of the electricity tariffs. Dijkgraaf et al. (2018) further highlighted that the introduction of an appropriately designed feed-in tariff has not only contributed to the uptake in solar PV installations but has also mitigated against significant losses in revenue.

### 6.3.4 Summary of discussion: Research Question 2

The findings have revealed that the sales from electricity are a major contributor to municipal revenue. The surplus generated from the sale of electricity has declined over the last few years. The respondents also observed that the uptake in solar PV has had a negative impact on the revenue of the municipality. However, the outcome from the individual studies have not been able to quantify the loss. The respondents suggested that the implementation of an appropriate feed-in tariff and fixed network charge, this will assist to mitigate the revenue loss.

These findings help develop a consolidated view of the response to research question 2 and the corresponding results from each individual study. This is reflected in Table 14.

Table 14: Consolidated Findings RQ2

		Individual studies		
Theme	Sub-theme	MM01	MM02	MM03
Electricity as a cash cow	Contribution to municipal revenue	X	X	X
	Reduction in surplus			X
	No longer a cash cow	X	X	X
Negative impact on revenue	Impact on revenue	X	X	X
	Revenue loss	X	X	X
	Downward spiral		X	X
Appropriate tariff		X	X	X

#### 6.4 Discussion: Research Question 3

**RQ3.** Describe the options available to municipalities given the changes in their core market?

The aim of this question is to determine whether municipalities have identified any opportunities outside of their core market to remain sustainable. REN21 (2019) highlights how local governments in certain countries have capitalised on the opportunity presented by renewable energy by (a) integrating solar PV into their building designs, (b) introducing electrically powered public transport (c) using waste and its associate biogases to generate electricity, and (d) diversifying into the sale, installation and maintenance of rooftop solar systems.

The discussion of this research question is categorised into two areas, viz. (a) confirmation of the core market, and (b) identification of opportunities outside of the core market.

#### 6.4.1 Core market

The most obvious finding to emerge from the analysis is that all the municipalities operate a traditional wires business. Power is purchased from Eskom (national electricity producer), transmitted along high voltage power lines, transformed at major substations within the municipal supply area and distributed to the customer load centres. Eskom acts solely on behalf of thirty percent (30 percent) of the municipalities, providing electricity supply to their citizens (National Treasury, 2011). The findings indicated that it had become more economical to purchase power from Eskom hence, the municipality performing a distribution service.

Another important finding is that municipalities hold a distribution licence to supply power to the customer. In other instances, both Eskom and the municipality provide electricity to the municipal residents, resulting in Eskom having approximately the same number of customers as municipalities (National Treasury, 2011). The provision of electricity is regulated through the Electricity Regulations Act 4 (2006) which is overseen by the NERSA (Electricity Regulations Act 4, 2006). The framework sets out the jurisdiction and conditions for operating a supply licence which each municipality holds in order to undertake this service (Electricity Regulations Act 4, 2006).

On the question of the existing business model, this study found that there were differences among the three individual studies whether the current business model is still relevant or not. However, it emerged from the findings that there was consensus amongst the respondents in the three individual studies that the sustainability of the municipality is at risk. The electricity business may become redundant if no change is undertaken. Other findings indicated that it requires out of the box thinking to remain sustainable. The provisions contained in the MFMA should be viewed in its broader context of ensuring the sustainability of municipal services (Reinecke et al., 2013).

#### 6.4.2 Alternative revenue streams

Shannon (2016) stated that the electric utility should introduce of a variety of options for customers to choose from in order for customers to take control of their energy

needs. Dantas et al. (2017) have argued that the customer of the twenty-first century is more exposed to information and technological advancements hence, changing their behaviour and becoming more cognisant of sustainability. Municipalities need to expand their focus to alternative revenue generating options which become attractive to the changing customer base.

The findings from the study indicate that municipalities should consider five alternative revenue generating streams in order to remain sustainable. These revenue generating streams included, (a) self-generation, (b) wheeling energy, (c) being a PV service provider, (d) the Provision of services, (e) operating the grid as a battery. This finding, of being a PV service provider, is consistent with that of REN21 (2019) who highlight how local governments in certain countries have capitalised on the opportunity to diversify into the sale, installation and maintenance of rooftop solar systems. Each alternative is now discussed.

*Self-generation:* With the abundance of roof space, whether owned by the municipality or privately owned, respondents state that this an area which the municipality can easily explore. An interesting finding is that the regulatory environment is changing allowing municipalities to enter this space. This may be undertaken by establishing their own PV generation sites with direct injection into the grid. This may offset the electricity purchased from Eskom.

*Energy wheeling:* The study revealed that the municipality should explore this option as there is no commitment to own the generating plant or being the customer who may need the energy. Municipalities currently own the electricity grid which would serve as the conduit for the generated power. This would also include wheeling electricity which may be purchased from generators in distant locations which may not even be connected to the municipal grid.

*PV service provider:* The findings of the study indicate that the municipality could consider venturing into becoming a solar PV service provider. As stated by one of the respondents, this can be undertaken by becoming the local sales agent of solar

PV infrastructure for internationally renowned companies. According to REN21 (2019), this may entail the sale, installation and maintenance of rooftop solar systems. Another respondent indicated that the municipality could consider the sale of solar cells to customers. This in essence will make the municipality a retailer of solar PV systems.

*Provision of services:* The findings indicate that the municipality could monopolise on the use of its existing infrastructure for the provision of alternative services. Municipalities have an expansive fibre network and these alternative services may include acquiring revenue from the fibre network. Some respondents indicated that the municipality could acquire revenue from the rental of roof space and/or streetlight poles.

*Grid as a battery:* The study found that the grid can be used as a battery. The findings state that customers be encouraged to export their excess energy to the grid and purchase from the municipality when in need. This will include the deployment of a net-metering tariff which will allow for the sale and purchase of PV generated and exported to the grid. The findings further state that the municipality will generate revenue via the implementation of a fixed charge tariff for the use of the grid.

#### 6.4.3 Summary of discussion: Research Question 3

The findings confirmed that the individual studies continue to operate a traditional wires business. They all hold the distribution licence to supply the customers within its jurisdiction. A further finding revealed that there is consensus that the sustainability of the current business model is at risk if no mitigating measures are implemented.

A summary of alternative revenue streams has been described in Figure 11 representing the options available to the municipalities to explore.

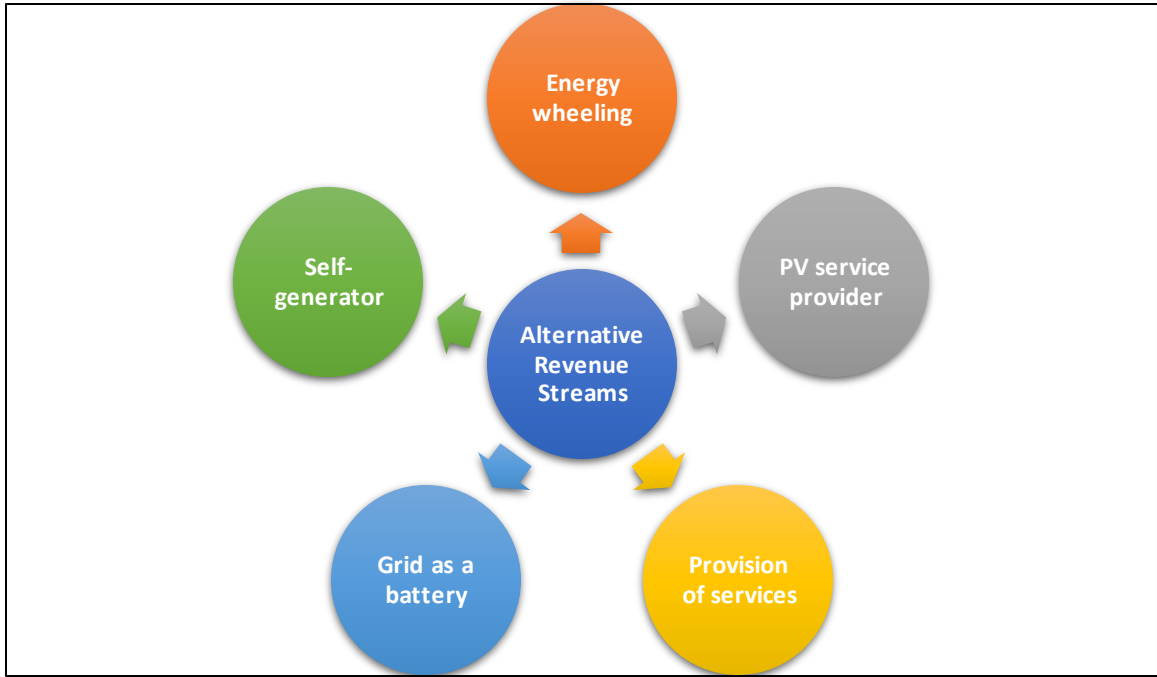


Figure 11: Alternative Revenue Streams

These findings help develop a consolidated view of the response to research question 3 and the corresponding results from each individual study. This is reflected in Table 15.

Table 15: Consolidated Findings RQ3

		Individual studies		
Theme	Sub-theme	MM01	MM02	MM03
Core market	Power distribution	X	X	X
	Sustainability	X	X	X
Alternative revenue streams	Self-generator	X	X	X
	Energy wheeling	X	X	X
	PV service provider		X	X
	Provision of services	X	X	X
	Grid as a battery	X	X	X

## 6.5 Discussion: Research Question 4

***RQ4.** Describe how the Municipality has attempted to change or has changed its business operations and processes to improve its service delivery in an incremental fashion in response to the advent of rooftop solar PV?*

The aim of this question is to understand if municipalities are improving the efficiency of their existing systems. Ossenbrink et al. (2019) in their study demonstrated how the changing environment shaped certain organisations' use of the structural and contextual approaches to ambidexterity. However, there is limited insight into how organisations combine the different approaches (structural and contextual) in their quest for ambidexterity (Asif, 2017; Fourne et al., 2019; Ossenbrink et al., 2019).

The discussion of this research question is categorised into two areas, viz. (a) identification of the improvement areas for the existing systems, and (b) classification of approach used to undertake improvement.

### 6.5.1 Operational efficiency

The findings indicate that improvements in operational efficiency have been undertaken in the areas of human resource and organisational processes. A significant focus is being given to improve the performance of the human resources dedicated to managing the rooftop solar in the municipalities. Significant investment is placed on skills development in solar PV. Another finding indicated that recognition was given to the need to acquire additional human resources to oversee the solar PV function which involved the secondment of existing resources. The findings further stated that significant improvements were undertaken in the existing processes in order to improve the management of the solar PV applications. Business operations were being optimised due to the advent of rooftop solar PV.

The findings further indicate that these improvements in operational efficiency are incremental in nature due to the limited skills and focus on other core functions within

the organisation. The implementation of these incremental changes within the organisation demonstrate a quest for organisational ambidexterity.

#### 6.5.2 Mixed approach

This study found that the improvements in operational efficiency due to the advent of solar PV were being undertaken within the existing departments with the utilisation of existing skills as well as in a separate department solely focusing on this function. Literature is mixed in terms of the ambidextrous approach organisations should follow. Lavikka et al. (2015) argue that organisational ambidexterity can be achieved solely through a contextual approach. This is in line with the findings of the one individual study, MM02, which stated that the improvements in operational efficiency due to the advent of solar PV were being undertaken within the existing departments with the utilisation of existing skills.

On the other hand, Fourné et al. (2019) state that the achievement of organisational ambidexterity is best acquired via a structural approach regardless of the size of the organisation. This argument is in line with the findings of the other two individual studies, MM01 and MM03, which stated that the improvements in operational efficiency due to the advent of solar PV were being undertaken within the separate department which was established to oversee the management of renewable energy within the municipality. A further finding from the study indicated that whilst MM02 follows a contextual approach to ambidexterity they are of the view that organisational ambidexterity is best achieved through a structural approach to ambidexterity. A separate organisational structure will allow for greater autonomy and dedicated focus in achieving organisational growth and achievement of its strategic objectives.

#### 6.5.3 Summary of discussion: Research Question 4

The findings of this study found that all three individual studies have introduced incremental changes to their operations due to the advent of rooftop solar PV. These improvements have been focused on the human resources and businesses within the organisation. These incremental changes have in the main followed a mixed approach in terms of the department executing these functions. The findings



revealed that for individual study MM01, this function has been undertaken in an existing department with the use of existing resources hence, the use of a contextual approach to ambidexterity. On the other hand, the findings revealed the other two individual studies utilised a separate department with its sole purpose to focus on the management of renewable energy activities hence, a structural approach to ambidexterity.

## 6.6 Discussion: Research Question 5

***RQ5. Describe how the Municipality has attempted to radically innovate and adopt new forms of service provision for electricity in response to the advent of rooftop solar PV?***

The aim of this question is to understand if municipalities are maximising on the innovative opportunities presented by rooftop solar PV. Ossenbrink et al. (2019) in their study demonstrated how the changing environment shaped certain organisations' use of the structural and contextual approaches to ambidexterity. However, there is limited insight into how organisations combine the different approaches (structural and contextual) in their quest for ambidexterity (Asif, 2017; Fourne et al., 2019; Ossenbrink et al., 2019).

The discussion of this research question is categorised into two areas, viz. (a) identification of innovative ideas considered by the municipality due to the advent of rooftop solar PV, and (b) classification of approach used to undertake the innovation.

### 6.6.1 Automation

The study indicated that all three individual studies recognised the need to introduce automation in order to simplify the management functions due to the advent of rooftop solar PV. One of the findings stated that any innovative initiative should hold the customer needs at the forefront of all activities. Another finding indicated that industry and the private sector will not wait for the municipality to deploy innovative ideas.

### 6.6.2 Structural approach

Findings from two of the individual studies, MM01 and MM03, state that a separate department had been established to focus on radical innovation. Another finding from the other individual study, MM02, states that the organisation has recognised the need to establish a separate structure to manage and focus on the strategy of achieving radical innovation. This separate structure would allow for autonomy in function including it to be more agile to undertake research, exploration and implementation of various innovative ideas. This complete separate department solely dedicated to this function lends itself to a structural approach to ambidexterity.

Nowacki & Monk (2020) argue that rapid innovation, within the government sphere, is best achieved through a structural ambidextrous approach. A designated independent agency acting on behalf of government can serve as this vehicle. The introduction of the structural approach helps separate the ongoing organisational operations from any innovative work (Jansen et al., 2009).

### 6.6.3 Summary of discussion: Research Question 5

The findings of this study found that all three individual studies have recognised the need to radically innovate by the introduction of automation due to the advent of rooftop solar PV. The automation will focus on the business processes and key systems within the organisation. The findings established that there is recognition that the effective management of this function will be best situated in a completely separate department solely dedicated to this function thereby, representing a structural ambidextrous approach.

## 6.7 Summary and implications of findings for Ambidexterity

The findings from Research Question 1 suggest that there is acknowledgement from all three individual studies that the penetration levels of rooftop solar PV are growing significantly on an annual basis. The average annual growth rate stated by this study being higher than the annual growth rates of other countries like the United States of America (Janko et al., 2016). The study identified seven challenges faced by the individual studies as the penetration levels grow coupled with a growing desire for

solar PV installations to be connected to the electricity grid. Management within the individual studies have, as reflected by the study, have instituted measures to manage the penetration levels of PV including mitigating any safety risks.

The results from Research Question 2 suggest that sales from electricity consumption serve as a major contributor to municipal revenue. Elsasser et al. (2018) indicates that electricity charges for electricity sold to customers is the largest revenue source for the municipalities and it is also used to cross-subsidise other municipal functions. The findings further state that rooftop solar PV is a significant threat to municipal revenue. Janko et al. (2016) has highlighted that a one percent increase in solar PV penetration resulted in an equivalent reduction in revenue for the utility. This adverse effect on the revenue of the municipality has the potential to negatively impact on the long-term sustainability of the municipality. This leads to the findings for Research Question 3 as discussed in the next paragraph.

The findings from Research Question 3 suggest that the individual studies continue to operate a traditional wires business and all hold the distribution licence to supply the customers within their jurisdiction. The Electricity Regulations Act 4 (2006) sets out the jurisdiction and conditions for operating a supply licence which each municipality holds in order to undertake this service (Electricity Regulations Act 4, 2006). As stated above, the growth in penetration of solar PV is directly proportional to the revenue loss. The findings from the study indicate that municipalities should consider five alternative revenue generating streams in order to remain sustainable.

The response of municipalities therefore needs to be ambidextrous in order to remain sustainable and mitigate the loss of revenue. The link between the findings of Research Question 4 and Research Question 5 suggest the intention of the individual studies in their quest to be organisationally ambidextrous. Organisational ambidexterity is achieved through the simultaneous attainment of incremental changes as well as radical innovation within the public sector (Kobarg et al., 2017). The findings from this study suggest that all the individual studies have demonstrated organisational ambidexterity through the simultaneous improvement in operational efficiency in human resource and processes (incremental change) and the

identification of automation of processes and systems as well as alternative revenue streams (radical innovation).

The findings from Research Question 4 and Research Question 5 further suggest a mixed approach (structural and contextual) to the achievement of organisational ambidexterity. Considerable studies have been undertaken of the structural and contextual approaches to ambidexterity (Fourne et al., 2019). The findings from one individual study revealed the attainment of organisational ambidexterity via a contextual approach whilst the findings from the other two individual studies revealed the attainment via a structural approach. Literature is mixed on which is the best approach however, there is recognition from Nowacki & Monk (2020) that rapid innovation, within the government sphere, is best achieved through a structural ambidextrous approach. There is also in line with the findings from this study.

The above summary suggests a refinement to the theory of ambidexterity, namely the development of a model which depicts the typology of possible responses within organisations to a competitive threat, in this case the response of municipalities to solar PV. The model is shown in Figure 12.

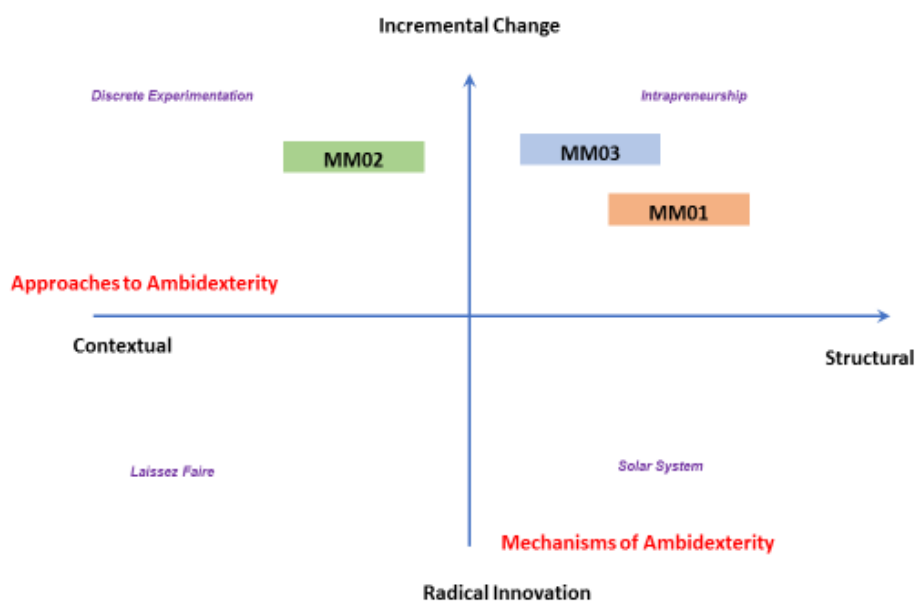


Figure 12: Typology for Municipal response to Solar PV

This figure illustrates the following design dimensions for the organisational ambidexterity approaches for municipalities due to the advent of solar PV:

1) Horizontal (x) axis:

This refers to the approach to organisational ambidexterity (contextual or structural) undertaken by the municipality

2) Vertical (y) axis:

This refers to the level/mechanism of ambidexterity (incremental or radical) that a municipality deploys in its effort to achieve its strategic objectives

3) Quadrant 1 ('Intrapreneurship'):

It reflects a greater focus on incremental change of an organisation in its quest for organisational ambidexterity where this incremental change is undertaken within a separate organisational structure with clear delineation of roles and responsibilities. This is where individual studies MM01 and MM03 are placed.

4) Quadrant 2 ('Discrete Experimentation'):

It reflects a greater focus on incremental change of an organisation in its quest for organisational ambidexterity where this incremental change is undertaken within an existing department through the use of existing skills who may also focus on other core functions. This is where MM02 is placed.

5) Quadrant 3 ('Laissez Faire'):

It reflects a greater focus on radical innovation of an organisation in its quest for organisational ambidexterity where the radical innovation is undertaken within an existing department through the use of existing skills who may also focus on other core functions. There is no individual study placed in this quadrant.

6) Quadrant 4 ('Solar System'):

It reflects a greater focus on radical innovation of an organisation in its quest for organisational ambidexterity where the radical innovation is undertaken

within a separate organisational structure with clear delineation of roles and responsibilities. There is no individual study placed in this quadrant.

The main purpose of this framework is to suggest how the various municipalities have responded to the advent of rooftop solar PV using the approach to organisational ambidexterity. It is evident from these findings that each municipality is responding in a slightly different manner with MM02 approaching organisational ambidexterity in a contextual manner and MM01 and MM03 approaching organisational ambidexterity in a structural manner. The findings from all three individual studies reveal the need to place greater focus on radical innovation in order to remain sustainable. This may be achieved through the introduction of automation of the organisational processes and systems as well as the adoption of alternative revenue streams such self-generation, becoming a PV service provider and using the grid as a battery. There is consensus that this should be approached in a structural manner in order to achieve maximum benefit to the municipality. The municipality may either introduce an independent agency acting on its behalf or establish an entirely new department within the organisation to focus on radical innovation.

## 6.8 Conclusion

This chapter presented the findings of this study. The findings of this study reveal that that the management within each individual study are aware of the growth in penetration of solar PV. Statistics on annual growth rates were presented by the respondents in each individual study. The results further indicated that municipalities within the individual studies have encountered numerous challenges due to the adoption of solar PV. In a bid to track and monitor the PV applications, all three individual studies have introduced business processes. These findings help develop a consolidated view of the response to Research Question 1 and the corresponding results from each individual study.

The surplus generated from the sale of electricity has declined over the last few years. The respondents also observed that the uptake in solar PV has had a negative impact on the revenue of the municipality. The one rather overwhelming observation is that all the municipalities have lost revenue over the last five years, suggesting that they have

not been effective at managing the transition. There is consensus that the sustainability of the current business model is at risk if no mitigating measures are implemented. A summary of alternative revenue streams has been identified from the study representing the options available to the municipalities to explore.

All three individual studies have introduced incremental changes to their operations due to the advent of rooftop solar PV. These improvements have been focused on the human resources and businesses within the organisation. These incremental changes have in the main followed a mixed approach in terms of the department executing these functions. This study found that all three individual studies have recognised the need to radically innovate by the introduction of automation due to the advent of rooftop solar PV. It was established that there is recognition that the effective management of this function will be best situated in a completely separate department solely dedicated to this function thereby, representing a structural ambidextrous approach. In other words, ambidexterity is not working. Less attention is being given to the introduction of radical innovative activities such as self-generation and provision of energy services due to the inability to overcome the bureaucratic systems within the municipality.

The results were used to suggest a refinement to the theory of ambidexterity, namely the development of a model which depicts the typology of possible responses within organisations to a competitive threat, in this case the response of municipalities to solar PV.

## 7.0 CONCLUSION

### 7.1 Introduction

The response by municipalities to the advent of rooftop solar PV utilising the approaches to organisational ambidexterity drove this research study. REN21 (2019) highlighted that renewable sources grew by 2 378 GW in 2018 and rooftop solar PV contributed to 1 308 GW to this growth. This growth in rooftop solar PV is significant as well in South Africa with an increase from five MW in 2012 to 242 MW in 2018 (AREP, 2019). Literature states the reasons for this expansion in the deployment of rooftop solar PV. These may be attributed to the rising costs of conventional electricity grid supply, the advancements in technology leading to improvements in performance of the entire rooftop solar PV system and the reduction in prices of materials for rooftop solar PV (Bonneuil & Boucekkine, 2016; Garcez, 2017; Hyysalo et al., 2018; Janko et al., 2016; Joffe, 2012; Korsten, Brent, Sebitosi & Kritzinger, 2017).

This study explored how municipalities within South Africa responded to the advent of rooftop solar PV using the approaches to organisational ambidexterity. The advent of rooftop solar PV has a significant impact on the revenue of the municipality (Casteneda et al., 2017; Janse van Rensburg et al., 2018; Korsten, et al. (2017); Korsten et al., 2019; Trollip et al., 2012). This is due to the uptake of rooftop solar PV and a shift from the conventional grid supply of electricity. Pacudan (2018) observed this reduction in grid consumption due to the grow in rooftop solar PV. This impact would be significant to municipalities due to the fact that a reduction in grid consumption refers to a corresponding reduction in revenue.

Literature has provided insights into the subject of ambidexterity which focusses on the dual role of incremental change as well as radical innovation within an organisation (Birkinshaw & Gibson, 2004). It is the responsibility of the leadership within the organisation to create a conducive environment to allow employees to determine when it is opportune to deploy these two mechanisms of ambidexterity (Ossenbrink et al., 2019). Fourné et al. (2019) established that significant studies have been undertaken exploring the use of the contextual and structural approaches to ambidexterity. Whilst, on the other hand, Kobarg et al. (2017) argue that there is



limited research into the contextual and structural approaches to ambidexterity within the government sector. This study sought to explore the joint use of these approaches to ambidexterity by municipalities given the advent of the advent of rooftop solar PV (Fourné et al., 2019).

This chapter presents the research findings to this study, discusses the implications for business and theory by the presentation of a typology model for ambidexterity, highlights limitations for the study and areas for future research.

## 7.2 Research Findings

A qualitative research study was undertaken to respond to the five research questions. The responses to Research Question 1 to Research Question 3 provided an understanding of the impact on the municipalities due to rooftop solar PV. The responses to Research Question 4 and Research 5 provided insight into the extent to which municipalities have responded to the advent of rooftop solar PV.

### 7.2.1 Growth in Solar PV

The study concurred with literature that there is significant growth in the penetration of rooftop solar PV. The average annual growth in rooftop solar PV penetration reflected an increase of 79 percent over a four-year period compared to an average annual increase in other countries of 58 percent (Janko et al., 2016). Similar drivers for the rapid uptake of rooftop solar PV were identified through the findings of this research. These drivers relate to the drastic reduction in costs of rooftop solar PV and the increase in the conventional grid supply tariffs.

The findings to Research Question 1 correlated with existing literature in terms of the growth of solar PV due to the reduction in costs.

### 7.2.2 Negative Impact on Revenue

The study revealed that sales from electricity is a major contributor to the revenue of a municipality. The income received from electricity sales is also used to cross-subsidise other functions within the municipality (Elsasser et al., 2018). A major finding was the significant impact of the growth in rooftop solar PV on the revenue of the municipality. Feedback from the respondents were unanimous in their views on this subject matter whilst unable, in all cases, to quantify the revenue loss. Janko et al. (2016) who highlighted that a one percent growth in rooftop solar PV resulted in a corresponding revenue loss of one percent.

### 7.2.3 Alternative Revenue Streams

Municipalities continue to operate the traditional wires business model which the findings revealed has been in existence for over 100 years since the establishment of the municipalities. The findings from the study indicated that the current business model is not sustainable and in order to mitigate the revenue loss, the municipality should be radical in the implementation of innovative initiatives. Five alternative revenue streams were identified by the study, namely, self-generation, energy wheeling, PV service provider (REN21, 2019), provision of services and use of grid as a battery.

### 7.2.4 Mechanisms of Ambidexterity

Research Questions 4 and Research Question 5 revealed findings for this study which identified examples of the dual mechanisms of ambidexterity, incremental change and radical innovation. These examples included incremental improvements in operational efficiency in the areas of business processes and human resource and the need to be radically innovative through the introduction of automation. The municipalities revealed the limitation to undertake radical innovation due to the bureaucratic processes and culture of the municipality.

### 7.2.5 Approaches to Ambidexterity

The feedback from the municipalities indicated a mixed approach to the achievement of organisational ambidexterity. One of the municipalities revealed a contextual approach in its quest to achieve organisational ambidexterity due to the advent of rooftop solar PV. On the other hand, the other two municipalities indicated that a separate department was established to undertake the current incremental changes due to the advent of rooftop solar PV. There is consensus among the municipalities that the achievement of radical innovation in the pursuit of organisational ambidexterity is best implemented via an independent department hence, a structural approach to ambidexterity. Nowacki & Monk (2020) stipulates that within a government or public sector, radical innovation is best achieved through a structural approach.

### 7.3 Proposed Conceptual Model

The study suggested a refinement to the theory of ambidexterity through the development of a typology of ambidexterity model. Figure 12 reveals this 2 x 2 typology model for ambidexterity with the vertical axis reflecting the mechanisms for ambidexterity and the horizontal axis reflecting the approaches to ambidexterity. The four quadrants reveal the combined mechanism and approach in an organisations quest for ambidexterity. 'Intrapreneurship' reflecting combined increment change and structural approach. 'Discrete experimentation' reveals the combined incremental change and contextual approach. 'Laissez Faire' reflects the combined radical innovation and contextual approach. 'Solar System' reveals combined radical innovation and a structural approach.

The purpose of this model is to suggest the maturity of municipalities in their response due to the advent of rooftop solar PV. One of the municipalities, MM02, is suggested to be placed within the 'discrete experimentation' sphere of the model reflecting its incremental changes being undertaken through a contextual approach. The other two municipalities, MM01 and MM03, is suggested to be placed within the 'Intrapreneurship' sphere of the model revealing its incremental changes being undertaken through a structural approach.

#### 7.4 Implications for Business

The findings from this study offered certain aspects which municipalities should consider due to the advent of rooftop solar PV. In order to remain sustainable as a municipality, the respondents revealed the following should be undertaken:

- a) The respondents indicated that municipalities need to be wary of the significant growth in rooftop solar PV as it impedes on the grid consumption and the potential to penetrate the core market of the municipality.
- b) In the current economic climate, sustainability for the municipality is crucial due to its constitutional mandate to deliver basic services to citizens hence, the municipality unable to afford to become bankrupt.
- c) The identification from this study of five alternative revenue streams provides potential business opportunities for municipalities. The opportunity for this to unfold is further improved by the changing regulatory environment.
- d) In order to unlock its radical innovative potential, municipalities need to establish separate, independent department which are more agile and flexible to manage rapid change and decision making, void of the current bureaucratic processes within the municipalities.
- e) The study has also revealed the need for municipalities to review its tariff structure to remain competitive and mitigate the short-term effects of the reduction in grid consumption.

#### 7.5 Limitations to the Research Study

Limitations to the current research study are as follows:

- e) Time horizon:  
Whilst acceptable as per Thornhill et al. (2009) for the study to be conducted in a cross-sectional time horizon which this study followed, it is of greater benefit to undertake a longitudinal study as per Ossenbrink et al. (2019).
- f) Access to other metropolitan municipalities:  
The study was able to gather data to produce valuable findings from the expertise of participants from various municipalities however, the researcher was unable to obtain access to participants from two metropolitan municipalities.

g) Access

Due to the ongoing pandemic, the researcher was impeded from acquiring access to the municipalities sites to conduct observations of their operations.

h) Researcher bias:

Within qualitative research, the risk of researcher bias is introduced. Due to the researcher also employed within the field of this study, this further emphasises the risk. However, the researcher mitigated this by exercising restraint in imparting their knowledge and expertise into the data which was collected and allowed the participants to be free to make their contributions.

## 7.6 Suggestions for Future Research

Based on the findings of this study, the following areas should be considered for future research:

a) Typology Model:

The proposed typology model should be tested further to determine its applicability for other municipalities who are also faced with the advent of rooftop solar PV. It may also be useful to determine its applicability for businesses operating within the private sector.

b) Type of Structural Approach to be deployed:

This study revealed a structural approach for the achievement of radical innovation in the quest for organisational ambidexterity should be undertaken. Given the study being undertaken within the municipal or government sphere, it may be useful to understand what for type of structure would be best suited to achieve this objective.

## 7.7 Conclusion

This study has provided useful insights into the ambidextrous approaches deployed by municipalities in their response to the advent of rooftop solar PV. This was presented through the results from the respondents to the five research questions. The findings from the study was also supported by literature. The study was able to demonstrate the

mixed use of the contextual and structural approach to the quest for organisational ambidexterity. This was presented through a proposed typology model for ambidexterity which reflected the maturity and response ability of each of the three municipalities explored during this study.

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## APPENDIX 1: CONSISTENCY MATRIX

Title: Exploring the responses of municipalities with the advent of rooftop solar PV using the approaches to ambidexterity

RESEARCH QUESTIONS	LITERATURE REVIEW	DATA COLLECTION TOOL	ANALYSIS
<b>Research Question 1:</b> Describe how municipalities have responded to the advent of rooftop solar PV?	Section 2.3.3 (Bonneuil & Boucekkine, 2016; Garcez, 2017; Joffe, 2012; Hysalo et al., 2018; Korsten et al., 2017).	Semi-structured Interviews (Section 2.3.3, 3.1 & 4.6)	Thematic Data Analysis with the use of Computer Aided Qualitative Data Analysis Software, ATAS.ti
<b>Research Question 2:</b> What is the understanding of the advent of rooftop solar PV on municipal revenue?	Section 2.3.3 (Casteneda et al. (2017); Janse van Rensburg et al. (2018); Korsten, et al. (2017); Korsten et al (2019); Trollip et al. (2012); Walwyn (2015).	Semi-structured Interviews (Section 2.3.3, 3.2 & 4.6)	
<b>Research Question 3:</b> Describe the options available to municipalities given the changes in their core market?	Section 2.2.5 (REN21, 2019)	Semi-structured Interviews (Section 2.2.5, 3.4 & 4.6)	
<b>Research Question 4:</b> Describe how the Municipality has attempted to change or has changed its business operations and processes to improve its service delivery in an incremental fashion in response to the advent of rooftop solar PV?	Section 2.4.3 (Asif, 2017; Fourne et al., 2019; Ossenbrink et al., 2019).	Semi-structured Interviews (Section 2.4.3, 3.3 & 4.6)	
<b>Research Question 5:</b> Describe how the Municipality has attempted to radically innovate and adopt new forms of service provision for electricity in response to the advent of rooftop solar PV?	Section 2.4.3 (Asif, 2017; Fourne et al., 2019; Ossenbrink et al., 2019).	Semi-structured Interviews (Section 2.4.3, 3.3 & 4.6)	

## APPENDIX 2: ETHICAL CLEARANCE

**Gordon Institute  
of Business Science**  
University of Pretoria

**Ethical Clearance  
Approved**

Dear Jonathan Hunsley,

Please be advised that your application for Ethical Clearance has been approved.  
You are therefore allowed to continue collecting your data.  
We wish you everything of the best for the rest of the project.

[Ethical Clearance Form](#)

Kind Regards

This email has been sent from an unmonitored email account. If you have any comments or concerns, please contact the GIBS Research Admin team.

## **APPENDIX 3: INFORMED CONSENT FORM**

**Informed Consent Letter**

Dear XXX

I am currently a student at the University of Pretoria's Gordon Institute of Business Science and completing my research in partial fulfilment of an MBA. I am conducting research on a topic entitled, "*Exploring the response of municipalities with the advent of rooftop solar PV using the approaches to ambidexterity*". I'm trying to understand how metropolitan municipalities have responded from a structural, systems and process perspective with the advent of rooftop solar PV.

Our interview will last from about 45 to 60 minutes and will help us understand how municipalities are navigating this changing paradigm. *Your participation is voluntary, and you can withdraw at any time without penalty.* Confidentiality will be adhered to wherein all data will be reported without identifiers. If you have any concerns, please contact my supervisor or me. Our details are provided below.

**Researcher Name:** Jonathan Hunsley  
Walwyn

**Supervisor Name:** Prof David

**Email:** hunsleyjp@elec.durban.gov.za

**Email:** david.walwyn@up.ac.za

**Phone:** 083 278 4280

**Phone:** (012) 420 2451

Signature of participant: \_\_\_\_\_

Date: \_\_\_\_\_

Signature of researcher: \_\_\_\_\_

Date: \_\_\_\_\_

## APPENDIX 4: INTERVIEW GUIDE



### Semi-structured Interview Guideline

**Thesis Title:** Exploring the responses of municipalities with the advent of rooftop solar PV using the approaches to ambidexterity

**Name:** Jonathan Hunsley

**Student #:** 19388251

#### A. Background Information

##### RQ1. Describe how municipalities have responded to the advent of rooftop solar PV?

- 1.1. Please share with me the organisation you are currently employed by?
- 1.2. Please share with me your position in the organisation?
- 1.3. How long have you been in the employ of the organisation?
- 1.4. What is your experience in the current environment?
- 1.5. Could you share with me about the penetration of rooftop solar PV within your Municipality?
- 1.6. Outline whether the Municipality is recording information of each of these installations?

#### B. Municipal Revenue

##### RQ2. What is your understanding of the advent of rooftop solar PV on municipal revenue?

- 2.1 What kind of challenges have municipalities encountered with the advent of rooftop solar PV?
- 2.2 What are the contributors to municipal revenue?
- 2.3 Describe whether the advent of rooftop solar PV has had any impact on municipal revenue?
- 2.4 Describe what the advent of rooftop solar PV will have on municipal revenue in the future?

## **C. Availability of Options**

### **RQ3. Describe the options available to municipalities given the changes in their core market?**

- 3.1 What is the current business model for the provision of electricity?
- 3.2 How relevant is the current business model for the provision of electricity?
- 3.3 Describe what alternative revenue generating options municipalities have for the provision of electricity?

## **D. Alignment**

### **RQ4. Describe how municipalities have attempted to change or has changed your business operations and processes to improve your service delivery in an incremental fashion in response to the advent of rooftop solar PV?**

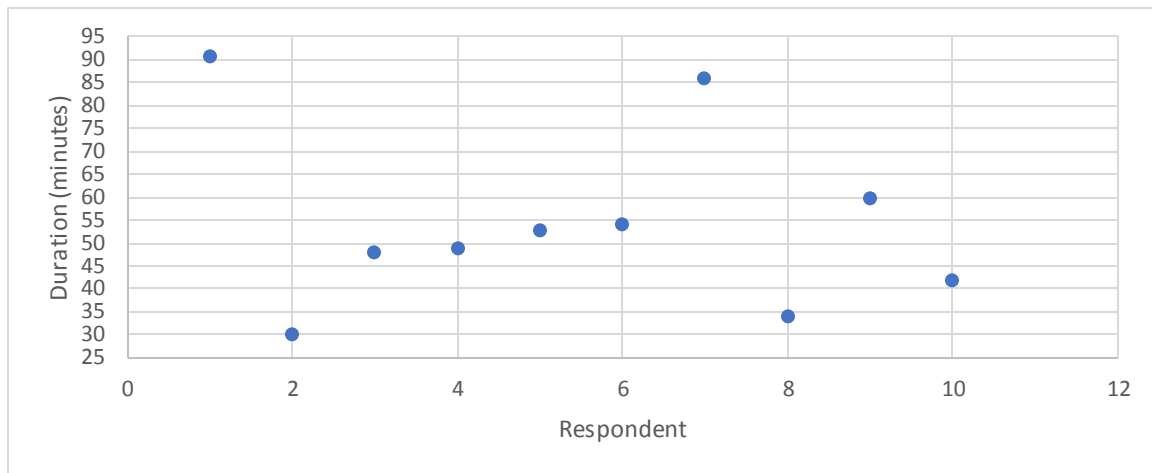
- 4.1 How has the municipality improved its operational efficiency due to the advent of rooftop solar PV?
- 4.2 Describe whether these improvements in operational efficiency have been introduced as part of a separate Department/Unit or part of the current core functions?
- 4.3 Outline whether the municipality has focused more on improvements in operational efficiency or in the introduction of innovative approaches due to the advent of rooftop solar PV?

## **E. Adaptation**

### **RQ5. Describe how municipalities have attempted to radically innovate and adopt new forms of service provision for electricity in response to the advent of rooftop solar PV?**

- 5.1 What innovative ideas has the Municipality introduced in response to the advent of rooftop solar PV?
- 5.2 How have these innovative ideas been introduced, part of a separate Department/Unit or part of the current core functions?
- 5.3 From your experience, what innovative approach(es) should the Municipality take in response to the advent of rooftop solar PV?

## APPENDIX 5: DURATION OF INTERVIEWS



Spread of Interview Duration