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Motivations & hindrances for SMEs in Drenthe for implementing solar panels in their businesses

(Duurzaam zonnepaneel, 2017)

26/01/2024
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Abstract

This thesis investigates the factors influencing SMEs in Drenthe to adopt solar panels. Integrating narrative analysis of interviews with SME representatives, the study assesses the impact of socio-economic, regulatory, and behavioural factors on solar energy adoption. Key findings include SME motivations like financial subsidies, climate awareness, and energy self-sufficiency, aligning with Rational Choice Theory, Green Business Theory, and the Self-Sufficiency Model. Barriers include knowledge gaps and financial constraints. These insights inform regional and broader EU policy directives for sustainable development, offering a nuanced understanding of SMEs' decision-making in solar energy adoption.

Keywords: Socio-economic factors, behavioural factors, regulatory factors, rational choice theory, green business theory, self-sufficiency model, knowledge gaps, financial constraints.

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1. Introduction

1.1 Background

The importance of sustainability is globally increasing (Rockströhm, 2018). Sustainability is a countermeasure to the adverse impacts of global climate change that pose a risk to our future prosperity (Rockströhm, 2018). This critical role of sustainability is acknowledged in the Sustainable Development Goals (SDGs) established by the United Nations (United Nations, 2015). Specifically, the United Nations has outlined goal 11: "Make cities and human settlements inclusive, safe, resilient, and sustainable" (United Nations, 2015, p. 18). Next to a global perspective of sustainability, there are also national perspectives on sustainability, specifically sustainability in the form of energy transition. The Netherlands is a country that is currently investing in the energy transition and is trying to reduce CO2 by switching to renewable energy, such as solar energy (Hooimeijer, 2016). The Climate Agreement target of 35 terawatt hours of onshore wind and solar energy is easily achievable, but in the longer term, growth will stagnate (Gastel, 2023). This is a reason for looking into the motivations and barriers to reaching the climate agreement target. Multiple stakeholders are involved in the transition to solar energy in the Netherlands, but the municipalities and provinces are responsible for setting and reaching goals (Gemeentepeiler, 2020). The RES 1.0 (Regionale Energie strategie), is a plan in which each region in the Netherlands describes how and where it can generate large-scale sustainable electricity on land (solar and wind), shape the heat transition in the built environment, and realise the necessary energy infrastructure (RES 1.0, 2021). Drenthe is one of the provinces in the Netherlands currently undergoing the energy transition and primarily focuses on the solar energy transition (RES 1.0 Regio Drenthe, 2021). Multiple stakeholders are involved in reaching goals within RES 1.0, such as the public and the private sector. Within these sectors, SMEs (small and medium-sized enterprises) are stakeholders who can impact the transition to solar energy. In the transition to solar energy, the solar panel is the most critical weapon in reaching the targets (de Leede, 2021). SMEs can be understood as businesses with less than 250 employees and a turnover lower than €43 million (European Commission, 2003).

Next to policy and climate goals, other factors can either serve as a motivation or a barrier to adopting solar panels. Several factors are driving the adoption of solar panels in the Netherlands. Financial incentives, such as tax breaks, subsidies, and the potential for cost savings on energy bills, play a significant role (Rijksoverheid, 2017). Many people also choose to use solar energy because of their commitment to reduce greenhouse gas emissions and environmental consciousness. Advancements also influence this trend in solar technology and innovative solutions for space utilisation, such as floating solar farms (BeSolar, 2021).
Additionally, the Dutch government's initiatives to promote renewable energy and the shift toward societal sustainability encourage the adoption of solar panels (Rijksoverheid, 2017). On the other hand, the widespread adoption of solar panels in the Netherlands needs to be improved by removing several barriers, which can be divided into financial, non-financial, knowledge-based, and other factors. Financial difficulties include high initial costs, constrained financing options, and apprehensions about return on investment. Aesthetic concerns, space limitations, and intricate building regulations are examples of non-financial barriers. Barriers based on knowledge include a need for expertise, false information, and

the perceived complexity of solar technology (Dutch Review, 2023). Adoption rates are also significantly influenced by factors like environmental concerns, energy independence, and government policies.

The research aims to uncover the specific motivations and barriers that SMEs in Drenthe encounter when considering the adoption of solar panels. It delves into how these local businesses approach sustainability within the unique context of their regional policies, such as the RES 1.0. This study provides detailed, qualitative insights which guide policy refinement to support regional solar energy adoption for SMEs in Drenthe. Thus, the study fills a gap in information available on SMEs' motivations and barriers to adopting solar panels by shedding light on the individual and collective factors influencing SMEs' energy decisions in Drenthe.

1.2 Research problem

There are different motivations and hindrances for SMEs in Drenthe to implement solar panels into their businesses. The research aims to investigate what precisely these motivations and hindrances are for SMEs in Drenthe. To investigate this, the following research question has been formulated:

What are the potential motivations and hindrances for SMEs to implement solar panels in their businesses in Drenthe?

To answer the main research question, the following sub-questions are formulated:

- What are the financial motivations and hindrances for SMEs to implement solar panels in their business in Drenthe?
- What are the non-financial motivations and hindrances for SMEs to implement solar panels in their business in Drenthe?
- How does knowledge about solar panels affect SMEs' decision-making to implement solar panels in their businesses in Drenthe?

1.3 Structure

Firstly, relevant concepts and theories are explained in the theoretical framework. After the concepts and theories are defined, a conceptual model is presented based on pertinent information from the literature. The literature is the base on which the hypotheses are formulated. The qualitative part of this research is explained in the methodology section, as well as a discussion on research ethics and positionality of the researcher. The methodology will also discuss the quality of the data obtained. After the methodology is discussed, the results are described following the procedure and method through which they were collected. In the results section, the quality of the results will be discussed and linked to the relevant theory and literature. Onwards, a conclusion of the main findings of the research is provided. Finally, this research's strengths and weaknesses are reflected on, and possible recommendations for further research are proposed.

2. Theoretical framework

Some concepts that are relevant to investigate the motivations and barriers for SMEs in Drenthe to adopt solar panels into their businesses need to be defined and clarified, namely;

Sustainability

In the context of this research, the definition of sustainability that will be used is the one provided by the United Nations. Sustainability is defined by the initiatives of SMEs in Drenthe to fulfil their current energy demands with solar power in ways that preserve the environmental, economic, and social frameworks for future generations (United Nations, 2015). The United Nations' local approach to sustainability reflects and contributes to the broader objectives outlined in the European Green Deal, which promotes a sustainable and inclusive growth strategy for the entire European Union, encouraging SMEs to actively participate in the transition towards a green economy (European Commission, 2020).

To further clarify, the sustainability practices of Drenthe's SMEs are not only about energy efficiency and renewable adoption but also intrinsically linked to the European Union's comprehensive sustainability agenda. The European Green Deal provides a strategic blueprint that aligns with the regional efforts in Drenthe, underpinning the significance of transforming business operations to be more environmentally conscious, economically viable, and socially responsible. Through such alignment, the practices of SMEs in Drenthe become instrumental in the collective pursuit of the Sustainable Development Goals, particularly in fostering resilient infrastructure, promoting inclusive and sustainable industrialisation, and fostering innovation (United Nations, 2015).

In embracing solar power, Drenthe's SMEs represent a smaller-scale reflection of global sustainability goals. Their efforts resonate with the United Nations' concept of intergenerational equity. They are in line with the ambitious objectives of the European Green Deal, fostering a sustainable future across the EU.

Behavioural Geography

Behavioural Geography scrutinises the psychological elements influencing spatial decision-making. This perspective can be especially pertinent to SMEs contemplating solar panels. From a behavioural geographical perspective, it can be acknowledged that the perceptions, attitudes, and knowledge about sustainability and renewable energy sources among SME owners play a critical role in their decision to adopt solar power (Montello, 2022). These psychological factors are not isolated but are often influenced by broader societal trends and policies.

Adding to this, a study by Kaplan and Kaplan (2016) on environmental preference posits that the aesthetic appreciation of natural environments, including solar technologies, can also affect the willingness of SME owners to invest in these systems. The visual appeal of solar panels, or lack thereof, may impact the decision of an SME to adopt solar energy as part of its business operations, indicating that the psychological impact of environmental design is significant (Kaplan & Kaplan, 2016).

These sources suggest that the decision-making process regarding solar energy adoption within SMEs is multi-faceted, involving practical considerations and deep-seated cognitive and aesthetic judgments that can either facilitate or obstruct the path towards sustainability.

Spatial diffusion theory

To better understand how solar energy adoption spreads among SMEs in Drenthe, we use the spatial diffusion theory in this study. This theory, used by academics like Baybeck (2002) and Miller (2000), is essential for understanding the proliferation of innovations. It offers insights into the roles that geographic, social, and economic factors played in determining the rate and adoption of solar energy. In particular, the theory provides a comprehensive view of the dynamic energy transition process by illuminating why some SMEs are more inclined than others to adopt solar technology.

In addition to Baybeck and Miller's contributions, Rogers (2003), in his diffusion of innovations theory, further elaborates that the spread of new technologies, such as solar energy, is also influenced by the perceived attributes of the innovation, the type of decision-making, the communication channels used, the time taken to adopt, and the social system into which the innovation is being introduced. This theory suggests that SMEs' adoption of solar energy is a complex process influenced by their network's communication channels, peers' opinions, and the overall social system's readiness to change (Rogers, 2003).

These theoretical perspectives provide a comprehensive view of how solar energy adoption is not just a matter of individual choice but is affected by a network of interrelated factors that can accelerate or impede the diffusion process within the SME community in Drenthe.

Proximity

Regarding SMEs and their adoption of solar energy, proximity refers to the various degrees of nearness —physical, social, institutional, organisational, or cognitive — that significantly impact the dissemination and acceptance of solar technology within a community (Boschma, 2005). This concept suggests that the likelihood of SMEs adopting solar technology is influenced by how closely they are connected to resources, knowledge centres, and networks relevant to solar energy.

Further expanding on this, according to Torre and Rallet (2005), proximity is not just geographical but also involves relational proximity, which is defined by the nature and strength of the relationships between actors, such as shared norms, common knowledge, and the ability to create a collective dynamic towards innovation. These relational dynamics can play a critical role in adopting solar energy. SMEs better integrated into knowledge networks and share vital common interests with these groups are more likely to adopt new technologies (Torre & Rallet, 2014).

Together, Boschma, Torre, and Rallet's viewpoints elucidate the multifaceted nature of proximity and its profound effect on the diffusion of solar energy technology among SMEs. Proximity goes beyond mere geographic closeness and includes the depth of social and institutional ties that foster or impede the uptake of solar technology within SME networks.

RES (Regionale energiestrategie)

RES 1.0 is the strategic framework formulated by the Dutch regions, such as Drenthe, which delineates integrating renewable energy sources and infrastructure into local practices. This strategic plan is pivotal as it directly influences and steers the efforts of SMEs within these regions towards a solar energy transition (RES 1.0, 2021). This plan acts as a roadmap,

providing guidance and setting benchmarks for SMEs' adoption of solar energy solutions, thereby shaping the local renewable energy landscape.

Additionally, RES 1.0 aligns with the National Climate Agreement of the Netherlands, a broader policy aiming to reduce greenhouse gas emissions in the Netherlands by 49% by 2030 compared to 1990 levels. This national policy framework supports the objectives of RES 1.0 by offering strategic direction and support for local initiatives, reinforcing the commitment to sustainable energy across different levels of governance and industry (Klimaatakkoord, 2019).

In sum, the RES 1.0 within the scope of this study represents a critical element in the network of policies and plans that guide SMEs in Drenthe, positioning them as active agents in the national goal towards a more sustainable energy future.

Rational choice theory

Within this study, Rational Choice Theory refers to the conceptual framework that posits SMEs make decisions based on rational evaluations of the cost-benefit outcomes of adopting solar energy. This theory is applied to understand how financial incentives, such as subsidies and tax benefits, influence SMEs' decisions to implement solar panels if these businesses opt for options that maximise their economic advantage (Sato, 2013).

Green business theory

In this research, green business theory is defined as the theoretical perspective emphasising integrating environmentally sustainable practices into business operations, according to Cato (2008). It explains SMEs' motivation to adopt solar panels not solely based on financial benefits but also their commitment to environmental stewardship and sustainability (Cato, 2008). This theory is relevant in interpreting why SMEs in Drenthe might choose solar energy to contribute to reducing environmental impact and promoting a greener business model.

Self-sufficiency model

In the study, the Self-Sufficiency Model is understood as a framework where SMEs aim to achieve energy independence and operational efficiency by generating their solar power. This model is pivotal in explaining the drive among SMEs to reduce reliance on external energy sources and control energy costs. It posits that by maximising their energy generation through solar panels, SMEs are cutting costs and positioning themselves as self-reliant entities regarding energy resources (Beyeler, 2021).

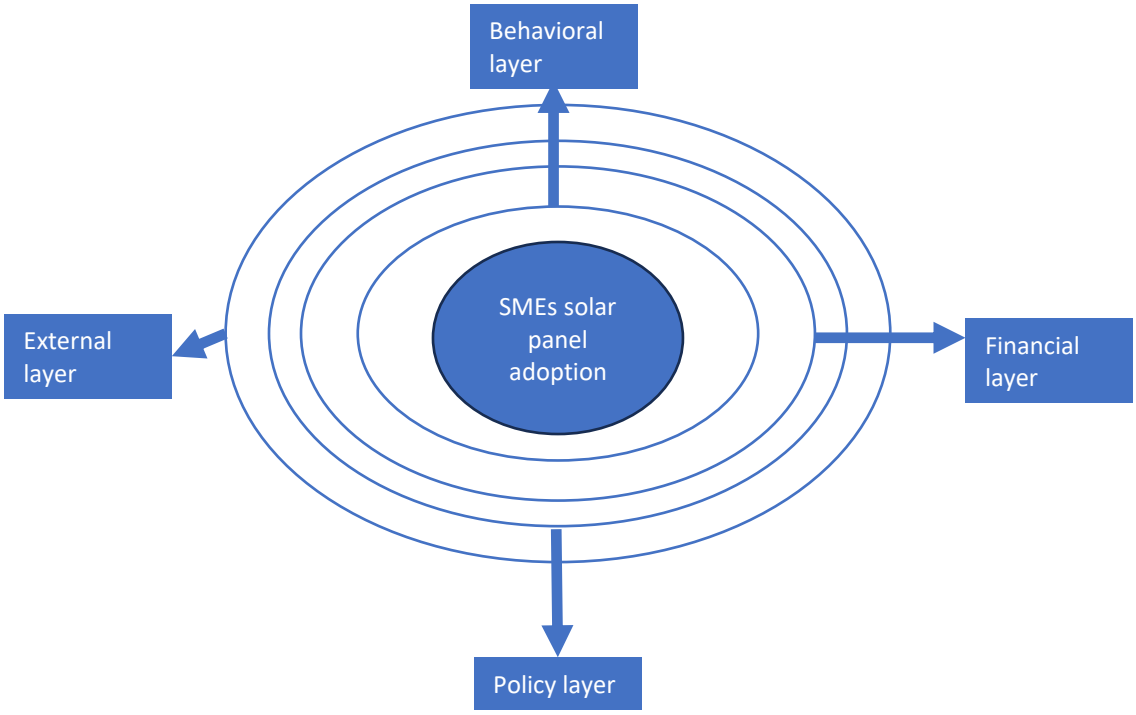
2.1 Conceptual model

The conceptual model in Figure 1 includes and links concepts previously explained and forms a multi-layered model (The Multi-Layered Influence Model for SME Solar Panel Adoption). The layers are interrelated in the Multi-Layered Influence Model for SME Solar Panel Adoption to form a comprehensive conceptual framework. This model effectively captures the multifaceted influences on SMEs' solar energy decisions, highlighting how each layer interacts to shape the overall adoption process.

This model's core is SME solar panel adoption, the central outcome of interest in this research. This core is surrounded by layers representing various influencing factors:

1. Behavioural Layer: Closest to the core, this layer encompasses the psychological factors of SME owners—attitudes, knowledge, and perceptions about solar energy—which directly determine the likelihood of adopting solar panels.
2. Financial Layer: This layer includes different types of financial aspects influencing the adoption of solar panels, such as subsidies.
3. Policy Layer: Enveloping the Proximity Layer, policies from the RES 1.0 framework create a regulatory context that can either facilitate or restrict the adoption of solar energy, influencing proximity dynamics and behavioural intentions.
4. External Layer: The outermost layer represents global sustainability trends that affect all inner layers by shaping national and regional policies and influencing local business practices and decision-making.

Figure 1: Multi-layered influence model for SME solar panel adoption



Conducted by author (2023)

2.2 Hypotheses

The hypothesis section of the thesis posits that financial incentives, environmental concerns, and a desire for energy self-sufficiency influence SMEs' decisions to adopt solar panels. These motivations align with Rational Choice Theory, Green Business Theory, and the Self-Sufficiency Model. Additionally, the influence of regulatory frameworks, like RES 1.0, and broader global sustainability trends are hypothesised to impact these decisions significantly, highlighting the complex interplay of internal and external factors in SMEs' adoption of solar energy.

3. Methodology

The qualitative method is chosen as it allows for an in-depth exploration of managers and owners of SMEs (Busetto, 2022). Given the nature of the research question, a qualitative method of conducting semi-structured interviews is deemed most suitable. The qualitative method allows for an exploration of the experiences, motivations, barriers, and incentives related to SMEs incorporating solar energy into their business models in Drenthe and their perceptions of public policies or initiatives that support or challenge them in the energy transition process.

3.1 Qualitative data

Semi-structured interviews were conducted with owners or managers of SMEs in Drenthe. The semi-structured approach has allowed for more flexible and open-ended discussions, enabling participants to share insights and experiences beyond the predetermined questions (Wilson, 2014). Interviews were conducted until a saturation point was reached where no new information was gleaned. Interviews were recorded, with the consent of participants, and transcribed verbatim for analysis. Furthermore, the interviewees have been fully anonymised.

3.2 Qualitative data analysis

Following the completion of the interviews, a narrative analysis technique was employed to distil the essential themes from all the conversations. Using a narrative analysis approach permitted the researcher to delve into the motivations and outcomes embedded in the interviewees' accounts, emphasising the regulatory, environmental, and economic contexts pertinent to this study (Frost, 2009). General overarching themes emerged from each of the interviews. The topics with the most significant overarching support ultimately became the themes regarding motivations and barriers.

3.3 Ethical considerations

In the data collection process, various ethical considerations need to be discussed. The research process, implications, and positionality of the researcher are the most prominent aspects considered in the ethical considerations.

In terms of the research process, participants should be fully aware of the research aims, methods, and how the data will be used, ensuring they consent to participate without coercion (Shaw, 2003). The study could reveal sensitive business information requiring strict confidentiality measures due to the focus on SMEs. Additionally, the researcher's positionality, which refers to their background, beliefs, and relationship to the subject of study, must be carefully managed to avoid data collection and interpretation bias. It's essential that the research methodology is transparent and that it accounts for any potential conflicts of interest or power imbalances between the researcher and the participants (Bourke, 2014). In this case, the researcher has a background in the energy transition in Drenthe due to their work. Though this can lead to a bias in favour or against solar energy, the researcher aims to have a neutral stance. Another aspect of positionality is that the researcher favours the energy transition in the Netherlands, which can create a bias for SMEs that also tend to the energy transition. Though there is a bias, the research aims to

provide an objective stance on SMEs in favour and against energy transition by discussing the incentives and barriers.
Additionally, measures were taken to safeguard potentially delicate details about the participants' personal information. The participants were not required to provide their complete names or addresses. They were assured that all data collected would be erased following the study's conclusion and that any data that could reveal their specific location would neither be utilised nor retained.

3.4 Sample selection

For this research, a mixed sampling technique is used by combining cluster sampling and convenience sampling. Firstly, cluster sampling was done by clustering ten business terrains in Drenthe. Out of these business terrains, one was randomly selected. Upon identifying the selected business terrain, it was noted that the terrain had over 40 SMEs. Given the practical convenience and availability of many SMEs in this terrain, it was decided to extract the sample exclusively from this location. All 40 SMEs on the terrain were contacted through e-mail and telephone. Of the 40 SMEs contacted, 14 agreed to be interviewed. Below, an anonymized table will elaborate on the interviewed SMEs (table 1.).

Interviewee	Number of employees	Currently adopts solar panels (Yes / No)
A	5-15 employees	Yes
B	5-15 employees	Yes
C	31-50 employees	Yes
D	5-15 employees	Yes
E	5-15 employees	No
F	16-30 employees	Yes
G	16-30 employees	No
H	5-15 employees	Yes
I	1-4 employees	Yes
J	31-50 employees	No
K	1-4 employees	Yes
L	5-15 employees	No
M	1-4 employees	Yes

(Table 1. Interviewee list)

4. Results

For this research, 14 owners and employees in management roles were interviewed to discuss the possible motivations and barriers for SMEs in Drenthe to incorporate solar energy into their business. The results section will be divided into motivations and barriers for SMEs to integrate solar energy into their business. Within these categories, various themes will be discussed based on the interviews.

4.1 Motivation for incorporating solar energy

After conducting interviews with owners and employees in management roles, it became clear that SMEs had multiple motivations to incorporate solar energy. In this section, the motivations are divided into three themes: subsidies (4.1.1), climate awareness (4.1.2), and

maximising own energy generation (4.1.3). These themes are based on the most frequent answers by the interviewees when discussing the motivations.

4.1.1 Subsidies

The first theme that resulted from the interviews regarding motivation is subsidies. Interviewees mentioned that every municipality in the Netherlands has implemented solar panel subsidies. For many interviewees, subsidies were a crucial motivational factor in incorporating solar panels into their SMEs. In the following examples, interviewees currently owning solar panels are asked about their motivations.

INTERVIEWEE	THEME: SUBSIDY
INTERVIEWEE A	**Researcher:** "What were factors that motivated you to adopt solar energy into the SME you work at?" **Interviewee: "**(…) mainly financial support from our municipality or government as solar panels are still pricey at the moment." **Researcher:** "Can you elaborate on the financial support?" **Interviewee:** "After my purchase, I was able to retrieve the VAT of the total price we ended up paying for the panels." (…) the subsidy we had was one of multiple options for subsidies but for us having a return of 21% of the total price of the solar panels due to the VAT was very attractive."
INTERVIEWEE B	**Researcher:** "What were factors that motivated you to adopt solar energy into the SME you work at?" **Interviewee:** "The municipality in which we live provided me with some financial help so I would say that motivated me to use solar panels." **Researcher:** "Could you explain what sort of financial help you received?" **Interviewee:** "(…) the municipality and I think the government have a subsidy regulation that provides subsidies for a lot of methods for green and sustainable energy generation."

4.1.2 Climate Awareness

The second theme from the interviews regarding motivation is climate awareness. Some interviewees mentioned that they were aware of the impact solar panels could have in the current climate crisis and said that this was part of the reason for adopting them.

INTERVIEWEE	THEME: CLIMATE AWARENESS
INTERVIEWEE A	**Interviewee:** "(…) and wherever I can, I like to contribute to solving and countering the climate problem (…) in my industry this is one of the simplest methods of becoming more sustainable."
INTERVIEWEE D	**Interviewee:** "(…) but I also find it important to give something back to the environment… so the purchase of my solar panels is not only a financial boost."
INTERVIEWEE G	**Researcher:** "Can you think of other non-financial motivations?" **Interviewee:** "Due to the fact that colleagues and friends in the area are increasingly leaning towards solar panels due to policy and guidelines, I have also become more aware that I would actually be better off using solar panels to combat climate change".

INTERVIEWEE I	**Interviewee:** "(…) but also that having panels on my roof matches that I've been voting for climate in the recent years. (…) climate-oriented measures also ensure that the financial picture becomes attractive because sustainable homes increase in value."

4.1.3 Maximisation of own energy generation

The third theme from the interviews regarding motivation is maximising one's energy generation. Some interviewees mentioned that generating their energy could help bring their energy costs closer to €0. In the long run, some interviewees said that generating energy on their own could reduce the fixed costs of the SME. Although some SMEs could see the long-term investment, they could not always secure financing in the short term.

INTERVIEWEE	THEME: MAXIMIZATION OF OWN ENERGY GENERATION
INTERVIEWEE C	**Interviewee:** "(…) and one of our goals in the future is to be able to reduce our costs in terms of energy by filling up our entire roof with panels."
INTERVIEWEE H	**Researcher:** "What percentage of your company's energy consumption is covered by solar energy?" **Interviewee:** "Currently I would say that about 20% is covered by our panels, however, considering the current prices we want to increase the total coverage."
INTERVIEWEE K	**Interviewee:** "(…) the more energy I can generate myself, the less energy I have to tap from the net."
INTERVIEWEE M	**Interviewee:** "(…) and also because heating the house in the winter is becoming more expensive, it is important to try to generate as much possible energy on our own."

4.2 Barriers to incorporating solar energy

After conducting the interviews, it became clear that, in addition to motivations, there were also barriers that prevented the incorporation of solar energy into SMEs. Similarly to the motivations for incorporating solar energy, the barriers will be divided into themes: knowledge (4.2.1), financial capabilities (4.2.2), and interest and necessity (4.2.3). The abovementioned themes are based on the most frequent answers by the interviewees when discussing the barriers.

4.2.1 Knowledge

The first theme from the interviews regarding barriers is the knowledge about solar energy and the requirements for incorporating solar panels into SMEs. Some interviewees mentioned and needed more information about the possibility of adopting solar energy and the conditions that need to be met. The theme of knowledge also concerns that only some are aware of the possible pros and cons of incorporating solar energy.

INTERVIEWEE	THEME: KNOWLEDGE
INTERVIEWEE C	**Interviewee:** "(…) was definitely because we had no idea how expensive they were, were we could buy them, if we could get a financial compensation (…) and after the research it all became a little more easy."
INTERVIEWEE E	**Interviewee:** "(…) because I don't know if I can have them".

	Researcher: "Can you explain a little more?" **Interviewee:** "I'm not aware if it is even possible to place solar panels on my roof now. I don't know if I can just approach a company or the government because I can't say with certainty if my roof is eligible for panels."
INTERVIEWEE K	**Interviewee:** "(…) was never really clear. Nothing from the government or municipality was told about the possibilities that were available for us. And eventually we found out via friends who already had an installation on their roof."

4.2.2 Financial capabilities

The second theme that results from the interviews regarding barriers is financial capabilities. For some interviewees, the costs of implementing solar energy are the bottleneck for implementation. Most of the interviewed SME managers/owners mentioned that they should have prioritised their funds for incorporating solar energy. Many owners and managers prioritised other areas within their SMEs.

INTERVIEWEE	THEME: FINANCIAL CAPABILITIES
INTERVIEWEE L	**Interviewee:** "(…) even though the prices of the panels have fallen in recent years, it remains a significant investment that we cannot think about at the moment because we have other priorities."
INTERVIEWEE B	**Interviewee:** "(…) and the fact that the panels are currently subsidized are really the only way we could afford them because they are still quite expensive, especially if you really want a result from them."
INTERVIEWEE H	**Researcher:** "Have you encountered any financial barriers to solar energy?" **Interviewee:** "I would say for me the only barrier is the fact that they cost money, otherwise I would already have bought more." **Researcher:** "Does the possible subsidy for solar panels not lighten this barrier?" **Interviewee:** "Yes of course, but it does not change the fact that there still needs to be a big investment that must be paid upfront before you can see any benefits of the long-term."

4.2.3 Interest and Necessity

The third theme from the interviews regarding barriers is interest and necessity. Some interviewees mentioned that they do not need solar energy within their SME; it is simply not a priority. Other interviewees say that, at this point, they don't see the added value or what it could be.

INTERVIEWEE	THEME: INTEREST AND NECESSITY
INTERVIEWEE E	**Researcher:** "Does your company currently use solar energy?" **Interviewee:** "No" **Researcher:** "Can you explain the reason why not?" **Interviewee:** "To be honest, I haven't delved into solar energy at all (…) since my company is still relatively young, I have not yet focused on solar panels."
INTERVIEWEE G	**Interviewee:** "(…) it is definitely something we might consider in the future but at the moment we do not yet see the need for solar panels.

	Especially because we do not have a huge consumption in the household and at the business premises."
INTERVIEWEE J	**Interviewee:** "Well, I opted for other sustainable energy sources. For instance, in my area, there's a lot of wind energy, and there are also cooperative solar energy projects. They seemed more practical, and I don't have to worry as much about maintenance.

4.3 Linking results to the theory

The motivations for Small and Medium Enterprises (SMEs) in Drenthe to adopt solar panels are intricately linked to the multi-layered conceptual model outlined in the thesis. SMEs' attitudes, knowledge, and perceptions about solar energy are pivotal in the behavioural layer. This includes motivations like subsidies, which align with Rational Choice Theory, highlighting the financial incentives driving solar energy adoption. Climate awareness, reflecting Green Business Theory, demonstrates a growing environmental consciousness among SMEs, influenced by global sustainability trends and local policies. The maximisation of own energy generation, connected to the Self-Sufficiency Model, illustrates SMEs' strategic approach towards energy independence and operational efficiency, shaped by the proximity layer of the model, which includes both institutional and cognitive proximity to solar energy resources and knowledge.

The layers of the conceptual model equally influence the barriers to solar energy adoption. At the behavioural layer, a lack of knowledge about solar energy and its implementation reflects the cognitive gap in the proximity layer, indicating a need for better information dissemination and educational efforts. Financial capabilities, primarily discussed in the policy layer, emerge as a significant barrier, highlighting the challenges SMEs face in allocating resources for solar energy amidst competing operational demands. Interest and necessity, a component of the behavioural layer, varies among SMEs and reflect the complexity of decision-making processes influenced by individual perceptions and business priorities. This barrier is further influenced by the external layer, which encompasses global sustainability trends and how they shape national and regional policies, thereby influencing local business practices and decision-making.

5. Discussion

Integration with Theoretical Frameworks

The findings of this study are intricately connected to the theoretical frameworks discussed in earlier sections of the thesis. The motivations of SMEs in Drenthe to adopt solar energy, such as subsidies, climate awareness, and the drive for energy self-sufficiency, align with the Rational Choice Theory, Green Business Theory, and the Self-Sufficiency Model, respectively.

This alignment confirms existing theories, indicating that financial motivations such as subsidies influence the decision-making when adopting solar panels (Viveen, 2023). This alignment is also seen within the rational choice theory in that SMEs will make a sensible decision based on a cost-benefit ratio (Sato, 2013). Next to financial motivations, the interview result also suggests that environmental motivations such as climate change can lead to the decision to adopt solar panels (Solar Energy Technologies Office, 2021). The

adoption of solar panels also fits in well with the green business theory that focuses on incorporating sustainable practices into business models (Cato, 2008). Finally, the interview results also support the idea that people want to produce solar energy to decrease energy costs (Bracke, 2022). Reducing personal costs also links to the self-sufficient model that addresses people becoming self-sufficient (Beyeler, 2021). However, the contribution of this thesis lies in integrating these disparate motivations within a multi-layered conceptual model, offering a more nuanced understanding than is typically presented in existing literature.

This thesis found that geographical and relational proximity, as discussed in the theoretical framework, did not significantly influence SMEs' adoption of solar panels in Drenthe. This finding suggests a unique aspect of this research, as proximity might be anticipated to play a role in such decisions. It indicates that, at least in the context of this study, other factors like financial incentives, environmental awareness, and self-sufficiency considerations were more critical. This outcome could be specific to the particular characteristics of SMEs in Drenthe or reflect a broader trend that warrants further investigation in future studies.

The research identified a significant barrier to SMEs' adoption of solar panels: a need for knowledge about the RES 1.0 framework and solar panel technology. Many SME owners needed more understanding of the RES 1.0 policies and how they could benefit from solar energy adoption. This knowledge gap hindered their ability to make informed decisions and leverage available incentives effectively. Consequently, this lack of awareness emerged as a critical obstacle, underscoring the need for better information dissemination and education strategies to support SMEs in transitioning to sustainable energy solutions.

Comparison with Other Research

The results regarding the motivations and barriers for SMEs adopting solar energy are consistent with findings from similar research. Like other studies and articles about financial motivations (Viveen, 2023), environmental motivations (Solar Energy Technologies Office, 2021), and strategic motivations (Bracke, 2022), this research highlights financial motivations and ecological concerns as prominent factors. However, the thesis extends beyond these common findings by situating them within a broader conceptual framework, emphasising the interconnectedness of various factors influencing SME decisions.

Recommendations for Future Research

This study opens several avenues for future research. A broader quantitative analysis across a larger population of SMEs could provide more generalisable data, enhancing the understanding of the motivations and barriers in different contexts. Further research might also explore the long-term impacts of solar energy adoption on SMEs' financial health and operational performance, offering insights into the sustainability of these investments.

Reflection on Research Process and Results

Reflecting critically on the research process, this thesis acknowledges potential limitations, such as the limited sample size and geographic focus on Drenthe. These limitations suggest caution in generalising the findings to other contexts. Additionally, the potential for selection bias in choosing interviewees might have influenced the results. Despite these

limitations, the study offers a comprehensive understanding of SMEs' perspectives in Drenthe, contributing valuable insights to renewable energy adoption in small businesses.

6. Conclusion

This thesis has effectively addressed the primary research question: "What are potential motivations and hindrances for SMEs to implement solar panels in their businesses in Drenthe?" The study's results confirm that motivations for SMEs in Drenthe to adopt solar energy are intricately linked to the multi-layered conceptual model. Key motivations include subsidies, climate awareness, and maximising own energy generation. These motivations are rooted in Rational Choice Theory, Green Business Theory, and the Self-Sufficiency Model, indicating that financial, environmental, and strategic factors play significant roles in SMEs' decisions to adopt solar energy.

Conversely, the barriers, including knowledge gaps, financial limitations, and varying levels of interest and necessity, are also framed within this conceptual model, highlighting the complex interplay of behavioural, policy, and external factors in influencing SME decisions. These findings demonstrate a comprehensive understanding of the multifaceted nature of SMEs' decision-making processes regarding solar energy adoption.

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8. Appendices

8.1 Appendix 1: Interview guide:

Achtergrondinformatie:

1. Wat is de aard van uw bedrijf?

2. Hoeveel jaar is uw bedrijf al operationeel in Drenthe?

3. Hoe groot is uw bedrijfspand ongeveer?

Subvraag 1: Hoe hebben MKB's en Zzp'ers in Drenthe zonne-energie in hun bedrijfsmodellen geïntegreerd?

1. Gebruikt uw bedrijf momenteel zonne-energie? (Ja/Nee)

2. Zo ja, hoeveel jaar gebruikt u al zonne-energie?

3. Welk percentage van het energieverbruik van uw bedrijf wordt gedekt door zonne-energie?

4. Heeft de adoptie van zonne-energie geleid tot veranderingen in uw bedrijfsmodel? (Ja, wat voor verandering?/Nee)

5. Heeft u enige certificering of erkenning ontvangen voor het gebruik van zonne-energie? (Ja/Nee)

Subvraag 2: Welke stimulansen of barrières bestaan er voor particuliere bedrijven in Drenthe om de overgang naar zonne-energie te prioriteren?

Stimulansen:

1. Waren er financiële stimulansen aangeboden voor de adoptie van zonne-energie? (Ja, welke? /Nee)

2. Waren er niet-financiële stimulansen (zoals erkenning, prijzen) aangeboden voor de adoptie van zonne-energie? (Ja, wat voor?/Nee)

3. Is u technische ondersteuning of training aangeboden voor de adoptie en het onderhoud van zonne-energiesystemen? (Ja/Nee)

Barrières:

1. Bent u financiële barrières tegengekomen bij de adoptie van zonne-energie? (Ja, welke?/Nee)

2. Waren er technologische uitdagingen of beperkingen bij het integreren van zonne-energie in uw bedrijf? (Ja, wat voor uitdagingen of beperkingen?/Nee)

3. Heeft u een gebrek aan kennis of middelen ervaren bij het overwegen van zonne-energie?

4. Waren er beleidsmatige of regelgevende uitdagingen die de overgang moeilijk maakten?

Subvraag 3: Hoe ondersteunen of bemoeilijken openbare beleidsmaatregelen of initiatieven MKB's of Zzp'ers in het proces van energietransitie?

1. Bent u op de hoogte van lokale of nationale beleidsmaatregelen die de adoptie van zonne-energie voor bedrijven ondersteunen? (Ja/Nee)

2. Zo ja, heeft u voordeel gehaald uit deze beleidsmaatregelen? (Ja/Nee)

3. Zijn er beleidsmaatregelen of regelgevingen die u als uitdagend beschouwt voor de adoptie van zonne-energie? (Ja/Nee)

4. Zou proactievere overheidssteun of initiatieven meer bedrijven zoals het uwe aanmoedigen om zonne-energie te adopteren? (Ja/Nee)

Algemene Vragen:

1. Denkt u dat de adoptie van zonne-energie door MKB's en Zzp'ers significant bijdraagt aan de klimaat verbetering van Drenthe? (Ja/Nee)

2. Is zonne-energie volgens u essentieel voor de toekomst van bedrijfsvoering in Drenthe gezien de uitdagingen die klimaatverandering met zich meebrengt? (Ja/Nee)

3. Zou u andere bedrijven en ondernemers in Drenthe aanbevelen om zonne-energie te integreren? (Ja/Nee)

8.2 Appendix 2: Informed consent form:

Informatieblad & Toestemmingsformulier

Titel van de Studie: Zonne-Energie Transitie in Drenthe's MKB op Bedrijfsterreinen

Beste,

Bedankt voor uw interesse in deelname aan dit onderzoek. Deze brief beoogt duidelijkheid te verschaffen over het doel van ons onderzoek, de manier waarop het wordt uitgevoerd en wat er van u als deelnemer wordt verwacht. We verzoeken u vriendelijk de volgende informatie zorgvuldig door te nemen. Mocht u vragen hebben of behoefte aan aanvullende informatie, dan kunt u altijd contact opnemen via de contactgegevens aan het einde van deze brief.

Waar gaat deze studie over?
Het doel van dit onderzoek is om de bijdragen en uitdagingen van MKB's in Drenthe te begrijpen met betrekking tot de bevordering van zonne-energie. U bent benaderd omdat uw bedrijf een representatief voorbeeld is van MKB's in Drenthe. Dit onderzoek wordt onafhankelijk uitgevoerd zonder externe financiering of sponsoring.

Wat houdt deelname in?
U wordt gevraagd om deel te nemen aan een interview van ongeveer 15 minuten, waarin vragen worden gesteld over hoe uw bedrijf zonne-energie integreert en welke uitdagingen u hierbij ondervindt. **De interviews kunnen zowel online uitgevoerd worden als in persoon.**

Moet u deelnemen?
Deelname is geheel vrijwillig. U heeft het recht om op elk moment zonder opgaaf van reden uw deelname te staken of bepaalde vragen niet te beantwoorden.

Zijn er risico's verbonden aan deelname?
Er zijn geen bekende risico's verbonden aan deelname aan dit onderzoek.

Zijn er voordelen verbonden aan deelname?
Hoewel er voor u geen directe voordelen zijn, helpt uw deelname ons om een beter begrip te krijgen van de uitdagingen en kansen rond zonne-energie bij MKB's in Drenth.

Hoe wordt de door u verstrekte informatie geregistreerd, opgeslagen en beschermd?
Alle door u verstrekte informatie wordt vertrouwelijk behandeld en anoniem opgeslagen volgens de AVG-richtlijnen van de universiteit. Alleen de onderzoeker(s) hebben toegang tot deze gegevens, die na afloop van het onderzoek zullen worden gearchiveerd.

Wat gebeurt er met de resultaten van het onderzoek?

De resultaten van dit onderzoek zullen worden gebruikt voor een bachelorproefschrift en kunnen worden gepubliceerd in wetenschappelijke tijdschriften.

Ethische goedkeuring
Dit onderzoek heeft ethische goedkeuring verkregen van de Campus Fryslân Ethiekcommissie. We verzekeren u dat we ons zullen houden aan de geldende ethische normen en richtlijnen.

Met wie kunt u contact opnemen voor meer informatie?

Onderzoeker: Roel Henricus Gerardus Coenen
Contact: e-mail: r.h.g.coenen@gmail.com
Instelling: Rijksuniversiteit Groningen

Beoordeling
● Ik heb het informatieblad gelezen en kon eventuele aanvullende vragen stellen aan de onderzoeker.
● Ik begrijp dat ik op elk moment vragen kan stellen over de studie.
● Ik begrijp dat ik me op elk moment zonder opgave van redenen uit de studie kan terugtrekken.
● Ik begrijp dat ik op elk moment kan weigeren een vraag te beantwoorden zonder enige consequenties.
● Ik begrijp dat ik niet direct zal profiteren van deelname aan dit onderzoek.

Vertrouwelijkheid en gegevensgebruik
● Ik begrijp dat geen van mijn individuele informatie zal worden bekendgemaakt aan iemand buiten het onderzoeksteam en mijn naam zal niet worden gepubliceerd.
● Ik begrijp dat de verstrekte informatie alleen zal worden gebruikt voor dit onderzoek en publicaties die direct verband houden met dit onderzoeksproject.
● Ik begrijp dat gegevens (toestemmingsformulieren, opnames, interviewtranscripties) gedurende 5 jaar worden bewaard op de Y-drive van de server van de Rijksuniversiteit Groningen, in overeenstemming met de AVG-wetgeving van de universiteit.

Toekomstige betrokkenheid
● Ik wil een kopie ontvangen van de wetenschappelijke output van het project.
● Ik stem ermee in om opnieuw gecontacteerd te worden voor deelname aan toekomstige studies.

Na het lezen en begrijpen van bovenstaande verklaringen:
Ik geef hierbij toestemming om deel te nemen aan deze studie.

Handtekening deelnemer: _____ Datum: _____

Met vriendelijke groeten,
Roel Coenen