An assessment of community renewable energy as one of the options for transition to low-carbon energy in South Africa (Gauteng).

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AN ASSESSMENT OF COMMUNITY RENEWABLE ENERGY AS ONE OF THE OPTIONS FOR TRANSITION TO LOW-CARBON ENERGY IN SOUTH AFRICA (GAUTENG).

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A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy (PhD)

Aberdeen Business School

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Declaration

I hereby declare that this thesis – 'An assessment of community renewable energy as one of the options for transition to low-carbon energy in South Africa' – is my own, unassisted work. It is submitted for the degree of Doctor of Philosophy in the Robert Gordon University, Aberdeen. I confirm that it has not been submitted elsewhere, and that no material has been used previously for any degree or examination at any other University.

***Signature of candidate)*--**

***Date* ---**

Acknowledgements

My Lord, "But by the grace of God I am what I am: and his grace which was bestowed upon me was not in vain; but I laboured more abundantly than they all; yet not I, but the grace of God which was with me." (1 Corinthians 15:10)

In memory of my father, the late Bogatsu James Monare. He brought us up to believe that, in addition to coping with life's challenges, our lives are irrevocably dependent upon learning and serving those who are in need. He has always been a great source of motivation and has inspired innovation within all of my ambitions. He contributed immensely to the lives of the underprivileged by providing them with the necessity of further education. Continuing on with this mindset and following in his footsteps, I chose to embrace this research with fervour and diligence. I remain focused on contributing to society in general, especially to those who consider '*light*' as a luxury. My guiding inspiration throughout all of my research efforts has ultimately been to contribute towards brightening the lives of others.

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As Nelson Mandela said, *"It always seems impossible until it is done!"*

Dedication

I dedicate this thesis to all those who seek to make the world a better place and continue to serve with honesty, dignity, delight, and pride.

Abstract

Governments around the world are actively developing policies encouraging consumers to move from passive to active engagement in localised renewable energy projects. In particular, small-scale, decentralised community renewable projects are being promoted as a means to diversify electricity sectors. However, there remains scant research exploring issues of social resources in communities, particularly prior to renewable energy project development. The present study addresses this knowledge gap by assessing public perceptions and the factors that promote or inhibit the formation of community solar projects. This research examined the salience and influence of four factors: (1) the perceptions of civil society and experts; (2) the challenges of developing community renewable energy projects; (3) the recent progress made with solar photovoltaic (PV) technology; and (4) a comparison of the policies that support community renewable energy. Defining these four factors provides an understanding of the transformation potential for community solar projects to contribute toward the transition to low-carbon energy in South Africa.

The proposed research is a single, exploratory, qualitative case study set in the urban suburbs of Johannesburg, Gauteng in South Africa. The study draws on qualitative data from in-depth interviews with 25 stakeholders from various communities, renewable energy experts, local government representatives, government agencies, and the energy market. The study deployed an integrated approach in explaining and addressing the transformation potential of community renewables. It was through the application of the socio-technical transitions framework – the multi-level perspective (MLP), as well as the use of social capital theory, that the technological and social components of community renewable energy were understood. The proposed study provides new insights into the possible developments of technology and society (co-evolution), and thus contributes to the growing literature on transitions at a micro-level of the MLP theory (both technological and social).

Thematic analysis revealed strong social trust within communities and an eagerness to engage in projects that contributed to community development. However, participants held varying views on whether they trusted shared ownership ventures with private developers or local municipalities. Participants considered community participation in all projects to be a key factor. The study shows that, for community projects to materialise, it is necessary for individuals to commit to the endeavour of community solar projects. There is also a need for government to introduce mechanisms that provide the support needed for such projects to succeed. This research suggests that greater commitment to diversification, beyond the implementation of legislative measures such as community benefits, is required. This would ensure local development and energy sustainability in communities. Furthermore, this research provides evidence for the importance of social resources to ensure the economic sustainability of community solar projects. The findings herein encourage discussions about the prospects of community participation in renewable energy in South Africa. This research also provides an essential contribution to policymakers considering moving forward with inclusive and participatory policies, and engaging in practices that will ensure wider-participation, ultimately contributing toward national priorities. The findings suggest that government should consider frameworks that will effectively promote, foster, and regulate small-scale solar PV deployment and community renewable energy (CRE) projects in the future.

Keywords: Community renewable energy, community participation, urban sustainability, solar PV technology, transition, social capital.

Table of Contents

Declaration ii

Acknowledgements iii

Dedication v

Abstract vi

Table of Contents vii

List of figures xiii

List of Tables xiv

Chapter 1: Research Overview 1

1.0 Introduction 1

1.1 Research focus 2

1.2 Background on the South African electricity sector 5

1.2.1 The regine - fossil fuels lock-in system 5

1.2.2 Landscape developments 6

1.2.3 Niche developments 7

1.3 Research scope 9

1.4 Thesis synopsis 10

1.5 Conclusion 13

Chapter 2: Research aim and Objectives 14

2.0 Introduction 14

2.1 Research aims 14

2.2 Research objectives and questions 14

2.2.1 Research Objectives 14

2.2.2 Research question and sub-questions 15

2.3 Research methodology 16

2.4 Significance of the study 17

Chapter 3: Focus on community renewable energy 18

3.1 The concepts of community and community renewable energy 18

3.1.1 An urban perspective of community renewable energy 20

3.1.2 The social and entrepreneurial aspects of community renewable energy projects 21

3.1.3 The difference between community renewable energy projects and commercial renewable energy 21

3.1.4 Developments regarding community renewable energy 22

3.1.5 Benefits and motivations associated with community renewable energy projects 23

3.1.6 Disadvantages of community renewable energy 25

3.2 Types of community ownership models 25
3.2.1 Co-operatives *25*
3.2.2 Joint ownership *26*
3.2.3 Community benefits *27*
3.3 Business models for community energy 27
3.3.1 Customer-owned *28*
3.3.2 Community shares *28*
3.3.3 Third-party owned *29*
3.4 Barriers to community renewable energy development 29
3.4.1 Regulatory barriers *30*
3.4.2 Economic and financial barriers *31*
3.4.3 Technological barriers *32*
3.4.4 Social barriers *32*
3.5 Conclusion 33
Chapter 4: Literature Review 34
4.0 Introduction 34
4.1 Perceptions of community solar projects 34
4.2 Social acceptance 35
4.3 Renewable energy and the public: general attitudes, surveys, and opinion polls 36
4.4 Moving away from 'NIMBYism' 37
4.5 The importance of social movements 38
4.6 Public willingness to pay for alternative energy 39
4.7 Public engagement in renewable energy 39
4.8 Stakeholder identity and partnership analysis for community-based projects 40
4.8.1 Local government engagement in residential areas *41*
4.8.2 Private developer engagement in residential areas *42*
4.8.3 From a passive role to a participatory approach *43*
4.9 Progress made with solar PV technology 44
4.10 Opportunities presented by adopting RE sources 45
4.11 Why solar PV technology is suitable for the current study 46
4.12 Limitations of solar energy technologies 48
4.13 Policies that have promoted the diffusion of community renewable energy 49
4.13.1 Support mechanisms *50*
4.13.2 Performance of support mechanisms *51*
4.14 Four main RE policy mechanisms that have been adopted in various countries 52
4.14.1 Feed-in tariffs and feed-in premiums (FITs and FIPs) *52*

4.14.2 Tendering systems *53*
4.14.3 Renewable Portfolio Standards (RPSs) *54*
4.14.4 Supplementary policy instruments *54*
4.15 Comparative analysis of country-specific PV support policies 55
4.15.1 Germany *55*
4.15.2 The United Kingdom *58*
4.15.3 South Africa *61*
4.15 Conclusion 64
Chapter 5: Theoretical Frameworks 65
5.0 Introduction 65
5.1 Theories concerning technological and societal perspectives 65
5.2 Integration of the theories (the MLP and social capital theory) 67
5.3 Socio-technical transitions 68
5.4 The multi-level perspective (MLP) 69
5.4.1 Socio-technical regimes *70*
5.4.2 Socio-technical landscapes *71*
5.4.3 Socio-technical niches *71*
5.5 Transition pathways in low-carbon transitions 72
5.5.1 Transition potential: typology of transition pathways *73*
5.6 Criticisms of the MLP 74
5.7 Social Capital Theory 76
5.8 Studies using social capital theory 77
5.9 Measurement of social capital 78
5.10 Conceptualisation of social capital constructs 78
5.11 The integration of social capital and renewable energy 80
5.12 Criticisms of social capital theory 81
5.13 Strengths of the approach, and the integration of theories used in this study 81
5.14 Conceptualisation of the typology of transition pathways 82
5.14.1 Learning has stabilised in the dominant market *82*
5.14.2 Support from regime actors and institutions *85*
5.14.3 Price of solar power drastically decreased *87*
5.14.4 Scale of solar PV *87*
5.15 Conclusion 90
Chapter 6: Research Methodology 91
6.0 Introduction 91
6.1 Methodological gaps identified in community renewable energy studies 91

6.2 Research philosophy and approach ... 93
6.3 Philosophical underpinning ... 95
6.4 Research Design ... 97
6.5 Research strategy ... 99
6.6 Case study background ... 102
6.7 Sample and selection criteria ... 102
6.8 Data collection method ... 104
6.9 Semi-structured interviews ... 106
6.10 Data analysis method ... 107
6.11 Method applied to analyse data (inductive and deductive) ... 108
6.12 Data coding process ... 109
6.13 Pilot Study ... 112
6.14 Reliability and validity ... 112
6.15 Ethical Considerations ... 114
6.16 Conclusion ... 116
Chapter 7: Presentation of Findings ... 117
7.0 Introduction ... 117
7.1 Profile of participants ... 117
7.2 A brief analysis of the themes developed from the interviews ... 119
7.3 Knowledge and awareness ... 120
7.4. Environmental concerns ... 124
7.5 Social acceptance ... 128
7.6 Perceptions on community renewable projects ... 130
7.7 Participation ... 143
7.8 Motivations ... 147
7.9 Social trust (community members) ... 152
7.10 Institutional trust ... 155
7.11 Social identity/connectedness ... 163
7.12 Social norms ... 167
7.13 Perceived benefits ... 169
7.14 Perceived costs ... 177
7.15 Challenges in implementing community renewable projects ... 180
7.16 Conclusion ... 187
Chapter 8: Discussion of Main Findings ... 191
8.0 Introduction ... 191

8.1 Discussion of the main results 191
8.2 Perceptions of citizens and experts toward community solar PV projects 192
8.2.1 Knowledge and awareness about solar PV and CRE 192
8.2.2 Environmental concerns 193
8.2.3 Participation in community solar projects 193
8.2.4 Motivation to participate in community projects 195
8.2.5 Trust in community members to implement CRE projects 196
8.2.6 Institutional trust and the lack thereof 197
8.2.7 Exit strategy 199
8.2.8 Social norms influencing the adoption of renewable energy technologies 200
8.2.9 Social identity/connectedness within communities 200
8.2.10 Perceived benefits of engaging in community renewable projects 201
8.2.11 Perceived costs of community solar projects 202
8.3 Challenges in developing community renewable energy projects 204
8.3.1 Regulatory-related barriers: policy, state utility, infrastructure 204
8.3.2 Economic and financial-related barriers 205
8.3.3 Technical barriers 205
8.3.4 Social barriers 206
8.4 Progress made with solar PV sources 206
8.5 Support mechanisms 209
8.5.1 Main support mechanisms for RE and their contributions to CRE development 209
8.5.2 Comparisons between Germany, the UK and South Africa 210
8.6 Conclusion 211
Chapter 9: Conclusion and Recommendations 214
9.0 Introduction 214
9.1 Contributions to the body of knowledge 214
9.1.1 Theoretical contributions 215
9.1.2 Practical contributions 216
9.1.3 Methodological contributions 217
9.1 Recommendations 218
9.1.1 General recommendations 218
9.1.2 Policy recommendations 218
9.2 Limitations of the study 222
9.3 Suggestions for future studies 222
9.4 Conclusion 223
References: 225

Appendix I: Invitation letter 275
Appendix II: Informed consent form.. 276
Appendix III: Participant information sheet... 277
Appendix IV: Demographics... 279
Appendix V: Interview Schedule (Individuals and Experts)... 280

List of Figures

Figure 1.1: The structure of the thesis 12
Figure 3.1: Benefits and motivations for CRE projects 24
Figure 4.1: Model illustrating a public-private partnership for collective action........ 41
Figure 4.2: Procured and operational capacity under South Africa's REIPPP programme.... 45
Figure 4.3: Solar radiation map of South Africa, Lesotho and Swaziland........ 48
Figure 5.1: User roles and transition dynamics........ 70
Figure 5.2: Transformation potential and essential factors that influence the pathways 74
Figure 5.3: The three interconnected analytical dimensions of the current research 82
Figure 5.4: Stages in the development of shared technological knowledge........ 84
Figure 5.5: Cumulative RE employment opportunities........ 85
Figure 5.6: The 2015 global rankings for solar PV generation capacity......... 88
Figure 5.7: Targeted energy mix by 2030 89
Figure 5.8: Planned RE capacity by 2030 in South Africa........ 90
Figure 6.1: The types of Qualitative approaches........ 101
Figure 7.1: Main themes and frequency of quotations........ 119
Figure 7.2: Diagram showing the environmental concern sub-themes 124
Figure 7.4: Participants' personal contributions to the environment 126
Figure 7.5: Perceptions on community renewable energy projects........ 131
Figure 7.6: Participation in community projects........ 144
Figure 7.7: Institutional trust themes........ 156
Figure 7.8: Community connectedness with regards to community projects 163
Figure 7.9: Cost-benefits analysis of renewable energy projects........ 169
Figure 7.10: Challenges associated with the implementation of CRE........ 180

List of Tables

Table 2.1: Summary of research objectives, questions and methods applied 16
Table 3.1: The various community-shared solar subscription models 28
Table 3.4: Barriers to implementation of renewable energy sources 30
Table 4.1: The advantages and disadvantages of the models 44
Table 4.2: Opportunities in adopting RE sources 46
Table 4.3: Advantages and disadvantages of solar PV technology 47
Table 5.1: Procurement prices according to rounds 87
Table 6.1: Summary of philosophical paradigms 96
Table 6.2: Fundamental differences between quantitative and qualitative research. 98
Table 6.3: Research participants 104
Table 6.4: The inductive and deductive coding process 110
Table 7.1: Demographic profile of participants 118
Table 7.2: Excerpts presented by participants regarding knowledge and awareness 121
Table 7.3: Excerpts on promoting and creating awareness 122
Table 7.4: Excerpts on concerns about air pollution caused by fossil fuels. 125
Table 7.5: Excerpts on the growing of trees 127
Table 7.6: Excerpts on adoption of solar PV sources 130
Table 7.7: Excerpts on the acceptance of solar PV technology and community projects 131
Table 7.8: Excerpts on the acceptance of community solar projects. 133
Table 7.9: Excerpts on free energy from solar PV 134
Table 7.10: Excerpts on the maintenance of solar panels 138
Table 7.11: Excerpts on environmental contributions made by solar PVs 139
Table 7.12: Excerpts on supplementation of power 139
Table 7.13: Excerpts on security of supply 140
Table 7.14: Excerpts on the excessive cost of solar technology 141
Table 7.15: Excerpts on support with regards to community solar projects 142
Table 7.16: Excerpts on participation in CRE 145
Table 7.17: Excerpts on leadership roles in community projects 146
Table 7.18: Excerpts on financial benefits as a motivation 148
Table 7.19: Excerpts on job creation as a result of community projects 148
Table 7.20: Excerpts on networking opportunities as a motivation 151
Table 7.21: Excerpts on economic enterprise development as a motivation 152
Table 7.22: Excerpts on cost-reduction motivations to participate 152
Table 7.23: Excerpts on community trust to implement community projects 153
Table 7.24: Excerpts on resource availability in communities 155
Table 7.25: Excerpts on trusting external developers 157
Table 7.26: Excerpts on skills transfer 159
Table 7.27: Excerpts on collaboration, expertise and resources 160
Table 7.28: Excerpts on experience, knowledge of the external developer 161
Table 7.29: Excerpts on a sense of belonging to a community 164
Table 7.30: Excerpts on commitment from members on community projects 165
Table 7.31: Excerpts on relationships with other members 166
Table 7.32: Excerpts on social-circle influence 167
Table 7.33: Excerpts on expectations from other members regarding community projects . 168
Table 7.34: Excerpts on community-advancement benefits of community projects 170

Table 7.35: Excerpts on environmental preservation as a result of CE projects 171
Table 7.36: Excerpts on the potential of CRE to contribute to energy generation................ 172
Table 7.37: Excerpts on an increase in the energy buffer 172
Table 7.38: Excerpts on security provided as a result of community solar projects 173
Table 7.39: Excerpts on the benefit of sense of ownership 174
Table 7.40: Excerpts on the potential of CRE to save costs.. 1776
Table 7.41: Excerpts on the costs of alternative energy 177
Table 7.42: Excerpts on the reduction of costs of solar PV panels 178
Table 7.43: Excerpts on non-monetary costs 179
Table 7.44: Excerpts on concerns about the theft of solar panels 181
Table 7.45: Excerpts on lack of capital 182
Table 7.46: Excerpts on lack of knowledge and skills 183
Table 7.47: Excerpts on racial tension in communities relating to RE projects.................... 184
Table 7.48: Excerpts on policy and legislation issues. 185
Table 7.49: Excerpts on the lack of support from communities.. 186
Table 8.1: A comparative summary of Germany, the UK, and South Africa 209

List of Abbreviations

AC	Alternating Current
ANT	Actor Network Theory
BEE	Black Economic Empowerment
Ca	Calcium
CARES	Community and Renewable Energy Scheme
CCGT	Closed Cycle Gas Turbine
CDM	Clean Development Mechanism
CES	Community Energy Scotland
CES	Centralised Energy System
CRE	Community Renewable Energy
CRI	Community Renewables Initiative
DECC	Department of Energy and Climate Change
DES	Decentralised Energy System
DoE	Department of Energy
DEDEAT	Department of Economic Development, Environmental Affairs and Tourism
DBSA	Development Bank of South Arica
EEG	The Renewable Energy Sources Act (EEG)
ET	Export tariff
FIT	Feed-in Tariff
FIP	Feed-in premiums
GEF	Global Environment facility
GHG	Greenhouse Gas
GI	Grassroots Innovations
GW	Gigawatt
IDC	The Industrial Development Cooperation
IEA	International Energy Agency
IPP	Independent Power Producers
IRP	Integrated Resource Plan
IRENA	International Renewable Energy Agency
Kw	Kilowatts
IS	Innovation System
LCOE	Levelised Cost of Energy
MLP	Multi-level Perspective

MW	Megawatt
NERSA	National Energy Regulator of South Africa
NIMBY	Not-In-My-Backyard
OCGT	Open Cycle Gas Turbine
O&M	Operations and Maintenance
PPA	Power Purchase Agreement
PV	Photovoltaic
RE	Renewable Energy
RES	Renewable Electricity Standard
RPS	Renewable Portfolio Standard
RO	Renewable Obligation
ROC	Renewable Obligation Certificates
SMT	Social Movement Theory
SME	Small to medium sized enterprises
SNM	Strategic Niche Management
SMT	Social Movement Theory
ST	Sustainability transitions
SSEG	Small-scale embedded generation
TM	Transition Management

CHAPTER ONE:
RESEARCH OVERVIEW

1.0 Introduction

Given mounting pressures to combat climate change threats, energy transitions are undeniably at the top of the agenda of most governments around the world, including Denmark, the United Kingdom (UK), Germany, Norway, Austria, Italy, South Africa (SA), and many others (Bolton and Foxon 2015; Araújo 2014; Strunz 2014; Foxon 2013; Batel et al. 2013; Späth and Rohracher 2010; Wirth 2014; IRP 2019). As the world is becoming more aware of the consequences of climate change, more focus has been placed on strengthening energy security, reducing energy poverty, ensuring economic competitiveness, stimulating technological innovation and providing social justice (Child and Breyer 2017). The current, unsustainable approach to energy production continues to urge governments to transition to low-carbon energy (Lachman 2013; Batel et al. 2013; Araújo 2014). The move from unsustainable fossil fuels to low-carbon energy is important for achieving societal sustainability, and has become a matter of great interest (McLellan et al. 2016; Child and Breyer 2017). Accordingly, Grubler (2012) succinctly reported that the current energy systems are clearly unsustainable in all aspects of economic, social, and environmental requirements, and that the next energy generation is therefore urgently necessary.

The energy sector is currently dominated by fossil fuels, which is a leading contributor to increased carbon dioxide (CO_2) levels in the atmosphere (Eleftheriadis and Ananostopoulou 2015). To mitigate the effects of climate change and environmental pollution (Boon and Dieperink 2014; Lam and Law 2016; McLellan et al. 2016), governments and policymakers are promoting an increased development of renewable energy (RE) sources (Yaqoot et al. 2016; Ruggiero et al. 2018). Similarly, South Africa is experiencing a transitional period of change and growth (Pollet et al. 2015), moving from fossil fuels toward an increased share of 20 per cent RE by 2020, and 30 per cent by 2030 (IRP 2010). South Africa plans to reduce its reliance on coal-fired power stations and aims to spend US$50 billion on clean energy (Pollet et al. 2015). This kind of transition is also evident in the Netherlands, the UK, Canada, France, Finland and Austria, who are similarly working to eliminate coal-fired power plants by 2025 and replace them with RE sources (Geels 2018).

On the other hand, issues of public participation and engagement are receiving increasing attention from policymakers (Devine-Wright 2014) who are interested in the roles played by different actors – commercial businesses/organisations, communities, households, and individuals – through multiple levels, especially since their efforts can have a large impact on the implementation and success of future energy systems (Goedkoop and Devine-Wright 2016). Indeed, community energy is becoming an important issue in global academia and policy circles (Holstenkamp and Kahla 2016), where researchers are interested in the role that society plays in RE generation (Ruggiero et al. 2018). Citizens who have the potential to influence the regulation and development of energy systems can contribute in a variety of ways, not only as consumers, but also as energy producers: they are participants in the organisation of the energy systems, and in the social and economic institutions affected by energy systems (Stern 2014). Currently, South Africa is witnessing an increase in new actors and technologies in this area, including prosumers, who produce small-scale, embedded generation electricity for self-consumption using rooftop solar photovoltaic (PV) systems (Baker and Phillips 2019). Bulkeley (2010) believes that communities thus form an alternative transition pathway, which focuses less on large-scale development, and more on reconstructing community renewables (Geels 2014).

Therefore, the purpose of this research is to assess whether the potential exists for successful community renewable energy (CRE) projects in urban areas of Gauteng, deploying solar PV technology. The study explores how urban conglomerates may be better positioned to influence change in the current energy systems (Mieg and Töpfer 2013). As urban areas contribute up to three quarters (76 per cent) of greenhouse gas emissions globally (Seto et al. 2014), they represent a significant opportunity to mitigate future climate change (White 2019). Adopting innovative products such as solar PV sources to encourage the use of low-carbon energy in urban areas is going to be an important step in addressing climate change (Noppers et al. 2016). However, energy transitions constitute complex phenomena that consist of economic, technical, and social dimensions, and thus necessitate a multi-directional approach (Candas et al. 2019).

1.1 Research focus

1.1.1 Centralised energy systems (CES):

Soon after the initial introduction of alternating current (AC) electrical systems that transfer bulk power over long distances, the electricity sector arranged itself into a top-down, centralised structure (Mehigan et al. 2018; Pepermans et al. 2005). For instance, South Africa operates a highly centralised energy system (CES) where almost all electricity is produced in one province, and subsequently distributed throughout the country (de Groot et al. 2013). The idea behind the centralised system is that large-scale power plants allow for balancing measures, though they normally operate using fossil fuels and nuclear power (Funcke and Bauknecht 2016), both of which have been shown to have serious environmental impacts (Owusu et al. 2016; Jin and Kim 2018; Jones 2018). Currently, centralised energy systems are also more economically attractive due to economies of scale (Allan et al. 2015; Sovacool et al. 2017; Bhattacharyya et al. 2019), and can therefore provide relatively low-cost electricity to end-users (Allan et al. 2015). Levin and Thomas (2016), however, note that the economics that once motivated a centralised system are changing due to cost savings associated with new, more distributed technologies like small wind turbines, rooftop solar PVs, and improved energy storage systems.

Consumers are now continuously decreasing their reliance on a centralised grid model and shifting to more decentralised generation sources (Sovacool et al. 2017). The centralised electricity system structure is being challenged by increasing generation levels from other energy sources connected behind meters at residential and industrial sites (Perez-Arriaga 2016). As noted in the above, there is growing acknowledgement that top-down approaches are losing their attractiveness when compared to more sustainable development initiatives that consider bottom-up community involvement (Carley and Smith 2013). In the discourse on energy transition, decentralised production is considered an important frontier for the future of electricity generation (Späth and Rohracher 2010; Vahl et al. 2013; Allan et al. 2015; Hecher et al. 2016).

1.1.2 Decentralised energy systems (DES)

Some countries advocate decentralised energy system (DES) as a powerful way to diversify away from a CES, and to provide new opportunities to liberalise the energy sector (Varho et al. 2016). Emerging DESs challenge the predominant centralised generation, transmission, and distribution model, as they allow prosumers a measure of control over the production and consumption of electricity (Sioshansi 2016). Such systems, in contrast to conventional centralised systems, offer high levels of energy security: they are reliable, more affordable, easily accessible, efficient, and environmentally-friendly (Turcu et al. 2011; Vezzoli et al. 2018). In South Africa, distributed generation is becoming an attractive option for high-income households, businesses, and industries; consumers are installing economic solar PVs to respond to the inefficiency of the state utility, high electricity costs, and rising tariffs (Baker and Phillips 2019). These types of systems, when deployed on a small-scale, can be classified as embedded generation; small-scale embedded generation (SSEG) systems are installed behind the meter, however, and are thus still connected to the grid (Rycroft 2019). They are normally installed by customers rather than the state utility, and typically encompass solar PV installations, but not exclusively (Rycroft 2019). Challenges may be encountered - however, when incumbents pursue their own agenda and have differing – if not opposing – ideas for the future of local and national electricity systems (Funcke and Bauknecht 2016). In spite of this, and to ensure that the new technology succeeds, consumer participation is critical during the development stage of the technology, else the transition from scientific invention to on-the-ground innovation will not occur (Yun and Lee 2015).

1.1.3 Community participation

In recent years, there has been a shift from a dominant centralised to decentralised generation, where prosumers are no longer passive users of electricity (Sioshansi 2016). The transition to RE involving communities is gaining momentum (Boon and Dieperink 2014; Oteman et al. 2014; Markantoni 2016; Brummer 2018b; McCabe et al. 2018) and is expected to grow exponentially in the coming decades (Augustine and McGavisk 2016). Community energy projects are gaining momentum and are becoming subjects of interest both politically and socially since they allow for participation, ownership, and distribution of shares (Haggett and Aitken 2015). According to Bauwens and Devine-Wright (2018), consumer participation is set to play an important role in the transition to low-carbon energy, but the case in South Africa is different. Here, community projects tend only to be implemented by independent power producers (IPPs), contributing to various economic development conditions, for example, by empowering communities where projects are located (Tait et al. 2013).

This study aims to extend the debate on community involvement by providing an empirical study examining the social resources required to drive community solar PV projects. This study focuses on the transition from a centralised to a decentralised electricity sector, where the roles of consumers are elevated, and locally-led renewable energy (RE) initiatives are promoted in urban areas (Dóci et al. 2015). The transformational potential of a union between technology, society, and policy to inform future efforts to transition to low-carbon energy in communities is explored.

1.2 Background on the South African electricity sector

1.2.1 The regime - fossil fuels lock-in system

In contrast to liberalised electricity sectors in many developed countries, South Africa's state energy utility, Eskom, dominates the country's electricity sector (Eberhard 2011). Eskom produces 95 per cent of the nation's electricity (Baker et al. 2014; Thopil and Pouris 2015), the remainder being shared between IPPs and municipalities (Treasury SA 2011). The state utility is responsible for the entire value stream – including generation, transmission, and distribution – but where distribution is shared between municipalities and Eskom, municipalities purchase 45 per cent of electricity from Eskom at a discounted price and then deliver it to their constituents and Eskom distributes the rest (Ngidi 2019).

The state utility boasts a nominally installed capacity of 44 175 megawatts (MW) (Msimanga and Sebitosi 2014), but stated that by 2028 it would require a capacity of more than 50 gigawatts (GW) to meet increasing demands, which is anticipated to come from both IPPs and Eskom (Msimanga and Sebitosi 2014). To ensure an uninterrupted supply of electricity, Eskom is currently engaged in the process of adding 17 000 MW of capacity, mainly from two mega coal-fired power stations (Medupi and Kusile) by 2021 (Swilling et al. 2016). The construction costs of the two stations is approximated to be US$30 billion (Pollet et al. 2015), but there have been multiple delays and problems during construction, and the costs are anticipated to escalate (Sowetan 2019). Additionally, as a result of financing, the coal-fired power stations will escalate power prices, and since the costs are always eventually passed on to consumers, tariffs will continue to rise over the next few years (Pollet et al. 2015; Thopil and Pouris 2015).

The era of South Africa's coal expansion began in the 1970s when investment in electricity generation, coal exports, and synthetic fuels (synfuels) soared (Eberhard 2011). This was caused by a lack of liquid fuel resources and historic sanctions, resulting in coal becoming the primary energy source (Pollet et al. 2015). Currently, South Africa leads Africa's coal industry, constituting over 90 per cent of the continent's coal production (Altieri et al. 2016; Eberhard et al. 2014), and nearly 70 per cent of the continent primary energy (Eberhard et al. 2014). The high abundance of coal resources has, however, lead to high dependency on cheap coal to produce low-cost electricity (Schmidt et al. 2017; Bohlman and Inglesi-Lotz 2018), and has attracted a political elite driven by powerful mining interests (Schmidt et al. 2017). The abundance of coal resources in South Africa has historically determined the path for the electricity sector, and the intricate associations between its political and economic institutions, social and technological capabilities, and networked infrastructures (Baker 2016).

The state utility has always provided a reliable and secure electricity supply owing to an over-investment in electricity in the 1970s and 1980s (Eberhard et al. 2011). However, in the past, the state utility was prohibited from investing in capacity generation, as the government anticipated that new private investment would support this instead (Eberhard et al. 2011). Ultimately the plan did not materialise and led to electricity shortages, resulting in the energy crisis of 2008 when electricity demand exceeded supply as a consequence of strong economic growth in some industrial sectors, mass electrification, and inadequate planning (Krupa and Burch 2011; Nhamo and Mukonza 2016). As a result, South Africa has experienced power cuts caused by under-investment in the new electricity infrastructure (Pollet et al. 2015); the electricity sector remains constrained, although programmes exist to reduce demand through improved usage, particularly in the residential sector (Ye et al. 2018). According to Baker et al. (2014), South Africa is experiencing a transition process of 'energy opulence' (a period of high abundance) as a result of infrastructural, environmental, economic, and physical constraint. In addition to the challenges experienced by the state utility, the country is expected to decommission approximately 24 100 MW of ageing coal-fired power stations by 2030 to 2050 (IRP 2019), thus producing a need to prepare for the retirements and replacements of the coal-fired power plants (IRP 2019). This further intensifies the mounting challenges of shortages, which should create opportunities to explore and develop low-carbon energy options. The current path thus clearly presents structural challenges in power generation (Boamah and Rothfuβ 2018).

1.2.2 Landscape developments

Heightened dependency on coal has resulted in South Africa being ranked the seventh highest carbon dioxide (CO_2) emitter in the world (Bekun et al. 2019). Considering the overwhelmingly carbon-intensive nature of the country's energy production, the government of South Africa has committed to the global convention to limit greenhouse gas (GHG) emissions (Trollip and Tyler 2011). During the Conference of the Parties (COP) in Copenhagen in 2009, the South African government committed to reducing emissions by 34 per cent by

2020, and by 42 per cent by 2025. However, these goals were based on financial resources that would be provided by international players, such as capacity building and the transfer of technology (Giglmayr et al. 2015). Although South Africa is one of the countries with the highest carbon emissions in the world, there are no binding international treaty obligations pressuring the country to reduce carbon emissions (Eberhard 2011). Despite this, the South African government has introduced various mid and long-term strategies to add new capacity while ensuring continuous sustainable development (Giglmayr et al. 2015). The Integrated Resource Plan (IRP) expects emissions to peak between 2020 to 2025 as the two new coal power plants (Medupi and Kusile) come online, increase for a decade, and then decrease in absolute terms once the old coal power plants are decommissioned (IRP 2019).

The transition to low-carbon energy will not only address climate change mitigation but will provide some opportunities with regards to energy access, secure energy supplies, sustainable and equitable economic development, as well as improved local environmental and health issues (Verbruggen et al. 2011). However, climate-friendly development pathways will obviously conflict with other economic and social considerations (Tait and Winkler 2012). According to Baker et al. (2014), it will be a challenge to address the problematic trade-offs, to ensure that jobs are protected, uplift the historically disadvantaged, and promote socio-economic development. Therefore, to ensure a fair transition, careful plans must be put in place to mitigate adverse impacts on local economies and people working in the coal industry when the plants are closed (IRP 2019).

1.2.3 Niche developments

The African continent, including South Africa, is endowed with diverse and immense RE resources capable of meeting energy needs (Sambo 2016). Montmasson-Clair and Ryan (2014) postulate that South Africa should be able to modify its current dependency on fossil fuels to follow a cleaner development path; a transition to low-carbon energy, as well as a widespread diffusion of RE technologies, can likely be accelerated (Mignon and Bergek 2016). However, RE continues to be debated across South Africa (Krupa and Burch 2011), particularly regarding the state utility's position as a dominant player and sole buyer in the electricity sector (Bohlmann and Inglesi-Lotz 2018). The state utility is responsible for connecting IPPs into the grid, but there were delays in signing the Power Purchase Agreement (PPA) in the later stages, where the state utility consistently procrastinated transactions (Kruger and Eberhard 2018).

Throughout the last decade, the government served as an important source of funding for energy projects, but more recently, private funding became the largest financial source for RE projects (Wüstenhagen and Menichetti 2012). The South African government recognised the need to include independent power producers (IPPs) to promote a more rapid increase in renewable energy sources (Giglmayr et al. 2015) when it introduced the Renewable Energy Independent Power Producer Procurement Programme (REI4P) in 2011 (Wlokas et al. 2012). As noted by Nkoana (2018), the goal of the REI4P is to increase the proportion of RE in energy production, reduce greenhouse gas emissions, as well as provide jobs and economic development for black communities (Africans, Indians, and Coloured people). Currently, there are approximately 102 projects amounting to a final output of 6 327 MW to be reached over four years through the procurement system (Kruger and Eberhard 2018). Despite the success of the REI4P, the policy still tends to promote large-scale production facilities (De Groot et al. 2013).

A notable disadvantage of centralised renewable projects is that although projects are distributed all over the country, the Cape areas house a far larger share of the solar and wind projects than other provinces, with about 59 in the Northern Cape, 17 in the Eastern Cape and 14 in the Western Cape (Cloete 2018; Lombard and Ferreira 2015). As such, projects have become concentrated in certain provinces, meaning locals will be the primary beneficiaries. As Wlokas et al. (2012) argue, the programme was targeted at reducing greenhouse gas emissions, stimulating the economy of the country, and making a significant impact on the local level. However, the question regarding the extent to which these projects have contributed to socio-economic development remains. Nkoana (2018) contends that the involvement of local communities in the IPP process is highly disintegrated, which permits influential stakeholders to take advantage of vulnerable communities.

On the other hand, the unfolding IRP allows for small-scale developers – for instance, individuals, businesses, and municipalities – to produce their own electricity (IRP 2019). In the meantime, municipalities are exploring other routes of producing electricity or buying directly from IPPs instead of relying on the state utility (Ngidi 2019). As previously mentioned, municipalities traditionally buy electricity from Eskom, but are now arguing that municipalities are overly dependent on Eskom (Ngidi 2019). Some municipalities, such as the City of Cape Town, have even gone as far as threatening to take the government to court to allow them to buy directly from private suppliers (Ngidi 2019). These recent developments will see many municipalities producing their own electricity for their jurisdictions, constituting an important step toward municipal control over electricity production as opposed to each household producing energy and feeding a larger grid. For the reasons mentioned here, it was deemed important that this study assess community projects due to the potentially pivotal roles they might play on their own, or in joining forces with municipalities. Studies by Rommel et al. (2018) and Becker and Naumann (2017) assert that consumers prefer electricity produced by municipal or co-operative models rather those offered by investor-owned firms.

It is important to note that as demand in South Africa remains poor, most solar panels manufactured in the country are diverted to the international market (Baker and Sovacool 2017). One reason for this is that small-scale developers may prefer to tap into local generation without compromising the opportunities available for large-scale developers. In that regard, De Groot et al. (2013) question whether investments in large, centralised solar parks are more beneficial than consumers investing in smaller, on-site PV systems. Indeed, as the cost of electricity continues to rise, business, industry, and high-income households are installing rooftops and ground-mounted solar PV apparatus (Baker and Phillips 2019).

1.3 Research scope

Community energy has been shown to play a significant role at the local level (Walker and Devine-Wright 2008; Walker et al. 2007; Hoffmann et al. 2013; Seyfang 2010; Strachan et al. 2015; Yildiz et al. 2015; Bauwens et al. 2016). However, Kalkbrenner and Roosen (2016) argue that studies have not reliably assessed citizens' willingness to participate in community based RE projects and their outcomes. Therefore, this study aims to assess transformative potential based on: (a) the perceptions toward community projects; (b) challenges to developing CRE projects; (c) progress made with technology; and (d) the support mechanisms necessary for promoting CRE projects.

Two conceptual frameworks were adopted to answer the research questions in this study. The multi-level perspective (MLP) on socio-technical transitions, which addresses questions relating to technology, and focuses on the four proxies of technological innovations introduced by Geels and Schot (2007). These proxies are significant to this study when addressing progress, where solar PV technology is used to assess transformational potential (Dóci et al. 2015). These proxies include: (a) price/performance; (b) that learning has stabilised; (c) support networks; and (d) scale (market share) (Geels and Schot 2007). Given that this study aims to assess the co-evolution of technology and society, it explores the crossover between the MLP and social capital theory to better elucidate the social dimensions of this issue.

Social capital theory provides a framework through which to understand the perceptions of individuals regarding the potential for CRE projects, especially those based on social resources in communities. The constructs that are instrumental here are those identified by Jones (2010), who defines social capital as a complex concept comprising four elements: social trust/interpersonal trust (trust among individuals); institutional trust (confidence in organisations such as the government and renewable energy developers); participation (in community activities and networking); and social norms and values (and the compliance therewith).

In addition to these factors, the study also considers social identity (connectedness), and the perceived benefits and costs in order to assess positive connections (Jones and Clarke 2014). Wentink et al. (2018) assert that connectedness is a necessary component to ensure the success of initiatives. Furthermore, Jones and Clark (2014) reason that because of the subjective nature of the constructs mentioned above, it can be argued that the value of associated costs and benefits has a direct influence over levels of social capital within communities, where there has been evidence supporting this (see Jones 2010).

1.4 Thesis synopsis

This study is divided into nine chapters, as depicted in Figure 1 below. There are four main central dimensions this study will examine to determine whether there is a possibility for widespread CRE project success in South Africa:

1. Perceptions of citizens and experts regarding the concept of CRE;
2. Challenges to developing CRE projects;
3. Progress with solar PV technology; and
4. Comparative analyses of policies that have contributed to the promotion of solar PV sources and CRE thus far.

***Chapter One*:** This chapter is divided into four parts, including an overview of the study, the research focus, a background on the electricity sector, and the scope of research.

Chapter Two**:** This chapter reports the aim of the study, as well as the objectives and research questions. The chapter also illustrates how the aim and objectives are connected to extend theory, where the theoretical frameworks and methodology used are summarised, and the significance of the study is discussed.

Chapter Three: This chapter introduces the concept of CRE and provides a review of the relevant literature. This chapter also justifies the importance of community renewable projects.

Chapter Four: This chapter provides an extensive literature review from a socio-technical perspective that is presented in three parts. The first part assesses literature regarding the perception of solar PV and community projects, and the challenges encountered while developing CRE projects. The second part details the progress made within solar PV technology, and the last part discusses the policy that has promoted solar PV sources and CRE, and touches on the development of community projects.

Chapter Five**:** This chapter introduces the theoretical frameworks underpinning this study, making connections between the multi-level perspective and social capital theory, and arguing that social capital is a necessary pre-requisite for RE projects to succeed at a community level.

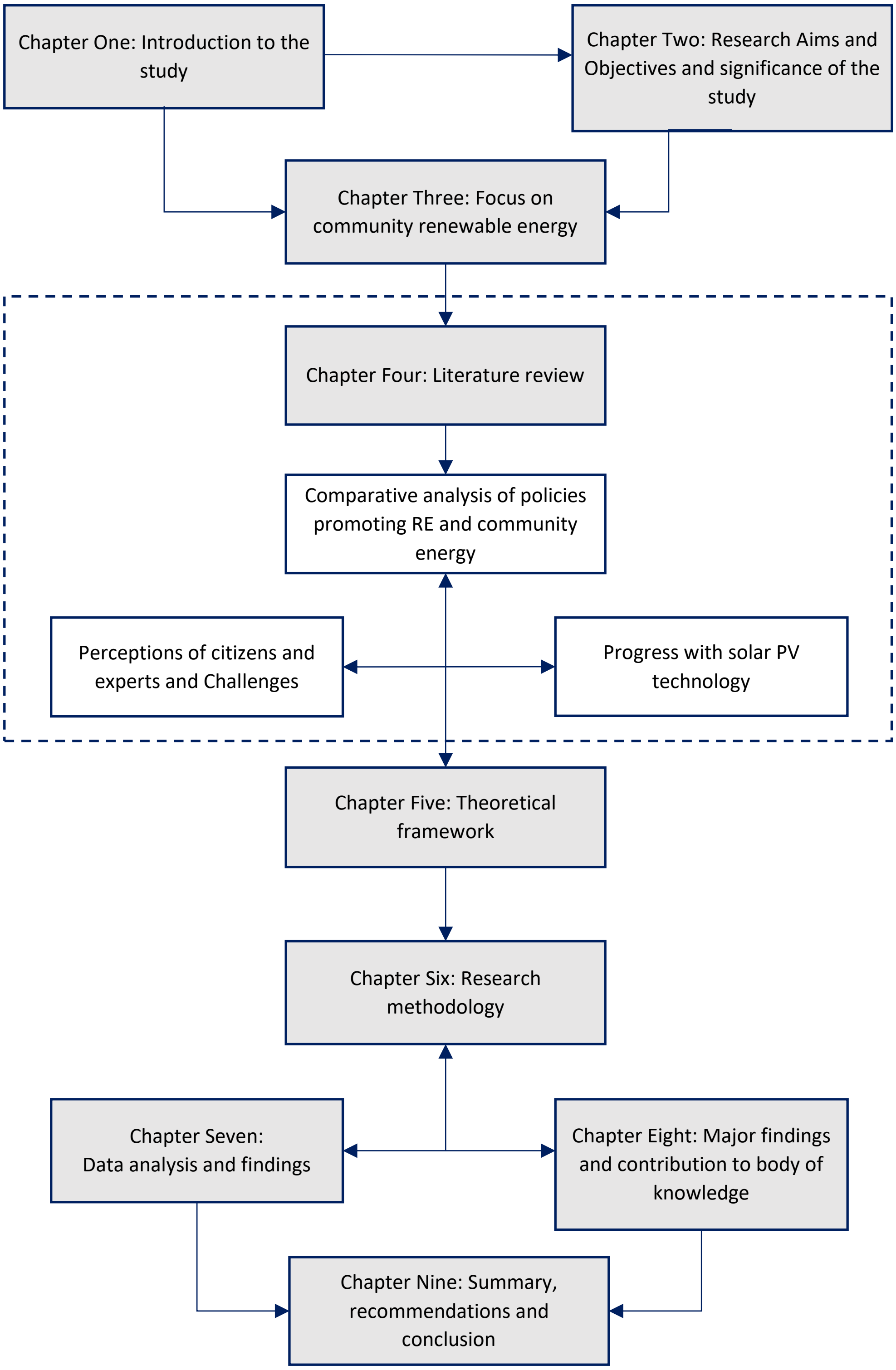
Chapter Six**:** The methodological approach of the study is discussed in this chapter, as well as the philosophical underpinnings and the research methods adopted. Details of the study location and a justification for the selected approach to data collection and analysis are presented.

Chapter Seven**:** The research findings are presented in this chapter, elaborating on the perceptions of individuals and experts with respect to community renewable energy. The demographic characteristics of participants are also provided.

Chapter Eight**:** In this chapter the major findings are reported, whereby the frameworks that model the development of technology and social resources within communities are applied and extended.

Chapter Nine**:** The last section provides a synopsis of the research, conclusion, and recommendations for further studies. Limitations of the study are also be presented in this final chapter.

Figure 1.1: The structure of the thesis



Source: Author generated

1.5 Conclusion

In summary, the chapter above provides an overview of the study and elaborates on the differences between a centralised and a decentralised electricity system, as well as the involvement of consumers in community projects using solar PV technology. The background of the electricity sector in South Africa was discussed in the context of the MLP framework, and the research focus and scope outlined. The next chapter elaborates on the aim, the objectives, research methodology and the significance of the study.

CHAPTER TWO:
RESEARCH AIM AND OBJECTIVES

2.0 Introduction

Governments and scholars are paying more attention to community energy as a potential source of innovation to promote sustainable energy transitions (Hargreaves et al. 2013; Holstenkamp and Kahla 2016; Creamer et al. 2018). In order to assess the potential of community energy in the South African context in a robust manner, this study must first acknowledge the evolution and influences of energy systems and their effects on other co-evolving systems (Kooij et al. 2018). As such, the study focuses on the co-evolution of technology and society at the micro-level through the lens of the MLP (Geels 2005a), and leverages social capital theory to better understand what social resources are readily available in urban areas. According to und Polach et al. (2015), social resources are fundamental to the implementation of CRE when described as a socio-technical system. It is well understood that artefacts on their own rarely achieve their function: they can only succeed when coupled with human agency, institutional and social structures (Geels 2005a). Furthermore, the role that policy plays in the development of CRE projects cannot be understated.

2.1 Overall aim

This study aims to investigate citizens' and experts' receptivity towards the concept of CRE, and to explore the factors that influence the development of CRE projects.

2.2 Research objectives and questions

The primary research objective and sub-objectives are discussed, justifications provided, and all are summarised, along with methodological approaches, in Table 2.1 below.

2.2.1 Research Objectives

Determine the extent of the potential for CRE to contribute to electricity generation in South Africa.

Relevance: Based on the findings of the study, this objective will elucidate whether there are viable opportunities for successful CRE implementations in South Africa.

2.2.1.1 Research sub-objectives

1. Conduct interviews to assess the perceptions of citizens and experts towards CRE projects by critically exploring the relationship between CRE and social capital.

   Relevance: In order to develop strategies for future energy portfolios in any country, it is critical to provide information regarding the perceptions of citizens. This research objective uses social capital constructs to determine the acceptance and readiness levels of citizens to operate solar PV projects. The findings also seek to ascertain whether social resources currently exist to support CRE projects.
2. Explore the challenges related to the adoption of community solar projects.

   Relevance: The findings will assist in highlighting the potential challenges that must be overcome to adopt CRE projects.
3. Critically explore the extent to which solar PV technology has advanced in the marketplace.

   Relevance: By using proxies for technological innovations, this question will uncover recent progressions made in solar PV technology. The progress, or lack thereof, will provide insight into the state of solar PV technology both internationally, and with specific reference to South Africa.

4. Conduct comparative analyses of policies that have contributed to the development of CRE in Germany, the UK, and South Africa.

   Relevance: These findings will increase our understanding of support mechanisms and the performance of assisting policies in three countries. The different mechanisms adopted by countries will enhance our understanding of the kinds of policies that have been most instrumental in promoting CRE.

2.2.2 Research question and sub-questions

The transition from a dominant, fossil fuel-based energy system to newer or cleaner energy systems requires changes in technology, in legislation, in the behaviour of adopters and users, and in political regulations (Sovacool 2016). As such, the study focuses on the following main research question and research sub-questions:

What is the potential for community renewable energy to contribute significantly to South Africa's electricity supply?

1. What are the perceptions of citizens and experts toward community solar PV projects?
2. What are the challenges to developing CRE projects?
3. What progressions have been made with solar PV technology?
4. What policy mechanisms have played important roles in contributing to the implementation of CRE projects both internationally and locally?

Table 2.1: Summary of research objectives, questions and methods applied

Research objectives	Research questions	Method adopted
Determine the extent of the potential for CRE to contribute to electricity generation in South Africa.	**What is the potential for community renewable energy to contribute significantly to South Africa's electricity supply?**	**Secondary method answered by sub-questions**
Sub-objectives and questions		
Conduct interviews to assess the perceptions of citizens and experts towards CRE projects by critically exploring the relationship between CRE and social capital.	What are the perceptions of citizens and experts toward community solar PV projects?	Qualitative method: face-to-face, semi-structured interviews with citizens and experts.
Explore the challenges related to the adoption of community solar projects.	What are the challenges to developing CRE projects?	Qualitative method: face-to-face, semi-structured interviews with citizens and experts.
Critically explore the extent to which solar PV technology has advanced in the marketplace.	What progressions have been made with solar PV technology?	Secondary document review.
Conduct comparative analyses of policies that have contributed to the development of CRE in Germany, the United Kingdom, and South Africa.	What policy mechanisms have played important roles in contributing to the implementation of CRE projects both internationally and locally?	Secondary method: Comparative analysis of the different policies used to promote CRE in Germany, the United Kingdom, and South Africa.

Source: Author-generated

2.3 Research methodology

This study seeks to gain a thorough understanding of the perceptions of citizens and experts regarding CRE projects, and elucidate the factors that influence transitions to more renewable energy solutions. This will involve evaluating how participants construct meaning based on their reality and experiences; thus, an interpretive constructivism paradigm was deemed appropriate to answer the research questions. Here, a case study approach is used to gain greater understanding in a real-life setting (Yin 2013). Because this study explores transformative potential at a niche level, particularly using social capital theory, the amount of supporting literature is limited and thus this study is exploratory in nature.

The study adopted both primary and secondary methods to address the aforementioned research questions. For primary data collection, the study deployed a qualitative method approach to answer questions regarding perceptions about CRE projects and the potential challenges to community renewable projects. A secondary method was chosen to examine questions regarding technology and policy mechanisms. Although past studies have sought to inform public attitudes towards RE, most have adopted a quantitative approach to assess public opinion as a homogenous entity (West et al. 2010; Radke 2014; Bayulgen and Benegal 2019). Accordingly, Wolsink (2007) called for studies to explore the lived experiences of citizens, particularly concerning energy choices. Therefore, a qualitative method was chosen for this study since it allows for a deeper understanding of the complex situation at hand.

2.4 Significance of the study

Over recent decades, studies of socio-technical transitions focused on historical events (Sovacool 2009; Verbong and Geels 2007; Geels 2005a; Konrad et al. 2008). Despite this trend, the past few years have given rise to studies that investigate the conditions by which grassroots innovation evolve (e.g., Seyfang et al. 2014; Smith et al. 2013). In addition, a small number of studies have also examined public opinion prior to project development (Rogers et al. 2008). Research has also shown how CRE could be promoted in a corporate energy environment (Strachan et al. 2015), how niches can be defined and expanded in the context of a civil society (Hargreaves et al. 2013; Seyfang and Longhurst 2013), and illustrated the impact of policy on grassroots innovations (Smith et al. 2016). Very little literature has considered the link between social capital and community initiatives (e.g. Wentink et al. 2018; Bauwens and Defourny 2017); to date, no studies have discussed the effect of social capital preceding project development.

CHAPTER THREE:
FOCUS ON COMMUNITY RENEWABLE ENERGY (CRE)

3.0 Introduction

CRE has emerged in government policies as a form of promoting involvement on the ground; making use of ownership models and diverse organisational structures (Walker et al. 2010). In recent years, community renewables or community renewable energy (CRE) has received significant interest from policymakers and researchers (Seyfang et al. 2013; Eadson and Foden 2014; Strachan et al. 2015; Süsser and Kannen 2017). Community energy projects are an emergent phenomenon and they allow citizens to participate in the production of electricity. CRE readily exists in various contexts and is driven by various motivations, including a range of organisational, social, economic, and technological factors (Hicks and Ison 2018; Curran 2019).

3.1 The concepts of community and community renewable energy

The term 'community' refers to a group of individuals with common interests regarding values, norms, identity, and a sense of place or a particular geographical area (for example, a neighbourhood, town, or village). However, the term is used differently by many scholars, and there is no definite consensus on the meaning of 'community' (Huang et al. 2017; Green and Haines 2015).

Similarly, there is no widely accepted definition for CRE (Becker and Kunze 2014), whereby the concept takes various forms of implementation depending on the context and groups wherein it is used (Walker et al. 2007; Klein and Coffey 2016; Brummer 2018a). For this same reason, CRE is also often referred to by different terms (Walker et al. 2010b; Walker and Devine-Wright 2008; Müller et al. 2011; Hoffman and High-Pippert 2010; DECC 2014; Seyfang et al. 2013; Yildiz et al. 2015), for example: 'local community initiatives' (van der Schoor and Scholtens, 2015); 'community renewable energy' (Strachan et al. 2015; Bauwens 2016; Creamer et al. 2019); or 'renewable energy co-operative' (Yildiz et al. 2015; Herbes et al. 2017; Brummer 2018b). There has been an absence of any definitive denotation of 'community energy' from its inception, and conceptualisations are continuously contested despite use and references throughout research, policies, and activism (Becker and Kunze 2014). It is not surprising, therefore, that the definition of 'community energy' continues in ambiguity and is a concept applied in various ways (Walker 2011; Rudolph et al. 2014;

Braunholtz-Speight et al. 2018; Seyfang et al. 2013; Becker and Kunze 2014; Hicks and Ison 2011). The term going to be used throughout this study is ‘community renewable energy’ or ‘CRE’.

Scholars have described CRE as being: ‘elastic’ (Hoffman et al. 2013 p.1760), ‘diverse’ or ‘slippery’ (Strachan et al. 2015 p.99), ‘problematic to define’ (Seyfang et al. 2014 p.978), ‘nebulous’, ‘potentially contentious’ (see Eadson and Foden 2014 p. 145; Park 2012), and ‘vague’ (Becker and Kunze 2014 p:180). Brummer (2018a), however, noted that despite disagreement over definitions, most researchers do agree that there are two important aspects to bear in mind when considering the CRE concept; these are: (1) CRE entails a system that accommodates democratic control and participation; and (2) CRE is a sustainable energy system that incorporates technological aspects.

Irrespective of the confusion surrounding the term, CRE has emerged in government policies as such that it promotes involvement on the ground, and makes use of ownership models and diverse organisational structures (Walker 2008; Walker et al. 2010). CRE has also been highlighted as a method for developing RE technologies, while simultaneously championing local participation, empowerment, self-sufficiency, and self-determination (Walker 2008). Rogers et al. (2008) emphasise that projects should ideally benefit community members, whether directly or indirectly; for example, supplying electricity to households, or selling electricity to the general grid. In the UK, CRE involves small-scale RE projects that range from: initiatives that purchase RE collectively, support groups, neighbourhood solar energy systems, and events that promote sustainable behaviour changes, and projects that aim at retrofitting energy efficiency measures (Smith et al. 2016).

There are various CRE projects and ownership structures, including energy co-operatives and initiatives, where energy co-operatives are considered to be grassroots innovations (GI) (Seyfang and Smith 2007). These are community-led groups that promote socially acceptable, low-carbon energy solutions (Hargreaves et al. 2013; Seyfang and Smith 2007). GIs largely consist of community organisations and non-profit, non-governmental organisations (NGOs) that are willing to develop new ideas and collaborate with local businesses and authorities (Ornetzeder and Rohracher 2013). Seyfang and Smith (2007), classified these types of social innovations as a bottom-up transformation by civil society ‘grassroots innovations’, and defines them as:

> "innovative networks of activists and organisations that lead bottom-up solutions for sustainable development; solutions that respond to the local situation and the interests and values of the communities involved. In contrast to the greening of mainstream business, grassroots initiatives tend to operate in civil society arenas and involve committed activists who experiment with social innovations as well as using greener technologies and techniques."

For the purposes of this study, the researcher follows Seyfang et al.'s (2013) lead and considers CRE to be GIs, initiated and managed by communities where the outcomes of the venture benefit all concerned.

3.1.1 An urban perspective of community renewable energy

For the past few decades, communities have been an important contributor to both sustainability transitions and the efforts made to address sustainability challenges (Frantzeskaki et al. 2017). At the United Nations Conference on Housing and Sustainable Urban Development held in October 2016, a key objective of 'Habitat III' was to position urban areas as a primary initiative, and to achieve sustainable development for future generations (Frantzeskaki et al. 2017). Several disciplines have since followed this objective and aim to address sustainable development and the important role that cities occupy in the transition to sustainable energy (Wolfram et al. 2016). However, Markard et al. (2012) note that only 6 per cent of studies conducted regarding sustainability transitions had adopted an urban perspective, compared to 38 per cent that have concentrated on a national perspective.

According to Petersen (2018), cities are responsible for approximately two-thirds of global energy consumption and play a crucial role in changing the energy sector; a key aspect considered in this study are these pivotal urban areas. Swilling and Hajer (2017) declare that African cities are in a key position to shape the direction of structural transformation still to come. Similarly, urban agglomerations are in a good position to influence novelty creations and inspire disruptive innovation, not only in the realm of technology, but also in the areas of policy, ethics, and social innovation (Mieg and Töpfer 2013). According to Bernauer et al. (2016) and Aylett (2010), urban communities show potential as legitimate sustainability alternatives since they are most likely to possess the skills, capacity, and flexibility to develop transformative projects and initiatives. Communities can identify local energy needs and organise local people to address collective goals such as the level of reliance on the national grid, energy costs, and reduction of CO_2 emissions (Koirala et al. 2016).

3.1.2 The social and entrepreneurial aspects of community renewable energy projects

CRE projects are characterised as self-governing groups of individuals united voluntarily to form a democratically controlled and jointly owned enterprise to ensure that their economic, cultural, and social needs are addressed (International Cooperative Alliance 2018). Renewable energy communities are able to facilitate the transition to low-carbon sustainable energy because they tend to focus their business interests on RE sources (Herbes et al. 2017). It is important not to overlook the fact that co-ownership and community engagements with RE sources create opportunities to deliver on many fronts, increasing social capital, building community capacity, and empowering communities (Slee 2015). However, when considering these types of projects, there must be clear distinctions between those communities based on localities, and communities of interest, where the latter refers to individuals with similar interests, but who do not reside in the same location (Musall and Kuik 2011).

Regarding the entrepreneurial aspect, CRE projects can serve as worthwhile investment opportunities due to their ability to generate profits and pay out dividends (Herbes et al. 2017). Community energy provides economic payback to investors and offers democratic governance over RE (Herbes et al. 2017). However, CRE is characterised by participation at all stages along the value chain, meaning those playing a role in the venture should also benefit (Rae and Bradley 2012). According to the Scottish Government (2018), the administration and development of CRE groups are growing, but should be shaped by local contexts to maximise local gains, and to promote other financial models that permit communities to invest in a way that maximises their profits.

3.1.3 The difference between community renewable energy projects and commercial renewable energy

CRE projects involve those living in the same locality sharing the aim to generate their own electricity, and therefore, investing jointly in localised RE projects (Dóci and Gotchev 2016). These projects are legally considered to be enterprises with formal ownership structures, albeit exercising the principle of democracy, which is somewhat different from capitalist norms (Klagge and Meister 2018). Community projects arise as a result of motivation toward a social economy of community actions, with the primary objective being to develop new ideas that address social needs (Ornetzeder and Rohracher 2013), and are usually driven by individuals and/or formal or informal lobby groups (Stirling 2014; Huybrechts and Haugh 2018; Proka et al. 2018). Compared to centralised energy systems and technologies, which exist on a far larger scale, community projects are typically small (Devine-Wright and Wiersma 2013; Walker and Cass 2007).

Community projects have a different ownership structure than capitalist ventures (Seyfang and Smith (2007); they are collectively owned and operated by members at the local level rather than by investors (Huybrechts and Mertens 2014; Yildiz et al. 2015; Bauwens et al. 2016). Bauwens et al. (2016) remark that community projects practice a democratic governance structure where there are no barriers to the addition of new members, and where all members have equal voting rights. Unlike capitalist corporations that are merely interested in monetary profits, social enterprises drive a different agenda focusing on specific goals and targets that are not motivated primarily by profits (Becker et al. 2017). To elaborate, capitalist organisations tend to be driven by profit-making, expansion, and paying out high dividends while also growing shareholders' confidence (Klagge and Meister 2018). Community energy groups, on the other hand, are not driven solely or even principally by financial returns; rather, they are driven by broader, non-financial goals that are, for example, socially or environmentally related (Holstenkamp and Kahla 2016). They also engage in area-based community enhancement, democratisation of energy systems, and local energy security (Bauwens et al. 2016; Becker and Kunze 2014; Burke and Stephens 2017).

3.1.4 Developments regarding community renewable energy

Globally, there are thousands of CRE projects that have significantly contributed to local development, including small-scale rooftop projects in Australia, wind guilds in Denmark, community-operated mini-grids in Scotland, and community projects in Germany (Entwistle et al. 2014). The promotion of community projects has yielded significant results and projects have contributed immensely to energy transitions across the world (Mey et al. 2016). There are countries taking the lead positions regarding CRE growth, especially Germany (Weismeier-Sammer and Reiner 2011; Schreuer 2012) and Denmark (Lipp et al. 2012), and, to a lesser extent, the UK, Spain and Southern Italy (Seyfang and Haxeltine 2012; Aitken 2010; Willis and Willis 2012; Nolden 2013; Harnmeijer 2016; Capellán-Pérez et al. 2020). Conversely, developing countries are generally noted to be lagging behind since their main focus is to provide affordable electricity to rural communities in order to 'catch up' with the rest of the developed world (Koirala et al. 2016).

In Denmark, CRE can be readily located within the successes of the nation's outstanding RE history (Sperling 2017). Similarly, the recent boom in energy co-operatives in Germany illustrates the importance of the contribution of these initiatives to sustainable development (Klagge and Meister 2018). By 2012, about 50 per cent of Germany's 53 GW of RE is owned by citizens in the form of co-operatives (Buchan 2012). The Department of Energy and Climate Change (DECC) (2014) remarks that, as of 2008, at least 5000 CRE projects have been actively running in the UK. The US boasts around 1387 MW of RE altogether, with about 43 states each running at least one community solar project by 2018 (SEIA 2019). As mentioned earlier, there has also been substantial growth experienced in Denmark, where, as of 2017, there has been a total capacity of 5229 MW installed, where it is estimated that 20% of total energy production is owned by local citizens (Kooij et al. 2018). In the Netherlands, citizens and social groups have initiated more than 500 projects to produce and consume electricity using (RE) technologies (Oteman et al. 2014).

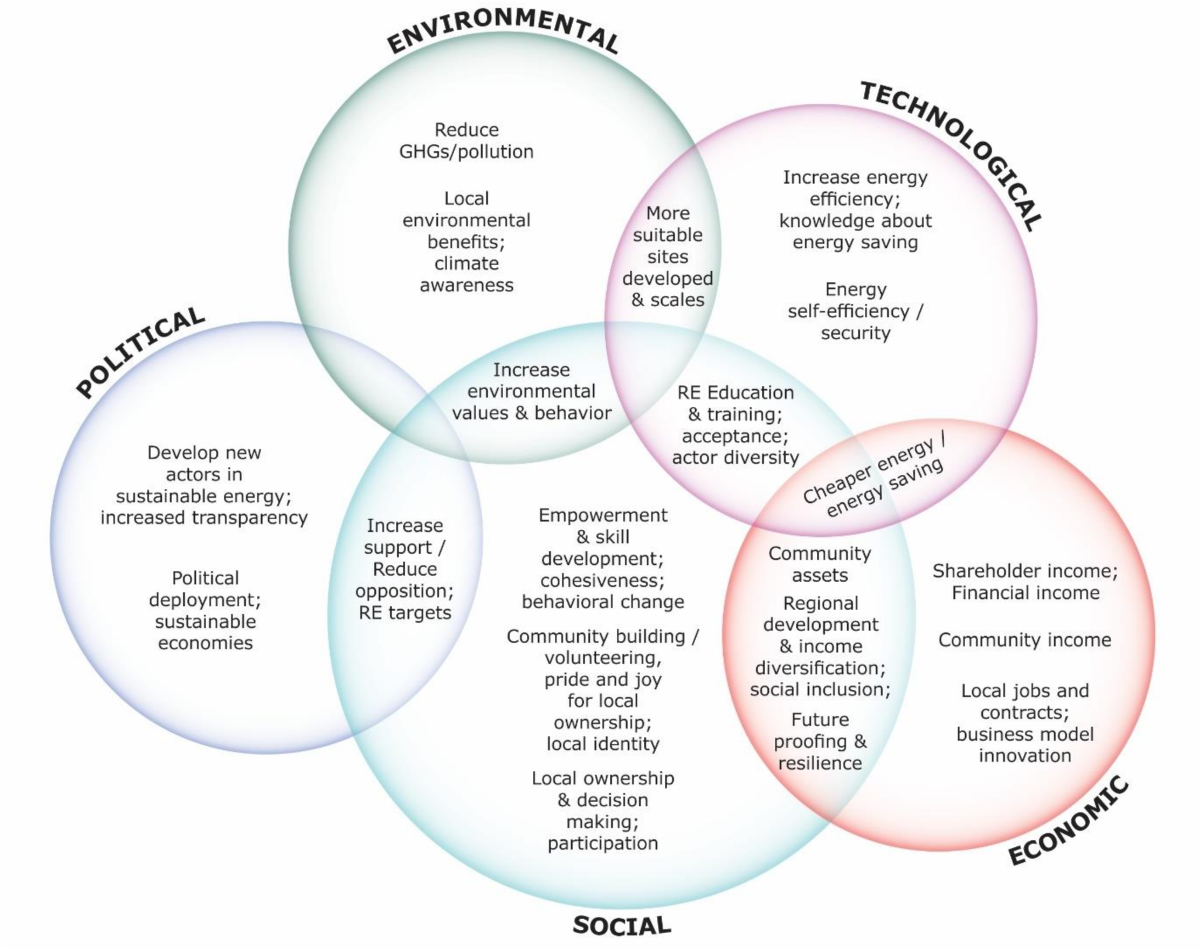
3.1.5 Benefits and motivations associated with community renewable energy projects

There are many benefits associated with community energy, ranging from economic development, engagement of local community members in energy policy implementation, as well as providing new social mechanisms for learning (Hoicka and MacArthur 2018). Furthermore, local generation has the potential to reduce harmful emissions and alter energy consumption, ultimately contributing to any given country's overall energy and climate objectives (Koirala et al. 2016). A study by Brummer (2018a) found that financial benefits, whether for individuals or collective action, are one of the benefits that CRE projects produce, where the economics of the project, benefits, and participation are all important aspects that lead to acceptance and support for the implementation of RE projects (REN21 2017).

There is an opportunity for communities to benefit monetarily through feed-in tariffs (FITs) from the electricity generated, or through part-ownership in large commercial energy ventures (DECC 2014). The revenue generated could be used for a variety of community needs, including funding for energy-saving measures in their area (DECC 2014). Walker and Devine-Wright (2008) emphasise that effective community benefits within any CRE project tend to constitute the results and outcomes of the process, where the 'process' dimension largely involves the owners of the project who execute the planning and decision making, and where the 'outcomes' dimension, in addition to the project owners, is concerned with those involved more generally and the benefits they receive in return.

The benefits of a CRE project are realised depending on the majority ownership held over the project, where the projects that yield greater beneficial outcomes are those owned by local communities since benefits and local development are shared between many individuals (Hicks and Ison 2011). In fact, in most cases, CRE projects are formed based on a range of motivations driven by social and normative (aiming to meet norms expected by the community or themselves) motives rather than economic gain (Seyfang et al. 2013; Becker and Kunze 2014; Dóci and Vasileiadou 2015; Bauwens 2016). These types of motivations are categorised into five dimensions as identified by various authors: social, technical, economic, environmental, and political (STEEP) (Seyfang et al. 2013; Becker and Kunze 2014; Radke 2014; Koirala et al. 2016; Bauwens 2016; Brummer 2018a; Hicks and Ison 2018; IRENA 2018). Figure 3.1 below illustrates the benefits and motivations for CRE projects.

Figure 3.1: Benefits and motivations for CRE projects



Source: Adapted from Hicks and Ison (2018)

3.1.6 Disadvantages of community renewable energy

The development of decentralised energy is associated with community energy projects, the benefits of which have been thoroughly discussed above, but the relative disadvantages of CRE projects when compared to conventional energy production mostly relate to economies of scale (Mckenna 2018). Even though community energy has the potential to stimulate the local economy, these projects are dependent on local conditions, and even then, it is difficult to measure their net effects (McKenna 2018). Accordingly, Bain (2011) asserted that local ownership should not be associated with local benefits as community projects are not always as beneficial as expected. Another point of contention is that although GIs have the potential to be an agent of change toward sustainability (Feola and Butt 2017), consideration should be given to employment displacement as a negative effect in other energy sectors (McKenna 2018). Considering that communities largely fail to achieve large-scale, socio-technical energy reconfigurations without the support of the government, they thus should be facilitated through a combination of bottom-up initiatives and top-down policies.

3.2 Types of community ownership models

There are various models of CRE, where Walker (2008) outlines some existing models of RE as co-operatives, including structures where communities within an area purchase shares to finance a renewable project (a development trust), and models where developers offer shares to local community organisations and charities and subsequently arrange services for said local community. According to Koirala et al. (2016) and Seyfang et al. (2013), the kinds of groups driving CRE projects are composed of various forms, including volunteer organisations, social enterprises, formally constituted co-operatives, and informal associations of interest groups or neighbours.

3.2.1 Co-operatives

Co-operatives exist worldwide as legal businesses, mainly in the fields of finance, agricultural production, and general consumption, but not as commonly in industrial consumption (Heras-Saizarbitoria et al. 2018). Koirala et al. (2016), define a co-operative as an enterprise that is operated and owned jointly by members, and which shares the benefits and profits derived from the initiative. They are considered to be regionally driven organisations; despite their size and the locations of activities, they are still technically privately owned by citizens who serve as key shareholders (Klagge and Meister 2018). As a result of being selfgoverned and value-driven, co-operatives are regarded as leading examples for different economies that aim to contribute to increased equitable, economic development (Klagge and Meister 2018). Co-operatives have the advantage of benefitting members as well as users of the firm (Huybrechts and Mertens 2014), and are particularly suitable for community ownership, where a large percentage of people participate in the decision-making process (Romero-Runio and de Andrés Díaz 2015).

Non-profit organisations are more effective and efficient in catering to local needs than for-profit entities (Bauwens 2013), but this means that community members are the ones responsible for financing and implementing energy co-operatives or other community-led structures (Harnmeijer et al. 2013). Such projects tend to involve significant personal and financial resources, which means that the communities running these projects are subject to substantial risks and responsibilities (Forman 2017). Accordingly, profits are normally divided pro-rata among all members, not necessarily based on their number of shares they hold, but rather on the transactions conducted with the organisation (Bauwens et al. 2016). Scholars note that if communities have full ownership of a project, it can increase the potential social and economic benefits across the board (van Veelen and Haggett 2017).

3.2.2 Joint ownership

Energy companies are able to establish relationships by forming partnerships with local communities to manage and operate community energy projects (Harnmeijer et al. 2013). Joint ownership, as this kind of arrangement is referred to, is the result of commercial developers agreeing to enter into legal agreements with local communities (Strachan et al. 2015). The developers are usually responsible for implementing the projects, and are characterised as follows: (1) equity partners – whereby a community benefit organisation purchases shares in the project; and (2) community shares – where a community-owned entity buys shares in the project. A disadvantage of joint ownership is that only those who invest directly in the organisation benefit, whereas a community trust's ownership of a project benefits all those in a defined area (Walker 2008). Feldman et al. (2015) and Chwastyk and Sterling (2015) assert that these types of arrangements (joint ownerships) are expected to increase tremendously over the next years. However, Koirala et al. (2016) note that for shared ownership to be successful, both national and local governments need to be involved as facilitators of projects.

3.2.3 Community benefits

Over the past few decades, community benefits of local RE projects have seen an increase in academic literature and political interest. This is due to the potential to increase acceptability and opportunities for local development, and the potential to alleviate tension and conflict in areas where the projects are implemented (Cowell et al. 2011; Wolsink 2007; Walker et al. 2014; Munday et al. 2011). Community benefits are well established for onshore renewables (Cowell, et al. 2011, Walker et al. 2017; Cass et al. 2010; Bristow et al. 2012), and are derived from local energy generation (Scottish Government 2018): benefits are offered in return to acknowledge that community is a host, where developers act on the principle of corporate social responsibility as a 'good neighbour' (Rudolph et al. 2018). According to MacDonald et al. (2017), this type of community benefit arrangement is sometimes viewed as a bribe or a way in which to approve and expedite planning applications.

There are various ways in which community benefits can be approached, but usually, an investor will process an annual payment made to communities where projects are implemented (Strachan et al. 2015). Community benefits in South Africa usually take the form of 2.5 per cent of the profits made from energy generation offered to communities where RE projects are developed (IPP 2019). In Scotland, the government has established a minimum rate that can be paid to communities yearly, constituting £5000 per MW, where developers are encouraged to offer a percentage of profits to local communities (Local Energy Scotland 2015). However, the government is aware that community benefit schemes can cause problems due to operation zones being set within certain geographical boundaries that, at times, supersede those communities with diverse needs and reduce available opportunities (Scottish Government 2018).

3.3 Business models for community energy

In a study conducted by Huijben and Verbong (2013), three primary types of funding or business models were identified and utilised within the photovoltaic (PV) systems market in the Netherlands. These are discussed below, and include: a) customer-owned, (b) community shares, and c) third-party owned. A business model can be defined in this context as a conceptual model that details the business operations and financial returns of a company (Osterwalder and Pigneur 2010), where, according to Koirala et al. (2016), successful implementation of community initiatives is highly dependent on the business model adopted. The three main types of business models relevant to the current research are discussed below.

3.3.1 Customer-owned

Customer-owned models entail structures whereby companies or individual households buy shares in renewable energy technology (RET) (for example, solar panel systems) in order to maintain direct ownership (Vasileiadou et al. 2016). In the Netherlands, a few customers collectively purchased PV panels, for example, where farmers and households joined forces to purchase the panels and thus claim a bulk discount from the supplier (Huijben and Verbong 2013). This type of financial model is beneficial to households and small companies who have enough physical space to host a solar farm, and who have funds available to invest in solar PV systems (Huijben and Verbong 2013).

3.3.2 Community shares

According to Horváth and Szabó (2018), community shares offer advantages regarding economies of scale. Table 3.1 below shows the types of models classified under ‘community shares’, the accompanying responsibilities and roles, and the advantages and disadvantages of each model.

Table 3.1: The various community-shared solar subscription models

	Purchase panels	**Lease panels**	**Invest in system**	**Buy energy/capacity**
Description	An upfront fee is paid by customers for all future electricity generation, and to obtain financial credits	Customers can either pay an upfront fee or monthly payments to secure energy supply for a defined period of time	Consumers join forces to receive a percentage of the shares, where each pays a percentage of the total project cost	End-users sign a contract for a fixed capacity per month and normally have their bills credited
Advantages	Offers upfront funding and long-term benefits for customers	Offers upfront funding and long-term benefits for customers	Owned by communities, funded externally, truly community-owned	Low-priced and flexible
Disadvantages	Difficult to sell, and attracts security and tax law scrutiny	Difficult to sell, returns on investment are lower than the purchase price	Financial risks are borne by customers and high demands for participation	No guarantee for revenue streams - can elicit lower returns

Source: Adapted from Augustine and McGavisk (2016)

3.3.3 Third-party owned

Various third-party funding models have been applied in developed countries and proven effective in bringing solar PV sources to the market (Ahlgren et al. 2015; Strupeit and Palm 2016). Third-party business models are used by solar companies to install solar panels on homeowners' rooftops at a fixed monthly rate, avoiding any upfront costs (Ode and Wadin 2019; Strupeit and Palm 2016). In addition to a predictable amount paid for electricity, maintenance of the panels is guaranteed for 20 years (Ode and Wadin 2019). Hobbs et al. (2013) assert that third party models reduce electricity bills by 10-20 per cent. However, at the same time, Huijben and Verbong (2013) reason that third-party owned business models are complex and may require changes to government legislation.

3.4 Barriers to community renewable energy development

In recent times, community projects have been encouraged to promote the use of RE, especially in countries such as the US, the UK, Canada, Denmark and Germany (Viardot 2013). However, for CRE to reach its full potential globally, various barriers need to be overcome, where the eradication of those barriers will ultimately lead to social benefits (Brummer 2018a). Scholars argue that grassroots community initiatives are currently at a disadvantage as they are not positioned on a level playing field with conventional electricity systems – policy support is necessary for them to succeed (Miller et al. 2015; Kuzemko et al. 2016; Burke and Stephens 2017). The primary disadvantages with CRE are thus rooted in policymaking itself: community energy projects face the challenge of not being recognised on agendas that should be driving and promoting renewables (Brummer 2018a).

The barriers to the implementation of renewable energy systems (RESs) encompass regulatory, economic and financial, environmental, technical, and social barriers (Seetharam et al. 2016; Luthra et al. 2015), and are ranked as presented in Table 3.2 below.

Table 3.4: Barriers to implementation of renewable energy sources

Barriers	Sub-barriers
1. Regulatory	Infrastructure, research and development, regulations, policies
2. Economic	Consumer awareness, financial issues, subsidies, incentives, pricing
3. Technical	Efficiency, operations, maintenance, skills requirement for design and development
4. Social factors	Acceptance, trust, risk perception, awareness

Source: Adapted from Luthra et al. 2015, and Seetharam et al. 2016

3.4.1 Regulatory barriers

There is a global trend moving toward auction systems, introducing severe challenges that community energy projects and small and medium-sized organisations must face to compete with more established energy entities and systems (IRENA 2018). Even South Africa promotes an auction system to increase the share of renewables (IRP 2019). Considering that the state utility dominates the electricity sector and are responsible for the entire supply chain (Eskom 2017), this makes it difficult for other players to penetrate the market (Kruger and Eberhard 2018). Sen and Ganguly (2017) found that most countries who have not yet liberalised their energy sectors still enforce policies and regulations, shielding the dominant energy entity, and making it difficult for RE to penetrate the market. To promote CRE, it is important to promote RE policies that are well planned, properly designed, and deployed (Ramli and Twaha 2015). Mirzania et al. (2019) assert that a general lack of policy support for small players from governments is a barrier that can impede the development of RE and CRE.

CRE projects are different from any of the traditional energy systems that have existed for centuries, where some countries' policies and regulations end up serving as barriers to the implementation of CRE projects (Hicks and Ison 2011). In South Africa, there are no clear regulations pertaining to CRE (IRP 2019), creating barriers to the meaningful development of community energy. Brummer (2018a) also highlights that the current regime in the UK discriminates small community projects when compared to large-scale energy companies. In the same way, large-scale, US companies challenge new community renewable start-ups that encroach on their business models (Brummer 2018a).

3.4.2 Economic and financial barriers

RE technologies are considered to have high initial capital outlay; however, costs are usually compared to grid-based, fossil-fuel energy entities (Mohammed et al. 2013; Koirala et al. 2016) that are already well established in the market (Hicks and Ison 2011). According to Hicks and Ison (2011), community projects have economic benefits and the potential to contribute to community development. However, smaller communities especially face the challenge of lack of access to third-party finances and may not have the capacity to raise equity on their own (IRENA 2018). Communities pursuing CRE projects tend to rely on equity from members, and loans from external entities like banks, where a lack of access to financial resources limits their ability to compete with established energy entities (Bauwens et al. 2016). Financial contracts require financial guarantees and creditworthiness that small organisations or groups typically lack (Heras-Saizarbitoria 2018).

Unlike large-scale developers who can distribute financial risk across various projects, small groups typically only have one or two active projects at any given time. Unable to distribute their risks across other portfolios (Bauwens et al. 2016) makes it difficult to secure any initial funding or access to long-term funding (Brummer 2018a). Since capital would be raised by community members for RE projects, there should be policies in place that support and encourage self-funding models (Koirala et al. 2016). Some communities, however, have been able to overcome this barrier through bulk-buying schemes, such as in the Netherlands (DECC 2014a).

Mohammed et al. (2013) assert that RE requires backing in the initial phase, and without government support – for example, subsidies and tax incentives – RE technologies may only yield energy output at an unreasonably high cost to consumers. Therefore, financial arrangements in the form of user subsidies or tax incentives for investment are necessary; without fiscal support, major dissemination of RE sources would prove difficult (Mohammed et al. 2013). To become competitive within the local industry, competency in RE, expansions of RET, support at all levels of research, experimentation, and development, and financial assistance (in the form of subsidies) are all required (Abdmouleh et al. 2015).

Sadly, governments around the world continue to subsidise fossil fuels over RE sources (Clark et al. 2020), and this is no different in the South African context. One of the mandates of the South African Central Energy Fund is to finance, promote, and market the exploitation and acquisition of coal deposits, and the production of oil and liquid fuel (Garg and Kitson

2015). Eleftheriadis and Anagnostopoulou (2015) emphasise that a lack of interest in subsidising renewables and the continuation of coal subsidisation – as well as supporting the carbon lock-in, path dependency, and techno-institutionality of the electricity sector – is the most prevalent blockade preventing the diffusion of new technology.

3.4.3 Technological barriers

One of the biggest problems that the expansion of RETs encounters is the high capital cost of procuring equipment, and, subsequently, high maintenance costs (Chen 2011). The other challenge encountered regarding RETs, especially wind and solar technologies, is their inherent irregularities (seasonal) or variable natures (Yaqoot et al. 2016), meaning that, sometimes, energy demands cannot be met (Yaqoot et al. 2016). Many community projects have challenged government decisions on energy policy development and implementation – for example, grid reform and RE subsidies – with varying degrees of success (Brisbois 2019). For community energy initiatives, securing access to the grid to transfer locally generated energy is paramount (Koirala et al. 2016), where another major barrier often encountered is the poor development of electricity grids (Steinbach 2013), further slowing what should be a rapid diffusion of CRE sources. The current infrastructure may even be entirely unsuitable for new technologies to be incorporated into the system (Negro et al. 2012).

Therefore, improvements to the current traditional system are necessary to allow for reliable access to the grid (Negro et al. 2012). Innovation advances quickly, ultimately creating a shortage of skilled staff – a phenomenon experienced acutely when innovations profoundly differ from existing systems: an insufficiency in knowledge about the new technologies occurs, creating the necessity for new technological paths and training programmes that require time to develop (Negro et al. 2012). Rathore et al. (2018) argue that, although efforts can be made to increase manufacturing facilities in a country, lack of awareness, policy support, poor quality of products, and a lack of financial support can wholly undermine the effort to promote RE and CRE projects.

3.4.4 Social barriers

According to the International Renewable Energy Agency (IRENA), the development pace of community projects can be hampered by various cultural issues. Some countries inherently practice shared ownership of community projects and democratic decision making; other countries, however, due to their historical contexts and societal characteristics, present some challenges (IRENA 2018). It is important to give adequate attention to social and cultural concerns when planning for community projects since social issues have often proven to negatively impact the dissemination of RETs (Sen and Ganguly 2017).

Similarly, people's lack of awareness of RE is considered to be a challenge that affects many potential consumers (OECD/IEA 2010). It is widely acknowledged that lack of information, experience, or lack of reliable information hampers the adoption of any new technology, not to mention RE technologies (Reddy and Painuly 2004). As such, there are issues around social equity to consider when designing policies, especially since any given society's upper or middle-class citizens have a notable advantage over working-class citizens in their access to information, in this case about RETs (Macintosh and Wilkinson 2011; Grösche and Schröder 2011; Nelson et al. 2012).

Due to the various social factors that can hinder the successful deployment of technologies, it is crucial to understand how RETs will impact societies and increase their chance of thriving (Byrnes et al. 2013), in order to see why such issues are worth overcoming. This makes social acceptance an important factor to consider when deploying RE sources. The 'not in my backyard' phenomenon – especially concerning wind technology placement – results in gravely negative opposition, which cannot be ignored (Byrnes et al. 2013). Were consumers to fully realise the potential benefits of such projects, the likelihood that they will object to the placement of RE technology on their properties is expected to decrease (Sen and Ganguly 2017).

3.5 Conclusion

In this chapter, the researcher elaborated on the concept of CRE, and identified and supported its key components and concepts. The study found that communities play an important role in sustainability transitions as they tend to facilitate the transition to low-carbon energy focussing their business interest on RE technologies. Governments around the world should reconsider subsidising fossil fuels over RE sources for CRE to thrive, and this is no different in the South African context. The community business structure is different from capitalist ventures as it is collectively owned and operated by members at the local level, meaning that projects benefit society at the local level, rather than corporate structures. The next chapter will extensively review the supporting literature used in this study, which includes the perceptions toward RE and community renewable projects and the factors that promote CRE projects.

CHAPTER FOUR:
LITERATURE REVIEW

4.0 Introduction

This chapter reviews the literature to assess the transformation potential for CRE in South Africa. It is structured around the central themes and arguments that emerge from the literature which are relevant to the research questions proposed by this study. The chapter begins by discussing (1) the perceptions toward CRE projects, and (2) the challenges encountered when developing such projects; (3) the developments in Solar PV technologies both internationally and in South Africa are discussed; and concludes by deliberating (4) the relevant policies that have demonstrably promoted RE and CRE sources in three countries. The four perspectives will provide an overview of both the general, and more focused literature on the transformative potential of CRE projects.

4.1 Perceptions of community solar projects

It is widely acknowledged that, in order to curb greenhouse gas emissions and limit negative climate change impacts, there is a dire need for transformation in the energy sector (Becker et al. 2017; York and Bell 2019). Karakaya and Sriwannawit (2015) mention that governments must support the use of RE sources in order to adequately respond to the threat of increasing levels of emissions. However, scholars argue that when plans are finally put in place to diversify energy portfolios, it is important to first investigate public opinions about the transitions, since it is the public that may very likely affect future plans and policymaking. (Walker et al. 2010a; Yazdapanah et al. 2015; Boudet 2019).

Stigka et al. (2014) note that in contemporary society, decision-making and arrangements are not always reliant on the opinions of the experts, but also public perceptions and attitudes. Furthermore, a positive public attitude plays a significant role in the successful widespread dissemination of RE technologies, and in ensuring that government energy policy targets are achieved (Karlstrøm and Ryghaug 2014; Sütterlin and Siegriest 2017). Therefore, having meaningful insight into what persuades the perceptions of individuals cannot be taken for granted – the public ultimately influence whether policy plans are achieved or not (Visschers and Siegriest 2014; Stigka et al. 2014). Decision-makers should bear in mind that there is no ‘one size fits all’ approach to understanding society’s acceptance or rejection of a technology (Scheer et al. 2017).

Various studies have been conducted on public perceptions and attitudes toward RE sources and community projects in developed countries (Karlstrøm and Ryghaug 2014; Reilly et al. 2015; Kalkbrenner and Roosen 2016; Ntanos et al. 2018; Yazdapanah et al. 2015; Sütterlin and Siegriest 2017), the public's willingness to pay for RE sources (Yazdapanah et al. 2015; Lee et al. 2017; Ntanos et al. 2018), and their willingness to participate in community-based RE projects (Woo et al. 2019; Rogers et al. 2008; Koirala et al. 2018). Prior research has also investigated the elements that might motivate communities to participate in CRE projects (Kalkbrenner and Roosen 2016; Dóci and Vasileiadou 2015). Most of these studies have assessed social acceptance or willingness to participate by examining projects that have already been developed, except for Kalkbrenner and Roosen (2016), Rogers et al. (2008), and Koirala et al. (2018), who all assessed projects prior to their implementation. Regardless, nearly all of the studies mentioned above focus on the factors driving acceptance and resistance, as well as engagement and participation in the initial stages of the project (Delicado et al. 2016).

In the South African context, only a limited study thus far has assessed public perceptions regarding RE sources (Lombard and Ferreira 2014). Previous studies instead tend to lean toward the inherent potential of RE sources (Winkler et al. 2017), the demand for and supply of electricity (Jamal 2015; Inglesi and Pouris 2010; Sigauke and Chikobvu 2011), willingness to pay for green energy (Moller 2018), barriers to RE adoption (Murombo 2016; Pegels 2010). On the other hand, prior research has investigated the elements that motivate communities to participate in CRE projects (Kalkbrenner and Roosen 2016; Dóci and Vasileiadou 2015; Holstenkamp and Kahla 2016). However, vastly different frameworks were used throughout these studies to understand the perceptions of citizens toward CRE projects. Hence, Seyfang and Haxeltime (2012) criticise many researchers' failure to place emphasis on 'social innovation'.

4.2 Social acceptance

Social acceptance is an important aspect in determining whether green energy technology will be accepted in any given society and whether energy policy targets can be reasonably met (van der Schoor et al. 2016; Bhowmik et al. 2018). 'Social acceptance' is defined as a positive response from members in a community, including attitude, behaviour, and intention relating (in this case) to a particular technology or socio-technical system intended to be put to practical use (Upham et al. 2015). According to Linnerud et al. (2019), the main challenge of developing RE projects is the lack of social acceptance, where social acceptance has also proven to play an essential role in the diffusion of RE sources, which peoples' willingness to support the implementation and use of RE technologies is paramount (Yazdapanah et al. 2015).

Governments across the world have set ambitious targets regarding the increase of RE sources, but perhaps have not considered the relevance of social acceptance as an obstacle to implementing sustainable energy technologies and realising policy goals (Wüstenhagen et al. 2007; Schweizer-Ries 2008). Understanding the dimensions that lead to social acceptance in this regard cannot be overlooked and require decision-makers' full attention, where meaningful community involvement in the deployment of RE projects across the world has proven to increase social acceptance and support (Byrnes et al. 2013).

Wüstenhagen et al. (2007) categorise social acceptance into three segments: market-based, socio-political, and community-based. The market-based element denotes the acceptance of a new technology by citizens in their capacity as consumers; socio-political acceptance refers to the acceptance of RETs and policies put in place by high-level government and cultural institutions; and the community-based element refers to acceptance of the implementation of RE projects by local stakeholders – especially local government and communities within the immediate area. The research at hand focuses on the last category – community acceptance. As Sütterlin and Siegriest (2017) state, public acceptance and perception are critical instruments in achieving auspicious, sustainable energy transitions, suggesting that it might be pertinent to analyse successful transitions that have already occurred alongside effective communication measures and policies in order to gain a clearer understanding of the opinions of individuals about energy systems. The importance of this study lies in understanding individuals' perceptions based on social capital resources prior to project development, ultimately in order to ensure sustainable production of CRE projects (und Polach et al. 2015).

4.3 Renewable energy and the public: general attitudes, surveys, and opinion polls

As mentioned above, several studies have explored the social acceptance of RE technologies (e.g. Jung et al. 2016; Sütterlin and Siegrist 2017; Leijten et al. 2014; Visschers and Siegrist 2014; Paravantis et al. 2018). On an abstract level, renewables are generally positively perceived (Bertsch et al. 2016; Sütterlin and Siegriest 2017; Bayulgen and Benegal 2019), where public acceptance – according to surveys – tends toward positive widespread support of RETs (Eurobarometer 2014; Karlstrøm and Ryghaug 2014). However, at a more granular, local level, public opposition and controversy are rife regarding various RETs (Devine-Wright 2005). According to Sütterlin and Siegrist (2017), abstract-level acceptance is a general, immediate response to a proposed energy system that is emotionally driven, while acceptance at a concrete, realistic level prompts more reflection regarding specific situations and contexts, thereby offering a more accurate interpretation of individuals' acceptance of energy technology implementation.

When considering energy supply replacements, the public is inclined to assess various benefits and cost ramifications (Perlaviciute and Steg 2014). If people perceive the process as fair, this can increase acceptance of a technology and its implementation (Schuitema and Bergstad 2018). In fact, Spence et al. (2010) argue that compared to nuclear power and fossil fuels, RE systems are preferred since people recognise the shared benefits and reduced costs, unlike nuclear power systems (Perlaviciute and Steg 2014). Ultimately, and to some degree, public acceptance and perception are influenced by a particular country's energy strategy and implementation policies (Kim et al. 2013).

4.4 Moving away from 'NIMBYism'

Governments the world over are tasked with promoting RE sources and their associated infrastructure during the course of addressing climate change (Batel et al. 2013). However, in the process of delivering public resources, local or grassroots opposition can hamper progress or even halt infrastructural implementation altogether (Batel et al. 2013; Boudet 2019). Despite RE technologies now being broadly accepted, new technologies that are introduced often face scepticism or rejection by the public. Social acceptance thus relies on various factors and cannot be guaranteed (Wüstenhagen et al. 2007; Eitan et al. 2019). Rejections often constitute 'NIMBYism' ('not in my back yard'), where individuals or groups oppose the development of RE infrastructure in their nearby vicinity in order to avoid possible negative externalities associated with that infrastructure (for example, wind turbines disrupting landscape views), but who still want the benefits of the technology if placed elsewhere (Eitan et al. 2019). 'NIMBYism' in the socio-political context thus describes local opposition to a technology based on irrationality, ignorance, or selfishness (Batel et al. 2013). Energy democracy supporters claim that the 'NIMBY' concept is a response from citizens who see potential in solar and wind projects for citizens' involvement, and realise these technologies are still implemented under a centralised system (Burke and Stephens 2018).

Even though the NIMBY concept is still commonly considered by stakeholders and policymakers, social science scholars propose that the idea is overgeneralised and does not necessarily reflect peoples' actual reasons for rejection (Scheer et al. 2017). It is thus possible to argue that local opposition to the implementation of RE can be reduced through participation in projects, decision-making, and the fair distribution of economic benefits (Toke et al. 2008; Musall and Kuik 2011; Agterbosch et al. 2004; Olson-Hazboun et al. 2016). Woo et al. (2019) also note in this regard that while people favour RE sources over fossil fuels, they may resist the siting of RE projects near to them, but that the NIMBY phenomenon could be resolved by offering local communities some incentives. In many respects, studies have conversely argued that small-scale, community-based projects are actually highly supported by local people (Warren and McFadyen 2010; Rogers et al. 2008).

4.5 The importance of social movements

The critical role played by communities regarding the move toward a successful and sustainable energy transition is recognised in political and public debate (DECC 2014a). The opportunities presented by CREs have encouraged activities that aim to advance environmental and social justice through a transition from fossil fuels to low-carbon energy (Burke and Stephens 2018). Soutar and Mitchell (2018) declare that, when compared to fossil fuels, RE offers many advantages, including distributed RE sources and the potential for a new ownership arrangement. Community projects can therefore create spaces or leverage local organisations to develop their assets by pursuing local benefits offered by external organisations that implement place-based programmes (Green and Haines 2015). The actions taken by these social movements are considered to be an extension of widespread social movements that aim to address the economic and environmental crisis. In so doing, they not only aid in preventing the use of fossil fuels and encouraging market-driven, green economic agendas, but also promote democratised, decentralised, and community-based RE investments (Burke and Stephens 2018).

Communities globally are taking action against corporate hegemony and ensuring the protection of environmentally valuable land: a number of projects in communities have developed in the form of energy co-operatives or community energy groups (van der Horst 2008; Weismeier-Sammer and Reiner 2011; Schreuer and Weismeier-Sammer 2010; Lipp et al. 2012; Willis and Willis 2012). Organisations that are taking the lead include: Enercoop in France, Ecopower in Belgium, Energy4All in the UK, EWS in Germany, and Middlegrunden in Denmark (Huybrechts and Mertens 2014). CRE projects have thus proven to be attractive across the world due to the many benefits promoted by these initiatives, including self-reliance, security of supply, and energy independence (Koirala et al. 2016). The energy democracy brought about by this type of project aims to increase democratisation and participation to serve the interests of the public, delivering equitable and tangible community benefits that include stable jobs, new public institutions, useful public spaces, and transportation (Burke and Stephens 2018).

4.6 Public willingness to pay for alternative energy

There is a general, albeit potentially misinformed consensus that consumers are prepared to pay a premium for low-carbon energy (Rommel et al. 2018; Su et al. 2018). For instance, in Germany, where RE is well-established, consumers often pay more for electricity produced from RE sources (Rommel et al. 2018). However, there are cases that have unsurprisingly presented a different scenario, such as was found in one study conducted in the UK. Despite RE being highly appreciated in the UK, individuals' willingness to pay more for it is low, especially where many households are not open to accepting micro-generation (Scarpa and Willis 2010). Customers in the United States are also evidently not willing to pay more for RE generation (Rommel et al. 2018). Rogers et al. (2008) demonstrate that, although people consider making energy changes in their households, only two-thirds are prepared to put money toward them, but this could be due to the 50 per cent of properties in this case being rented. Consumers in higher income brackets, however, are willing to pay more (Batley et al. 2001), but may only be willing to pay a premium if the electricity is produced by their own communities (Herbes et al. 2017).

4.7 Public engagement in renewable energy

The transition toward a more sustainable, socio-technical energy future that includes transport and energy production is impossible without broader participation and engagement from citizens (Ornetzeder and Rohracher 2013). The UK's DECC also acknowledges that projects may have a greater probability to succeed if there is large backing from the public, and if participation and ownership are inherent factors of the projects (DECC 2013). Ornetzeder and Rohracher (2013) state that grassroots actions have not been given much attention and consideration as sources of innovation, where scholars are arguing that, for community projects to succeed, there should be a robust public participation relationship in place (Radtke 2014; Kalkbrenner and Roosen 2016).

To allow for much needed radical changes in the transition to low carbon energy, scholars have highlighted the potential of grassroots initiatives as a means for developing and driving radical, sustainable innovations (Seyfang and Smith 2007; Hvelplund 2011). Governments have subsequently realised the need to include more public involvement in the energy sector in order to address inclusiveness, and are thus changing policies to focus on new methods and frameworks that encourage engagement both with the public and stakeholders in the governance of science and technology (Stirling 2008).

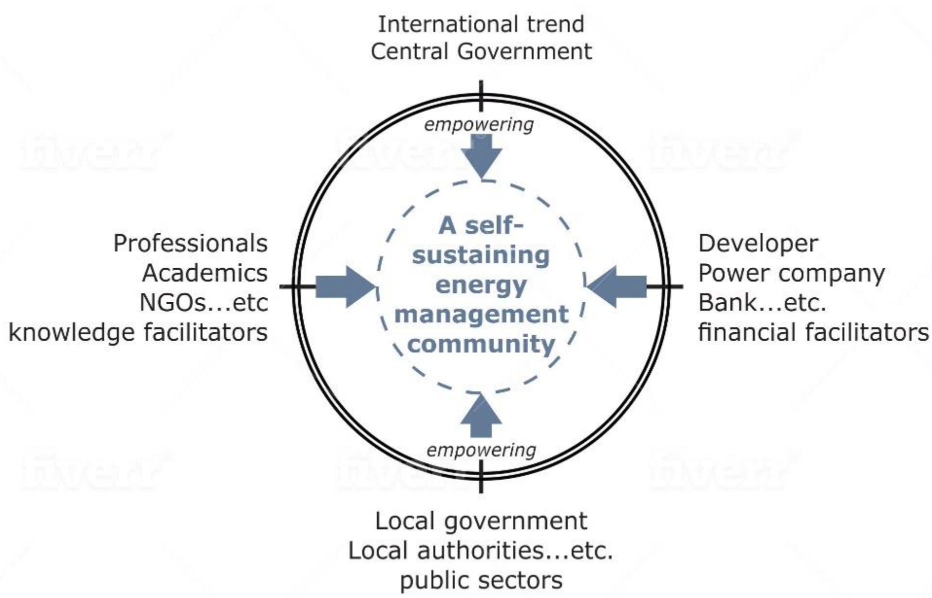
It is important for society to actively participate in community initiatives in order to reassure commitment and build trust between members (Österberg and Nilsson 2009). Community members are faced with a continuously developing environment concerning energy policy, and should aim to be in a position to build relationships and establish networks within such an environment (Radtke 2014). Technologies do not operate independently from society to provide consumers with services such as electricity (Nygaard and Hansen 2015); they shape and are shaped by the societies in which they develop – institutionally, economically, and politically (Rip and Kemp 1998; Arthur 2009). However, it cannot be emphasised enough that changes in systems do and will not occur without changes in policy: vested interests in the current, dominant systems mean that the regime will not succumb to changes without power struggles and politicking (Geels 2011).

4.8 Stakeholder identity and partnership analysis for community-based projects

CRE projects are often reliant on institutional arrangements and broader social structures referred to here as ‘external context’, where the local context of the communities wherein they are developed plays an important role (Sperling 2017). Integrating a multiple actor partnership in community projects could empower local communities to accomplish a self-sustaining energy system (Li and Yu 2016). As Warner and Sullivan (2017) argue, partnerships that allow for engagement with government, companies, and civil society can, under the right conditions, produce sustainable results for communities and businesses. Eitan et al. (2019) argue that like any other collaboration, RE partnerships occur in response to the need for skills, resources, and other matters that may help the project at hand to progress, where the most suitable way to recognise the strategies and the interests of actors involved in CRE projects is through stakeholder analysis (Li et al. 2013).

Figure 4.1 below shows a bottom-up perspective that classifies the general actors who could potentially be affected by the implementation of renewable projects, as well as the interactions and relationships between them. A ‘multiple-actor partnership’ would involve stakeholders such as politicians, project developers, governors, technology market actors, citizens, and professionals (Li et al. 2013). The connections illustrate private sector involvement in sharing knowledge and technical, financial, and business services, and are well-coordinated through a systematic process with different actors, ultimately resulting in the ideal outcomes (Li et al. 2013). Warner and Sullivan (2017) regard a ‘tri-sector partnership’ to be a new form of strategic alliance that can pool resources, capacity, competence, and expertise, thereby able to accomplish results that add value to the partnership. A tri-sector partnership can be further explained as a voluntary collaboration aimed at promoting sustainable development, and which taps into the complementary resources of government, business, and civil society.

Figure 4.1: Model illustrating a public-private partnership for collective action to empower a self-sustaining community energy project.



Source: Li et al. (2013:721)

4.8.1 Local government engagement in residential areas

Policies globally are paying attention to new frameworks and methods that promote working relationships between stakeholders and the public in managing science and technology

(Stirling 2008). Eitan et al. (2019), acknowledge that collaboration can bring together resources, capacities, and assets to generate a combined effect: by gathering knowledge, professional financial skills, natural and human resources, and other related resources, RE projects might be developed more efficiently. To build a sustainable community, the many roles of different stakeholders are all essential to forming a network of partnerships for collective action (Li and Yu 2016). Similarly, intermediary organisations also play an important role in promoting and fostering experimentation at the niche level and can be considered an essential theoretical lens for contributing to the upscale of community projects (Bird and Barnes 2014). However, forming such partnerships is not a simple task, as local identity, lack of trust, and the general drive for people to protect common interests must be addressed in order to activate and develop community social capital (Li and Yu 2016).

Local government plays an essential role in the energy sector in South Africa. As mentioned in chapter one, they are responsible for the distribution of electricity to customers in their vicinity. However, current trends seem to indicate that individuals are putting up solar panels on their rooftops (Rycroft 2019; IRP 2019), highlighting the failures of local government infrastructure and their management of social issues, which will ultimately impact municipal assets. As noted by Jones et al. (2017), when distributed generation increases, a change in the use of electricity networks is the result: increases in power flows within the local energy network may necessitate changes to the current infrastructure. Warner and Sullivan (2017) note that organisations that can manage social issues will be able to create a competitive advantage for themselves, guaranteeing long-term viability for their respective industries. Therefore, policymakers could ensure that there are partnership agreements with local government regarding external resource expansion, and in order to ensure that policy goals are achieved. However, local government utilities might not accept RE communities and might consider them a threat, presenting a potential barrier to partnership (Herbes et al. 2017); this is the case in South Africa, where municipalities are concerned that individual solar PV installations will impact their revenues (Mayr et al. 2015).

4.8.2 Private developer engagement in residential areas

The transition to RE sources includes profound political, economic, and environmental impacts. Indeed, governments play an essential role in defining policies, setting the new rules of the game, and investing in infrastructure that will accommodate the transition to low-carbon energy (Eitan et al. 2019). However, governments cannot face the challenges of investing in new infrastructure on their own, and for that reason, partnerships between the private sector and local communities are becoming more crucial. A partnership can address the needs of local communities and the public sector, as well as harnessing the resources and powers of the private sector (Eitan et al. 2019). Warner and Sullivan (2017) consider this approach to be an innovation: it necessitates companies deviating from the conventional ‘command and control’ method toward community development, and allows for voluntary agreements with parties that they might not have previously worked and engaged with. A partnership allows for parties to pool resources, capacity, expertise, and competencies in order to realise mutual goals that benefit all parties. Yildiz (2014) notes, however, that larger co-operations may not be interested in partnering with smaller companies since they may lack experience working with small projects.

4.8.3 From a passive role to a participatory approach

Participation by citizens in PV initiatives is an essential element in promoting the diffusion of RE (Fleiβ et al. 2017). However, when developing CRE projects, trust among members is crucial (Johnston et al. 2014), necessitating the need for social capital in those networks: if levels of social capital are high in society, they can lead a better-performing economy (Halpern 2005). Wentink et al. (2018) also acknowledge that when it comes to societal initiatives, social capital is a fundamental requirement in ensuring that projects succeed. Other essential aspects leading to the acceptance of RE sources include subjective norms such as peer behaviours, expectations, and attitudes toward solar PV (Korcaj et al. 2015). Social status and financial gain also influence attitudes toward PV systems: risks, costs, and efforts associated with solar PV technology are not the only factors shaping customer behaviours (Korcaj et al. 2015). Wolske et al. (2017) do, however, observe that elements such as maintenance requirements of panels and perceived costs affect peoples’ intentions to adopt solar PV. Koirala et al. (2018) further point out barriers that could hinder participation in local initiatives, including financial resources, lack of time, and a lack of technical expertise. Table 4.1 below illustrates the advantages and disadvantages of the different models of participation:

Table 4.1: The advantages and disadvantages of the models

Selection	Advantages	Disadvantages
Employment	May lessen theft and sabotage of equipment, as provisions meet community expectations.	The number of jobs available might not meet demand. May produce inter-community and intra-community suspicion.
Compensation	Defines individual responsibilities and confines financial risk exposure of companies.	As it is implemented by government authorities – there is more room for inefficiency and corruption.
Partnerships in voluntary community projects	Risks are shared. Assists with voluntary community project resources.	Loss of control. Main business is exposed to uncertainties.
Company-led local projects	Company is credited. Responsibilities are transferred to communities. Considered a good story for social reporting.	Difficulties in accessing funding from donor communities. Transaction costs may be high. Competent parties may be excluded.
Company-led voluntary local projects	Company has control. Costs limited by targeting the project-affected people.	Doesn't consider the role of government. Not able to meet community expectations.
Subcontracting community projects to consultants	May meet initial compliance requirements - detailed in development agreements.	Costs are higher. Sustainability of community projects is decreased.
Contract out community projects to non-governmental organisations	Cost savings. Risks and responsibilities are shifted. Reputation is enhanced.	Cultures may clash. Competencies in company may be under-utilised.

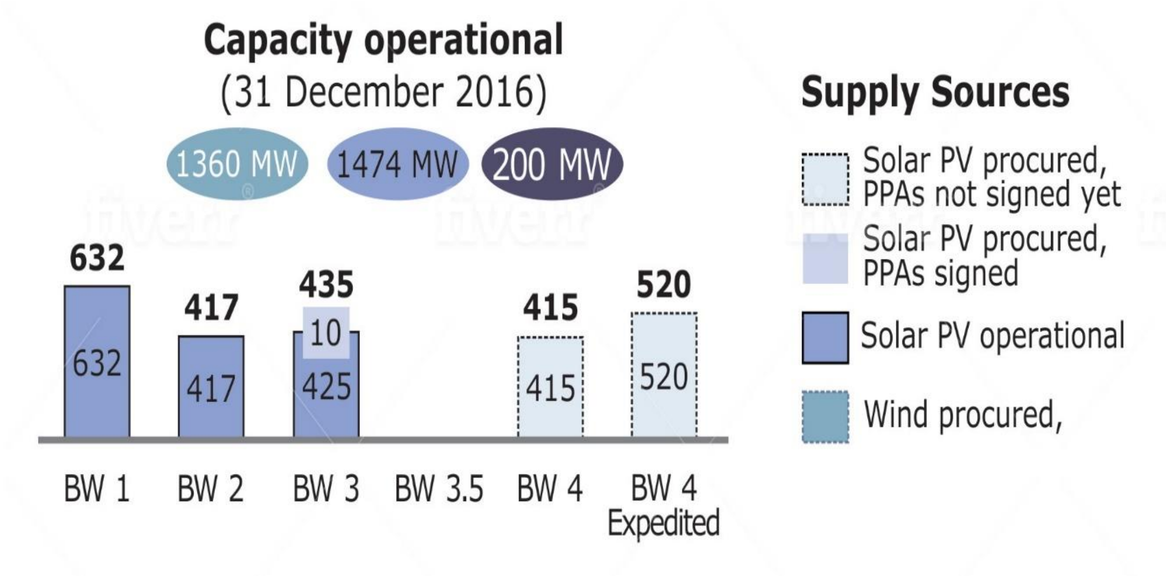
Source: Warner and Sullivan (2017)

4.9 Progress made with solar PV technology

Following concerns about environmental degradation, RE sources have been gaining momentum (Frances et al. 2013). As of 2018, there was a significant capacity of 94 GW added worldwide, which accounts for 55 per cent of new generation capacity. Countries leading the RE charge in 2018 were China, India, the United States, and Japan, with 44GW, 9GW, 8GW and 6GW respectively (IRENA 2019). As illustrated in Figure 4.2 below, in 2016, South Africa had an installed solar PV capacity of 1 474 MW, a 1 460 MW capacity of wind power generation, and 200 MW of concentrated solar power (CSP), all of which were operational and supplying the network (CSIR 2017). Furthermore, RE sources have, in many parts of the world, reached the lowest cost for sources of new energy generation (IRENA 2019).

As the world's energy demand continues to increase at an exponential pace due to technological advancements and growth in populations, it is crucial to consider affordable, reliable, sustainable sources such as RE in order to meet future energy demands (Kannan and Vakeesan 2016). The technological maturation presented by RE sources provides a suitable and well-equipped technological alternative to fossil fuel technologies (Krey and Clarke 2011). Solar energy, when compared to fossil fuels, is renewable and eco-friendly, and there is no need to worry about it eventually being depleted (Görig and Breyer 2016; Herzog et al. 2001).

Figure 4.2: Procured and operational capacity under South Africa's REIPPP programme in 2016



Source: CSIR (2017: p4)

According to Naicker and Thopil (2019), South Africa boasts an abundance of RE potential. Despite excellent prospects for development, South Africa has not made significant strides to realise the benefits of RE sources, and they largely remain untapped (Pegels 2010). Considering the above, if fair and notable deliberation is given to the potential of RES, and the focus on fossil fuels-based technologies lessened, it may be possible for the challenges faced to be mitigated. It seems clear that, unlike fossil fuels which will eventually deplete, RE is characterised as the energy that has exponential potential, and remains a promising alternative to fossil fuels (Chang et al. 2003).

4.10 Opportunities presented by adopting RE sources

There are other essential characteristics worth mentioning that are related to the renewable energy sources illustrated in Table 4.2 below, which include energy security, climate change mitigation, socio-economic development, and easy access to energy (Sen and Gangguly 2017). An important point to bear in mind is that REs are considered to be an enhanced alternative for power generation (Luthra et al. 2015), possibly because they are derived from natural resources which are continuously replenished, decreasing the risk of unforeseen circumstances resulting from fossil fuel price fluctuations, which can and often do send countries into economic endangerment (Sen and Gangguly 2017).

Table 4.2: Opportunities in adopting RE sources

Opportunities in adopting RE sources such as PV sources	
Energy security	Non-dependence on fossil fuels, avoids unforeseen import crises
Climate change	Climate change mitigation is an important driver toward RE demand
Socio-economic development	There is more demand for flexible energy like renewables as the economy expands.
Energy access	The cost-effective option to supplying electricity in remote areas is through off-grid and mini-grid options.

Adapted from: Sen and Gangguly (2017)

4.11 Why solar PV technology is suitable for the current study

Global energy systems need to change and adopt low-carbon energy sources in order to meet the COP21 (Conference of Parties) agreements (Breyer et al. 2017). As a result of limited fossil fuel resources, and their impact on climate change, governments worldwide have been encouraged to diversify the energy sector and to intensify the search for sustainable energy technologies like solar PV systems (Rode and Weber 2016). Different technologies with various scale opportunities are accessible to communities depending on the resources within those communities (Hicks and Ison 2018). Because wind technology is the cheapest to produce per kWh among the RE options, a number of CRE projects preferred this technology to other sources. But it is worth considering that the costs of solar PV sources are steadily dropping, whereby newer projects are opting for solar PV, often due to its suitability for many areas because of its modularity (Hicks and Ison 2018).

Compared to other RE sources (for example, wind, hydropower, and biomass), solar PV has gained momentum at a household level as an alternative source of clean energy and a substitute for fossil fuels (Babacan et al. 2017). Solar PV systems are considered advanced enough to be installed at domestic properties, and are increasingly deemed to be the future of energy generation (Cherrington et al. 2013). Solar energy presents the opportunity to meet future energy demand since it surpasses other sources with regard to efficiency, capacity, cost-effectiveness, and accessibility (Kannan and Vakeesan 2016; Peters et al. 2018). Equally, solar water heating has gained a huge market potential across the world and is the mostly used water heating system (Bianchini et al. 2017; Ge et al. 2018). However, this study only focuses on solar PV source. Table 4.3 below illustrates the advantages and disadvantages of solar PV systems when compared to coal, fossil fuels, and nuclear power.

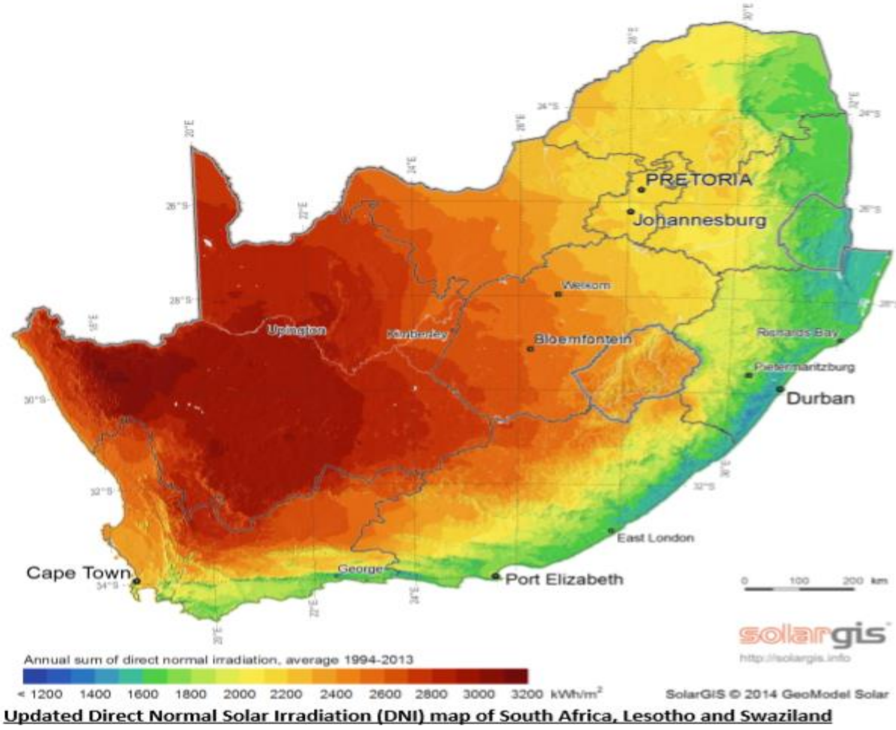
Table 4.3: Advantages and disadvantages of solar PV technology compared to nuclear, and coal and fuel-based sources

	PV technology	**Coal and Fuels**	**Nuclear**
Advantage	Infinite source	Conventional electrical energy source	Reliable
	Low CO_2 emissions	High efficiency	Not expensive
	Free source	Power plants can be built anywhere	No air pollution
Disadvantages	Large area required	Source of greenhouse gases	Very dangerous
	Low-efficiency	Price increase year by year	Source of uranium is depleting
	Weather dependent	High emission of CO_2	

Source: Adapted from Tyagi et al. (2013)

Compared to other continents, Africa has some of the most reliably sunny weather on the planet (Kabir et al. 2018). South Africa, as well as Algeria, Namibia, Sudan, Tanzania, and Egypt, have some of the highest potentials for PV and CSP energy generation in Africa (IRENA 2014). Moreover, when compared to those developed nations pursuing solar energy, South Africa has one of the highest average solar radiation rates of about 220 Watts per square metre (W/m2), with the US averaging about 150W/m2, and Europe and the United Kingdom averaging around 100 W/m2 (DoE 2017). Figure 4.3 below shows solar radiation levels in South Africa and its neighbouring countries.

Figure 4.3: Solar radiation map of South Africa, Lesotho and Swaziland



Source: SAURAN (2020)

Were projects are implemented locally, money would circulate within the local economy, meaning that communities might be able to save a considerable amount of money that would otherwise have been used to pay for energy from fossil fuels, especially if imported (Kabir et al. 2018). From an economic perspective, there are numerous benefits brought about by solar energy, such as increased property values, high durability, and the eradication of external electricity bills and tax incentives (Kabir et al. 2018). Because of their high rate of energy production and durable characteristics, solar PV systems are generally considered to be a feasible economic choice (Zweibel 2010; Yates and Hibbert 2012).

4.12 Limitations of solar energy technologies

One of the disadvantages of solar energy is that it only works at maximum efficiency in sunny areas, and can only be harnessed during the day, and cannot, therefore, be considered as being the most reliable source of energy, especially for areas with unreliable weather conditions (Kabir et al. 2018). There are also issues pertaining to output, particularly among domestic solar panels, where the efficiency is around 20 per cent, unless if more efficient (ca. >20%) panels are used, but these come at a higher cost (Kabir et al. 2018). Another limitation is associated with shortages of skilled labour to install, maintain, inspect, and repair solar systems once installed (Kabir et al. 2018). A potential rebuke to the arguments around unreliable weather is the merging of seasonal and daytime energy generation with the larger grid (Grossmann et al. 2013; Francés et al. 2013). However, household-level batteries are now gaining traction as the next energy technology on the verge of bulk roll outs to the market (Agnew and Dargusch 2017). Studies have shown that for many commercial customers, storage has already made it economical to reduce peak consumption levels (Frankel and Wagner 2017). On the contrary, accessing reasonably priced and viable electricity battery storage allow consumers control over their electricity and independency from the centralised system, as well as reducing the exposure to fluctuating electricity prices (Agnew and Dargusch 2017). Customers are realising the advantage of combining solar with storage, that it enables households to have control over their consumption rather than exporting power to the grid (this is referred to as partial grid defection) (Frankel and Wagner 2017). Ultimately, solar PV sources are considered to be the cornerstone of future energy production because of their low implementation costs (Fleiβ et al. 2017).

4.13 Policies that have promoted the diffusion of community renewable energy

Energy transitions meet with various challenges: path dependency, lock-in systems, and resistance to change by incumbents. However, considerations regarding global climate change challenges and widespread commitments to reducing emissions and meeting clean energy targets mean that a great number of strategies and policies have been implemented by governments targeting the diffusion of RE technologies (Elmustapha et al. 2018; Milanés-Montero et al. 2018). Challenges faced by new entrants to the energy market require well-designed policies that will result in a change to the energy industry. As argued by Sovacool (2016), the transition from the current dominant system to a cleaner energy system not only involves technology, but also a shift in policy regulations and the behaviours of users. Therefore, a diversification of energy policy instruments is essential to promote successful transitions (Rogge et al. 2017).

Without adequate support from the public, transitioning to RE sources may be negatively affected, or even entirely impossible (Perlaviciute and Steg 2014). RE policies have emerged specifically to promote the expansion of RETs, and to address climate change issues (Baldwin et al. 2019; Kilinc-Ata 2016), where various countries have implemented policies, strategies, plans, and control measures that allow them to organise themselves in the process of transition (Kannan and Vakeesan 2016; Viardot 2013). Geels (2014) points out, however, that incumbent regimes and policymakers can potentially use power to influence policy and resist changes to the system, particularly concerning climate change and transitions to low-carbon energy. Therefore, policy frameworks that address such externalities to ensure a level playing field for new technologies are essential (Masini and Menechetti 2012).

CRE projects rely on technologies that do not compete with current traditional power generation technologies, meaning that support mechanisms play an important role in addressing the predicament of RE's ability to compete in the market (Bauwens et al. 2016; del Río and Cerdá 2014; Otitoju 2010). It is important to bear in mind here that the energy generation costs for nuclear and fossil fuel-based power are lower as a result of subsidies issued by governments and capital costs that are eventually recovered, as opposed to RE sources that demand a higher percentage of capital costs (Abdmouleh et al. 2015).

4.13.1 Support mechanisms

Energy policies are strategies intended to address issues of energy development and sustain industry growth, which includes production, distribution, and consumption (Solangi et al. 2011). As previously stated, RE technologies are not cost-competitive relative to traditional systems, and therefore cannot compete on a level playing field without the necessary support (Aguirre and Ibikunle 2014; Abdmouleh et al. 2015; Choi et al. 2018). Policies that promote the use of RE are required, particularly in the early phases of development in order to protect innovations from having to compete with conventional technologies (Menanteau et al. 2003). Considering their high price, in many countries policy support is essential for a PV system to succeed and to be lucrative (Karakaya and Sriwannawit 2015; Hillman et al. 2018).

The development of the solar PV industry has, to an extent, been promoted by various support mechanisms that are specifically aimed at levelling the playing field by reducing the gap between the price of energy for conventional generation, and the price of energy for PV sources (Dusonchet and Telaretti 2015). Various countries have introduced solar energy support mechanisms in order to increase the share of domestic energy generation, and to minimise reliance on fossil fuels (Solangi et al. 2011; Macintosh and Wilkinson 2011; Atalay et al. 2017). It is important to note that there has been a significant uptick in RE sources as a result of such support mechanisms (REN21 2018). Dóci and Gotchev (2016) argue that such support mechanisms should ensure that the lowest social and financial costs of the electricity supplied are achieved.

There are three main policy instruments used to promote RE: the Renewables Obligation (RO) scheme, FIT systems, and tendering systems (Carley et al. 2017; Schallenberg -Rodriquez 2017). The most prevalent and effective support mechanism that has contributed to the growth of solar PV in Europe and other countries (e.g. Germany, Japan) is the FIT scheme (Atalay et al. 2017; Milanés-Montero et al. 2018; Schallenberg-Rodriguez 2017). South Africa adopted a tendering system (IRP 2010), which has been applauded as a notable success (Eberhard et al. 2014). There is also a tax incentive which serves as a complementary policy for solar PV sources (SARS 2016).

At the beginning of 2010, there were 50 nations using the FIT mechanism, and only ten having adopted renewable portfolio standard (RPS) mechanisms, making FIT the most endorsed support mechanism. By the end of 2015, about 110 provinces worldwide (at national and state or provincial level) had enacted FIT policies, 64 used a tendering system, and 52 countries had adopted net billing or net metering mechanisms (IRENA 2016). These policies are also used in developing countries where RE sources are considered helpful in reducing emissions and fostering economic development (Baldwin et al. 2019). Alongside the three main mechanisms mentioned herein, there are other complementary instruments such as tax incentives and investment subsidies (Schallenberg-Rodriquez 2017).

4.13.2 Performance of support mechanisms

The introduction of support policies to promote PV sources has stimulated cost reductions. However, PV sources are still non-competitive in relation to the traditional energy system. For PV to advance further, adequate support policies are necessary for levelling the playing field in order for RE projects to become economically feasible (Dusonchet and Telaretti 2015). FITs, feed-in premiums (FIPs), and quota obligations are the most widely used mechanisms throughout Europe that have promoted the deployment of RE sources (Otitoju 2010; Bauwens et al. 2016). Since the start of 2016, the number of countries that adopted RE targets reached 173, more than 100 authorities adopted FITs, another 100 enacted RPSs, while 64 were using tendering systems to increase their shares of renewables (REN21 2016).

More recently, some of the countries that initially implemented RO schemes have either fully or partially changed to the FIT system (Schallenberg-Rodriquez 2017). On the other hand, some countries like Germany have now changed from FIT to a tendering system (Herbes et al. 2017). Usually, quota systems are considered to be more appropriate for liberated electricity sectors. But ever since the premiums system was introduced, the argument has swayed toward FIPs as being more compatible with the electricity market, much in the same way as quota systems are (Schallenberg-Rodriquez 2017). Quota systems are not always implemented in a mutually exclusive manner, however; in 2015 there were 12 countries that had adopted both quota and FIP policies (REN21 2016). States typically choose one, however, or the choice would change over time (Carley et al. 2017; REN21 2016). For instance, Japan changed from a quota system to a FIT scheme, and Norway and South Korea switched from FITs to the quota system (REN21 2016).

4.14 Four main RE policy mechanisms that have been adopted in various countries

The policies are discussed below:

- The feed-in tariff (FIT) (Germany; Denmark): fixed-rate tariffs intended for developers to sell electricity to networks
- Competitive bidding (South Africa; recently Germany): suppliers are obliged to buy RE electricity at a high price and costs are borne by consumers
- Renewable energy target/portfolio standards (UK) (UNDP 2014; Msimanga and Sebitosi 2014)
- Financial incentives: grants, together with tax and fee exemptions.

4.14.1 Feed-in tariffs and feed-in premiums (FITs and FIPs)

FITs are policy mechanisms that promote the development of investment in RE technologies. They offer long-term contracts to developers of REs based on the cost of generation of power by the technology deployed (Dusonchet and Telaretti 2015). Across the world, FIT policies have become very popular. However, the manners in which they are designed, the approach to calculating tariffs, and the number of years the support covers differs across countries (Baldwin et al. 2019). Feed-in schemes can be classified into FITs and FIPs: whereas FITs are price-driven and production-based mechanisms, FIPs are mechanisms where a price is paid over and above the electricity market price (Ragwitz and Steinhilber 2014; Milanés-Montero et al. 2018).

In comparison to other support mechanisms such as auctions and the quota system, FITs are generally considered to be the most effective instrument (Masini and Menechetti 2012; Haas et al. 2011). Under a FIT system, governments establish a tariff which is guaranteed for a fixed time frame and utilities are expected to buy the energy produced by RE generators (Dusonchet and Telaretti 2015). FITs have contributed significantly to the development of the solar PV industry in recent years (Milanes-Montero et al. 2018). Although FITs are common in developed countries, they have also been introduced in developing countries – for instance, Mauritius and Ghana (Baldwin et al. 2019).

It is widely accepted that a FIT is a crucial policy in enabling energy democracy by allowing various other parties such as community-based generators or shared solar generators to play a role in the energy sector (Burke and Stephens 2017). FITs also offer certainty to producers: the risks or costs are passed onto utilities and consumers (Davies and Allen 2014). FIT mechanisms are classified as: (1) gross feed-in tariffs (where, regardless of the amount exported to the grid, the tariff is paid on all the electricity generated); (2) net feed-in tariffs (where only the amount exported to the grid is paid for); (3) net metering (where the electricity that is sent to the network is paid at retail tariff price); and (4) net billing (where payments for electricity are netted out over a period of time) (UNDP 2014).

4.14.2 Tendering systems

According to Abdmouleh et al. (2015), the tendering system is the most preferred policy for government and consumers, considering that prices are reduced through market-based pricing. However, the disadvantage is the risk of unsustainable price bids as prices could be found lacking and could discourage investors – potentially affecting the industry. As compared to the FIT and the quota systems, the tendering system is not as common a mechanism, where, during the past few years, FITs have been gaining massive traction and have been applied in various countries.

The tendering process involves the government opening bidding rounds targeting a certain quantity of renewable sources, and then potential bidders are invited to compete. The lowest bidders are then selected to reach the target of renewables specified. Once the final stage is reached, the investors are paid a bidding price, which is then passed to consumers (Schallenberg-Rodriquez 2017). Although the FIT and quota systems have been prominent, in the coming years the tendering system is expected to become the main support system with the highest growth prospects (Schallenberg-Rodriquez 2017). In the tendering process, the producers with the lowest bids are the ones that are contracted to generate electricity, which therefore encourages competition between the developers (Kilinc-Ata 2016).

4.14.3 Renewable Portfolio Standards (RPSs)

Compared to FITs which subsidise RE production, RPSs constitute quota systems where utilities are legally obliged to buy a certain percentage from RE producers over a period of time (Carley et al. 2017; Schmalensee 2012; Choi et al. 2018). Such quota systems are also referred to as Renewable Portfolio Standards (RPSs), Renewable Electricity Standards (RESs), and Renewables Obligations/Certificates (ROs/ROCs) (Schmalensee 2012). The RPS mechanism lowers the cost of technology at an early stage, and, as a result, a competitive market for other RE sources is created. They are considered to be a cost-effective choice to diffuse RE sources (Abdmouleh et al. 2015), and were developed to address the challenges that made it impossible for RE sources to break through and compete with conventional energy systems (Liu et al. 2018).

4.14.4 Supplementary policy instruments

There are other support mechanisms such as tax incentives and investment subsidies besides the three main instruments discussed above. However, these mechanisms are mainly complementary policy tools (Schallenberg-Rodriquez 2017; Ragwitz and Steinhilber 2014), but play an important role in enabling FIT and RPS policies to thrive. They also encourage RE generation without any main support mechanisms; for instance, there are 69 countries promoting subsidies for RE, just through RE investor subsidies, tax incentives, or generation incentives (Carley et al. 2017). Subsidies offered by the government may, however, present the issue of being changed without much warning as a result of being influenced by domestic politics. They may depend on fiscal or political considerations instead of being designed to ensure that investors are able to recoup their costs over a set period of time (Carley et al. 2017).

4.14.4.1 Tax incentives

According to Schallenberg-Rodriquez (2017), tax incentives are usually not implemented alone, but as an additional policy tool. Abdmouleh et al. (2015) believe that they might lessen operational efficiency as the owners granted the incentives might neglect their system regarding maintenance and operation of the technology. They argue that a production tax credit is a better option as it promotes more involvement and thus generates more electricity.

4.14.4.2 Investment subsidies

Investment subsidies were implemented more frequently in the past as compared to recently; the instrument is beneficial in terms of addressing challenges linked to high capital costs of RE sources. Additionally, low-interest loans can be used in conjunction with this instrument (Schallenberg-Rodriquez 2017).

4.15 Analysis of country-specific PV support policies

This section uses comparative analysis to analyse policies that have promoted CRE projects. Sovacool (2014) asserts that when assessing interactions in energy society, the use of a comparative approach can increase the applicability and robustness of case results. To conduct a comparative analysis of the three countries at hand (Germany, the UK, and South Africa), two of the main factors identified by Bauwens et al. (2016) are used herein: support mechanisms, and performance of support mechanisms. The sections below analyse the policies of three countries using different policy mechanisms in order to assess which policy mechanism has contributed most to the diffusion of solar PV sources.

4.15.1 Germany

Germany is noted as being an environmental and economic leader in the RE industry as a result of its competitive market, diverse ownership structures, and its ability to transition to renewable and distributed energy (Julian 2014). For more than a decade (since the 1990s), Germany has placed the issue of RE sources high on the political agenda, and the reduction of greenhouse gas emissions is central to the government's strategy (Dóci and Gotchev 2016). The German government introduced the Renewable Energy Sources Act (EEG) (BMU 2012), allowing for favourable conditions that support investment – especially for photovoltaics – over a long period, and a stable FIT scheme lasting up to 20 years was implemented (Frondel et al. 2010; Yildiz 2014; Ćetković and Buzogány 2016). This was a critical move that brought a legal framework, along with policy instruments, that promoted wider diffusion of RE sources (Inderberg et al. 2018). Dóci and Gotchev (2016) highlight that the EEG was not intentionally created to develop CRE, but ended up creating favourable conditions for individual investors and community-based electricity generation.

4.15.1.1 Support mechanisms

The *Energiewende (AA 2020),* has operated as the German government's energy transition strategy since 2011, following the Fukushima Daiichi nuclear disaster. The plan aims to eliminate nuclear power by the end of 2022. *Energiewende* considers RE to be one of its cornerstones, and now Germany is considered one of the countries to have realised a considerable increase in the diffusion of RE sources over the last two decades (Peters et al. 2018). To reach the set targets for RE, the German government offered a very supportive environment for RE and energy efficiency to thrive by providing a FIT scheme, priority feed-ins, as well as other complementary support systems (Geddes et al. 2018). The introduction of the EEG in 2000 spurred a broader diffusion of the PV market, and is seen as the single most important policy for promoting CRE in Germany (Inderberg et al. 2018; Dóci and Gotchev 2016).

Between 1990 and 1995, the '1000 Roofs Programme' was initiated – a subsidy programme meant to test small, decentralised, grid-connected systems. The early adopters were to receive up to 70% off their installation costs for systems ranging between a kilowatt peak (kWp) of one and five. The programme resulted in around 2000 PV rooftop installations. Subsequently, between 1999 and 2003, a new programme ('100 000 Roofs') was launched, which promoted the installation of solar panels exceeding 1kWp (Inderberg et al. 2018).

The German government also played an essential role in the promotion of the growth of CRE projects in the country (Yildiz 2014). This growth has largely been promoted by a particular policy framework that encouraged a sustainable energy transition in the form of financial support such as subsidies, and the development of an infrastructural network that would accommodate the technologies (see Peters et al. 2018).

4.15.1.2 Performance of support mechanism

The success of *Energiewende* was realised when RE reached more than 30% of all electricity produced in the country (Brummer 2018b). The government promoted the RE sector and required electricity utilities to pay a fixed preferential price per kilowatt-hour (kWh) supplied (REN21 2016). This facilitated the widespread installation of solar PV in the commercial and residential sector, with more than 60 per cent operating at low voltage levels (Eid et al. 2016). By the end of 2016, the country boasted a mature and well-developed low-carbon energy sector (Rommel et al. 2018; Geddes et al. 2018).

In 2011, about 7485 MW was added to the grid over and above the 6988 MW added in 2010. In 2012 solar accounted for 42.3% of RE's installed capacity (Davies and Allen 2014), and by 2014 Germany had already installed 38 GW's worth (Eid et al. 2016). The targets were made possible as a result of various factors: a thriving national industry, the long-term stability of support mechanisms, the confidence of stakeholders, and uncomplicated authorisation and permission procedures (Dusonchet and Telaretti 2015).

CRE projects in the country have in recent years, attracted considerable attention because of the FIT mechanism. Since 2004, the number of registered energy co-operatives in Germany reached almost a thousand (Herbes et al. 2017; van der Schoor et al. 2016). Citizen participation in Germany played an important role in establishing and promoting RE technologies (Bauwens and Devine-Wright 2018; Salm et al. 2016; McKenna 2018; Yildiz 2014; Julian 2014), where Yildiz (2014) highlights that about 48 per cent of the installed renewable capacity is controlled by communities. This makes them the second largest group to own power generation in the country, following closely behind strategic and institutional investors who own a share of 48.5 per cent of the installed RE capacity. Community projects in Germany represent about 56 per cent of total PV capacity: about 850 000 systems out of the 1.5 million installed (Inderberg et al. 2018). There are 973 CRE projects in Germany, which account for an investment of €1,67 billion, and a total number of over 130 000 members (Brummer 2018b; Herbes et al. 2017).

The FIT system was favourable until 2012, and offered the highest tariffs for electricity produced from PV sources (Yildiz 2014). The policy was changed, and Germany has adopted an auction system since 2017 deemed likely to impact on CRE projects (Herbes et al. 2017; IEA-RETD 2016). Since the change in policy and the considerable reduction of FIT, the economy of solar PVs has seen a dramatic change (Holstenkamp and Kahla 2016). With the reduction of FITs for PV systems in 2012, the introduction of the mandatory 'market premium' system in 2014, and the substitution of the FIT system with a procurement system in 2017 as a means of ensuring cost-effectiveness, there has been an increasing trend toward increased dependence on market mechanisms (Lang and Lang 2015; Ćetković and Buzogány, 2016; Bauwens and Devine-Wright 2018).

Changing from a FIT to a tendering system transfers pricing decisions that were managed by the government to the market, introducing pricing risks that less established organisations such as community projects cannot manage in relation to more established organisations, since it removes investor security for community projects (Herbes et al. 2017). This is further complicated by the new amendment, which states that once the country has installed 52 GW of solar plants, EEG payments will no longer be applicable (Davies and Allen 2014). The move favours large-scale developers at the expense of small-scale developers (Ćetković and Buzogány 2016).

The change of support mechanism from FIT that previously supported the development of RE is likely to have an impact on community projects (Herbes et al. 2017). Inderberg et al. (2018) assert that the change in support mechanism and the reduction in payments can be linked to the drop in newly formed community energy projects. Furthermore, the drop in payments rates have not only affected small players, but also larger PV system developers. The drop in prices cannot, however, be compared to decreasing PV panel prices, which has resulted in economic uncertainty across the German market (Inderberg et al. 2018). Already concerns have been raised about increasing professionalisation, which has resulted in less community involvement and will result in RE projects being rejected by society (Holstenkamp and Kahla 2016).

4.15.2 The United Kingdom

The electricity sector in the UK was privatised following the introduction of the Electricity Act of 1989, which separated the generation, distribution, and supply activities by establishing a licencing regime (Julian 2014; Inderberg et al. 2018). Thereafter, several financial incentives were introduced as part of the government's effort to ensure energy security and to address climate change (Woodman and Mitchelle 2011).

4.15.2.1 Support mechanisms

Unlike Germany, which was aiming to increase the share of RE to meet EU Renewable Energy Directive (RED) levels, the UK government only adopted RE technology in response to the EU regulations and international climate and energy policy commitments. Energy suppliers were obliged to increase the share of RE in their portfolio, but the motivation to increase the percentage of RE was driven by cost-effectiveness, rather than societal participation, innovation, or job creation (Ćetković and Buzogány 2016) – a testament to the policy adopted to promote RE sources. The UK government approved the Renewable Obligation (RO) scheme (DTI 2007; BEIS 2017), which mainly, however, supports large-scale developers (Ćetković and Buzogány 2016; Inderberg et al. 2018).

The support scheme was criticised for being too complex, and includes revenues that are undefined, making it difficult for community groups to comprehend and follow (Hall et al.

2016). Because the RO mechanism was completely technology-neutral and market-based, it was impossible to meet RE targets since it was not providing enough incentives to promote costly and less mature technologies such as offshore wind and solar energy (Ćetković and Buzogány 2016).

To address the challenges presented by the RO, the UK government introduced a FIT scheme, which was launched in April 2010 to work in conjunction with the RO (DECC 2012). The programme targeted RE installations such as PVs below 5 MW, and the tariffs were guaranteed over 20 to 25 years (Inderberg et al. 2018; Cherrington et al. 2013; Balcombe et al. 2014). The main reason for the policy was to attract a considerable number of investors by offering a guaranteed price for a fixed period (Cherrington et al. 2013). Inderberg et al. (2018) assert that significant support was given to installations below 4kWp, and tariffs were allocated at various rates depending on the size of the facility. To date, solar PV sources are the most highly registered installations in the country. Usually, the electricity supplier pays owners per unit of electricity generated or exported to the grid, and an export tariff (ET) is payable based on the amount of electricity exported to the network (Pearce and Slade 2018).

Concerning CRE projects, several instruments have been set up to promote community projects in different parts of the UK since 2010 (see Seyfang et al. 2013; Mirzania et al. 2019). For instance, the Scottish government developed programmes that encourage communities to participate in the transition toward sustainable energy (Markantoni and Woolvin 2015; Creamer 2015). The first-ever Community Energy Strategy was published on 27 January 2014 by the DECC, which emphasised the ambitions of community-led projects (Mirzania et al. 2019; Ćetković and Buzogány 2016; McCabe et al. 2018). The Green Investment Bank also allocated a substantial amount to support community-scale projects. However, in a centralised energy regime, it remains to be seen whether this support will succeed (Ćetković and Buzogány 2016). Hall et al. (2016) also note other movements that support small-scale citizen finance: companies such as Pure Leapfrog and Abundance have been set up in the UK to offer citizen finance debentures for small-scale companies. At the beginning of 2010, community projects generating under 5 MW became qualified for FIT, where, for an agreed period, the electricity produced by community projects is sold to the grid (Hicks and Ison 2011). Markantoni (2016) highlights that innovations of that nature work toward increased numbers of community energy projects, which are instrumental to a gradual transformation in the energy sector.

4.15.2.2 Performance of support mechanisms

The implementation of solar PV sources in the UK has been strongly driven by policy support (Kay 2015). The RO scheme has been the main support policy for installations above 50kW, and this is where most of the generation capacity was derived in the country over the last few years (Kay 2015). On the other hand, FITs have been an important mechanism for supporting small-scale RE projects. As a result of these support mechanisms and attractive tariffs, there has been a significant increase in the diffusion of solar PV sources in recent years (Kay 2015; IEA 2019; Balcombe et al. 2014; Milanes-Montero et al. 2018; Pearce and Slade 2018). According to Inderberg et al. (2018), between 2010 and 2015, there was a significant increase in prosumers investing in solar PV panels of up to 4kWp as a result of the FIT mechanism.

According to Kay (2015), FITs accounted for over 98 per cent of all solar PV connections in the UK, and 55 per cent of the total solar capacity. The solar energy industry grew by 81 per cent in the UK in 2014, meaning the capacity doubled between 2013 and 2014 (Kay 2015). Since the significant increase in global solar PV installations, UK installation costs had dropped by almost 50 per cent by 2012 (Balcombe et al. 2013). Pearce and Slade (2018) note that, since 2010, there have been 700 000 small-scale solar PV installations registered under the FIT scheme, and as of May 2019, there were over 13 GW of solar capacity installed in the UK, and more than 200 community renewable projects (BEIS 2019).

Compared to Germany, however, progress with respect to decentralised electricity system (DES) and CRE projects in the UK are lagging (Julian 2014; Strachan et al. 2015; Ćetković and Buzogány 2016). The current dominant support mechanism (RO) favours large-scale developments that are controlled by large power utilities (Ćetković and Buzogány 2016). The main barriers for CRE projects to succeed in the market are the overly complex regulations pertaining to electricity generation and marketing: considering that communities have limited resources compared to large-scale developers, they end up demanding efforts from individuals who are not experts in the field for projects' success in the market (Brummer 2018a).

Recently, however, there has been a significant change made to RE policies in the UK that will hugely impact the development of RE sources (IEA 2019), where Mirzania et al. (2019) acknowledge that in recent years, the UK's community energy sector has seen significant growth.

Over the years, the UK has experienced an increase in RE support, moving from RO to FIT, and more recently replacing the RO with a Contracts for Difference (CfD) auction scheme (Geddes et al. 2018; IEA 2019). Although government support has played an essential role by introducing different support mechanisms including subsidies and grants, the support has not been constant and recent policy uncertainty has not favoured CRE projects – particularly solar PV arrangements (Mirzania et al. 2019). In 2012, the solar PV FITs were reduced by half, thereby significantly impacting uptake of such systems by financially motivated communities (Balcombe et al. 2014). Thereafter, government was concerned about the cumulative cost of the scheme, and decided to cut the tariff by a further 65 per cent in early 2016, resulting in solar PV installations dropping by 75 per cent in early 2016 compared to the same period in 2015 (IEA 2019).

The impact of the policy has been proven by the decline in installations at the end of May 2019, when compared to the end of May 2018. There was a significant difference from a 21 per cent decline to a 68 per cent decline, which could be due to the FIT scheme being shuttered at the end of March 2019 (BEIS 2019). The DECC implemented the Renewable Obligations Closure Order in 2015, which stated that ROs to large-scale (>5MW) solar PV developers would cease as of 1 April 2015, meaning that recent changes in policy not only impacted small-scale installers, but large-scale developers as well. The changes in policy were enacted as a result of large-scale solar PVs being implemented at a rate faster than could be afforded. Due to policy changes that were previously supporting the growth of CRE, the UK is now faced with developmental challenges where some projects have not succeeded, and where those that are currently active are only just surviving (Mirzania et al. 2019). Because of the many changes in support mechanisms, the policy has great uncertainty among RE investors in the UK, and has reduced the attraction to invest in RE in the country. Within this context, investors are concerned that policy uncertainties may delay investment (Geddes et al. 2018; IEA 2019).

4.15.3 South Africa

The Renewable Energy Feed-in Tariff (REFIT) system was initially introduced by the National Energy Regulator of South Africa (NERSA) to allow for procurement of electricity from qualifying RE generators (DoE 2015). However, due to irregularities in the system, the REFIT mechanism was cancelled without having overseen a single project (Montmasson-Clair and Ryan 2014). Subsequently, the Department of Energy (DoE) introduced the Renewable

Energy Independent Power Producer Procurement Programme (REI4P) in August 2011 (Wlokas et al. 2012; Eberhard and Kåberger 2016; IRP 2010). Some believe that the programme has been a success, while others perceive it as flawed since it is mostly international companies that benefit from the ensuing projects. Furthermore, the programme has failed to deliver any meaningful socio-economic benefits (McDaid 2014).

The concept of civic engagement – including citizen participation and public-private partnerships – is promoted by many if not most post-apartheid policy documents in South Africa (Emmett 2000). However, community participation in RE projects is not encouraged by the current policy – only community benefits (IPP 2019).

4.15.3.1 Support mechanisms

The REI4P was introduced in order to procure clean RE from Independent Power Providers (IPPs) and to diversify the energy sector (IRP 2010; DoE 2015). Since the introduction of the policy, there has been a significant influx of IPPs in the country (Sewchurran and Davidson 2017). The REI4P is an extensive programme that is expected to deliver RE deployment from 2012 to 2030, and is aimed at installing approximately 18GW of electricity generated from renewables (biomass, solar, wind, hydropower, and biogas) (Walwyn and Brent 2015). Since the endorsement of the REI4P, South Africa has been providing the national grid with electricity produced through large-scale RE projects (Wlokas et al. 2017). Another support instrument is tax incentives (Section 12B of the Income Tax Act), which offer an accelerated capital allowance of 100 per cent depreciation allowance deductible in the first year of implementation for solar energy projects that are below 1MW (SARS 2016).

Compared to European countries where FITs have succeeded in promoting the dissemination of RE sources, the scheme has mostly failed to attract any significant investment from around Africa. Auctions have been more successful and have introduced the connections of thousands of megawatts to the grid at a cheaper price (Eberhard et al. 2016), and since the introduction of the procurement system, South Africa has seen an influx of RE projects (Sewchurran and Davidson 2017). At the moment South Africa is leading the continent in respect to investment in RE (Kruger and Eberhard 2018). Because of the procurement policy that targets large-scale developers, South Africa promotes community benefits, but there is no policy in place that supports CRE projects (IRP 2019). Community benefits are arranged as a legal measure to ensure that developers distribute the gains of projects to a given community/s (Burke and Stephens 2017). When projects are awarded, the companies are expected to contribute between 1 and 1.5 per cent of the project's profits to communities within a 50 km radius from where the projects are based (SAPVIA 2019).

Concerning small-scale developers – or small-scale embedded generation (SSEG) as it is referred to in South Africa – there is still some ambiguity about the regulations relating to these kinds of organisations (Rycroft 2019). There were previously no regulations requiring individuals or businesses to register any installations, meaning total solar PV capacity for own use is unknown (IRP 2019). More recently, any RE operation such as generation, transmission, or distribution has been required to register or apply for a licence with the NERSA (Rycroft 2019), the process of which involves three stages: registration, licensing, and ministerial determination (Rycroft 2019). Small-scale generators below 1MW are obligated to register, but do not require a ministerial decision. Installation with a capacity above 1MW but less than 10MW necessitates licensing, but not ministerial commitment. Installations above 10MW require a licence and a ministerial commitment (Rycroft 2019). The new IRP (2019) that allows small-scale embedded generation up to 200 MW per annum has recently been finalised (SAWEA 2019; IRP 2019).

4.15.3.2 Performance of support mechanisms

Since REI4P was introduced, followed by competitive bidding from rounds one to four, South Africa has procured 6 327 MW through the programme alone (Kruger and Eberhard 2018; Sewchurran and Davidson 2017). One technical adviser stated that the RE sector has grown to be a 'competitive and commoditised industry' (Power et al. 2016). The procurement programme has attracted US$19 billion of private investment (Eberhard and Kåberger 2016). When the REI4P was introduced, it was anticipated that a range of auctions would take place to increase competition and, over a period of time, increase the share of renewables. In the first round of the auction, there was limited interest, but companies offered more capacity than was required, resulting in prices being too close to the amount set or capped for the bid (Kruger and Eberhard 2018).

On the other hand, over the rounds introduced by the procurement system, the prices of solar and wind energy dropped by 71 per cent and 46 per cent (in nominal terms) respectively (Eberhard and Kåberger 2016). Of the 112 RE projects procured by the DoE through the procurement programme, 62 had been connected to the grid by December 2017 (Cloete 2018). The prices for solar and wind energy have fallen to as low as US$0.047/kWh for wind and US$0.064/kWh for solar, which are among the lowest in the world (Eberhard and Kåberger

2016). The success of the programme has been applauded as an international success, with prices being below the utility’s average cost of supply (Kruger and Eberhard 2018). However, the state utility has been a risk to the programme, refusing to sign the power purchase agreement (PPA) and leading to speculation about whether the program is sustainable (Van Rensburg 2016).

Although REI4P has been instrumental in driving the diversification of the energy industry- the programme requires IPPs to contribute to resources in order to address local socio-economic needs (Wlokas et al. 2017), and is commended for its success in the diffusion of renewable sources in South Africa (Eberhard et al. 2014), there are doubts about whether this policy contributes to socio-economic development (Wlokas et al. 2017) and small-scale RE development (Msimanga and Sebitosi 2014). REI4P is mandated to ensure that IPPs meet the criteria for socio-economic development and Black Economic Development (BEE). However, achieving this has been problematic because of the competitiveness of the industry: few developers are in a position to coordinate with each other to address issues of labour and socio-economic development (Power et al. 2016).

4.16 Conclusion

Overall, the literature addressed the transformation potential by deliberating on social aspects, developments in technology, and policy mechanisms that have been instrumental in promoting CRE projects. The above literature review has demonstrated that CRE projects have played an important role in diversifying the electricity sector. Important factors that must be considered when implementing CRE projects were also highlighted. Solar PV technologies have evidently advanced in the market, and have contributed to the diversification of the electricity sector in different countries. However, importantly, the implementation of policies to support the diffusion of solar PV sources and the promotion of local initiatives has been the most relevant aspect in the context of the current research. From the three case studies mentioned above – Germany, the UK, and South Africa – it has been shown that the FIT mechanism is the best policy in driving community solar projects.

CHAPTER FIVE:
THEORETICAL FRAMEWORKS

5.0 Introduction

The previous chapter of this text outlined the literature addressing the scope of the study. This chapter reviews the theoretical frameworks that inform the current study, and the essential factors guiding the research questions (Creswell and Creswell 2017). To understand system transformation dynamics, the present study adopts a particular theory of socio-technical transition – the MLP – that has contributed to assessing the role of protected niche spaces as ‘seedbeds of radical innovation’ (Seyfang et al. 2014:22).

According to Geels (2018), the MLP is a middle-range theory that has the potential of benefitting from the many crossovers with other approaches in the broader social sciences (Geels 2018). As such, this study also adopts social capital theory, which involves analysing the resources entrenched in a social structure, and the social relations that can be exploited in an envisioned situation to increase the chances of success (Lin 2003). These two theories were used to develop the framework that guides this research.

5.1 Theories concerning technological and societal perspectives

Several theoretical frameworks have been developed throughout history that provide a clear understanding of societal transitions. To understand the intricate processes involved, studies on transitions have primarily adopted ‘systems change’ theories. Examples of the latter include the Techno-Economic Paradigm (TEP), the Innovation System (IS), the socio-technical systems model, and, most recently, the MLP (Sarrica et al. 2016). This study is aware of other theoretical frameworks that could have been suitable for this study but were found lacking in rigour in terms of addressing the co-evolution of technology and societal factors prior to project development.

Theories considered from a technological perspective include the diffusion of innovation theory (DIT) (Rogers 1995), and the technology acceptance model (TAM) (Davis et al. 1989), which originate from the theory of reasoned action (TRA) (Fishbein and Ajzen 1975). The TAM and DIT theories are widely recognised when addressing the process of technology user acceptance (Viardot 2013). The TAM recognises that several factors can influence the behaviour and willingness of users who are introduced to a new technology. The model strives to extrapolate those external factors that could impact internal behaviour, and utilises the intentions of users to anticipate the acceptance and use of the technology concerned (Viardot 2013). DIT explores how individuals make decisions regarding technology, providing a framework for researchers and policymakers who are interested in how human energy use is impacted (Brewer and Stern 2005).

Other theories on socio-technical transitions that stem from the MLP include Transition Management (TM) – which involves creating space (financial, institutional, technological, and regulatory) for the development of social innovation (Frantzeskaki and Loorbach et al. 2010) – and Strategic Niche Management (SNM). The theory of TM aims to introduce and disseminate new sustainable technology through societal experiments (Caniëls and Romijn 2008). However, like other theories that were considered for the present study, the latter theories are more focused on technology than societal aspects – an observation that is supported by authors who criticise the SNM and TM theories for paying too much attention to technological aspects while overlooking the social factors behind innovation (de Haan and Rotmans 2011; Hielscher et al. 2013; Witkamp et al. 2011; Rauschmayer et al. 2015).

Previous studies have addressed social factors using social practice theory (Reckwitz 2002), social entrepreneurship theory (Dees 2001), and actor-network theory (ANT) (Callon 1999; Latour 1987). Social practise theory has been used by scholars to understand individuals' specific actions, and offers alternative clarification regarding a person's actions as separate from their behaviour (Maller 2012). Some studies have applied social entrepreneurship theories in order to develop an integrated approach that is more relevant to analysing bottom-up, small-scale energy initiatives (Becker et al. 2017), with social enterprise as a possible niche innovation (Hillman et al. 2018). ANT's purpose is to elucidate how diverse actors converge to form networks (Shim and Shin 2016) and to understand individuals and their interactions with inert objects (Cresswell et al. 2010). These theories, however, are only relevant to extant projects, and are not applicable to pending projects.

To understand the related factors of technology and society, some studies have integrated theories that concentrate on technology, with theories that address the social dimension. For instance, Tsai (2014) integrated social capital theory, social cognitive theory, and TAM to investigate the relationship between technological factors, social factors, and self-efficacy. A study by Chang et al. (2017) also integrates DOI, TAM, and social capital theory, and yet another study combines the MLP and discourse theory to address the agential and political character of transitions (Rosenbloom et al. 2016). Others explored integration between the MLP and practice theory (Seyfang and Gilbert-Squires 2019; Hargreaves et al. 2013; McMeekin and Southerton 2012).

Geels (2010) suggests that the MLP could utilise social movement theory (SMT) in order to assess conflict amongst established situations and groups, thereby rectifying injustices found in the system. However, Sarrica et al. (2016) note that, notwithstanding the existence of the crossovers between the MLP and micro-oriented theories (such as social construction theory, practice theory, and ANT), further development in the MLP were needed concerning interactions among individuals and shared levels. Although the models used in the abovementioned theories have yielded interesting results, they have not captured the co-evolution of technology and society to adequately understand the contribution of the social dimension. Additionally, the integration of the MLP and social capital theory to understand the social factors of transitioning to low-carbon energy has not been considered. As such, this study aims to understand the unfolding developments within technology and society by focusing on the niche (micro) level of the MLP.

5.2 Integration of the theories (the MLP and social capital theory)

The MLP has played a principal role in furthering the understanding of socio-technical transitions, specifically by providing a set of tools to illustrate the transitioning processes involved (Jørgensen 2012). However, since CRE is mainly interested in social innovations, the focus is placed on adopting new behaviours that consider how social groups are supported and managed, developing unique solutions for energy independence and modern production practices rather than creating a technological innovation (Dóci et al. 2015). To understand the dynamics and drivers of system-wide transitions, theories on sustainability have adopted a co-evolutionary approach to technological and social systems (Grin et al. 2010; Turnheim et al. 2015).

According to Smith et al. (2010), studies should focus on the niche level in order to elaborate on niche development as well as broader impact. Socio-technical transitions can offer insight into the elements that promote and inhibit the societal adoption of RE technologies (Papachristos 2011). The present study, therefore, adopts the theory of socio-technical transition (MLP) (Verbong and Geels 2010; Geels and Schot 2007), and social capital theory to focus on both the technology and social dimensions, rather than concentrating solely on green, niche innovations (Geels 2014; Strachan et al. 2015). This is an approach supported by Geels (2005a), who states that artifacts can only perform their functions through their interactions with social structures, human agency, and organisations. Another important aspect to note in a socio-technical system is the social resources, which are considered significant factors in the development and execution of CRE (und Polach et al. 2015). Geels et al. (2017) assert that understanding the co-evolution and alignment of technology and society offers an opportunity to uncover the differences inherent therein, and further acknowledges that socio-technical systems can be assessed at varying stages through different lenses (Geels 2018).

5.3 Socio-technical transitions

A socio-technical transition is regarded as a necessary step in the transformation of a socio-technical system (Geels and Schot 2010). In the current study, a transition is regarded as a change from one regime to the other – for instance, a system innovation (a shift from fossil fuels to a RE system) (Geels 2005a; Schneidewind and Augenstein 2012). A transition includes not only physical changes in organisation and infrastructure, but also drives a reformulation of values and norms (Schneidewind and Augenstein 2012). A transition is a multifaceted process that involves technological, organisational, socio-cultural, as well as institutional change and, in the process of a transition, various attributes – including regulations, new products, organisations norms, and consumer practises – develop to complement and/or substitute existing practices (Markard et al. 2016).

Transitions in the MLP are non-linear practices that result from the interplay of various developments at three analytical levels: the exogenous socio-technical landscape (Rip and Kemp 1998; Geels 2005a; Geels 2011); socio-technical regimes (the locus of rules and traditional activities); and niches (where radical innovation develops). Energy transitions are considered to be an extensive, long-term (50 to 100 years), and large-scale shift from one socio-technical regime system to another, that involves the interplay between regimes, landscapes and niche dynamics (Schot et al. 2016).

According to Verbong and Geels (2010), transitions occur when developments at all three stages intersect and support one another. That includes when: (1) a regime is forced to act based on pressure at the landscape level; (2) niche development builds up sufficient momentum; and (3) regime destabilisation or problems experienced create windows of opportunities (Geels and Schot 2007; Schot and Geels 2008; Geels 2018). Transitions occur as a result of the developments at the different levels and manners in which the levels support one another in creating windows of opportunity. For instance, landscape features will destabilise a regime, while the niches developed in protective spaces will gather momentum and influence the regime overall (Geels 2006). Markard et al. (2016) argue, however, that due to the considerable structuration of socio-technical systems, which includes material, institutional, and vested interests between incumbent actors, changes within a traditional system may encounter high degrees of resistance.

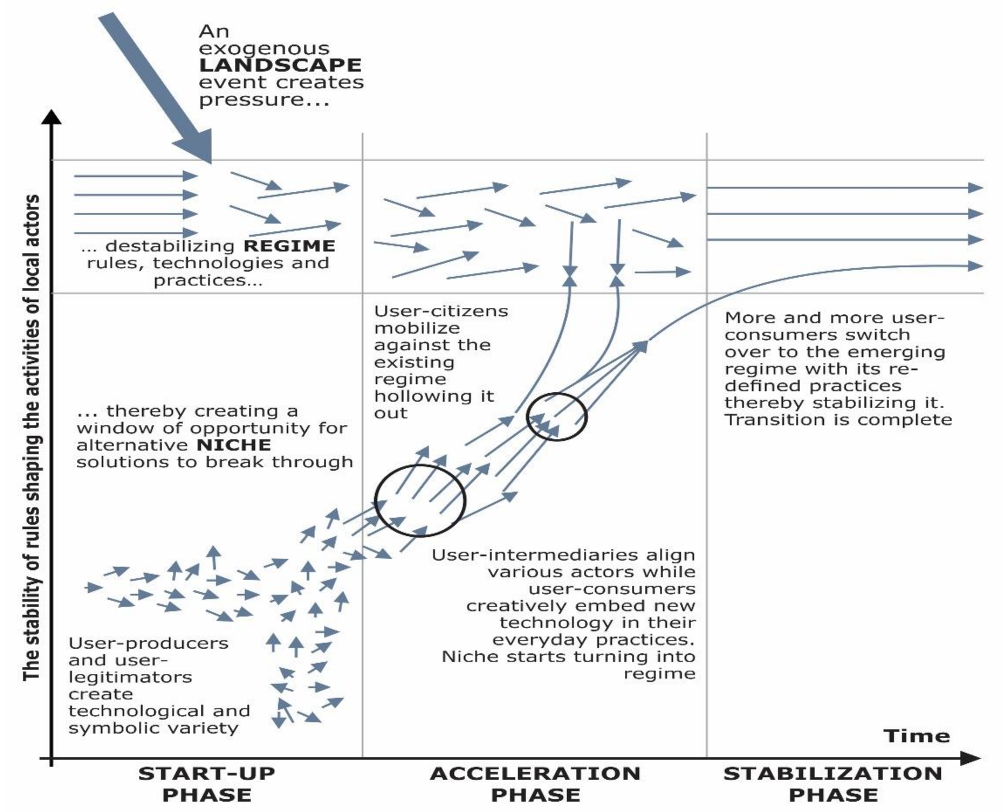
5.4 The multi-level perspective (MLP)

The MLP (Geels 2002; Geels 2004; Schot and Geels 2008; Geels 2011) is a useful framework applied to gain an understanding of socio-technical transitions. According to Whitmarsh (2012), the MLP framework provides a unifying, system-wide view, which is most suitable for the multifaceted difficulties encountered alongside unsustainability. What is appealing about the MLP for sustainability research is its treatment of the dynamics of large-scale socio-technical systems, which continue to expose the sustainability challenges presented by the current energy system (Elzen et al. 2004).

As mentioned above, the MLP is shaped by three analytical levels: the socio-technical landscape, the socio-technical regime, and socio-technical niche (Geels 2010), the latter of which is characterised as a nested hierarchy within the structuring process (Geels and Schot 2007; Verbong and Geels 2010). The MLP is instrumental in understanding observations of stability at the regime level, and surges of change in activities at the niche level (Geels 2007). Accordingly, Baker et al. (2014:795) argue that, "as a framework, the MLP is concerned with the way in which incumbent regimes lose stability and thereby undergo transitions as a result of coordinated pressures from the niche and landscape levels." As shown in Figure 5.1 below, transitions occur as a result of landscape pressure destabilising the regime, which in turn promotes social experiments by user-producers. The regime usually remains challenged when moving into the acceleration phase, and the user-producer will build momentum and increase the stability and size of their operation. The stabilisation phase will see user practices being re-focused, resulting in newly acquired behaviours and habits of several user-consumers (Schot et al. 2016).

Geels (2002) asserts that an essential aspect of the MLP is that technological development is not only influenced because of events within the niche, but it is also shaped by the developments at the socio-technical landscape and the regime levels. The MLP has, in recent years, been utilised to study the transition potential of CRE using the constructs for technological innovations, although strictly from a social aspect (Dóci et al. 2015). To understand both the technological and social niches together, the MLP framework will aid in this current study's goal of identifying and explaining socio-technical transitions, and furthering current understandings of how innovations can develop and influence regimes to move toward sustainability (Dóci et al. 2015).

Figure 5.1: User roles and transition dynamics



Source: Adapted from Schot et al. (2016:5)

5.4.1 Socio-technical regimes

Regimes are extant dominant institutional structures that ensure stability is maintained in a set system (Smink et al. 2015). Regimes are determined by path dependency and lock-in systems, which result from stabilising mechanisms: for instance, sunk investments, vested interests, organisational capital, and firm beliefs (Verbong and Geels 2010). Regimes are not considered merely as bodies of rules and institutions, but rather as structured representatives in the political arena (Hess 2014). The current Western system of energy production is characterised by nuclear power plants, and large fossil fuel transmission and distribution grids, and energy-intensive practices (Schot et al. 2016). It is a case wherein the expansion of innovation alternatives is hindered by sunk investment in artefacts, regulation, the stability of existing infrastructure, cognitive and normative rules, and interdependency between actors and material networks (Schot and Geels 2008).

Regimes are characterised as being stable and exhibit path dependency and technological lock-in, and, therefore, will only employ incremental developments in improving sustainability performance (Seyfang et al. 2014). Set regimes also only change in response to pressure at the micro-level (bottom-up developments), from internal conflicts within the system, and when external pressures are exerted. They range from being self-protective and seeking to discredit other actors, to employing only reactive approaches to improving their system, or – at the other end of the spectrum – may find ways to contribute actively to transitions (Rotmans et al. 2001).

5.4.2 Socio-technical landscapes

The macro-level of the MLP is shaped by the socio-technical landscape, which denotes the exogenous environment, and impacts socio-technical development (for example, environmental issues, globalisation, and cultural change) (Geels 2005b). Changes at this level are slow and are influenced by dynamics at the niche and regime levels (Verbong and Geels 2010). Landscape factors are characterised by concerns over energy security, government commitment to emission reduction targets, public knowledge about climate change, the need to liberalise the energy system, factors impacting external supplies (for example, terrorism, war, foreign government limiting supply), concerns about fuel poverty and affordability, and changes in financial and economic institutions (Foxon et al. 2010). As times change, shifts in the regime can occur as a result of niches taking advantage of windows of opportunity created by landscape pressure (Markard et al. 2012). It can be reasoned that socio-technical landscape changes pressure governments to reform their policies to increase the share of renewable energy (Verbong and Geels 2010).

5.4.3 Socio-technical niches

Technological niches form the micro-level: the locus where radical innovations develop. Based on their low competitiveness, niches arise in ‘protected spaces’, which shield them from mainstream market determinations (Verbong and Geels 2010). Technological niches usually consist of small networks of actors who study novel technologies and their effects (Swilling et al. 2016); although innovators working on novelty technologies will be restricted to those such as nascent market niches and research and development (R&D) projects (Verbong and Geels 2010). A restriction occurs when the existing regime is stabilised, which creates the challenge for novel technologies to break into a market (Verbong and Geels 2010). However, decentralised energy system is one example of a niche that is able to challenge regimes (Schot et al. 2016); because protection is provided by 'small networks of actors' who are willing to invest in developing new technologies (Verbong and Geels 2010).

Niches play an essential role in offering locations for learning processes, where these learning processes are derived from many dimensions, including regulations, technology, infrastructure, and user preferences (Geels 2005b). Although niche development plays an important role, on its own, it is inadequate for the diffusion of practices and innovative ideas (Seyfang et al. 2013). Dóci et al. (2015) argue that niches differ regarding the actors involved and purpose for existence.

They differ in the sense that market niches aim to create and develop new technologies – ultimately for use within the regime, whereas social niches are created to address particular needs that the incumbent regime fails to fulfil. When developments are ongoing at the regime and landscape levels, a 'window of opportunity' is created that – through a process of radical innovations and niche build-ups – can transfer from the niche to the regime level (bottom-up) (Geels 2002).

5.5 Transition pathways in low-carbon transitions

The notion of 'pathways' is being employed to structure the challenges of transitioning to low carbon societies (Rosenbloom 2017). Transition pathways are highlighted as they allow for improved understanding of the socio-technical system in the way that it captures the transition process and allows for possible interventions to be identified (Turnheim et al. 2015). Several scholars studying the complicated issues of low-carbon transitions have shown interest in transition pathways (Foxon et al. 2010; Turnheim et al. 2015; Geels et al. 2016; Rosenbloom 2017).

The term 'pathway', broadly defined, means either: (1) 'a path which you can take'; or (2) a particular course of action or a way of achieving something (Collins 2018). Transition pathways, on the other hand, are defined as "patterns of changes in socio-technical systems unfolding over time that lead to new ways of achieving specific societal functions" (Turnheim et al. 2015:240). Although pathways have been used in broader ways, they all point to the general qualities that resemble movement and change from one aspect to another (Rosenbloom 2017).

Rosenbloom (2017) identifies three core conceptions of pathways when considering low-carbon transitions, which are founded upon differing dynamics and perspectives. These three conceptions include: (1) *biophysical pathways* – which are rooted in the climate science research constituency and consider pathways as lengthy approaches to addressing GHG emissions; (2) *techno-economic pathways* – which are connected to notions based in economics and technology, which evaluate pathways as processes of techno-economic modifications that connect current changes in the sector to suitable low-carbon future states; and (3) *socio-technical pathways* – pathways within the socio-technical research perspective that are considered to be developments of schemas of patterns of changes in socio-technical systems as they prepare to encounter human needs in an alternative energy environment. According to Verbong and Geels (2010), the socio-technical pathway aims to interlock technical and social patterns of change within the system to ensure that a societal function is met (e.g., provision of electricity).

The present study considers the socio-technical pathway, which could potentially transform the electricity sector in South Africa. This study's focus on socio-technical pathways helps to unravel the dynamics of technological development and social resources during transitions to low-carbon energy. This study locates niches as complex systems where social and technological innovations co-evolve, where, during the process of transition, the entire niche connects with the regime (Dóci et al. 2015).

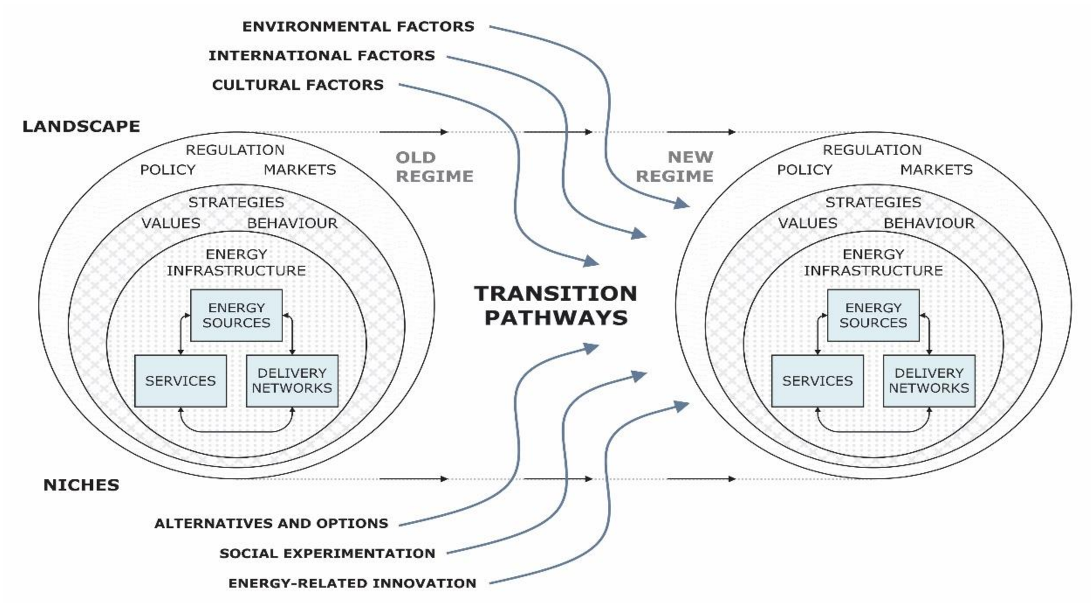
5.5.1 Transition potential

There is an ongoing debate among researchers over the potential pathways that achieve desirous goals when considering that a socio-technical system guides the process (Smith and Stirling 2008). To assess the transformative potential, based on progress made with technology, the study at hand adopts the four proxies of technological innovations introduced by Geels and Schot (2007) to assess whether the niche innovations present are in a position to breakthrough. These proxies are significant to this study in terms of addressing the progresses within technology as previously used to assess transformation potential (Dóci et al. 2015), and include: 'learning has stabilised', 'price/performance', 'scale (market share)', and 'support network'

(Geels and Schot 2007). Since this study aims to assess the co-evolution of technology and society, it explores the crossovers between the MLP and social capital theory.

To fully explore transition potential, the three elements that are instrumental to transition – society, technology, and policy – have been integrated by borrowing from the MLP, and by applying features from technological innovations. As shown in Figure 5.2 below, Foxon et al. (2010) have established the critical aspects of the current regime and identified the primary factors that prompt the dynamics of stability and change, where the shaded features illustrate the different configurations at the beginning and the end of the transition in question. In this way, the figure details the current decision-making processes followed by stakeholders, policymakers, and industry partners (Foxon et al. 2010). This study focuses on the niche level (both technological and societal) to understand the future potential energy transitions that originate from the niche level, to inform policymakers and stakeholders.

Figure 5.2: Transformation potential and essential factors that influence the pathways



Source: Adapted from Foxon et al. (2010:1206)

5.6 Criticisms of the MLP

Despite the MLP's ability to conceptualise socio-technical transitions, the framework has received its fair share of criticism from several scholars (Markard and Truffer 2008; Smith et al. 2010; Geels 2010; Kern 2012). Of particular concern to this study, the MLP has been subject to criticism saying that it pays too much attention to technology, and overlooks the importance of cultural and social aspects (Geels 2005a). Other researchers have criticised the MLP for acknowledging innovations only insofar as their inclusion of technical artefacts, not accounting for options such as social and grassroots innovations (Seyfang et al. 2010). Scholars do acknowledge that efforts have been made to address other aspects relating to power, cultural dimensions, and civil society, especially to appreciate agency (Geels 2011; Geels and Verhees 2011). Some studies do acknowledge and address agency specifically, but it has been noted that other types of agency warrant further investigation (Rosenbloom et al. 2016).

A handful of researchers have criticised the MLP for not adequately emphasising the role that powerful actors play in transitions, due to the MLP's foundation being based on a systems perspective and focusing on change from the niches (bottom-up) (Späth et al. 2016). The MLP has also received criticism for not concentrating on the role and scale of collective actors (Geels 2011; 2014), which includes the market, state, third sector, and community, including actors within various categories (organisational actors, sectors, and individual actors) (Avelino and Wittmayer 2016). Several studies have been conducted to address these criticisms (Geels 2011; Geels and Schot 2007; Avelino and Wittmayer 2016), though these were concentrated on reviewing perspectives in developed countries (Hess 2014; Geels 2014).

Despite all the criticisms attached to the MLP, it has continued to capture the interest of scholars as they unpack issues concerning the interactions between niches and regimes, relations between the conceptual levels, the definitions of boundaries, and the empirical operationalisation of concepts (Geels 2012). The MLP also serves as a powerful tool for policymakers to guide transitions effectively and efficiently by focusing on niches and regimes (Geels 2012). This study considers the above criticisms and thus concentrates on both the technological and social aspects, especially by utilising social capital theory to understand the latter.

Regardless of the above criticisms, as the world is becoming increasingly concerned about sustainable development, so too does the demand increase for innovations to achieve specific sustainable transitions – making the needs to transition from lock-in, path dependence, and to transform socio-technical regimes, a key priority (Smith et al. 2010). The MLP offers a structure that enables social actors to understand socio-technical constituencies and deliver apparatuses to potentially identify change that results from innovations (Jørgensen 2012).

5.7 Social Capital Theory

The social capital theory is accepted as a valid theoretical lens for analysing social relations and norms entrenched in the social structures of communities (Narayan and Cassidy 2001). The concept of social capital was introduced by Bourdieu in 1983 and later Coleman in 1988 (Telusiewicz-Pacak 2017); in 2000, Putman expanded the work of Coleman (Pramanik et al. 2019). Putman's work moved social capital from being a theory that was overly specialised and not widely used, to a place where it experienced remarkable progress in the 1990s (Putnam 1993; 1995; 1996; 1998; 2000), becoming popularised and integrated into community development theory and practice (Jones 2010).

Coleman considers social capital to be comprised of two characteristics: the component of social structure, and the activities of individuals (Coleman 1988). Bourdieu (1986), on the other hand, used social capital theory to evaluate how classes are formulated and divided. Bourdieu and Wacquant (1992:119) argue that "social capital is the sum of the resources, actual or virtual, that accrue to an individual or a group by virtue of possessing a durable network of more or less institutionalised relationships of mutual acquaintance and recognition." Putnam (2016) defines social capital as the characteristics of a social corporation being composed of norms, networks, and social trust that coordinates and allows for co-operation between members for mutual benefit.

All things considered, the fundamental tenet of social capital lies in a modest, straightforward explanation, which involves investing in a community and expecting something in return (Lin 2017). Despite all the definitions of social capital outlined above, researchers agree that social capital mainly focuses on the relationship the society is able to build among people within a community (Tsai 2014). Most importantly, Tsai (2014) notes that social capital concentrates on the capabilities of individuals within a given setting, and their relationships with others.

The concept of social capital has some resonance in South Africa and is seen to be applied to the traditional norms of teamwork: '*ubuntu*', an expression of 'humanness', meaning 'I am who I am because you exist' (Bayat 2005). Current African scholarship argues that, compared to Western epistemology which foregrounds individuality before community, African epistemology prioritises society, where individuality is a secondary consideration (Battle 2000). Desmond Tutu conceptualised the philosophy behind ubuntu when he declared:

> "No real human being ... can be absolutely self-sufficient. Such a person would be subhuman. We belong therefore in a network of delicate relationships of interdependence. It is marvellous to know that one who has been nurtured in a loving, affirming, accepting family tends to be loving, affirming and accepting of others in his or her turn. We do need other people, and they help to form us in a profound way" (Battle 2000:179).

Throughout Africa, particularly in Southern Africa, the Bantu languages of the Eastern and Central regions view the concept of *ubuntu* and what it means to be human in different ways. Those that have adopted the concept of *ubuntu* strive to maintain good relationships in their society and place a high value on communal life (Murithi 2009). Social capital theory, which is conceptually close to the latter, contributes to this study since it seeks to understand the perceptions of the public and experts regarding the potential for CRE, based on social resources in communities.

5.8 Studies using social capital theory

Green and Haines (2015) note that there are seven types of community capital: physical, human, environmental, political, financial, cultural, and social. These authors recognise the importance of investment in these capital resources to yield higher returns on quality of life in communities (Green and Haines 2015). The current study uses social capital theory to expand the research's applicability to transition potential. Although social capital has been academically neglected as a critical component for the success of grassroots projects in the past, in more recent years it is considered in social science literature to play an important role in contributing to climate change mitigation strategies (Wolf et al. 2010; Clark and Semmahasak 2013; Jones and Clark 2013; 2014) and sustainable development (Devine-Wright et al. 2012).

The social capital theory has also recently been used in sustainability studies. Wentink et al. (2018), analyse how social capital plays a role in the formation, realisation, and success of urban citizen initiatives, and deduce that social capital was a key criterion in the success of community initiatives (Wentink et al. 2018). Additionally, Bauwens and Defourny (2017) have contributed to the theory of social capital by studying two co-operatives and assessing how social capital differed between the two organisations with the same benefits.

5.9 Measurement of social capital

Understanding potential resources within a particular society is critical in identifying foundational relationships, whether regarding an individual or a corporation (Nahapiet and Ghoshal 2000). The constructs identified by Jones (2010) are instrumental to the current study in investigating such resources and relationships. Jones (2010) defines social capital as a complex concept comprised of four elements: 1) social/interpersonal trust (trust among individuals); 2) institutional trust (confidence in organisations including government and renewable energy developers); 3) participation (in community activities and networking); and 4) social norms and values (compliance with social norms).

Apart from the above measurements, the current research proposes the addition of social identity (connectedness), and perceived social benefits and costs, in order to assess connections with community members' acceptance (Jones and Clarke 2014). Wentink et al. (2018) assert that connectedness is a necessary component in the success of initiatives. Jones and Clark (2014) reason that, because of the subjective nature of the constructs, it could be argued that the level of cost and benefits is directly linked to levels of social capital within communities. Evidence has shown that social benefits and costs are associated with levels of social capital (Jones 2010), where McMichael (2007) asserts that social capital essentially refers to the resources present through social norms, reciprocity, associated levels of trust, and networks.

5.10 Conceptualisation of social capital constructs

5.10.1 Participation

To develop communities and improve the quality of the lives therein, there is a need for participation and involvement from the local citizens (Green and Haines 2015). Citizen participation involves citizens playing a role in the decision-making process for programs, institutions, and the surroundings they occupy (Kalkbrenner and Roosen 2016). Tsai (2014) notes that a higher level of social participation improves the frequency at which community members became involved in other related initiatives.

5.10.2 Social trust

According to Newton et al. (2018), trust between citizens enables compromise, lessens social conflict, and improves co-operative relations. Studies have shown that social trust is the glue that binds society together, the oil that makes the operation flow seamlessly, and is linked to happiness, health, sense of belonging, long-life, and prosperity (Newton et al. 2018). Some researchers have argued that trust is dependent on familiarity and proximity to a person, while others have reasoned that unknown people with demographic similarities such as class, language, sex, ethnicity, and the appearance of status can form trusting relationships (Zmerli and Newton 2017).

5.10.3 Institutional trust

Trust in institutions is dependent upon their competence, legitimacy, and their ability to deliver on assigned responsibilities (Khodyakov 2007). Therefore, the effective functioning of an institution will increase the level of trust in that particular institution (Parry 1976). According to Parry (1976), institutional trust is more reliant on the performance of institutions than on the level of participation in civil society when determining the overall level of societal trust. In modern society, as a result of institutions' central potential to provide people with the means of attaining goals, trust in institutions is considered to be more significant than interpersonal trust (Khodyakov 2007). Therefore, trust is crucial for a successful relationship as both parties recognise the importance of a working relationship in achieving desired goals (Khodyakov 2007).

5.10.4 Social identity

Tajfel (1978) introduces the idea of social identity in reasoning how individuals perceive their self-worth among communities, and how a system of social standing can define and construct one's place in society. Social identity or connectedness is defined as an individual's belief in themselves, which is constructed from their knowledge of being a member in a social group or groups, combined with the emotional significance and values associated with being part of that group (Tajfel 2010). Social groups, whether organised as small, task-oriented teams, or large demographic structures, enable members to possess a shared identity that determines and defines their beliefs, identity, and behaviour (Hogg 2016).

5.10.5 Social norms:

Ajzen (2005) defines social norms as the way an individual perceives pressure to enact the actions performed by others. Young (2015) notes that social norms are self-imposed behaviours in a group or society, whereby all individuals are expected to conform or comply.

Scholderer and Veflen (2019) state that social norms are considered to be appropriate behaviours acted out in particular social contexts. According to Bicchieri (2005), a social norm is apparent when society expects people in their reference group to behave in a prescribed manner.

5.10.6 Perceived benefits:

Zhao et al. (2017) define perceived benefits as the egoistic personal gains that can be recognised by an individual, where, according to Seigo et al. (2014), perceived benefits include all the possible benefits that a public will receive from a proposed technology, including personal, environmental, and social benefits. Leclercq-Vandelannoitte (2015) indicates that consumers assess the effectiveness of a technology based on its perceived costs, benefits, and risks, where Kim et al. (2008) maintain that consumers only adopt products if the perceived benefits outweigh the perceived costs.

5.10.7 Perceived costs:

Perceived costs do not only pertain to financial costs – which could be endured by an individual or society – but also psychological costs that include effort (Seigo et al. 2014) and time (Parry ad Sarma 2019). Financial costs include the price of the product, user customisation and training, and product setup expenses; whereas time costs consist of the time invested in learning to use a new product, and the time spent in setting up a new product (Parry and Sarma 2019).

5.11 The integration of social capital and renewable energy

A limited number of studies have evaluated the question of whether social capital and energy could be connected (Aune et al. 2002; und Polach et al. 2015; Bauwens and Defourny 2017). Even fewer theoretical and empirical studies have connected social capital to climate change, sustainability, and the environment (McMichael 2007), and connected RE to social capital (Walker et al. 2010b).

Accordingly, one of the objectives of the current study is to integrate the theoretical perspective of the MLP and social capital theory to develop and empirically examine the correlation between technological developments, and the behavioural model of residents in an urban area of Johannesburg. Pargal et al. (2002) assert that social capital constructs are a useful measure of success when intervening in various social and public good-oriented projects.

5.12 Criticisms of social capital theory

Similarly to the MLP, social capital theory has received a fair share of criticism regarding its applicability. For instance, Fine (2002) argues that the theory is ambiguous and muddled, and can be used to extrapolate to any resolve (pre-chosen or not); in response, McMichael (2007) asserts that, in social capital research, researchers must ensure accuracy in the classifications and measurements used to appreciate values, ensuring that a defensible and supported argument is presented. Cresswell et al. (2010) also highlight the challenges researchers face when handling multiplicities and unsteady realities, as well as when trying to achieve a balance between the focus of the research, the various possible realities, and the differences, all of which can obscure extant complex relationships.

Regarding the use of social capital theory in the current study, as Portes (1998 p:2) so succinctly notes:

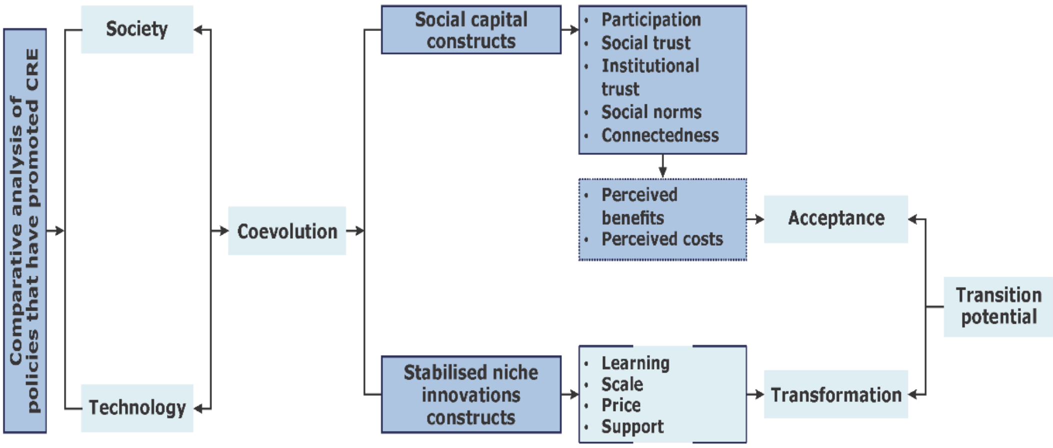
> ‘‘The novelty and heuristic power of social capital come from two sources. First, the concept focuses attention on the positive consequences of sociability while putting aside its less attractive features. Second, it places those positive consequences in the framework of a broader discussion of social capital and calls attention to how such nonmonetary forms can be important sources of power and influence …’’

This study leverages the opportunities presented by this theory to understand the social aspects of potential transformation in South Africa’s electricity sector.

5.13 Strengths of the approach, and the integration of theories used in this study

Geels (2010) argues that transition research contributes to researchers being open to undiscovered fields of study. Researchers have used transition theory in various disciplines to advance transitional thinking in conjunction with the methods and ideas from those disciplines (see Geels et al. 2018; Geels et al. 2016; Rosenbloom 2017). Such an approach demonstrates that transition scholars are not confined to their own academic territories, but are open to interdisciplinary research (Lachman 2013). The research questions proposed by the present study are answered according to the categorisation depicted in Figure 5.3 below. This framework is used to analyse empirical questions on society, utilises secondary sources to understand the progress in technology, and to analyse policies that have been instrumental in promoting CRE in Germany, the UK, and South Africa.

Figure 5.3: The three interconnected analytical dimensions of the current research



Source: Author-generated, based on the co-evolution of technology and society; see Geels (2005); social capital theory – Coleman (2002), and proxies for stabilised niche innovations – Geels and Schot (2007).

5.14 Conceptualisation of technological innovations

Research by Geels and Schot (2007:400) proposes the following proxies: (1) learning has stabilised in the dominant market; (2) powerful actors have joined the support network; (3) price/performance improvements, where there are strong expectations for continued improvement; and (4) the innovation is used in market niches, which cumulatively amount to more than 5 per cent market share. A similar study approach is also employed by Dóci et al. (2015).

According to Geels and Schot (2007), a transition occurs when there is an interaction between processes at three levels: (1) internal momentum is built in niche innovations through price/performance improvements, learning processes, and support from influential groups; (2) changes presented at the landscape level apply pressure to the regime; and (3) windows of opportunity are created for niche innovations by regime destabilisation.

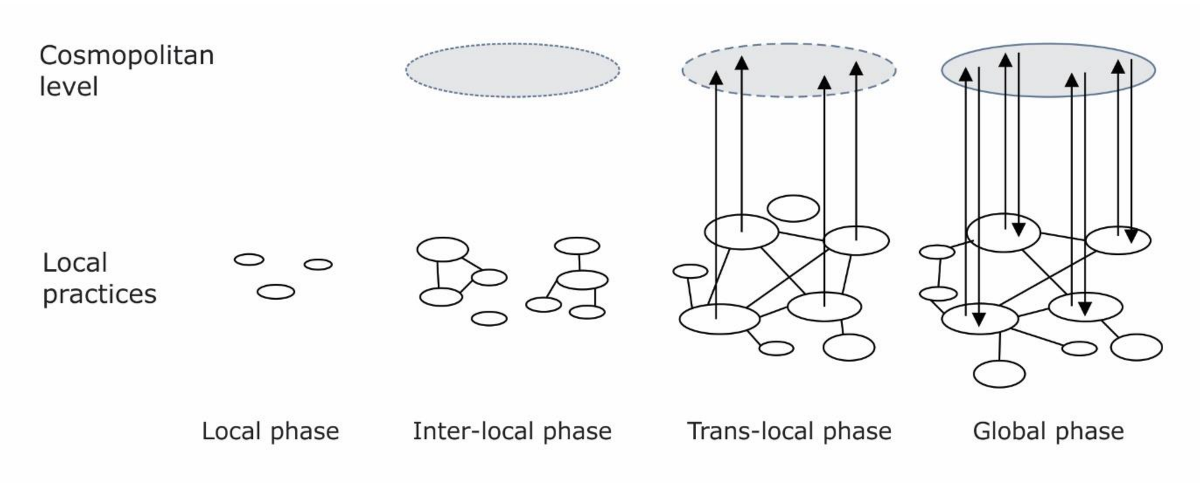
5.14.1 Learning has stabilised in the dominant market

In order for innovative ideas and practices to spread, developing niches is considered a crucial aspect (Seyfang et al. 2014). Niches play an important part by allowing space for learning processes to occur, for example, learning on the job, learning by interacting, or learning by using (Geels 2002; Berka and Creamer 2018). However, in this case, there is a range of expertise required at the different stages of production and installation of solar PV sources that are needed for stabilisation to occur (Jaegersberg and Ure 2011).

Studies on solar PV sources reiterate the requirement for skills and deployment-specific knowledge that covers acceptance and adaptation of the technology (for example, technology selection, procurement, implementation, design, installation, and use) together with administrative procedures, which include land-use planning and permitting (Neij et al. 2017). According to Seyfang et al. (2014), if communities are to succeed in growing their projects, it is necessary to have ‘soft’ or ‘people’ skills – which are often considered to be of equal value to technical skills – to ensure that they overcome challenges, become persistent, and build determination. Additionally, personal and emotional support is needed to support a project, especially if plans are altered, thereby ensuring that projects can continue.

Geels and Deuten (2006) identify four stages in the development of shared technological knowledge: (1) *local phase* – in this phase, knowledge starts and continues at the local level; (2) *inter-local phase* – this involves organisations building networks to support their technology, where information pertaining to that technology is circulated within alliances, networks, and supplier-producer relations; (3) *trans-local phase* – this stage involves knowledge production and circulation but is expanded beyond specific local practices to the field as a whole (for example, articles and handbooks); (4) *global phase* – this last step occurs when standardisation and institutionalisation establish dominant cognitive rules, and comprehensive knowledge is standardised in guides, standards, codes, and textbooks producing a shared knowledge pool. Figure 5.4 below illustrates this model.

Figure 5.4: Stages in the development of shared technological knowledge



Source: Geels and Deuten (2006: 269)

Strategic niche management (SNM) explores experiments in protected niche spaces that offer an opportunity to learn and empower sustainable technologies (Raven et al. 2008; Heiskanen et al. 2015). When considering learning associated with the development of RE sources, consideration should be given to learning by different actors at varying levels – firms and organisations, individuals, inter-organisational networks, and shared learning (Neij et al. 2017). According to Dyball et al. (2007), when considering learning from a social perspective, the procedure for participation and involvement can be considered as single, double, and triple-loop learning.

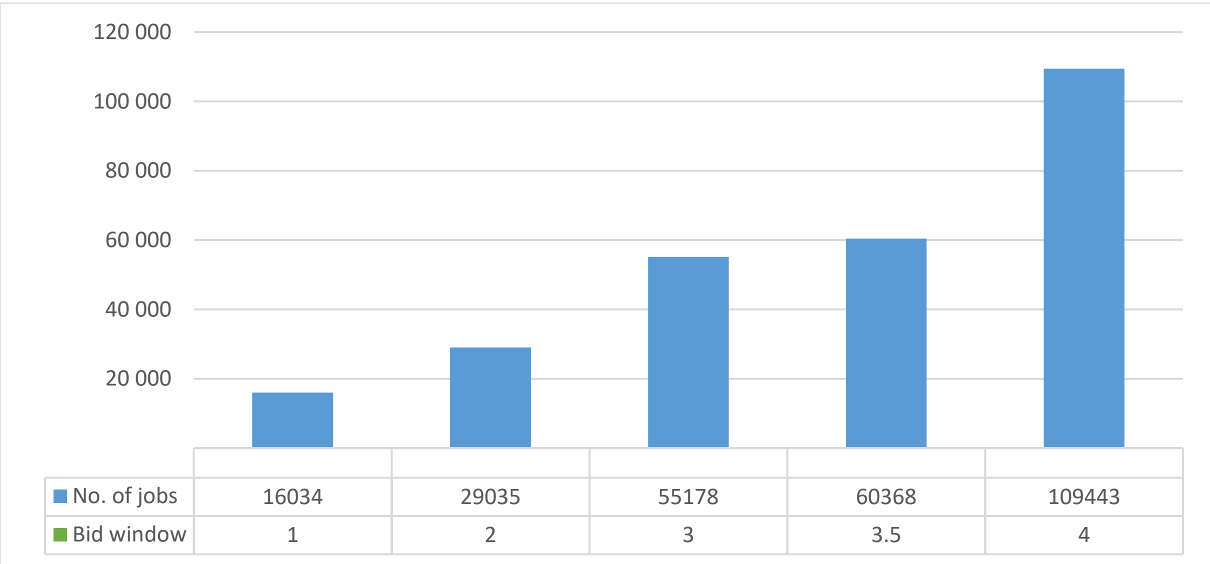
For instance, Schot et al. (2016) note that niche development, like network building, is encouraged by 'broad and deep' learning, where broad learning implies that the focus is not only on technology, but also regulatory barriers, social impacts, user preferences, and other factors. 'Deep learning' is referred to as 'double-loop' learning, where niche actors are encouraged to question their underlying assumptions regarding energy demands and consumption practices, which is unlike 'single-loop' learning that does not consider uses but rather tests new technologies against assumptions (Schot et al. 2016). Scholars argue that deep learning is a requirement for transitioning to low-carbon and sustainable energy systems (Schot et al. 2016).

Learning is actively occurring in the solar PV market, as is illustrated by employment and deployment performance: significant increases in the number of people employed in the

RE industry and the training offered by various organisations have been noted (IRENA 2018). In 2017, solar PV energy constituted the largest employer in the RE sector, in part due to the increased installations of solar PVs compared to other sources of renewable energy (IRENA 2018). There were approximately 10.3 million people employed directly and indirectly in the sector (IRENA 2018). According to Francis (2018), South Africa does not lack research and development potential, which could open up doors to manufacturing facilities and job creation. However, the head of energy research at the Council for Scientific and Industrial Research (CSIR) stated that the current emphasis is on taking advantage of the global value chain.

There are several institutions training individuals in solar PV installation in South Africa and, as such, the South African Photovoltaic Industry Association (SAPVIA) introduced the ‘Green Card’. Companies awarded Green Card status ensure the competency of their design and installations of solar panels, and that they have undergone all necessary training and proven to be capable (SAPVIA 2019). The REIPPP programme is projected to create approximately 109 443 cumulative job opportunities for South Africans in the construction and operational stages, as illustrated in Figure 5.5 below (DoE 2015).

Figure 5.5: Cumulative RE employment opportunities



Source: DoE (2015)

5.14.2 Support from regime actors and institutions

Geels and Schot (2007) assert that, in order to examine the transition potential of a niche, it is crucial to investigate the capacity held within the niche, and the strength of their ability to network and build relations with sub-regimes, gaining support in return (for example, from financial institutions or policymakers). The quantity and strength of associations that a niche can establish regarding information exchange, financial support, political lobbying, and education improves its position in the regime, and its chances at a successful transition (Dóci et al. 2015). The investments, policies, and support for RE research that various governmental and non-governmental organisations have contributed in building a solid foundation for the development of solar PV-powered systems (Kabir et al. 2018).

According to Rycroft (2019), there is no shortage of accessible finance for solar projects in the form of project finance or personal loans in South Africa. However, single, high-value projects are experiencing difficulties in securing funding because institutions prefer to fund pipeline or portfolios comprised of several projects. Luckily, regarding small projects, clients can incorporate the cost of solar panels into their existing home loans or arrange to apply for direct lending. The Development Bank of Southern Africa (DBSA) has allocated approximately US$300 million (about ZAR4.2 billion) to finance distributed electricity generation in the range of 1 to 10 MW in South Africa, pending the outcome and finalisation of the new IRP 2019 (Rycroft 2019).

Additionally, Msimanga and Sebitosi (2014) highlight several funding mechanisms are available to support project development and manufacturing facilities:

- The Industrial Development Corporation’s (IDC) Green Energy Efficiency Fund offers loans at a prime of less than 2 per cent;
- The IDC Gro-E Scheme offers equity financing and loans at prime rates less than 3 per cent;
- The Global Environmental Facility (GEF) offers various financial investments including capacity building and small grants;
- The Clean Development Mechanism (CDM) allows for the registration of various renewable energy technologies, which can generate carbon credits;
- The South African-German Energy Programme (SAGEN) offers grants to improve investment in renewable energy technologies and energy efficiencies;
- The DoE and the World Bank initiated the Renewable Energy Market Transformation Project to offer pre-investment grant finance and develop policy and legal frameworks;
- The Green Fund has been established to support green initiatives in South Africa.

In the last three bidding rounds, the IDC has funded 22 local ownership components of various projects, and the Department of Economic Development, Environmental Affairs and Tourism (DEDEAT) has proven to be hands-on in ensuring a positive environment for the REIPPP projects (DEDEAT 2014).

5.14.3 Price of solar power drastically decreased

Until recently, solar PV electricity could not compete in price with traditional electricity generated from fossil fuels. However, demand and installations of solar PV systems have increased drastically, contributing to a reduction of costs (Comello and Reichelstein 2017; Rode and Weber 2016). Germany has managed to reach grid parity with solar energy, meaning that consumers can utilise solar PV to produce their electricity at the same cost as the retail rate of electricity from the grid (Breyer and Gerlach 2013; Spertino et al. 2014; Fraunhofer 2015). The levelised cost of solar PV sources was reduced by 73 per cent between 2010 and 2017 (IRENA 2018).

The same pattern applies in South Africa: as shown in Table 5.1 below, solar PV prices have decreased in price by 75 per cent since the first round of the procurement process, which began in 2013 (Bronkhorst et al. 2017). As mentioned earlier, the prices have fallen to settle among some of the lowest in the world, with wind at US$0.047/kWh and solar prices being as low as US$0.064/kWh (in nominal local currency terms) (Eberhard and Kåberger 2016). The set goals to increase the share of RE sources is no longer unrealistic as the price of solar panels are increasingly falling as their efficiency improves, making PV much more competitive when compared to conventional power generation (Brummer 2018b).

Table 5.1: Procurement prices according to rounds

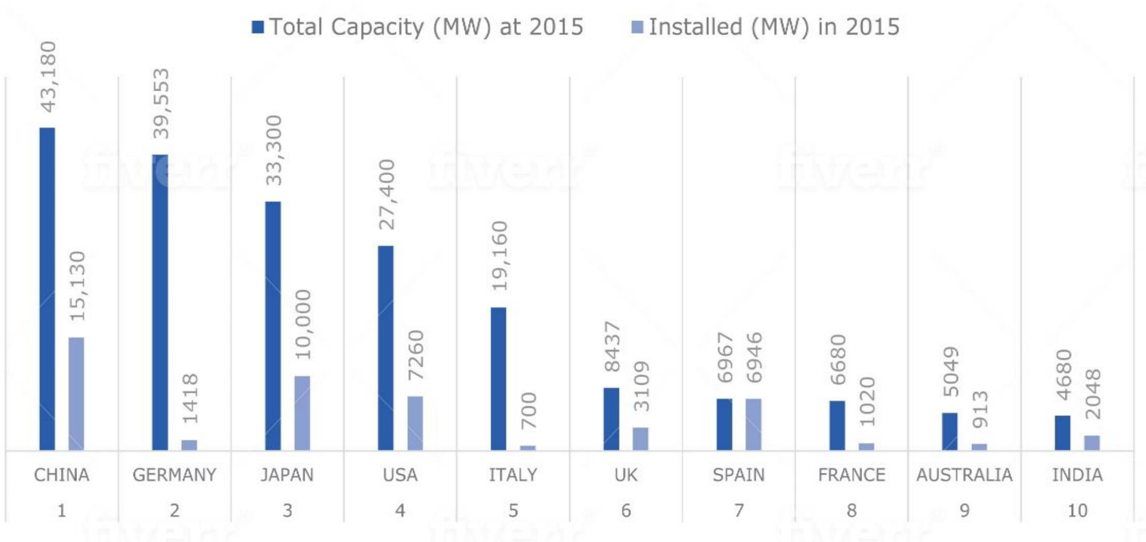
Technology	**Average price for each round (ZAR/kWh)**				
Solar PV	**Bid 1**	**Bid 2**	**Bid 3**	**Bid 4**	**Bid 4B**
Price (ZAR/kWh)	3.52	2.06	1.04	0.82	0.89
Total reduction of 75 per cent					

Source: Adapted from Bronkhorst et al. (2017)

5.14.4 Scale of solar PV

Due to technological improvements, government support for RE technologies, and decreases in the cost of material, the development of solar PV sources has in recent years seen a considerable increase (Tyagi et al. 2013; Görig and Breyer 2016; IEA 2013). Solar PV technology is one of the fastest-growing technologies in the market (Tyagi et al. 2013) and on its own reaches an added level annual capacity of 50 GW (Breyer et al. 2017). The graph pictured in Figure 5.6 below visualises the world rankings of solar PV generation capacities at the end of 2015, with China taking the lead.

Figure 5.6: The 2015 global rankings for solar PV generation capacity.

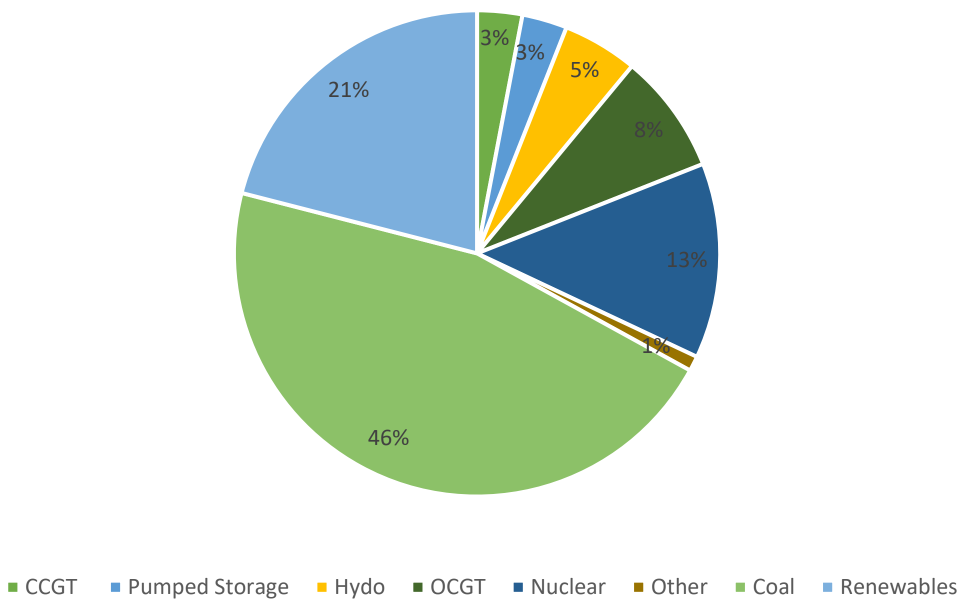


Source: Adapted from REN21 (2016) and Kabir et al. (2018)

Although there are limitations to this technology, billions of US dollars have been invested in this sector to address these, and more capital is expected to be invested: PV has become popular and well-entrenched worldwide (Kabir et al. 2018). In 2015, the global installed capacity was estimated at 237 Gigawatt-peak (GWp), but this is considered small compared to what will come in the near future (Breyer et al. 2017); solar PV has become a promising solution to meet the energy needs of the future (Yildiz et al. 2015).

Many countries have adopted the use of RE competitively alongside traditional energy generation, thus contributing to their nation's energy mix (Jones et al. 2017). South Africa has set a target of 17 800 MW of newly generated power to be produced from RE technologies as part of the national obligation to diversify the electricity sector toward including low-carbon energy (IRP 2010). About 7000 MW from RE generation is expected to be operational by 2020 (IPP 2019). As shown in Figure 5.7 below, 21 per cent of total energy will come from RE sources by 2030.

Figure 5.7: Targeted energy mix by 2030



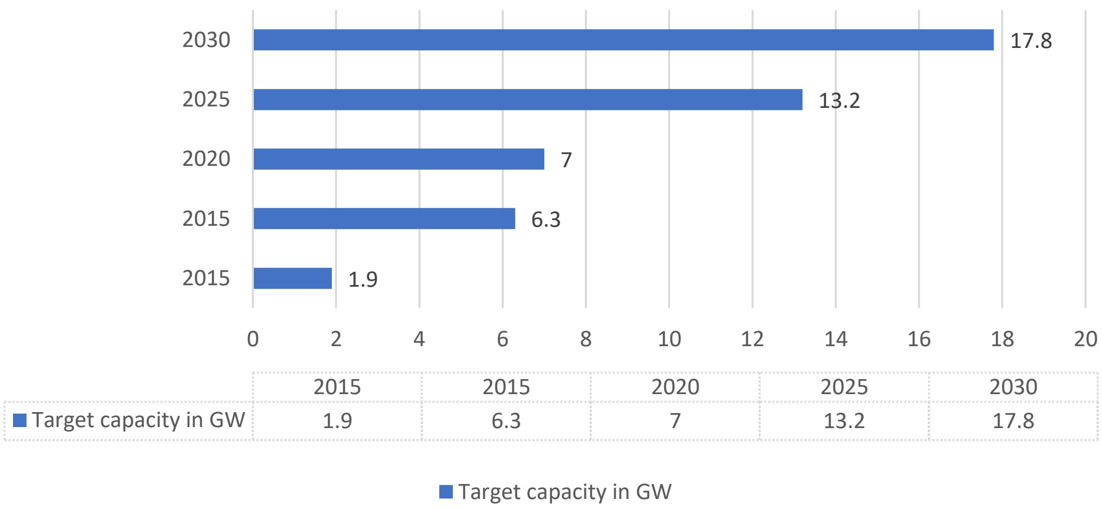
Source: DoE (2015)

On a micro-scale, several businesses and households in South Africa are installing solar PV sources for personal consumption (Rycroft 2019). Despite the increase in usage at the household level, however, solar PV in South Africa remains largely untapped (Nhamo and Mukonza 2016). According to the CSIR, close to 387 MW of embedded generation was installed in South Africa by the end of 2017 (Creamer 2019), further emphasising that, although support was lacking, the estimated levels embedded generation, mostly in the form of rooftop solar, exceeded 400 MW (Creamer 2019).

South Africa is also seeing an increase in the number of manufacturing facilities of solar PV panels, with an output of approximately 1040 MW per annum (Baker 2016). However, South Africa only allocates approximately 600 MW for solar within each round of the procurement system, which has left many arguing that it is unnecessary to promote the development of the sector (Baker 2016). At this rate, by 2030, coal will still dominate the energy mix for South Africa, but increases in the RE share will definitely be visible by 2050, where the lowest costing mix will consist of 70 per cent wind and solar PV (Rycroft 2019).

In South Africa, REI4P has targeted a RE production of 7000 MW to be accomplished by 2020, and 17 800 MW by 2030, as shown in Figure 5.8 below (IPP projects 2019). In the recent report compiled by the DoE, it has been noted that, of the 112 renewable projects procured through REI4P, 62 of those projects were in production by December 2017 (Cloete 2018). Since the introduction and subsequent success of REI4P, South Africa has experienced an increase in RE investments (Baker 2015): in the four competitive tenders, South Africa attracted an investment of US$19 billion in private equity, as well as a decline in prices of wind and solar by 46 per cent and 71 per cent (in nominal terms) respectively (Eberhard and Kåberger 2016).

Figure 5.8: Planned RE capacity by 2030 in South Africa



Source: DoE (2015)

5.15 Conclusion

This chapter discussed the theories instrumental to the current study's understanding of transformation potential in the energy sector. The study uses the MLP and social capital theories to evaluate the developments in RE technology and society at the niche level, rather than concentrating solely on technology. Considering that previous studies have not focused on the transformative potential of CREs, assessing both technology and society, the results of this study are seen to be novel concerning solar PV in South Africa: this research aims to close this gap by addressing both niches – social and technological.

CHAPTER SIX:
RESEARCH METHODOLOGY

6.0 Introduction

This chapter provides a detailed discussion of the research paradigms and methodologies applied in the present study. The research methodology was designed to ensure a framework that addresses the overall aim, research objectives, and research questions of this study, ultimately providing a meaningful contribution to community energy studies. Firstly, the methodological gaps identified in the literature outlined in the chapters prior are discussed.

6.1 Methodological gaps identified in community renewable energy studies

The methodological gaps identified in the literature concerning transitions and social capital are addressed in this section and are subsequently used to provide the rationale for the research methodology. This study seeks to understand the transition potential for community renewable energy projects based on communities' social capital resource availability and the factors associated with the transition. In the literature review, studies argue that social capital is key in determining whether a project will succeed or fail in communities, and whether social transitions occur. For instance, Pramanik et al. (2019) examine the connection between trust and collective action, where their study found that social capital was necessary to achieve success and sustainability. In the same study, the researchers argue that social capital plays a major role in whether a human is able to deliver welfare or not (Pramanik et al. 2019). Elmustapha et al. (2018) further note that the successful diffusion of technology depends on persuasion, understanding, and acceptance by consumers and stakeholders: it is essential to understand their perceptions.

Several studies have assessed the transition potentials for energy, buildings, transport systems, and food, and offered insight into policies using different analytical approaches (Geels et al. 2016b). In this study, the researcher aims to integrate the socio-cultural dimension in understanding social and technological aspects (Elmustapha et al. 2018). Geels et al. (2016b) note that social science theories offer important insights into transitions, and account for the actors involved, how they interact, develop, and implement various types of innovation. This supports the argument that a comprehensive analysis of transitions to low-carbon energy needs to be completed using cross-departmental social science theories as reference.

Prior studies on community energy have largely applied quantitative methods to assess transition efficiency (Kalkbrenner and Roosen 2016). However, other studies applied mixed methods. Warren and McFayden (2010) use a questionnaire-based case study to understand the attitudes of citizens toward a community-based project and a developer-owned RE project in Scotland. Rogers et al. (2008) explore the perspectives of a small community in a lake district in England regarding a potential community energy project, and uses both qualitative and quantitative methods to understand the perceptions of citizens. The current study has adopted a qualitative method to evaluate the perceptions of citizens and experts about social resources in communities, and the factors that promote the development of community energy. Most studies on social acceptance have used mailed questionnaire or online surveys as a method of data collection, and so this study uses a qualitative method to achieve a more in-depth understanding of social acceptance of technology and community projects, given that other sustainability studies have applied a qualitative approach (Walker et al. 2007; Mattes et al. 2015; Romero-Rubio and de Andres Diaz 2015; Martiskainen 2014). According to Sütterlin and Siegriest (2017), in order to examine social acceptance of RE sources, quantitative studies are preferred as a method to better inform policymakers. However, concerning the development of projects, a quantitative method would not offer sufficiently reliable information for action-related decisions (Sütterlin and Siegriest 2017). Hence, the researcher uses a qualitative method herein to better inform on a concrete level rather than an abstract one, especially to ensure that more dependable data is obtained (Sütterlin and Siegriest 2017) regarding the perceptions of individuals and experts on the concept of community solar projects.

As argued by Saunders et al. (2009), qualitative research is focused on studying the context of a specific phenomenon and is used where thorough, 'in-depth' insight is required concerning consumer attitudes, behaviours, and motivations (Barnham 2015). This method was thus deemed the most appropriate as it would allow the researcher to gain an in-depth understanding of the perceptions of citizens regarding the issue under investigation. This method has been applied across the breadth of previous studies concerned with community energy initiatives (Süsser et al. 2017; Seyfang et al. 2014; Goedkoop and Devine Wright 2016; Rogers et al. 2008; Martiskainen 2014; Becker et al. 2017; Hicks and Ison 2018).

Another study that established the basis of the current research was conducted by Wentink et al. (2018), who employ a qualitative method to understand the role of social capital in an existing initiative. They found social capital to be an important component and a prerequisite for the formation of initiatives, as well as serving as the reason for continuity.

According to Sarrica et al. (2016), energy transitions consist of various pathways, but which requires further research in linking multiple theoretical disciplines and methodological viewpoints. Sovacool (2014 p:11) asserts that research methods that are human-centred – such as interviews, surveys and focus groups – are insufficiently utilised, even though they are paramount to establishing the multidimensional ways that habits, attitudes, and experiences influence consumption.

6.2 Research philosophy and approach

It is widely assumed that any research design and choice of methods should be supported by the researcher's (often implicit) philosophy – referring to the researcher's comprehension of the nature of the world and how that world should be studied (Moses and Knutsen 2012). It is crucial that the researcher shed light on their philosophical position before the research is conducted (King and Horrocks 2010). Understanding one's philosophical position not only enlightens the selected strategies and methods, but also the "explicit or implicit assumptions about the nature of the social world and the way it may be investigated" (Burell and Morgan 2017 p.1).

Bracken (2010) notes that it is essential for researchers to ensure that their epistemological stances, ontological perceptions, and methods for data gathering and interpretation are closely examined. Since the purpose of the current study is to understand the perceptions of individuals and experts regarding CRE projects, and to share their subjective experiences, a subjective, interpretive approach has been chosen. Tracy (2012) asserts that paradigms are used to build knowledge, understand reality, and gather information concerning the world. A researcher's paradigm varies based on their ontological (the nature of reality), epistemological (the nature of knowledge), axiological (the values linked to research), and methodological (the approach used to gather, collect and analyse data) views (Tracy 2012). These philosophical approaches and paradigms are discussed below.

6.2.1 Ontology

Ontology considers the reality of and associations among individual and society, as well as in the world in general (Eriksson and Kovalainen 2016). Generally, researchers believe that there are various constructed realities and that there is no single 'true' reality waiting to be discovered (Ponterotto 2005). In this study, a qualitative approach was chosen based on the ontological assumption that reality is presumed to be subjective, and based on experiences and perceptions that may vary for each individual, and which may be altered in context depending on time and situation (Eriksson and Kovalainen 2016). The most important question to ask in the domain of ontology concerns what makes up the world *(*Moses and Knutsen 2007*)*, whereafter it is essential to appreciate what we know about knowledge – epistemology – in research.

6.2.2 Epistemology

Epistemology is concerned with how knowledge is constructed in the world around us, and what makes it true. It is rooted in an ontological assumption that we ask questions about what knowledge is, where, from a subjective perspective, it is believed that only through our observations and interpretations can we understand the external world (Eriksson and Kovalainen 2016). While holding an epistemological assumption, researchers conducting qualitative studies strive to be as close as possible to the participant being studied, allowing for subjective evidence to be gathered based on individuals' views (Creswell and Poth 2018). In this study, the researcher holds the belief that it is only through the subjective experiences of individuals that knowledge is created and known (Creswell and Poth 2018).

6.2.3 Axiology

In philosophy, axiology is concerned with what the researcher believes is ethical and valuable. Fundamental beliefs about what is ethical should guide a researcher's decision-making, and should be engrained within their research paradigms (Killam 2013). As we go through life, our actions and behaviours are guided by our philosophy of life. How we believe in reality, truth, and value ultimately shapes our perceptions of the universe and the world (Bourne et al. 2017). Interpretivists uphold the notion that it is challenging to separate a researcher's values and experiences from the research process. In that sense, the researcher should aim to describe, acknowledge, and 'bracket' their values, but not entirely eradicate them (Ponterotto 2005).

6.2.4 Methodology

Methodology aims to uncover the process and procedure of a study (Ponterotto 2005), where the term 'methodology' describes how knowledge about social reality can be acquired, and questions the 'how' of such knowledge is obtained (Moses and Knutsen 2012 p.4). Methodology can also be referred to as the study of methods, where, in essence, a good study is one where the methods utilised are sufficient to produce reliable knowledge *(*Moses and Knutsen 2007*).*

6.3 Philosophical underpinning

Saunders et al. (2009) identify four philosophical approaches: realism, positivism, interpretivism, and pragmatism. Of those four different theoretical approaches, the most influential are positivism and interpretivism (Gray 2013). *Realism* considers reality to be objective and, although interpreted by humans, as existing independently of human thought. *Positivism* considers reality to be objective, independent, and external to social actors (Saunders et al. 2009), but as accessible through research (Vildasen et al. 2017): reality exists external to the researcher and, therefore, must be studied by applying rigorous scientific enquiry (Gray 2013). *Interpretivism* (*social constructivism)* disagrees with the latter two philosophies, maintaining that truth and meaning are a result of the subject's interaction with the world, and that reality does not exist in some external world (Gray 2013). Creswell and Poth (2017) assert that, in social constructivism, individuals attempt to understand the world in which they live, where interpretivism is engrossed with how individuals, or a group of people, understand and interpret their social settings and events. *Pragmatism* considers reality to be external and multiple, but informed by subjective meanings and observable phenomena. This philosophical argument is mainly concentrated on the differences in the opinions held between positivist and interpretivist schools of thought. According to (Wilson 2014), those who do not take a position on either, or who consider their study to not be associated with either of the philosophies, are considered pragmatist since they see both the social and physical world as being necessary considerations. The following Table 6.1 summarises these philosophical paradigms.

Table 6.1: Summary of philosophical paradigms

Basic Beliefs	Positivism	Post-positivism	Constructivism	Critical Theory
Ontology (reality)	Realism: believes that one reality exists that can be discovered; independent of the human mind and behaviour	Critical realism: there is truth out there that cannot be accurately perceived	Relativism: realities are co-constructed by those experiencing the phenomena; multiple, dynamic, and many relative truths as opposed to one single truth	Historical realism: reality is shaped by experiences and values
Epistemology (knowledge)	Objective and dualist: results are true	Objective and dualist: results are likely to be true; insufficient data lead to inaccuracies	Interactions and findings are subjective; cannot separate the researcher from knowledge	Findings are subjective and influenced by values
Axiology (focus on ethical values)	Honesty, trust and integrity; independent of data	Respect and fairness	Viewpoint are balanced, raise awareness, and develop community rapport	Reciprocity, respect, beneficence, culture and social justice
Methodology (systematic inquiry)	Quantitative approach: verified hypotheses; highly structured	Interpretive studies are used to falsify hypothesis; selection of methods to fit the study	Qualitative approach: interpretative findings and well-described situations; Grounded theory, phenomenology, narratives, case studies, surveys	Logic and discourse based; both quantitative and qualitative methods

Source: Adapted from Killam (2013); Winit-Watjana (2016)

According to Lincoln and Guba (1985) and Neuman (2013), the interpretivist elements associated with ontology and epistemology consider knowledge to be socially constructed around everyday interactions and the actions of people, instead of being objectively determined. Constructivism, on the other hand, acknowledges that knowledge is content-dependent and relative, and that a researcher's or a participant's views and values form an important part in knowledge development through hermeneutic interpretation (Høiseth et al. 2014). Individuals tend to develop subjective meanings based on their experiences and views of the world and are derived from a wide range of experiences, requiring the researcher to dig into the complexity of the different views instead of reducing meaning into a few simple categories (Creswell and Creswell 2017). Coming from an interpretive point of view, the current researcher believes that reality is not something that exists out there somewhere, waiting to be discovered. Instead, reality and knowledge are uncovered through interaction, communication, and practise, and therefore, reality is translated through the researcher (Tracy 2012).

All paradigms considered, this study was socially constructed based on the assumptions individuals have regarding social capital in communities, rather than anything being objectively determined. This approach believes that a dearth of understanding exists regarding considerations made about the social resources available before implementation of community renewable projects, and that this has been overlooked by prior researchers. On that basis, this study holds a theoretical perspective akin to a subjective interpretivist (constructivist) approach (Carcary 2009). Constructivists recognise that we do not just 'experience' the world objectively or directly; our perceptions are channelled through the human mind, often in elusive ways.

It is a short journey between the eye and the brain: between sense perception and the experience of the mind, we may find challenges to naturalism. When scientific investigation is aimed at perceptions of the world, rather than the world 'as it is', we create the possibility for multiple worlds (or, more accurately, multiple experiences) to become manifest (Moses and Knutsen 2012). According to Vildasen et al. (2017), constructivists assume reality to be mentally constructed, social, and based on local experiences shared between different people. People may look at the same thing but consider it differently: aspects such as age, race, or gender, or social characteristics such as culture, era, and language influence or obscure one's perception about the world (Moses and Knutsen 2012). Wentink et al. (2018) uses a social-constructivist approach to social capital and aimed to research a complex phenomenon in its natural setting. This study thus considers the subjective views of those who experience a situation in its natural setting, and has adopted qualitative, interpretive, and constructivist approaches to understand the phenomena of the current study.

6.4 Research Design

The research design was essential in providing a framework for the collection and analysis of data (Bryman 2012). Good social science requires a well-planned research design and solid analytical skills (Abbott and McKinney 2013). When conducting a study, there are two main research methods that a researcher can choose between – qualitative or quantitative. Saunders et al. (2009) assert that researchers must be aware of all philosophical commitments when choosing a research strategy, since each method has its strengths and weaknesses. The chosen method will impact the way that research is conducted and the understanding of what is investigated. Choosing between the two methods depends on a range of factors, including how the researcher plans to investigate the phenomena, and the researcher's position regarding the nature of the world (Ritchie et al. 2013). Mayer (2015) notes that careful consideration of a researcher's view of the world and the research objective is useful and essential in terms of choosing the right method.

A quantitative methodology focuses on accurate and reliable measurements for statistical analysis, while qualitative research is a largely social research method that is applied to a particular issue in order to obtain in-depth knowledge of the complex reality of a phenomenon (Queiros et al. 2017). Harding (2018) differentiates between qualitative and quantitative in terms of the volume of participant, and argues that quantitative research tends to collect specific and limited information from a large number of people, achieve a breadth-based examination (Harding 2018; Patton 2002); whereas qualitative research is more focused on a single question, and information is collected from a smaller sample to achieve depth (Harding 2018; Patton 2002). Table 6.2 below summarises the differences between qualitative and quantitative methods.

Table 6.2: Fundamental differences between quantitative and qualitative research.

Point of Comparison	Qualitative	Quantitative
Philosophical underpinning	Relativism, constructivism	Realism, positivism
Researcher perspective	Emic (insider's perspective)	Etic (outsider's view)
Aim	Subjectivity Build theories Describe phenomena Generate hypotheses Establish meaning in experiences	Objectivity Illustrate correlations among variables Hypothesis testing Measure concepts Concerned with cause and effect
Methods	Observations Interactions Documents	Surveys Experiments Questionnaires
Sample selection	Purposive Specific and limited	Random Large, representative
Data analysis	Study words and meaning Inductive	Statistics used to define findings Deductive
Findings	Findings are richly descriptive, co-created, holistic	Numerical findings Precise 'Truth' is discovered

Source: Adapted from Killam (2013); Harding (2018); Merriam and Tisdell (2016)

To effectively gain a thorough understanding of the perceptions of communities toward the transition to low-carbon energy, this study has adopted a qualitative method. Yin (2011) asserts that qualitative methods should be applied when one seeks to understand a complex reality and uncover activities in a particular setting, especially, if little is known about the phenomenon (Bryman 2016). It does not aim to generalise the study, but rather to gather data that provides information about the phenomena being studied (Yin 2011). Merriam and Grenier

(2019) note that a crucial aspect of qualitative research is that it considers meaning to be socially constructed by those who experience and interact with the world, unlike in quantitative research where the world or reality is fixed or measurable. This study uses a qualitative method to provide the researcher with the opportunity to assess the views of respondents and ask probing questions to get to the root of the phenomenon (Harding 2018). Qualitative methods are used to collect data, simplify the complexity of the research question, and to provide richness to the situation that quantitative approaches would otherwise not illuminate (Hanson et al. 2011).

This method was chosen due to its suitability for research questions aimed at understanding real-life contexts, which require various considerations and perspectives of cultural influences (Radtke 2014). Silverman (2016) notes that those seeking to understand how others interpret meaning tend to use qualitative methods as they provide a means to interact with and explore the meanings of participants' viewpoints. This method allows the researcher access to a social world and an understanding of the events in participants' territories, their experiences, and how they make sense of the situation in their positionings (Silverman 2016). While qualitative studies use a small sample, and where this study takes note of that limitation, the approach is still considered valuable as participants are able to provide information that extends beyond what could potentially be captured by a quantitative study (Brandenburg and Caroll 1995).

6.5 Research strategy

The research approach for this study uses an exploratory case study that seeks to determine the perceptions of citizens and experts towards the concept of CRE. According to Mayer (2015), an exploratory research design is a way of seeking new insights into a situation and clarifying an unfamiliar phenomenon, such as in this study where little is known about perceptions toward CRE projects. According to Yin (2018 p. 15), a case study is:

> "an empirical method that investigates a contemporary phenomenon (the "case") in depth and within its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident."

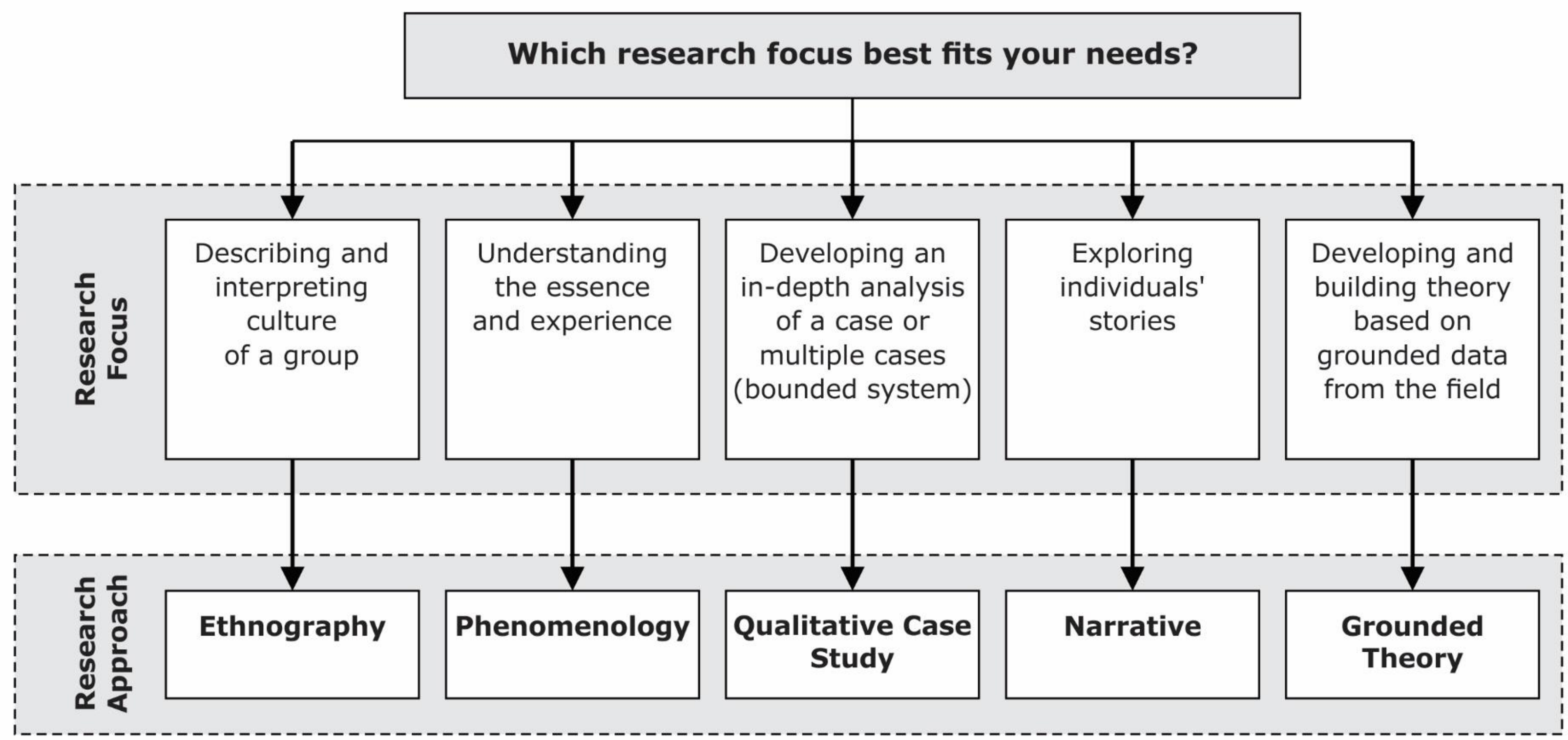
Since this study seeks to explore a situation in its natural setting, a case study was selected (Saunders et al. 2016). Carcary (2009) asserts that a case study is used in cases where the researcher wishes to gain in-depth, holistic understanding of broad, complex phenomena;

case studies are used by researchers to study real-life content that is still progressing in order to gather information that is current (Creswell and Poth 2018). It is suitable when one seeks to understand relationships, interactive processes, political issues, and matters that can influence strategies in a particular context (Carcary 2009).

Yin (2018) notes that there are two approaches to consider when designing a case study: a single, and multiple case studies. The researcher should determine, before engaging in data collection, whether a single or multiple case study is appropriate (Yin 2018). This study aims to gather detailed and comprehensive data relevant to the research questions within a particular time frame, and thus a single case study was deemed appropriate (Picardi and Masick 2013). It provides the researcher with the opportunity to define the case and analyse a situation that few researchers have considered (Saunders et al. 2016).

Yin (2013) asserts that if the researcher need only study a single group, then a single case study is the best choice, particularly if the aim is to capture the setting and conditions of an everyday circumstance, allowing for the identification of information about the social processes that eventually answer to the initial theoretical interest (Yin 2018). The aim of this study is not to compare cases; hence a comparative or multiple case study was not considered. A single case study was deemed relevant for this research (Creswell and Poth 2018) since the researcher seeks to gain an in-depth understanding of a phenomenon occurring in a bounded context (Miles et al. 2013; Merriam and Tisdell 2016). Figure 6.1 below illustrates the different research approaches as identified by Creswell and Poth (2018).

Figure 6.1: The types of Qualitative approaches



Source: Adapted from Creswell and Poth (2018); Merriam and Tisdell (2016)

6.6 Case study background

Several reasons account for the selection of the sample cases herein. Creswell and Poth (2018) recognise that there could be several possible case candidates to research for any given study, and that the researcher should be able to select the best system to study depending on its knowledge value. Many areas in South Africa could have fit the criteria for this study, but the current researcher has selected the City of Johannesburg due to it being the largest city in South Africa, boasting a population of approximately 4.5 million, and constituting about 1.5 million households according to polls conducted in 2011 (StatsSA 2011). This city was also chosen because various organised communities exist there that are running community projects to maintain their areas, for instance, security and environmental projects.

One example is the suburb of Lonehill where, a few years ago, the community was concerned about security in the area. The community subsequently set up a trust account for each family to contribute toward deploying a security company and for upgrading the landscape of the area. The residents responded with interest and employed an estate manager and board of directors for promoting community initiatives (LRA 2018).

6.7 Sample and selection criteria

This study has applied theoretical sampling to select participants who could offer the richest, most meaningful data. According to Eisenhardt and Graebner (2007), theoretical sampling implies that those selected are able to offer informative details and extend the association and logic between constructs. During the length of this study, the researcher attended various conferences and interacted with key domain experts in the field of renewable energy, as well as government officials, in order to examine their perspectives on the role of community projects in South Africa. These exercises were beneficial in helping the researcher gain access to key participants who are otherwise challenging to contact. Participants have been chosen on the basis that they would contribute to meaningfully answering the research questions at hand, to the theoretical intentions of the case study (Picardi and Masick 2013; Yin 2018). Regarding sample selection, quantitative research methodologies tend to use a sample set representative of the studied population (Nicholls 2017). However, qualitative methods resist this notion and aim for samples that provide appropriate and sufficient understanding, thereby selecting people who embody the breadth of human experience and who can offer depth and richness in their accounts (Nicholls 2017).

The selection of the small sample herein has followed the qualitative sampling rule which argues that a small sample allows for rich, case-oriented analysis (Christensen et al. 2014), where the aim was not to achieve results that were representative, but rather demonstrative (Schaube et al. 2018). Therefore, it was important to identify and select individuals that are knowledgeable or who are heavily experienced in the phenomenon being investigated (Creswell and Clark 2017). The criterion for the inclusion of ordinary citizens was based on two factors: (1) the person having some kind of knowledge of co-operative structures; and (2) them having knowledge about renewable energy sources, particularly solar PV technology.

Ordinary citizens were selected on the merits that they could provide the researcher with information spanning the depth and breadth of the subject under analysis (Palinkas et al. 2015). Experts were selected on the basis that they have, to some extent, been involved in the development of RE projects. As shown in Table 4 below, the participants were selected from government agencies, industry, construction, and finance, and possessed sufficient knowledge and experience in RE projects. The selection was executed following Foxon and Pearson's (2011) guidelines, where they assert that three main stakeholders influence transition – including those in markets, policymakers, and society. As such, the researcher ensured that all three were sampled.

According to Galletta (2013), selection criteria must ensure that the sample is ethnically and culturally balanced, and that it represents a range of perspectives and experiences. In line with qualitative sampling requirements, this study has aimed to ensure that the sample was heterogeneous and diverse, and therefore the choice to use purposeful rather than random sampling was made (Merriam and Tisdell 2016; Creswell and Poth 2018). As shown in Table 6.3 below. The researcher focuses on individuals that could contribute meaningfully to answering the research questions, thereby adding value to the central phenomenon and research problem under analysis (Creswell and Poth 2018). The selection follows a snowball approach, which consisted of asking participants at the end of each interview to recommend individuals who might be interested in contributing to the study and who have the sufficient knowledge (Galletta 2013; Merriam and Tisdell 2016). The sampling was terminated when the researcher reached saturation: a point where no new information was emerging from the interviews being conducted (Johnson and Christensen 2014).

Table 6.3: Research participants

Respondents	Organisation/type of organisation	Position
Individuals		
PT1	Funding agency	Community member
PT2	Investment company	Community member
PT3	Funding agency	Community member
PT4	Property developer	Community member
PT5	Consulting	Community member
PT6	Construction company	Community member
PT7	Construction company	Community member
PT8	Community leader	Estate manager
PT9	Construction company	Community member
PT10	Resources company	Community member
PT11	Funding agency	Community member
PT12	Banking	Community member
PT13	Energy sector	Community member
PT14	Engineering company	Community member
PT15	Energy sector	Community member
PT16	Government agency	Community member
PT17	Infrastructure development	Community member
PT18	Funding agency	Community member
Experts		
PT19	Infrastructure development	Executive
PT20	Department of Energy (policy unit)	Executive
PT21	Funding agency	Executive
PT22	Developer (solar PV – 50 MW to date)	Executive
PT23	Innovation hub	Executive
PT24	City of Johannesburg (local municipality)	Executive
PT25	Funding agency	Executive

Source: Author generated

6.8 Data collection method

The current research constitutes an exploratory study (Viardot 2013; Heras-Saizarbitoria et al. 2018) conducted in the urban areas of Johannesburg. The study focuses on the perceptions of individuals and experts towards CRE projects, and assesses their socio-demographic profile and ethical orientation towards CRE. The use of qualitative methods for the study enabled participants to relay their experiences regarding everyday interactions with society and energy-related practices. Data was collected through primary (interviews) and secondary (documents) sources. The theoretical orientations of social capital theory constructs guided the primary data collection and analysis, and the secondary data was guided by proxies for technological innovations (Geels and Schot 2007; Dóci et al. 2015).

To address policy issues, a comparative analysis was conducted between the UK, Germany, and South Africa, including their RE support mechanisms and the performance thereof. The current study was undertaken in February 2019, and centres on a cross-sectional approach (Saunders et al. 2016), where data was collected from sixteen ordinary citizens and eight experts, guided by a qualitative sampling rule: the study uses a sample size that was enough to achieve saturation – the point where no new data emerge as more interviews are conducted (Johnson and Christensen 2014 p. 273). To arrive at a more focused view on how individuals and experts view community projects based on social capital resources, data collection involved in-depth interviews with 25 key informants and stakeholders in the field that included local government representatives, social enterprise networks, construction, financial support structures, government departments, and renewable energy developers. Data collection proceeded in a manner discussed below.

Firstly, information was sourced from a variety of documents, including government and policy documents, journals, grey literature on CRE – especially solar PV technology – as well as policies that support the development of community energy projects. To assess the progress of solar PV sources, the study uses previously established proxies to understand the transition potential (Geels and Schot 2007; Seyfang and Hazeltine 2012; Seyfang and Longhurst 2013; Dóci et al. 2015). The study focuses on solar PV technology as a technology that can be widely deployed in urban areas when compared to other RE sources (Amado et al. 2016; Horváth et al. 2016). Additionally, focusing on one technology facilitated an easier comparison between the policies of the different countries.

Secondly, primary data collection via interviews with citizens and experts was necessary in order to elicit their views on social resources in developing community projects. Questions for the interviews were carefully selected through an in-depth exploration of the literature (Kalu 2017), and were selected to guide the participants toward conveying their honest and true experiences concerning the research topic (Galletta 2013). The questions were open-ended, allowing participants flexibility in narrating their accounts (Galletta 2013).

An interview schedule was developed based on the operationalisation of the following constructs: (1) knowledge and awareness; (2) environmental concern; (3) participation; (4) social norms and values; (5) social trust; (6) institutional trust; (7) connectedness; (8) perceived benefits; (9) perceived costs; and (10) acceptance (see Appendix 1). These constructs were carefully selected to fully address the research topic and to direct the participants toward conveying their experiences with the research topic (Galletta 2013). Although flexibility was provided in answering the questions, most questions were centred on specific thematic issues that were important to answer the research questions. These interviews aimed at mapping social resources based on which could most accurately address the transformation potential based on technology advancement and policy.

6.9 Semi-structured interviews

Various methods can be used to conduct interviews: highly structured, unstructured, and semi-structured (Gray 2013; Merriam and Tisdell 2016). The semi-structured method was chosen for this research as it allows for the investigation of participant's perceptions in more detail and depth, and permits flexibility in narrating their accounts. To understand the social world from the perspective of research participants, one-on-one, face-to-face, in-depth interviews were considered the ideal method to accurately elicit the views of participants (Silverman 2016). According to Hennink et al. (2010), in-depth interviews are important when aiming to capture the stories and voices of individuals. The reason for selecting semi-structured interviews was to allow for the opportunity to enter into a dialogue with the evidence; it allows one to structure and ask the relevant questions – a requirement posed for case study researchers (Yin 2018).

The interviews allowed the researcher to study the social world from the perspective of the research participants (Creswell 2015; Silverman 2016). The study used a guide during data collection, which made analysis manageable since participants were all asked similar questions (Harding 2018). The method employed allowed the participants to respond to standardised questions while also providing the opportunity to diversify the conversation to yield new ideas as the interviews progressed (Schaube et al. 2018) (see Appendix IV). The interviews lasted for approximately forty-five minutes to an hour and thirty minutes each (Carcary 2009; Yin 2018), and were recorded and transcribed verbatim to produce interview transcripts (Merriam and Tisdell 2016).

Initially, the researcher considered focus groups, but was conscious of the fact that individuals in the group might distort responses by influencing the others being interviewed (Picardi and Masick 2013), thus the decision to use one-on-one, semi-structured interviews was made. While focus groups were not suitable in this situation, they are appropriate when addressing sensitive topics or in an institutional environment where individuals may be in a position to share their views in front of others (Harding 2018).

Furthermore, although the study was designed as such that one-on-one, face-to-face interviews were to be conducted, three participants opted for remote interviewing (written responses) because they were unavailable at the time that interviews were proceeding. Remote interviews can be used in qualitative studies if the respondent is unavailable for a physical interview, or depending on the nature of the interview topic (King et al. 2018). The researcher notes that a written interaction enabled them to reflect on the questions more efficiently (King et al. 2018). There was no need for translation of language, since all the interviews were conducted in English.

6.10 Data analysis method

Data analysis was the most time consuming and challenging part of the current research, particularly due to the volume of data collected (Merriam and Tisdell 2016). It was important to learn how to code accurately and easily to ensure proficiency in the analysis (Saldana 2015). Before engaging in the analysis, an extensive literature review was conducted by the researcher (Huybrechts and Mertens 2014; Silverman 2016), allowing the researcher to identify any relevant work conducted by scholars in the field (Walker et al. 2007; Walker et al. 2010b; Walker and Devine-Wright 2008; Smith et al. 2016; Lipp et al. 2012; Strachan et al. 2015; Martiskainen 2014). The researcher connected the empirical annotations with the relevant theoretical literature that this study focuses on (Huybrechts and Mertens 2014).

Data analysis was conducted simultaneously with data collection (Merriam and Tisdell 2016), which permitted for questions to be assessed and adjusted, ensuring they were clear and understood by participants. The process allowed the researcher to adjust the questions as the interviews progressed and helped to redirect data collection based on emerging and test concepts, categories, and themes (Merriam and Grenier 2019). Before the analysis, interviews were audio-taped and transcribed verbatim (Jain and Ogden 1999), and written transcripts from remote interviewing were added to the transcribed information. While the researcher initially planned to transcribe the data alone, the fact that data collection was conducted concurrently with analysis and time limitations necessitated that a transcriber be employed for some of the transcripts (Ruggiero et al. 2015). Once the data were transcribed, all the transcripts were spot checked to ensure accuracy (MacLean et al. 2004).

Since this study aims to understand the perceptions of participants' interpretation, and to allow them to share their individual and subjective experiences in their setting, data analysis for the study was guided by an interpretive paradigm where it was deemed important to understand the narrative of participants and their subjective views in their respective locations. As this study employs a qualitative approach, interpretation played an important part in the analysis (Eriksson and Kovalainen 2016).

Qualitative research is considered a naturalistic, interpretative, approach, mainly concerned with understanding how people make sense of a given phenomena within their social circles (Denzin and Lincoln 2011). Understanding how individuals interact and experience their social world calls for an interpretive (constructivist) approach (Merriam and Grenier 2019). The interpretative paradigm in social science is wide-ranging, but can be summarised as being concerned with how the social world is experienced and understood from a society's point of view (King and Horrocks 2010). A qualitative data analysis software (CAQDAS) package (NVivo 12) (Woods et al. 2016), was used to organise data, and ensure accuracy and depth during the analysis (Bazeley and Jackson 2013; Merriam and Tisdell 2016).

6.11 Method applied to analyse data (inductive and deductive)

In addition to choosing between quantitative, qualitative, mixed methods, and critical approaches, the researcher needed to decide whether to use a methodology that was mainly inductive or deductive. Tracy (2012) argues that there are two approaches to reasoning: either inductive (a bottom-up) or deductive (a top-down) approach. The methodology aligned with qualitative research is considered inductive and emerges depending on the researcher's experience in research, data collection, and analysis (Creswell and Poth 2018). Merriam and Grenier (2019) assert that the process of analysing data in qualitative studies is inductive irrespective of the strategy applied, and involves moving from the particular to the general to arrive at the findings of the study. To derive the meaning of the data, the themes that developed from the data were considered using an inductive approach (Bernard 2017).

Most social research, however, consists of both inductive and deductive reasoning (Tracy 2012; Saunders et al. 2016). The current work was directed from a theoretical perspective, therefore both of the aforementioned methods were used to analyse the data

(Saunders et al. 2016; Winit-Watjana 2016). The process involved using an inductive approach in first collecting and analysing the data, and then determining how the analysis correlates to the literature, followed by a deductive approach where the researcher first read the literature and then answered the research questions based on that literature (Harding 2018).

According to Creswell and Poth (2018), the inductive process entails working up and down between the data and themes to a point where a wide-ranging set of themes are identified. This means that important themes are developed from the raw data (Ruggioro et al. 2014), and that data is generated based on participants' own accounts, thereby enabling their subjective, lived experience to be interpreted (Davenport and Anderson 2005). Because this study was guided by social capital theory, the study turned to social capital and transition theories to assess how emerging themes fit into extant frameworks, and whether the findings extend or complicate these theories (Tracy 2012). Although the study was mainly inductive (Saunders et al. 2016), previous theories were also considered when addressing the problem. The intention was not to misrepresent what has already been tested, but to establish consistencies, patterns, and meanings (Gray 2013). The researcher used both approaches to gather evidence that supported the themes from the data and the interpretations (Wentink et al. 2018).

6.12 Data coding process

Before proceeding with the coding, the first step involved a thorough process of cleaning the interview transcripts by removing any spelling mistakes and addressing missing words, and then systematically organising the participants (Brummer 2018b). They were organised according to whether they were ordinary citizens or experts. Thereafter, a coding system was developed before the data was analysed and interpreted (Picardi and Masick 2013). This was followed by data coding, which is essential for providing a structure for analysing text (Neuendorf 2016). Initially, all the transcripts were printed and coded manually using descriptive coding before transferring them into an NVivo project (Mirzania et al. 2019). Saldana (2015) notes that this process allows one to have control and maintain ownership of the collected data, where, in this case, the researcher read the transcripts line by line, in detail, in order to promote trustworthiness. During this preliminary reading, the relevant paragraphs were highlighted to ease the process of the data analysis process (Creswell 2013:205).

In the first stage, the researcher applied open coding to assign initial codes, where the process of open coding allowed the researcher to take account of any code that emerged

(Merriam and Tisdell 2016). The researcher followed Saldana's (2015) concept of a first coding circle, or initial coding, which included coding methods of descriptive coding, in Vivo coding, and process coding. Initial coding offered the researcher the opportunity to reflect deeply on what was emerging from the data and to take charge of the distinctions that were apparent, and constitutes an open-ended approach to data coding, which should then be followed by a specific recommended guideline (see Saldana 2015). Descriptive coding was used to attribute and assign labels to data to create record of the topics that were emerging. In Vivo coding was considered important as it respects and prioritises the voice and language of participants for codes, and process coding was instrumental as it focused on gerunds to create codes (Saldana 2015).

The codes were formulated using a combination of emerging and predetermined codes (Creswell and Creswell 2018). The coding process started as inductive, but as themes emerged, it was clear that they were linked to social capital theory, hence both inductive and deductive methods were followed. The researcher focused on themes addressing social capital and transition potential as 'units of analysis' (Polit and Beck 2004). Once the codes were created, the second step involved sorting the codes systematically into a codebook based on types, categories, and relationships. Initially, there were 65 codes, thereafter irrelevant codes were removed and some codes were merged resulting in a final number of 52 codes. Considering the research questions and objectives, the selected themes were refined and labelled. In the end, 15 main codes were identified as shown in the findings in chapter seven. In order to achieve the envisioned analysis outcome of identifying three to eight main categories that reflected the main themes of the research question, difficult decisions had to be made in order to combine select categories (Thomas 2003; Creswell 2002), as seen in Table 6.4 below. The final main themes were: participation, social trust, institutional trust, connectedness, social norms, perceived benefits, perceived costs, and acceptance.

Table 6.4: The inductive and deductive coding process

Read through the data	*Identify important segments*	*Develop categories by highlighting the segment of data*	*Eliminate unnecessary categories*	*Highlight important categories*
Great number of pages	Huge amount of text	65-52 categories	15-20 categories	3-8 categories

Source: Adapted from Creswell (2002:266)

6.12.1 Thematic analysis as a research approach

According to Silverman (2016), there are various ways in which data can be analysed: thematic, content-based, ethnographic, narrative, discourse-based, phenomenological, experiential, or conversational analysis. Content analysis could have been used for this study, an important characteristic of which pertains to the many words derived from the data being grouped into smaller content categories (Weber 1994). The frequencies of the categories would then be counted to get a better idea of what the data contains (Hickey and Kipping 1996). However, the challenge with content analysis is maintenance of the integrity of narrated data when analysing data, which can be lost if the data is compressed. Equally, the richness of the original narrative could be lost if supporting quotations are not included, and if the data are only summarised (Elo and Kyngäs 2008).

For this study, interviews were analysed using a thematic approach (Silverman 2016; Merriam and Tisdell 2016). Thematic analysis, according to Wrapson and Devine-wright (2014), is a process whereby data is immersed and interpreted, where Guest et al. (2012:15) state that thematic analysis is “a rigorous and inductive set of procedures designed to identify and examine themes from textual data in a way that is transparent and credible”. Braun and Clarke (2006) highlight that thematic analysis is typically used to identify, analyse, and report themes as they emerge from the data. The essence of thematic analysis lies in identifying emerging themes, the process of which involves interpreting and deriving sense from the data rather than merely summarising it (Maguire and Delahunt 2017).

Analysis was first approached inductively by acknowledging the themes emerging from the data, rather than being obligated to focus on specified themes (Dawson 2019). Following Braun and Clarke’s (2006) thematic analysis framework, a thematic approach was adopted in analysing the data from the 25 interviews. Based on the information derived from the data, analyses were conducted to identify any patterns arising that signified relationships between variables (Gray 2013). Transcripts from the interviews were examined over and over again, and coded into similar categories, patterns, and themes to a point where no new groupings of data was emerging.

The following six-step thematic analysis framework was followed as per Braun & Clarke (2006):

1. *Familiarising with the data:* transcribing data if necessary (to immerse and engage in the information fully), reading the transcripts over and over again, noting initial concepts and initial ideas.

2. *Generating initial codes:* identifying preliminary codes that highlight important features of the text.
3. *Searching for themes:* gathering all the relevant data that captures aspects related to the research question, and allocating data to each potential theme.
4. *Reviewing themes:* developing and modifying the preliminary themes identified in stage three, and checking whether they make sense and support the extant themes**.**
5. *Defining and naming themes:* ongoing analysis (refining and defining) of the themes and subthemes in the analysis.
6. *Producing the report:* this final stage presents an opportunity for the researcher to produce a report of the findings.

6.13 Pilot Study

Upon completion of the interview schedule, the researcher conducted a pilot study with two individuals and one expert to determine whether the questions were understood and comfortably answered by the participants (Fowler 2013). As postulated by Johnson and Christensen (2008), it is essential to fully explore the research phenomenon at the beginning of a study before the actual interviews proceed. The pilot study was important in preparing, refining, testing, and tweaking the questions used to interview participants within the formal case study (Yin 2018). It was also beneficial for improving data collection plans regarding the content of the information and the process that was later followed (Yin 2018).

This pilot study was influential in developing relevant lines of enquiry, and provided a conceptual direction for the research design (Yin 2018). This exercise allowed the researcher to address any potential concerns that participants raised about the questions, where the feedback from pilot interviews was integrated into the final revised instrument (interview schedule) (Creswell and Creswell 2017). The researcher identified questions that were confusing to respondents and re-worded them accordingly in order to best obtain the type of information needed to address the research questions (Merriam and Tisdell 2016).

6.14 Reliability and validity

The difference between positivist and interpretivist researchers is how their study outcomes are evaluated (Carcary 2009). Issues of reliability, validity, and generalisability that are considered important in positivist studies are of less significance for qualitative researchers (Carcary 2009). Unlike quantitative criteria that aim for reliability, objectivity, and internal and external validity, Guba and Lincoln (1989) identify credibility, dependability, transferability, and confirmability as the overall goal in qualitative studies. As Morse (2015) argues, although integrity is an important goal, it is only a concern to external evaluators wanting to ensure that qualitative research is valuable (Morse 2015). Merriam and Grenier (2019) note that in qualitative studies, readers are convinced of the findings because of the rich, deep findings described using words rather than numbers.

6.14.1 Reliability

The term 'reliability' is often associated with quantitative studies as a concept used for testing or appraising quantitative research, but it is used within all types of research (Golafshani 2003). Gatewood and Hubert (2001) assert, that there are varying definitions of reliability, including the degree to which the measure is consistent and dependable. Leung (2015) notes that reliability is concerned with the exact replicability of the research process followed, and the study's findings. Since qualitative research consists of diverse paradigms, the concept of reliability thereof can be challenging. As such, for qualitative studies, the importance of reliability resides in consistency (Grossoehme 2014; Carcary 2011), meaning that qualitative research is concerned with the degree to which a measurement is dependable, consistent, and stable (Picardi and Masick 2013).

Merriam and Grenier (2019) note that several strategies can be applied to prove the validity or credibility of research. Reliability, in quantitative studies, ensures that if another researcher investigates the same phenomena, they will arrive at the same results (Yin 2017). However, Strauss and Corbin (1998) argue that, in qualitative studies, it is difficult for qualitative researchers to reproduce the phenomena results due to difficulty in duplicating the exact conditions under which the initial study was conducted. Carcary (2009) notes that even if the same participants are used in a study, it may be difficult to reproduce the same responses.

The current research seeks to provide reliability concerning the results and, as such, the findings were forwarded to some of the participants for review. The researcher used conferences as an opportunity to present the results of the study, as per Morse's (2015) recommendation of presenting findings or debriefing to help the researcher avoid bias and support the conceptual development of the research. It allows researchers to reflect on their study and see additional angles after following audience questions (Morse 2015). To accurately represent a member's experiences, the findings were shared with the participants to ensure trustworthiness and accuracy (Anfara and Mertz 2014; Merriam and Tisdell 2016). The overall goal of the review was to eliminate biases and mistakes in the study (Yin 2017).

6.14.2 Validity

It is noted that issues of validity challenge both qualitative and quantitative methods. Although some qualitative researchers maintain that validity is not relevant in qualitative research, it is acknowledged that there should be some measure and qualifying check for their studies (Golafshani 2003). Validity, according to Polit and Beck (2012 p. 745), is the "degree to which inferences made in a study are accurate and well-founded." Questions surrounding validity seek to ask whether reality was portrayed accurately when data slicing was done, and whether the final product truly portrays what it claims (Grossoehme 2014; Gaber and Gaber 2018).

The researcher ensured that the processes, tools, and data used were suitable, meaning that the research questions met the desired outcomes, and that the correct methodology was chosen to answer the research questions. Additionally, the validity of the selected methodology design was assessed in terms of sample selection, data analysis design, and whether the findings were valid (Leung 2015). To ensure quality and assess validity, the researcher asked for members validation of the final product, by taking the findings back to participants to review whether it portrays their experiences accurately or not (King and Horrocks 2010).

Bryman (2016) argues that validity can be measured by the truthfulness of the conclusions reached when the research is presented. The researcher ensured methodological soundness in how the research was conducted in order to avoid hampering the reliability of the findings (Saunders et al. 2016). In addition, the researcher took measures to ensure that the interpretations were captured precisely (Killam 2013), and paid cautious attention to how the study was conceptualised, and the presentation of findings (Merriam and Tisdell 2016). To ensure transparency, accuracy, and credibility, the researcher consulted with two participants to review the findings report to ensure that the findings echoed the phenomena under analysis (Bazeley and Jackson 2013).

6.15 Ethical Considerations

It is often the case when probing for rich data that researchers are presented with ethical challenges, which are an important part of qualitative studies (Silverman 2016). According to Yin (2013), when research involves human subjects, some ethical considerations always emerge from the study. The researcher was aware of this factor and felt a moral responsibility towards those interviewed (Silverman 2016). Before proceeding to collect data, approval was secured from the Institutional Review Board (IRB): the research questions, methods used, and data collection instruments were detailed for the approval of the board and the supervisory team (Galletta 2013), where this research was thus conducted with the ethical approval of the Robert Gordon University.

This research aimed to deduce meaning from the lives of participants, a result that can only be achieved by close contact with those involved (Stake and Jegatheesan 2008). Before the interviews commenced, participants were first asked to sign a consent form that was sent prior to the interviews being conducted. A signed consent form ensured that participants were aware of the research objectives, and gave their permission to participate (Silverman 2016). Participants were then contacted to arrange an interview time, but some participants opted for remote interviewing. Prior to interviews being conducted, the following protocol was followed by the researcher: a) background about the concept of community renewable energy projects was clarified; b) interviewees were informed about the purpose of the study; c) the researcher reported how the data would be protected for confidentiality; d) the duration of the interview was communicated; and e) participants were informed that should they wish to not proceed with the interview, they were allowed to be excused without obligation (Creswell 2015). Before the interviews commenced, participants were asked for permission to be recorded, and interview responses were recorded using an electronic device.

In addition to the above, the researcher followed the following protocol to ensure that special care and sensitivity was considered (Yin 2018):

- Gain informed consent from those who will be participating in the study.
- Inform them of the nature of the study and that participation is voluntary.
- Ensure that those who participate are protected from any form of harm and that they are not being deceived.
- Select a balanced proportion of participants so as to avoid excluding certain groups.
- Ensure that privacy and confidentiality are protected so that participants are not unwittingly put in an undesirable position as a result of the study.

6.16 Conclusion

This chapter details the research methodology and methods of this study, which sought to understand the perceptions of citizens and experts toward community projects and the factors that contribute toward energy transition. The study adopted an interpretivist approach, as the researcher's stance considers reality not to be objectively determined, but socially constructed by those who experience the phenomenon. A constructivist approach was deemed appropriate to elicit different perspectives as perceived by participants. The analysis of the study was based on primary data, which was guided by the literature review to understand the views of individuals and experts regarding the social resources held in communities needed to implement CRE projects.

CHAPTER SEVEN:
PRESENTATION OF FINDINGS

7.0 Introduction

This report analyses the data collected from experts and citizens using semi-structured interviews. The empirical results are analysed in order to explore the perceptions of citizens and experts on the implementation of community solar PV projects and the available social resources that could potentially influence the success of CRE projects in Johannesburg, South Africa. Themes, sub-themes, and categories that emerged from the data are discussed, and the perceptions of community solar projects are supported through quotes from individuals and experts. Data was collected from all hemispheres of Johannesburg (southern, northern, eastern, and western parts of the City), and treated as one case study instead of as comparative cases.

This study is guided by an interpretive paradigm, which aims to understand participant narratives from their own contexts. The study adopts social capital constructs to understand the social resources in communities, and to ascertain whether communities have the potential and are well-enough equipped to implement community solar projects. A number of participants were chosen, as shown in Table 7.1 below. It was important that the study first determine the level of knowledge and environmental concerns concerning solar PV and CRE projects, and then assess social resources within communities.

7.1 Profile of participants

Before detailing the findings of the current study, it is important to examine the profile of all the participants in this research. The demographic profile plays an important role in providing context to the perceptions of citizens and experts, and is summarised below.

Table 7.1: Demographic profile of participants

Participant pseudonym	Gender	Age	Organisation/type of organisation	Employment status	Area
Individuals					
Participant 1	Female	45-55	Funding agency	Employed	North
Participant 2	Male	45-55	Investment company	Self-employed	North
Participant 3	Male	45-55	Funding agency	Employed	North
Participant 4	Male	45-55	Property developer	Employed	North
Participant 5	Female	56-64	Consulting	Self-employed	North
Participant 6	Female	30-44	Construction company	Employed	North
Participant 7	Female	30-44	Construction company	Employed	North
Participant 8	Female	30-44	Community leader	Employed	North
Participant 9	Female	45-55	Construction company	Employed	North
Participant 10	Male	45-55	Resource company	Self-employed	North
Participant 11	Male	45-55	Funding agency	Employed	South
Participant 12	Male	30-44	Banking	Employed	North
Participant 13	Male	45-55	Energy sector	Self-employed	East
Participant 14	Male	30-44	Engineering	Self-employed	North
Participant 15	Male	45-55	Energy sector	Self-employed	East
Participant 16	Female	45-55	Government agency	Employed	North
Participant 17	Male	56-64	Infrastructure development	Employed	West
Participant 18	Female	45-55	Funding agency	Employed	South
Experts					
Participant 19	Male	45-55	Infrastructure development	Self-employed	East
Participant 20	Male	45-55	Department of Energy (policy unit)	Employed	North
Participant 21	Male	45-55	Funding agency	Employed	North
Participant 22	Male	45-55	Developer (solar PV) 50MW to date	Self-employed	West
Participant 23	Female	45-55	Innovation hub	Employed	North
Participant 24	Male	56-64	City of Johannesburg (local municipality)	Employed	South
Participant 25	Male	45-55	Funding agency	Employed	North

Source: Author-generated

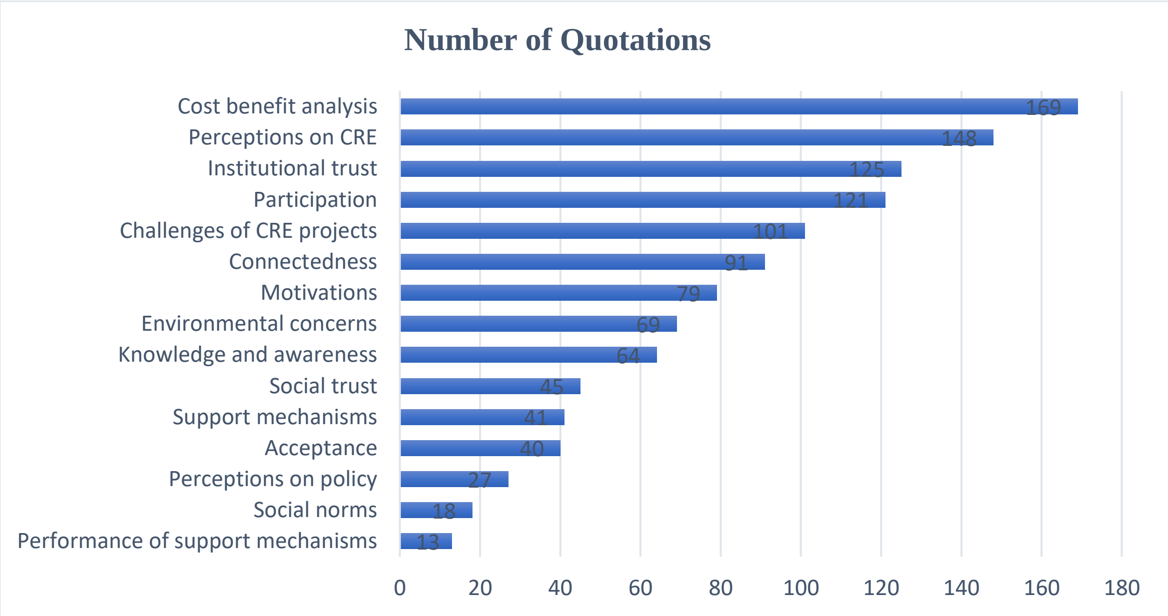
A total number of 25 participants from Johannesburg participated in the current study. The demographic breakdown shows that 17 participants were ordinary citizens from different communities in Johannesburg suburbs, and the remaining eight were experts on renewable sources. The demographic information is clustered according to their gender, age, type of organisation, employment status, and finally, the participant's area of residence. Of the 25 participants who were interviewed, 16 were males and nine were females.

A key aspect that emerged was that all the participants owned their own property, which is omitted from the table. Of note, 17 participants resided in the northern area of Johannesburg, three from the southern part of Johannesburg, three from the eastern parts, and two were from the western area of Gauteng province. In terms of education, seven participants held undergraduate university degrees, and 18 had completed university postgraduate degrees. With regards to the participants' occupation, 17 were employed, and eight were self-employed. Lastly, the research population consists of people aged between 30 and 64.

7.2 A brief analysis of the themes developed from the interviews

The results generated by the data analysis contribute to building this study's theory. 15 themes and several sub-themes emerged from participant narratives that contributed to answering the research questions at hand. The main themes to emerge from this study are presented in Figure 7.1 below, and sub-themes are detailed in the discussion of the main themes. The graph depicts all the themes collected from data analysis and the number of quotations obtained for each theme.

Figure 7.1: Main themes and frequency of quotations



Source: Author generated

The graph above indicates that the most discussed theme, according to the data, was 'cost-benefit analysis' of solar projects, with 169 quotations being noted in total, and all participants (n= 25) commenting on the theme. 'Perceptions of solar PV sources and community projects was the second-most discussed theme with 148 quotations. 'Institutional trust' and 'participation in social networks' were a close third and fourth, respectively, with 125 and 121 quotes recorded in total. Themes with the fewest quotations included: 'promotion and awareness' (25), 'social norms and values' (18), and lastly 'performance of support mechanism' (13).

7.3 Knowledge and awareness

As previously mentioned, assessing the level of knowledge about a particular technology is essential since knowledge can influence decisions of whether to accept or reject new or alternate technologies. Compared to other countries, solar PV is still in its infancy in South Africa. Hence, participants were asked knowledge and awareness questions to ascertain their levels of knowledge and awareness regarding solar PV technology and CRE projects, especially in order to estimate the potential influence of knowledge on their perceptions concerning community solar projects. This approach allowed for the study to include subsequent appropriate questions to help fully understand the level of solar PV awareness among participants. All participants were aware of solar PV sources and their potential, as most had already adopted some form of solar (for example, solar geysers or solar panels) in their own households. Despite a general awareness of solar PV sources, however, all participants who were interviewed had varying levels of knowledge and awareness, as one of the interviewed officials (PT20) mentioned:

> *"I think you can classify the general public into three: there are those that are totally unaware; they are not alive to alternative energy – the rationale, the benefits, the pros and cons, and tend to be the last movers. Then there are those who are at the cutting edge – those that will push the boundaries because they have seen what it can do elsewhere; they are fast movers – let's call it the sophisticated. Then you've got the middle – those are the ones that will follow because they have seen the benefits from somebody else."*

The wide range in levels of knowledge and awareness was further supported by the following participants' quotes listed in Table 7.2 below. The table highlights relevant comments made by some participants concerning their knowledge and awareness about solar PV technology and community projects.

Table 7.2: Excerpts presented by participants regarding knowledge and awareness about solar PV sources and community projects

Participant	**Excerpt**
Participant 3	*"… I am fairly knowledgeable, not as an expert but just as being entrusted in renewable energy and how it can help us, as far as I know…"*
Participant 7	*"I am fairly knowledgeable… not that I'm an expert or anything. We have installed this type of a system in a number of places…"*
Participant 11	*"I have a lot of background experience in terms of solar."*
Participant 16	*"My knowledge about solar… honestly, I don't have much depth on that."*
Participant 25	*"I am quite knowledgeable as a man in the street… I have a very good grasp of what's in this business."*

Source: Author-generated

Considering that solar PV is still new and not widespread in South Africa, participants note that there is insufficient promotion in the industry, and that knowledge, especially concerning benefits, is currently isolated to those in the solar industry. Participants indicated that there is inadequate promotion by companies in the industry, who are normally focused more on the market and where there is interest in the product. This assertion was supported by participant 22:

> *"Awareness is really driven by a perception of where the market exists for solar, and the guys that would be promoting that would be [the ones] providing solar energy and installation."*

Other participants are also concerned about the inadequate promotion of solar PV sources. They argue that the government is not actively promoting the dissemination of solar PV, and is instead focusing more on large-scale developments. These assertions are reflected in Table 7.3 below.

Table 7.3: Excerpts on promoting and creating awareness

Participant	Excerpt
Participant 18	*"The only thing that gets coverage is the IPP program, and that's an industrial scale […] It is not marketed enough."*
Participant 21	*"From where I sit, it is only technical people who are in the energy space who really get to know and discuss or drive it. But generally, communities out there have little knowledge about the PV or renewable energy projects…"*
Participant 21	*"Honestly, there is not much promotion – there is no one out there in government driving solar PV at an individual or community level."*

Source: Author-generated

Because of the government's decision to increase the electricity tariff annually, however, there is a perception that it will result in numerous people seeking out alternative energy to counter the increase, which will create awareness about the available options. This assumption is supported by a statement from participant 20:

> *"So, I think by-and-large the tariff['s] upward pressure on the residential user [is] largely driven by Eskom and also by municipal sur-charges […] So that will push a lot more people into awareness of more cost-effective options that are available out there, and solar PV is one of them."*

Considering that the concept of CRE has not been introduced in the country, participants were asked their thoughts on CRE projects. One of the participants (PT 1) stated that:

> *"I don't see it as a large thing, I see it more as smaller, compact, little engagements or arrangements between people; probably people who have the money, and people [who] have the initiative and the knowledge to do that, and I think that solar components can eventually feed into something bigger. That's how I see it. But for [a] community base, I don't see it as a huge project; I see it as small interventions that eventually can make a big difference."*

In urban areas, some buildings could be used to mount solar PVs for community projects. In many communities, shopping malls, garage stations, schools, and churches are all viable locations to implement solar projects. However, whether the concepts can be applied in

South Africa remains to be seen as it will impact the dynamics of the current system. The following quotation from participant 13 amplifies this deliberation:

> *"Yeah, in an urban setting, I think it makes sense, and I can think of two instances where it would make sense. Firstly, say, for a school, it would be a facility that is of common interest to a community, so I can see parents who have kids in the school investing in the project for power supply to the school to reduce the running cost of the school, and hopefully reducing their fees. Or people living in apartments or complexes paying for the installation of a renewable project to cover their consumption, or the common area consumption, which will then again reduce the cost of some levies in such a community.*

Further elaborating that:

> *The idea of generating for feeding into the grid for profit – great idea, but [...] I am not sure if, in this country, they would do that, because it would then upset the dynamics of the energy provision industry in the country if private citizens can jump into the grid and get paid for it."*

It was noted, however, that CRE could work in rural areas: there is adequate space in rural areas to develop community solar projects, but it would require government support to develop projects for such communities because many people in rural areas lack the necessary funds to establish solar PV projects. According to participant 13:

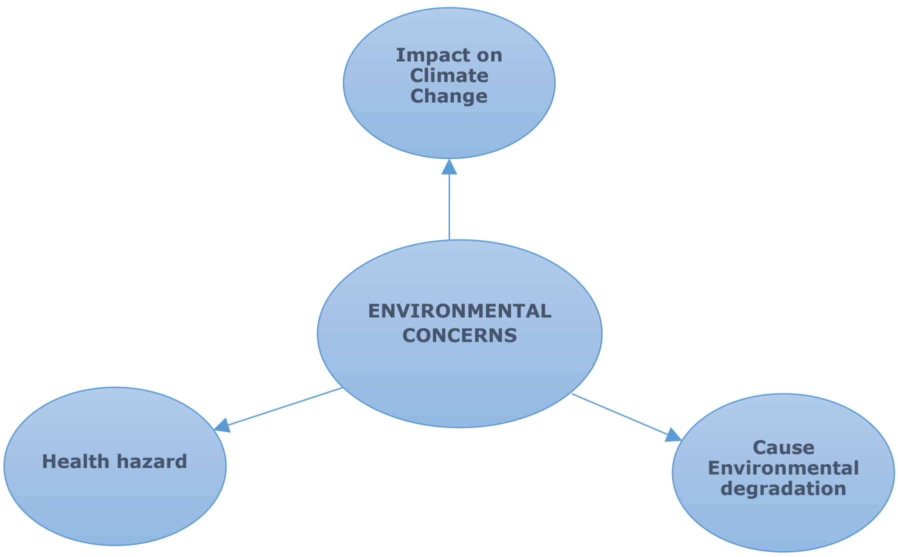
> *"Community... one tends to think of a rural set-up, but I can imagine it in an urban setup as well, but my first instinct would be rural, poor, and the project being mainly for economic upliftment of that community. But it can also be done in an urban setup."*

It was important here to assess participants' knowledge about technology since it is only the technologies that people are familiar with that get adopted as they realise the benefits of solar technology and collaboration in such initiatives. There was a general agreement that not enough has been done in the country to promote solar PV technology, let alone the technology's involvement in CRE projects. It was observed that those who had already adopted solar PV sources were now leading the charge to implement solar PV both at the individual and business levels as a result of ongoing challenges with current electricity providers. According to these findings that examine knowledge about community projects, communities in most areas are already engaged in some type of project. Participants are aware of the potential of solar PV sources but have not considered CRE projects. When asked about CRE projects, most people were quick to refer to RE projects in rural areas because the government is promoting community benefits in those areas.

7.4. Environmental concerns

The study enquires about participants' environmental concerns in order to assess individuals' level of concern about such issues, where they highlighted several environmental concerns and their impacts on the environment. It has been argued that those aware of environmental issues tend to look for alternative ways to contribute to environmental protection. While most participants were aware of climate change and that fossil fuels contribute to environmental degradation, some participants believed that humans are too insignificant a factor to cause climate change. The analysis highlights three main points from participants when asked about environmental issues, namely that fossil fuels: (1) contribute to climate change, (2) cause environmental degradation; and (3) can be a health hazard, all of which are depicted in Figure 7.3 below.

Figure 7.2: Diagram showing the environmental concern sub-themes pointed out by participants



Source: Author-generated

Analysis reveals that some interviewees are concerned about air pollution, and assert that finding an alternative to fossil fuels would contribute to saving the environment. As mentioned by participant 10:

> *"Firstly, we know that there is a lot of impact on the globe; global warming at the moment and most of it caused by fossil fuels. So, my immediate response is that if we can find a substitution to those sources of energy, we would have gone a great mile to resolve this problem that we are facing as a globe in terms of global warming."*

This assertion was further echoed by other participants, as shown in Table 7.4 below.

Table 7.4: Excerpts on concerns about air pollution caused by fossil fuels.

Participant	**Excerpt**
Participant 12	*"I am particularly concerned about air pollution; they pollute the air which people inhale, and it can lead to some detrimental health [issues]."*
Participant 13	*"Firstly, in terms of health, pollution affects the health of communities, especially if the pollution is within those communities, so fossil fuels cause pollution, [and] pollution affects health."*
Participant 19	*"If you go to Mpumalanga where production is happening and you look at the community, how they are suffering from coal dust, the health issues that come with that."*

Source: Author-generated

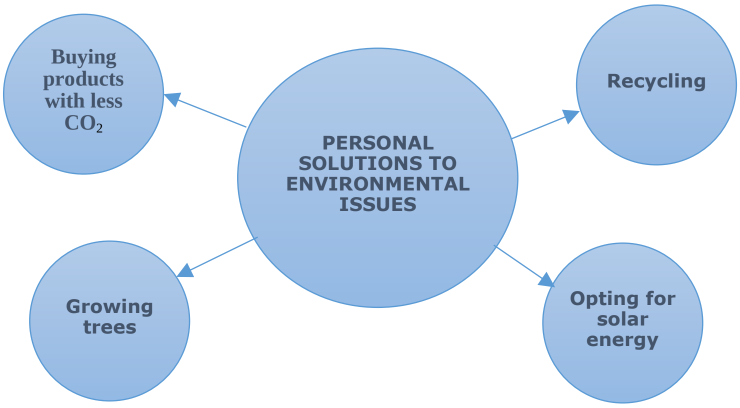
There is ongoing debate concerning the contribution of fossil fuels in driving climate change, with sceptics questioning if humans are responsible – a belief that was articulated by some participants in this study, for example, participant 14:

> *"I think at the core of it, humans are causing climate change, but I just believe we are so insignificant that our impact cannot alter the weather."*

7.4.1 Personal contributions

When discussing environmental issues, participants highlighted their own contributions to addressing climate change. Individuals, communities, businesses, cities, and other organisations are taking action and are increasingly moving away from dependence on governments to help fight climate change. The culmination of multiple people changing their behaviour to favour the environment has some potential to address climate change, rather than waiting for governments to transform the energy sector. Interestingly, participants identified several important contributions they engage in, in order to reduce the impacts of climate change, as illustrated in Figure 7.3 below, and the comments that follow.

Figure 7.4: Participants' personal contributions to the environment



Source: Author-generated

7.4.1.1 Recycling

Some participants commented that they are concerned about the environment and have started recycling. One participant highlighted that, although they are not a conservationist, they are worried about environmental sustainability, hence their desire to contribute to saving the environment via recycling. Participant 4 made the below assertion:

> *"I would not say I am a greenie beanie, but I care about the sustainability of our environment. I care about the fact that we need to be able to sustain in terms of the future of the next generation – we cannot really exploit whatever is with us now and not leave anything for the next generation. So, let's recycle to keep our environment clean."*

Another respondent (PT 7) had a similar perspective and declared:

> *"The only thing I am particular about is the littering. I make sure that it doesn't happen. At work, we [have] already created ways of dealing with recycling, a lot of recycling. So that's how we are dealing with it currently, recycling."*

7.4.1.2 Opting for solar energy

Participants also mentioned opting for solar energy as a viable option in reducing environmental degradation and the associated pollution. Participant 15 contended that:

> *"So, one can do much better [...] if I put my solar geyser and my solar PV on the house, I would reduce a lot on using electricity, which will contribute to reducing carbon footprint."*

Participant 16 supported the above idea by alluding that:

> "*... opting for solar energy [...] is cheap and not hazardous to our health."*

7.4.1.3 Growing trees

In addition to recycling, some participants discussed growing trees as a solution to curb environmental degradation. Information derived from the participants indicates the need to actively protect the natural environment by planting more trees, and recycling products made from tree material. Two of the participants highlight this belief, as seen in their statements in Table 7.5 below.

Table 7.5: Excerpts on the growing of trees

Participant	**Excerpt**
Participant 12	*"... by going digital and not printing, so indirectly we save the trees."*
Participant 14	*"I plant trees."*

Source: Author-generated

However, participant 13 had a different view to those presented by the participants above, stating that:

> *"... adaptation is probably the best cause of action, rather than trying to prevent it. [I'm] not sure if we can prevent it through growing trees to take the carbon generated by the fossils."*

7.4.1.4 Buying eco-friendly products

Some participants comment on purchasing eco-friendly products with smaller CO_2 footprints, for instance, in the processes of production, use, or disposal. Some people choose to go vegetarian or vegan to reduce their CO_2 footprint as part of their contribution toward preserving the environment. This is echoed through participant 19, who said:

"*Yes, I try to adopt technologies which are more efficient. So, let's buy products with less CO_2 and methane, try to cut down on meat consumption wherever I can, or try to buy local; I think that also helps…"*

Reinforcing the above statement, participant 25 emphasised the use of eco-friendly products as a solution, claiming that:

"I live in a house that I believe is eco-friendly, we've done a lot to make it as eco-friendly as possible. We've lowered our cost of energy based on the design in the things that we have, we have installed the gas heater and the gas geyser now in November – we believe it's one of the steps of going green as a household."

South Africa is one of the countries facing the most significant impacts from climate change, where visible signs have already been noted, especially regarding recent weather patterns (for example, water usage and drought). From these findings, it is clear that people are aware of environmental issues and have taken steps towards protecting the environment.

7.5 Social acceptance

Social acceptance, as in the case of community solar PV, plays a crucial role in the success of any initiative, and is a deciding factor on whether renewable energy (RE) sources will succeed in South Africa. Unlike other RE sources such as wind energy, individuals can generate their own electricity using solar, and often prefer putting solar PV panels on their rooftops themselves without engaging in a collaborative effort. As such, this study will first highlight the acceptance of solar technology and community projects before discussing the positive and negative perceptions about community solar projects.

It is important to note that one of the main themes generated from the analysis referred to the acceptance of community solar PV projects. Most of the participants maintained that they were willing to install solar PVs in their homes, whilst some stated that they had already installed them due to their efficiency when it comes to load shedding implemented by Eskom.

Participants were first asked if there were community projects in their areas in order to ascertain whether there is already a working relationship amongst community members. Some participants mentioned that they were already involved in community projects, but none of them were solar. As is in line with this study, one participant commented on their involvement in raising funds for solar streetlights in their community, but not on a large-scale since they relied on individual and business contributions. Participants expressed that they were already involved in community projects in their areas; according to participant 1:

> *"Well, we are doing it now. But we also have other community projects, for instance, we have a river near to us and then the community every now and then, we come together and clean the river. We also now and then put sands on the roads to fill potholes temporarily – we have got that intervention, yes."*

It was noted from the interviews that respondents were aware that relying on municipalities to deliver on all services within their jurisdiction was unrealistic, leading one of the respondents (PT 1) to say:

> *"I think it is important to understand that we cannot take everything to the municipalities. We have a lot of backlogs, and we have no choice as a community if we want to make a difference…"*

Supporting the above statement that municipalities are overburdened, a municipality official acknowledged that communities have an obligation to ensure that their areas are maintained if municipalities are unable. This takes into consideration that municipalities in South Africa often face financial woes because they are unable to collect revenue from consumers. He (PT 24) notes that:

> *"Of the many needs that municipalities ought to meet, certain portions of service delivery would be neglected, quality of river systems, quality of electricity."*

The analysis also indicates that some participants had already installed solar PV systems on their rooftops and were enjoying the cost savings, as seen in Table 7.6 below. However, it should be noted that the adoption of solar PV technology in urban areas in South Africa is limited compared to other developed countries.

Table 7.6: Excerpts on adoption of solar PV sources

Participant	Excerpt
Participant 1	*"We have installed solar in our house, and we are going to install a lot of solar panels on hospitals."*
Participant 11	*"I have adopted them for my house."*
Participant 16	*"Absolutely, I have installed one, and it reduced the cost of our electricity that we pay on a monthly basis, and it works efficiently."*

Source: Author-generated

While some participants have already installed solar PV panels, others are aware of the benefits of solar PV but are still considering installing solar PV: they believe it will reduce grid pressure and save on costs. This statement was supported by one respondent (PT 10) who stated the following:

> *"I have considered installing solar PV; I think it is the best way to go. First of all, we would lessen the burden on the national grid and take advantage of what we have naturally. The investment is once-off, of course, we have maintenance, but you know you have invested once, and it is for a long period, at least you know: five years, you don't have to be paying bills every month."*

7.6 Perceptions on community renewable projects

As a result of ongoing problems with unreliable electricity sources and increases in tariffs, several individuals and companies are looking for alternatives to state-utility electricity provision. There have been intermittent power cuts in South Africa as a result of the government failing to invest in new generation when the state utility advised them. On the other hand, because of the need to finance two mega coal power plants, the electricity tariff has been rising and will continue to increase in the coming years. In some areas, cables are being stolen, which impacts electricity supply. In this study, participants highlighted both positive and negative perceptions towards the acceptance of solar PV sources and community projects, as seen in Table 7.7, and Figure 7.5 below. One respondent (PT 1) stated that:

> *"…at this stage, people would love to go off the grid, but I think it is motivated by other reasons. It might be because of the unreliability of electricity and the cost going up, but seriously we are moving into that direction, where people are really educated in terms*

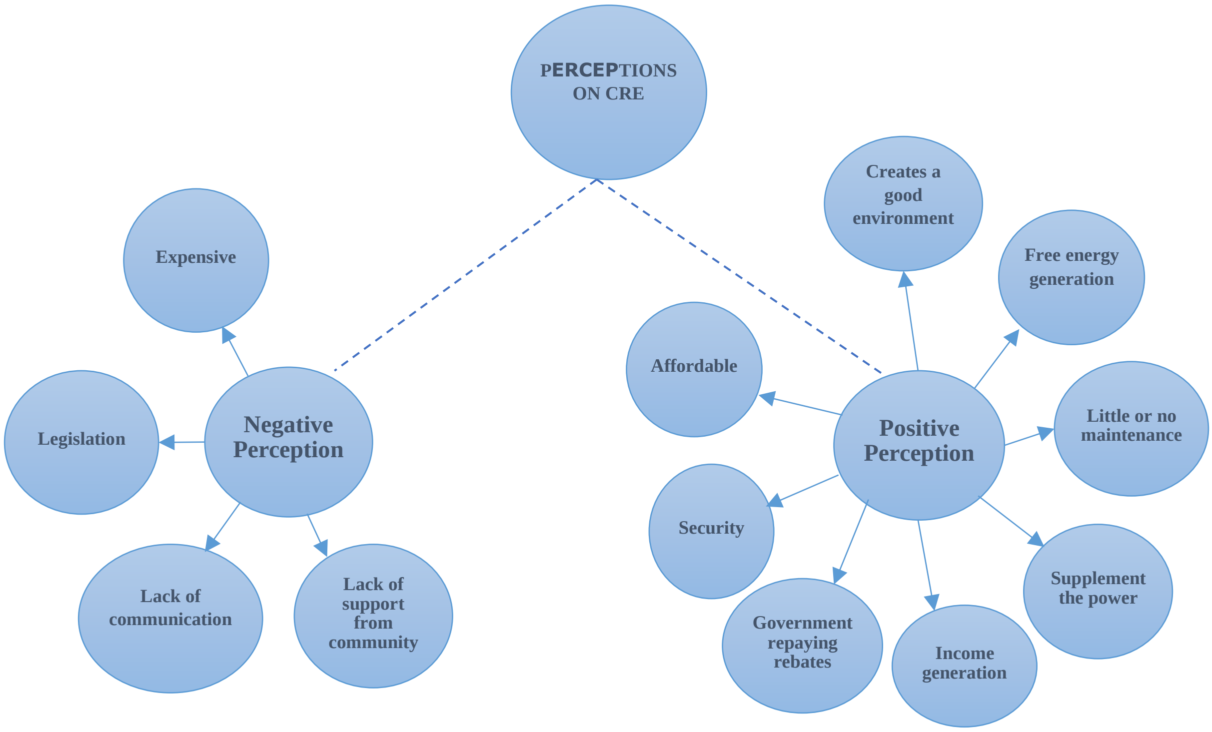
of the benefits of solar energy in a community and how smaller communities can contribute to the greater good."

Table 7.7: Excerpts on the acceptance of solar PV technology and community projects

Participant	**Excerpt**
Participant 2	*"… solar PVs are actually the future – a lot more needs to be invested in the research and development as well as capital expenditure."*
Participant 12	*"… I think definitely it could work; it just needs fierce stakeholders to embrace it and understand how it can impact the country at large. Given the power challenges that we have, it is something that they should be considering."*
Participant 18	*"If you create the market for this economic driver that [is] to build the plant for the solar, you would then create off-grid systems that would then feed into particular communities."*

Source: Author-generated

Figure 7.5: Perceptions on community renewable energy projects



Source: Author-generated

7.6.1 Positive perceptions

Throughout the analysis process, it seems that most of the participants acknowledge that solar PV is a solution for resolving the ongoing challenges and crises with the electricity system. As noted below, South Africa has excellent solar exposure and, considering that the cost of solar PV has decreased, a great opportunity exists. In addition to the sentiments expressed in Table 7.8 below, one participant (PT 23) commented that:

> *"I think solar PV has great potential, and the potential stems from the fact that we have excellent radiation, and the cost has come down drastically over time, especially for utility-scale. The cost is slightly higher for small scale solar PV, but it has become competitive as a renewable source of energy."*

This was further supported by another respondent (PT 12) who pointed out that this is something new, and that community projects could make a difference in communities:

> *"…these community projects can be a ground-breaking initiative if people realise the benefits beyond just self-satisfaction - it can go a long way in helping this community at large, however, the execution is going to be very important."*

One official (PT 24) also stressed the importance of advancing wider community involvement:

> *"We [are] anchored within the city, the growth and development strategy; it is anchored on sustainable development goals, the leverage is to teach the people: even if you can do the small-scale type of renewables, it is appropriate."*

Building on the above statement, another respondent (PT 20) highlighted that:

> *"So, you can have smaller [projects]; you can bring more people into the mainstream of the economy through this solution without it being a 'Cinderella' business. It is a core business because the world is moving away from integrated large-scale utility times. It is more distributed and spread with smart systems."*

Table 7.8: Excerpts on the acceptance of community solar projects.

Participant	**Excerpt**
Participant 10	*"I think it is a noble project – it is something that you need to obviously get the politics."*
Participant 15	*"… this can be a very ground-breaking kind of a project where you educate communities that there is an alternative, which is cleaner, which can also be of benefit to them."*
Participant 16	*"We need such projects to stimulate the economy – it is not only about cost reduction, but it is also about income generation and stimulating other projects."*
Participant 19	*"These projects will not only benefit South Africa but […] will benefit Malawi, Lesotho, Namibia, Zimbabwe and countries around us."*

Source: Author-generated

7.6.2 Community renewable energy project benefits

CRE projects are thus considered beneficial to communities in several ways. Participants have highlighted a number of benefits derived from forming community solar PV projects, which are discussed in the following section.

7.6.2.1 Free energy generation

Participants emphasised the fact that supporting the supply of electricity from solar PV is an opportunity for them to produce electricity themselves rather than relying on state utility services. They believe that electricity from solar PV is free and could improve energy generation in the country. Once the upfront cost is paid, electricity becomes more or less free thereafter, where the only thing that communities need to be concerned about is maintenance. Hence, participants stress the value of free energy generation, echoed by participant in Table 7.9 below:

Table 7.9: Excerpts on free energy from solar PV

Respondent	**Excerpt**
Participant 6	*"I think about the cost - is it affordable? I also think about the free energy that can be generated, amazing."*
Participant 11	*"Solar is kind of free energy."*
Participant 18	"*I am a proponent of solar PV technology because [of] the obvious reasons of free energy generation."*
Participant 25	*"This community solar PV project, could actually improve [the] energy situation in the country if a lot of communities were to adopt the concept, because it generates energy freely, which is cost efficient."*

Source: Author-generated

One of the participants (PT 7) further argued their support of renewable energy projects, suggesting that renewable energy projects could benefit local communities instead of international companies:

> *"We have a free source of energy, most of the time, throughout the year. We get international companies coming here setting up the solar PVs and [...] selling electricity to us [that] we could be producing. This would be an opportunity for us to produce electricity for ourselves and not have to worry about paying someone else."*

7.6.2.2 Source of income

The perception that solar PV installation creates a source of income was emphasised by participants. It is worth noting that, if a feed-in policy is introduced, communities could produce electricity and sell it to the grid, and the profits could be used for developmental purposes. This is supported by participant 11, who notes that:

> *"... if we could put up the solar panels, it can generate income for the community."*

Participant 15 furthered the above sentiment, saying:

> *"What comes to my mind is that communities that are generating their electricity for their [own] use, and if they've got excess, they can put it on the grid and make money for themselves."*

Adding to the above statements was a participant from the municipality (PT 24) who highlighted that:

> *"There is something that is called democratisation of the network: the community, if they have put solar PVs [up], they have got surplus electricity: they can sell that electricity to us, we would love to buy that electricity during peak periods because that's when we buy electricity at higher prices."*

South Africa is a country facing substantial inequality issues. As such, participants believe that if people in townships are able to sell electricity to the grid, it could encourage positive feedback that would benefit even more people. As one expert (PT 22) pointed out that:

> *"We are living in a country where the macro-economic policies are wrong from the start. To correct the ills of such macro-economic systems, such as if you empower society, i.e., if, within the townships, people are given the opportunity to create [their] own electricity systems [and] enter into a contract with the municipality, the municipality will buy your electricity at such time and such cost – that could work."*

Another participant (PT 23) further remarked on the current policy system that promotes large-scale development:

> *"Stop being robust to operate in policies that are not addressing current developmental needs. Remove those barriers of entry, and […] you are emancipating municipalities, you are emancipating development of the economy, and the people. That's my opinion, rightly or wrongly."*

A third participant (PT 19) reinforced the above statements and described how this process could unfold, particularly as most people are not home during peak solar energy generation hours. The electricity could then be sold elsewhere, especially when a storage facility is unavailable, avoiding any electricity being wasted. He highlights that other organisations could use that electricity during the day:

> *"This is how it would then work: […] if you generate electricity at a time during the day, at a time when most of you are at work, […] you are not using that electricity, That electricity you can sell […] and you are then able to generate income."*

7.6.2.3 Potential income for developers:

As mentioned previously, South Africa promotes large-scale developers for RE supply, and several international companies have set up offices in the country to capitalise on the opportunity**.** When asked whether developers would be interested in community projects – considering their focus is typically on large-scale developments with greater capital and profits involved – one of the experts (PT 20) interviewed remarked that:

"I don't think it is about the margins. We've run models where the returns on small-scale alternative energy solutions are much more attractive than large ones."

Further remarks on the issue of profits from large-scale developments were made by another developer. The participant (PT 22) noted that the cost of panels has vastly reduced, and if developers were not generating a profit, they would not be providing electricity at the low rates seen in recent bids:

"The cost of solar PV technology has come down drastically. In the later days [of] REI4P, they would not be going at low rates if they didn't think they would be making money – it is […] supply and demand at the moment."

7.6.2.4 Potential income for municipalities

One participant argued that adoption of solar PV in South Africa could be a source of income for municipalities if they partner with communities, particularly since individuals and businesses are already installing solar PVs to generate electricity. This was echoed in participant 13's comment:

"So, I think municipalities are going to get into a deeper and deeper hole because people are already starting to put up their solar PV. So, that is affecting their income […] let's see if they come up with a solution – they could partner with communities instead."

One participant from the municipality (PT 24) stated, however, that they are looking at ways to accommodate communities:

"We are also looking at the probability and the possibility of changing our tariff structure [to] such that we can accommodate renewable energy generation from individuals and companies, that we can buy that energy at prices that would not put the city at a disadvantage."

Participant 24 further remarked that:

"We have to put bi-directional meters between ourselves and those that have renewable energy, such that now we can submit what we are gaining and what they give us, so it would be net-meter terrain."

Participant 20 felt it would be difficult to set policy at the national level that focuses on CRE projects since municipalities exist at the local level, questioning the focus on municipalities, and where that leaves the state-utility:

"It is a tricky one because it is not a national government issue alone to the extent that it impacts municipal financial viability. So, you could not have a policy stance that would drive municipalities to the ground."

Participant 20 further remarked that municipalities rely on income from electricity. Therefore, it has to make economic sense for municipalities to engage in such ventures:

"Remember, municipalities survive on three financial living elements: its equitable share, which is government allocation; its property rates; and utilities, [where] utility is basically electricity. So, you drive this from the national government, but being cognisant of the fact that you cannot impose it and you have to persuade people and show them how this could work side by side with municipalities."

Participant 13 supported Participant 20's considerations:

"... if you look at the way municipalities in South Africa are structured, they also sell electricity. So, if the electricity is generated within those communities, it might be a source of income for the municipalities as well, so I think the adoption might be much bigger than we think."

Regarding partnering with developers to implement community energy projects, one of the developers (PT 22) argued that municipalities are resellers of electricity, which would make it difficult for municipalities to buy electricity from a third party to then sell to the community:

"A lot of municipalities are not keen on resellers because municipalities rely on that small margin to keep the coffers funded."

Overall, based on the perceptions of individuals from all three parties, although support exists for community solar projects, difficult situations embedded in the current structure must first be overcome. The state utility sells electricity to municipalities and some of its customers; the municipality is responsible for distributing electricity, and derive income from such transactions. A win-win solution must be identified if municipalities are going to remain in the business of providing electricity to communities. Consumers will continue to intrude on the system, therefore, government will need to enforce regulations to protect consumers and municipalities, ensuring that individuals do not overload the system.

7.6.2.5 Little or no maintenance

Interestingly, some participants highlighted that they are not overly concerned with maintaining solar PV technology or sources. Some argued that there is little to no maintenance involved, where a lack of concern was noted by participants in Table 7.10 below.

Table 7.10: Excerpts on the maintenance of solar panels

Participant	**Excerpt**
Participant 9	*"... and with less or no maintenance as the solar will be a once-off installation on the rooftops."*
Participant 13	*"And the maintenance is not perceived to be heavy, so most people may feel that they can handle it."*
Participant 15	*"...solar energy is very affordable and does not need much maintenance."*
Participant 18	*"I am a proponent of solar PV technology in South Africa because [of] the obvious reasons of free energy and little to no maintenance or cost in operating."*

Source: Author-generated

7.6.2.6 Harmonious environment

Participants also highlighted perceptions that solar PV contributed to a clean, good, and harmonious environment in communities, as seen in Table 7.11 below.

Table 7.11: Excerpts on environmental contributions made by solar PVs

Participant	**Excerpt**
Participant 4	*"… the benefit of renewable energy […] creates a good environment, and we need to deal with those other forms of energy that are not good for our environment."*
Participant 19	"*… it reduces health issues: we are not burning things, so health-wise, our community would be really cleaner. So, if that goes to the whole country, then we are a clean nation, a clean environment."*

Source: Author-generated

Continuing the sentiment of those above, participant 15 notes that:

> *"Obviously, with global warming […] it is important because you know that when you put a [solar] PV, you are not going to use an irreplaceable resource like coal and things that people mine [which] are not replaceable. So, the sun is always there, we are using that, so we have less emissions, so it is highly important to protect the environment."*

7.6.2.7 Supplement power generation

There was a perception identified wherein RE technologies are seen to supplement traditional power generation, as evident in the quotes from participants in Table 7.12 below.

Table 7.12: Excerpts on supplementation of power

Respondent	**Excerpt**
Participant 1	*"I think solar components can eventually feed into something bigger […] I see it as small interventions that eventually can make a big difference."*
Participant 13	*"… community solar projects or community projects basically are there to supplement the power which is good."*
Participant 18	*"It will supplement some of the power that we need as a country, but not at the industrial scale. I think we all understand that if the sun is shining, if the wind is blowing, you will get to use renewable energy."*
Participant 19	*"To me, it is lucrative; it's an area that we really need to look at as a supplementary way of generating energy."*

Source: Author generated

Participant 24, from the municipality, supported the above:

> *"... if we talk to communities who already have solar systems on their premises, if we say to them: we need X amount of megawatts, the total of that could make a difference."*

7.6.2.8 Security

When asked about the benefits of community solar projects, some participants argued that such projects would promote energy supply security for the community. This was highlighted by one of the participants (PT 24) who noted that:

> *"Solar PV can play a significant role in energy poverty alleviation – solar energy could be useful when combined with a storage system, particularly the battery system."*

Table 7.13 below presents additional support for participant 24's from other respondents

Table 7.13: Excerpts on security of supply

Respondent	**Excerpt**
Participant 3	*"I think that's where I would love to see it because I think [what] they can do is huge: it brings about security through easy supplementation of power, which is cheap and easy to generate."*
Participant 8	*"Improved security in the area through Solar PV installation."*
Participant 25	*"We are driven by the need to get reliable source."*

Source: Author generated

7.6.3 Negative perceptions of solar PV technology

Some participants have negative attitude concerning solar PV technology and argue that it is still expensive, considering the upfront capital costs when compared to traditional electricity system as illustrated in the comments below:

7.6.3.1 Expense and inefficiency

Interestingly, some participants indicated negative perceptions towards solar PV technology, labelling it expensive and inefficient compared to conventional electricity provision. However, one participant from the municipality (PT 24) did point out that people need to be better educated on solar PV:

"The perceptions from a lot of people is that it does not totally meet your entire energy needs, and, to some extent, some people think it is an inferior form of energy. However, some people [...] realise the need [for] energy [to] be mixed, utilise solar for lighting, entertainment, whilst for cooking, they utilise gas. And few of those who are enlightened within communities who utilise that tend to be satisfied, given that solar energy comes with storage."

Other participants commented on the cost of solar PV sources, noting that upfront capital cost is a deterrent, as seen in Table 7.14 below.

Table 7.14: Excerpts on the excessive cost of solar technology

Respondent	**Excerpt**
Participant 11	*"For me, I think the biggest problem is the cost of solar PV. The technology is supposed to be getting cheaper now, previously it was quite expensive, and it wasn't efficient."*
Participant 12	*"A lot of people love them, but the cost structure is quite high at the moment."*
Participant 18	*"People still have a perception that they are expensive."*
Participant 25	*"The perception still remains: it is expensive, but also it is a practicality thing – who is at the house or who is at the facility at the time when you are dispatching that power."*

Source: Author-generated

Participant 7 also alludes to the above:

"Definitely. I mean the capital costs of doing that – of putting [in] my own solar PV – just the capital cost alone depends on [...] the square meters of your house, the bare minimum [...] is ZAR250 000. Not everybody's got that type of cash [...] I think that's the main reason why people are not doing it at an individual scale. It is a bit expensive."

7.6.3.2 Lack of support

A negative perception highlighted by participants, which could affect the implementation of community solar projects, was a lack of support by community members. This assertion was highlighted because of challenges in rural areas where solar PV projects were already implemented. In some areas where there is no grid access, the government took the initiative to install solar PV panels for communities. In other large-scale developments, developers were expected to contribute to socio-economic development, but major challenges were encountered in the process; hence, the negative perceptions such as those echoed by participant 20:

> *"Community projects have, over time, been rolled out, I think since 1999. So, we've got ample experience with perceptions from the community about that, and I must say it varies from area to area. So, by-and-large, it's not acceptable as a permanent solution because there is lack of community support and community members do not agree on one thing…*"

Other participants also expressed a negative attitude towards community projects, which are outlined in Table 7.15 below.

Table 7.15: Excerpts on support with regards to community solar projects

Respondent	**Excerpt**
Participant 8	*"There is a good potential, but the community is not cohesive enough to fully implement an initiative. There is no support among the community members when it comes to projects like these."*
Participant 8	*"People are often quick to talk but slow to act and also apathetic and lazy."*
Participant 21	*"Solar PV is still perceived to be a half-baked solution, and that is the challenge we have within our communities – there is no support."*

Source: Author generated

7.6.3.3 Legislation

CRE projects are not recognised in South Africa, and no legislation exists pertaining specifically to community renewable projects. Hence, one participant (PT 24), who works for the municipality, argued that:

> "*In terms of communities going on their own to do solar systems, there may be problems, and the problems are associated with the fact that now, Section 104B of the constitution tells us that electrical reticulation is the domain of the mandate of the municipality. However, municipalities can provide services neutralising external mechanisms. Let's utilise the current policies that are available to enable communities*

[and] individuals to enter the space of energy. The many needs of society should also be met."

As mentioned by the last participant, the constitution states that municipalities are responsible for electricity reticulation, leading another participant (PT 24) to remark that the city will need to charge consumers for the transportation of electricity fed into the grid system:

> "*Should the community [using] solar demand that the city now provide them over and above the solar system grid electricity, then the city will have to have a revenue stream that comes from the transportation of the electrons to those people. [Since] that is an asset of the city, […] whether you have utilised it or not, its mere presence there, that on demand you switch on, 'let there be light', 'and there shall be light' – you need to pay for it.*"

7.6.3.4 Lack of communication

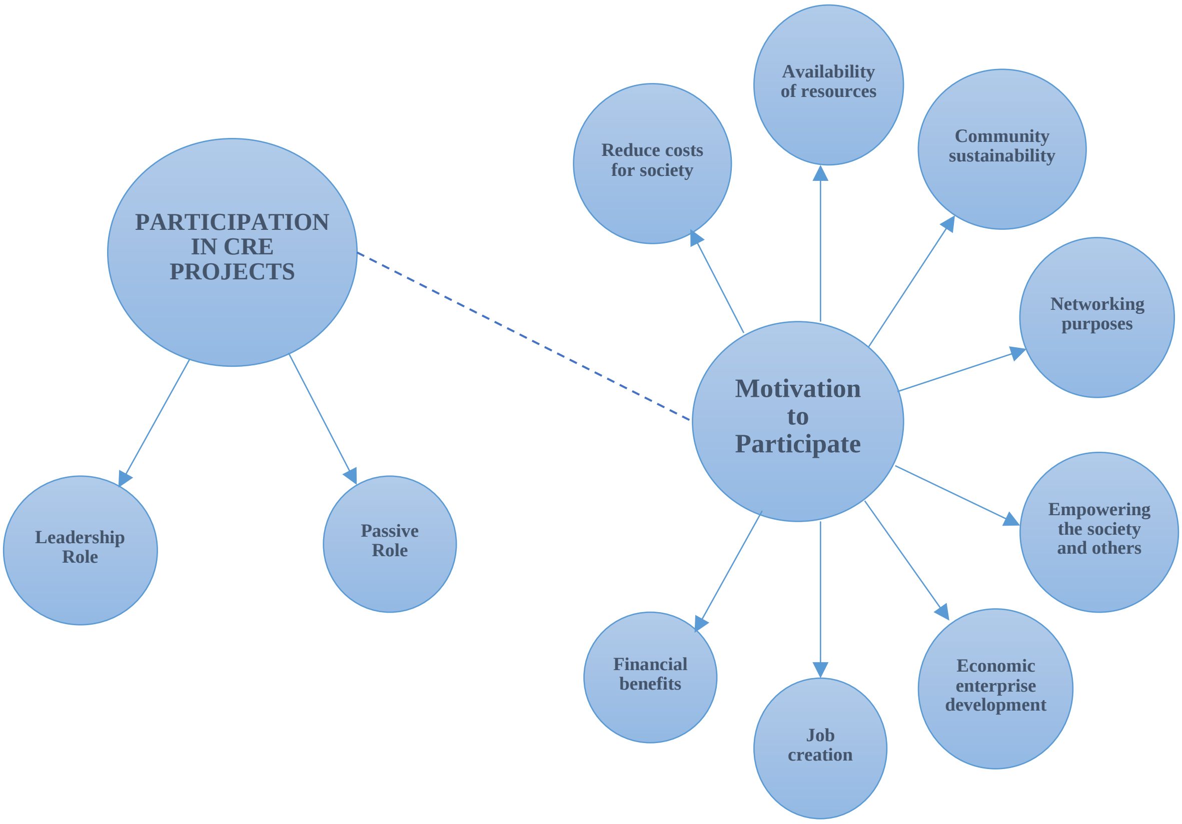
A lack of communication was highlighted by participants as a negative perception toward solar PV projects in rural areas where large-scale developers had already implemented community projects. Compared to urban areas, CRE projects implemented in rural areas were referenced by participants regarding issues surrounding a lack of communication, which caused misunderstandings between project developers and communities. Participant 20 mentioned the following in this regard:

> *"So, the lack of, shall we say, communication and explanation of the modalities of this thing have created a sense that communities are being ripped off, because at the same time the community leaders will probably be working for this project company deriving salaries and so on and they're perceived to be benefiting. So, I think, by-and-large, that remains one of the biggest challenges that face communities, and [that] also shapes their perception of the solar project."*

7.7 Participation

All of the research respondents expressed interest in participation in community projects, as reflected in Figure 7.6 and Table 7.16 below. When asked how they would like to participate in initiatives, participants expressed interest in taking up either passive or leadership roles, with others vocalising hesitancy in taking more active roles, such as being a member in the initiative.

Figure 7.6: Participation in community projects



Source: Author-generated

Participants were first asked whether they think that smaller players contribute to the energy mix and if they would like to participate. One participant (PT 23) remarked that:

> *"Smaller players have a role to play; property developers in the urban context have a huge role to play – we have to ensure that we stimulate industrialisation by ensuring that we implement some of these ourselves and show the rest of the society what is achievable."*

Participant 23 further highlighted that the responsibility to produce electricity was not solely that of the government, but that urban communities also have a role to play:

> *"So, I think it is not just the central government that has to play a role; other smaller players have potentials [...] affluent communities are likely to play a role – it could be out of choice, not an obligation."*

Table 7.16: Excerpts on participation in CRE

Participant	**Excerpt**
Participant 5	"*Yeah, I would want to participate in it: I have some bright ideas on community-based renewable energy projects. So, if the opportunity came, and it was solid, I [would] clearly participate."*
Participant 23	*"I would want to understand how it is going to benefit me and whether it will offer me the same stability, and, in the long run, whether it will make sense for me to invest in it; but definitely."*

Source: Author-generated

Participant 24 was in support of the above comments:

> *"The resource plan of the country tells us that small-scale that is anything between 0 to 10 MW; you do not need a licence. So now there is a policy that is appropriate for you to start implementing."*

However, a developer (participant 22) noted that implementation is possible, but ensuring it is operational is paramount:

> *"You've got to get the community to buy in and to operate and maintain it, and also pay their bills for that power. So, you need to have the right systems in place to monitor and be open in terms of people knowing exactly how much power they are getting from Eskom, and how much power they are getting from the solar…"*

7.7.1 Leadership role

Some of the participants indicated that they already hold leadership roles in their community initiatives and are expected to fill leadership roles in CRE projects when the opportunity presents itself. Some of the participants commented on their desires to contribute to sharing renewable energy knowledge by partaking in leadership roles, as evidenced by excerpts quoted in Table 7.17 below.

Table 7.17: Excerpts on leadership roles in community projects

Participant	**Excerpt**
Participant 10	*"Well, I am part of the committee, I would be willing to participate in a community project, both to champion and [to] provide funding where it is necessary."*
Participant 13	*"[A] leadership role would be [ideal] because I really like to be active as well – contribute what I can in terms of ideas, resources, and even help with activities."*
Participant 15	*"I would actually be [on] the forefront of it because I believe in communities that are self-sustainable […] and I am already involved in a different type of community project."*
Participant 16	"*Definitely, I would like to partake in [a] leadership role in terms of coming up with new ideas."*

Source: Author generated

Participant 12 expressed intentions to become involved at the administrative level rather than in a leadership role, by participating in sub-committees:

> *"…I would like to take a leadership role, but it could be in any capacity, I don't have to be a chairperson of a group, but I can be a chairperson of a sub-committee because, if you are the leader of something, you need to first check your availability as well. So, I don't think I am in a position to take […] total leadership in such a project, but as one of the sub-committees – I would love to be [a] part of it."*

7.7.2 Passive role

A few participants noted wanting to occupy more passive roles concerning community renewable energy projects, as was expressed by participant 1:

> "*Look, I am not a leader, but I will do the work. I will work*."

Other participants also expressed their intentions to hold passive roles, providing their support on a consultancy basis by contributing to, and communicating any necessary information regarding renewable energy projects, where participant 9 noted:

> *"I would enjoy a passive role where I am being involved in the consultation for the project [and] help[ing] the community members understand the importance of the project."*

7.7.3 Active role

Participant 16 indicated an interest in making a difference, particularly in poor communities rather than in urban areas:

> *"For me, I wouldn't want to be a passenger, because I really want to transform our African continent. But I would like to play an active role, especially in rural areas – our people need new solutions, they want innovations to improve their lifestyle[s]."*

Participant 10 echoed the above sentiment:

> *"I would want to participate, but not on a large scale. Where I stay, I am part of community security, mostly security, not in terms of renewable energy."*

7.8 Motivations

Recent studies have shown that two major factors lead to the adoption of solar panel systems; these are considered to be financial and non-financial drivers. A study by Sharma et al. (2012) found that financial support provided by both central and local government strongly influences the adoption rate of solar PV technology in developing countries.

7.8.1 Financial benefits

During their interviews, participants referenced different motivational factors that encouraged them to engage in community projects. Some of the participants mentioned that financial benefits associated with CRE projects influenced their decisions, as seen in Table 7.18 below.

Table 7.18: Excerpts on financial benefits as a motivation

Participant	**Excerpt**
Participant 2	"*People are unlikely to get involved out of just being excited, so monetary values in this type of initiative are actually enough as an incentive to get people involved.*"
Participant 12	"*… also, there are financial benefits and […] incentives that will make me participate.*"
Participant 14	*"I would consider financial benefits, […] I am looking at financial benefits."*

Source: Author-generated

Further supporting the above statements was participant 15, who noted that:

> "*The main motivation obviously is financial: for anything to be sustainable, for communities especially, they need to see the financial benefits for it, because whether we like it or not, we can say 'no'. Skills and all that … people get skilled, maybe in six months – after [that], then what? So, financial benefits should be on top of the agenda for the community.*"

7.8.2 Job creation

Some participants indicated that job creation motivated their participation in their community's renewable energy projects, as is evidenced in Table 7.19 below.

Table 7.19: Excerpts on job creation as a result of community projects

Participant	**Excerpt**
Participant 2	"*… my primary motivation would be job creation.*"
Participant 12	*"… there are benefits with regards to job creation and availability of incentives which will make me participate."*
Participant 15	*"People are unemployed, people are looking for alternative ways of earning money."*
Participant 25	*"… you know, job creation and related issues, and those are softer issues, but they are important, and they will drive you."*

Source: Author-generated

Job creation as a motivating factor was reinforced by participant 7, who said:

> *"My main motivation to participate in a community project [would] be based on creation of employment opportunities, because I know that a project like this in a community like ours will create job opportunities.*"

Participant 6 echoed the above:

> *"Uplift the communities by teaching them new skills. Create some employment and alleviate poverty and crime."*

7.8.3 Empowerment

Empowerment as a motivational factor was expressed by several participants regarding community participation in renewable energy projects. Participant 10 stressed that:

> *"I think about empowerment and self-reliance. What needs to happen is that developers must come with the technology, bring the skills, and teach the community how to do it in a period of time. They need to say: in three-years' time, we will be out. You know the venture capitalist model: where you are there for three years and then the champions of that project are owners of that project – the PPP projects, the BLT projects, all [of] those are models that can be used for those community projects, and eventually the community must own it."*

Participant 15 went on to support the importance of empowerment:

> "*I believe in communities that are self-sustainable. I believe that communities should be able to do things that can empower them."*

Participant 16 reinforced that people in poor areas should be empowered in order to reduce their struggles:

> *"My main motivation, honestly, even before this interview, my passion is to make sure that one contributes to the people who are poor and how we can uplift them: come up with our solution, resolve our issues, so purely, it's just to see the life of poor people changing, so that we reduce the burden that they are facing on a day-to-day basis and the extreme poverty that our country is facing."*

7.8.4 Community sustainability

Participants also reported community sustainability as another motivational factor when choosing to participate in community renewable energy projects. Participant 10 contends that an element of sustainability must exist within these types of projects:

> "*I've got a radical approach in terms of wealth distribution: I don't believe in handouts, I believe in empowering. As they say, 'don't give a man fish, but teach him how to fish'. So, I prefer […] community projects [to be] made by the community so the communities can sustain themselves."*

Participant 22, who is a developer, indicated that:

> *"My main motivation as a supplier of solar PV in the industry is to get involved on that side. But at the community level, if it was my community, [I would] do it for the benefit of the whole community, and for any community for that matter, to [remove] reliance [on] Eskom."*

7.8.4.1 Environmental sustainability

Participants noted the need for environmental sustainability if community projects are to be successfully implemented. As pointed out by participant 3:

> *"The issue is about consuming less from the grid, […] that will then make sure that the power utility in the country is using less coal to produce because we will have been using alternative energy for our consumption."*

Participant 4 reinforced the notion of sustainability:

> *"A project like this, first, is about sustainability; it's about taking care of the earth, making sure that the earth is not polluted – that's the first thing. Secondly, it would be able to, in the case of rooftop solar, it is the ability to use clean energy as opposed to using fossil fuel to generate energy."*

Participants 17 and 2 both reinforced the importance of sustainability in their respective comments below:

> *"My motivation firstly would be to save the earth, and […] leave a better legacy for the next generation."*

> *"I have children who need to inherit [an] environment that is cleaner and better, where they will be able to live healthier lives."*

7.8.5 Networking opportunities

Another factor brought up was the motivation to develop networking opportunities by participating in community renewable projects, as evidenced in Table 7.20 below.

Table 7.20: Excerpts on networking opportunities as a motivation

Participant	**Excerpt**
Participant 4	*"...just being part of a community and participat[ing] in community projects."*
Participant 5	*"...one can never underestimate the importance of social networking [...] because that is the only way [...] one [is] able to make [the] impact of what they are doing greater."*
Participant 7	*"My main motivation would be for networking."*
Participant 13	*"Yes, if the project makes sense and appeals to me, I would, and the fact that there will be networking involved as we really don't know each other in the community."*

Source: Author-generated

7.8.6 Economic enterprise development

Economic enterprise development apparently also contributes to citizens opting to partake in community renewable projects. Participants argued that their primary motivation focused on how community projects could help the country's economic development, as evidenced by the statements in Table 7.21 below.

Table 7.21: Excerpts on economic enterprise development as a motivation

Participant	**Excerpt**
Participant 2	*"My second motivation would be enterprise development because you give people the tool to become self-sufficient."*
Participant 10	*"I think about development because communities in developing countries need a steady, reliable, and sustainable source of income. I think any government […] - local or national […] – needs to think about empowering communities, so they [are] less [of a] burden on the fiscals."*
Participant 11	*"Look, I am all going for solar power: it contributes to the economic development of the community, reducing the coal usage."*

Source: Author-generated

7.8.7 Cost reduction

Interestingly, some participants referenced a cost reduction to society as a result of community projects as another motivator encouraging citizens to participate, as evidenced by participant statements in Table 7.22 below.

Table 7.22: Excerpts on cost-reduction motivations to participate

Participants	**Excerpt**
Participant 7	*"We all want to have the electricity at a cheaper cost, and that is fully functional."*
Participant 12	*"…we've got very intermittent power disruptions from the municipality, so I would absolutely want to go off-grid completely sooner than later, and reduce the cost [thrusted] on us by Eskom."*
Participant 13	*"[The] main motivation to participate would be to really reduce the cost to society, not so much financial gain."*

Source: Author-generated

7.9 Social trust (community members)

Social trust was a notable issue regarding the implementation of community renewable projects. Some participants believe that communities have the potential to implement projects, but lack the necessary skills for projects to succeed; therefore, the role of experts is critical from the start. Other participants argued that communities could implement or execute renewable energy projects provided there is at least a good level of trust amongst the members, and the required resources available. Table 7.23 below contains participant excerpts reflecting these comments.

Table 7.23: Excerpts on community trust to implement community projects

Participant	**Excerpt**
Participant 1	*"Absolutely, I trust community members. I have seen community projects in my area; it has been done a few times."*
Participant 3	*"We have what I can call community trust."*
Participant 10	*"In my community, the element of trust is obviously something that we have to work with; to ensure that there is trust, but I think it is something that can be done with ease…"*
Participant 14	*"… most people in my community are smart, it's just egos, they would execute anything, it's just that it might be painful, but I trust they will."*
Participant 25	*"if there are skills within the community and the money to execute a project, I would trust community members."*

Source: Author-generated

Participant 15 further remarked on the issue of social trust:

> *"The community themselves, I think, can be trusted; whether they [are] able, on their own, to execute the project – I don't think so. With […] help, yes; skills – there might not be enough skills, but then the skills can be taught. So, in terms of trusting the community, as long as the community have a binding, and they know what is in it for them, I think they can easily be introduced to community projects"*

In support of the above, participant 3 argued that:

> *"I would not say I would trust communities to execute it, but I would trust community members to be able to initiate and support it. In terms of execution or implementation, I think we need experts to do this. Communities really would just need to give support and buy-in, but the execution – you need someone with the knowledge to be able to execute a project of this nature."*

Some individuals believe, however, that communities can deliver on projects if external developers are involved in the initial stages, such as participant 22:

> *"…generally, solar is not a simple plug-and-play system; there is a lot of engineering that needs to go into the design, installation and implementation. So, if communities were to go into such … again, it comes to the education side of things."*

Another participant (PT 3) noted that communities may be equipped to lead the project and maintain ownership, but implementation should be left to developers:

> *" … community members can lead in terms of the conceptualisation, but in terms of implementation: you source-in the skill – you still have control of the project, you don't outsource the control, the control is still in your hands, you still have full ownership…"*

Adding to the above assertions, participant 13 believes that people can differentiate between times when they can deliver on an objective, and when assistance is needed from an external party:

> "*I think people are fairly knowledgeable and sophisticated enough to know what they can or not bring into a project. So, I don't have trust issues, the biggest problem I think in […] society is that it is always about whether there is money to be made; if it is properly structured and constructed, then it should be okay."*

7.9.1 Resources in communities

Resource availability was one factor mentioned frequently by participants. Some argued that the availability of resources was an essential factor for the successful execution of these community projects. Participants worry that insufficient resources are available within communities for the implementation of renewable energy projects, as highlighted by the excerpts in Table 7.24 below.

Table 7.24: Excerpts on resource availability in communities

Participant	**Excerpt**
Participant 1	*"We are living in a generally good area, where people do have money for these things."*
Participant 8	*"The community has a great, cared-for natural environment and above-average disposable income. It has three schools which can be involved."*
Participant 9	*"The community has [the] skills needed to work co-operatively, the ability to raise capital needed – provided they agree with the benefits."*

Source: Author-generated

The following two participants (14 and 4, respectively) also voiced their views on the impacts of resource availability:

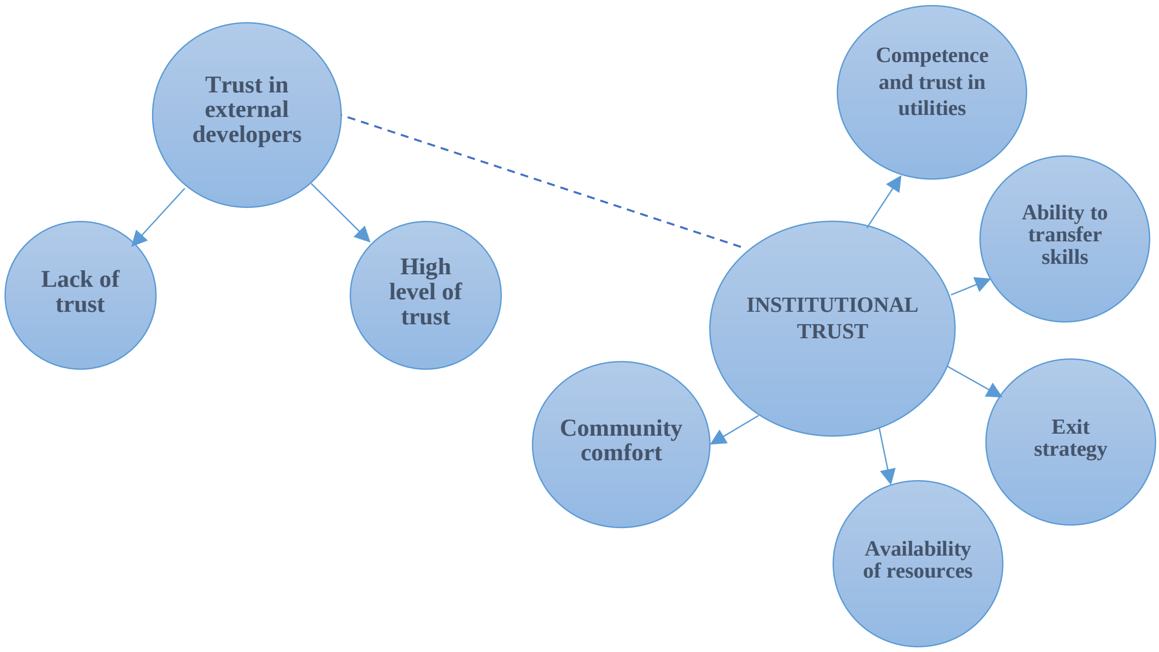
> "*I am sure [that] if you say people should contribute this much, these are long term benefits, and after a few years, we would not necessarily be paying for electricity, I am sure it would work. So, financially, and the technical skills, I am sure they will help the community to execute the project. It's just the collaborative skills that are lacking, but I am sure they would pull it out."*

> "*The community [has] the will; the community [has] the means, [has] the desire and the drive, but what is lacking would be technical skills, availability of resources, but we [are] able to outsource […] without losing control of the project."*

7.10 Institutional trust

Institutional trust was considered to be an important aspect for any project's success, especially when the communities are partnered with external developers. The participants felt that trust in institutions to execute community projects on behalf of communities was governed by several factors, which are outlined below and illustrated in Figure 7.7. Some participants strongly emphasised that trust in developers and institutions will be important in allowing developers and institutions to develop projects on behalf of communities. These participants concluded by stating that they would not trust external developers since their interests lie in profits and, in some cases, do not assist in the skill development required by the community. Therefore, the participants would prefer external development interactions to take place strictly in the capacity of consultancy. They also commented on corruption by municipalities and the state-utility, and argued that they prefer to choose communities to implement solar projects, if the resources are available, of course. The diagram below Figure 7.7 depicts the themes and sub-themes that emerged when participants discussed institutional trust.

Figure 7.7: Institutional trust themes



Source: Author-generated

7.10.1 Trust in developers

The citizens interviewed emphasised that external developers must have previous experience on similar projects to earn their trust in implementing community projects. Participant 11 states:

> "*So, my take is, as long as the developer is experienced, and he has a proven track record, we will trust him to execute.*"

Reinforcing the above point concerning external developers' experiences, participant 23 argued that:

> "*If it's an external developer, they have to have that track record; they ought to have implemented similar projects successfully and demonstrate having developed and operated for a certain period because the development of energy projects is not [a] competency of most communities.*"

7.10.2 Lack of trust

A lack of trust was considered by participants to be a deterrent for community members in allowing external developers to implement renewable energy projects on behalf of a community. Some participants doubted that the external developers' involvement in such projects was for the benefit of the communities, with statements echoing this concern in Table 7.25 below.

Table 7.25: Excerpts on trusting external developers

Participant	Excerpt
Participant 8	*"I think many developers just like to capitalise on the initiative to make as much money as possible."*
Participant 14	*"Most communities don't trust external developers because they believe that they are just in it for the sake of just making money."*
Participant 16	*"No. I will not trust. It depends, what is the intention of the external developer?"*
Participant 24	*"... the investors are out there to ensure maximum ripping [off] of the country, now you find that the IPPs in the first window, their prices skyrocketed beyond any imagination."*

Source: Author-generated

Participant 16 reinforced the above notions by stating:

> *"Absolutely not, I would not trust them because I have observed, especially with the multinational organizations, mostly, it is more profit-driven. So we need a local company that has passion, interest, because this is how we grow the industry, so, definitely, I would support a local company – we do not trust multinationals as they will be pushing their agendas."*

Participant 6 indicated, however, that they would trust external developers if there was a negotiated, legally binding agreement between both parties, arguing that:

> *"Yes, as long as there is mutual understanding, trust, and communication of roles and costs involved, companies outside the community can be trusted to provide the services."*

The government introduced community trust to benefit communities where projects are implemented in rural areas, but there have been major challenges experienced while managing those benefits. One participant (PT 20) explained that the external developers must first service their debt before communities can realise any major benefits:

> *"Community trust is set up for people to participate, but it is a project financing structure which means it is largely debt finance, and [the community will] not see the benefits immediately, […] that is one of the criticisms because people don't understand that there is a debt to be paid."*

7.10.3 Exit strategy

The participants noted being concerned about the longevity of experts in the projects. They indicated that exit strategies must exist to ensure that developers leave once the communities can sustain the project on their own. For instance, one of the participants (PT 12) asserted that:

> *"I wouldn't want it to be owned by the external party completely, because eventually, the community is not going to benefit that much. Preferably the arrangement must have an exit structure so that it can benefit the community"*

Participant 15 commented further along these lines:

> *"We would trust them if their intentions [were] genuine in terms of developing these projects, and ownership would be passed to the community. Because communities need to have a sense of ownership."*

Stressing the issue of exit strategies further was participant 23, who asserted that:

> "*…any sizable project needs to have a clearly articulated exit strategy, and ensure that there are warranties in place to protect the community. […] It is not only the responsibility of project developers – it is the responsibility of whoever owns the initiative on the ground, and the community must have representation in that – whether a municipal leader, local government leader, or somebody from the initiative. That individual or committee, together with the project developer, needs to make sure that they have systems in place, to ensure that when these people exit, there is enough capacity to manage the project."*

7.10.4 Skills transfer

Some participants emphasised the ability to transfer skills as a factor to consider when allowing external developers to execute CRE projects, as evidenced in Table 7.26 below. They maintain that external developers should transfer skills to the communities where the projects are implemented, otherwise, communities cannot sustain the projects, where skills development was mentioned as an important, related factor for developers when working with communities. Individuals believe that external developers are not interested in developing communities, but only in benefitting their own interests.

Table 7.26: Excerpts on skills transfer

Participant	Excerpt
Participant 2	*"…skills transfer is very important; it's something that developers would need to leave behind for a community."*
Participant 10	*"My approach would be an apprenticeship program for the community: the external investor or technical partner must, by its nature, transfer the skills and teach the community how to do it, so that they can do it themselves…"*
Participant 16	*"… they should be able to transfer the skills to community members, and then they depart from the program."*
Participant 19	*"… just bringing them to build and leave, we would run into problems, then we would not be able to maintain them."*

Source: Author-generated

7.10.5 External developers and resources

Participants indicated a willingness to partner with external developers, provided they bring resources to the project that advances the communities, especially communities that may lack the resources needed to implement community projects, as indicated in Table 7.27 below. Participant 12 also supported this when indicating that:

> *"For me, there is no straight answer to that. It would depend on, what is it that the external party is bringing on board? If they are bringing resources, expertise, then it is worth considering, because the community may not necessarily have the necessary resources to undertake such a project on their own."*

Table 7.27: Excerpts on collaboration, expertise and resources

Participant	**Excerpt**
Participant 18	*"the availability of resources also plays a part in the execution of community projects by external contractors."*
Participant 23	*"... you want to engage with somebody who has done this before, who will only rely on you in so far as the community dynamics are concerned, and they've also got to be skilled."*

Source: Author-generated

Conversely, participant 2 believes that, if communities possess the know-how and resources, then the communities should implement projects on their own and perhaps only source an installer:

> *"If communities have the skill and the resources, there is no need for the communities to have external developers."*

However, participant 2 also acknowledged the contribution of external developers:

> *"... but external developers always come with specialised skills and they also come with access to funding and other forms of resources."*

Participant 2 concluded by mentioning that both methods, with and without external developers, have merit:

> "*... if communities have the skills and access to resources, and access to financial capital, then there is no need for external developers to get involved, but [a] lack of resources within communities means that the door must always be open for external developers."*

7.10.6 Competence

Participants discussed the availability of developers' levels of experience and expertise as a factor for bringing in external contractors to implement community projects, as evidenced by the excerpts seen in Table 7.28 below.

Table 7.28: Excerpts on experience, knowledge of the external developer

Participant	**Excerpt**
Participant 2	"*But what is more important is that external consultants need to come in with the sole objective of delivering on the project; linked to that, skills transfer and teaching people how to access resources…"*
Participant 4	*"In terms of execution, I think we need experts to do this – external consultants that come to the communities to give support and buy-in; but the execution, you need someone with the knowledge to be able to execute a project of this nature."*
Participant 15	*"So, my take is, as long as the developer is experienced, and he has a proven track record, we will trust him to execute and [that] the project to be successful."*

Source: Author-generated

7.10.7 ***Trust in municipalities and Eskom***

When participants were asked whether the municipalities and Eskom should implement renewable energy projects on behalf of communities, some participants remarked that they have worked with municipalities on previous projects and trust them to execute community renewable projects. Participant 9 posited that:

> *"I would trust municipalit[ies] to execute the program, and they can be trusted; we have executed projects together before – they are reliable."*

However, two respondents (7 and 11, respectively) argued that they did not trust the municipalities nor the state utility, mainly because of ongoing corruption:

> *"No, I don't trust Eskom or the municipality because of corruption. We have [the] problem of corruption in [this] country that is crippling the economy – it is crippling everything; and also most of the municipalities don't even know how to run their municipalities. And Eskom as well – they have some knowledge drain."*

> *"…they're all just worried about collecting income […] That's fine, but there is a huge potential for people to self-generate and provide electricity – but the municipality will argue that: 'please, do not overload our grid'."*

Adding to the point on grid capacity, participant 24 (from a municipality) argued that perhaps it would be better if communities worked together on projects rather than as individuals, allowing for their networks to handle the burden together. Regardless, municipalities are seeking ways to produce electricity, as noted by participant 24:

> *"... our network is stretched, overloaded because of various things. One, lack of maintenance, two, the age of the network. To resolve issues of grid capacity, we are saying that we can go to communities and put solar systems and then provide energy to those communities. It is something that we are planning and hoping to implement in the next two or three years, all things being equal."*

The participant (PT 24) went on to note that the time has come for municipalities to consider local energy generation that can be provided by communities:

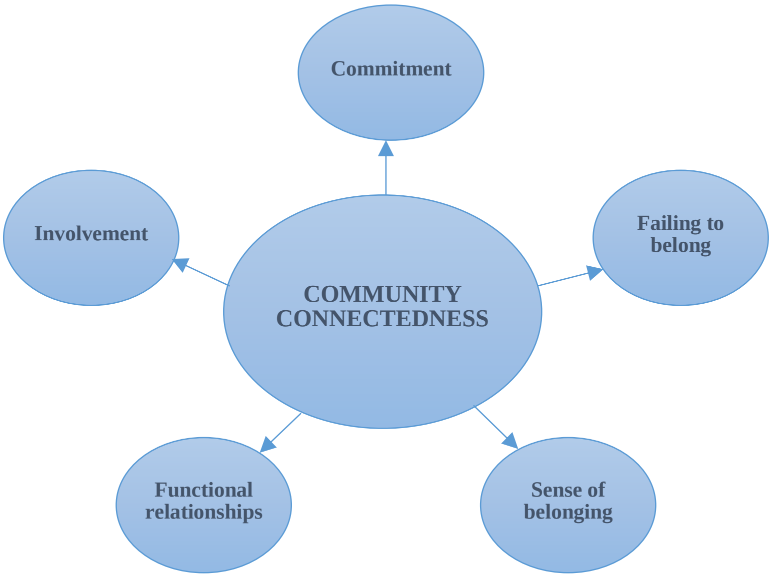
> *"The days of the municipality being the sole provider of electricity are gone. Communities, wherever they are, if they have got the potential capacity to run their affairs, or together with the municipalities, I think we need to accommodate that, given the fact that certain communities intrude on our networks and reconnect or connect themselves illegally. And therefore, if they are given the potential for themselves to develop localised energy production, whether they form themselves into NPOs or NGOs – whatever form."*

To summarise these results regarding institutional trust, it has been established that, while some participants have trust in institutions, others do not trust external organisations based on their previous experiences. Participants believe that, for this type of project to succeed, a developer should only implement projects on behalf of the community, and ownership should remain with that community. The developer should ensure that once on-site, he transfers skills to the community so that, once implemented, the communities can maintain and monitor the project on their own. Another point raised by citizens was concern regarding exit strategies: they want to ensure that developers are not involved in the projects long-term. Another critical point raised was that communities are now producing electricity, but are faced with the issue of overloading the grid, which cannot be ignored. Municipalities must find a way to accommodate communities who are generating electricity.

7.11 Social identity/connectedness

Over the duration of the interviews, participants indicated different points regarding communities that are united in developing community projects. Some of the sub-themes that emerged concerning connectedness included: commitment, sense of belonging, failing to belong, functional relationships, and involvement, and are outlined in Figure 7.8 below.

Figure 7.8: Community connectedness with regards to community projects



Source: Author-generated

7.11.1 Involvement

When participants were asked about their relationships with members in their communities, some reported a close working relationship amongst members, and that working toward the same goal improved their environment. Participant 1 highlighted that:

> *"…it is quite interactive, and you also understand that everybody is quite caring, and it is a combined effort, and it is not just about the community coming together; we have done a lot around the river…"*

7.11.2 Sense of belonging

A strong sense of belonging to their community was noted by multiple participants, especially since it enables them to work together on community projects. The participants indicated that the sense of belonging helped community unity, as noted by participants in Table 7.29 below.

Table 7.29: Excerpts on a sense of belonging to a community

Participant	***Excerpt***
Participant 7	*"We have a body corporate, and the relationship is good. We look at ways to improve the complex and because we are all wanting the same thing [...] if you all have the same goal, you will be able to achieve that goal because you all want that goal to be achieved."*
Participant 10	*"Well, I am part of the committee, I think it is a friendly community, the people that are there, have a very good sense of oneness …"*
Participant 25	*"Yes, I am in a gated community, about 38 households, we have regular meetings about stuff."*

Source: Author-generated

However, some participants remarked that, in their area, people are not as close, but would still be able to unify under one banner if needed, as is seen in the comment made by participant 1:

> *"I would not say we are close-knit, especially South Africans; we do know each neighbour, I think if it is a project to be done, people will really put it together. If there is a problem, you can call [...] and people do take notes, and they make themselves available."*

Reinforcing the above point was participant 12, who argued that:

> *"This community is really quite private, but if there is an opportunity to mingle and socialise, you will get a sense that, if there were something that you needed to do as a collective, they would be able to participate. We've got lots of WhatsApp groups, one of them is for [a] business forum, the other one is just to assist the residents of this place, and they really come out a lot, assist a lot, if someone needs something. So, there is that sense that this community is looking after each other, though it is obviously very private at large."*

7.11.3 Commitment

It is worth noting that it is generally quite difficult to establish community projects: a commitment from members is considered a key factor for success in such projects. Some participants noted that people only show interest if they know the project will benefit them. Others commented on the importance of having the right leader for the project – strong leadership is what makes these initiatives thrive. These points are confirmed in Table 7.30 below.

Table 7.30: Excerpts on commitment from members on community projects

Participant	**Excerpt**
Participant 3	*"I think it will need commitment from each community member [...] it is not easy to do community projects, because people have got their own perception of issues, but the way you sell it at the beginning will determine [its] success or its failure."*
Participant 12	*"... if it is going to benefit them, and they can see that it is going to benefit them, they will definitely get involved."*
Participant 15	*"It depends on how you sell the project: 'What is in it for us?' Then people will show commitment, but if they don't see the benefit, they might look at it and say it is one of the schemes."*

Source: Author-generated

Participant 13 reinforced the above statements by observing that:

> *"People are committed, and, if you have the right leader, [...] people can only go as far as they are led. [...] People will stay committed for as long as the project is properly led, and they can see that the objectives are being achieved, or can see that they are going to be achieved. No one walks away from a successful project, and no one stays perpetually in a project that is not working: it's all about leadership".*

Another participant (PT 17) noted the process starts with people being passionate about the course and commitment from other participants:

> "*commitment is shown when people are passionate about the initiative. You start small and build the project from there. The projects must involve love and concern for the environment. People must realise the value of the initiative for them to commit. By and large, people participate in the community projects when there is commitment and when the other members are also showing commitment."*

7.11.4 Functional relationships

The importance of functional relationships in communities was evidenced by participant comments in Table 7.31 below, and was noted by participant 13:

> *"Yeah, there is a functional relationship, […] considering everything else. Oh, yes. I appreciate that communities now are not like what they have been traditionally: we've got communities where you have houses in the same estate, you all go to the same church, there is a gym, a soccer club and everyone goes there, you shop in the same areas, the school – everyone goes to the same school, and there is a golf course. […] So the linkage[s] between members of communities [are] not what they used to be."*

Table 7.31: Excerpts on relationships with other members

Participant	**Excerpt**
Participant 4	*"We are not friends, but we care about our space, so there is communal-ship in terms of saying: 'let's keep our environment safe, let's make sure there are developments within our suburb'. So, I think that way, yes, there is a positive relationship within our area."*
Participant 9	*"We have functional relationships in this community – we understand and work together."*
Participant 16	*"Absolutely, yes, there is a working relationship with the neighbours."*

Source: Author-generated

7.11.5 No sense of belonging

Interestingly, some participants contended that they lacked a sense of belonging to their communities, which affected their acceptance. Participants believed that people in urban areas hold a form of pride as opposed to those in rural areas who need each other for support; as was so succinctly noted by participant 14:

> "*Thinking from just where I stay, in my estate; we have a body corporate, it does what we are supposed to do, but with great pain, people are always fighting. But, [in] my experience, I believe wealthier communities have issues with cohesion because everybody is smart, everybody is rich, nobody needs anybody, unlike when you go to poorer communities, they will identify one or two smart people and then install them as their leaders and they would listen to everything they say; yes, until there is a revolt somewhere."*

Reinforcing the above was participant 17, who highlighted that:

> *"In urban areas, there's also some social apartheid, social discrimination, or class discrimination. And sometimes, it's like, even the way people build their houses with high boundary walls. I strongly believe that it depends, again, to what extent individuals feel that [independence] and not needing each other."*

Another participant (PT 24) raised the issue of cultural difference, which can deter social cohesion:

> *"… certain communities are not stable – unstable in the sense that they don't know each other. They simply occupy a specific place, what […] their origins and backgrounds [are] plays a significant role for them to […] create a united force, structured in a form of community, or in any form".*

7.12 Social norms

The influence of social circles and social norms was noted by several participants as influencing their choices concerning the adoption of renewable energy in their homes. Participants reported that friends, neighbours, colleagues, and family impacted them when considering the desirability of solar PV. Engaging in conversations with those in their social circles impacted some participants' decisions to adopt renewable energy sources, as is echoed in the comments in Table 7.32 below.

Table 7.32: Excerpts on social-circle influence

Participant	**Excerpt**
Participant 8	*"People will be happy to have a hand in preserving the environment."*
Participant 13	*"Solar panels are very popular these days, […] and family will influence the adoption of solar PVs."*
Participant 24	*"… I installed my gas geyser on the [basis] of discussions with my friends."*
Participant 25	*"I mean, the idea of [a] gas geyser I got […] from a friend of mine [who] installed one in his house. He said it is quick and efficient, [and] I said, 'really?'. Then I got it."*

Source: Author-generated

These comments revealed that social circles influence the behaviour of individuals concerning the adoption of a particular technology. If someone observes a technology benefiting an individual close to them, they are inclined to acquire that technology themselves.

7.12.1 Expectations from members

When dealing with projects of this nature, members are expected to contribute in some form to the initiative, helping it to flourish. It is not expected that every member will have the same means to contribute, but everyone should contribute what they can. This point was confirmed by one participant (PT 12) who remarked:

> *"… my expectation is that you have to bring in something, be it skill, be it funding, being able to source assistance, so you don't become a passenger on the bus. Noting that we are not gifted the same way, but you need that commitment, and that commitment can only be applied through the manifestation of something."*

The comments in Table 7.33 below reiterate participants' opinions on expectations within their community.

Table 7.33: Excerpts on expectations from other members regarding community projects

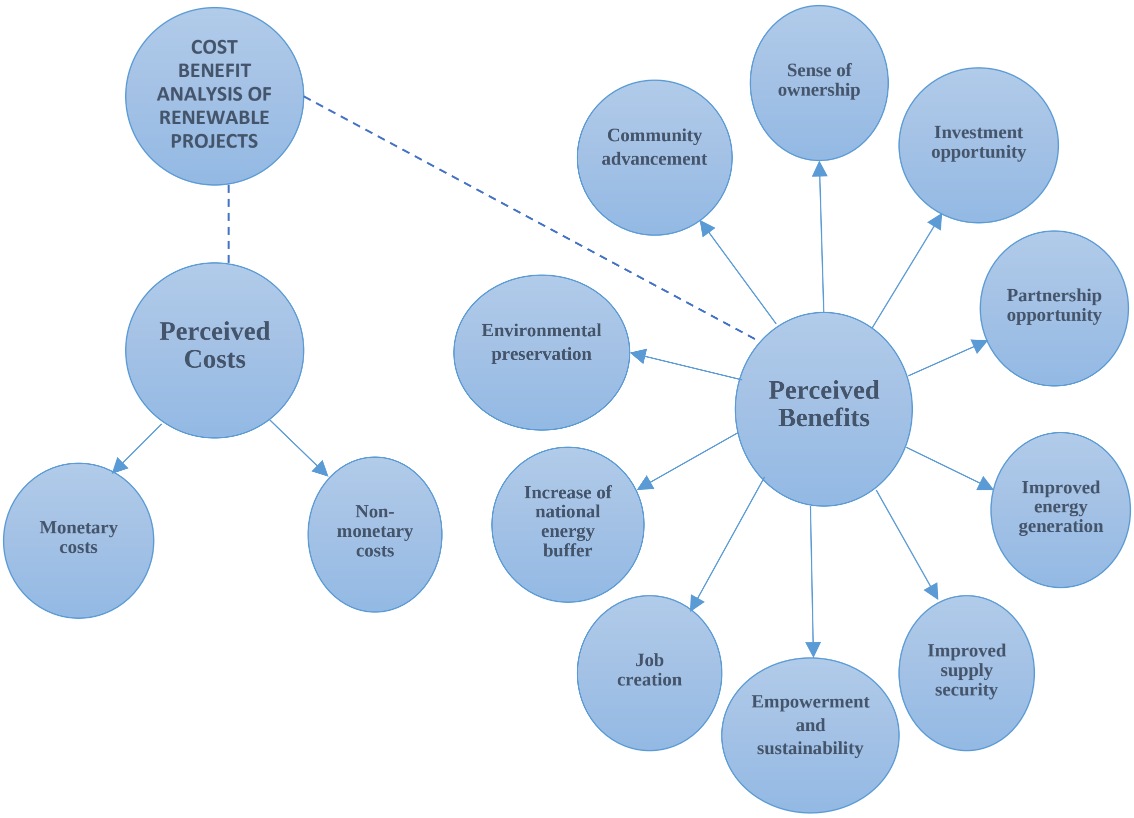
Participant	**Excerpt**
Participant 1	*"I think they must bring in knowledge, […] bring interest and participation, […] also working together – everybody wants the best for their area."*
Participant 8	*"… to fully support it, take it beyond an initial phase, back the initiative with their money and/or time/other resources."*
Participant 15	*"For me, I would expect members to support the project and mobilise themselves behind the project to ensure that people do not vandalise the equipment."*
Participant 19	*"We need to be honest with each other; we need to commit to the project as a community – where we need resources, every member should [take] part, we don't want certain members reneging from the project."*

Source: Author-generated

7.13 Perceived benefits

Renewable energy is perceived to contribute toward socio-economic development, both nationally and locally. National benefits include a decrease in atmospheric pollution and increased energy security, whilst local-level benefits address developmental needs and local capacity building (del Río and Burguilo 2009). The benefits and costs of solar PV technology were deemed important by this study's participants, the dynamics of which are outlined in Figure 7.9 below.

Figure 7.9: Cost-benefits analysis of renewable energy projects



Source: Author-generated

7.13.1 Empowerment and sustainability

Participants highlighted 'empowerment and sustainability' as one of the benefits of engaging in community projects. One participant (PT 12) expressed that:

> *"I think in our community, in particular, we've got a lot of power disruptions, and relying on Eskom and the municipality is just really failing us. So, if we've got our independent source, then we know we will always be connected, so we can benefit from 100 per cent up-time, we can benefit… it is very cost-effective going forward, and*

hopefully, it can add value to our investment, which is our properties; and it adds to the sustainability of our communities."

Participants felt that community solar PV projects would benefit communities positively, as highlighted by the participant 5's comment below.

"From a social point of view, again, you bring technology closer to people who use it, have a better understanding, training opportunities, employment opportunities closer to where it is being consumed. So, the benefits are many, so, a distributed generation: ideally, that should be the norm."

It was also noted that, with CRE projects, communities could generate income and use the money to improve their surroundings, as mentioned by participant 7:

"We will be able to sell this power to our neighbours, and [...] use that money to improve our area. So, if everybody can see the benefits, then everybody now is able to work towards that goal and [ensure] that everyone [benefits] off all of that. [...] The initial capital cost might have been high, but the ripple effects are even better than what it was before we started building."

7.13.2 Community advancement

The information generated by participants highlighted community advancement as another benefit that the community perceives as obtainable when partaking in CRE projects, further raising the issue of sustainable income, all of which are noted in Table 7.34 below.

Table 7.34: Excerpts on community-advancement benefits of community projects

Participant	**Excerpt**
Participant 6	*"These community projects uplift the communities by teaching them new skills, [...] [creating] some employment, and alleviat[ing] poverty and crime."*
Participant 13	*"... community renewable projects contribute towards community and technological advancement as well. I think from that point of view, it does make sense. From a social point of view, again, you bring technology closer to people who use it..."*

Source: Author-generated

7.13.3 Environmental preservation

Environmental preservation was also highlighted as a benefit of adopting solar PV projects in communities. Participants argued that, compared to fossil fuels, solar PV sources contribute fewer greenhouse gas emissions. One participant noted, however, that because solar panels are not produced in South Africa, emission production instead occurs where the panels are manufactured. These comments can be seen in Table 7.35 below.

Table 7.35: Excerpts on environmental preservation as a result of community energy projects

Participant	**Excerpt**
Participant 2	*"It makes absolute sense, but most importantly, you actually contribute towards environmental preservation."*
Participant 3	*"In my opinion, I believe that there will be a reduction of environmental pollution if communities implement renewable energy projects such as solar PV."*
Participant 16	*"the benefit, more than anything, would probably contribute positively to the environment."*
Participant 20	*"... because then it also has zero-variable cost, so you don't have emissions from generations. Yes, people will argue that there are emissions from producing the panels, etcetera, but that is somewhere else where they are being produced."*

Source: Author-generated

7.13.4 Increased energy generation

Renewable energy projects, such as solar PV, improve energy generation; Table 7.36 below identifies some of the benefits mentioned by participants.

Table 7.36: Excerpts on the potential of community solar projects to contribute to energy generation

Participant	**Excerpt**
Participant 1	*"… it is these small projects that will eventually make a bigger difference."*
Participant 8	*"I believe that community projects could improve our energy generation."*
Participant 16	*"I think that community renewable projects could actually* contribute to *the generation industry successfully. And yes, I believe it will contribute positively on the issue of energy generation."*

Source: Author-generated

7.13.5 Increased national energy buffer

Some participants also highlighted that CRE projects increase the national energy buffer, as evidence in Table 7.37 below.

Table 7.37: Excerpts on an increase in the energy buffer as a result of community solar projects

Participant	**Excerpt**
Participant 8	*"I believe that community projects could improve our energy generation and energy buffer."*
Participant 10	"*… if you can make it in a scale that you would have excess, it would increase the national energy buffer to ensure that we don't strain […] the current production, so that's it."*
Participant 12	*"I wish we could be able to come together and put a solar project together that we can all share, which will reduce cost and the excess energy – we [would] be able to assist the country."*

Source: Author-generated

7.13.6 Improved security of supply

Participants emphasised the benefit of improved energy supply security if CRE projects are introduced in their areas, where participant 13 noted that:

"Distributed generation can also play a very useful role in terms of security of supply for communities, as opposed to central generation. Then you have transmission, and if there is a break in transmission, then all the community in the downstream of that are in trouble. If you have generation […] close to the point and source of use, there [are] benefits in terms of emissions or efficiencies and so on."

7.13.7 Safety

Safety was the focus of participant 8's comments, seen in Table 7.38 below, regarding solar projects in their area.

Table 7.38: Excerpts on security provided as a result of community solar projects

Participant	**Excerpt**
Participant 8	*"For streetlights, for everything, and this improves security."*
Participant 8	*"A more sustainable community and improved security at night."*

Source: Author-generated

7.13.8 Job creation

Participants highlighted the benefit of job creation when CRE projects are implemented. Participants argued that many people are unemployed, and that developing projects of this nature creates employment opportunities. This point was confirmed by participants 15 and 2 respectively:

"People are unemployed; people are looking for alternative ways of earning money, there is a lot of them. And my feeling is that people would adopt this if there is a benefit in it".

"We are living in a country with 27 per cent unemployment rate. Any monetary incentive would be enough to get people to start moving and start getting involved in initiatives of this nature".

7.13.9 Sense of ownership

A sense of ownership was also mentioned by participants as a potential benefit associated with community solar projects. Quotes from participants 5 and 15 along these lines are listed in Table 7.39 below.

Table 7.39: Excerpts on the benefit of sense of ownership

Participant	**Excerpts**
Participant 5	"*Yeah, the basis of the project would be for the benefit of the community. So, if they have it in an area, it would be for their benefit, and then they would have a bit more control on a piece of infrastructure that supports them.*"
Participant 15	*"For me, the sense of ownership as well. For them, when they look at, let's say, those solar panels being installed; them knowing that those solar panels are there for them and by them."*
Participant 15	*"… communities need to have the sense of ownership, that 'this is ours'. If […] you are going to develop that project, [and] the developer […] still [has] some sense of ownership, people won't see that to be owned by them."*

Source: Author-generated

7.13.10 Investment opportunities

Two of the participants mentioned that community projects also offer investment opportunities. Community projects have the potential to generate income for members, particularly if projects are done collectively. Participants 20 and 3 argue respectively that:

> *"When we put money in, it's pooled together – that pool buys. It's like an investment scheme, but it's in that space. When you have done that, then you are able to write down or defer the tax that would have been due, commensurate with the amount of investment that would have been made in that. Yeah. So, these projects are helpful…"*

> *"When we are able to produce and sell energy – the profits could be ploughed into other projects within the community."*

7.13.11 Local generation

Another important point raised was that local generation eliminates the potential losses incurred by centralised systems. Participants 9 and 13 confirmed the latter respectively:

> *"the beauty is that […] in [this] situ[ation], you produce where you consume – so there are fewer losses that will happen in the process."*

"...from a social point of view again, you bring technology closer to the people who use it – employment opportunities closer to where it is being consumed."

On the other hand, it appears that municipalities are driving the same agenda. One participant (PT 24) pointed out that municipalities are looking for areas within communities to implement solar projects, allowing for projects to be closer to sources of consumption, thereby reducing losses incurred when transporting electricity:

"We have set to find what are the ways that we can find locations for solar PV panels within the city that would then say that the solar system is nearer to the community, and therefore, we reduce our transmission and our distribution losses because the solar system is nearer to the load."

7.13.12 Potential partnerships

There is the potential for partnerships between developers, municipalities, and communities. Individuals and businesses are already installing solar PV panels on their rooftops, which has the potential to impact municipal income in the areas they distribute electricity. One official from the municipality (PT 24) commented that, instead of every individual producing electricity, it is better for a group of people to work as a whole, especially considering the constraints of the current energy network:

"Like you say, co-operatives; if that system suits the conditions of a specific utility within South Africa, like the City, which cannot afford to have each and every individual [generating] electricity, given the constraint and restrains of our network, such endeavours must be encouraged together with the city."

Although municipalities rely on income generated from selling electricity, people are not waiting for municipalities to implement solar PV projects. If municipalities are no longer benefitting from selling electricity, other avenues should be made available; otherwise, they must work with communities to ensure that they remain in the business. Participant 24 further asserted that:

"There are many needs that the municipality must meet. Somehow, the municipality must meet those needs. If the milk cup is electricity and is taken away from the municipality, the municipality must not cry foul. Let it look for other means of

sustaining itself. Municipalities must work with communities to ensure that [there is] still some level of revenue that would meet other non-revenue services."

7.13.13 Cost savings

Cost savings was one of the primary motivations identified by participants for wanting to be involved in community solar projects. As the cost of electricity from centralised systems increases, the allure of the cheaper cost of solar PV is evidently motivating participants to adopt solar panels, drastically reducing their electricity costs once the initial capital costs are paid in full. These sentiments are evidenced in Table 7.40 below.

Table 7.40: Excerpts on the potential of community renewables to save costs

Participant	**Excerpt**
Participant 3	*"... being able to derive savings instead of buying energy from Eskom."*
Participant 4	"*Yes, I think if the buy-in of the community is done in a way that it is en masse, definitely the opportunities would be better, as opposed to if it is being done by one individual."*
Participant 7	*"Solar PV is cost-effective because it helps in terms of cost reductions as well."*
Participant 13	*"I suppose the big one will be saving on electricity cost[s]."*
Participant 15	*"... it has been proven that solar PV is actually becoming cheaper and cheaper. It is cheaper at the moment than putting up coal power station[s]."*
Participant 16	*"the benefit, more than anything, is to make sure that you reduce your cost of electricity."*
Participant 18	"*I think renewable energy is a good idea which can be cost-effective to the communities"*.

Source: Author-generated

The comments by participant 17 below strongly reinforce the benefits of cost savings.

"It is about the community becoming interested in the economics of energy generation and trying to get involved in the pricing structure of electricity for their own benefit, and to what extent can they reduce the cost of electricity for themselves so that the energy itself, or the electricity, does not become [the] number one budget [item] in the

home on a monthly basis. […] There should be other things that are way [more] important."

7.14 Perceived costs

The perceived costs of community solar PV projects was one of the major themes identified from participants' interviews. The issue of up-front or capital costs was raised as a potential deterrent to community solar projects. However, the cost of solar panels is notably decreasing, while the tariffs on conventional electricity are increasing, suggesting that, over the long term, conventional energy will eventually cost more than the up-front costs of solar PV. Essentially, the participants asserted that the monthly costs of the centralised system would total more in their entirety than the initial costs for solar PV. Participants raised monetary concerns (for example, cost of the panels), and non-monetary concerns (for example, time spent on the project) regarding costs when considering community solar projects.

7.14.1 Monetary costs

Most of the participants stated that they had considered installing solar PV on their own rooftops, but the cost was ultimately the deciding factor. Participants noted that the cost of solar PV is decreasing and, when combined with storage facilities, are thus avenues worth considering. The following two tables (Tables 7.41 and 7.42 below) present quotes by participants relating to the changing costs and options concerning solar PV.

Table 7.41: Excerpts on the costs of alternative energy

Participant	Excerpt
Participant 3	*"I have considered [installing a] solar PV on my rooftop; what has been the challenge is that it appears to be costly."*
Participant 14	*"I think, not until recently, solar without storage was very expensive, compared to fossil-fuel managed kWh. But I think medium to large-scale projects have now become competitive in terms of solar PV installations."*
Participant 15	*"The deciding factor at the end would be the costing versus another form of energy which could be gas or electricity from Eskom."*

Source: Author-generated

Table 7.42: Excerpts on the reduction of costs of solar PV panels

Participant	**Excerpt**
Participant 2	*"... capital cost is a bit high, but over time it evens out."*
Participant 10	*"...there may be an up-front cost now, but when you think about what you invest in conventional electricity, you must know that it is a sunk cost – you never recoup that money. But if I invest that money in solar PV, it is a better investment."*
Participant 11	*"... I have considered it, especially in combination with Tesla battery storage. It makes much more sense, and [there is] fact that there is a cost reduction cost in terms of purchasing energy."*
Participant 13	*"I think the other issue is usually the high up-front capital costs, but those are coming down…"*
Participant 21	*"... prices of solar panels have come down drastically."*

Source: Author-generated

As mentioned in the table above, some participants noted that alternate energy models are becoming available that allow for more individuals to afford solar panels. Additionally, some participants mentioned being comfortable with electricity delivered to their homes, but that the cost of conventional electricity should not be perceived as cheap compared to solar PV. They emphasised that many people feel overly comfortable with the current electricity provided by the state utility, as they are unaware of hidden costs. This information is supported by two participants (PTs 17 and 12) who argued that:

> *"It is a costly comfort zone."*
>
> *"... that can be something that discourages people to put it up-front, and they rely on the municipality or Eskom – [it] is still expensive, but when you pay a little bit, it doesn't appear, but eventually, in the long run, you are going to pay more. But you don't feel it, you don't have that sense really. It's definitely something that really discourages people."*

One of the participants (PT 4) noted that, recently, financial packages had been developed for those in enclosed areas like complexes and estates; these packages address the issue of up-front capital costs to individuals:

"... there are packages for complexes so that they can get the structure in place and get it off their levy. If they can create [sorts] of financial packages that are viable, then I think people are going to go for it".

Participant 22 also contended:

"My perception is that small-scale PV solar is viable, starting off at the residential level because of the affordability. I can say it very much depends on the current tariff that users are paying because the tariff determines the payback period on the investment of [...] solar."

7.14.2 Non-monetary costs

Some participants emphasised the perceived cost of time associated with implementing renewable energy projects. Participants commented that these projects need substantial time commitments from people if they are to succeed, leading some to ponder how much time might be required for these projects. Though others noted that systems exist to help streamline the process, reducing the need for people's time. These sentiments are expressed in Table 7.43 below.

Table 7.43: Excerpts on non-monetary costs

Participant	**Excerpt**
Participant 12	*"Well, time is money, and when you spend your time, you want to realise that gain. So, in my view, this can be a ground-breaking initiative if people realise the benefits beyond just self-satisfaction, that it can go a long way in helping this community at large."*
Participant 18	*"If it wouldn't take up much of my time, it is something that I would probably look into".*

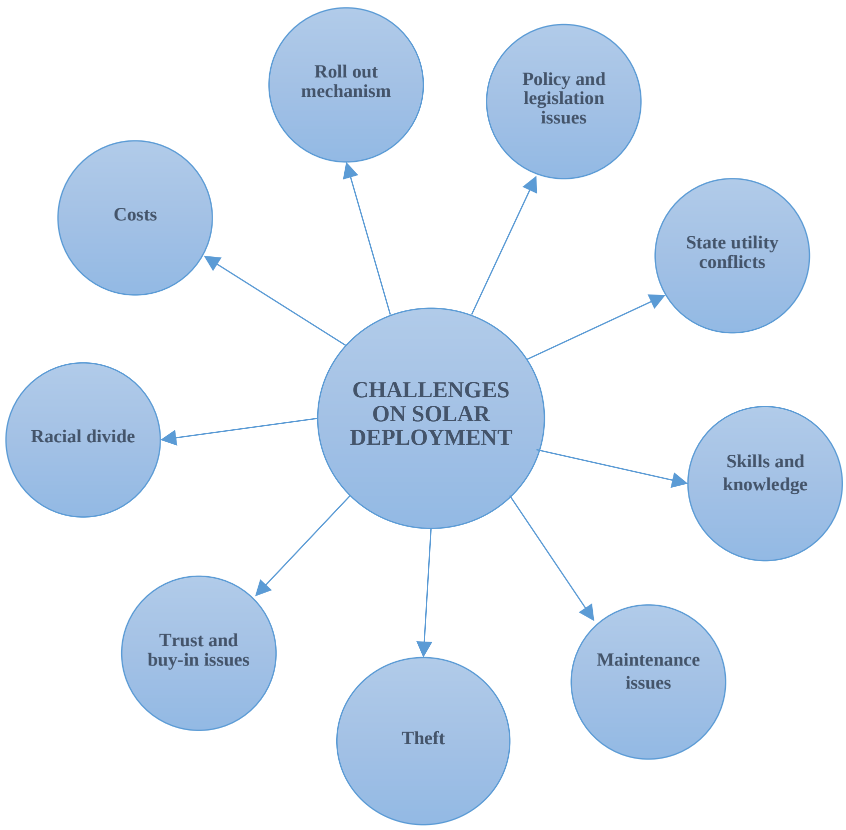
Source: Author-generated

Most people still perceive solar PV as expensive because of the upfront costs; however, those who have considered installing solar PV on their roofs note that the cost is decreasing. The up-front cost also seem less concerning when the monthly fees and hidden costs of conventional electricity from the state utility were considered in comparison. Additionally, some people still assume that solar panels, storage battery, and maintenance costs exceed the price of conventional electricity. However, paying electricity costs every month amounts to significantly more in the long-term than solar energy systems in current cost models.

7.15 Challenges in implementing community renewable projects

Participants identified several challenges associated with community renewable projects, which are noted in Figure 7.10 below. Participants raised issues such as cost, theft of panels, maintenance, and lack of knowledge.

Figure 7.10: Challenges associated with the implementation of CRE



Source: Author-generated

7.15.1 Monetary cost

As discussed further up, the cost of solar PV was perceived to be more expensive than traditional electricity from Eskom. The majority of participants mention the issue of cost as the main challenge to adopting solar PV technology. Their concerns were reinforced by the following participants (PTs 11 and 12 respectively), who stated that:

> *"But for me… the biggest problem is the cost of solar PV – the technology is supposed to be getting cheaper now also. Previously, it was quite expensive and inefficient."*

"Everyone, I am sure, love[s] to have renewable energies in their households, but the initial capital layout really makes people think twice. It also depends on your intended tenure.[…]. So, people would certainly look at the cost, the cost structure is quite high, and that can be something that discourages people."

7.15.2 Theft

Several participants expressed concern about the safety and security of the physical solar panels, as they indicated they are prone to theft. These sentiments are expressed in Table 7.44 below.

Table 7.44: Excerpts on concerns about the theft of solar panels

Participant	**Excerpt**
Participant 8	*"My concern is theft of infrastructure."*
Participant 11	*"And you know, South Africa, of course: you can't put these things in your backyard; you would not find them; they would come back to steal them."*
Participant 22	*"… the community needs to look after that system because, at the moment, we are getting a lot of panel theft."*

Source: Author-generated

Another participant (PT 9) emphasised that solar panels were stolen due to lack of knowledge, noting that sometimes people erroneously believe that the panels can be repurposed:

"So, you need to advise the community on the solar panels, what they can do. I know, like, solar panels we put on some of the schools – they've been stolen, and people are burning them to get the residue out to smoke it."

Reinforcing the comment above was participant 12, who felt that:

"… the challenge is that our communities have a tendency of destroying the same infrastructure that is supposed to benefit them. So, this is going to be a challenge: how this infrastructure is going to be protected from damage, by the same people that are supposed to be benefiting from it."

7.15.3 Maintenance

Data revealed that some participants were more concerned about the difficulties of maintaining the panels and the time it takes to replace parts. This was noted by participant 11:

> *"And you know, you also need to look at the maintenance, and sometimes the cabling is not right. And if any panels break down and how quick is it to get another one; who carries the stock, who doesn't carry the stock."*

Numerous companies have been established who leverage the opportunities presented by solar PV. When solar geysers were promoted by the government to address efficiency, multiple companies brought in products that were defective or inefficient, which reflected poorly on the reputation of solar products. Their sub-par products were prone to breaking down and needed upkeep. Participant 22 notes in this regard:

> *"There are a lot of people coming into the industry, there is a lot of flop, and those who want to make a quick buck and keep the whole industry bad, because of bad installations, using cheap products."*

7.15.4 Lack of capital

Lack of capital was a theme noted by participants, especially that solar panels are expensive and that communities need access to financing to implement such projects. These sentiments are expressed in Table 7.45 below.

Table 7.45: Excerpts on lack of capital

Participant	**Excerpt**
Participant 20	*"One of the biggest challenges that we face, insofar as capital is concerned, is that there is scarcity of capital specifically in relation to the emerging sector."*
Participant 20	*"I can tell you from the REI4P that everybody goes to the IDC* (Industrial Development Corporation) *or PIC* (Public Investment Corporation). *If you succeed, the cost of the money that you get, it is not as competitive as other alternatives."*
Participant 22	*"You want to have finance in place, because I don't think right now people are going to buy it, paying a lot of money, so I think you need to find finance to get a buy-in."*

Source: Author-generated

7.15.5 Lack of knowledge and skills

Participants noted a lack of knowledge and skills as a major concern regarding solar PV sources, as is reflected in Table 7.46 below.

Table 7.46: Excerpts on lack of knowledge and skills

Participant	Excerpt
Participant 5	*"I think we have become apathetic about some of these issues because we don't understand that much, what the benefits are. I think that's a challenge."*
Participant 14	*"... and these guys are changing labour force without skilling people. We found out in the solar market, every time a guy comes with a solar geyser, it is some different guy."*
Participant 15	*"For me, communities don't have the knowledge of alternative at the moment, and obviously in South Africa, we are sort of programmed that electricity must come from Eskom."*
Participant 19	*"Number one is people are not aware, they are only told that it's expensive, and if you tell a community person who is not schooled in the area, he will think it's really expensive. It is a no-go area, we can only deal with Eskom, forgetting that Eskom is controlled politically."*

Source: Author-generated

One expert (PT 20) remarked that, because renewable energy is still in its infancy in South Africa, the grid operators struggle to deal with the variability in the changing system:

> *"On the negative side, in relation to this roll-out model, is that technically you are feeding into a utility that is not necessarily familiar with how to run a system with so much variability."*

7.15.6 Racial divide

Another point raised by participants was, when considering community projects, issues of racial divide must be considered, particularly in South Africa, as expressed in table 7.47 below.

Table 7.47: Excerpts on racial tension in communities relating to RE projects

Participant	**Excerpt**
Participant 10	*"To some extent, yes, South Africa has got [a] racial divide, and knowledge and skills are also divided accordingly."*
Participant 24	*"It can be done. It should be done. However, because of the racial composition of South African society, certain communities are enlightened about such issues. Certain communities have got higher trust levels than others".*

Source: Author-generated

Alternatively, one participant (PT 24) felt that, although some communities are isolated, they also support each other:

> "*Certain communities have got the very same concepts of* ubuntu, *more than the onus of the concept. For any development to take place, if the concept can be applicable in the rest of the other societies, then development would be expedient in those communities."*

7.15.7 Policy and legislation issues

Participants maintained that current policy and legislation issues are barriers to the adoption of renewable energy projects, commenting that, although policy on RE has been touted as a success, there are notable weaknesses in policies concerning small-scale developers. South Africa launched REI4P to promote renewable energy in the country, but some of the interviewees argued that the policy is failing to motivate local ownership, as evidenced in Table 7.48 below.

Table 7.48: Excerpts on policy and legislation issues.

Participant	**Excerpt**
Participant 5	*"I don't know to what extent our government or institutions buy into this, or maybe it is too complex. But I do not think that the commitment is there."*
Participant 18	*"The REI4P does nothing that motivates local ownership."*
Participant 24	*"We simply just need to shake ourselves from robust, moribund policies to flexible policies."*

Source: Author-generated

As previously indicated, South Africa promotes large-scale renewable energy projects to diversify the energy mix. With regards to perceptions on policies that govern renewable energy projects, participants mentioned that policy needs to be comprehensive enough to allow for small-scale players in the renewable energy sector. Participant 23 comments twice on this issue, followed by participant 22:

> *"I think our policy should be comprehensive enough so it could take into consideration the different dynamics within the sector. […] On […] one hand, we need [a] utility-scale solution, on the other hand, we have to explore the smaller-scale systems […] that might be related to mini-grids. […] In the next revision of the iteration, it needs to take into consideration the small-scale value."*

> *"… the policies need to address the change in dynamics - it has to be dynamic enough to know that once we have the utility-scale system, we need smaller systems, we need smart grids …"*

> *"I think the biggest issue is the legislation, and the requirement to connect with Eskom's supply: you have to go through the process of applying to Eskom, and getting that approval, which can be a very slow process, even [with] small-scale, embedded generation."*

Participant 19 asserts that large-scale developments have not significantly helped local communities; the government implemented large-scale projects with IPPs in some parts of the country, but questions are being asked if they are truly beneficial to local people:

"As South Africans, we don't have any benefits; it has mainly benefited foreign companies. Maybe some people, not necessarily us as general South Africans. To say, if I go to Northern Cape and ask them, with all these plantations of solar, what have you benefitted? You guys should be good. There is nothing."

7.15.8 Lack of support and buy-in

Lastly, some participants highlighted the issues of trust and buy-ins from community members, indicating that the issue of trust was still a big concern, while others emphasised the difficulties facing the community members concerning buy-in issues lead some individuals to go at it alone. These sentiments are reflected in Table 7.49 below, while participants 10 and 12 address the latter respectively:

"...some people don't want [a] collective lifestyle, [they] want private lives. So those things are some of the challenges we would face but have to be managed. [...] As long as you champion it, and we have the buy-in from members, it would work."

"Somehow, people have decided to go solo. There is not that solidarity, that 'let's do it collectively', and we can benefit if we do it on a large scale – economies of scale really."

Table 7.49: Excerpts on the lack of support from communities

Participant	**Excerpt**
Participant 6	*"It is to get the buy-in from people, and convince them of long-term benefits."*
Participant 8	*"lack of support – general apathy and despondency among community members."*
Participant 17	*".... and at times, buy-in from the community members as we do not have the same agenda."*
Participant 22	*"It is often difficult to get communities to all agree on the same thing – so the challenge is education."*

Source: Author-generated

However, participant 3 noted that, despite the challenges in uniting people, he believes that advocacy and clearly defined objectives would convince people to undertake community projects:

> *"... we need to be able to clarify the objective to everyone and be sure that we have a buy-in, that there are systems in place to be able to monitor the performance of the system, and be a way to report back to communities."*

Participant 23, however, believed that despite the challenges with intermittent electricity supply, South Africa receives reliable electricity supply from the state utility:

> *"I am yet to see a community that is taking the initiative to set it up in their neighbourhood – I think that is because there is relatively stable energy and electricity supply from Eskom and, notwithstanding the current situation, that we are on and off load shedding."*

In summary, several challenges were identified by all respondents concerning the implementation of community renewable energy projects, especially solar PV. Despite the number of challenges identified, most were expected to concern social ventures where there is no clear, extant legislation supporting such initiatives. The government will need to introduce legislation defining the roles of communities, municipalities, and Eskom in the residential sector, especially considering that all three parties have the potential to generate electricity from renewable energy sources.

7.16 Conclusion

CRE projects contribute to the diversification of energy sources and include communities in the energy sector at a local level. However, the dissemination of these projects and their success is determined by acceptance and social resources available to communities. Moreover, the role of policy and decision-makers in championing renewable energy will determine whether community projects succeed or fail. Participants demonstrated that, although solar PV is still in its infancy in South Africa, the majority of interviewees were aware of the technology and its potential to contribute to increasing electricity availability in South Africa. Some participants showed a high level of knowledge, whereas others had fair knowledge about the technology, but still lacked familiarity with CRE projects.

Given that CRE projects in urban areas are not supported by the government, it was essential to examine the perceptions of individuals and experts regarding community solar projects and how such projects could potentially unfold. After all, individuals and businesses are capable of installing solar PV on their rooftops without the involvement of the community. Respondents saw the concept of CRE as an essential contributor to social development.

However, since the concept of CRE has not yet been introduced in South Africa, several participants were unaware of the possibility of forming community renewable projects. There are, however, extant, ongoing, non-renewable energy community projects in various communities in the urban areas, so participants could easily imagine how such initiatives could contribute to growth and development when substituted with renewable energy sources. Most communities have been innovative in searching for income-generating opportunities to improve their areas, and have worked to remedy the inadequacies of their local governments.

Generally, most respondents perceive CRE projects as an initiative that could benefit their communities' developmental needs. Based on the analysis, participants showed interest in solar PV technology, with some of the participants knowing someone, or themselves having already installed solar technology. In addition, the general perceptions of the individuals and experts towards community solar projects are positive. However, examining the costs of solar PV revealed varying perceptions about the willingness to use solar PV sources, though participants noted that solar PV is becoming affordable when compared to electricity from the Eskom. Irrespective of the high cost of the technology, participants acknowledged that adopting solar PV would yield long-term benefits. Considering the economies of scale when individuals unite to procure the necessary technology to establish solar farms, it creates an opportunity to sell electricity to the grid and to reinvest the income generated back into their communities.

The literature affirms that social and institutional trust profoundly impact the development of renewable projects, as will be discussed in the next chapter. Developers rely on communities just as the communities rely on developers for implementation, and where an equal relationship must also be maintained with local government. Most interviewees believe that there are strong relationships within communities, and that they trust communities to successfully implement solar PV projects. Their involvement in communities, via other projects, has confirmed this trust, allowing those with the capabilities and resources to implement projects. They highlighted that the government should provide supportive policies for CRE projects to flourish. There were many contending opinions regarding the role the government should play in driving community projects, with participants generally believing that communities should take the lead, along with the aid of developers, to implement the projects.

Examining interests for developers to implement projects in urban areas showed that societal values, norms, and dominant culture influence adoption and actions regarding community projects. Municipalities and private developers must gain acceptance from communities if they plan to penetrate urban areas. Unlike in rural areas, the land in urban areas is limited for projects that might be of interest to municipalities; therefore, acceptance from the communities concerned is critical. Although municipalities are responsible for reticulation, and mandate the production and supply of electricity within their jurisdiction, they face challenges in urban areas where proper regulations are lacking (for example, small-scale legislation and pricing). Based on the results of the present study, most participants seem not to trust their municipality and state utility, largely because of ongoing issues with corruption (for example, misuse of municipal funds and state capture linked corruption at Eskom).

Despite these concerns, municipalities, are responsible for managing the distribution of electricity within their jurisdictions: municipalities buy electricity from Eskom at a discounted rate, which they distribute to their customers. This relationship is complex because municipalities are reliant on Eskom for the supply of electricity, but new policies afford small-scale (about 50 MW's worth of energy production) developers – including municipalities – to maximise profits by selling and controlling their own production. In other words, municipalities can produce their own electricity, or partner with communities, but in doing so, excluding the state utility. Knowing this, participants argue that the state utility could concentrate on baseload.

Regardless, consumers will continue to produce electricity and 'intrude' on the grid, where municipalities will be forced to work with individual producers, or produce their own electricity within their jurisdictions. To avoid undermining the interests of each party, the government must develop policies to regulate small-scale producers. Hence, a comprehensive policy based on stakeholder engagement is required to support small-scale and community renewable energy projects.

Overall, participants believed that community solar PV projects would benefit their communities, where their main rationale is that local government cannot deliver on the necessary basic services. If the government were to introduce FITs (where people are paid to feed into the grid), this would go a long way to ensure that money is used to invigorate and develop communities' RE efforts. Communities and developers, as social niches, could then take advantage of the infrastructure and work together with municipalities instead of community members putting up individual solar panels, which, in the long term, will cause problems in the system (over-burdening). In terms of selling points, respondents believe that community projects would ensure long-term cost savings if they produce their own electricity. Participants noted that industry requires substantial amounts of electricity which residential community projects could help remedy.

With respect to roll-out, some participants acknowledged that proper organisation is needed for these projects to be successful. They also noted that the government might not be ready to enforce these types of projects, or that government might not be prepared to manage excess electrical production feeding into existing grids. In a country where there are problems with electricity supply, this could be regarded as an opportunity for communities to work alongside developers and respective municipalities to supplement electricity levels. While much has yet to be determined regarding Eskom, the future of municipalities, and the future of solar PVs and CRE projects, the need for research in this area – particularly stakeholder engagement and co-operation – has proven to be paramount.

CHAPTER EIGHT:
DISCUSSION OF MAIN FINDINGS

8.0 Introduction

In the previous section, the major outcomes of this study's results were presented. The present chapter discusses the main findings of the study by highlighting similarities, differences, relationships, and themes that emerged from this investigation, where themes are specifically discussed with reference to the literature discussed earlier (Hsieh and Shannon 2005). The first part of this chapter presents the qualitative findings, discusses the perceptions of citizens and experts towards the concept of CRE, and addresses the challenges experienced when developing community renewable projects. The second part focuses on the findings from the secondary study that address progress made by solar PV technologies, and the policies relevant to developing community solar projects.

8.1 Summary of the main results

As previously mentioned in chapter two, the aim of this study has been to assess the perceptions of citizens and experts regarding community solar projects, and to explore the factors that influence transition. Within this broad aim, four main questions were formulated and addressed, as described below.

8.1.1 Research questions and sub-questions

The main research question and sub-questions throughout this study have been:

1) **What is the potential for community renewable energy to contribute significantly to South Africa's electricity supply?**
   a) What are the perceptions of citizens and experts toward community solar PV projects?
   b) What are the challenges to developing CRE projects?
   c) What progressions have been made with solar PV technology?
   d) What policy mechanisms have played important roles in contributing to the implementation of CRE projects both internationally and locally?

This section aims to answer each research question by drawing on the results reported in the previous chapter. The following sections reflect on the findings from the semi-structured interviews to answer the sub-questions of the study.

8.2 Perceptions of citizens and experts toward community solar PV projects

This study adopted social capital theory constructs to investigate the perceptions of citizens and experts toward community solar projects, and to evaluate the resources available within communities to implement such projects.

8.2.1 Knowledge and awareness about solar PV and CRE

Scholars have long argued that prior knowledge about technology can have a large influence on an individual's decisions and perceptions of the technology's benefits, costs, and risks (Demski 2011; Huijts et al. 2012). Moreover, such knowledge can indirectly influence their decision of whether or not to accept the technology (Huijts et al. 2012). In a study by Koirala et al. (2018), it was reported that most participants were aware and showed a positive attitude towards local RE projects, where some respondents indicated that they had already installed solar panels on their rooftops.

In support of these findings, the current study revealed that most of the participants have a good wealth of knowledge about solar PV technology, with some participants having already installed panels on their rooftops, as mentioned by (PT 7) *"I am fairly knowledgeable… not that I'm an expert or anything. We have installed this type of a system in a number of places…"*

Other participants, however, had only limited knowledge about the technology, as illustrated in section 7.3. It was interesting to learn that most participants were not aware of the potential of CRE projects, but this is perhaps not surprising given that CRE projects have not been formally introduced as a concept in South Africa, and considering there is no regulation pertaining to CRE. As one expert (PT 23) expressed, "*I don't think we have explored it enough to really make an informed decision on whether it would work for us."*

The development of CRE projects can be deterred if there is a lack of knowledge and understanding between the general public, bankers, potential partners, and politicians (Huybrechts and Mertens 2014). Bauwens et al. (2016) do argue, however, that if a co-operative model is adopted by society, that could play a role as people become aware of legal structures, and how CRE can benefit the community.

8.2.2 Environmental concerns

Fossil fuels are an overwhelmingly dominant source of electricity generation, particularly in developing countries (Molyneaux et al. 2016; Bekun et al. 2019), and are the main contributor to environmental degradation on both the local and global scales (Sakulniyomporn et al. 2011). According to some, environmental beliefs may influence attitudes toward developing local RE projects, but it remains to be seen whether that relationship is positive or negative (Olson-Hazboun et al. 2016).

The results of the current study show that most participants are aware of the environmental issues associated with the consumption of fossil fuels, including impacts on the environment, and people who live in areas close to coal power stations in South Africa. This statement is supported by (PT 12) *"I am particularly concerned about air pollution; they pollute the air which people inhale, and it can lead to some detrimental health [issues]."*

Accordingly, it is noted that power plant emissions can negatively impact human health, climate, building materials, crops, and the natural ecosystem (EU 2015). As one participant (PT 19) mentioned, *"If you go to Mpumalanga where production is happening, and you look at the community, [you can see] how they are suffering from coal dust, [and] the health issues that come with that.*"

If fossil fuels are replaced with renewable sources, the results could contribute to reductions in lost workdays, decreases in premature mortality rates, and ultimately lower the overall costs associated with healthcare (Machol and Rizk 2013).

8.2.3 Participation in community solar projects

Community projects are a means by which community members can be more involved in the implementation and management of the projects relevant to them (Hicks and Ison 2018; Brummer 2018b). However, engaging communities in CRE projects is dependent on local contexts where, in some cases, local conditions can hamper the development of CRE projects (Fernandes-Jesus et al. 2017). In a study by Koirala et al. (2018), it was found that the majority of participants were willing to be involved in a CRE project. In contrast, Rogers et al. (2008) reported that some of their participants were not interested at all in participating, while others were neutral toward involvement in CRE projects. Regarding the latter, however, it was noted that some participants were renting and did not own their homes, which might explain their low interest in participation.

The findings of the current study reveal that most participants are keen to participate in community solar projects, as was shown in section 7.7, where one of the experts (PT 23) argued that "*[s]maller players have a role to play; property developers in the urban context have a huge role to play. We have to ensure that we stimulate industrialisation by ensuring that we implement some of these ourselves and show the rest of the society what is achievable."*

Furthermore, *(PT 15) remarked that "I would actually be [on] the forefront of it because I believe in communities that are self-sustainable [...] and I am already involved in a different type of community project."*

Members' willingness to participate in CRE projects is considered paramount for project success (Koirala et al. 2018). Furthermore, the long-term survival of communities is dependent on the level of participation therein, and on ownership structure (Urmee and Anisuzzaman 2016).

8.2.3.1 Roles played

Community members can play passive or active roles in CRE projects (Kalkbrenner and Roosen 2016), where Martiskainen (2017) notes that leadership roles are typically assumed by those who are well known in the community and who are very active in the initiatives. Green and Haines (2015), however, make the point that there is often a lack of a diverse set of influential leaders, and it is usually the same people who try to improve local conditions and take accountability in being leaders of initiatives. Rogers et al. (2008) found that most of their respondents were interested in participation, but rarely was there a single person keen to serve in the role of project leader.

The findings of this study support these previous studies, wherein it proved to be the case that some participants were eager to take a leadership role as mentioned by PT 13 and 10 *"[A] leadership role would be [ideal] because I really like to be active as well – contribute what I can in terms of ideas, resources, and even help with activities."*

"Well, I am part of the committee, I would be willing to participate in a community project, both to champion and [to] provide funding where it is necessary." where others indicated that they already held a leadership role in their communities, also as shown in section

7.7.1. However, the majority of participants were happy to only play a passive role, as illustrated in section 7.7.2.

8.2.3.2 Resources

Three main resources are required for a community project to succeed: funding, expertise, and time, where a lack of these resources could result in project failure (Park 2012; Sperling 2017; Brummer 2018b). Communities must have technical, legal, and funding resources prior to setting up an initiative, since a lack of any one of these could hinder the establishment of community renewable projects (Brummer 2018b).

According to my findings, participants believe that there are resources in their communities to implement community solar PV projects. Particularly, participants argued that communities in urban areas have the financial capacity to implement CRE projects, as noted in section 7.9.1. One of the participants (PT 8) highlighted that "*the community has a great care for natural environment, and above-average disposable income. It has three schools which can be involved.*", another participant (PT 4) further added that "*The community [has] the will; the community [has] the means, [has] the desire and the drive, but what is lacking would be technical skills, availability of resources, but we [are] able to outsource […] without losing control of the project.*"

Despite these viewpoints, participants were also hesitant regarding a lack of skills with regard to implementing RE sources (see section 7.9.1).

8.2.4 Motivation to participate in community projects

Communities engage in RE projects for various reasons and motivations (Becker and Kunze 2014; Seyfang et al. 2013; Martiskainen 2017). Some researchers have highlighted both financial and non-financial motivations for being involved in CRE projects (Bauwens et al. 2016). Studies report that the most common reason for communities to participate in RE is to generate income and strengthen local economies (Hicks and Ison 2011; SCENE 2012; Hicks and Ison 2018; Fleiβ et al. 2017; Sperling 2017; Li et al. 2013; Wiersma and Devine-Wright 2014). In addition to concerns for the environment (Hicks and Ison 2011; Li et al. 2013; Ntanos et al. 2018), other benefits of RE include lower energy costs (Rogers et al. 2008; SCENE 2012; Mey et al. 2016), energy independence (Peters et al. 2018), and improved quality of community life (Rogers et al. 2008; Ornetzeder and Rohracher 2013; Li et al. 2013; Julian 2014; Hicks and Ison 2018). In the latter case, collective efforts toward delivering a successful project empower communities and bring a feeling of community pride and resilience, especially when the results are clearly visible after the project has been initiated (Hicks and Ison 2011).

The findings of this research demonstrate varying motivational cases that range from financial benefits, job creation, community pride, environmental health, social networking, energy independence from the state utility, and others, as shown in section 7.8. However, most participants were motivated by financial benefits for community advancement (see section 7.8.1), followed by job creation (see section 7.8.2). Also, most participants were motivated by the idea of self-sufficiency and empowerment, as reflected in the comments of one participant (PT 15): "*I believe in communities that are self-sustainable. I believe that communities should be able to do things that can empower them.*" Similarly, in the UK, communities were motivated by cost reduction and income generation for their community (DECC 2014).

8.2.5 Trust in community members to implement CRE projects

According to Walker et al. (2010b: 2657), trust is a crucial component to the successful development of CRE projects: "trust is both a necessary characteristic and a potential outcome of co-operative behaviour." Suebvises (2018) found that only four out of every ten people (38.8 per cent) had trust in other people, indicating that the majority of people have trust issues. By contrast, Koirala et al. (2018) found that most respondents had little to no trust in their community, but argued that joint ownership is simply not the norm in their culture. Similarly, Zhou et al. (2017) found that, even though there was a low attendance in the community meetings arranged by the community head, the level of trust was still high among community members because of entrepreneurial spirit, where the lack of leadership did not necessarily deter communal motivation (Zhou et al. 2017).

In this study, most participants expressed high levels of trust in members of their communities, stating that they are involved in other projects, but not RE.

As one participant mentioned, "*we have a river near to us, and [...] the community, every now and then, we come together and clean the river.*" This statement is further substantiated by the following participant (PT 25) *"if there are skills within the community and the money to execute a project, I would trust community members."* These findings run counter to Green and Haines (2015), who report that, in most cases, communities are unorganised and are unable to bring about social change. In this study, participants trusted that communities would be able to handle CRE projects, albeit with some assistance from experts regarding implementation (see section 7.9).

8.2.6 Institutional trust and the lack thereof

Community energy projects are multifaceted, and various ownership models are available to inform their structures. Projects can either be owned and operated by the community, or alternatively the community can partner with private or public sectors like local government (Warner and Sullivan 2017; Eitan et al. 2019). Private sector investment is essential for sustainable economic development (Fadly 2019), and rapid growth in the share of renewables (Cedrick and Long 2017). Joint ownership can promote community support for RE projects during the formative stage (Strachan et al. 2015).

However, for a partnership to develop between a developer and community members, there must be a degree of trust and confidence between the two parties. Similarly, the negotiation process should include a detailed description of the organisational structure of the partnership in terms of the vision, objectives, responsibilities, tasks, grievance mechanisms, and contractual arrangements to ensure that benefits flow efficiently over time (Warner and Sullivan 2017). Fairness in the process and outcome by both supporters and non-supporters of the energy projects is critical (Aitken 2010). In a study by Julian (2014), participants were concerned that private developers directed the profits of RE projects elsewhere, either to areas not recognised by the community or outside the areas in which they operated the business. In some cases, it illustrated that private developers do not keep community interests in mind. Scheer et al. (2017) also noted that their participants generally lacked trust in political and business decision-makers.

Supporting this previous work, the current study found that several participants were sceptical about private developers and asserted that they do not trust external developers (see Table 7.25). Moreover, one of the participants (PT 23), argued that:

> "*If it's an external developer, they have to have that track record; they ought to have implemented similar projects successfully and demonstrate having developed and operated for a certain period because the development of energy projects is not [a] competency of most communities.*"

Results presented in section 7.10.4 demonstrate that, although they distrust developers, participants are also concerned about external developers' willingness to transfer the necessary skills to the members in order to ensure continuity when developers exit the project. Supporting the statements on trust issues, one participant (PT 8) asserted: *"I think many just like to capitalise on the initiative to make as much money as possible."* Aligned with these findings, Goedkoop and Devine Wright (2016), and Saintier (2017), both reported that almost all their participants were concerned that developers are motivated mainly by financial gain and only view community members as potential constraints on maximisation of their profits. However, Goedkoop and Devine-Wright (2016) also assert that lack of trust is prevalent both ways, as developers also express lack of confidence in communities regarding capacity and representativeness.

Furthermore, communities consider private developers as solely interested in profit and in gaining planning consent. Goedkoop and Devine-Wright (2016) argue that successful partnerships between the private sector and community groups dependent on communities being informed of the opportunities presented, and require the identification of leaders that can represent them. Authentic relationships rely on the way shared ownership is founded, and concentrate on resolving conflicts between the actors involved in the project.

8.2.6.1 Trust in municipalities or local government

There are increasing opportunities for local governments to participate in community projects because of greater grassroots initiatives (Mey et al. 2016). Municipalities are responsible for regulating land use and, therefore, are the gatekeepers of distributed energy systems. They are responsible for formulating regulations and overseeing installations, sitting, and deployment of small-scale decentralised systems (Cruz 2018). However, Mey et al. (2016) found that lack of financial resources in most municipalities limits their ability to develop and implement RE projects.

In Germany, there is a robust municipal structure that are able to form monopolies amongst themselves and prevent grassroots projects from benefitting from value generated from energy services, which then impacts negatively on community interests despite the good intentions of investors (Julian 2014). Moreover, some municipal utilities oppose any establishment of community projects (Herbes et al. 2017), as that may impact on their economic feasibility (Yildiz 2014). However, as noted by Mey et al. (2016), local government is more aligned with local communities and therefore are in a better position to facilitate the requirements of national policy targets with the interests of locals.

Participants in this study were asked if they trusted municipalities to implement RE projects on their behalf, and the responses varied considerably. Most participants raised issues of distrust in municipalities because of ongoing corruption.

One participant (PT 7) argued: "*We have a problem of corruption in [this] country that is crippling the economy. Even the things that were working are now incapacitated because of corruption. I would rather have us as a community doing it on our own."* However, participant (9) still expressed trust in municipalities, *"I would trust municipalit[ies] to execute the program, and they can be trusted; we have executed projects together before – they are reliable."* But McLellam et al. (2016) argue that, in general, consumers tend not to support new entrants: consumers tend to resist change and would instead follow a reorganisation transition as they tend to have strong support for existing electricity companies rather than new establishments.

8.2.7 Exit strategy

An essential aspect of community development is that, ultimately, communities must learn to do things themselves (Green and Haines 2015). This is referred to as 'capacity building', referring to the ability to become active agents as opposed to being objects of change (Green and Haines 2015). Joshi et al. (2019) state that, to ensure that knowledge is transferred to a community, it is critical to work together when carrying out operational activities. People should feel that they can express their views and that they are listened to, that they can initiate the desired actions, and are involved in processes that concern them (Laverack and Wallerstein 2001).

In this study, although participants acknowledged the need for external developers to implement projects on behalf of communities, several participants reiterated the importance of an exit strategy for developers as highlighted by (PT 2) *"...skills transfer is very important; it's something that developers would need to leave behind for a community."*

Participants were more interested in the transfer of skills by external developers, as shown in section 7.10.4. Respondent 10 also mentioned that: *"My approach would be an apprenticeship program for the community. The external investor or technical partner must, by its nature, transfer the skills and teach the community how to do it so that they can do it themselves."*

Many community-based initiatives focus on training that increases the level of human capital and, in the end, improves the quality of life (Green and Haines 2015). Also, communities prefer to work directly with organisations with a strong and accountable record (Green and Haines 2015).

8.2.8 Social norms influencing the adoption of renewable energy technologies

The importance of social influence, particularly on households, as to whether to adopt solar systems due to the influence of friends or neighbours, is widely acknowledged (Elmustapha et al. 2018). In this study, several participants conceded that their decision to adopt technology is often influenced by friends and family as asserted by participant (24) *"... I installed my gas geyser on the [basis] of discussions with my friends."* Participants also admitted to favouring RE technologies if they successfully worked for a friend (see section 7.12).

8.2.8.1 Expectations

According to Schot et al. (2016), the expectations of niche actors are instrumental to the success of CRE projects as they create a sense of urgency for changes in the community. Brummer (2018a) also notes that, when CE projects benefit all participants, there must be a collective effort to avoid free-riding behaviour that might manifest in this context.

In the current study, participants raised a number of concerns, as summarised in section 7.12.1. Participants expected that members would commit to a CRE project, citing that people would generally be excited about the project in the initial stages, but that there might not be any follow-through during later stages; as participant (8) stated, *"... I expect people to fully support it, take it beyond an initial phase, back the initiative with their money and/or time and other resources."* Schot et al. (2016) assert that the expectations of niche actors are significant when they are persistent and are shared amongst civil society actors, users, producers, and regulators.

8.2.9 Social identity/connectedness within communities

Social connectedness is an important aspect in determining whether a technology is accepted or not (Bauwens and Devine-Wright 2018). Studies have shown that the potency of existing community networks is linked to the success of community projects; for example, those that lack close ties rely mainly on outside agencies (Rogers et al. 2008). On the other hand, the perception of communities may influence whether an individual gets involved in community problem-solving behaviours (Larsen et al. 2004). Also, those who have been longer-term residents in a particular community are reported to have stronger bonds (Larsen et al. 2004). In their study, Koirala et al. (2018) found that 29 per cent of participants felt that they were strongly associated with their community, 47 per cent were neutral, and about 24 per cent felt no involvement in their community.

The findings of the current study revealed that most participants felt that they have a sense of belonging within their communities, and acknowledged that their communities have a working relationship (see section 7.11.2). One participant (PT 25) asserted that *"I believe I belong; we have our issues. But yeah, I am part of the community. My kids are part; my family is part of the community, my neighbours know my kids, I am part of it."*

Another participant (PT 10) corroborates the above statement *"Well, I am part of the committee, I think it is a friendly community, the people that are there, have a very good sense of oneness ..."*

CE projects can help in community building by assisting members to identify with members in their communities, and increasing their interest in participating in local initiatives (Brummer 2018a; Rogers et al. 2008). Furthermore, it can be used as a platform for self-realisation, which ultimately promotes a sense of pride and happiness in what can be achieved by the community (Brummer 2018a).

8.2.10 Perceived benefits of engaging in community renewable projects

Communities decide to participate in RE projects for multiple reasons, including financial benefits, environmental benefits, energy independence, and the realisation that projects can lead to an overall improvement in local communities (Brummer 2018a). Furthermore, community projects contribute new sources of income, thereby creating an opportunity for economic and community growth and development (Hicks and Ison 2011; van der Schoor and Scholtens 2015). Brummer (2018a) asserts that financial benefits to individuals and entire communities can be substantial. There are some projects for instance, in Scotland, where all resulting profits are contributed to a community fund that is then used to fund other community initiatives like the maintenance of shared assets and services (Hicks and Ison 2018).

According to Berka and Creamer (2018), several studies that assessed economic impacts both in the UK and the USA have shown that potential regional projects regarding RE installations greatly exceed that of commercial ownership. In the UK, there has been an increase in the adoption of solar PV sources since 2012, and the return on investment on domestic PV installations was significantly higher than the interest accumulated from personal bank accounts or other means of financial products that were available to households (Inderberg et al. 2018). As noted by Brummer (2018a) and Heras-Saizarbitoria et al. (2018), an important aspect of community energy is an increased level of energy independence from external suppliers. Furthermore, as compared to conventional fossil fuels, solar projects support more jobs per unit of electricity production (Kabir et al. 2018). According to Suebvises (2018), local authorities can fail to deliver services and public goods, but when there is community participation in CRE projects, communities are able to intervene and use the income generated to upgrade their areas.

In this study, benefits included a sense of ownership, improved security, investment opportunities, an increased energy buffer, community advancement, and others (see section 7.13). A central theme that emerged throughout the interviews was cost saving (see section 7.13.13) and sense of ownership (see section 7.13.9). For example, participant 5 asserted that: *"From a social point of view, again you bring technology closer to people who use it, have a better understanding, training opportunities, employment opportunities, closer to where it is being consumed. So, the benefits are many. So, a distributed generation – ideally, that should be the norm."* According to Rycroft (2019), the localisation of RE technology in South Africa would create jobs at the same time as increasing the local quantities of products.

8.2.11 Perceived costs of community solar projects

8.2.11.1 Monetary costs

A primary challenge facing CRE is that almost all the capital costs of RE technologies are paid up-front (Kabir et al. 2018; Eitan et al. 2019). Despite this, Upham and Roberts (2011) found that cost was not a significant disadvantage to adopting technology for participants in the UK, Poland, and Germany. Karakaya and Sriwannawit (2015) posit that the cost of conventional electricity might impact on the diffusion of solar PV sources as potential adopters may compare the price. Although RE sources have made significant economic progress and are expected to reach cost parity with fossil fuels, RE sources are criticised for their low performance in terms of power density (Naicker and Thopil 2019; Kammen and Sunter 2016). However, some scholars speculate that their efficiency has increased significantly in recent years, parallel to decreased costs of implementation (Kabir et al. 2018; Lerch 2017). This is in contrast to fossil fuels that are highly prone to price volatility (Kabir et al. 2018).

In this study, participants raised issues of upfront costs of solar PV sources, *"I think the other issue is usually the high up-front capital costs, but those are coming down…"PT13*

> and questioned their efficiency *"But for me… the biggest problem is the cost of solar PV – the technology is supposed to be getting cheaper now also. Previously, it was quite expensive and inefficient.*" PT11

Together, these concerns could be a temporary deterrent for adoption (see section 7.14.1). Some participants argued that there might be an up-front cost for solar PV sources, but, concerning conventional electricity, that there are hidden costs and eventually the total economic burden may exceed solar in the long run. The latter was echoed by participant 10:*"There may be an up-front cost now, but when you think about what you invest in conventional electricity, you must know that it is a sunk[en] cost, you never recoup that money. But if I invest that money in solar PV, it is a better investment."* In addition, some acknowledged that the cost of solar panels is decreasing, whereas the cost of electricity from the state utility continues to rise, thus potentially promoting people toward adopting solar PV sources.

8.2.11.2 Non-monetary costs

Seigo et al. (2014) claim that costs of RE include both financial costs for the individual and society, as well as psychological costs associated with the tremendous efforts required for implementation. In a study by Koirala et al. (2018), however, it was noted that the majority of people cited that time was not a barrier for them to participate. In a study by Li et al. (2013), over 50 individuals, ranging from school students to retirees, invested their time to inform individuals about the project and convince people to invest. In the latter case, the project very successfully ended up producing 14 million kWh, that exceeds community demand by over 2 million kWh (Li et al. 2013).

The current study shows that some participants were concerned that being involved in CRE would consume some of their time. As pointed out by one participant (PT 18) *"If it wouldn't take up much of my time, it is something that I would probably look into"*.

However, other participants asserted they are already taking part in community initiatives in their areas, and that they think that the additional time investment would be minimal (see section 7.14.2).

8.3 Challenges in developing community renewable energy projects

There are numerous potential challenges facing community projects, ranging from regulatory, institutional, economic, to social barriers. In accordance with Luthra et al. (2015) and Seetharam et al. (2016), this study classified community-related barriers into regulatory, economic and financial, environmental, technical, and social in order to understand the socio-technical barriers. Commonly, community initiatives face challenges of securing sufficient funding, applying effective team leadership ensuring continuity, and attracting members (Van der Schoor and Scholtens 2015). In fact, Brummer (2018a) asserts that at times, communities may have inadequate resources, funding, expertise, and time which could contribute to community project failures.

8.3.1 Regulatory-related barriers: policy, state utility, infrastructure

In many countries, the electricity sector is dominated by large, centralised corporations. Consequently, decentralised RE systems and CREs are faced with the challenge of overcoming regulatory barriers that favour large corporations (Abdmouleh et al. 2015; Koirala et al. 2018). In fact, utilities are playing a role in developing utility-scale solar PV projects, and overpowering small-scale installations and the policy mechanisms that are aimed at supporting them (Davies and Carley 2017).

The current study reveals that current policy does not support small-scale developers (see section 7.15.7). South Africa promotes large-scale RE projects as exemplified by the adoption of the tendering system policy, where similar challenges exist in the US (Brummer 2018a). Furthermore, there may be challenges associated with infrastructure that requires continual upgrading and maintenance (see section 7.15.3). The increase in RE sources can cause insufficient electricity network capability (Hua et al. 2016). Markantoni (2016) states that grassroots innovation depends on institutional support by incumbents who are not able to influence energy, and who are thus not subject to dominant power relations. As participant 23 asserted: *"… the policies need to address the change in dynamics – it has to be dynamic enough to know that once we have the utility-scale system, we need smaller systems, we need smart grids."*

8.3.2 Economic and financial-related barriers

The challenges of up-front costs often promote community groups to come together to develop innovative solutions that involve them combining community investments, bank credits, public funds, and partnering with businesses and public authorities to form joint ventures (Huybrechts and Mertens 2014). Studies have shown that access to capital, may be a challenge for the development of CRE projects, particularly in the start-up phase (Huybrechts and Mertens 2014; DECC 2014; Abdmouleh et al. 2015; Ebers and Hampl 2018; Brummer 2018a). However, the majority of participants from previous studies indicate that their projects did not encounter difficulties raising risk capital for the implementation of their projects (IEA -RETD 2016)

Although South Africa has a well-entrenched financial services industry and support for RE projects (see chapter four), some of the participants herein argued that challenges exist in accessing funding. As one expert (PT 20) notes, *"One of the biggest challenges that we face, in-so-far as capital is concerned, is that there is scarcity of capital specifically in relation to the emerging sector."* Additionally, participant (22) mentioned that, *"You want to have finance in place, because I don't think right now people are going to buy it, paying a lot of money, so I think you need to find finance to get a buy-in."*

8.3.3 Technical barriers

Despite the government supporting solar PV and wind energy, as shown by the recent REI4P developments, there are also significant technology barriers to widespread implementation (Naicker and Thopil 2019). These technologies are not able to meet baseload requirements, and therefore must be supplemented with fossil fuel technologies. The other challenge involves grid infrastructure, which, in some instances, may not support the expansion of technologies (Naicker and Thopil 2019). On the other hand, solar PV technology requires maintenance, which incurs a cost.

In the current study, some participants expressed concern about the maintenance of solar PV (see section 7.15.3). However, Mohtasham (2015) asserts that, when compared to other RE sources, such as hydroelectric and wind energy, residential-sized solar panels have little impact on the neighbouring environment, and the solar panels require little to no maintenance beyond the requirement of clean regularly. Some participants were concerned about the theft of solar panels, but one participant argued that, if community members are investors in the projects, then they will undoubtedly look after their asset (see section 7.15.2).

8.3.4 Social barriers

At times, the individualistic nature of a community may create challenges for a collective effort toward CRE projects (Elmustapha et al. 2018). It can also be difficult to convince consumers to convert to a solar technology if they are accustomed to conventional electricity systems (Huybrechts and Mertens 2014; Elmustapha et al. 2018). However, technology suppliers believe that it is easier to promote technology to an organised community group than targeted individuals (Elmustapha et al. 2018). Despite this, people are likely to be hesitant about the reliability of the energy supply of community projects (Brummer 2018a).

A central theme emerged from the current study: there exist core concerns regarding buy-in from communities, as they are already accustomed to the conventional electricity system. This was noted by participant 12: "*Stakeholder[s] [are] a big thing: to get people involved, they need to be able to trust you, they need to believe in your concept, in what you are telling them. It will take a great deal of time and a lot of hard work to really convince people."* Participant 23 further argued that: *"By-and-large, there is stability, and people don't want to invest that much money because there is an up-front cost."* However, other participants mentioned that people are unhappy with the instability of the current supply, and would support alternative energy (see section 7.6). Koirala et al. (2018) highlight that, when there is more control within communities, they are able to organise themselves to form community energy projects.

8.4 Progress made with solar PV sources

The establishment of RE is acknowledged as a viable option to reduce greenhouse gas emissions, while at the same time meeting the increasing demand of electricity both in developed and developing countries (Hua et al. 2016). Because solar power is continuously available, it provides energy independence and energy security to all. Moreover, it is a freely available energy source that is capable of managing long-term issues concerning energy predicaments (Kannan and Vakeesan 2016). Therefore, solar power is recognised as an important source not only to benefit individuals, but also to promote the socio-economic progress of societies, companies, nations, and states (Kabir et al. 2018).

8.4.1 Price improvements

A review of the literature revealed that the price of solar has drastically decreased both nationally and across the world, and that further decreases are expected in the coming years. According to Comello et al. (2018), the price of solar has seen a reduction from about US$4 per Watt, to approximately US$0.35 per Watt, for the period between 2007 and 2017. As prices decrease, there has been significant growth in the deployment of solar PV panels (Comello et al. 2018). Similarly, South Africa has witnessed a considerable decrease of about 75 per cent since the introduction of the procurement programme (see chapter five).

8.4.2 Learning

Studies have demonstrated that participation in CRE projects leads to knowledge and skills development in a range of areas: leadership, project management, organisational management, project finance, teamwork, problem-solving, engagement and community consultation, law, marketing and communication, fundraising, and technical knowledge around energy efficiency and RE technologies (Berka and Creamer 2018). Gubbins (2010) further reports that communities learn new skills by taking part in CRE projects. Martiskainen (2017) also found that community leaders would go out of their way to seek information about funding and technology options, and would share their knowledge with other intermediaries and communities or organisations. Finally, communities are able to draw on internal skills, knowledge, and capacities that exist within (Seyfang et al. 2013; Seyfang et al. 2014; Martiskainen 2017; Walker et al. 2010a).

In South Africa, the government promotes large-scale developers that are already largely established as energy contributors to the grid. However, at a small-scale level, solar PV technology is still in its infancy, and there are no CRE projects that are promoted by the government, thus resulting in individuals and businesses experimenting on their own (Rycroft 2019). However, steady progress has been made with regard to product accreditation, training, safety standards, technical standards and standardisation, certification of designers and installers, and so on, for solar PV installation of up to 10 MW (Rycroft 2019).

8.4.3 The scale of solar PV

Solar PV sources are among the best options to meet the energy demand of the future because of their capacity, accessibility, efficiency, availability, and cost-effectiveness in comparison to other RE sources (Kabir et al. 2018). A significant increase in RE sources was experienced globally in 2016, with a capacity of approximately 161 GW added, representing at least 47 per cent of newly installed capacity in 2016 (Zurita et al. 2018).

In 2017, solar sources displayed remarkable worldwide historical progress, with the installation of solar PV sources exceeding that of other power generation sources, including other renewables and all conventional fuels (Zeitouny et al. 2018). In 2017, another 100 GW of new capacity was installed globally over and above the 300 GW already installed; now accounting for 6.3 per cent of total installed capacity, and 1.7 per cent of total power generation (BP 2017). In 2018, solar PV sources experienced significant growth with an increase of 29 per cent, thus making a considerable impact concerning power generation growth by contributing approximately 14 per cent growth to global power generation (BP 2019).

Recent evidence indicates that significant progress has been made regarding solar PV technology both internationally and in South Africa (see chapter five). Since the promulgation of the REIPPP programme, South Africa has experienced substantial growth in solar PV levels. Despite this, more needs to be done to promote awareness at the individual level for an accelerated diffusion of the technology. There is an opportunity for further growth in the sector, considering that solar panels manufactured in the country are diverted to the international market because of low demand.

8.4.4 Support

Numerous organisations exist to support RE sources in South Africa (as reviewed in chapter four). In terms of solar PV technology, SAPVIA has played an essential role in promoting the technology to industries, businesses, and individuals, thus ensuring that it is the technology of choice for the South African market (SAPVIA 2019).

This section has addressed the third research question and objective by assessing the progress made with solar PV sources both internationally and in South Africa using the proxies of transition typology, concluding that solar PV technology has advanced in the South African market and therefore, there is a potential for community initiatives to utilise this technology in the future.

8.5 Support mechanisms that have contributed to the development of community renewable energy projects

To ensure that communities have the resources needed to succeed, external sources of support are needed, such as consistent policies as well as intermediary networks (Seyfang et al. 2014). There is a requirement for resilient, efficient, and financially healthy policies to ensure that the country can grow and satisfy the economic empowerment of ordinary citizens (Bhowmik et al. 2018). On the whole, governments play a central role in setting policies, defining new rules that need to be followed, investing in infrastructure, and restructuring the markets (Eitan et al. 2019). As previously discussed in chapter four, there are three primary support mechanisms that promote RE sources (the quota system, FITs, and tendering systems), and two complementary tools (tax incentives and investment subsidies) (Schallenberg-Rodriquez 2017). Table 8.1 below reports a comparison between the three countries examined in section 4.14, and illustrates that Germany has set itself apart by promoting broader participation.

Table 8.1: A comparative summary of Germany, the UK, and South Africa

	Germany	**UK**	**South Africa**
Total installed capacity	183.4GW	77.9GW	51.3GW
Owned by communities	47%	0.08%	Community benefits

Source: Julian (2014); US AID (2018)

8.5.1 Main support mechanisms for RE and their contributions to CRE development

In many respects, clear policy support and ambitions are considered paramount to the success and sustainability of CRE projects (Rogers et al. 2012; Süsser and Kannen 2017; Seyfang et al. 2013). Accordingly, several countries have adopted different support mechanisms that are best suited to their national circumstances (Schallenberg-Rodriquez 2017). Such policies determine who adopts solar energy technologies, and therefore it is necessary to promote policies that ensure wider diversification and increase the potential motivation for adoption besides environmental reasons (Schelly 2014). Goedkoop and Devine-Wright (2016) argue that it is as a result of supportive mechanisms that CRE has made significant progress in recent years.

Some recent studies have compared the successes of RPSs and FITs, and generally found FITs to be more effective (Schmalensee 2012; Carley et al. 2017; Schallenberg-

Rodriquez 2017). It has also been shown that an increasing number of countries and regions are introducing FITs not only to develop RE technologies, but also to promote job creation and industrial development (Schallenberg-Rodriquez 2017). FITs promote higher penetrations of RE sources, investor security and technology diversification (Schallenberg-Rodriquez 2017), as well as small-scale renewable projects (Ruggiero et al. 2015; Schallenberg-Rodriquez 2017). Leading countries regarding the diffusion of solar PV sources include Germany, Belgium, Japan, Italy, and Greece, all having predominantly relied on FITs as primary supports to develop RE sources (Schallenberg-Rodriquez 2017).

8.5.2 Comparisons between Germany, the UK and South Africa

8.5.2.1 Germany

The FIT has been the primary mechanism ensuring the success of the RE industry, including many CRE projects, in Germany (Davies and Allen 2014; Haukkala 2015; Brummer 2018a; Peters et al. 2018). According to Wurster and Hageman (2018), FITs supporting electricity from RE sources were essential for the dynamics of expansion; without it, the high levels of adoption would not have been realised. Koirala et al. (2018) note that out of 2800 CRE projects in Europe, about 1000 projects are in Germany, and contain close to 165 000 members. Germany is a leading destination for community energy projects. In 2014, almost half of RE generation was community-owned (POLIMP 2019), and, by 2016, the installed capacity of solar PV had grown from 1 GW to 40 GW (Bayer et al. 2018).

8.5.2.2 The UK

The UK initially adopted a market-driven approach to promoting RE (RO), followed by the introduction of a FIT to support small-scale projects (Harnmeijer 2016; Brummer 2018a). According to Haf et al. (2019), only about 10 per cent were owned and operated by individuals and communities in the UK as of 2012, compared to Germany, which, at the same time was at 65 per cent. Community projects in the UK contribute a small percentage (< 0.4 per cent) of total renewable capacity to the energy mix (Harnmeijer 2016). As lamented by Strachan et al. (2015), community projects serve a minimal role in the energy mix and contributions toward RE targets: it is apparent that they are not fully supported and are not the recipients of adequate financial support.

With all the policy reform and reductions in the FIT in November 2016, (Saintier 2017), the government's support for CRE projects became less robust (Mirzania et al. 2019), and as a result, the future policy landscape for community energy in the UK remains uncertain (Harnmeijer 2016).

8.5.2.3 South Africa

South Africa initially introduced a FIT in 2008 to accommodate large-scale RE development (DoE 2015). However, some three years later, in 2011, the FIT was terminated by NERSA, and subsequently a competitive bidding system for RE was introduced that has proven only to be successful regarding the promotion of large-scale developers (DoE 2015). South Africa has set a target of 7000 MW by 2020, and 17 800 MW by 2030 (IRP 2010). By 2016, about 6 400 MW of the 7 000 MW target had already been procured (IPP 2019), however, these gains have been achieved through large-scale provisions, offering community benefits (IRP 2019).

The economic and socio-economic contributions of RE have largely benefitted communities within a radius of 50 KM from where IPP projects are developed (DoE 2015; SAPVIA 2017). Projects are mainly situated in specific areas, meaning there is an overconcentration of development funds within a limited capacity (DoE 2015).

In light of the above, introducing FITs may promote more considerable penetration of solar PV sources when compared to situations where only IPP projects are developed. This section demonstrates that FITs have been the most instrumental tool in developing solar PV technology and CRE projects in the countries that have the most PV installations.

8.6 Conclusion

This chapter has summarised the major findings of the current study by reviewing: (1) the perceptions of citizens and experts toward the concept of CRE; (2) the challenges in developing CRE projects; (3) the developments of solar PV sources both internationally and nationally; and (4) the policies instrumental to the development of CRE, especially by comparing policies adopted in Germany, the UK, and South Africa. Overall, this research answered the aims and objectives of the study by addressing the aforementioned interrelated factors that lead toward transformation.

The findings reveal that the concept of community projects is not foreign to local communities in Johannesburg. However, CRE is not common to many people, but, because of existing initiatives in various communities, participants could make sense of how CRE could meaningfully develop. The results of the study reveal a positive attitude towards the concept of CRE. Motivations for participation amongst participants varied greatly; the most common motivator was financial benefits for community development. The study demonstrates a high degree of social trust among community members, as most communities are previously involved in community projects. Regarding institutional trust, most participants lacked trust in external developers or local government, but note the expertise of private developers as being important contributions in the implementation CRE projects.

Based on the literature review, South Africa is experiencing an increase in the number of manufacturing facility, however, the level of demand remains poor resulting in some panels being diverted to the international market. To increase the share of RE in South Africa, more actors are required to be mobilised beyond the extant IPPs. This is an opportunity for small scale developers to be supported to ensuring wider participation and the dissemination of solar panels.

As previously highlighted, South Africa supports the tendering system and tax incentives for diffusion of RE sources. However, these mechanisms are not currently sufficient to encourage small-scale developers, particularly CRE projects. From the literature review, it is apparent that FITs have increased the share of renewables in countries that initially adopted the mechanism. It was also noted in the literature that FITs have supported the growth of CRE. The findings of the current study reveal that there is an opportunity to develop CRE projects in South Africa, particularly with the introduction of a FIT support mechanism. As remarked by Mankiw (2014), evidence suggests that society does respond to incentives if they are available. Richter (2013) also acknowledges that microgeneration technologies are disseminated mainly in countries that offer financial incentives.

Considering that the South African government promotes community benefits – the next step is to support community renewable projects that are owned and operated by communities, or joint-ownerships with private developers or local government. However, there are a number of challenges, including a lack of capital, institutional support, and community buy-in, as well as limited interest from private developers as they may not be familiar with handling small-scale projects. On the other hand, the lack of political commitment may jeopardise the evolution of CRE in the future.

CHAPTER NINE:
CONCLUSION AND RECOMMENDATIONS

9.0 Introduction

This chapter reflects on the research methodology applied in the current study, and the major findings as presented in the previous chapters. The contributions, recommendations, limitations, and suggestions for future studies are also addressed. A literature review was conducted to identify key gaps in energy transitions that occurred in the past and in a variety of contexts. Previous research revealed that, although advances in the understanding of many aspects of transformations in the energy sector have occurred, there is much need for more in-depth insight into social elements and related factors. As a consequence, the present research sought to better understand the perceptions of citizens and experts on CRE projects, and explore the factors that influence the development of CRE in South Africa.

The study adopted transition theory and focused on the micro-level of the multi-level perspective to fully explore the potential for energy transition. Considering that studies assessing the micro-level have predominantly concentrated on technological niches, the present study leveraged social capital theory to understand the social aspect. To gain an on-the-ground understanding of the situation, it was considered necessary to apply semi-structured interviews guided by social capital constructs. The approach was further extended with dimensions of perceived costs and benefits, as it is argued that these factors may influence acceptance, as previously discussed in chapter five. This research is timely in the sense that the new Integrated Resource Plan (IRP 2019) – a plan that sets out policy for RE in South Africa – for the first time discusses issues associated with small-scale generation.

9.1 Contributions to the body of knowledge

This study advances the extant body of knowledge by assessing the three interrelated factors relating to the development of CRE projects, namely: societal, technological, and policy factors. To the researcher's knowledge, this study is the first to empirically assess the resources available, particularly in the stages prior to community project development. Further, it is the first to make a linkage between transition theory and social capital theory by systematically addressing the micro-level of the MLP.

9.1.1 Theoretical contributions

Numerous studies evaluating energy systems and transitions have focused on technological innovation and economic processes, while neglecting social factors (Shove and Walker 2014; Berkhout et al. 2004; Strachan et al. 2015; McMeekin and Southern 2012; Hillman et al. 2018). As Strachan et al. (2015) note, studies that seek to explain transitions must go beyond the economic and technological to consider the social agents participating in the process. As an example, two new models have been introduced to examine transitions: strategic niche management (SNM), and transition management (TM) (Kemp et al. 2007). These models neglect the role that individuals can play during the transition process, instead retaining a more traditional focus on the technical aspects (Rauschmayer et al. 2015; Witkamp et al. 2011).

Nevertheless, new interests have focused on a more dedicated investigation of social properties (Seyfang and Longhurst 2016; Witkamp et al. 2011; Rauschmayer et al. 2015; Seyfang et al. 2014; Hillman et al. 2018). For instance, social practice theory has also been used to perceive the links between society and technology (Hargreaves et al. 2013; Ford et al. 2017; McMeekin and Southerton 2012; Rauschmayer et al. 2015), and social enterprise as a possible niche innovation (Hillman et al. 2018). Despite this, studies have yet to investigate social capital as a cornerstone for the success or failure of projects, particularly prior to their execution. Although Busch and McCormick (2014) have argued that social capital can have both positive and negative consequences on adoption, the contributions of social capital to these effects are not yet clear.

In addition, many studies have investigated niches at a technological and societal micro-level of the multi-level perspective (Neuvonen et al. 2014; Walker et al. 2014; Batel and Devine-Wright 2015). This study explores how transition theory can play a key role in CRE, in particular, at the niche level of local contexts and local projects (Strachan et al. 2015). Unlike the current study, past studies did not use frameworks that understood RET as a social and technological factor in today’s society. Consequentially, there is little collective perspective of transformation potential, which has led to some scholars noting the need for a socio-psychological process to better perceive the willingness of individuals (Batel and Devine-Wright 2015).

This study deployed a co-evolutionary outlook on socio-technical innovation (Foxon et al. 2010), finding niches to be a possible springboard for creating new ideas and discovering solutions (Seyfang and Longhurst 2016). This study is notable for introducing social capital theory to MLP, and furthering the understanding of the resources held in communities and their impact on the implementation of CRE projects. This research expands on the work by Geels (2018), who proposed that studies on transitions must strengthen associations with the social sciences. Although there have been efforts to study the perceptions of RE projects and the features that could either assist or impede the development of RE (Boon and Dieperink 2014), little attention has been given to social resources and their influences prior to project development.

9.1.2 Practical contributions

Much of the previous research on socio-technical systems has primarily emphasised technology; often studies have overlooked social capital as being central to the development of niches (Noppers et al. 2016). Hence, Noppers et al. (2016) appeal that more studies are needed to investigate the factors that foster the acceptance of sustainable innovations. These factors include social norms, environmental values, knowledge and technical support, and trust in the institutions delivering the innovation.

This study attempts to narrow the gap noted by Heras-Saizarbitoria (2018), where studies should examine the perceptions of different stakeholders regarding CRE, the expectations that eventually influence them to participate, and, ultimately, their involvement in projects. The findings herein indicate a number of suggestions for policy implications. It is important for governments to consider that there is a need for broader participation in the sector. A significant effort has shifted toward the involvement of IPPs in contributing to energy generation and diversification in South Africa, however, there is also an opportunity for consumers who are interested in generating electricity through solar PV sources.

Most studies regarding CRE are based on already existing projects (Bauwens 2016; Martiskainen 2014; Hicks and Ison 2018), an important contrast to the current study where social acceptance was analysed *prior* to the implementation of CRE projects in urban settings. This study extended the work of Dóci and Vasileiadou (2015), who indicate that more research should be conducted in urban areas, where close ties among citizens are lacking when compared to a rural setting. Śahović and Pereira da Silva (2016) remark that energy generation, distribution, and consumption involves both human and technological dimensions. Therefore, it is worthwhile considering social and human elements as opposed to only focusing on technical and economic dimensions when assessing energy-related activities. The positive feedback from citizens and experts introduces new possibilities to implement CRE policies that increase the share of RE and improve relationships between private developers, local governments, and the public.

The findings of this study help inform communities who are interested in developing CRE projects and properly assessing whether adequate resources exist. Further, the results of the study can provide guidance to policymakers when comparing different regulations that seek to promote the diffusion of CRE projects in South Africa, and other parts of the African continent.

9.1.3 Methodological contributions

Studies using social capital theory have focused predominantly on using quantitative methods to assess resources within society (Pena-López and Sanchez-Sántos 2017; Tilt and Gerkey 2016). As asserted by Bhowmik et al. (2018), most previous studies aimed to understand social acceptability issues by deploying quantitative methods. Irrespective of the number of studies that address public acceptance, most studies have not considered social capital in CRE projects (Seigo et al. 2014), with the notable exceptions of Bauwens and Defourny (2017), and Wentink et al. (2018), who focused on existing initiatives. This is an essential aspect as the success of community projects is largely dependent on strong management relationships, and the accurate identification of key stakeholders (Bourne and Walker 2005). As argued by Sahovic and Pereira da Silva (2016), more directed research is necessary, specifically with a focus on field research, interviews, and focus groups that capture the multidimensional roles of experience, attitude, and habits. Furthermore, future research must recognise and understand the relations between the actors who are involved in community projects (Ruggiero et al. 2014).

In addressing technology, this study applied proxies for technological innovations to assess development regarding solar PV sources. Dóci et al. (2015), applied the same concept but focusing on social niches, this study, however, uses the same proxies focusing on technological niches.

Lastly, this study provides a robust comparison of the policies that have contributed to CRE in Germany, the UK, and South Africa. These three countries reflect the adaptation of different policies and approaches to the diffusion of solar PV sources and the promotion of CRE projects.

Comparing the three countries who have different policy mechanisms illustrated the importance of policy in developing CRE projects.

9.2 Recommendations

To support the growth of solar PV technology and community projects, I propose a number of recommendations below. However, it is noted that research alone cannot directly influence changes of policy, but that it is an indirect contributor to policy through intellectual association (Bulmer 2015).

9.2.1 General recommendations

Throughout all the stages of this research, the importance of broader participation in the generation of electricity in South Africa and the positive impact of CRE projects emerged as central themes. Considering the challenges currently present in the electricity sector (see chapter one), it may be necessary to include other parties in the electricity sector besides the IPPs in order to promote small-scale development and CRE projects. Because individuals of the public are installing solar panels on their homes, the potential for community projects is there regarding the management of single installations to the grid.

In that vein, policymakers must be aware of the importance of invoking regulations prior to many people installing solar PV for self-consumption. By doing so, this will ensure the greatest contribution to local energy demands (see chapter seven). It is inadvisable to avoid adopting policies that seek to simultaneously govern energy sectors in both developed and developing countries (Jimenez et al. 2016). Considering the limited funding faced by local municipalities, introducing policies that support small-scale generators could be an opportunity to broaden current possibilities ranging from IPPs to other parties such as individuals, communities, and businesses.

9.2.2 Recommendations for Policy and Practice

The current policy mechanism (auctions) adopted in South Africa favours large-scale developers (see chapter four). The European Commission argues that if auctions are well designed, they should be able to promote competition between technologies without excluding those that are not fully developed from penetrating the market (European Commission 2013). Although the study has demonstrated that all three of the central policies mentioned earlier play a role in promoting RE sources, governments must make a special effort to assess the various policies and ensure compatibility with different support mechanisms. Lawrence (2020) argues that the government may need to consider replacing the REI4P as an alternative means of promoting RE. However, the REI4P can work alongside a FIT mechanism to promote small-scale developers. In this study, it has been confirmed that a FIT is instrumental in promoting solar PV sources as well as community renewable projects.

It is important to introduce policies that promote CRE in order for significant contributions by community projects to occur. However, selecting between different policies is a complex but essential decision-making process based on the situation of the country (Choi et al. 2018). Analysts have argued that quantity-based approaches (e.g., RPSs and tender mechanisms) are less effective than price-based (FIT) policies (Schmalensee 2012), particularly when promoting small-scale developers. Despite the evidence that FITs may be the most effective policy mechanism promoting the use of RE around the world, they are only considered to be effective if the policy is well designed and presents transparent pricing schemes (Sovacool and Jacobs 2010).

It is clear that a FIT was initially considered for large-scale RE development in South Africa. Yet, if this approach cannot be adopted for small scale developers, then an alternate price support mechanism can be considered to promote small DES, such as a real net-metering scheme.

An important point to consider is that solar PV sources have the ability to be widely adopted and reach capacity, with government reducing subsidies at some point (Kay 2015). The development of the technology can be achieved with a stable support mechanism through subsidy reductions (Kay 2015). The European Commission (2019) emphasised that, as technology matures, subsidies must be progressively reduced. An example is the replacement of a FIT with FIPs and other support schemes to encourage generators to adopt measures to cope with market developments (European Commission 2019). The support mechanisms should equally reflect the necessary flexibility when responding to falling production costs (European Commission 2013). Fell (2019) asserts that a FIT could ensure widened participation in the energy sector unlike tendering schemes, which mainly support large-scale developers. This is also supported by Abdmouleh et al. (2015), who outlines the various advantages of FIT support mechanisms in supporting the growth of solar PV sources. These are summarised below:

- **Attract SMES because doing so ensures a short pay-back period for the initial investment.**

It is necessary to introduce policies that enable broad participation in the generation of electricity to ensure that there are stable revenue flows for communities over a fixed period of years, which can also ensure that the RE asset is paid off over a short period. FITs are policy instruments that are widely used to promote the diffusion of RE sources. They encourage the acceptance of RE technologies as participation in the sector increases. The government should consider that tenders reduce the diversity of actors. For instance, SMEs and community projects are excluded from submitting their bids given the high application requirements. However, FITs must be reviewed in light of evolving policy goals.

- **Eliminate barriers to entry. Therefore, large corporations will not be in positions to monopolise the industry.**

It is noticeable that countries that have introduced a FIT mechanism have proven to be successful in attracting a diversity of players in the energy industry. However, some countries that initially introduced a FIT are moving to the tendering system, but the impact of the change will impact small-scale developers because they are prevented from taking part because of scale, therefore, new models must be adopted. However, some countries have limited FIT to small-scale developers. Not introducing a mechanism to support SMEs will encourage the market power by established energy industry and large companies, therefore neglecting the contributions of SMEs to the industry.

- **Help increase the penetration of RE sources when a higher price is provided to small-scale developers.**

If a FIT policy is well designed, then it presents several advantages over other RE mechanisms, such as net metering, upfront rebates, auctions and quota systems. Specifically, if they are well designed, they will present a maximum output. Germany introduced the FIT in the 1990s and is now one of Europe’s leading markets and the best solar PV markets in the world. FITs that are designed to promote small-scale installations will promote the wide distribution of facilities to other provinces and communities that are not benefiting from the REI4P. The introduction of the FIT mechanism will ensure that communities in rural areas benefit by having access to electricity or by being empowered when connected to the grid.

- **Secure a positive return over a set amount of years, which in turn, reduces the risks faced by small-scale investors.**

The main reason for a FIT is to encourage enough investment in low-carbon energy to promote the wide adoption of RE technology, which ultimately reduces the cost of alternative energy. If the government guarantees to support RE production by means of a fixed FIT, then it creates a level of trust and security in investments. The initial investment in RE sources is not considered to be a high-risk undertaking. Rather, it is considered to be a guaranteed investment with measured returns.

- **Cater to different RETs, locations, price adjustments and market structures.**

A number of studies in Europe have proven that FIT policies have promoted RE projects more than other policy instruments on average. The government can introduce the RE fund dedicated to financing FIT to promote RE sources, mainly in the townships. The FIT can be financed through a RE surcharge, which can be added to each kWh of electricity produced. This will ensure that RE projects are spread across the country rather than being concentrated in some areas and only benefiting a few communities, as promoted by the tendering system. Auctions are intended to cap the market volume, hindering free-market forces from increasing the share of RE, thereby limiting the spread of RE sources and slowing the cost reduction of RE sources.

- **To better promote CRE, the South African government should consider taking the following actions:**

It is apparent that auctions are the preferred way to develop renewable projects. However, FITs have proven to be lenient toward small-scale and community projects. Therefore, policy actions should take into consideration the contribution of small players.

- The government should note that the tendering system has yet to attract the participation of community energy investors and consider promoting small-scale developers for broader involvement in the energy sector.
- There should be authorities whose mission is to support community projects by offering funding opportunities, providing advisory services, increasing public awareness, and facilitating stakeholder engagement.
- The government should create spaces for learning and networking that allow for the exchange of ideas and knowledge between various communities.

- The government must develop an alternative business model that encourages financial institutions to promote RE by providing loans to communities, especially to avoid individual installations.
- When developing RE support mechanisms, there are other considerations, such as the overall socio-economic benefits and macroeconomic costs, as opposed to only accounting for price per kWh. This analysis could form a part of any developmental and long-term energy plan (IRENA 2018).
- If incentives are introduced, then the correct group must be targeted following the recommendations of WWEA (2018).

9.3 Limitations of the study

It is important to recognise that, like any research, this study is not without limitations. Conversely to many countries that have introduced CRE projects, South Africa lacks regulations on community projects, except for community benefits. For this reason, it was impossible to find an existing CRE project that could be studied to assess the resources available in communities. However, because other community projects exist, it was essential to select participants who are familiar with a community model, and experts that are involved in the RE industry.

This study focuses on only one province out of the nine provinces in South Africa; thus, generalisation is not guaranteed. The sample focuses only on those who live in urban areas, and most participants were not aware of the concept of CRE. For this reason, the findings could present a different scenario if community renewables were already developed. The current study is descriptive and exploratory in nature, suggesting that additional opportunities exist for more quantitative research.

9.4 Suggestions for future studies

This study paves the way for future work focused on different ways of assessing diversified solutions to energy capacity challenges. This study utilises a multi-level perspective framework and social capital constructs to assess transition potential, and employed qualitative methods to understand perceptions of society. Future studies could use a similar set of variables, but adopt quantitative approaches to arrive at more rigorous results. This study concentrates on initiatives that currently do not exist: from an international perspective, studies could assess social resources in established CRE projects, and whether social capital has contributed to project success or failure therein. There are also other community projects that are not successful: it is crucial to assess what the reasons were for project failure, particularly in countries where community projects are abundant, as opposed to countries where they are only marginally present as in South Africa.

South Africa promotes community benefits; future studies could therefore, interview community members to elucidate the socio-economic impacts of this current support system. Future research could also assess the influence of the conventional system on adopting renewable energy sources, and evaluate whether people would instead prefer a traditional system if there were no challenges regarding load-shedding. It would be essential to assess perceptions once the projects have been developed, and compare these perceptions to the pre-development period. Although this study was conducted in Johannesburg, it provides a foundation that allows for the opportunity of additional research in other urban areas of South Africa and neighbouring countries (Southern Africa). Therefore, there is an opportunity to guide future studies using qualitative and quantitative approaches to studying community renewable projects. In other words, it sets a footprint for future studies on transition potential in other developing and developed countries.

9.5 Conclusion

This study was motivated by recent trends toward CRE projects in some parts of the world, such as Germany, Denmark, the United Kingdom, and Australia (Mey et al. 2016; Hicks and Ison 2018). It was interesting to discover that participants in this study were interested in community renewable energy, but indicated that there would be challenges in forming the initiatives due to the necessary requirement of buy-in from community members, and government support. However, currently, there are various ongoing community projects in South Africa, and despite that fact that there are no CRE projects, CRE projects could become an opportunity for communities to generate income toward other community projects.

In South Africa, RE projects are primarily located in specific areas, meaning that they only benefit a small number of people. If a FIT were to be introduced for small-scale developers, it would encourage the spread of RE sources in other areas. These projects, as opposed to a centralised system, are able to extent to other regions, thereby reducing transmission costs, as well as increasing the share of renewables.

This study provides a systematic exploration of a future transition pathway (Verbong and Geels 2010). Both technology and social characteristics are investigated, and policies that allow community projects to thrive are explored. This ultimately provides guidance to policymakers regarding the strategies that could promote broader participation in the electricity sector. The government is encouraged to promote and motivate businesses, communities, and individuals to install solar PV sources to increase the overall share of renewables country-wide. As asserted by Panagiotou et al. (2017), community renewable energy projects could be a solution for locally produced renewables, and could potentially provide opportunities for members to reduce energy costs, address climate change mitigations in cities, increase energy security, promote participation, the control the supply, demand and the leadership in developed and developing countries. CRE projects will not only benefit communities in South Africa, but also communities in the Southern African countries as they could learn from each other.

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Appendix I: Invitation letter

Robert Gordon University, Garthdee House, Garthdee Road, Aberdeen
AB10 7QB

Date: 20 January 2019

Invitation to participate in the research project titled: An Assessment of community renewable energy as one of the options for transition to low-carbon energy in South Africa.

Dear ……………………

I am conducting interviews as part of my PhD studies in community renewable energy. The aim of the study is to explore individual's receptivity toward community renewable energy projects and the factors that contribute to the development of community projects.

I would like to extend this invitation to you to participate in this research. You are chosen to participate because I think you are in an ideal position to give us your perceptions about whether the concept can be applied in your community. The time set for the interview is about 45 to 60 minutes. Should you wish to participate, please let me know by responding to this e-mail.

Your participation will be valuable to our research.

Should you have any questions, please do not hesitate to contact me via e-mail at k.g.monare@rgu.ac.uk or on my mobile 082 498-4633.

Thank you,

Kgomotso Monare Doctoral Researcher	Professor Peter Strachan Principal Supervisor

Appendix II: Informed consent form

CONSENT FORM

Research Tittle: An assessment of community renewable energy as one of the options for transition to low-carbon energy in South Africa.

I, ……………………………………………………………confirm that I understand that by ticking each box I am consenting to this element of the study. I understand by not giving consent for any one element I may be considered ineligible for the study.

PLEASE TICK THE APPROPRIATE BOXES		
Participating		
1.	I confirm that I have read and understood the Project Information Sheet. I have been given ample time to consider the information, as well as the opportunity to ask questions about the study and my participation.	☐
2.	I understand that participation is voluntary and that I can withdraw at any point without any obligations.	☐
3.	I understand that taking part will include semi-structured open-ended face-to-face interview, which would be audio recorded and transcribed.	☐
4.	I understand that there may be an additional follow-up(s) for clarification purposes (via email or phone call).	☐
The use of information I provide for this project only		
5.	I understand that my words may be quoted in publications, reports, thesis, web pages and other relevant research outputs.	☐
6.	I understand that my confidentiality and anonymity will be maintained (during and beyond this study) according to the UK Data Protection Act 1998.	☐
The use of information I provide beyond this project		
7.	I understand that collected data may be shared with the supervisory team without being directly or indirectly identified.	☐

Researcher

Kgomotso Monare

Email: k.g@rgu.ac.uk

Principal Supervisor

Professor Peter Strachan

Email: p.a.strachan@rgu.ac.uk

Research Participant

By signing this consent form, I acknowledge that I am interested in participating in this research and that I have read and understood the above information.

Signature……………………………………………….. Date of Consent………………………………

Appendix III: Participant information sheet

Participation information sheet

Information and Purpose:

- The aim of this study is to investigate receptivity toward community renewable energy (Solar PV) projects in South Africa and the factors that contribute to the development of community projects.

The benefits of the study:

- To determine whether communities should consider the option of initiating Community Renewable Energy (CRE) projects.
- The data collected in this study will create awareness about community renewable energy projects in Johannesburg. Should the study find CRE viable for the South African climate, the study will provide policymakers with guidance on policy formulation necessary to promote deployment of CRE projects.

Your Participation in the study:

- Participation consists of a one-on-one interview, which will last for approximately forty-five minutes to an hour. During the process, you are encouraged to raise any concerns and ask questions about the nature of the study or methods applied.
- The interview will be audio-recorded unless requested by the participant not to be recorded.
- The interview is voluntary, and you have the right to terminate at any time should you wish not to proceed. There will be no penalty for discontinuing participation.

Use of Data and Confidentiality:

- All the information collected, and interview responses will be kept confidential, and your name will not appear in any of the written reports.
- All information provided will be kept confidential, including audio recording which would be kept safe in a locked cabinet and passworded computer. Some interview transcripts may be read by my principal supervisor but in anonymised form - coding and pseudonym will be used to replace identifying information to protect your confidentiality and identity.

- In short, data will be handled as stipulated in the UK Data Protection Act 1998. Collected data will be used in research outputs such as thesis, journal articles, academic presentations, and seminars. Recordings will be destroyed at the end of the research project; only anonymised transcripts would be securely kept by me.

Should you have any questions or concerns, please contact the interviewer Kgomotso Monare – 082 498-4633, or my Principal Supervisor – Professor Peter Strachan - p.a.strachan@rgu.ac.uk

Appendix IV: Demographics

Instruction: Respond to each question below to the best of your knowledge.

Q1. Gender

☐ Male

☐ Female

Q2. Age

☐ 18 - 29

☐ 30 - 44

☐ 45 - 55

☐ 56 - 64

☐ 65 and above

Q3. Highest Educational Qualification attained

☐ No High School Leaving Certificate

☐ High School Leaving Certificate

☐ Diploma

☐ Degree

☐ Postgraduate

Q4. Employment Status

☐ Unemployed

☐ Self-employed

☐ Employed

☐ Retired

Q5. What is the status of the property you reside in?

☐ Owned

☐ Rented

☐ Do not have a property

Q6. What is your area of residence?

☐ South

☐ North

☐ East

☐ West

Appendix V: Interview Schedule (Individuals and experts)

<u>Research Title: An Assessment of Community Renewable Energy as one of the options for a transition to low-carbon energy in South Africa</u>.

Section 1: The perceptions and attitudes of communities in respect of community solar PV projects		
S/N	***Questions***	***Probes to address selected categories***
KNOWLEDGE AND AWARENESS		
1	How knowledgeable would you say you are about renewable energy – particularly solar PV technologies?	
2	What comes to mind when you think about community renewable energy projects?	
3	What is your position on environmental issues caused by fossil fuels?	
PARTICIPATION IN SOCIAL NETWORKS: Imagine that citizens initiate a solar energy project within your community, e.g. an energy cooperative, with the objective to produce electricity from solar PV panels. For instance, in Germany, almost half of the electricity is supplied by communities.		
4	How do you feel about participating in a community renewable project?	
5	How would you like to participate in a community project?	

6	What would you say will be your motivation to participate in a community project?	
INSTITUTIONAL TRUST： If the community was to partner with external developers:		
7	Would you trust renewable energy companies to execute community renewable projects on behalf of the community? If not – why?	
8	Would you say that you trust the municipality or Eskom to execute renewable energy projects on behalf of the community? Why?	
COMMUNITY IDENTITY/CONNECTEDNESS, NETWORKS		
9	How would you describe the relationship between community members?	
10	Can you tell me how you feel you belong to this community?	
SOCIAL TRUST		
11	Can you tell me if community members can be trusted to reliably execute community renewable projects or would you say that you can't trust them? If not – why?	
12	What do you think are the resources that this community has to trust that they can execute CRE on their own?	
SOCIAL NORMS AND VALUES		
13	How do you think people who are close to you would react to community renewable energy projects?	

14	What are your expectations of the members of a community project – once the project is set up?	
PERCEIVED BENEFITS		
15	What do you think will be the benefits/advantages of community renewable projects?	
16	In your opinion, would you say that community solar PV projects can improve our energy generation industry successfully?	
PERCEIVED COSTS		
17	What would you say are your major concerns about community renewable projects operated by members?	
18	Would you say that it is an effort to form a community project or not? Why?	
A summary of the discussion		
19	In general, what is your perception of community solar PV projects in your community?	
	A summary of the discussion – Is there anything you would like to add to what we discussed?	