Smart Micro Grids in business parks

An explorative case-study on the enabling and constraining factors of the diffusion of Smart Micro Grids, resulting in a sustainable business model design

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Colophon

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Preface

This is my Master thesis about the diffusion process of Smart Micro Grids in business parks, which is the end assignment of my study programme. Four years ago I started with the Bachelor Programme Geography, Spatial Planning and Environment. Due to my study I got passionate about radical innovations in the spatial environment, increasing the livability of citizens. At the same time I got worried about the future of our climate. I developed an ambition to contribute to reducing climate change, both with my personal lifestyle and with scientific knowledge. Because of my passion for innovation and sustainability, I wanted to research the innovation of Smart Micro Grids as they can accelerate the energy transition.

This research explores the social feasibility of Smart Micro Grids and provides guidelines for the development of a sustainable business model for this innovative energy system. In this way insight is offered on how these energy systems can be organised, with the purpose of accelerating the energy transition. The focus is on business parks, since these areas are in particular interesting for Smart Micro Grids. Besides, I personally think it is interesting to explore the motivations of businesses to invest in a sustainable, technical innovation. Over the past months I have carried out this research with a lot of dedication. Nevertheless, researching an innovation that is in its early beginnings and on the intersection of technology, behavioural and institutional change is quite challenging. Due to the innovativeness of my research object, several aspects of a Smart Micro Grid that I wanted to know more about were unknown to the experts. For this reason, my research has led to explorative results. However, during my research I noticed that a lot of different stakeholders from this field of expertise are interested in the results, which shows the societal relevance of this thesis.

I would like to thank a few people who have contributed to this thesis. First, I would like to thank Dr. Carton for her supervision during the process. She provided me critical feedback and helped me to think out of the box. With her positive attitude and innovative ideas, after each meeting I was full of new energy. Second, I would like to thank HVE for offering me an internship place where I could learn about the technical aspects of the energy system, the energy market and the design of a Smart Micro Grid. Besides, I would like to extent my gratitude to all experts who found time to talk with me. It was very interesting to get involved in the small community of experts in the field of Smart Micro Grids and to learn from their experiences. Moreover, I would like to thank the entrepreneurs located at business park Apeldoorn Noord who were willing to fill in my survey. Lastly, I would like to thank my family and friends for their support during my research period.

With the completion of this thesis, my study Spatial Planning has come to an end. I’m glad that my research has led to the start of the implementation of a Smart Micro Grid in business park Apeldoorn Noord. I’m looking forward to contribute to making the living environment sustainable with other initiatives as well.

P. Ibrahim

Nijmegen, 2020
Introduction

The Dutch energy system is undergoing significant changes: the societal demand for electricity and the generation of renewable energy are both increasing, while the energy generation is decentralising, which is all contributing to congestion problems on the electricity grid. Consequently, there is an increasing need for a flexible energy system. Moreover, local energy communities are becoming increasingly more important. To cope with these changes, innovative solutions are inevitable. Smart Micro Grids (SMG) are one of the most promising innovations. SMGs respond to inconveniences of the electricity grid by regulating the demand, supply, storage and exchange of energy at the local scale by adding additional communication and information. SMGs are particularly promising in business parks, due to diversified consumption patterns of businesses. Although SMGs are promising future energy systems, the large-scale implementation remains a rare occurrence. The social feasibility inhibits the expansion since an SMG only works with the involvement of local actors who want to become part of the particular SMG and become an energy ‘prosumer’. Currently there is a knowledge gap on what exactly determines the decision of businesses to become part of an SMG. Therefore, the first aim of this research is to explore which factors would convince businesses to agree on adopting an SMG.

Furthermore, a reason why the large-scale implementation of SMGs does not take place, is a lack of business models that describe the organisation of the system. Hence, the second aim of this research is to co-create a business model for the organisation of an SMG. These two research aims are intertwined; it is not yet clear which role businesses can and want to perform and which resources they have, and this makes designing a business model more challenging. The research aims have led to the following research question:

“Which factors explain the adoption of SMGs by businesses at a business park in the Netherlands from a behavioural-institutional perspective and how can public and private actors co-create a sustainable business model for the development of an SMG, reflecting these factors?”

Theory

To answer this question effectively, investigation took place about what an SMG entails. This included the status of the current ongoing institutional change process, the drivers and barriers for businesses to adopt an SMG and how the building blocks of a business model work for the organisation of an SMG. Several scientists have written about the diffusion process of certain innovations (e.g. Rogers, 2003) including the willingness of people to adopt something (e.g. Ajzen, 1991), the influence of institutionalisation on the rise of local energy systems (e.g. Oteman, Kooij & Wiering, 2017) and the organisation of sustainable business models (SBMs) (e.g. Jonker, 2014). Based on these theories, we can conclude that the diffusion of an SMG in a business park depends on the agenda setting and matching of the innovation by individual businesses, the co-creation of an SBM and the implementation of the SMG itself.
Methodology
In this research, an explorative single instrumental case-study is conducted. The case study has been based on business park Apeldoorn Noord, since the businesses at this business park have diversified energy consumption patterns and an SMG fits within the ambitions of the municipality. First, a literature review is performed which was followed by in-depth interviews with experts and businesses at business park Apeldoorn Noord. The acquired knowledge was a starting point for a survey among the businesses located at the business park. Lastly, an interactive workshop session was organised to co-create an SBM with the local public and private stakeholders. These data-collection methods have led to the following conclusions.

Institutional factors
The adoption of an SMG by businesses at a business park depends partly on the institutional context and on individual preferences of businesses. From an institutional perspective, the Electricity Law that forbids the local exchange of energy between small energy users is a constraining factor. Additionally, the market for flexible energy prices is undeveloped which decreases the advantages of shifting the energy consumption to another time of the day. Moreover, the Net Metering Law stimulates the balancing of the energy demand and supply on a national level instead of local level. However, some institutional changes stimulate the adoption of an SMG. For instance, an increased tax on natural gas and subsidies. Technology is part of the institutional context as well. The technologies that are needed for an SMG are developed but some are still expensive and therefore hard to commercialise.

Behavioural factors
Based on the preferences of individual businesses, the biggest driver for the adoption is a positive attitude about an SMG, since it is believed that an SMG contributes to sustainability, innovativeness, a lower energy bill, confidential use of energy data, affordable energy supply, accessible energy supply and an improved image of the company. Moreover, businesses are more likely to adopt an SMG when they have a flexible energy consumption pattern. A park management organisation that unburdens the individual businesses is also a positive factor to convert. The biggest challenge for the adoption are a lack of ownership of the building and a lack of time to explore the possibilities of an SMG.

Co-creation of an SBM
Based on the institutional context and the drivers and barriers of businesses, an SBM is created (figure 1). The SBM shows that the added value is mainly economic, but also ecological and social. Additionally, the key stakeholder is the park management organisation that performs a directing role. Next to this stakeholder, there are several public and private parties who perform multiple roles. Only when they actively work together and share the investments and returns, an SMG will be implemented. Hence, it is important that the diffusion starts with creating a shared understanding. Important factors for the diffusion of SMGs are commitment to the process, intermediate outcomes and a mutual recognition of interdependency.
Conclusion and reflection

This research contributes to scientific knowledge about innovative and community energy systems, as this research provides insight in the behavioural-institutional aspect of the development of SMGs in business parks. This research shows that legislation hinders the possibilities to locally exchange energy and to financially profit from an SMG. This is an important barrier for the development of SMGs, since the most important driver for businesses to adopt an SMG is the expectation of positive outcomes. Hence, this research shows the relation between the institutional context and the behaviour of businesses and reduces the knowledge gap regarding the diffusion process of SMGs. Moreover, this research contributes to the scientific knowledge about which public and private parties must perform which role, to organise an SMG and thereby revitalise business parks. A limitation of this research is that the N-rate of the survey is too low to conclude significant relations between the characteristics of businesses and their willingness to adopt an SMG. A second limitation is that the interviews and workshop session have led to soft evidence, rather than actual facts. Consequently, no clear statements can be made about how an SMG should be organised. A third limitation is that the SBM framework is rather abstract, which makes the results of this research somewhat abstract as well. However, this research shows that SMGs can be used in business parks as part of enforcing the energy transition, with the guidance and implementation of the developed SBM. Lastly this research does not delve into different kind of public and private partnerships and does not explain which form fits best in which situation. This is a possible idea for further research.
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List of abbreviations

ACM = Authority of Consumer and Market
DEA = Dutch Enterprise Agency
EC = European Commission
EV = Electric vehicles
PV = Photovoltaic (solar panels)
TPB = Theory of Planned Behaviour
RES = Regional Energy Strategy
SBM = Sustainable business model
SDR = Smart Demand Response
SMG = Smart Micro Grid
UN = United Nations

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“We live in a society in transition (...) This envisaged transition demands new methods of organising—new societal deals at an individual and a collective level.”

Jonker and Faber (2019)
Because the master thesis has a long length of 166 pages, a summary per chapter has been added to this thesis, to provide the reader a brief overview of all chapters.

1. Introduction; the emerging of SMGs

This thesis explores the diffusion of SMGs in business parks. An SMG is an innovative energy system in which energy is locally generated, used and exchanged. An SMG can be implemented in different situations. Particularly business parks are suitable for SMGs, due to the diversified energy consumption patterns of businesses, which increases the possibilities for energy exchange. Currently, SMGs are slowly emerging in society. However, insight in the drivers of businesses to participate in an SMG project and guidance to organise SMG projects in business parks is lacking, which hampers the diffusion of this innovation. To reduce this knowledge gap, the following research question is answered in this thesis: “Which factors explain the adoption of SMGs by businesses at a business park in the Netherlands from a behavioural-institutional perspective and how can public and private actors co-create an SBM for the development of an SMG, reflecting these factors?” Four sub questions are formulated: 1. What is an SMG? 2. What are the current ongoing institutional change processes in which the diffusion of SMGs takes place? 3. To what extent are businesses willing to adopt an SMG and which drivers and barriers do they perceive regarding the adoption of an SMG? 4. How do the building blocks of an SBM work for the organisation of an SMG in a business park?

An innovation can be researched from different perspectives such as a technical, financial-economical, institutional and behavioural perspective. In this research the latter two are combined to explore how the institutional context and the behavioural preferences of businesses influence the organisation of SMGs. This is of importance since local businesses must perform an active role in an SMG (Rodríguez-Molina, Martínez-Núñez, Martínez & Pérez-Aguiar, 2014). To explore the organisation of an SMG, this research is focused on designing an SBM, which describes the logistics of value creation from a community and circular perspective. More concretely, an SBM consists of a description of the added value, involved stakeholders, key actions and resources. By describing the building blocks of the organisation of an SMG, guidance can be provided for the development of this innovative energy system. This research is of scientific relevance, since there is a lack of knowledge about the motivations of businesses to adopt an SMG, the co-creation of an SBM and the role of local stakeholders to collectively revitalise business parks by the organisation of an SMG.

2. SMGs as an innovation in the energy transition

An SMG is an innovation that is currently emerging in society. Despite some overarching characteristics of an SMG, it can be concluded from analysing the literature that an SMG is still an ambiguous concept. The following definition of an SMG is used in this research: “An SMG consists of the self-contained decentralised generation, use and exchange of renewable energy sources, which are managed locally with the use of smart technologies to ensure an economically efficient, sustainable power system with low energy losses.” An SMG has several advantages compared to the traditional centralised energy system. Examples are: increased flexibility of the energy system, reduced societal costs as a result of
postponed or cancelled costs of the enforcement of the central grid, reduced carbon emissions and increased room for community involvement in the electricity supply. An SMG is built upon the willingness of end-consumers to become co-producers, as they see a benefit in the co-operation of the consumption and production of electricity. The role of local businesses at a business park is mainly to invest in an SMG.

3. Theoretical foundation for analysing the willingness of businesses to adopt an SMG

Innovation literature, cognitive-behavioural literature and economic literature are used as a theoretical foundation of factors that influence the adoption of an SMG by businesses. In total, four main theories are used to analyse the willingness of businesses to adopt an SMG. Three of them explain ‘the agency’ of businesses, while the latter theoretical approach explains the importance of the ‘context’. The Diffusion of Innovation Theory (Rogers, 2003), is used to describe the adoption of an SMG from the perspective of innovation literature. This theory is chosen because it describes both the steps of innovation adoption and variables explaining the adoption. According to this theory, the adoption process consists of agenda setting, agenda matching and implementation. An important driver for adoption in relation to this research is the perception of innovation attributes. It is assumed that if the following attributes are present, businesses will be more likely to adopt an SMG: relative advantage, compatibility, complexity, trialability and observability. Moreover, since an SMG is an interactive innovation, there is a first mover disadvantage which results in the need to achieve a critical mass (Mahler & Rogers, 1999). Hence, the achievement of a critical mass will be a driver for the adoption.

Next to the Diffusion of Innovation Theory, the Theory of Planned Behaviour (TPB) (Ajzen, 1991) is used to understand the willingness of businesses to adopt an SMG. The TPB assumes that the performance of behaviour depends on the ‘intention’ to perform behaviour. The intention is influenced by the attitude regarding the expected outcomes of the behaviour, the subjective norm and the perceived behavioural control. Hence, the TPB combines the rationale-choice theory (e.g. Hedstrom & Swedberg, 1996) and the theory of social comparison process (Festinger, 1954), which are both well-established behavioural theories.

Since the adoption of an SMG by businesses at a business park is mainly to invest, an invest model is used to complement the other behavioural theories. The investment model of Wüstenhagen and Menichetti (2012) is used to view the willingness of businesses to adopt an SMG from an economic perspective. According to this theoretical model, the decision to invest depends on the trade-off between the perceived risk and return. This trade-off is influenced by energy policy, organisational characteristics and prior investments. However, it is assumed that the latter is not that important for businesses whose main core businesses is not to invest in renewable energy.

The duality of structure (Giddens, 1984) explains that the agency of humans is influenced by the institutional context, which can be described as ‘the underlying rules’. Hence, social life is more than arbitrary actions of individuals, yet it is not entirely determined by social structures. In this thesis, the structures are defined as, ‘social, economic and political settings’ (Ostrom, 2007).
4. Theoretical foundation for designing an SBM through a process of co-creation between public and private actors

In this thesis the Cloverleaf Model (Jonker, 2014), is used as a framework to get insight in the building blocks of an SMG. This model is selected as a theoretical foundation, since this is one of the few theories that explains the organisation of something new, from a community and circular perspective.

The Cloverleaf Model, which in this thesis is referred to as SBM, consists of principles, values, people taking part in the community, performing activities in the community and bringing in tools in the community.

Moreover, the concept of co-creation is used to explain how different public and private parties can work together to implement the building blocks of the SBM. The co-creation between the different stakeholders on the design and implementation of the SBM can be interpreted as a precondition of a successful SBM. Co-creation is concerned with the active involvement of different parties in the value creation process to create something new. There are multiple articles about the definition of co-creation, but articles on the exact process of co-creation are scarce. Hence, the theory of Ansell and Gash (2008) regarding collaborative governance, is used to explain the success factors of co-creation.

Both collaborative governance and co-creation are concerned with a collective decision-making process between different parties that aim to make or implement plans. The success of the co-creation process depends on five factors: face-to-face dialogue, trust building, commitment to process, shared understanding and intermediate outcomes.

5. Conceptual model

This research consists of two parts: exploring factors explaining the willingness of businesses at a business park to adopt an SMG and designing an SBM through the process of co-creation between public and private actors. The willingness of businesses to adopt an SMG depends on: perceived attributes of innovation, critical mass, attitude regarding an SMG, subjective norm, perceived behavioural control, trade-off between perceived risk and return and organisational characteristics of the company. These drivers are the starting point for the collaborative process of designing an SBM.

An SBM consists of principles, values, community structure and organisation design (activities, team and tools). These building blocks must be designed through the process of co-creation. Success factors of this process are: face-to-face dialogue, trust building, commitment to the process and intermediate outcomes. The collaborative process of designing an SMG could lead to the implementation of SMGs.

To conclude, exploring the factors influencing the willingness of businesses to adopt an SMG and exploring the organisation of an SBM for an SMG, will provide insight in the diffusion process of SMGs in business parks.

6. Methodology

The research paradigm of this research is social constructivist. According to this research paradigm individuals have specific constructed realities. The used research design in this thesis is an explorative case-study. A single, instrumental case is selected: business park Apeldoorn Noord. This case is chosen because of several reasons. First, the municipality of Apeldoorn has the ambition to enforce the energy transition with innovative solutions, in collaboration with local businesses. This fits with the
organisation of an SMG, which is an innovation that asks for co-creation. Second, the consumption patterns of businesses at business park Apeldoorn Noord are diversified, which is beneficial for the development of an SMG. Third, the business park is located at the edge of the city. Consequently, there is a lot of empty space available for the generation of renewable energy.

In order to collect the necessary data, a mixed method design is used. The data-collection methods are: literature analysis, interviews with experts, interviews with entrepreneurs, a survey and a workshop session. The survey is designed for the businesses at Apeldoorn Noord. The workshop session provides a simulation of the process of co-creating an SBM for the development of an SMG in business park Apeldoorn Noord. This means that the workshop session is a simplified simulation of reality and that real stakeholders participate in an interactive decision-making process. The invited stakeholders are: two advisors from the municipality of Apeldoorn, an expert on business locations from the province of Gelderland, a representative of the park management organisation, a managing partner of a real-estate company and two technical experts from a consultancy agency.

The qualitative data, which includes the literature, interview transcribes and the workshop session assignments, is analysed by conceptualisation. The survey is analysed in a quantitative way, by using the software SPSS. Bivariate correlations are used to look for a correlation between certain categorial variables. Furthermore, multiple actions are performed to increase the validity and reliability of this research. For instance, different kind of businesses are interviewed to increase the external validity. Moreover, there is tried to reach a sample as large as possible. Therefore, the initial online survey was as a result of a low response rate complemented with a face-to-face survey.

7. The institutional context in which SMGs emerge
Several changes in the institutional context are enforcing the diffusion of SMGs in business parks. It is assumed that these institutional changes are indirect drivers for businesses to adopt an SMG. For instance, a lower tax on renewable energy affects the financial benefits and thus influences the perceived outcomes of the adoption. Also, the gradually ending of the Net Metering Law will be a driver for the diffusion of SMGs. Changing this rule will make it financially less interesting to transport the locally generated renewable energy over long distances and will increase the incentive to exchange energy locally. Moreover, the technologies that are needed for an SMG are developed, which might be a driver for the diffusion. However, some of the technologies are still expensive and therefore hard to commercialise. Some other aspects of the institutional context are constraining the diffusion of an SMG in a business park as well. The current Electricity Law is for instance a barrier for the development, since it forbids the local exchange of energy between small energy users. The Experimentation Act makes it in very specific situations possible to locally exchange energy. However this permission is only given for a relative short period of time compared to the investments that have to be made. Furthermore, the liberalisation of the energy market hinders experimentation with economically unviable technologies. Besides, measures to enforce the generation of renewable energy by local communities are undeveloped. Last, a lack of dynamic pricing makes it less interesting for a business to adopt an SMG and to shift the energy consumption pattern.
8. Willingness of businesses to adopt an SMG

70% of the businesses at business park Apeldoorn Noord are willing to adopt an SMG. It can be concluded that a positive attitude regarding the outcomes of an SMG is the most important driver for businesses to adopt an SMG. Businesses must perceive the expected outcomes of an SMG as positive in order to put adopting an SMG on the agenda. In particular, the increased sustainability, the increased innovativeness of the company, the expected lower energy bill, a greener image of the company and the increased energy independency are mentioned in the interviews and survey as drivers influencing the attitude of businesses. Based on this list of drivers, it can be concluded that the willingness of businesses to adopt an SMG depends on multiple value creation.

The subjective norm in this research consists of pressure from clients, the choice of other businesses (participation pool) and political pressure. Although it is of less influence for the adoption of an SMG, pressure from clients and the choice of other businesses are mentioned multiple times in the interviews as a driver for the adoption. However, from the interviews and survey it can be concluded that on average the subjective norm is less important than gaining financial and ecological benefits. When it comes to the perceived behavioural control, the presence of a park management organisation is relevant, since this organisation can unburden individual businesses. The biggest barrier for the diffusion of SMGs is, according to the survey, the lack of time to delve in the concept of SMGs. The park management organisation can take part in this task, relieving the businesses.

Furthermore, some organisational characteristics influence the willingness of businesses to adopt an SMG. In particular flexibility of the energy consumption and ownership of the property are drivers for the adoption. Finally, based on the interviews, three innovation attributes are drivers for businesses to adopt an SMG: complexity, observability and compatibility with previous introduced ideas.

9. Towards an SBM for SMGs

The developed SBM shows that the added value of an SMG is both economic, social and ecological. Besides, the new developed SBM presents the roles of the different stakeholders and mentions the park management organisation as a key player. Moreover, the research results show that the activities consist of three phases: initiation, commitment to the process and implementation. The step in the middle is important, since the organisation of an SMG depends on the willingness of multiple stakeholders to take action. Therefore, a collaborative arrangement must be achieved. This will be stimulated when the investments and returns are shared. A substantial difference between the SBM of Jonker (2014) and the new developed SBM is that the category ‘risks’ is added. The mentioned risks regarding the organisation of an SMG in a business park are: a lack of financial resources, a lack of sense of urgency, no permission within the legal framework and ‘old wine in new bottles’.

Furthermore, the results describe how success factors of co-creation can be embedded in the SBM. The embedded success factors of co-creation are: a shared understanding, commitment to the process, intermediate outcomes and a mutual recognition of interdependency regarding the roles and responsibilities. By embedding these success factors in the SBM it is more likely that an SMG will be realised through the process of co-creation. Lastly, it is explained how an SBM can be co-created by organising an interactive workshop session in which the community members make assignments and
have discussions with each other. Through a negotiation game at the end of the workshop session, consensus is reached about the building blocks of the SBM. The interactive workshop session increased the trust the community members have in the development of the SMG in business park Apeldoorn Noord.

10. Conclusion
An SMG is an innovative and sustainable energy system in which energy is locally generated, used and exchanged. To manage this, an SMG makes use of smart technologies. It is expected that companies play an active role in the diffusion of SMGs. From energy consumers they must shift to energy prosumers.

Institutional drivers and barriers
The empirical data collection supports the Structuration Theory (Giddens, 1984), stating that agency and structure are intertwined. The institutional context influences the diffusion of an SMG in a business park. As a result of the liberalisation of the energy market there is room for local energy communities to diffuse. Moreover, the development of smart technologies made it possible for SMGs to emerge. Nevertheless, the legal framework provides a barrier for the adoption. Currently, it is not possible to exchange energy between small energy users, which is a crucial element in an SMG in a business park. Within the legislation an exemption must be made but an effective procedure still needs to be arranged for this. Furthermore, the current energy tax system and the cheap energy prices explain why companies have not adopted an SMG yet. Moreover, the market of flexible energy prices is not well developed, which means that the financial advantages of shifting the energy consumption to another time of the day are relatively low.

Agency related drivers and barriers
The case-study showed that 70% of the businesses at business park Apeldoorn Noord are willing to adopt an SMG. The most important drivers are: sustainability, innovativeness, a lower energy bill, a confidential use of energy data, a nearby accessible and affordable energy supply, an improved image of the company and having a flexible electricity consumption pattern. Regarding the lower energy bill, 62% of the businesses expect a decrease of at least 10% of the energy bill. The most important barriers are a lack of time to delve in the concept of an SMG and a lack of property ownership.

Co-creation SBM by public and private actors
This research shows that the building blocks of an SBM in a business park are: actors and roles, value proposition, activities, tools, risks and organisation. From both public and private parties, it is expected that they play an active role. Some of the roles that must be performed to develop an SMG can only be performed by public actors (e.g. providing room in legal framework). Regarding the activities; since a positive attitude is the most important driver for businesses to adopt an SMG, the first activity that must be performed in the development process is the creation of a shared understanding. Afterwards commitment to the process must be established, for instance by a letter of intent. A recommendation for practice is to give the park management organisation a leading role. By doing so it can contribute to the revitalisation of business parks by the implementation of SMGs.
11. Reflection

In this research, the phases of the adoption process according to the Diffusion of Innovation Theory are adjusted to the adoption of SMGs. The phases ‘co-creation of the SBM’ and ‘commitment to the process’ are added to the original phases. Moreover, to explain the nature of the social system, the Diffusion of Innovation Theory is enhanced with institutional theories, through which the social system is viewed more broadly and is replaced by a description of social, economic and political settings. Moreover, based on interactive innovation theories it was assumed that reaching a critical mass is a barrier for the diffusion of SMGs. However, it appeared that the participation pool is influential, but mostly due to the subjective norm and observability.

The TPB is used as second theory to understand the willingness of businesses to adopt an SMG. The biggest downside of the TPB in relation to this research is that it does not explain the institutional context in which the diffusion takes place. Therefore, the Structuration Theory (Giddens, 1984) and several other institutional approaches (Ostrom, 2007; Oteman et al., 2017; Van der Heijden, 2015) have been added to the theoretical framework.

The Cloverleaf Model (Jonker, 2014) is used to design the building blocks of the SBM. In this research the building block ‘community structure’ is replaced by ‘actors and roles’, since these seem to be the most important aspects of the community structure for the diffusion of SMGs in business parks. A limitation of this research is that no attention has been paid to the relation between the different actors and the forms of communication between the actors. Researching this is a recommendation for further research. Furthermore, it became clear that the Cloverleaf Model includes some elements that are hard to put into use. Besides, it appeared that there are some overlapping elements, such as the value proposition and collective values, and such as the community structure and the design team. The community structure and the design structure (actions and tools) are the main elements that provided guidance in the development of an SBM in this research.

This research consists of a single, explorative case-study. Due to this research design, it is hard to generalise the results. A limitation of this research is that the different drivers and barriers described in the theoretical framework have a lot of overlapping elements, which made it hard to subcategorise the drivers and barriers. Therefore, in the data analysis some answers are coded with multiple categories. Furthermore, the non-response rate was too high to get reliable research results with the online survey. To overcome this problem, the businesses are visited by the researcher. With the face-to-face survey a response rate of about 50% has been achieved. Another limitation of this research is the low N-rate due the split up of the survey in the very beginnings. As a consequence, it was hard to find significant relations between the variables. Regarding the workshop session, this data collection method provided soft evidence on the design of an SBM for SMGs in business parks. Critically reflecting on the program of the workshop session, part of the assignments was too hard for some of the respondents. The technical experts had to help the others with the assignments.

This research has led to multiple conclusions, answering the main research question. It is notable that the survey gives more insight in the drivers than the barriers of the adoption. The analysis of the survey
showed that the statements proposed to the companies who are not willing to adopt an SMG, do not reflect their reasons very well to not adopt an SMG. Moreover, some of the statements of the interviews are not supported by the survey results. This is probably the result of the sample being too small. It shows the difficulty of using a mixed methods design, since there are no strict rules about when results are reliable. Furthermore, due to the explorative research design, no hard statements can be made about the factors explaining the adoption of an SMG and the co-creation of an SBM for an SMG in a business park. The developed SBM should therefore be considered as an explorative model that can be further developed. Further research could focus on an SMG connected to a neighbourhood, a cost-benefit analysis of an SMG, the legal form of an SMG and multiple ways of co-designing an SBM.
Chapter 1. Introduction; the emerging of SMGs
1.1 Overview of the research project

This thesis explores the diffusion of SMGs in business parks. An SMG is an innovative energy system in which energy is locally generated, used and exchanged using smart technologies. The energy generated in an SMG is usually from renewable sources (Koirala, Koliou, Friege, Hakvoort, & Herder, 2016). Hence, an SMG could enforce the energy transition. An SMG can be implemented in different situations. Particularly business parks are suitable for SMGs, due to diversified energy consumption patterns of businesses, which increases the possibilities for energy exchange (Morales González, Torbaghan, Gibescu & Cobben, 2016). Currently, SMGs are slowly emerging in society. At several business parks in the Netherlands pilot projects are organised. However, guidance to organise SMGs projects in business parks is lacking, which hampers the diffusion of this innovation. Moreover, park management organisations have noticed that it is difficult to stimulate businesses to participate in an SMG project. Consequently, a park management organisation of a business park in the Netherlands set out the question: ‘How can we organise an SMG in our business park, considering the preferences of the local businesses?’.

To get an in depth understanding of this question, writing this thesis is combined with an internship. The internship took place at a consultancy agency for smart energy solutions (HVE). Next to the park management organisation and the consultancy agency, other stakeholders have an interest in guidance for the organisation of an SMG as well. These stakeholders are for instance the Cleantech Region, VNO-NCW, municipalities and the regional development company OostNL. This research has therefore been carried out in their interest as well.

To reduce the lack of information about the organisation of SMGs in business parks, the question from practice is translated in a scientific research question: “Which factors explain the adoption of SMGs by businesses at a business park in the Netherlands from a behavioural-institutional perspective and how can public and private actors co-create an SBM for the development of an SMG, reflecting these factors?” Moreover, four sub questions are formulated: 1. What is an SMG? 2. What are the current ongoing institutional change processes in which the diffusion of SMGs takes place? 3. To what extent are businesses willing to adopt an SMG and which drivers and barriers do they perceive regarding the adoption of an SMG? 4. How do the building blocks of an SBM work for the organisation of an SMG in a business park?

In this research an SMG is described as: an energy system that consists of the self-contained decentralised generation, use and exchange of renewable energy sources, which are managed locally with the use of smart technologies to ensure an economically efficient, sustainable power system with low energy losses.

An innovation can be researched from different perspectives such as technical, financial-economical, institutional and behavioural perspectives. In this research the latter two are combined to explore how the institutional context and the behavioural preferences of businesses influence the organisation of SMGs. This is of importance since local businesses must perform an active role in an SMG (Rodríguez-Molina, Martínez-Núñez, Martínez & Pérez-Aguilar, 2014). Hence, to provide guidance for the
organisation of an SMG insight in the drivers and barriers of businesses to participate is needed. Based on the drivers and barriers of businesses to participate in an SMG, a business model can be designed. A business model describes the logics of how to create value (Jonker, 2014). The focus in this research is on a sustainable business model, which describes the logics of value creation from a community and circular perspective (Jonker, 2014). By describing the building blocks of the organisation of an SMG, guidance can be provided for the development of this innovative energy system. In section 1.2 to 1.6 the research questions will be explained in more depth. Afterwards, section 1.7 and 1.8 describe the scientific and societal relevance of this research. This chapter ends with a description of the research model and reading guide in section 1.9.

1.2 Trends shaping the energy landscape

The Dutch energy system is undergoing significant changes, which are described in this chapter as an introduction to the research aim.

1.2.1 Increasing societal demand for electricity

A day without energy can no longer be imagined in our daily lives. We use energy to create heat, to cool and to illuminate our houses, offices and public spaces. We use energy as a driving force for industrial processes, for transportation, for communication and much more. The use of energy is anchored in our society and crucial for modern cities (Andrews-speed & Hezri, 2013; Masera, Bompad, Profumo & Hadjsaid, 2018; Rodríguez-Molina et al., 2014; Urmee & Md, 2015). Energy consists of various forms, from which electricity is becoming more and more important (CBS, 2018a; IRENA, 2019). It is even stated by the Universal Service Obligation that access to electricity is a basic human right, comparable to the right to have access to clean water (Bennett & Price, 2000). The amount of electricity used in the Netherlands increased from 222PJ in 1980 towards 382 PJ in 2018 (CBS, 2018b) and it is forecasted that part of this electricity in the final energy consumption will double in 2050 compared to 2005 (IRENA; 2019). Particularly, the electricity consumption will grow in the building and industrial sectors (Koirala, et al., 2016). The increased electricity consumption is the result of the ‘electrification of society’ and the growing population (Koirala, et al., 2016; Masera et al., 2018; Rodríguez-Molina et al., 2014). The electrification of society is for instance reflected in the number of electric vehicles (EV), which increased in 2017 with 60% compared to the year before (CBS, 2018c). Besides, the electrification of society is shown by the ‘power to heat’ movement, which means that electricity is to an increasing extent used to heat buildings (Edens & Lavrijssen, 2019; Koirala et al., 2016). As a consequence of the increasing use and thus dependency on electricity, it is becoming more and more important to create a reliable and affordable electricity system.

1.2.2 Towards a renewable energy mix

The current energy mix in the Netherlands is dominated by fossil fuels like natural gas, oil and coal, releasing CO₂ emissions to the air (CBS, 2018a). To mitigate climate change, there is a strong drive to reduce the use of fossil fuels and to increase the use of renewable energy sources, such as wind and
solar energy (Climate Agreement, 2019; Ministry of Economic Affairs, 2016). The generation of renewable energy, both on large- and small-scale is worldwide increasing (IRENA, 2019), enforced by institutional developments such as the United Nations (UN) Paris Agreement (UN, 2015) and the national Dutch Climate agreement (2019). This shows that an energy transition is occurring in society. Currently 8% of the Dutch energy mix consists of renewable energy sources (CBS, 2018a).

1.2.3 Decentralised power generation
A third trend within the Dutch energy system is concerned with the decentralised power generation. The traditional energy system consists of the centralised generation from a limited amount of power plants who push the energy through transmission and distribution networks to the energy consumers (Gelažanskas & Gamage, 2014; Palensky & Dietrich, 2011; Wolsink, 2012). This traditional energy system operates top-down and transports the energy in one direction from producer to consumer. The traditional energy system is shown in figure 2. This energy system is changing as a result of smaller and geographically dispersed power generation units (Koirala et al., 2016; Wolsink, 2012). The decentralised generation units are close to the energy consumers and therefore they can overcome transmission losses (Erol-Kantarci, Kantarci & Mouftah, 2011). Another advantage of the decentralised generation units is that they are associated with a sustainable energy supply, since the distributed generation is preferably from renewable sources (Ministry of Economic Affairs, 2018; Wolsink, 2012; Yoldaş, Önen, Muyeen, Vasilakos, & Alan, 2017). A trend related to the decentralisation of generation units is the increased amount of local energy communities (Oteman, Wiering & Helderman, 2014). As a consequence of this decentralisation, local residents and businesses play a more active role in the organisation of the energy system (Burke & Stephens, 2018; Miller, Griendling & Mavris, 2012; Wolsink, 2012; Yoldaş et al., 2017). The development of local energy communities is enforced by the National Climate Agreement (2019), in which it is argued that energy should to an increasing extent be generated by local actors.

Figure 2 The traditional centralised energy system (Nobel & Watt.nl, n.d.)
1.2.4 Congestion problems on the grid

As a result of the increasing demand of electricity and the decentralised generation units, congestion problems occur on the electricity grid (Koirala et al., 2016; Blom et al., 2012). The electricity grid has a limited transmission capacity, which means that the input (delivery) and purchase of electricity via the electricity grid must be balanced. In the Netherlands the electricity must be balanced at 50Hz (Donker, Huygen, Westerga & Weterings, 2015). If the network capacity is exceeded, congestion occurs on the grid and grid components can become overloaded leading to energy disruptions (Blom et al., 2012; Koirala et al., 2016; TU Delft, 2011). Therefore, throughout the day the energy consumption and production must be matched. The decentralised generation units increase the congestion problems, since the local generated electricity can be delivered back to the central electricity grid when the local demand is lower than the supply, which means that the energy system is becoming two directional (Gelazanskas & Gamage, 2014; Palensky & Dietrich, 2011). The current electricity grid, which is designed for a one-way transportation, cannot handle this two-way transportation in certain places (Koirala et al., 2016). In this way, distributed renewable energy units increase the congestion problems on the grid (Blom et al., 2012). Second, renewable energy generation units increase the congestion problems since renewable generation is weather dependent, which makes it hard to estimate the supply of electricity. Without estimations about the supply, it is hard to balance the supply with the demand. Without a new way of designing our energy system, the only way to deal with the congestion problems and to overcome energy disruptions is by conducting grid reinforcements. These grid reinforcements, performed by the semi-governmental grid operators ask for high investments, increasing societal costs (Blom et al., 2012) and causing a lock-in (Koirala et al., 2016). Therefore, grid reinforcements are not seen as the ideal solution to congestion problems on the electricity grid (Koirala et al., 2016; Overlegtafel Energievoorziening, 2018).

1.2.5 Increased need for flexibility

Another trend in the energy system is the increased need for a flexible electricity system (Climate Agreement, 2019; DEA (Dutch Enterprise Agency), 2019a; Gelazanskas & Gamage, 2014; Koirala et al., 2016; Palensky & Dietrich, 2011; Overlegtafel Energievoorziening, 2018; Wang et al., 2018). The flexibility of the electricity system is concerned with the capacity to quickly respond to an abundance or scarcity of electricity to ensure a reliable electricity supply. This is done by balancing the electricity demand and supply, as explained in the previous paragraph. Improving the flexibility is a key solution to issues caused by (1) the increasing demand of electricity, (2) the increasing generation by weather dependent renewable sources (3) the need for a flexible peak load capacity. The increased need for flexibility is suggested by multiple actors such as grid operators, the National Government and scientists (Climate Agreement, 2019; DEA, 2019a; Gelazanskas & Gamage, 2014; Koirala et al., 2016; Palensky & Dietrich, 2011; Overlegtafel Energievoorziening, 2018; Wang et al., 2018). Since renewable energy sources are weather dependent and contribute to inconsistent supply, the amount of renewable energy determines the level of flexibility that is needed. It is argued that if the part of renewable energy is more than 40%, a different and more flexible system is required (PBL, 2017). Since the European Parliament decided in 2018 that in 2030 32% of all energy must be generated from
renewable sources (Alonso, 2018), the need for a more flexible energy system is becoming closer. However, the time to introduce this flexible electricity system and executing this in an efficient way, is one of the biggest challenges in the energy transition (Donker, et al., 2015).

It can be concluded that the electricity grid must be prepared for a strong electrification of society in combination with a change to a more sustainable, decentralised and two-directional system. To deal with these pressures, the energy system must be looked at in a different way, emphasising flexibility. The question is not if, but when and how alternative energy systems will emerge (Loorbach, Van der Brugge & Taanman, 2008).

The shift towards an alternative energy system is not only a technical issue, but a major social innovation process as well; the organisation of the energy system requires transformation and people need to change their behaviour (Loorbach et al., 2008). This thesis is an explorative research regarding factors influencing the development process of an alternative energy system.

1.3 SMGs as a solution

1.3.1 Smart technologies
To cope with the current issues of the energy system and to prepare for the future, innovative solutions are inevitable (Climate Agreement, 2019). One of these solutions is the realisation of a smart grid, which turns out to be one of the most promising future energy systems (Rodríguez-Molina et al., 2014). Smart grids are a promising solution, because they respond to inconveniences of the electricity grid by regulating the demand, supply, storage and exchange of energy using a communication and information layer (Gelazanskas & Gamage, 2014; Hare, Shi, Gupta & Bazzi, 2016; Koirala et al., 2016; Wolsink, 2012; Yoldaş et al., 2017). This means that based on energy consumption and production data, the communication and information technologies balance the electricity demand and supply on the grid. These smart technologies can for instance shift the energy consumption to off-peak hours, balancing the energy load. In this way smart technologies are used to increase the flexibility of the electricity system, reducing congestion problems (Koirala et al., 2016; DEA, 2019a). As a result of these advanced technologies and the possibility to quickly respond to changes in the supply and demand of electricity, smart grids are interpreted as ‘intelligent’ energy networks.

1.3.2 Local assets and increased benefits
Smart grids can develop in two different ways depending on the dominant scenario (Goulden, Bedwell, Rennick-Egglestone, Rodden, Spence, 2014; Naus, Spaargaren, Van Vliet & Van der Horst, 2014). In a scenario with radical centralization there will be transnational super grids, in which all energy consumers and producers are connected to each other. In a second scenario with decentralisation, smart grids will develop as micro grids (Naus et al., 2014; Yoldaş et al., 2017). The second scenario in which Smart Micro Grids are dominant is the main focus of this research, since it is for several reasons more likely that the energy system will decentralise instead of centralise. First, the previous section
shows that there is already a trend towards decentralisation, making the probability of micro grids more realistic. Second, it is aimed in the Dutch Climate Agreement (2019) that in 2030 50% of the used energy is produced locally within a community. On European level local energy communities are promoted as well (European Commission (EC), n.d.). This shows that the energy policies are enforcing the decentralisation of the energy system. Moreover, at local level smart grids can overcome transmission losses and contribute to local independency, which are benefits a transnational smart grid does not have (Goulden et al., 2014). Thus, it is assumed that SMGs are more likely to emerge than transnational smart grids and that the former are one of the most promising future energy systems.

Within an SMG the generation, consumption, storage and exchange of energy takes plays at ‘local’ level (Koirala et al., 2016; Wolsink, 2012; Yoldaş et al., 2017). This means that within a geographically defined area one generates energy, uses this energy and exchanges the surplus of this energy with other local actors. Therefore, an SMG can be interpreted as a small-scale local distribution system. The main aspect of this local distribution system is the generation of renewable energy, which is locally managed with the use of smart technologies (EC, 2011). Figure 3 shows the different elements of an SMG.

![Figure 3 Elements of an SMG (Berkeley Lab, n.d.)](image)

The figure shows that there are different forms of energy generation in an SMG. The most common forms of renewable energy generation are PV (photovoltaic) and wind turbines. Besides, the figure shows that an SMG consists of different forms of energy storage, such batteries and EV’s. Moreover, in an SMG there can be different energy consumers and producers, for instance households and businesses located at large office buildings. The generation, consumption and storage assets are connected to each other by the controller who uses big data to manage the energy flows. To gather data the buildings are provided with smart meters that measure the demand of energy and the
generated supply (Hong & Kim, 2016). The energy markets and the weather forecast are connected to the controller as well, to make estimations about the energy supply and the energy costs. Besides, as shown in figure 3 an SMG can be connected to the central grid and other micro grids and exchange energy with these entities as well. In the figure it is demonstrated that the SMG can choose to be connected or disconnected to the central grid. The central grid makes use of fossil fuel energy, which means that even without sun or wind there will be energy available in the central grid.

An SMG has several advantages compared to the traditional energy system, such as low transmission losses, reduction of energy costs, decreased CO₂ emissions, increased flexibility overcoming congestion problems and independency of the national grid (EC, 2011; Koirala et al., 2016). Some of these benefits are for the people participating in the SMG itself (independency) while other benefits are for the whole society (decreased CO₂ emissions). Considering the assets and benefits, SMGs can enforce the transition to a low-carbon energy system, contributing to an affordable and reliable energy supply. An extensive explanation of SMGs is described in chapter 2.

1.3.3 Participation local actors

As is shown in figure 3, an SMG consists of the decentralised generation and storage of renewable energy. These assets have a spatial impact on the living environment (DeGroff, 2010; Koirala et al., 2016). The current fossil fuel energy system is hardly visible in our physical environment; we get our energy from the deep surface and a large part of the energy infrastructure is underground. However, renewable energy sources take more space than conventional energy sources (PBL, 2017). As a result of the spatial assets, the development of an SMG consists of reserving space for renewable energy resources. This space can be on the rooftop of commercial buildings, on the rooftops of private housing, on farmland, in public spaces, alongside roads etcetera (Wolsink, 2012). However, the space that is available for the generation of renewable energy and its transportation infrastructure is limited, which is the result of property and resource rights (Koirala et al., 2016; Wolsink, 2012). Therefore, the emergence of SMGs depend on the willingness of the local population to make space available for renewable energy and storage assets.

However, considering the local energy management that consists of generation, consumption, storage and exchange, an SMG requires more actions from locals. For the development of SMGs local citizens must be willing to become small-scale co-providers of energy. The current energy consumers are expected to shift from passive consumers to active prosumers (Rodríguez-Molina et al., 2014), whereas ‘prosumers’ is a combination of the words ‘consumers’ and ‘producers’. In short, the actions local people must perform in an SMG are: reserving room for renewable energy sources, investing in renewables and smart grid assets, exchanging energy with others and shifting the energy consumption to another time of the day to match the demand and supply of energy (Goulden et al., 2014; Wolsink, 2012). This means that the development of an SMG is concerned with the willingness of local citizens to perform these diverse range of actions. If the locals perform these actions, they can create their own local energy community and decrease their independency on the national grid. Hence, an SMG is concerned with self-ownership of the energy system.
### 1.3.4 Development phase

An SMG is an innovation that is currently emerging in society. However, SMGs are not very common yet, as they are still in the development phase (Grimley & Farrell, 2016; Naus et al., 2014). However, they are not completely new anymore, since there has been a growing interest in building SMG’s for several years now around the world. For instance on campuses, business parks and remote communities (Erol-Kantarci et al., 2011). The economic case for SMGs is growing as a result of decreased generation and storage costs (Grimley & Farrell, 2016). Moreover, the worldwide introduction of smart meters, as part of the information layer, indicates the shift to the future energy system of SMGs (Ballo, 2015). Nevertheless, currently only pilot projects are taking place. The pilots that are taking place with SMGs are testing out the technology, legal models and business models (Grimley & Farrell, 2016). However, until now, no standard way of deployment has been developed (Grimley & Farrell, 2016; González, Wattjes, Gibescu, Vermeiden, Slootweg & Kling, 2018; Rodríguez-Molina et al., 2014).

SMGs are not the only solution to cope with the problems of the current energy system. Nevertheless, this research does not examine the different options to solve issues regarding the energy system, but explores only the feasibility of an SMG. This is decided since SMGs fit within the trends of sustainability, flexibility, locality and self-ownership, which will be further outlined in the rest of this research.

### 1.4 SMGs in business parks

Most national (DEA, 2015a) and international SMG pilots (Koirala et al., 2016; Morales González, et al., 2016) are concerned with residential communities. The potential of SMGs within residential communities has turned out lower than expected due to low participation rates, limited flexibility of resources and high entrance costs (Koirala et al., 2016; Morales González et al., 2016). The lower potential than expected could slow down the development process of SMGs. However, it is expected that business parks provide better circumstances for the implementation of SMGs. A reason why business parks are more suitable for SMGs than residential communities, is that companies often have a higher energy consumption rate and a higher peak-demand compared to households (Morales González et al., 2016). Consequently, businesses have greater possibilities to match the demand and supply of energy. Furthermore, there is more room for flexibility in business parks since the energy consumption patterns between companies differ more than between households (Morales González et al., 2016). The more the energy consumption patterns differ, the more possibilities there are for energy exchange within the micro grid and thus there are more possibilities for the successful implementation of SMGs (Koirala et al., 2016).

Next to these technical reasons, another reason why it would be useful to implement SMGs in business parks, is that the percentage of renewable energy at business parks is about 5% (TNO, 2016), which is lower than the average amount of generated renewable energy in the Netherlands (CBS, 2018a). This means that business parks are even more lagging behind the objective to reduce 95% of the CO₂
emissions in 2050 compared to 1990 than other sectors. In total, small and medium-sized business parks (1300 business parks in the Netherlands) use 170PJ energy each year, which is 6% of the total Dutch energy use (TNO, 2016). In new policy documents, such as the Climate Agreement (2019) no attention is given to the energy transition on these business parks. Besides, most of the measures are directed to large companies, mobility and neighbourhoods, leaving the potential of reducing CO₂ emissions at small and medium-sized businesses out of sight. An SMG could contribute to reducing CO₂ emissions at business parks.

Currently, in the Netherlands there is no SMG developed at a business park. However, 45% of the businesses located at business parks state that improving their energy management in a sustainable way is high on their agenda (DEA, 2018). On the other hand, 26% of the businesses state that they do not give attention to sustainable energy measures at all (DEA, 2018). Although the research of the DEA (2018) is not specifically directed at SMGs, but at sustainable energy management in general, the research results implies an interesting distinction between businesses who are frontrunners and want to take sustainable energy measures and businesses who are not interested in sustainable energy management at all. However, it remains unknown why certain companies want to act, and others do not. Moreover, from the companies that are willing to perform sustainable energy measures only a very few have performed actions, which shows a gap between the willingness to perform sustainable actions and the actual implementation (Veldhuis-Van Essen& Hoevenagel, 2014). Until now it remains unknown what determines the decision-making process between (sustainable) values, the willingness to do something and the actual implementation of plans (González et al., 2018; Rodríguez-Molina et al., 2014). From this section can be concluded that SMGs are a promising innovation in business parks, but that there is a knowledge gap about factors influencing the willingness of businesses to participate in an SMG.

### 1.5 The need to understand the adoption and organisation of SMGs

As can be concluded from previous paragraphs, due to problems that are occurring in the current energy system and that will possible increase in the future, an innovative energy system that is prepared for the future is needed. In particular, there is a need for a more flexible system (Climate Agreement, 2019; Gelazanskas & Gamage, 2014; Koirala et al., 2016; Palensky & Dietrich, 2011; Overlegtafel Energievoorziening, 2018; Wang et al., 2018). An SMG contributes to this flexibility and seems to be able to solve current and forthcoming problems and to guarantee a sustainable, affordable and reliable energy system (Gelazanskas & Gamage, 2014; Hare et al., 2016; Pitt, Diaconescu & Bourazeri, 2017; Wolsink, 2012). Even though pilot projects are occurring, the large-scale implementation of SMGs does not yet take place in society (González et al., 2018; Koirala et al., 2016). Nevertheless, there are no technical barriers holding back the development of SMGs (Gelazanskas & Gamage, 2014; Hare et al., 2016; Wolsink, 2012). Several scientists argue that the lack of scaling-up of SMGs concerns the social feasibility (e.g. González et al., 2018; Wolsink, 2012). The social feasibility
influences the scaling-up, since an SMG only work with the involvement of local actors who wants to become part of the SMG (Miller et al., 2012; Wolsink, 2012; Yoldaş et al., 2017). In other words, SMGs will only diffuse in business parks if businesses are willing to ‘adopt’ an SMG and become active prosumers (González et al., 2018; Miller et al., 2012; Wolsink, 2012). Adoption refers to the willingness of people to buy or use an innovation (Rogers, 2003). The sum of all the individual adoption processes is called the ‘diffusion’ of an innovation (Rogers, 2003). Researching the diffusion of an innovation gives insight in the social feasibility and consequently in the actual implementation.

Following this line of reasoning, to explore if SMGs will emerge in business parks, insights on the factors influencing the willingness of businesses to invest and use an SMG is required. In general terms, the adoption process is partly determined by individual preferences (e.g. Ajzen, 1991; Rogers, 2003; Wüstenhagen & Menichetti, 2012) and partly by the broader social (e.g. Ajzen, 1991) and institutional context under which actors make decisions (e.g. Koirala et al., 2016; Krewitt, Simon, Graus, Teske, ZeDEAs, & Schafer, 2007; Lindberg, Markard, Andersen, 2018; Loorbach et al., 2008; Oteman, Kooij & Wiering, 2017; Wolsink, 2012; Wüstenhagen & Menichetti, 2012). However, what determines the willingness of businesses to adopt an SMG remains unknown. Consequently, it can be concluded that an SMG is a promising innovation, but that there is a knowledge gap about if and why this innovation will be adopted by businesses. To reduce this gap, knowledge should be gained about the institutional context in which the diffusion process takes place (Adil & Ko, 2016; Burke & Stephens, 2018; Grimley & Farrell, 2016; Wolsink, 2012). Secondly, insight should be gained in the drivers and barriers of the individual businesses to adopt an SMG (Koirala et al., 2016; Wolsink, 2012).

Moreover, it is argued that the development of SMGs depends, next to the adoption by local actors, on the effective organisation of the system (Gui, Diesendorf & MacGill 2017; Koirala et al., 2016; Lammers & Heldeweg, 2016). The organisation of an SMG can be structured in a business model and is concerned with roles and responsibilities, key activities, key resources and value propositions (Koirala et al., 2016; Rodríguez-Molina et al., 2014). On international level pilots with SMGs are testing out potential business models (Grimley & Farrell, 2016). Nonetheless, an overview of the literature shows that in most cases there is weak description of business model ideas (Koirala et al., 2016; Rodríguez-Molina et al., 2014; Wolsink, 2012). Consequently, there is no standard way to develop business models for SMGs and thus to organise SMGs in business parks (Rodríguez-Molina et al., 2014). As a result of the weak description of business models, it is hard to realise SMGs in practice (Koirala et al., 2016).

The weak description is partly the result of the lack of insight in the drivers and barriers of businesses to adopt an SMG. If it is not clear which role the businesses can and want to perform and which resources they have it is difficult to design a business model, since the businesses are the central actors in the SMG in a business park. Besides, the weak description of business models is the result of the innovativeness of an SMG and the lack of insight in the costs and revenues (Rodríguez-Molina et al., 2014). Furthermore, an SMG is not only concerned with financial benefits, but with social and ecological benefits as well (e.g. EC, 2011; Hong & Kim, 2016; Sintov & Schultz, 2015; Wolsink, 2012). Hence, an SMG requires another kind of business model than a conventional business model that
consists of financial flows (Jonker, 2014). Another challenge of the design of a business model for SMGs is the co-creation between different actors (Rodríguez-Molina et al., 2014). The organisation of an SMG can only be realised with the involvement of both public and private parties (Gui et al., 2017; Lammers & Heldeweg, 2016). Which parties exactly should be involved in the organisation and which role they must play remain unknown. A crucial element for the success of a business model is the alignment of interests of different parties (Bocken, Short, Rana & Evans, 2014), which means that the different public and private parties need to reach consensus about how they want to organise an SMG. It follows that in order to develop SMGs, it must be found out how different parties can work together to design a business model. To summarize, a lack of insight in the willingness of businesses to adopt an SMG, the innovativeness of the concept of SMGs, the multiple value creation and the need to collaborate with different parties, are reasons why there are only weak descriptions of business models for SMGs.

This section explains that there are two main reasons why SMGs have not been implemented on large-scale in business parks yet. First, it is unclear if and why businesses are willing to adopt an SMG. Second, a business model that gives insight in the organisation of an SMG is lacking because of several knowledge gaps. These two reasons are related to each other, since if it is known what drives businesses to adopt an SMG, this could be the starting point for the development of a business model. This is the case since the preferences of the local businesses, the central actors in an SMG in a business park, can then be included in the business model. To conclude, the research problem is that several studies show that SMGs are promising to guarantee a reliable, sustainable and affordable energy system in business parks, while at the same time it is unclear how a business model can be developed to realise SMGs in practice. This first requires insight in the factors explaining the adoption of an SMG by businesses.

1.6 Research questions

Resarching the diffusion of an SMG is hard, as it is about gaining insight in a socio-technical system that does not exist yet (Goulden et al., 2014). Nevertheless, through a sociological and institutional lens, this thesis aims to identify and clarify the drivers and barriers of the diffusion of SMGs in business parks in the Netherlands. Second, this thesis aims to develop a business model reflecting the drivers and barriers and aligning the interests of the different public and private actors. By developing a business model, knowledge can be gained about the organisation of an SMG, which is currently lacking. Researching this, this thesis allows one to see if the diffusion of SMGs in business parks is feasible. Based on these research aims, the following research question is formulated:

“Which factors explain the adoption of SMGs by businesses at a business park in the Netherlands from a behavioural-institutional perspective and how can public and private actors co-create an SBM for the development of an SMG, reflecting these factors?”
To answer this main question, the following sub questions are formulated:

1. What is an SMG?
   a. What are the different elements within an SMG?
   b. What are the advantages and disadvantages of an SMG?
   c. What is the expected role of companies in the diffusion of an SMG?

2. What are the current ongoing institutional change processes in which the diffusion of SMGs takes place?
   a. Which developments in the energy market influence the diffusion process?
   b. Which developments in the technological context influence the diffusion process?
   c. Which trends in society can strengthen the diffusion process?

3. To what extent are businesses willing to adopt an SMG and which drivers and barriers do they perceive regarding the adoption of an SMG?

4. How do the building blocks of an SBM work for the organisation of an SMG in a business park?
   a. What are the building blocks to design an SBM for an SMG in a business park?
   b. How can the building blocks of an SBM for an SMG in a business park be co-created by public and private actors in a way that the co-creation is embedded in the development of the SMG?

To answer these questions a case-study is conducted. In this research the diffusion process refers to the extent to which businesses are willing to invest in and use an SMG. There are more stakeholders involved in the diffusion process of SMGs, but in this research it is assumed that businesses are the one who need to adopt the innovation, while the other stakeholders perform a facilitating, stimulating or regulating role. Therefore, the other stakeholders are not the object of study.

A few concepts mentioned in the research questions ask for a brief description:

**Business parks:** There are several definitions of a ‘business park’. In this thesis a broad definition described by the CBS (n.d.) is used. The definition is translated from Dutch: “Land in use for industry, trade and businesses services. The following fits within the definition of a business park: factory site, port area, auction site, exhibition sites, cattle market (covered or not), wholesale market, site with banks, insurance companies etc., associated storage area and parking, garage, garage of bus company, office buildings, belonging parking areas.”

**Behavioural-institutional perspective:** A behavioural-institutional perspective means in this research that the willingness to adopt an SMG depends on behavioural preferences of the business. Furthermore, this research explores how this behaviour is influenced by institutions and how institutions influence behaviour. Hence, this research seeks for a combination of behavioural and institutional theories to explore factors influencing the diffusion process.

**SBM:** A business model describes what is needed to realise the value proposition (Jonker, 2014; Jonker, Kothman, Faber & Navarro, 2018). In this case the value proposition consists of the development of an
SMG in a business park. In this thesis the term SMB is used, because it is argued that traditional business models are not sufficient enough to describe the organisation of an SMG, which will be further explained in chapter 4. An SBM can be interpreted as a strategy (Casadesus-Masanell & Ricart, 2010), which is concerned with the programs to achieve a common goal (Mintzberg, Lampel, Quinn & Ghosal, 2003). More concretely, an SBM consists of a description of the added value, involved stakeholders, key actions, resources, revenue streams and cost structures (Jonker, 2014; Koirala et al., 2016).

Co-creation: Co-creation takes place in various sectors and has several definitions (Voorberg, Bekkers & Tummers, 2015). The term originates from marketing studies, in which it has been defined as “The practice of developing systems, products, or services through collaboration with customers, managers, employees and other stakeholders” (Ramaswamy, 2011, p.195). Over the past years the term ‘co-creation’ is used in urban planning articles as well (Barrutia & Echebarria, 2012; Bisschop & Beunen, 2019; Kemp & Scholl, 2016; Lund, 2018; Nevens, Frantzeskaki, Gorissen & Loorbach, 2013; Oksman, Väätanen & Ylikauppila, 2014). In general terms, co-creation can be described as a form of participation (Van Berlo, 2015). However, co-creation is more specific than participation, since co-creation refers to the ‘active involvement’ of stakeholders (Voorberg et al., 2015). Moreover, co-creation is described as “do-it-yourself settings that engage local actors in the processes of shaping the city” (Nordregio, Austrian Institute for Spatial Planning, OTB Research for the Built Environment & TU Delft, 2016). There are different perceptions of which stakeholders play a role in co-creation. An overview of the literature shows that some authors emphasise the relation between the government and citizens, while other authors do not describe which parties are co-creating (Voorberg et al., 2015). Sanders and Stappers (2008) define co-creation for instance as “any act of collective creativity, i.e., creativity that is shared by two or more people” (pp. 16). In this research it is assumed that the co-creation takes place by local public and private participants. The focus is on these consumers since previous research indicates that an SMG can only be developed by public and private parties working together (González et al., 2018; Gui et al., 2017; Miller et al., 2012; Wolsink, 2012). In this research co-creation is defined as a form of active participation in which local public and private parties work together to reach a common goal (Van Berlo, 2015). The common goal in this research is the development of an SBM for the establishment of an SMG in business parks. The concept of co-creation is further explained in chapter 4.
1.7 Scientific Relevance

The aim of this research is to reduce the knowledge gap regarding behavioural-institutional factors influencing the diffusion process of SMGs in business parks. Second, the aim of this research is to reduce the knowledge gap regarding the development of an SBM for the organisation of an SMG. In this way an attempt is made to gain insight in the social feasibility of SMGs in business parks. Considering these research aims, this research is related to behavioural studies, institutional studies and business model studies. Various sub-topics of the diffusion and SBM development have been researched before, as will become clear in this section. However, scientific insight in the behavioural-institutional factors and the building blocks of an SBM for specific business parks is lacking.

The diffusion of SMGs asks for behavioural change (Miller et al., 2012; Wolsink, 2012; Yoldaş et al., 2017). Several researchers studied certain aspects of energy behaviour, such as energy saving behaviour (e.g. Chen, 2016; DEA, 2018; Frederiks, Stenner & Hoban, 2015; Martiskainen, 2007; Paço & Lavrador, 2017; TNO & IVAM 2015; Trotta, 2018; Wang, Wang, Guo, Zhang & Wang, 2018) and energy investment behaviour (e.g. Busch & McCormick, 2014; DEA, 2018; Masini & Menichetti, 2012; Reubsaet, Midden & Zolingen, 2019; TNO & IVAM 2015; Yazdanpanah, Komendantova & Ardestani, 2015). These studies provide insight in why people perform or do not perform sustainable energy behaviour. By analysing these particular studies, a large variety of factors influencing the willingness to perform sustainable energy behaviour is discovered. Factors mentioned multiple times are environmental concerns and financial benefits. What is notable is that various studies (e.g. Busch & McCormick, 2014; Chen, 2016; Kowalska-Pyzalska, Maciejowska, Suszczyński, Szajd-Weron & Weron 2014; Liu, Wang & Mol, 2013; Macovei, 2015; Martiskainen, 2007; Mulville, Jones, Huebner & Powell-Greig, 2017; Paço & Lavrador, 2017; Sarkis, 2017; Sintov & Schultz, 2015; Yazdanpanah et al., 2015), use the TPB (Ajzen, 1991) to explain the decision-making process. However, these studies do not specifically relate to behavioural change to establish an SMG.

Next to these studies about ‘sustainable energy behaviour’, quite a lot of research is focused on ‘smart’ energy. Previous research about SMGs, smart grids or SDR (Smart Demand Response) is often concerned with the technical feasibility (e.g. Abdi, Beigvand & La Scala, 2017; Conejo, Morales & Baringo, 2011; Fan, 2012; Hernández et al., 2013; Jiang & Low, 2011). Nevertheless, in the last few years several scientists researched the social feasibility of smart grids (Balta-Ozkan, Davidson, Bicket & Whitmarsh, 2013; Goulden et al., 2014; Luthra, Kumar, Kharb, Ansari & Shimmi,, 2014; Naus et al., 2014; Sintov & Schultz, 2015; Toft, Schuitema & Thøgersen, 2014) or certain aspects of it such as SDR (Enckevort, 2017), smart metering (Chou & Yutami, 2014; Van Aubel & Poll, 2019) and dynamic pricing (Kowalska-Pyzalska et al., 2014). It is striking that often one part of a smart grid is studied and not the change to a completely new energy system (Koirala et al., 2016). Factors influencing the social feasibility that have been revealed several times are for instance familiarity with the technology and a perceived relative advantage. Furthermore, it is argued that (national) policy determines the adoption of a smart grid (Adil & Ko, 2016; Burke & Stephens, 2018; Grimley & Farrell, 2016; Wolsink, 2012). Nevertheless, none on these studies concerns the willingness of people to use a smart grid on micro-
scale. However, the difference between a large-scale smart grid and an SMG at community level is of significant relevance (Goulden et al., 2014; Wolsink, 2012). In large-scale smart grids energy-consumers perform the same role as in the traditional system (Wolsink, 2012). In contrast, actors in a ‘micro’ smart grid will play a more active role (Goulden et al., 2014; Wolsink, 2012). Consequently, it can be concluded that knowledge about factors influencing the diffusion of smart technologies exists, but that this knowledge is not concerned with the aspect ‘micro’. Additionally, there is large variety of research on the diffusion of local energy communities, wherein energy consumers do play a more active role compared to the traditional energy system (e.g. Becker, Kunze & Vancea, 2017; Bomberg & McEwen, 2012; Boon & Dieperink, 2014; Kalkbrenner & Roosen, 2016; Oteman et al., 2017; Walker, 2008). Nevertheless, in these initiatives the aspect ‘smart’ is missing and consequently factors explaining this diffusion cannot simply be translated to SMGs.

Moreover, the analysis of the scientific landscape shows that most research regarding the diffusion of energy innovations concerns citizens (e.g. argued by Andrews & Johnson, 2016; Goulden et al., 2014; Morales González et al., 2016; Wolsink, 2012). Research that concerns business organisations is often related to environmental behaviour in general (Sanchez-Medina, Romero-Quintero, Sosa-Cabrera, 2014; Testa, Gusmerottia, Corsini, Passetti & Iraldo, 2015), which does not fill the research gap of the unknown motivations of businesses to adopt an SMG. In particular it is interesting to fill this knowledge gap since SMGs seem more promising in business parks than residential areas (Morales González et al., 2016). Besides, the difference between the studied population groups is important since it is assumed that businesses will react differently to SMGs than domestic users. First, within a business organisation the decision to invest in a sustainable energy system depends on organisational characteristics (Frambach & Schillewaert, 2002; Hameed, Counsell and Swift, 2012; Wüstenhagen & Menichetti, 2012). Second, it might be the case that businesses feel detached from the space they occupy (Mulville et al., 2017) and therefore have little interest in SMGs. This will be enforced when the energy bill is included in the rental price of the building (Van der Heijden, 2015).

Next to factors influencing the diffusion process, there exists a knowledge gap about how the SBM of an SMG should look like (Koirala et al., 2016; Rodríguez-Molina et al., 2014; Wolsink, 2012). There are only a very few weak models explaining the relationship between stakeholders, the actions that need to be performed, the revenue streams etcetera. Therefore, this research contributes to the development of a theoretical model to organise SMGs in business parks.

The description of the scientific relevance so far, shows that the energy transition is on the intersection of multiple disciplines: psychology, technology, engineering, information science and economics. The interdisciplinary character of energy research includes spatial planning as well (Pellegrino & Musy, 2017). To achieve a successful energy transition, early consideration of the spatial design of new energy landscapes is essential (Sijmons et al., 2017). Currently, most research on local energy landscapes is concerned with rural areas (Sijmons et al., 2017). However, recent studies have been completed about the role of business parks in the development of local Dutch energy landscapes (Sijmons et al., 2017). This research is contributing to the design of energy landscapes on business parks, with the implementation of SMGs. Business parks are often concerned with the need for revitalisation (Van der
Krabben, Pen & De Fijter, 2015). Since at these business parks, part of the buildings is outdated, there is a need to transform business parks (Van der Krabben, Pen & De Fijter, 2015). The energy transition can be included in the transformation of these business parks (Sijmons et al., 2017). This research give insight in how the energy transition can be included in the revitalisation of business parks. An SMG could improve the business climate and consequently contribute to the revival of a business park. The empirical data of this research provides insight in how an SMG is valued by businesses and other stakeholders of business parks. In that way knowledge will be gained about the behavioural-institutional possibility to implement an SMG in business parks.

Moreover, it is expected that the local government has in the upcoming years less and less money available for the maintenance of business parks (Van der Krabben, Pen & De Fijter, 2015). This is the result of the decentralisation of multiple tasks from the central to the local government. Hence, there is a need to look for public-private partnerships to revitalise business parks (Van der Krabben, Pen & De Fijter, 2015). This thesis explores a possible public-private partnership to revitalise business parks, including enforcing the energy transition. Particularly, this thesis provides a theoretical understanding of the role of a park management organisation in the revitalisation of business parks. Due to the fragmented property ownership at business parks, park management organisations can play an essential role in the transformation of business parks. They are the overarching institution that can stimulate collaboration. Previous research has been conducted about the multiple roles of park management organisations (De Vries, 1998; Pellenbarg, 2004). However, these studies do not explain the role of a park management organisation to enforce the energy transition in business parks. This thesis provides an understanding of the role of a park management organisation to collectively revitalise business parks by the organisation of an SMG.

The fact that the diffusion of concepts related to SMGs (energy saving behaviour, investment renewable energy, smart grids, local energy communities) are researched, show that there is an interest to know how the energy system will develop in the future. Almost all the before mentioned studies describe which developments in the energy system are promising and why. SMGs can be added to this list and consequently this research, in combination with previous research, provides insight in the future development of the energy system. In this way this research contributes to reducing the knowledge gap between promising innovations of the energy transition.
1.8 Societal relevance

This research is of societal relevance for several reasons. In general, this thesis seeks to contribute to the realisation of a reliable, affordable and sustainable energy system in business parks with the development of SMGs. As the concept ‘SMG’ represents a new approach, further academic research is important to evaluate the drivers and barriers for adoption. By researching these drivers and barriers, this thesis intents to contribute to a better assessment of how innovations such as an SMG can be established. Besides, the design of the SBM provides a guideline for the organisation of an SMG in business parks. Furthermore, if it is known what drives businesses to adopt an SMG, SMGs can be organised in a way that the preferences of these businesses are included in the business model. Hence, this research is relevant for project managers, park management organisations, development companies, municipalities, provinces and the National Government who have an interest in the implementation of SMGs, but do not have knowledge about the drivers and barriers of the diffusion process and/or the organisation of the SMG.

Furthermore, the societal relevance of this research is apparent in the National Climate Agreement (2019). The Climate Agreement increases the urgency of the diffusion of sustainable energy strategies, such as SMGs. In the Climate Agreement the concept of SMG is not literally mentioned, but an SMG could contribute to the objectives that are described in the Climate Agreement. First, it is described in the Climate Agreement that participation and acceptance of citizens and businesses are preconditions for goal achievement. This shows that it is important to gain insight in the motivations of businesses to adopt a sustainable energy system. Second, it is described in the Climate Agreement that the flexibilization of the energy system, which is essential in SMGs, should be stimulated. The development of an SBM for SMGs in business parks will stimulate the development of SMGs and consequently it will stimulate the flexibilization of the energy system. Besides, an SMG will contribute to reducing CO₂ emissions, which is the main objective of the Climate Agreement. Consequently, this research contributes to achieving the objectives of the Climate Agreement.

After the national Climate Agreement is signed, the official development of the Regional Energy Strategy (RES) starts. A RES provides an overview of projects, plans and strategic choices for the short- and long-term to achieve the aimed CO₂ emission reduction (VNG, 2018). In 2019, municipalities, provinces and water boards need to create an introductory memorandum of the RES and in 2020 the plans will be implemented. Part of the regional energy goals to reduce CO₂ emissions will have to come from the contribution by businesses at business parks. Therefore, the insights required in this research can be used in the design process of the RES.
1.9 Research model and reading guide

In this section the research model is presented and explained. The research model (figure 4) shows which different steps must be taken to achieve the goal of this research. The first step concerns desk research and eventually leads to the development of a conceptual framework and a research strategy. Phase 2 consists of an extensive literature review and in-depth interviews with experts and businesses, providing general knowledge about SMGs, the institutional context and factors influencing the decision of businesses to adopt an SMG. Insight in the latter is achieved by asking experts about their experiences and by talking to the businesses of the case-study. Based on these findings a structured survey is conducted in phase 3. Conducting a survey provides knowledge about the adoption factors from a broad range of companies. Last, research phase 4 consists of a workshop session with local public and private parties. Within this workshop session an SBM is developed based on the results of the previous held interviews and survey. By developing an SBM based on the factors influencing the diffusion of SMGs by businesses, the SBM is better aligned with the interests of the businesses, increasing the chance of a useful SBM. A new designed SBM for the development of SMGs in business parks, including the preferences of businesses, is the end goal of this research.

Figure 4 Research model (Author, 2019)
The different steps presented in the research model are reflected in the outline of this thesis. First, for an in-depth understanding of the researched phenomenon, the concept ‘SMG’ is explained in chapter 2. Afterwards in two chapters the theoretical framework is described (chapter 3 and 4), followed by the conceptual model (chapter 5). Chapter 6 explains the methodology of this research. Next, chapter 7 describes the institutional context in which the diffusion process of SMGs takes place. This description explains a number of institutional barriers and enablers for the diffusion process. This chapter is based on the literature review and the expert interviews. Chapter 8 is based on the interviews and survey and provides knowledge about the extent to which businesses are willing to adopt an SMG and what the drivers and barriers are for adoption. Thereafter, in chapter 9 the co-creation of an SBM is described. The main research question and sub questions are answered in the conclusion section in chapter 10. Last, chapter 11 consists of a critical reflection of the research processes and the research results and it provides recommendations for further research.
Chapter 2. SMGs as an innovation in the energy transition
2.1 Introduction to chapter

This chapter serves to describe the concept of SMGs. Various scientific and policy articles are used to explain this innovative and interdisciplinary concept. In this chapter first the characteristics of an SMG are explained (section 2.2), followed by the advantages and challenges of an SMG (section 2.3) and the role of businesses in an SMG (section 2.4). This chapter ends with a conclusion on the concept of SMGs (section 2.5).

2.2 The characteristics of an SMG

To understand the diffusion process of SMGs in business parks and the co-creation of an SBM, first the concept ‘SMG’ needs to be explained. Therefore, in this section the question “What is an SMG?” is answered, based on an extensive literature analysis. The concept ‘SMG’ includes the words ‘smart’ and ‘micro’. ‘Smart’ refers to the use of technologies that can regulate the generation, consumption, exchange and storage of energy (Gelazanskas & Gamage, 2014; Hare et al., 2016; Koirala et al., 2016; Wolsink, 2012; Yoldaş et al., 2017). The concept ‘micro’ refers to locality. Micro grids have a long history as the first power plants from the end of the 19th century were micro grids (Wolsink, 2012). By that time, there was no centralised grid, so electricity was produced and consumed at local scale (Asmus, 2010). In an SMG several activities take place at local level: “The micro grid enables the production and storage of renewable energy, as well as the exchange of electricity between energy providers and consumers, to take place locally.” (Wolsink, 2012, pp. 223). There is no strict definition of the size of a ‘micro’ area, but ‘micro’ can for instance refer to a cluster of energy consumers within a distribution transformer (Koirala et al., 2016). Moreover, a micro grid can operate in two ways: “A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island mode.” (Ton & Smith, 2012, pp. 1). In the 19th century the grids were designed in island mode, meaning that the energy prosumers were completely self-contained. In more recent studies, an SMG is assumed to be connected to other SMGs and/or to the central grid (Goulden et al., 2014; Wolsink, 2012). This is the case since the grid-connected mode has several advantages compared to the island mode, for example cheaper energy when there is a surplus at other SMGs (Koirala et al., 2016). Hence, in this research an SMG does not have to operate in island mode, it can be connected to other SMGs as well. However, it is assumed that the energy exchange takes place at the lowest level as possible, to overcome transmission loses.

The assets of an SMG can be divided in three categories: generation and storage assets, distribution assets and micro grid assets (Gui et al., 2017). Generation assets consist of decentralised units in which energy is produced. Often the generation units are directed at electricity generation, but other forms of energy, such as heat, could be part of an SMG as well (Li, Rezgui & Zhu, 2017).
Considering the increasing demand of electricity (CBS, 2018b), the focus in this research is on SMGs in which electricity is generated. According to some authors decentralised generation units do not necessarily make use of renewable sources (Hare et al., 2016). However, other scientists argue that an SMG consists of the integration of ‘renewable’ energy technologies (Bourazeri & Pitt, 2014; Grimley & Farrell, 2016; Goulden et al., 2014; Hong & Kim, 2016; Wang et al., 2018; Wolsink, 2012). Moreover, most scientists mention reduced carbon emissions as an important benefit of SMGs. Therefore, in this research it is assumed that an SMG makes use of renewable energy sources.

Each participant of an SMG can choose what to do with an overcapacity of renewable generated energy; a surplus can be stored for the future or it can be sold to interested energy buyers (Gui et al., 2017). Taking this into consideration, next to energy generation assets, energy storage assets are important in an SMG. Energy storage can be deployed in several ways. Individual businesses can have a storage asset on their own, for instance the TESLA Powerwall (Koirala et al., 2016). Besides, locally generated energy can be used to charge EVs and EVs can serve as a distributed battery within an SMG (Bourazeri & Pitt, 2014; Luthra et al., 2014; Wolsink 2012). Consequently, reloading EVs within the SMG can become a significant factor in the deployment of renewable energy sources (Wolsink, 2012).

Second, there are possibilities for community energy storage, such as the Tesla Megapack (TESLA, n.d.). Next to generation and storage assets, distribution assets are part of an SMG. The distribution assets consist of the physical components to transport energy. Currently the distribution assets are owned by the grid operators. The distribution assets are underground and ask for high investment costs. Therefore, they cannot easily be owned by the businesses themselves. This is in contrast with generation assets, which can easily be owned by the local businesses at the business park.

Next, an SMG consists of several micro grid assets, that is a combination of sensing, control and communication technologies (Hare et al., 2016). One of the aims of the micro grid assets is measuring, since measurements are the foundation of the connection between the technological appliances (Akerboom, Buist, Huygen, Ottow & Pront-van Bommel, 2011). Therefore, an essential technology in an SMG is the use of smart meters (Wolsink, 2012). Smart meters are intelligent monitoring systems and contribute to the regulation of energy on both the production and consumption side (Wolsink, 2012). The technology of smart meters is necessary to efficiently control the SMGs and to perform power trades within the SMG (Hong & Kim, 2016). Next to smart meters, an important micro grid asset of an SMG is demand-side management. The aim of demand-side management is to balance the supply and demand of energy to avoid environmentally and economically expensive supply investments (Gelazanskas & Gamage, 2014; Naus et al., 2014; Palensky & Dietrich, 2011). Within demand-side management several technologies can be used, for instance SDR (Good, Ellis & Mancarella, 2017; Goulden et al., 2014). The average energy consumption rate differs during the day and consists of several peak-moments. The electricity grid must be able to deliver enough electricity, even during these peak-hours with high demand (Gelazanskas & Gamage, 2014). SDR is a specific program to motivate energy consumers to change their pattern of electricity consumption, as a response to the low availability or high prices of electricity (Gelazanskas & Gamage, 2014). A methodology to use SDR consists of three steps: “(1) prediction of energy demand and generation, (2) planning of flexible
devices and converters and (3) real-time control of flexible devices and converters.” (Van Leeuwen, DE Wit & Smit, 2017, pp.946). SDR can be performed remotely by flexible appliances or by individual man-made actions (Koirala et al., 2016). Sintov and Schultz (2015) describe this as follows: “Voluntary curtailment, which involves appealing to consumers to temporarily curtail consumption by changing behaviour in real-time in response to alerts” and “Direct control, in which consumers permit utilities to remotely control home equipment” (Sintov & Schultz, 2015, pp.3). Hence, a distinction can be made between real behavioural change and automatic SDR. To stimulate people to use energy off-peak-hours, this must be rewarded. Therefore it is necessary that energy prices differ during the day (Lammers & Heldeweg, 2016; Rodríguez-Molina et al., 2014).

2.3 The advantages and challenges of an SMG

An SMG has several advantages compared to the traditional energy system. A few of the advantages found in literature are shown in table 1.

<table>
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<tr>
<th>Advantage</th>
<th>Literature reference</th>
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<td>Reduced carbon emissions.</td>
<td>(EC, 2011; Hong &amp; Kim, 2016; Sintov &amp; Schultz, 2015; Wolsink, 2012)</td>
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<tr>
<td>Reduced dependency on the public grid.</td>
<td>(Hare et al., 2016; Wolsink, 2012).</td>
</tr>
<tr>
<td>Reduced societal costs as a result of postponed or cancelled costs of the</td>
<td>(DEA, 2019; Edens &amp; Lavrijnssen, 2019; Gelazanskas &amp; Gamage, 2014; Hong &amp; Kim, 2016;</td>
</tr>
<tr>
<td>enforcement of the central grid.</td>
<td>Koirala et al., 2016)</td>
</tr>
<tr>
<td>Reduced dependency on fossil fuels from foreign countries.</td>
<td>(Bossart &amp; Bean, 2011)</td>
</tr>
<tr>
<td>Reduced transmission losses, because the generators are close to the</td>
<td>(EC, 2011; Hong &amp; Kim, 2016)</td>
</tr>
<tr>
<td>consumers.</td>
<td>(EC, 2011; Wang et al., 2016)</td>
</tr>
<tr>
<td>Improved energy security.</td>
<td>(Bourazeri &amp; Pitt, 2014; DEA, 2019; EC, 2011; Gelazanskas &amp; Gamage, 2014; Hare et al., 2016; Pitt et al., 2017; Tu Delft, 2011)</td>
</tr>
<tr>
<td>Increased flexibility of the energy system.</td>
<td>(Roelich &amp; Knoeri, 2015; Ton &amp; Smith, 2012; Wolsink, 2012)</td>
</tr>
<tr>
<td>Increased room for community involvement in the electricity supply and</td>
<td>(Grimley &amp; Farrell, 2016)</td>
</tr>
<tr>
<td>community resilience.</td>
<td>(Grimley &amp; Farrell, 2016)</td>
</tr>
</tbody>
</table>

Table 1 Advantages SMG (Author, 2019)

From this list of advantages of an SMG can be concluded that an SMG will lead both to financial benefits as to improved social and ecological values. The most mentioned advantage of an SMG in the literature is the increased flexibility of the energy system. This advantage requires some additional explanation. Research of the University of Delft (2011) shows that due to the increased decentralisation of the energy system and the two-sided transportation, there will be more instabilities in the electricity grid.
and maybe even big black-outs in the future if measures are not taken in time. The instabilities are the result of the mismatch between the supply and demand of energy, causing over-generation and under-generation. Especially when businesses located at a business park are supplied from the same low voltage network, when the distribution network is crowded, the power network might overload as a result of excessive demand. This could lead to undesirable service interruptions (TU Delft, 2011). SMGs could overcome this problem by balancing the demand and supply of electricity on local level. For instance, when there is a surplus of electricity the SMG assets could automatically charge EVs. This smart charging is recommended in the Climate Agreement (2019). The increased flexibility of the energy system is in the first place a technical advantage of an SMG. However, since the increased flexibility reduces the imbalances on the electricity grid, it reduces the need for grid enforcements as well. This will lower societal costs. Hence, the advantage of increased flexibility and reduced societal costs are related to each other. Reduced carbon emissions is the third most mentioned advantage of an SMG mentioned in the literature. Since in an SMG the energy is generated by renewable sources, an SMG will reduce the use of fossil fuels. Consequently, SMGs will enforce the transition towards a more sustainable energy system. Independency is in two ways an advantage of an SMG; an SMG reduces the dependency on the national grid and on foreign countries. Within an SMG the local businesses are responsible by themselves for the generation, use and balance of the electricity within their businesses park, which increases their independency. The advantages of increased independency are related to the increased room for community involvement in electricity supply and demand and community resilience. These advantages are concerned with social values.

It would not be realistic to state that an SMG only has advantages compared to the traditional system, since an SMG is concerned with challenges as well. These challenges can be divided in three categories: technical challenges, regulation challenges and behavioural challenges. Considering the former, it is argued by several scientists that an SMG does not face technical barriers (Gelazanskas & Gamage, 2014; Hare et al., 2016; Wolsink, 2012). However, an SMG consists of different elements, such as PV, EV, a communication system, inverters, control software etcetera and it might be a challenge to make all these components compatible (Yoldaş et al., 2017), especially when the technologies are derived from different vendors (Koirala et al., 2016; Rodríguez-Molina et al., 2014). Besides, there might be technical challenges concerned with the protection of an SMG (Yoldaş et al., 2017) and long-term electric storage (Koirala et al., 2016). Next, regulations for the implementation of an SMG are limited and prevent the proper use of it (DEA, 2015a; Yoldaş et al., 2017). Uncertainties might influence the investment choice, since it is for example unclear when delivery licenses are needed and when tax need to be paid over energy storage (DEA, 2015a). The regulatory barriers are described in more depth in chapter 7. Last, there are several challenges concerned with the participation of energy prosumers, since an SMG will only work when local prosumers play an active role (Noorman, 2018).
2.4 The role of local businesses in an SMG

The traditional energy system is a centralised techno-scientific domain, which is dominated by experts (Szulecki, 2018). In this traditional energy system energy is distributed to end-consumers, but the end-consumers cannot decide about the energy structure or its future (Szulecki, 2018). The energy generation and distribution are controlled by the grid operators and energy supply companies. In contrast, with SMGs the energy system becomes decentralised, which means that local consumers play an active role in the energy system (Miller et al., 2012; Wolsink, 2012; Yoldaş et al., 2017). They can decide about the energy generation and the organisation of the local energy community. Consequently, SMGs will enforce the shift from a top-down approach towards a decentralised bottom-up approach. This shift can be linked to the dilemma of spatial planning between control (top-down approach) and spontaneity (bottom-up approach); on the one hand there is an increased desire to guide spatial changes towards desired scenarios, while on the other hand the advantages and importance of self-organisation get more attention (Savini, Majoor & Salet, 2015). In Dutch policies regarding the energy transition the focus is more and more on self-organisation (Climate Agreement, 2019; Loorbach et al., 2008; Ministry of Economic Affairs, 2016), which fits with the development of SMGs. The question is how this self-organisation looks like for the development of SMGs in business parks?

An SMG is built upon the willingness of end-consumers to become co-producers, as they see a benefit in the co-operation of the consumption and production of electricity (Rodríguez-Molina et al., 2014; Wolsink, 2012; Yoldaş et al., 2017). For the shift from energy consumers towards energy prosumers, energy users must go through several stages (Rodríguez-Molina, et al., 2014). First, the energy consumer must be aware that he is willing to make a change. Second, an energy consumer must find out how to change. Third, an energy consumer must implement the wanted changes. Last, the end user must consolidate these changes. These stages of the shift towards energy prosumers are comparable to the stages of an adoption process as proposed by Rogers (2003), explained in chapter 3. In this research the energy consumers that must shift to energy prosumers are the businesses located at a business park. The shift of businesses as energy consumers towards businesses as energy prosumers means that they become active entities. As active entities they can fulfil the following roles (Rodríguez-Molina, et al., 2014):

- consume, produce and store electricity;
- take part in economic and technological optimization in electricity consumption (demand-side-management);
- get actively involved in the creation of value for electricity services.

With the latter role is meant that SMG prosumers organise the generation, use, storage and exchange of energy by themselves. This self-organisation means that the local energy prosumers have a shared responsibility of the local energy management. Besides, the self-organisation requires community capacity (Wolsink, 2012). The importance of self-organisation as an activity the local energy prosumers
must perform is mentioned by a broad range of scientists (Hare et al., 2016; Pitt et al., 2017; Skjølsvold & Ryghaug, 2015; Wolsink, 2012). They argue that an SMG means; this is how much energy is available, how are you going to distribute this? When this is the case, local prosumers should be willing to manage and organise the local energy generation and consumption and have the resources to do so. For SMGs in business parks this means that local businesses should next to their business as usual be actively involved in the local energy management system. However, based on a pilot in Enschede with SMGs (Lammers & Heldeweg, 2016) and the expert interviews conducted in this research, it can be concluded that the distribution of energy is in fact regulated by technology. Thus, it appears from practical examples that local businesses at a business park do not have to perform a daily active management in the organisation of the SMG. However, they are responsible for the generation and consumption of energy and they should be willing to let technology take over the energy exchange.

The following list provides an overview of concrete actions a business at a business park can perform in an SMG, based on the description of an SMG given in this section:

- Investing in the generation of renewable energy (most likely is PV).
- Investing in energy storage possibilities such as an EV.
- Investing in communication and information technologies, such as a smart meter.
- Giving permission to exchange energy with other businesses.
- Changing the energy consumption to another time of the day with the lowest price or the most available sustainable energy.

This list of actions shows that the role of local businesses in an SMG is mainly to invest. There are three types of assets in which local businesses can invest to participate in the SMG; generation assets, storage assets and communication and information assets. The last described activity in the list above indicates that businesses must be willing to change their energy consumption pattern. This asks for a behavioural change or technologies automatically changing the production process to off-peak hour. The listed activities are simplified, since within an SMG there can be an exchange of heat as well, which requires other investments and behavioural changes. To keep the SMG concept clear and structured, in this research the emphasis is on these actions.

### 2.5 An SMG as an ambiguous concept

Despite some overarching characteristics of an SMG, it can be concluded from analysing the literature that an SMG is an ambiguous concept. The terms ‘local energy management system’ (Mengelkamp et al., 2018), ‘decentralised generation units’ (Wolsink, 2012), ‘smart grids’ (Goulden et al., 2014), ‘micro grids’ (Ton & Smith, 2012), ‘community micro grids’ (Gui et al., 2017), ‘integrated community energy systems’ (Koirala et al., 2016) and ‘SMG’ (Aghajani, Shayanfar & Shayeghi, 2017) are found in literature with more or less the same definition. At the same time, there are differences between the described concepts. The ambiguity is partly caused by the variety of designs that can be applied to an SMG (Hare
et al., 2016; Wolsink, 2012). No standard way of deploying SMGs has yet been developed (Grimley & Farrell, 2016; Rodríguez-Molina et al., 2014). Most of the work on SMGs is pilot work and is based on ad hoc solutions (González et al., 2018). Moreover, an SMG can be seen as a manageably sized entity that grows organically and that can be designed in several ways, depending on natural resources such as the geographical conditions and on social conditions such as acceptability and accessibility (Hare et al., 2016; Wolsink, 2012). The very few pilot SMGs that have been implemented differ in the used techniques, control systems and financing (Hare et al., 2016). Moreover, no standard way of deploying SMGs has been developed, because each project has different objectives and stakeholders. Due to all the different ways in which an SMG can be developed, there is no simple answer to the question: “What is an SMG?” Therefore, an SMG is in this thesis viewed as a 'sensitizing concept', which means that the concept gives direction to the research (Vennix, 2011), but that the meaning of the concept can change if it turns out that the concept in reality has a different meaning according to the respondents involved in this research. Nevertheless, based on the overlapping characteristics and the definition of the EC (2011), the following definition of an SMG is used in this research:

“An SMG consists of the self-contained decentralised generation, use and exchange of renewable energy sources, which are managed locally with the use of smart technologies to ensure an economically efficient, sustainable power system with low energy losses.”

Figure 5 shows the different elements of an SMG: energy generation with PV, wind turbines and geothermal heat; energy storage with EVs, community batteries and hydrogen; electricity, heat and cold exchange. The figure represents a business park with a diversity of businesses consisting of large office buildings, large distribution centres and small buildings. All these entities take part in the SMG.

Figure 5 SMG at a business park (HVE, 2019)
Chapter 3. Theoretical foundation for analysing the willingness of businesses to adopt an SMG
In this chapter a theoretical framework based on scientific literature is proposed. This framework consists of theories regarding the willingness of businesses to adopt an SMG. As a result, this chapter contributes to answering the first part of the research question: \textit{Which factors explain the adoption of SMGs by businesses at a business park in the Netherlands from a behavioural-institutional perspective?} To get an understanding of the willingness of businesses to adopt an SMG, several theories can be used. Since an SMG is an interdisciplinary concept, it has been chosen to select theories from different disciplines. Innovation literature, cognitive-behavioural literature and economic literature are used as a theoretical foundation of factors that can influence the adoption of an SMG by businesses. Within these disciplines there is a wide array of theories that can be used to design a theoretical framework. A few well-known and established theories are selected in this research. Two well-known theories in innovation literature are the Strategic Niche Management Theory (Schot & Geels, 2008) and the Diffusion of Innovation Theory (Rogers, 2003). Both theories describe how social-technical innovations emerge. The main difference between these theories is that Strategic Niche Management puts more emphasis on how an innovation emerge in society, while the Diffusion of Innovation theory puts more emphasis on the adoption process by an individual. As the aim of this research is to understand the adoption of an innovation by businesses, the Diffusion of Innovation Theory (Rogers, 2003) is used to describe the adoption of an SMG from the perspective of innovation literature. This theory explains the motivations of an individual, in this case a business, to adopt an innovation. Moreover, this theory is chosen because it describes both the steps needed for innovation adoption as well as variables explaining the adoption. Since the innovation process of interactive innovations differs from the process of other innovations, the Diffusion of Innovation Theory is extended with an additional theory on interactive innovations.

Moreover, several behavioural theories can be used to understand the willingness of businesses to adopt an SMG. The rational choice theory (Hedstrom & Swedberg, 1996) explains the social and economic behaviour of humans. According to this theory, humans want to maximise their (economic) benefits. Maximising these benefits is considered as a ‘rationale choice’. Hence, this theory assumes that behaviour is influenced by the expected benefits of a certain action. According to the rational choice theory, emotions play a minor role in behavioural decisions. The theory of social comparison processes (Festinger, 1954) explains the behaviour of humans as well. According to this theory, humans compare their behaviour to the behaviour of other people. The tendency to compare oneself with a specific person decreases as the difference between his behaviour and one’s own increases (Festinger, 1954). This means that businesses at a business park will be more likely to perform certain behaviour if comparable businesses perform that behaviour too.

The TPB (Ajzen, 1991) combines the importance of expected benefits from the rationale-choice theory and the importance of the behaviour of other people from the theory of social comparison process. Besides, the TPB describes an additional factor explaining human behaviour. The TPB is a well-established theory and is used in a wide array of research on environmentally friendly behaviour (e.g.
Busch & McCormick, 2014; Liu et al., 2013; Martiskainen, 2007; Mulville et al., 2017; Yazdanpanah et al., 2015). Therefore, the TPB is used in this research to find factors influencing the willingness of businesses to adopt an SMG. A benefit of the TPB compared to other behavioural theories is that it explains how certain factors influence the intention to perform certain behaviour. Since an SMG does not exist yet, in this research the businesses are asked about their intention to adopt an SMG and not about their actual behaviour. Another reason why the TPB is selected in this research, is that the TPB covers the impact of individual preferences, the impact of other people and the ease to perform the behaviour. A large number of factors fits within one of these three categories and thus a wide arrange of factors is covered within this theory. However, other theories from behavioural science could have been used as well, for instance the Responsible Technology Acceptance Model (Toft et al., 2014). Nevertheless, this theory puts more emphasis on the technological aspect of an innovation compared to the TPB. Since the emphasis in this research is more on the organisational side of the innovation than on the new technologies, the TPB is selected.

Moreover, a theory from the economic approach is chosen to describe the willingness of businesses to adopt an SMG. Since businesses are the object of study, there is searched for a theoretical foundation that describes investment decisions in commercial companies. Most theories on business investment decisions can be categorised in describing internal and/or external conditions of a firm. In this thesis the investment theory of Wüstenhagen and Menichetti (2012) is selected, as it describes both factors. Besides, this theory is one of the few theories that is particularly directed to the investments of businesses in renewable energy.

Together, the Diffusion of Innovation Theory (section 3.2), the TPB (section 3.3) and the investment theory (section 3.4) provide an interdisciplinary perspective on the willingness of businesses to adopt an SMG. These theories all explain the agency of an actor. However, section 3.5 explains that the diffusion of an innovation does not only depend on the agency of potential adopters, but on the context in which the diffusion takes place as well. This is explained by an institutional approach.

The selected approach is part of new institutionalism, which focuses on how institutions affect behaviour. Within new institutionalism different sub approaches are formulated, such as historical-institutionalism, rational-choice-institutionalism, behavioural-institutionalism and sociological-institutionalism (Hall & Taylor, 1996; Trampusch, 2014). Historical-institutionalism has a political and historical understanding of how actors make decisions (Hall & Taylor, 1996). Rational choice-institutionalism assumes that actors maximise their interests by a specific and fixed ‘preference function’ (Trampusch, 2014). Rational-choice-institutionalism is related to behavioural-institutionalism, as both perceive the decision-making process from an economic perspective (Trampusch, 2014). However, behavioural-institutionalism assumes that rationalist calculations are limited by psychological effects, such as ‘framing effects’. Hence, behavioural-institutionalism acknowledge that preference shifts are possible. Sociological-institutionalism argues that normative and cognitive dimensions influence the behaviour of actors (Hall & Taylor, 1996). What differs behavioural-institutionalism from historical- and sociological-institutionalism is that it argues that behavioural preferences can shift by weighing the relative losses and gains of certain behaviour.
(Tampusch, 2014). Therefore, the focus in this thesis is on behavioural-institutionalism. Besides, this line of thinking fits with the TPB and the used investment model.

In this research no further attention is given to a description of the different approaches of new institutionalism. In contrast, a rather abstract description of the influence of institutions on the willingness of businesses to adopt an SMG is provided. This is done since the main goal is to explain that the behavioural choice of businesses is influenced by the context in which businesses operate. An extensive description of the different approaches is therefore not in the scope of this research. As it is assumed that each approach has some strengths and weaknesses (Hall & Taylor, 1996), in this thesis aspects of each approach are combined in one coherent story about the role of institutions in relation to the willingness of businesses to adopt an SMG (section 3.5). However, behavioural-institutionalism is the most dominant approach.

The factors that explain the willingness of business to adopt an SMG are summarised in section 3.6. A critical reflection on all the described theories can be read in section 11.1.

### 3.2 Diffusion of Innovation Theory

#### 3.2.1 The adoption process

The aim of this research is to explore which behavioural-institutional factors explain and enforce the diffusion process of SMGs in business parks. Second, this research aims to, based on the institutional-behavioural factors, explore how an SM for the development of an SMG can be co-created. The theory explained in this section, contributes to the first research aim. To gain knowledge about factors influencing the diffusion of SMGs, first the diffusion process itself needs to be understood. For an in-depth understanding of the diffusion process, the Diffusion of Innovation Theory of Rogers (2003) is used. The aim of Diffusion of Innovation research is to explain or predict rates and patterns of innovation adoption over time and/or space. The case-study performed in this research, focuses on the adoption potential of an innovation, within a geographically defined space. In general terms, Rogers (2003) studied why, how and by who some innovations are adopted and others don’t. With adopting an innovation Rogers (2003) refers to the willingness of adopters to *buy or use an innovation*. The sum of the individual adoption processes is the diffusion of an innovation. According to Rogers (2003) an innovation is an idea, practice or object that is perceived as new in the eyes of an individual. An SMG differs from the traditional energy system on various points and has not been deployed in the Netherlands before. Therefore, an SMG will be interpreted as an innovation by businesses at a business park in the Netherlands.

An important aspect of the Diffusion of Innovation Theory in relation to this research is the difference in the adoption process between individuals and organisations. It is argued that the adoption of an innovation by an organisation is more complex than that of individuals, since the former is not only the aggregate of its individuals, but an organisation is a system with procedures and norms as well (Greenhalgh, Robert, Macfarlane, Bate & Kyriakidou, 2004). An example of norms within an
organisation influencing the adoption is the innovativeness of the organisation (Frambach & Schillewaert, 2002): the more important innovations are within the company, the more likely it is that the company will adopt an SMG.

For organisations Rogers (2003) describes the innovation process as follows. First, there is an initiation phase, which consists of two stages: agenda setting and agenda matching. In these phases awareness is raised about the innovation, which creates an attitude regarding the possibility to adopt the innovation. Based on information gathered in the initiation phase, the decision is made to adopt or not (Rogers, 2003). This is a ‘go/no go moment’. After a ‘go’ the implementation phase takes place, which consists of redefining, clarifying and routinizing (Rogers, 2003). Based on these stages it is assumed that if businesses are asked if they are willing to adopt an SMG, they will decide if: it is important (agenda setting), if it fits with other plans of the company (agenda matching) and if they have resources to invest and change their behaviour (Hameed et al., 2012). The adopters of an innovation go through the before mentioned stages at different speeds. Some businesses will adopt an innovation in a shorter time period than others. Rogers (2003) categorises five groups of adopters: Innovators (2.5%), Early adopters (13.5%), Early majority (34%), Late majority (34%) and Laggards (16%) (Rogers, 2003). The innovators are the group who are most likely to take a risk, while the laggards are the most risk averse.

3.2.2 Variables determining the adoption

Whether the shift is made from one phase to another, depends on a number of factors (Rogers, 2003), which is presented in figure 6.

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**Figure 6 Framework Diffusion of Innovation (Rogers, 2003)**

First, the adoption of an innovation depends on how the attributes of an innovation are perceived by the organisation. These attributes are relative advantages, compatibility, complexity, trialability and observability (Rogers, 2003). The relative advantage is the extent to which an innovation has an advantage over existing alternatives. It is concerned with the ‘perceived’ advantage and not with the absolute advantage. It is stated by Bomberg and McEwen (2012) that a barrier to participate in a
Community energy initiative is the belief that the action will not make a difference, which can be seen as a lack of relative advantage. Compatibility is the degree to which an innovation is in line with existing standards, values, experiences and needs. According to the theory of Rogers (2003), if an innovation has common ground with things people are used to do, it is more likely that they will adopt the innovation. Complexity concerns the extent to which potential adopters think to know how to use the innovation. If businesses do not know how to use the techniques involved in an SMG, it is less likely that they adopt the innovation (2003). Trialability influences the decision to adopt because if the innovation can be tested, there is less uncertainty about the advantages of the innovation. This means that if one can experiment with an innovation, one can learn by doing which decreases the uncertainty. Last, the easier it is to observe an innovation, the more likely it is that the innovation will be adopted (Rogers, 2003).

A second factor influencing the rate of adoption is the innovation decision. Within a company the innovation decision can be made collectively by all participants or by an authority that makes the decision by itself (Rogers, 2003). In the latter case, the adoption rate is often faster (Rogers, 2003). Third, the used communication channels impact the adoption rate. An innovation can be communicated through for instance mass media or by face-to-face dialogue (Rogers, 2003). The more targeted the communication, the greater the chance that the innovation will be adopted. Communication channels are part of the building blocks of the co-creation of an SBM (Jonker, 2014). Next, change agents influence the decision to adopt. The change agents are the individuals or organisations that want others to adopt the innovation. Their effort, compatibility with clients’ needs and empathy influences the adoption rate of an innovation (Rogers, 2003).

Moreover, according to Rogers (2003) the decision to adopt an innovation depends on the structure of the social system in which the diffusion process takes place. With a ‘social system’, Rogers (2003) means “a set of interrelated units that are engaged.” (Rogers, 2003, pp.24). The members of a system can be individuals or formal and informal organisations. The members of the social system work together to solve a common problem, in order to reach a mutual goal. The common goal binds them together. In this research the social system is the business park, including all stakeholders which are involved in developing an SMG on the business park. The structure of the social system refers to “the patterned arrangements of the units in a system” (Rogers, 2003, pp.24). Hence, the structure could be interpreted as the way the stakeholders collaborate to achieve the common goal.

### 3.2.3 Critical mass

An innovation can be perceived as a success when it is adopted by the early majority, since if they adopt the innovation, this provides an example for the other groups (Rogers, 2003). When this tipping point or ‘critical mass’ is achieved, there is a minimum number of participants to draw in the participation of others (Marwell & Oliver, 1993). For interactive innovations, the critical mass is around the same number of participants, but it takes more time to achieve this tipping point (figure 7). An SMG is an interactive innovation since the participants are reacting on each other’s energy generation and consumption and are exchanging energy. With an interactive innovation, if the adoption rate is too low, part of the benefits will be lost (Marwell & Oliver, 1993). A great example to show this, is the
diffusion of the telephone in the 20th century: Why would you buy a telephone if your friends and family do not have a telephone and you have no one to call? (Marwell & Oliver, 1993). It is assumed that the importance of a critical mass for the diffusion process applies to an SMG as well. Two businesses can together create an SMG, however if more businesses participate, more benefits can be achieved, since there will be more possibilities to exchange energy and to reduce the demand curve during peak time (Miller et al., 2012). Since participators perceive more value as the participation pool grows, it will take longer before the critical mass is achieved (Mahler & Rogers, 1999). Understanding how the diffusion of an SMG as an interactive innovation proceeds, explains to some extent why SMGs are not adopted yet: there is a great first mover disadvantage. In this case-study will be explored whether the critical mass indeed influences the adoption decision.

Figure 7 Critical mass (Mahler & Rogers, 1999)

To conclude, the Diffusion of Innovation Theory can be used to explain which factors influence the adoption of innovations. Based on these factors, predictions can be made about the adoption potential of SMGs. However, it is important to mention that the application of the theory at organisational level has highly been criticised (Hameed et al., 2012). A limitation of the theory is that it provides an individualistic approach and does not explain the influence of organisational and environment factors (Hameed et al., 2012). Therefore, additional theories are used to explore the behavioural-institutional factors influencing the diffusion of SMGs in business parks.

3.3 Theory of Planned Behaviour

The TPB (Ajzen, 1991) (figure 8) is used in many studies regarding sustainable energy measures, for instance in studies about energy saving behaviour (Martiskainen, 2007; Mulville et al., 2017), in studies towards the acceptance of renewable energy (Busch & McCormick, 2014; Liu et al., 2013; Yazdanpanah et al., 2015) and in studies regarding the participation in demand-side management (Kowalska-Pyzalska et al., 2014; Sintov & Schultz, 2015). The TPB is useful to provide a framework to answer the research question: To what extent are businesses willing to adopt an SMG and which drivers and barriers do they perceive regarding the adoption of an SMG?
According to the TPB, behavioural change depends on behavioural intentions (Ajzen, 1991). This means that individuals consider the consequences before acting, as it is assumed that people choose to perform behaviour that lead to desirable outcomes (Fishbein & Ajzen, 1975). The TPB is built around the assumption that individuals make reasoned decisions, choosing the opportunity with the highest benefits (Steg & Vlek, 2009). In this thesis the concept ‘willingness’ is used instead of ‘intention’, but the same thing is meant. The behaviour that is researched in this study is ‘the adoption of an SMG’ which consists of: investing in renewables, storage and communication-information devices; exchanging energy and shifting energy consumption to another time of the day. According to the TPB, the willingness to perform certain behaviour depends on the attitude, subjective norm and perceived behavioural control (Ajzen, 1991). The attitude refers to leading beliefs about the outcomes of behaviour and the evaluation of these outcomes. The subjective norm is, simply formulated, the sum of the beliefs of what other people think (Fishbein & Ajzen, 1975). Thus, the subjective norm refers to the perceived societal pressure to perform or to not perform certain behaviour (Ajzen & Fishbein, 1975; Martiskainen, 2007; Yazdanpanah et al., 2015). A third factor influencing the behavioural intension is the perceived behavioural control (Ajzen, 1991). The perceived behavioural control refers to the perceived ease or difficulty of the individual to perform certain behaviour (Ajzen, 1991) and depends on the perception of self-effectiveness and control (Liu et al., 2013). Moreover, the perceived behaviour control refers to the time, financial resources and knowledge that are available, which reflects the degree of control regarding the behaviour (Ajzen, 1991). To summarize, it can be stated that the attitude refers to behavioural beliefs, the subjective norm to normative beliefs and perceived behavioural control to control beliefs (Ajzen, 1991). It is expected that a positive attitude, societal pressure and perceived behavioural control increase the willingness to perform behaviour and thus the actual performance. In other words, a positive attitude, societal pressure and perceived behavioural control are drivers to perform behaviour (Ajzen, 1991).

Considering the research aim, in this research the TPB is used to explain the adoption of an SMG by businesses at business parks. According to the theoretical assumptions of the TPB, it is assumed that the adoption of an SMG by a business depends on the attitude regarding the outcomes of the behaviour, the beliefs of what other people think about the behaviour and the extent to which the business has control over the behaviour. Previous research show that using these factors as dependent
variables, can be useful to explain the adoption of sustainable energy measures (e.g. Busch & McCormick, 2014; Chen, 2016; Kowalska-Pyzalska et al., 2014; Liu et al., 2013; Martiskainen, 2007; Paço & Lavrador, 2017). In most of these studies, the factors ‘attitude’, ‘subjective norm’ and ‘perceived behavioural control’ are divided in different subfactors, to make the concepts more concrete and to be able to give a more detailed description of what explains the researched behaviour. These subfactors of the three main categories can be described as drivers. Accordingly, it is assumed that a lack of drivers is a barrier to perform the behaviour (Ajzen, 1991). Considering this, each of the three main concepts (attitude, subjective norm and perceived behavioural control) can be divided in different drivers and barriers influencing the adoption of an innovation.

To research the attitude regarding the outcome of behaviour, there is researched which outcomes a business expect by adopting an SMG and how (positive or negative) these outcomes are perceived by the business. In other words, to measure the attitude of a business regarding the adoption of an SMG, insight is required in the advantages and disadvantages a business thinks an SMG will bring. The attitude can thus be divided in positive outcomes and negative outcomes and the weighting of these two determines the attitude (Ajzen, 1991). In former scientific research in which the TPB is used to explain the performance of sustainable energy behaviour, four examples of positive outcomes influencing the attitude are described: concern with the environment, economic advantages, image, enthusiasm for technology (table 2). These four examples can be perceived as drivers for the adoption of an SMG influencing the attitude. No examples of perceived negative outcomes (barriers) of sustainable energy behaviour are described in previous research using the TPB. In this thesis it is studied whether these four drivers are perceived by the businesses of the case-study as positive outcomes of the adoption. Furthermore, it is researched whether the businesses perceive other positive outcomes of adopting an SMG and if their attitude is influenced by expected negative outcomes.

The subjective norm can be divided in different drivers and barriers as well. In general, the subjective norm can be divided in three subfactors: pressure from the social network, pressure from the local network (neighbours) and pressure from the political context (table 2). It is assumed that if a business feels pressure from the social, local or political context, this is a driver for the adoption of an SMG. On the other hand, if a business does not perceive any pressure, this can be interpreted as a barrier for the adoption. Notably, the three forms of pressure are not exclusively, in the sense that someone from the social network can be part of the local network as well. However, with the local network is referred to explicitly the neighbours, in this case the other business at the business park, while the social network refers to friends and family, who could live far away as well. Concerning the political context, it is argued that the political context is important since actors will be more likely to perform certain behaviour if the actions contribute to policy goals (Busch & McCormick, 2014). However, the scientists arguing this have based their argument on the perceptions of civil servants, so it must be accessed to what extent the political context will affect the behaviour of businesses at a business park as well.

The perceived behavioural control is concerned with the ease or difficulty to perform certain behaviour (Ajzen, 1991). In addition, the perceived behavioural control is concerned with the extent a business
believes to have control over the behaviour. As argued by Ajzen (1991) drivers for the performance of behaviour in the category of perceived behavioural control are having enough time, financial resources and knowledge. In addition, based on research that elaborated the TPB in the context of sustainable energy measures, it can be concluded that the perceived behavioural control depends on six drivers: knowledge, time, financial resources, social capital, feeling responsible and the ease to perform the behaviour in general (table 2). For businesses the perceived behavioural control regarding energy behaviour will differ from domestic users, as businesses as tenants might feel detached from the spaces they occupy (Mulville et al., 2017). This fits in the category ‘feeling responsible’.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Description</th>
<th>Drivers</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>Beliefs about the outcome of the behaviour</td>
<td>Concern with the environment</td>
<td>(Busch &amp; McCormick, 2014; Chen, 2016; Liu et al., 2013; Martiskainen, 2007; Paço &amp; Lavrador, 2017)</td>
</tr>
<tr>
<td>Subjective norm</td>
<td>Beliefs about what other people think of the behaviour</td>
<td>Pressure from social network</td>
<td>(Busch &amp; McCormick, 2014; Chen, 2016; Kowalska-Pyzalska et al., 2014; Liu et al., 2013; Martiskainen, 2007)</td>
</tr>
<tr>
<td>Perceived behavioural control</td>
<td>Beliefs about the ease or difficulty to perform the behaviour</td>
<td>Knowledge, Time, Financial resources, Social capital, Feeling responsible, Easy to use/understand</td>
<td>(Busch &amp; McCormick, 2014; Chen, 2016; Ajzen, 1991; Martiskainen, 2007; Mulville et al., 2017; Paço &amp; Lavrador, 2017; Sarkis, 2017)</td>
</tr>
</tbody>
</table>

*Table 2 TPB applied on sustainable energy behaviour, divided in drivers based on previous research (Author, 2019)*

To conclude, the TPB originating form Ajzen (1991) is used in many studies to explain drivers and barriers for certain behaviour. Moreover, the TPB is applied in several studies regarding sustainable energy behaviour. By analysing these studies, the original framework of Ajzen (1991) is added with several, more concrete drivers. In this research it is assumed that this framework with drivers (table 2) contributes to the explanation of the willingness of businesses at a business park to adopt an SMG. However, table 2 is based on research regarding all different types of sustainable energy measures and not directed to SMGs. Besides, this framework does not specifically apply to businesses. Therefore, this framework is only used as a guideline and it will be further investigated to what extent these drivers actually influence the adoption of SMGs by businesses at business parks and which drivers and barriers are missing in this framework. As described before, the attitude, subjective norm and
perceived behavioural control are drivers for certain behaviour (Ajzen, 1991). Furthermore, the TPB suggests a relation between the three predictors (Ajzen, 1991). It is for instance argued the attitude is influenced by the subjective norm (Ajzen, 1991). In fact, most previous TPB research concerns the influence of the predictors on each other and does not explain the actual behaviour (Martiskainen, 2007). Nevertheless, in this research the TPB is not used to explore the relation between the attitude, subjective norm and perceived behavioural control, but to explore how these factors, translated in drivers and barriers, influence the diffusion of SMGs in business parks.

### 3.4 Decision to invest in an SMG

The TPB (Ajzen, 1991) provides a useful framework to find out which drivers and barriers explain the willingness of businesses to adopt an SMG. However, the TPB provides a very general approach on behavioural change and is not directed to the investment decision of businesses. Since adopting an SMG consists for a large part of the decision to invest, the TPB is complemented with the theoretical framework provided by Wüstenhagen and Menichetti (2012), which explains the decision to investment in renewable energy. According to these scientists, an investment in renewable energy is a strategic decision. A strategic decision is a new, one-off, complex decision which requires resource commitment, and which is not easily reversible (Wüstenhagen & Menichetti, 2012). Considering these elements, adopting an SMG can be seen as a strategic decision. When a business dissolves its energy contract and invests in SMG assets, this is not easily reversible.

The decision to invest in an SMG is in general terms a function of risk, return and policy (figure 9) (Wüstenhagen & Menichetti, 2012). The factors ‘risk’ and ‘return’ are often used in financial theory to understand investments choices (Wüstenhagen & Menichetti, 2012). A business rationally weighs the level of risk and return of possible investment opportunities and chooses the investment with the best return regarding a given level of risk (Wüstenhagen & Menichetti, 2012). How the ‘return’ is perceived depends for instance on the investment money, payback time and the interest of the investment. The risk depends on the probability (of not getting the invested money back) and the consequences of this. In weighing the risks and returns environmental externalities are often not included. The environmental externalities refer to uncompensated environmental effects of production and consumption that affect costs outside the market mechanism (Organisation of Economic Cooperation and Development, 2003). As a consequence of the environmental externalities, the actual financial paid costs of fossil fuel energy are lower than the ‘social’ costs. Policy might correct those externalities, since policy can cause an increasing return (e.g. through feed-in tariffs) or a decreasing risk (e.g. through loan guarantees) for environmentally friendly alternatives (figure 9). Based on these theoretical assumptions, the decision to invest in an SMG consists of weighing the risk and return, which are influenced by energy policy.
Nevertheless, Wüstenhagen and Menichetti (2012) argue that this model is too simple and therefore they designed an elaborated model. Besides ‘risk’, ‘return’ and ‘policy’ an import aspect of the investment decision is ‘bounded reality’, meaning that the perception of risk and return are influenced by cognitive factors (Wüstenhagen & Menichetti, 2012). As a result of a lack of information, businesses will not be able to judge the actual risk and return. To overcome cognitive barriers, policy makers could invest in education and training for financial decision-makers (Wüstenhagen & Menichetti, 2012).

Another point mentioned by Wüstenhagen and Menichetti (2012) is path dependency in the sense of prior investments. Past investments in fossil fuels influence the risk-return perception of investors. However, this will mainly be the case for e.g. oil companies or energy corporations who invested in coal plants (mean focus of Wüstenhagen and Menichetti), since their prior choices cause a lock-in. Translated to the businesses located at a business park, a recently purchased central heating boiler can for instance cause a lock-in. Therefore, it is assumed that the investment decision of an SMG depends on prior investments in other energy sources.

Furthermore, according to Wüstenhagen and Menichetti (2012) the type of investor, for instance energy companies, electric utilities, insurance companies, homeowners and businesses affect the investment decision. In this research the focus is on investments only made by one type of investor; businesses located at a business park. Therefore, in this research the ‘type of investor’ is replaced with ‘organisational characteristics’. It is argued by several scientists that organisational characteristics are important for the innovation adoption process (Frambach & Schillewaert, 2002; Greenhalgh et al., 2004; Hameed et al., 2012). Top management support, organisation size and expertise are often mentioned as influencing factors (Hameed et al., 2012). However, some of these characteristics are ambiguous as for instance on the one hand large companies are more likely to invest since they in general have more financial resources, while on the other hand it is argued that small business are more likely to invest in innovations since they are more flexible (Frambach & Schillewaert, 2002).

Portfolio aspects are brought up by Wüstenhagen and Menichetti (2012) as a last factor explaining the investment decision. In this research this is of less importance, since Wüstenhagen and Menichetti (2012) argue that this is important for businesses who are working in the energy sector. Thus, this factor is not relevant for the average business located at a business park. Based on the theoretical assumptions of Wüstenhagen and Menichetti (2012), a framework is developed that explains the investment decision of an SMG (figure 10).

Figure 9 Simple investment model renewable energy (Wüstenhagen & Menichetti, 2012)

![Simple investment model renewable energy](image)
Figure 10 shows that the investment decision depends on the trade-off between risk and returns, which is influenced by cognitive barriers. Hence, the investment decision depends on the *perceived* trade-off. To summarise, in this section the trade-off between risk and return is described as a factor explaining the adoption of an SMG by businesses at business parks. It has become clear that the trade-off is affected by several other factors, in which in particular energy policy, prior investments and organisational characteristics are important.

### 3.5 An institutional approach

#### 3.5.1 Structure versus agency

The Diffusion of Innovation Theory (Rogers, 2003), the TPB (Ajzen, 1991) and the proposed investment model (Wüstenhagen & Menichetti, 2012) contribute to the explanation of the willingness of businesses to adopt an SMG. The Diffusion of Innovation Theory and investment theory refer in a certain extent to structures influencing the adoption (structures within the social system and structures within the policy system). In this section, the importance of these structures, the institutional context, is elaborated. Consequently, this section provides a framework to answer the research question: *What are the current ongoing institutional change processes in which the diffusion of SMGs takes place?*

It is argued by Giddens (1984) that actions are influenced by purposeful choices and by structures. The purposeful choices which are described by Giddens (1984) as ‘agency’ take place at micro-level. This agency consists of human actions such as: decisions, behaviour and routines. Next to this agency, structures (macro-level) influence the actions of an individual, as the state and institutional organisations regulate the individual. These structures can be interpreted as the underlying rules. The two concepts of agency and structures are intertwined; social life is more than arbitrary actions of individuals, but it is not entirely determined by social structures. This relation between agency and
structure is described as the ‘duality of structure’ (Giddens, 1984). The relation between agency and structure is shown in figure 11. To summarise, ‘agency’ consists of human action and ‘structure’ consists of the underlying prescribed rules and the interpretation of this by individuals (Giddens, 1984). Following the Structuration Theory of Giddens (1984), the agency of individuals cannot be understood without insight in the structures and the other way around. Therefore, to gain knowledge about the factors explaining the adoption of an SMG by businesses, insight on the structures, the ‘institutional context’ in which individuals act, is required. The investment theory of Wüstenhagen and Menichetti (2012) provides an example of the relationship between agency and structure. The perceived trade-off between risk and return depends on the agency of an individual, but is at the same time influenced by policy, which is something structuring the decision of the investor.

![Diagram showing the duality of structure (Giddens, 1984)](image)

**Figure 11 Duality of structure (Giddens, 1984)**

### 3.5.2 Definition and importance of institutions

Institutions are part of the structures in which the adoption process of an SMG takes place. The importance of institutions to accelerate the energy transition is mentioned by a broad range of scientists (Andrews-Speeds, 2016; Burke & Stephens, 2018; Kuzemko, Lockwood, Mitchell & Hoggett, 2016; Martiskainen, 2007; Oteman et al., 2017; Oteman et al., 2014; Wolsink, 2012). Institutions can be described as “*formal or informal procedures, routines, norms and conventions embedded in the organisational structure of the polity or political economy*” (Hall & Taylor, 1996, pp.938). Moreover, institutions are humanly created constraints that shape human interaction (North, 1990), since they are rules of the game based on existing patterns of behaviour (Wolsink, 2012). This shows that the definition of ‘institutions’ is comparable to ‘structure’, as both are defined as the underlying rules influencing behaviour. According to Alexander (2005) “*All planning, then, takes place within a specific institutional context, or often in sets of different and varying ‘nested’ institutional contexts as indeed do all societal activities.*” (pp.210). This means that the adoption of an SMG takes place within different institutional contexts. According to Ostrom (2007), the institutional context can be divided in several segments: social, economic and political settings. This includes for instance economic development, government policies, markets and technological developments (Ostrom 2007; McGinnis & Ostrom, 2014). These segments are used as a guidance to describe the institutional context in which the adoption of SMGs takes place.

The role of institutions is related to what Van der Heijden (2015) calls ‘getting the governance right’. He argues that this is the missing piece in sustainability puzzles. Technical fixes are a partial solution,
but they lack in scale and speed to achieve a sustainable transition. Moreover, agency is necessary but not sufficient to address sustainability issues (Van der Heijden, 2015). Institutions in the sense of new rules of the game are necessary, since market barriers often stand in the way to capitalise the economic benefits that sustainable options, such as SMGs, might bring (Van der Heijden, 2015). An example of a market barrier are first-mover disadvantages, which are related to financial, legislative and cultural risks. Other examples of market barriers are the vicious circle of blame (why should I do it and not others?) and split incentives between real-estate owners and tenants (Van der Heijden, 2015). Based on this line of argumentation, the technical solution of an SMG and the potential willingness to adopt an innovation by businesses will not be enough the achieve a fast and large-scale implementation. It is argued that institutions need to change, since in the current situation the decision of businesses to adopt an SMG is determined by the old rules of the game focussed on the traditional unidirectional fossil fuel energy system (Andrews-Speeds, 2016; Martiskainen, 2007; Wolsink, 2012).

Edquist (1997) describes the change of institutions as follows: an innovation system consists of all important economic, social, political, organisational and institutional factors influencing the development, diffusion and use of the innovation. These factors are constantly interacting with the innovation. Consequently, the development of an SMG can be viewed as an interactive process: “a certain degree of institutionalization enables further development of the movement, which then increases their potential to instigate change and reduce the institutional obstacles that hinder their development” (Oteman et al., 2017). This means that the diffusion of an SMG depends on institutions, but that on the other hand the institutions are influenced by the SMG itself. Institutionalization can for instance occurs when local experiments lead to changes in the energy policy system (Oteman et al., 2017). In this research it will be studied how the institutional context, in which the adoption of SMG takes place, currently looks and which changes are necessary to enforce the adoption.

The institutions of the energy system are created and maintained by all people who participate in the system, including government parties, market players and civil society groups (Oteman et al., 2014). All these people contribute to the institutional design and together there is a set of interrelated perceived incentives and constraints influencing the adoption of SMGs by businesses. Thus, it can be concluded that the adoption of an SMG by businesses at a business park depends on the institutional context in which the adoption process takes place.

### 3.6 Summary theories explaining the willingness to adopt an SMG

The Diffusion of Innovation Theory (Rogers, 2003), the TPB (Ajzen, 1991) and the investment model of Wüstenhagen and Menichetti (2012) describe multiple drivers and barriers for the adoption of an SMG by businesses at a business park. Besides, the duality of structure (Giddens, 1984) explains that the actions of humans are determined by both agency and structures. Hence, it is assumed that institutions can be drivers or barriers for the adoption of an SMG by
businesses. Bundling the different factors together, a framework can be developed that explains the willingness of business to adopt an SMG. This framework is shown in figure 12.

The innovation attributes are derived from the Diffusion of Innovation Theory (Rogers) and it is assumed that these attributes affect the willingness of businesses to adopt an SMG. Besides, according to the Diffusion of Innovation theory the ‘type of innovation decision’ affects the willingness of businesses to adopt an SMG. In this research the ‘type of investment decision’ is seen as part of the perceived behavioural control, since both are concerned with the level of control regarding certain behaviour. Therefore, ‘type of innovation decision’ is not described as a separate factor in figure 12. The communication channels, the effort of change agents and the nature of the social system are other factors influencing the adoption according to Rogers (2003). However, these factors are interpreted as part of the building blocks of an SBM and are therefore not included in figure 12. The importance of these factors is not ignored, but is briefly described in section 4.2. Next to the innovation attributes it is assumed that the critical mass explains the willingness of businesses to adopt an SMG (Marwell & Oliver, 1993; Mahler & Rogers, 1999).

The attitude, subjective norm and perceived behavioural control are derived from the TPB (Ajzen, 1991). Each of these factors is a driver for businesses to adopt an SMG. Another factor explaining the willingness of businesses to adopt an SMG is the trade-off between risk and return. With the trade-off between risk and return the willingness of businesses to adopt an SMG is perceived from an economic perspective. The trade-off between risk and return is influenced by prior investments (Wüstenhagen & Menichetti, 2012), organisational characteristics (Frambach & Schillewaert, 2002; Greenhalgh et al., 2004; Hameed et al., 2012) and energy policy (Wüstenhagen & Menichetti, 2012). The organisational characteristics are described as a separate factor explaining the willingness of businesses to adopt an
SMG, since multiple scientists using different theoretical assumptions mention the importance of this factor (Frambach & Schillewaert, 2002; Greenhalgh et al., 2004; Hameed et al., 2012). The factor ‘prior investments’ is not described as a separate factor in figure 12. This is the case since prior investments are important when the decision maker is an energy investment party. An indisputable difference between the research of Wüstenhagen and Menichetti (2012) and this research, is that in their research the core business of the decision maker is to earn money from energy investments. In that case prior investments determine the willingness of businesses to invest in sustainable energy generation units. In this research, the core business of the businesses is not to invest in energy generation systems. Hence, prior investments will in this research play a smaller role than in the proposed theoretical model. Therefore, prior investments are seen as part of the trade-off between the perceived risk and return (see section 8.4.6). Energy policy is the third factor influencing the trade-off between the perceived risk and return (Wüstenhagen & Menichetti, 2012). Certain aspects of energy policy can be a driver or barrier for businesses to adopt an SMG. Energy policy is included in the conceptual model as part of the context under which businesses make decisions (figure 12). Energy policy is included in the concept ‘social, economic and political settings’. To summarise; from an agency perspective it is assumed that the willingness of businesses at a business park to adopt an SMG can be explained by seven factors: innovation attributes, critical mass, attitude, subjective norm, perceived behavioural control, trade-off between risk and return and organisational characteristics. All these factors are influenced by the social, economic and political settings under which businesses make decisions. This is shown in figure 12 by the square that represents the institutional context.
Chapter 4. Theoretical foundation for designing an SBM through a process of co-creation between public and private actors
4.1 Introduction to chapter

This chapter provides a theoretical foundation for the design of an SBM through the process of co-creation between public and private actors. Hence, this chapter provides a theoretical framework for answering the second part of the research question: How can public and private actors co-create an SBM for the development of an SMG?

If businesses are willing to adopt an SMG, they can collaborate in the organisation of this innovation. An SBM is used as a support tool for analysing the necessary ingredients to organise an SMG in a business park. The Cloverleaf Model (Jonker, 2014) is selected as a theoretical foundation, since this is one of the very few theories that explains the organisation of something new from a community perspective, in which values are shared. Besides, it provides a framework to explain the organisation of an SMG from a circular instead of linear perspective. Hence, the provided SBM model is fundamentally different, compared to conventional business models. A more in-depth explanation of why the SBM is chosen as a model to structure the organisation of an SMG is described in section 4.2.

Different approaches can be used to explain the design of a collaborative arrangement for an SMG in business parks. Examples of these approaches are theories on public-private partnerships (e.g. Bovaird, 2004), collaborative governance (e.g. Ansell & Gash, 2008), participatory planning (e.g. Forestor, 1999) and co-creation (e.g. Kemp & Scholl, 2016; Lund, 2018). All theoretical approaches are concerned with the inclusion of multiple stakeholders in the decision-making process, for instance spatial planning projects. In this thesis ‘co-creation’ is selected as the main concept to design a collaborative arrangement. The concept ‘co-creation’ is selected as it refers not only to working together to achieve something, but it refers to creating something new as well (Schrage, 1990). This fits with the organisation of an innovation, such as an SMG. The selection of the concept of co-creation is further explained in section 4.3.1. To conclude, the theory on SBMs explains which ingredients are needed to organise an SMG in business parks. The theory on co-creation explains how these ingredients can be organised by a collaboration between public and private parties.

4.2 An SBM

The Diffusion of Innovation Theory (Rogers, 2003), the TPB (Ajzen, 1991), the investment model (Wüstenhagen & Menichetti, 2012) and the institutional context (e.g Giddens, 1984; Ostrom, 2007) provide a framework to gain insight in which factors explain the adoption of an SMG by businesses at a business park. When knowledge is gained about these factors, an SBM can be co-created to capture the value realisation. This section explains which theoretical assumptions are underlying the co-creation of an SBM. Hence, this section provides a framework to answer the research question: How do the building blocks of an SBM work for the organisation of an SMG?
First, the differences between a conventional and an SBM are described to highlight the important characteristics of an SBM. Afterwards, the building blocks of an SBM are explained.

### 4.2.1 Sustainable versus conventional business models

There are many theories explaining the building blocks of a conventional business model (Jonker, 2014). However, there are multiple reasons why a conventional business model is not suitable to explain the organisation of an SMG in a business park and why an SBM seems more suitable. Table 3 shows the differences between a conventional business model and an SBM. A few of these differences are explained in this section.

<table>
<thead>
<tr>
<th>Conventional business models</th>
<th>Sustainable business models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value creation: economic</td>
<td>Value creation: economic, ecological and social</td>
</tr>
<tr>
<td>Value relation for: one organisation</td>
<td>Value realisation for: multiple stakeholders</td>
</tr>
<tr>
<td>Organisation design: organisation-centric (no need for co-creation)</td>
<td>Organisation design: community-centric (need for co-creation)</td>
</tr>
<tr>
<td>Collaboration: linear realisation of value proposition in (functional) value chain</td>
<td>Collaboration: within a network of people and institutions, who together have the capacity to organise a proposition</td>
</tr>
<tr>
<td>Economy: linear realisation of the value proposition, distribution and use</td>
<td>Economy: circular realisation of values, both materialistic as social</td>
</tr>
<tr>
<td>Ownership: financial shared ownership is central</td>
<td>Ownership: access is more important than ownership</td>
</tr>
<tr>
<td>Transaction: producer and consumer are separated and transactions are based on money</td>
<td>Transaction: producer and consumer can be the same person, transactions can be based on money, time, credits etc.</td>
</tr>
</tbody>
</table>

Table 3 Conventional versus New Business Models (Jonker, 2014, adapted by Author)

First, a conventional business model shows “the logic of how a company intends to make money” (Osterwalder & Pigneur, 2010, pp. 15). A conventional business model emphasises the generation of financial values, narrowing down value creation to profit and money (Jonker, 2014). Nevertheless, as a reaction to the growing interest of sustainability, multiple scientists have developed business models aimed to describe the organisation of sustainable ideas (Bocken et al., 2014). A business model aimed at sustainability can be described as a model that “aligns interests of all stakeholder groups, and explicitly considers the environment and society as key stakeholders” (Bocken et al., 2014, p.44). Jonker (2014) elaborates the importance of sustainable business models, arguing that ‘New Business Models’ should be designed that describe economic, ecological and social values. He states that the future should be more focused on multiple value creation. In this thesis the term ‘SBM’ is used, but the same is meant as Jonker’s ‘New Business Model’ (2014). An SMG concerns economic values (e.g. lower energy bill), ecological values (e.g. CO₂ emission reduction) and social values (e.g. community involvement) and therefore the organisation of an SMG rather asks for an SBM than a conventional business model.
Second, a conventional business model describes the steps of value realisation for one organisation (Jonker, 2014). This means that the organisation design of a conventional business model is often organisation-centric. An SMG provides added value to multiple public and private parties and will be developed by these public and private parties together (Gui et al., 2017; Wolsink, 2012). It is not possible to define one organisation that gains added value by adopting an SMG in a business park. Therefore, in an SMG the organisation design will be community-centric instead of organisation-centric. The organisation design is strongly connected to the kind of collaboration. In a conventional business model the collaboration consists of the linear realisation of the value proposition in a functional value chain (Jonker, 2014). In an SMG, just like in other business models aiming at multiple values, the collaboration consists of a network of people and institutions, who together have the capacity to organise a proposition (Jonker, 2015; Oteman et al., 2014). In other words, the SBM for an SMG requires ‘co-creation’ between different companies and other public and private parties to realise the value cycle (Gui et al., 2017; Wolsink, 2012). The co-creation within a network with multiple people and institutions is a fundamental difference between conventional business models and SBMs, related to the adoption of an SMG. The co-creation of different stakeholders to realise the value cycle is common for business models aimed at improving sustainability (Beattie & Smith, 2013; Bocken et al., 2014). The process of co-creation will be further explained in the next section.

Another reason why a conventional business model is not suitable to describe the building blocks of an SMG, is that conventional business models are based on the principle of the linear realisation of value proposition, distribution and use (Jonker, 2014). It is assumed that the organisation of multiple values, which is the case with an SMG, consists of the circular realisation of values. This means that the values are created in an ongoing process. Consequently, the plan of action between a conventional business model and an SBM will differ in their structure. Furthermore, a difference between a conventional business model and an SBM is that a conventional business model is built around ‘ownership’ and an SBM around ‘access’. An SBM will be more suitable for an SMG, as considering the assets and aims of an SMG (chapter 2) access is more important than ownership. An SMG is concerned with the access to an affordable, sustainable and reliable energy supply (EC, 2011). Moreover, an SBM is useful to explain the organisation of an SMG, since it is based on the idea that a producer and consumer can be the same person (Jonker, 2014), which is the case in an SMG (Hare et al., 2016; Pitt et al., 2017; Skjølsvold & Ryghaug, 2015; Wolsink, 2012). Last, in an SBM the transaction can consists of other things than money, for instance time or credits. In an SMG the transaction consists of energy. The described differences between a conventional business model and an SBM explain why an SBM would provide a useful framework for the organisation of an SMG in a business park. An SMG fits with all the seven characteristics of an SBM.
4.2.2 The building blocks of an SBM

The previous section described why an SBM is useful for the organisation of an SMG in a business park. In this section the building blocks of an SBM are explained. According to Jonker (2015) an SBM consists of:

1. Establishing a collective value proposition.
2. Determining and considering the context factors in which your business model operates.
3. Defining how the building blocks work for your organisation.

These three steps are walked through in this research. Based on the problems of the current energy system (chapter 1) and the preferences of businesses at a business park, the collective value proposition of an SMG can be established. The importance of the institutional context is explained in section 3.5 e.g. with the Structuration Theory (Giddens, 1984) and the process of institutionalization (Oteman et al., 2017). In this paragraph the focus is on step 3. The building blocks of an SBM are presented by Jonker (2014) in the Cloverleaf model (figure 13).

![Cloverleaf Model (Jonker, 2014)](image)

The Cloverleaf model consists of four elements aimed at realising the value proposition. The value proposition describes what is offered to the community. It describes the added value for the different stakeholders and indicates the importance of the co-creation of the SBM. The four elements that are part of the cloverleaf are: principles, value creation, community and design. It does not matter with which of the four leaves one starts with, the most important thing for the development is that all parts of the Cloverleaf Model are considered (Jonker, 2014).
The leaf at the upper side, principles, is concerned with three things (Jonker, 2014). The first principle is ‘multiple’, meaning that the value proposition should emphasis economic, social and ecological values. The second principle is ‘collectively’, meaning that multiple stakeholders should co-create the SBM and should together perform actions to realise the value proposition. The last principle is ‘Win-win’: the results should be collective shared among the community members.

By sharing the benefits and collectively taking actions, a community is formed (Jonker, 2014). Regarding the community, two things should be considered. First, consciously there should be decided ‘who’ takes part in the community and ‘why’. Businesses, citizens and governmental parties can all take part in the community structure of an SBM. Second, the relation between the stakeholders should be considered. There are different relation and communication possibilities. Some community members might be stronger connected than others. Among the people who play a role in the community, a distinction can be made between conditional partners, supporting partners and additional partners (Jonker, 2014). The initiators and active participants bear the initiative and therefore their contribution is conditionally. Next, there are participants who are enforcing the SBM, these are for example administrative employees who support the project. Last, some community members play a very little role, for instance following the project without being active. Thus, within the community the members will play different roles, one being more important than the other. Which roles must be performed in the development of SMGs can be derived from literature and are the following: energy consumer and producer (Rodríguez-Molina et al., 2014); grid manager (Pitt et al., 2017); grid partners (Pitt et al., 2017); investors (Wolsink, 2012) and grid owners (Wolsink, 2012). What these roles exactly entail, is not described by the scientists and need to be discovered in this research.

As already mentioned explaining the principles, the SBM should provide economic, social and ecological values (Jonker, 2014). The fourth leaf of the Cloverleaf model consists of the design structure (Jonker, 2014). The design structure consists of four main elements:

- Activities
- Design team
- Tools
- Organisation

The activities that should be performed need to be clearly formulated. The activities regarding the organisation of an SMG consists for instance of investing in renewables and communication towards the community. Moreover, it should be clear who should perform which activities. Second, the design structure consists of a team, which consists of choosing people with the right tools. The ‘tools’ involve skills, resources and knowledge. This design team can be seen as the ‘change agents’ described by Rogers (2003). They are the ones who want to introduce a new idea and who want others to participate in or adopt the idea. Next to activities, a team and tools, the design structure of an SBM consists of the ‘organisation’. The function of an organisation should be first developed, before it can be recorded in an appropriate legal form (Jonker, 2014). The functional organisation can be described as a plan of action and is a fundamental part of the SBM. After having a clear view of the function of the
organisation, the legal form of the organisation can be considered. There is no clarity about the appropriate legal form of an SMG, but several articles are written about the legal form of local energy communities in general and based on these articles it can be concluded that the most common ownership arrangement is a co-operative (Koirala et al., 2016). This is an organisation that is owned and governed by the members who collectively share the benefits. In the rest of this study, there is no focus on other legal forms for SMGs in business parks.

It can be concluded that an SBM consists of principles, values, people taking part in the community, performing activities in the community and bringing in tools in the community, which will eventually lead to the realisation of the value proposition.

## 4.3 The co-creation process

### 4.3.1 The importance of co-creation

In this chapter the concept of co-creation and success factors for the co-creation process are described. It is argued by Jonker (2014) that an SBM must be co-created. Jonker (2014) describes co-creation as an active, creative and social process in which value is created by a collaboration between initiators, consumers, end users and other stakeholders. The co-creation between the different stakeholders on the design and implementation of the SBM can be interpreted as a precondition of a successful SBM. Next to the theory about SBMs (Jonker, 2014), other theories use the concept of co-creation as well. The term ‘co-creation’ is for instance used in the marketing sector, social innovation sector, public (health) sector and urban planning sector (Voorberg et al., 2015). Schrage (1990) was one of the first scientists that emphasised the value of shared creation: “Collaboration is the process of shared creation: two or more individuals with complementary skills interacting to create a shared understanding that none had previously possessed or could have come to on their own.” (Schrage, 1990, pp.140).

In this research the focus is on the use of co-creation in urban planning studies (e.g. Barrutia & Echebarria, 2012; Bisschop & Beunen, 2019; Kemp & Scholl, 2016; Lund, 2018; Mačiulien & Mačiulis, 2017; Nevens et al., 2013; Oksman, et al., 2014) and the SBM study (Jonker, 2014). In very general terms, in urban planning co-creation is concerned with the involvement of citizens in the planning process (Barrutia & Echebarria, 2012). In urban planning co-creation is for example used in research about sustainable cities, because making cities sustainable is a difficult task which asks for the active participation of different actors (Barrutia & Echebarria, 2012; Nevens et al., 2013; Oksman et al., 2014). Due to the complexity of sustainability issues, businesses, citizens and NGO’s are to an increasing extent expected to co-create new solutions (Arnouts, Arts, Kamphorst & Tatenhove, 2012). Moreover, it is argued that co-creation is an important theme in future smart cities (Oksman et al., 2014).
Co-creation in urban planning partly builds on the development of communicative planning (Lund, 2018). Besides, co-creation has some interfaces with participatory and collaborative planning (Kemp & Scholl, 2016; Nevens et al., 2013; Oksman et al., 2014). The common ground between these concepts is that citizens are treated as active, creative, decision making equals, rather than as passive recipients of top-down design (Innes & Booher, 2010; Mačiulien & Mačulis, 2017). Considering this, these approaches to urban planning, including co-creation, fit within the shift from government to governance, in which businesses, citizens and NGO’s are to an increasing extent involved in the decision-making process (Rhodes, 2012; Van der Heijden, 2015; Voorberg et al., 2015). As a consequence of the decentralisation of the energy system, the energy policies will be implemented by a collaboration between local public and private parties (Ministry of Economic Affairs, 2016). The importance of collaboration is argued by Andrews-Speed and Hezri (2013) as well, stating that: “All energy markets require to be governed and this governance is provided by a range of public and private actors and by institutions (e.g., treaties, laws, regulations and contracts).” (pp.149).

Key elements in these approaches to urban planning are collaboration, interaction, communication and dialogue (Innes & Booher, 2010). Co-creation is in line with this communicative, collaborative and participatory planning, but analysing theories showed that with co-creation the focus is more on innovations and actively creating something, which is less apparent in theories about collaborative, participatory, and communicative planning (Kemp & Scholl, 2016). Lund (2018) describes co-creation in urban planning as: “Innovation and value creation taking place as a collaborative process involving different types of actors.” (pp.8). Moreover, co-creation is defined as “doing something novel through a co-development partnership” (Kemp & Scholl, 2016, pp.91), working together on “new innovative ideas” (Barrutia & Echebaria, 2012) and creating “something that wasn’t there before” (Schrage, 1990).

These examples show that co-creation is concerned with doing something new. Furthermore, a key element in co-creation is collectively taking action to reach a common goal (Barrutia & Echebaria, 2012). Hence, co-creation will lead to the development of innovative ideas and the collective performance of actions to implement these ideas. Translated to the design of an SBM this means that to design an SBM firms co-create with other firms and external parties, within informal arrangements or formal alliances to realise the value proposition (Beattie & Smith, 2013). There can be differences between the parties who are co-creating, but they should all desire to work collectively to realise added value (Jonker, 2014). Practices of co-creation can have several objectives such as: gaining more effectiveness, gaining more efficiency, gaining user satisfaction, increasing citizen involvement and long-term loyalty (Jonker, 2014; Oksman et al., 2014; Voorberg et al., 2015).
4.3.2 The success factors of co-creation

A precondition of co-creation is an understanding of the motivating factors to participate in the co-creation process (Barrutia & Echebaria, 2012). The motivating factors affect the effort of the stakeholders. Next to this precondition, there are several factors which affect the success of co-creation, such as negotiation of preferences and needs (Barrutia & Echebaria, 2012; Oksman et al., 2014), dialogue, shared understanding (Barrutia & Echebaria, 2012; Jonker, 2014; Kemp & Scholl, 2016) and commitment to the process (Jonker, 2014). Ansell and Gash (2008) defined five success factors of collaborative governance, which reflects these success factors of co-creation and they added a few more factors. Moreover, in several articles about co-creation the factors mentioned by Ansell and Gash (2008) are mentioned as success factors. Hence, in this thesis the assumption is made that the five success factors of collaborative governance described by Ansell and Gash (2008) are success factors of the co-creation process as well.

The five success factors are: face-to-face dialogue, trust building, commitment to process, shared understanding and intermediate outcomes. The face-to-face dialogue is a necessary but not sufficient condition to co-creation (Ansell & Gash, 2008). The aim of the face-to-face dialogue is to build trust between the participants and to create a shared understanding. Moreover, a dialogue is a medium for the negotiation about preferences and needs. The importance of a face-to-face dialogue in urban planning is mentioned by several other scientists as well (Healey, 1992; Innes & Booher, 2010; Rudolph, 2004). The second success factor is trust building. Trust building between the participants is a success factor, since it is argued that participants who trust each other are more likely to commit to the process. The commitment to the process is one of the most or maybe even the most important success factor of co-creation (Ansell & Gash, 2008). Commitment is closely related to the motivation of people to participate in the process (Ansell & Gash, 2008). The commitment to the process increases when there is a recognition of interdependence. When the participants acknowledge that they need each other to reach certain benefits, they will be more likely to commit to the co-creation process. Furthermore, the commitment to the process increases when there is shared ownership of the process. The fourth success factor described by Ansell and Gash (2008) is a shared understanding. The participants of the co-creation process must have a common problem definition and a clear mission. The importance of a shared understanding in the co-creation process is mentioned by Barrutia and Echebaria (2012) Jonker (2014) and Kemp and Scholl (2016) as well. The last success factor mentioned by Ansell and Gash (2008) is intermediate outcomes. Co-creation is more likely to ensure when the advantages of the co-creation process are concrete and when small wins are possible. Tangible outcomes will motivate participants to continue with the co-creation process.
4.3.3 Conclusion co-creation SBM

From this chapter can be concluded that an SBM is more useful to organise an SMG in a business park than a conventional business model. Besides, it has become clear that the building blocks of an SBM can be divided in four categories: principles, community structure, values and design structure. Since an SMG depends on the participation between different local public and private actors, it is important that the design and implementation of the SBM are built around to concept of co-creation. Co-creation is concerned with the active involvement of different parties in the value creation process to create something new. The success of the co-creation process depends on five factors: face-to-face dialogue, trust building, commitment to process, shared understanding and intermediate outcomes. Thus, to co-create an SBM for an SMG in a business park the local private and public parties should design the building blocks by following the just mentioned success factors. Furthermore, these success factors should be embedded in the designed SBM to make sure that the whole process of the development of an SMG is concerned with co-creation.
Chapter 5. Conceptual model
5. Conceptual model

In this chapter a conceptual model is presented and explained to provide a framework to answer the main research question:

"Which factors explain the adoption of SMGs by businesses at a business park in the Netherlands from a behavioural-institutional perspective and how can public and private actors co-create an SBM for the development of an SMG, reflecting these factors?"

To answer this research question, theories are used to explain the diffusion process from the start, to the actual implementation of the innovation. The diffusion of an innovation is the sum of the individual adoption processes (Rogers, 2003). In this thesis the researched innovation is an SMG in a business park in the Netherlands. Thus, the innovation of SMGs is researched in a specific geographical context. The diffusion of an innovation starts with its emerging (Rogers, 2003). The reason why an SMG has emerged in society is explained in chapter 1. After the emerging the innovation might diffuse in society, which depends on several factors. Moreover, the diffusion of an innovation takes place in an institutional context (Rogers, 2003), which consists of social, economic and political settings (Oteman et al., 2017; Ostrom, 2007; Wolsink, 2012). The institutional context can be interpreted as structures, which are interacting with the innovation (Giddens, 1984; Oteman et al., 2017). This means that the institutional context determines the playing field in which the innovation takes place, while at the same time this institutional context can change as the result of the emerging innovation (Oteman et al., 2017).

Within the institutional context, several processes take place which lead from the starting point ‘emerging of innovation’ to the end point ‘establishment of innovation’. The diffusion of an SMG depends on the one hand on the willingness of individual businesses to adopt an SMG (González et al., 2018; Miller et al., 2012; Wolsink, 2012). Second, the diffusion of an SMG depends on the co-creation of an SBM (Gui et al., 2017; Koirala et al., 2016; Lammers & Heldeweg, 2016; Rodríguez-Molina et al. 2014). This second step is not derived from the traditional Diffusion of Innovation Theory (Rogers, 2003), but SMG research (e.g. Gui et al., 2017; Koirala et al., 2016; Lammers & Heldeweg, 2016) shows that a lack of an SBM is a barrier for the diffusion of SMGs. The adoption by individual businesses and the co-creation of an SBM are both influenced by the institutional context in which the diffusion process takes place (Jonker 2014; Rogers, 2003).

The willingness of individual businesses to adopt an innovation is concerned with the agenda setting and matching (Rogers, 2003). Whether a business sets an SMG on the agenda depends on several factors. First, innovation attributes influence the decision of a business to adopt an SMG. The innovation attributes (relative advantage, complexity, observability, compatibility and trialability) are characteristics of an innovation and it is assumed that the perception of these attributes by businesses, impact their decision to adopt an innovation (Rogers, 2003). Second, the critical mass explains the willingness of businesses to adopt an innovation (Mahler & Rogers, 1999; Marwell & Oliver; 1993). This
is the case since it is assumed that the benefits of an SMG increase when more businesses adopt the innovation. Assuming that businesses will make a rationale weigh between the benefits and costs, a critical mass increasing the benefits will affect the willingness of businesses to adopt an SMG. Third, the attitude regarding an SMG, the subjective norm and the perceived behavioural control (Ajzen, 1991) will affect the willingness of businesses to set an SMG on the agenda. A positive attitude, pressure from other people (=subjective norm) and perceived behavioural control are expected to be drivers for the adoption of an SMG by businesses at a business park. Furthermore, the investment decision which consists of the trade-off between the perceived risk and return influences the willingness of a business to invest in SMG assets (Wüstenhagen & Menichetti, 2012), which is a crucial part of the adoption of an SMG. It is assumed that each individual business will make a rational weigh between the perceived risks and returns of an SMG. The expectation is that if the perceived returns are higher than the perceived risks, a business will adopt an SMG. Last, organisational characteristics affect the willingness of a business to adopt an SMG (Greenhalgh et al., 2004; Hameed et al., 2012). Literature shows that for instance expertise is a driver for businesses to adopt an innovation (Hameed et al., 2012). Summarizing, if a business at a business park is willing to adopt an SMG depends on his willingness to set an SMG on the agenda and to match it with other agenda items. This process of agenda setting and matching is influenced by seven factors: innovation attributes, critical mass, attitude, subjective norm, perceived behavioural control, trade-off between perceived risk and return and organisational characteristics.

In general, after the agenda setting and matching a business needs to decide if it wants to implement the innovation (Rogers, 2003). In this research the implementation is preceded by the co-creation of an SBM, since it is argued that the diffusion of an SMG is currently hampered by the lack of business models (Gui et al., 2017; Koirala et al., 2016; Lammers & Heldeweg, 2016). An SBM describes the building blocks of the value realisation and consists of principles, values, community structure and design structure (Jonker, 2014). Thus, it is assumed that the diffusion of an SMG in a business park depends on the design of these building blocks of an SBM. An important aspect of an SBM for an SMG is co-creation, since previous research show that different local public and private participants actively need to work together to realise an SMG (Gui et al., 2017; Lammers & Heldeweg, 2016).

Co-creation is a collaborative process involving different types of people who are actively working together to create something new. Involving local people in the creation of (spatial) plans will increase the satisfaction of the end users and will make the process more efficiently (Jonker, 2014; Oksman et al., 2014; Voorberg et al., 2015). In this research, public and private parties create value by designing an SBM for the implementation of an SMG in a business park. The success of the co-creation process depends on five factors: face-to-face dialogue, trust building, commitment to the process and a shared understanding (Ansell & Gash, 2008). If these factors are present, it is more likely that a successful SBM is co-created and SMGs will diffuse in business parks. It is important to mention that the co-creation does not only has to do with the design of the SBM, but with the implementation of the SBM as well.

The agenda setting and matching of individual businesses and the co-creation of an SBM together affect the diffusion of an SMG in a business park. However, these two processes are intertwined. This
is the case since the factors explaining the willingness of individual businesses to adopt an SMG should be included in the SBM. Including the preferences of the individual businesses in the SBM will increase the success of the SBM (Jonker, 2014). Considering all of this, the diffusion of an SMG depends on the willingness of businesses to set an SMG on the agenda; the development of the building blocks of an SMG and the successful co-creation of these building blocks. This process is schematically presented in figure 14.

**Figure 14 Conceptual model diffusion SMG in business parks (Author, 2019)**

Figure 14 shows that the diffusion of an SMG in a business park starts with its emerging and ends with its establishment. The diffusion of an SMG in a business park is the dependent variable in this research. Furthermore, figure 14 shows that the diffusion of an SMG in a business park depends on three main processes: agenda setting and matching by individual businesses, the co-creation of an SBM and the implementation of an SMG. The focus in this research is on the two first processes, they are explained in more detail based on theoretical assumptions. The agenda setting and matching depends on seven factors which can be perceived as drivers and barriers of the adoption. The co-creation of an SBM consists of the design of the building blocks of an SBM. The success of the co-creation depends on five factors. Hence, the Cloverleaf Model (Jonker, 2014) describes ‘what’ should be included in the SBM,
the success-factors of co-creation (Ansell & Gash, 2008) describe ‘how’ the SBM and the further development of an SMG should be organised. The implementation of an SMG consists of performing the activities that are derived from the SBM. The three processes of ‘agenda setting and matching’, ‘the co-creation of an SBM’ and ‘the implementation of an SMG’ take place within the institutional context, which is visualised by the striped square. Important to mention is that the agenda setting and matching, represent the willingness of an individual business to adopt an SMG. In contrast to this individual process, the co-creation of an SBM is a collaboratively process. First, insight must be gained in the willingness of businesses to adopt an SMG, before an SBM can be effectively co-created. This does not mean that all businesses need to be willing to adopt an SMG before an SBM can be co-created, but insight in their drivers and barriers will make the SBM more successful. An SBM is successful when the added value is realised (Jonker, 2014). The process of agenda setting and matching and co-creation of an SBM can take place at the same moment.

To conclude, exploring the factors influencing the willingness of businesses to adopt an SMG and exploring the organisation of an SBM for an SMG, will provide insight in the diffusion process of SMGs in business parks. Hence, the knowledge gap about how to implement this innovation in business parks in the Netherlands can be reduced.
Chapter 6. Methodology
6.1 Introduction to chapter

In this chapter the methodological choices of this research are described. First, the research paradigm is described in section 6.2, which is followed by a description of the research design in section 6.3. Afterwards the data collection (section 6.4) and data analysis (section 6.5) are explained. This chapter ends with a description of important quality criteria and ethics (section 6.6).

6.2 Research paradigm

Research is always influenced by the philosophical assumptions of the researcher (Creswell, 2013; Saunders, Lewis & Thornhill, 2009). Therefore, it could be helpful for the researcher to choose an research paradigm that defines the limits of legitimate inquiry (Guba & Lincoln, 1994). A research paradigm can be described as “a set of basic beliefs (or metaphysics) that deals with ultimates or first principles. It represents a worldview that defines, for its holder, the nature of the world.” (Guba & Lincoln, 1994, pp.107). Several research paradigms, based on ontological, epistemological and methodological aspects can be distinguished. The aim of this research is to explore factors explaining the adoption of SMGs by businesses at business parks. Second, the aim of this research is to co-create an SBM for the diffusion of SMGs in business parks. Considering the aim of this research, a social constructivist approach is used. According to a social constructivist worldview, an innovation develops as a contingent process, influenced by heterogeneous factors (Couros, 2003). Researching these factors is the main focus of this research.

A characteristic of constructivism, is the relativist ontology, meaning that individuals have specific constructed realities (Guba & Lincoln, 1994). The truth in this constructivist view is only subjectively created by individuals and it is necessary for the researcher to understand the differences between humans (Saunders et al., 2009). In this research it is assumed that businesses have different ‘constructions’ about the concept of SMGs, based on seven factors: perceived innovation attributes, critical mass, attitude, subjective norm, perceived behavioural control, trade-off between the perceived risk and return and organisational characteristics. As argued by Skjølsvold and Ryghaug (2015) technologies are subject to interpretive flexibility, meaning that different social groups have different ideas of how a technology can be used and which benefits it can bring. However, it is assumed that some elements of these constructions are shared among many individuals (Guba & Lincoln, 1994). Thus, on the one hand the constructed realities differ between the individuals, on the other hand, there will be similarities between the constructions of some groups of individuals. Besides, it is expected that individuals react differently on institutional structures, as they create their own specific reality. This assumption is based upon the fact that in the same situation individuals behave differently (Sánchez-Medina et al., 2014). Therefore, it is important to research the details of the situation (Saunders et al., 2009). The importance of ‘details’ is reflected in the research design, elaborated in the next section.
The epistemology of this research is transactional and subjectivist, meaning that findings are created by interactive linkages between the researcher and respondents. The factors influencing the diffusion process and the co-creation of an SBM are constructed and are not visible without the intervention of the researcher. Last, the research paradigm consists of methodological aspects (Guba & Lincoln, 1994). The used methods in this research are hermeneutical and dialectical, meaning that the individual constructions can only be identified through an interaction between and among the researcher and the respondents. In this way, a “reconstruction of previously held constructions” can be created (Guba & Lincoln, 1994, pp.112). The data collection methods described in the following section reflect this social constructivist world view.

6.3 Research design

6.3.1 Qualitative and quantitative research

The purpose of this research is to identify responses of businesses, which are based on their specific personal attitudes, and interpretations from their perspectives, in order to reveal drivers and barriers of the diffusion of SMGs in business parks in the Netherlands. Second, this research aims to co-create an SBM reflecting the drivers of businesses to adopt an SMG. These processes together will provide insight in the social feasibility of the diffusion of SMGs in business parks. The best way to achieve these research aims is by a combination of different research methods. A distinction can be made between quantitative and qualitative research methods (Saunders et al., 2009; Vennix, 2011 Verschuren & Doorewaard, 2010). Qualitative research gains insight in the qualitative picture of a given phenomenon expressed through words, whereas quantitative research provides insight in various numerical data. Consequently, quantitative data results in standardised data in contrast to qualitative data (Saunders et al., 2009). In this research a combination of qualitative and quantitative research methods is used, but the focus is on gathering qualitative data. To understand the social (perceived) reality of an object or process, often qualitative methods are used (Vennix, 2011). Qualitative research contributes to the researcher’s understanding of what the respondent thinks that is important in his own reality (Verschuren & Doorewaard, 2010). This qualitative research is more useful to understand behavioural and institutional changes in the (energy) transition, whereas quantitative research can provide technical depth (Robertson et al., 2017). This is the case since behavioural and institutional changes are relatively abstract and ambiguous. It is stated that: “the more ambiguous and elastic our concepts, the less possible it is to quantify our data in a meaningful way” (Dey, 1993, pp.28). Since this research is explorative, there are no possibilities to clearly operationalise the concepts, leading to relatively abstract conceptions. Therefore, the aim of this research is to test the existing theories and to discover patterns in empirical data (inductive approach), which could contribute to the existing theory. To get these new insights and discover empirical patterns, qualitative research methods, such as open interviews whereby respondents can provide new insights, seems the most suitable (Saunders et al.,
2009; Vennix, 2011). Consequently, the willingness of businesses to adopt an SMG is in this research not concerned with numerical data such as ‘how many times’, but with category data, such as ‘I’m willing to adopt an SMG because...’. Based on the qualitative data, the concepts can be further operationalised, and the existing theories can be expanded.

While the main focus of this research is on qualitative data, quantitative data plays a little role as well. To gain data about all the businesses at a business park, quantitative data could be useful, since qualitative data from all businesses will be hard to structure. Based on the quantitative data, statements can be made about how many respondents give a certain answer. This means that the questions consist of category data, but that this data is quantified. Besides, a few quantitative questions are asked to the respondents, which is primarily done to get more detailed information about the preferences of the businesses. For instance, the respondents are asked if they want subsidy and how much this should be. It can be concluded that because of the explorative, inductive research approach, qualitative data is more useful to achieve the research objectives that quantitative data, but quantitative data is used to get more detailed information.

### 6.3.2 Explorative case-study

**A single, instrumental case**

The research design of this thesis is a case-study. A case-study can be used when the aim of the research is to get insight of how something is (diffusion of SMGs in business parks in the Netherlands) and why it is that way (Creswell, 2013). Therefore, the case-study research design is often used in explorative, inductive studies (Saunders et al., 2009), which is the case in this research. An important characteristic of a case-study is that different kind of sources are used, which is called triangulation (Creswell, 2013; Saunders et al., 2009;) and which is further explained in section 6.4. Within the research design of a case-study different forms exists (Creswell, 2013; Vennix, 2011; Yin, 1989), where a key distinction can be made between single and multiple case-study designs (Yin, 1989). This research contains a single case-study, since only one business park is the object of study. The choice was made for a single-case study, because with a single-case study in the same amount of time, more in-depth knowledge can be required about the diffusion process than with a multiple case-study (Yin, 1989). Since the adoption of an SMG in a business park and the co-creation of an SBM for an SMG in a business park are unexplored phenomena, the choice was made to commit all the attention to one single case, to get more in-depth information. Moreover, the multiple observations of a single case, provide stronger evidence of the factual accuracy of a given angle. A disadvantage of a single case-study is that it is difficult to generalise the results, which will be considered in the data analysis. Second, a distinction can be made between instrumental and unique cases (Creswell, 2013; Yin, 1989). The researched case is an instrumental case, since this research is not concerned with an exclusive phenomenon, but with a new phenomenon that can be applied at multiple cases. This means that in this research the case is subordinate to the subject. Since the case is not an unique case, the lessons learned can be applied to other cases as well. However, as just explained the single case-study makes it hard to generalise the research results.
Case-selection

This thesis explores the diffusion of an SMG in one business park; business park Apeldoorn Noord (figure 15). Businesses park Apeldoorn Noord is one of the very few business parks in the Netherlands who already wants to get started with the implementation of SMGs. However, as a result of the paradox between the possible benefits of an SMG and the uncertainties regarding the adoption of an SMG by businesses, stakeholders of business park Apeldoorn Noord set out the question: ‘What determines the decision of local actors to adopt an SMG, so a sustainable, affordable and reliable energy supply can be guaranteed?’ This scientific research is based on this question which emerged out of practice and represents an urgent knowledge gap. Besides this question from practice, there are different reasons why business park Apeldoorn Noord is selected as the case for this explorative research.

In 2016 the municipality of Apeldoorn developed an implementation agenda for the energy transition (Municipality of Apeldoorn, 2016). In this agenda the municipality states that it aims to generate 28% of the energy use with renewable sources by 2030 and to go faster than the national trend (Municipality of Apeldoorn, 2016). As stated by the municipality herself (2016), a difficulty with the aim to achieve 28% renewable energy in 2030 is that the municipality depends to a great extent on investments of other stakeholders. The budget for the energy transition in the industry and small to medium-sized businesses is €100,000 in 2018 and increases to €240,000 in 2021 (Blom & Schilling, 2018). Nevertheless, this budget is not enough to achieve the set goals, as currently the percentage of renewable energy in Apeldoorn is 6% (Blom & Schilling, 2018). The dependency on other stakeholders for investments in the energy transition explains why the municipality is interested in the decision-making process of businesses to adopt an SMG.

In 2018 the implementation of the energy transition agenda was reviewed by the independent party CE Delft (Blom & Schilling, 2018). One of the recommendations for the municipality of Apeldoorn is to research "how innovations can be fastened together with local businesses who have an executive role" (Blom & Schilling, 2018, pp.7). Moreover, it is mentioned in the report that because of the increased electrification of society, it is becoming more important to match the local demand and supply of energy on annual and daily basis. Although the report does not mention the concept of SMGs directly, this innovation can provide an opportunity to match the local demand and supply of energy with the involvement of local businesses. Furthermore, SMGs fit within the ambition of the municipality to install PV on all suitable roofs (Municipality of Apeldoorn, 2016) and to explore storage possibilities (Blom & Schilling, 2018).

Besides the fact that SMGs fit within the policy of the municipality of Apeldoorn, another reason to research Apeldoorn Noord is that the businesses located here are diversified. The businesses located at Apeldoorn Noord are small and medium-sized businesses in the sectors trade, services, technology, small industry and logistics. Considering these different branches, it is expected that the companies have different energy consumption patterns, increasing the advantages of an SMG (Morales González et al., 2016). Moreover, since the business park is at the edge of the city, near the park a lot of space is available to generate renewable energy in the future, which could contribute to a better match of
the demand and supply of energy. Another argument why business park Apeldoorn Noord is a suitable case to explore the adoption of an SMG and the co-creation of an SBM is that business park Apeldoorn Noord is located next to the residential neighbourhood Zuidbroek. The households in this neighbourhood have invested in a collective solar park and they make use of a heat network based on sustainable heat from the sewage treatment, making it the most sustainable neighbourhood in Apeldoorn (Municipality of Apeldoorn, 2016). Since the energy consumption patterns of households differ to a great extent to the energy consumption patterns of businesses (Morales González et al., 2016), integrating the neighbourhood Zuidbroek could be an opportunity to make the SMG more efficient, as there are more opportunities to exchange energy. Although the potential integration with the neighbourhood makes the case more interesting, the participation of households is not explored in this research. A case-description of business park Apeldoorn Noord, showing for instance the generation potential of renewable energy, is included in Appendix 1. To conclude, the combination of the energy policy of the municipality and some geographical characteristics, make Apeldoorn Noord a suitable case for this research.

Figure 15 Business park Apeldoorn Noord (Municipality of Apeldoorn, n.d.)

6.4 Data collection

To answer the research questions a combination of different data collection methods is used. In total four different methods are used, which means that a ‘mixed methods design’ including quantitative and qualitative methods is developed (Saunders et al., 2009). Figure 16 shows which data collection method is used to answer which sub question. The advantage of using multiple data collection methods is that the sources can be combined and that the results of the different methods can be
compared with each other (Vennix, 2011; Creswell, 2013). A description of each method follows in this chapter.

**Figure 16 Data collection methods (Author, 2019)**

### 6.4.1 Literature analysis

The first used data collection method is a literature analysis. A literature analysis can be quantitative or qualitative (Vennix, 2011). Considering the research aims, in this research the choice was made for a qualitative literature analysis. The literature analysis serves various aims. First, the literature analysis is used to gain knowledge about what an SMG is, as a lot of scientific and policy documents are published about this. Consequently, the assets of an SMG, the advantages and disadvantages of an SMG and the expected role of businesses in an SMG are derived from the literature analysis. Second, the literature analysis is used to develop the theoretical framework, explaining which factors influence the adoption process of an SMG by businesses and explaining how an SBM for the organisation of an SMG can be co-created. Several theories explaining these processes are found in the scientific landscape and are summarized in chapter 3, 4 and 5. Besides, the aim of collecting relevant literature is to require detailed information about the institutional context in which the diffusion process of SMGs takes place, since it is argued that this context influences the willingness of businesses to adopt an innovation (Rogers, 2003) and the co-creation of an SBM (Jonker, 2014). By analysing the institutional context, the information required by the other data collection methods can be placed in a certain context. The analysed literature mainly consists of scientific papers and policy documents about the energy transition. In addition, some websites are analysed, for instance website pages of the DEA. Due to the innovativeness of the diffusion of SMGs in business parks, the secondary data is not qualified enough to answer the research questions. Most existing literature is for instance about smart grids or local energy communities and not about SMGs. Besides, most existing literature is about households instead of businesses. Therefore, to fill in the gap in the existing data, other data collection methods are used as well.
6.4.2 In depth-interviews

In this study, interviews are an important data collection method to answer the research questions. One-on-one conversations enable a detailed discussion about factors explaining the adoption of an SMG by businesses at business parks. Hence, in-depth interviews are conducted to meet the research aims. The in-depth interviews are semi-structured, meaning that before the interviews take place an interview guide is prepared based on the conceptual framework. The clusters of questions guide the interview, but there is enough room to anticipate on the answers of the respondents (Saunders et al., 2009). Consequently, the respondents can talk about their own experiences. The majority of the interviews (total 14) are conducted face-to-face, because in many cases this makes it a more pleasant conversation and the researcher can get more in-depth information (Saunders et al., 2009; Vennix, 2011). In addition, face-to-face interviews generally have a higher response than surveys or telephone interviews.

Three types of parties are interviewed: experts with knowledge about SMGs and/or experience with making business parks sustainable; businesses located at business park Apeldoorn Noord and real-estate companies owning property at Apeldoorn Noord. Regarding the former, interviewing experts serves the purpose of requiring knowledge about the meaning of an SMG and in particular the role of businesses in an SMG, the Dutch ongoing institutional change process and drivers and barriers of businesses to adopt an SMG. The meaning of SMGs and the institutional context can partly be described based on the literature analysis. However, the expert interviews serve to gather more detailed information about this. Besides, the institutional context of SMGs is constantly changing, and the experts can provide the latest information about the institutional changes. Furthermore, the experts provide insight in the drivers and barriers for the adoption of an SMG by businesses. The interviewed experts are not stakeholders of business park Apeldoorn Noord, but it is assumed that they have knowledge about the drivers and barriers of businesses to adopt an SMG based on their own experiences. It is researched whether the drivers and barriers mentioned by the experts, apply to the adoption of an SMG in business park Apeldoorn Noord as well. Last, the experts can provide knowledge about the organisation of an SMG by the co-creation of an SBM. Since there is no SMG developed at a business park yet, the experts will not be able to provide readymade business models. Nevertheless, their personal ideas about the organisation of an SMG can be discussed. Since the theory of SBM was added to the theoretical framework after the expert interviews took place, the expert interviews do not provide in-depth knowledge about the development of an SBM for an SMG in a business park, but the interviews do give a little insight in the organisation of an SMG.

The expert interviews are exploratory, hence new factors that are not found in the literature review can get to the surface. It is aimed to interview experts from different organisations, as is shown in Appendix 2. All the experts have experiences with the energy transition in the specific context of business parks. The ‘snowball method’ whereby the respondent suggests another respondent (Saunders et al., 2009) is used to select the respondents. An advantage of this method is that people can be reached who would otherwise have been ‘invisible’.
Next to the experts, five businesses located at business park Apeldoorn Noord are interviewed. By interviewing them, drivers and barriers for the adoption of an SMG can get to the surface. The advantage of interviewing local businesses is that the drivers and barriers can directly be derived from the businesses themselves, without the intervention of experts. The businesses are given the opportunity to talk about their perception and expectations of SMGs, experiences with other sustainable energy measures and the perceived drivers and barriers for the adoption of an SMG. The businesses are partly selected by the local park management organisation, who provided a list of ‘active members’. In addition, the own network of the researcher is used to select the fifth respondent. The choice was made to approach businesses from different branches and with different company sizes.

The third category of respondents consists of real-estate companies, owning property on Apeldoorn Noord. The survey and other in-depth interviews show that property owners play a role in the diffusion of SMGs in business parks as well. They can invest in certain parts of an SMG and they influence the perceived behavioural control of businesses. The specific aim of interviewing real-estate companies is to find out whether they are willing to cooperate with businesses to realise an SMG and which role they would like to perform in an SMG. The interviews with this group only serve to support the other results and do not answer a specific research question. The respondents are selected based on the survey: in the survey the businesses are asked if they own the building and if not, who does own the building. The real-estate owners mentioned most often are interviewed, since it is assumed that these property owners have the most power in business park Apeldoorn Noord. The interview guide for each respondent is shown in Appendix 3.

6.4.3 Survey

The third data collection method is a survey. A survey has primarily a quantitative focus and can be used in different research strategies, for instance in case-studies (Saunders et al., 2009). In this thesis the survey is used to research whether the results of the in-depth interviews with the businesses can be generalised to the other businesses located at business park Apeldoorn Noord. These in-depth interviews and the survey serve both to gain insight in the drivers and barriers of businesses located at a business park to adopt an SMG. Second, the survey is used as input for the co-creation of the SBM, since it is assumed that in an SBM the preferences of the stakeholders (businesses at business park Apeldoorn Noord) should be included (Bocken et al., 2014; Jonker, 2014). A survey is in particular useful for collecting big amounts of data. Considering the amount of businesses at Apeldoorn Noord (N=182), a survey is a qualified research method. The aim of the survey is to identify and describe the variability in the willingness of businesses to adopt an SMG and the reasons behind this variability. To meet this aim, the survey consists of a mix of attribute questions (finding out organisational characteristics), opinion questions (what do they think about SMGs and related subjects) and behaviour questions (did they invest in the past, do they now or will they in the future). The survey questions are shown in Appendix 4.

The survey strategy is usually associated with a deductive research approach (Saunders et al., 2009). Moreover, surveys are often not very useful for exploratory research, which requires open-ended
questions, while surveys work best with standardised questions (Saunders et al., 2009). Nevertheless, in this explorative research a survey is conducted since the questions of the survey are based upon the in-depth expert and business interviews. Consequently, the survey can be seen as a method to verify the answers found in the interviews, increasing the external validity. Part of conducting a survey is determining the sample population (Saunders et al., 2009). In this research all businesses located at business park Apeldoorn Noord are part of the sample population.

The choice was made for an Internet-mediated questionnaire: the survey is distributed with the online program Qualtrics and was sent by e-mail and posted on the Intranet of the park management organisation of business park Apeldoorn Noord. Advantages of a self-completion questionnaire are that there is an absence of interviewer effects and that respondents can fill in the survey when they want to. Besides, they can choose the speed they want to go (Bryman, 2012). A downside is that the respondents cannot ask questions and that no additional questions can be asked to the respondents (Bryman, 2012). The software Qualtrics is used since it has point-and-click design, it includes advanced features such as a comprehensive selection of question types and it is possible to route different subgroups of respondents to answer different questions using a filter question. The survey of this case-study mainly consists of a combination of categorial and Likert-style questions.

This research is adaptive, meaning that methods designed on beforehand, are adjusted based on the first findings, when it appears that the first chosen research method is not achieving the research goals. Since the response on the online survey was relatively low (15 out of the population of 182) it is decided to visit the businesses and to let them fill in a paper version. The researcher has tried to visit all the 182 businesses, which took several weeks. A higher response rate has been achieved in this way.

### 6.4.4 Workshop Session

*Meaning workshop session*

The literature analysis, interviews and survey provide an answer to the first part of the research question: “Which factors explain the adoption of SMGs by businesses at a business park in the Netherlands from a behavioural-institutional perspective?” The expert interviews give some insight in the second part of research question (“How can public and private actors co-create an SBM for the development of an SMG, reflecting these factors?”), but to gain knowledge about how the building blocks of an SBM look like for the organisation of an SMG and how an SBM can be co-created, an additional research method is needed. The choice was made to co-create the building blocks of an SBM in a workshop session with the local stakeholders of business park Apeldoorn Noord.

There is no clear format about how a workshop session should look like. The workshop session held in this research provides a simulation of the process of co-creating an SBM for the development of an SMG in business park Apeldoorn Noord. This means that the workshop session is a simplified simulation of reality and that real stakeholders can participate in an interactive decision-making process. Within a simulation the participants can experiment with decisions they have to make in the future, the institutional designs and the consequences of these decisions (Mayer, Carton, De Jong, Leijten, & Dammers, 2004). During the workshop session the public and private parties involved in the
development of an SMG in business park Apeldoorn Noord together take action to change the business as usual situation, since in the business as usual situation there is no SBM for SMGs in business parks. In other words, with the workshop session a scenario is conducted that differs from the businesses as usual scenario. Hence, the function of the workshop session is to intervene. The co-creation of an SBM with the real local public and private parties in order to improve the lives of those participating, makes that the workshop session is a form of participatory action research (MacDonald, 2012).

**Advantages workshop session**

In this section, the reasons for a workshop session as data collection method are explained. First, a workshop session provides the researcher an opportunity to learn (Mayer et al., 2004). In this case, the researcher learns how the building blocks of an SBM can be co-created for the organisation of an SMG in a business park. Because there is a knowledge gap about how the SBM of an SMG should look like, an inductive approach in which new ideas emerge is needed. Consequently, the outcome of the workshop session contributes to scientific knowledge about the development of SMGs. Second, a workshop session contributes to the principle of ‘collaborative planning’. In short, collaborative planning means the inclusion of different stakeholders in the decision-making process (Innes & Booher, 2010). It is argued that if plans are not collaboratively constructed, they are an expression of exclusive powers (Savini et al., 2015). In the workshop session the voice of the different local public and private parties are heard, in order to co-create an SBM. The workshop session facilitates an open dialogue between these parties, which is important for consensus building in collaborative planning (Ansell & Gash, 2008; Habermas, 1981). The goal of the workshop session is to reach consensus on as much aspects of an SBM as possible. The open dialogue is important for the development of an SBM, since it is argued by Jonker (2015) that, *to find out if a potential partner can and wants to add value to your New Business Model network, you will have to talk to each other.*” (Jonker, 2014, pp.167, translated form Dutch). Besides, with an open dialogue between the local public and private parties, knowledge can be shared between the participants (MacDonald, 2012). In the workshop session the participants learn how the other participants think about the co-creation of an SBM, for instance: What are their interests? Which resources could they employ? Which role would they like to play? With this collaborative learning the participants together gather information, creating common basic knowledge and assumptions, which can lead to new creative solutions (Healey, 1992; Rudolph, 2004). To solve a complex problem, such as designing an SBM for an SMG, collaborative learning is useful (Rudolph, 2004). Furthermore, the participants of the workshop session can learn about the previous results conducted by the researcher. The workshop session provides a setting in which the results of the interviews and survey are presented and discussed. By presenting the results of the empirical-data collection, the participants are brought to the edge of knowledge, so together plans can be designed across this edge. For the stakeholders of the development of an SMG in business park Apeldoorn Noord this will be interesting, since they will gain knowledge about where they should pay attention to when co-creating an SMG. Another advantage of the workshop session is that it is argued that participation in projects is greater when the idea has not yet been fully developed (Jonker, 2014). Therefore, it is expected that the workshop session will increase participation in the real-life project.
Outline workshop session

The aim of the workshop session is to co-create an SBM, which includes the value proposition, principles, values, community structure and design structure (Jonker, 2014). The goal is to reach consensus about how these building blocks can be organised. Through several assignments and topics of discussion, these building blocks are described. Considering the importance of collaborative planning, it is tried to include all different stakeholders involved in the development of an SMG in business park Apeldoorn Noord in the workshop session. An overview of the stakeholders who participated is shown in Appendix 2. The participants of the workshop session are in this case-study, the ‘design team’ of the SBM. The researcher guides the workshop, but is not a participant in the process of co-creating the SBM.

The workshop session last three hours and is divided in four phases, based on the Cloverleaf Model of Jonker (2014). An in-depth explanation of the workshop session is described in Appendix 5.

Phase 1: Value proposition

The aim of the first phase of the workshop session is to collaboratively find an answer on the questions ‘What is an SMG?’ and ‘Why should an SMG be developed?’ Answering these questions give insight in the value proposition of an SMG in business park Apeldoorn Noord. First, the issues of the current energy system are explained and discussed with the participants. Second, the participants are asked to describe how they think the energy system in business park Apeldoorn Noord will look like in 2050. This is done through a creative brain dump activity with post-its. The results are collectively discussed to find out if an SMG fits with their expectations of the future energy system. Afterwards an explanation of an SMG as a solution to current energy issues is given and it is discussed with the participants which elements are crucial for SMGs. Besides, in the first phase the results of the survey are shown and discussed.

Phase 2: Community structure

Phase two gives an answer on the question ‘Who should play which role in the SMG?’ The participants are asked who are involved in the development of SMGs, what the interests of the involved public and private parties are and which role they could play in the development of an SMG in business park Apeldoorn Noord. Moreover, the participants are asked to describe which public and private parties are conditional partners, supporting partners and additional partners. In groups of two/three they created a frame work describing the interests, roles and position of the different parties. Besides, the participants are asked how willing they are to collaborate on the development of SMG themselves and what in their perspective the pros and cons are.

Phase 3: Design structure

The third phase provides insight in ‘what’ should be done and ‘how’ the SBM should be organised. First, the activities that need to be performed are discussed. The workshop participants individually developed a strategic roadmap, describing the actions they think that need to be performed to develop an SMG in business park Apeldoorn Noord. Next to the activities the strategic roadmap describes the tools that are needed in the eyes of the participants.
Phase 4: Collaboration arrangement

In the last phase of the workshop session the previous parts come together in a collaboration arrangement. Jonker (2015) argues that it is important to make agreements with the stakeholders about the added value and who should do what. Therefore, a collaboration arrangement is set up in the workshop session. This collaboration arrangement can be described as a ‘letter of intent’. First, a scenario is given to make sure the participants understand it is a fictive arrangement. In the scenario it is the year 2021 and the second chamber elections have taken place. It is decided that one business park in the Netherlands gets a subsidy from the National Government, but only when they reach consensus about the SBM. Therefore, a framework of a collaboration arrangement is provided to the participants, which they can adjust according to their preferences. After individually constructing an arrangement, they can compare their arrangement with the other participants, and negotiate about the differences. In this way a negotiation game is played to reach agreement on the organisation of an SMG in business park Apeldoorn Noord. The different elements that are discussed in the arrangement are: the added value for each stakeholder; the activities that must be performed; the formal form of organisation; the responsibilities of the different stakeholders; financing; preconditions for collaboration. The results of the collaboration arrangement will be used in the SBM.

6.5 Data analysis

After collecting data, the data is analysed taking several steps. The qualitative data is analysed through the use of conceptualisation, in contrast to quantitative analysis in which statics and diagrams are used. In this research the focus is on the former method of data analysis. However, since there are four methods of data collection, there are four methods of data analysis as well.

6.5.1 Literature analysis

The scientific papers and policy documents are analysed by reading the texts and summarizing the parts contributing to the research aim. Afterwards, the information from the various literature sources is combined and described as a coherent story in this thesis.

6.5.2 Interviews

To analyse the interviews, they are first transcribed. By doing so, the answers of the respondents remain unchanged (Saunders et al., 2009). Next, the transcribes are analysed. The answers of the respondents are marked in different colours, corresponding to different categories. The categories are: drivers for the adoption, barriers for the adoption, role of the government and future value proposition of SMGs in business parks. These categories are used in the interviews with the experts and in the interviews with the businesses and real-estate owners. The categories are not expressed in operational terms, since this is not relevant in explorative research (Saunders et al., 2009) and hard to do based on previous research. The analysis of the interviews is therefore based on an inductive approach. However, the drivers and barriers are categorised in more detail, based on the theories described in chapter 3, to draw conclusions about which kind of drivers and barriers are mentioned by the
respondents: perceived innovation attributes, critical mass, attitude, subjective norm, perceived behavioural control, trade-off between perceived risk and return or organisational characteristics. The main focus of the in-depth interviews is to gain knowledge about the factors explaining the willingness of businesses to adopt an SMG. Since the theory of SBMs (Jonker, 2014) was not part of the theoretical framework when the in-depth interviews were conducted, the respondents are not explicitly asked about the building blocks of an SBM. However, the respondents are asked how they see the role of the government in the development of SMGs. This provides insight in the potential of co-creation between the public and private parties. The results of the ‘role of the government’ described in the interviews are added to chapter 9. The category ‘future value proposition of SMGs in business parks’ is not directly derived from the theoretical framework. However, analysing the interviews showed that some of the respondents have an explicit opinion about the future value proposition of an SMG. Therefore this category is added to the codebook. The coded answers of the respondents are shown in Appendix 6. The coded answers are summarised in tables, ordered by which respondent gave which argument. This is followed by a short qualitative summary of the results shown in the tables.

The answers given by one respondent are presented to other respondents, to find out whether they recognise themselves in the answers. Besides, the most important drivers and barriers for the adoption of an SMG by businesses at a business park according to the respondents of the interviews, are included in the survey. The decision of ‘the most important factors’, is based upon the most mentioned factors, considering to what extent the factor is described as important. Furthermore, the decision of ‘the most important factors’ is based on the Likert-item table the experts filled in during their in-depth interviews (Appendix 6). Citations from the respondents are used to substantiate the research results. In this thesis the citations from the respondents are translated from Dutch into English. It is aimed to translate as accurate as possible.

6.5.3 Survey

The data derived from the survey is mainly categorical, however some answers are numerical (e.g. percentage desired subsidy). The categorical questions led to descriptive data (e.g. attributes of the businesses, willingness to adopt an SMG and specific preferences) and ranking data (drivers and barriers explaining the willingness to adopt an SMG).

The analysis of the survey consists of several steps (Field, 2009). First, codes were added to the response categories and a codebook was created. Second, all data was entered in the software program SPSS, creating a matrix with all the coded answers of the respondents. After checking for errors, the data analysis continued with developing frequency tables and calculating means. This descriptive data is described in chapter 8 and compared to the answers of the interviews. Besides, the drivers and barriers of the respondents to adopt or to not adopt an SMG are ranked. This is done by calculating the amount of times a driver or barrier is answered with ‘Agree’ or ‘Strongly Agree’, as a percentage of the total answers. The drivers and barriers that are answered most often with ‘Agree’ or ‘Strongly Agree’ are the most important. Considering the explorative research approach, the aim of the survey is not to find correlations between the different drivers and barriers but to get insight in
the most mentioned drivers and barriers. For this reason no explanatory tests are performed between the different drivers and barriers.

However, between the organisational characteristics and the willingness to adopt an SMG, a correlation is expected and therefore correlation tests between these variables are performed. Each time the correlation between one organisational characteristic and the willingness to adopt an SMG is tested (Appendix 7). Since the correlation between two variables is tested, a bivariate correlation test is used. The variables are categorial. A Pearson Chi-Square test is performed, since this is a standardised measure of the strength of relationship between two category variables (Field, 2009). It has a value range from -1 to 1 and the closer to the edge, the stronger the correlation between the two variables is. For all tests, a significance level of 0.05% is used, which is common in social research (Field, 2009). In some cases, the variables are categorised in less categories, to make sure that the expected N-rate in each cell is high enough (Appendix 7). When both variables are divided in two categories, a 2x2 tables is commuted. For all the 2x2 tables, there is looked at the continuity correction instead of the actual Pearson Chi-Square, since these variables are dichotomous (Field, 2009).

A precondition for the Pearson Chi-Square test is that each cell has an expected minimum count of 5 (Field, 2009). When this is not the case a Fischer’s Exact test can be performed, which is done several times in this research (Appendix 7). The Cramer’s V gives a description of the effect size of the relations (Field, 2009). When the Cramer’s V is higher than 0.3 or lower than -0.3 there is a strong relation between the variables (Field, 2009).

It can be concluded that the main analysis of the survey consists of describing how many times a certain answer is given and by describing the means of certain questions. Only between the organisational characteristics and the willingness to adopt an SMG, explanatory tests are performed. By analysing the survey data according to these steps, conclusions can be drawn about the extent to which businesses at Apeldoorn Noord are willing to adopt an SMG. This includes their drivers and barriers to do so and the effect of organisational characteristics on their opinion.

### 6.5.4 Workshop session

The workshop session is evaluated in three different ways. First, the workshop session is observed. What is said and done by the participants is recorded by two observers who took notes and pictures. The observers try to write down as many quotes as possible. Second, the notes, forms and letter of intent filled in by the participants during the workshop are gathered at the end of the workshop session and analysed. The analysis consists of summarizing the results and comparing the answers of the different participants. Lastly, a sound recording has been made, so certain parts of the workshop can be listened to again and citations can be used in the results section.
6.6 Research quality criteria and ethics

6.6.1 Validity

An important criterion in research is validity (Saunders et al., 2009; Vennix, 2011). A distinction can be made between internal validity and external validity. Internal validity concerns the extent to which the measure instrument provides a good representation of the concepts that need to be measured (Vennix, 2011). Several considerations can increase the validity of the conducted research. First, mixed methods increase the validity (Saunders et al., 2009). Therefore, to provide a valid measure instrument, the interview questions, survey and workshop design are based on extensive literature research. Furthermore, mixed methods are used to increase the validity since the survey questions are based upon the in-depth interview results. This increases the ‘content validity’ (Saunders et al., 2009) of the survey. Second, the internal validity is ensured with open interview questions, wherein the respondents get the chance to explain themselves and the researcher can ask follow-up questions to make sure he understood the participant well. Applying reflective listening increases the chance that the researcher interprets the answers of the respondent in a correct manner (Vennix, 2011). Third, the internal validity is increased, by researching the willingness to adopt different elements of an SMG. In this way the concept ‘SMG’ is made more tangible for the respondents. Moreover, the survey is sent to a professor from the Radboud University for feedback. Besides, the survey is tested by businesses located elsewhere and students who have a lot of experience with questionnaires, before it was sent to the respondents at business park Apeldoorn Noord.

Besides the internal validity, external validity is important in scientific research, which is concerned with the question whether results can be generalised (Vennix, 2011). Since a case-study has been chosen as the research-design, the external validity, unlike the internal validity, will not be very high (Verschuren & Doorewaard, 2010). Nevertheless, an instrumental case is performed so the results can easier be generalised than with a unique case-study. Furthermore, to increase the external validity, different kind of businesses (different sectors and size of company) are interviewed. Besides, experts from different working branches are interviewed, so answers focused on self-interest can be filtered.

6.6.2 Reliability

A second important criteria in research is reliability. The reliability is concerned with the question whether the results of research are repeatable (Bryman, 2012; Vennix, 2011). To obtain reliable research, a researcher must provide insight on how the research was carried out. To increase the reliability of the different steps of data collection and data analysis, they are clearly described in this thesis. Furthermore, the interview guides, the analyses of the interviews, the survey, its results and an extensive description of the workshop session are added to the appendices. Moreover, to increase the reliability of the survey, a few ‘check questions’ are included. These check questions measure the same drivers or barriers of the adoption of an SMG, but are formulated in a different way. Hence, it can be concluded if the respondents read the questions well. Third, the reliability is influenced by the number of respondents; the larger the sample (in relation to the total research population), the more reliable the research will be (Saunders et al., 2009). This is particularly important for the survey. To increase
the reliability of the research, the aim is to reach as many businesses at business park Apeldoorn Noord as possible. To meet this aim, the business park has been visited multiple days at multiple times. All companies have been approached (by e-mail, telephone and physically passing by) and no distinction have been made between different types of businesses. Besides, the non-response rate influences the reliability. The researcher tried to keep the non-response rate as low as possible by contacting the businesses in different ways. Furthermore, the businesses were contacted in different weeks on multiple days at different times, to increase the chance that the businesses were able to fill in the survey.

6.6.3 Ethics

Each profession carries moral norms and codes of ethics and so does social research. Bryman (2012) distinguishes four main areas of ethical principles. First, there should be no harm to participants. Since the participants in this research are not forced to contribute to this research and are respected by the researcher, no harm is caused. Second, participants should be well informed, meaning that they should be given as much information as is needed to make an informed decision about if they want to participate in the research or not. To comply with this ethic principle, the participants are well informed about what the research is about, who is financing it and why it is conducted. As this research is performed in collaboration with the consultancy agency HVE, it is clearly communicated with the participants. However, the researcher does not act in the interest of HVE, meaning that the researcher tries to remain as objective as possible without being steered in a certain direction. A third ethical principle concerns the issue of privacy (Bryman, 2012). The participants are asked if the interviews and the workshop session may be recorded. Moreover, the answers of the businesses are anonymised, and the experts are asked if their name can be used in the research report. The last ethical notion concerns deception. Deception occurs when a researcher presents its research as something other than what it is. To overcome this, the participants are informed in a timely manner with fair information about the research.
Chapter 7. The institutional context in which SMGs emerge
7.1 Introduction to chapter

This chapter provides an answer to the sub question: What are the current ongoing institutional change processes in which the diffusion of SMGs takes place? A description of the institutional context combines the general (theoretical framework) with the contextual. It provides insight in the institutional changes that have led to the introduction of SMGs. In this way, background information about the emerging of SMGs is revealed. Besides, the willingness of businesses to adopt an SMG and the co-creation of an SBM depend on the institutional context (Adil & Ko, 2016; Burke & Stephens, 2018; Grimley & Farrell, 2016; Jonker, 2014; Krewitt et al., 2007; Lindberg et al., 2018; Wolsink, 2012). Based on the institutional context, elements that must be considered in an SBM, can be revealed. Hence, it is important to gain knowledge about the institutional change processes in which the diffusion of SMGs takes place. This chapter consists of a brief analysis of the liberalisation of the energy market (section 7.2), a description of the transition towards a sustainable and decentralised energy system (section 7.3), a description of the phenomenon of dynamic energy prices (section 7.4), an analysis of the expansion of new technologies (section 7.5), a list of barriers in the legal framework (section 7.6) and an evaluation of current trends in society which could affect the diffusion process of an SMG in a business park (section 7.7). This chapter ends with a short conclusion of the research findings (section 7.8). The choice of these descriptions is based on the Social-Ecological System Framework, which highlights the importance of market, political, technological and social settings in the development process of sustainable actions (McGinnis & Ostrom, 2014; Ostrom, 2007). The results presented in this chapter are derived from the literature review and expert interviews.

7.2 The liberalisation of the energy market

In this section the development of the (Dutch) energy market and the influence of this market on SMGs are described. In the 1920s in Europe and the US, the development of national high voltage lines and regional distribution grids started (Naus et al., 2014). Over decades the energy was distributed and provided by semi-governmental utilities. The energy consumers were passive end-users of energy (Naus et al., 2014). In the 1990s, in the Netherlands, the liberalisation of the energy market began, which led to the split-up between semi-governmental grid operators and private providers. This was part of the liberalisation process. The Netherlands was one of the frontrunners in the liberalisation process compared to other countries in the European Union (Verbong & Geels, 2007). The liberalisation of the energy market has been a gradual process. The ‘Derde Energienota’ (Tweede Kamer, 1995) played an important role, since this memorandum stated that the Netherlands must prepare for more international competition and the increasing desire of energy consumers to make their own choice. This shows that already in the 1990s energy consumers wanted to have say something about their energy supply. Three years after this memorandum the Electricity Law came into force (Tweede Kamer, 1998) and in 2000 the Natural Gas Law followed (Tweede Kamer, 2000).
With the Electricity Law, the generation, distribution and sale of electricity were officially separated among different parties (Verbong & Geels, 2007). Parties generating energy or buying energy from the generators and selling it to energy consumers were commercialised (Verbong & Geels, 2007). Consequently, new energy suppliers entered the market, which led to more competition (Köper, 2009). On the other hand, even with the liberalisation, the distribution grid operators retained their regional monopoly for energy transportation (Van Aubel & Poll, 2019).

Moreover, part of the liberalisation of the energy market is the founding of TenneT, which is the national state-owned transmission system operator that is responsible for the national management of the high voltage network. Furthermore, the Dutch Competition Authority was appointed to monitor the market, in particular the enforcement of the Electricity Law and the Natural Gas Law. This authority later merged and is now called the Authority of Consumer and Market (ACM). This authority is important for the development of SMGs, since it determines what is and what is not permitted by law, for instance regarding local energy exchange. An example of this is given in an expert interview: “You maybe want to match the locally generated energy with specific end users. But this is not allowed. (...) When you want to keep the energy locally, you need permission from the ACM.” (Wolbert, personal communication, May 2, 2019). Another result of the liberalisation of the electricity market is the integration of national markets in an active international trade of electricity (APX-ENDEX). On this wholesale market, producers, traders, energy companies and large consumers, buy and sell large volumes of electricity and gas (Nau et al., 2014). Figure 17 shows an overview of the different actors in the energy system in the beginning of this decade. The figure shows that the supply chain of energy is a linear process. It also shows that the entire process takes place within the range specified by the ACM.

Due to the liberalisation of the energy market, more emphasis was placed on the profit aspect of the energy system. Consequently, the liberalisation hinders experimentation with economically unviable technologies (Oteman et al., 2017). This aspect of the liberalisation of the energy market can be perceived as a constraining factor for the diffusion of SMGs, since it constrains the possibilities for pilot projects who still have to work on their business case. A profitable business case is nowadays a requirement for projects in the energy sector (De Leeuw, August 22, 2019; Markus, personal communication, April 9, 2019; Wolbert, personal communication, May 2, 2019).
7.3 The transition towards a sustainable and decentralised energy system

7.3.1 Rise of renewable energy

In the history of the Netherlands, several energy transitions have taken place. From simply making fire with wood, the energy system changed towards a complex system with different sources, producers and users. In the 1960s the Dutch energy system based on coal was within ten years replaced by an energy system mainly based on natural gas (Rotmans, 2011). Currently the Netherlands is facing a transition towards a more sustainable energy supply, as is explained in chapter 1. Consequently, the energy market consists to an increasing extent of the generation of renewable energy sources (CBS, 2018a). There are institutional changes aiming to enforce the transition towards a more sustainable energy system. Examples of these institutional changes are the introduction of the National Energy Agreement for Sustainable Growth (SER, 2013), the UN Paris Agreement on Climate Change (UN, 2015) and the Dutch Climate Agreement (2019). These agreements are arranged since it argued that a fast response is necessary to overcome irreversible damage and uncontrollable impact of climate change (Noorman, 2018). With these national and international agreements goals to reduce the CO₂ emissions are set and a brief description is given of how this should be done. Nevertheless, developing an energy system which guarantees sustainability, and which is reliable and affordable is challenging (Cherp, Vinichenko, Jewell, Brutschin & Sovalcool, 2018; Rotmans, 2011; Schot & Geels, 2008; Wolsink, 2012). The following citation describes the difficulty of changing the current electricity grid: “It is believed that the electric grid is the most complex and gigantic machine ever made in human history; it consists of wires, cables, towers, transformers and circuit breakers installed together in outdated manner.” (Daoud & Fernando, 2011, pp.53).

Next to these agreements the Dutch Government took other actions to enforce the energy transition. To enforce the transition towards a sustainable energy system the Dutch Government decided in 2019 to raise the tax on natural gas and to reduce the tax on electricity (National Government, n.d.). This shift in energy tax might stimulate people to use more electricity and to use less natural gas. In particular when the electricity is from renewable sources, the changed tax enforces the transition towards a sustainable energy system. Furthermore, the Dutch Government wants to introduce a new national levy on CO₂ emissions of electricity generation for companies who produce electricity (National Government, n.d.). This new minimum price of CO₂ emissions is expected to be introduced in 2020 and will be an addition to the European emission price on CO₂ (ETS). Moreover, the SDE+ rule, which is subsidy for renewable energy generation, will be continued in the upcoming years in another, not yet determined form (Coalition Agreement, 2017). These are just a few examples, showing the institutional shift to a greener tax system in which the polluter pays (Coalition Agreement, 2017). In an SMG, the energy is generated with renewable sources. Therefore, institutional changes increasing the profit of renewable sources will stimulate the diffusion of SMGs in business parks.
### 7.3.2 Development of local energy communities

Renewable energy is to an increasing amount generated by local participants (Naus et al., 2014; Oteman et al., 2017). These local people can be individuals generating their own renewable energy or communities collectively generating energy. The rise of the latter is the focus of this section. Local energy communities are:

“an association, a cooperative, a partnership, a non-profit organisation or other legal entity which is effectively controlled by local shareholders or members, generally value rather than profit-driven, involved in distributed generation and in performing activities of a distribution system operator, supplier or aggregator at local level, including across borders” (EC, 2019, pp.52).

According to this definition, an SMG can be perceived as a local energy community. Nevertheless, the characteristic ‘smart’ is not mentioned by the EC (2019), from which it can be concluded that an SMG is a kind of local energy community, but that a local energy community does not necessarily have to be an SMG. Since within an SMG the energy is generated and used within a local community, an analysis of the development of this phenomenon provides insight in the diffusion of SMGs. The first local energy communities started in 1970, but of the current 360 formalised initiatives 75% are established since 2008 (Oteman et al., 2017). The development of local energy communities fits within the broader trend in which energy consumers become energy producers. Over history, different kinds of initiatives, based on different motives have been developed in the Netherlands. From anti-nuclear action groups in the 1970s to ‘new pioneers’ in the past decade (Oteman et al., 2017). In general, the development of technologies for decentralised energy generation and the increasing social interest in local sustainability played an important role in the rise of local energy communities (Hajer, 2011). It is notable that the development of local energy communities coincided with institutional developments (Oteman et al., 2017). The first group of community initiatives faced a difficult institutional embeddedness. For instance, decentralised grid access was forbidden (Oteman et al., 2017). An institutional development that enabled the diffusion of local energy communities is the Electricity Law, which forced energy suppliers to buy locally produced electricity (Oteman et al., 2017). The institutional development of provincial subsidies played an important role in the development of Frisian turbines a few years later. During the liberalisation of the energy market, the development of initiatives slowed down as a result of uncertainty about the free market and new rules (Oteman et al., 2017). After the liberalisation process a new wave of grass roots initiatives took place. Institutional aspects that were relevant for these pioneers were the Net Metering Law, the decrease of PV prices and a dissatisfaction with governmental policies. It is remarkable that since the last years local energy communities are becoming more professional, acting as commercial organisations (Kooij et al., 2018). Nevertheless, a lot of the current initiatives are still organising meetings and developing business cases instead of the actual deployment (Oteman et al., 2017).

The institutionalisation of local energy communities has taken place in the form of the SER agreement (2013), the Paris Agreement (2015), the Energy Agenda (2016), the Climate Agreement (2019) and the recast European Electricity Directive (2019). However, in the Energy Agenda no measures are described to stimulate the expansion of local energy communities. In fact, it is even stated that it is
more expensive and less cost efficient than large-scale production. In contrast, in the European Electricity Directive and the Dutch Climate Agreement (2019) there are high expectations of local energy communities:

“Local energy communities can be an efficient way of managing energy at community level by consuming the electricity they generate either directly for power or for (district) heating and cooling, with or without a connection to distribution systems. To ensure that such initiatives can freely develop, the new market design requires Member States to put in place appropriate legal frameworks to enable their activities.” (EC, 2019, pp.5).

This quote shows the importance of an appropriate legal framework for the diffusion of local energy communities. However, how this legal framework exactly should look like is not described. In the Dutch Climate Agreement it is stated that there will be a revolving fund to stimulate local energy communities, but no specific changes of the legal framework are described. Based on the Dutch Climate Agreement (2019) and the European Energy Directive (2019) it can be concluded that the involvement of local contributors in the energy system is becoming more and more institutionalised. The upcoming Dutch Climate Law could guarantee a stable institutional playing field, but whether this is really the case remains to be seen.

A lot of previous research is conducted about drivers and barriers for the adoption of local energy communities. Table 4 provides an explorative overview of factors found in literature. The factors explaining the diffusion process of local energy communities can be used as a guidance to explore the factors influencing the diffusion process of SMGs (Kortman, personal communication, April 19, 2019). Nevertheless, an SMG differs on the ‘smart’ aspect from the local energy communities mentioned in literature. Moreover, the local energy communities described in literature are about citizen participation and not about the involvement of businesses. Therefore, the factors in table 4 only give direction to factors explaining the diffusion of SMGs in business parks. The categorisation of the factors is done by the author of this thesis.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Category</th>
<th>Authors</th>
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<tbody>
<tr>
<td>Becoming self-sufficient</td>
<td>Attitude</td>
<td>(Becker et al., 2017; Bomberg &amp; McEwen, 2012; Kiorala et al., 2016, Naus et al., 2014; Walker, 2008; Wolsink, 2012; Young &amp; Brans, 2017)</td>
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<tr>
<td>Environmental awareness</td>
<td>Attitude</td>
<td>(Becker et al., 2017; Boon &amp; Dieperink, 2014; Kalkbrenner &amp; Roosen, 2016; Oteman et al., 2017; Walker, 2008; Young &amp; Brans, 2017)</td>
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<tr>
<td>Social cohesion</td>
<td>Subjective norm</td>
<td>(Boon &amp; Dieperink, 2014; Kalkbrenner &amp; Roosen, 2016; Oteman et al., 2017; Wolsink, 2012)</td>
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<tr>
<td>Keeping revenues within the region</td>
<td>Attitude</td>
<td>(Bomberg &amp; McEwen, 2012; Koirala et al., 2016; Oteman et al., 2017; Walker, 2008)</td>
</tr>
<tr>
<td>Local independency</td>
<td>Attitude</td>
<td>(Becker et al., 2017; Bomberg &amp; McEwen, 2012; Boon &amp; Dieperink, 2014; Oteman et al., 2017).</td>
</tr>
<tr>
<td>Reducing the energy bill</td>
<td>Attitude, perceived trade-off risk and return</td>
<td>(Koirala et al., 2016; Oteman, Kooij &amp; Wiering, 2014; Walker, 2008; Young &amp; Brans, 2017).</td>
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<tr>
<td>Investment costs/payback time</td>
<td>Perceived trade-off risk and return</td>
<td>(Becker et al., 2017; Boon &amp; Dieperink, 2014; Walker, 2008)</td>
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<tr>
<td>Generating profits for the local community</td>
<td>Attitude, perceived trade-off risk and return</td>
<td>(Becker et al., 2017; Oteman et al., 2017).</td>
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<td>The absence of local opposition</td>
<td>Perceived behavioural control, subjective norm</td>
<td>(Boon &amp; Dieperink, 2014; Wolsink, 2012)</td>
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<td>A non-constraining participation possibility for locals</td>
<td>Perceived behavioural control</td>
<td>(Boon &amp; Dieperink, 2014; Viardot, 2013)</td>
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<td>The support of external parties (suppliers and other local initiatives)</td>
<td>Subjective norm</td>
<td>(Boon &amp; Dieperink, 2014; Young &amp; Brans, 2017)</td>
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<tr>
<td>Dissatisfaction with government policy</td>
<td>Attitude</td>
<td>(Boon &amp; Dieperink, 2014; Oteman et al., 2017)</td>
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<tr>
<td>Familiarity with technology</td>
<td>Innovation attributes</td>
<td>(Boon &amp; Dieperink, 2014; Viardot, 2013)</td>
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<td>Reliable supply</td>
<td>Attitude</td>
<td>(Boon &amp; Dieperink, 2014; Walker, 2008)</td>
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<tr>
<td>Load management (SDR), contributing to network stability</td>
<td>Attitude</td>
<td>(Koirala et al., 2016; Walker, 2008)</td>
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<tr>
<td>Experts advice</td>
<td>Perceived behavioural control</td>
<td>(Boon &amp; Dieperink, 2014; Walker, 2008)</td>
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<tr>
<td>Anti-nuclear movement</td>
<td>Attitude</td>
<td>(Becker et al., 2017; Oteman et al., 2017)</td>
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<tr>
<td>Existence of other local energy organisations</td>
<td>Subjective norm, innovation attributes</td>
<td>(Boon &amp; Dieperink, 2014)</td>
</tr>
<tr>
<td>State support</td>
<td>Subjective norm</td>
<td>(Bomberg &amp; McEwen, 2012)</td>
</tr>
<tr>
<td>Job creation</td>
<td>Attitude</td>
<td>(Young &amp; Brans, 2017)</td>
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<tr>
<td>Energy security</td>
<td>Attitude</td>
<td>(Young &amp; Brans, 2017)</td>
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Table 4 Factors influencing the adoption of local energy communities found in literature (Author, 2019)
It can be concluded from this list of factors that the TPB (Ajzen, 1991) explains part of the adoption of local energy communities. A positive attitude regarding the outcomes of a local energy community is the most mentioned driver for the adoption. Besides, some factors of the Diffusion of Innovation Theory (Rogers, 2003) explain the adoption, for instance the visibility of technology and familiarity with technology. Moreover, the importance of the trade-off between risk and returns is reflected in drivers for the adoption. Drivers are for instance the generation of profits for the local community and a lower energy bill. No risks as barriers for the adoption are founded in the articles mentioned in table 4. Hence, the category of ‘perceived trade-off between risk and return’ is mainly concerned with financial returns.

The diffusion of SMGs is closely related to the development of local citizen energy communities (Kortman, personal communication, April 19, 2019). The development of local energy communities might be a driver for the diffusion of SMGs in business parks, as it is becoming more usual to people to generate their own energy. However, there are multiple differences between citizen local energy communities and an SMG in a business park. In a business park there is, for example, less social cohesion than in a neighbourhood, which may make companies less inclined to take collective action (Kortman, personal communication, April 19, 2019). On the other hand, at a business park, the energy consumption patterns between different businesses are more diversified than the energy consumption patterns between households in a neighbourhood (Mulder, personal communication, June 18, 2019). Hence, the options for energy exchange are bigger in a business park than in a neighbourhood, which will stimulate the diffusion in business parks.

This section shows that the diffusion of local energy communities is dependent on the institutional context. If the institutional context does not make room for the development, the communities will not expand in society. The importance of local energy communities is to an increasing extent institutionalised, which will thus enable the expansion. This could have an influence on the diffusion of SMGs in business parks as well. However, if this will be the case depends on the concrete measures that are taken to enhance the diffusion of local energy communities.

### 7.3.3 Dynamic market with blurred roles

Due to the decentralised generation of renewable energy sources and the rise of local energy communities, the energy market has become more dynamic (Rodriguez-Molina et al. 2014). The division between the different roles as presented in figure 17 has been blurred. This is the case since an increasing amount of energy consumers has become an energy prosumer, playing multiple roles. Besides, grid operators and energy supply companies started to play multiple roles (Koirala et al., 2016; Naus et al., 2014). For instance, the Dutch grid operator Liander now performs a role as facilitator of self-provisioning initiatives. Besides, Greenchoice, a green energy provider, is to an increasing amount participating in local initiatives as an administrator and intermediary (Naus et al., 2014). Hence, it can be concluded that there is an institutional change process going on in which grid operators and supply companies change their roles and focus more on local energy initiatives (Koirala et al., 2016). Performing different roles fits within the idea of an SMG, in which actors must play multiple roles as well (Wolsink, 2012).
7.4 Dynamic prices

For an SMG to be successful, in particular for SDR to be successful, dynamic, time dependent network tariffs are important (Edens & Lavrijssen, 2019; Mulder, personal communication, June 18, 2019; Schneider, personal communication, July 12, 2019). With variable energy tariffs, the price of energy is based on the balance between the demand and supply on the electricity market. In other words, there is a price on the scarcity of energy (Edens & Lavrijssen, 2019). These dynamic prices will stimulate businesses to use energy off-peak hours, since at those moments the energy is cheaper. In 2015 the DEA argued that the lack of variability in electricity prices for small consumers is an institutional barrier for the implementation of SMGs (DEA, 2015b). The energy prices at the Power Exchange itself change continuously, but the energy suppliers make contracts with standard prices, as a result of which the prices are not flexible for energy consumers. Since 2017 it is possible for small consumers to have variable energy tariffs. Nevertheless, the market of energy suppliers which delivers variable energy tariffs is in its beginning (Netbeheer Nederland, 2017). In the current energy market only in very specific situations a business might be able to achieve financial benefits by having an energy contract with flexible prices (Schneider, personal communication, July 12, 2019). Therefore, it is argued that energy suppliers should develop more flexible market prices to enforce the diffusion of SMGs. However, since the prices of electricity are currently based upon the day-ahead market this cannot simply be changed. A lack of dynamic energy prices is currently a barrier for businesses to adopt an SMG (Mulder, personal communication, June 18, 2019; Schneider, personal communication, July 12, 2019).

7.5 Rise of smart technologies

Several technologies that have been developed in the past decades determine the institutional context in which the diffusion of SMGs take place. One of these technologies are smart meters (Naus et al., 2014). To fully implement an SMG, smart meters are necessary. Smart meters have several advantages: grid operators can gather insight in the energy balance on the grid, the costs of taking meter readings can be reduced, fraud can be reduced, and energy consumers have a better insight in their electricity consumption (Van Aubel & Poll, 2019). According to EU policies all houses need to have a smart meter in 2020 (Naus et al., 2014). This institutional enforcement is the result of the increasing electricity usage, which makes it harder to balance the energy voltage on the national grid. Despite the policy, the roll-out of smart meters was slowed down due to several issues, such as its vulnerability to cybercrime and privacy issues (Naus et al., 2014). To decrease the issues regarding the privacy of smart meters, it is decided to not have a central storage, but to only store the metering data in the smart meter itself (Van Aubel & Poll, 2019). The described issues are mainly based on the perception of households, but it is likely to assume that businesses will face the same issues regarding the use of
smart meters. At the end of 2016 about 3 million households in the Netherlands have a smart meter (Van Aubel & Poll, 2019). How much businesses have a meter remains unknown.

A second technology influencing the diffusion of SMGs is SDR, as part of demand-side management. Demand-side management was adopted in the late 1980s and the development was possible as a result of interactive control, network flexibility and participant users (Naus et al., 2014). One of the tools within demand-side management is SDR. The diffusion of this technology faced several barriers, on economic, social, technological and political level (Van Dievel, Vos & Belmans, 2014), such as: a lack of legal clarity on data rights, unclear policies regarding the energy transition, the regulation of network operators which are holding back innovations and end-use price regulation (Good et al., 2017). The well-functioning of SDR is closely related to the development of flexible energy prices, which is currently in the beginning phase (Mulder, personal communication, June 18, 2019; Schneider, personal communication, July 12, 2019). Besides, as stated by Schneider (personal communication, July 12, 2019), the possibilities for an average business to shift his energy use are small, but the more the production processes of businesses will electrify, the more businesses could apply SDR.

Another crucial technology for an SMG is energy storage technology. There are several options to store energy, such as using the storage capacity of EVs. Nevertheless, the storage of energy is currently expensive: “Some technology is simply not yet affordable, look at batteries, those Tesla power packs, you can’t afford that here, you just can’t do it.” (Markus, personal communication, April 8, 2019). At the same time, the interviewed experts do not mention storage possibilities as a real constraining factor for the diffusion process. This has probably to do with the decrease of energy saving costs in the last decade, which will continue in the future (Koirala et al., 2016).

In an SMG, energy prosumers who generate their own renewable energy and have a surplus, can sell this energy to other companies. There are several platforms facilitating this trade (Mulder, personal communication, June 18, 2019). The trade of electricity between the producers and consumers can for instance be managed with the platform ENTRNCe (Liander, 2017; Mulder, personal communication, June 18, 2019). The platform ENTRNCe was launched in November 2017 and can play an important role in the development process of SMGs. ENTRNCe is an independent transaction platform for electricity which administratively manages the direct transaction between the energy producers and consumers, despite their location. It is “a software program where you as an energy supplier can supply electricity from one EAN code directly to another EAN code” (Mulder, personal communication, June 18, 2019). ENTRNCe does facilitate energy transactions over large distances as well and is therefore not specific stimulating local energy exchange (Schneider, personal communication, July 12, 2019).

The experts do not mention a lack of a certain technology as a barrier for the diffusion of SMGs in business parks. Smart meters, SDR and the trading platform ENTRNCe are important milestones in the development process of SMGs. Moreover, it is expected that in the next few years, technologies like data-analytics, cloud-based systems and blockchain will add layers of software on top of the energy grid, making it even smarter (DNV GL, 2018).
7.6 The legal context in which SMGs emerge

The legal context is part of the ongoing institutional change process. Currently it is argued that SMGs are undefined in the legal system and consequently, whether SMGs will diffuse in business parks depends on rules changing over time to allow the development (Grimley & Farrell, 2016). The interviews with the experts and the literature review revealed which aspects of the legal framework hold back the expansion of SMGs. The following summary of barriers is explorative and does not claim to be complete.

7.6.1 Delivery to other businesses

Pilot projects show that the energy supply between different participants of an SMG is perceived as a problem (DEA, 2015a). The production and exchange of electricity are free since a free market of electricity is the basic principle of the Dutch Electricity Law (Akerboom et al., 2011). However, an exception is made for the supply to small energy users. It is stated by law that who supplies energy to small energy consumers, needs to have an energy supply license (DEA, 2015a). This complicates the mutual energy exchange within an SMG. Based on previous pilots the DEA recommends making the law more flexible so local energy communities can share energy without the involvement of a ‘traditional’ energy supplier (DEA, 2015a).

7.6.2 Connection to switching stations

An example of a smart grid pilot in business park A1 in Deventer shows an institutional aspect in the current legal framework which holds back the diffusion process of SMGs. On this business park there are two wind turbines, which the project managers wanted to connect to the same medium voltage ring as the business park. Nevertheless, according to the law, the turbines need to be connected to a separate switching station (DEA, 2015b). This means that the energy is transported over long distances, which is not in line with the basic principle of an SMG, aimed at local generation and use. The transportation asks for a lot of cabling resulting in tons of extra costs (Wolbert, personal communication, May 2, 2019). To realise the project anyway, it was hoped to get an exception on the Electricity Law (DEA, 2015b). Nonetheless, it is concluded that the wind turbines need to be connected to the transformation station miles away (Wolbert, personal communication, May 2, 2019). The ambassador of the pilot in Deventer states: “As long as the legislation is not flexible, energy supply flexibility has no value” (DEA, 2015b, pp.2).

7.6.3 The Net Metering Law (Salderingsregeling)

The Net Metering Law is a rule stating that the renewable energy you generate and that you return to the grid because of (temporarily) overcapacity, is subtracted from your own energy consumption. First, in the Dutch Electricity Act of 1998 it was stated that people who generated their own energy only could deliver maximum 5000 kWh back to the central grid and settle this with their own use. Since 2014 all self-generated electricity that is delivered to the electricity grid, can be deducted from the electricity that is purchased. The price that you get for your energy is dependent on the energy supplier. On one side, the Net Metering Law seems an enabling factor for the diffusion process of
SMGs; people get motivated to buy PV since they can get a discount on their energy bill. Oteman, Kooij and Wiering (2017) even mention this law as “an institutional development relevant for grassroots initiatives” (pp.17). However, Mulder (Personal communication, June 18, 2019), argues that the Net Metering Law can be perceived as a barrier for the diffusion of SMGs, since it aims to balance the energy supply on the national grid instead of locally within a community. Consequently, this rule stimulates the development of renewable energy generation, but it lowers the incentive to locally match the demand and supply of energy (Den Ouden, Van Aken & Kooiman, 2016; Mulder, personal communication, June 18, 2019).

“At this moment the legal framework is organised in a way that the most efficient way to balance your energy is by putting it on the national energy grid. (...) This means that if someone has a high peak because the PV produce a lot of energy, this prosumer shifts this problem to the national energy grid. (...) If we end the Net Metering Law, it will become way more interesting to do something about the energy peaks. For instance, the energy can be stored or exchanged with the neighbour. This will make the business case a lot more interesting.” (Mulder, personal communication, June 18, 2019).

From January 2023 onwards, the Net Metering Law will gradually be ended, which thus could be beneficial for the diffusion of SMGs.

7.6.4 Experimentation Act

According to the experts, there are enough possibilities to exchange energy between different businesses at a business park. For instance, with the platform ENTRNCe energy can be administratively exchanged. Yet, this is not ideal because of the energy tax that still needs to be paid (Mulder, personal communication, June 18, 2019). A second option is the development of a closed distribution network (Mulder, personal communication, June 18, 2019). Nevertheless, to exchange energy within a closed distribution network, legal permission of the Experimenteer wet (Experimentation Act) is needed. The Experimentation Act offers room to create a local grid, which is at one point connected to the regional grid.

“If you want to exchange energy between small energy users, you need an experimental status and you need an exemption on the current rules for that. If you only exchange energy between large energy suppliers, you can organise an SMG already.” (Schneider, personal communication, July 12, 2019).

From this citation can be concluded that an Experimentation Act is only needed for the energy exchange between small energy users. On an average business park, such as Apeldoorn Noord, there are both small and large energy users, which means that permission by the Experimentation Act is necessary. The permission within the Experimentation Act is issued for a maximum of ten years. Permission within the Experimentation Act is not easily granted, which can be a barrier for the development. The Experimentation Act will be further developed to make it more easy to use (Mulder, personal communication, June 18, 2019; Schneider, personal communication, July 12, 2019).
7.6.5 Energy tax

A barrier for the diffusion process of SMGs is the Dutch tax system regarding electricity (DEA, 2015a). In the Netherlands the tax system is organised in a way that the more energy you use, the less tax per kWh you need to pay. This tax system does not stimulate businesses to reduce the amount of electricity they buy from the central grid. It is possible that if a business participates in an SMG and it has to buy less energy from the central grid, because it buys energy from its neighbour, the company has to pay more tax per kWh for the energy it receives from the central grid (Personal communication, June 18, 2019). For the diffusion of SMGs in business parks it will be encouraging when the tax per kWh increases as you use more energy (Mulder, personal communication, June 18, 2019).

There is a second way in which tax can be used to enforce the diffusion of SMGs. According to the current rules, even when you exchange energy locally, you must pay tax for the energy you receive (Mulder, personal communication, June 18, 2019; Schneider, personal communication, July 12, 2019). This makes it financially less beneficial to participate in an SMG compared to a situation wherein an energy prosumer does not have to pay taxes when delivering and receiving energy from a business within the local grid (Koirala et al., 2016; Mulder, personal communication, June 18, 2019). This issue can be solved as follows:

“If you design a micro grid with a point where you connect to the national energy system, so that you actually place all your energy consumption behind one meter, then it could be an advantage that you do not have to pay energy taxes on the energy flows that remain within that grid. In that case you only must pay energy tax when energy flows from your micro grid to the national grid or vice versa. But I have to say that we are now working on an analysis to see if that is indeed the case.” (Mulder, personal communication, June 18, 2019).

It is now being investigated whether the legislation can be organised in a way that businesses do not have to pay energy taxes when they exchange energy within the SMG. This institutional change process might play a crucial role in the diffusion of an SMG in business parks. Moreover, currently when you save energy to a battery you need to pay taxes when you take energy from the battery, if the battery is not directly connected to the energy generation unit, which will be the case with SMGs. Therefore, if the government changes this rule, the benefits of a business to store energy locally instead of transporting it will increase (Schneider, personal communication, July 12, 2019).

7.7 Related trends in society

Fastening the energy transition in business parks by developing SMGs fits within several trends in society: increased attention on sustainability, digitalisation, decentralisation, energy democracy, independency and the sharing economy. First, an SMG fits within the trend of the increased attention on sustainability. The Paris Agreement of 2015 (UN, 2015) and the Dutch Climate Agreement (2019) show that the importance to reduce CO₂ emissions is high on the political agenda. In the business sector sustainability got increased attention as well, as is showed by the growing attention on
Corporate Social Responsibility (CSR) (Crowther & Seifti, 2018; Ruiter, personal communication, April 8, 2019). This CSR is strongly connected to the energy transition, as resource depletion of fossil fuels is mentioned as one of the most important causes of the increased attention on CSR (Crowther & Seifti, 2018). Hence, adopting an SMG could contribute to a company’s CSR level.

Moreover, a trend related to SMGs is digitalisation and in particular the Internet of Things. The Internet of Things is a fast-growing paradigm (Atzori, Lera & Morabito, 2010), concerned with a network in which internet is combined with all kinds of appliances (Townsend, 2013). Consequently, individuals are constantly connected to everything around them. An important aspect of the Internet of Things are sensors connected to ‘things’, which collect big data (Townsend, 2013). In an SMG, smart devices are used to collect data about energy consumption and possible energy savings (Diamantoulakis, Kapinas, & Karagiannidis, 2015). Besides the energy sector, the Internet of Things is applied in other sectors as well, such as the mobility and security sector (Townsend, 2013). It is argued that the Internet of Things can be a game changer, accelerating other developments such as the sharing economy (Jonker, 2015). Meanwhile, the trend of Internet of Things is concerned with pressure on public values, such as privacy, safety, transparency and reliability (PBL, 2017).

Another trend related to SMGs is the increased focus in policy on decentralisation and localisation. In recent years there have been large-scale administrative reforms in the Dutch welfare state, aimed to redistribute individual and collective responsibilities (Thomese & Van Noije, 2016). As a result, individuals received increased responsibility and more aspects of social life are organised at local scale. SMGs fit within the trend of localisation and becoming independent: “It is a way to become less dependent on third parties and to solve things locally with each other. I think that is a trend in our society” (Mulder, personal communication, June 18, 2019). Kortman (personal communication, April 19, 2019) as well, states that SMGs fit within society because of the local generation and use: “I think the best thing is that you do it locally, so in a business park or in a residential area, you organise it in a way that the residents see the benefits. You actually create a local energy company and you are not dependent on the big boys.”

As a result of this decentralisation, management and policy can be adjusted to local circumstances and needs. By bringing policy closer to citizens, they can influence their own living environment and their involvement increases (Thomese & Van Noije, 2016). Moreover, citizens and businesses want early participation in planning processes instead of participation after plans are ratified, so they can make their needs known beforehand (Mayer et al., 2004). This explains the increased use of co-creation in the urban planning sector as well (Oksman et al., 2014). This trend of decentralisation and the related increased participation is in line with an SMG (Mulder, personal communication, June 18, 2019), which asks for the active engagement of local energy-users (Gelazanskas & Gamage, 2014; Skjølsvold & Ryghaug, 2015; Wolsink, 2012). Furthermore, within an SMG, local participants can decide how, where and when they want to generate renewable energy, how they want to organise an SMG and who has control over what. This characteristic of an SMG fits not only with the trend of decentralisation, but with the increased attention on energy-democracy as well (Morris & Jungjohann, 2016). It is argued that the energy transition causes a window of opportunity to democratise the energy sector (Morris &
Jungjohann, 2016). Energy democracy refers to a system in which all stakeholders who are interested in a common good are included in the decision-making process, which increases both the legitimacy and quality of decisions (Szulecki, 2018). The extent to which an SMG will contribute to energy democracy depends on how the SMG will be organised.

Perhaps not as much a ‘trend’, but something that occurs in society and that can be related to SMGs, is the sense of urgency of becoming independent on foreign countries. Previous research shows that citizens want to be independent from foreign countries regarding their energy supply (Van der Lelij, De Graaf & Visscher, 2016). With an SMG, energy can be generated locally, making businesses independent of other countries regarding their energy supply.

Furthermore, SMGs fit within the trend of the sharing economy. In society there is a trend towards new ways of collaborating in the form of exchanging products and services (Jonker, 2014). Examples of the sharing economy are people sharing houses through using Airbnb, people sharing cars using Uber (Kalathil, WU, Poolha & Varaiya, 2016) and people sharing tools using a local platform (Jonker, 2014). SMGs in which energy is shared among several companies fit within this broader trend of the sharing economy (Pitt et al., 2017). Moreover, the SMG assets can be a shared ownership between the participants.

### 7.8 Concluding remarks institutional context

Based on the expert interviews and the literature review, the institutional context in which the diffusion of SMGs takes place is analysed. Several changes in the institutional context are enforcing the diffusion of SMGs in business parks. It is assumed that these institutional changes are indirect drivers for businesses to adopt an SMG. For instance, a lower tax on renewable energy affects the financial benefits and thus influences the perceived outcomes of the adoption. Furthermore, the increased attention on decentralisation and citizen participation might enforce the diffusion, since an SMG will be co-created by different contributors which fit with these trends. On the other hand, some aspects of the institutional context are constraining the diffusion of an SMG in a business park. It is assumed that these constraints are indirect barriers for businesses to adopt an SMG. The current Electricity Law is for instance a barrier for the development, since it forbids the local exchange of energy between small energy users. Hence, the legal framework influences the activities that will be described in the SBM. Moreover, a lack of dynamic pricing makes it less interesting for a business to adopt an SMG and to shift the energy consumption pattern.
Chapter 8. Willingness of businesses to adopt an SMG
8.1 Introduction to chapter

This section provides an answer to the research question: **To what extent are businesses willing to adopt an SMG and which drivers and barriers do they perceive regarding the adoption of an SMG?**

This chapter consists of three parts. First, it is described how willing businesses at business park Apeldoorn Noord are to adopt an SMG (section 8.2). This provides an answer to the first part of the question. Second, the key drivers and barriers derived from the survey are presented (section 8.3). Third, the drivers and barriers are explained in more detail, based on the interviews with the businesses and experts (section 8.4). This chapter ends with some concluding remarks about factors explaining the willingness of businesses to adopt an SMG (section 8.5). The results described in this chapter are based on the interviews with experts, the interviews with businesses at Apeldoorn Noord and the survey conducted at business park Apeldoorn Noord.

8.2 The extent to which businesses are willing to adopt an SMG

With the survey conducted at business park Apeldoorn Noord, the extent to which businesses are willing to adopt an SMG is measured. In total 92 companies located at business park Apeldoorn Noord participated in the survey, which is about 50% of the total amount of businesses (N=182). 77 of these businesses were physically visited by the researcher, since they did not respond to the online survey, which was the preferred data collection method in the first place. 19 of the 92 respondents only filled in the attribute questions about their organisation. They were not willing to answer questions about an SMG. These missing values can be explained since a lot of respondents that do not own the building argued that they as a tenant do not have an interest to invest in an SMG. They argued that the survey should be filled in by the real-estate owner. Besides, some businesses stated that only the head office can fill in questions about the adoption of an SMG. The managers of the local sites did not want to answer in the name of the head office and did not want to bring the researcher in contact with the head office. The non-response is explained in more depth in chapter 11. 73 businesses answered the questions about the willingness to adopt an SMG. Based on the answers of these 73 respondents several conclusions can be drawn.

Adopting an SMG consists of the performance of several sub-activities. In the survey these sub-activities are narrowed down and described as: investing in the generation of renewable energy, renting the roof to others, exchanging energy with other businesses, investing in an EV and changing the energy consumption to another time of the day. This list of activities shows that investing in collective batteries, communication and information technology are left out as an activity, to make the activities more concrete for the businesses. The respondents of the survey revealed the adoption phase of each of the sub-activities. The adoption phases are ‘agenda setting and matching’ and ‘implementation’ (Rogers, 2003). In this research, in the adoption phase ‘agenda setting and matching’ a distinction is made between businesses who are willing to adopt and businesses who are willing to
adopt and have resources to implement the innovation. Hence, the adoption phase of agenda setting and matching is translated in the categories: ‘No, this kind of actions is not in the scope of our business’; ‘No, because of practical or financial reasons our company does not choose this option’; ‘Our company is willing, but does not have the resources’; ‘Yes, our company is willing and has the resources to take action.’ The implementation phase is concerned with performing actions or having concrete plans (Rogers, 2003), which is translated to the category ‘Yes, our company already does this or the plans are already developed’. By analysing which activities are in which adoption phase, insight can be gained in the feasibility of the sub-activities and the performance of an SMG as a whole. Table 5 shows in which adoption phase an SMG and the belonging sub-activities are, according to the companies (N=73).

<table>
<thead>
<tr>
<th>Activity</th>
<th>Yes, our company already does this or the plans are already developed</th>
<th>Yes, our company is willing to do this and has the resources to take action</th>
<th>Our company is willing, but does not have the resources</th>
<th>No, because of practical or financial reasons our company does not choose this option</th>
<th>No, this kind of actions is not in the scope of our business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our company is willing to invest in generating renewable energy.</td>
<td>15</td>
<td>13</td>
<td>26</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Our company is willing to rent the roof to others, so they can invest in solar panels.</td>
<td>3</td>
<td>21</td>
<td>18</td>
<td>9</td>
<td>22</td>
</tr>
<tr>
<td>Our company is willing to exchange energy with the other companies at this business park.</td>
<td>6</td>
<td>16</td>
<td>34</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>Our company is willing to invest in an EV.</td>
<td>23</td>
<td>16</td>
<td>9</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Our company sees possibilities to change the energy consumption to another time of the day.</td>
<td>2</td>
<td>4</td>
<td>17</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Our company is, on first sight, willing to adopt an SMG</td>
<td>5</td>
<td>18</td>
<td>28</td>
<td>6</td>
<td>16</td>
</tr>
</tbody>
</table>

*Table 5 Results survey, willingness to adopt an SMG in absolute numbers (Author, 2019)*
Table 5 shows that from all sub-activities investing in an EV is the most popular action, 23 out of 73 businesses stated to have an EV or to have plans to invest in one. There is no other activity where so many businesses are already in the implementation phase. Changing the time of energy consumption to another time of the day is the least popular action, only 2 businesses are doing this or have plans to do so. The majority of businesses (50 out of 73) state not to see possibilities to shift the time of energy consumption. Furthermore, it is notable that quite a lot of businesses are willing to generate renewable energy (N=26) or exchange energy with other businesses (N=34), but lack resources to do so. In total, 51 of the 73 businesses at business park Apeldoorn Noord is willing to adopt an SMG. Quite a lot of companies, 28 out of 73, are willing to adopt an SMG, but lack resources for the implementation. 18 out of 73 companies state that they are willing to and have the resources to adopt an SMG. Only five companies have made concrete plans to adopt an SMG and are thus arrived at the implementation phase.

Adding up the three columns on the left, provides insight in the number of businesses that are willing to perform the activities, despite the fact that some businesses do not have the resources to do so. Table 6 shows the results.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Percentage willing and has resources + willing but not has resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our company is willing to invest in generating renewable energy.</td>
<td>74%</td>
</tr>
<tr>
<td>Our company is willing to rent the roof to others, so they can invest in solar panels.</td>
<td>58%</td>
</tr>
<tr>
<td>Our company is willing to exchange energy with the other companies at this business park.</td>
<td>77%</td>
</tr>
<tr>
<td>Our company is willing to invest in an EV.</td>
<td>66%</td>
</tr>
<tr>
<td>Our company sees possibilities to change the energy consumption to another time of the day.</td>
<td>32%</td>
</tr>
<tr>
<td>Our company is, on first sight, willing to adopt an SMG.</td>
<td>70%</td>
</tr>
</tbody>
</table>

Table 6 Results survey, willingness to adopt an SMG in percentages (Author, 2019)

The activity that businesses are most willing to perform is exchanging energy with other businesses. 77% of the businesses at business park Apeldoorn Noord is willing to exchange energy. This result is quite striking since this activity is not performed yet. Only 12% of the businesses that are willing to exchange energy, has the resources to do so. Consequently, there is a gap between ‘willing to’ and the ‘actual implementation’ as a result of the lack of resources. Next, 74% of the businesses at Apeldoorn Noord is willing to generate renewable energy. Besides, 66% of the businesses are willing to invest in an EV and 58% of the businesses are willing to rent the roof to others for PV. Changing the energy consumption to another time of the day is not something a lot of businesses are willing to do. Only 32% of the businesses are willing to perform this action. In the interviews, the experts gave insight as to why they think companies are not willing to change the time of energy consumption. First, some businesses might not be willing to shift their daily routines. It is argued that in particular office workers are not willing to work outside office hours (Kortman, personal communication, April 19, 2019;
Wolbert, personal communication, May 2, 2019). Second, it is argued that to change the time of energy consumption, sometimes the production processes need to change, which is often complex and thus expensive. The financial benefits these businesses can achieve by using energy at a ‘cheap moment’, is offset by the high investment costs (Wolbert, personal communication, May 2, 2019). Consequently, for some businesses it is not worthwhile to shift their energy consumption to another time of the day. Third, businesses might not be willing to let smart devices control their energy consumption: “Entrepreneurs find that very annoying because then they lose their independency” (Wolbert, personal communication, May 2, 2019). In total 70% of the businesses located at business park Apeldoorn Noord are willing to adopt an SMG. This means that there are relatively many early adaptors, since usually the percentage of early adaptors is 13.5% (Rogers, 2003). However, the intention and not the actual adoption is measured.

### 8.3 Key drivers and barriers according to the survey

This section describes the drivers and barriers that businesses at business park Apeldoorn Noord perceive regarding the adoption of an SMG. The results are only based on the survey conducted at business park Apeldoorn Noord. 64 businesses at this business park filled in questions about their drivers or barriers to adopt an SMG. The businesses who stated that they are willing to adopt an SMG (N=46) are asked what the drivers are behind their willingness. The businesses that are not willing to adopt an SMG (N=18) are asked which barriers they perceive. Hence, the survey provides insight in both drivers and barriers for the adoption of an SMG in a business park. For each of the drivers and barriers it is calculated which percentage of the businesses agree or strongly agrees with the influence of this driver or barrier on their willingness or lack of willingness. Figure 18 shows a ranking of the drivers that have been most often answered with ‘Agree’ or ‘Strongly Agree’. The top ten are shown. In this thesis it is assumed that each driver that has been answered with ‘Agree’ and ‘Strongly Agree’ by more than 50% of the businesses influences the adoption process. This means that seven drivers influence the willingness of businesses located at Apeldoorn Noord to adopt an SMG.
As is shown in figure 18, sustainability is the most important driver for businesses to adopt an SMG. 83% of the businesses state that the importance of sustainability in their company is a reason to adopt an SMG. Innovation is the second most important driver for the adoption. For 74% of the businesses this is an important factor. Other drivers are the relative advantage of lower energy costs (63%), a confidential use of energy consumption data (59%), a nearby accessible (57%), affordable (54%) energy supply and an improved image of the company (57%). All these seven drivers indicate a perceived relative advantage of an SMG compared to the current situation. This means that the outcomes the businesses are expecting of an SMG are evaluated as positive, influencing their attitude regarding the
adoption of an SMG. Based on the survey it can be concluded that a positive attitude regarding an SMG is the most important driver for the adoption.

18 businesses at businesses park Apeldoorn Noord stated that they are not willing to adopt an SMG. These businesses are asked which barriers they perceive regarding the adoption of an SMG. Figure 19 shows which barriers are most often answered with ‘Agree’ or ‘Strongly Agree’. Only the top ten barriers are showed.

Figure 19 Results survey, barriers for the adoption of an SMG (Author, 2019)

Figure 19 shows that a lack of time to explore the possibilities of an SMG is the most mentioned barrier for the adoption. A lack of time is part of the perceived behavioural control regarding the adoption of
an SMG. This is the only barrier that is important according to the majority of the respondents. 56% of the businesses state that this barrier influences their willingness to adopt. The other barriers are only mentioned by a small amount of businesses as important for the adoption of an SMG. After a lack of time, the most important barriers are long payback times, insufficient knowledge and not seeing the importance of being a pioneer. However, only 39% of the businesses perceive these barriers as important. Most of the statements that were proposed to the respondents were answered with ‘Disagree’ or ‘Strongly Disagree’, which means that these statements did not explain their barriers regarding the adoption of an SMG. Moreover, the businesses that are not willing to adopt an SMG answered a lot of time ‘neutral’. This explains why the percentages in figure 18 are higher than in figure 19.

The most important barrier for adoption is a lack of time to explore the possibilities of an SMG. However, 31% of the businesses who are willing to adopt an SMG state that they have a lack of time as well. Despite their lack of time, they are willing to adopt an SMG. Hence, it can be concluded that they perceive the benefits of adoption as more important than a lack of time. These businesses make a different trade-off between the time they have to invest in the adoption in relation to the benefits.

To conclude, the survey provides insight in seven important drivers for the adoption of an SMG by businesses at a business park, that are all part of the attitude regarding an SMG. The survey led to one important barrier for the adoption of an SMG, which is part of the perceived behavioural control. Other barriers of the top ten, are part of the attitude, subjective norm, perceived behavioural control and innovation attributes (complexity).

### 8.4 In depth analysis drivers and barriers

Based on the interviews with businesses and experts, the list of key drivers and barriers presented in the previous section is elaborated and explained in more detail in this section. This section consists of a description of the drivers and barriers for the adoption of an SMG in a business park, ordered by the concepts of the theoretical framework. Hence, insight is gained in which factors explain the willingness of businesses to adopt an SMG. Table 7 provides an overview of the drivers and barriers that are explained in this section. The table shows that some of the concepts of the theoretical framework are subdivided in more concrete drivers and barriers.
Table 7 Overview drivers and barriers adoption SMG based on interviews and survey (Author, 2019)

8.4.1 Perceived attributes of the innovation

The innovation attributes consist of the relative advantage, complexity, observability, compatibility and trialability (Rogers, 2003). The relative advantage is concerned with the evaluation of the outcomes of the adoption and therefore this driver is in this research combined with the factor ‘attitude’ and explained in the next section. Trialability is not mentioned as a driver in the interviews or survey. Thus, the innovation attributes influencing the willingness of businesses to adopt an SMG are complexity, observability and compatibility.

1. Complexity of technology and organisation

According to the expert interviews, when an innovation is complex and difficult to understand, businesses are less likely to adopt the innovation (Kortman, personal communication, April 19, 2019; Markus, personal communication, April 9, 2019; Mulder, personal communication, June 18, 2019; Ruiter, personal communication, April 8, 2019; Wolbert, personal communication May 2, 2019). The theory of Rogers (2003), stating that ‘complexity’ could hinder the adoption of an innovation, is thus supported in this research. The experts argue that SMGs are difficult to understand which might be a
barrier for the adoption. According to them, businesses want to know exactly where they invest in, before they decide. As a result of the complexity, an SMG can be perceived as non-transparent:

“I think with a smart grid, the most important thing is that it is so complex, technologically. Even I have sometimes difficulties with it. I am working with those companies who design it, but it is like choosing a healthcare policy or something; it is actually rather opaque…” (Kortman, personal communication, April 19, 2019).

Complexity does not only refer to the technology, but to the organisation of an SMG as well. Mulder (personal communication, June 18, 2019) argues that it is so complex to ensure that all businesses benefit from an SMG, that it is in most situations not worth it to focus on this innovative energy initiative. Kortman (personal communication, April 19, 2019) has a more positive attitude and indicates that the solution is to organise an SMG as simple as possible. The expert does not exactly know how this should be done, but starting with PV will decrease the complexity of an SMG in the eyes of the businesses. Moreover, the issue of complexity can be limited through good information and communication about the project (Ruiter, personal communication, April 8, 2019). Even though complexity is according to the experts a barrier for the adoption of an SMG, the survey shows that only 13% of the businesses at Apeldoorn Noord think that an SMG is complex to use. Hence, it can be concluded that for the specific case of Apeldoorn Noord, complexity is not a barrier for the adoption.

2. Observability

According to the interviews with experts and businesses, businesses are more likely to adopt an innovation when they can ‘see’ how it works, which complies with the Diffusion of Innovation Theory (Rogers, 2003). The observability can be increased when other businesses at the same business park adopt an SMG, when pilots are developed at other business parks or when design teams make visible how an SMG works and will look like (Kortman, personal communication, April 19, 2019). The survey revealed that 15% of the businesses at Apeldoorn Noord are only willing to adopt an SMG if an SMG is first developed at another business park and positively experienced. Besides, 36% of the businesses argue that the successful implementation elsewhere is important, but not a crucial driver for the adoption of an SMG. In total, more than half of the businesses state that the observability of an SMG at another business park is a driver for the adoption.

3. Compatibility with previous introduced ideas

Compatibility is concerned with values and beliefs, previously introduced ideas and needs (Rogers, 2003). The in-depth interviews with the businesses at Apeldoorn Noord show that businesses are more likely to adopt an SMG when it is compatible with previously introduced ideas. In business park Apeldoorn Noord a few years ago the businesses collaboratively invested in an optic fiber project. Consequently, the businesses are used to organising things collaboratively. All the five interviewed entrepreneurs state that this is a driver to take collective action again.
One of the businesses at Apeldoorn Noord argues in the interview: “As a business park we have developed our own fiber network here, so why won’t we develop our own energy system as well?” (personal communication, June 6, 2019). Thus, businesses are more likely to adopt an SMG when collaboratively acting is compatible with previous introduced plans.

**8.4.2 Critical mass**

According to Mahler and Rogers (1999) and Marwell and Oliver, (1993) the decision to adopt an innovation depends on the amount of people who adopt the innovation, since when the adoption pool grows, the benefits of the innovation for the individual adopter increase. At a certain point the critical mass is achieved, after which the innovation is self-sustaining. Hence, it is expected that the critical mass is a driver for the adoption of SMGs in business parks. Nevertheless, in the interviews with the experts and businesses it is not explicitly mentioned that the presence of a critical mass is a driver for the adoption of an SMG. On the contrary, it is argued that the diffusion of an SMG can easily start small: “I can imagine that you start with two companies and that there is a third company that connect later and that you gradually grow.” (Mulder, personal communication, June 18, 2019). There is not a specific amount of businesses that must adopt an SMG before the innovation will be self-sustaining (Mulder, personal communication, June 18, 2019). In the interviews it is argued that a business can perceive ‘enough’ benefits to adopt an SMG, even if a critical mass is not achieved. However, it is argued by all experts that the amount of other businesses adopting an SMG is a driver for the adoption. Hence, it can be concluded that the size of the participation pool is a driver for the adoption of an SMG by businesses at a business park. Therefore, in this research, instead of the concept ‘critical mass’ the concept ‘size participation pool’ is perceived as a driver for the adoption. From the survey it can be concluded that businesses are only willing to adopt an SMG if 53 (mean of all the answers) other businesses adopt an SMG as well. This means that 29% of the businesses located at Apeldoorn Noord must be willing to adopt an SMG, to persuade the other companies. Striking is the large variation between the answers; 10% is willing to adopt an SMG without any other companies adopting and 10% only adopts an SMG if all the other companies adopt an SMG as well. The first 10% of the businesses can be seen as the early adopters, whereas the latter 10% of the businesses are the laggards. These percentages more or less comply with the Diffusion of Innovation Theory, stating that 13,5% are the early adopters and 16% are the laggards (Rogers, 2003). The size of the participation pool is strongly connected with the subjective norm, which is further explained in section 8.4.4.

**8.4.3 Attitude**

The attitude represents the evaluation of the expected outcomes of adopting an SMG. Therefore, in this research, the attitude regarding the adoption is taken together with the innovation attribute ‘relative advantage’ described by Rogers (2003), since both are concerned with the evaluation of the expected outcomes. Based on the theoretical framework, the attitude will depend on concerns with the environment, economic advantages, image and enthusiasm for technology (table 2 chapter 3). The former three are confirmed in this research. Besides, three additional drivers influencing the attitude regarding the adoption of an SMG are revealed by the empirical data collection in this research.
1. Sustainability and innovativeness

The contribution of SMGs to the sustainability level of the company is mentioned by almost all respondents of the survey as a driver for the adoption of an SMG (83%). This is in line with literature about drivers to invest in sustainable energy (Busch & McCormick, 2014; Gui et al., 2017) and with literature about drivers to invest in local energy communities in general (Hajer, 2011; Naus et al., 2014; Oteman et al., 2017). In contrast, the experts argued in the interviews that businesses do not care about sustainability, since the benefits of CO₂ emissions reduction are for everyone and not just for the direct businesses who adopt an SMG. This might lower the incentive for businesses to adopt an SMG. It could be possible that the businesses provided a socially desirable answer or that the experts have drawn the wrong conclusions. The in-depth interviews with the businesses at Apeldoorn Noord provided three reasons why companies mention sustainability as a driver for the adoption of an SMG. First, some respondents explicitly mention that they are willing to adopt an SMG because in that way they can contribute to national objectives regarding CO₂ emissions reduction. Second, sustainability is important because of certain certificates the company might receive. Third, sustainable measures could improve the image of the company. Three of the five interviewed businesses explicitly argue that they are willing to adopt an SMG because CSR is important in their business branch, leading to a higher ranking with tenders.

The survey shows that next to sustainability, innovation is an important driver for the adoption of an SMG by businesses. An SMG could contribute to the innovativeness of the company. The in-depth interviews with the businesses at Apeldoorn Noord show that businesses find it important to keep up with the new developments. “We want to be frontrunners or just behind the frontrunners. But we want to be open minded towards new developments. We do not want to be reticent about that.” (Entrepreneur, personal communication, July 2, 2019).

2. Lower energy bill

Financial benefits achieved by a lower energy bill or by the generation of revenues of selling the renewable energy, are the most important drivers for businesses to adopt an SMG according to the experts. “Companies are always looking for cost savings, and if an SMG leads to lower energy costs there is a greater chance that they will participate” (Wolbert, personal communication May 2, 2019).

The general principle within the business culture is to lower the costs and to increase the benefits. If the adoption of an SMG contributes to this, it fits within the usual decisions businesses make (Kortman, personal communication, April 19, 2019; Wolbert, personal communication, May 2, 2019). In addition, the decrease of the energy bill contributes to the realisation of an affordable energy system. The survey reveals that 63% of the businesses at Apeldoorn Noord are willing to adopt an SMG because they expect it will lower their energy bill. To what extent they expect a lower energy bill differs between the companies. The results are shown in table 8.
The energy bill must decrease with more than 10% 
The energy bill must decrease with at least 10% 
The energy bill must stay the same 
The energy bill may increase until 10% 

| Percentage | 31% | 31% | 35% | 3% |

Table 8 Results survey, desired change energy bill (Author, 2019)

35% of the businesses state that the energy bill can stay the same, 62% of the businesses accept a lower energy bill and 3% of the businesses accept a higher energy bill. It can be concluded that to get the majority of the companies at business park Apeldoorn Noord to adopt an SMG, the energy bill of companies must decrease with at least 10%. It is quite striking that a lower energy bill is, according to the survey, the third most important driver while only 2% of the businesses state that the energy costs are an important cost item in their business.

3. A reliable energy supply

These days it is important for businesses to have access to energy. None of the interviewed businesses can still carry out their work without energy. Therefore, it is important that they have access to a reliable energy system. The interviewed businesses at Apeldoorn Noord have experienced energy outages and perceived it as quite dramatic: "It was actually only ten minutes or fifteen minutes. Then you will find out on a working day what kind of disruption that just causes. The work stopped" (Entrepreneur, personal communication, July 2, 2019). An SMG could contribute to the reliability of the energy system, since an SMG could prevent energy disruptions by balancing the energy supply and demand on the electricity grid (Kortman, personal communication, April 19, 2019; Mulder, personal communication June 18, 2019; Ruiter, personal communication, April 8, 2019; Wolbert, personal communication, May 2, 2019). However, if the SMG is connected to the regional grid, the energy disruption will, without an emergency power supply, also be felt at the business park. 35% of the respondents of the survey are willing to adopt an SMG because of the increased long-term reliability of the energy system. This percentage means that a reliable energy system is not one of the ten most important drivers for the adoption of an SMG for businesses. However, it can be concluded that for part of the businesses the contribution of an SMG to a reliable energy system is a driver. According to the experts, a lot of businesses lack knowledge about the possible energy outrages in the future. Therefore, it is assumed that as a result of a lack of knowledge, businesses underestimate the risk of energy outages and thus the importance of a reliable energy provision in the future. This could explain why only 35% of the businesses perceive the contribution of an SMG to a reliable energy system as a driver for the adoption.

4. An improved image of the company

The image of a company is mentioned by several experts as an important driver for businesses to adopt an SMG. Moreover, 56% of the businesses at Apeldoorn Noord are willing to adopt an SMG because of the positive effect adoption has on the image of the company. It is expected that adopting an SMG will give the businesses a greener, more sustainable image. The contribution of an SMG to an improved image of a business, is a more important driver when the company delivers to consumers instead of
other businesses (Markus, personal communication, April 9, 2019; Wolbert, personal communication, April 9, 2019). Since none of the businesses of Apeldoorn Noord only deliver to consumers, this assumption of the experts cannot be tested by the survey results. Furthermore, the image of a business is a more important driver for the adoption when the business participates in tender processes in which the CO₂ performance ladder is one of the factors determining the winner (Ruiter, personal communication, 8 April, 2019).

5. Energy independency
It has been mentioned several times in the interviews that businesses appreciate it when they become independent from others regarding their energy supply. This mainly concerns the independency of large energy suppliers and foreign countries. 40% of the businesses at Apeldoorn Noord state that energy independency is a driver for the adoption. This means that this factor is in the top ten of most important drivers. One of the businesses at Apeldoorn Noord argues in the interview:

“This of course also has to do with the fact that we want to be independent of the countries around us. We don’t want gas to be imported from abroad, so you want to get it from your own country. Well if we close Groningen we will have to do something else.”  (personal communication, June 13, 2019).

An advantage of energy independency is that the energy bill becomes more transparent, which gives the company insight in what it is paying for (Entrepreneur, personal communication, June 6, 2019).

6. Privacy and data
One of the outcomes of an SMG is concerned with the way in which the energy consumption data is used. For a well-functioning SMG other businesses or a third party must get insight in the energy data (Mulder, personal communication, June 18, 2019). For the diffusion process it is important that this data is used correctly. Privacy issues are both mentioned in the expert interviews (Markus, personal communication, April 9, 2019) as in the literature (Naus et al., 2014; DEA, 2012) as a barrier for businesses to adopt an SMG. It is important to carefully consider how and where which information from smart meters and other sensors is stored and processed, to overcome unwanted effects. If this is done, privacy will not be a barrier for the adoption of SMGs (Mulder, personal communication, June 18, 2019). This argument of Mulder is in line with the results of the survey. The confidential use of energy data, is for 59% of the businesses, a driver for the adoption. Only one company states that it is afraid that an SMG invades the privacy of the company. Moreover, only 8% of the businesses at Apeldoorn Noord state that it is important that the energy data is not made public, otherwise they will not adopt an SMG. Based on these facts it can be concluded that privacy is not a barrier for the adoption of an SMG in business park Apeldoorn Noord.

8.4.4 Subjective norm
The subjective norm can be a driver for the adoption of an SMG by businesses at a business park. According to the theoretical framework, the subjective norm can be divided in the social context, local context and politics (table 2 chapter 3). In this research the subjective norm consists of pressure from clients, the choice of other businesses and the political context. According to the survey these are not important drivers for the adoption of an SMG by businesses. However, the interviews show that the
subjective norm is a driver for the adoption of an SMG in business parks and therefore these drivers are nevertheless explained in this section.

1. Pressure from clients

About 30% of the businesses at Apeldoorn Noord feel pressure from clients to take sustainability measures. The in-depth interviews with the businesses show that some businesses have clients who specifically ask about sustainability, while other businesses (e.g. automotive) argue that their clients do not care about sustainability at all. One business states that his clients are explicitly asking for sustainability labels and that if an SMG contributes to this label, this would be a driver to adopt an SMG (Entrepreneur, personal communication, June 6, 2019). In contrast, another business at Apeldoorn Noord states: “In our sector sustainability is not an important value. People only care about the prices and not about how sustainable the reparation of their car is performed.” (personal communication, June 13, 2019). Thus, pressure from clients as a driver for the adoption depends on the sector in which the business operates. Moreover, pressure from clients is often not the most important driver to adopt an SMG. Nevertheless, in combination with a profitable business case, it can enable the diffusion of SMGs in business parks (Kortman, personal communication, April 19, 2019).

2. Choice of other businesses

In section 8.4.2 it is already mentioned that the choice of other businesses to adopt an SMG affects the size of the participation pool, which is a driver for the adoption. In this paragraph the importance of the choice of other businesses is explained in more depth. The importance of the adoption by other businesses can be the result of the fear of missing out. Wolbert explains this by referring to the ‘postcode loterij gevoel’ (zip code lottery feeling) (personal communication, May 2, 2019). According to him, businesses might be afraid that they miss a good opportunity if other businesses adopt an SMG while they do not. Hence, the choice of other businesses put pressure on the individual businesses. Another reason why the choice of other businesses is a driver, is that if other businesses adopt, they can give the right example. If businesses see that an SMG works, they will be more likely to adopt it. As is stated by one of the interviewed businesses at Apeldoorn Noord: “Perhaps it is an idea to say let’s just pick two companies and they will organise an SMG together. Because if you have an example it will always work better.” (personal communication, June 13, 2019). Furthermore, this citation shows the relation between the observability and the choice of other businesses. The first movers who adopt an SMG do not only give an example, it is argued that they should take the role of an ambassador as well, stimulating other businesses to adopt an SMG. The importance of these ambassadors or ‘pioneers’ is mentioned by Kortman (personal communication, April 19, 2019):

“Actually within those business parks or park management organisations you need entrepreneurs, daring to get that off the ground, because it is quite complex. Most businesses drop out because of the complexity and then you need to motivate those companies to participate. So you need very driven and daring people.”

Hence, it can be concluded that ambassadors can reduce the perceived complexity. Moreover, businesses feel more pressure from other businesses, than from a (exploiting) party from the outside
they do not know (Kortman, personal communication, April 19, 2019). To summarise, the choice of other businesses is a driver for the adoption of an SMG because of three reasons: fear of missing out, having an example and ambassadors stimulating others. Consequently, businesses will be wanting to meet the subjective norm at the business park.

3. The political context

The interviews with the businesses at Apeldoorn Noord show that several businesses are willing to adopt an SMG because they want to contribute to national objectives regarding CO₂ emissions reduction. All of the interviewed businesses at Apeldoorn Noord acknowledge the problem of climate change and state that they are therefore willing to perform actions to enforce the energy transition. According to them it is becoming more and more the norm to reduce CO₂ emissions. “It is all about the climate... participating is a little help.” (Entrepreneur, personal communication, June 13, 2019). None of the survey questions were concerned with the political context. However, in the survey, several companies added in the open field that a driver for the adoption is the contribution to national energy objectives. Based on the interviews with the businesses and the fact that several respondents in the survey mention it as an additional driver, it can be concluded that the political context is a driver for the adoption of an SMG. This is in line with the theory of Busch and McCormick (2014) explaining that political resolution is part of the subjective norm, influencing the willingness of agents to invest in renewable energy.

8.4.5 Perceived behavioural control

The perceived behavioural control is concerned with the possibility to have resources to perform a certain action (Ajzen, 1991). According to the theoretical framework, the perceived behavioural control consists of knowledge, time, financial resources, social capital, feeling responsible and ease of use/understanding the innovation (table 2 chapter 3). In this research the perceived behavioural control consists of knowledge, time, financial resources and the control by a park management organisation. The other elements of the perceived behavioural control mentioned in table 2 are not found in this research or combined with another driver/barrier.

1. Knowledge

It is stated by Rogers (2003) that the first step of the adoption of an innovation is creating awareness about the innovation, which is related to the availability of knowledge. Bomberg and McEwen (2012) argue that a barrier to adopt an SMG is the lack of accurate knowledge, which is supported in this research. In the interviews the importance of having knowledge is mentioned multiple times. The lack of knowledge concerns information about what an SMG exactly is and how it works (see complexity) and knowledge about what the project plans are and what is expected from the businesses (Ruiter, personal communication, April 8, 2019). In the survey, a lack of knowledge is in the top three most important barriers. Exactly 50% (32 out of 64) of the respondents of the survey argue they do not have enough knowledge about SMGs to adopt one. However, most of these businesses (N=25) are despite the fact that they lack knowledge, willing to adopt an SMG anyway. Thus, it can be concluded that a lack of knowledge is not a crucial barrier for the adoption of an SMG by businesses at Apeldoorn Noord.
2. Time

A lack of time is a barrier for the adoption of SMGs by businesses since the complexity of an SMG demands in-depth research of what an SMG is. There is a paradox between wanting to know everything about an SMG and not having time to do so:

“You really have to make it very clear what the pros and cons of an SMG are for those companies, what they really benefit from it. They don’t have time to delve into it, so there is a contradiction.” (Kortman, personal communication, April 19, 2019).

According to the survey, a lack of time is the most important barrier for the adoption of an SMG. 47% of the businesses at business park Apeldoorn Noord state they do not have enough time to delve into the concept of SMGs. 34% of the businesses answered ‘neutral’. Only 19% of the businesses do have enough time to delve into the concept of SMGs.

3. Financial resources

With a lack of financial resources a participant might have the perception to not have control over a certain action, and therefore he might not be willing to perform that action (Ajzen, 1991). According to the expert interviews a lack of financial capability to invest in and to maintain an SMG is a barrier for the diffusion of SMGs. From the five interviewed entrepreneurs at business park Apeldoorn Noord only one argues they do not have enough financial resources to adopt an SMG. The survey revealed that 38% of the companies at business park Apeldoorn Noord have enough financial resources to adopt an SMG. Since 70% of the businesses are willing to adopt an SMG, a large part of the companies that are willing to adopt an SMG does not have the financial resources to do so. Hence, a lack of financial resources is not a very important barrier for the adoption of an SMG in business park Apeldoorn Noord.

4. Park management organisation

The presence of a park management organisation is a driver for the adoption of an SMG. With a park management organisation the thresholds for a business to adopt an SMG are lowered, because if a park management organisation takes control, individual businesses have to make less effort themselves: “Then they can join a train that someone else has put on track and getting into something that already exists is always easier than coming up with something yourself.” (Wolbert, personal communication, May 2, 2019). A park management organisation could play a role in decreasing cognitive barriers, by bringing stakeholders together and providing information about possible subsidies for example (Kortman, personal communication, April 19, 2019; Mulder, personal communication, June 18, 2019). It is argued that a park management organisation is the right institution to perform these tasks, because businesses are willing to give the control over their energy to a local institution they trust (De Leeuw, personal communication, August 22, 2019). Moreover, the presence of a park management organisation could be a driver for the adoption since the presence of a park management organisation often means that there is already something collectively organised. To summarise, a park management organisation could increase knowledge and decrease the needed time to delve into SMGs, and therefore it is a driver for the adoption of an SMG. However, the businesses at the business park need to have the feeling that the organisation acts in their interest.
(Wolsink, 2012). 50% of the businesses at Apeldoorn Noord that are willing to adopt an SMG state that trust in the park management organisation is a driver to adopt an SMG. Besides, the survey shows that the trust in a park management organisation is higher than in a commercial party.

### 8.4.6 Trade-off between perceived risks and returns

The willingness to invest in renewable energy depends on the perceived risk and return (Wüstenhagen & Menichetti, 2012). In this thesis it is researched if and how the trade-off between the perceived risk and return affects the willingness of businesses to adopt an SMG at business park Apeldoorn Noord. First, it is assumed that the perceived risk influences the willingness of businesses to adopt an SMG. The greater the risks, the less businesses will be willing to adopt an SMG. The risk is concerned with the possibility of getting the invested money back (Wüstenhagen & Menichetti, 2012). In general, the interviewed businesses at Apeldoorn Noord do not mention risks regarding the investment as a barrier for the adoption of an SMG. However, one business argues that if participants withdraw the SMG, he is afraid he would lose financial returns on his investment (personal communication, July 2, 2019). Furthermore, it is argued that some businesses are more risk averse than others, from which it can be concluded that the perceived risk differs between the businesses (Kortman, personal communication, April 19, 2019). In the interviews with businesses or experts, no other statements are made about possible risks and their influence on the adoption. Next to the perceived risks, the investment decision depends on the perceived return. The return on the investment in SMG assets takes place in the form of a lower energy bill. After a certain time, the investment is earned back as the result of a structural lower energy bill. Section 8.4.3 provided insight in the preferred return of the businesses at business park Apeldoorn Noord.

The return on an investment does not only consists of the amount of money, but on the payback time as well. Hence, the payback time influences the willingness of businesses to invest in an SMG. According to the experts, there are no concrete insights in the payback time of SMG assets. However, there are insights in the payback time of PV, which is a crucial asset in SMGs (Mulder, personal communication, June 18, 2019; Wolbert, personal communication, May 2, 2019). The payback time of investments in PV is often between five and seven years, whereas the average payback time of business investments is usually between one and two years or even less (Wolbert, personal communication, May 2, 2019). Therefore, according to the experts, a lot of businesses are not interested to invest in PV, if they can invest in, for instance, their own machine too which has a shorter payback time. Nevertheless, in the interviews with the businesses at Apeldoorn Noord it appeared that businesses accept a longer payback time for sustainable investments. One of the businesses argues: “Most investments in materials, resources, machines, cars, are paid back in four to five years. For me, with green investments this is doubled, but not more than that” (personal communication, June 13, 2019). Consequently, based on the in-depth interviews with the businesses it can be concluded that the payback time is not a barrier for the adoption of an SMG. The survey provided additional insights in the preferred payback time by businesses at business park Apeldoorn Noord. The results are shown in table 9. Table 9 shows that most businesses will only adopt an SMG if the payback time is shorter.
than five years, 31% of the businesses accept a payback time longer than ten years and 7% accept a payback time longer than 15 years.

<table>
<thead>
<tr>
<th>Percentage</th>
<th>The payback time must be shorter than 5 years</th>
<th>The payback time must be shorter than 10 years</th>
<th>The payback time must be shorter than 15 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>62%</td>
<td>31%</td>
<td>7%</td>
<td></td>
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</tbody>
</table>

*Table 9 Results survey, preferred payback time (Author, 2019)*

Wüstenhagen and Menichetti (2012) argue that the perceived risk and return is influenced by energy policy. An example of an energy policy measure influencing the trade-off between the perceived risk and return is subsidy. 31% of the businesses at Apeldoorn Noord are only willing to adopt an SMG if it receives a subsidy to lower the investment. On average, the businesses at business park Apeldoorn Noord expect a subsidy of at least 36% of the investment money. The experts argue as well that a subsidy will be an important driver for the adoption. Whether a subsidy for the diffusion of SMGs in business parks will be made available is a political choice (Mulder, personal communication, June 18, 2019). Besides, an increased energy tax or a CO₂ tax for businesses are important drivers for some businesses to adopt an SMG. According to 18% of the businesses at Apeldoorn Noord these are drivers for the adoption. However, this means that most of the businesses state that these measures are not of decisive importance. Investment rebates are mentioned as another energy policy measure influencing the investment decision (Kortman, personal communication, April 19, 2019). Hence, it can be concluded that energy policies indeed influence the trade-off between the perceived risk and return of at least some businesses. However, the interviews show that much energy policy is aimed at large companies and not at small and medium-sized businesses.

Furthermore, next to the lower energy bill, the payback time and energy policy, the investment decision in an SMG depends on prior investments, which complies with the investment theory on renewable energy (Wüstenhagen & Menichetti, 2012). It is argued by experts and the businesses themselves that if businesses have just invested in conventional energy assets, they are less willing to invest in an SMG.

“So the moment there is a new installation, a brand-new central heating boiler installed, businesses are less inclined to make another investment than if they have very old installations that need to be replaced anyway. They have often included a budget to compensate for this in the coming years. This budget can be used to switch to this technology (SMG). So that is a determining factor.” (De Leeuw, personal communication, August 22, 2019).

As a result of the different elements influencing the trade-off between the perceived risk and return, the investment decision will differ between the businesses. As is argued by Kortman (personal communication, April 19, 2019):

“So it’s all more complex. We can’t say it’s money... you have to dive further into it. For every company ‘money’ means something else? How high is their energy bill? What is their profit? Do they receive a tax deduction? Subsidy? It is not the same for every company.”
It can be concluded that the trade-off between the perceived risks and returns influences the willingness of businesses to adopt an SMG. A lower energy bill, lowered risks, a short payback time, subsidy, taxes, investment rebates and compatibility with prior investments are all drivers for businesses to adopt an SMG.

**8.4.7 Organisational characteristics**

According to several scientists, organisational characteristics affect the willingness of businesses to adopt an innovation (Greenhalgh et al., 2004; Hameed et al., 2012; Rogers, 2003). Top management support, organisation size, expertise (Hameed et al., 2012), norms and procedures within an organisation (Greenhalgh et al., 2004) are mentioned as influencing factors. The importance of expertise is derived from the interviews with the businesses at Apeldoorn Noord as well. One of the interviewed businesses at Apeldoorn Noord explains:

“Looking from our profession, we have to deal with that. Recently, several times it is said to us by the municipality and province that we must be one of the designers of the energy transition since we can implement measures.” (personal communication, July 2, 2019).

This business explains that he feels responsible to be an early adaptor because of his expertise in the energy sector. The other factors mentioned in the literature did not appear in the interviews. However, other organisational characteristics came to the surface. It is for instance argued in the expert interviews that the amount of the monthly energy bill influences the willingness of businesses to adopt an SMG. It is assumed that with a high energy bill businesses are more likely to adopt an SMG, since they can probably achieve a higher relative advantage. Three out of the five interviewed businesses at Apeldoorn Noord state that they have a relatively low energy bill, which is for them a barrier for the adoption of an SMG. One of them states: “If I’m very honest to you, I must say that a lower energy bill is not a driver for me. Our energy costs are not very high.” (personal communication, June 6, 2019).

Furthermore, it is argued that ‘business to business’ companies are less likely to adopt an SMG compared to ‘business to consumer’ companies (Wolbert, personal communication, May 2, 2019). This is argued since it is assumed that consumers care more about the sustainability level of a company than other businesses. Moreover, experts state that companies renting property are less inclined to adopt an SMG compared to businesses owning the business property (De Leeuw, personal communication, August 22, 2019; Kortman, personal communication, April 19, 2019; Markus, personal communication, April 9, 2019; Ruiter, personal communication, April 8, 2019; Wolbert, personal communication May 2, 2019). According to the experts this organisational characteristic is the most important barrier for businesses to adopt an SMG (Appendix 6). Businesses who rent the building are less inclined to invest in SMG assets, since they will not benefit from the investment in the property. The increased value of the property as a result of the investment goes to the real-estate owner. Hence, businesses renting property argue that the real-estate owner is responsible for the adoption of an SMG. “You hear quite often: I want to invest but I can’t because I do not own the property” (Ruiter, personal communication, April 8, 2019). On the other hand, the benefits of a lower energy bill are often for the businesses and not for the real-estate owner (De Leeuw, personal communication, August
22, 2019; Ruiter, personal communication, April 8, 2019). This shows that the adoption of an SMG is concerned with a responsibility issue. In other words, businesses who rent the building feel less responsible to adopt an SMG, which is a barrier for the adoption.

Moreover, it is argued that businesses who have decision-making authority are more likely to adopt an SMG than business who do not have decision-making authority. Businesses that are part of a large company are less likely to adopt an SMG when they are not allowed to make independent decisions (Wolbert, personal communication, May 2, 2019). The organisational characteristic of ‘decision-making authority’, is concerned with the possibility to have control over the behaviour and therefore it is part of the perceived behavioural control as well. The last organisational characteristic mentioned by experts is a flexible energy consumption pattern as a driver for the adoption of an SMG (Mulder, personal communication, June 18, 2019). Businesses with a flexible energy consumption pattern have more possibilities to change their consumption pattern and to profit from SDR.

Based on the literature analysis and the in-depth interviews, a few organisational characteristics are included in the survey, to research if these characteristics are drivers for the adoption of an SMG by businesses. The researched organisational characteristics are organisation size, ownership of the property, decision-making authority, age of the company, client segment, amount of the energy bill, the importance of the energy bill and the possibility to shift the energy consumption. For each of these characteristics it is researched if there is a significant relation with the willingness of businesses to adopt an SMG. The questions about organisational characteristics contain nominal or ordinal variables and therefore multiple statistics tests are performed. An explanation of the performed tests is described in Appendix 7. Based on the survey, with one exception, no significant relations between the organisational characteristics and the willingness to adopt an SMG can be concluded (Appendix 7). The assumptions made by the experts are reflected in the frequency tables in percentages, but the differences are not large enough to indicate a significant relation between the organisational characteristics and the willingness of businesses to adopt an SMG. The exception concerns the flexibility of the energy consumption. Based on the survey it can be concluded that there is a significant relation between businesses who perceive the possibility to shift their energy consumption to another time of the day and their willingness to adopt an SMG (Appendix 7). From the businesses that have the possibility to change their energy consumption, 91% is willing to adopt an SMG and only 9% is not willing to adopt. The p-value of the Pearson Chi-Square test is 0.015, which is smaller than the significance level of 0.05, meaning that there is significant relation (Field, 2009). The Cramer’s V is 0.317, from which it can be concluded that there is strong relation between the possibility to shift the energy consumption and the willingness to adopt an SMG.

Ownership of the property is not a driver for the adoption of an SMG according to the static analysis of the survey (Appendix 7). However, businesses who refused to fill in the survey were mainly renters arguing that because they are renters, they are not interested to fill in a survey about SMGs. Moreover, 80% of the businesses that did not complete the survey, do not own the property. Hence, based on the fact that a lot of businesses not owning the property were not even willing to answer questions about ‘energy’, since they do not feel responsible for it, it is assumed that ownership of the property
is a driver for the adoption of an SMG in business parks. From the other perspective, not owning the property is a barrier for the adoption. Since 65% of the businesses that filled in the survey (N=92) do not own the building, this barrier might be important for the diffusion of an SMG in business park Apeldoorn Noord. Thus, because most renters did not want to fill in the survey, no significant relation between the organisational characteristic of ‘ownership of the property’ and the willingness to adopt an SMG is found. However, since experts mention property ownership as the most important barrier (Appendix 7) and renters refused to fill in the survey, it can be concluded that not owning the property is a barrier for the adoption of an SMG in a business park. To conclude, based on the literature analysis and the interviews, several organisational characteristics are drivers for the adoption of an SMG. However, only the possibility to shift the time of energy consumption is a driver according to the statistical analysis of the survey.
This section shows that 70% of the businesses at business park Apeldoorn Noord are willing to adopt an SMG. Multiple drivers and barriers for the adoption of an SMG by businesses at a business park can be derived from the in-depth interviews with experts, the in-depth interviews with businesses at Apeldoorn Noord and the survey. It can be concluded that a positive attitude regarding the outcomes of an SMG is the most important driver for businesses to adopt an SMG. Businesses must perceive the expected outcomes of an SMG as positive, to put adopting an SMG on the agenda. In particular, the increased sustainability, the increased innovativeness of the company, the expected lower energy bill, a greener image of the company and the increased energy independency are mentioned in the interviews and survey as drivers influencing the attitude of businesses. Based on this list of drivers it can be concluded that the willingness of businesses to adopt an SMG depends on multiple value creation; e.g. increased sustainability emphasises ecological values, a lower energy bill emphasises financial values and increased energy independency emphasises a social value. The drivers found in this research thus relate to the argument of Gui et al. (2017), that the support of an SMG depends on economic, social and environmental reasons.

The subjective norm, which in this research consists of pressure from clients, the choice of other businesses (participation pool) and political pressure, is of less influence for the adoption of an SMG. Nevertheless, pressure from clients and the choice of other businesses are mentioned multiple times in the interviews as a driver for the adoption. However, from the interviews and the survey it can be concluded that on average the subjective norm is less important than gaining financial and ecological benefits. When it comes to the perceived behavioural control, the presence of a park management organisation is relevant, since this organisation can unburden individual businesses. The biggest barrier for the diffusion of SMGs is, according to the survey, namely the lack of time to delve in the concept of SMGs. Businesses want to delve into the different steps before they adopt something, but some of them argue they do not have time to do so. The park management organisation can take part in this task, relieving the businesses. More obvious drivers for the adoption of an SMG influencing the perceived behavioural control are having access to knowledge and financial resources.

Furthermore, some organisational characteristics influence the willingness of businesses to adopt an SMG. In particular the flexibility of the energy consumption and the ownership of the property are drivers for the adoption. Finally, based on the interviews, three innovation attributes are drivers for businesses to adopt an SMG: complexity, observability and compatibility with previous introduced ideas.
Chapter 9. Towards an SBM for SMGs
9.1 Introduction to chapter

This chapter explains how an SBM for an SMG in a business park can be co-created. Hence, this chapter provides an answer to the question: *How do the building blocks of an SBM work for the organisation of an SMG?* The framework of building blocks is based on the Cloverleaf Model of Jonker (2014) and the success factors of co-creation (Ansell & Gash, 2008). Both theories provide stepping stones for the development of an SBM. The Cloverleaf Model (Jonker, 2014) describes ‘what’ should be included in the SBM. The success-factors of co-creation (Ansell & Gash, 2008) describe ‘how’ the SBM and the further development of an SMG should be organised. For each of the building blocks it is described which aspects are important for the development of an SMG in a business park. The results described in this chapter are mainly based on the outcomes of the workshop session, adjusted with the results of the in-depth interviews, survey and literature review, to make it a coherent story.

According to the Cloverleaf Model (Jonker, 2014), the building blocks of an SBM are principles, values, community structure and design structure, which together lead to the value proposition. In this research, the principles and values are not described as separate building blocks, however they are integrated in the other building blocks. Furthermore, the building block ‘design structure’ is split-up in the building blocks ‘activities’ and ‘tools’. The empirical-data collection showed that these two categories need in-depth research before SMGs can diffuse in business parks. First, in this chapter the community structure is outlined, explaining who is involved in the development of an SMG (section 9.2). This is followed by a description of the interests of the community members, which leads to a description of the value proposition of an SMG in business park Apeldoorn Noord (section 9.3). Afterwards, it is described which activities community members must perform to realise the value proposition (section 9.4). Then, the tools that are needed to perform the actions are explained (section 9.5). The last described building block of the SBM are the risks (section 9.6). Afterwards, an overview of the building blocks of an SBM for the development of an SMG in a business park follows (section 9.7). Next, the embeddedness of co-creation success factors in the SBM (section 9.8) and in the workshop session (section 9.9) is explained. This chapter ends with a brief conclusion of the most important research findings of the SBM (section 9.10).

9.2 Community structure

The community described in the SBM consists of all parties that are sharing the benefits and that are collectively taking action to develop an SMG in a business park. The community structure is concerned with who takes what part in the community and who plays which role (Jonker, 2014). In this research, the community structure is formulated based at a ranking of important community members and the roles of these community members.
To describe the community structure, first it is decided which stakeholders are involved in the development of an SMG in business park Apeldoorn Noord. The workshop participants argued about which stakeholders can take action to develop an SMG in business park Apeldoorn Noord. A distinction is made between conditional partners (voorwaardelijk), supporting partners (versterkend) and additional partners (mooi meegenomen) (Jonker, 2014). The participants of the workshop are asked to describe which stakeholders they think are the most important and which stakeholders are of less importance. The participants of the workshop session were split up in two groups and filled in the actor map. Figure 20 shows the results.

Figure 20 Actor map (Author, 2019)

Figure 20 shows that there are several differences between the two actor maps. However, there are several similarities as well. Businesses are the most important stakeholders, as in both groups they are described as conditional partners. HVE (consultancy agency) and the OBAN (park management organisation) are in one group described as conditional partners, while in the other group they are placed on the edge between conditional and supporting partners. Nevertheless, in the plenary discussion after the group assignment, agreement was reached about the crucial importance of HVE and the OBAN. HVE could, according to the workshop participants, be replaced by another consultancy agency, but it is of crucial importance to have a party involved with technical and operational knowledge. One group felt that the municipality is a conditional party. However, later an agreement was reached that the municipality is a supporting party. Thus, the conditional partners of the development of an SMG in business park Apeldoorn Noord are the local businesses, a park management organisation and a company with technical and operational expertise. Next to the municipality, other supporting parties for the development of an SMG in business park Apeldoorn Noord are the National Government, the province, Liander (regional grid operator) and real-estate owners. These parties can stimulate the diffusion, especially in the sense of financing. Liander is of
crucial importance to establish a physical local grid. Nevertheless, the other parts of an SMG can be realised without the involvement of Liander, therefore Liander is considered a supporting party for the development of an SMG. The Cleantech Region, which is a network of government, market and civil society parties, stimulating sustainable growth in the region of Apeldoorn, is perceived as the least important stakeholder. Involving this stakeholder is a ‘pleasant bonus’. In total, the community of an SMG in business park Apeldoorn Noord consists of nine different public and private parties.

9.2.2 Roles

Next to a description of ‘who’ is involved, the community structure consists of a description of the different roles that the community members must perform. This indicates why these community members are important. Based on literature, several roles that must be performed in an SMG are described: energy consumers and producers (Rodríguez-Molina et al., 2014), grid managers and partners (Pitt et al., 2017), investors (Wolsink, 2012), grid owners (Wolsink, 2012) and communication agents (Jonker, 2014; Rogers, 2003). The role of grid manager is also referred to as aggregator (Consultancy agency, workshop; Gkatzikis, Koutsopoulos, & Salonidis, 2013). This will be a new role in the energy market. Next to these roles, the empirical-data collection showed that ‘ambassador’ is a role that must be performed (Entrepreneur, personal communication, June 13, 2019; Kortman, personal communication, April 19, 2019). The participants of the workshop session are asked which public and private parties should perform these roles and if there are additional roles that must be performed. First, the participants discussed in groups of two what the roles of the different community members are. The results are shown in Appendix 8. In the last round of the workshop session, the workshop participants shortly wrote for which role the community members are responsible. The results are shown in Appendix 8. A summary of the roles that the community members are expected to perform is described in this section.

According to the workshop participants, all roles mentioned in the literature clearly matches one or more stakeholders. The businesses at the business park must perform a role as prosumer, investor and ambassador. The first role is performed by them alone, meaning that the businesses are 100% responsible for the generation and consumption of renewable energy. The role ‘investor’ is shared with many other public and private parties. This means that the companies are not 100% responsible for the investment in SMG assets. The role of ‘investor’ is assigned to both public and private parties. When a business invests in an SMG, this mainly consists of an investment in PV and smart meters. When public parties invest, they are more concerned with investments in a local grid and communication and information assets, since these are shared goods of the businesses at the business park. The fact that multiple parties are given the role of ‘investor’, means that investing in SMG assets is a shared responsibility. Next to ‘prosumer’ and ‘investor’, a business can perform the role of ‘ambassador’. An ambassador shares his experiences with the adoption of an SMG, aiming to motivate others to adopt an SMG as well. The role of ambassador can thus best be performed by early adopters. The role of an ambassador is comparable to that of a change agent, since both roles are concerned with motivating others to adopt an innovation. In addition to the businesses at the business park, other parties can perform the role of ambassador as well. These are for instance the park management
organisation, consultancy agency and real-estate owners. The best ambassadors of the project are the stakeholders who are already close to the businesses (Kortman, personal communication; April 19, 2019; Park management organisation, workshop), since they will have the most compatibility with the clients’ needs and feelings, which determines their success (Rogers, 2003). Therefore, the park management organisation and the businesses at the business park who are early adopters are considered as the most important ambassadors of the project.

The OBAN as the park management organisation must play a role as investor, ambassador, grid manager and owner and connector. In general, from the OBAN a directing role is expected. The survey shows that 38% of the businesses at business park Apeldoorn Noord trust the OBAN to take care of the organisation of an SMG. Moreover, 53% of the businesses is not sure about whether the OBAN could organise an SMG and only 9% does not have trust in the OBAN to organise an SMG. Furthermore, based on the survey it can be concluded that the trust in the OBAN to organise an SMG is higher than the trust in a commercial party to organise an SMG. Because the OBAN is close to the businesses, the workshop participants expect that the companies will trust them if they perform a directing role: “I see the role of the OBAN as very important, not only as facilitating. There is a lot of trust in the OBAN and therefore I think it should have a directing role as well.” (Province, workshop). Since trust building between community members is a success factor of co-creation (Ansell & Gash, 2008), it is important that there is enough trust in the party with the directing role. The directing role is translated in the roles of grid manager and connector. The grid manager must ensure the utilisation of the SMG. This means that the grid manager ensures that all assets are present, that all assets are connected to each other, that all businesses are connected and that the energy flows are managed (Consultancy agency, workshop). The agent that balances the energy demand and supply is also referred to as ‘aggregator’.

Considering the needed technical knowledge to perform the role of a grid manager, a consultancy agency should perform a role as grid manager as well. According to the workshop participants, both the OBAN and the consultancy agency have the responsibility to guarantee a properly functioning energy system. The consultancy agency could be more involved in the technical operation side (aggregator), while the OBAN is in charge of the social/organisational management side. Besides, the participants of the workshop session expect that the OBAN performs a role as grid owner. The role of grid owner is strongly connected to the role of grid manager. The difference is that the grid owner is in the possession of certain assets. Further research is needed to give a more detailed explanation of the role of a grid owner. The last role the OBAN must perform in an SMG, is the role of a connector. A connector is responsible for the relations with the different parties which is important for a successful collaboration (Ansell & Gash, 2008). In this sense, a park management organisation could be perceived as a change agent as well. Nevertheless, it appears that the role of a change agent is not very clear in a collaborative, community initiative. Both in the interviews and in the workshop session it is mentioned that a park management organisation is an absolute key partner.

HVE as a consultancy agency must perform the role of investor, grid manager and owner, ambassador and advisor. The first four roles are shared roles between multiple parties. The last role is a specific role for the consultancy agency. A consultancy agency can provide technical and operational advice on
how to develop an SMG for a business park. Hence, a consultancy agency could support the park management organisation with the organisation of the SMG.

In general, it is expected that the public parties, municipality, province and National Government perform the same roles. From these public parties is expected that they invest, facilitate and lobby. Facilitating the development of an SMG in a business park mainly refers to providing room within the existing rules for experimentation and to adjust the existing rules. Providing room within the legal framework can be performed by the public parties themselves or by lobbying. The role as a lobbyist is not derived from previous research, however based on the discovered regulatory issues, the participants of the workshop session state that lobbyists are necessary for the diffusion of an SMG in a business park. The municipality could lobby at the province and the province could lobby at the National Government to provide room within the legal framework. “If there are more and more signals coming from the provincial consultations, to the national government, this can have a stimulating effect, so we could perform that role.” (Province, workshop). Furthermore, from the government parties it is expected that they provide information about energy policy: “The municipality and province must ensure transparency. Objectives and promises from government parties cannot change over time.” (Province, workshop). This task is part of the role as a facilitator. In the in-depth interviews it is explicitly asked about the role of the government as well. A regulating, facilitating and stimulating role are all mentioned in the interviews. Examples of governance tools that the government could use to regulate are lowering the energy tax for people who invest in sustainability measures, providing room for experimentation (Experimental Law) and giving permits and permit exemptions. The stimulating role is related to lobbying. From the local government a more active role in the diffusion process is desired than from the province and National Government. This is the case since the municipality is closer to the businesses and the project in general. The results of the in-depth interviews with the businesses and experts are in line with the results of the workshop session. While discussing the different roles of the community members, the participants added a public party to the community structure: The Environmental Service. It is argued that “For some subsidies it is a precondition that the Environmental Service is informed and commits itself to the process.” (Municipality, workshop). It is expected that the Environmental Service performs the role of facilitator and lobbyist.

The real-estate owner, one of the supporting parties, must perform a role as ambassador and investor. Since businesses who do not own the property are less likely to adopt an SMG, it is argued in the workshop session that the real-estate owners should try to motivate the businesses to adopt an SMG. Hence, real-estate owners could perform a role as an ambassador, stimulating other businesses and real-estate owners to adopt an SMG. Second, it is expected from real-estate owners to invest in SMG assets. The real-estate parties owning property at business park Apeldoorn Noord could potentially invest in PV on their roofs, since it is difficult for companies, that are renting, to invest in rooftop PV. This investment will increase the value of their property.

The current grid operator (e.g. Liander) is another supporting party of the development of an SMG. The current grid operator could perform the role of an investor and grid partner. An SMG could reduce grid enforcements costs, which reduces the costs of Liander. Hence, this party might be willing to invest
in an SMG instead of grid enforcement costs. Besides, since Liander owns the current grid, they could become a grid partner in an SMG considering the SMG will be connected to the main grid. How this collaboration exactly should look like remains unknown. Lastly, the Cleantech Region is expected to perform a role as investor and lobbyist. An overview of the community members and their expected roles in an SMG in a business park is shown in figure 21.

**Figure 21 Community structure of an SMG in a business park (Author, 2019)**

Figure 21 consists of a circle with six rings: three rings with actors and three rings with the roles they must perform. The parties in the inner circle are the most important community members and the parties in the outer circle are the least important community members. The businesses, consultancy agency (HVE) and park management organisation (OBAN) are the conditional community members. The roles they should perform in an SMG in a business park are presented in purple. For instance, a business must perform a role as ambassador, prosumer and investor. The municipality, province, National Government, Environmental Service, grid operator (Liander) and real-estate owners are the supporting community members. For each of these parties their expected role in an SMG is mentioned in blue. The external network (Cleantech Region) in the only party which performs an additional role, which consists of lobbying and investing. This is shown in the green circles.
9.3 Value proposition

To find out which values are important to the community members and to find out how an SMG could add value to the community members, the participants of the workshop session are asked to formulate for each community member the added value an SMG could bring. The results are shown in Appendix 8. Based on this assignment and the followed-up discussion, several conclusions can be drawn about the value proposition of an SMG in a business park. First, it can be concluded that a large variety of economic, social and ecological values are mentioned. According to all workshop participants, financial profit is the most important added value for businesses. Ecological values are mentioned as values for businesses as well, but are directed to a commercial interest. The discussion with the workshop participants showcases that the participants do not think that reducing CO₂ emissions is a real driver for businesses to adopt an SMG, since businesses are rather interested in having a green image. “I expect that having a green image is becoming more and more important for businesses” (Real-estate owner, workshop). Hence, the results of the workshop session are in line with the assumptions made by the experts in the interviews. Social values are less important, only energy independency could be interpreted as a social value. The workshop participants do not think this value is very important for the businesses at business park Apeldoorn Noord. Financial added value is by far the most important value for businesses (Park management organisation, workshop). The survey showed that the added value of an SMG for businesses consists of sustainability and innovativeness, a lower energy bill, a reliable energy supply, an improved image of the company and energy independency, which shows a lot of similarities with the results of the workshop session.

According to the workshop participants, the park management organisation will receive economic value since it is expected that the business climate will improve when an SMG is realised. Besides, it is expected that an SMG increases the social cohesion on the business park, which according to the park management organisation is beneficial for economic activities. For the consultancy agency an SMG provides economic value as well. The public parties have an interest in the development of SMGs since it could contribute to achieving climate objectives. Besides, an SMG could increase the local employment opportunities (economic value). The province says about the interest of the municipality the following:

“In my opinion in twenty or thirty years it is not possible anymore to have a traditional business park. As a municipality you must be able to offer this type of facilities to your companies, otherwise you will no longer be competing. An SMG is therefore certainly in the interest of the municipality.”

Moreover, an SMG could improve the image of the municipality, province and National Government, since it contributes to an innovative and green image (Municipality, workshop). No other added values were mentioned as important for the public parties.

For real-estate owners the added value consists of economic value if the real-estate owners rent out their roof for PV.
“Real estate owners might be very willing to rent their roof for PV, because in that case they can earn money with it, while normally a roof only costs money. In an economic way it is thus very beneficial for them.” (Real-estate owner, workshop).

Furthermore, the real-estate owner has an interest in an SMG, because it contributes to complying with laws and rules. Adopting an SMG will make it easier for real-estate owners to comply to the upcoming rule of having energy label C. However, the real-estate owner himself argues in the workshop session that this not a real driver to adopt an SMG, since energy label C can also be achieved with just implementing Led-lighting. Therefore, the real-estate owner thinks that the usefulness of laws such as an obligated energy label C is overrated. Other added values for real-estate owners at a business park are a greener image and an increased value of the property. These are all economic values.

An SMG will bring economic value to the current grid operator. It is even argued by the workshop participants that participating in the development of SMGs is the only way for grid operators to survive (Consultancy agency, workshop; Park management organisation, workshop). The expected costs of the grid enforcements will otherwise become unaffordable. Besides, if the grid operators keep enforcing the current grid without implementing radical innovations, they will cause a lock-in holding back the opportunities for an SMG. Last, an SMG can bring added value to the Cleantech Region since it improves the local economy.

Based on this analysis it can be concluded that an SMG brings added value to each of the community members. For private parties the economic values still seem the most important, while public parties will receive mainly ecological values. However, the public parties could also economically benefit from the green and innovative image for instance. Based on the added value an SMG should bring to the community members, the value proposition of an SMG at business park Apeldoorn Noord can be formulated as follows: an SMG is a local energy system which decreases the energy bill of local businesses, increases the business climate, improves the image of the businesses, real-estate owners, businesses park and government layers, reduces CO₂ emissions and prevents grid enforcements. In the negotiation game, at the end of the workshop session, consensus is reached about the idea that the benefits should be shared among the community members. Otherwise they will not be willing to participate and the value proposition will not be realised.
9.4 Activities

According to Jonker (2014) an essential step in the development of an SMG is deciding which activities need to be performed by the community members to realise the value proposition. Moreover, it is important to indicate which activities should be performed first and which activities can be performed later in the development process. To gain insight in the activities for the development of an SMG in business park Apeldoorn Noord, the participants of the workshop session are asked to draw a strategic roadmap. The participants described from their own perspective which activities they think need to be performed to realise an SMG. Figure 22 shows an example of one of the designed strategic roadmaps. An overview of the key activities of each of the separate roadmaps is shown in Appendix 8. In this section the results of the strategic roadmaps are summarised.

Figure 22 Example strategic roadmap (Author, 2019)
9.4.1 Initiation phase

Based on the workshop session it can be concluded that the first step of the development of an SMG in a business park is to make the park management organisation and the businesses at the business park enthusiastic about the adoption of the innovation. To make them enthusiastic, they should first acknowledge the problem and second they should see an SMG as a solution to that problem. This means that the first activities should be focused on the creation of a shared understanding. When businesses at the business park have the feeling that an outdated energy system is their problem and that they can benefit from adopting an SMG, they will be more likely to co-create an SMG. It is important that the businesses have a shared understanding of the end goal, because “businesses will not get excited about just PV, they have to see the total picture” (Consultancy agency, workshop). Since the park management organisation is close to the businesses and can unburden the businesses, it is important that they are enthusiastic about the diffusion of an SMG on the business park as well. After all, this institution is a key partner in the diffusion process. Moreover, creating a shared understanding work better in one to one conversations with businesses that with plenary meetings (Park management organisation, workshop).

To create a shared understanding, information must be shared between the change agents and the businesses, “the businesses must be provided with information about the project” (Municipality, workshop). This argument complies with the Diffusion of Innovation Theory (Rogers, 2003), assuming that communication channels and change agents are crucial for the adoption of an innovation. The change agents are for instance the consultancy agency and the park management organisation. It is important that the park management organisation and the businesses have a sense of urgency. Besides, it is argued that: “The arguments to make entrepreneurs enthusiastic should be a combination of showing financial benefits and creating a sense of urgency.” (Municipality, workshop). This argument is also given by one of the interviewed businesses at business park Apeldoorn Noord:

“But there just has to be a good story and communication, that is just very important. How do we deal with that? (...) So I think that communication about how you approach this and what the benefits are, that they are simply the most important things and that is what it is all about.” (Personal communication, June 13, 2019).

Hence, the first activity for the development of an SMG in a business park is to communicate with the businesses and park management organisation as well as to provide information to them to create a shared understanding. This will make them enthusiastic about the adoption. The most mentioned activity to make businesses enthusiastic is to find ambassadors who are willing to adopt an SMG and to let them speak about their experiences.

Moreover, several workshop participants argue that in the beginning of the development of an SMG, preliminary research must be conducted. Terms that the workshop participants use to indicate this are: exploring the technical possibilities, financial possibilities, communication tools, legal possibilities and a development business case. Researching these different aspects is summarised with the term ‘preliminary research’. Finding room within the existing legal framework is only mentioned by one
workshop participant in the strategic roadmap. Nevertheless, while discussing the roadmaps it became clear that more participants acknowledge the importance of finding room within the legal framework. Hence, this activity is added to the preliminary research phase.

Intermediate outcomes are mentioned as an important step in the beginning of the development of an SMG in a business park as well. The participants of the workshop session created common sense about the importance of starting with small wins. One workshop participant states: “The bigger picture must be divided in small energy projects, otherwise the SMG principle becomes unmanageable for the companies. By the realisation of small projects, the results become visible.” (Park management organisation, workshop). For instance, a few businesses can already start with the implementation of PV on their roofs, while the other SMG assets are implemented later in the process. It is expected that the businesses that already start with small wins, but acknowledge the common end goal of an SMG, are the ambassadors of the project. It is expected that these ambassadors have a major influence on the willingness of other businesses to adopt an SMG.

### 9.4.2 Commitment to the process

After making the businesses enthusiastic, conducting preliminary research and starting with quick wins, the stakeholders must commit themselves to the project. “It is about establishing commitment from the government as well as from the entrepreneurs.” (Municipality, workshop). There are different ways in which commitment to the process can be established. In the workshop session it is argued that a letter of intent is a way to get certainty about the commitment of the community members. This letter of intent must be signed before someone starts with the implementation of an SMG (Consultancy agency, workshop; Municipality, workshop). The letter of intent must include the commitment of businesses, the park management organisation, the municipality, the province, the old grid operator and the new operator of the SMG. The letter of intent can be seen as both quick wins and intermediate outcomes of the process of co-creation. It describes the new collaborative arrangement. Based on the letter of intent, resources can be collected. “It is about investments from the companies and making use of stimulating measures such as SDE+” (Municipality, workshop).

After signing the letter of intent and searching for investment possibilities, a business plan can be co-created. A business plan including subsidies is a precondition for implementation (Consultancy agency, workshop; Municipality, workshop; Province, workshop). Afterwards, contracts can be signed to further define the commitment of the community members to the development of an SMG in a business park. According to the survey, on average, businesses are willing to sign a contract of four years maximum. Based on the workshop session, it can be concluded that the contracts need to have a longer term, since within four years the investments of the SMG assets will not be paid back. In particular, contracts with the government parties and Liander, giving permission to design a local distribution grid, must have a longer duration in the direction of thirty years.
### 9.4.3 Implementation phase

After these activities have taken place, the implementation will start, which first of all consists of virtually exchanging electricity. The implementation phase ends with the implementation of a local distributed energy grid, including electricity and different forms of heat. Figure 23 provides an overview of the activities that must be performed by the members of the community to realise an SMG in a business park. The list of activities does not claim to be complete but provides an explorative overview of the needed actions to capture the value of an SMG in a business park.

<table>
<thead>
<tr>
<th>Initiation phase:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Shared understanding: Making entrepreneurs enthusiastic (task of park management organisation) showing the relative advantages and providing factual information. Creating a sense of urgency.</td>
</tr>
<tr>
<td>2. Preliminary research: Researching the technical and financial possibilities and searching for scope in the legal framework.</td>
</tr>
<tr>
<td>3. Quick wins: Starting with pioneers, investing in quick wins. The most obvious quick win is investing in PV. Using the pioneers as ambassadors of the project.</td>
</tr>
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<table>
<thead>
<tr>
<th>Commitment to the process</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Letter of intent: Commitment of the businesses, park management organisation, municipality, province, current grid operator and the new operator. Shared ownership of the process. Deciding who is going to do what.</td>
</tr>
<tr>
<td>5. Application for permits, subsidies and further roll out business case.</td>
</tr>
<tr>
<td>6. Signing contracts.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Implementation phase:</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Precondition: Certainty on funding.</td>
</tr>
<tr>
<td>8. Connecting the small projects, creating a virtual SMG based on electricity exchange.</td>
</tr>
<tr>
<td>10. When up and running expanding with other forms of energy.</td>
</tr>
</tbody>
</table>

*Figure 23 Plan of Action SMG business parks*

Figure 23 shows that the activities of the organisation of an SMG can be split up in three phases: The initiation phase, establishing commitment to the process and the implementation phase. Each of the phases consists of several activities. In total, the activity package can be subdivided in to ten activities.
9.5 Tools

The participants of the workshop session reached consensus about the needed tools. Tools are concerned with time, financial resources, knowledge and legal tools (Jonker 2014; Van der Heijden, 2015). From the strategic roadmaps it has become clear that more legal and technical knowledge is required before the other activities of the SBM can be performed. Based on that knowledge, more insight can be gained in the financial resources. In the workshop session no attention has been paid to the tool ‘time’. However, the interviews and survey indicate that time is an important tool for the development of an SMG in a business park.

9.5.1 Division of financial resources

The focus of the workshop session regarding the tools is to gain insight into the division of the financial resources. Even with a lot of the community members participating in the workshop session in this early phase of adoption, it is not possible to estimate the investments for the development of an SMG in a business park. The investment costs of the quick wins such as PV are feasible, but the investment costs of the other SMG assets such as the local distribution grid are less clear. Consequently, the co-created SBM does not consists of an in-depth cost-benefit analysis but consists of an explorative overview of the division of costs. The participants of the workshop session are asked to write a letter of intent and to describe in that letter of intent which part of the investment they think each community member is responsible for. The results are shown in table 10. The public and private parties ranked in the columns represent the participants of the workshop session. The public and private parties in the rows indicate who must pay which part of the investment. For instance, one of the municipality employees participating in the workshop states that businesses are responsible for 60% of investment, the municipality for 10% and the province for 30%.

<table>
<thead>
<tr>
<th>Responsible for...% of the investments</th>
<th>Municipality</th>
<th>Municipality</th>
<th>Province</th>
<th>Park management organisation</th>
<th>Real-estate</th>
<th>Consultancy agency</th>
<th>Consultancy agency</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Businesses</td>
<td>60%</td>
<td>60%</td>
<td>40%</td>
<td>25%</td>
<td>25%</td>
<td>40%</td>
<td>50%</td>
<td>43%</td>
</tr>
<tr>
<td>Municipality</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>25%</td>
<td>25%</td>
<td>10%</td>
<td>20%</td>
<td>16%</td>
</tr>
<tr>
<td>Province</td>
<td>30%</td>
<td>30%</td>
<td>20%</td>
<td>25%</td>
<td>25%</td>
<td>10%</td>
<td>30%</td>
<td>24%</td>
</tr>
<tr>
<td>Investors</td>
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<tr>
<td>Civil citizens</td>
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<tr>
<td>HVE</td>
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<td></td>
<td>15%</td>
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<tr>
<td>Park management organisation</td>
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<td>10%</td>
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<tr>
<td>Real-estate owner</td>
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<td></td>
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<td>25%</td>
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<td>25%</td>
</tr>
</tbody>
</table>

Table 10 Results workshop, division financial resources (Author, 2019)

The table shows that businesses at the business park are responsible for the largest part of the investment. Looking at the means, the businesses are responsible for almost half of the investment (43%). The park management organisation is, according to the means, responsible for 10% of the
It is notable that the park management organisation is the only party that believes that the park management organisation is responsible for part of the investment. At the same time, the real-estate owner is the only party that believes that the real-estate owner is responsible for part of the investment. Eventually, in the workshop session, an agreement is reached about the division of investments as proposed by the park management organisation. It can be concluded that a spread of investments is the most preferable for the organisation of an SMG in business park Apeldoorn Noord. The businesses, municipality and province should all contribute 25% of the investments, the consultancy agency should take care of 15% of the investments and the park management organisation 10%. The workshop session have made the vision of the participants regarding the financial investments tangible. Moreover, it shows the price tag of the government if they really wants to push this project further as a real implementation pilot. Furthermore, the discussion of the letter of intent led to a consensus about the payback time of the invested resources. For the participating businesses, the payback time must be within five years. With this timeframe, the payback time is still clear for the businesses. For the other community members, the payback time can be thirty years, since the payback time of developing a local energy grid cannot be realised within five years.

9.5.2 Financial tools

Next to the division of the investment money, the building block ‘tool’ is concerned with different forms of financing that can be used to stimulate the diffusion of SMGs. Based on the expert interviews, survey and workshop session, multiple financial tools for the diffusion of an SMG in a business park can be described. First, subsidies can be used to finance the co-creation of an SMG. The percentages of table 10 behind the public parties indicate the expected subsidies. Thus, it is expected that the municipality and province together subsidise 50% of the investment costs. The businesses themselves expect on average a subsidy of 36% of the investment costs. There should be a specific subsidy for the development of an SMG in a business park and/or for the different aspects of it (Municipality, workshop).

A second financial tool is an Energy Service Company Organisation (ESCO). ESCOs are companies that provide energy services to their clients (Van der Heijden, 2015). The basis of an ESCO is a contract between the ESCO and a public or private party. The ESCO takes energy-efficient measures and maintains these, lowering the energy costs of a building or region. It is up to the ESCO to deliver it in the most efficient way (Van der Heijden, 2015). The ESCO charges a fee lower than the old energy bill of the client, so the client achieves benefits as well. The key tasks of an ESCO are the management and mobilisation of financial resources and the installation and maintenance of energy assets (EC, 2017). An advantage of an ESCO is that the risk of the individual business decreases, since another party takes responsibility of the risks (Wolbert, personal communication, May 2, 2019). 8% of the businesses at business park Apeldoorn Noord state that an ESCO is a precondition for participation, 30% think an ESCO is important but not of crucial importance and most of the companies (51%) do not have an opinion about the realisation of an ESCO. In the workshop session, the real-estate owner and the consultancy agency both mention the importance of an ESCO for the financing of an SMG.
A third financial tool that can be used for the co-creation of an SMG is a green lease. According to the expert interviews, the main barrier for the adoption of an SMG by businesses is the lack of perceived behavioural control when the business does not own the building (Appendix 6). If the company is not the owner of the building, the company will not feel inclined to invest in SMG assets. On the other hand, the real-estate owner might be unwilling to invest, since the financial advantages, in the form of a reduced energy bill, are for the tenant (Ruiter, personal communication, April 8, 2019; Kortman, personal communication, April 19, 2019). This is called the problem of the split-incentive (Van der Heijden, 2015). To research how this barrier can be overcome, real-estate owners of business park Apeldoorn Noord are interviewed. One of them argues that he is willing to invest in PV, if he can increase the rent to get a return on his investment (Van de Waerdt, personal communication, August 7, 2019):

“Our tenant will benefit from a lower energy bill. So yes, suppose we are going to do it, we will of course ask if they want to invest if we are going to install PV on our roofs. We can raise the rent a little, while they have a greater saving and we both benefit from it.”

The tenant achieves a lower energy bill as a result of the PV and thus it is possible that he will accept the increased rent. This solution to the problem of the split-incentive is called a ‘green lease’ (Van der Heijden, 2015). A green lease does not have a fixed form, as both parties can together determine how certain actions, such as investments and energy consumption behaviour are contractually recorded. According to the interviewed real-estate owners, whether a green lease is financially acceptable depends on the investment costs and thus on the possibilities for subsidy.

To conclude, the tools that are needed for the diffusion of an SMG in a business park are time, technical knowledge, legal knowledge and investment money. The realisation of the investment money is a shared responsibility between public and private parties. Subsidy, an ESCO and a green lease are specific tools to realise the investment money of SMG assets.

### 9.6 Risks regarding the implementation of SMGs

Risks are not a separate building block in the Cloverleaf Model of Jonker (2014). Nevertheless, he states that identifying risks is an important aspect in the development of an SBM. In the beginning and end of the workshop session it is asked how much trust the workshop participants have in the co-creation of an SMG in business park Apeldoorn Noord. They described this in a percentage from 0 to 100%. The participants that do not have 100% trust in the beginning of the workshop, are asked which risks they perceive.

Some participants argue that the financing of the needed investment money is a risk. If the financing is not organised in time, this could slow down or even hold back the process. It is argued by the workshop participants that the financing will, even with the innovative financial tools, be a hard task. A second risk is concerned with a lack of sense of urgency. Currently, there are almost no energy
outages at the business park. “*Maybe a big disaster need to occur before people start to realise the added value of an SMG.*” (Municipality, workshop). Another risk is that it is questionable whether financial benefits for the businesses at the business park will be achieved, since currently energy is very cheap (Province, workshop). Since in general the energy costs are quite low, companies might not see the added value in an SMG. Because of these two reasons, businesses might not feel the sense of urgency to change something. Moreover, the survey shows that 70% of the businesses at business park Apeldoorn Noord are willing to adopt an SMG, but this statement does not state anything about ‘when’ they are willing to do this. This statement shows the intention of businesses and not the actual behaviour. Hence, the businesses that argue that they are willing to adopt an SMG might lack a sense of urgency to actually implement one (Municipality, workshop). The lack of a sense of urgency will affect the commitment to the process.

Moreover, risks regarding the legal framework are mentioned. One of the technical experts argues in the workshop session: “*There are several constrictions by law, by the ACM, and consequently there are long processes before an SMG can be realised. Maybe it should be made easier to get to the experimental phase to stimulate radical innovations.*” More concretely, there are risks regarding the possibilities to get a permit to create a local distribution network and to exchange energy between the energy consumers. The Experimentation Act provides room for experiments with a local distribution network in which energy can be exchanged. With the Experimentation Act, a permission for ten years is given, while the payback time for the assets of an SMG is about thirty years. The operator of the SMG faces the risk that the permit is not extended and the investment will not be paid back. “*This makes my businesses case very uncertain.*” (Consultancy agency, workshop). At the moment, the Experimentation Act is being revised. If there is no certainty about how the Experimentation Act will look like, the SBM is concerned with quite a large risk. Furthermore, the participants of the workshop expect that the change of laws and rules is too slow to keep up with the development of an SMG: “*The law is always running behind.*” (Municipality, workshop).

Another risk of the diffusion of an SMG in a business park is concerned with the process of co-creation. All community members need to get on the same page to develop an SMG in a business park. Getting all the community members on the same page could slow down the process (Province, workshop). For example, contracts should be signed with all the different businesses and real-estate owners, which is quite complex (Mulder, personal communication, June 18, 2019). To overcome this risk, the project should start with a small amount of community members. When the first results are visible, other community members could be involved later in the process. Because of this solution, getting all the community members on the same page is not a very important risk. Another risk related to co-creation is that due to the reluctance of certain stakeholders, especially grid operators, the radical innovation can be lost out of sight:

>“We must prevent a situation of old wine in new bottles. The current grid is not made for an SMG. An attempt has already been made to do something new within the old system, which did not work. We must do it differently in a radical way.” (Consultancy agency, workshop).
In other words, there is a risk that there is not a shared understanding about the end goal and that community members, in particular the current grid operator, try to put old wine in new bottles. The message of old wine in new bottles will not make the businesses enthusiastic to adopt an SMG and can thus be a barrier for the diffusion. The current grid operator, Liander, explains (Schneider, personal communication, July 12, 2019) that they are willing to discuss the options of an SMG with the local participants, but that they are on first sight not enthusiastic about energy exchange on private grids. To summarise, risks regarding the diffusion of an SMG in a business park are concerned with financial resources, a sense of urgency, the legal framework and a shared understanding of the project vision.

At the end of the workshop the participants are asked if their trust in the co-creation of an SMG in business park Apeldoorn Noord has increased compared to the beginning of the workshop session (table 13). Hence, it can be concluded whether the co-creation of an SMG in the workshop session has a positive or negative effect on the trust of the participants.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Trust beginning</th>
<th>Trust end</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipality (relation manager)</td>
<td>70%</td>
<td>80%</td>
</tr>
<tr>
<td>Municipality (energy director)</td>
<td>80%</td>
<td>95%</td>
</tr>
<tr>
<td>Province</td>
<td>70%</td>
<td>85%</td>
</tr>
<tr>
<td>Park management organisation</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>Real-estate owner</td>
<td>75%</td>
<td>80%</td>
</tr>
<tr>
<td>Technical expert consultancy agency</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Technical expert consultancy agency</td>
<td>87%</td>
<td>93%</td>
</tr>
<tr>
<td>Mean</td>
<td>80%</td>
<td>88%</td>
</tr>
</tbody>
</table>

Table 11 Trust in the co-creation of an SMG in business park Apeldoorn Noord (Author, 2019)

Six participants have more trust in the co-creation of an SMG after the workshop. The technical experts from the consultancy agency argue that if they are not working together to achieve an SMG, there will be more energy outrages in the future and energy will become unaffordable. Therefore one of them argues: “To me it is a no brainer, it is the only solution.” This workshop participant had 100% trust from the beginning to the end of the workshop in the development of an SMG. In total, the trust of the participants increased with 8%. It is notable that in particular the trust of the public parties has increased (from 73% to 87%). The technical experts already had a lot of trust in the beginning of the workshop, therefore there were little possibilities to gain confidence in the co-creation of an SMG in a business park. The increased trust indicates that by the co-creation of a (fictive) SMG and signing a letter of intent, the perceived risks have been lowered. In particular, the risk that it is hard to get every community member on the same page, is no longer seen as a risk at the end of the workshop. The park management organisation argues at the end of the workshop: “Developing the letter of intent and reaching agreement about the different elements was so easy today. I wish the real process of collaboration went this easy.”
9.7 An SBM for SMGs in business parks

In the previous sections of this chapter the building blocks for an SBM for the development of an SMG in a business park are described. Combining these building blocks leads to the following SBM (figure 24).

**Figure 24 SBM for SMGs in business parks (Author, 2019)**

Figure 24 shows that an SBM for an SMG in a business park consists of six building blocks: added value, actors and roles, activities, tools, risks and organisation. The building block ‘added value’ describes which values an SMG brings to the members of the community. The added value consists of economic, social and ecological values. The second building block is ‘actors and roles’. The community structure is in particular concerned with who plays which role and therefore the term ‘community structure’ of the theory of Jonker (2014) is in this SBM replaced by ‘actors and roles’. A distinction can be made between conditional, supporting and additional roles. The conditional actors for the co-creation of an SMG in a business park are businesses, a park management organisation and experts. The businesses are the one who need to adopt the innovation and the park management organisation and the experts together guide the process. The supporting parties are the public parties, the old grid operator and the real-estate owners. They must perform roles as investors, ambassadors, facilitators and lobbyists. The old grid operator is in particular needed to perform a role as a grid partner in the development of the local grid. An external network such as the Cleantech Region plays an additional role. It is explicitly mentioned in the SBM that the park management organisation is a key contributor. In the workshop session it is argued that a park management organisation must perform multiple roles, but the importance of this organisation is derived from the interviews as well.

“In the commercial process it is very important that people trust you, understand what you are doing and know who you are. (...) All the businesses at a business park know each other and therefore it is
important to be connected to the local organisation. You need these people to support your project.”

(De Leeuw, personal communication, August 22, 2019).

A park management organisation therefore builds trust, which is one of the success factors of co-creation. The third building block of the SBM is concerned with the activities that must be collaboratively performed. A distinction can be made between the initiation phase, the commitment to the process and the implementation phase. Each of these activity phases consists of multiple activities who can be performed by an individual business (e.g. investing in PV) or by a group of actors (e.g. preliminary research). The fourth building block is ‘tools’. This building block describes which resources are needed for the co-creation of an SMG in a business park. A distinction can be made between knowledge, financial resources and time. Furthermore, the financial resources can be split-up in short-term and long-term investments. Investments in PV can be earned back within five years, while investments in a local grid will have a payback time of about thirty years. Since the results of the empirical-data collection show that organising the financial resources is a hard task. Some tools to make the financing a bit easier are derived from this research. Subsidy, an ESCO and a green lease can be used as tools to organise the financial resources.

The fifth building block is ‘risks’. This building block is not one of the building blocks of the Cloverleaf Model (Jonker, 2014). Nevertheless, the in-depth interviews and workshop session show that risks are an important aspect to consider when designing an SBM for an SMG in a business park. Some of the risks are obvious, others provide new insights. The risks are: a lack of financial resources, a lack of sense of urgency, no permission within the legal framework and ‘old wine in new bottles’. The risks are related to each other. When there is a lack of sense of urgency it will be less likely that the legal framework will be adjusted and that people will invest. The risk of ‘old wine in new bottles’ means that the total concept of an SMG is not understood, but that only small activities are performed. Consequently, not all of the possible benefits an SMG can bring will be achieved in the case of ‘old wine in new bottles’.

The last building block of the SBM is ‘organisation’. The organisation is not described as a separate section in this chapter, but throughout this chapter three elements of the organisation came to the surface. First, the organisation of an SMG consists of a collaborative arrangement. Different contributors must be willing to co-create, to realise the value proposition of an SMG. The collaborative arrangement is a precondition for the organisation and describes what the participants can expect from each other. Second, the organisation is concerned with transactions of energy prosumption. Energy is in the SBM used as a medium of exchange. The last important aspect of the organisation is that businesses share the investments and returns. In the workshop session it was discussed which actor is responsible for which part of the investment. The results showed that the investment is a shared responsibility between public and private parties. Furthermore, the results of the workshop session showed that the returns of an SMG in a business park bring added value to multiple actors. The added value will motivate the actors to participate in the collaborative arrangement. These six building blocks together form an SBM for the development of an SMG in a business park.
The diffusion of an SMG is a process of co-creation; public and private parties need to be actively involved in the design of the building blocks of an SBM and the implementation of the actual SMG. Considering this, it is researched if and how the success factors of co-creation (Ansell & Gash, 2008) are embedded in the SBM that is designed in the workshop session. The success factors mentioned by Ansell and Gash (2008) are: face-to-face dialogue, trust building, commitment to the process, shared understanding and intermediate outcomes. In none of the strategic roadmaps designed by the workshop participants or in the discussions, the importance of face-to-face dialogues is explicitly mentioned. It is argued that the community members should share information and think about each other’s preferences and needs, but it is not stated that this should be done through the medium of a face-to-face dialogue. The second success factor of co-creation is trust building (Ansell & Gash, 2008). The survey shows that trust in the park management organisation is, for 50% of the businesses that are willing to adopt an SMG, an important driver. The workshop participants acknowledge the importance of trust in the park management organisation. However, no concrete measures are mentioned to increase trust in the park management organisation or to increase trust between the other community members. Another success factor of co-creation is the commitment to the process. Ensuring commitment to the process is reflected in the building block ‘activities’. It is argued by the workshop participants that a letter of intent must be signed before anyone can draw conclusions about the resources and start with the design of the in-depth business plan. It is in particular stated that a letter of intent between the consultancy agency and the park management organisation must be signed, to show the other community members that they are committed to the process. Moreover, the importance of contracts is mentioned in a few strategic roadmaps, which shows the importance of ensuring the commitment to the process as well.

The community members will be committed to the process as a result of a shared understanding, which is the fourth success factor of co-creation (Ansell & Gash, 2008). If the community members acknowledge that there is a common problem and that they together have the possibility to solve that problem, they will be more likely to commit to the process of co-creating an SMG. Hence, it is argued that the commitment to the process is a follow-up of creating a shared understanding (Municipality, workshop). Both the commitment to the process and a shared understanding are embedded in the SBM in the kind of activities that must be performed. It is explicitly mentioned in the strategic roadmaps and discussions that businesses must not only have a common problem definition, but a shared understanding of the end goal as well. Starting with quick wins such as PV and not mentioning the end goal will not stimulate businesses to adopt an SMG: “The innovativeness of the project will then be lost out of sight, and we will look like another PV seller.” (Park management organisation, workshop). Therefore, it can be concluded that a shared understanding about a clear end goal is important in the process of co-creating an SMG. Besides, it is argued by the workshop participants that to make businesses enthusiastic, they should have a feeling of urgency, which is the result of
acknowledgement of the problem. The last success factor mentioned by Ansell and Gash (2008) is intermediate outcomes. Intermediate outcomes are embedded in the SBM since every activity is focused on developing a piece of the SMG. It is argued in the workshop session that the intermediate outcomes will make the businesses enthusiastic about the adoption of an SMG. If they can see what already has been done, they will be more likely to adopt an SMG. Therefore, the municipality states in the workshop session that intermediate outcomes must be celebrated to show the successes and to stimulate other businesses to adopt an SMG: “I think it is really important that we celebrate milestones. This will make other businesses enthusiastic.” (Municipality, workshop). Intermediate outcomes can be divided into intermediate outcomes of the process (letter of intent, singing contracts and development business plan) and intermediate outcomes of the implementation of an SMG (starting with PV, virtual electricity exchange, local grid and other forms of energy). Moreover, a mutual recognition of dependency as a result of shared roles and responsibilities is embedded in the SBM. This can be interpreted as a success factor of co-creation as well. To summarise, it can be concluded that several success factors of co-creation are embedded in the SBM to ensure that the implementation of the SBM will be a process of co-creation. In particular, commitment to the process, intermediate outcomes and dependency are success factors that are embedded in the designed SBM.

### 9.9 The embeddedness of co-creation success factors in the workshop session

For a successful SBM the building blocks must be co-created by different parties (Jonker, 2014). Therefore, in the workshop session, the building blocks of an SBM for an SMG in business parks are described through the process of co-creation. The success of this co-creation depends on five factors: face-to-face dialogue, trust building, commitment to the process, shared understanding and intermediate outcomes (Ansell & Gash, 2008). In this section it is evaluated to what extent these success factors of co-creation were present in the workshop session. The success factor ‘face-to-face dialogue’ is reflected in the design of the workshop session, since the participants were asked to have conversations with each other. The workshop participants talked to each other in one-to-one conversations, in small groups and in plenary discussions. The face-to-face dialogues were in the workshop session a medium for knowledge sharing and negotiation. Hence in the workshop session, multiple engaging conversations took place in which the participants listened to one another’s reactions of each other’s statements and questions.

The factor ‘trust-building’ is concerned with the level of trust among the workshop participants. Trust-building is in particular important when the prehistory is highly antagonistic (Ansell & Gash, 2008). Since it is assumed that this is not the case with the workshop participants, no attention was given to trust building among the participants during the workshop session. The factor ‘commitment to the process’ is concerned with a belief that working together is the best way to achieve a desirable outcome (Ansell & Gash, 2008). It can be concluded that the workshop participants were very committed to the process of designing the building blocks of an SBM. All participants took the assignments and discussions very seriously and were willing to continue with the discussions, even
after the planned time of the workshop session was over. This is probably the case because they acknowledged that they all need to work together to develop an SBM. “This is such a difficult task, we can only realise it if everyone is willing to think about the process.” (Consultancy agency, workshop). Nevertheless, some participants found the assignment of designing a strategic roadmap so difficult, that they stopped with the assignment before they finished it. Thus, it can be concluded that in general the participants were committed to the process of designing an SBM, but that when the process became difficult, the commitment decreased.

Another success factor of co-creation is a ‘shared understanding’, which is concerned with getting the participants on the same page by formulating a clear mission and a common problem definition (Ansell & Gash, 2008). In the beginning of the workshop session the problems of the current energy system and an SMG as a solution to these problems were discussed with the participants. The aim of this introduction was to create a shared understanding. Furthermore, through the brainstorming assignment about the energy system of the future, it became clear to what extent the workshop participants have the same vision about the future energy system. The results show that all participants believe in a more sustainable energy system in which energy is locally generated (Appendix 8). Based on the willingness of the participants to actively participate in the co-creation of an SBM, it can be concluded that there is a shared understanding about the importance to develop an SBM for an SMG in business park Apeldoorn Noord. The last success factor of co-creation is ‘intermediate outcomes’. The different assignments in the workshop session can be seen as intermediate outcomes, leading to
a complete SBM as the end result. It is argued by one of the workshop participants that by splitting the end result in different sub assignments, the process of co-creation became more manageable.

The workshop participants are asked how willing they are to work together with the other community members to develop an SMG in business park Apeldoorn Noord. Each of the workshop participants gave themselves a grade and described arguments for and against co-creation. In general, every participant of the workshop session is willing to co-create an SMG. The private parties are more willing to work together than public parties, but the difference between public and private parties is relatively small. On average the public parties gave themselves an 8.3 and private parties a 9.5. The technical experts are more willing to work together than the other parties. This may be due to the fact that they already have a lot of information about SMGs and that working with smart energy solutions is their core business. The most mentioned argument to co-create is that it is ‘inevitable’. In particular, for the financing, co-creation is needed. In other words, without co-creation it is not possible to realise an SMG and the participants understand that they need each other. Hence, there is mutual recognition of interdependence. Besides, added value is seen in co-creation, “since with working together more new ideas will occur” (Consultancy agency, workshop). The most mentioned reason to not co-create is that there are so many different interests that it will be hard to accomplish something. As argued by a technical expert in the workshop session, different opinions could slow down the development process, which is explained when describing the risks. Looking at the given grades and arguments, it can be concluded that the participants are committed to the process of co-creation, recognising their mutual independence.

In this section it is aimed to evaluate to what extent the success factors of co-creation were present in the workshop session. However, since the workshop is not designed to measure the success factors, but rather to co-create the building blocks, no in-depth conclusions can be drawn about the evaluation of these factors.
In this chapter it is described how the building blocks for the organisation of an SMG in a business park work. The developed SBM provides a summary of the most important aspects of the SBM. Furthermore, this chapter describes how success factors of co-creation can be embedded in the SBM. The embedded success factors of co-creation are: a shared understanding, commitment to the process, intermediate outcomes and a mutual recognition of interdependency regarding the roles and responsibilities. By embedding these success factors in the SBM it is more likely that an SMG will be realised through the process of co-creation. Lastly, this chapter shows how an SBM can be co-created by organising an interactive workshop session in which the community members make assignments and have discussions with each other. Through a negotiation game at the end of the workshop session, consensus is reached about the building blocks of the SBM. The interactive workshop session increased the trust the community members have in the development of the SMG in business park Apeldoorn Noord. Hence, the workshop session is a way to intervene in the usual business situation.
Chapter 10. Conclusion
10.1 Introduction to chapter

The aim of this research is to explore the social feasibility of an SMG in a business park, by researching factors explaining the willingness of businesses to adopt an SMG and by researching the co-creation of an SBM for SMGs. It is assumed that these steps together will lead to the diffusion of SMGs in business parks. To meet the aim of this research, a single explorative case-study is performed. In this section the results of the case-study are summarised. First, the four sub questions are answered (10.1, 10.2, 10.3, 10.4). Afterwards, an overall conclusion answering the main research question follows (10.5). The chapter ends with recommendations for practice (10.6).

10.2 What is an SMG?

An SMG is an innovative, rather fuzzy concept. Therefore, this research started with an investigation of the concept ‘SMG’. To get insight into what an SMG is, three sub questions have been researched and are answered in this section.

“What are the different elements within an SMG?”

Until now, no standard way of the deployment of SMGs has been developed. Nevertheless, there are several elements of an SMG that are described in multiple articles. In general terms, an SMG is concerned with the local generation, use, storage and exchange of energy. It is a self-containing energy system in a geographically defined area, such as a business park. To facilitate the local generation and use, an SMG consists of several connected assets. An SMG consists of generation, storage, distribution, communication and information assets. The generation and storage units are small-scale, decentralised and must get a space in the business park. This can be on the roof of businesses (e.g. PV) and in the public spaces (e.g. collective batteries). Furthermore, an SMG makes use of several technologies such as smart meters, SDR and a trading platform. The smart technologies are used to manage the local generated energy. For full operation it is important that all parts are well connected to each other.

“What are the advantages and disadvantages of an SMG?”

An SMG will lead to financial benefits and improved social and ecological values, which means that an SMG is concerned with multiple value creation. An SMG reduces the load pressure on the electricity grid by locally balancing the demand and supply of energy. This will reduce societal costs. Furthermore, an SMG contributes to reduced carbon emissions, reduced energy dependency, increased flexibility of the energy system, increased local economic growth, increased room for community involvement, improved image of a company, decreased energy bills and improved energy system reliability. A disadvantage of an SMG is that it might be complex to connect all technologies and to find a way to collaborate with all the different actors. Hence, there are a few complex facets to an SMG that have
not yet been fully thought through. Furthermore, a disadvantage of an SMG is that the exchange of energy between small energy users is currently not permitted by law.

“What is the expected role of companies in the diffusion of an SMG?”

It is expected that companies play an active role in the diffusion of SMGs. From energy consumers they must shift to energy prosumers. Concretely, this means that a business can perform six different actions: investing in the generation of renewable energy (most likely in PV), renting the roof to others who can invest in PV, investing in energy storage possibilities (such as an EV), investing in communication and information technologies (such as a smart meter), exchanging energy with other businesses, and changing the energy consumption to another time of the day with the lowest price or the most available sustainable energy. Renting the roof to others is an alternative of investing in renewable energy by the businesses themselves. A business does not necessarily have to fulfil all actions, but to fully participate in an SMG, this is recommended. The described six actions show that from the companies it is mainly expected that they invest. The investment in renewables is concerned with making space available for sustainable energy generation assets as well. In the first place, this means that companies must install PV on their roofs to make their real estate more sustainable. Besides, an SMG is concerned with a behavioural change, since it is expected that the businesses change the time of energy consumption, if that is possible. Contrary to what other scientists claim (Hare et al., 2016; Pitt et al., 2017; Skjølsvold & Ryghaug, 2015; Wolsink, 2012) the energy prosumers, in this case the businesses at the business park, are not responsible for the organisation of the SMG. It is expected that other parties perform the management tasks.

10.3 What are the current ongoing institutional change processes in which the diffusion of SMGs takes place?

The institutional context in which SMGs emerge is changing and these changes influence the diffusion of SMGs in business parks. Changes have taken place in the energy market, in the technology in society in general. Therefore, to gain knowledge about the institutional change processes, the institutional context is divided in these three settings.

“Which developments in the energy market influence the diffusion process?”

Several changes have taken place in the energy market over the past decades, such as the liberalisation of the energy market, the increased use of renewable energy, the rise of local energy communities, the blurring energy market roles and the start of dynamic energy prices. These changes had an effect on the emergence of SMGs and influence the further development of this innovation as well. Due to the liberalisation, the energy market split-up between semi-governmental grid operators and private providers. Consequently, energy consumers could choose their own energy supplier. However, the grid operator retained a regional monopoly. Therefore, it is currently not possible to create a private local grid without permission. This task is fully attributed to the semi-governmental regional grid operators. Another result of the liberalisation of the energy market is the Electricity Law and the enforcement of this law by the institution ‘ACM’. This institution determines what is and what is not permitted
regarding the realisation of an SMG in a business park. The different elements of an SMG must fit within the existing laws. According to the experts this is a challenge because of the innovativeness of SMGs. The Electricity Law, developed in 1998, could have not taken into account the development of SMGs at that time. Consequently, this law that forbids the energy exchange between small energy users is a constraining factor in the diffusion process of SMGs in business parks. The ACM determines if a project fits within the Experimentation Act, which is a way to get an exemption on the Electricity Law. Without the Experimentation Act, it is currently not possible to exchange energy between small energy users. This means that the position of the ACM is a crucial factor for the diffusion of SMGs.

Another change in the energy market is the increased amount of renewable energy, which is institutionalised in national and international agreements. There are several ways in which the Government tries to stimulate the use of renewable energy sources, such as SDE+ rule and an increased tax on natural gas. These measures will stimulate the diffusion of SMGs, which is to a large extent concerned with the generation of renewable energy. Moreover, the rise of local energy communities in the energy market show that to an increasing extent people want to generate their own energy, which may indicate the development of SMGs as well. More and more policy documents pay attention to local energy communities, although concrete measures for reinforcement are lacking. Furthermore, a lack of dynamic prices in the energy market is a constraining factor for the diffusion of SMGs in business parks.

Moreover, five barriers in the energy market that are concerned with the legal framework are formulated. First, in the Electricity Law it is stated that it is not allowed to exchange energy between small energy users. Second, in some cases renewable energy generation units must be connected to transformation stations miles away, which is a barrier for the local generation and use. Third, the Net Metering Law stimulates the exchange of energy on national scale, instead of on local scale. Thus, this rule can be perceived as a constraining factor for the local exchange, while local energy exchange is an important element in SMGs. Moreover, the Experimentation Act provides room within the existing legal framework to exchange energy between small energy consumers, but this exemption is only given for ten years while the payback time is much longer. In the current form, this rule is therefore not efficient for the diffusion of SMGs.

Lastly, a barrier in the legal framework for the diffusion of an SMG is the way the energy tax is regulated. Currently, there are no tax advantages when one uses, exchanges and stores locally generated renewable energy.

“Which developments in the technological context influence the diffusion process?”
A few of the technologies that are needed for the diffusion of an SMG in business parks are smart meters, SDR, energy storage and a trading platform. Smart meters are already well developed and can be implemented on large-scale. The development of SDR is more difficult, because it depends on dynamic energy prices, which are currently not well developed in the Dutch energy market. Besides, SDR can only be applied when businesses can shift the time of the energy consumption. Some companies can easily shift their energy consumption pattern, while others cannot. The technologies of energy storage are well developed but are currently very expensive. It is expected that these costs will
decrease in the future, stimulating the diffusion of SMGs. Lastly, a trading platform is needed to facilitate the local energy exchange. There are various options for this. In general, the technologies for an SMG are still partially under development for optimal cost-effective use.

“Which trends in society can strengthen the diffusion process?”

Trends in society that may enforce the diffusion of SMGs in business parks are: the increased attention on sustainability, digitalisation, decentralisation, energy democracy, independency and the sharing economy. The increased attention on sustainability, decentralisation and energy democracy are derived from both the expert interviews and the literature review. The other trends are, according to the experts, not of direct influence on the diffusion of SMGs in business parks. Sustainability is, according to the survey, the most important driver for the adoption, which shows that SMGs fit within the trend of increased attention on sustainability.

To conclude, different aspects of the institutional context enable and constrain the diffusion of SMGs in business parks. The institutional context influences both the willingness of individual businesses to adopt an SMG and the building blocks of the SBM. An example of the former is that the current energy tax system makes businesses less willing to adopt an SMG than a tax system with tax advantages for energy exchange within an SMG. Regarding the latter, the institutional context determines the range in which the activities of an SMG can take place, since the activities must take place within the (outdated) legal framework.

It appears that the most important constraining factors of the institutional context are part of the legal framework. If something is not allowed by legislation, this hinders the actual diffusion but it is not easy to come up with creative solutions to bypass the legislation. Hence, the legal framework lags behind innovations. Moreover, the analysis of the institutional context shows that changes in the different parts of the institutional context are intertwined. For instance, the liberalisation of the energy market led to the Electricity Law, which is part of the legal context. Furthermore, the development of technologies for decentralised energy generation have led to the rise of local energy communities. This makes it hard to pinpoint exactly which institutional change is affecting which aspect of the diffusion process. Furthermore, the fact that lobbying is mentioned as one of the activities that must be performed to co-create an SMG, shows that an innovation should influence the institutional context. Thus, the empirical data collection supports the Structuration Theory of Giddens (1984), stating that agency and structure are intertwined. All in all, the institutional context certainly has an influence on the diffusion of an SMG in a business park.
10.4 To what extent are businesses willing to adopt an SMG and which drivers and barriers do they perceive regarding the adoption of an SMG?

The survey conducted at business park Apeldoorn Noord revealed that 70% of the businesses are willing to adopt an SMG. Besides, the survey revealed that most companies are willing to perform most of the sub-activities that are part of an SMG. The only activity for which this does not count is the change of the energy consumption to another time of the day. Only 32% of the businesses are willing to perform this activity. However, this percentage is still relatively high, since usually the percentage of early adopters is 13.5% (Rogers, 2003). Investing in renewable energy or an EV have passed the early adopter phase, so the high percentages of more than 50% are not that surprising. Nevertheless, the adoption of an SMG in a business park has not taken place yet, from which it can be concluded that in business park Apeldoorn Noord there are a lot of early adopters. However, the intention in the survey is to measure hypothetical behaviour and not the actual behaviour, which could explain the relatively high percentage of businesses who are willing to adopt an SMG. Since only one case is researched, it is not possible to state that in all business parks 70% of the businesses are willing to adopt an SMG. To gain insight in this, multiple cases should be investigated.

Multiple drivers and barriers for the adoption of an SMG in a business park are derived from the survey, interviews with businesses and interviews with experts. According to the survey, a positive attitude regarding the outcomes of an SMG is the most important driver for adoption. The most important barrier for the adoption is, according to the survey, a lack of time to explore the possibilities of an SMG. The expected positive outcomes derived from the survey are sustainability, innovativeness, a lower energy bill, a confidential use of energy data, a nearby accessible and affordable energy supply and an improved image of the company. Regarding the lower energy bill, 62% of the businesses expect a decrease of at least 10% of the energy bill. The most important drivers and barriers according to the survey are presented in figure 28.
A lack of ownership of the property and a lack of flexibility of the energy consumption pattern are added to the figure, without mentioning a percentage. Based on the survey, it can be concluded that a lack of these organisational characteristics is a barrier for the adoption. A lack of ownership is the most important reason for businesses to not fill in the survey. The businesses without ownership, argued to not have an interest in an investment in an SMG, because they do not own the building. As these businesses did not fill in the survey, no significant relation can be concluded from the SPSS analysis. Nevertheless, due to the reasons behind the non-response, this factor is included in figure 28 as a barrier for the adoption. Moreover, the factor ‘lack of flexibility of the energy consumption pattern’.
pattern’ is included in the model. The SPSS analysis showed a strong relation between this factor and the willingness of businesses to adopt an SMG. Since this factor was questioned in a different way than the other drivers and barriers (see appendix 4), no percentage can be calculated for this factor. However, the survey shows the importance of this factor. Next to the survey, the interviews show as well that a positive attitude regarding the outcomes is the most important driver for adoption. The interviews add the factor ‘energy independency’ to the list of positive outcomes of an SMG.

Furthermore, in the interviews it is argued that complexity of the technology and the organisation, the observability of an SMG and the compatibility with previous introduced plans explain the willingness of businesses to adopt an SMG. These factors are less clear in the survey results. Nevertheless, the interviews reveal that these innovation attributes derived from the Diffusion of Innovation Theory (Rogers, 2003) are drivers in this case-study as well. As is just explained, the attitude is the most important factor of the adoption of an SMG. The other factors of the TPB (Ajzen, 1991) explain the willingness of businesses to adopt an SMG as well, but to a lesser extent. Three aspects influence the subjective norm: pressure from clients, choice of other businesses and the political context. These factors indicate that the choice of companies to adopt an SMG depends on the social pressure they feel. However, only the importance of the choice of other businesses is apparent in the survey results.

In addition, the perceived behavioural control influences the willingness of businesses to adopt an SMG. A lack of time, knowledge and financial resources are barriers for the adoption. The lack of time is the most important barrier. Consequently, a park management organisation which influences the perceived behavioural control and unburdens the businesses, is a driver for the adoption. Furthermore, the trade-off between the perceived risks and returns influences the willingness of businesses to adopt an SMG. A lower energy bill, a short payback time, subsidy, taxes, investment rebates and compatibility with prior investments are all drivers for businesses to adopt an SMG, since they influence the expected return on the investment. Thus, the investment model of Wüstenhagen and Menichetti (2012) is applicable on the adoption of an SMG in a business park. Nevertheless, the importance of investment risks, which is part of the investment model, is only mentioned in the workshop session and not in the other data collection methods. Hence, in this specific case-study, the perceived returns seem more important than the perceived risks. The risks in this research are to a large extent related to the payback time because a long payback time increases the risk of the investment and is a barrier for the adoption. Most of the businesses want a payback time of maximum five years. Another driver for businesses to adopt an SMG are specific organisational characteristics. Looking at the survey results, a flexible energy consumption pattern is the only organisational characteristic that affects the willingness of businesses to adopt an SMG. Nevertheless, the interviews show that a relatively high energy bill, ownership of the property and decision-making authority are drivers for the adoption of an SMG as well. Ownership of the property is of crucial relevance, since if a business does not own the property of the company, he will feel less responsible for an investment in an SMG. The critical mass which influences the adoption of some innovations (Marwell & Oliver, 1993; Mahler & Rogers, 1999), is not a driver in this case-study.
It is notable that some of the drivers and barriers are derived from the interviews with experts, the interviews with businesses and the survey, while other drivers and barriers are only derived from one data collection method. This makes it difficult to make strong statements about the most important drivers and barriers. Nevertheless, it is clear that a positive attitude regarding an SMG is an important driver. Besides, it can be concluded that the attitude is concerned with economic, ecological and social values.

Moreover, there are a lot of similarities between factors influencing the diffusion of local energy communities and factors influencing the adoption of SMGs. For both phenomena the attitude is the most important driver. Besides, the attitude is in both cases concerned with a positive evaluation of economic, ecological and social values. The largest difference is that with local energy communities the innovation attributes play a little role. Local energy communities are, to an increasing extent, included in energy policy documents, which could be a driver for the diffusion of SMGs as well. To conclude, the theories of the theoretical framework are to a large extent supported in this research, in particular the TPB (Ajzen, 1991). The presence of a critical mass and some organisational characteristics, are the only factors of the theoretical framework that do not explain the adoption of an SMG by businesses at a business park.

10.5 How do the building blocks of an SBM work for the organisation of an SMG in a business park?

To answer this question, two related sub questions are formulated and answered in this section.

“What are the building blocks to design an SBM for an SMG in a business park?”

The building blocks of an SBM for the organisation of an SMG in a business park consist of actors and roles, value proposition, activities, tools, risks and organisation. Regarding the first building block of actors and roles, the local businesses, park management organisation and consultancy agency are considered as conditional actors. The municipality, province, National Government and Environmental Service are supporting public parties, while real-estate owners are supporting private parties and Liander is a supporting semi-governmenal party. It is expected from these actors to play multiple roles, varying from investor to lobbyist and grid manager. Consequently, with SMGs the energy system becomes more dynamic as actors are playing multiple roles. Most of the roles are performed by multiple actors, which means that the actors must work together. Moreover, the division of roles indicates that the parties depend on each other for the realisation of an SMG.

The building block ‘value proposition’ describes the added value for the just mentioned actors. An SMG will add economical, ecological and social values. For the private parties, the economic values are the most important. It is in particular important that the companies at the business park see added value in the realisation of an SMG. After all, a positive evaluation of the outcomes of an SMG is the most important driver for the adoption. In contrast to the private parties, the public parties will mainly receive ecological benefits. However, the public parties can economically benefit from an SMG as well. For private parties, the contribution to sustainability is important, but not only because of climate
objectives. Sustainability will improve the image of the companies and will increase their CSR level. This counts for both the local businesses and the real-estate owners. It is important for the park management organisation that an SMG will contribute to an improved business climate. Besides, an SMG can increase the social cohesion, which is beneficial for economic activities. Hence, this thesis provides knowledge of how an SMG could contribute to the revitalisation of business parks.

The building block ‘activities’ describes which activities must be performed in which order to realise an SMG. In other words, it describes a plan of action. For the diffusion of an SMG it is important that first a shared understanding is created, which is followed by preliminary research and quick wins. Afterwards, the community members must show their commitment to the process by signing a letter of intent and contracts. However, before parties will sign contracts, there must first be a good business plan. If this is solid, the actors can start with the implementation. The initiation phase and implementation phase are important phases for the adoption of an innovation according to the Diffusion of Innovation Theory (Rogers, 2003). The initiation phase is comparable to what Rogers (2003) calls ‘agenda setting and matching’. The importance of commitment to the process in the adoption process is not derived from literature, but the empirical-data collection shows that this step is important when an innovation must be co-created. Hence, for collaborative innovations, the diffusion phases consist of initiation (shared understanding, preliminary research, quick wins), commitment to the process and implementation. By formulating these phases, this research contributes to the diffusion theory of innovations.

The fourth building block is concerned with tools for implementation. The needed tools are time, legal knowledge, technical knowledge and investment money. The amount of investment money cannot be determined yet. However, insight is gained in which party is responsible for which part of the investment. The public parties are responsible for half of the investments, the business for 25%, the real-estate owners for 15% and the park management organisation for 10%. Since there is no insight in the total amount of the investment, these percentages are exploratory. To acquire the investment money, several financial tools can be used. For instance, subsidy, an ESCO and a green lease.

The building block ‘risks’ describes the potential barriers for the diffusion of an SMG in a business park. Risks are concerned with a lack of financial resources, a lack of sense of urgency, a lack of shared understanding (old wine in new bottles) and problems within the legal framework. The sixth and last building block an SBM is concerned with is the organisation of an SMG in general. An SMG can only be organised by a cooperation between different public and private parties. They must form a collaborative arrangement in which the benefits and investments are shared. This means that the values are collective. Furthermore, a central aspect in the organisation is that energy will be used as a medium of exchange. The organisation is built around the prosumption of energy. The six building blocks of actors and roles, value proposition, activities, tools, risks and organisation provide guidance for the development of an SMG in a business park.

“How can the building blocks of an SBM for an SMG in a business park be co-created by public and private actors in a way that the co-creation is embedded in the development of the SMG?”
An SMG will only diffuse in a business park if public and private parties work together. Together the actors must provide the necessary tools and perform the activities described in the SBM. Some of the roles that must be performed to develop an SMG can only be performed by public actors (e.g. providing room in legal framework), other roles are preferably performed by private actors. The performance of some roles is a shared responsibility between both public and private actors (e.g. investor). From both public and private parties it is expected that they play an active role. By involving the various parties in the design of the SBM, it is more likely that they will also be actively involved in the development of the SMG itself. Therefore, designing the building blocks of the SBM and the development of the SMG itself must be a process of co-creation. Co-creation is, in this research, considered as a collaborative process in which public and private parties are actively involved to reach the common goal of the diffusion of an SMG in a business park. Thus, through a co-development, the parties create value to the community members of the SMG. The building blocks of an SBM for an SMG in a business park are, in this research, co-created through an interactive workshop session. By bringing the different actors together and facilitating a face-to-face dialogue, the community members created a shared understanding, which is the first step in the development of an SMG. Moreover, knowledge sharing between the participants led to the creation of the key elements of the SBM. By combing the knowledge of the different participants, a new SBM has been created. Besides, the workshop session increased the trust that the workshop participants have in the co-creation of an SMG. Through a negotiation game about a letter of intent, including the preferences of each of the workshop participants, the workshop participants realised that it is not that hard to get all of the community members on the same page. Consequently, the workshop session led to a consensus about the actors and roles, activities and the shared responsibility of investments.

To make sure that the development of the SMG itself is a process of co-creation as well, the workshop participants embedded several success factors of co-creation in the SBM. The success factors of co-creation that are embedded in the SBM are a shared understanding, intermediate outcomes and commitment to the process. The building block ‘activities’ describes that the first activity is concerned with creating a shared understanding. Furthermore, it is important that the community members experience intermediate outcomes, which will give them confidence in achieving the end goal. Moreover, the commitment of the public and private parties to the process must be ensured, which can be done through a letter of intent and contracts. The workshop session showed that commitment to the process is a precondition for the further development of an SMG in a business park. Next to these success-factors derived from Ansell and Gash’s theory (2008), the success of co-creation depends on the mutual independency as a result of a division of roles. As a result of the mutual independency, the parties will be more likely to commit themselves to the process of co-creation. The success factor face-to-face dialogue, which is both mentioned by Ansell and Gash (2008) and Rogers (2003), is not of crucial importance according to this research. To conclude, a workshop session can be a way to intervene in the current situation and to create new knowledge about the SBM for an SMG. To enhance the co-creation process of the SMG the SBM includes the elements of creating a shared understanding, intermediate outcomes, commitment to the process and mutual recognition of interdependency.
## 10.6 Final conclusion

The main research question that has been investigated in this research is: *“Which factors explain the adoption of SMGs by businesses at a business park in the Netherlands from a behavioural-institutional perspective and how can public and private actors co-create an SBM for the development of an SMG, reflecting these factors?”*

The literature review, in-depth interviews with businesses, experts and the survey provided insight into factors explaining the adoption of SMGs by businesses at a business park in the Netherlands. First, it can be concluded that the adoption of an SMG by businesses can partly be explained by institutional factors and partly by individual drivers and barriers for adoption. Regarding the institutional settings, several factors explain the adoption of an SMG by businesses. As a result of the liberalisation of the energy market there is room for local energy communities to diffuse. Moreover, the development of smart technologies made it possible for SMGs to emerge. Nevertheless, the legal framework provides a barrier for the adoption and partly explains why businesses have not adopted an SMG yet. Currently, it is not possible to exchange energy between small energy users, which is a crucial element in an SMG in a business park. Within the legislation an exemption must be made, but an effective procedure still needs to be arranged for this. Furthermore, the current energy tax system and the cheap energy prices explain why companies have not adopted an SMG yet, since they reduce the possibility of financial benefits. Moreover, the market of flexible energy prices is not well developed, which means that the financial advantages of shifting the energy consumption to another time of the day are relatively low. Another barrier for the adoption is the lack of ownership of the building. Due to a lack of feeling responsible and a lack of perceived behavioural control, businesses renting the building will be less inclined to adopt an SMG.

Nevertheless, the case-study showed that 70% of the businesses at business park Apeldoorn Noord are willing to adopt an SMG. The most important driver for businesses to adopt an SMG is a positive attitude regarding the outcomes of an SMG. Furthermore, an important driver for the adoption is a park management organisation which unburdens the individual businesses. Based on the factors explaining the adoption of an SMG by businesses, an SBM can be developed. An SBM can be co-created by public and private parties in an interactive workshop session. Here, it is important that the public and private actors are committed to the process and acknowledge their mutual interdependency.

Several explaining factors that are derived from the first research phases are reflected in the SBM (figure 29). For instance, since a positive attitude is the most important driver for businesses to adopt an SMG, the first activity that must be performed in the development process is the creation of a shared understanding. Hence, the businesses must acknowledge the benefits of an SMG before they will adopt one. Moreover, only 38% of the businesses state that they have enough financial resources to adopt an SMG and on average the businesses expect 36% subsidy if they adopt an SMG. Therefore, in the SBM it is included that public parties are responsible for 50% of the investments. Besides, to reduce the barrier of a lack of financial resources, an ESCO and a green lease are built into the SBM as
financing tools. Furthermore, the survey shows that a lack of time is the biggest barrier for businesses to adopt an SMG. Therefore, in the SBM it is mentioned that the park management organisation guides the project, which will unburden the businesses. The survey shows that the trust in the park management organisation is higher than in a commercial party, hence the park management organisation is, in the SBM, defined as a key partner. Moreover, the in-depth interviews with the experts and the workshop session showed that the legal framework is a barrier for the adoption. Consequently, in the SBM, the role of lobbying and providing room within the legal framework is appointed to the public parties. Besides, providing room in the legal framework is included as an activity in the initiation phase of the project.

Figure 29 SBM for SMGs in business parks (Author, 2019)

The SBM that is developed through a process of co-creation (figure 29) contributes to the existing theories about SBMs for SMGs. There are only very few scientists who have been working on business models for SMGs (e.g. Koirala et al., 2016; Rodríguez-Molina et al., 2014; Wolsink, 2012) and none of them have developed an SBM for an SMG in the specific context of a business park. Rodríguez-Molina et al., (2014) have analysed ten different business models and concluded that overall, there is a weak description of business model ideas for SMGs. Koirala et al. (2016) have developed a business model canvas for an SMG in a citizen community, but this is a conventional business model that does not emphasise the importance of a community structure and collaboration. It is an organisation centric model. However, Jonker (2014) states that these kind of conventional business models are inadequate for sustainable innovations, such as energy communities. The conventional business models are organisation centric, linear and financially based (Jonker, 2014), while an SMG has none of these characteristics. Moreover, in the existing business models (Koirala et al., 2016; Rodríguez-Molina et al., 2014), public parties are not mentioned as partners. They only emphasise the demand and supply
relations and leave other stakeholders out of context. The SBM developed in this research contributes to the existing theories, since it includes the process of co-creation between different public and private parties. For instance, it shows that commitment to the process is an important aspect of the business model. Hence, the new developed SBM combines the building blocks of the Cloverleaf Model (Jonker, 2014), with the conventional business models about SMGs (Koirala et al., 2016; Rodríguez-Molina et al., 2014), to develop a new SBM that is community based, involves multiple values and includes the process of co-creation. In particular, a lack of collaboration is something that is missing in current business models for SMGs.

Moreover, the new designed SBM gives insight into which activities must be performed and how the success factors of co-creation are embedded in these activities. Besides, the model does not only indicate whom key partners are, which has been done in other business models (Koirala et al., 2016; Rodríguez-Molina et al., 2014), but the designed SBM also indicates that the partners must form a ‘collaborative arrangement’. The new SBM shows that the organisation of an SMG is concerned with the cooperation between public and private parties, in which the investments and benefits are shared. Furthermore, the designed SBM is more specific than existing models about the responsibility of resources. Koirala et al. (2016) state that the resources consist of households and community distribution energy resources, but the business model does not explain how this is financed. The new developed SBM explains that there is a difference between long and short-term investments and that the investment is a shared responsibility between public and private parties. The new model also mentions tools to realise the financing of the SMG. Finally, the existing business models do not mention risk management, while this research shows that the adoption of an SMG is not without any risks. Consequently, in the new SBM potential risks are included, which are for instance concerned with creating a shared understanding.

Since only one case has been researched, the SBM cannot be generalised to other business parks in the Netherlands. However, the SBM is partly based on expert interviews, who shared their experiences about other business parks. Moreover, business park Apeldoorn Noord has not been chosen because it is a unique case. Therefore, it is assumed that to some extent the developed SBM can be used at other business parks as well.

To conclude, the SBM developed in this research contributes to the existing theories, since it provides guidelines for the process of co-creation. It includes a plan of action and for this reason it explains the risks of the development of an SMG in a business park. By combining the Cloverleaf Model (Jonker, 2014) with specific information about SMGs, this research contributes to the theoretical foundation of business models for SMGs in business parks and reduces the knowledge gap about this subject. Besides, with this new business model chances are increased that the model contributes to the realisation of an SMG in a business park, considering that it embeds the process of co-creation which is necessary for SMGs. The developed SBM does not claim to be complete, however it contributes to the existing theories and can be interpreted as dynamic model in development.
10.7 Recommendations for practice

Based on the conducted explorative case-study, several recommendations for practice can be formulated. The SBM provides guidance for the development of an SMG in practice. In this section, some recommendations that are derived from the SBM are explained in more depth. First, recommendations for the public parties (National Government, province and municipality), who want to contribute to climate objectives are formulated. An SMG fits within the ambition described in the Dutch Climate Agreement (2019), to make the energy system more flexible and to enforce the development of local energy communities. Although it is not explicitly mentioned, an SMG fits within the ambitions of the government. To meet the ambitions, the government parties are recommended to seek contact with park management organisations. Park management organisations are expected to perform a guiding role in the development of an SMG in a business park, since they are close to the local businesses. Public parties, in particular municipalities, can enhance the project by approaching this party and seeking a collaborative arrangement. Furthermore, it is recommended for public parties to lobby for room within the existing legal framework. The Experimentation Act is a way to give permission to energy exchange between small energy users, but the exemption provided by the Experimentation Act is only given for ten years while the payback time of the investment in an SMG is about thirty years. Consequently, the exploitation parties, face a huge risk when they implement an SMG. Therefore, the advice for public parties is to make the Experimentation Act more flexible so that permission can be given for a longer time period. Third, to stimulate the diffusion of SMGs, energy policy makers are advised to adjust the Net Metering Law. Currently, energy prosumers are being rewarded when they put energy on the national grid. The two-way transportation of electricity causes imbalances on the national grid which make grid enforcements necessary. These grid enforcements increase societal costs. Therefore, it is advised to change the Net Metering Law and to reward energy prosumers when they keep the energy locally. This will decrease the need for grid enforcements. Furthermore, it is recommended for public parties to subsidise part of the investment in SMG assets. The businesses expect at least a subsidy of 36%. The subsidy will decrease the payback time, which is needed to motivate businesses to adopt an SMG. Since an SMG contributes to CO₂ emission reduction, the public parties profit from giving subsidies as well. When the government parties follow the advice, it will be more likely that SMGs spread to more business parks, which is a way for public parties to reach their climate objectives.

A park management organisation can benefit from the diffusion of an SMG as well. An SMG will improve the business climate and enforce local economic activities. The advice for park management organisations is to start with the creation of a shared understanding about SMGs. The park management organisation could organise meetings to explain to the businesses what an SMG is and which advantages it has. This will decrease risking a lack of sense of urgency. The park management organisation should explain to the businesses that an SMG is more than installing PV. The whole concept has to be understood. When there are a few businesses that are enthusiastic about the adoption of an SMG, these businesses can perform the role of an ambassador. Starting with just a few
amount of businesses, will make the organisation of an SMG, such as the design of contracts, less complicated. Besides, businesses will be more likely to listen to the experiences of other businesses, than they will listen to parties they do not know. The park management organisations could offer these ambassadors a platform to share their experiences. Moreover, an advice for the park management organisation is to include the real-estate owners in the process of creating a shared understanding. The real-estate owners are responsible for part of the investment in SMG assets as well. Hence, it is important that they see added value in the adoption of an SMG. Moreover, from park management organisations it is expected that they guide the development process. For more technical and operational knowledge, they could collaborate with a consultancy agency and together they can perform the role of grid managers. Besides, a park management organisation must relieve the businesses, for instance, by helping them to apply for subsidies.

An advice for businesses who want to adopt an SMG is to start with small wins. Starting with PV is an accessible first step. Besides, an advice for the early adopters is to motivate other businesses at their business park to adopt an SMG. In this way, the innovation will spread like an oil stain. Furthermore, businesses who do not have the financial resources to adopt an SMG, could explore the possibilities of an ESCO. 38% of the businesses at business park Apeldoorn Noord state that an ESCO is a driver for the adoption. An ESCO taking responsibility for the investment and risks could be an outcome for businesses who want to adopt an SMG, but do not have the resources to do so. The park management organisation could facilitate the ESCO.

An advice for real-estate owners is to talk with businesses about the possibilities for a green lease. When a real-estate owner plays a role in an SMG, it could improve the image of the company. Besides, the value of the property could increase, and the real-estate owner could receive financial profit by renting out his roof for PV. Thus, there is certainly an added value for real-estate owners to participate in an SMG. However, the issue of the split incentive must be overcome. This barrier can be taken away when the real-estate owner arranges a green incentive with the businesses.

Next, several parties together should explore how they could stimulate the market for flexible energy prices. This will be a task for energy suppliers, grid operators and maybe public parties and businesses at a business park. Without a market for flexible energy prices, businesses cannot fully profit from SDR and therefore it is in the benefit of multiple parties to enhance this market. To summarise, this research has led to several recommendations for both public and private parties to enforce the diffusion of SMGs in business parks. If this advice is followed, the chance increases that SMGs are, in the future, common energy systems at business parks, contributing to the energy transition.
Chapter 11. Reflection
11.1 Introduction to chapter

This chapter consists of a critical reflection on the research theories (section 11.2), methods (section 11.3) and results (section 11.4). Both the positive sides and the limitations of the conducted research are briefly described. This chapter ends with recommendation for further research (section 11.5).

11.2 Reflection theoretical framework

In this research, factors influencing the adoption of SMGs in business parks are explored and second, the co-creation of the building blocks of an SBM are researched. Consequently, the social feasibility of the innovation of an SMG in the specific context of a business park is researched. To meet this research aim, theories explaining the willingness of businesses to adopt an innovation and theories explaining the co-creation of SBMs are used. Considering the explorative research approach, the theories are used as a framework to structure the research and to formulate the main categories of drivers, barriers and building blocks of an SBM. Hence, it can be investigated whether the variables from the theoretical framework influence the diffusion process. Furthermore, the theories are adjusted to make them applicable to the specific context of SMGs at business parks.

To research the diffusion process, several theories are used. The Diffusion of Innovation Theory (Rogers, 2003) is used to describe the phases in which the adoption of an innovation works within a company. Compared to the adoption phases of an individual, the phases of an organisation are only briefly described by Rogers (2003). Consequently, based on the research on SMGs and the importance of working together to realise it, an additional phase is added to the phases described by Rogers (2003). Thus, the diffusion phases do not consist of ‘agenda setting and matching’ and ‘implementation’, but instead consist of ‘agenda setting and matching’, the ‘co-creation of an SBM’ and ‘implementation’. It can be concluded that for community innovations ‘the co-creation of an SBM’ is an additional step in the diffusion process. Moreover, as explained in section 10.5, on an individual level the step of ‘commitment to the process’ is added to the adoption process.

Furthermore, the theory of Rogers (2003) explains that five factors (innovation attributes, type of innovation decision, communication channels, nature social system, change agents’ promotion efforts) influence the diffusion of an innovation. Out of these factors, the innovation attributes were the most important in this research. To explain the nature of the social system, the Diffusion of Innovation Theory is enhanced with institutional theories, through which the social system is viewed more broadly and is replaced by a description of social and economic and political settings (Ostrom, 2007). The other factors should be operationalised more clearly, before they can be researched, which is a recommendation for further research. Moreover, the Diffusion of Innovation Theory (Rogers, 2003) is used in this case-study to understand the difference between early adopters and laggards as well as to explain the critical mass of interactive innovations (Mahler & Rogers, 1999; Marwell & Oliver, 1993).
Although the research shows that an SMG is an interactive innovation, it is not a constraining factor for the diffusion process. The participation pool is influential, but mostly due to the subjective norm and observability. Thus, looking back, the ‘critical mass’ could be removed from the theoretical framework. Last, the factors described by Rogers (2003) explain the adoption ‘rate’, while in this research the focus is on the adoption ‘social feasibility’. Nevertheless, the theory provided a good basis for an understanding of the diffusion process.

Second, the diffusion process is explained by using behavioural theories. The TPB (Ajzen, 1991) is used as a framework to understand the adoption process. The TPB states that behavioural change consists of an intention, which will lead to the actual behavioural change (Ajzen, 1991). In this research only the intention of businesses to adopt an SMG is measured, which means that part of the TPB theory has not been used in this case-study. Instead of the TPB, there are other theories that can be used to explain environmental behaviour as well, for instance the value-belief-norm theory (Stern, 2000). However, it is argued that this theory is not very useful to gain knowledge about situations with high behavioural costs (e.g. investment SMG assets) or strong constraints on behaviour (using energy at different times of the day) (Steg & Vlek, 2009) which is more or less the case with SMGs. The TPB is more useful since it considers more diverse factors (Steg & Vlek, 2009). Furthermore, the Responsible Technology Acceptance Model (Toft et al., 2014) could be an alternative theory to the TPB. According to this model, the acceptance of technology depends on the perceived usefulness, perceived ease of use, personal norm and attitude towards the technology (Toft et al., 2014). In fact, this theory consists of more or less the same elements as the TPB. The most important difference is that the Technology Acceptance Model puts more emphasis on technology instead of behaviour. Since an SMG asks for a collaborative arrangement, which goes further than technology, the TPB is used instead of the Technology Acceptance model. The biggest downside of the TPB in relation to this research is that it does not explain the institutional context in which the diffusion takes place. Therefore, the Structuration Theory (Giddens, 1984) and several other institutional approaches (Ostrom, 2007; Oteman et al., 2017; Van der Heijden, 2015) have been added to the theoretical framework.

During this research it became clear that the adoption of an SMG mainly consists of the decision to invest. Therefore, another theory that is used to explore the diffusion process, is the theory about investments in renewable energy by Wüstenhagen and Menichetti (2012). Although the original theory describes the investment choices in energy as investor parties, the model is, with the adjustments (see chapter 3), useful to explain the investment choices of businesses that are not working in the energy sector as well. However, it was a risk to use this model which relates to a different target group. The theory states that the investment decision depends, among other things, on prior investments. This factor is not included in the conceptual model as a separate factor, but is considered as part of the trade-off between risk and return. This is explained in section 3.6. However, looking back the concept of ‘prior investments’ could have been included in the interviews and survey as a possible factor influencing the adoption. In the survey this factor could for instance be formulated as: I am willing/not willing to adopt an SMG because I have (not) made prior investments in a central heating boiler or other energy related units.
The Cloverleaf Model of Jonker (2015) is used to design the building blocks of the SBM. This model provided a useful framework, because it emphasizes multiple values, a community structure and a long-term commitment, which is important for SMGs. More traditional business models such as the Business Model Canvas (Osterwalder & Pigneur, 2010) do not explain these building blocks. The building block activities, tools and added value that are part of the new designed SBM are derived from the Cloverleaf Model (Jonker, 2014). Another building block, according to Jonker (2014), is concerned with the community structure. In this research the community structure is replaced by ‘actors and roles’, since these seem to be the most important aspects of the community structure for the diffusion of SMGs in business parks. Nevertheless, a limitation of this research is that no attention is paid to the relation between the different actors and the forms of communication between the actors. Researching this is a recommendation for further research.

In the new developed SBM the building blocks of values and principles are left out, since the building block ‘added value’ already explains that there is multiple value creation and the building block ‘organisation’ already explains that the values are shared collectively which are important principles (Jonker, 2014). Besides, the building block ‘risks’ is added to the model, as the workshop session showed that risk management is important to overcome these potential barriers. By using the Cloverleaf Model to design a business model for SMGs in business parks, it became clear that the Cloverleaf Model includes some elements that are hard to put into use. Besides, it appeared that there are some overlapping elements, such as the value proposition and collective values, and such as the community structure and the design team. The community structure and the design structure (actions and tools) are the main elements that provided guidance in the development of an SBM in this research. By using this model as a guidance in the workshop session it became clear which activities need to be performed by who to realise the diffusion of an SMG in business park Apeldoorn Noord. To conclude, in this case-study the Cloverleaf Model (Jonker, 2014) is applied to the adoption of SMGs in business parks, but the model is adjusted to the specific case.

Considering the importance of the co-creation of the SBM and the SMG itself, there was effort put into finding theories that explain the process of co-creation. It appeared that there are a lot of scientists who describe the concept of co-creation in a way that fits with the idea of how an SMG can be developed (e.g. Kemp & Scholl, 2016; Lund, 2018; Schrage, 1990; Voorberg et al., 2015). These theories explain that co-creation is concerned with the active involvement of multiple stakeholders to create something new that could not be created without collaboration. However, it turned out that it is difficult to find theories that describe the process of co-creation, especially theories that do not focus on co-creation initiated by the public sector (e.g. Gouillart & Hallet, 2015). Prahalad and Ramaswamy (2004) describe the process of co-creation, but still focus on the relation between consumer and producer, which is hard to translate to the development of an SMG that is concerned with ‘prosumers’. As a result of a lack of theories about the process of co-creation in a community, the success factors of collaborative governance of Ansell and Gash (2008) are used in this case-study. Applying these success factors is perhaps a bit questionable, but although the success factors are concerned with another process than co-creation, they indicate how an SBM can be organised. Besides, the definition of
collaborative governance of Ansell and Gash (2008) does not fit with the diffusion of SMGs, since an SMG is not in particular initiated by public parties and therefore the concept ‘co-creation’ is used instead of ‘collaborative governance’. Since the theory about the success factors is added to the theoretical framework after the interviews took place, unfortunately in the interviews no explicit questions were asked about the success factors of co-creation. As a consequence, these factors cannot be critically reflected.

11.3 Reflection methodology

This research consists of a case-study design. The choice of the case ‘business park Apeldoorn Noord’ is influenced by the internship company HVE and thus the case selection is partly based on practical reasons instead of scientific reasons. Other business parks could have been the object of the study as well, which means that the choice for the case is not intrinsic but instrumental. Nevertheless, as explained in chapter 6, the case has some characteristics which made it useful to research. Due to time constrains, the possibility of performing a multiple case-study was excluded, which is a limitation of this research. Consequently, it is hard to generalise the research results. However, the interviewed experts were not involved in the case-study of Apeldoorn Noord, as a result of which, the diffusion process is viewed from the perspective of other cases as well. As a result of this and the fact that no unique case has been investigated, it can be assumed that the research results of this case-study can be, to a (very) limited extent, generalised to other business parks in the Netherlands.

In this research, a mix methods design is applied. The advantage of a mixed methods design is that the downside of each data collection method can be compensated by another data collection method. For instance, a downside of the in-depth interviews with the businesses is that is hard to generalise the results, which is compensated by conducting a survey among all businesses at business park Apeldoorn Noord. The choice to start the empirical data collection with in-depth expert interviews was made because of the little knowledge that was available on beforehand about SMGs in business parks. Hence, the experts provided insight in the diffusion of SMGs by talking about their own experiences. Particularly, they talked about the drivers and barriers they experienced in their own projects with businesses. Consequently, the expert interviews provided a first insight into factors explaining the adoption of an SMG by businesses. As experts from different kind of organisations were interviewed, a diverse range of perspectives is included in this research. To strengthen the data results of the expert interviews, more public parties could have been interviewed, for instance municipalities and provinces that are frontrunners with the implementation of SMGs. However, these parties were hard to identify.

Next, the statements of the experts were discussed with five businesses at business park Apeldoorn Noord in the in-depth interviews. In this way, more depth was given to the assumptions of the experts. The interviews are analysed by coding the answers with categories derived from the theoretical framework. In the codebook, the drivers and barriers are not subcategorised. Looking back, different codes for each kind of driver and barrier would have made the interpretation of the data easier.
Moreover, it became clear that the different drivers and barriers described in the theoretical framework have a lot of overlapping elements, which made it hard to subcategorise the drivers and barriers. Therefore, in the data analysis (Appendix 6) some answers are coded with multiple categories.

The expert interviews and the interviews with the businesses were both input for the survey. The survey was input for the workshop session. The aim of the survey was to get insight into the extent to which businesses are willing to adopt an SMG and the motivations explaining their willingness. To be able to get reliable research results, it was aimed to achieve a response rate as high as possible. It is not easy to say how high the response rate exactly should be (Saunders et al., 2009; Vennix, 2011). About 50% of the companies at business park Apeldoorn Noord eventually were willing to fill in the survey. To achieve this response rate, e-mails have been sent, phone calls have been made and businesses have been physically visited. Beforehand, it was not expected that it would be that hard to gather the data. The non-response can be the result of four interrelated problems: ineligibility to locate respondent; refusal to respond; ineligibility to respond; inability to contact the respondent (Saunders et al., 2009). In this research, the non-response was the result of the latter three problems. The companies that were visited and that refused to fill in the survey were asked why they refused. Almost all of them argued that they were renting the building and thus in their eyes, the subject of the questionnaire was not relevant for them (refusal to respond). Some of the renters still tried to fill in the survey, but while doing this, they claimed to have too little knowledge to respond (ineligibility to respond). This explains why quite some surveys are filled in until question 10. These companies are perceived as partial non-response. An alternative option would be to conduct the survey only among businesses who own the building, since in that case a higher response-rate would be expected. The downside of doing this, is that the survey in that case does not provide a reliable representation of the businesses at the business park. As a consequence of the non-response of the renters, in this research it is decided to interview some real-estate owners. It has been researched to what extent they are willing to adopt an SMG and how willing they are to work together with the renters. Nevertheless, the results of these interviews are hardly shown in this thesis, because afterwards it was decided that the focus is on the companies itself.

Sometimes the owner of the business was not available and other employees were unable to fill in the survey (inability to contact respond and ineligibility to respond). Besides, about 10% of the businesses stated to not have time to fill in the survey and therefore they refused. Moreover, it was impossible to contact about 20% of the businesses. Looking back, the survey was maybe too challenging to fill in for businesses who do not know anything about energy. Nevertheless, when the survey is adjusted slightly, by removing some questions and explaining other questions in more depth, the survey could be used at other business parks as well to measure the willingness of businesses to adopt an SMG.

The survey is analysed with the software SPSS, in which several descriptive static tests have been performed. Most questions consisted of Likert-items. There are different ways in which Likert-item questions can be analysed and the chosen method has an impact on the research results (Saunders et al., 2009). In this case-study, each driver or barrier for adoption that is answered with ‘Agree’ and ‘Strongly Agree’ with more than 50%, is interpreted as an important driver or barrier for the diffusion
process. Another way to interpret the Likert-item questions is to calculate means. As a result of the large number of times that ‘neutral’ has been answered, calculating means seems inappropriate. A difficulty of the data analysis is that the N-rate was relatively low. When performing cross tabs, each of the cells needed to have a minimum expected count of five (Field, 2009), which was not often the case in this research when two variables were compared. The low N-rate is the result of the split-up after question 10 between respondents who are willing to adopt and respondents who are not willing to adopt. Looking back, it would have been better if the survey was designed without a division halfway in two groups. The issue of the low N-rate is solved by using the Fisher Exact Test instead of the Pearson Chi-Square, since with the former there is no precondition of an expected count of at least five in each cell (Field, 2009).

Next to the interviews and survey, the other used empirical data collection method is the workshop session. Eventually, in the workshop session a model was designed based on the previously required knowledge. In the workshop session, seven stakeholders from practice were involved. In real-life there are more stakeholders involved in the development process of an SMG in a business park. The decision to not include all stakeholders is a limitation of this research, since some interests are not included in the SBM now. However, because of practical reasons, it was a well-reasoned decision to not invite all stakeholders. With a limited number of participants, the participants have more room to explain themselves and the workshop can be more easily structured. The stakeholders that are not involved are the regional grid operator Lliander (their vision and interest is known due to the interview), the Environmental Service Veluwe IJssel, the National Government and the Cleantech Region. It is assumed that the invited stakeholders are the stakeholders with the most power and interest. Moreover, a limitation of the workshop session as a tool within intervention research is that the data collection contributes to soft evidence, rather than actual facts (Mayer & Veeneman, 2002). Although this is a downside of the data collection method, ‘soft evidence’ fits with the explorative research approach.

Moreover, a downside of a workshop is the risk of too much talking without actual impact (Albrechts, 2004; Savini et al., 2015). Besides, a risk of a workshop session is group thinking. With group thinking the desire to achieve unanimity leads to a dysfunctional outcome, as alternative courses of action are not realistically considered (Janis, 1972). The wish to achieve unanimity is in the case of group thinking bigger than a critical view on possible actions (Janis, 1972). Next to pressure towards uniformity, other risks of group thinking are overestimations of the group and closed mindedness. Several characteristics enforce the chance of group thinking: high group cohesiveness, insulation of the group, lack of impartial leadership, lack of norms requiring methodological procedures, homogeneity of social backgrounds and ideology and situational context (Janis, 1972). It is assumed that these enforcing factors of group thinking only apply to a limited extent to the workshop session. Consequently, the disadvantages of group thinking would not, to a large extent, have affected the research results.

The aim of the workshop session was to collaboratively design an SBM. To bring the participants to the ‘edge of knowledge’ first the concept of an SMG and the research results of the survey were elaborately discussed. Afterwards, assignments and discussion questions were used to develop an SBM, focusing on a letter of intent. In general, the objective of the workshop has been achieved.
However, the participants stated that the assignments were quite difficult to perform. This shows that the development of an SBM is not an easy job. Critically reflecting on the program of the workshop session, perhaps the focus should be only on the community structure, since the participants were able to share most of their knowledge about this component of an SBM. In contrast, the participants had relatively little knowledge about the activities and tools. Consequently, contribution of the workshop participants to the development of the SBM was lower than expected. In particular it was assumed that public parties, like the municipality and province, had more ideas about bringing the different stakeholders together. However, from the workshop session it can be concluded that public parties do not have a lot experience with guiding community-based energy initiatives. However, the technical experts had a lot of knowledge about both the technical and the organisational side of an SMG. These workshop participants drew the others on board.

The workshop session was useful to stimulate the implementation of SMGs in practice. One of the results of the workshop session is that a real letter of intent is signed by the park management organisation of Apeldoorn Noord and the consultancy agency. They decided to continue with a close co-operation. Moreover, every six weeks meetings are organised between these parties and the municipality of Apeldoorn. In these meetings the public and private parties discuss with each other which actions from the plan of action they have performed and what help they need to perform further actions. Besides, several businesses were that enthusiastic about the SMG concept, that they installed PV on their roof. It is expected that on the very short term these businesses will exchange energy as well. Hence, it can be concluded that the workshop session had an intervention value.

### 11.4 Reflection results

This section provides a critical reflection on the results. This research aimed to explore factors influencing the willingness of businesses to adopt an SMG and to use these factors to develop, through a process of co-creation, an SBM for SMGs in the context of business parks. First, this research shows that the diffusion of an SMG consists of three steps: agenda setting and matching by individual businesses, the co-creation of an SBM and the implementation. To find out which factors explain the agenda setting and matching, several theories are used. The results show that a positive attitude is the most important driver for the adoption. A positive attitude depends on various factors, such as sustainability and a lower energy bill. The most important barriers for the adoption are a lack of time and a split-incentive between businesses and real-estate owners. Besides, the legal framework causes a barrier for the exchange of energy. These conclusions are based on both the interviews and the survey.

Based on the survey alone, it is easier to explain the drivers than the barriers for adoption. The analysis of the survey showed that the statements proposed to the companies who are not willing to adopt an SMG, do not reflect their reasons very well to not adopt an SMG. Most of the statements were answered with ‘Disagree’ or ‘Strongly Disagree’, which means that these statements did not explain
the reasons of businesses to be willing to adopt an SMG. Besides, a lot of the time ‘neutral’ is answered, which makes it difficult to draw conclusions about the barriers. Hence, as a result of this, in combination with the low N-value, no clear overview of barriers can be derived from the survey.

Some of the statements of the interviews are not supported by the survey results. For instance, the experts explain in the interviews several organisational characteristics that influence the willingness of businesses to adopt an SMG. Even though some of these characteristics are clearly described in the interviews as drivers for the adoption, no correlation in the survey is found between most of the organisational characteristics and the willingness of businesses to adopt an SMG. This is probably the result of the sample being too small. It shows the difficulty of using a mixed methods design, since there are no strict rules about when results are reliable. Do the results need to be derived from all data collection methods? To deal with it in this research, it is clearly stated which results are derived from which data collection method. Regarding the workshop session, the developed SBM is to a large extent influenced by the workshop participants and with other participants the results might would have been different. Hence, the results are difficult to generalise.

Finally, it is important to mention that this research is explorative which influences the interpretation of the research results. Because the research subject is innovative, it is difficult to compare the results with previous research. Moreover, due to the explorative research design, no hard statements can be made about the factors explaining the adoption of an SMG and the co-creation of an SBM for an SMG in a business park. The developed SBM should therefore be considered as an explorative model that can be further developed.

11.5 Subjects for further research

By researching factors explaining the adoption process and by designing the building blocks of an SBM, subjects for further research came to the surface. First, further research could focus on the integration of the neighbourhood Zuidbroek in the case-study. In this research, due to time constraints, only the willingness of businesses was researched. However, the integration of the neighbourhood provides additional possibilities for balancing the energy system, therefore increasing the advantages of an SMG (Mulder, personal communication, June 18, 2019). A considerable amount of research has already been conducted about the motivations of citizens to participate in a community energy initiative (e.g. Becker et al., 2017; Bomberg & McEwen, 2012; Koirala et al., 2016, Naus et al., 2014; Oteman et al., 2017; Walker, 2008; Wolsink, 2012; Young & Brans, 2017). Nevertheless, the combination with a business park may lead to additional insights. It can be interesting to investigate to what extent citizens and businesses are willing to cooperate with each other to realise an SMG. Thus, a subject for further research is to explore the adoption process of an SMG in a business park integrated with a neighbourhood.
Another subject for further research is the development of a cost-benefit analysis, which should be part of the SBM (Jonker, 2014). Since SMGs are in the beginning phase and there is no clarity about the organisation and the actions that need to be performed, until now, no conclusions can be drawn about the costs or benefits of an SMG in a business park. Nevertheless, when the community structure, activities and room within the legal framework are clear, it would be possible in further research to delve into the costs and benefits of an SMG. The cost-benefit analysis should not only be concerned with financial costs and revenues, but also with ecological and social costs and benefits (Jonker, 2014). By elaborating the costs and benefits, a more complete SBM can be designed.

Besides, further research could focus on the legal form of an SMG. In this research, the legal form of a corporation is proposed and has not been contradicted by the experts in the interviews or by the participants in the workshop session. However, no extensive discussion has taken place about which legal form fits best with the function of an SMG. Since the legal form is important for the development of an SBM (Jonker, 2014), researching the advantages and disadvantages of possible legal forms is a recommendation for further research.

Moreover, the participants of the workshop session argued that it was quite challenging to develop an SBM, when it is not exactly clear how the SMG will look like. As explained in chapter 2, an SMG can have different forms, depending on the physical characteristics, objectives, stakeholders and financing. Consequently, a subject for further research is to explore which form of an SMG fits best in which situation. By exploring the different forms in relation to different contexts, a framework can be developed that explains which business model is suitable in which situation. Currently, insight into this cannot be found in existing literature.

Lastly, further research could focus on the co-creation aspect of an SMG. Until now, not many scientific articles have been written about the co-creation of an SMG. On the other hand, the experts explained in the interviews that they would like more information about how an SMG can be co-created by different public and private actors. It appears that there is a knowledge gap about how an SMG can collaboratively be organised. This research touches on this subject briefly, but further research could explain this in more depth. For instance, a multiple case-study could be performed, comparing different forms of collaboration. The quote mentioned in the beginning of this research shows the importance of new ways of organising transitions: “We live in a society in transition (...) This envisaged transition demands new methods of organising—new societal deals at an individual and a collective level.” Hence, to enforce the energy transition, more research should be conducted about the organisation of local energy initiatives. Moreover, when more research is conducted about SMGs, insight will be gained on if and how SMGs could diffuse in society. When the studies show positive results and guidelines for practices are developed, SMGs might become the norm in the future.
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