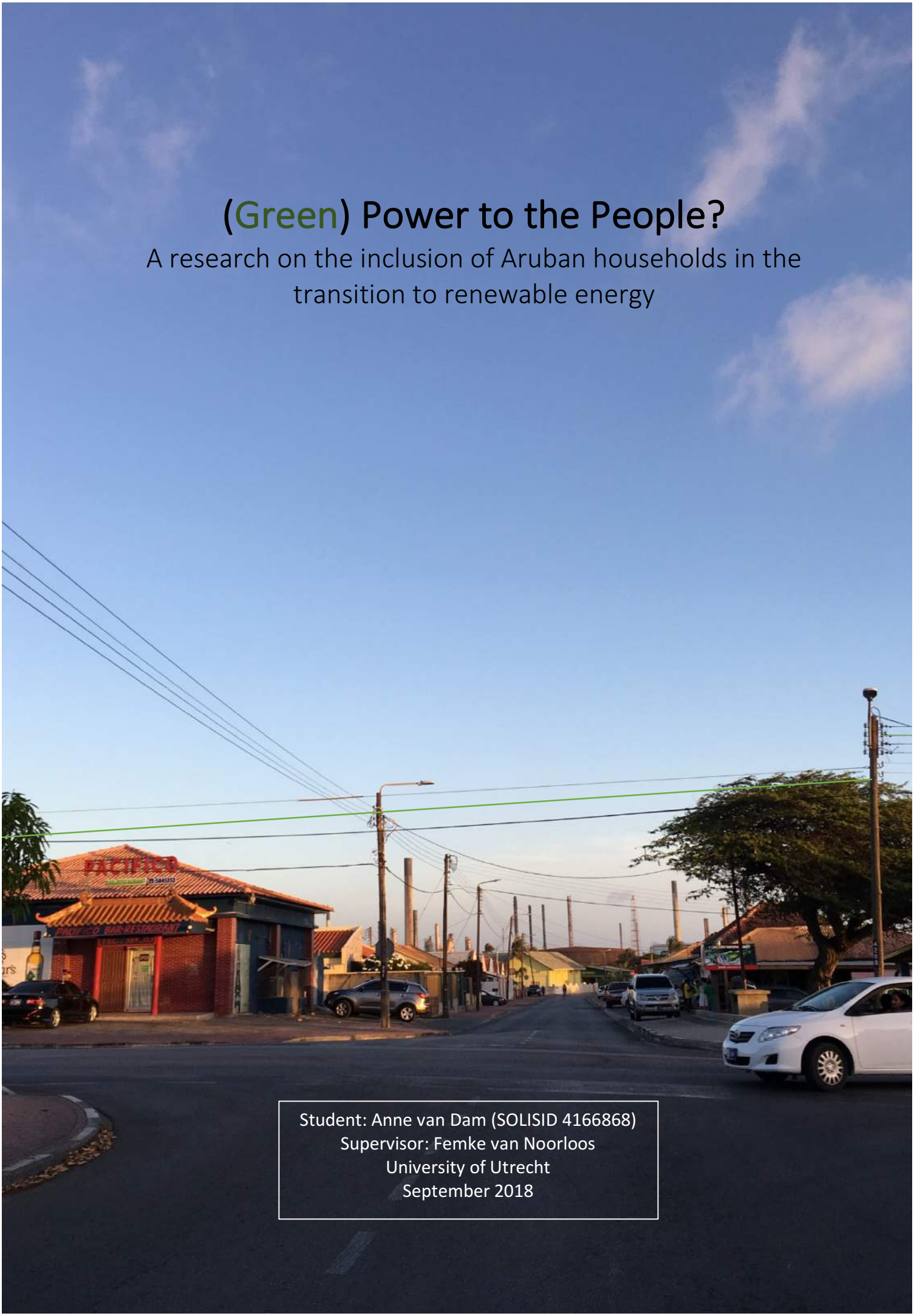
(Green) Power to the People?

A research on the inclusion of Aruban households in the transition to renewable energy



Student: Anne van Dam (SOLISID 4166868)
Supervisor: Femke van Noorloos
University of Utrecht
September 2018

Cover photo: *Depicted on the cover photo are electricity lines, ever-present sunshine and trees blowing in the wind. Households are to be found on both waysides, with the refinery's chimneys rising above the horizon in the background.*

Preface

This research was conducted as part of the Master Degree 'International Development Studies' at the University of Utrecht. The objective was to gain insight on the ways in which households could be better included in the transition to renewable energy on Aruba. The process of creating, and later on working out a research plan, has been a most educative and enriching experience. Without the hospitality and openness of households and other stakeholders, this research would not have been possible. Therefore, I would like to thank all participants for their stories, information and knowledge they shared with me during my research.

Furthermore, I would like to thank my supervisor, Femke van Noorloos for her guidance, understanding and support throughout my research. Lastly, I would like to especially thank my parents and siblings for their continual support, motivational talks and for their faith in me.

Anne van Dam

September 2018

Abstract

The socio-technical transition to renewable energy is taking place in areas all over the globe. The transition is understudied for the Small Island Developing States (SIDS). A diverse array of unique challenges is central to SIDS in this transition to renewable energy. Aruba, a small island state in the Caribbean, has expressed the will to attain the goal of 100% renewable energy by the year 2020. In this transition household involvement and engagement is crucial. This paper focusses on how households in Aruba could be (better) involved in the transition to renewable energy, and explores how the local oil refinery has influenced their perceptions of this transition. It discusses the current use, involvement and awareness of households and it pays attention to the obstructions and opportunities in this transition. This study is conducted within the framework of the socio-technical transition theory, strategic niche management and political ecology. Data collection has been executed by means of interviews with households, a local politician and technical service and installation companies, as well as a literature review. The major findings are: the necessity of better information provision; lack of trust in politics; politicisation of the transition; and the lack of financial means.

Key words: SIDS, Aruba, renewable energy, socio-technical transition theory, political ecology, oil refinery, household involvement.

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List of Abbreviations

AVP	Arubaanse Volkspartij (Aruban People's Party)
FCCA	Fundacion Cas Pa Comunidad Arubano (Social community bank)
IDB	Inter-American Development Bank
MEP	Movimiento Electoral di Pueblo (People's Electoral Movement)
MLP	Multi-level perspective
R&D	Research and Development
SCA	Smart Community Aruba
SDG	Sustainable Development Goals
SIDS	Small island developing states
SNM	Strategic niche management
UN	United Nations
WIC	West India Trading Company
WEB	Water en Energiebedrijf (Water and Energy company)

Introduction

Since the United Nations Earth Summit in Rio de Janeiro 1992, the need for a global change of attitudes to environmental problems was advocated. Since then, the mission has been to show the public that global problems are in fact, local problems (Uzzel, Pol & Badenas, 2002).
One of the most well-known initiatives for promoting sustainable development is the UN initiative 'the sustainable development goals' (SDGs) for the global 2030 Agenda for Sustainable Development ("United Nations sustainable development agenda", 2018). Aruba, a small island in the Caribbean island just North of Venezuela, belonging to the 'Small Island Developing States' (SIDS) is one of the islands that faces substantial structural challenges in achieving sustainable development. Factors such as the remoteness, physical size, small economy, and impact from climate change are part of the challenges that are prevalent in most SIDS ("Small Island Developing States .:. Sustainable Development Knowledge Platform", 2018).

In light of these global initiatives, Aruba has drawn up a report 'Vision 2020', a vision embodying the sustainable energy transition, which is part of the larger plan of making Aruba a 'green and sustainable island'. The goal of this vision is to supply the whole island with 100% renewable energy by the year 2020, as well as making it a business case (2020 Vision Green Deck, 2015). By creating 'Vision 2020', Aruba confirms what Leiserowitz, Kates and Parris (2006) write about (global) society: it has the resources, (emerging) knowledge and the opportunity to carefully and purposefully create the future it aspires, unlike the past. Aruba tries to prioritise environmental concerns and move away from the fluctuations in the oil market, on which the energy supply is heavily reliant (2020 Vision Green Deck, 2015).

The government is actively pursuing SDG goal 7: 'affordable and clean energy', and at the same contributing to goals 11 (sustainable cities and communities) and 13 (climate action) (''United Nations sustainable development agenda", 2018). The technical pursuit of Vision 2020 is a win-win situation, according to the previous government, as it provides economic growth and it contributes to a cleaner environment. Current initiatives on the island range from large wind farms (Vader Piet) and reduction on import tariffs on electric cars to placing solar panels on small schools and raising awareness through educational programmes (2020 Vision Green Deck, 2015). These are interesting development goals for the island, considering that it is still

heavily reliant on oil for its electricity generation (roughly 80% of the energy is oil-generated) (WEB Aruba N.V., 2018).

Problem statement

Construction of large wind parks and solar installations on Aruba would have the capability of providing the island with the renewable energy needed to fulfil the goal of 100% renewable energy in 2020 as the island has abundant wind and solar hours per year (respectively 5000 and 2500), offering the possibility to transition to renewable energy (2020 Vision Green Deck, 2015). However, in order to achieve this goal with the greatest result, it is necessary, as several studies have pointed out, to involve all levels and groups of the population in this transition in order to generate support and willingness to transition to a new system (Verbong, Beemsterboer & Sengers, 2013) (Scoones & Leach, 2015) (Ince, Vredenburg & Liu, 2016). The realisation has dawned that sustainable development will only be achieved if people lead sustainable lives, meaning that all have to engage in the sustainable transition, right down to the household level (Uzzel, Pol & Badenas, 2002). This does however pose several challenges: users can be barriers in the transition to sustainable renewable energy because they lack interest/time, they are reluctant in changing routines, and they might experience loss of self-control and privacy (in the case of smart grids) (Verbong, Beemsterboer & Sengers, 2013). This challenge becomes even more complicated by the current electricity infrastructure which favours dominant fossil fuels (Shirley & Kammen, 2013). Last but not least, there are many forces in society that drive people in unsustainable directions, which makes the transition an even greater challenge (Verbong, Beemsterboer & Sengers, 2013).

As Scoones and Leach (2015) state; true transformation does not happen if entrenched interests and power aren't addressed and confronted. This leads to the 'capture of the green agenda' by conservative and neoliberal interests, resulting in reconfigurations of the system rather than fundamentally changing it. This creates conflict over the definition of transformation. Does transformation come down to simply reducing carbon emissions? Or is transformation about a more structural change in production, consumption and ownership that will lead the way to a low-carbon economy in the long term, while it meets at the same time other objectives such as distribution, sustainability and justice? This poses the question:

‘If the renewable energy goal is reached, does this involve an actual contribution to sustainable development if the rest of the population’s socio-economic are not dealt with?’

The focus of the previous government was: achieving socio-economic progress through smart growth. In order to move away from the reliance on the volatile oil market, renewable energy is the key. Whilst the vision of achieving socio-economic progress through smart growth is not necessarily a problem in itself, it becomes a problem when the human factor is not sufficiently incorporated, and economic gains become the main goal. In the expansion drive for renewable energy, disagreements and friction occur in Aruban society such as demonstrations against the construction of a new wind park and the high prices of sustainable energy technologies (Spier, 2015). The ‘soft factors’ such as culture and mind-sets are important factors that need to be addressed in order to make a meaningful transition towards sustainable energy (Peterson, 2018). It is therefore important to focus on efforts to include households in the transition.

The renewable energy transition in Aruba is necessary to move away from the volatile oil market in order to become self-sustaining in the energy production in a sustainable manner. As to date, there is no (detailed) data available on the inclusion of households in renewable energy initiatives and technologies concerning their culture, social factors and attitudes in San Nicolas. The town of San Nicolas was, and is, the hub of the oil refining industry on the island. It is where the ‘oil culture and mentality’ is strongly rooted. There is strong favour for re-opening the oil refinery, which closed in 1985 (Peterson, 2018) (Spier, 2015). Therefore, making the town San Nicolas a relevant case study in the light of the energy transition, which is focussed on renewable and sustainable energy, not oil. The goal of this research is to give insight into the inclusion of households in San Nicolas in the transition. In-depth research is needed for this to gain insights on entrenched cultural norms, values and attitudes regarding renewable electricity and how this influences households’ livelihoods and decisions in the light of the sustainable energy transition. Consequently, the main question guiding this research will be: ‘’*How could households in San Nicolas, Aruba, be (better) included in transition to renewable energy?*’’

Relevance of the research

The transition to renewable energy technology is a radical change from the existing electricity generation and distribution methods. The difference lies mainly in the large reduction on the environmental impact, thus starting a paradigm shift (Ince, Vredenburg & Liu, 2016). There is a need to move to a more sustainable way of living as our world is running out of non-renewable resources: there is rampant pollution and global warming is causing dramatic climate changes with devastating effects. For SIDS, renewable energy and sustainability are especially important themes due to the fact that small islands are highly vulnerable to the repercussions of climate change, that they have unique and isolated ecosystems which are valuable to researchers and that most islands states depend on imported fossil fuels. The uniqueness and diversity is not only present in the eco-systems and size, but also in the socio-economic systems (Ince, Vredenburg & Liu, 2016) (Shirley & Kammen, 2013). Aruba's pathway for a sustainable transition is part of this process. Studies on renewable energy are upcoming all over the world, however, studies on clean energy development and innovations are understudied in island regions (Shirley & Kammen, 2013). Furthermore, the explicit 'oil identity' in San Nicolas, makes the research even more relevant, in the sense that it is obvious that a complete 180-degrees transition needs to take place in values, attitudes and cultures concerning energy.

Within the Caribbean, 90% of the generated energy derives from imported fossil fuels, thus also creating electricity infrastructure that favours dominant fossil fuels. Consequently, a large part of the national budget is allocated to energy expenditure, and this part is only growing due to rising electricity demands. The dependence on fossil fuel causes the retail electricity rates to be among the highest rates worldwide (Shirley & Kammen, 2013). Similarly, on Aruba, the main source for electricity generation are fossil fuels (80%) ("CIA World Factbook — Aruba", 2018). Most supporters and scholars of sustainable development perceive a need for an alteration of human attitudes, behaviours and values in pursuance of a sustainable transition (Leiserowitz, Kates & Parris, 2006). This alteration needs to take place at household level by changing attitudes and behaviour towards sustainable transitions. The challenge at household level lies in actual action, not merely declaring sustainability values, and prioritising environmental values over economic ones. The focus on households in an 'oil-town' and their

renewable energy attitudes/initiatives provides new insights and information on behaviour, attitudes and actual action in a culture strongly formed by the presence of the oil refinery. Furthermore, as there is little to no data available on households and their renewable energy technologies and perceptions in general, this research creates household level data of the town of San Nicolas. These data might yield recommendations for better inclusions of San Nicolas' households in the transition to renewable energy.

TNO (a Dutch applied scientific research organisation) has done research into the drivers of energy consumption behaviour among the Aruban population (TNO, 2013). However, the purpose of this research was to look at the support for a technological approach. TNO is a more physics oriented research institute, and as a consequence their approach lacks political ecology perspective and perspective on the soft factors such as culture (Peterson, 2018).

By combining the three theories of political ecology, socio-technical transition theory and strategic niche management, a holistic overview of dynamics in power, politics and economy is given. The niche of renewable energy is explored by SNM, placing it in the wider context of socio-technical transition theory framework, and critically examined with a political ecology lens.

1. THEORETICAL FRAMEWORK

For a greater understanding of the topic 'renewable energy', this first chapter will give an elaboration on the underlying theoretical approaches which formed the foundations of this research. First, the theories and concepts are worked out and explained in detail, followed by the research design.

1.1 CONCEPTS AND THEORIES

1.1.1 Socio-technical transition theory

The socio-technical transition theory builds on technology and science studies, political science, environmental studies, ecological and evolutionary economics, and ecology. It is useful for studying societies' transitions to more sustainable futures (Schot & Geels, 2008). ''Transition thinking is grounded in 'traditions of systems' thinking. This highlights the co-evolution of the social and technical. It tries to understand the emergence, transformations and decay of socio-technical systems'' (Shove & Walker, p.763, 2007). Systems innovations and transitions take a long time, often decades or more. These changes occur when dominant systems are disrupted, this results in a new 'system structure' or architecture (Lawhon & Murphy, 2011).

Recently, transition scholars have been paying more attention to geographical aspects. More recent transition literature focusses more on the governance of transitions in urban contexts and the impacts of globalisation. The aim of including geography in sustainability transitions is to better explain and understand the different spatial forms transitions and their interaction with (un)even regional development. It is about the way spatial contexts and territories shape transition processes, this emphasizes the heterogeneity and multiplicity of transition pathways (Coenen & Truffer, 2012). In the case of Aruba, it's geographical location, being a small developing island state in the Caribbean, is of importance as it highlights island small-scale economies, the dependency on oil and environmental challenges.

For the analysis of socio-technical transition the Multi-Level Perspective (MLP) has proved useful. The MLP looks at agencies and structures at different analytical levels in order to ''understand how specific innovations or technologies are (or are not) integrated into socio-technical practices through influences from within or outside a regime'' (Lawhon & Murphy, p.5, 2011). The MLP's core notion is that transitions arise through interaction between the three different levels of analysis (Verbong & Geels, 2010); (Schot & Geels, 2008):

- Micro-level: technological niches
    - The emergence of radical novelties, focussed on learning and innovation.
- Meso-level: socio-technical regimes
    - Stable large-scale systems e.g. energy and infrastructure. Belief systems, cognitive routines, normative rules and regulative roles are part of the landscape.
- Macro-level: socio-technical landscape developments
    - The exogenous environment which cannot be directly influenced by regime and niche actors (e.g. deep cultural patterns, macro-economics and macro-political developments.

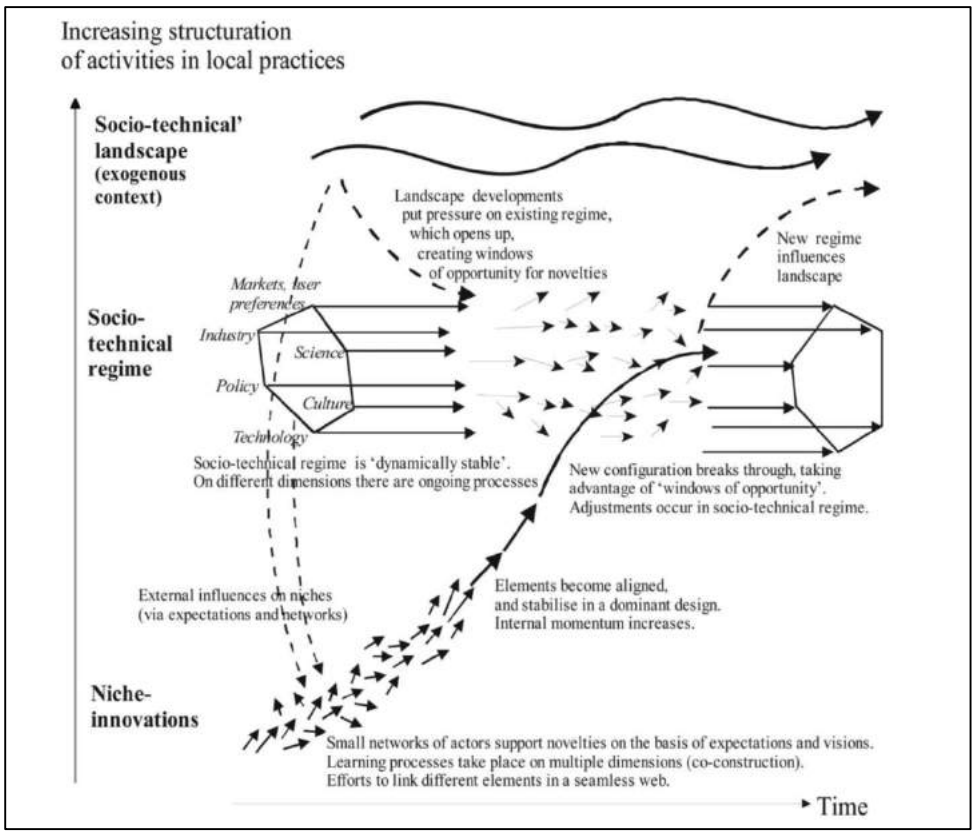

Figure 1: Multi-level perspective on transitions (Schot & Geels, 2008)

It is at the meso-level (socio-technical regimes) of the MLP where political, economic, cultural and social dynamics in the energy regime frame our future energy system. All these dynamics are of great interest in the transition to renewable energy in the oil-town, San Nicolas. Transitions (in the socio-technical regime) do not come about easily because current systems are characterized by lock-in and stability, creating path dependency. Especially in the case of energy infrastructure, there are many sunk investments in technology (Verbong & Geels, 2010). Other factors highlighted by Kemp, Schot and Hoogma (1998) that play a role in regime changes are: the uncertainty of social gains and demand and the need for change on many different levels (technology, social, infrastructure and organisation).

On a more critical note, the theory of socio-technical transition management requires a transition in a current provision system (e.g. electricity), however it has little to say on what organisations and individuals can/could/should do to steer and affect these processes/trajectories to set goals for a new way of living. Furthermore, corporate and policy actors are taken for granted as the most important players, but there are also other vital players (e.g. community) (Shove & Walker, 2007). The authors Lawhon and Murphy (2011) bring forward the criticism of socio-technical framework by stating that it is too elitist (by not addressing the role of power relations and participatory decision-making processes), too much technology focussed (at the expense of political and social relations), and not sensitive enough to geographical and spatial factors (naïve in scale, transferability and conceptualisation of space). If these critiques can be overcome, it is a very useful theory.

1.1.2 Strategic niche management (SNM)

Kemp, Schot and Hoogma (p. 186, 1998) provide a definition of SNM: ''Strategic niche management is the creation, development and controlled phase-out of protected spaces for the development and use of promising technologies by means of experimentation, with the aim of (1) learning about the desirability of the new technology and (2) enhancing the further development and the rate of application of the new technology''. SNM was introduced to bridge the gap between Research and Development (R&D) and market introduction. As a consequence, a lot of SNM literature is focussed on understanding early technology adoptions and their potential contributions for sustainable development (Schot & Geels, 2008).

Sustainable innovations can be reached by creating technological niches. As argued by SNM scholars, sustainable development can only be reached by acknowledging the interrelation of technological and social change. This insight builds on the sociology of technology, the argument that social and technological change are reciprocal (Schot & Geels, 2008). The assumption of the interrelation between technological and social change, is the same as in the socio-technical transition theory. SNM focusses on the niche, in which endogenous change, not top-down change, is key. Niche management, like the socio-technical transition theory, makes use of the MLP for contextualisation and analysing transitions through inter-level interaction (Schot & Geels, 2008).

Niches are not only useful for testing and designing technology, but also for researching the alignment of societal issues, technology and demand in the broader context such as sustainable development (Schot & Geels, 2008). Furthermore, it is noted by several authors that a new niche technologies should enjoy protection within the niche before its introduction into the market with stiff competition, for which it is not yet ready as it needs much development and usually still performs below standard (Schot & Geels, 2008); (Shirley & Kammen, 2013); (Verbong, Beemsterboer & Sengers, 2013). With the arrival of new niche technologies in the socio-technical regime, social acceptation is very important. Verbong, Beemsterboer and Sengers (2013) give three types of social acceptation: 1) community acceptation, 2) market acceptation and 3) socio-political acceptation. In technical transitions, social aspects are often neglected. SNM fills the gap left by the socio-technical transition theory for a 'new way of living' by the allowance of experimentation and co-evolution of technology, regulatory structures and user practices within the niche (Schot & Geels, 2008). Shirley and Kammen (2013) confirm the importance of real life, hands-on experiences in demonstration projects and the application of visions in experiments, because these can be useful in developing the niche. They also state that in the case of failed niche development, it is mainly due to a lack of 'second order' learning and the lack of involvement of outsiders.

Green energy is still in the early stages of transition: in the 1970s solar and wind technologies received a development push due to the energy crisis, however the market is still characterized by technological and market uncertainty. The technologies will not naturally develop through market forces due to current embedded energy infrastructure and the shortcoming of markets

to punish pollution/waste instead of attributing value to sustainable technologies. Essentially, these new energy technologies are still in the niche, or slowly transitioning into the main regime (Mazzucato, 2015). Also on Aruba, the main form electricity is still fossil fuel based. The renewable electricity is still in the niche on the island, seeing that roughly 80% of the energy supply is still reliant on oil, and that current electricity infrastructure favours this fossil fuel (WEB Aruba N.V., 2018).

1.1.3 Political ecology

In political ecology, the political dynamics concerning the discursive and material struggles over the environment are examined. The unequal power relations in the politicized environment and the vulnerability and marginalisation of the poor in these environmental conflicts are central themes (Bryant, 1998). Political ecology is concerned with and analyses power relations in environmental decision-making. It analyses the construction and distribution of costs and benefits, and how these impacts can be shaped by class, race, gender etc. Furthermore, within political ecology specific attention is paid to the construction of knowledge; linked to environmental crises and resource conflicts (Lawhon & Murphy, 2011). From a political ecology perspective, the environment in question can vary from political, natural or cultural environment (Greenberg & Park, 1994).

There is a need for more understanding of political processes in sustainability transitions. Politics are always intertwined with (sustainable) socio-technical transitions. It can play many different roles within transitions at different levels, it can figure as an obstacle, arena, context, manager of repercussions, arbiter or enabler (Meadowcroft, 2011). However, political ecology can become problematic and complex when it is used in different scalar dynamics; what is favourable for the local level may not necessarily be so on the global level (Lawhon & Murphy, 2011). This notion is further elaborated by Ince, Vredenburg and Lui (2016); whilst well-functioning subsidies, economic incentives and tax schemes are important for renewable energy industries' market stimulation, 'informal aspects' such as cultural norms, informal stakeholder interaction, historical legacy and informal networks are all important for the development of policies, and whether they will be effective in their implementation. This is especially interesting and exciting in the case of Aruba, what can be favourable at the

household level, may not be so favourable at the national level. Furthermore, where the SNM and socio-technical transition theory pay little/no attention to the distribution of (political) power in sustainable transitions, the political ecology perspective gives voice to the more marginalised groups in society and their role in the renewable energy transition.

Politics should be 'put first' in understanding how human-environment interaction and how this may be linked to issues of environmental degradation. Since the UN Rio 1992 conference, political ecology has grown rapidly as a tool to explain economic and political obstacles in order to achieve meaningful change, and not just 'business as usual'. As observed by political ecologists, the impact of human environmental change is unevenly distributed, the marginalised and poor groups usually experience the more harmful and negative effects (Bryant, 1998). This has to do with the fact that society and nature are socially constructed to a certain extent, but, both systems have constraints facilitated by this human purposive activity (Greenberg & Park, 1994). The history of American and European colonial powers and their interventions in the 'third world' is crucial to the understanding of current patterns of power relations and human-environment interaction. This intervention embodied the incorporation of the 'third world' countries and their environments into the 'first world' dominated global system of capitalist production, causing millions of livelihood transformations (Bryant, 1998). On Aruba, especially the Dutch colonial powers have left a significant imprint on the island.

1.1.4 Concept clarification

To date, there are is no internationally and standard definition on the term 'renewable energy'. Factors that come up in current definitions are: sufficient energy sources, energy security, sustainability of energy sources and the environmental impact of energy sources. There are, as the researchers of UNSTATS mention, several 'grey areas' which need to be addressed to create clear and all-encompassing definitions (Gritsevskyi, n.d.). These grey areas consist of e.g. the use of wood as a 'renewable energy source'. This however needs to take into account a much longer regeneration period than with sun or wind energy. Another example is the use of biogas which could have negative effects on the environment through combustion.

The definition of renewable energy I will be using is from Eurostat*: "renewable energy sources include renewable non-fossil energy sources such as wind, solar, geothermal, hydro-power and energy from biomass/wastes. The latter refers to electricity generated from the combustion of wood and wood wastes, other solid wastes of a renewable nature (for example, straw), biogas (including landfill, sewage, and farm gas) and liquid biofuels, and from municipal solid waste incineration."* (Gritsevskyi, n.d.)

When studying renewable energy in the Aruban context, it is intrinsically intertwined with the larger plan for 'sustainable development' on the island. Households consume about a third of the energy on Aruba and form thus a significant part of the users. This is the reason why the research focus is on household energy consumption. The definitions for 'sustainable development' and 'households' are definitions used by the UN.

Sustainable development: "*sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs*." ("Report of the World Commission on Environment and Development: Our Common Future", 2018)

Household: ''*a residence unit that consists of one or more persons who make common provision for food and other essentials for living*.'' (''UNdata'', 2018)

Awareness levels:

1- Having heard of the transition
2- Having considered it for own household
3- Active engagement by purchasing technology

1.1.5 Small Island Developing States (SIDS)

Aruba, being a 'Small Island Developing States' (SIDS) faces structural challenges in achieving sustainable development. The factors mentioned in the introduction, such as the remoteness, physical size, small economy, impacts from climate change etc. are part of the challenges that are prevalent in most SIDS ("Small Island Developing States .:. Sustainable Development

Knowledge Platform", 2018). In the case of a transition to renewable energy on Aruba, it is currently heavily reliant on oil as its main source of electricity generation. The constant import of oil causes a large outflow of foreign currency. As the oil market is extremely volatile, Aruba has adjusted its 'energy course' to reducing its dependence on oil (interview TNO, 2018).

1.1.6 Reflections

The preceding paragraph 1.1 offers a theoretical and conceptual background on the energy transition. Important concepts are highlighted and explained. Three main theories to frame this research, are investigated.

The socio-technical transition theory is useful as it places the energy transition in the wider social and technical context. The theory states that the social and technical context should evolve and interact simultaneously, in order to make the implementation of renewable energy sources a success. With the MLP on the transition to renewable energy, an analysis of interaction between levels and actors can clarify the role of each level in this socio-technical transition. The use of the second theory, SNM, is to bridge the gap between R&D and market introduction. Renewable energy is still largely situated in the 'niche innovations' sector, and only slowly making its way into the dominant socio-technical regime. The specific focus of SNM offers advice and information on successfully introducing and incorporating in society. It especially highlights the importance of social acceptation of new technologies. The third theory, political ecology, is useful in highlighting the unequal power relations in the energy transition. It asks the question which population group, or group of actors, profits from the transition. It also highlights the need of incorporating and understanding political processes in 'environmental' transitions.

1.2 RESEARCH DESIGN

In the previous chapter an introduction and theoretical background were given that form the basis of this research. In this chapter, the research questions, the conceptual model, the justification for the site selection and methodology are discussed.

1.2.1 Research questions

The focus of this research is on better inclusion of households in the energy transition. The main research question formulated in the introduction is: *''How could households in San Nicolas, Aruba, be (better) included in the transition to renewable energy?''.* The data will be interpreted in the framework of three theories: SNM, socio-technical transition theory and political ecology.

The five sub questions listed below were formulated in order to assist the research by addressing the different topics embodied in the main question.

1. What is the level of awareness and current usage of renewable energy (technologies) in households?
2. To what extent are households involved in initiatives concerning the renewable energy transition?
3. What are the differences in renewable energy usage, awareness and role between households and how can these differences be explained?
4. What are the barriers and opportunities for the inclusion of households experienced in the transition to renewable energy?
5. To what extent has the oil refinery influenced the transition to renewable energy of households on Aruba?

1.2.2 Conceptual model

The conceptual model below gives a graphic rendering of the links between the research questions and the process of this thesis. It shows how the transition to renewable energy is

part of a bigger vision of making Aruba a sustainable island. The focus is on the households in San Nicolas, looking at their role, culture, awareness and usage in renewable energy, which refers to the energy transition, and its extent of reaching the households.

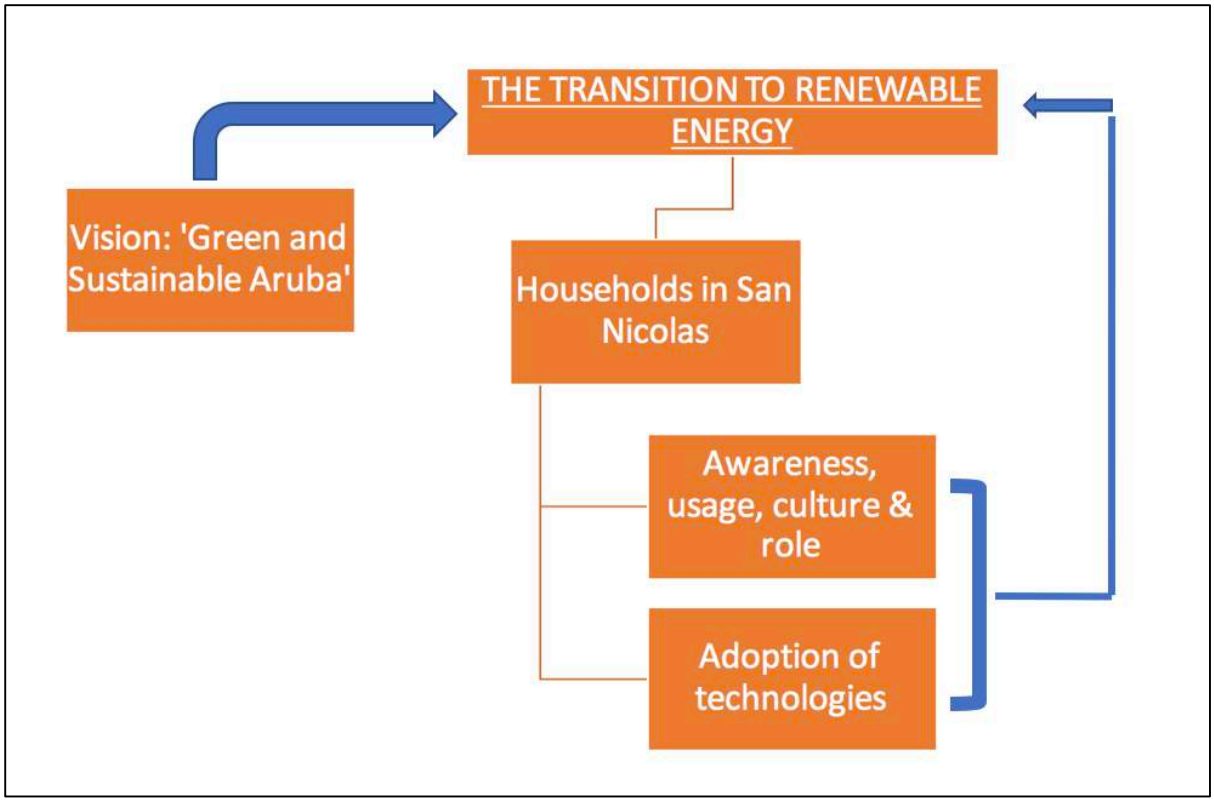

Figure 2: Conceptual model

1.2.3 Justification for site selection

Aruba is one of the many SIDS in the earth's oceans and seas. It is an island which has recently been very active in the transformation to a more sustainable way of living, business and economics. A part of this sustainable transition is focussed on renewable energy generation and usage on the island. Furthermore, apart from merely stating a will to transition a different energy source, there have been actual changes on the island in order to facilitate this change. It is a fairly new stance taken up by the island, as the promotion for a more sustainable way of living and 'doing things on the island' started roughly ten years ago. The island has many partnerships with organisations such as the Carbon War Room, Utilities Aruba and several universities in an attempt to make this transition a success. It seeks to become an 'export product', in the sense of showing other SIDS how one can transition into a sustainable society

(running on renewable energy). Relevant issues are information on how to deal with utilities, how to obtain funding, and persuading the business sector to participate. Due to the major influence that the oil refinery had on the island (population growth, economic prosperity and cultural changes), the town of San Nicolas was chosen as the focus area of the research. San Nicolas is where the oil refinery is located, and where it arguably had the largest influence on the population.

In the transition to an island running on renewable energy, the ongoing discussion about the reopening of the refinery is an unexpected factor. The population of San Nicolas therefore consists of important actors in the energy transition.

1.2.4 Methodology

This methodology chapter clarifies the way in which this research was conducted. For the methodology underpinning this research several methods of data collection have been used: structured interviews, secondary literature research, open interviews and an extensive guided tour in the museum of industry (San Nicolas). The three main theories (SNM, socio-technical transition theory and political ecology) used to discuss and place the research in a theoretical context were chosen after extensive literature research on renewable energy transitions. Most of the interviews were conducted with the households in San Nicolas, the focus group of the research. However, a further five in-depth interviews were held with non-household actors, who were also closely involved in the transition: Mike Eman (former prime minster of Aruba, and head of the AVP party), Incoe Martinus (owner of 'Green Solutions Aruba'; a solar panel installation company), Gidrich Bislik (credit and commercial control at the FCCA), a representative from TNO Caribbean and a representative from Elmar (the electricity supply company).

In the beginning of the research, the reaching of respondents proved to be a bit of a challenge. Different 'plans of action' were undertaken in order to obtain households for the interviews. The three different strategies are listed below:

Plan 1: The method used to reach the participants will be done through the random selection of 5 streets in each of the five neighbourhoods of San Nicolas. In each street, the researcher will choose house number six, in the next street seven, in the next street eight etc. up until ten. In the next neighbourhood, the number will again start at six moving up to ten. In this way, all the neighbourhoods in San Nicolas will be covered. Additional interviews with actors concerned with the transition, convenience sampling (as to their profession and knowledge on the subject) will be used.

> Outcome: The random selection of households in San Nicolas could work theoretically, but by various informants and actors involved in the transition, indicated that this would not be a feasible approach in the sense that people will not want to be interviewed, will not take you seriously or be inappropriate (due to the fact that you are a foreign, young blond woman).

Plan 2: The second strategy was to obtain information from the Utility companies for 25 random addresses and take one of their employees along for the interviews and to give introductions, seeing that they could also benefit from the research for this thesis.

> Outcome: However, after having contacted and proposed this method to Utilities, it appears that the utility companies cannot give this information (due to privacy), and they do not supervise students with their research in this way.

Plan 3: It seemed to be quite difficult to gain access to the research population, as well as trying to find a company or person that was willing to aid the researcher to do this in a scientific manner (meaning: obtaining a representative sample with as little bias as possible). After some more brainstorming, the idea came up to try and approach the participants by means of (social) institutions such as schools and churches. The largest non-religious public government high school in San Nicolas (Colegio San Nicolas) as well as the English Protestant church in San Nicolas were contacted for participation in the research. These two particular institutions were chosen due to the fact entry to my respondents was easily facilitated and people were helpful in aiding in the research. This approach has facilitated the opportunity to approach possible participants in a safe and comfortable way. Both institutions contain people from many diverse backgrounds, financial situations and ages. Subsequently, each respondent was asked to name another household which could be contacted for an interview.

The concepts from the research questions have been operationalised in my interview questions (see chapter: '1.1.4 Concept clarification' and '1.2.1 Research questions'). The data from interviews were coded and further analysed using Nvivo, a coding software.

There were certain limitations and constraints that presented themselves during the course of this research which might have influenced the outcomes of the research. Due to the fact that a 'sustainable and green lifestyle' is a socially desirable lifestyle, the answers of respondents might have been given in such a way in order to create a positive impression. In order to reduce this possibility, the respondents were asked to name the specific activities in which they engaged with (renewable) energy. Several themes were approached from different angles. The constraint of time plays a role in every research. More households could have been approached, although the repetition of answers indicated that no further variety in responses would emerge. Unfortunately, I could not reach a representative of WEB, although I have tried repeatedly to do so. Regarding the outcome of this research, it might have been helpful whether WEB regards the households as competition in the production of energy or otherwise. Considering all the above, I am convinced that in the actual situation the research was conducted in the best possible manner. The necessary data have been collected and were used as sufficient material for the conclusion.

2. THEMATIC AND GEOGRAPHICAL CONTEXT

2.1 A SHORT HISTORICAL OVERVIEW OF ARUBA

The Netherlands Antilles are divided into two groups of islands: The Leeward islands; St. Eustatius, Saba and St. Martin and the Curacao islands/Windward islands; which is composed by Aruba, Bonaire, Little Bonaire, Curacao and Little Curacao. The latter island group is located in the South of the Caribbean, North of the Venezuelan coast, and just outside the hurricane area (Goslinga, 1979). Aruba is the smallest of the Curacao islands, being just 180km², with a population of 115,000 ("CIA World Factbook — Aruba", 2018). In 1499, the Curacao islands were discovered by the Spanish conquistador Alonso de Ojeda. The Spanish forcibly removed the local Indians to mainland Venezuela for slave labour (Goslinga, 1979).

A century later, the Caribbean was frequently visited by the English, Dutch and French. By 1636, all the Leeward and Windward islands were occupied by the Dutch. Especially the Windward isles gained the special interest of the Dutch as strategic trade and war maritime bases for the WIC (West India Trading Company) and the potential for salt production facilities. In the succeeding decades, the Windward Islands changed possessions several times through due to European power shifts at global level (Goslinga, 1979).

The economy of Aruba has been dominated by five main industries: phosphate mining, aloe production, gold mining, the oil refinery and more recently and the start of a booming tourism industry in the last decades of the 20th century, which is still growing (Exhibition Aruba's Industry, 2018). Especially the arrival of the oil industry brought on a new migration wave from other Caribbean islands, as well a change of jobs. Where 'traditional jobs' such as fishing were mainly pursued by the inhabitants of the Antilles, the arrival of lucrative jobs in the oil sector intensified the job switch, which were later mostly substituted by the tourist industry due to the combination of a decline of oil refining (Venezuela started with its own oil refining), automatization in the oil industry and a population explosion (Goslinga, 1979 & Spier, 2015).

In 1986 Aruba became an autonomous member of the Kingdom of the Netherlands (constituent country), with king Willem Alexander as its official head of state. In this dependency status, the Dutch government is responsible for foreign affairs and defence ("CIA World Factbook — Aruba", 2018).

2.2 GEOGRAPHICAL INFORMATION

Aruba is a small island of just 180 square kilometres in the South of Caribbean, just 35 kilometres North of the Venezuelan coast. To the East the other Leeward islands can be found, Bonaire and Curacao. The island has gently sloping terrain inland, with the highest peak (Ceru Jamanota) being 188m above sea level. The Southern and Western coast are flat terrain with sandy beaches, whilst the Eastern and Northern coasts are more rugged
(CIA World Factbook – Aruba, 2018).

Figure 3: The position of Aruba in the Caribbean (CIA World Factbook – Aruba, 2018)

Situated on the South of the Island, is the town of San Nicolas (shaded in red). This is one of the six district located on the island (Central Bureau of Statistics Aruba, 2018). Aruba has a population of around 115,000 inhabitants, with a growth rate of 1,27% per year. Most inhabitants live in San Nicolas or Oranjestad (the capital) (CIA World Factbook – Aruba, 2018).

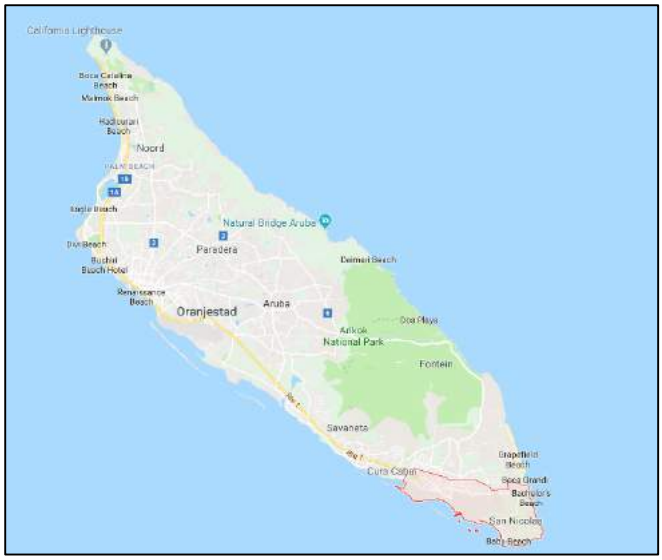

Figure 4: topographical map of Aruba (Google Maps, 2018)

2.3 ENERGY ON ARUBA

2.3.1 The development of the electricity sector

In the 1920s the commercial production of electricity started by a small government company, the generating capacity was sequestered to a Dutch cooperation. In later years, this cooperation become known as Elmar, it held the exclusive control in the distribution and generation of electricity on Aruba. Many years later a diesel power station was bought by the government with a capacity three times the size of Elmar's. As a consequence, the state-owned company; Water and Power Company (WEB N.V.), was established by the government, and all the electricity generation and distribution came into Aruban hands. An agreement was reached between Elmar and the state: Elmar was to be responsible for the maintenance, transmission and distribution, and WEB N.V. would be the sole generator of electricity. Complete state ownership of the electricity operations came in the 1990s, a holding company owned by the government, Utilities Aruba N.V., took over from Elmar (Shirley & Kammen, 2013).

The current electricity figures in Aruba are as follows:

1. Population without electricity: 9%
2. Electrification of the total population: 91%
3. Electrification of urban areas: 100%
4. Electrification of rural areas: 80%
5. Electricity from fossil fuels ± 80% ("CIA World Factbook — Aruba", 2018)

2.3.2 Renewable electricity on the island

Renewable energy in the Caribbean is new and complex owing to the large number of regional groupings interacting with different international agencies such as the World Bank and the Inter-American Development Bank (IDB) (Ince, Vredenburg & Liu, 2016). Focussing specifically on Aruba: the electricity is generated by WEB and distributed by Elmar, both organisations are owned by Utilities Aruba, a government-owned holding company. Electricity has a four 'rate structures', household customers have a fixed starting rate. On the WEB Aruba website, it is stated that the average of renewable energy produced on the island, in 2018, is 20,1% of total energy production (WEB Aruba N.V., 2018). Large renewable energy initiatives contributing to this 20% have been set up such as the Vader Piet windfarm and the solar park next to the Reina Beatrix airport (2020 Vision Green Deck, 2015).

At household level, up until 2012, Arubans only knew of power coming from utility companies. However, in 2012 Elmar introduced a revised net metering policy, enabling households to sell more electricity (10kW) back to the grid (Energy Snapshot Aruba, 2015). The effort to try and convince households to switch to their own power supply, and simultaneously sell their surplus to ELMAR (electricity distribution), has not been easy. Households are hesitant and reluctant to adopting residential solar technologies, with cost being one of the main barriers. In 2012 Aruba announced a partnership with the 'Carbon War Room' to help with the island's renewable energy transition (2020 Vision Green Deck, 2015). The partnership, if successful, will make Aruba the first sustainable energy economy in the world. The Carbon War Room had taken up the challenge by the UN to learn from the transition on Aruba and apply these to ten other islands, hereby the 'Aruba model' will be exported on a global scale, which is part of the 2020 Vision (2020 Vision Green Deck, 2015).

Coinciding with ELMAR's efforts to include individual households, in literature a trend has come up to pay more attention to the users/households. One of the reasons why renewable energy initiatives fail to successfully leave the niche stage in smart grid projects is the lack of social embeddedness of new technologies. Therefore, social networks, capabilities and belief

systems play an important role in involving smart users in a smart grid (Verbong, Beemsterboer & Sengers, 2013).

Households using renewable energy have the preference of solar panels over windmills. Windmills need a lot of maintenance due to their moving components. The strong gusts of wind on the island, shorten the life span of windmills considerably, solar panels have no moving components and need little to no maintenance (interview Elmar, 2018) (interview Incoe Martinus, 2018). In the figure below the yearly increment in kW capacity for the commercial and residential sector. Please note that the 2018 figures are not for a full year. It represents about four months of the current year. The average production of electricity at WEB is 135 megawatts, which shows that the kilo watts produced by the residential and commercial put together are only a fraction of the total electricity generated on the island (WEB Aruba N.V., 2018).

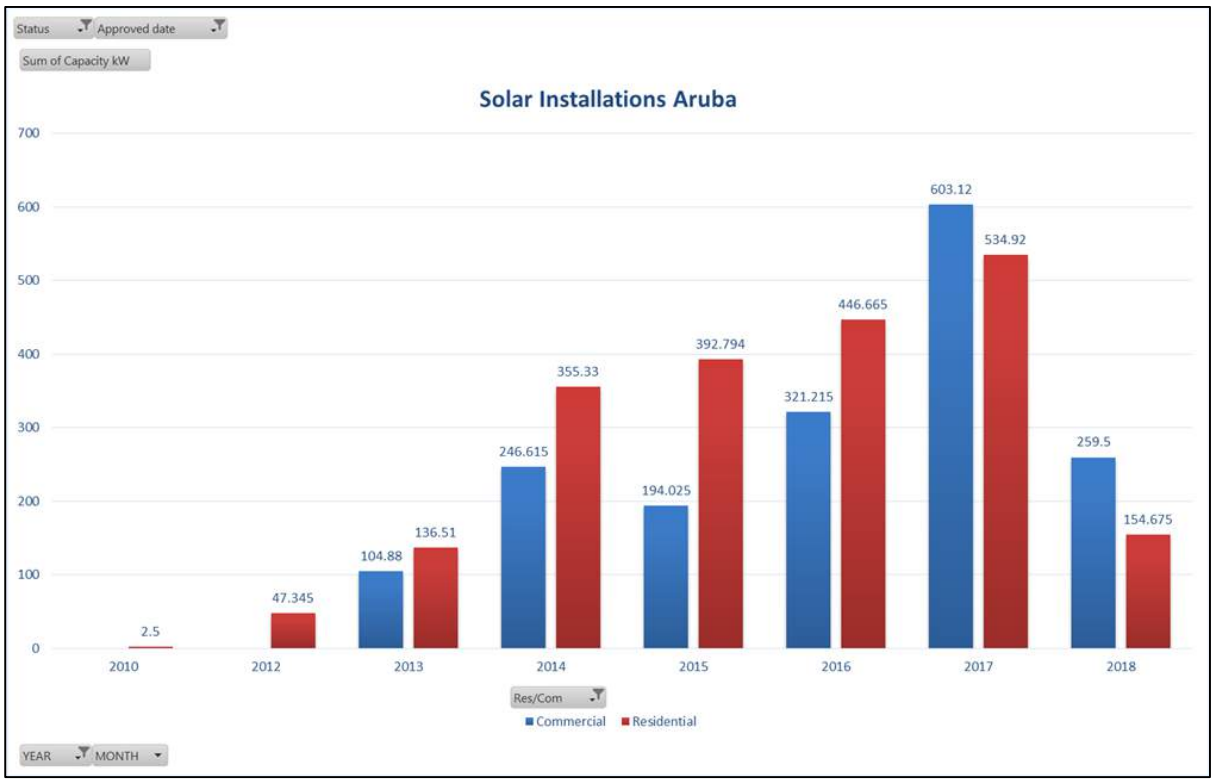

Figure 5: Annually newly installed kW capacity of solar power in the residential and commercial sector

2.3.3 The energy policy environment

On Aruba, the local government involvement in electricity provisions has been forceful in its drive to manage functions and assets. With the start of commercial electricity production in the early 1920s, the Dutch had a strong hand in the electricity industry, however, the installation of a new diesel power station the transition to full Aruban ownership of the electricity supply and demand was set into work. What is interesting to note, there is no regulation and no legislative body that oversees the operations of the utility companies (Elmar and WEB N.V.). This in combination with the incentives to build wind farms coming mainly from private developers, creates a situation in which it is difficult for new technologies such as wind energy to be incorporated into the electricity system as there is no integration procedure, no incentives for standardisation in bidding processes and standardized grid access (Shirley & Kammen, 2013).

In 2011, the government of Aruba presented the document 'The Green Gateway', a plan for economic development, including the promotion of clean energy. In order to reach this goal several efforts have been made in the past few years to incorporate more renewables. As mentioned in the previous chapter (4.2), in 2012 Aruba announced its partnership with Carbon War Room, for the transition to a 100% renewable energy programme (Shirley & Kammen, 2013). Also in 2012, Elmar came with a revised net metering policy allowing for a higher capacity of kW and compensation for surplus production of system owners (Energy Snapshot: Aruba, 2015). Furthermore, import tariffs on solar panels, electric cars and wind turbines were reduced to encourage clean energy technology adoption (2020 Vision Green Deck, 2015). Apart from aiming for 100% renewable energy in 2020, the aims to become a knowledge hub and market for sustainable technologies. The pursuit of this sustainable identity aims to offer both public and private sector, locally and internationally, the opportunity to examine the 'Aruba model', and thereby also collaborating in the development of the model, and at the same time create a business platform between Latin America and Europe (The Green Gateway) (2020 Vision Green Deck, 2015).

A big project in the light of the 'Green Gateway' is the SCA (Smart Community Aruba). The SCA is a small new sustainable 20 home residential neighbourhood in the Kibaima neighbourhood,

Oranjestad, Aruba. The SCA aims to be a 'living lab' in which experiments concerning sustainable construction, smart technologies, small wind turbines, solar power and local energy storage can be tested, perfected and demonstrated (BearingPoint Caribbean, 2016). Even though the SCA is fairly small, with only 20 homes, the stakeholders and government hope that the community's successes will be exported on a larger scale elsewhere. The key objective of this community is knowledge development linked to the scalability of the business models and technology solutions, thereby enabling the transition to sustainable energy in Aruba (Utilitiesarubanv.com, 2016). This new neighbourhood is especially built for the experimentation of new technologies, however, there is much less experimentation in existing neighbourhoods with renewable technologies.

If the energy section is to be transformed, policies that focus on both the demand and supply side are necessary (Mazzucato, 2015). As there are many forces in society that drive us in unsustainable directions, taking the users' perspectives and their economic and emotional drivers into account is important in the creation of policies. Also, it needs to be acknowledged that there is a need to trigger users to get involved in their own energy use (Verbong, Beemsterboer & Sengers, 2013). Furthermore, an impartial regulatory body or policy would help create a more enabling environment for new energy technologies (Shirley & Kammen, 2013).

3. THE OIL REFINERY AND ARUBAN CULTURE

3.1 The oil refinery – contextual background

History of Aruba's economy:

Aruba has been characterised by five main industries (gold mining, phosphate mining, aloe production, oil refinery and tourism) that generated incomes for the islands, the most influential industry being the oil refining. Before the arrival of the oil industry on Aruba, work and life was hard. Many Arubans left to work in Venezuela on the large sugarcane and banana plantations, despite the other money generating sectors on the island over time. Between the years 1890-1900 +- 2500 Arubans left to work on the plantations in Venezuela alone. By far the largest group of workers left to Cuba between 1916-1930 (4072 workers). The outflow of

workers stopped with the arrival of the two oil refineries, Eagle and Lago, to the island (Alofs and Merkies, 2001) (Exhibition Aruba's Industry, 2018). The mining of phosphate was the trigger to the emergence of the hamlet San Nicolas (Alofs and Merkies, 2001). The arrival of Lago Oil and the Transport Company resulted in the most radical shift in the history of Aruba. It gave a huge boost to San Nicolas, which grew out to be the main (economic) hub of the island. Furthermore, its arrival attracted thousands of immigrants, created global connections and tripled the population of Aruba is just over three decades.

Table 1: Population numbers Aruba 1817-1981 (selection) - (Adaptation from Ridderstaat, 2008)

Year	Population size
1817	1,732
1863	3,258
1900	9,702
1920	8,265
1930	15,687
1940	30,614
1950	51,000*
1960	56,910
1972	57,905
1981	60,321
***estimate**	

History of the oil refinery:

The start of Aruba's oil history commenced with it being a storage and transhipment location for oil coming from the Maracaibo oil fields, in North-West Venezuela. Aruba's close proximity to Venezuela, as well as having fairly deep waters for large oil tankers to deliver their goods made it a prime location. The harbour for ocean tankers still needed to be deepened, but was far more favourable than deepening the lowlands of the Maracaibo basin. Furthermore, San Nicolas being in Dutch territory provided political stability which was not to be found in Venezuela at the time (Ridderstaat, 2008).

In 1924, the American Lago Oil & Transport company (a subsidiary of the Standard Oil Company from New Jersey) was established in San Nicolas. In 1925, it received a 75year lease-contract for the use of land in San Nicolas for storing oil. Soon after the start of oil storage on Aruba, the Lago company expanded in San Nicolas, obtaining permission from the colonial

government to enlarge their premises. In 1928, the approval for the construction for the oil refinery was given, along with more land to develop the area surrounding the refinery and storage facility. Along with the oil industry came many different jobs such as: book keepers, engineers and brick layers. This attracted labour immigrants from all around the globe, ranging from other Caribbean island to labourers from Europe and Turkey. The long-term demand for skilled workers, led to the establishment of a training facility. Apart from training facilities, the refinery also boasted several facilities such as a hospital, shop, school and housing (Ridderstaat, 2008).

In 1983, Venezuela started selling less barrels of oil to Aruba due to political and economic problems within the country. The advantageous price Aruba bought Venezuelan oil for, was no longer deemed a good deal by the Venezuelan government, leading them to stop the 'preferential selling price' of oil to Aruba. This led to worries within the refinery management. The Lago refinery was only suited to refine heavy crude oil, coming mostly from Venezuela. As a result, losses started rising from the unfavourable market conditions, and in 1984, the refinery announced its definite closure for the following year, 1985 (Ridderstaat, 2008) (Exhibition Aruba's Industry, 2018). Also, the increasing automation in the refinery resulted in a steady decrease in employment. Of the approximate ten thousand employees working for the refinery in the 1950s, in the 1980s roughly 1,500 employees were left over (Exhibition Aruba's Industry, 2018).

The closure of Lago brought many economic worries, as well as political worry. Aruba was aspiring to obtain a *status aparte* within the Kingdom of the Netherlands, to be separate from the neighbouring country Curacao. The question being asked by politicians was if this new status could be financed without the refinery supplying the island with its large contributions to government revenues. Despite these worries, the transition to a *status aparte* went ahead. However, the government was, and is, accumulating debts to the Dutch government.

The (global) importance of oil for Aruba remained, in the following decades the refinery was reopened and operated by several companies; Coastal Petroleum followed by the Valero Energy Corporation, which closed the refinery for the second time in 2011. Currently, the Citgo Petroleum Corporation (which owns and supplies all gas stations on the island) is looking into

reopening the refinery once more in San Nicolas (Exhibition Aruba's Industry, 2018). The refinery, however, is outdated and currently definitely not fit for reopening. Many renewal projects need to be carried out to make it fit for running once more (Exhibition Aruba's Industry, 2018).

Contributions of Lago:

Lago had a large influence on the labour market. The high wages paid in the refinery attracted many labourers coming mainly from the Caribbean and the British West Indies. Due to Lago being a private owned company, and at the time the largest wage payer on the island. As a consequence, it paid a lot of wage tax to the government. It also contributed greatly to government revenue (Ridderstaat, 2008). At the height of its productive powers, the refinery boasted a work force from 56 different countries (Exhibition Aruba's Industry, 2018). This large melange of nationalities led to the establishment of English as the main working language in the refinery. Furthermore, the Lago refinery boasted excellent facilities such as a school, hospital and sports club. Apart from direct oil refinery labour, many indirect jobs were created by the presence of both refineries such as shops, companies, entertainment venues etc. This gave a huge boost to the local economy. Undeniably, the refinery caused the rapid population growth on Aruba (Ridderstaat, 2008) (Alofs and Merkies, 2001).

Table 2: Migration balance 1938-1951 (Adaptation of Alofs and Merkies, 2001)

Year	Immigration	Emigration
1938	3,620	
1939	1,328	
1940		773
1941		82
1942	1,519	
1943	2,098	
1944	896	
1945	2,133	
1946	1,836	
1947	638	
1948	1,741	
1949	839	
1950		2,171
1951		358
Total	17,088	3,384

Lago never directly produced oil for the Aruban market, produce was shipped to all over the world, with a large portion of its shipments going to England. In order to keep the refinery running, as well as the entire compound surrounding the refinery, Lago was one of the largest consumers of water and energy on the island. Lago did however supply fuel for boats and airplanes and it gave tours of the oil refinery, hereby playing a role in the promotion of tourism and transportation (Ridderstaat, 2008). Apart from having quite a number of positive influences on Aruba, the oil refinery has also left its 'oil-stains' on the island. Whilst Lago was still functional, certain beaches in San Nicolas were off limits for locals, and reserved for the employees and families living in 'Lago Colony'; the complex of housing and facilities built for the refinery employees. Apart from having negative social effects, there were also environmental consequences. The residual waste chemical products from the refinery were dumped in caliche pits (old caliche mining pits) in Seroe Colorado and Lago Heights, two neighbourhoods in San Nicolas. This dumping of chemical products (sulphur, oil waste, refinery waste, rubble and heavy metals) made these areas unsuitable for housing due to air, ground and water pollution. Furthermore, the deepening of the harbour caused damage to the coral reef (Ridderstaat, 2008).

After Lago:

The dismantling of the refinery was a contested affair. The decision to dismantle (parts) of the refinery, and when, changed several times. Up to date, several parts of the refinery are dismantled, and ownership has been transferred to the Aruban government. In 2004, the refinery was sold to Valero Energy Cooperation (Ridderstaat, 2008). The absence of Lago caused two major changes in the political and economic structure on Aruba. In politics, the structure changed from single party dominance to coalition ventures. In economics, the income used to come mainly from the refinery and only slightly from tourism, after the departure of Lago, the focus shifted completely to tourism as the source of income for the island. Furthermore, the largest foreign exchange generator fell away with the departure of Lago (Ridderstaat, 2008). Along with the departure of Lago, many skilled and well-educated labour left the island, resulting in a know-how and capital flight, causing a huge brain drain (Exhibition Aruba's Industry, 2018).

3.2 The oil refinery – respondent findings

Respondents' link(s) to the oil refinery

All household respondents have a personal link with the refinery. The respondents, with the exception of 35-year-old Lina, had family or friends that had worked in the refinery, or still worked there. Just as Juan and Amy stated: everybody used to be reliant on the Lago refinery, in whatever way, it could be a brother, a son, anyone. Six respondents have either come from abroad themselves to live and work on Aruba, or their parents/grandparents moved to Aruba for the job opportunities the oil refinery facilitated, or the industries which were linked to the refinery. For example; Lara (2018) stated in her interview that her father moved to Aruba from Colombia because the refinery was creating a lot of jobs and business opportunities, he opened up a large bakery which was successful for quite a number of years. Unfortunately, the closure of the refinery led to a decline of labour forces shrank the economy in San Nicolas, meaning the bakery had to close.

Apart from knowing people that worked in the refinery, many respondents commented on the fact that the fact that the oil refinery was a major source of income to many families. It was seen as the most lucrative employer in terms of social and health benefits and income. ''*Aruba during Lago, Aruba flourished. It really grew as an island. We didn't have tourism, what the refinery brought to Aruba was enough, we didn't need tourism. It was a lot of money, a lot*'' (interview Amy, 2018). Apart from providing jobs, quite a number of respondents stated that the Lago refinery provided more than jobs in the refinery; such as creating infrastructure, schooling and jobs in other sectors. Furthermore, it was mentioned that the refinery was not only beneficial to San Nicolas, but to the whole of the island (interview Enya, 2018). In some way or another, everybody profited from the economic boost. This has however changed in the last 40 years, because with the decline and closing of the refinery tourism and other services popped up, diversifying the mode of income (interview Amy, 2018). As Connie (2018) also mentions, when the refinery closed, many people lost their jobs, and that made the life in San Nicolas quite difficult. Mike Eman (2018) also mentions the first closing of the refinery; when the refinery closed for the first time in 1985, a plan was devised to deal with the large impact of the declining economy and job loss. The plan was to boost the tourism on the island,

this resulted in a strong decline of unemployment which prevailed after the first closure of the refinery.

Contributions of the oil refinery

As mentioned in the contextual background, the oil refinery attracted a lot of workers from abroad. Along with all these nationalities, new cultures entered the island. All respondents mentioned new habits that the immigrants brought along such as carnival, culinary dishes and the celebration of thanksgiving. Apart from the new cultures that intertwined with the local culture, the whole town of San Nicolas became a vibrant and lively hub. ''*the economy was great, all was well in San Nicolas. San Nicolas was alive''* (interview Lara, 2018).

What is interesting, all respondents were very positive when talking about the Lago, the first oil refinery. Five respondents mentioned that their fathers got a lifelong job in the refinery, or linked industry. Families profited from the stable income which enabled permanent settlement on Aruba. Many fond memories and stories were told and recalled. It is therefore also understandable that once the oil refinery closed, the world was collapsing around the inhabitants of San Nicolas. Most industries, in one way or another, had a link to the oil refinery. Due to the fact that so many other services and industries were dependent on the oil refinery, the closure had consequences in many different sector of Aruban society. Apart from the loss of jobs in the oil refinery, people seem to be very frustrated or sad that San Nicolas has become very quiet and is more or less a forgotten town on the island. Enya (2018) sums up the general sentiment by stating: ''*the oil refinery gave a lot of jobs to the people. It was very, very important… Because now San Nicolas is dead''.* This also came to Elmar's attention (2018); the closing of the refinery caused the consumption of energy to decrease drastically. A lot of businesses closed (such as the earlier mentioned bakery owned by Lara's father) and a lot of people moved abroad due to lack of work, less people and businesses in San Nicolas create a lower electricity demand in the town.

San Nicolas can be classified as a 'company town'. These towns are complexes in which large industries have created numerous facilities and amenities (sport facilities, hospital, schools, a club etc.) for their workers. Commercial and residential areas planned by an industrial

enterprise, with a small section reserved for the managers and supervisors (Seroe Colorado in San Nicolas) (Bowen, 2018). Beneficial as these company towns can be for the population in a certain area during a certain period there are also obvious problems related with it. Apart from the benefits, there were also disadvantages such as dependence on one industry, vulnerability for international developments which you cannot influence, dependence on local supplier (Venezuela) for which no political solution could be found and the automatization on the industry (leading to job loss).

Reflecting on the comments of the respondents, it is clear that San Nicolas is a prime example of such a company town. The oil industry gave shape to the economic fabric and social presence in areas such as education, healthcare and leisure. In short, it is not exaggerated to say that the oil refinery equated 'the life' of the inhabitants of San Nicolas for a long time.

Plans for the re-opening of the refinery

Since 1985 the refinery has opened and closed again several times. The previous government (the AVP) had plans for reopening the refinery once more. A requirement was that refinery had to be 'sustainable' and the possibility of running it on gas was being investigated. The sustainable angle of the refinery would be to capture part of the CO2 from the refinery and used to start growing algae (interview Mike Eman, 2018). The general trust of the respondents on the refinery opening once more is generally low, they do not see it happening. As Jenny (2018) puts it '*I think the refinery is history, because it is closed now*'. Although the general trust in the reopening of the refinery is low, interestingly, the majority of the respondents (13 out of 22) stated that they would still like the refinery to remain open. 7 out of 22 respondents wanted definite closure of the refinery. The remaining two respondents were neutral in their thoughts. Every respondent, no matter what their thoughts on the re-opening plans were, agreed to the fact that it was a shame that so many people were out of jobs without the oil refinery running. Diverse respondents mentioned the liveliness the refinery had brought to San Nicolas. People had many opportunities to obtain work, either in the refinery itself or in laundromats, restaurants and small service businesses. '*Everybody got a piece of the cake*' (interview Maria, 2018). Amy (2018) mentions that when the plans for reopening the refinery by the previous government (AVP), it brought a short surge back to the town. All of a sudden,

businesses and shop owners seemed more interested in settling themselves in the town. Unfortunately, this trend did not continue, for the refinery did eventually not reopen. As Mike Eman said (2018); work and economic development are experienced strongly by the population of San Nicolas linked to the refinery.

Jobs were mentioned as the main reason for those in favour of reopening the refinery. However, there were three respondents that stated they would only want the refinery to re-open if it was able to run in a more environmental-friendly and sustainable way (in this case: creating the algae farm as mentioned by Mr Eman). One respondent, Mandy, only wanted the refinery to open up again if the Arubans would get the jobs, and that the oil refinery would not bring their own employees from abroad. Most respondents did also mention the negative aspect of the refinery causing environmental damage, however, jobs and a flourishing town were generally deemed more important.

The reasons given against the re-opening of the refinery were more diverse. The different topics that came up were: 'we don't need it anymore', 'we've learned to live without it', 'it's bad for the environment', 'it's too old', 'it's a political stunt', 'we have new technologies' and 'it's ugly'. The arguments linked to the environment are very specific to the inhabitants of San Nicolas. Oranjestad (which is located a rough 20km from San Nicolas) is not bothered with the smelly and possibly dangerous toxic fumes from the refinery. As Enya (2018) says: '*to be honest, I don't really want it here in San Nicolas, because when it is in function, you get all the poisonous gasses. So, it us living and working here that get ill'*. Four other respondents mentioned arguments along this line.

Contrary to the researcher's expectation, age didn't really matter in whether respondents wanted the refinery to stay open or not. For example, the 85-year-old Candyce (2018) says that she would like the oil refinery to open again for the job opportunities it will provide, but she also states '*we have learned to live without it'*. Hereby letting on that there are ways of living without the refinery. Nathalie of 39 (2018) also reasons along these lines '*A lot of talks focus on if the oil refinery will open again, and if it opens, the boom that it will bring to San Nicolas community. But then I say: okay, why are we waiting on one source, while we are ourselves can think of different things in what we can do differently?*'.

Perceptions of national actors in the energy transition

The national actors have different things to say on the subject of the oil refinery re-opening which are in some cases quite different compared to the household findings. For Mr Eman the re-opening of the refinery would be an opportunity for an international marketable good; that is, if the experiment of a refinery running on gas and growing algae with the CO2 emissions would work. The export of Aruba's 'green products and technologies' was one of the spearheads by the previous government. According to Eman, the current government does not have this vision as a focus point (interview Mike Eman, 2018). However, the current government has not been in power for long, only since January 2018. Another interesting striking point Mr Eman's commentary is the role of the Netherlands. According to Eman the Dutch government is partly responsible for the reopening of the refinery, by putting a lot of pressure on Aruba's finances to repay its debts. The refinery is a major contributor to the gross domestic national product (GDP). The political pressure by the Dutch government to reopen the oil refinery resulted in a higher GDP. In Eman's view, the reopening of the refinery served the Dutch financial plan.

Both TNO and Elmar agree that the switch over to renewable energy is an ideal way to gain independence from the oil industry. As the TNO representative puts it '*if you look at Aruba, and generally most of the islands in the Caribbean, they are almost entirely dependent on fuel oil for the generating of electricity, and that fuel oil needs to be imported*' (interview TNO, 2018). There are large fluctuations on the oil market, making it difficult to plan the yearly budget to spend on oil imports. The import of oil also leads to a continuous outflow of foreign currency (dollars) to pay for the fuel. These dollars do need to be present in order for trade to take place, and need to flow into the country from different sources such as tourism. So, it is beneficial to limit the import of oil, in order to limit the numbers of dollars leaving the country, as reserve of foreign dollars is always useful in times of crises. Consequently, there is a strong economic incentive to limit the imports of fuel oil (interview TNO, 2018). Furthermore, it is beneficial for the environment to switch over to alternative energy sources (interview Elmar, 2018) & (interview TNO, 2018). Mr Eman (2018) highlights the potential for alternative energy resources by saying '*we have a constant North-Eastern wind which is strong. We also have 12*

hours of fairly consistent sun, so a lot of energy'. At the moment, these opportunities aren't used enough. And taking into account the high prices the island is paying for fuel oil to generate electricity, it would be a 'no-brainer' to say switch over to renewable energy (interview Mike Eman, 2018) *(Vision 2020 Green Deck, 2015)*.

Summary chapter 3

It is clear from the literature as well as form respondents' findings that the oil refinery served as a 'company town' and thus has had an immensely influence the island, and in particular San Nicolas. The unprecedented economic- and population growth caused by the refinery influenced the island. The first refinery, Lago, is praised by many of the respondents for their contributions to the town of San Nicolas. Practically all respondents had family or acquaintances associated with the refinery. A number of respondents ended up living on the island because their families moved to Aruba to work in the refinery. Most respondents were advocates for the re-opening of the oil refinery. Most of them bear the hope for a rejuvenation of San Nicolas and jobs for the local community. A couple of respondents however, stated that they had learned to live without it and that different ways of creating a vibrant and healthy economic community should be devised. The environment was mentioned as a negative consequence of the refinery (re-opening). Despite this acknowledgement, most respondents valued jobs and a busy town more than the negative environmental consequences of the refinery.

Having stated thus the importance of the oil refinery in San Nicolas, this raises the question how households can make the transition to renewable energy, which will be discussed in the next chapter.

4. AWARENESS, INVOLVEMENT AND USAGE OF RENEWABLE ENERGY

4.1 Extent of knowledge on the energy transition

The transition to renewable energy was part of a larger plan for a more sustainable Aruba by the government of the AVP (2009-2017). Eman, the then prime minster, and head of the AVP had the vision of 'sustainable and shared prosperity'. Eman explains this as follows: '*renewable energy is part of greater 'welfare, sustainability, fair incomes, green, clean, new economic sector, based on the knowledge that we gather in the creating of a green economy*'. A business case was developed for 'green transition'. The central concept was, that knowledge obtained from this could be used as an export product, as well as having beneficial side effects for the development of Aruba such as attractive jobs for young graduates. It is in this plan for 'sustainable Aruba' that the goal of a 100% renewable energy in 2020 has been set. A mix of wind, solar and the processing of waste to create biogas (interview Mike Eman, 2018). In order to inform and include the people in this 'green transition' extensive media coverage was given as well utilities offering informative sessions in households for tips and advice on water and electricity usage. With the start of term for the new MEP government in January this year, the target seems to have changed. The explicit focus on renewable energy and 'green identity' have not (yet) been addressed.

Due to the fact that the transition to renewable energy is part of the larger sustainable transition in Aruba, the respondents were asked if they had heard about these plans. All respondents, with the exception of Delilah (74) had heard of the sustainability plans (Delilah was abroad for a couple of years, and only came back to Aruba two years ago). What is curious to note is that even though practically all respondents heard of the sustainable transition, eight hadn't heard of the transition to renewable energy, suggesting that perhaps the communication on this particular part of the transition could use more attention. As Mr Eman mentioned in his interview *'in society, you need support for a sustainable society [...] and also for people to understand this, that have studied and to look at all facets of society, that is how you create a sustainable society'*. In line with Mr Eman's quote are the authors: (Verbong, Beemsterboer & Sengers, 2013), (Scoones & Leach, 2015) and (Ince, Vredenburg & Liu, 2016).

They state the need to involve all levels of society in the transition in order to create willingness and support for a new system. This translates into the inclusion of users of new technologies in order to make it a success by providing them with information, listening to their concerns/ideas and by taken them seriously. To this extent where the whole general vision of sustainable Aruba has sunken in, the transition to renewable energy is still somewhat lacking. For example; Enya (2018) mentions that she has heard of, or seen, anything related to renewable energy. She states that if you aren't really in a social circle which is concerned with solar panels, and talking and giving information about it, you won't be as knowledgeable on these matters.

The knowledge of households on the transition to renewable energy was mainly obtained from friends that had solar panels, social media, newspaper, radio and TV. Each respondent mentioned a different combination of sources of information, the older people generally mentioned newspaper and radio more than the younger generation. Most respondents added on to this that a few years ago the hype on renewable energy and solar panels was much bigger than now. As Lina says: *it is not really something people talk about all the time or something, I don't think so. I think they do not have enough knowledge*' (interview Lina, 2018). There were seven respondents that referred to other countries (the Netherlands, United States, Costa Rica and England) for their information on renewable energy and sustainable living by having lived there or holiday visits. Respondents mention the separation of garbage, recycling of products, solar panels in the neighbourhood and a general more conscious attitude amongst the inhabitants of these foreign countries compared to Aruba. They reflect on this observation by posing the question; 'why can't we have this on Aruba'? Respondents express a general willingness to make a change for a more sustainable way of living. It is however difficult to do that, they explain, due to the fact that there are no drop-off points for separated waste, no recycling programmes and no subsidies to push people in the right direction. They conclude by stating that it is difficult to change your lifestyle to a more sustainable one. Last but not least, three of the respondents mentioned their partners for their source of information and knowledge on renewable energy. For example: '*my wife was interested in it and talked to our neighbour, who already had solar panels. So, she was busy with it*' (interview James, 2018). Enya on the other hand mentions that she is quite interested in the renewable energy

transition, but her husband is rather sceptical about it, and is not interested in solar panels, or the like.

The awareness of households of the energy transition can essentially be categorised into four different levels:

1- Having heard of the transition
2- Having considered it for own household
3- Active engagement by purchasing technology

The first level of awareness refers to whether information on the energy transition has reached households at all (8 households had not heard of the energy transition in particular, as mentioned earlier in this chapter). The second level is about active cognitive engagement with renewable energy as part of households (for example Ralf who has been critically thinking about whether to use solar panels in his home or not). The third level is about actual implementation of renewable energy technologies; these are the two ladies who have invested in solar panels for their homes.

What should be mentioned, is that even though people had heard of the transition, it didn't necessarily mean they believed it or trusted the source of information. A very clear and outspoken example given by Juan (44): '*you often hear about the propaganda on green energy, and green this and green that. But I am bit sceptical because I think there is a double morale to it all'*. When the researcher asked him what this 'double morale' was, he replied: *'take electric cars for example; that is all very well, but it doesn't make that big of a difference because we are a small island, and on top of that, to produce those cars and batteries they might use other polluting substances' (interview Juan, 2018).* These strong sceptical attitudes towards the renewable energy transition, as well as the plan for 'sustainable Aruba' were shared by two other respondents.

Source of information on renewable energy

Not one of the households is participating actively in renewable energy initiatives/organisations in the neighbourhood, or the island. The two households that have solar panels however, do mention that people regularly ask them questions about solar panels, or want to see their electricity bill to see that they are indeed paying less money to Elmar.

There are also three respondents: Amy (60), Valerie (64) and Susan (86) that mention Expo Cas, a yearly expo of a few days on all sort of home improvements for saving electricity, water, money in building etc. The respondents mention that this is where they have obtained information on solar panels and home improvements in saving energy. When respondents were faced with the question where they got most of their information for solar panels from, they replied with 'colleagues and friends'. Take Ralf for example: '*I talked with a colleague a few weeks ago. He told me about his experience with his solar panels. He bought them and said it is worth the trouble of getting them. So, since then I have been thinking that I need to start informing myself more on solar panels*' (interview Ralf, 2018). It seems that in particular for solar panels, the way information reaches households, is via personal contact.

4.2 The extent of the socio-technical transition in reaching households

Renewable energy in households

As mentioned in the previous chapter, all respondents (with the exception of one) know about the 'sustainable transition' Aruba was aiming to set into motion. There were several households which had not heard of the transition to renewable energy however. There were two respondents; Lara (32) and Cora (33) that had solar panels in their households. Apart from these two rather obvious examples of people whom had actively engaged with renewable energy, there were other smaller initiatives that could be found. These initiatives are listed in table 3 and worked out in the paragraph below.

Table 3: energy saving practices and renewable energy initiatives by households

Energy saving practices	Renewable energy initiatives
Inverter appliances (washing machine, air-conditioning, freezer, fridge)	Solar panels
LED lights	Solar lights
Painting roof white (to reflect sunlight)	
Switching of lights	
Unplugging appliances	

There were a lot of respondents that switched over to inverter appliances (what an inverter motor in an appliance does is to control the speed of the motor in the appliance to continuously regulate the temperature, which can be up to 50% more energy efficient). If you take a standard household, most of these will have two till four air conditionings. If these energy consuming appliances are replaced with inverter variants it can save quite a lot of electricity. As the TNO representative said; it is that air conditioning in the housing that consumes most of the electricity (interview TNO, 2018). Not only are there air conditionings in inverter options, you also find fridges, washing machines and freezers. Thus, if you go about upgrading your appliances to inverter appliances the electricity bill is likely to drop quite a bit. This is arguably not renewable energy per se, but is a consciousness in energy usage, and saving as much electricity as possible. All household had at least one type of inverter appliance, despite the acquisition cost being substantially higher than a 'normal appliance'. Other initiatives that were found concerned the construction of the houses. For example, there was one respondent, Maria, who had painted the roof of her house white in order to reflect sunlight, which cools down the house substantially (interview Maria, 2018). There were two households which had plans for large renovations or moving to a completely new house altogether. Lina (35) wants to move out of the flat above her mother in law (where she is staying with her husband and toddler), and build their own house in an energy efficient way. She has moved back to Aruba from the Netherlands a few years ago and says *'I now have a permanent contract (for work), and we are going to find a house suitable for solar panels. My husband also wants grass on the roof, he has a lot of ideas, he wants the house to be as green as possible because he's studied the environment for his education*' (interview Lina, 2018). She further states that at the moment they are not doing much related to energy efficiency in their flat, due to the fact that they will soon be moving out. The other household, is Amy's (60 years old) household (living with her partner). She mentions that since she married her husband about 35 years ago, they have never renovated the house any way. They are planning to renovate, insulate and upgrade the house in the coming year. For this big renovation, they are looking into the installation solar panels, upgrading to (more) energy-saving appliances and better insulation for the walls and roof (interview Amy, 2018). Last but not least, the adoption of LED lights is widely spread. Eighteen out of the twenty-two respondents stated that they have LED lights in their home, to save energy. There were three households that used solar

lamps (lamps using solar power to charge themselves, and not connected to the electricity grid).

Neighbourhood and renewable energy

Not one single respondent knew of any neighbourhood initiatives concerning renewable energy. There were some people that could name neighbours with solar panels in the area, or a company that installs solar panels, however any private or government initiatives concerning renewable energy in the area were not known by respondents. Martinus, who has a solar panel installation company could also not name any organisations (interview Incoe Martinus, 2018). Furthermore, Elmar, Mr Eman, TNO and the FCCA could not come up with any current initiatives or organisations either. 4 out of the 22 households mentioned that a few years ago Elmar and WEB had programs for giving more information about energy and water usage. People were able to call either of the companies and they would give advice personally by coming to your home and explaining energy or water-saving technologies. One did however have to call them personally, it was not like they visited all households on the island.

Interesting to note is that when Mr Eman's party was in power he said: '*when we were busy with it intensively, the interest amongst the households was very big as was their enthusiasm*'. However, he also mentioned that when people started calculating what the costs and benefits would be for their household and what it would mean financially, it turned out to be too large a threshold, which most households could not cross, despite the import tariff reduction on 'green technology' such as solar panels, wind mills, energy saving lightbulbs etc. When the researcher asked Mr Eman if there was any specific focus on households in switching over to alternative energy sources he replied that the main focus was on large wind- and solar parks. But he mentioned the import tariff reduction for households, which did not seem to be enough to get people to switch over. The tariffs were adjusted to 2% import tariff. Before this reduction, goods that were imported had a tariff of up to 40% (2020 Vision Green Deck, 2015). Later on, in the interview he concedes that subsidies would be more of an incentive to get people to 'cross the line' to switch over to renewable energy (interview Mike Eman, 2018).

After all this information, the opinion of Mr Eman of the previous government is positive as he was the then prime minister. [1]

Summary chapter 4

The transition to renewable energy is part of a bigger island-wide plan of turning Aruba into a green and sustainable hub. All (except one) households had heard of this plan, the component of switching over to renewable energy however, was not as widely known. Information concerning the transition was obtained from social media, friends, newspapers and TV. The use of renewable energy is linked to more sustainable living by the respondents. There is a general consensus amongst households that the island is lagging behind in environmental consciousness and techniques compared to other countries (such as waste removal, recycling etc.), and this can make transitioning to a more sustainable lifestyle difficult. The information on the sustainable (energy) transition on the island was not deemed trustworthy by all respondents, uncovering a dubious attitude towards ('green') politics by some respondents. Two of the households had solar panels, the rest of the households all had smaller, but contributing technologies and habits in saving electricity.

Having noted the level of households' awareness and involvement in the energy transition, the next chapter deals with barriers and opportunities for the households.

[1] Time doesn't allow to verify all of Mr Eman's statements

5. BARRIERS AND OPPORTUNITIES OF RENEWABLE ENERGY IN THE ENERGY TRANSITION

5.1 Households' opportunities in joining the energy transition

It will probably come as no surprise that the main reason for people wanting to switch over to renewable energy, is money. All the households, with no exception, talked about the 'benefits for their wallets', of having renewable energy. TNO and Mr Peterson (National Bank Aruba) also both mention money as the main reason people switch over. To give some examples: Nathalie (39) '*mainly cost saving, I think that may be the main concern for people here'* and Maria (63) *'it is a lot cheaper, and I can save money*'. It is the main reason people mention, however, if one delves further into their reasons for switching over there are more reason that come up. Another big reason ¾ of the respondents give, is environmental conservation. To give some examples: Valerie (64) '*it is important for the environment, that people start tackling that problem seriously now*' and Ria (41) '*I think it is important… in relation to nature and the environment*'. One respondent added an interesting afterthought: '*in the past we didn't make so much money, but that is different now. There is a bit of money left over. But I don't think that should be our motivation (money), but to save the earth and slow down global warming*'. Fair enough, this won't be the case for all the households. There were three households in which the respondents got help with paying their electricity bills by their children. This illustrates that there is a need amongst residents for affordable household energy in the San Nicolas, seen the fact respondents sometimes have problems with paying the electricity bill.

It is difficult to give figures on hidden poverty, with the culture of people 'living on a credit card'. However, extensive research has been done on poverty in Aruba. In 2010, in a research done by the Central Bureau of Statistics Aruba, an extensive multi-dimensional poverty index was created. The report has created a multi-dimensional poverty meter by region. The largest poor regions are more in the South of Aruba, in San Nicolas, (Central Bureau of Statistics Aruba, 2018). Both the incidence and intensity of poverty are the highest in San Nicolas, especially in the South of San Nicolas. This illustrates that apart from hidden poverty, on the South of the island poverty is generally more prevalent than in the North (see figure below). It can be assumed that the prevalence of poverty causes for the low acquisition rate of solar panels.

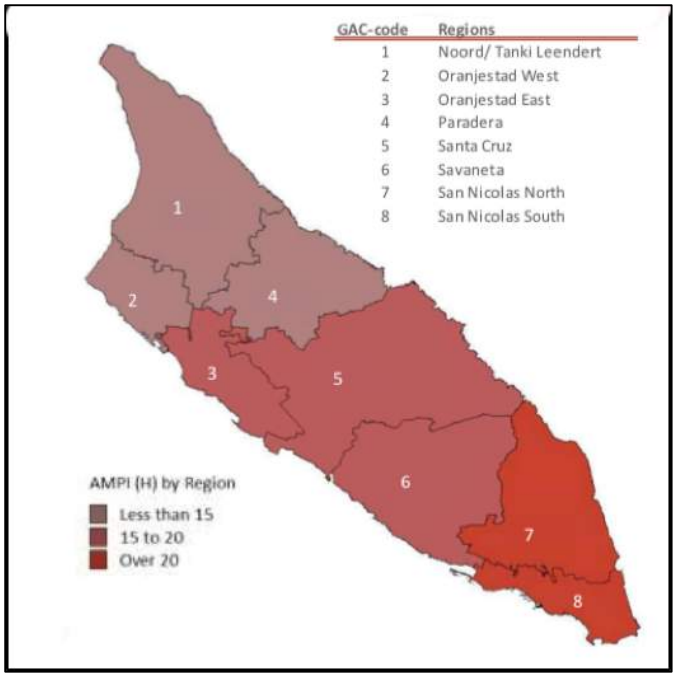

Figure 6: Proportion of households in poverty (prevalence %) by region (Central Bureau of Statistics Aruba, p. 9, 2018)

Of the two households that had solar panels, one of the respondents with solar panels (Lara) made a very striking remark: she said she wasn't sure if the oil reserves would actually finish/are finite. Her main reasons for switching over to solar panels are: saving money and having her own supply of electricity in preparation of economic uncertainty (for example: if Aruba is not able to import any more fuel oil from the market due to conflicts often linked to oil). The environment was mentioned as a relevant factor, but in relation to the pollution of the oil refinery, and not to their contribution to the environment with the acquisition of solar panels. Cora (33) also mentions 'saving money' when asked what her motivation for switching over to solar panels. When she is asked what she thinks is good about renewable energy, she mentions that is better for the environment, but also in this case, the use of solar panels in the household is not directly linked to environmental friendly behaviour.

An intriguing comment made by Mr Martinus on his clients interested in solar panels is worth mentioning. He says that the clients who actually end up buying solar panels from him, are the clients that mention the economic benefits of switching over, as well as the positive environmental aspects of solar panels. His clients that only mention 'money' as a reason to switch over to solar panels, decide not buy the solar panel once they have seen the costs

involved in installing and buying the solar panels. They see it as not having to pay money for their electricity consumption, but they forget they have to pay for the investment. He thinks it has to do with *'education… and how you inform yourself, knowledge. It is more about knowledge, those people have a different drive to buy solar panels'* (interview Incoe Martinus, 2018).

Both of the respondents with solar panels managed to afford the solar panels by taking out a loan which was incorporated in the mortgage of their house. In this way, they had the starting capital to afford the solar panels. As Mr Martinus (2018) mentioned, the average cost of one solar panel is 500 euros. Mr Eman adds on to this that people end up spending 15,000 - 20,000 euros on solar panels (interview Mike Eman, 2018). This is a substantial amount to have in your savings. In financing of the solar panels, one can obtain a loan at a bank, or if one doesn't have enough money for a down payment, the 'social commercial construction foundation'. In Aruba, it goes by the name of FCCA (Fundacion Cas Pa Comunidad Arubano). The FCCA enables people with no money for down payments to take out loans, it is more flexible than a standard bank, but has higher interest rates. What usually happens is; people take out a loan at the FCCA, then after about two years they go to a commercial bank, which buys out their loan from FCCA, and they now pay the bank the interest. It is not micro credit system as we know it from multiple aid organisations, but is a way to give people without savings access to investments. The price for this access, however, is higher than other commercial banks. The FCCA charges interest rates between 7,5 and 9,5%, a standard commercial bank charges between 5,5 and 7,0% on its interest rates (interview FCCA, 2018). Lara says: '*people ask me if it is good to have solar panels, but they are a bit scared to go to the bank to get a loan. Because they do not see it as an investment, they see it as a cost. But I see it more as an investment. They have a lifespan of twenty years, with a revenue of 80% […] But Arubans see it more as a cost'* (interview Lara, 2018). Obtaining a loan is however, not always possible. Elderly people (70+) in the interviews told me they would not be able to borrow that much money in order to afford solar panels (not allowed by money lending institutions), and/or they would not be able to see their return of investment which made it unattractive for them.

5.2 Households' role in the energy transition

As mentioned before in chapter four, households are not engaged in any organisations or initiatives in promoting renewable energy, even though there were several respondents that seemed to be fairly enthusiastic. 8 out of 22 respondents said that if they were to choose a role in the transition, they would gladly do it. Most however were not keen, or as Connie put it '*I have other priorities*' (interview Connie, 2018). This comes up in different household and in-depth interviews with national actors. Despite the fact that San Nicolas is not categorised as 'extremely poor', there is a lot of hidden poverty. People tend to live on their credit cards, which means constant debts and the illusion of wealth (Peterson, 2018), (interview Incoe Martinus, 2018), (interview Nathalie, 2018), (interview Delilah, 2018), (Household Amy, 2018). Apart from 'living on the credit card', another cultural phenomenon was discovered in a research done by TNO (on the willingness of people to join the energy transition) was in Arubans' lifestyles. The TNO research labelled it as rather hedonistic (TNO, 2015). Amy articulates this sentiment rather well with her following remark: '*people here would rather take a loan to celebrate carnival than to take care of their house*' (interview Amy, 2018). The oil refinery 'complex' might have contributed to what TNO mentioned as 'hedonistic culture'. One should however not forget that the oil refinery impacted especially the South of the island, which is the poorer part. The oil refinery provided a livelihood for many people, which is quite a different scale compared to a 'hedonistic lifestyle' as mentioned by TNO.

Of the seven households that demonstrated interest in playing a role in the transition. The two ladies who own solar panels already play a small role in giving acquaintances information about their experience with solar panels (interview Lara, 2018) (interview Cora, 2018). Furthermore, Nathalie mentioned that she already has regular talks and discussions with her colleagues on electric cars and solar panels, in this way spreading information and gathering knowledge (interview Nathalie, 2018). Mandy mentioned that she also giving out information on the transition, due to her job as lecturer in nature and technology at a teacher's college (interview Mandy, 2018). The other four respondents that are currently not yet actively involved mentioned that they would like to: motivate others (if they have enough information on the transition, and change their own ways first) and would like to attend information evenings on the subject.

5.3 Barriers in joining the energy transition

Household findings on barriers in joining the energy transition

Each respondent mentioned different barriers for their household to be able to join in on the energy transition. 19 out of the 22 households mention money as a barrier. Once again it is the financial aspect which is most prudent as a barrier in joining the transition. But if one ask on, there are many more reasons which come to the fore. Important to note is that the barriers that the households mention, have different 'time spans'. For example; Lina said she is going to move to a different apartment in about two years' time, therefore they are currently not investing a large amount of money in the apartment they stay at the moment. Amy on the other hand, is planning on a big renovation at the end of this year, which means she will be thinking about using (renewable) energy/technologies sooner than Lina. The want for more competition on the Aruban market however, could take many years, if it is ever to happen at all. The table listed below provides the prevalence of barriers mentioned by respondents.

Table 4: Barriers to joining the energy transition as mentioned by households

Barrier	Prevalence in households	
Lack of financial means for solar panels	17/22	77%
Lack of knowledge and information	8/22	36%
Lack of interest in the transition	3/22	14%
Electricity bill is not very high, no need to switch to another electricity source	2/22	9%
Large renovation planned for the house	1/22	4,5%
Moving to a different apartment	1/22	4,5%
Life is too busy as it is (children and work)	1/22	4,5%
The want of more competition in electricity prices on the market	1/22	4,5%

During the interview, the respondents were asked how the approach to renewable energy could be improved for households. The recommendations are listed in table 5.

Table 5: recommendations by households for a better household approach in the energy transition

Household recommendations
- More need for information, people do not really know how solar panels work
- Information and Q&A meetings in community centres (barrios). These are more personal, and people have direct contact with experts explaining the technology. Workshops could also be given to the population in these barrios.
- The whole transition must not be politicised. But the government must be the backer of the transition, if they do it well, respondents believe their trust in the government will rise.
- More working together between different actors in the transition: WEB, Elmar, government and solar installation companies
- Education in schools on the subject of renewable energy
- More consumer friendly in the economic sense

Perceptions of national stakeholders on the barriers in the energy transition

Where the households are mainly concerned with information services and financial stress, national stakeholders shed light on other sides of transition to renewable energy. The TNO representative goes further into the multifaceted side of the transition. In 2012 Utilities Aruba commissioned a research on the energy transition in Aruba. The research institution TNO took up the study, and consequently introduced the term 'trilemma' in the context of the transition to renewable energy (see figure depicted below). Three interrelated terms come to the fore in this so called 'trilemma': sustainability, affordability and reliability. In the transition, there is a question of demand and supply. In an energy transition, the focus is on 'sustainability', but this should not be at the expense of affordability. Because, it can become more expensive because you need to earn the investment back in one way or another. As it takes a considerable investment to build solar and wind parks, and to pay for their maintenance. A few critical notes can be placed next to this trilemma. The question is: who's trilemma is this? It does not seem to be TNO's trilemma, nor does it seem to be a household trilemma (households are mainly concerned with affordability). If it is someone's trilemma, it is the trilemma of the policy makers responsible for the strategy and policies for a sustainable island. They are the ones that need

to convince households of joining the transition and convincing them it is part of the overarching sustainability goals. Reliability is the focus of the technicians, affordability is the main concern for the households and the policy makers need to make sure that the whole transition fits within the sustainability goals.

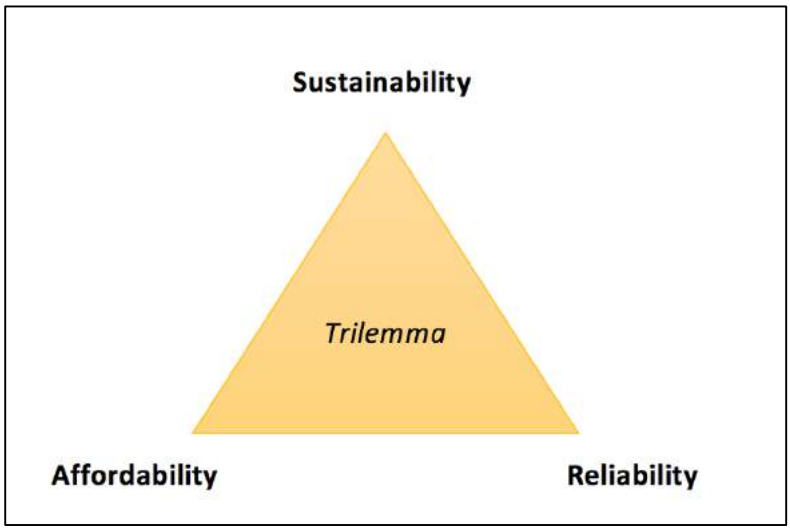

Figure 7: Trilemma

Furthermore, sustainable energy causes instability on the electricity grid (due to a windless or overcast day, resulting in loss of energy and the need for a generator to produce the electricity which is lost) (Verbong, Beemsterboer & Sengers, 2013) (interview TNO, 2018). If machinery has to 'shift gears' between producing a lot electricity and a little, it is less efficient and energy is lost, as well as wearing out the machines faster. However, despite these challenges, in the end renewable energy will be advantageous. Additionally, the electricity grid would not be able to handle everybody/a large portion of the population switching over to renewable energy because the grid will become too instable (interview TNO, 2018) (interview Elmar, 2018). Adverse effects could be experienced by the poorer population by them having to pay for the grid maintenance cost which solar panel owners would not be contributing to as much as before. This could mean that the electricity costs would rise for the least fortunate in society, hitting the those who need cheap electricity most.

The previous government (AVP) focussed on international promotion for sustainability, but it was mainly about supply side of the energy system. The focus was on what is being generated by wind and solar parks, with the macro-economic advantages that were linked to this. There wasn't a large focus on awareness campaigns for the population (interview TNO, 2018) (interview Mike Eman, 2018). This also come to the fore in the Green Deck document, large solar and wind parks are highlighted, as well as the focus on international green conferences on Aruba (2020 Vision Green Deck, 2015). Mr Martinus adds on to this that there were indeed many 'green conferences' and advertising campaigns. According to Martinus, the AVP perhaps spent too much money on advertising and promotion, and not enough in subsidies or the like (interview Incoe Martinus, 2018). This would arguably also be a logical thing to say for a solar panel installation company; the more subsidies there are available, the more customers he will get. According to TNO (2018), the current government (MEP) is mostly concerned with the affordability of renewable energy. Mr Eman (2018) mentioned the challenge of getting utilities to join in on the energy transition. Utility companies can see the transition as a threat to their existence. Without them, however, it is impossible to make the transition to another system, and you cannot force them to change, they have too much power (Verbong & Geels, 2010). You need their support, and this should be done by having dialogues and creating common ground (interview Mike Eman, 2018).

All national stakeholders agree on the fact that the main obstacle remains economic for households. The hedonistic lifestyle which is prevalent on the island doesn't help to speed up the transition either (TNO, 2013). Due to the fact that people are accustomed to a high level of comfort, this can be seen in the electricity consumption of Arubans compared to Curacao. The use of electricity in households on Aruba is nearly double, despite it being smaller and less populated (interview Elmar, 2018). As Mr Martinus says: '*our culture is living on our credit card. So, we live above our budget […] And if we get something, like a thirteenth month or another buffer, we finish it straight away. We go on holiday, throw a party or we get married or something'* (interview Incoe Martinus, 2018). This becomes a problem if one were interested in taking out a loan for solar panels. There are so many people that can only just pay of their current mortgage and loans, taking up another loan for solar panels would not be feasible for a number of households (interview FCCA, 2018).

Summary chapter 5

The main reason given for not joining in the energy transition is financial. However, when asked many more reasons emerged: lack of information and lack of trust. These reasons together which make the transition to an alternative energy source quite challenging. There are no known organisations known to households that promote renewable energy for households in San Nicolas or the surroundings. Respondents gave recommendations on how the approach to renewable energy could be improved in targeting households in San Nicolas (these recommendations are further elaborated in the discussion).

National stakeholders highlighted different aspects of households in the energy transition. Important findings were: the inability of the electricity grid to handle a quick transition to renewable energy, possible adverse effects for the poor, instability on the grid, not so much focus on households, but rather on large wind- and solar parks. All national actors agreed that the economic barrier was still largest for households, however, another important component is the 'hedonistic streak' in Aruban culture, which also does not ameliorate a transition to renewable energy.

With the barriers, opportunities and roles of respondents in the transition discussed in this chapter, the next chapter will focus on why there are differences between households and how these differences can be explained.

6. HOUSEHOLD DIFFERENCES IN THE RENEWEABLE ENERGY TRANSITION

Although there is no possibility of giving a statistical analysis (based on the twenty-two interviews conducted for this research) as to why certain households switch over to solar panels and others do not, there are several factors that stand out. The two respondents which acquired solar panels for their home were both young women in their early thirties (Cora and Lara). Both women have managed to overcome any possible barriers mentioned in the previous chapter (5.3). The financial hurdle has been tackled by taking out a loan incorporated with the house mortgage by both women. Furthermore, they have found a way to obtain information about the use and installation of solar panels form a source whom they trust and feel comfortable with. When Lara was asked the question how she came in contact with solar panels, she answered: '*Actually through my husband. He works for someone who has them installed…. So, it came from his side and this man gave us information. I trust this man*'. This is crucial if you look at the other respondents. There were quite a number of respondents that mentioned the lack of trust in these solar panels plans. As well as knowledge gap. These two factors are crucial in the acquisition of solar panels, as the barrier of politics is also avoided here because politics does not enter the game here. Lara and Cora both obtained their information from their husband's acquaintances. These acquaintances both had solar panels and informed the respondents of how things worked and how happy they were with their investment (interview Cora, 2018) (interview Lara, 2018).

By looking at the two early adaptors of solar panels, inequalities between groups in the population came forward. The inequalities arise in the financial, knowledge and trust domain. The financial inequalities come to light when respondents are willing to buy solar panels, but there is not enough money available for a direct buy, and in some cases not even enough money to take out a loan for the financing of solar panels. Knowledge and information play a significant part in the adoption rate of renewable energy technologies in households. The lack of information on how solar panels work, what you need to install them, how much money they will save, what maintenance they need etc. is a large barrier to actual implementation because it is not clear what respondents will get out of their investment. The uncertainty of monetary benefits as well as the ignorance of the new technology makes households hesitant

to take more decisive measures in whether to join the transition or not. The lack of trust households have in politics and its green plans for the island are due to window dressing and lack of support for poorer households by political parties. These 'trust issues' of households make it difficult for politicians to persuade them to a more sustainable future. Where households have lost their trust in politics, they place it in acquaintances and friends whom have knowledge and experience with solar panels.

Communication plays a vital role in equipping households with information and knowledge on financial affairs, technology function and use, and the building up of trust. An overarching organisation for the advancement and promotion of solar panels would be highly useful for the communication and information dispersion to households. It would be ideal if such an organisation could also provide households with an opportunity to physically get close to the solar technology in order to provide them with hands-on experience and information of solar panels. This 'closeness' to technology plays a big role in the two households which already have solar panels. The opportunity to observe and ask questions about the technique from a trusted source are important in the transition to alternative energy sources.

A point highlighted by one of the researchers of the TNO study on the willingness of individuals to join the energy transition, is that there needs to be a certain degree of pain in conducing change in attitudes and application of new technologies (Peterson, 2018). If there are no 'painful' aspects to sticking with the way things have always been done on the island, the way to change is difficult. Mazzucato (2015) states that the weak point of market forces to punish waste and/or pollution is a factor which contributes to the slow adaptation of new technologies. Organisations and politics should not merely focus on the appraisal and promotion of new technologies, but also on 'punishing' certain behaviours in order to change society. The research has not yielded any private or government measures in which the society is 'punished' for current behaviour and adaptation concerned with (renewable) energy.

The history of San Nicolas as a company town means that for a large part the city was planned and functioned with a top down structure. This probably created an environment which was not very conducive to exploiting private initiatives. As a result, the inhabitants of San Nicolas might have slowly but surely accepted the gradual increase of pollution in the area. This could

have contributed to the acceptance of this negative side of the oil refinery next to the many positive sides such as: a stable well-earning job, education, healthcare and leisure activities. This is not a good starting position for a transition to renewable energy. Even though no quantitative analysis is possible, it was striking that the households that did acquire solar panels were both young families. An explanation for this could be that the company town complex was less interwoven with their history and daily lives than with that of the older respondents. A slight nuance to this explanation is the position of an older respondent (Delilah of 74). Despite her age, she was very interest in participating in solar panels. In her case her age prevented getting a big enough loan and she dissuaded by the solar company to have an installation installed due to her low electricity bill.

Summary chapter 6

Households which have succeeded in the implementation of solar panels have overcome the barriers of finance, knowledge and trust. The nearness to, and open trustworthy communication about the new technology are important components of creating a safe and conducive atmosphere for the realisation of an actual transition. Communication on the transition is lacking in depth, detail and reach.

The focus on appraisal of technologies, and lack of punishment by market forces, creates less push factors to actively join the transition. The fact that San Nicolas is a company town, reduces the scope and the speed of the transition. This is not intentional, but has grown into the population's mentality and way of life.

With the interpretation of the differences in households all the sub-questions of this research have been dealt with. The outcome is discussed in the next chapter.

7. DISCUSSION

This chapter discusses the research findings in relation to the three main theories: socio-technical transition theory, SNM and political ecology. It is followed by policy recommendations and the contributions this research has made.

SOCIO-TECHNICAL TRANSITION THEORY

Aruba's transition to renewable energy is part of a larger plan of making Aruba a sustainable and 'green' island. The socio-technical transition theory is useful to study Aruba's transition for a more sustainable future. The transition to renewable energy involves a disruption of the system: in this case, the heavy reliance on the oil industry for the generation of electricity. Aruba's government started to focus on renewable energy around 2010. The means for this transition were solar panels and wind mills, which prove to be a great challenge in a society dominated by oil. Oil is essential for the production of electricity and oil is essential in the presence of the refinery for employment, healthcare, education, leisure etc. However, Aruba has made several steps towards the implementation of renewable energy technologies and system changes. These changes can be regarded as substantial changes, as in processes like these it often takes decades to achieve changes like this (Lawhon & Murphy, 2011). The fact that Aruba is a SIDS, is an implicit handicap in the transition toward independent sustainable energy production (Coenen & Truffer, 2012).

Within Aruba the main economic focus has shifted from San Nicolas (oil refinery) to Oranjestad (tourism). Technology also has to overcome the problems of lock-in and instability of the current system once solar and wind power really take off. The path dependency due to many sunk investments, makes it difficult for niche technologies such as solar panels to enter into the market successfully (Verbong & Geels, 2010). In the case of Elmar and WEB; there seems to be two sides to the transition to renewable energy. WEB would generate a lower revenue if many households and businesses switch over to solar panels, due to the fact that electricity they would otherwise sell to their clients, they now produce themselves. A measure that has been taken up by WEB to limit the loss of income is: the rule of not being able to produce more electricity than the connection clients have been equipped with. This means it is impossible to

generate extra income with your solar panels. Both TNO and Elmar highlight the problem of too many renewable energy producers causing surges on the grid, which it cannot handle. This incapability of the grid to handle large surges on the electricity lines, needs further technological solutions.

Kemp, Schot and Hoogma highlight more factors which play a role in changing regimes: the uncertainty of socio-economic gains and the need for change on many different levels (technology, social, infrastructure and organisation). As mentioned earlier, infrastructure is not yet fully developed for the transition; the electricity grid is not ready as of yet for a complete transition to renewable energy. The technology however, seems to be ready. During the author's field work and research on solar panels and windmills, no problem was mentioned or found with the functioning of these technologies. Naturally, as time passes, the technologies will become more economical and efficient. The social aspect in the transition needs more attention as was mentioned by respondents. Households lack information, know-how and trust in local authorities. Respondents mentioned that the different organisations (WEB, Elmar, solar panel installation companies) and politics need to work together to create a trustworthy and well-functioning system for the adoption and functioning of solar panels in Aruban society.

The use of renewable energy is slowly moving from the micro-level (technological niche), into the meso-level (socio-technical regime). A major acceptance at the meso- or macro level involves a disruption of the current energy system based on oil. This disruption involves cognitive routines, regulative roles and normative rules (Verbong & Geels, 2010). Fieldwork showed that households are firmly set in their cognitive routines when it comes to energy knowledge. The cognitive capacity of many respondents could be developed further. There is not only lack of information, but also a lack of a good affinity between people and technology. A less deterring character of the involved technology could probably be achieved by making the technology more tangible for the people. A recommendation given by one of the respondents mentions a test location or showroom house where people can genuinely touch and ask all their questions about solar power would be an ideal way for participants to really start understanding the technology and build a relationship with it. Another suggestion that comes to the fore by respondents is to start using the community centres (barrios) to create direct contact between experts of the technologies and the people. These experts can give

information and be present at Q&A sessions. The barrios could also be the place for workshops that provide people with hands-on experience with renewable energy technologies. As Shirley and Kammen (2013) also state: the importance of real life, hands-on experiences and demonstration projects can be useful in developing the niche.

Further recommendations mentioned by respondents in chapter 5.3 relate to education in 'sustainable living', de-politicisation of the energy transition and a more consumer-friendly attitude in the economic sense.

STRATEGIC NICHE MANAGEMENT (SNM)

The definite introduction of solar panels on the Aruban market shows that the R&D phase of solar panels in Aruba has been passed (Schot & Geels, 2008). However, the market is not yet an affordable market for the majority of the respondents. Most of the respondents could not afford solar panels for their homes. The 'rich' and more knowledgeable are better off in this transition to alternative energy sources.

With the arrival of new niche technologies such as solar panel in the socio-technical regime, social acceptation is very important. Verbong, Beemsterboer and Sengers (2013) give three types of social acceptation: 1) community acceptation, 2) market acceptation and 3) socio-political acceptation. On Aruba, there is a lack of acceptation on all three levels in varying degrees of severity. Besides social acceptation, Mazzucato (2015) states that technologies (in this case solar panels and windmills) will not naturally develop through market forces due to the earlier mentioned embedded and locked-in energy infrastructure. Another shortcoming of market forces is that pollution and waste is not punished which reduces the urge to move to sustainable technologies. This is also expressed by Mr Peterson (2018): pain is needed to make a change. People should not just be 'a little uncomfortable' but very much so. However, the so-called hedonistic aspects of Aruban culture do not encourage people to deal with the uncomfortable reality. It is however essential to realise that both encouragement and discouragement play a role in changing social behaviour. This confirmed by Schot and Geels (2008) who state that social and technological change are reciprocal. Furthermore, Schot and Geels (2008) point at the importance of second order learning and the actual involvement of

prospective consumers. This can be achieved by facilitating the nearness of technology and the use of proper ways of communication and information channels.

POLITICAL ECOLOGY

Central to political ecology theory are the unequal power relations in the politicized environment and the vulnerability and marginalisation of the poor (Bryant, 1998). On Aruba, the perception of many respondents is of being overpowered by the government and technology. Not all respondents perceive this overpowering in the same manner. The findings show that better informed and more affluent people will switch over to sustainable energy sources sooner than those who are not.

It is worth mentioning that there is a need for more understanding of political processes in sustainability transitions. Politics are always intertwined with (sustainable) socio-technical transitions. It can play many different roles within transitions at different levels: it can figure as an obstacle, arena, context, manager of repercussions, arbiter or enabler (Meadowcroft, 2011). The fact that the complex context of the renewable energy transition is also politicised makes a quick and easy transition for most households unattainable. Politics is often approached with mistrust and in this case politics is complex with its multiple roles of enabler, regulator and cashier.

Apart from dealing with the income gap in the acquiring of solar panels, it is necessary to incorporate informal aspects such as cultural norms, informal stakeholder interaction, historical legacy and informal networks for the development of policies. These soft factors can determine whether they will be effective in their implementation (Ince, Vredenburg and Lui, 2016).

POLICY IMPLICATIONS AND RECOMMENDATIONS

When these three theories are brought into relation with this research, a number of policy recommendations emerge:

- Trust in the transition will grow when the role of the various stakeholders is made clear. Households should not have the idea that the government financially exploits citizens.
- Provision of information should be geared towards the target groups. This involves getting acquainted with the involved technology and having access to consumer platforms.
- Government can encourage the transition by subsidizing the households.
- Government can influence its subsidiary, Elmar, with a simplification of the application process and the speeding up of the practical connections.
- Government should encourage net stability. This can be effected through application of large batteries. Government should create the opportunity for households to produce electricity for the grid.

CONTRIBUTION OF RESEARCH

From this research, it has become clear that more attention needs to be paid to the storage of electricity and stability of the net. The sustainable vision of Aruba, with its international focus on the 'Green Gateway' (information hub between Europe and South America) has undermined the local renewable energy implementation on the island. It shows us that solely striving for a political goal does not work out satisfactorily if not all the population groups are involved. The information and involvement through all phases of the project with the population is essential for success. The existence of technological solutions for energy transitions does not automatically imply that the problem will be solved. The socio-technical transition theory rightly states the fact that both the technical and the social component need to be addressed. In the case of Aruba, the balance so far lies on the availability of technical solutions and not on the social acceptance.

Areas for further research are: whether the combination of nearness to technology and targeted information will be sufficient to blow new life the transition process; the role of Elmar and WEB in the transition process; the increase or decrease of political influence in the transition process; and the development of a green image for the whole of Aruba.

8. CONCLUSION

This chapter provides the conclusion of this research along with several recommendations. The main question of this research is *''How could households in San Nicolas, Aruba, be (better) included in the transition to renewable energy?''.* The preceding chapters have provided data to answer this question; which is summarised below.

There is quite a variety in the awareness and usage of renewable energy. Some households are very well informed, others on the other hand, hardly know anything of the transition and its goals. This results in quite a variety of actual involvement in the transition. Only two of the households have actually installed solar panels. Another third household wanted to do so, but didn't qualify due to age restrictions for loans and low electricity consumption. The differences of renewable energy awareness, role and usage lie in having heard of the transition, having considered it for one's own household and the practical adoption of technologies. The barriers that came up were: a lack of well targeted information for the user groups, a lack of finances and a lack of trust. This is also where the opportunities lie: providing information, creating a closeness to technology, cultivating trust and financial aid to ease the transition. The approach to the transition should be done through a holistic approach in order to change the identity of San Nicolas as a company town. The key lies in advancing and promoting local initiatives and the creation of consumer platforms.

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Appendices

Sub questions: operationalisation

1. What is the level of awareness and current usage of renewable energy (technologies) in households?
    - How, if at all, is the socio-technical transition to renewable energy reaching the households?
    - What aspects and technologies in the households' daily lives are linked to (renewable) energy?
    - What opportunities could renewable energy give in household livelihoods, according to households' perspective?
    - What is the extent of the knowledge of household level of the aimed transition in energy?
2. To what extent are households involved in initiatives concerning the renewable energy transition?
    - What renewable energy initiatives can be found within households and their social circles?
    - To what extent are (community) organisations, spurred on by the actors (such as government, utilities, private companies etc.), informing and engaging households in the energy transition?
    - What form does household engagement in renewable energy initiatives take?
    - How and by whom are community renewable energy initiatives instigated?
3. What are the differences in renewable energy usage, awareness and role between households and how can these differences be explained?
    - What characteristics characterize early adaptors of renewable energy initiatives and technologies in households?
    - What are the main reasons not to engage in the renewable energy transition?
    - What does the cost and benefit distribution look like for households?
4. What are the barriers and opportunities for the inclusion of households experienced in the transition to renewable energy?
    - In what ways, if at all, are households demanding to be part of the renewable energy transition?
    - What, according to households, is their role in the renewable energy transition?
    - What factor(s) come up most as a barrier to inclusion in the renewable energy transition by households?
5. To what extent has the oil refinery influenced the transition to renewable energy of households on Aruba?
    - What are the memories linked to the oil refinery?
    - What successes or failures in San Nicolas are attributed to the oil refinery?

Table: Household respondents - basic characteristics

Name	Sex	Age	Job	Solar panels	Bill (awg)	HH situation
Ann	F	68	Nurse	no	300	1 adult
Enya	F	38	Teacher	no	300	2 adults, 2 children
Maria	F	63	Administrative clerk	no	400	2 adults
Nathalie	F	39	Human Resources manager	no	120	1 adult
Mandy	F	44	Lecturer Nature and Technology	no	150	2 adults
Delilah	F	74	Dietitian	no	80	1 adult + apartment to let (with 1 adult)
Amy	F	60	Assistant accountant	no	130	2 adults
Candyce	F	85	*Retired*	no	150	1 adult
Juan	M	44	Teacher	no	250	2 HH, one of 3 in total including himself, and an individual HH
Lina	F	35	Teacher	no	Doesn't pay bill	2 adults, 1 child in apartment with 2 grandparents
Ralf	M	61	Teacher	no	450	2 adults
Connie	F	46	Teacher	no	250	3 adults (parents + live-in grandmother), 3 children
Lara	F	32	-	yes	80	2 adults in main, 1 apartment with grandmother
June	F	57	-	no	300	3 adults
John	M	83	*Retired*	no	200	2 parents, 1 grandparent, 1 child
Cora	F	33	Teacher	yes	70	2 adults, 2 children
Jenny	F	30	Teacher	no	400	2 adults, 5 children in main house, apartment with 1 nanny
Susan	F	86	*Retired*	no	70	1 adult

Valerie	F	64	Nurse	no	120	1 adult
James	M	64	Security manager	no	300	1 adult, 3 children
Laurens	M	67	Chef in hospital	no	300	1 adult
Ria	F	41	Head of general support - Nature and Environment office	no	300	2 adults, 2 children

ETHICAL REVIEW

In this ethical review, the handling of five ethical issues in this research will be discussed.

1. Access to participants / participant recruitment

The access to participants in households will be done by the snowballing method. This a convenience based sampling model. In this qualitative research, the aim is to understand and obtain detailed information on renewable energy in households for which purposive recruitment of interviewees belonging to the target group is appropriate (Hennink, Hutter & Bailey, 2015). Important is to ensure participants' confidentiality in obtaining information on new contacts. Special attention needs to be paid to keeping confidential information from different participants from each other.

2. Informed consent

With all participants in the interview it is important to obtain their informed consent for the interview. At the beginning of each interview it is important make very clear that people consent to the interview, the recording and what is going to be done with their answers. Furthermore, the guarantee of confidentially must be made clear at the beginning of the interview, and that the greatest care will be given to the protection of the data. In sum, at the start of interviews the information concerning the informed consent, confidentiality and recording must be clear and conscious, and giving space to decline the interview if participants feel uncomfortable in participating in the interview.

3. Potential risk to participants, including data protection and confidentiality

The potential risks to participants are naturally aspired to be as low as possible. The greatest care will be given to the anonymization of interviews, especially in household interviews. This is due to the fact that it would be helpful if expert interviews could be on the record, emphasizing their expertise if their names are known, however at the start of each interview there will be clear that interviews can also be fully confidential and anonymous if necessary. The names of interviewees are stored in a separate document, and only acronyms will be used in the interview documents. Concerning the protection of data, extra passwords are

installed on the researcher's laptop, hard drive and cloud (which are the three locations where the data will be saved). Only the researcher has access to the 'raw' data.

4. Sharing of findings

The sharing of the findings will be done with the insurance of confidentiality to the participants. The first and second supervisor at the University of Utrecht will be reading the research outcomes. Furthermore, in the interviews with 'experts' and involved actors in the transition, as well as the households, will receive a digital copy the final report when finished.

5. Conflict of interest

In the interviewing of research subjects and experts, there may be conflicting interests. For example, when interviewing government officials/representatives they may want to give a (more) favourable insight in the happenings concerning the renewable energy transition and how it benefits all of island's population. When interviewing households, there could be a tendency to give socially wanted answers such as: "I think renewable energy is very important'', even if this is not the case. These conflicting interests should be kept in mind when interviewing, and if possible addressed in the questions asked during interviews.