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Energy poverty and the elderly-care

Exploring energy poverty in the elderly-care through case studies with social welfare organizations in Taiwan

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Abstract

The topic of energy poverty has recently gained prominence amongst researchers and academia in Taiwan within the context of rising energy prices and low emission energy transitions. Social welfare organizations (SWOs) that provide 24-hour residence and care for vulnerable populations, such as the elderly and disabled, highly depend on various energy services and are likely to be significantly affected due to rising energy prices, adding to their existing financial pressure. Thus, it is essential to investigate energy poverty within SWOs both in the local and global context. Addressing this, the study aims to explore energy poverty within SWOs using a case study analysis of three SWOs working with elderly care. The SWOs are framed within the Green Energy Charity (GEC) project, developed by Sunnyfounder, a social enterprise working towards enhancing the green energy access of SWOs. Using the capabilities framework and three forms of justice under energy poverty, this thesis seeks to analyze the level of energy poverty of the SWOs by understanding their differential energy needs and vulnerability as well as the role of the GEC in addressing the same. Data collection consisted of interviews and observations. The results of the study conclude that it is inappropriate to define the studied cases as energy-poor based on their current status. However, the cases have a high risk of becoming energy-poor. This risk can be attributed to the sensitivity and disabilities of the elderly, and the different adapting capacities seen within the SWOs. Finally, the study provides recommendations targeting research as well as the company in study, including, long term tracking of beneficiaries, investigating the gap between project potential and outcomes of the GEC, and examining the energy use within other highly vulnerable and least-recognized SWOs.

Keywords: energy poverty, solar power, social welfare organization, elderly-care, capabilities framework, justice

Executive Summary

Problem definition

Energy is anticipated to be one of the most critical challenges in the coming decade, particularly with regards to increased consumption, the transition from fossil fuel to renewable energy, and the unequal energy access and distribution. Amongst energy-relevant issues, energy poverty is a challenge that encompasses the aspects mentioned above. The sustainable development goal seven also highlights this issue. There is no universally accepted definition for energy poverty. Nevertheless, the multiple definitions all highlight the inability to receive adequate energy services for obtaining one's well-being due to a lack of accessibility, affordability, or the greater use of energy. Energy poverty was first discussed in the UK in the early 1990s when the term fuel poverty was used to describe the situation of low-income families lacking access to affordable heating in winter. The discussion soon expanded to cover more aspects, such as energy efficiency, energy price, accessibility of electricity, and the justice perspective. In addition to the development of different elements under the issue, the scope began to cover a broader range of geographical regions, entering Asia's academic sphere in recent years.

In Taiwan, the problem of energy poverty is currently overlooked under research and political considerations. Access to energy is not considered a significant problem in Taiwan due to the state-owned centralized energy supplier who has stabilized electricity supply and energy prices. Nevertheless, the new energy transition plan moving towards renewable energy uptake and changes in the energy supply system will invariably lead to an increase in energy prices. This is considered by the advocacy groups and a few researchers to be one of the main causes resulting in energy poverty. However, academics in Taiwan do not discuss energy poverty to a large extent. In 2015, the government started a collaboration with an enterprise to address energy poverty within low-income households through domestic energy efficiency improvement initiatives. In spite of this project, the issue still appears only as a brief goal in the energy transition policy and is not accompanied by specific interventions or targets. The risk of increasing energy prices in Taiwan, nonetheless, will not only influence the low-income households but also all the vulnerable populations and groups, including the SWOs. Thus, it is important to understand the extent and risk of energy poverty faced by them, a problem that has not been addressed previously. The Green Energy Charity (GEC) project implemented by Sunnyfounder, tries to address this intervention gap by having the social welfare organizations (SWOs) instead of households as the beneficiaries of the project. In general, SWOs are organizations that provide 24-hour residential care for vulnerable populations like the elderly and disabled. The goal of GEC is to transform financial resources from corporate social responsibility (CSR) of the enterprises into the investment for rooftop solar panels, which can be owned by the SWOs. Driven by the state-supported feed-in tariff (FiT) system and the green certificate trading system, the SWOs will be able to generate benefits from producing green energy with solar panels.

The innovative business model of the GEC showcases potential to address energy deprivation issues within SWOs and thus warrants further investigation both under the context of Taiwan and within the energy poverty research field. Besides, studying the different energy needs within SWOs can provide further understanding of the vulnerability of certain populations before developing suitable support for them.

Aim and research questions

Based on the reflection that the current transition plan lacks practical discussions and concrete solutions for energy deprivation, this research aims to investigate the concept of energy poverty within SWOs and examine the potential of renewable energy in addressing the issue, through a

discussion of the strategies used and the outcomes from the GEC project. This is carried out by first studying the energy usage within the SWOs and the potential challenges they face with regard to meeting these energy needs. Next, the GEC project and its strategies are discussed and analyzed to understand how the GEC supports the SWOs. Lastly, the findings are reflected upon, and the status of the SWOs in relation to energy poverty is discussed. Following this rationale, the author develops the research questions as followed,

RQ1: What are the different energy needs in the chosen social welfare organizations (SWOs), and why are they essential?

RQ2: What strategies have the Green Energy Charity (GEC) project used to support the SWOs, and what aspects of energy deprivation have been covered?

RQ3: How can the energy needs in SWOs with elderly-care be understood with the concept of energy poverty?

Theoretical approach, research design, and methodology

The primary framework used in this study is an integration based on two theoretical frameworks, namely, the capabilities framework of conceptualizing energy poverty and three forms of justice under energy poverty. Both frameworks allow the discussion on energy poverty to go beyond the simple problem of accessibility and affordability, or merely the three aspects of energy prices, energy efficiency, and income. The framework focuses more on the vulnerability of certain populations and the underlying causes. The study uses the capabilities framework to analyze the SWOs' differential energy needs and difficulties for fulfilling various necessary capabilities for the elderly. On the other hand, the three-forms-of-justice framework is used to provide a broader explanation for the high risk of energy poverty faced by the SWOs' and helps develop further recommendations for the energy transition.

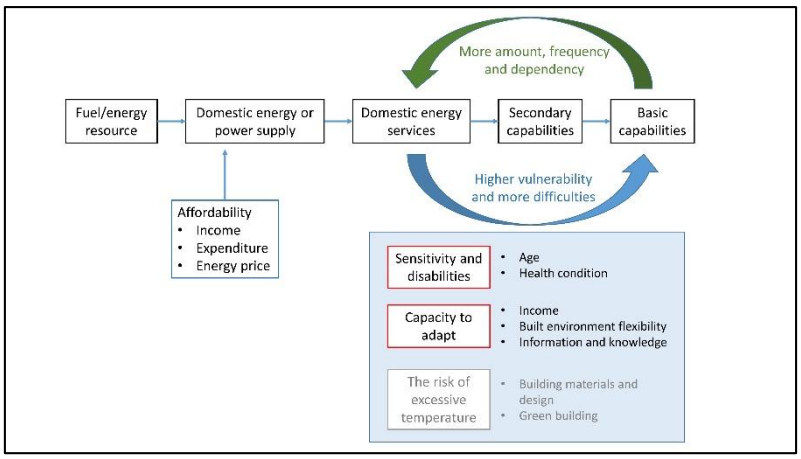
Considering that this study is conducted within the scope of a master's thesis and owing to time constraints, this research is limited to an exploratory case study of three SWOs who primarily focus on elderly care. Methods of data collection initially included interviews and observation. However, only two observations were conducted in the pre-study with two SWOs other than the ones studied. It is impossible to conduct further observations with the three studied cases due to the outbreak of COVID-19. In total, the author conducts eight interviews with three groups of respondents, including the project recipients (SWOs), administration (colleagues in charge of the GEC project from Sunnyfounder), and one academic researcher. The main contact people for the GEC project within SWOs are also the head or top director of the organizations, making the information provided by them strongly reliable.

Main Findings

The results of the study identify air conditioning, space heating, and the use of elevators as the three most essential energy services within the SWOs. Other energy services include power for electronic appliances, water heating, lighting, and refrigeration, but the extent of requirement differs amongst the SWOs. The elderly tend to consume more and rely more on multiple energy services due to their sensitivity and disabilities, both influenced by their age and health status. The overall vulnerability of the SWOs to rising energy prices also varies because of their differential capacity to adapt, which is an interplay of multiple factors like income and the energy efficiency of the buildings the SWOs inhabit.

The GEC is a business model in which the mediator company connects the beneficiaries and the sponsors looking for CSR recipients. These beneficiaries usually include the SWOs and the disadvantaged. The main strategies used in GEC represent different approaches to increase the SWOs' energy affordability by generating income from solar power and savings from domestic

energy use. Besides, some SWOs had reported an increase in their recognition by new enterprises and individuals. This led to a rise in donations from those new donors. Other side effects of joining GEC include the information and knowledge empowerment of SWOs.



Based on the main findings, the vulnerability of the studied SWOs to energy poverty is mapped out (see the figure on the left). Based on the definition used in the capabilities framework and this study as well, the three studied cases cannot be categorized as energy-poor by virtue of their current status. Nevertheless, they are facing a higher risk of energy poverty owing to rising energy prices. Because of the vulnerable populations and the non-profit characteristics of the organization, many SWOs often struggle between balancing the provision of good-quality services and reducing costs. Moreover, the distributional aspect is not the only factor causing the vulnerability of the SWOs. From the justice perspective under energy poverty, the lack of recognition of the SWOs' differential energy needs and higher risk, as well as the unequal access to relevant information like the change in energy prices and energy supplies, can make some SWOs more vulnerable than the others.

Conclusion and recommendations

Energy poverty is a critical issue that should be taken into serious consideration within renewable energy transitions as well as within the context of increased energy dependency of the vulnerable population. Among all the similar SWOs, the studied SWOs are of a relatively better condition in balancing between providing qualified services and covering the massive cost of operation, including the expenditure in energy. At the same time, many other SWOs have sacrificed the quality of services to sustain the operation. Enterprises tend to be unwilling to take risks in supporting such SWOs. Thus, it is crucial that the government investigates and intervenes in assisting such poor SWOs who are often excluded from the purview of CSR.

This study recommends Sunnyfounder to keep track of the SWOs supported by the GEC, especially on their energy use pattern and improvement. Also, the company can report their investigating results periodically to both the sponsors and the public. Regular evaluation will help the company better assess their real social impact through the GEC model and make adjustments to optimize the impact. The company can also focus on translating and implementing the model under different geographical contexts and on different target groups. The central and local governments together play an essential role in investigating population groups that might be vulnerable to the changes occurring along with energy transitions. Instead of dealing with all the energy deprivation issues with subsidies and financial support, the government can focus on building capacity for vulnerable populations through the promotion of renewable energy.

Finally, the address of energy poverty should be viewed from a preventative perspective together with the preparation of an aging society and increase energy consumption. To do so, the collaboration between government sectors, private sectors, and academia will be essential. The study has opened up the discussion into the relevant issue in this regard.

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Abbreviations

CREP	Community Renewable Energy Projects
CSR	Corporate Social Responsibility
FiT	Feet-in Tariff
GEC	Green Energy Charity
kWh	Kilowatt-hour
kWp	Kilowatt-peak
MSPRP	Million Solar Panel Rooftop Project
REDA	Renewable Energy Development Act
SII	Semi-structured Interview
SWO	Social welfare organization
TWD	New Taiwanese Dollar

1 Introduction

Energy will remain one of the most significant challenges of sustainable development in the coming decades, especially with the issues on continuing increase in energy demand, energy efficiency, and alternative energy in concern of carbon emission from traditional fuel sources (Glenn, 2013). One of the 17 sustainable development goals (SDGs), goal seven, highlights the importance of energy in moving toward a sustainable future and, in particular, to ensure the access to "*affordable, reliable, sustainable and modern energy*" (United Nations, 2019a). Energy relevant issues have indeed become a strong focus both on a global and local context. In 2020, all three presidential candidates in Taiwan had a clear energy plan for the next four to ten years as one of their main politics (Sun, 2020). The pertinent issues, for example, the accessibility of energy, have varied among countries and regions, making the entire affair more complex. Specific solutions designed according to different contexts are thus required other than a common universal principle or technology (Glenn, 2013).

Energy poverty, a term that is often used to describe the lack of accessibility and affordability of energy as well as the inability to be better off through the use of energy, is an especially interdisciplinary and hot topic among the other pertinent issues (Day, Walker, &Simcock, 2016; González-Eguino, 2015; Li, Lloyd, Liang, &Wei, 2014). The subject encompasses the focus of multiple aspects like environmental justice, energy vulnerability, climate adaptation, and societal inequality (Bouzarovski, Petrova, &Tiradodherrero, 2014; Walker &Day, 2012). It is not a new concept but has gradually gained more attention worldwide since the first academic discussion in the UK from the early 90s (Boardman, 1991; Hills, 2012). The initial discussion from the UK started with the term "fuel poverty" and focused on the affordability problem for heating in low-income households. The idea later expands to other relevant issues like cooling and overheating (Horta et al., 2019; Mastrucci, Byers, Pachauri, &Rao, 2019; Mazzone, 2020; Sánchez-Guevara Sánchez, Neila González, &Hernández Aja, 2018; Tabata &Tsai, 2020; Thomson, Simcock, Bouzarovski, &Petrova, 2019), nexus between energy poverty and health (Castaño-Rosa, Solís-Guzmán, &Marrero, 2020), as well as a concern of energy poverty resulting from rising energy prices under energy transition (Bouzarovski et al., 2014). The issue has also expanded to a broader range of geographical scope which includes more European countries (Bouzarovski, 2014; European Commision, 2020; Horta et al., 2019; Kerr, Gillard, &Middlemiss, 2019) and regions from the global south (Bhide &Monroy, 2011; Khanna, Li, Mhaisalkar, Kumar, &Liang, 2019; Mazzone, 2020; Sanz-Hernández, 2019). The nature of energy poverty faced by the global North and South is, however, pointed out to be different by some researchers (Li et al., 2014). In the global south, the focus of energy poverty has been primarily on the lack of accessibility to modern energy, like electricity, and sometimes the nexus between energy poverty and low-income (Adusah-Poku &Takeuchi, 2019; Bhide &Monroy, 2011; Ismail &Khembo, 2015; Khanna et al., 2019). On the other hand, the dominant discussion over energy poverty in the global North has been on the affordability problem faced by the social disadvantages and low-income households. Further perspectives from justice in energy distribution and climate adaptation thus appear (Bouzarovski et al., 2014; McCauley, Heffron, Stephan, &Jenkins, 2013; Sanz-Hernández, 2019; Walker &Day, 2012). Energy poverty is indeed an interdisciplinary and global issue the world together will come across in the coming decades.

The challenge and relevant addressing measures of energy poverty are often argued as being either a potential or a hindrance to a low-carbon society. Some standard solutions in tackling energy poverty and achieving SDG seven such as subsidies for electricity price, infrastructure for expanding electricity grids to rural areas, or financial support for low-income families, are leading to different extent of an increase in energy consumption on traditional fossil fuels, depending on the energy supply system of the region (Day et al., 2016; Li et al., 2014). Sustainable approaches in addressing energy poverty thus become an essential focus of the issue.

In addition to increasing domestic energy efficiency, solar power often serves as the best off-grid energy alternative for supporting rural communities and vulnerable households (Lee &Shepley, 2020; Liao &Fei, 2019; Yadav, Davies, &Sarkodie, 2019). As a result, addressing energy poverty through the use of renewable energy can, at the same time, contribute to sustainability from realizing social equality, carbon neutrality, and energy transition dimensions.

1.1 Problem definition

Discussions over energy accessibility, sustainability, and affordability often refer to dealing with energy poverty and energy vulnerability (European Commision, 2020; González-Eguino, 2015). This discussion, in recent years, has entered East Asia but on different focuses. In China, the focus has been on defining energy poverty and looking into potentials from increasing accessibility to energy (Bonatz, Guo, Wu, &Liu, 2019; K.Wang, Wang, Li, &Wei, 2015). On the other hand, the affordability problem regarding the concern of increased energy price was the initial focus of energy poverty in Japan (Okushima, 2016), followed by other studies in measuring regional energy poverty under the impact of energy transition (Okushima, 2019), and the cooling perspective of the issue (Tabata, 2020). The example from Japan after the Fukushima accident showed that the incident had led to an energy shortage and energy price escalation for several years (Okushima, 2016).

Still, compared with abundant studies in Europe, India, and African countries, studies regarding energy poverty have been relatively underdeveloped and limited in numbers in East Asia. Especially in Taiwan, the term is often used by the public and advocacy groups against the increase in electricity prices but has not been widely studied in academia (Zhao &Chou, 2017). Energy poverty is also only briefly introduced as a broad goal in the government guide of energy transition (Bureau of Energy, 2018, 2017). Some believe the call against an increase in energy prices concerning energy poverty has hindered the renewable energy transition in the country (Liang, 2017) and has made the electricity supply system lock-in with nuclear power and coal power.

The limited attention of energy poverty in Taiwan might be resulting from, according to some researchers, the relatively little impact of the issue currently in Taiwan (Y. H.Yin, 2018; Zhao &Chou, 2017). However, fewer households currently influenced by energy poverty do not mean there are zero problems of energy poverty in Taiwan. In contrast, it is now essential to discover the hidden population that might become energy-poor in the future due to the energy transition plan leading to change in the energy supply system and a potential increase in energy prices (J. M.Wang, 2017; W. K.Xie, 2016; Y. H.Yin, 2018; Zhao &Chou, 2017). The government in Taiwan has joined hands in recent years with enterprises and social workers to understand and tackle the hidden problem through on-site visits and practical actions. Sunnyfounder is one of the enterprises attempting to explore and address the hidden energy deprivation, particularly within social welfare organizations (SWOs) in Taiwan, through the intervention of small-scale solar power plants. The company's novelty in addressing the issue through the business model, Green Energy Charity (GEC), and the focus on SWOs have inspired this study. In collaboration with the company, this research aims to explore the hidden energy poverty within some SWOs under GEC.

Before starting the primary research, a pre-study was done by the author in another course, in which the two companies, DOMI and Sunnyfounder, were interviewed and understood about their work in addressing energy poverty and pertinent issues in Taiwan. DOMI is a certified B

corporation[1] that has been dealing with energy poverty in poor households, together with the government sectors, through improving households' domestic energy efficiency (DOMI, 2015). Replacing old devices with more energy-efficient alternatives is their primary approach. On the other hand, Sunnyfounder is a social enterprise that has one of the two main business models, the GEC project, targeting SWOs as the beneficiaries of solar power. GEC is novel in tackling potential energy deprivation in SWOs through helping them create partial energy self-sufficiency with solar power (Sunnyfounder, 2020). In other words, the company supports the installation of rooftop solar panels on the SWOs' building. The energy generated from the panels can be either directly used by the SWOs or sold back to the state grid. More details of the model are explained in 2.2.

The GEC model from Sunnyfounder also kindles the author's interest since the core rationale of the model regarding social justice in sustainable development strongly echoes with the author's background in sociology and economics. According to Sunnyfounder, the original motivation for conducting the GEC project was to redistribute the benefits of renewable power to the disadvantaged. The model later expands to more SWOs based on the assumption that SWOs are facing a relatively high pressure on electricity expenditure because of their increased needs in energy services for the caring of vulnerable populations and disabilities. Besides, the company further assumes that the increase in electricity prices aligned with energy transition might worsen the situation, or even make some SWOs energy-poor, referring to those suffering from energy poverty. In response to this potential challenge, the company thus initiated GEC to alleviate the pressure on energy use within these organizations. This narrative had inspired the author to reflect on the current energy transition plan, especially on the concern of increasing energy prices and its impact, as well as the potentials from solar power.

Academia has been giving recommendations on energy transition policies, but few have mentioned their potential side effects on, for example, energy poverty resulting from the increase in electricity price (Liang, 2017; M. X.Lin, Liou, &Chou, 2020; Zhao &Chou, 2017). Instead, the statement against price rising has been coming from the public and advocacy groups and mainly focusing on poor households. On a global level, the focus has been solely on the concerns of low-income families rather than a broader discussion over all the potential targets that might be facing issues of high energy price, low income, and reduced energy efficiency. Almost all the studies so far have households as the primary and only focus in the studies of energy poverty despite the suggestions of also including community and organization perspectives in a few studies (Bouzarovski et al., 2014; Day et al., 2016). Furthermore, although the rationale behind GEC sounds reasonable, there has not been proper research in understanding the particular energy needs within the specific vulnerable populations cared by the SWOs under the context in Taiwan, and the reasons for these organizations to face a higher risk of becoming energy poor.

Hence, in collaboration with Sunnyfounder, this thesis aimed to explore energy poverty under the context of Taiwan in especially vulnerable groups and the disabled through three case studies of SWOs under GEC. Considering time constraints and the representatives of different types of SWOs, only three out of ten SWOs under GEC were chosen. In particular, this study focuses on three SWOs supporting elderly-care. From experience during the pre-study, the author found that SWOs with elderly-care tend to be more open for external researchers compared to SWOs

[1] According to Certified B corporation, B corporations are "*businesses that meet the highest standards of verified social and environmental performance, public transparency, and legal accountability to balance profit and purpose*". Any business who meets the certification requirement will have the chance to be certificated. Source: https://bcorporation.net/about-b-corps

caring for mental disorders and children. Moreover, the pressure of an aging society in Taiwan also makes the issue of elderly-care more critical when considering sustainable development.

Extending the research subject of energy poverty from households to SWOs is novel in addressing the issue both on a global level and under the Taiwanese context. SWOs often care for more vulnerable populations than a single household and are essential in supporting the social security network of society. Helping local SWOs can hence create side benefits for the local community. Through collaboration with the GEC project, SWOs have also shown potential in supporting the implementation of renewable energy and participating in sustainable development. However, a more in-depth understanding of the exact energy needs and possible challenges faced by SWOs, as well as the evaluation of GEC, will be required to explore energy poverty in Taiwan from a comprehensive perspective and to clarify the contributions from GEC to SWOs. As a result, this study tried to extend the discussion of energy poverty to the new subject, SWO with vulnerable populations, and discuss how a novel solution contributes to the issue.

1.2 Aim and research questions

Overall, the GEC project run by Sunnyfounder attempts to extend the social value of solar power, to promote renewables under energy transition, and to take the first step in tackling the potential issues regarding energy poverty and energy vulnerability in Taiwan. It is less disputable to assume that the elderly are consuming more electricity to maintain their living compared to healthy and young populations and are thus adding pressure on the SWOs'operations. However, there has not been rigorous research about the specific energy needs required by the SWOs with elderly-care. Further research is needed to answer why the elderly might require extra energy and how these additional needs might connect them with energy poverty. Moreover, Sunnyfounder has little understanding of how the GEC model has or has not contributed to SWOs in terms of the possible occurrence of energy poverty. The aim of this research is thus to explore energy poverty under the context of SWOs for elderly-care in Taiwan and to briefly evaluate the implementation of GEC in supporting SWOs with solar power. Based on this rationale, the study develops research questions (RQs) as followed:

> *RQ1: What are the different energy needs in the chosen social welfare organizations (SWOs), and why are they essential?*
>
> *RQ2: What strategies have the Green Energy Charity (GEC) project used to support the SWOs, and what aspects of energy deprivation have been covered?*
>
> *RQ3: How can the energy needs in SWOs with elderly-care be understood with the concept of energy poverty?*

1.3 Audience

The first audience of this study is the company, Sunnyfounder, particularly the contact person who is also the director of the GEC project. This study can provide the company with a third-person perspective outlining successful aspects and gaps of the GEC model. In addition, the study could assist the company in better understanding the SWOs' evaluation of GEC in addressing the energy deprivation and in exploring other potential implementations for building capacity for the SWOs and specific vulnerable populations.

The second audience of this paper could be the academic researchers in Taiwan studying energy poverty under the local context. The energy needs identified in this study, especially for elderly-care, can serve as an investigating base or reference for further studies probing into the energy

deprivation faced by the disabilities from other SWO, a single household, or a community. The intervention through solar power presented in the GEC project can also inspire further innovative solutions for vulnerable populations in facing the risk of becoming energy-poor due to the increase in energy prices.

The third group of audience includes all the researchers or government officials working with energy poverty from different countries and regions. Especially those that are looking into the potentials of solar energy along with corporate social responsibility (CSR) in addressing energy poverty in SWOs or households with spare rooftops might find this research fascinating. The study provides them with a deeper understanding and reflection on the GEC model and how the model could contribute to tackling energy poverty for the vulnerable populations.

1.4 Disposition

Chapter 2 describes the background literature regarding energy transition in Taiwan and the Green Energy Charity (GEC) project. The individual actions from the government, referring to the energy transition plan, and private sectors (GEC) seem to be significant facilitators of rising awareness in energy accessibility, sustainability, and affordability. Chapter 3 explains the results from reviewing previous studies, which provide a better understanding of the definition and concept of energy poverty, as well as the prior discussion of energy poverty on disabilities and especially the elderly. Chapter 4 further elaborates on the two main theoretical frameworks used for data analysis and structuring the discussion. Chapter 5 introduces the method for data collection and analysis. Chapter 6 presents the main findings and results from the empirical studies. The results are then discussed and reflected upon in Chapter 7 and finally concluded in Chapter 8.

2 Background

2.1 The development of renewable energy in Taiwan

2.1.1 Energy transition plan: a response to a social consensus toward a sustainable future

Lack of access to energy, especially electricity, is usually believed to be a minor problem in Taiwan in general (Liang, 2017). The operation efficiency and overall performance of the centralized electricity supply company are also believed to be better than global North countries like Japan, France, and Canada (Liang, 2017). According to Taipower, the centralized electricity supply company in Taiwan, the national electricity available rate has overall reached up to 99.9% so far that almost everyone on the island has access to stable energy and relevant services (Taipower, 2020a).

However, a high accessibility rate does not equal zero problems regarding energy generation, consumption, and deprivation in Taiwan. Instead, some other issues have led to abundant discussions on the energy supply system and to further requests for the energy transition. First of all, although the operation of the coal-fired power plant is disputable of being the most prominent cause to poor air quality, it indeed has aggravated the already-existing air pollution problem and contributed to the total carbon emission (K.-T.Chou, 2019; C. S.Lin, Liou, &Huang, 2011; Liu, 2018; Shin, 2016; M. L.Xie, 2017). In addition to emission and air quality, the Japan Fukushima accident in 2011 was a massive shock to society and resulted in continuous effects. People started to reconsider the unpredictability of the reactor and the risk of hazardous waste from nuclear power (D.Chen, 2011; Jiang, 2018; Tsing-Tyan &Li-Fu, 2011; Zhang, 2011; Zhu, 2011). Since then, a continuing call for a better arrangement for the energy supply system has been initiated from bottom-up (D.Chen, 2011). The idea of a better energy supply system encompasses three concepts, less or non-nuclear power, less coal-fired power, and more renewable energy (Bureau of Energy, 2018). This call has quickly reached a broad social consensus and finally becomes the central part of the political considerations (Bureau of Energy, 2018; MEA, 2019).

The Renewable Energy Development Act (REDA) and the feed-in tariffs (FiT) system in Taiwan was launched in 2009. But not until 2012, the "Million Solar Panel Rooftop Project (MSPRP)" facilitated the broad engagement of individuals from the general public and small private sectors, including Sunnyfounder (Industrial Technology Research Institute, 2018; Ministry of Economic Affairs, 2019b). Moreover, the later amendment of the Electricity Act and REDA has opened up and liberalized the renewables market even more and allows for various types of engagement in renewables investment, especially in solar power. In 2018, the amendment of REDA officially encompassed a detailed plan for the energy transition, targeting electricity supply of 20% of renewables, no more than 30% of coal power, and 50% of natural gas by the year of 2025, compared to 2019 with 39% coming from coal and oil, 13% from nuclear, and 38% from natural gas (Taipower, 2020b). Five years for a transition to renewable energy from 5% in 2019 to 20% is viewed by some researchers and practitioners as being too rapid and might bring in or worsen problems like energy poverty due to an inevitable and quick rise in electricity price (X. J.Lin, 2017; Y. H.Yin, 2018; Zhao &Chou, 2017). However, since the accessibility of energy has been a minor problem in Taiwan in terms of the number of households being influenced, the issue has not been properly discussed either among academia or policymakers (Zhao &Chou, 2017). Instead, more awareness is coming from civic groups and individual specialists (X. J.Lin, 2017; W. K.Xie, 2016).

Nevertheless, other aspects of energy poverty, such as the affordability and social justice, taking into account the vulnerable populations, are the real issue regarding energy poverty under the local context. Sunnyfounder had noticed this potential problem and had looked into possible solutions to address the issue. The next section covers the brief introduction of their work done so far.

2.1.2 Solar power in Taiwan and the Green Energy Charity project

Initiated by the MSPRP, solar power has become one of the most popular renewable energy resources for community engagement and investment in Taiwan. Different from the conventional model following the idea of scale economy, the development of solar power plants in Taiwan has moved toward the direction of small-scale, dispersed, and community-engaging. Private sectors have become the first movers to build up the systems for a renewable energy market allowing individuals and enterprises to invest in solar power. Some examples are Sunnyfounder, Mr. Watt, and Chailease Energy Development Corporation (Chailease Energy, 2020; Mr. Watt, 2020). Based on the FiT system and a 20-year price guaranteed by the government, solar energy has been seen as a stable and proper long-term investment.

Apart from running the model for generating income from selling green energy back to the centralized electricity supplier, Taipower, Sunnyfounder has another different view for utilizing solar power through the FiT. As a social enterprise, the company also focuses on creating social impact from the investment of solar power plants and the redistribution of benefits to the disadvantaged. To realize the idea, the company designed a business model called Green Energy Charity (GEC) (Sunnyfounder, 2020), in which the company serves as a mediator who helps bridge the sponsors and beneficiaries together (see Figure 2-1). The donors are usually companies looking for project recipients to work with on their corporate social responsibility (CSR) practices, as well as individual donors. Beneficiaries so far are mainly social welfare organizations (SWO) that are assumed to spend a higher proportion of income on electricity services. Some other beneficiaries also include disadvantaged communities in rural and mountainous areas. Sunnyfounder launched the first case of GEC in 2016 and reached to another nine more cases by the year 2019 (Sunnyfounder, 2019).

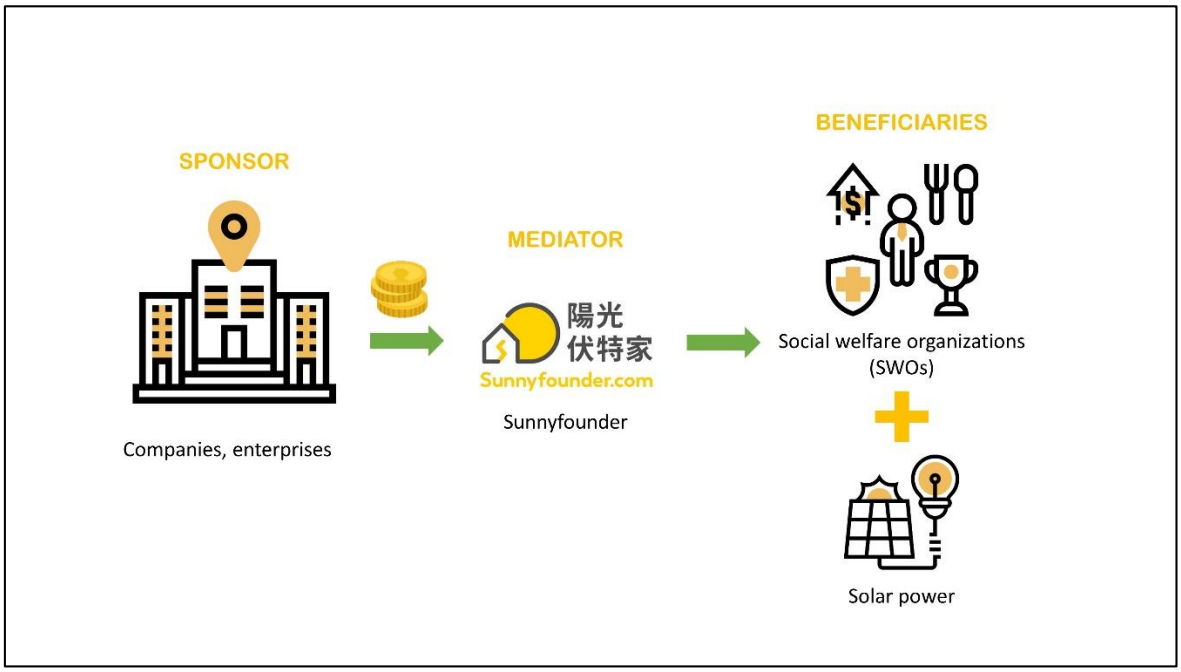

Figure 2-1. Green Energy Charity (GEC)

Source: Illustrated by the author

The SWOs are mostly selected based on their roof size and space availability. In a few cases, the sponsors and Sunnyfounder also choose the SWOs to support specific social issues. The electricity generated is either connected and transported back to the main grid or used by the organization. The profits gained from the FiT or selling the certificates, which is further explained under section 2.2, will be entirely owned by the organization. On the other hand, the sponsoring companies can gain CSR credits for joining the project. As a mediator, Sunnyfounder charges maintenance fees annually from the beneficiaries based on a specific portion of the construction costs. The company provides periodic checking and cleaning service for the solar panels with a 20-year guaranteed. Sunnyfounder is also in charge of setting up a tracking system that provides the SWOs with accessibility to the real-time condition of their power plants.

The head of the department for the GEC project, Phoebe, was the primary contact person from Sunnyfounder in this study. Since the very beginning, when Phoebe co-founded the company in 2015, she emphasized on designing a business model that can create social values. Her study background in social science and a particular focus on the disadvantaged populations had become her motivation for GEC. According to Phoebe, the company had collaborated with ten different SWOs by the end of 2019, with total financial support reaching up to 30 million TWD (roughly 890 thousand Euro). The sponsors included six big enterprises. As for the beneficiaries, SWOs working with long-term care for the elderly and intellectual disability are two main groups for two reasons. Firstly, the problem of massive and unavoidable expenditure on continuous electricity services within these two kinds of institutions is obvious and hardly-arguable. The example brought up by Phoebe is that temperature control in both organizations is essential for ensuring a stable living environment to keep the residents both physically and mentally comfortable and healthy. The second reason is due to the recent rising awareness of issues regarding aging society and the stigmatization of mental or intellectual impairments. Thus there has been more focus on addressing the relevant issues.

2.2 GEC and the two sub-models

Green Energy Charity (GEC) is an innovative business model that combines the Corporate Social Responsibility (CSR), supporting social welfare organizations, and the promotion of solar power altogether, aiming to create so-called tripartite benefits. There are two ways, or two sub-models, to carry out GEC, including FiT and renewable energy certificate trading. Both sub-models involve three important stakeholder groups: Sunnyfounder, the sponsors, and the beneficiaries. In GEC, Sunnyfounder signs up a 20-year maintenance contract with the SWOs according to the regulations of the FiT system and the green certificate trading system. It is also a guarantee for the SWOs to not worry about the maintenance after installation. The next two sections explain how the two sub-models work.

2.2.1 Sub-model one: 20 years of income generated from the FiT system

Sunnyfounder created its first GEC model from the feed-in tariffs (FiT) system supported by the government. The FiT system was launched in 2009 in Taiwan, referencing the FiT systems in Europe. The FiT system aimed to encourage more investments from private sectors and the public on renewable energy, especially solar power. Under the FiT system, the only legal electricity seller, the Taiwan Electric Power Company, more often known as Taipower, guarantees to procure the electricity at a fixed price for the next 20 years since the start of each authorized contract. Sunnyfounder designed their first model based on the FiT system and made SWOs the beneficiaries of the model.

At the beginning of the project, Sunnyfounder is in charge of, on the one hand, finding sponsors for investing the project, and on the other hand, looking for suitable beneficiaries. The sponsors are usually big-scale enterprises. For example, Citibank, LITE-ON Technology, and Taiwan Mobile are the three enterprises that work with the studied cases (Sunnyfounder, 2019). Other minor sponsors also include individual donors and a few from specific project resources of government sectors (e.g., municipal department of social welfare). After successfully matching the two, Sunnyfounder moves on to handle all the administration and paperwork, including signing contracts with the sponsors and SWOs, as well as sending applications and reports to the government sectors. The engineering team from Sunnyfounde will take care of the installation after the Bureau of Energy has approved the request. The electricity generated through the solar panels is connected with the main grid. The state-owned centralized electricity supplier, Taipower, then procures the electricity at a fixed price, giving the SWOs continuous income every two months and lasting for the next 20 years.

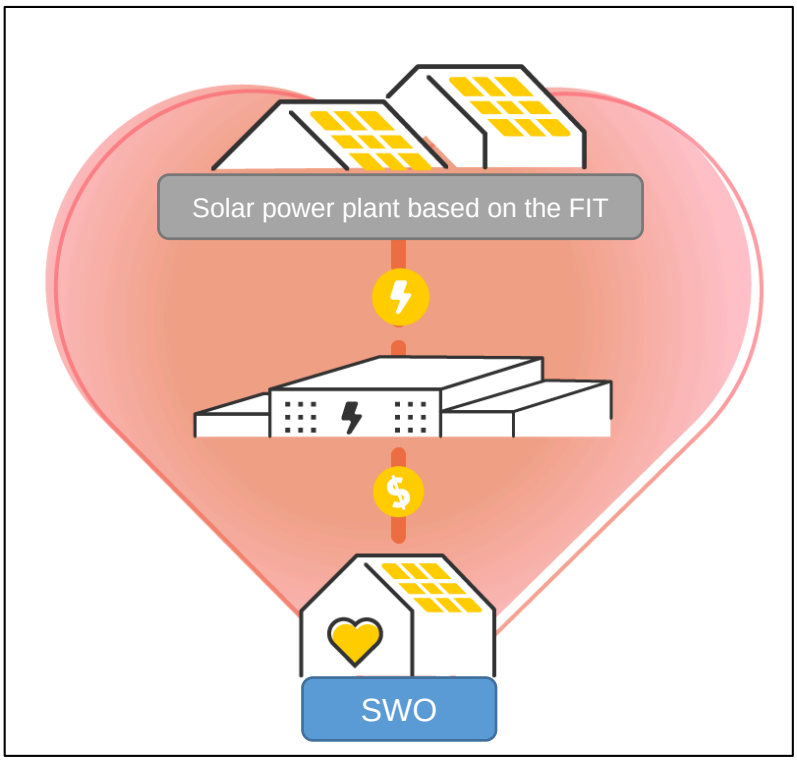

Figure 2-2. Sub-model one: the feedback system based on the FiT

Source: Sunnyfounder webpage (Sunnyfounder, 2020)*, translation made by the author*

However, the model is recently less preferable due to its limitation on the minimum scale of the power plant and the decreased price from the FiT. According to Sunnyfounder, they do not recommend the power plants that are under 20 kW of installed capacity to use this model due to cost-benefit consideration. When the scale of the power plant is too small, it can be hard to pay back the massive construction costs within the expected period, or the benefits can be tiny. On the other hand, the guaranteed price of FiT has been decreasing year by year (Bureau of Energy, 2019). For instance, for rooftop solar power plants with a capacity between 20 kW to 100 kW, the maximum purchase price had reduced from nine TWD (approximately 0.3 Euro) per kWh in 2011 to four point five TWD (about 0.15 Euro) in 2019 (Ministry of Economic Affairs, 2011, 2019a). The decrease in feed-in tariffs price is an action for the government to gradually exit the market after the first stage in encouraging more investors (Bureau of Energy, 2018). However, the adjustment has also discouraged many new investors who are about to join

the market, especially the individuals and communities (Peng, 2019). Thus, this model has gradually become not preferable for GEC as its main implementation. Instead, Sunnyfounder turns to another relatively new model of selling green certificates to collaborating sponsors. This model is further explained in the next section.

2.2.2 Sub-model two: self-sufficient and green certificates

Since 2017, the Executive Yuan founded the National Renewable Energy Certification Center, starting the trading system of renewable energy certificates, or often called the green certificates (National Renewable Energy Certification Center, 2017). Based on the system, power producers can sell a green certificate of producing green energy to other enterprises. The type of sponsors and the beneficiaries are the same as model one. The differences are in the users of the electricity and the way of generating benefits. In the self-sufficient model, the grid from SWO's power plant is also connected to the main grid. Still, the electricity produced by the solar panels is used entirely by the SWOs. The solar power is thus served as an alternative for the electricity supply, which can reduce the SWO's energy consumption from the main grid. The main function of the power plant is thus helping the SWO save energy and electricity expenditure. Meanwhile, SWOs can generate incomes by selling green certificates to the sponsors. In other words, the same amount of green energy generated will create double benefits for the SWOs through energy-saving and incomes from green certificates.

On the other hand, companies who are required to use a certain percentage of renewable energy in their production will be able to buy the green energy certificate instead of building their power plants. The rationale of the green energy certificate model is similar to the trade of carbon credit in which SWOs have positive credits while the companies have negative ones. Every 1000 kWh of electricity can be converted into a certificate. Once a company has become the main sponsor of a SWO, the company is required to continue the purchase for the next 20 years. See Figure 2-3 for a summary of the sub-model two.

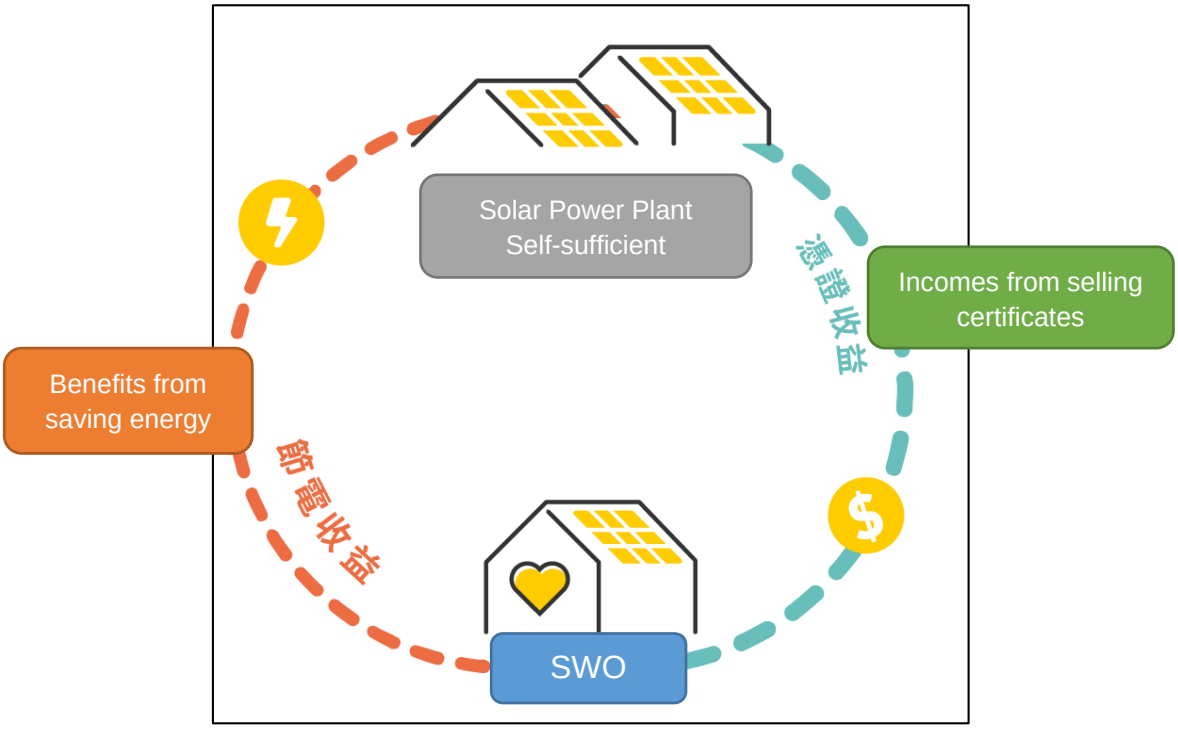

Figure 2-3. Sub-model two: self-sufficient along with selling green certificates

Source: Sunnyfounder webpage (https://www.sunnyfounder.com/fund_projects) and translation made by the author

2.3 Green Energy Charity and social welfare organizations

After understanding how the two sub-models work, in this section, the focus shifts to the beneficiaries, which are the ten SWOs. This section first elaborates on their roles under the GEC. Moreover, this section further explains the rationale of the project and its relationship with this study from defining SWO to the choice of having the elderly as the study targets for energy poverty.

Followed by the introduction of two submodels of GEC in the previous section, this section provides more details about the SWOs in its definition and the pertinent social issues to gain an overview of their practical contexts. As shown in figure 2-1, GEC encompasses two relevant stakeholder groups, the sponsors and the beneficiaries. By the end of 2019, six private companies had conducted their CSR through joining the GEC project, providing financial support to the infrastructure of solar power plants at the SWOs. As for the beneficiaries, ten SWOs have successively joined the project since 2016. Hundreds of children, elderlies, and disabilities are believed to have benefited from GEC (Sunnyfounder, 2019).

2.3.1 Understand the social welfare organization (SWO)

Social welfare organizations (SWO) are a type of social organization that aims to support several vulnerable populations, including the elderly, children and teenagers, women, intellectual disabilities, and physical disabilities, etc. These organizations are usually non-profit but can be operated by either the private stakeholders or municipalities. The former is more common and well-distributed in different regions or cities. All the authorized SWOs should be registered under the local municipalities and should pass the annual inspection from the local government.

Note that all studies discussing energy poverty and disabled people so far are still viewing the issue from a household-based perspective, which means that the study objects are households with disabled people. In contrast, this study tries to explore energy poverty faced by vulnerable populations on an organization basis, which is different from most of the previous studies within the field of energy poverty. There are many types of SWOs. Some provide only daycare services, while many SWOs provide 24-hour residential services. Most cases under GEC are the later. Sending the elderly or the disabled to special care centers and SWOs is a common way in Taiwan for families to share the responsibility of caring (Q. F.Chen, 2016; Y. Z.Chen, 2018). In those organizations, expertise staffs provide 24-hour care for the service recipients. The services usually include providing food, clothing, residence, and medical supports. By understanding this fundamental difference, it might explain why the focus of energy poverty with disabled people in SWOs has not been found in the studies from the UK but should be one important focus under the context of Taiwan.

2.3.2 Who are the SWOs under GEC?

The ten SWOs in GEC cover the four main types of SWOs, including care for elderly, children, mental impairments, intellectual and physical disability, and the disadvantaged. Among these SWOs, two have been mainly handling the elderly issue; two for orphanages or sick children; four are curing centers for mental impairments or intellectual disabilities; one for the aboriginal tribe in which the people lost their homes after a typhoon in 2009; and the last one for both the elderly as well as intellectual and physical disabilities. These SWOs mainly located in three districts, Yilan, Taoyuan, and Pingtung, with the former two cities in northern Taiwan and the later one in the South. The following table summarizes the ten SWOs with their main issues focused.

Table 2-1. The ten SWOs under GEC

The elderly	Intellectual impairments and mentally disabled	Disadvantage populations	Children
St. Camillus Long-term Care Center	St. Camillus Center for intellectual disability	Pingtung New Laiyi Tribe's Community Center	SOS Children's village, Taiwan
Julin Nursing Home	Huai-jhe Recovering Center		Pingtung Victory Home
The Chensenmei FamilyLand			
	Fu-hua Da-tung Foundation		
	Taoyuan Development Center for the Spinal Cord Injured		

Source: (Sunnyfounder, 2019)

2.3.3 Reasons for having SWOs as the primary beneficiaries

According to Sunnyfounder, the decision to target SWOs as beneficiaries instead of households include two primary considerations, the extended value of green energy and the practical aspect of finding a feasible place for installing solar panels. First of all, social welfare organizations are part of the social security network in society and are seen as the extension of governmental support at a local level. The value of renewable energy, like solar power, has long been focused on its potential contribution to the general environment and carbon reduction. The social value of solar power is not further explored until recently. For example, in India and Sub-Saharan African, solar power has been often used as an alternative and affordable energy option to support the rural economy (Arora, Tejwani, Solanki, Narayanan, &Venkateswaran, 2016; Joshi, Narayanan, Venkateswaran, Solanki, &Kumar, 2019). Due to its flexibility in scale and potential in off-grid installation, solar power is a relatively immediate solution to lacking access to electricity. Under the context of Taiwan, the same flexibility of solar power allows the SWOs to become less dependent on the main electricity suppliers.

From a practical perspective, these SWOs usually own buildings for providing a certain amount of living and activity spaces for the residents. Compared to apartments consisted of different individual households, these SWOs tend to have full ownership over the rooftop spaces of the buildings. This ownership and the big stretch of the rooftops together make the solar power plant more possible with SWOs. Full ownership of the building can avoid the difficulties and complexities of reaching an agreement between different residents in the buildings. Reaching an agreement in building solar panels is a problem often faced by general households in the cities where people live together in the same building and share the ownership of the roof spaces. This same problem is especially evident in Taiwan with such high population density and the majority living in apartments in the cities.

Sunnyfounder assumes that SWOs are facing high expenditure on electricity due to their extra needs for conducting 24-hour care services for vulnerable residents. As a result, they promote the involvement of solar power through GEC projects, expecting the project to generate benefits and energy saving for the SWOs. More importantly, the company also assumes that the rise in electricity price align with energy transition plans will create more financial difficulties for these SWOs, further leading to the inability of SWOs to continue operation and providing caring services. Thus, GEC aims to alleviate this kind of pressure.

2.3.4 SWOs with elderly-care

Among the ten SWOs under the GEC project, the author chose to focus on three SWOs working with elderly-care for three reasons. First of all, the issue of an aging society has gradually become a critical problem in Taiwan. According to the Department of Household Registration, Ministry of the Interior, Taiwan, the population age over 65-year-old has officially exceeded 14% of the total population in 2018, making Taiwan the aging society (Department of Household Registration, 2019; Ministry of Health and Welfare, 2018). This trend is believed to be irreversible. On a global scale, Taiwan is estimated to become one of the oldest countries in the next 30 years (United Nations, 2019b) with an expectation of massive demand for elderly-care coming along. As a result, understanding the specific needs of the elderly in energy usage is also a vital aspect to prepare for moving toward a sustainable society.

Secondly, despite the link with a general social issue, the elderly are one of the most representative groups of disabled and vulnerable people. The elderly tend to face various physical and mental illnesses with age, for example, chronic and arthritis or Alzheimer's and Parkinson's disease (George, Graham, &Lennard, 2013; Snell, Bevan, &Thomson, 2015). Discussed briefly by some researchers, the intellectual and physical impairments can lower the elderly's adaptability to changes of the environments, making them more sensitive to temperature and noise, and could also further lead to other problems like incontinence or sleeping issue (DeHaan, Hirai, &Ryan, 2016; George et al., 2013; Snell et al., 2015; Stewart &Habgood, 2008). This chain of plights makes the aging problem regarding energy consumption and needs more challenging and complex. All these vulnerabilities could hinder the elderly from living a decent life and gaining well-being.

Last but not least, SWOs working with elderly-care are usually more open compared to SWOs working with intellectual impairments or vulnerable children. In the pre-study, the author visited two other SWOs working relatively with intellectual impairments and mental illnesses. During the visit, the author had noticed that the nursing personnel, especially from the SWOs with mental illnesses, were feeling uncomfortable having external visitors or even bringing the visitors around in the building. It was understandable, as explained by the nursing personnel, that the SWO usually does not allow visitors in order to avoid the disturbance to the vulnerable residents. As a result, considering the possibility of conducting fieldwork within the SWOs, the author decided to avoid the SWOs working with mental illness patients.

In conclusion, the cases chosen were three SWOs working with elderly-care, which included The Chensenmei Family Land of Chensenmei Social Welfare Foundation in Taoyuan, St. Camillus Long-term Care Center in Yilan, and Julin Nursing Home in Yilan. Before conducting fieldwork with the three SWOs, the author reviewed the potential issues regarding the higher energy consumption of the elderly and disabled, and the theoretical concepts of energy poverty. The results from the previous research are presented in the next two chapters.

3 Results from previous research

3.1 Understanding energy poverty

3.1.1 The what question: definition and similar terms

Finding the general definition of energy poverty is quite tricky since energy poverty is a global but context-specific issue that there is no single definition that could fit in perfectly under different local and regional contexts. However, there are some key concepts identified and several common factors that can be summarized to learn about the core of the issue. According to the World Energy Assessment (Sueyoshi &Goto, 2000, p.44), energy poverty is defined as "*the absence of sufficient choice in accessing adequate, affordable, reliable, high-quality, safe, and environmentally benign energy services to support economic and human development*." Under this definition, availability and affordability of energy, as well as the necessity of the transition toward the use of sustainable energy, are highlighted. This definition has later been adopted in other studies (González-Eguino, 2015; Li et al., 2014). The European Commission sees energy poverty as a distinct problem from poverty, and it occurs when households' experience with essential energy needs, including attaining warmth, cooling, lighting and powering basic appliances, reaches an inadequate level (European Commision, 2020). Some will further argue that the problems of energy poverty occurring in developed countries and developing countries are different (González-Eguino, 2015; Hills, 2012; Li et al., 2014). This perspective will be further discussed in the next subsection.

Another interesting point from the literature review is the distinction between "energy poverty" and "fuel poverty." Li (2014) and the others clearly state the difference in their paper from four dimensions, including definitions, research priorities, existing situations, and the problems(Li et al., 2014). In general, energy poverty refers mostly to the lack of access to electricity in developing countries like India and sub-Saharan Africa (Li et al., 2014; Nussbaumer, Nerini, Onyeji, &Howells, 2013). On the other hand, fuel poverty initially refers specifically to the situation in the UK where low-income households are unable to heat up the house due to the inability to pay for fuels/energy (Allison, 2019; Li et al., 2014). Later, fuel poverty is also used in other developed countries facing similar warmth sustaining issues like Scotland and New Zealand (Hills, 2012). Thus, in conclusion, the focus of energy poverty is on "availability," while the focus from fuel poverty is on "affordability" (Li et al., 2014).

Although the two terms have some differences in study targets and focus, they have been mixed-used in many studies since the fundamental stance has been quite similar. Both terms consider affordability, sustainability, and leading to well-being as the main focus of energy services and that everyone should have equal possibilities in accessing adequate amounts of energy. Following this rationale, this study uses the word "energy poverty" when discussing relevant issues with energy affordability, justice, and cleanness.

3.1.2 Measurement of energy poverty

Measurement is not the main focus of this study but might be worth mentioning in order to provide a better understanding of how to identify energy-poor in reality. Initially being used to measure fuel poverty by the Department of Energy and Climate Change, Government of UK, in 1991, the 10% indicator is now also often used in identifying the energy poverty (Okushima, 2016). When a household has to spend more than 10% of their income on energy services, including cooking, lighting, heating, this household is considered as fuel/energy poor. Although this indicator is sensible and can be used under different circumstances, there are some problems within this measurement that could overestimate the population facing energy poverty. Hills (2012) argued that under this 10% threshold, not only the poor households who are unable to

afford the energy bills are included, but also rich households consuming extremely large amounts of energy might be miscounted as fuel/energy poor too. Therefore, he suggested that when measuring fuel poverty, three drivers of the issue should be considered, fuel price, low-income, and energy efficiency (Hills, 2012).

3.1.3 Drivers of energy poverty

According to Hills (2012), the three main drivers of energy/fuel poverty are low-income, high energy prices and housing energy-inefficiency. Firstly, the low-income driver points out that the families, communities or organizations with financial difficulties might be under higher risk of energy poverty compared to the middle-class above group of people. Expenditure on energy (usually equivalent to electricity under the Taiwanese context) could easily occupy a high proportion of their income which some suggest that 10% above is considered to be high. Secondly, energy price is the external factor that can not be controlled by the energy-poor and is also one of the reasons making energy poverty distinct from the general poverty issue. Some researches have shown the concern for aggravation of energy poverty owing to the rise in energy prices (Zhao &Chou, 2017) or even the evidence of this causal relationship (Okushima, 2016). Align with the energy transition plan, the energy price in Taiwan is expected to rise by 29.4% in the next 5 years (Zhao &Chou, 2017). However, the impact of this change on low-income families or vulnerable groups are still under-investigated. A research gap, this research is addressing. The final driver, energy inefficiency, not only makes energy poverty distinct from the poverty issue, but also highlights the common challenge faced by poor households and the SWOs. Financial support needed to conduct the systematic upgrade for more energy-efficient devices is the main difficulty.

3.1.4 The global interests

Energy poverty is a relatively new topic regarding energy issues in general. It is believed that climate change, the security of energy supply and energy poverty are the three major concerns in the next decades and energy poverty has been the least discussed topic by the government, the public, and academia (González-Eguino, 2015). However, another similar idea 'fuel poverty" had been brought up since the early 90s in the UK, before anywhere else in the world (Hurtado, 2007). At the time, the country was facing health and mortality issues among low-income households being unable to afford the heating service in winter. The reason why energy poverty hasn't been emphasized for a long time could be the default classification of the problem under the general poverty issue and has long been seen as part of the problem resulting merely from low-income (Hills, 2012).

A recent study in Japan comparing energy poverty before and after the "denuclearization" in 2011 provides some concrete examples of the income and energy price factors (Okushima, 2016). This study measures the energy poverty in Japan from 2004 to 2013 and has a specific focus on the comparison in the before and after the 2011 Great East Japan Earthquake and the Fukushima accident. According to Okushima (2016), this was the first academic paper measuring energy poverty in the context of Japan and thus was a novel study. Japan experienced an immediate and intense call for energy transition from a nuclear-dependent system to renewable energy as the main energy resource after the accident. The rapid change of shutting down all the nuclear power plants resulted in massive dependence on fossil fuels and a constant increase in energy prices due to the higher cost of expanding the scale of renewable energy. From 2004 to 2013, low-income and high energy prices had played the key roles in causing energy poverty in Japan and especially after 2011 the price factor had dominated the situation (Okushima, 2016). Vulnerable households like single parents with kids, alone-living elderlies and low-income families were affected the most and were having difficulties in paying the electricity bills regularly.

In contrast to the rising awareness in Europe (Bouzarovski, 2014; European Commision, 2020) and other countries in Asia like Japan and India (Bhide &Monroy, 2011; Nussbaumer et al., 2013), there is a distinct lack of information and academic research regarding energy poverty under the Taiwan context. This is another research gap this study is filling. This will become a challenge when having Taiwan as the geographical object for the study, but might also create an opportunity for the author to contribute new information and raise awareness of the issue.

3.2 Energy poverty and disabled people

The focus of energy poverty has long been on low-income households due to the direct assumption of them meeting the two out of three criteria of being energy poor, referring to low-income, and energy-inefficiency resulting from worse housing conditions. However, more research has probed deeper into this broad scope and found a group of people that are even more likely to become energy-poor, namely the disabled people (Day et al., 2016; George et al., 2013; Gillard, Snell, &Bevan, 2017; Snell, Bevan, &Thomson, 2014; Snell et al., 2015; Thomson et al., 2019). Snella et al. (2017) argue that, in England, "fuel poverty rate was higher amongst households containing disabled people compared to those with-out". The definition of disabled, often includes also the elderly, people suffering from chronic diseases, cognitive and sensory impairments, and physical impairments, etc (George et al., 2013; Snell et al., 2014).

According to Gerorge et al. (2013), disabled people tend to require more energy services, both in types and amounts, in their daily life compared to the non-disabled in several aspects which can include mobility, ventilation, lighting, laundry services, and the use of special equipment. Stewart and Habgood (2008) also found the similar results that, for example, sedentary or ill people usually have more trouble in keeping their body temperature than healthy and active people (Stewart &Habgood, 2008). This condition requires an extra energy expense on regularly keeping the indoor temperature either through an air conditioner or heater. Another special need from disabled people is the more often demand for laundry. This could be resulting from the special hygiene requirements for people with sensitive skin or allergies (George et al., 2013; Stewart &Habgood, 2008). It could also come from frequent washing due to incontinence or eating difficulties (George et al., 2013). All the conditions mentioned above add to the cost of energy for disabled people and the problems faced by them are distinctly different from non-disabled people.

Although the specific energy needs from disabled people seem to be quite evident for them to easily become energy poor, few studies have highlighted their particularity under the energy poverty issue, even the energy poverty policies in England have been criticized for omitting this important aspect (Snell et al., 2015). Many have suggested investigating energy poverty for disabled people from an "energy justice" perspective (Gillard et al., 2017; Sanz-Hernández, 2019; Walker &Day, 2012). Walker and Day (2012) suggested a framework of "three forms of justice in fuel/energy poverty" which help to comprehend the situation of disabled people from three aspects, distributional justice, procedural justice and recognition of justice of energy. This framework is the main theoretical framework for this study and will be further discussed in Chapter five.

4 The theoretical frameworks

4.1 Capability framework in conceptualizing the relationship between energy, energy services, and outcomes

Scholarship over energy poverty has long been on either the accessibility to energy, which is discussed more often in the global South, or the affordability problem influenced by energy price, income and domestic energy efficiency, which is commonly discussed in the global North. The focus of these researches, argued by Day, Walker and Simcock (2016), are defining the relationship between energy needs and its relevant problem like energy poverty simply based on the issue of inadequate income, energy efficiency and infrastructures (Day et al., 2016). However, they argued that the problem pertinent to energy deprivation is more multi-dimensional and should be conceptualized with another more comprehensive definition that will not be limited to geographical scope or the economic development scope.

Extended from the idea that energy per se is not what brings in the true value to human's well-being but the energy services, Day and the others integrate the capability theory to further understand how capabilities and well-being have been further achieved through the use of multiple energy services. Developed by Sen and Nussbaum (DeHaan et al., 2016; Nussbaum, 2000, 2003), the capability theory was initially a critical reflection on the aggregate indicator for evaluating the relationship between economic development and the well-being of humankind. The main argument is that a good performance in aggregate economic development is not the ultimate purpose for all humankind, but the focus of "human flourishing". Different functioning like being educated and keeping in good health as well as the capabilities to obtain these functioning based on individual willingness are identified as more essential to the human flourishing. As a result, income and development in the economy are not the final purposes but just part of the different means to access these significant functioning and capabilities.

The same rationale is used to understand the use of energy services and is shown in Day and the others' capabilities framework in conceptualizing the relationship between energy services and the outcomes. Day and the others (2016) argued that most of the previous research tended to mix up the needs in energy services and secondary capabilities that they often lead to some conclusions of requiring more on energy services to improve living quality. However, more energy consumption as a solution to relevant issues with energy use is not considered as an appropriate solution in line with the overall goal of moving toward a low-carbon and sustainable future. As a result, the problem of energy poverty and energy deprivation should be understood from the ultimate purpose of using energy services instead of having energy services as the ultimate purpose. As shown in figure 4-1, various energy services are the connection between energy and fuel consumption to the fulfillment of the ultimate purpose, which is building basic capabilities.

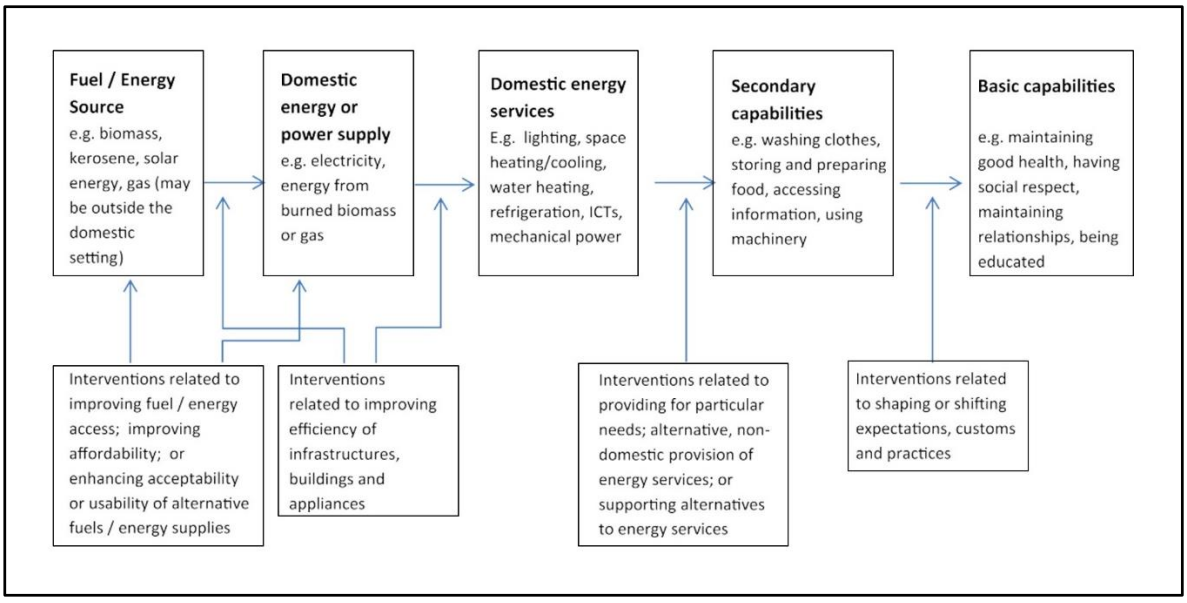

Figure 4-1. Conceptualizing energy use and energy poverty using the capability framework

Source: (Day et al., 2016)

Basic capabilities are defined as the most fundamental and essential ones that, according to Nussbaum (2000), include the ability to live a human life within reasonable length, to maintain good health, and to live with physical integrity, etc. Secondary capabilities are more concrete and specific and can be viewed as the premises for fulfilling basic capabilities. For example, to maintain good health (basic capability) regardless of the change in temperature, one has to keep adequate warmth and cool (secondary capability), and thus is in need of energy services like space heating and cooling. Since the basic capabilities are considered to be the same for all humankind, this framework is believed to have extended the definition and studied objects of energy poverty that it does not lock in with the issue of lacking on certain energy services under specific regions or economics. In addition to defining the problem, the framework is also claimed to have opened up space for more creative interventions that do not always end up with solutions like increasing income or building more infrastructure for transporting energy. Instead, alternatives to energy supply and energy services, or even the change in using practice and custom were also introduced as potential interventions.

The capabilities framework developed by Day and the others (2016) in understanding energy needs and the outcomes of using energy opens up room for a more general discussion on multiple energy-use issues such as energy poverty, energy vulnerability and energy deprivation. Energy poverty was the main potential challenge the author wanted to explore through the case studies with the SWOs, but was not limited to become the only result the author expected to produce. Moreover, the author wanted to explore not only the affordability issue but also other vulnerabilities that could result in the energy poverty of SWOs with elederly care. Therefore, this framework was chosen to support the exploration of the vulnerability of the three studied cases in their specific energy needs. The framework helped to expand the exploration of potential energy poverty issues within SWO, from simply understanding the issue with income and energy expenditure, to deeply investigating the difficulties faced by the elderly and SWOs between energy services and the fulfillment of basic capabilities.

4.2 Three forms of justice under energy poverty

According to Walk and Day (2012), energy poverty can be understood from an energy justice perspective which can be comprehended and realized in three forms: distributional justice, procedural justice, and recognition justice. They argued that the previous studies in energy/fuel poverty have been merely focusing on distributional justice which is the most direct aspect and has overlooked the other two important forms. Thus, the study officially discussed all three forms and created a framework for probing energy poverty from an energy justice perspective. The three forms of justice in understanding the concept of energy poverty are elaborated respectively in the next paragraphs.

Among the three, the distributional aspect might be the most explicit one when discussing the issue relevant to justice. Based on Hills's (2012) categorization, the distributional justice of energy can be understood from three aspects, income, energy prices, and energy efficiency in housing and technology. Distributional issues of income have long been discussed under sociology and economics. For disabled people, it is harder to get stable and high-payment jobs due to their physical or mental constraints that could be unfavorable by the employers (George et al., 2013). This situation often results in lower income on average for disabled people. Moreover, followed the income element, the fluctuation in energy prices will have a higher impact on disabled people than non-disabled since they tend to have less financial resilience or the specific knowledge needed in handling the changes (Snell et al., 2015). As for lower energy-efficiency housing and technology is another challenge that is faced by many poor households with disabled people. With financial difficulties, they tend to live in old and not-well-equipped housing conditions which leads to more expenditure on energy from low energy efficiency.

Procedural justice of energy encompasses access to pertinent information, participation in relevant policies, and the access to legal rights and requirements. Firstly, pertinent information includes specific knowledge in understanding the concept of energy/fuel poverty, the relationship between energy poverty and energy prices, and the potential solutions in tackling the issue. Accessing information empowers the disabled people to comprehend the possible challenge they are facing, to understand the causes, and to seek assistance. Secondly, the procedural justice in energy also looks at the participation in decision making on relevant policies, for example, energy, housing, climate, and fiscal policies which will influence the daily living and energy usage of disabled people. To realize this aspect of justice, advocacy groups and political representatives for disabled people are essential in speaking out for them since it is usually impossible to participate directly as individuals. Lastly, access to legal rights and requirements should not be hindered in the name of simplifying complex discussion or tax saving.

The third form of energy justice, recognition justice, is considered to be the most important form in tackling energy poverty especially faced by disabled people (Walker &Day, 2012). Many have argued that understanding the specific energy needs of disabled people is the key in addressing their situation of energy poverty (George et al., 2013; Snell et al., 2014, 2015). Otherwise, the disabled people have long been stereotyped and simplified as "old and temperature-sensitive" whereas in reality the characteristics and needs are actually quite different and nuanced (Snell et al., 2015). In addition to the stereotyping of the features and needs of disabled people, they are often overlooked in public and political discussions among the energy. Politicians tend to simply conclude that energy poverty faced by disabled people could be solved merely with the national welfare and benefits without noticing the distinction of their situation.

Figure 4-2 summarizes the three forms of injustice under energy poverty. This framework was used to reflect on the actions taken by GEC and to analyze the aspects that have been solved or unsolved by the project.

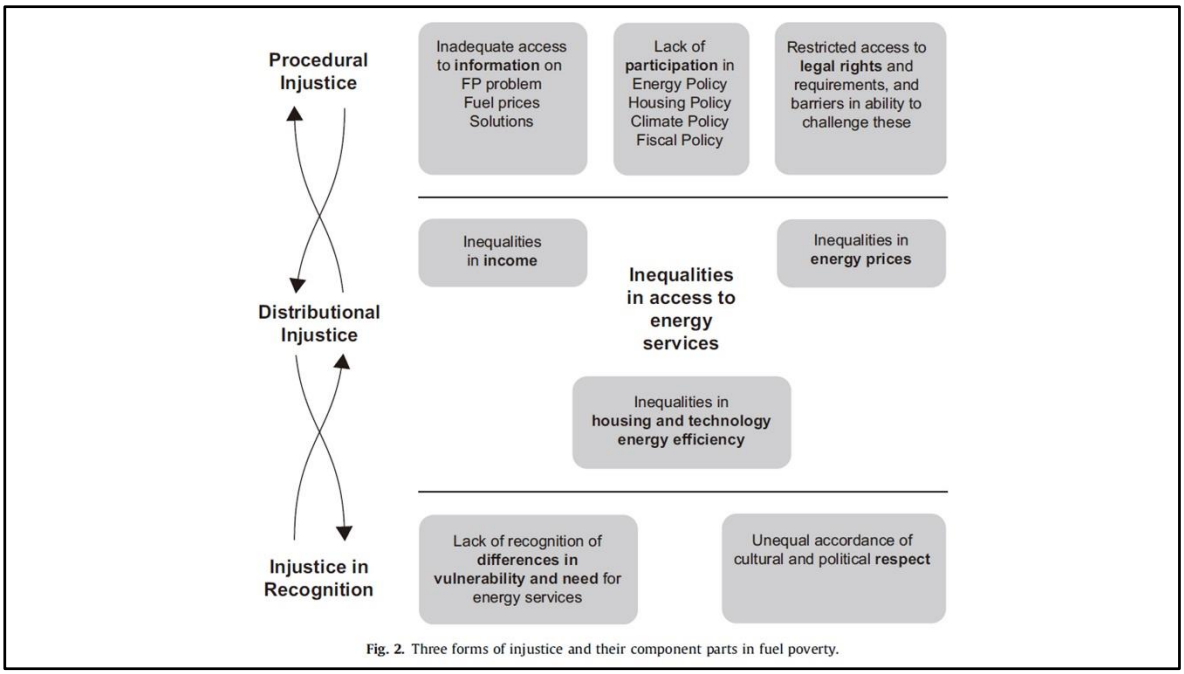

Figure 4-2. Three forms of injustice under energy poverty

Source: Gordon Walker, Rosie Day, 2012

To conclude, the three forms of justice under energy poverty were chosen as the analytical framework for exploring energy poverty in SWOs for the following reasons. First of all, the theory extends the discussion on energy poverty from the three commonly-mentioned drivers, income, energy prices, and energy efficiency, to the participation and recognition of the issue. This will better cover the multiple aspects and levels of the challenges and differential energy needs from SWOs, as well as the values GEC brought in. Secondly, the rationale of the framework viewing energy poverty from an environmental justice perspective also better respond to the core initiative of GEC and Sunnyfounder. The aim of the GEC project does not only focus on the support of solar energy and sustainability in the energy transition but more importantly, to create opportunities for disabilities and vulnerable groups to participate in the energy transition and to be better recognized in their differential needs in diverse energy services. Last but not least, the framework can not only help categorize the current status of the studied cases, but can also serve as a framework for finding solutions from different means, through knowledge empowerment, legal aid, or collaboration with academia, etc.

5 Methodology

5.1 Research design: an exploratory case study

A case study is chosen as the primary approach in answering the research questions. According to Yin (2018), a case study is defined as "*an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used*" (R. K.Yin, 2018, p.114).

The case study can be categorized into explanatory, descriptive, and exploratory case studies (R. K.Yin, 2018). Exploratory case study design has been chosen for this research since it can best support in answering the what and how questions after the external intervention, namely the GEC, has entered the studied organizations. The exploratory case study is also designed for understanding a new phenomenon through an in-depth study of certain cases under specific conditions, and the result from it can inspire further research under the same topic (R. K.Yin, 2018). Energy poverty has been a new term under the Taiwanese context and has rarely been understood from an organizational aspect and scale. Thus, an exploratory case study of the SWOs under GEC will not only serve as the first academic study for Sunnyfounder on their project results but also give a reflection back to the definition of energy poverty, inspiring for more studies in the energy-relevant challenges faced by communities and disadvantaged organizations.

Case study is often being criticized for lacking reliability, validity, and ability to generalize theories or concepts (R. K.Yin, 2018). However, the in-depth study of certain cases with the use of multiple data has made case studies more holistic compared to theory-based studies (R. K.Yin, 2018). Besides, some argue that the collective results found through multiple cases can be developed into some form of generalization and can be replicable (Noor, 2008). Case studies in this research will be an in-depth understanding of the typical pattern in energy consumption and the benefits from either energy saving or income increase within the chosen SWOs after joining the GEC. Three SWOs handling the elderly care issue were chosen instead of all ten recipients under the GEC to lower the complexity of data collection, make sure the depth of each studied case, and reflect upon the sustainability in an aging society. It is also a choice of considering the time limit and a proper scope of the thesis that handling a social issue at one time and focusing on only three cases is appropriate for the scope and workload.

In the next section, details in data collection regarding interviews and observation will be justified further in the reason for choosing the methods and the data expected to be collected from both approaches.

5.2 Data collection and analysis

5.2.1 Data collection/methods

To understand how Green Energy Charity (GEC) has been implemented in SWOs, this study bases on qualitative data collected through interviews and observation. Qualitative data includes the understanding of the perspective of the SWOs' owners (or the main person in charge) on the energy-relevant challenges faced by the organization, the reason for these challenges to occur, and the changes after joining GEC. According to the previous work and studies that were done by Sunnyfounder, the main challenge regarding energy usage within these ten SWOs is identified as high expenditure in electricity due to their particular needs (e.g., to keep the indoor temperature steady for ill patients and elderly). This research wants to investigate more in-depth problems regarding specific energy services and potential challenges in accessing these services within the SWOs. The study also wants to explore other challenges that could be addressed

directly or indirectly through GEC. Moreover, some key challenges and their causes might be identified and generalized. These results can be further used as a correspondence on investigating and comparing other similar SWOs. Additionally, the author intends to understand these SWOs' motivations for joining the project and their concerns over it. This information can be valuable in inspiring recommendations for adjusting the current model into more effective and appealing ones.

Interviews

The interview allows for the understanding of individual perspectives under a specific topic and is a suitable way to explore the respondents' in-depth opinions that could better explain the why and how of a condition (Adams, 2015; Steinar &Svend, 2009). Interviews are also often used in case studies. It can either serve as the primary method in data collection or the supporting methods in verifying information generated through other resources (Adams, 2015; Steinar &Svend, 2009). The interview is the primary method for data collection in the study to learn in-depth opinions from the different participant groups under GEC.

Among different types of interviews, semi-structured interviews (SSI) is chosen as the best method in this study for the following two reasons. SSI is an intermediate method that falls between closed-ended surveys and open and free focus group interviews (Adams, 2015), leaving more room for additional questions and unexpected answers while the direction is clear. SSI gives the flexibility to explore additional thoughts during the interview with open-ended questions (Adams, 2015). SSI is also suitable for one-on-one interviews allowing for delving into in-depth and independent opinions within a limited time (Adams, 2015). This characteristic fits well with this study since the research enters the field with a roughly clear direction, but the data collected is not limited to only the prepared topics or questions. Instead, the researcher was expecting to discover more concepts that had not been thought of before entering the field, for example, various energy services required by different SWOs, within a controlled time to avoid frustration or too much bothering for the interviewees. This type of interview also properly fits with the purpose of this study in which the initiative and opinions on joining GEC are probed.

The interviewees can be categorized into three groups, the project recipients, interested parties, and the administration (Adams, 2015). The project recipients are mainly the SWOs and their representatives. Note that the residents within these SWOs seem to be part of the recipients but were not interviewed mainly due to two reasons. Firstly, the joining of GEC did not change the way of their living (e.g., less or more access to air conditioning). Secondly, and more importantly, it is inappropriate and impossible to interview the vulnerable residents who are suffering from physical sickness or intellectual impairment. As a result, the owner or managers of the SWOs are the targeted respondents instead of the residents. Interested parties, in general, include the suppliers and contributors to a program (Adams, 2015). In this case, they might be sponsoring enterprises but are omitted since they are outside the focus of this study. However, interested parties also include "*any other stakeholders who are neither the direct recipients nor the program administrators*" (Adams, 2015, p.494). In terms of this, some academic researchers and the representatives from the government sectors are part of the interested parties. Lastly, the administration here mainly refers to Sunnyfounder's employees, who are the primary operator of the GEC project. The administration also overlaps with the representatives from the SWOs that have been engaged in the GEC.

Note that the recipients of the project are the most significant group of stakeholders in this study. The author manages to interview the core members from each of the three SWOs. These respondents are either the director or the top manager of the SWOs. They are also the primary contact persons for the GEC project when collaborating with Sunnyfounder. As a result, these respondents from the SWOs all acknowledge well on their domestic energy usage, issues of

elderly care, and the whole implementation process of the GEC, making the information provided from the group of recipients more reliable and credible.

Sunnyfounder was the primary contact mediator between the author and the interviewees and was responsible for introducing the author to the SWOs. After the first connection, the author sent messages through the communication software Line directly to each of the interviewees and briefly explained the purpose of the interview as well as the author's research focus. Prior to every interview, the author asks for permission to record the interviews. The consideration for confidentiality of the interviews is also informed. All the interviews are conducted voluntarily. Besides, the informants are confirmed with their preference over being anonymous or not in the study. If one interviewee has expressed the wish to be anonymous, then all the names of the interviewee and institution will be covered. A list of interviewees can be found in appendix A. It is worth mentioning that having Sunnyfounder as the contact window has massively lowered the possibility of being rejected by the SWOs. However, the author had to be careful with how she introduced her role to the SWOs. In order to obtain more neutral interviews, the author has always presented herself as a master student who is interested in the GEC and is doing a collaboration with Sunnyfounder instead of introducing herself as a colleague or intern from the company. By doing so, the author tries to clarify that the primary purpose of the interview is not to merely probe and confirm the values of the GEC but also to reveal the real challenges SWOs might be facing and the opportunities of finding solutions from solar power through the GEC model.

Lastly, note that all the interviews are conducted in Mandarin, which is both the respondents' and the author's native language. The author thus has substantially prevented the possible misunderstanding resulting from language barriers. In the next section, the supporting method for increasing the validity of the data, namely observation, is further elaborated on its definition, types, and the application in this study.

Observation

The observation is planned as another major method in data collection. During a pre-study conducted earlier in February of 2020, the author did two observations with the other two SWOs outside the studied ones. Note that, however, due to the later severe outbreak of COVID-19, the author is unable to conduct further observations with the three studied cases. The data collected with the three chosen cases mainly rely on interviews. Nevertheless, as observation is one of the significant methods designed for the fieldwork, the author finds it still worthy of presenting as a research design under the methodology to explain what the author expected to add through the observation.

Observation can be useful in discovering the untold or hidden behaviors that the participants did not mention or were considered silly and unwilling to mention (Greg, Emily E., &Marilyn L., 2013). Some roles, routine actions, and behaviors might be important for the study, but the actors might be unaware of its importance, or the actors are unwilling to talk about them. For example, specific energy-saving actions could have been done in organizations and might have influenced the living quality of the residents. Compared to turning off the heaters, as a more explicit action, mentioned in the previous studies of fuel poverty in the UK, more implicit measures within SWOs in Taiwan might be less running hours of air conditioners.

Direct observation and participant observation are the two types of observation and are both planned to be used in data collection. Direct observation does not require any interaction between the observer and the ones being observed (Greg et al., 2013; R. K.Yin, 2018). The focus should be on the facts and objects that can be observed without probing opinions from and asking questions to the observed. In this study, the observable data could include the

electrical equipment on-site, the number of people, the frequency one certain equipment is used or mentioned, etc. To make it more specific, this kind of observation is designed to obtain certain data relevant to the frequency in this study. For example, these data include the frequency of using the elevator, rehabilitation equipment, laundry machine, just to name a few, in a normal-operating day within the SWO. In addition, photographs are another important data collected from direct observation that could help to evident other data (R. K.Yin, 2018).

Participant observation, on the other hand, aims to discover the untold roles, routine actions, and behaviors by joining the participants under their context and staying in a neutrally-observing position (Greg et al., 2013; R. K.Yin, 2018). Data collected through participant observation is more free-flowing compared to direct observation. The result analyzed could also be more interpretive. The purpose of using mostly participant observation in this study is to discover the behaviors regarding energy usage that might be some routines in common-operating days. These behaviors encompass the turning on/off of the air conditioner or lights when leaving the room or other energy-saving practices.

Due to COVID-19 constraints, the only two observations were conducted during an earlier pre-study with other two SWOs, through participant observation. These observations serve as an exploratory strategy for understanding essential elements on-site as well as structuring the data collection. During the pre-study and before any interview, the author joined a field visit with a government-supporting group consisting of one representative from industry supporting consultancy, one academic expert, and a colleague from Sunnyfounder. Each visit lasted one hour, including a tour inside the buildings and a meeting with the representatives from the SWOs. Duration and visited SWOs are summarized in Appendix A. Although the visit was to two other SWOs other than the three chosen cases, it helps the author to categorize and generalize some everyday energy needs within SWOs, which has massively helped structure a more precise interview guide.

5.2.2 Data analysis

Interviews are the primary resources of the data generated from the following three interview groups, which are the project recipients (the SWOs), interested parties (academic researchers), and the administration (colleagues from Sunnyfounder). Interviews with the three SWOs and colleagues from Sunnyfounder are for answering the first and second research questions. The interview with the academic researcher is to support the understanding of the concept of energy poverty and the relevant research in Taiwan.

Interviews with the SWOs encompassed four themes of questions, including a) an introduction to the institutions and their roles, b) current condition and needs in energy usage within the SWOs, c) their understandings of GEC and the impacts GEC have brought into the SWOs, d) acknowledgment of energy transition and potential concerns for it. More details in the interview structure are presented in Appendix B.

All interviews were first transcripted and then coded with NVivo (Earl, 2013). The analytical framework for organizing the energy usage data is based on the capability framework, which has been introduced previously in chapter 4. The benefits and justice aspects that have or have not been covered by the GEC are analyzed with the three forms of justice under energy poverty, which is also explained in-depth under chapter 4. The intertwining of two theoretical bases forms the core theoretical framework of this study.

5.3 Reflection on methodology

The first reflection of the methodology is the importance of using the familiar communicating tool that the respondents are using. In the author's experience, one SWO and the coworkers from Sunnyfounder states that they often use a communicating app called Line instead of other communicating applications like a Facebook messenger or Whatsapp. Initially, the author had some trouble using the mobile application Line. The communication with coworkers from the company and interviewees was done through other means like the Facebook messenger and phone calls. The author soon realized that by communicating through messenger, both coworkers and the interviewees tend to ignore the messages or reply later. After the author solved the problem and switched to Line with the respondents, the messages were rarely ignored. Most of the time, they would reply within a few minutes after the messages were sent. Using the right communication tool can massively speed up and facilitate communication.

The introduction of the interviewer during the interview, in the beginning, is another important factor in creating a comfortable environment for communication, avoiding letting the respondents feel doubted and challenged. During the first interview, the author made a small mistake regarding this. In order to show credibility and professionalism, the author introduced herself first as a graduate student studying in a foreign country. The author soon realized that the interviewee had put on his guard and became more aggressive in talking that his tone raised up, and he talked faster. He also asked the author three times whether the author understood anything about elderly care and what the author had learned before that interview. The author could sense that the interviewee felt the pressure of presenting his professionalism and thus turned to doubt the author's professionalism in studying in this topic, especially in issues related to elderly care. This first interviewee is at a relatively young age in being at his position (the top manager of the SWOs), as his co-worker also emphasized his young age when introducing him to the author. Therefore, the author guesses that the interviewee might have felt challenged by the author in the beginning when the author made her introduction sound like an environmental elite coming from a foreign university but acknowledging less about social issues and elderly care. The tension faded right after the author revealed her study background in sociology, which is more similar to the interviewee's study background, social work, and that the author had acknowledged certain information about the study and expressed the respect for his work. He then understood better the motivation of the author studying energy poverty within SWOs. The respondent thus became more relaxed in the interview (e.g., sit back in the chair instead of leaning forward to the author, and lower the speed of speaking).

Lastly is the reflection on the contact process of the interviews. Some questions regarding data were asked during the interviews, for example, the monthly expenditure on electricity and the proportion of electricity expenditure compared to the total income and total expenditure. Since the interview questions are not sent beforehand to obtain more neutral and intuitive responses, the interviewees are not prepared for the exact answers to these data-relevant questions. Much of the data are thus obtained through text messages and emails after the formal interviews. Sometimes, it could be hard to keep track of every data with different people after the interview. The remaining questions or data needed are thus organized with post notes in the author's notebook to help remind the collection. What could be done better is to inform interviewees in advance not only the purpose and scope of the study but also questions regarding data of numbers and facts. Moreover, the quantitative data was not accessible in some SWOs due to confidential reasons, which has limited the author's data collection and analysis to certain extend.

5.4 Limitations

The outbreak of COVID-19 from January 2020 has been the biggest challenge throughout the research. Neighboring the first out-breaking country, China, Taiwan has been under high pressure since the very beginning. The author has a struggle on whether to visit the SWOs on-site since the residents within the three chosen SWOs are one of the most vulnerable groups at the very moment. Finally, under mutual agreement, the interviews with the SWOs are mostly conducted on-site, but only in the visitor areas. The author also has rigorously followed the visiting rules. However, further observations after the pre-study are not possible since the overall situation of COVID-19 has gotten worse in March. Some of the later interviews are thus also conducted through other online approaches.

5.5 Ethical considerations

All interviewees are informed of the purpose and scope of the study before the interviews. Interview questions are not proactively sent to the interviewees beforehand unless being required. Explicit consent for interview recording is obtained prior to every interview. Moreover, respondents are informed in advance of the option of being anonymous. Records and notes from interviews and observations are saved in a password-protected online drive folder.

In consideration of respecting the residents and concerns for coronavirus, all interviews are conducted in public and visitor areas other than the residential areas. The author's own traveling history is honestly informed before every interview. The author has also rigorously followed the visiting rules, including wearing masks throughout the whole visit, temperature checking, and hand disinfecting before entering the organizations.

The research is not funded by Sunnyfounder, although the company supervisor has kindly called the author the intern to help build credibility for the author when contacting interviewees. The researcher remains independent of the company and has always introduced herself as a student from a master's program. Institution supervisors and the company supervisor have provided suggestions and feedback on the scope and methodology of the study; however, the theoretical framework, literature review, and result analysis are not influenced by them.

6 Empirical results and finings

6.1 An overview of the three studied cases

This section gives a brief overview of the three studied cases before discussing and comparing examples from each case. Interviews were conducted with three SWOs working on elderly-care. All three SWOs provide 24-hour of residence and care services for the elderly. The service recipients are slightly different between the SWOs. In the Chensenmei Family Land, they provide service to both the elderly and younger people with intellectual impairments. Hence, rehabilitation for relatively younger residents is one of their main focuses. The other two SWOs consist of the elderly aged over 60. Julin Nursing Home also provides hospice care for terminal-stage patients. All three SWOs are medium size organizations consisting of over 50 and no more than 200 residents (Ministry of Health and Welfare, 2012).

The scale of the built rooftop solar panels ranges differently between the three cases. The Chensenmei Family Land owns the biggest power plant among all the ten SWOs under the GEC project. This has allowed them to gain massive incomes from selling green electricity. Julin nursing home was the last SWO joining the GEC project and has yet started to generate income from the power plant. According to both Sunnyfounder and the director from St. Camillus Long-term Care Center, they had taken extra effort in discussing the contract and installation process, thus it took longer than usual from joining the GEC to start selling green certificates. The information is summarized below in table 6-1, followed by pictures illustrating the power plants owned by the three SWOs.

Table 6-1. An overview of the three SWOs: services, organizational scale, and information regarding the collaboration with GEC

	The Chensenmei Family Land	St. Camillus Long-term Care Center	Julin Nursing Home
Services recipients	Elderly, intellectual impairments aged over 35	Elderly aged over 60	Elderly aged over 60, terminal-stage patients
Services	24hr care, academic research collaboration	24hr care, community care, respite care, daycare	24hr cares, community cares, respite care, daycare
Number of residents[2]	52	120	96
Green Energy Charity			
Power plant scale/capacity	168 kWp	22 kWp	44 kWp
Investment in installation	9,090,000 TWD	1,400,000 TWD	1,024,580 TWD
Sponsors	Company + more than 3000 individuals	Only the company	Company and its552 employees
Model applied	Sub-model 1: FiT	Sub-model 2: green certificate, energy saving	Sub-model 2: green certificate, energy saving
Project started	July 2018 (started selling electricity since May 2019)	March 2018 (started selling green certificates since February 2019)	July 2019 (Not yet selling green certificates)

[2] The number only includes the residents living inside the SWOs who are the main service receipients. Note that there are also people coming into the SWOs for day care but are not included in this number.

Source: The data were cross-collected through interviews, official website and Facebook page of the SWOs, official website of Sunnyfounder, and summarized by the author

Figure 6-1. Solar panels at the Chensenmei Family Land

Source: Taken by the author

Figure 6-2. Solar panels at the St. Camillus Long-term Care Center

*Source: Sunnyfounder webpage (*https://www.sunnyfounder.com/fund_projects)

Figure 6-3. Solar panels at Julin Nursing Home

Source: Taken by the author

The next sections compare and summarize the energy needs within three SWOs, as well as the respondents' insights on the relationship between energy use and elderly-care.

6.2 Differential energy needs within the SWOs for elderly-care

Demand in energy does not come from energy per se but the energy services provided through the use of energy, such as cooling, heating, and lighting (Day et al., 2016; Wilhite, Shove, Lutzenhiser, &Kempton, 2000). These energy services further fulfill different capabilities that one needs in order to live decently and obtain well-being (Day et al., 2016). This rationale lies in the initiative of understanding the use of energy and the issue of energy poverty through the capability framework in which the energy services are required and essential in realizing multiple capabilities of the users (Day et al., 2016).

As already mentioned in the previous research results, the recognition and understanding of different energy needs from various vulnerable populations, such as elderly and children, is a relatively underdeveloped area under energy poverty but is equally important especially in studying the causes of energy poverty. Therefore, to answer the first research question of the energy needs and potential challenges faced by SWOs, respondents were interviewed about the significant energy uses for daily caring services that are important for the SWOs' to maintain decent living quality for the elderly. The data was then organized and analyzed using the capabilities framework suggested by Day and the others (2016). The capabilities framework has opened up a broader perspective for understanding the possible occurrence of the issue under all kinds of context and geographical scope (Day et al., 2016). Since basic capabilities like maintaining good health and living with respect are fundamental living goals shared by all humankind, the framework heightens the discussion of energy poverty to a level of defining energy poverty as when people fail to fulfill the basic capability through the use of energy. The studied object is thus not limited to households or individuals, but also a community or an organization. The framework is chosen to generalize and conceptualize the energy using patterns and challenges between different SWOs, and to remind the interveners to focus on the

capabilities building when addressing energy deprivation. After all, the ability to maintain good health and living with dignity till the end of life matters the most for the elderly and helping to fulfill this wish is the main existing purpose of the three studied SWOs.

The commonly basic capabilities for the elderly shared by the three studied SWOs include living a reasonable length of life, maintaining good health, and living with physical integrity and social respect. Some also add the capability to have fun and enjoy activities. These basic capabilities might seem to be intuitional and not a big deal for many ordinary people with good health already, but for the residents in the SWOs, especially the elderly studied in this research, they strongly rely on various energy services to maintain a normal or basic living. By using the capability framework for understanding the energy using pattern, the energy services and its utilized outcomes can be organized into the capabilities framework with five important concepts, namely the fuel/energy source, domestic energy or power supply, domestic energy services, secondary capability, and the basic capability, as shown in figure 6-4.

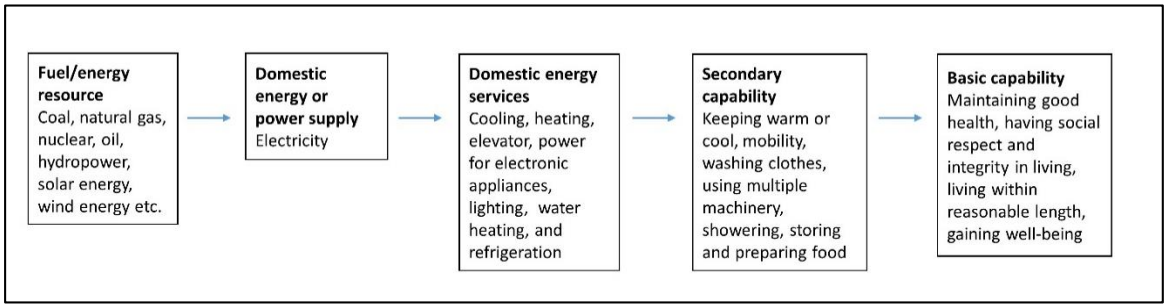

Figure 6-4. Energy use of SWOs structured in the capability framework

Source: Illustrated by the author based on the capability framework of energy poverty

The main domestic power supply to all kinds of energy services, except the gas for cooking, is electricity. Nearly 90% of electricity in Taiwan now comes from natural gas, coal and nuclear power (Taipower, 2020b). The proposition of renewable energy only accounted for 6% of the total electricity generation. Among the renewable energy, solar power accounts for 28.2% as the second biggest followed after hydropower accounting for 39.3% (Taipower, 2020b). The supply of energy resources and power supply is dominated by the centralized power supply company, Taipower, which is a state-owned enterprise.

In the next sections, the domestic energy use patterns in the studied SWOs are first described and compared, followed by the discussion of secondary and basic capabilities required in the SWOs. Finally, further elaboration on the reasons for extra energy needs is presented in 6.2.3.

6.2.1 Domestic energy services within SWOs

During the first two observations in other SWOs prior to the rest of the interviews, the author had summarized a brief list of energy services mentioned in the visit. The list was used as a reference for the later interviews to understand the respondents' perspectives on different energy services. This section summarizes the findings for the first research question.

In all three SWOs, domestic energy services encompass seven common types of needs, including cooling, heating, elevator, power for electric machinery, lighting, water heating, and refrigeration. The significance of each energy service is slightly different within a SWO. Nevertheless, among the 7 energy services, space cooling, heating and the use of elevators were reported to be the most important services. Note that the author intentionally separated the

energy service of running the elevator from part of power for electric machinery since elevators were many times emphasized by all the respondents from the SWOs on its essentialness for their daily operation and its uniqueness for SWOs with high-rise buildings.

In addition to having the same three significant energy services, the three studied SWOs also share similarities in other energy services which are further elaborated in the following paragraphs.

Cooling/air conditioning

Cooling is essential in SWOs and especially under the context of Taiwan under subtropical climate. In all three SWOs, the cooling system is provided with separate air conditioners in different rooms. In this way, it is believed to be easier for management and temperature control. During daytime, when the residents are out from the bedrooms, the nursing personnel or "teachers", as one of the respondents called them, will help turn off the air conditioner to save electricity. As one SWO had specified, they will turn on the air conditioner when the temperature reaches around 27~28 degree Celsius, and control the room temperature around 25~26 degree Celsius which is believed to be most comfortable for the elderly and also energy saving. Other SWOs reported to act the same. However, the air conditioning services control in public areas might be a bit different between different SWOs. In one SWO who has some residents with better mobility and health conditions, they do not control the freedom of the residents in moving and staying, so wherever the resident is, even when there is only one person in a room, they will still turn on the air conditioner if it is needed. But this might not be the case for other SWOs in which the residents are moving and doing activities in groups. In this case, the energy consumption of air conditioners in public areas might be less.

During night time, the air conditioners are usually turned on in the evening and run until two to three o'clock in the morning when the overall environment is cooler. Between the dawn to eight to nine o'clock in the morning, the cooling system is supported by electronic fans and opening the windows. This is due to the consideration of energy saving and health concerns for the elderly. According to one respondent from Yilan, the location of the SWO in the northern part of Taiwan and in rural areas with more open spaces together create a relatively comfortable climate in the summer compared to other SWOs located in urban areas or Southern part of Taiwan (Respondent 5). As for health considerations, replacing indoor air with fresh air is considered to be important for maintaining the elderly's good health.

Among all three cases, space cooling service is considered to account for the biggest portion of energy consumption during summer. It is also hard to cut down on the consumption since the service is essential and hard to be replaced with other means, especially in elderly-care. Among the three SWOs, one has highlighted that the organization invested more than 10,000,000 TWD (roughly 310,000 Euro) ten years ago on changing all the air conditioners into more energy-efficient ones. As the respondent argued, the massive investment was worthy since energy-efficient air conditioners had helped the SWO save a lot of money. Still, in that same organization with the largest population among the three cases, the monthly electricity expenditure during summer is usually around 200,000 TWD (roughly 6,200 Euro) while it is only 50,000 TWD (roughly 1,550 Euro) during winter. The need for cooling services during summer is thus considered as the main factor of causing the huge difference in energy needs from SWOs.

Heating

Although heating might seem relatively minor compared to cooling, it is on the other hand important during the winter for especially the SWOs with elderly. In the winter, cold waves usually start from time to time in December and last until February or March. On normal days,

the average winter temperature is around 15 to 22 degree Celsius, but cold waves will bring in sudden temperature drops to 10 or even lower degrees for a couple of days or even weeks. Elderly people are especially vulnerable to a sudden temperature drop and cold weather in general. Thus, heating becomes another important energy service in Taiwan during the winter. One SWO uses three mobile electric heaters or heat fans that can be put in the shower rooms or public spaces to adjust the temperature. The other two SWOs have been using the air conditioners, which also have the function of delivering warm air.

The heating service in SWOs is an extra need in energy services under the context in Taiwan. In general, households or school dormitories are usually not equipped with heaters and the function of delivering warm air through air conditioners is rarely used. This is because the coldness in the winter is relatively bearable in Taiwan for healthy people. People tend to make behavioral adjustments like wearing more layers of clothes, closing the window to avoid cold winds, and covering themselves with blankets when sleeping. People also think it is not worth having a heating system at home since the winter is much shorter than summer. In the SWOs, the behavioral adjustments are made to certain extent due to the sensitivity of the elderly which will be discussed further under 6.2.2. Moreover, heaters are essential for the elderly when doing activities outside their rooms during daytime.

The use pattern of heating service is similar to cooling service, adjusting according to the temperature and usually running for four to six hours at night from the beginning of the sleeping time. Due to safety concerns, SWOs are either using less electric heaters or not using the device at all. The main heating service is still provided by air conditioners. In addition to electric heaters and air conditioners, another type of heating service was mentioned, the special room with the far-infrared ray floor heating system. The floor heating system is used as a support to the main heating system.

Elevator

Elevator is another important energy service which was emphasized by all three studied cases. In order to provide enough living space for the residents on limited land areas, all three SWOs come in buildings with at least three floors. The SWOs thus strongly rely on elevators to provide vertical mobility for delivering services and transport the residents. Elevators are used often both by the nursing personnel and the residents for moving around to conduct different activities. For example, in two SWOs, the rehabilitation areas, restaurants and gardens are located on the first floor whereas the bedrooms are located on the second floor and above. One SWO calculated that their basic trip per day of using the elevator is 200 times, but the real condition often exceeds this number (Respondent 8). Another SWO reported their daily use of one elevator more than 50times at least (Respondent 6). In addition to the high frequency of using the elevator daily, what makes the service of elevators different from cooling and heating is that it is consuming electricity for 24 hours. In order to provide service at any time, the elevator has to stand by all the time. Moreover, the elevators in SWOs are designed to be bigger in size to contain a bed when moving the residents. The elevator service hence adds to the total consumption of electricity, particularly in SWOs with two-floors or above buildings.

Space cooling, heating and the use of elevators are the three energy services especially emphasized by all three SWOs. The use pattern of three services in supporting the daily operation also shares similarities among the three cases. The following paragraphs discuss the four other energy services that have either shared less similarities between the SWOs or are not as significant as the previous three services according to the respondents.

Power for electronic appliances

Some often used electronic appliances in SWOs for elderly-care include medical devices, rehabilitation equipment, and washing machines. Medical devices include oxygen concentrator, machine for sputum suction, and other devices supporting breathing and body circulation. The amount of use on different medical devices depends on the type of resident the SWO is caring for. According to one of the SWOs with more elderly at the terminal stage, this kind of residents highly rely on multiple medical equipment like oxygen concentrators and suction machines to sustain their lives (Respondent 6). On the other hand, the SWOs that do not provide services for terminal-stage patients have less needs in using these medical devices. Instead, one of the SWOs has extra needs in rehabilitation equipment compared to other SWOs since "deferring aging" has been one of the SWO's goals in supporting the care for relatively younger elderly with intellectual impairments (Respondent 1 & 2). The residents in that SWO thus have been spending more time than an average elderly in rehabilitation. Lastly, washing machines and dryers for laundry are two other energy-consuming equipment that are used on an everyday basis. To give examples, the most frequent use is a SWO with around 120 residents requiring three washing machines running ten times per day and one dryer running six times per day (Respondent 8). The least frequent use is another SWO with 96 residents requiring one washing machine and one dryer each running one time per day (Respondent 6).

Water heating, lighting, and refrigeration

Water heating, lighting and refrigeration are the three services that the SWOs had reported to be less significant in their total energy consumption. Through changing or supporting electric water heaters with heat pump systems, water heating is no longer an energy consuming service. Nevertheless, note that the average demand for hot water from the elderly per shower is often more than a normal person uses since the elderly tend to use more time in taking showers due to their disabilities.

As for the lighting service, the SWOs all reported to have used or recently replaced the old ones with LED light bulbs for the purpose of saving energy. In addition, the respondents often viewed lighting as one of the easiest and most direct ways to save energy. One of the SWO, in particular, showed little concern on lighting service since the whole building was designed according to the principle of green building. Large pieces of windows, for example, allow the natural lights to come in and have helped save the energy consumption of lighting during daytime.

Refrigeration was the last to be mentioned by the SWOs and was considered to also be less influential in their energy consumption. Refrigeration often comes as part of the kitchen equipment and is considered to be accounted as a basic, fixed and small-portion of energy service compared to other services. One of the SWO does not have their own kitchen or cooking area within the building and thus exclude the service of refrigeration.

6.2.2 Secondary and basic capabilities

The above section gives an overview on the essential energy services required by the three SWOs and points out where the extra needs might occur. However, it does not provide the explanation on what has caused the difference in energy needs among the elderly. Capabilities framework gives the possibility to understand SWOs' energy needs from a capability building perspective which can respond to the core existing purpose of the SWOs. As a result, before probing into the reasons for the extra needs within the studied cases, one has to first understand the capabilities that are essential for the SWOs and how different energy services are supposed to fulfill these capabilities.

Basic capabilities can be understood as the ultimate and the most general purposes of using energy. In the case of SWOs with older people as main service recipients, the basic capabilities encompass the ensure of good health, decent life and social respect for the elderly regardless of their disabilities and impairments. There are many aspects and approaches to take into consideration of fulfilling these basic capabilities. For instance, building a comfortable and sanitary living environment can lower prevalence and morbidity for the elderly who tend to have poorer immune systems for bacteria and viruses. To ensure the provision of quality in multiple living aspects like food, clothing, housing, mobility and well-being, different secondary capabilities transformed from energy services thus play the key role to support the fulfillment of basic capabilities.

In Taiwan, energy resources are usually transformed into electricity so the provision for energy services can be diverse in meeting different needs. Space cooling and heating through air conditioners and ventilation systems help support the secondary capability of obtaining adequate indoor warmth and coolness. The use of elevators enables the elderly with higher vertical mobility. According to Nussbaum (2000), ensuring one's mobility to move around freely can further contribute to the realization of living a decent life with integrity and social respect. As one respondent had observed, the elderly with better health conditions often use the elevator to transport themselves to the first floor and take a walk in the garden, or sometimes visit other people on other floors. Power for appliances supports the secondary capabilities like washing clothes, using medical equipment and doing rehabilitation. Other common secondary capabilities within the SWOs include showering and preparing and storing food, etc. A flow of how energy services transformed into secondary and basic capabilities is shown in figure 6-5. Most of the secondary capabilities directly contribute to the maintenance of good health and keeping a reasonable length of lifetime. Among the secondary capabilities, laundry, showering and mobility especially also contribute to living with integrity and social respect.

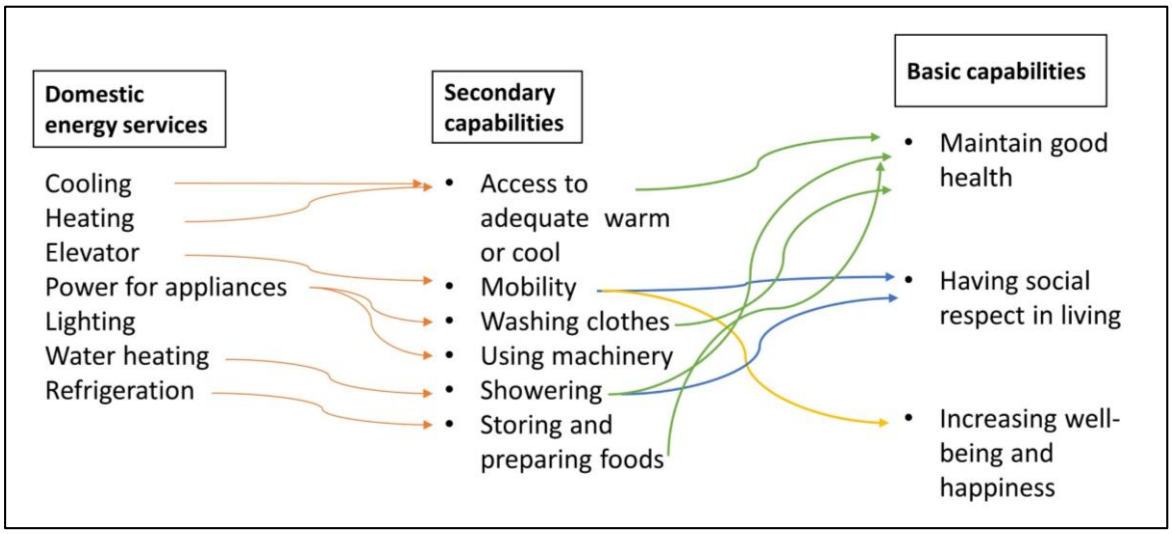

Figure 6-5. The nexus between energy services, secondary capability and basic capabilities

Source: Illustrated by the author

All the secondary capabilities provided through the use of energy services ultimately attempt to support the basic capabilities which include maintaining the elderly's good health, ensuring the elderly are able to live, and supporting them to obtain social respect and integrity regardless their health and age. However, to what extent a basic capability is considered to have been achieved, the standard can be quite different between SWOs. In the three studied cases, the respondents

all showed strong confidence in their service quality and their high achievement of fulfilling the three basic capabilities for the elderly. The respondents often mentioned and compared themselves with other less qualified SWOs in terms of service quality and the residents' well-being (Respondent 2, 5 & 6). One respondent even encouraged the author to visit more other SWOs in the same district and experience the difference (Respondent 2). Furthermore, some other bigger and famous SWOs in Taiwan were questioned by the respondents for failing to make proper use of their huge amount of donations to improve service quality for the service recipients (Respondent 5 & 6). As one respondent told the author,

"*...they[the donors] feel like supporting those poor SWOs are reasonable and natural, but what they do not know is that, what we often have told people, these "poor" ones are taking the money but doing nothing, and continuing pretending to be poor. At last, the most suffering people are the service recipients.*" (Respondent 6, Director of Julin Nursing Home, 27th of March). One respondent emphasized that some other SWOs have been providing exactly the same basic quality of service for the last 10 years (Respondent 2). Other respondents used the words "poor and pitiful" to describe the residents living in those organizations that have only received the very basic capabilities just for staying alive (Respondent 5 & 6).

A difference between the studied SWOs and the other SWOs compared by the respondents can hence be delineated as the failure or success in assisting the elderly to live with integrity and social respect. While the three studied SWOs claimed to have fulfilled the three basic capabilities and some even have covered extra basic capability such as the "play" aspect (Nussbaum, 2000), many other SWOs were believed to have only fulfill the first basic capability for the elderly, partially fulfill the second one, and nothing on the third one. Energy services support the realization of secondary capabilities. Nursing personnel then utilize the secondary capabilities to fulfill the basic capabilities for the elderly through providing different services. As a result, the extent of the fulfillment of basic capabilities is influenced by both the accessibility to different energy services as well as the adequacy of the human resource. From the perspectives of the respondent, human resource seems to be the sole factor resulting in the different service quality between SWOs. Nevertheless, the accessibility to adequate energy services and the possibility to transform energy services into secondary capabilities might also be the driving factors and worth further studies.

6.2.3 Challenges and difficulties in fulfilling secondary and basic capabilities

The identification of significant energy services as well as the essential capabilities provides the background information of understanding the special energy needs of the elderly in the three SWOs but does not fully explain its connection with energy poverty. The difficulties for the elderly to fulfill secondary capabilities through different energy services are the key of their vulnerability to energy poverty. To fully answer the first research question, the difficulties faced by the elderly when building secondary capabilities from utilizing energy services is further elaborated systematically in this section with more concrete examples shared by the respondents.

According to Thomson and the others' study on energy poverty and cooling (2019), the vulnerability to excessive indoor heat is the interplay of three characteristics of the individuals which include the sensitivity to harmful consequences, capacity to adapt, and the risk of excessive indoor warmth. From the study of the three SWOs, the research found that the three factors discussed by Thomson et al. (2019) can also be discovered and extended to multiple energy services, not only cooling, and to the three studied cases. Under the context of the elderly within SWOs, the three relevant factors have interplayed and determined where the difficulties

might occur for elderly to fulfill basic capabilities. Due to time constraint and scope set for this study, more focus was placed on the sensitivity and the capacity to adapt, leaving the last factor, risk of excessive heat or coldness, which has more relation with the construction material and design of the building, to future studies.

Sensitivity and disabilities

As summarized by Thomson and the others' (2019), sensitivity to harmful consequences are mainly influenced by age and health condition. The result of the greater sensitivity is a higher dependency on multiple energy services and more amount needed to fulfill the secondary and basic capabilities. The author also added another factor, disability, together with sensitivity. The two factors are the main cause of additional difficulties for the elderly to obtain basic capabilities through energy services.

People with pre-existing diseases or age over 65 are believed to be more sensitive with heat coldness, and hygiene issues. Firstly, as the respondents often brought up, elderly are more vulnerable to the change in temperature. In addition, ensuring a stable indoor temperature is especially critical under the sub-tropical climate in Taiwan where the temperature deviation can be great between morning and night or between summers and winters. Some common cases in the SWOs are elderly with intellectual and cognitive impairments. They tend to be over sensitive with the comfort of the environment or react slowly and incorrectly to the change in temperature. As one respondent described,

"*...air conditioner is necessary, since first of all, a lot of our service recipients have intellectual impairments…that they only sleep when the environment is comfortable enough, otherwise they will argue with you the whole night...so in consideration of their sleeping quality, sometimes during summer, the air conditioner should be running the whole night during his/hers sleeping time*", and moreover,

"*...they tend to be less sensitive to temperature…or some with intellectual impairments, they often have difficulties in expressing themselves that they will not tell even if they are feeling too hot, so if they have a heatstroke in bed, it is hard to find out...some other have limited cognitive ability that they put on heavy jackets in the summer...so basically, we do need air conditioning in the summer*" (Respondent 1, Director of The Chensenmei FamilyLand, March 13, 2020). Note that the incorrect behaviours (e.g. wearing heavy jackets in the hot summer) from elderly with cognitive impairments further add on the consumption of cooling service.On the other hand, heating is essential during the winter, especially when cold waves occur. The elderly often have poor blood circulation and a cold environment can easily lead to a sudden body temperature drop. This can further cause cyanosis in fingers or other cardiovascular diseases (Respondent 1 & 6).

In addition to the sensitivity to temperature, disabilities due to age and poor health conditions make it more difficult for the elderly to maintain physical hygiene. Many older people have stiff facial muscles which add on the difficulties of eating. They might often drop food or drip when eating and thus have to change clothes more frequently. Besides disability with facial muscles, some with problems of incontinence also require more frequent changing in clothes and bed linens. As a result, to ensure the physical hygiene status and sanitation of the environment, laundry service is highly required in the SWOs. Washing machines and dryers are underlined as energy-consuming due to high frequency of use, large amount of clothes, and high temperature for washing. In addition to frequency on laundry services, showering is another necessary secondary capability to support hygiene for the elderly. According to the respondents, the elderly usually spend a longer time in the shower. For the elderly who are able to take shower themselves, they act slowly and more carefully during showers. As explained by one respondent,

"*... because of aging, their movements become slower, and they might have to stop and think for a long time when turning on the hot water, this results in a huge consumption of hot water*" (Respondent 1, Director of The Chensenmei FamilyLand, March 13, 2020). For some paralyzed patients, even with the help from nursing personnel, it can still take more time to shower. Under these conditions, the time estimated per shower could easily exceed 20 minute. Nevertheless, the different time needed per shower strongly depends on the health condition of the elderly. Another SWO with more elderly in better health condition has reported the average shower time per person around 10 to 15 minutes Respondent 8). Also note that due to skin sensitivity consideration, not all the elderly take showers everyday but every two days (Respondent 8).

Lastly, age and poorer health status increase the elderly's dependency on various medical support and rehabilitation. For example, rehabilitation has been one of the main focuses for elderly-care with the purpose of alleviating physical degeneration and relevant illness resulting from lack of muscle exercise. On the other hand, the support from medical devices such as oxygen concentrators is essential in some SWOs for supporting the elderly with cardiovascular diseases or other specific illnesses. The energy consumption on rehabilitation equipment and medical devices may thus have different levels of significance between SWOs, depending on the slightly different types of service recipients within the SWOs. The time lengths per rehabilitation and frequency of equipment used varies between the SWOs. For example, some have everyday classes for the residents to do rehabilitation (Respondent 1 & 2) while others might not have fixed any schedule or frequency for the residents. The former SWOs hence reported to consume more energy on rehabilitation equipment compared to other SWOs. In addition, the use of medical equipment also varied among different SWOs. For example, the SWO caring for more terminal-stage patients reported relying on medical appliances like oxygen concentrators to sustain the patients' lives (Respondent 6). Those medical appliances are usually energy consuming and thus also account for a higher proportion of the energy consumption in the SWO.

Sensitivity and disabilities resulting from age and poor health have made it more difficult for the elderly to fulfill their secondary and basic capabilities. They tend to have higher dependency on multiple energy services and consume more energy in order to obtain the equivalent quality of life compared to young and healthy people. However, not only the sensitivity and disability of the elderly has made the threshold of fulfilling the basic capabilities high. The SWOs' capacity to adapt, covered in the following section, is another critical determinant for how well the SWOs could handle the challenge of high dependency on energy services and large energy consumption.

Capacity to adapt

While the factors of sensitivity and disabilities focus on the level of the ultimate users which are the elderly in SWOs, the capacity to adapt looks at the level of the entire organization. Multiple factors together influence the SWO's capacity to adapt with external changes. Inspired by the research from Thomson and the others (2019), the most significant elements determining the capacity to adapt are identified as income, built environment flexibility and tenancy relations, and added by the author, the accessibility to relevant information. The three elements are discussed relatively in the following paragraphs.

First of all, income is the most important element deciding SWO's resilience on external changes like the rise in energy price and global warming. Although identified as non-profit, the overall financial situation between SWOs can be very different mainly due to the amount of donations received. In the three studied cases, two SWOs reported that they often struggle for balancing the income and cost (Respondent 2 & 6), as the other one claimed to receive a more stable and adequate amount of donation continuously (Respondent 5). SWO's income mainly comes from

four resources, service fees, government subsidizes, government project support, and donations. Service fees and the subsidies from the government are fixed according to regulations and do not vary much between each SWO. As a result, SWOs usually turn to the latters to generate extra income, especially through fundraising. Donation is a particularly dominant resource for SWOs to improve service quality. As elaborated by one respondent,

"*...since the government has supported the very basics, I think the basic need for food will not be a problem. But if you want their [SWOs] service to reach a certain basic quality that people can tell that the environment here is good, the children [referring to the elderly] have been taken good care of, more often many SWOs have to look for fundraising…without fundraising, only the subsidizes from the government, it will be terrible...you will walk into the organization and find that there is only one teacher [referring to the nursing personnel], and the students [referring to the elderly] are doing nothing*" (Respondent 2, Head of the Department of Donation from The Chensenmei FamilyLand, 13th of March). Abundant income can not only stabilize SWOs in providing continuously decent-quality services but can also increase their resilience in facing all kinds of changes in energy consumption, for example, increasing needs for air conditioning due to global warming, or higher expenditure on electricity due to the increase in energy price. Among the three studied cases, one SWO taught the author that they were able to replace all the old air conditioners with more expensive but energy-efficient ones thanks to the adequate donation they receive regularly (Respondent 5). More income also allows the SWOs to maintain the service qualities without making sacrifices on human resources or food in order to afford the basic electricity consumption.

Secondly, the built environment flexibility and tenancy relations also influence the SWO's possibility of conducting new construction or making long-term investment on energy-relevant infrastructure. In terms of this, all the studied SWOs have shown high adaptation due to having the full ownership of the building. The flexibility and ownership of the dwellings allow SWOs to do further renovation like upgrading lighting and cooling systems, and installing insulation; or to invest in long-term projects like joining GEC and installing 20-year-guaranteed solar panels. One respondent brought up that many other SWOs might have difficulties in making long-term investments due to the unpredictability from the tenancy (Respondent 2). They are probably not willing to make a 20-year long contract if the tenancy of the building is not permanent and thus have little chance to join a project like GEC even though they are aware of the benefits from the project.

Lastly, the accessibility to or even further participation in obtaining relevant information, such as new energy policies or the mechanism of energy bill calculation, helps build the adaptability of SWO to future changes related to policy change and energy transition. This element is especially correlated with the ability, background, and network of the operators in the SWOs. One respondent who has a working experience in the government sector for more than 10 years and still keeps close contact with the municipality showed more understanding of the energy policies and energy transition (Respondent 5). During the interviews, the respondent actively expressed his opinions on energy policies and energy transition which was very little or even not at all acknowledged by the other respondents who did not have background in working with the government or energy field. When being asked about opinions and understanding of energy transition, that particular respondent mentioned the potential rise in energy price but showed confidence in the government providing extra financial support for SWOs (Respondent 5). He was therefore not so worried about the situation. On the other hand, with the same interview question, the other respondents were focusing more on the environmental benefits energy transition could bring in and had no idea about the potential increase in energy prices (Respondent 2 & 6). The lack of information and understanding of the newest energy policies can leave the other two SWOs prepareless and more vulnerable to a future escalation in energy prices.

The risk of excessive indoor warmth or coldness

The last factor adding difficulties for SWOs to fulfill secondary and basic capabilities can be the risk of excessive indoor warmth or coldness. This factor has a particular focus on the nexus between building design and the indoor temperature. Due to the scope and limitation of the research, this third factor has not been covered deeply in the study. However, from some pieces of information brought up by certain respondents, this does not seem to be a minor factor in determining the SWOs' vulnerability in energy needs. Among the three studied SWOs, the respondent from Julin Nursing Home especially highlighted their great result in energy saving owing to the initial design of the SWO as a green building (Respondent 6). Bigger windows allow the natural sunlight to come in, and trees are widely planted to create more shading areas and hence decrease the use of air conditioning. The SWO considered themselves to have used even less energy compared to other SWOs on the same scale. In order word, SWOs with dwellings that are not built according to green-building designs or are built without green materials, which can sustain indoor temperature, may consume even more energy and become more vulnerable to external change like the increase in energy prices and global warming.

Through understanding SWOs' energy needs and their vulnerability to external change from the perspective of building and fulfilling capabilities, the identification of energy poverty is extended beyond the discussion of accessibility and affordability of energy. As summarized in figure 6-6, the studied SWOs are not only facing affordability problems with income, expenditure and energy price under the level of domestic energy supply, but are also facing more difficulties between transforming the energy services into the basic capabilities. . To summarize, the difficulties for the SWOs to fulfill the elderly's basic capabilities firstly comes from the sensitivity and disabilities of the older population, in which age and health status are the keys . Secondly, the SWOs' capacity to adapt to change in the energy prices and climate depends on the three elements, income, built environment flexibility, and accessibility to certain information. The last aspect regarding the hardware of the dwellings is less significant in this study but is also an important factor making the SWOs more vulnerable.

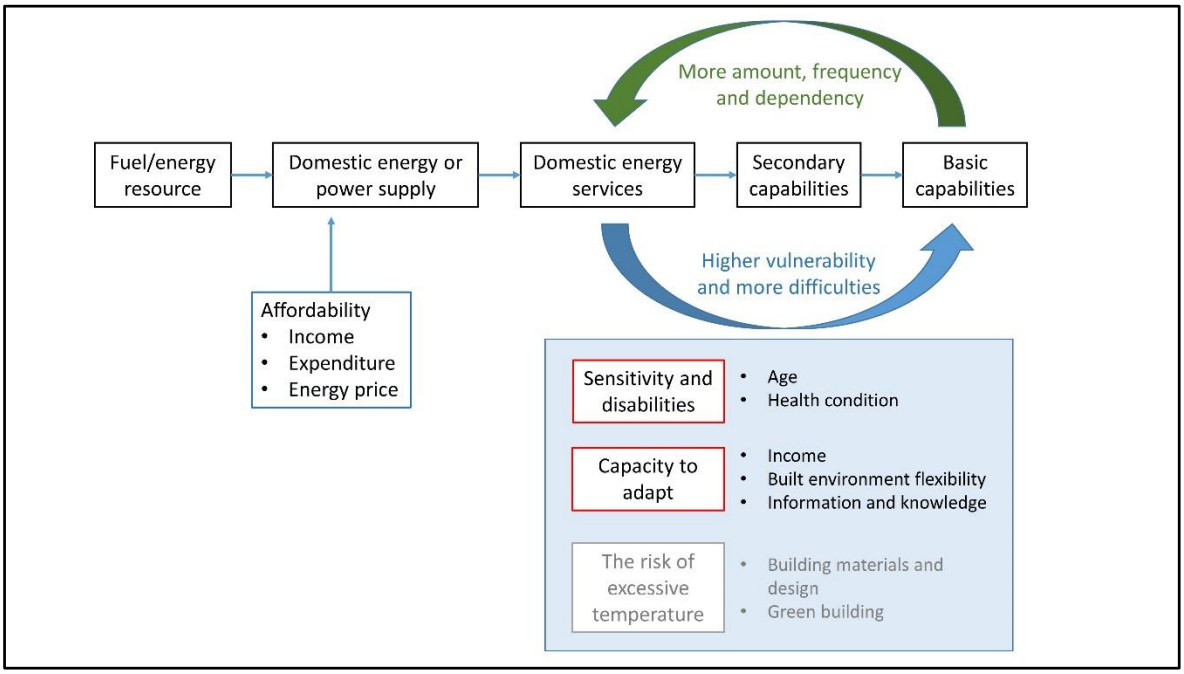

Figure 6-6. Vulnerability of SWOs in fulfilling basic capabilities through energy services

Source: Illustrated by the author.

The above results again highlight the importance of understanding energy needs within different vulnerable populations and the reason for them to consume extra energy when trying to live a decent life. Due to more difficulties caused by sensitivity and disabilities, as well as the lack of capacity to adapt, some SWOs for elderly-care tend to consume more energy services compared to non-vulnerable populations. In line with this, researchers have called for more attention on especially the low-affordability households with vulnerable people like elderly and children when addressing energy poverty. As for the SWOs caring mostly for vulnerable populations, the challenge indeed also exists to certain extent and can be even more challenging for those SWOs with less resources.

6.3 The strategies used by GEC and its outcomes

After understanding the energy needs and using patterns within the studied SWOs, this section discusses the Green Energy Charity (GEC) project that has been trying to alleviate the pressure of SWOs in their energy consumption through installing solar panels on their rooftops. To answer the second research question on how GEC has support to alleviate the challenges of huge energy consumption in SWOs, the strategies used by the project are further discussed. The intervention through GEC by Sunnyfounder could be understood together with the energy policies using the capability framework. As shown in figure 6-7, there are multiple ways to intervene in energy-using issues throughout the whole capability building process.

Some very common ways in handling the accessibility of energy poverty which mostly occurred in the global south mainly focus on the left side of the framework. These solutions can be improving fuel/energy access by building local off-grid solar panels or changing the type of fuel resource by replacing kerosene lanterns with solar lanterns (Indian Institute of Technology (IIIT), 2019; Joshi et al., 2019).

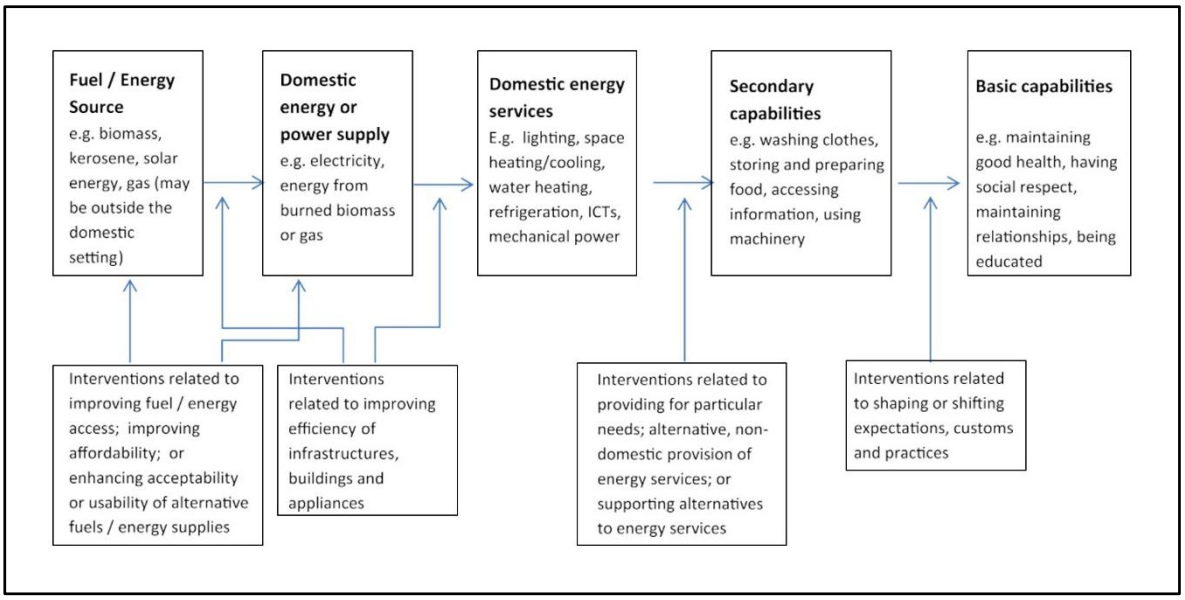

Figure 6-7. Conceptualizing energy use and energy poverty using the capability framework

Source: Day, Walker and Simcock, 2016

In addition, common approaches for addressing the affordability aspect of energy poverty which has been the challenge especially in global north or developed economies like Taiwan, are also

focusing on the left part of the framework between energy resources and domestic energy services. One intervention commonly used is the subsidy from the government on electricity price for certain vulnerable groups or social-oriented organizations to improve their affordability. In Taiwan, besides the continuous subsidizes for daily operation, authorized SWOs and nursing homes have also received another 15% discount on the electricity price within their contract capacity since 2013 (Content, 2019).

Another popular approach which usually requires the collaboration with academic experts and professional firms is to improve the efficiency of domestic appliances (e.g. lighting system, refrigeration, heat pump) by replacing the old and energy consuming devices or changing the infrastructure of the building and indoor environment (e.g. green wall, big windows for letting in natural lights, green roof). Among the studied cases, two have reported to use heat pump systems instead of electric water heaters, one had replaced all the air conditioners with more energy-efficient ones 10 years ago, and all of the three SWOs have recently changed the lighting to more energy-efficient alternatives like LED light bulbs.

To better understand how the GEC has contributed to alleviate the pressure of energy usage within the SWOs, the strategies used and its outcomes are discussed under the intervention in energy resources, interventions between electricity supply and domestic services, and the overall effectiveness in supporting the SWOs in fulfilling the basic capabilities of the elderly.

6.3.1 Intervention in domestic energy services: improve affordability

The main principle of the GEC project is to support the SWOs generate financial resources through installing their own off-grid solar power plants. The financial resources in SWOs have mostly been used in paying basic expenditure on human resource, food, and energy services. Resources left after minus the basic expenditure is believed to be mostly devoted to ameliorating service quality and investment in infrastructure. For example, extra money can be spent on replacing old furniture and appliances, arranging more activities and trips for the residents, buying more wheelchairs, etc. How to balance the income and cost when ensuring a decent living environment for the service recipients has always been the main struggle for the three SWOs, and has been a challenge faced by many other SWOs too. Thus, an increase in income can support the SWOs in many ways of achieving better living quality for the residents.

The intervention for improving affordability is done directly through the mechanism of selling electricity or green certificates, and indirectly through increasing the SWOs' chance to be seen and donated.

Directly though selling green electricity or green certificates

Strategies to increase affordability can be further divided into direct and indirect approaches. The direct strategy used in both submodels under GEC to increase the affordability of SWOs is income generation through selling electricity or green certificates. In the first submodel, SWOs gain income monthly by selling the electricity generated from their roof-top solar panels to Taipower, the centralized and the only company for supplying electricity in Taiwan. One studied cases with the solar power plant scale of 168kWp reported to have earned 930,000 TWD (approximately 28,550 Euro) from May to December in 2019 through this model. In the second submodel, SWOs gain direct income from selling green certificates to the contract company that are in need for CSR achievement or other purposes for generating every kiloWatt hour (kWh) of electricity. For example, another case studied has sold out 21 green certificates with 2,100 TWD (approximately 64.5 Euro) for each green certificate since its official starting day of power generation in the beginning of 2019. The income generated from either selling electricity or from selling certificates to enterprises is expected to be an extra and stable income to the SWOs for the next 20 years.

However, the amount of this type of income strongly depends on the scale of the solar power plants the SWOs own. As the biggest power plant among the ten completed SWOs under GEC, the Chensenmei FamilyLand is satisfied and even overwhelmed by the first year profit earned through selling green electricity. On the other hand, respondents from St. Camillus Long-term Care Center which owns a relatively smaller size of power plant showed disappointment in the result of the profits from selling certificates. Since the SWOs have to pay an annual maintenance fee to Sunnyfounder after the installation, the more the SWOs gained from the power plant, the more net profit they could finally recover from the investment.

Indirectly through the increase in donation received

In addition to direct income earned through selling either electricity or green certificates, another indirect increase in income comes from the supernumerary donation from the sponsoring companies and the public. According to the respondents 2 & 6, GEC has helped connect the SWOs with different sponsoring companies. During the collaboration process, the sponsors got the opportunity to visit the SWOs and to better understand the issues addressed and services delivered in the organizations. The companies often show satisfaction and high approval after viewing the service quality and acknowledging the SWOs' initiative in maintaining and improving better quality for elederly care. Therefore, even after the GEC project, the company may more likely choose the same SWOs they once have collaborated with for charity and money donation since those SWOs are considered more promising for them (respondent 2&6). Moreover, one respondent mentioned that small to middle-sized SWOs like the three studied cases are unlikely to be considered or even noticed by the big enterprises since the bigger companies tend to go for bigger and famous SWOs in order to increase their visibility with the public when doing charity (Respondent 6). However, through the connection by GEC, three big companies had made donations to the SWOs and also brought more attention to the organizations from other cooperating businesses. As for the donation from the public, two of the SWOs had also accepted donations from individuals on the GEC project. Both through information spreading between individuals and the reports from online and social media, the SWOs have thus gained further visibility which is likely to lead to more donations in the future (Respondent 2&6). Although as one respondent pointed out, the indirect income had its "honeymoon period" that donation coming from everywhere massively increased for just a few months after the GEC project was done and reported by medias, it was still an extra income compared to the same period of time in previous years and the SWO was able to use the money and take the residents on a travel and bought some devices (Respondent 2). However, for SWOs that are already famous or are receiving continuing support from religious groups, this kind of co-benefits from networking with enterprises does not have a significant extra contribution to their income (Respondent 5). In other words, the indirect effect of increase in donations received due to greater recognition by the public does not have the same effectiveness in every SWOs. The GEC project has connected the small and medium-sized or infamous SWOs with bigger enterprises that are usually hard for them to reach but it does not make a big difference to other SWOs that are already well-known.

Both the direct and indirect outcomes resulting from joining the GEC have led to an increase in the financial resources. However, the evaluation from the beneficiaries on the project is influenced by the scale of the power plant, the original financial condition, and the popularity of the SWOs. While the SWO with a bigger scale of the power plant and was reported to be in worse financial condition among the three cases was really satisfied with the result, the other one with the smallest scale and better financial condition does not report to benefit a lot from the project.

6.3.2 Intervention in energy resource: alternative energy from solar power

Another important intervention used in the GEC project is to provide the SWOs with alternatives for the electricity supply. This strategy is used in submodel two together with the selling of green certificates. The idea is that energy generated from solar panels is fully supplied to fit the energy needs in SWOs and thus helps the organizations to save some energy and further save money in electricity bills.

However, the effectiveness of energy saving from this model is highly depending on the scale of the power plant. For the SWO with a smaller scale of power plant, the monthly savings from energy ranging from 1,000 TWD in the winter to 6,000 TWD in the summer with saving at two TWD per KWh. Moreover, compared to selling energy with a promised price that is usually higher than the electricity price for SWOs, the savings from self-generated energy is based on the discounted price designed especially for SWOs. The overall result is thus disappointing for the SWOs with smaller power plants and using submodel two (Respondent 5). The extent for SWOs to become energy-sufficient is thus limited to the capacity of spare space that a SWO can provide for installing solar power plants. In addition, the off-grid solar power plant could hardly replace the main electricity suppliers for supporting the SWO's daily demand on energy services. In conclusion, although SWOs usually have bigger space for building solar panels compared to households, the energy savings from especially smaller power plants can be quite limited due to the limitation on the scale or when compared to the big energy consumption. Therefore, having solar power as an alternative to the centralized supplies of energy is more of a less effective intervention in the studied cases.

6.3.3 Other interventions and the overall evaluation of GEC

Some other co-benefits from installing the solar panels were identified, including the insulation effect from the panels that have helped to lower the temperature on the top floors, and the extra spaces created under the solar panels allowing activities to be held. An ongoing collaboration between GEC with the carbon reduction project from the Foundation of Taiwan Industry Service has shown another opportunity in supporting SWOs to conduct renovation on dwelling and replace less energy-efficient devices. As summarized in figure 6-8, despite the co-benefits and opportunities in collaborating with other projects, the main strategy used by GEC is still focused on improving SWO's affordability through selling electricity, selling green certificates and saving domestic energy. The improvement of efficiency in buildings and appliances was conducted in two other SWOs under GEC but not in the three studied cases.

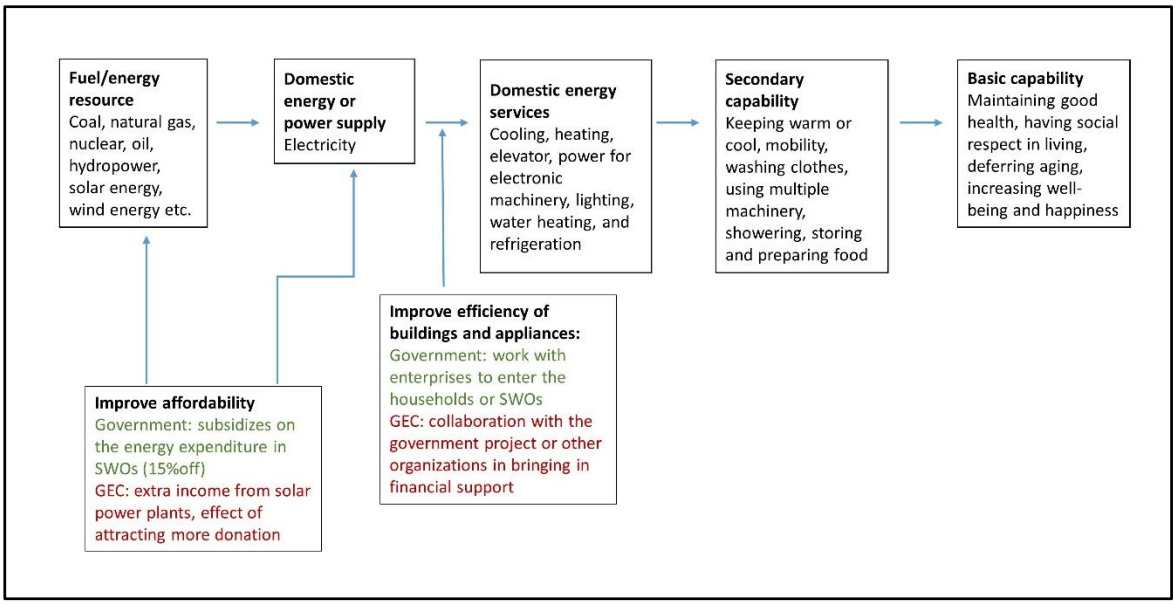

Figure 6-8. Strategies and interventions used in GEC and the current policies

Source: Illustrated by the author

In addition to improvement in energy efficiency, power generated from the solar panels were directly used to support the elevator service in another case but was not reported in the three interviewed SWOs. Overall, less has been addressed on the right side of the diagram through the GEC project. This could become a further potential area for GEC to explore for more opportunities in contributing through the project. The intervention may include to understand the differential needs in energy services from the different SWOs caring for various disabled and vulnerable populations, to provide direct power alternatives for the particular energy service, or to give advice on changing behaviours and optimizing practices. Nevertheless, note that the intervention on the capability fulfillment can be limited and ineffective due to lower flexibility of the vulnerable population within the SWOs. For example, saving energy consumption on cooling services simply through changing clothes is recommended as an alternative for using cooling and heating services. This solution is, however, not suitable for the elderly who tend to react slowly to the temperature change or not be able to express their feelings well. They might not be able to distinguish well when to dress up more and when not to. As a result, keeping a stable indoor temperature is relatively more promising but also leads to higher consumption of the energy services.

The last important finding from the evaluation of GEC is that the whole project is still seen as an investment means for many SWOs. Although the narrative for communicating the value of GEC is emphasized on the equivalent better off for three parties, including the economic benefits for the beneficiaries, sponsoring companies' CSR performance, and the environmental benefits with renewable energy, what really matters to the SWOs is the effectiveness of the project in generating economic benefits for the organizations. In terms of this, it is reasonable for SWOs to always go for the most beneficial options regardless of the values created for other parties. For instance, the three cases all reported to have studied about the investment in solar power or even had already been in contact with other firms before the GEC came in. For relatively rich SWOs with capacity to invest in solar power with their own money, they often compare GEC with other firms that can provide the same or even better quality of services. GEC might be therefore more attracted to SWOs with less financial resources for affording the initial investment. However, this type of relatively poor SWOs were not the major cases in this study. The situation led to the result differentiating from the assumption of GEC being the best

choice and rare opportunity for SWOs to engage in renewable energy. Many SWOs actually have other choices other than GEC which on one hand prove that the model of FIT works pretty well, but on the other hand create challenges to GEC. Either the extra value of GEC should be highlighted through changing the narrative of presenting the model, or the targets of GEC could be reconsidered in order to maximize the value expected to be created by the project.

In the next section, an integration on the findings from the previous two sections is together discussed to further explore energy poverty with the elderly care in the SWOs. Justice perspective was chosen to guide the analysis and bring the potential energy poverty issues within the SWOs to the thinking of "opportunities creating" and "capacity building".

6.4 Energy poverty and the SWOs: a risk rather than a current status

In section 6.1 and 6.2, the differential needs in energy services from the three studied SWOs are discussed to answer the first research question, and the second research question of understanding the main strategies used in GEC is explained in section 6.3. This final section integrates the findings discussed in the previous sections and tries to answer the last research question of how can people understand energy poverty within SWOs for elderly-care with the capabilities perspective as well as the energy justice perspective. In other words, this section discusses whether the studied SWOs are energy poor, and what risks they might be facing in terms of energy poverty under energy transition, viewing from the justice perspectives..

From the previous research results, there are many approaches and definitions used to measure and conceptualize energy poverty in particular households, groups or communities. The standard and targeting scope can be very different, but the common division between the energy poor and energy unpoor is the inability either to access, to afford energy and/or to support the fulfillment of basic capabilities. One common defining criteria is based on the proportion of energy expenditure accounted for the total expenditure within a single household, for example, the 10% indicator. If viewing the issue from the perspective of expenditure, the major expenditure in all three SWOs were reported to be on human resources and food, accounting for 60 to 70 percent. The expenditure in electricity only accounts for five to eight percent of the total expenditure (Respondent 1,5 & 6). This could have quickly led to a conclusion that despite the large absolute amount of energy consumption, compared to other expenditure, energy is still a minor issue for the SWOs and they are not facing any issue related to energy poverty. However, the above statement does not move the study of energy poverty forward and could neglect hidden problems within the studied SWOs. As a result, to further understand energy poverty under the context of SWOs with elderly-care, the conceptualization of energy from capability and justice perspective are used instead of the simple focus on soley the energy expenditure.

6.4.1 Capability and vulnerability perspective

The definition for positioning energy poverty according to Day et al. (2016) is "*an inability to realise essential capabilities as a direct or indirect result of insufficient access to affordable, reliable and safe energy services, and taking into account available reasonable alternative means of realising these capabilities*" (p. 260). However, in the three studied SWOs, none of the cases showed the current inability to access, afford or to realize the essential capabilities. Instead, the findings identify difficulties faced by the SWOs when trying to fulfill the basic capabilities and their vulnerability to external changes like the increase in energy prices. In other words, the three studied SWOs can not be defined as energy poor according to their current status. However, they are indeed facing higher risk of becoming energy poor when energy prices increase or when income decreases. For instance, donations decreased massively during the time of the outbreak of COVID-19, as especially

mentioned by one SWO (Respondent 2). The vulnerability of the elderly and the limited capacity to adapt together result in the SWOs' poorer resilience in facing external changes. The SWOs will thus often have to rely on the government subsidies which is, however, not a long-term solution for the SWOs to become self-sufficient and sustain good quality of service.

In addition, the risk and possibility of becoming energy poor is different between SWOs. Among the three SWOs, The Chensenmei FamilyLand might be impacted the most from the potential increase in energy prices. First of all, the SWO reported having more elderly with poor health conditions and intellectual impairments. As discussed previously, sensitivity and disabilities will add on additional needs in cooling, space heating, elevator, and water heating for realizing the elderly's secondary and basic capabilities. The SWO with the elderly in poorer bodily and mental health conditions will make the situation even challenging. Secondly, the SWO was reported to be least abundant in their financial resources compared to the other two cases due to obtaining less stability and adequacy in donations. The respondent claimed themselves being less recognized by the donators (Respondent 2). . Finally, the respondents from the SWO showed less understanding of energy transition and energy policies. As discussed previously, the lack of accessibility to certain information will influence the SWO's capacity to adapt and the ability to prepare for new changes in energy policies, especially the rise in energy prices align with energy transition.

The result of not discovering strong evidence for the three studied SWOs to be identified as energy poor does not shadow the value of the study though. Instead, as the respondent studying energy poverty in Taiwan pointed out, the study of energy poverty in Taiwan could be also taken from a preventory perspective that the policies should take into account of the design of supporting measures to address the potential energy poverty within households and the vulnerable communities and SWOs (respondent 7). Case study in the three SWOs thus have contributed to more understanding of the factors that will make a SWO or other vulnerable population in danger of becoming energy poor. Moreover, the three SWOs have shown the opportunities of becoming stronger support for local disadvantaged families. In conclusion, the SWOs might become the energy poor due to the vulnerable population they are caring for, but can also become a solution on the local level to more vulnerable families and communities.

6.4.2 Justice and energy poverty in SWOs and elderly-care

As defined by Walker and Day (2012), the theory of studying energy poverty from three forms of justice highlights the interplay of injustice between policy-making, distribution of wealth, and the recognition from the public. This perspective was initially used to broadley understand the cause of fuel poverty but the author found it also suitable for explaining the cause of energy poverty and avoiding locking in with the single influence from distributional injustice which often covers the discussion of the affordability problem and energy expenditure.

The use of Justice perspective in discussing energy transition in Taiwan can be seen in some scholarship already (Y. F.Chen, 2018; M. X.Lin et al., 2020). The research usually focuses on exploring the potential from local communities to invest in civic power plants as an alternative for local electricity supply other than the centralized system. However, the exploration has not reached the vulnerable population and the SWOs who also show potential in contributing to energy transition and renewable energy.

According to Sunnyfounder, the main purpose for initiating GEC was to create positive social impact through realizing justice in the energy field . Social and environmental value are equally important in the GEC project and the integration is what makes the GEC project unique and interesting. To realize environmental justice and contribute to creating a sustainable society, Sunnyfounder has chosen solar power as the main path in supporting the objective. As for

realizing social justice, the company chooses to have SWOs as the direct beneficiaries of GEC. Through assisting in the investment of solar panels, they expect to alleviate the SWOs' pressure on significant energy usage.

In response to environmental justice and social impact that are embedded in the core of GEC, understanding energy poverty within SWOs from the justice perspective can echo with GEC's initiative and bring in multiple aspects on the vulnerability of three studied cases. This theoretical framework is used as a comprehensive method in summarizing the previous finding of energy needs in SWOs, exploring their vulnerability to energy poverty and the potentials under different justice aspects. Three forms of justice used to discuss energy poverty include distributional justice, justice in recognition and procedural justice.

Distributional justice: increase affordability and energy efficiency

Firstly, as the most discussed and recognized perspective among the three, the distributional justice is also the most clear aspect to understand the vulnerability of SWOs and the main rationale driving the model of GEC. The distributional injustice of energy can be viewed from three aspects, income, energy price and energy efficiency. SWOs might face varying degrees of difficulty and different challenges in terms of income generation. As mentioned previously, the income of SWOs mainly comes from the government subsidies, service fee, and a big part from external donations. The amount of government subsidies for elderly-care SWOs is basically the same between the three cases . Service fees have also been regulated by law, ranging from 28,000 to 40,000TWD (approximately 860 to 1227 Euro) per month in the three studied cases. However, elderly coming from low-income or disadvantaged families usually pay even lower service fees. Moreover, the total cost is reported to easily exceed the basic income generated from the service fees and subsidizes. For example, in the Chensenmei FamilyLand, the SWOs usually spend three times the service fees on a single resident (Respondent 1). In other words, with more elderly coming from disadvantaged families and paying lower service fees, the SWOs will have to put more effort on fundraising to cover the cost. Thus, one respondent explained that they will limit the numbers of elderly coming from more vulnerable backgrounds in order to sustain the operation and balance the income and cost (Respondent 6). Another respondent explained that it can be pretty hard to sustain decent services for the elderly if the income only comes from government subsidies and service fees (Respondent 2). As a result, all the three cases claimed to have taken active actions in fundraising, especially the Chensenmei FamilyLand from which the respondent believed the organization to be less recognized by the donors (Respondent 2). However, results from fundraising vary very differently among SWOs. The effectiveness e of fundraising is strongly influenced by multiple factors like religious backgrounds, reputation, and visibility, just to name a few. For instance, one SWO with strong support by the Catholic church claimed to be in quite good financial condition since they have continuously received stable donations from religious groups (Respondent 5), while the other two SWOs who have no religious support and are not so popular are often struggling to balance the cost and income (Respondent 2 & 6).

The primary value of GEC in realizing social and environmental justice lies in the distributional aspect. SWOs are able to engage in renewable energy without worrying about the money for the initial investment. Profits generated from the rooftop solar power plants are seen as another stable resource of income to the SWOs. Through the GEC model, the beneficiaries from FiTcan be expanded beyond individual investors and enterprises to the vulnerable and disadvantaged populations like the residents in SWOs. The benefits generated from selling green electricity can thus be redistributed to less-privileged populations who usually have less resources in finance and professional knowledge.

Secondly, poor domestic energy efficiency is another injustice driver for causing or leading to higher risk of energy poverty. Dwellings with old or energy-consuming appliances are often spending more on attending the same amount of energy services compared to green buildings and energy efficient housings. The renovation and replacement of energy-consuming appliances can be costly for the SWOs. It is also not a priority for their regular operation as long as the appliances still function. As a result, without the intervention from the government and financial support from external parties, SWOs tend not to put much attention on domestic energy efficiency.

GEC does not directly connect the SWOs with sponsors that are willing to invest in energy-efficiency renovation for SWOs. Nevertheless, during the earlier visit to two other SWOs, the author noticed the potential of improving SWOs' domestic energy efficiency through GEC's collaboration with academic and governmental sectors. During the visit, the academic expert checked all the primary electronic appliances used in the SWOs and gave immediate suggestions on what to replace and how to save energy. At the end of each visit, the expert checked the SWOs' monthly electricity bills and gave written recommendations in recalculating their contract capacity which can help reduce the fines due to exceeded energy consumption[3]. The results from the visit and the written recommendations were collected by the representative of the government and were later organized as a report to the government. According to the governmental representative, the SWOs might be able to obtain monetary support from the government in replacing old appliances once the report is approved. This example has shown the potential of external stakeholders entering the SWOs, providing professional information and solutions to improve their domestic energy efficiency. Such collaboration can further realize the distributional justice on energy consumption in the SWOs.

Lastly, energy price is assumed to be a critical factor in driving energy poverty. Energy users usually have very limited control over it. According to the respondent from academia, an appropriate energy transition should take rising energy prices into consideration in order to better balance the loss and profits of the state-owned and only electricity supplier in Taiwan, the Taipower (Respondent 7). Taipower is believed to have been unable to cover its loss with the little profits due to the relatively low energy prices (Liang, 2017; J. M.Wang, 2017). The government thus has been paying lots of subsidies to cover the deficit. The deficit is also believed to have crowded out the national finance that could have been devoted to investment in renewable energy and energy-efficient solutions (Liang, 2017). However, whenever touching upon the issue of increasing electricity prices, the issue of energy poverty within low-income households and vulnerable groups will also arise and hinder the relevant policy-making (Respondent 7). Nevertheless, an overall suggestion from academia is not to never increase the electricity price, but to investigate the potential impacts such as energy poverty and prepare supporting measures in handling the issue as part of the energy transition goals. A common approach to realize distributional justice, especially in terms of energy price, is to provide subsidies or price discounts for certain populations and SWOs. Stepped electricity price is especially well-accepted by academia and the public. It is, however, arguable that monetary support does not improve the SWOs' capacity to adapt in the long run. Moreover, governmental support always has its maximum, and SWOs often have to seek for other supporting measures. GEC has shown its potential in building SWOs' capacity to adapt through green energy investment.

Distributional justice is the most recognizable and easiest-handled aspect among the three forms of injustice under energy poverty. The main contribution of GEC is also especially focused on

this aspect. The effort in realizing distributional justice can help build SWOs' capacity to adapt to the increase in energy price and energy consumption. The vulnerability of the elderly, however, remains invisible if the distributional justice is the only notice. This led to the discussion over the importance of the next justice form in differentiating the special needs within various populations in order to suggest different interventions.

Justice in recognition

Justice in recognition includes the understanding of certain population's vulnerability and differential needs in energy services, as well as the accordance of cultural and political respect. As discussed already under the results from previous research, the vulnerable population, including the elderly, disabled, and infirms, tend to spend a longer time at home and require additional energy services to support their living. As a result, recognizing the special needs within these populations will help to target the even more vulnerable people under energy poverty and to give them extra support. Sunnyfounder has noticed this vulnerability and has used it as the narrative to communicate with the sponsors in joining GEC. For the sponsors, GEC is thus not only a CSR project to engage in environmental issues, but is also at the same time making contributions on social issues. Another side effect is that through the collaboration with the SWOs, the enterprises can have a chance to visit and know about a new organization. According to one respondent, the SWO got to introduce the organization and the issues of elderly-care to the sponsor during the visits (Respondent 6). This has helped the SWO to gain more respect and trust from the sponsors on their services and organizational goals (Respondent 2 & 6). Moreover, through story building and cases published on Sunnyfounder's websites and other media (W. Z.Chen, 2019; Gao, 2019; Ye, 2019), the SWOs, as well as the issue of elderly-care, have a better chance to be recognized and understood by the public. Government sectors also tend to notice these SWOs first through the GEC project and contact the organizations through Sunnyfounder. The increased recognition by the public, enterprises, and government sectors all together influence the opportunity for the SWOs to obtain more financial support. This again echoes with the nexus between the three forms of justice under energy poverty. As argued by Walker et al. (2012), realization in the justice of recognition can further contribute to distributional justice, in the cases of this study, through the increase in donations and government subsidies.

Although the narrative of the elderly's vulnerability to energy deprivation has so far proved to be a persuasive narrative for the sponsors, an in-depth understanding of the vulnerability has yet to be studied by the company (Respondent 3 & 4). In order to explore the risk of SWOs in face of energy poverty and other pertinent issues, and to explore innovative interventions for building the SWOs' capacity to adapt, the current knowledge of the energy needs within SWOs is not enough. The case study of the three SWOs with elderly-care provides an in-depth view into the sensibility and disabilities of the elderly and how these have caused difficulties for them in fulfilling basic capabilities. As already discussed in previous findings, capabilities are what really matter for the elderly, energy services are part of the means to fulfill these capabilities. Therefore, the realization in recognition of justice should start with the understanding of the basic capabilities required by the elderly, then followed by the differential needs in energy to fulfill the capabilities. For example, instead of simply highlighting the importance of indoor heating service for the elderly and setting a minimum amount of energy needed on that particular service, the UK government set a threshold on indoor temperature for the eldely (Walker et al., 2012). Regardless of the domestic environment and appliances used, the energy services should be able to provide adequate warmth based on the threshold.

Procedural justice

Procedural justice is the least covered aspect within the strategies of GEC and the least discussed aspect by the respondents from SWOs. Although policy evaluation was not covered in the scope

of this study, the author noticed that the procedural justice of SWOs in terms of the engagement in energy transition and various energy policies is very little mentioned in the current policies.. As the focus of procedural justice and energy poverty has all been on the level of individuals, households, and sometimes the local communities (Y. F.Chen, 2018), the risk and potential regarding energy poverty within the SWOs has never been discussed. However, the findings from the case studies with the three SWOs not only highlight their higher risk of becoming energy poor, but also explore their opportunities in becoming solutions to energy deprivation. As SWOs play the key role in supporting local social security networks, the improvement of SWOs' capacity to adapt will not only support the organization itself, but also support the local communities and the system for elderly-care.

The FiT, green certificate system, and GEC have indirectly contributed to the information accessibility aspect under procedural justice. Two SWOs mentioned that Sunnyfounder was not the only company they had in contact with (Respondent 5 & 6). In fact, the contacts with different firms had provided the SWOs with abundant information to compare various proposals and chose the best one for the organization. The respondents further stated that they had gained basic knowledge of the installment of solar panels and the principle of green certificate system through the interaction with Sunnyfounder and other solar panel manufacturers(Respondent 5 &6). Nevertheless, the other respondent who had only collaborated with Sunnyfounder claimed to be unfamiliar about the policies and FiT system (Respondent 2). Since the company had taken full responsibility for the installment and paper works, the SWO did not have incentives to learn more about the process. Overall, the access to information on energy prices is currently not a big deal for the SWOs since the supply of the electricity is still controlled by the single state-owned company. This has stabilized the energy prices and united different information. However, along with the energy transition, when more suppliers join the market in the future, there might be a chance for SWOs to face the injustice of accessing complicated information on the energy prices and supplier options. The energy transition plan should thus take into account the procedural justice aspect in terms of energy information and price setting.

In terms of participating in policies, respondents showed less willingness in participating in energy-relevant policies, more willingness on elderly-care policies due to the consideration of their own professionalism. As the vulnerability of SWOs has not been uncovered officially by academia and governmental researches, there is currently no clear representative speaking for the SWOs in the policy making of energy related issues. Nevertheless, since SWOs are usually in close contact with the municipality, their voice could be delivered more directly to the policy makers compared to individuals and households. For example, one respondent utilized the municipality funding originally for air pollution prevention onto the investment of the SWO's solar power plants (Respondent 5). Together with the actions in justice of recognition, a deeper understanding of the differential energy needs of various SWOs can further realize procedural justice by making more effective interventions.

To conclude, the three forms of justice provide a systematic view into the risk of the studied SWOs in terms of energy poverty, and the potential of GEC in realizing different justice aspects. The risk of the three studied cases in facing energy poverty thus comes from not only the challenges in affordability, but also the chance of each SWO to access and react to the new information and policies. The three studied cases have shown different extent on the distributional injustice. Some SWOs have better financial conditions than the others. As for the justice in recognition, the study had filled the gap in the understanding of differential energy needs of the elderly. Lastly, the procedural injustice might be the least significant problem for the SWOs at the moment but could be challenging in the future when more energy suppliers join the market.

7 Discussion

The research on energy poverty has come a long way from the single focus on unaffordable heating within households, which are defined as fuel poverty in the UK, to a more holistic outlook including justice and capabilities fulfillment. However, the scope of the problem has rarely reached outside the scale of households; only a few had mentioned the vulnerable communities could be the direction for future research (Bouzarovski et al., 2014). Inspired by the Green Energy Charity (GEC) project carried out by Sunnyfounder, the author looks into the potential energy poverty issue within social welfare organizations (SWOs) and tries to explore the matter outside the scope of households. In addition to the fixed research target, some previous studies had emphasized the importance of understanding the different energy needs of disabled people and vulnerable populations, such as the elderly and children, to increase the completeness of understanding energy poverty. Those studies, however, either presented the difference based on only a few types of energy services, or briefly discussed the disabled people as a whole, and have not studied the difficulties faced by the elderly, in particular, for fulfilling their necessary capabilities from multiple energy services. Moreover, the statement of SWOs requiring increased energy needs is used as a narrative for communicating the purpose of GEC to the sponsors and beneficiaries. Still, this statement has not been officially and rigorously studied. As a result, the study has moved the scholarship of energy poverty forward by expanding the focus outside households to the vulnerability of the elderly. This study also provides a better understanding of the effectiveness of GEC in addressing the energy poverty issue in SWOs. The following sections discuss some important results.

7.1 Energy poverty and SWOs

It is evident from the results that the three studied SWOs and the elderly have higher energy needs due to sensitivity and disability from age and health condition. Besides, the difference in capacity to adapt to energy prices between different SWO has influenced their potential for becoming energy poor. However, compared to households, the three studied SWOs are more prepared with the massive amount of energy used for supporting the elderly, and they tend to acknowledge well the resources they can get to support the daily operation. In other words, they are the experts in taking care of the elderly through all kinds of services and, at the same time, balance the income and cost. Furthermore, unlike the assumption at the beginning of the study, the three SWOs tend to view energy expenditure as a minor part of their operation cost compared to the considerable portion focused on human resources and food. The personnel within these SWOs have not made explicit changes on their energy usage behaviors after joining GEC, which is different from what the author had expected. The GEC and profits generated from solar power are more of an improvement to their income and affordability instead of addressing the heavy use of specific energy services. It seems that GEC is more of an icing on the cake for some studied cases under better financial condition. This fact could be different from the expectation of Sunnyfounder.

Nevertheless, the findings from the three cases still support the discussion over the elderly being more vulnerable to energy poverty. The main difference with other studies of the elderly and disabilities in households is that the pressure on facing energy poverty is shifted from individual families to the organizations. Some might argue that organizations tend to have more effective approaches and abundant resources for generating income. They thus have higher possibilities to invest in energy-efficient devices. Compared to households, the pressure from energy poverty within these SWOs might be lower, or the problem is not even existing. The above assumption can be true in some studied cases. However, the results have shown that the situation can vary differently between SWOs due to their different financial conditions. Moreover, SWOs are often taking care of the elderly with detrimental health conditions that could no longer live by themselves at home. In other words, these SWOs resemble a bigger scale of households who

have overall received more financial support from the government but are often caring for even more vulnerable patients, also leading to higher costs.

In addition to finding the reasons making SWOs highly vulnerable to energy poverty, the study highlights the potential of SWOs in supporting the local communities. Although SWOs are mainly responsible for the internal residents who need 24-hour care, they are often asked by the municipalities to visit some vulnerable local families regularly within their jurisdiction. Through every visit, the SWOs provide free food and necessary medical consultation for the households. These families usually consisted of the elderly who prefer to and can live alone by themselves. The more resources one SWO can obtain, the more vulnerable families can be reached out to by the organization. As a result, the support for a single SWO is not limited to benefiting only the residents but also the local communities. In addition, there is a potential to better cover the investigation within local households through collaborating with local SWOs. A stronger SWO can support a more reliable social network, covering more vulnerable individuals.

7.2 From 10% indicator to the perspectives of building capabilities and realizing justice

Almost all the studies of energy poverty currently under the context of Taiwan are still using the definition and measurement of the 10% indicator (K.-T.Chou, 2019; X. J.Lin, 2017; W. K.Xie, 2016; Zhao &Chou, 2017). Although this definition was already pointed out to be deficient for understanding the real issue of energy poverty and fuel poverty (Hills, 2012), the 10% indicator is still a dominant concept due to its simplicity and ease of measurement. According to some researchers (K.-T.Chou, 2019; Zhao &Chou, 2017), in Taiwan, only 0.06 % of the total population can be identified as energy-poor if measured with the 10 % indicator. However, the percentage is higher amongst low-income families, reaching up to 63 % over the threshold, taking Hsinchu city as an example (Zhao &Chou, 2017). The low-income families should thus become one of the major focuses of energy poverty in Taiwan.

The study argues that the adoption of the 10% indicator might hinder both the identification of energy-poor and the energy-saving actions in Taiwan. From the case studies within SWOs, the subsidies on energy prices have been one of the reasons the organizations are spending less on electricity. The idea of relatively lower expenditure on energy might have led to SWOs in ignoring their actual significant spending on the energy since compared to other expenses, electricity seems to be a minor one. The subsidies in energy prices for low-income households might also lead to similar results. In other words, the 10% indicator only covers the vulnerable populations who are already struggling to afford essential energy services but does not present the high risk of specific populations in becoming energy poor.

The study suggests that the focus on dealing with energy poverty along with energy transition should also be on identifying the populations who have higher risk and vulnerability to energy poverty. Since the electricity price has not increased yet, the design of measures should be considered from a preventative perspective. This study gives an example of mapping out the vulnerability of specific populations with the use of the capabilities framework and three forms of justice in understanding energy poverty. The use of both perspectives can be expanded to other SWOs or vulnerable populations to further understand the entire picture of energy poverty under the context in Taiwan and to prepare for the change from the energy transition.

7.3 Potentials and Limitations of the GEC model

The model of GEC is proven to work and can indeed assist the SWOs as another income resources. In addition to the social aspect of the project, it has great potential in promoting the expansion of small-scale solar power plants and in enabling the proactive engagement of SWOs

in energy transitions and increasing their contributions towards sustainability. Since SWOs usually need extra resources and time spent on fundraising for installing a solar power plant, which will provide the marginal benefit for the organization, through GEC and the connection to the sponsors, they will be able to save those resources and time for other needs. The model thus has the potential to be copied and implemented in many other SWOs who have spare rooftops.

However, the model has a critical limitation on the types of SWOs it can reach out to and successfully connect with. Those poor or the SWOs really in need might not be able to benefit from GEC. When considering whether to invest in an SWO, sponsors usually want to make sure the quality of the SWO is good enough that it doesn't cause controversy, which might decrease the reputation of the enterprise. However, the SWOs with a better quality of service are usually the ones with relatively more resources. GEC for them is more like icing on the cake, while in other poorer SWOs, the GEC can make a huge difference and could even lead to further upgrade within the SWOs. If Sunnyfounder wishes to support the most vulnerable SWOs in need, the focus should maybe turn to the less-qualified SWOs, and the goal will be to improve their service quality through the GEC. However, in this case, the company will need a new narrative and approach to persuade the sponsors. Reaching out to the less-recognized SWOs could be challenging since Sunnyfounder is at the same time representing the SWOs and is responsible to the sponsors. If the SWOs' conditions have not been better off after joining the GEC, the sponsoring company's credibility might be sharply questioned. In terms of this, the company would have to make sure the investment will result in real positive impacts on the beneficiaries through continuous and periodic tracking of the SWOs' statuses.

Regardless of whether the company might shift focus to the poorer SWOs in the future, this study suggests Suunyfounder keep track of every collaboration case to evaluate the effectiveness of GEC better. Keeping track of the cases is not only for assessing the social impact from GEC, or the social positiveness the sponsors have created through collaborating with GEC as part of the CSR actions. It is also for understanding the real social value embedded in GEC's initiative, which is helping the people in need through sustainable approaches.

7.4 Reflections on the chosen cases and methodology

Although the overall results have shown that case study through interviews and observation has been a proper method in understanding the research questions, there are some limitations of the chosen cases and rooms for improvement on the methodology.

First of all, the three studied cases have all shown a relatively positive outcome in facing energy usage and hidden issues of energy poverty, but this might not be the case of the majority of the SWOs for elderly care in Taiwan. The three SWOs have revealed their challenges in energy services and the clear vulnerability of the elderly in energy needs. However, they all claimed to have managed to maintain decent service quality compared to many other SWOs. For example, the common reason for the three SWOs in having higher expenditure on human resources is due to having more nursing personnel hired to ensure qualified services. The spending on electricity has thus accounted for a relatively small portion (around 5~6%) of their total expenditure. They do need a considerable amount of electricity on daily operations, but compared to the cost of human resources and food, the electricity expenditure is only a minor challenge. The SWOs, therefore, tend to neglect the significance of energy expenditure in the daily operation. The above situation could explain why electricity expenditure is considered as a relatively small problem even though the dependency and total amount of energy usage by the residents is very high.

Moreover, the three SWOs have also reported to have undergone renovations of the dwellings, replacing energy services systems like lighting and air conditioners with more energy-efficient alternatives. Nonetheless, this is usually not the case for most SWOs. Many other SWOs are facing higher pressure due to the expenditure on electricity owning to low income or less energy-efficient dwellings and appliances. In other words, the three cases investigated might bias the author's results to a relatively optimistic conclusion that the issue of energy poverty is not as severe as expected in the SWOs caring for the elderly. As a result, one of the directions for future research could be investigating SWOs that are in worse financial conditions and have not been able to provide qualified services for the elderly or other disabilities. This direction of research could be hard to carry out since the SWOs are rarely willing to admit to providing poor-quality services. However, with the engagement of social workers and governmental sectors, the SWOs in need might be more comfortable to open up and receive external assistance.

The first reflection on the methodology is the relatively slow adjustment on the data collection approaches due to COVID-19. The pandemic of coronavirus in spring 2020 has been the biggest challenge for conducting this research, mainly since a high proportion of the data is designed to be collected through on-site observation. Although the author has kept in touch with the SWOs and waited for the situation to get better in April for doing observation as a supportive method, the decision to give up further observations could have been made earlier. Thus, the author could have put more time and effort onto other methods for data collection. Secondly, the author could have included more literature regarding energy poverty from the west, and especially from the UK. In addition to more literature review, the study could have gone deeper into different research papers and make some comparisons with the scholarship in Taiwan. By doing so, this thesis would have an increased value in providing global perspectives and a more comprehensive overview of energy poverty issues for the readers.

8 Conclusion

The case study of three SWOs working with elderly-care contributed toward novel research on energy poverty in the context of Taiwan by having vulnerable organizations as the focus of study. Although the result did not lead to the definite identification of SWOs as energy-poor, the research indeed presented the SWOs' vulnerability to energy deprivation and their particular energy needs. Moreover, the study also showed the potential of solar power in supporting SWOs and building their adaptive capacity to any change due to the energy transition or even global warming.

The importance of recognizing the vulnerability of the elderly concerning energy needs is essential not only to the study of energy poverty but also to the overall planning towards a sustainable future. It is clear from the result that people with disabilities and worsening health conditions often require more support from the energy services to fulfill necessary capabilities and daily needs. Aligned with the population growth, the growth in the number of the elderly worldwide is of massive significance. The elderly could become one of the most significant and unique energy consumers in the coming decades. Energy services for cooling, heating, mobility, and medical-equipment support are especially crucial. An understanding of the differential energy needs of the elderly is critical in preparing for an aging and more energy-consuming society.

GEC presents an opportunity to make use of the spare roof spaces from the SWOs to promote the development of solar power and, at the same time, support the SWOs' operation. On the one hand, although the evaluation and outcomes of the project vary between cases due to multiple factors, such as the scale of the power plant, overall, it still has supported the SWOs to a certain extent. On the other hand, SWOs having building ownership show great opportunities for widely installed solar panels, supporting the energy transition target for the year of 2025. Government sectors can do a comprehensive investigation of all the SWOs with available roof spaces, and even some public areas like school buildings or activity centers. More enterprises can join and invest in the installation of solar power plants in those spaces.

Nevertheless, not all SWOs can benefit from GEC. Mainly, those SWOs that are worse off are less likely to be supported by such a project because the sponsors tend to prefer well-performing SWOs for reputational and return on investment concerns. The role of municipalities is thus crucial in investigating and supporting these least recognized organizations and in involving them within energy transition plans and sustainable development. The dual support from GEC and the municipalities can together help realize the justice in the energy transition process. Overall optimization and investigation of the SWOs can not only prepare the organizations for tackling energy poverty and the increasing dependency on energy services but also, on a national level, increase the whole social adaptability in facing an aging society.

There are some potential directions for further research. First of all, as mentioned previously, there can be research on more SWOs with elderly care outside the three cases in this study. Including multiple examples will help to gain a more comprehensive view of energy poverty in SWOs with elderly-care under different circumstances, such as financial conditions, scales, and various service qualities. A broader research scale can also help to ensure the generalizability of the different energy needs presented in this thesis. Secondly, future research can focus on exploring energy poverty within different types of vulnerable populations and SWOs. For example, people suffering from intellectual impairments or ill children could share some similarities with the elderly in the vulnerability to energy poverty but could also have other differences. The solutions to address energy poverty with various vulnerable populations can be different, from improving their affordability to providing support in certain energy services.

The third potential is to extend the study to other geographical contexts, for example, the nursing homes and SWOs for elderly care in the US. These organizations might be facing similar challenges as the cases in Taiwan. More research can explore energy poverty in SWOs under other contexts, and the potential of having support from renewable energy through similar models of the GEC. Moreover, as for creating innovative solutions, more focus can be put on interventions other than subsidies for electricity prices or the increase in energy efficiency. There can be more proactive actions involving behavioral change, prevention approaches, and alternatives from different renewable energy resources that could be used regardless of geographical scope and economic development. In this way, addressing energy poverty can come in line with moving toward a low carbon society.

Last but not least, the study recommends Sunnyfounder to keep track of each case under the GEC and report their status regularly to both the sponsors and the public through periodic reports and web page updates. This tracking should include not only the structural changes and revenue numbers but also the operational changes within the SWO. For instance, operational changes could consist of the capacity of the SWOs in adapting to the increase in energy prices and other policy changes, or their ability to provide more community services, etc. By doing so, the company can, on the one hand, better evaluate the real social impact of implementing the GEC and, on the other hand, adjust the model according to feedback from the stakeholders. The study also recommends the company to explore replicability of the GEC model so the project can be repeated similarly under other geographical and cultural contexts, which will further expand the impact of the GEC.

Issues regarding energy poverty and sustainable energy transitions will be of great importance in the coming decades, not only in Taiwan but also globally. This study provides novel research in connecting the nexus between the two issues with a particular focus on the elderly population. The research highlights the importance of understanding the different energy needs of this group and its connection with energy poverty. Energy poverty under the context of Taiwan is thus not merely an issue relating to affordability but a discussion that should be viewed from the users' perspectives and needs. After all, energy is a necessity for every humankind for obtaining better living quality. Therefore, the ultimate purpose of using energy and whether the purposes have been widely reached should be taken into account when discussing energy transition plans and even under climate adaptation. Through collaboration between government, private sectors, and academia, there is a great potential for tackling energy poverty more comprehensively in Taiwan.

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Appendix A: List of interviews and observation

A.1 Observation list

Observation number	SWOs	Date	Duration
1	St. Camillus Center for intellectual disability	19th of February	1 hour
2	Huai-jhe Recovering Center	19th of February	1 hour

A.2 Interview list

Interview number	Role/position	Categorization	Date	Duration (minutes)	Form of interview
1	Director of The Chensenmei FamilyLand	Project recipients (the SWOs)	13th of March	40	Face to face
2	Head of the Department of Donation_ The Chensenmei FamilyLand	Project recipients (the SWOs)	13th of March	35	Face to face
3	A colleague working with the GEC project_from Sunnyfounder	Administration	16th of March	75	Face to face
4	A colleague working with the GEC project _from Sunnyfounder	Administration	16th of March	35	Face to face
5	Director of St. Camillus Long-term Care Center	Project recipients (the SWOs)	24th of March	125	Face to face
6	Director of Julin Nursing Home	Project recipients (the SWOs)	27th of March	57	Face to face
7	Academic researcher from National Taiwan University	Interested parties (academic researcher)	7th of April	40	Phone call
8	Head of the nursing personnel from St. Camillus Long-term Care Center	Project recipients (the SWOs)	27th of April	22	Phone call

Appendix B: Example of interview guideline for SWOs

Part 1: About the interviewee and the organization	
1	Could you explain the aim and goals of this organization and your role here? (1) What is your job here? How long have you been working here? (2) What are your study and working background? (3) What is your role in collaboration with the GEC project?
2	I would like to learn some facts about: (1) The number and types of residents (2) The primary financial resources and how the service fees are counted (3) What services does this organization provide?
Part 2: Electricity uses and the difficulties	
3	What energy services/uses are essential for your operation? How frequently do you use these services? (1) Air conditioning (2) Space heating (3) Lighting (4) Refrigeration (5) Elevator (6) Power for appliances (7) Water heating (8) Others
4	Why are the mentioned energy services significant to the organization and the elderly?
5	How significant is the expenditure on electricity? How much proportion does energy expenditure account for the total expense?
6	Have you/organization faced any difficulties or challenges in terms of the energy uses in the following aspects? (1) Energy price (2) Energy consumption and energy expenditure (3) Income
7	How do you currently address these difficulties?
Part 3: About the collaboration with GEC	

8	What is your understanding of the Green Energy Charity project? What model does your organization use?
9	What was your initiative/motivation of joining GEC and what were your expectations?
10	Do you know how much energy generated by the solar panels per month? Does this energy generated use on specific service or appliance?
11	What is your overall thoughts and evaluation on the GEC project? (1) Any benefit? Or to what extent does GEC help in addressing the challenges regarding energy usage you've mentioned? (a comparison between before and after GEC) i. Energy saving ii. Increase in income iii. Increase in visibility and recognition by the public iv. Other? (2) Any problem? Does the project create issues for the organization? i. During the installation ii. Different from what was expected iii. Others?
12	Do you think the model of GEC could be copied and is worth copying to other similar SWIs? (1) Yes->what factors do you think have made the project repeatable? (2) No->what constraints have you seen that will hinder the project?
<u>Part 4. Energy transition and its influence on the SWO</u>	
13	Have you heard of energy transition? What is your understanding of it? What changes do you think it will bring in?
14	Do you think energy transition will influence the organization? If yes, in what way? If no, please explain why?
<u>Part 5. Other questions</u>	
15	Do you have any questions for me?