School of Media, Creative Arts and Social Inquiry

Rethinking energy development to prioritise equity: The case of Cambodia

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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgement has been made. This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Human Ethics

The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) – updated March 2014. The research study received human research ethics approval from Curtin University Human Research Ethics Committee (EC00262) Approval number – HRE2017-0216

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Abstract

Energy plays a fundamental role in development, and this thesis is set in a period of increasing industrialisation and electrification in Cambodia. This thesis asks how discourses articulated by transnational actors working within renewable energy and development agencies in Cambodia influence the path of energy development. The methodologies utilised in this thesis include: textual analysis of key policy documents; discourse analysis applied to interviews with transnational actors; and ethnographic techniques of participant observation, to enable an understanding of everyday energy practices in Cambodia. Content analysis of the local English language press was also conducted during a three month period of electricity shortages in Phnom Penh.

This thesis contributes to scholarship in energy and social science research, and provides important understandings about transnational energy actors in Cambodia and the challenges they face in their attempts to increase renewable energy in the country. The research finds that transnational energy actors interviewed in Cambodia have limited influence on energy development, due to a lack of mutual understanding and influence with state level energy actors. The exception to this is where transnational energy actors in Cambodia can offer power supply in areas where the grid does not reach. Despite more villages being connected to the grid as the country rapidly electrifies, some households remain unconnected due to cost barriers. However, many solar home systems provided by energy actors and sold on the market in Cambodia have demonstrated limited functionality, with growing household energy use. Solar home systems provided also encountered frequent breakdowns, mostly due to battery failure.

Issues of equity and affordability of electricity were also raised through policy documents and discourse by the influential state level energy actor, Electricite du Cambodge in this thesis. This research finds that discourses of equity and affordability were largely absent from transnational energy actors and thus, a certain disconnect exists between the priorities of the Cambodian state, and transnational energy actors. This thesis invites a rethinking of energy development by transnational energy actors in Cambodia to prioritise equity in renewable

energy discourse. These findings have relevance for energy and development actors and researchers in Cambodia, as well as other countries undergoing a renewable energy transition.

Figures and tables

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Abbreviations

AC – Alternating current

ADB – Asian Development Bank

AEMO – Australian Energy Market Operator

ASEAN – Association of Southeast Asian Nations

BOT – Build Operate and Transfer

DC – Direct current

DFAT – Department of Foreign Affairs and Trade (Australia)

EAC – Electricity Authority of Cambodia

EDC – Electricite du Cambodge

INDC – Intended Nationally Determined Contributions

kW - kilowatt

kWh – kilowatt hour

MDGs – Millennium Development Goals

MEF – Ministry of Economy and Finance

MME – Ministry of Mines and Energy

MW – Megawatt

MoE – Ministry of the Environment

PPA – Power Purchasing Agreement

PV – Photovoltaic

REE – Rural Electrification Enterprise

SDGs – Sustainable Development Goals

UNCED – United Nations Conference on Environment and Development

UNDP – United Nations Development Programme

UNTAC – United Nations Transitional Authority in Cambodia

USD – United States Dollar

WTO – World Trade Organisation

Chapter 1: Introduction

1.1 Context and research question

Many electricity systems around the world are undergoing a form of transition, with several countries decarbonising their energy sources. Australia is continuing to add more renewable energy to replace ageing fossil fuel infrastructure (Simshauser, 2019), and in Germany, nuclear power is being replaced by a growth in renewable energy (Markard et al., 2020, p. 12). As countries in Europe and Australia begin the process of transitioning their electricity sources, globally questions are also being raised about whether more renewable energy is simply expanding the overall amount of energy produced, while energy use increases and fossil fuels, particularly oil and gas, continue to grow (Jackson et al., 2018, p. 3; York & Bell, 2019). Johnsson et al. (2018, p. 260) find that fossil fuels still constitute more than 80 percent of the global primary energy supply, despite USD 281 billion of renewable energy investment in 2020 alone (International Energy Agency, 2021). The increased investment in renewable energy has so far not led to primary energy reductions in fossil fuels. This is in part due to transitions only occurring within the electricity sector, which accounts for 20 percent of total energy consumption (International Renewable Energy Agency, 2018, p. 19). Regions and countries with significant fossil fuel reserves such as India, China, Venezuela and the Middle East, have also seen a steady increase in primary energy demand from fossil fuels (Johnsson et al., 2018, p. 263). Clearly, this has implications for global climate change.

This thesis is set within a pivotal time in Cambodia's development where economic growth is fuelling increasing power generation and electrification of the country (Intelligent Energy Systems & Mekong Economics, 2016, p. 14). Energy demand is increasing at approximately 18 percent per year between 2010 and 2016; most of which occurs in Phnom Penh (Economic Research Institute for ASEAN and East Asia, 2019, p. 60; Intelligent Energy Systems & Mekong Economics, 2016, p. 14). The rapid increase of energy demand in Cambodia is consistent with findings from Nguyen and Kakinaka (2019, p. 1055), that initial stages of economic development accelerate the need for more energy, particularly for non-renewable energy consumption in low income countries.

This opening chapter will introduce the research question, context for the research, and provide a brief summary of discourse theory applied in the methodology of this thesis. It will

also outline the main findings in this thesis and their significance, along with a summary of each chapter in the thesis. This research addresses the question of how discourses articulated by transnational energy actors operating in Cambodia influence energy policy and provision in the country. The research also considers the equity implications of energy development in Cambodia and addresses a secondary question, of how the energy needs of people are considered in energy planning for the country. Reference to transnational actors interviewed for this research consist of individuals and organisations involved in the renewable energy and international development sector in Cambodia. These actors utilise discourse and storylines (Hajer, 1996, p. 69) in their advocacy for more renewable energy in Cambodia. This research applies techniques of discourse analysis to key policy documents and interviews, to shed light on the energy situation in Cambodia during a period of significant change and rapid growth (Hill & Menon, 2013). An example of a niche level, solar micro grid project is also studied to address how the energy needs of people are met in Cambodia. Representations by an influential state level energy actor are analysed from an energy vision event I attended in Phnom Penh, where the Managing Director of Electricite du Cambodge (EDC), His Excellency Keo Rattanak, spoke of a vision of energy for the country. The inclusion of these representations provide important context about regime level discourse in Cambodia (refer to Chapter 8).

The fieldwork component of this research was undertaken in Cambodia between 2017 and 2019. Despite increasing electrification in Cambodia, this research was initially undertaken with knowledge of the low levels of electrification in the country, where as recently as 2014, only 56 percent of the population in Cambodia had access to electricity (World Bank, 2020). Since that time and throughout this research, electrification in Cambodia has increased markedly and the latest World Bank statistics for 2019 put electrification in Cambodia at 93 percent (World Bank, 2020). However, this figure is likely to only include electrification rates for villages, and not household electrification, as not all houses are connected to the grid, even if a village is electrified. Where villages have been electrified, particular households may not be able to afford to pay the connection fee, which ranges from USD 75 to 300. This point is discussed further in this thesis (refer to Chapter 8).

My approach and thoughts on energy development in Cambodia prior to starting this research have shifted since beginning fieldwork in Cambodia in 2017. I was cognisant of the path of development that Cambodia was following, that of state led industrial development, which

necessitates increasing electricity consumption (Wong, 2012). However, due to lower levels of electrification in Cambodia at the outset of this research, I hypothesised that Cambodia may have the opportunity to avoid a centralised model of energy provision and, instead, pursue more decentralised energy options for energy access. However, this research has uncovered where my initial considerations of energy development in Cambodia towards a leapfrog scenario, as described in the development literature (Wieczorek, 2018, p. 209), has lost relevance, particularly when considering the scale of economic growth and development within Asia (Berkhout et al., 2009, p. 225). The overarching reality is that while industrial development remains at the core of national agendas, a shift to a more sustainable energy system will remain inherently challenging. Smil (2020, p. 14) also discusses the challenges of a complete shift to renewable energy, noting that expecting the decarbonisation of global energy supply can be achieved in the short term, ignores the scale of the task and the fact that there needs to be increases of energy in low income countries. The increased electrification that has occurred in Cambodia through the period of this research has meant that significantly more people in Cambodia now have access to grid electricity. However, as discussed in this thesis, areas remain with low levels of energy access in Cambodia, which includes limited hours of electricity per day for some people. This research found that localised energy production through solar home systems seldom sufficiently meet people's energy needs in Cambodia. However, there are some promising energy developments in Cambodia as discussed in the observation of a solar micro grid project (refer to Chapter 7).

Politically, Hughes and Un (2011) describe post conflict development in Cambodia as a form of crony capitalism, where bureaucrats in the state apparatus are influenced by business elites who are given rights over resources and sections of the economy, in exchange for "patronage resources for political elites" (Hughes & Un, 2011, p. 17). Patronage networks extend beyond the bureaucracy in Cambodia, with links between individuals with the Cambodian People's Party (CPP) and the business sector (Hughes & Un, 2011, p. 72). According to Global Witness, the construction, energy, tourism, trade and finance sectors are rife with patronage, documented in their exposure of Hun Sen's family fortunes amassed through ownership and control of private companies (Global Witness, 2016, pp. 4, 10). However, Springer (2015, p. 29) allocates some of the blame for cronyism and patronage to the very nature of capitalism itself, asking; "when in any capitalist system have the agents of capital not been intimately connected with politicians?" Springer (2015), goes further to note that regime stability is the main concern of capitalism and there is little preference for democracy or authoritarianism, as

long as there is a strong state that provides a "secure marketplace" (Springer, 2015, p. 29). Norén-Nilsson and Bourdier (2019, p. 3) also state that Cambodia has experienced hardening authoritarianism since 2013, yet the ruling Cambodian People's Party (CPP) is shifting its approach to one that seeks consensus. This is consistent within the region and reflects the states attempt to constrain opposition and protest movements that are severely restricted in Cambodia (Norén-Nilsson & Bourdier, 2019, p. 3).

The Cambodian government consistently receives criticism for forced evictions from land, of both rural and urban populations in Cambodia (Norén-Nilsson & Bourdier, 2019). Land evictions in Cambodia are taking place under a range of guises such as poverty reduction, climate change mitigation and for various development and resource extraction projects including construction, timber, hydroelectric dams, agriculture, plantations and for land speculation (Baker & Milne, 2015; Hunsberger et al., 2018; Rudi et al., 2014; Scheidel, 2016; Springer, 2015; Work & Thuon, 2017). Springer (2015, p. 49), observes that upholding protections for foreign investors in Cambodia through a legal framework would only serve to entrench violence and dispossession towards people in Cambodia, due to a "level playing field" where property accumulation is legitimised. However, Young (2020, p. 421) notes that Cambodia's reputation of corruption, and lack of consistency and enforcement of laws, attracts "opportunistic" and exploitative companies, of which Chinese investments under the Belt and Road Initiative are singled out as prevalent. How these companies operate in Cambodia is via the patronage regime through the establishment of joint ventures, or in collaboration with influential Sino-Cambodian partners, who often hold the honorary title of Oknha (Young, 2020, pp. 422-433). The title of Oknha is given to individuals who contribute substantial sums of money to the state. The system of Oknha's and Advisors in Cambodia is described as the "mechanism by which money and power connect" (Hughes & Un, 2011, p. 72). Advisors in Cambodia receive the honorary title of Ayodom or Excellency, which differs from Oknha in that they have a personal, rather than official relationship to a powerful office holder, or long term service to the CPP (Hughes & Un, 2011, p. 73). The production and distribution of energy is shaped through this context, which will be touched on throughout the thesis and explored in more detail in the discussion of the role of the Managing Director of EDC, His Excellency Keo Rattanak, in chapter 8.

The methodological approach of this thesis is discussed briefly below, while further discussion on discourse theory and the methods utilised in this research are discussed in

Chapter 3. Discourse theory assumes that meaning develops within historical and social contexts (Howarth, 2000, p. 12). Techniques of discourse analysis are used in this thesis to further understandings of the complexities shaping energy policy and provision in Cambodia, as well as account for the historical and regional context of development. The analysis for this thesis examines the historical path of development for Cambodia and the discourse being used by institutions and transnational actors involved in the energy sector. It is important to understand the historical significance of where discourses of development prevalent in Cambodia today are sourced from and how these and other ideas of progress and development for the country entered the policy discourse of the Royal Government of Cambodia (Fairclough, 2013, p. 184). For example, Cambodia is in pursuit of development as a least developed country, as classified by the United Nations, with aspirations to reach the status of an 'upper middle income' country by 2030 and a 'developed country' by 2050 (National Climate Change Committee, 2013; Royal Government of Cambodia, 2014, 2015b). The history and use of the term 'development', as discussed in the literature review (Chapter 2), is largely based on notions of growth and industrialization (Moore & Schmitz, 1995, p. 22), which suggests that the attainment of 'developed country' status for Cambodia will follow the same pattern of growth as previous industrial societies (Pieterse, 2010b, p. 23). This has particular influence on the energy sector, as industrial growth suggests and necessitates high energy consumption.

1.2 Research significance

This research is multidisciplinary and is situated within the social sciences (development and political science). Knowledge from the applied and natural sciences, specifically environmental and technology studies is also utilised throughout this thesis. The research can be most accurately described as contributing to the growing area of scholarship in energy and social science, and furthers understandings about transnational energy actors in Cambodia and the challenges they face in attempting to move the energy sector towards a more sustainable path. This has implications for how energy transitions are approached in Cambodia and within Southeast Asia. Transition literature has emerged predominately from Europe, specifically Germany and the Netherlands. Much of the transition literature theorises that socio-technical transitions operate on three levels, termed the multi-level perspective (Geels, 2010, 2011). These three levels broadly represent the external environment, rules and institutions, and new innovations, characterised by the landscape, regime and niche levels

respectively (Geels, 2011, p. 26). This thesis uses transition theory and applies it in analysing the discourse of actors operating in Cambodia on the regime and niche levels to understand the influence of transnational actors on the regime level. Geels (2011, p. 27) describes the "deep structure" of socio-technical regimes, as a set of rules that orientate the reproduction and stability of an existing technological trajectory. However, these regime rules are not always rigid or regulatory; they also consist of beliefs, user practices, institutional arrangements and contracts. For Cambodia, the regime level actor or institution identified through this research is EDC, the state owned utility, and one of the more influential actors in the energy sector in Cambodia.

Hansen et al. (2018, p. 202) identify a gap in the transition literature, within the context of developing countries noting that there is a need to understand the different mechanisms influencing sustainability transitions, the role of transnational actors and regime resistance in non-Western contexts. Leipprand and Flachsland (2018, pp. 191, 200) also state that a focus on the discourse of various actors in the process of energy transitions is important to understand the framings and debates that occur after new technologies break through; beyond the niche level, which utility scale solar in Cambodia has largely done so. A further gap in the literature identified by Hansen et al. (2018, p. 202), is how informal institutions may play a more significant role in energy transitions in non-Western contexts and the different nature of regime actors. There is also limited ability for niche level or innovative projects to be transformative in developing countries, and niche level projects are at risk of instead becoming isolated, ad hoc projects (Hansen et al., 2018, p. 201). This is partially due to the lack of sharing of information with state actors, as well as limited state support for innovation and more reliance on external actors and donors (Hansen et al., 2018, p. 199). Thus, this thesis provides an original contribution to knowledge in the transition literature by furthering understanding of the discourse of transnational actors attempting to increase renewable energy in Cambodia, and on the resistance they face from regime actors in the country, specifically EDC. This thesis interrogates the discourse of transnational actors in Cambodia, as well as actors operating on the regime level to identify where there is a lack of mutual understanding (Hajer & Versteeg, 2005, p. 177). This lack of mutual understanding between the actors has further implications for energy transitions in Cambodia. This thesis also provides further insights on a niche level renewable energy project in Cambodia, confirming the argument by Hansen et al. (2018), on the limitations of transformation through this type of project in a Cambodian context (discussed further in Chapter 7).

More broadly, this thesis was written in response to a global approach to energy provision as a technical and economic issue, with limited consideration of issues of equity and societal relationships to energy. This dominant approach to energy provision is also encouraged in responses to climate change, where renewable energy development is pursued for the sake of reducing carbon emissions, without asking broader, philosophical questions about energy provision and practices. Additionally, this thesis suggests that insufficient attention is being paid to the replication of inequities and detrimental impacts of energy development for people, which is becoming evident as energy sources are transitioned to renewable energy. Some of the inequities in energy transitions discussed in this thesis include increasing electricity costs and spatial inequities that intensify energy poverty and precarity (Ansarin et al., 2020; Bouzarovski & Simcock, 2017; Golubchikov & O'Sullivan, 2020; Johnson et al., 2020; Sovacool et al., 2019). Klinsky et al. (2017, p. 172) describe the importance of including equity perspectives in energy transitions to ensure that the "greater good" of attempting to address climate change does not come at the expense of people who may, at best, be excluded as beneficiaries and, at worst, become further entrenched in disadvantage by the changes occurring. Other transboundary justice issues, particularly relating to the construction of more hydroelectric dams in Laos (Marks & Zhang, 2019), are touched upon in this thesis as they relate to Cambodia, but are not the focus of this research. Displacement and land evictions in Cambodia from energy projects have also occurred in relation to hydroelectric dams, such as the 400 MW Lower Sesan II dam in Steung Treng province (Young, 2020, pp. 426-427).

1.3 Summary of findings

This research finds that transnational energy actors have limited access to, and engagement with, the influential energy actor at the regime level, EDC. Several factors contributed to this lack of influence, with one significant reason being a lack of mutual understanding between transnational energy actors and EDC. This is evidenced in the use of simple storylines (Hajer & Versteeg, 2005, p. 177), which are voiced by both transnational actors and senior EDC staff with an assumption of mutual understanding. Energy actors interviewed in Cambodia also express modernist thinking, described as techno-institutional fixes that enable progress and do not require structural change (Hajer, 1996, p. 32 & 33). Where transnational energy actors interviewed were focused on renewable energy supply, for Cambodia to embrace a form of sustainable development; EDC's Managing Director, Keo, voiced concerns about

reliability and affordability (refer to Chapter 8). Reliability discourse is typical of industrial states and is "symbolic of strength and economic power" Rinkinen et al. (2019, p. 73). Hajer (1996) also provides insight into this type of discursive dominance that occurs as the narrative is convincing, and there is no sufficient counter narrative. In the case of reliability, the counter narrative of an unreliable energy supply is not persuasive and thus reliability discourse is "routinely reproduced" (Hajer, 1996, p. 60). Statements made by transnational actors interviewed in Cambodia did not challenge the storyline of reliability, nor did they provide a convincing counter narrative.

The simple storylines of affordability and reliability by EDC's Managing Director; however, do not capture the complexity and nuance of concerns that were articulated, which encompass equity issues. At the energy vision event in Phnom Penh in 2019, Keo expressed concern about the distribution of costs and benefits in renewable energy transitions (Schlör et al., 2013; Sovacool et al., 2019). Keo, referred to the UK, Germany and the United States, where rooftop solar has contributed to increasing costs for non-rooftop users and stated: "We don't want that situation either. It's going to take a different type of conversation" (Keo, 2019). This thesis shows through recent literature (Chapters 2 and 8), that there are equity issues to be considered on the path toward a sustainable energy transition (Johnson et al., 2020; Monyei et al., 2019; Sovacool et al., 2019). Thus, comments by the representative of EDC are valid and reflect new knowledge of the reality for many countries undergoing energy transitions. This thesis suggests that it may be beneficial for transnational energy actors in Cambodia to have that "different type of conversation" (Keo, 2019), and incorporate equity issues in recommendations of technology paths for Cambodia.

Affordability of electricity for people in Cambodia was not commonly discussed among the transnational actors interviewed. Many transnational actors interviewed in Cambodia were involved in the supply of off grid electricity with solar home systems. However, this market in Cambodia was becoming less viable for transnational actors in the country, due to increasing electrification of the country and limited usefulness and lack of trust in smaller solar home systems. Many solar home systems ranged in size from 80 to 250 watts, which were often too small to meet growing energy needs in rural areas. Electricity demand in rural areas is growing in response to the supply of electricity and as people added more appliances to their solar home systems, the additional load on small systems led to batteries having a short life span. Additionally, many of the solar home systems provided in Cambodia were

expensive, either through higher tariffs or through unaffordable repayments that left people in debt. Lessons have been learnt in Cambodia within the market for solar home systems; however, this market is significantly reduced in Cambodia due to increased electrification and a preference for grid electricity, which is also more affordable for people.

Transnational energy actors in Cambodia voiced their view that the regime actor EDC, were motivated by profit as a reason to limit the progression of solar PV on the national grid (refer to Chapter 8). However, statements from the Managing Director of EDC as a regime actor, demonstrates that EDC are not overly concerned with losing business as they have market control and influence in Cambodia and this is not being threatened. I came to see EDC as exhibiting a form of resistance to change that Arranz (2017) describes from regime actors in technological transitions of "influence", which is based on observations of the monopoly provider of Hong Kong's electricity. EDC exerts direct control over Cambodia's energy market and they exercise this control by allowing change at their own discretion and this includes access to land as discussed in section 8.2. EDC and the Cambodian government are, however, open to solar when it meets the need for more power, as evidenced by the announcement of several utility scale solar PV projects through the extended power outages in Phnom Penh in 2019 (discussed in Chapter 6). Openness to solar is also supported for rural electrification as evidenced through a focus on rural electrification in the policy documents discussed in Chapter 4. However, this research shows that solar home systems, which have been provided in Cambodia are not always affordable for people and, ensuring this affordability is not always a priority for transnational actors.

1.4 Outline and summary of chapters

Chapter 2 of this thesis provides a comprehensive review of the literature and theories of main relevance to this thesis. The literature review includes an extensive discussion of theories informing this thesis: from modernisation theory to transition theory and energy justice literature. The chapter begins with a historical overview of development and modernization theory to provide the broader context for the Cambodian state attempting the transformation from a least developed country to an upper middle income country by 2030. Transition theory (Geels, 2010, 2011, 2014) is reviewed in the literature to understand the positioning of key energy and development actors in Cambodia at the regime level and transnational actors, who often operate outside the regime level. For transnational actors

operating with disparate beliefs and views of energy development in Cambodia, challenges are apparent in their attempts to influence regime actors, such as EDC, towards a more sustainable energy system. Transition theory is also helpful in analysing the energy sector in Cambodia in identifying forms of resistance by regime actors, such as influence and risk aversion identified by Arranz (2017, p. 136). Finally, the literature review also includes more recent scholarship on issues of energy equity and justice, particularly distributive justice and cosmopolitan justice (Sovacool & Dworkin, 2015; Sovacool et al., 2019) relating to energy access, costs and an equitable share of benefits, as well as transboundary justice issues in relation to coal and hydro developments, in Cambodia and the region. Recent literature on inequities occurring in energy transitions in other parts of the world is also reviewed to aid in understanding the discourses articulated in Cambodia.

Chapter 3 provides a more detailed overview of the methods and a brief discussion of discourse theory as the methodology used in this thesis. The thesis applies three main methods of analysis: textual analysis of six key policy documents selected for thematic analysis and coded according to broad energy and development themes; 21 semi-structured interviews with transnational energy and development actors in Cambodia; and ethnographic techniques of participant observation to enable an understanding of everyday energy practices in Cambodia.

The analysis of six key energy and development policy texts is described in Chapter 4 to provide an understanding of the development priorities of Cambodia and to examine whether the transnational actors interviewed had any influence over key energy and development policies in Cambodia. The chapter outlines the common development and energy related discourse within the six key policy texts and discusses the discourses of equity, reliability and affordability. These discourses are identified in and across the key policy documents.

Chapter 5 provides further context on the growing energy needs in Cambodia from reviewing relevant literature as well as insights and philosophies on energy from Frigo (2017); Geerts (2018); Geerts et al. (2014); Illich (1974); Rinkinen et al. (2019) and Shove and Walker (2014). Data from interviews with transnational energy and development actors in Cambodia, as well as observations from fieldwork undertaken in Cambodia between 2017 and 2019 are analysed in Chapter 5. The chapter depicts increasing energy use in Cambodia and the drivers of that increase, such as building construction in the capital, Phnom Penh and the broader

landscape of industrial development. The chapter demonstrates the necessary context of growing energy needs and excess; in juxtaposition with people in Cambodia lacking sufficient electricity for their daily lives.

Chapter 6 offers direct observation of life in Cambodia during the extended power outages that occurred between March and May, 2019. Throughout these months and over the dry season, Phnom Penh experienced daily load shedding[1] to manage a shortfall of approximately 400MW of electricity capacity (Taing, 2019). My observations in Cambodia over this period of power outages describe how the Government of Cambodia attempted to resolve the issue throughout this time by trying to source additional power from Thailand and Laos, and ultimately announced the construction of an additional 80MW hydroelectric dam in Pursat province and, three 60MW solar PV projects, to assist in meeting future electricity demand (Kunmakara, 2019; Lipes, 2019). Statements by EDC's Managing Director on the power outages are discussed along with an analysis of 35 English language articles from this period. Many of the articles emphasised solar, often as solutions to the energy crisis during the period of electricity shortages in Cambodia. However, there was little evidence of transnational actors interviewed for this research having an impact or influence on the decisions made by government or EDC at this time. Instead, external factors, in the form of increasing energy demand, enabled the Cambodian government to see solar as a viable solution to the energy crisis.

Chapter 7 discusses an onsite observation of a micro grid solar project in Cambodia, as an example of a niche level project in Cambodia. The chapter begins with an overview of rural electrification and the levels of energy access using the multi-tier framework from the World Bank's most recent survey in Cambodia (Dave et al., 2018). The chapter also provides further data from interview participants on the solar homes system market in Cambodia, including some of the challenges and failures that have occurred with these systems, which do not always meet people's energy needs. The chapter provides findings from the interviews and site visit on the influence that Participant 14's organisation was having on rural electrification in Cambodia.

[1] Load shedding is when demand for power exceeds supply and power needs to be cut to areas to maintain balance of the system as a whole. See, Harrison (2019)

Chapter 8 is the main discussion chapter of this thesis, which focuses on discourses by transnational energy actors in Cambodia and, includes an analysis of texts from the main regime actor, EDC. This chapter furthers understandings about the work of transnational actors interviewed and the challenges they encounter in attempting to influence the energy sector in Cambodia towards a more sustainable path. In conclusion, Chapter 9 brings the research together and discusses the contribution to knowledge of this thesis. It also addresses the limitations of the research and, provides recommendations for future research in Cambodia.

Chapter 2: Review of literature

2.1 Introduction

This chapter begins with a review of the development literature, which provides the historical context of development in the post-World War II era and the many external and internal influences that shape development in Cambodia today. Cambodia is a rapidly developing state, however, as discussed in this chapter, the growth model that Cambodia is pursuing is significantly influenced by industrialization and modernization, with aspirations by the Cambodian state to move beyond the United Nations classification of a least developed country by 2030 (Royal Government of Cambodia, 2014, 2015b). Although categorisations of least developed and developed states appear dated, and indeed there is much to criticise about a "one-world world" as Law (2015) and several other scholars such as Marsh (2014) and Pieterse (2010b), do indeed criticise. Nonetheless, the reality for Cambodia is an agenda to develop the infrastructures of an industrialised state, of which electrification is fundamental and where discourses of reliability and security continue dominant forms of energy production (Curran, 2012; Simpson, 2007), and thus provide a type of industrial certainty (Beck, 1997; Yang et al., 2018).

We ought to be cautious in our critiques however, as Pieterse (2010a, p. 188) counsels, in attempts to dictate an alternative, post or even sustainable development model, that arrives with a fixed view, where reflexivity is likely more helpful. For Cambodia, a state with its own history and modern civilisation of the Khmer empire (Sinanan, 2013), there needs to be a more nuanced depiction of modernity for the future. One that grasps what is not simply a technological shift from a smoke stacked future to a clean renewable energy future, but incorporates discussions of social and cultural change (Kangas, 2019). There is also the potential for the replication of inequalities and further injustices with shifts towards sustainable and ecological development as discussed in the literature by Golubchikov and O'Sullivan (2020), Sovacool et al. (2019), Sovacool and Dworkin (2015) and Wong (2012). This chapter and review of the literature also presents transition literature, which provides further context to a Cambodian energy transition, and utilises the multi-level perspective that sees transitions operate on three levels, incorporating the external landscape, regime and niche levels (Geels, 2011). As noted by Wieczorek (2018), however, much of the transition literature does not engage with development literature enough to offer flexibility and address concepts that already occur in development literature, such as leapfrogging of technological

paths. Further still, the concept of leapfrogging for countries like Cambodia is by now outdated, given the speed of electrification occurring in the country. However, concepts in the transition literature such as niche level actors and innovations (Geels, 2010), and forms of resistance (Arranz, 2017; Geels, 2014), can offer further insight, beyond the development literature. Thus, the use of transition, development and energy justice literature discussed in this chapter provides a broader analysis than simply utilising transition or development literature alone to understand the changes occurring in Cambodia's energy sector.

2.2 Development theory

As organisations such as the United Nations (UN) are propelled by a development agenda (United Nations, 1997), the literature and historical changes in development theory are fundamental to understanding the path of energy development in Cambodia and the broader development trajectory that Cambodia and many countries in the region are taking. As well as taking a historical view of development since the post-World War II period, it is also important to recognise the process of development as being a constant work in progress. As Andrews and Bawa (2014, p. 923) state, "there is no end state in the development trajectory." Despite this, the current view on development from the UN is an agenda and a set of 17 loosely worded Sustainable Development Goals (SDGs) for all states to meet by 2030. Development in some form will evolve over this time and it is not a linear or homogenous process for all states to adhere to the SDGs, regardless of how comprehensive and inclusive they may seem on the surface. As discussed by Herath (2008, p. 1462), top down approaches to development often fail to meet local needs and priorities, particularly in post conflict societies, and he notes the need to understand development from the perspective of people that are affected by it.

In the post-World War II period, the idea of development was central to the western economy and the structures to implement the development worldview were set in place through intergovernmental agencies such as the UN, the World Bank and other agencies, such as the International Monetary Fund (Escobar, 1992, pp. 23-24). In this time period, development was underpinned by Keynesian economics (Weiss et al., 2007). However, development also derived from and has been influenced by other social theories such as Marxism, structuralism, and dependency theory among others (Pieterse, 2010b, p. 4). Critics of the all-encompassing western development model such as Pieterse (2010b, p. 37) notes that

development “theories promote facades of consistency as part of their single minded future building project” and Sinanan (2013, p. 48) states that development is not only an economic project, but a political and cultural project that, “seeks the total political and cultural transformation of states.” Escobar (1992, p. 24) has a similar view and asks why so many countries started to see themselves as underdeveloped, correlating the discourse of development to other colonising discourses. Andrews and Bawa (2014, p. 924) partially answer the question of why so many countries saw themselves as undeveloped when, in the post-World War II era, development became almost a universal truth with no regard for other methods of social and cultural organisation. Development was also based on notions of industrialization (Moore & Schmitz, 1995, p. 22). Both Moore and Schmitz (1995) and Sachs (1993) identify the foundation of development as being based on the centrality of economics and the prioritisation of growth, which turned into “sustained growth” (Moore & Schmitz, 1995, p. 22), as well as the mandate for “sustaining development” that emerged from the United Nations Conference on Environment and Development (UNCED) in 1992 (Sachs, 1993).

Not only was the concept of development based on a model of industrialization but, as discussed by Weiss et al. (2007, p. 241), the pursuit of economic growth with equitable distribution of resources that met basic human needs, was seen as an indirect way to maintain peace and security. The theory of development has not been static and has changed over the period since 1945. Dadzie (1993) identifies four phases and time periods that occurred within the UN on their approach to development, and Weiss et al. (2007) have further classified these as “national state capitalism” from 1945-1962, “international affirmative action” from 1962-1981, “return to neoliberalism” from 1981-1989 and “sustainable development” from 1989 to present (Weiss et al., 2007, pp. 246-262). In a paper analysing the history of development studies from the post-World War II era, Andrews and Bawa (2014, p. 923) refer to the process of development as encompassing three key features that include, welfare, improvement and social change, and have the view that, based on these key features, all states can be considered ‘developing countries’ (Andrews & Bawa, 2014). Other authors such as Hettne (2010) have discussed a shift in the 1970s that lasted for three decades and could be said to continue to this day of freeing the market from state regulation and “bureaucratic hurdles”. What this looked like in practice was the dominance of economic growth to the detriment of other issues such as environmental protection and social justice (Hettne, 2010, p. 38). This is not news to many, however, the importance that is placed upon economic growth

above all other concerns should not be understated in regards to 'development', as this discourse persists to our present time within the language of the SDGs.

However influential intergovernmental agencies such as the UN and the World Bank are in setting the agenda for development, many states have pursued their own path to development. Countries such as Singapore and Japan have become economic success stories, while maintaining state centred approaches to development. Weiss et al. (2007, p. 255) refer to countries such as these and uses the example of South Korea as continuing "various forms of statism", where national industries are largely protected from competition in the global market. The development of the Cambodian state has taken forms that have varied from ideal UN models of development since the post-World War II period, but have adopted certain aspects of neoliberal and capitalist development. The history of the Khmer Rouge in Cambodia from 1975 to 1979, with their own paranoid and distorted vision of a classless rural society, untainted by Western culture, had a significant effect on people and development in Cambodia (Mehmet, 2010). Sinanan (2013, p. 45) notes that, "Cambodia is in a unique position in relation to development" due to the history of Cambodia, "not as a world power in modern, nation state terms, but as an empire and civilisation." Sinanan (2013, p. 48) goes on to state that being 'modern' is largely compressed into an indicator of technological and economic progress. However, it does not incorporate 'culture' in broad terms or acknowledge the Khmer empire that existed in Cambodia from the 9th to the 15th century (Plubins, 2013), which under a different set of indicators, could constitute the height of modernity.

There is however a risk in idolising the Khmer empire, like nostalgia for other empires, such as the British. This is particularly the case when the building of Angkor Wat was based on slave labour and the Khmer Rouge also utilised nationalism, pride in past achievements of the Khmer empire and slavery in attempts to achieve their distorted vision of a utopian agrarian society (Mehmet, 2010). Cambodia today still remembers the glory of the Angkor empire, but is also "strongly informed by the trauma perpetuated by the Khmer Rouge" (Din, 2020, pp. 16-17). Din (2020) reflects on the "official" narratives of the Khmer Rouge used in Cambodia today, which are "politically charged" and perpetuated through the "Day of Hatred", which includes a re-enactment of the Khmer Rouge violence. The day is now referred to as the National Day of Remembrance (Kopsa, 2019). Peou (2018) also reflects on narratives used by the Cambodian People's Party (CPP) when observing "Victory Day" on 7

January, which commemorates the end of the Khmer Rouge regime. Narratives from this day include struggles against colonial rule, US imperialism and independence under French colonial rule (Peou, 2018, p. 44).

Historically, the influence of the United Nations Transitional Authority in Cambodia (UNTAC) was significant in attempts to implement a peaceful democracy and conduct a 'free and fair' election from their deployment in March 1992 to the election in May 1993 (Mersiades, 2005, p. 210). However, as discussed by Mersiades (2005, p. 211), the UNTAC initially lacked legitimacy within Cambodian society due to their inability to disarm the Khmer Rouge and ongoing factional violence. Despite this, UNTAC was able to mobilise support for the election by ensuring security and safety for Cambodians to vote, which maintained some validity as a bringer of peace to the Cambodian people; however political violence and instability continued (Mersiades, 2005, pp. 212-213; Strangio, 2014, p. 63). At the time of transitional governance under UNTAC, Cambodia was dependent on foreign aid and in the decade after the Paris Peace Accord, foreign aid was approximately 10-15 percent of gross domestic product in Cambodia (Hill & Menon, 2013, p. 48). Overseas development aid in Cambodia is declining and in 2007, foreign direct investment overtook overseas development aid for the first time (Hill & Menon, 2013, p. 48).

Cambodia's development and economic growth has also been heavily influenced by the aid sector and extractive industries such as forestry (Ear, 2012). More recently, development and construction in Cambodia has occurred through a significant amount of foreign direct investment from China, mostly through concessional loans and financing of infrastructure projects, such as roads, bridges and transmission lines (Sato et al., 2011, p. 2095). Foreign direct investment from China in Cambodia also improves China's own state development through the use of resources, as well as economic integration in the region (Ear, 2012, p. 134; Sato et al., 2011, p. 2095). Ear (2012, p. 55) also notes the openness to the private sector that exists in Cambodia, with generous tax rules compared with other countries in the region. Energy development in Cambodia is also very open to the private sector and Chinese investment in the power sector in Cambodia is significant, with Chinese companies owning almost 80 percent of generation capacity in the country (Li et al., 2020, pp. 5-6).

Perhaps the most interesting phase of UN development models was the second phase between 1962 to 1981, which Weiss et al. (2007, p. 250) identified as the phase of "international

affirmative action", based on self-determination for states and decolonisation for colonised states. There was also a focus on income inequalities between the North and South of the world based on the work of dependency theorists such as Raul Prebisch, who became the first secretary general of the UN Conference on Trade and Development (UNCTAD) (Weiss et al., 2007, p. 252). Andrews and Bawa (2014, p. 925) also note this change from a focus on the homogenous, growth focused model of development to a recognition of the inherent issues of inequality built into the capitalist system that the development model was founded on. Watts (1993) refers to this era as seeing a "rise of anti-developmentalism", which was influenced by activists in the South and 'postcolonial intellectuals' in the North (Watts, 1993, p. 258). Pieterse (2010b, p. 85) identifies two forms of the alternative development camp, the structuralist approach, following on from Prebisch's dependency theory that advocated for macroeconomic change, and the normative approach that encouraged individual agency to create change. However, knowledge of the damaging aspects of development and calls for alternative strategies did not fundamentally change the way development was applied, as the third phase of development in the 1980s is referred to by Weiss et al. (2007) as a "return to neoliberalism", with a focus on deregulation and privatisation, with a greater role for the private sector in international development (Dadzie, 1993, p. 305). Structural adjustment programs and conditional loans were implemented at this time, led by the United States through the IMF and the World Bank, which emphasised a cut in public spending for states and a larger role for private markets, as opposed to public policy (Weiss et al., 2007, p. 257). The 1980s were also a time of debt, inflation and unemployment and the overarching austerity at the time did not favour alternative development strategies or even state focused development (Watts, 1993, p. 258).

From this third phase and focus on neoliberalism, the fourth phase from 1989 to the present time has been identified by Weiss et al. (2007) as "phase four: sustainable development". However, Perkins (2013) states how sustainable development predates even the United Nations Conference on the Human Environment, or the Stockholm Conference in 1972. Fears were raised at the Stockholm Conference from parts of the developing world that the focus on environmental issues such as controlling industrial pollution could limit their economic development (Perkins, 2013, p. 1005). It could be argued, and indeed it has been argued by authors such as Sachs (1993), that there is very little that is sustainable about our development trajectory anyway. In practical terms, it would appear that we are not in a phase of sustainable development when we see how unsustainable our growth focused world is

becoming. Nonetheless, according to the UN, the world is indeed pursuing sustainable development and, as of 2015, the SDGs came into being as a set of 17 global goals that states can strive for to eradicate poverty and factor in the economic, environmental and social aspects of development that underpin the concept of sustainable development (UN DESA, 2015c).

Castro (2004, p. 196) discusses how, for some authors, the concept of sustainable development began as a reaction to what he called the "radicalism of the environmental movement" with their calls for limits to growth. Whether as a reaction to environmentalism or an extension of development, as is the view of Escobar, the result is in many ways the same; almost a safeguarding of development and growth (Castro, 2004). The view at this time, which Castro (2004) relates to dependency theory with flows of expertise, capital and technology from the core to the periphery, is encapsulated in a quotation from the Brundtland Report, *Our Common Future,* from the World Commission on Environment and Development in 1987. The quotation, proposes, as the solution to global environmental problems and poverty, more "rapid" economic growth in both industrial and developing countries with freer markets and more technology transfer (Castro, 2004, p. 197). Graf (1992) also takes a dependency theory view and makes the observation that the World Commission on Environment and Development did not identify and deal with the inequalities underpinning the economic relations of the North and South at this time, but merely incorporated the issues into environmental problems, thus offering technical, material and non-political solutions (Graf, 1992, pp. 555-556).

Following on from the World Commission on Environment and Development in 1987 was the UNCED, known as the Rio Earth Summit, in 1992. Perkins (2013) states that the Rio Conference again brought up issues that were raised by developing countries at the Stockholm Conference that the environmental policy agenda proposed may impact on their industrialization. This led to a distinction in the developed and developing world dichotomy that continued throughout the 1990s and 2000s. Within this dichotomy, the developing world was provided with rights to development in recognition of the position they were starting from and what was seen as an unfair advantage afforded to the developed world (Perkins, 2013, p. 1006). With increasing diversity and complexity across and within states, Perkins (2013) supports the abandonment of the broad terms 'developing' and 'developed world' in the sustainable development literature, to move away from the idea of a 'single developing

world'. Perkins (2013) is of the view that to actually achieve sustainable development, we cannot continue to perceive the world as a homogenous developed and developing dichotomy, however, he does not disagree with the use of terms such as 'least developed', as these may provide additional benefits such as financial assistance. Law (2015) also discusses the oversimplification, with the use of the terms 'North' and 'South', and what he refers to as "single reality doctrines" that originate from the North and are most often transferred to the South. But even within these seemingly powerful and fixed doctrines of the North, Law (2015, p. 128) points out the multiple realities that exist and urges people living in the North to undo thinking about our Western worldview as the only reality (Law, 2015, p. 136). It is an important point to make, particularly within the field of development and sustainable development, which originates from economic and technical fields (Berthoud, 1990, p. 23), and a current list of global SDGs that propose precisely what Law rallies against: "a one-world world."

Prior to the SDGs that came into force on September 2015, a set of eight Millennium Development Goals (MDGs) had been in existence since September 2000. The MDGs focused on indicators relating to poverty reduction, health indicators, education, gender and sustainability (United Nations, no date). Common critiques of the MDGs relate to the use quantifiable, results based targets, the limitations of the goals applying only to 'developing' economies as well as the structural causes of poverty that were left out of the MDGs; for example, inequality, unemployment, stagnant wages and land dispossession (Fukuda-Parr, 2016; Liverman, 2018; Saith, 2006; Sexsmith & McMichael, 2015). One of the more significant criticisms relates to the use of targets that have been shown to be based on questionable indicators to begin with, in the case of poverty reduction, which was based on a purchasing power parity of USD 1.25 per day (Pogge & Sengupta, 2015; Saith, 2006). Pogge and Sengupta (2015, p. 58) highlight that if there were a more adequate and realistic poverty indicator of USD 3 per day in 2005, the number of people living in poverty would have risen by approximately 26 million. Liverman (2018) also argues that the MDGs shifted the "activities and discourses of donors, nongovernmental organisations (NGOs), and developing countries." This has been done through a market orientated approach that focuses on public-private partnerships and measurable outcomes (Liverman, 2018, p. 169). In the context of Cambodia, Strangio (2014) offers an example of this process at work, with donors in Cambodia seeking to capitalise on the MDGs and be somewhat separate from the fraught political environment. This is achieved by focusing on areas such as health and education that

are absolutely necessary due to the lack of public funding in these areas, but that can also be quantified, for example with numbers of school children enrolled. However this focus on numbers can be questioned in regards to the quality of education or health care provided, as well as the ability of statistical representations to be distorted by government agencies (Strangio, 2014, p. 227).

An interesting point made in the book by Strangio (2014, p. 227) was the need for NGOs and donors subscribing to the MDGs to "justify their presence" as well as their ability to step in and meet needs in the case of health and education due to the lack of public services. Interviews with the solar energy industry and NGOs in Cambodia working on energy issues suggest that the SDGs, in particular SDG7 relating to sustainable energy, were not used as a measure to justify their existence or the work they were doing as was the case for some NGOs in the field of health and education, as discussed by Strangio (2014). The majority of organisations interviewed for this research in Cambodia were not donor funded, thus their continued existence is more likely to pertain to profit gained from providing energy services, with some having more altruistic motives of provision of energy services, rather than a need to report on results of meeting the SDGs. In the case of NGOs and other organisations that have received international donor funds, reporting requirements were focused on driving investments into infrastructure (Participant 13, 2018). Pieterse (2010b, p. 52) talks of NGOs as being part of a "globalising ethos" and in that sense are able to influence social development to the point of transformation. Ziai (2013, p. 130), however, presents a more pessimistic view; that most development organisations will not seek to participate in transformative projects, but instead will develop technocratic projects to avoid political conflict.

Following on from the MDGs, as previously noted, the SDGs were introduced in September 2015. The SDGs encompass all countries and are considered a more comprehensive agenda than the MDGs, with 17 goals and 169 targets to reach by 2030 (Liverman, 2018, p. 177). The SDGs were lauded for their inclusivity in bringing together multiple parties from civil society, scientists and governments to be part of the 'input process' in the development of the SDGs (Sexsmith & McMichael, 2015, p. 586). However, there is also much to suggest that the reality of the SDGs, like the MDGs before them, will bring a great deal more of the same, with minimal change to the neoliberal landscape of today. Sexsmith and McMichael (2015, p. 588) refer to this business as usual approach of the SDGs as "a Faustian bargain that

subordinates environmental processes and relations to the economism underpinning development thinking." Latour (2014) refers to the beginning of this phenomenon in the post-World War II era as the replacement of first nature – the environment, with second nature – capitalism or the economy. Latour (2014, p. 6) argues that this was a time when the economy was released from the constraints of nature and that in this period 'second nature', or capitalism writ large, became more solid and dependable than 'first nature', that which actually sustains us.

The preamble to the "transforming our world" agenda of the SDGs uses persuasive language to suggest major transformational change, stating,

> We are resolved to free the human race from the tyranny of poverty and want to heal and secure our planet. We are determined to take the bold and transformational steps which are urgently needed to shift the world onto a sustainable and resilient path. As we embark on this collective journey, we pledge that no one will be left behind. (UN DESA, 2015d)

In reality, however, we need to question no one being left behind as we watch the plight of migrants, stateless people and landholders affected by development and dispossession from their land (Sexsmith & McMichael, 2015, p. 590). Sexsmith and McMichael (2015) discuss why the SDGs are likely to lead to many people being left behind, particularly as the developing thinking that created the SDGs does not tackle structural causes. Other criticisms of the SDGs relates to their top down nature and failure to specify any means of implementation or responsibility for ensuring the goals are met (Hajer et al., 2015; Pogge & Sengupta, 2015, p. 57).

2.3 Modernization theory and industrialization

Modernization theory originated from the US in the 1950s and had evolutionism at its foundation, along with industrialization and growth. Although the theory and discourse of modernization comes out of the US, the 'theme' of modernity is a European concept, with origins in the Enlightenment and social change theories (Marsh, 2014, p. 263; Pieterse, 2010b, pp. 6-7, 21-25). Modernization theory can be said to contain an underlying belief that all societies will follow a linear pattern of growth, with a known destination as per industrial societies and described in Rostow's theory of growth (Pieterse, 2010b, p. 23; Rostow, 1994). Marsh (2014), however, notes the structural and cultural diversity among societies and suggests that there is not only one path to growth, but several. Pieterse (2010b, p. 25) also discusses how the categorisation of countries by the UN of least developed, developed and

highly developed countries resembles the evolutionism inherent in modernization theory. Cambodia was classified as a least developed country in 1991 (United Nations, 2015) and has aspirations to move towards being an 'upper middle income' country by 2030 (Royal Government of Cambodia, 2014, 2015b).

Although it may seem that modernization theory has lost its appeal, as stated by Pieterse (2010b, p. 25), Marsh (2014) disagrees with this and discusses how interest and literature on modernization theory has steadily increased since 1970. However, this could be a result of increased academic literature in general and the application of modernization theory across several disciplines. We may not hear discourse about modernization from the Australian government; however, industrial development is referred to within China as modernization (Marsh, 2014, p. 267). Engineering and modernization were viewed by China as part of the historical mission of "nation saving", as a response to external threats, feelings of humiliation and a need to be seen as a "strong nation" (Yang et al., 2018, p. 283). Industrialization was seen as a way to acquire this strength and education, for Chinese and Taiwanese students, and was focused on science, engineering, medicine and agriculture. Many graduates went on to become the officials who led this industrialization pathway of China and Taiwan (Yang et al., 2018, p. 283). Thus, as argued by Marsh (2014), the concept of modernization continues today particularly in China, Taiwan and Vietnam, which continues their rapid industrialization. Cambodia is following this development trajectory with its own form of rapid industrialization, which as discussed, is significantly supported by China through the funding of infrastructure projects (Li et al., 2020; Sato et al., 2011). Although Cambodia does not outwardly use the language of modernization or attempt to project a powerful image of itself to the world; the use of concepts such as reliability within the power sector in Cambodia (see chapter 8) and increasing concern about electricity shortages, can be seen to reflect modernity as discussed in the case of Taiwan by Yang et al. (2018).

The language of modernity was also adopted through the UN by the SDG 7, which states, "ensure access to affordable, reliable, sustainable and modern energy for all" (UN DESA, 2015a). Not only is the concept of modern used, but the SDGs also refer to "sustainable industrialization" in SDG 9, which aims to "build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation" (UN DESA, 2015b). The use of modern in SDG 7 is not clearly defined; however, the targets and indicators suggest it is quite

simply having access to electricity and the use of "clean fuels" and "technology", which could pertain to several types of fuels or technologies. As for the meaning of sustainable industrialization in SDG 9, according to the targets and indicators, it is quite simply, "manufacturing value added as a proportion of GDP and per capita" as well as "manufacturing employment as a proportion of total employment" (UN DESA, 2015c). So the best the SDGs could come up with out to 2030, as we move into a vastly changing world, is the sustaining of industrialization, which is essentially the same story, as we have had, since the post-World War II era. However, as described by Kangas (2019), the use of imagery in journalism increasingly visualises a world of two modernities – that of the polluting modernity depicted by imagery of smokestacks, and a 'sustainable' modernity shown through images of wind and solar farms. Kangas (2019, p. 72) argues that this depiction simplifies the complexity of shifting towards a more sustainable society, as a technological shift is unlikely to fully convey the social changes needed to avoid the worst effects of climate change.

The process of modernization is also reliant to a large extent on the state. Pieterse (2010b, p. 25) and Eisenstadt (1964, p. 577) refer to the structural characteristics of modernization encompassing "increased extension of the central administrative, legal and political activities", as well as more power to wider societal groups, a "weakening of traditional elites" and increased accountability. Clearly this is an 'ideal' form of modernization and he concedes further that there are many cases of "unsuccessful adaptation" or partial adaptation that may inhibit "continuous growth" (Eisenstadt, 1964, p. 578). Beck (1997, pp. 7-8) refers to the benefits of European modernity in the form of parliamentary democracy, human rights and individual freedoms but urges a rethink of western modernity due to the lack of an adequate response by our current institutions to various social and ecological challenges as a result of the global industrial system. Democracy, human rights and individual freedoms may have been a fundamental aspect of European modernity in its earlier incarnations; however, modernization these days is more likely to equate to losses of political freedom, corporate political influence and environmental destruction (Latour, 2014, p. 8).

The influence of modernization theory and discourses on development and energy is used by Smits (2015, p. 17) to describe the "material consequences" of modernization that occur in the organisation of infrastructure. This includes all aspects of electrical infrastructure, such as power stations, transmission and distribution lines, substations and homes (Smits, 2015). Smits (2015) also discusses the significance of energy as being fundamental to the modernist

vision, which is often seen through projects such as hydroelectric dams and other seemingly 'modern' forms of energy. Some states of Southeast Asia, such as Vietnam with extensive hydroelectricity infrastructure, were heavily influenced by the stages of growth presented by Rostow (1994), with its pre-determined and limited view of development through five reductive stages from traditional societies to high consumption societies. Rostow, however, was of the belief that Communist societies would not be able to effectively progress through his theoretical five stages of growth and was apparently dogmatic in his belief that Communism must be eliminated in Vietnam for the society to prosper (Hilsenrath, 2017). Rostow spent time learning from Soviet development and industrialization and utilised some of the lessons from the agricultural sector in his theory, while simultaneously discrediting the Soviet approach (Engerman, 2000, pp. 411-412). It would appear that Vietnam and China's rapid industrial growth go some way towards refuting Rostow's belief about Communist societies. The rapid industrialization of Vietnam however, may also be attributed to the former Prime Minister of Vietnam, Ho Chi Minh, who, as a revolutionary communist leader, was known to favour modernization and Leninism as noted by Chong (2007, p. 398).

World Bank financing has also traditionally had a significant impact on prioritising industrial schemes that included roads and electricity, as well as a strengthening of the institutions of modernization (Escobar, 1995, p. 167). This pattern of industrialization continues in Southeast Asia today with the goal of integration of infrastructure across the region through China's One Belt, One Road strategy. Part of this initiative includes the creation of the Asian Infrastructure Investment Bank, with China as the largest shareholder, offering loans and technical services for infrastructure projects (Yu, 2017). The One Belt, One Road initiative also provides China with significant geopolitical influence in the region, as well as access to energy and other natural resources across Central, South, Southeast and North Asia, as well as the Middle East, Africa and Europe (Yu, 2017). Additionally, Yu (2017, pp. 357-358) discusses the impetus for China to assist with infrastructure development in Asian countries as helping to "modernize their infrastructure", to ultimately assist in cross border trade and economic integration with the region, thus assisting China's domestic economic development. The language of Rostow (1994) is also apparent, with discussion about ports and harbours contributing to trade and viewed as the second stage of growth, according to Rostow's theory as "pre-conditions for economic take-off" (Yu, 2017, p. 357).

The concept of ecological modernization originated in Germany within the Berlin state parliament in 1982 due to concern about ecological damage from traditional industrialization and a need to consider ecology in modernization (Mol et al., 2009, p. 17). The centrality of industrialization is at the heart of the ecological modernization approach, with a move towards clean technologies and a move away from centralised state control, towards decentralization with minimal influence from the state (Wong, 2012, p. 99). Christoff (1996) provides a typology for ecological modernization and discusses the various uses of the term. The first aspect of ecological modernization is classified as "technological adjustment", for example pollution control or technology, such as renewable energy technology that does not necessarily result in structural changes to corporate or political values (Christoff, 1996, p. 480). Secondly, ecological modernization is often used in "policy discourse" and is considered as a corrective to the 'anti-modern' discourses of the environmental movement. This approach recognises the structural aspects of environmental degradation and proponents such as Hajer (1995) advocate for discursive and policy change; however, Christoff argues that it also follows the same economist logic in its attempts to achieve results that benefit the environment (Christoff, 1996, pp. 482-483). Finally, Christoff classifies the use of ecological modernization as a belief system with the understanding that, without environmental protection, economic development is not possible. However, even this approach is limited and uses the language of the market, with environmental standards, inclusion of environmental externalities and the use of "green products" (Christoff, 1996, p. 484). Christoff concludes with concerns about the legitimacy of the term ecological modernization, which continues with what is essentially industrialization at the expense of the environment (Christoff, 1996, p. 497).

Raising further questions about the value of techno-economic fixes that underpin ecological modernization, Curran (2019) asks, "is renewable energy still green?" Curran (2019) identifies the different aspirations from various energy actors in Australia, such as households, large retail and generation companies, as well as community energy actors. Curran (2019) finds that some community energy actors are motivated by not only environmental concerns, but also social aspects, such as energy justice. As renewable energy has been largely mainstreamed in Australia, Curran (2019, pp. 964-966) questions whether this success could also limit environmental reform, with commercial actors holding considerable power, driving a business as usual approach with the use of renewable energy. A similar questioning of the transformative potential of renewable energy is detailed by York

and Bell (2019, p. 41), who consider historical trends in energy transitions and note how former sources of fuels continue to be used, while newer sources may take a more prominent role. One potentially unintended, but rather devastating impact of fossil fuel use in power tools, led to the accelerated consumption of wood and deforestation as biomass was increasingly used as a building material (York & Bell, 2019, p. 42). Thus, rather than being a transition away from one fuel source to another, York and Bell (2019, pp. 42-43) suggest this is more akin to "additions", as global energy consumption continues to grow, largely as a result of a continued global growth impetus.

Wong (2012, p. 95) offers a perspective of ecological modernization with developmental state theory in East Asia, in particular Singapore, and notes how the traditional theory fails to take the region into account, with differing paths of industrial development and the dominance of state structures. The lack of applicability of the theory to Asia is perhaps not surprising, given the origins of ecological modernization in Europe. Traditional forms of modernization and industrialization however, are embedded in Asia, both materially through infrastructure and into the decisions of government when planning for development. The path of industrialization that is being followed in countries such as Singapore, Vietnam, China and Japan is a market economy led by the state, which in some cases has led to lower levels of technology and institutional capacity (Wong, 2012, pp. 101-103). This is particularly the case with "late industrializer" states (Wong, 2012, p. 101), such as Vietnam, and from experience within institutions in Vietnam, this situation was apparent with limited research and development for technologies such as solar PV. Low levels of solar PV technologies and research and development in Vietnam were made more severe by the lack of technology exchange with China, who are more technologically advanced in this sector (Allen et al., 2020). China prioritised the solar PV sector and is now a global leader in both manufacturing of solar cell technology and modules, as well as installations of solar PV within the country (Allen et al., 2020, p. 6). Wong does note, however, that the Singaporean state is proactive in encouraging technological innovations through support such as research and development in clean technology (Wong, 2012, p. 108), thus a lack of institutional capacity and low levels of technology do not apply uniformly in the region.

Despite low levels of research and development for renewable energy technology in Vietnam, the country is experiencing significant growth in the installation of solar PV, with approximately 4500 MW of solar PV installed in Vietnam in the first six months of 2019 (Do

et al., 2020, p. 1). It was a slow start for Vietnam to get to this stage, but two significant factors provided the impetus for this growth in solar PV. Firstly, an attractive feed in tariff for solar PV was announced by the Government of Vietnam in 2017. Secondly, there was concern about energy security in the country with shortfalls of electricity projected as early as 2020 (Do et al., 2020, pp. 5-6). As will be discussed in chapter 6 of this thesis, energy shortages in Cambodia also catalysed the announcement of new solar PV projects in the country in 2019. Dent (2012) discusses how East Asia has seen the fastest growth in renewable energy, more than any other region in the world, and this is partially due to depleting local reserves of energy sources as well as the high intensity industrialism of East Asia. The development of renewable energy in the region is also linked with state capacity and what Dent (2012, p. 584) refers to as new developmentalism, of which the primary objective of economic growth remains. The extraordinary growth of China's renewable energy sector is also attributed to command and control strategies in the developmental state, with modernisation as the primary objective (Chen & Lees, 2016, p. 577). Chen and Lees (2016, pp. 577-578) also note, that within developmental states, the government "picks winners" and shields local businesses, which in turn, maintains stability and legitimacy for authoritarian governments. This approach is evident in Cambodia through the use of joint ventures as discussed in the introduction (Young, 2020).

In distinguishing between first and second modernity, Beck (1997) discusses the questioning of nineteenth century industrialism as a result of not only the environmental crisis, but also the permeation of the effects of industrialism into all aspects of modern life, such as employment, nuclear families, business and the welfare state. In all aspects of society, there is instability as we cling to a dying era of industrialization. Beck takes to task the variants of "modernization as usual" in society, which is a victim of its own solidity in following the well-worn path of modernization despite evidence of the futility of that path in an era of significant change (Beck, 1997, p. 13). In other words, the challenges that global society now faces are largely due to the success of what Beck and Lau (2005, p. 526) term 'first modernity', or simply the linear model of industrialization with a focus on economic growth, such as that propelled by Rostow. One aspect of this overreliance on a fixed, solid certainty that industrial modernization has brought us, is a lack of certainty or security when our political, ecological and societal systems fail to cope with the changes or flexibility required of us to adapt (Beck & Lau, 2005, p. 526). In many ways, centralised electricity infrastructure, high consumption and systems that dominate western societies are

characteristic and a predictable result of industrial, modern society. It is a system that needs rethinking and revising, but it too is a victim of its solidity, its fixed nature and the institutions and interests that rely on it, including those of us who are consumers of energy, who barely know anything other than expecting access to reliable electricity. A version of first or industrial modernity is being implemented throughout Asia, including in Cambodia and, as noted by Beck, a "majority of countries are now running more or less hopelessly after the goals of simple industrial modernity, at the same time that those goals are becoming dubious in the centres of developed modernity" (Beck, 1997, p. 16). Bernstein (1971), in referencing Daniel Lerner, notes a similar belief among "the modernizing lands" of the emulation of western societies in their pathway of development and the speed at which they are rushing towards development (Bernstein, 1971, p. 151).

Beck (1997) believes the answer to moving towards a reflexive, second modernity is in modernity itself: in a sense, building upon its foundations and mitigating against the need to completely dismiss modernization, dismantle institutions for revolution and collapse. Beck argues that these "multiple modernities" are already occurring, however, that Western sociology assumes a social order that is constant and based on industrial certainties (Beck, 1997, pp. 17-22). Eisenstadt (2000) clarifies this point, noting that developments occurring beyond western societies are not homogenous, however there is an underlying structure that is familiar to industrial modernization, with the basics of a nation state and institutional, legal and administrative structures (Eisenstadt, 2000, pp. 1-4, 14). Beck describes the movement from first modernity to a second, more reflexive, modernity as a process of "disembedding of industrial social forms and then the re-embedding of other modernities" (Beck, 1997, p. 23). Beck notes that the old structures, whether physical infrastructure or institutions, do not simply disappear and crumble away, but are merged with new elements (Beck & Lau, 2005, pp. 540-541). This makes sense in the context of energy systems, which are being transformed, and indeed the physical and institutional structures are being rearranged. In fact, one of the common terms used in electricity networks is that of "embedded generation" or distributed generation, which refers to decentralised, mostly renewable energy that is "embedded" into the existing grid infrastructure that was built in the era of first modernity (Energy Networks Australia, no date). Calhoun (2010) questions what a successful path to second modernity would look like. Likewise, Maharaj (2010, p. 569) questions whether multiple modernities are all pursuing the same dream, when the core of first modernity remains in existence at the centre. By asking these questions, the authors open up one of the

key points Beck makes on reflexive modernity and that is its uncertainty, and the lack of a destination or an end point, which is so fundamental to traditional industrial modernization (Beck, 1997). However, these questions also raise concerns about the somewhat immovability of certain institutional structures that largely maintain the status quo in western societies. Within that context, the merging of new elements with the old in reflexive modernization has the potential to lead to stagnancy and inflexibility, with only minor corrections made in the path of industrial modernization.

Modernity certainly has an ongoing influence on development in Cambodia and Southeast Asia as a whole, as discussed here. However, Love and Isenhour (2016) implore us to view modernity as a "historical phase" in thinking about plausible futures, while also cautioning against putting too much faith in technological progress, as the likelihood of energy transitions playing out unevenly among regions and social classes is high (Love & Isenhour, 2016, p. 8). Narratives of endless progress and increasing high energy consumption since the post-World War II era is seen as normal, yet Love and Isenhour (2016, p. 10) suggest it is in fact a temporary state that humanity has taken for granted, and we are more deeply intertwined than ever with energy in our daily lives. If modernity is a temporary state, it is one that Cambodia and Southeast Asia will be enmeshed in for the foreseeable future.

2.4 Energy transitions and regime resistance

A transition from industrial modernization to what can be considered sustainable brings with it enormous challenges. Part of this challenge lies in the process of change when, globally, we are still hurrying towards some form of modernization that is based on industrial society and notions of progress. Sustainability transitions are not only socio-technical changes, they are also political and governments play a significant role in the technological paths that are followed (Meadowcroft, 2011). Geels (2010, p. 495) theorises on the multiple levels that operate when considering socio-technical transitions and notes that transitions do not occur easily due to existing regimes that are essentially 'locked-in' and path dependent. Wieczorek (2018, pp. 208-209), when discussing path dependence, states there is some freedom for developing countries due to the lack of highly organised and centralised systems of infrastructure that allow for different pathways. Development literature has covered this context in some depth and refers to the process as leapfrogging (Wieczorek, 2018, p. 209). However, the leapfrogging process appears also to be losing relevance when faced with the

scale of growth within Asian countries and the type of industrial development that is taking place, which is creating significant global environmental pressure (Berkhout et al., 2009, p. 225).

The multi-level perspective sees transitions as an interaction on three levels that include the niche level (new innovations), the regime level (rules, practices and institutions of the existing system) and the external landscape (macro-economic, political and environmental) (Geels, 2011, p. 26; Kivimaa & Kern, 2016, p. 206). Thus, to effectively transition a sector such as the electricity sector requires disruption, not only in technology, but also effective policy to support the new conditions (Kivimaa & Kern, 2016, p. 206). Geels (2014, p. 23) refers to 'regime resistance', which is opposition to change by incumbent actors and destabilisation of the status quo. In the electricity sector, the incumbent actors are mostly utilities and those who own and operate the distribution grids, as well as industries with an existing customer base, such as coal, oil and gas (Heiskanen et al., 2018, p. 57). Meadowcroft (2011, p. 73) discusses that there is often a favouring of technology that fits with the existing infrastructure, capabilities and business models and he encourages new centres of power to be formed in sustainability transitions.

Strategically targeting the niche, regime and external landscape levels of socio-technical systems however, may not necessarily lead to a transition occurring, as is pointed out by Matschoss and Heiskanen (2018, p. 1), due to the entrenchment of the energy sector regime. The main barrier to a transition in the energy sector, as identified by Matschoss and Heiskanen (2018, p. 3), is what is referred to as sunk investments in network infrastructure, such as power plants, transmission and distribution infrastructure and transformer and sub-stations. Other barriers to a transition in the energy sector include belief systems and the market power of incumbents, such as the coal industry or established utilities (Matschoss & Heiskanen, 2018, p. 3). Geels (2011, p. 29) is of the view that there are multiple factors that lead to transitions, which ultimately assist each other in a circular manner. Two case studies were used by Turnheim and Geels (2012) to highlight historical factors that destabilised the British coal industry. The factors identified were competition, lessening government support and negative discourse around coal, leading to the Clean Air Act, 1956. These factors all contributed to coal being less influential within the domestic market and replaced by other fuels such as gas, oil and nuclear energy (Turnheim & Geels, 2012, p. 44).

Geels (2014, p. 23) also challenges the belief from transition scholars and policy makers that 'green' innovation will bring change, pointing to the incumbents' resistance to change as a barrier. However the multi-level perspective, as theorised by Geels (2010), has been criticised for lacking consideration of agency and power in transitions (Heiskanen et al., 2018). There are likely to be many instances of regime resistance among incumbents; however, this is not always the case. The electricity sector in Australia has traditionally been heavily dominated by the coal industry, with 63 percent of our electricity generated from coal in 2016 to 2017 (Australian Government, 2018). This is rapidly changing however, with approximately 5000 megawatts (MW) of coal generation also exiting Australia's National Electricity Market (NEM) between 2012 and 2017 and causing significant challenges for reliability and affordability at this time (Simshauser, 2019). AGL, one of Australia's largest generators and an electricity retailer with significant assets in coal generation, stood firm on a decision to proceed with the decommissioning of the coal fired Liddell Power Station by 2022, despite Australian government pressure for it to remain operational (Cockburn, 2017). The mining sector and energy intensive industries in Australia may be an exception to these changes occurring in Australia and they do have significant political influence in Australia (Curran, 2012, p. 237).

This view about regime resistance is also challenged by Heiskanen et al. (2018, p. 66), who provides examples of how many of the challengers to the regime are not necessarily outside of the incumbents, but are often found within the incumbent regime or are setting up "experimental spaces", where rules and regulations may be deferred. One aspect or rule of electricity generation within centralised energy systems that remains unchallenged, particularly in industrial societies, is that of reliability of supply (Curran, 2012). Curran (2012) refers to the political narratives that are used in Australia when renewable energy is discussed. The narratives used have been characterised into four categories that include, "feasibility, security, cost and jobs". Reliability sits under the category of "security" and the narrative identified by Curran is "keeping the lights on", which is characterised by reliability and affordability of electricity supply (Curran, 2012, p. 240). The concept of reliability is seen to be one of the main issues with the feasibility of renewable energy, due to the intermittent nature of renewable energy and a requirement of industrial societies to have a continuous source of running power, 24 hours of every day (Curran, 2012, p. 239). Curran points out that having a continuous source of power is a "core energy characteristic of advanced industrial states" (Curran, 2012, p. 239). As an aspect of industrial society, the

concept of reliability in the electricity sector correlates with the view from Beck (1997, p. 18) of a secure social order based on industrial certainties.

The implications of the concept of reliability being so prevalent in industrial societies is that it provides a technically valid reason to limit what are termed intermittent or variable sources of energy, such as wind or solar (Wolsink, 2020). Issues of intermittency with renewable energy sources are a reality and, as stated by Smil (2017, p. 271), are "nontrivial" when attempting to integrate these sources of energy into existing grids. Renewable energy such as wind and solar can impact on power quality, voltage and system security, thus negatively impacting on centralised energy systems. However, some of these issues can be mitigated, through storage, information and communication technology, to more 'active' distribution networks to accommodate bi-directional flows of electricity and interconnection with other states in the region (Bayod-Rújula, 2009, pp. 380-382; Huang et al., 2019). Heiskanen et al. (2018, p. 66) also make the point that within energy companies and utilities the principle of providing "reliable and affordable energy" has continued over decades. Adherence to this principle with centralised grid systems also ensures the continuation of this narrative as a barrier to integrating other sources of energy that may initially be less reliable or affordable (Heiskanen et al., 2018). This is despite some of the benefits of distributed and renewable sources of generation, including domestic energy security, by reducing imports, reduction of fossil fuel consumption and fewer transmission and distribution losses (Bayod-Rújula, 2009, p. 379). Yet, the SDG 7 continues an emphasis on energy reliability with its goal of "access to affordable, reliable, sustainable and modern energy for all" (UN DESA, 2015a). On the surface, this goal appears reasonable and worth striving for, however, the literature discussed above suggests the reliability emphasis constrains renewable energy generation, and is more likely to perpetuate an industrial model of energy development that necessitates increasing energy consumption for all societies.

Augenstein and Palzkill (2016), in their research on incumbents in sustainability transitions, discuss how incumbents are beginning to face the challenge of crisis in areas such as climate change: however, when faced with the reality of changing, they have a choice to continue with their proven business models and contribute to the crisis and thus be affected by it, or to transform their business models, which is likely to lead to failure in the short run. In relation to work and the economic means of production and consumption, Beck and Lau (2005, p. 531) also confirm a similar view of institutions that "cling to the old order" and struggle to

adapt to the uncertainties that exist. Turnheim and Geels (2012, p. 36), in their work on the destabilization of the British coal industry note the slow uptake of renewable energy and the limitations of the speed of any transition to have a mitigating effect on climate change. They support a 'deliberate destabilisation' approach to fossil fuel industries and suggest that a better understanding of these destabilisation processes would assist in a transition. The forms of destabilisation advocated by Turnheim and Geels (2012) mostly relate to external pressure; for example, the influence of social movements, public opinion and policy in the case of the British coal industry. The introduction of other energy options is also equally important in destabilising the fossil fuel industry (Turnheim & Geels, 2012, p. 49).

Arranz (2017) also examines the multitude of factors that led to regime destabilisation and resistance for 34 past energy and transport technological transitions across a range of industrial and non-industrial countries. Arranz (2017, p. 136) describes 'factors of destabilisation' and 'forms of resistance' that provide a perspective of actors' motives and resistance to change across the identified technological transitions. Several factors of destabilisation are identified, including health and lifestyle (pollution, hygiene), economic fundamentals (scarcity of resources, population growth), centralised power (bureaucracy, powerful lobbies, knowledge and capacity) and ideals such as progress and equality. The most common forms of resistance found by regime actors in the energy cases discussed by Arranz (2017) were risk aversion and using influence and suasion to resist change and enforce a business as usual approach (Arranz, 2017, p. 137). Table 1, below, shows the forms of resistance identified by Arranz (2017, p. 136). These forms of resistance identified by Arranz, will be discussed further in chapter 8.

Table 1 – Forms of resistance identified in technological transition (Arranz, 2017)

Forms of resistance (FoRs).

Locus of resistance	Abstracted form of resistance (abbreviated term)	Rationale for the category	Examples
Regime	**Challenging** of evidence	Finding fault with the projected change for self-interested (even if justified) reasons	Ontario electrical incumbents accused government of socialism and called for liberal minded individuals to prevent nationalisation (Rosenbloom and Meadowcroft, 2014)
Landscape	**Popular** complaints	Users or the broader public resist change, incl. by legal action against technical expertise	Dutch public oppose road building for environmental and lifestyle concerns (Geels, 2007)
Regime	**"Sailing ship** effect"	All the known techno-economic reactions of sailing ships to the appearance of steam boats: market specialisation, mergers to increase efficiency, entry into new markets	UK gas companies adoption of gas mantle technology only after competition from electricity became clearer (Arapostathis et al., 2013)
Regime	Moral/political **suasion**	Appeal to higher principles (as opposed to attacking the content of the evidence as above)	Ghandi's teachings against centralisation (incl. of electricity) (Rao and Lourdusamy, 2010)
Regime	**Risk-aversion**	Slow-down of new development, continuation of business as usual as much as possible	Dutch utilities preference for BAU and end-of-pipe solutions to comply with environmental regulation (Verbong and Geels, 2007)
Regime	**Influence**	Direct exercise of market or political power to prevent changes from happening	HK's entrenched monopoly guaranteed availability of funding (Moss and Francesch-Huidobro, 2016)
Regime	**Co-option**	Of critics into the regime by incorporating them into decision-making bodies within the regime, where they may be outvoted or acculturised	BMW sought to integrate architect critics in the road planning process (Switzer et al., 2015)

2.5 Niches as spaces for innovation

The previous section focused on the regime level of the multi-level perspective of energy transitions. This section will discuss the niche level, which often occurs on a smaller, more localised scale, however, research and development in new technologies often occurs at the national level and can be instrumental for innovation. Wieczorek (2018, p. 205) describes the niche level as places that are "shielded" from the existing regimes, and thus have the space to learn from experimental innovations. In their work on regime shifts through strategic niche management, Kemp et al. (1998, p. 184) discuss the problems that occur with public policy makers when attempting to change a system that has been traditionally focused on a single technology, to an integrated system of technologies and social practices. Kemp et al. (1998, p. 184) discuss three strategies for policy makers when shifting to a sustainable technological regime. The first strategy that is favoured by economists is to change the incentives that the market operates in, such as taxing negative externalities and rewarding positive externalities. The second approach is a planning approach for a new socio-technical regime that often includes large infrastructural works, like railways or sewerage systems, and the third approach is process orientated to push technological change in a desired direction by leaving room for variation and not allowing domination by certain actors (Kemp et al., 1998, p. 185). This final approach does not start from a single goal, for example, 100 percent electrification, but it is aimed at keeping the process of change moving through a set of goals towards a desired direction (Kemp et al., 1998, p. 185).

The transition literature states that technological regimes are about both technology and rules, with these two things considered path dependent and not amenable to change (Kivimaa & Kern, 2016, p. 209). According to the multi-level perspective, transitions to dominant systems occur through three different levels that include the external landscape (political and macro-economic), the regime level (policy, regulations, industry and institutions) and the niche level (spaces for new innovations) (Kivimaa & Kern, 2016, p. 206). However, Hansen et al. (2018, p. 201) make the important point that the transitions literature emerged from western democracies in Europe with social welfare systems based on tax revenue. In the context of a least developed country, such as Cambodia, the lack of transparency in political decision making increased corruption and the lack of an independent judiciary leads to less ability to provide public services that would alleviate poverty and inequality (Hansen et al., 2018, p. 201). Using transition management theory in the example of a sanitation project undertaken by a Dutch NGO, van Welie and Romijn (2018) discovered that although the NGO was able to initiate capacity building, raise awareness of sanitation issues and create local networks to assist in the project, there was a significant gap in being influential at the regime level to create systemic change in the sanitation sector.

Wieczorek (2018, p. 207) also notes that in the context of developing countries, the transnational linkages are strong. The author also suggests that transition scholars engage more with development literature as the problems facing developing countries have been covered in depth in this literature (Wieczorek, 2018, p. 213). Hansen et al. (2018, p. 202), also conclude that the trajectories of niche development and transitions outlined in the literature differ in the context of a developing country and further research is required in several areas, including the significant role of informal institutions, transnational actors, donors, NGOs and investors in developing countries, as well as the transference of knowledge to enable structural change over the longer term. The literature of cases in India, Dar es Salaam in Tanzania and Kisumu in Kenya show that niche activities relating to biomass gasification, urban development and sanitation suffered due to the instability in planning and coordination at the local level (Hansen et al., 2018, p. 200). Furthermore, Wieczorek (2018, p. 213) concludes in a systematic review of 115 publications that the multi-level perspective, transition management and strategic niche management theories are useful in understanding complex factors affecting the macro to the micro scale of economic and political development. However, Wieczorek (2018, p. 208) states that reflexivity is required

when applying transition theories to non-Western contexts due to the lack of stability in the provision of public services that exists.

Niche level perspectives may have much to contribute to the energy transition literature, however, I do agree with the perspectives of Hansen et al. (2018) and Wieczorek (2018) on the limitations for niche level projects to create structural change in countries such as Cambodia. A lack of state level investment in innovation and technology development in Cambodia is also limiting for changes on the niche level, like the type of investment that occurred in China with the development of a leading solar PV cell and module manufacturing industry, as discussed (Allen et al., 2020). In the context of Cambodia, the actors who are involved in niche level projects are often transnational actors with minimal influence and power in the country. An example of an innovative niche level, solar micro grid project in Cambodia is discussed further in Chapter 7.

2.6 Energy justice and equity perspectives on energy transitions

Renewable energy transitions are increasingly facing questions about equity and energy justice. There are numerous ways to approach justice and equity perspectives on energy. For example, the uneven distribution of costs and benefits or locational disadvantage, such as living in rural or remote areas with limited access to affordable energy are a few examples (Golubchikov & O'Sullivan, 2020). Golubchikov and O'Sullivan (2020, p. 2) discuss the concept of "energy peripheries", which are spatial patterns of disadvantage through all aspects of an energy system, including generation, distribution and consumption. The periphery occurs according to power relations, industrial demand and energy networks that prioritise urban "core" areas, while marginalising periphery areas, outside of the core (Golubchikov & O'Sullivan, 2020, p. 3). In essence, energy peripheries are systemic of uneven development, but not necessarily in the traditional sense of core and periphery nations, although it does originate from dependency theory scholarship (Golubchikov & O'Sullivan, 2020, p. 3). Energy injustices therefore continue with low carbon energy transitions in the context of already existing energy peripheries and these injustices, new and old, perpetuate uneven development of energy systems (Golubchikov & O'Sullivan, 2020, pp. 8-9). As mentioned, there are numerous ways that energy injustices can occur, but they are common globally, both in developed and least developed societies such as Cambodia. In Cambodia, examples of injustices exist in areas that have little to no energy access, or where

energy access exists, it is limited and expensive, as will be discussed in this thesis. Injustices also occur where people are displaced from land for hydro and other power developments. Often this occurs in the name of energy security, in countries like Laos for example, where power projects are developed, and the resultant electricity is exported to neighbouring countries, including Thailand, and more recently Cambodia (Chea, 2019a; Marks & Zhang, 2019; Simpson, 2007).

Sovacool et al. (2019, p. 591) identify four energy justice dimensions in low carbon transitions that include: distributive justice (ensuring access and equitable share in benefits and costs); procedural justice (due process is followed, public participation and consent); cosmopolitan justice (global human rights, mitigation of global externalities) and justice as recognition (recognition of marginalised, poor and vulnerable groups). The equity issues raised throughout this thesis relate first and foremost to energy affordability and poverty alleviation (distributive justice and justice as recognition). To a lesser extent, transboundary justice issues (cosmopolitan justice) are discussed relating to hydropower and coal projects, particularly in Laos (Marks & Zhang, 2019). As Cambodia is becoming increasingly interconnected and reliant on power imports in the region (Chea, 2019a), power generation projects in Laos in particular, are of relevance. Other areas of energy justice that are just as relevant, but will not be addressed in this thesis relate to the issue of land acquisitions for energy and extractive projects (renewable and non-renewable), resources for the production of energy systems and the siting of energy infrastructure, such as transmission lines and substations. Johnson et al. (2020, p. 9) also discuss aspects of land grabbing with renewable energy projects and how the discourse around renewable energy transitions can further marginalise indigenous and rural communities, by suggesting that these communities must comply with broader environmental goals. These concerns are documented in the literature identified by Johnson et al. (2020), and are likely to increase with more renewable energy projects globally, particularly larger scale projects, that seek to meet a significant proportion of global energy needs. Another aspect of equity and access identified by Johnson et al. (2020) is the high initial costs of household solar energy products in Sub-Saharan Africa, deepening wealth divides with the result that families find themselves in debt, due to the repayments on solar systems (Johnson et al., 2020, p. 9). This is also an issue of relevance to Cambodia and this is discussed further in this thesis (refer to Chapters 5 and 7).

Sovacool and Dworkin (2015) provide some useful considerations on energy justice, noting that affordability should not just be about lower prices, but also equitable prices – meaning that lower income households should not have to spend more of their income on energy. This is again an issue of distributional justice and inequities have occurred in Australia in the case of non-solar households carrying the cost of feed in tariffs for solar households through retail electricity bills (Chapman et al., 2016; Simpson & Clifton, 2016). Solar households in Australia benefit with lower electricity prices and income from solar generated energy into the grid if they have a feed in tariff with their retailer. Non-solar households, on the other hand, are often the least able to mitigate higher electricity prices and are unduly impacted, particularly disadvantaged households (Simpson & Clifton, 2016, p. 264). Nelson et al. (2011) note that the electricity industry itself is tasked with paying for feed in tariff policies in Australia and not state or territory governments. The benefits of feed in tariff policies in Australia are therefore privatised to the individual household level as the cost of feed in tariffs are externalised to all consumers on household electricity bills (Simpson & Clifton, 2016, p. 264). Ansarin et al. (2020) also refers to inequities that occur with high amounts of distributed renewable energy on centralised grids, such as those found in California and states of Australia, as a form of "socially regressive wealth transfer", which is built into traditional flat residential tariffs (Ansarin et al., 2020, p. 2).

Incentivising the uptake of renewable energy in developed economies is also discussed by Mastropietro (2019). In discussing how the costs of renewable incentive schemes are recovered, through electricity tariffs of residential customers, Mastropietro (2019, pp. 2-3) notes that this has led to an almost doubling of electricity prices in Europe for residential customers between 2012 and 2017. This is shown as having far greater distributional impacts on people with lower incomes, who may consume slightly less energy, but have less ability to mitigate the costs of higher tariffs and spend a much higher proportion of their income on electricity than people with higher incomes (Mastropietro, 2019, pp. 4-5). Ultimately, energy transitions are occurring across many countries and the cost of generating electricity from renewable energy has also reduced markedly, therefore the transition will continue. As discussed by Mastropietro (2019, p. 1), however, the costs of supporting renewable energy for electricity will continue to increase out to 2035, and he provides several recommendations for a less regressive cost allocation to support renewable energy, including through taxation, rather than tariff charges. The inequities occurring in energy transitions do need to be

addressed, as failing to address the issues that are now apparent will only enable opposition to energy transitions and decarbonisation efforts, as noted by Klinsky et al. (2017, p. 172).

This literature review presents a historical view of development from the post-World War II era to the present time of sustainable development, to provide the context and theoretical basis to the broader energy trajectory in Cambodia. Throughout history, energy has been fundamental to the 'modernized' state or city. Cambodia is hurtling towards industrial development with increasing energy needs: however, Sinanan (2013, p. 19) observes that approaches to development by international actors in Cambodia fail to consider the country's own rich history and experiences of a modern nation. The theoretical basis of this thesis, as discussed in this literature review suggests that discourses of development and modernization are important to contextualise the energy transition occurring in Cambodia today as a broader influence. Transition theory is also included to situate the various actors operating on the regime and niche levels, or outside of these levels in the case of transnational energy actors, and the resistance that may occur between and amongst actors in the transition literature. Finally, theories of energy justice are discussed as recent (and earlier) scholarship identifies equity and justice issues occurring globally in renewable energy transition scenarios.

Of particular relevance to Cambodia are instances of distributive and cosmopolitan justice, as well as justice as recognition (Marks & Zhang, 2019; Sovacool et al., 2019). As discussed by Jenkins (2018), where environmental and climate justice movements have seen little success due to a lack of definition and unboundedness, an energy justice framework can focus on the parts of a whole energy system: from the resources to develop the energy system, the waste, consumption, and, in the case of this thesis, the distributive, locational (cosmopolitan) and equity aspects of energy development. This thesis builds and contributes to the literature discussed in this chapter, in particular the energy transition literature, by providing a discursive understanding of transnational energy and development actors in Cambodia that are seeking a more sustainable energy path for the country. The following thesis highlights a need for reflexivity from transnational energy and development actors in Cambodia to not simply offer transplanted solutions for renewable energy transitions but, instead, incorporate equity dimensions of energy development in Cambodia to have greater influence with key regime actors in the country.

Chapter 3: Methodology

3.1 Introduction

Following the review of literature most relevant to this thesis, this chapter describes the methodology and methods applied in answering the research question of how discourses articulated by transnational actors in the renewable energy industry and international development agencies in Cambodia influence energy development in the country. Further aims of the research were to investigate how the energy needs of people are considered in energy planning for the country. The chapter outlines a framework of discourse analysis for the research after a brief discussion of discourse theory. The chapter then details the three main methods applied within the framework: a textual analysis of key policy documents; interviews with transnational energy sector actors in Cambodia and an observation of a solar micro-grid project. These methods will be described along with preliminary information about the policy documents, interview participants and the observation of a solar micro grid project. Interview participants are referred to as Participant throughout this thesis. Participants and their respective organisations are not identified to enable anonymity. Where appropriate or for context, the organisation may be broadly identified; for example, energy industry, NGO or a European Union development agency.

3.2 Discourse theory as a methodology

Discourse theory is located in the post-positivist and constructivist tradition (Hajer, 1996, p. 43; Hajer & Versteeg, 2005, p. 176; Jørgensen, 2010, pp. 12-15). Where positivism is science based, post positivist thinking does not subscribe to the view of science based knowledge as superior (Jørgensen, 2010, p. 155), nor the existence of one reality (Lincoln & Guba, 1989, p. 226). A post-positivist approach is particularly relevant to understanding the processes of change in the energy sector in Cambodia, a country at the centre of changing world politics, with ties to Western democracies such as the US and Australia after the devastation of the Khmer Rouge on Cambodian society (Strangio, 2014, p. 39). Older, historical ties to Cambodia exist, particularly to China, Thailand and other communities of Southeast Asia (Chanda, 2002). Chandler (1997, p. 42) discusses the isolation that occurred in Kampuchea starting in 1975 under the Khmer Rouge, which was to some extent an extension of the isolation of Cambodia from its neighbours in the region under French colonial rule from 1863 to 1954. Chandler (1997, p. 43) further notes that, “A good deal of Kampuchea was a reaction to Cambodge and was based on a jaundiced reading of the past, in which the Khmer Rouge

view nearly all Cambodians had been enslaved." The extension of anti-Vietnamese sentiment and a belief that Cambodia was surrounded by enemies under the Khmer Rouge continued on from the Sihanouk years from 1955-1970 (Chandler, 1997, p. 44). More recently, ties with China are becoming dominant again, as China provides the largest share of foreign direct investment in Cambodia, with an estimated $9.6 billion of Chinese investment from 1994 to 2013 (O'Neill, 2014, p. 179).

Discourse theory has its detractors in the positivist tradition, who accuse theorists of ignoring facts and being too subjective in describing social phenomena (Howarth, 2000, p. 13). Applying the theory is not free of problems, particularly in regards to the methodological approach. However, rather than conform with a positivist approach, Howarth (2000) employs the approach of a "complex theory of truth" from the tradition of Foucault and Heidegger, in which problems are analysed relative to the paradigm in which they exist (Howarth, 2000, p. 14). Likewise, Hajer (1996, pp. 16-17) critiques a realist approach to environmental issues for failing to understand the different perceptions that exist among various actors, which are influenced by individual experiences, language and culture. Hajer (1996), in referencing Foucault, also states that explaining the influence and power of institutions as "vested interests" is inadequate – as institutions are only considered powerful by the weight that is provided to them via other actors through discourse (Hajer, 1996, p. 51). To enable an analysis and understanding of discourse in practice and to show how discourses transmute, Hajer forms the concepts of storyline and discourse coalitions (Hajer, 1996, p. 61). Hajer, makes the observation that the storyline of sustainable development arose, not from straightforward agreement, but from struggles between "unconventional political coalitions" that included scientists, activists and politicians among other actors (Hajer, 1996, p. 12). Storylines are thus used by actors to give meaning to specific phenomena. These storylines can assist in simplifying complex environmental issues, as well as enabling actors to position themselves in relation to an issue (Hajer, 1996, pp. 56, 61, 64). Storylines can become dominant on two conditions – firstly, if the storyline is used frequently and actors are persuaded or forced to accept the discourse and, secondly, if the discourse is institutionalised through policy (Hajer, 1993, p. 48).

Discourse coalitions will utilise storylines to persuade others of their view of reality (Hajer, 1993, p. 47). Hajer (1996) discusses how discourse coalitions within environmental politics will often develop and utilise the same storyline to describe an environmental issue; however,

they may have quite different interpretations of these storylines (Hajer, 1996, p. 13). Despite the diversity of interpretations and, at times, a loss of meaning through the adoption of simple storylines, Hajer argues that storylines are important as they overcome fragmentation and achieve "discursive closure", or agreement (Hajer, 1996, pp. 62-63). As storylines also become dominant, they provide a narrative for actors to claim a position that appears conclusive and convincing (Hajer, 1996, p. 63). An example of a dominant storyline in the energy sector and, which is also used in Cambodia, is that of reliability or security. Security can relate to the ability of nations to have access to a 'secure' supply of energy, whether that is from imported or domestic sources of energy (Scrase & Ockwell, 2010, p. 2229).

This thesis identifies the overarching norms of energy development in Cambodia (Finnemore & Sikkink, 2001, p. 396) and, in this way, is directed at identifying patterns within the relevant discourses that sustain them within the broader context of development in Cambodia (Yates et al., 2001, p. 7). How regime actors in Cambodia such as EDC use storylines and how transnational actors interpret and understand these simple storylines, is also analysed. As discussed by Finnemore and Sikkink (2001, p. 394), constructivists are not known for taking interests and identities at face value, so understanding the process of change within the discourse enables an understanding of the dominant influences on this sector. Rueschemeyer (2009, p. 81) discusses how rationalist explanations fail to explain the persistence of norms beyond their utility. An example of a global norm in the energy sector is the persistence of centralised power systems that prioritise reliability and, which are being applied to developing economies, including Cambodia, with all the cumbersome infrastructure that goes along with it. Due to the industrial path of development that Cambodia is pursuing, high energy intensity development is practically guaranteed.

3.3 Textual analysis of key policy documents

Six key Cambodian policy texts were selected for thematic analysis in this study (refer to Table 2, Chapter 4). Hyperlinks to the policy documents are included in Table 2 for ease of access to the policy texts, without having to extend the Appendices section of this thesis by 1535 pages. With the exception of the electricity law, all the policy documents were released between 2007 and 2017. These policy documents were selected to capture variation and variety (Flick, 2007, pp. 27-28) in policy texts focusing on energy and development across an important period of rapid economic and energy production growth in Cambodia. Flick (2013,

pp. 370-371) also remarks that the inclusion of documents from a particular social setting can provide information about that setting and, thus, the importance of understanding the circumstances and actors behind the production of documents. In addition to the policies listed in Table 2, regulations on connecting solar PV to the national grid from the Electricity Authority of Cambodia (2018a) were subsequently released and are referred to in Chapter 4, where relevant. While discourse analytical studies are usually carried out on untranslated material (Yates et al., 2001, p. 18), the use of some translated policy documents has been an unavoidable limitation of this study. Policy documents have been translated by the authority responsible for the document; for example, the electricity law has been translated by the Electricity Authority of Cambodia. The policy documents from Table 2 were initially coded in NVivo (Adu, 2019), according to broad energy and development related themes (Appendix 1). It should also be noted that only the seventh version of the Environment and Natural Resources Code of Cambodia has been coded in NVivo. Changes to subsequent versions of the code are discussed in Chapter 4. Codes from the policy texts relating to the third most frequent theme of electricity supply and energy were further informed by discourse that occurred in the interviews, participation in energy events and through ten months of fieldwork and participant observation in Cambodia. These themes are further discussed in section 4.6.

3.4 Interviews with transnational energy sector actors in Cambodia

Data selected for this research comprise interviews from various transnational energy and development actors in Cambodia. These organisations include the solar energy industry, solar industry associations and advocates, local and international NGOs, development organisations, entrepreneurs, lawyers involved in policy development and the United Nations. A total of 21 interviews were conducted with Cambodian and foreign staff at these organisations over several months in Cambodia between 2017 and 2019. Within qualitative discourse studies, it is inefficient to capture a wide range of discursive texts (Yates et al., 2001, p. 24). Therefore the interview participants were chosen specifically for their involvement in the energy sector in Cambodia, whilst still capturing a broad range of actors from NGOs, industry, entrepreneurs and international organisations. Contact details for government representatives were sometimes provided by research participants, however, I did not receive a response to my requests for an interview from these government representatives in Cambodia.

The use of semi-structured interviews using broad themes was chosen for this research to allow participants space to respond and enable more conversational interviews (Kallio et al., 2016, p. 2955). Conducting informal and semi-structured interviews with participants also encouraged more conversation and a greater variety in responses by participants, and allowed interview participants to say what they wished to disclose in the interview (Brinkmann, 2013, p. 32; Qu & Dumay, 2011, p. 247). The interviews were conducted as social practice that Brinkmann (2013) defines as those that work from a constructivist perspective, and is therefore an appropriate method for discourse analysis (Brinkmann, 2013, pp. 37-39). Additionally, informal interview methods were preferred over structured interview questions due to my knowledge in the subject area of renewable energy, which allowed for spontaneous follow up questions based on responses from participants (Kallio et al., 2016, p. 2955). As the interview participants were all professionals (both foreign and Cambodian) within their respective organisations, the interviews began with introductory questions about the energy sector in Cambodia, the work of the organisation and "small talk" to establish rapport and trust (Qu & Dumay, 2011, p. 250). The broad themes of the interview then differed according to the type of organisation interviewed, and the use of semi-structured interviews provided the opportunity to ask topic related questions, of which I wished to learn (Qu & Dumay, 2011, p. 246). For example, for organisations working closely with people in rural areas on energy provision, several questions involved understanding the experience of people in Cambodia relating to their energy use and the types of energy systems being provided. Other interviews, such as with Participant 15 (2018) were more specific, with questions relating to a particular policy, in this case the Environment and Natural Resources Code of Cambodia as discussed in Chapter 4.

The use of informal and semi-structured interviews can pose challenges for the researcher when attempting to interpret the relevance and accuracy of the discussions outside of the interview setting (Brinkmann, 2013, pp. 39-40). To lessen this interpretive risk and to include additional insights that may have been missed, I also used ethnographic techniques of participant observation in Cambodia (Gournelos et al., 2019, pp. 101-102). The use of participant observation is also discussed further in section 3.5 below. Living in Cambodia over a period of ten months between 2017 and 2019, enabled an understanding of everyday energy practices in Cambodia and proved invaluable to the research findings discussed in Chapters 5 to 8. However, there were limitations with this, as a non-Khmer speaker. For

example, language barriers prevented the surveying of street vendors over the period of power outages, to enable more depth and understanding of energy practices at this time. To overcome this limitation, I utilised participant observation as discussed; and media articles throughout the period of power outages in Phnom Penh. The findings of this research also differ from my initial view of energy provision in Cambodia, which is precisely the point of participant observation, as described by Shah (2017, p. 48), in that it provides the possibility to be surprised. Shah (2017, p. 47), in describing the importance of participant observation in fieldwork, notes that it enables researchers to question existing theories and assumptions and allows for new ways of thinking and knowledge. Questioning initial ideas and theories in the process of observation also often leads to the ideas we started with becoming obsolete (Shah, 2017, p. 49).

As I was unable to access interviews with government representatives as discussed, the use of policy documents (Chapter 4) and discourse from the energy vision event, hosted by the American Chamber of Commerce in Phnom Penh, provides context from state energy actors. I also contacted several Cambodian solar energy companies that were recommended by other research participants; however, I did not receive a response to these requests for an interview. Being a non-Khmer speaking expatriate in Cambodia with few local connections is likely to have limited my ability to source interviews with local actors. Many of the actors I did interview were found using the snowball technique from other interview participants. The snowball technique for sourcing interviews has been criticised for lacking in sample diversity, however, other scholars also see the value of this technique to generate more in depth and contextualised knowledge (Kirchherr & Charles, 2018, p. 3). As discussed, some perspectives are absent from this research due to my being unable to source interviews; however, the research includes a representative sample of transnational energy and development actors attempting to influence a more sustainable energy path in the country. Utilising offers of referrals and invitations to meetings from interview participants in Cambodia greatly assisted in gaining access to other interview participants to whom, I would not have otherwise had access. While in Cambodia, I also worked from co-working spaces; however, many of the connections I made while working in these spaces were also expatriate actors. Few local actors involved in the energy sector utilised these spaces, however several local entrepreneurs not involved with the energy sector did use the co-working spaces. These connections helped to inform my understanding of transnational communities in Cambodia.

3.5 Observation of energy practices and a solar micro-grid project

Finally, this research includes an observation of a solar micro-grid project in an area south of Phnom Penh. The solar micro grid project site was chosen as it can be considered a niche level project (Smith & Raven, 2012, p. 1025) and was developed by a foreign technology company based in Cambodia (Participant 14, 2018 & 2019). Interviews with Participant 14 were conducted in 2018 and in 2019 and I visited the project site in 2019 accompanied by staff from Participant 14's organisation. Participant 14 also partnered with a local organisation for the project, which undertook installation at the project site and the billing of customers for electricity. I requested an interview with the partner organisation while in Cambodia; however, I was unable to source this interview.

As discussed in section 3.4 above, I employed the use of observation techniques (Gournelos et al., 2019, pp. 101-102) in Phnom Penh, and at the solar micro grid project site. These observations were combined with interviews with Participant 14 to understand more about the solar micro grid project. Shah (2017) provides some crucial points about the use of participant observation in the field and provides strong support for using this method, combined with informal interviews. Firstly, using participant observation provides the opportunity to reach conclusions that may never have been reached without the possibility of fieldwork (Shah, 2017, p. 48). Participant observation also enables a questioning of our own perspective of the world through daily engagement with people who are effectively strangers (Shah, 2017, pp. 49, 51-52). Shah (2017, p. 52) describes participant observation as "an inherently democratic form of knowledge production", as it ensures the perspectives of the people we engage with are taken seriously. As noted, there are some limitations to this approach, due to being a non-Khmer speaker, however, a Cambodian staff member of Participant 14 accompanied me to the project site and provided translations at the time from informal conversations with people in the village (refer to Chapter 7). Another aspect of ethnography discussed by Flick et al. (2004, p. 377) is in gaining access to the field and the obstacles that need to be overcome for the researcher in the field. A certain level of trust (Flick et al., 2004, p. 377; Kirchherr & Charles, 2018, p. 4) had to be gained for Participant 14 to allow access to the village where the solar micro grid project was located. I conducted two interviews with Participant 14 in 2018 and 2019 before this access occurred.

The project is located in a region that is officially considered electrified after transmission lines were expanded in 2003 in a project funded by the World Bank and the Nordic

Development Fund (Saing, 2018, p. 148). However, the project site itself is not connected to electricity infrastructure due to the houses being located close to a body of deep water, making the site less accessible. Connection costs for households in the region were also identified as being prohibitive (Saing, 2018, p. 161). The relatively high costs for grid connection was also confirmed by several interview participants (Participant 8, 2017; Participant 11, 2018; Participant 13, 2018; Participant 14, 2018 & 2019), as will be discussed further in Chapter 8. The project site is de-identified for this study to protect residents as well as the company undertaking the solar micro grid project. Non-identifiable photos at the project site are included in Chapter 7 to provide further context of the site.

Providing an observation of the solar micro grid project provides additional context of a niche level project in Cambodia and to the broader research question regarding energy provision and policy in Cambodia. Kemp et al. (1998, pp. 183-184) also note the importance of entrepreneurs and niche level activities to the transition process due to their ability to demonstrate the viability of new technologies and to be a catalyst for institutional changes. At the time of the site visit, the project was operating outside of the usual licensing requirements set out by the Electricity Authority of Cambodia (EAC). The EAC were, however, aware of this, and have allowed the project to continue through an informal exemption to the rules (Participant 14, 2018 & 2019). The literature on niche level projects states that temporary spaces are created to allow technologies the opportunity to develop (Kemp et al., 1998, p. 185). The solar micro grid project was not created to be a niche level project in Cambodia with government support per se; however, it appears to have taken on these characteristics, albeit unintentionally.

This thesis also discusses energy needs in Cambodia in Chapter 5 and the project example provides further context of this in the community. The solar micro grid project in this study contributes and in some ways tests the transition literature in the Cambodian context. To ensure external validity and reliability, the findings are interpreted using transition theory, as discussed in the literature review (Chapter 2) covering the broader issues relating to energy transitions on the landscape, regime and niche level in Cambodia (Geels, 2010). My initial premise is that the solar micro grid project has limited influence on the overall energy development trajectory in Cambodia. This is partly due to the regime level of the electrification works that influence Cambodia at the present time, which are becoming rather entrenched with the scale of investments that are being made in network infrastructure

(Matschoss & Heiskanen, 2018, p. 1). In addition, the project is operating with limited influence at the regime level to effectively transition policies in the country. When considering the context in Cambodia, it is important to also situate the regime level within the broader regional perspective that influences energy development in the country. This includes the importation of electricity from Vietnam, Thailand and increasingly from Laos, as well as the investment in infrastructure from various sources, including China (Derbyshire, 2015, pp. 24-25; Marks & Zhang, 2019).

3.6 Considering an equitable framework for energy services in Cambodia

This thesis considers changes occurring in the energy sector in Cambodia from an equitable and energy justice framework, as discussed in the literature review, using discourse analysis. I apply textual and discourse analysis to six key policy documents (Table 2) and interviews with transnational energy sector actors in Cambodia. I also utilise an example of a solar micro-grid project and employ ethnographic processes throughout my research with observations of the energy landscape in Cambodia. Chapter 4 begins with an introduction to the energy landscape in Cambodia and introduces the corpus of six Cambodian policy documents. An analysis of the main energy and development related discourse in the policy texts is then undertaken.

Chapter 4: Energy and development discourse in Cambodian policy texts

4.1 Introduction

The Cambodian government's energy and related development policies are examined in this chapter to understand the relationship between energy policy and provision in Cambodia and discourses of the Royal Government of Cambodia, non-government organisations (NGOs), international development organisations and transnational renewable energy actors in Cambodia. The policy analysed in this chapter broadly correlates to development thinking in the post 1990 era where human development, focusing on capabilities and the development of the state, is central (Pieterse, 2010b, p. 10). This is reflected in coded themes from the policy documents that have a focus on governance, poverty, capacity and education, and electricity supply (refer to Appendix 1). Discourses of private investment, trade and markets also feature prominently in the policy analysed, as well as themes around international cooperation, sustainability and equity. This chapter also discusses how transnational energy actors in Cambodia have engaged in the development (where known) of these policy documents.

The purpose of this chapter is to document the main energy and development related discourse in the six policy documents identified in Table 2. Understanding the policy context in Cambodia will assist in answering the research question of how discourses articulated by transnational actors working on energy and development in Cambodia influence the path of energy policy and provision in the country. This chapter also includes data from interview participants, where those participants indicated their involvement in the construction of the policy text. The policy texts have been coded in NVivo manually and using text search queries (Appendix 1). A literature review of Cambodia's energy situation for context, regional influences and international policy commitments is also provided before describing the key themes emerging from the policy analysis.

4.2 Energy situation in Cambodia and regional influence

Electricity generation in Cambodia is changing rapidly and figures from the Electricity Authority of Cambodia (EAC), show that the total installed generation capacity in Cambodia was 2916 MW in 2020. This is an increase from 2018, when the total installed generation capacity was 2500 MW. Cambodia also imported approximately 980 MW of power from Thailand, Vietnam and Laos in 2020, with the majority of this coming from Laos (Electricity

Authority of Cambodia, 2020, p. 1). Most of the electricity generated in 2020 in Cambodia was sourced from coal at almost 47 percent, and hydro power at 41 percent. Cambodia also sourced approximately 8 percent of electricity from fuel oil, and just over 3 percent from solar power. A small percentage of electricity (just over 1 percent), was sourced from biomass (Electricity Authority of Cambodia, 2020, p. 1). Cambodia is still reliant on wood fuel for domestic cooking and in some industries that require the use of thermal energy, such as the garment sector. Figures for wood fuel as a primary energy source in Cambodia varies from 45 to 60 percent (Asian Development Bank, 2018, p. 2; Participant 20, 2019). The installed capacity of solar PV in Cambodia has increased from 2019 when the percentage of installed solar was 3.8 percent, which increased to 8 percent in 2020, and is projected to reach 12 percent in 2021 (Electricity Authority of Cambodia, 2020, p. 1).

Electricity consumption in Cambodia between 2010 and 2016 experienced an average annual growth rate of approximately 18 percent (Economic Research Institute for ASEAN and East Asia, 2019; MME & ERIA, 2016, p. 46). The high increase in electricity consumption in Cambodia is attributed to annual Gross Domestic Product (GDP) rates of approximately 8 percent, urban population growth and increased electrification (Intelligent Energy Systems & Mekong Economics, 2016, p. 14). Most of the growth in electricity demand has occurred in the service sector including hotels, hospitals, schools and commercial buildings (MME & ERIA, 2016, p. 46). Approximately 70 percent of electricity demand is in the capital, Phnom Penh (Intelligent Energy Systems & Mekong Economics, 2016, p. 14), home to approximately 9 percent of the national population of 16 million (United Nations Statistics Division, 2017). With rapid development in Cambodia and increasing electricity demand, there are various challenges for energy policy and provision in Cambodia. One of these challenges is meeting the actual energy needs of people in the country. In 2014, 56 percent of the population in Cambodia had access to electricity (World Bank, 2020); however, the rate of electrification is rapidly increasing in Cambodia. Figures from an energy access workshop in Phnom Penh in November 2017 stated that 71.5 percent of households in Cambodia were connected to grid electricity, based on a multi-tier framework survey conducted in 2017 (World Bank Group, 2017). Official figures for the year 2019 from the World Bank, state that 93 percent of the population has access to electricity (World Bank, 2020), and the most up to date figures from the EAC, state that the coverage of the distribution network in Cambodia in 2020 is at 97 percent (Electricity Authority of Cambodia, 2020, p. 7). However, this figure is likely to only include village electrification (or coverage of the distribution network) and may

not be entirely accurate if referring to houses connected to the grid. This point is discussed further in Chapter 5. Nevertheless, the country is electrifying at a rapid pace.

Within countries of the Association of South East Asian Nations (ASEAN), the rate of electricity consumption grew at 5.1 percent per year on average between 2010 and 2015, compared with 18 percent per year in Cambodia over the same period (ASEAN Centre for Energy, 2015a, p. 32). Projections for the growth of electricity in ASEAN remains around 5-7 percent per year from 2016 to 2020 (ASEAN Centre for Energy, 2015b, p. 17; Chang & Li, 2013, p. 153). Increasing energy needs within ASEAN have created the impetus for centralized and interconnected power grids across the region. The International Energy Agency states that Vietnam, Thailand, Malaysia and Singapore are expected to be the beneficiaries of imported electricity from Myanmar, Laos and Cambodia (International Energy Agency, 2015, p. 109). The transmission of electricity through borders is planned across an integrated power network throughout Southeast Asia, named the ASEAN Power Grid. However, as will be discussed, the ASEAN Power Grid is only mentioned once in the policy documents analysed. The vision for this grid was determined at the second ASEAN Informal Summit in 1997 by heads of state as part of the ASEAN Vision 2020 (Chang & Li, 2013, p. 153). Cambodia was not a member of ASEAN at this time, becoming the last member to join in 1999 (Narine, 2006).

Historically, a significant amount of electricity losses occurred in Cambodia, with transmission and distribution losses accounting for 27.8 percent of the annual growth of electricity consumption for the period 2010 to 2015 (MME & ERIA, 2016, p. 46). However, this figure was corrected by Participant 19 (2019), who stated that transmission losses in Cambodia were now around 7-8 percent and this correlates to the figure reported for Phnom Penh in 2016 (Economic Research Institute for ASEAN and East Asia, 2019). This has not been updated by the World Bank (2018a), which states that transmission and distribution losses for Cambodia in 2014 were at 23 percent of electricity output. Earlier figures on transmission and distribution losses for Cambodia in 1995 were 34 percent, which indicates a significant improvement if the current figures are correct (Karki et al., 2005, p. 505). In countries surrounding Cambodia, transmission and distribution losses in 2014 for Vietnam were around 9 percent, Thailand was around 6 percent and Myanmar was 20 percent (World Bank, 2018a). Transmission and distribution losses in Cambodia may have implications for increased electrification in the country and the ASEAN Power Grid, if this occurs. Ahmed et

al. (2017), in a simulation of transmission options for cross border energy trading in ASEAN, found that the use of high voltage, direct current (HVDC) for interconnections, such as those found between Thailand and Cambodia, is preferred over high voltage, alternating current (HVAC) for longer distances. This is due to reduced costs and lower transmission losses with HVDC transmission over distances greater than 160 kilometres.

Although the full vision of the ASEAN Power Grid has not yet been implemented, transmission and trade of electricity already occurs between Cambodia, Vietnam, Thailand and Laos. The transmission network that existed in Cambodia until 2007 was essentially a ring line around Phnom Penh. The national grid has since expanded, much of it through private investment on a Build Operate and Transfer (BOT) basis (Derbyshire, 2015, p. 5). Prior to 2007, electricity supply in Cambodia was mostly from oil generation, with some hydroelectricity. Interconnectors between Thailand and Vietnam were commissioned in 2007 and 2009 respectively and imports of electricity increased after 2008 (Derbyshire, 2015, p. 5; MME & ERIA, 2016, p. 12). In 2010, 62 percent of power to Cambodia was imported; however, electricity imports from Vietnam, Thailand and Laos to Cambodia are reducing due to increasing domestic power sources (Electricite du Cambodge, 2016, p. 9). In 2016, power imports reduced to 19 percent and were reported to be 14.5 percent in 2018 (Electricite du Cambodge, 2016; Electricity Authority of Cambodia, 2018c).

Interviews with transnational energy and development actors in Cambodia indicated that the main government institutions responsible for energy include: the Ministry of Mines and Energy, the Ministry of Industry and Handicraft, the EAC and the state owned utility, Electricite du Cambodge (EDC) (Participant 3, 2017; Participant 13, 2018; Participant 15, 2018; Participant 20, 2019). The Ministry of Mines and Energy was established in 1996 as the main administrative government body in Cambodia responsible for energy in the country (Heng, 2015, p. 410). On the international level, the United Nations Development Programme (UNDP) is reasonably active in the energy sector in Cambodia, along with the Asian Development Bank (ADB), various NGOs and private industry actors, including Independent Power Producers (Ministry of Economy and Finance, 2016). In April 2017, ADB provided debt financing for the construction of a 10MW solar photovoltaic (PV) power plant in Bavet, a special economic zone. The project was granted a 20 year power purchasing agreement from EDC (Asian Development Bank, 2017). The ADB were also mentioned by

Keo (2019), stating that EDC were working with the ADB on updating their "power sector master plan."

Cambodia is also increasingly influenced by foreign donors and investors from China, India, Korea and Thailand (Sato et al., 2011, p. 2091). Cambodia, as part of the Lower Mekong Basin, is affected by hydropower projects along the various tributaries of the Mekong River. These hydropower projects are supported by international finance and the ADB to contribute to plans for the Greater Mekong Subregion, which includes energy trade and cooperation across borders (Yong & Grundy-Warr, 2012, pp. 1037-1038). China is also investing in hydropower and infrastructure projects in Cambodia, including roads and transmission lines (Sato et al., 2011). Heng (2015) describes China as the most important international actor in Cambodia, mostly due to being the largest foreign investor in the country, particularly in the natural resources and energy sector, such as coal and hydroelectricity (Heng, 2015, pp. 415-417). Calabrese and Cao (2021, p. 4) also note that as of 2015, China held approximately 31 percent of total foreign investment in Cambodia, mostly in energy (including hydropower), garment manufacturing and agriculture. Speaking at the energy vision event in Phnom Penh, Keo (2019) confirmed his commitment to ensure that there is no more hydropower developments on the mainstream Mekong. This is discussed further in Chapter 8.

The type of contracts between dam builders and the local government is significant in terms of who has control of water issues in the Greater Mekong Subregion in the coming decades (Urban et al., 2017). The use of BOT contracts means that ownership, revenue from the sale of electricity and operation of the dam remains with the contractor for decades. In the case of the Kamchay dam in Kampot province, this was developed under a BOT contract with the Chinese state-owned entity, Sinohydro. The contract with Sinohydro is until 2050, at which time the ownership will then pass to the Cambodian authorities (Urban et al., 2017, p. 12). The payback to Cambodia comes in the form of aid for investment in infrastructure and electricity access. Beyond this, the benefits of dams for the broader civil society appear negligible, particularly with regards to impacts on water quality and food security. A more beneficial contract arrangement for any power development projects in Cambodia may be found in engineering procurement and construction contracts, which are commonly used in Australia. In these contracts, control and operations are handed over to local authorities after construction of the dam or other power projects (Urban et al., 2017, p. 12). BOT contracts are also criticized by Urban et al. (2017, p. 13) as knowledge and capacity of dam building and

operations is only transferred to Cambodian actors after several decades, rather than after construction.

For energy policy, Shove and Walker (2014, p. 42) have suggested that energy policy focuses less on the technologies, infrastructures and politics of power and more on the fundamental question of what energy enables us to do in daily practice. However Smits (2012, pp. 188-189), argues that this focus is predominantly based on western practices of energy use. Kivimaa and Kern (2016, pp. 208, 215) also discuss the most beneficial policy support for sustainability transitions, which includes support for niche innovations such as research and development funding, as well as the destruction of incumbent regimes through the withdrawal of supportive policies, including taxes and regulations. In 2018, the Electricity Authority of Cambodia introduced legislation that could be seen to further entrench the incumbent regime and hinder the export of solar PV generation to the grid. The regulations inhibit households (or low voltage customers) from connecting solar PV to the national grid by legislating that only medium and high voltage consumers may connect solar to the grid. All power generated to the grid must also have a Power Purchasing Agreement (PPA) in place with EDC (Electricity Authority of Cambodia, 2018a; Hasan & Lin, 2020). However, anyone can source their own electricity consumption from solar, as long as they do not connect to the national grid (Hasan & Lin, 2020). This particular regulation was not included in the policy documents analysed; however, it is referred to as required.

Affordability of electricity is another key focus of the Cambodian Government (Keo, 2019; Royal Government of Cambodia, 2014), with the country having some of the highest electricity prices in the world, partially due to electricity imports (Urban et al., 2017). Individual households are also required to pay the grid connection costs as they become available. Figures on connection costs for households vary from USD 75 to 300 (Participant 8, 2017; Participant 11, 2018; Participant 13, 2018; Participant 14, 2018 & 2019). Historically, Cambodia was reliant on imported oil for electricity generation, with prices fluctuating with world oil prices. From 2012 onwards, with increased imported electricity from neighbouring countries (mainly Vietnam and Thailand) and increased generation from coal and hydroelectricity, electricity tariffs have reduced. This is projected to continue to decline and it is a priority identified in Cambodia's Industrial Development Policy (Royal Government of Cambodia, 2015b). However, prices remain high in comparison to the region (Derbyshire, 2015, p. 5).

4.3 International policy commitments

At the twenty first session of the Conference of Parties (COP21) in Paris, the Government of Cambodia submitted an Intended Nationally Determined Contribution (INDC), which stated Cambodia's adaptation and mitigation actions to meet the Paris Climate Accord by 2030 (Royal Government of Cambodia, 2015a). Cambodia ratified the Paris Climate Accord and, on 8 March 2017, their commitment through the INDC entered into force (UNFCCC, 2016). Mitigation actions noted by the Government of Cambodia include grid connected renewable energy such as solar, hydro, biomass and biogas and connecting decentralized renewable energy to the grid. The INDC also includes off grid electricity, such as solar home systems, solar lighting and mini hydro, as well as the use of renewable energy for irrigation and other industries, such as garment factories, rice mills and brick kilns (Royal Government of Cambodia, 2015a, p. 6). Many garment factories in Cambodia still rely on the use of wood as fuel, which is becoming increasingly unsustainable for industrial use due to deforestation (Participant 20, 2019; Ploechl et al., 2015, p. 21).

Cambodia is a signatory of the International Energy Charter (2015), and an observer to the Energy Charter Conference (International Energy Charter). The International Energy Charter stresses the importance of the development of international energy transmission networks and their interconnection, including cross-border oil and gas networks and power grids (Energy Charter Secretariat, 2015). Point 8 of the International Energy Charter notes the importance of access to sustainable, modern, affordable and cleaner energy, including reference to developing countries to assist in poverty alleviation. Diversification is also included in order to enhance energy security (Energy Charter Secretariat, 2015). However, the main purpose of the original 1994 Energy Charter Treaty, which entered into force in 1998 and is largely dominated by European states, was to provide stable investment conditions for foreign investments in the energy sector (Pekkanen, 2011). The significance of the Energy Charter Treaty, according to Pekkanen (2011, p. 131), lies in the way it has created an environment of legalized investment of energy resources with limited impairment or risk for investors. Aalto (2016) confirms this view, highlighting how the recent International Energy Charter (2015) requires signatories to avoid discriminatory rules in relation to foreign investments in the energy sector. China is a signatory to the most recent International Energy Charter (2015), but was not a signatory to the original charter.

Aalto (2014), in his methodological overview of institutions in East Asia and European energy markets, provides a summary of informal and formal institutions, regulations and rules, and the functions fulfilled by these institutions (Aalto, 2014, p. 11). Aalto notes that the states are responsible for national energy regulations and laws. In terms of trade and exchange of energy, formal organisations include the Asia Pacific Economic Cooperation, ASEAN, state owned energy companies, ADB, the European Investment Bank, World Bank and other international finance institutions (Aalto, 2014, p. 11). Other actors and institutions in the energy sector in East Asia include energy companies, business lobbies and NGOs (Aalto, 2014, p. 11). Chinese companies are also increasingly influential in the energy sector in Cambodia and throughout South East Asia, with domestic policies in China, such as the recent One Belt, One Road project, encouraging Chinese companies to operate overseas. As a result, there are numerous dam construction companies spread across the region with significant investments (Urban et al., 2017). As discussed by Hill and Menon (2013, p. 48), economic growth has increased in Cambodia since 1998 and in 2007 foreign direct investment into the country overtook official development assistance for the first time.

4.4 Selection and analysis of data

The policy documents listed in Table 2 and information from some interviews became the corpus for this chapter, which was entered into an NVivo server for coding (Rapley & Flick, 2007, p. 130). The policy documents can be sourced through the hyperlinks of Table 2 below. The policies were chosen based on those that were considered most relevant for the development and energy sector earlier through this research and they were coded manually and using text search queries in NVivo, according to broad development and energy related themes (Appendix 1). The Environment and Natural Resources Code of Cambodia – 7th, 9th and 10th drafts (hereafter the draft environment code) were chosen specifically as the code was considered to be a progressive piece of legislation by several actors interviewed early in this research. Some energy actors in Cambodia also stated their input into the draft environment code (Participant 1, 2017; Participant 4, 2017; Participant 15, 2018). However, as will be discussed further in this chapter, the draft environment code continues to be stalled in Cambodia (Nachemson, 2020). The fact that the draft environment code has stalled and is included in this analysis is unexpected. In hindsight, the uncertainty that exists for the draft environment code also assists in answering the research question of how discourses

articulated by transnational renewable energy actors and international development agencies in Cambodia influence energy development in the country. This point is discussed further in this chapter and also in Chapter 8.

Table 2: Cambodian energy and development policy analysed

Policy or Plan	Government Ministry	Focus
Electricity Law of the Kingdom of Cambodia 2001	Electricity Authority of Cambodia (EAC)	Reliable and adequate power supply at reasonable cost for consumers, principles for licensees and operations in the provision of electricity, EAC as regulator, competition and favourable conditions for investment in the power sector, and the promotion of private ownership of facilities.
National Strategic Development Plan 2014-2018	Ministry of Planning	Comprehensive and broad focus on economic development, investment and growth, as well as governance and institutions, international cooperation and references to reducing poverty. Also contains development aspirations for Cambodia to move away from a least developed country towards an upper middle income and developed country.
Cambodia Industrial Development Policy 2015-2025	Ministry of Industry and Handicraft	Focus on the industrial sector. The vision of the policy is a transformation and modernization of Cambodia's industrial structure from a labour intensive industry to a skill based industry by 2025.
Cambodia Climate Change Strategic Plan 2014-2023	Ministry of Environment (National Council for Sustainable Development)	Reducing climate change impacts to the most vulnerable, move towards a green development path and promoting awareness of and participation in climate change response.
Environment and Natural Resources Code of Cambodia (7th, 9th and 10th Drafts)	Ministry of Environment	Comprehensive overview of environment and natural resource issues in Cambodia. Sustainable energy is included.
Cambodia's Intended Nationally Determined Contribution (INDC)	Royal Government of Cambodia	Cambodia's submission to the United Nations Framework Convention on Climate Change for the 21st Conference of Parties (COP) in Paris, December 2015. Details Cambodia's contribution and commitment to assist in reducing global greenhouse gas emissions.

4.5 Development and poverty related discourse

References to governance, poverty, capacity and education, electricity supply and energy and the economy and development emerged as central themes from the coding across the six policy documents. As the policy documents have human development themes as central concepts, it is important to consider the meaning of development for Cambodia. Cambodia

can be considered to be following the human development model of thinking that focuses on developing the state and capabilities within the state administration, as well as a focus on human well-being. References to poverty reduction were stated 170 times across four of the policy documents, and most significantly within the National Strategic Development Plan 2014-2018 (hereafter the development plan), where poverty is mentioned 158 times. Capacity and education (referenced 160 times) was also a significant theme across five policy documents, most significantly in the Cambodia Climate Change Strategic Plan 2014-2023 (hereafter the climate change plan) and the development plan. Equity discourse also occurs frequently across five policy documents (except the electricity law) and is referenced 99 times, again most significantly in the development plan, where it is referenced 74 times. Table 3 below provides a summary of discourse occurring in the policy documents relating to equity.

Table 3: Equity discourse in policy documents analysed

Policy document	Equity discourse
Cambodia's Intended Nationally Determined Contribution (INDC)	• Aim to develop Cambodia towards a "green, low-carbon, carbon-resilient, equitable, sustainable and knowledge based society."
Cambodia Industrial Development Policy 2015-2025	• Sustainable economic growth with equitable redistribution of wealth.
National Strategic Development Plan 2014-2018	• Growth, employment, equity and efficiency is a central theme of the rectangular strategy and adopted by the development plan • Equitable socio-economic development, equal opportunity, equality before the law and social justice • Rural electrification policy through EDC "to promote equity in access to electricity supply services" • Equitable access to education • Gender equity • Health equity.
Environment and Natural Resources Code of Cambodia (7th draft)	• Principles of intergenerational equity • Decisions relating to natural resources, good and services to equitably meet the developmental, social and environmental needs of present and future generations. • Principle of equitable participation to consider the needs of vulnerable, marginalised and at risk people • In the event of resettlement, the project proponent or government shall provide compensation for lost assets or impact to livelihoods, ensuring it is fair and equitable • Sustainable and equitable use of all lands and resources in Cambodia • Fair and equitable access to all areas for local resource users • Addressing worker and gender equity

	• Equitable allocation of revenue from carbon offset mechanisms.
Cambodia Climate Change Strategic Plan 2014-2023	• Vision of Cambodia as a "green, low-carbon, climate resilient, equitable, sustainable and knowledge based society" • Ensuring that climate change response is "equitable, gender sensitive, transparent accountable and culturally sensitive" • Strengthening accountability, equity and transparency.

As can be seen in Table 3 above, even though equity is included across five policy documents, and is a central theme of the development plan, much of the discourse in the policy documents are broad statements and visions. Springer (2015, p. 90) is entirely unconvinced of what he terms "cheerful sloganeering" by the Cambodian government, referring to discourse on good governance, social justice and human welfare in the Rectangular Strategy. The development plan analysed in this chapter covers the period from 2014 – 2015 and is based on the evolving Rectangular Strategy, which has been referred to as the "hallmark of development" since 2004 and has undergone three changes since its inception. (Royal Government of Cambodia, 2014, pp. 2-4). Rather than a shining example of good policy however, Springer (2015, p. 91) is of the view that the discourse in policy documents like the Rectangular Strategy are in fact a "a covert agenda", to ensure a secure business environment for foreign investment under the guise of good governance. For energy development in the country, the development plan includes statements for equitable access to electricity, which suggests that this is a priority for the Cambodian government. However, Cambodia's Industrial Development Policy 2015 – 2025 (hereafter the industrial development policy), states to "direct energy supply to major production zones" (Royal Government of Cambodia, 2015b, p. 28). Thus, rather than a covert agenda, there is in fact a clear agenda to ensure electricity supply for business and industrial development.

The draft environment code has the most specific and targeted aspects of equity included. This starts with the broad principle of intergenerational equity and includes equity issues with decisions relating to natural resources, land and livelihoods, workers, gender, and consideration of the needs of vulnerable and marginalised people. Recognising the needs of vulnerable and marginalised people is an aspect of recognition justice, as identified by Sovacool et al. (2019, p. 589), and refers to recognising where circumstances for a population may be worsened through any process, in this case low carbon transitions, and understanding the differences for marginalised populations. The aspects of energy justice identified by

Sovacool et al. (2019), and discussed in Chapter 2, are important to note in relation to equity for Cambodia. As identified in Table 3, above, Cambodia's climate change plan and the INDC correlate with concepts of green and low-carbon and an equitable society. However, Sovacool et al. (2019) identify 120 injustices that occurred with low carbon transitions, and Johnson et al. (2020, p. 11) also identify ways that existing disadvantage can be prolonged through energy transitions and recommend that marginalised voices are explicitly sought in planning and implementation of energy transitions .

The policy documents also show a clear commitment to the economy, which has been discussed, with aspirations to be a developed country – evidenced by the theme of economy and development that occurred 139 times across five policy documents (Appendix 1). There are also concerns about climate change, reflected in discussions of adaptation, resilience and disaster risk reduction, mentioned most significantly in the climate change plan (74 times) and Cambodia's INDC (17 times). Sustainability is also a focus across all policy documents, except the electricity law, and is referenced most frequently in the development plan (48 references) and in the draft environment code (44 references). The Sustainable Development Goals (SDGs) and the Millennium Development Goals, however, are rarely mentioned; 17 times across three policy documents that include the development plan, climate change plan and the draft environment code.

Cambodia was classified as a least developed country in 1991, and a recurring theme throughout several of the policy documents is what can be referred to as the development aspirations of Cambodia. Within the development plan, the industrial development policy, Cambodia's INDC and the climate change plan, the focus is on moving out of being a least developed country to an upper middle income country by 2030 and progressing towards a developed country by 2050. Statements, such as those below from the development plan, are indicative of the development aspirations evident in several of the Cambodian policy texts:

> The Cambodian economy, having achieved a per capita GDP exceeding USD 1000, will be moving towards becoming a low-middle income country soon. This in itself is a welcoming factor, but it will result in the country becoming increasingly less eligible for grants and will have to rely on (concessional or other) loans. (Royal Government of Cambodia, 2014, p. 4)

International support mechanisms are in place for countries defined as least developed. This support comes in the form of financial and technical assistance, as well as flexible and preferential trading terms (United Nations, 2015, p. 12).

According to the UN classification, least developed countries are low income countries that are vulnerable to economic and environmental shocks and have a low level of human assets (United Nations, 2015). Criteria assessed to be included in the classification of a least developed country includes: gross national income per capita, a human assets index, and an economic vulnerability index (United Nations, 2015, p. 3). For Cambodia to meet the criteria to move into the classification of an upper middle income country, it is required to exceed the threshold for inclusion in at least two out of three of the above criteria and this is determined over a review period of several years. At the 2015 triennial review, Cambodia met what is termed the graduation threshold for the human assets index only (United Nations, 2015). The human assets index incorporates nutrition, under five child mortality, school enrolment and adult literacy rates (UN Department of Economic and Social Affairs, 2015). Weinhardt (2020), discusses how the numerous classifications to categorise developed, developing and emerging economies in the post-World War II era, is essentially "socially constructed" (Weinhardt, 2020, p. 390). However, there are also real implications from the categorisation of countries in the form of special and differentiated treatment, such as technical and financial assistance through the World Trade Organisation (WTO) (Weinhardt, 2020, p. 389), of which Cambodia is a member (World Trade Organisation, 2020). Vazquez Tezanos and Sumner (2016, p. 851) critique the static nature of the UN criteria to move out of least developed country status, noting that it is difficult for countries to meet all of the criteria. However, as discussed by Weinhardt (2020), within the architecture of the WTO, member countries can self-declare their status as developing, with other members being able to challenge the categorisation. There are no formal criteria under the WTO regime, unlike the UN classification (Weinhardt, 2020, p. 389). Regardless of the challenges in moving out of least developed country status, and the loss of potential special and differential treatment for Cambodia, several of the policy documents show a clear desire and aspiration to move towards developed country status, as classified by the UN.

Other discourses relating to development and a focus on the economy from the climate change plan, exhibit some of what Hajer (1996, p. 268) refers to as "various practices of micro-power" to make issues such as climate change "manageable" for industrial society. For example, the climate change plan acknowledges the existence of climate change and states that: "it is crucial that measures are put in place to minimise the impacts of climate change risk and disasters." However, in doing so, it states that this is "in order for Cambodia to

achieve the desirable economic growth and development expected in the national development programmes" (National Climate Change Committee, 2013, p. 9). This normalising of economic growth and development in the face of climate change is an example of "black boxing", where the prospect of growth and development is so fundamentally fixed that there is no questioning of the legitimacy of "economic growth" in the face of climate change (Hajer, 1996, p. 272). There is, of course, acknowledgement that climate change is a reality, but only that disasters are expected and must be "minimised" as economic growth takes precedence. This is also apparent in the over 100 instances of the term "adaptation" in relation to climate change across five policy documents, except the electricity law.

It is perhaps not reasonable to criticise this approach from Cambodia, with stated intentions in the policy documents to make climate change manageable through adaptation. Firstly, it is an acknowledgement of the reality of climate change and a commitment to undertake actions to attempt to adapt to its effects. Secondly, as the climate change plan states, greenhouse gas emissions in Cambodia are "extremely low" compared with the region and globally (National Climate Change Committee, 2013, p. 9). The climate change plan also includes a fairly ambitious vision that states: "Cambodia develops towards a green, low carbon, climate resilient, equitable, sustainable and knowledge based society" (National Climate Change Committee, 2013). However, by now it is clear that economic development is a priority for Cambodia and industrial development, which is not particularly green, equitable or low-carbon, is occurring apace.

Another significant theme of the energy and development related policy analysed is that of private investment and the private sector being considered as an important driver of economic growth (Royal Government of Cambodia, 2014, p. 49). The development plan includes the theme of encouraging private investment in energy infrastructure, including generation, transmission and distribution assets, with a focus on electricity for industrial development and within the special economic zones (Royal Government of Cambodia, 2014). Likewise, the industrial development policy also discusses a lack of infrastructure and technical capacity in the country as being one of five obstacles to developing the industrial sector in Cambodia (Royal Government of Cambodia, 2015b). A stated commitment to poverty reduction is also found across all policy documents analysed, except the electricity law. As discussed through interviews conducted by Springer (2015), the pro-poor and poverty

discourse is not seen as legitimate when social services are cut and organisations such as the World Bank are seen as "substituting what the government is supposed to do" (Ou Virak) in Springer (2015, p. 95). Blunt and Lindroth (2012, p. 475) also critique the language of development such as poverty alleviation, empowerment and good governance, stating that these terms are widely used by development practitioners, conveying a sense of optimism and moral superiority. However, they are terms that are essentially meaningless in practice and there is an inability for development practitioners to critique the conventions of development assistance, that ultimately leads to a denial of social justice (Blunt & Lindroth, 2012, p. 479).

An example of the reliance on the private sector for "growth" to alleviate poverty can be found in the quotation below from the development plan, which states:

> The private sector is the engine of economic growth and poverty reduction. The Royal Government recognises that improving the business climate and creating an enabling environment for private sector development are pre-requisites for fostering growth, creating jobs, reducing poverty and achieving sustainable economic development. (Royal Government of Cambodia, 2014, p. 49)

As we can see from the above quotation, there is significant focus on growth and a reliance on the private sector to assist Cambodia in achieving their aspirational development goals, which include poverty reduction. This correlates with the "return to neoliberalism" form of development, as discussed by Weiss et al. (2007), which was prevalent in the 1980s. However, as noted by Turnheim and Geels (2012), there are very few incentives for the private sector to consider societal issues. The electricity law of Cambodia also includes, "the promotion of private ownership on the facilities for providing electric power services, and the establishment of competition wherever feasible within the electric power sector" (Electricity Authority of Cambodia, 2001).

One of the key priorities in the development plan is to diversify the economy and move away from aid dependence, as well as increasing south to south cooperation within Asia with what the policy has termed as non-traditional development partners (Royal Government of Cambodia, 2014, p. 121). This is consistent with the regional investment climate being led by China, Japan and South Korea (Pekkanen, 2011, p. 132) and the emboldened discourse from Prime Minister Hun Sen daring the United States to cut aid funding following the dissolution of the main opposition party, the Cambodia National Rescue Party (Reuters, 2017). In addition, private investment in Cambodia currently provides a larger share of financing for

the country than public investments (Royal Government of Cambodia, 2014, p. 235). This rejection of aid from western donors like the US is no surprise to some, including Ear (2012, p. 134), who previously suggested that Cambodia was on the cusp of rejecting western aid in favour of lenders from China. Ear (2012, p. 134), also notes the implications for democracy and human rights in the country from the alliance, with China's strategy being one of influence over decision making in Cambodia in order to source resources for Chinese development.

The significance of private investment in the energy sector is also a strong focus of the Scaling up Renewable Energy Program (SREP), which in July 2017 detailed an indicative revised investment plan for solar energy development in Cambodia. The projects to be financed to assist solar energy development in Cambodia included a 100MW solar park, as well as stated utility scale and rooftop solar. The total funding amount was stated as USD 244.2 million, with 172 million of this funding to be sourced from the private sector. The total amount of government funding is USD 2.5 million, with 40 million of ADB funds and 29.7 million of SREP funds (Climate Investment Funds, 2017, p. 1). The previous financing plan under the SREP that was endorsed in June 2016, included USD 10 million of government funds, out of a total of 165.7 million. Private sector funding in the previous financing plan was USD 95 million, with 31 million of Asian Development Bank funds and the above mentioned 29.7 million of SREP funds. The previous financing plan included solar home systems and solar mini grids, as well as a biomass power project, all of which are missing from the revised financing plan, which focuses more on large scale solar in the form of a 100MW solar park project that appears to have a significant amount of private sector funding (Climate Investment Funds, 2017, p. 1).

With the exception of the draft environment code (7th, 9th and 10th draft), all the policy documents express a focus on the development of capacity and education, which includes institutional capacity and governance within Ministries, as well as technical capacity for industry development. Increasing knowledge through education, training programs and research and development is one of the policy instruments discussed by Kivimaa and Kern (2016) that enables niche support for sustainability transitions. Therefore, having a fairly strong focus on this area in the policy documents is positive; however, it is non-specific and may achieve more if it were targeted, with a clear path to implementation. The climate change plan aims to develop non-specific science and climate knowledge to assist the public

to build resilience and adaptation responses to climate change. In the development plan, there is a focus again on institutional capacity and governance, as well as a focus on education and "human capital", with an emphasis on how education will assist in industrialization and development, as well as capitalising on the young population, as reflected in the quotation below:

> Lack of adequate human capital remains a major bottleneck to industrialization and development in the country. In education, providing 9-year basic education and spreading technical education have so far been elusive. Next, improving the quality of education at all levels - basic and technical - stays an unmet need. It is only with these requirements met, that the country can really take advantage of the demographic dividend, which the country has begun to experience now (Royal Government of Cambodia, 2014, p. 87).

This focus certainly fits within the human development model; however, as argued by Telleria (2017, p. 2146) in his critique of UNDP discourse in the Human Development Reports, it also reflects the inherent conflict within this model, which considers human beings in development as simply fulfilling the means to the end. In this case, the end point is industrialization and development of the state. It also seeks to take advantage of the "dividend" of the country, to utilize the young population in fulfilling the goal of development and industrialization. There is little reflection on whether this path of industrialization and development is indeed what the youth of Cambodia foresee for their own future.

Issues of capacity and technical knowledge and skills were also discussed with the energy actors interviewed in Cambodia and this is an area that some interview participants in the energy sector were actively involved with. Some interview participants were providing training for local electricians and installers and others provided internships for young people in the clean energy sector to connect them with industry partners (Participant 4, 2017; Participant 6, 2017; Participant 8, 2017; Participant 11, 2018). According to the interview participants, the capacity and technical skills for solar PV installations exist in the country; however, when questioned on whether the technical skills in designing off grid renewable energy systems were available, it emerged that these skills were limited in Cambodia. The solar energy industry in Cambodia are nonetheless proactive in developing training for people in the country. Some institutions and NGOs in Cambodia also offered courses and training, such as the Institute of Technology which offered a free 100 hour course for solar engineering. The Department of Physics at the Royal University of Phnom Penh also has course modules on "renewable energy and electricity generation" and "renewable energy

projects and electrical distribution" that were developed with assistance from Engineers without Borders (Royal University of Phnom Penh, 2016).

Overall, the development plan is the most comprehensive and utilises discourse of governance, poverty alleviation, infrastructure, private sector development, employment, capacity development, agriculture and environment. However, as discussed, it is contestable if any of the language used in the development plan translates to tangible outcomes for Cambodian people. The development plan analysed in this chapter and the updated National Strategic Development Plan 2019 – 2023 also retains the main focus of the Rectangular Strategy of "Growth, Employment, Equity and Efficiency" (Royal Government of Cambodia, 2014, p. ii; 2019). The updated development plan (2019 – 2023) is of similar length (281 pages), and was released in July 2019 (Royal Government of Cambodia, 2019). The most recent development plan is not included in the analysis due to it being released after this analysis was completed. The 2019 – 2023 development plan, however, states that in 2015, "Cambodia graduated from low income country to lower middle income country status". This is still considered "least developed", according to the UN classification (UN Department of Economic and Social Affairs, 2015). The Government of Cambodia further states that "The RGC has been putting great efforts to move Cambodia out of the group of least developed countries in the near future" (Royal Government of Cambodia, 2019, p. 1). Thus the development aspirations of Cambodia continue. With the pace of change and development in Cambodia today, the country is likely to fulfil this aim quite soon.

4.6 Energy and electricity supply related discourse

The official policy for electricity of the Government of Cambodia consists of two targets based on two different indicators for energy access. The first target, based on the village level, is that all villages will have access to electricity supplied by the grid and other sources by 2020 (Electricite du Cambodge, 2015; Royal Government of Cambodia, 2014, p. 156). The second target is that 70 percent of households will have access to grid quality electricity by 2030 (Electricite du Cambodge, 2015; Sarraf et al., 2013). The distinction between these two targets is important to clarify. In initial interviews with NGOs and the solar energy industry in Cambodia, it was pointed out that what is happening in regards to the first target of all villages having access to electricity supplied by the grid by 2020, is that in a particular village, one house may be connected to the grid, leaving the remaining houses in that village

without access to grid electricity (Participant 6, 2017). The actual cost for a household to connect to the grid is prohibitive for many people in Cambodia (refer to Chapters 7 and 8), and this cost falls on the individual household to pay for this connection (Participant 8, 2017). The Government of Cambodia does have an incentive program in place to assist people to pay for this connection cost, called Power to the Poor. This program provides interest free loans for connection fees and installation of wires from the connection point to the house (Electricite du Cambodge, 2015).

Reference to regional energy cooperation and the ASEAN Power Grid is made only once in the development plan from the Ministry of Planning and the industrial development policy from the Ministry of Industry and Handicraft. The concept of integrated energy networks and energy trading between nations in ASEAN and the broader region is not included in any other policy documents analysed. Discussion of the ASEAN Power Grid is noted in reference to Cambodia having participated in the implementation of the ASEAN Power Grid, as well as reference to Cambodia's participation in the Greater Mekong Sub-region Power Trade Plan (Royal Government of Cambodia, 2014, p. 47). With increasing distribution infrastructure being developed in Cambodia, there is the real possibility of increased energy cooperation between nations within ASEAN and China. An announcement was also recently made about investment in a 500 kilovolt transmission line that will connect Cambodia to the Laos and Thailand border (Sarath, 2020), and this coincides with a decision in 2019 (refer to Chapter 6), enabling the purchase of 2400 MW of coal fired electricity from Laos (Asia News Network, 2019). Energy and development policy in Cambodia, however, does not appear to be focused or planning strategically for energy trading between nations of ASEAN and if the simulation discussed by Ahmed et al. (2017) is an accurate depiction of the future of energy cooperation in the region, substantially more generation capacity would be required from Cambodia.

The 7th draft version of the environmental code provided goals relating to sustainable energy projects, which were optimistic within the defined terms of sustainable and non-sustainable energy. The goal stated that within ten years of the date of authorisation of the code, a minimum of 40 percent of generation will be from sustainable energy sources and this will increase to 100 percent by 2030. The code also states that national energy demand shall reduce by 20 percent (Vishnu Law Group, 2016, p. 99). The goal for sustainable energy generation was unsurprisingly removed from the 9th and 10th versions of the code. Sustainable

energy systems were clearly defined as an article in the 7th draft version of the code as those from solar, wind, small scale hydro (under 15MW), and biomass from sustainable sources, geothermal, wave, tidal and waste to energy. Additionally, non-sustainable energy sources were also clearly defined as those deriving from fossil or nuclear fuels, including coal, natural gas, diesel and large scale hydropower (greater than 15MW) (Vishnu Law Group, 2016, pp. 99-100). Both of these definitions were removed as articles from the 9th and 10th draft versions of the code. It is very difficult to see how the goal of reaching 100 percent sustainable energy sources in Cambodia by 2030 could be met with growing energy demand and the original definition of sustainable energy sources being under 15MW.

Article 16 of the 7th draft of the environment code discussed the promotion of mini and micro grid supply, in areas where the national grid exists or where the grid is yet to arrive (Vishnu Law Group, 2016, pp. 100-101). References to the grid were removed from the 9th and 10th drafts along with reference to the responsible entity, EDC. The same article, 261, in the 10th draft, is devoid of any responsible institution and instead refers to competent ministries or institutions that support the provision of mini and micro grids and does not specify any particular generation source, such as solar or diesel. This particular article also refers to entering into agreements with electricity providers to sell electricity; however, again the electricity providers are not identified (Vishnu Law Group, 2018, pp. 76-77). Discussions with Participant 15 (2018) in Phnom Penh shed some light into the development of the draft environment code over its various iterations and the removal of responsible entities, as well as some of the more progressive aspects of the environment code relating to sustainable energy. The first point made by Participant 15 (2018), was questioning if the code will ever get enacted, "and in what form would it get enacted if it were to get enacted?" In 2020, the environmental code is still not endorsed and as the title of a recent article on the code states, "In Cambodia, a sweeping new environment code languishes in legal limbo" (Nachemson, 2020). It appears that some oversights may have been made in the early drafts of the environment code, as discussed by Participant 15 (2018) who stated:

> I think that there are certain subjects of the code that are more controversial than others and the sustainable energy title is one that is controversial. Not just because it's sort of progressive, but it's also that when they developed the title, the main three actors of the electricity sector in Cambodia weren't really involved. That being, Electricity Authority of Cambodia, Electricite du Cambodge and MME [Ministry of Mines and Energy] (Participant 15, 2018).

Initial meetings with representatives with MME and EAC started well according to Participant 15 (2018), who stated that, "we had everybody in the same room" and described the people there as, "some pretty high level people at all of those agencies, including the vice chairman of EAC and one of the directors of MME" (Participant 15, 2018). However, as the meeting progressed, government representatives present stated that they did not think the sustainable energy title should be in the code, with one of the reasons being that they already had an electricity law (Participant 15, 2018). A follow up meeting with EAC and EDC occurred, with Participant 15 (2018) observing that the government representatives were at "a much lower level. In fact, two participants from EAC and EDC were only advisors" (Participant 15, 2018). This is a significant admission by Participant 15 (2018), who was involved in developing the code at the 9th and 10th draft stage. Participant 4 (2017), who was also involved in early consultations of the draft environment code, stated:

> Now they were also very.. you know the lawyers who drafted it.. I mean if you read it, it sounds amazing.. But the lawyers were very honest and saying now look guys, this was our attempt to get things in, but when it gets reviewed.. maybe half of these things will get taken out. That's what we're kind of waiting on. That was supposed to happen in March. But obviously there's been delays, so we don't have a final.. But it's positive, even if they take out 90 percent and they keep 10 percent. (Participant 4, 2017)

As will be discussed further in Chapter 8, the lack of engagement with key organisations such as EDC, EAC and the MME will prove to be reflective of why the draft environment code remains in limbo in late 2020. Perhaps, in hindsight, it would have also been more helpful if transnational actors, involved in the early stages of the draft environment code and the lawyers drafting it, tempered the wildly divergent aspects of the environment code from current policy settings, and instead focused on progressive elements that had a better chance of being accepted by the key Ministries. It appears that there are also political issues with the code, as discussed by Nachemson (2020), with ongoing discussions and conflict regarding responsibility among the various Ministries. Another important observation from Pak (2011, p. 180), may indicate that the reason the draft environment code languishes is less about responsibility and more about informal networks within Ministries of Cambodia, where decision making is determined by a few people. To the extent that if those few people are unwell or on holidays, key decisions will remain stalled. Therefore, if no one within the key Ministries involved with the draft environment code has an interest or reason to pursue it, then it is unlikely to proceed. Pak (2011) states that this results in limited information sharing within the bureaucracy, with "loyalty and ceremony given more weight than technical capacity" (Pak, 2011, p. 180).

Several of the policy documents analysed also refer to support and promotion of decentralized energy in the form of solar, biogas, biomass, solar home systems, household rooftop solar and micro and mini hydropower, as well as the integration of renewables into the grid, particularly solar (National Climate Change Committee, 2013; Royal Government of Cambodia, 2015a; Vishnu Law Group, 2016). All versions of the environment code also include an article stating the right to connect to the grid and sell excess electricity. The tenth version of the environment code, in "Article 253 – Right to connect to the grid and sell excess electricity" states:

> Sustainable energy electricity generators including but not limited to households, natural persons, companies, communities, and mini- and micro-grid operators shall have the right to connect to the grid and to enter into agreements with electricity providers to sell excess electricity in accordance with this Code and other relevant laws and legal instruments. (Vishnu Law Group, 2018, p. 74)

This article has been watered down from the seventh version, in which "Article 27 – Regulation of excess electricity to the grid" states:

> In the case of the supply of excess electricity to the grid by rooftop solar installations, the added supply of electricity shall be regulated and commissioned by Electricite du Cambodge. In addition, any natural person or private legal entity that owns a rooftop solar installation for its own consumption has the legal right to connect to the grid. (Vishnu Law Group, 2016, p. 103)

As will be discussed further in Chapter 8, it becomes clearer why EDC, MME and the EAC did not believe the sustainable energy title should be included in the environment code and were not particularly interested in engaging further with the lawyers drafting the code. The articles in the environment code, stated above, also conflict with the most recent regulations from the EAC, on connecting solar PV to the national grid (Electricity Authority of Cambodia, 2018a). The EAC regulations stipulate that decentralized sources of energy that are for personal use and located off the national grid can be promoted; however, there are barriers in place for household solar PV to connect and export electricity to the national grid. Within the EAC regulations, allowances are made for medium to high voltage customers to install solar PV as long as certain conditions are met, which include inverters programmed so that consumption of the electricity from the solar PV occurs, with no export. However there may be exceptions where permission is provided for the export of electricity, if an agreement is in place with EDC (Electricity Authority of Cambodia, 2018a, pp. 5-6).

Further textual references pertaining to electricity supply and energy are coded in the policy documents (Appendix 1) and include references in the climate change policy to promote renewable energy, energy efficiency, low carbon development and decentralised energy production, especially solar (National Climate Change Committee, 2013, p. 13). Both the industrial development policy and the climate change plan note that Cambodia is "short" of energy, with the climate change plan stating, "Cambodia is short of energy, which is one of the reasons for its low level of development" (National Climate Change Committee, 2013) and the industrial development policy noting that the "key challenge for industrial development is the lack of stable electricity supply at a competitive price." (Royal Government of Cambodia, 2014). Thus both policies see shortages of energy in Cambodia as being both the cause of and a challenge to further industrial development in the country.

Although discourse on affordability and reliability of electricity is not as common as other codes found in the policy documents, it is important to note the discourse on affordability and reliability under the electricity supply and energy theme. Affordability and reliability of electricity supply has been identified in four policy documents analysed here and summarised in Table 4, below, as a priority for the Cambodian government. References to reliability and affordability (including tariffs) of electricity supply occurred approximately 31 times across all four documents, most frequently in the industrial development policy. The main themes are summarised in Table 4. Affordability and reliability of electricity is also a significant theme raised by Keo (2019) at the energy vision event in Phnom Penh and this is discussed further in Chapter 8.

Table 4: Reliability and affordability discourse in policy documents analysed

Policy document	Reliable discourse	Affordability/tariff discourse
Electricity Law of the Kingdom of Cambodia 2001	• Safe and reliable operation of transmission grid and connection facilities • Rights of consumers to receive reliable and adequate supply of electric power services at reasonable cost.	• Provision of electricity at reasonable cost • Protect consumers against monopolistic prices • Cost of provision of power cannot be recovered through electricity tariffs except where specific funds are provided to subsidise consumers • Licensees to provide generation, transmission, dispatch or distribution services, at least cost.

Cambodia Industrial Development Policy 2015-2025	• Reliability and confidence of electricity supply • Expanding transmission coverage and improving supply reliability • Strengthening reliability and expanding coverage of electricity supply • Limits on garment industry due to not having an adequate or reliable supply of electricity • Attracting more investment in electricity sector crucial to ensure a reliable electricity supply.	• Garment sector requires reliable and low cost electricity • Reducing price of electricity for targeted industrial and commercial zones • Reduce price of electricity directly purchased from sub-stations • Reduce purchase prices of electricity from EDC in Phnom Penh, Kandal and Kampong Speu provinces • Set a different day and night time tariff for industrial use (time of use).
National Strategic Development Plan 2014-2018	• Reliability of electricity supply to attract investment and foster economic development • Strengthening energy security.	• Expand electricity supply and lower the tariff • Differences in electricity prices from urban to rural areas • Investment in power to ensure reasonable availability and price for families, business and industry • Affordable electricity supply and distribution to respond to development needs • Reduction of electricity consumption by reducing tariffs during off peak hours • Reducing electricity tariff to an appropriate level.
Environment and Natural Resources Code of Cambodia (7th draft)	• EDC to regulate imports of energy into grid to ensure reliability and safety.	• EDC to offer a fixed, pilot feed in tariff for renewable energy generated from solar or other renewable energy system.

As can be seen in Table 4, above, the focus of the industrial development plan for reliability and affordability of electricity is centred on industry development to ensure sectors, such as the garment sector, have access to affordable and reliable electricity. The development plan is also focused on attracting investment; however, it also notes the need to have affordable electricity for families, rural areas and business and industry. Reference to reliability and feed in tariffs for renewable energy in the draft environment code does not appear to reflect the views of the government and, indeed, one transnational energy actor in Cambodia suggested that feed in tariffs are not the right strategy for Cambodia to follow (Participant 4, 2017). The recent Cambodia Basic Energy Plan, also does not recommend feed in tariffs for Cambodia

and notes, as disadvantages, that a feed in tariff policy is likely to increase the cost of electricity for customers, as well as the need to improve the grid system to enable more renewable energy (Economic Research Institute for ASEAN and East Asia, 2019, p. 64). Discourse on reliability and affordability in the electricity law in Table 4, is the most consumer focused of all the policy documents. Despite the electricity law not mentioning the word equity, it is focused on ensuring that customers are protected from "monopolistic prices" and legislating that electricity must be provided "at reasonable cost" (Electricity Authority of Cambodia, 2001). It is not surprising then, that representatives from the EAC, EDC and the MME in meetings with Participant 15 (2018) stated that they felt the sustainable energy title should not be in the environment code as they already have an electricity law. Under the electricity law, as noted in Table 4, consumers do actually have reasonable protections, particularly against high prices, which the draft environment code does not ensure.

4.7 Conclusion

The policy documents analysed in this chapter provide the broader context to energy and development discourse in Cambodia; an understanding of government priorities and begins to answer the research question of how discourses articulated by transnational actors in the renewable energy industry and development agencies in Cambodia influence energy development and policy in Cambodia. As this chapter has shown, the influence of the transnational actors interviewed through this research on energy policy in Cambodia is limited and the policy documents largely utilise the language of development, suggesting a hopeful future. However, this hopeful future where everyone is free from poverty belies an actual focus on economic and industrial development, evidenced in the policy documents and discussed by Blunt and Lindroth (2012) and Springer (2015).

In the case of the draft environment code, the lack of influence from transnational actors is evidenced in the way the code continues to be stalled and the lack of interest that was shown in the code from representatives from the MME, EDC and the EAC. It could be said that the draft environment code was too ambitious from the outset, and perhaps also too far removed from existing policy in Cambodia, as discussed in this chapter. More importantly, it is also likely that the draft environment code had little to no connection with influential decision makers in the Ministries, who were tasked with deciding the fate of this policy. It may also be

prudent for transnational actors to focus more on equity aspects of development as a core theme of the development plan. There is a focus in the policy documents on energy infrastructure for industrial development; however, there is also a stated focus on human well-being, capacity development, poverty reduction, affordable electricity, and assertions of equitable and sustainable development. The focus on private investment in energy infrastructure is likely to intensify with increasing electrification and, therefore, transnational actors in Cambodia may have more success if they focus on aspects of energy development that the government have prioritised, such as energy affordability to assist in Cambodia's goals of poverty reduction.

Chapter 5: Energy needs

5.1 Growing energy needs

When it comes to discussing energy needs in Cambodia, this research is based on a review of relevant literature (Chapter 2), Cambodian government policy documents (Chapter 4), and interviews with transnational energy and development actors, who are either directly involved with renewable energy provision, or involved in energy policy in the country. These interviews and fieldwork observations from time spent in Cambodia between 2017 and 2019 are drawn on in the discussion of energy use in this chapter. This chapter also provides a picture of Cambodia today, with growing energy consumption, visible through the construction of new high rise buildings with bright lights and increasingly busy traffic. This energy intensive scene is juxtaposed by street vendors in Phnom Penh using wood fuel for cooking and ice boxes for selling drinks. As discussed by Smith and High (2017, p. 2), people engage and understand energy in a diversity of ways and this chapter provides observations on how Cambodian people utilise energy in their daily lives. When discussing what people are using energy for and how people in Cambodia are already having their energy needs met, one interview participant, who has spent decades as an anthropologist in Cambodia, asked, "why is everyone making such a fuss about supplying [people] with electricity" (Participant 7, 2017). From this participants' perspective, people were resilient in securing energy for their needs and this certainly was apparent throughout the extended energy outages in Phnom Penh as discussed in Chapter 6.

Cambodia is at a juncture when it comes to meeting its energy needs. On one side, energy demand is increasing rapidly with development and modernization, particularly in the growing cities of Phnom Penh and Sihanoukville, home to increasing construction and thus energy consumption (Durdyev et al., 2018, p. 2). But on the other side, energy consumption for a typical household in rural Cambodia is minimal and ranges from 25 kilowatt hours (kWh) per month to approximately 38 kWh per month (Dave et al., 2018, p. 29; Participant 10, 2018). Urban households consume more than rural households in Cambodia, with usage around 128 kWh per month (Dave et al., 2018, p. 29). For comparison, my own household electricity consumption in Australia is approximately 183 kWh per month in summer, slightly less than the average one person household of 235 kWh per month in summer.

As discussed by Rinkinen et al. (2019, p. 7), the discourse of demand for energy is often partnered with supply and related to needs that are taken as a given. But the question for Cambodia is needs for whom and for what? In the context of the power outages that occurred in Phnom Penh from March to May 2019 (Chapter 6), the services that were required on a daily basis included lighting, cooking, water pumps, power for electronics and cooling through fans or air conditioners. As load shedding was scheduled during the day, lighting was less of an issue. In effect, the lights stayed on as power was continuous for most people in Phnom Penh throughout the evening. For the Government of Cambodia, the black outs were challenging politically, but it did avoid the criticism of failure to 'keep the lights on', which is a typical critique of governments when power outages occur (Rinkinen et al., 2019, p. 69). Several interview participants noted that power failures in Cambodia have improved significantly over the last decade and one participant, who first came to Cambodia in 2005, noted that power was more reliable now that ever (Participant 7, 2017). Power failures used to occur almost daily in Phnom Penh for four to five hours each day (Participant 6, 2017; Participant 7, 2017), yet these comments were made prior to the daily load shedding in 2019.

For many people in Cambodia, particularly those in rural areas that do not rely on grid electricity, life continued as per usual during the power outages. Even in Phnom Penh, many street vendors could still cook with wood or gas, and power for appliances such as phones could be recharged when it was known that the power would be on. Of course there were challenges for people and particularly for businesses that needed to use generators during the outages, which was expensive, and there were several reports and experiences of water outages, as discussed in Chapter 6. But some energy needs, particularly cooking, could be met without electricity. This is not to romanticise traditional ways and life before electricity, for example burning wood and charcoal for cooking also has detrimental effects on health and contributes to deforestation. But if we take a different approach in the supply and demand dichotomy, as described by Rinkinen et al. (2019, p. 73), then we would question the ever increasing demand for electricity and need for continuous additional supply and perhaps instead ask how we can meet the need for energy for the things that people, businesses and industry use in their daily lives.

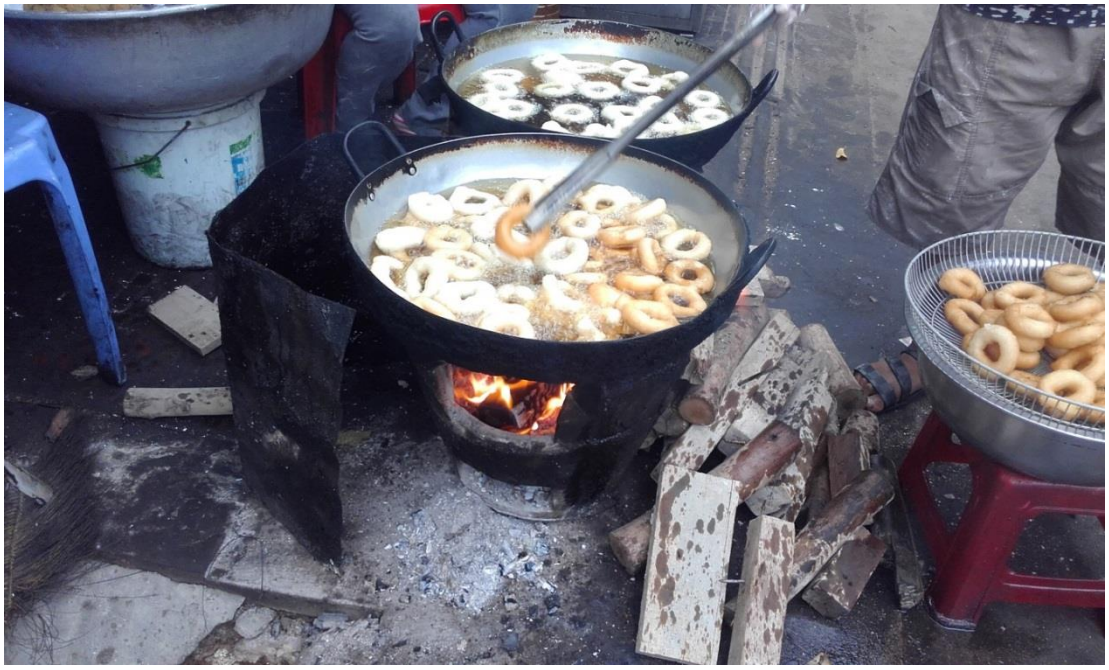

Figure 1. Street vendor using an improved wood stove, Phnom Penh (May, 2019)

Questioning the increasing supply and demand of energy in Cambodia would, however, require questions relating to the very path of development and industrialization that Cambodia is pursuing. Keeping in mind that Cambodia has a minimal impact when it comes to global energy demand, with carbon dioxide (CO_2) emissions from electricity generation at 12.6 percent in 2013, the lowest in ASEAN (Ang & Goh, 2016). However, this most likely reflects the lower levels of electrification in 2013. Electrification is increasing in Cambodia and more people are gaining access to electricity; however, there are still inequities in electricity access, as discussed in Chapter 7. Resolving these inequities in electricity access may be required if the country wishes to pursue a path of development that fairly meets the needs of people and provides a quality of life that takes care of the natural environment. Taking the building sector as an example, Berardi (2015, p. 129) discusses how 40 percent of total energy consumption in developed countries is from the building sector and in 2010 buildings accounted for 19 percent of energy related greenhouse gas emissions. The buildings being constructed in Phnom Penh are far from being energy efficient examples and, they do require a significant amount of air-conditioning to cool in the hot and humid weather. In addition, Berardi (2015, p. 131) also notes that energy consumption in the building sector in China, partly due to increasing urbanization, recently surpassed total US energy consumption. This is significant and relevant for Cambodia with so much new building stock being constructed, and China's influence on its construction sector.

Another aspect of energy use in Phnom Penh relating to buildings is the use of lighting on buildings. As one interviewee noted when discussing one of the malls in Phnom Penh,

> "It is always lit and the buildings around these… you could see these big skyscrapers, if you look at ten o'clock at night the office is empty, but it's all lit up. Everything is lit up. And these big signs, big like movie billboards. Times Square kind of billboards everywhere. So I find that fascinating in terms of energy needs, right? And the way that fits into the discourse. Because I mean we have a discourse of energy needs and what we can see with our naked eyes, is energy waste" (Participant 7, 2017).

Granted, the use of lighting in buildings that are unoccupied is not in any way unique to Cambodia. It is an aspect of the modern world, evident in most cities. Most of us expect to see cities with lots of light, in fact it would be unusual to see a dark city. And we do find it unusual in blackouts, when cities go down in darkness. However, when you have spent time in rural areas and villages, with no lights, coming back to a bright city with blinking lights seems odd. Which is probably how it should feel. We have become so accustomed to brightly lit cities. It is considered wasted light for some people, while others rarely consider the strangeness of so much light in a city and many people also view city lights as beautiful. But as rightly questioned by Participant 7 (2017), is this an energy need? Does the building of more hydroelectric dams and coal fired power stations just fuel this type of unnecessary excess? And where does this type of excess fit into the whole of Cambodia, with some people having limited hours of electricity per day. As discussed by Rinkinen et al. (2019, p. 100), the energy trilemma of responding to the need for low carbon supply and balancing this with energy security and affordability always ensures that supply is static or increasing, thus overlooking any consideration of demand. Rinkinen et al. (2019, p. 100) also note, that what this actually does is normalises technological responses to Western notions of energy needs, which ultimately maintains and extends the size of the problem, in this case energy supply, meeting unquestioned energy 'needs'.

A comprehensive study for low carbon development in Cambodia projected a 4.7 percent increase in energy demand annually for the country between 2010 and 2035, with the highest growth in the industrial sector of 5.4 percent annually. Energy demand from the transport sector was projected to grow by 4.6 percent annually and residential demand at 4.4 percent (Hak et al., 2017, p. 246). However, other studies since have stated that the annual growth of electricity demand between 2011 and 2016, was 18 percent, with projected growth of 8.8 percent annually to 2030 (Asian Development Bank, 2018, p. 14; Economic Research

Institute for ASEAN and East Asia, 2019, p. 60). The study by Hak et al. (2017, p. 249) states that Cambodia could achieve significant reductions of CO_2 emissions (up to 55 percent in 2030), through several measures. The most significant emission reductions are projected by Hak et al. (2017) to occur through initiatives in the transport sector, including public transport, the use of hybrid and efficient vehicles, biodiesel fuel and the creation of walkable cities with differentiated bicycle lanes and footpaths. Most people in Phnom Penh drive motorbikes or seek transport in tuk tuks; however, large vehicles are becoming common. Fewer people cycle and even fewer people walk in the city. Other suggested measures for CO_2 reductions by Hak et al. (2017, p. 250) include the introduction of renewable energy and improvement of losses of electricity on transmission lines. Improvement of transmission losses on the electricity network in Cambodia is starting to occur, with current estimates of transmission losses at 8 percent, which is lower than World Bank figures of 23 percent in 2014 (Participant 19, 2019; World Bank, 2018a).

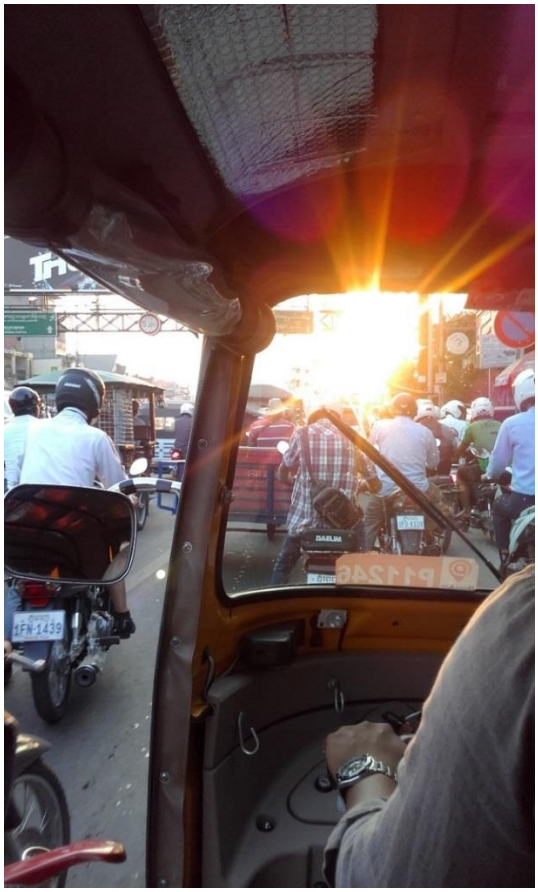

Figure 2. Peak hour traffic in Phnom Penh (February, 2019)

5.2 People's energy needs

Energy consumption in Cambodia differs relating to the location, as larger cities such as Phnom Penh, and increasingly Sihanoukville, consume approximately 70 to 80 percent of the energy in Cambodia, with the remainder of consumption occurring in rural areas (Participant 10, 2018). Many people in rural Cambodia travel for work to Thailand and Korea and approximately nine percent of people in rural areas do not consume grid electricity throughout the year, except in December and Khmer New Year (Participant 10, 2018). Power usage in rural areas of Cambodia is mostly for the use of televisions, lights, fans, sometimes radios or sound systems and phone chargers (Participant 4, 2017; Participant 7, 2017; Participant 8, 2017; Participant 14, 2018 & 2019). Some farmers will have water pumps and there is small percentage of people requesting refrigeration, and this is likely to increase (Participant 4, 2017). People in rural Cambodia who do not have grid access mostly use car batteries and some also have a small solar panel (Participant 7, 2017; Participant 8, 2017; Participant 17, 2018). Other people in rural areas have generators and people using car batteries will regularly take their battery to someone with a diesel generator to recharge when needed, often after two to three days (Participant 8, 2017).

One of the issues that was raised with energy actors in Cambodia was that when people have access to solar and a battery for electricity, they observed that energy consumption will grow relatively quickly, and there is not always a conscious awareness that the solar and battery only provide a limited amount of energy each day (Participant 6, 2017; Participant 8, 2017). Additional load; such as televisions, are often added and people will find that the battery needs replacing more quickly than they expected, often after two years (Participant 6, 2017; Participant 8, 2017; Participant 17, 2018). In addition, other components like charge controllers are not sold with solar and battery systems that are bought separately. Charge controllers are an important component in solar and battery systems to protect the battery from discharging too quickly, thus limiting the amount of energy consumed at any one time (Participant 17, 2018). Thus, we have a situation where energy consumption grows in rural areas as soon as people have some access to electricity. What was discussed frequently by energy actors interviewed is that there is not always a conscious awareness of the limited amount of power from a small solar panel and battery system, and people outside of the cities often do not have meters to see how much power they are using (Participant 6, 2017; Participant 8, 2017). As a result, when people add further appliances to their system, it often causes system failure, largely due to the constant discharging of the battery below the

minimal limits of its design (Participant 17, 2018). It is not necessarily a failure of the system – in reality, it is a situation of limited energy not meeting the increasing consumption that occurs for the services that energy provides, like watching television. As discussed in Chapter 6, many of these rural solar systems are small, around 100 watts of electricity per house, which, when we consider all the appliances in most Western households, would not even power a kettle.

Should transnational actors working on rural electrification projects in Cambodia have expected that energy use would grow when people have access and that perhaps small solar home systems would prove inadequate in a relatively short period of time? Geerts et al. (2014, p. 124) provide important thinking on this question, asking whether our energy consumption in western societies is a result of our energy supply, rather than the fulfilment of our actual needs and wants? Furthermore, Geerts et al. (2014, p. 124) observe that in the transition from fixed fossil based systems to a more fluctuating renewable energy based system, that we should now ask consumers to have flexibility when they use electricity to more accurately match the resources of intermittent renewable energy. However, while the technocrats implore consumers to meet demand when the sun is shining, there is a forgetfulness of how removed we are from thinking about flux in an energy system. We flick a switch on an appliance or a light and expect that our demand will be met at any time. Fundamentally, our demand and supply co-evolved to the current situation and Geerts et al. (2014, p. 124) point out that an energy transition cannot simply be a case of changing the source of power, without considering the energy practices that come with this. Electricity was supplied and we increased our demand, quite simply because we could. In Western societies, many of us have lost our ability to be flexible with our energy demand, because we have never had to think about the limits of our supply.

Where people have access to grid electricity, this is not an issue. People do not need to concern themselves with limited hours of electricity or batteries failing before their time. Grid connected households have and expect a constant 24 hour supply of electricity. However, expectations in Cambodia are also kept relatively low in this regard with awareness that power cuts can occur at any time, but, which appear to be largely managed and scheduled now with Electricite du Cambodge (EDC). Whereas, a decade ago power outages appear to have been more random. Knowing that these power cuts can occur, people are relatively prepared, with many businesses in Cambodia, particularly hotels, larger apartment buildings

and cafes having generators. On the topic of energy demand, Rinkinen et al. (2019, p. 9) make the important point that when energy provision is planned and forecasts and projections are made on what investments are needed, the scenario that is not considered is that demand grows in response to supply. In the case of rural areas of Cambodia, this is exactly what is happening. Supply is provided and demand grows, perhaps inevitably. People in Cambodia have a right to electricity and access to more than a few hours of electricity per day is preferable. Industrial development, however, demands increasing amounts of energy for cities with bright lights, and roads filled with cars that require fuel. The world over, we build and design cities that require enormous amounts of energy.

Illich (1974, p. 5) writes on energy and equity that, above a certain wattage per capita, energy needs grow at the expense of equity. Illich (1974, p. 7) also refers to the vested interest inherent in industrial infrastructure that does little but further the use of energy and notes that when a "poor country accepts the doctrine that more energy, more carefully managed, will always yield more good for more people, that country is hooked into the race for enslavement to maximum industrial outputs" (Illich, 1974, p. 10). Illich (1974, p. 11) makes this point throughout the book, referring largely to transport, and he manages to encapsulate the ridiculousness of how modern cities are designed to move people around with fuel being burnt "in a rain dance of time consuming acceleration", which has ultimately led to people being "captive consumers of conveyance" (Illich, 1974, p. 12). The point that Illich makes is that beyond a certain level of consumption of energy, we are all but slaves to industrial infrastructure and this point is still valid today for many societies, including Australia and Cambodia. How can societies even begin to live more sustainably and with less when the systems and ways of life that surround us promote such excess in consumption. The extensive bushfires in Australia in early 2020 (Komesaroff & Kerridge, 2020) created a reckoning that we must change, but how? Changing climate policy will not suffice, when our societies remain so fundamentally tied to high energy consumption through our infrastructure and ways of life. Shifting entirely to renewable energy may also not suffice, if we question, as York and Bell (2019) do, that our energy systems globally are not really transitioning. Instead, new sources of energy (in this case renewable energy) are simply being added to existing stock.

Geerts (2018, p. 55) also discusses the work by Illich validating the critique that it is high energy consumption that is problematic. This is indeed an issue, but there are also equity

issues with limited growth in countries that are considered least developed, like Cambodia, as there is not an equitable balance of energy demand globally. If there were this balance globally, many of us in Western societies would be consuming much less energy that we do, in order to allow for growth in energy demand in other regions. In addition, Geerts (2018, p. 59) notes that in his later work, Illich was equally critical of the eco-frugality approach due to further control and authority provided to what he terms 'ecocrats', who fit nature into neat domains. The view of Frigo (2017, p. 8) on Western approaches to energy is one that believes that with the harnessing of energy comes human liberation from limitations present in the natural world. Frigo (2017, p. 8) also notes that this dominant view is perpetuated within education, it informs energy policy and is present and unspoken in our everyday design of machines and devices (Frigo, 2017, p. 14). It also continues, unabated, and there is little doubt that the path of energy development in Cambodia today is one that is influenced and perpetuated by this hegemonic view and industrialisation. Like many industrial societies, Cambodia promotes its attractiveness to foreign investors and limits to energy production, for the industrial sector, are considered a limit on the country's development (Royal Government of Cambodia, 2015b).

What this industrial worldview does not consider is people's experience of energy in daily life. Frigo (2017, pp. 14-15) points to the factors behind what she terms the "energy paradigm" as mostly governments, international organisations and multi-national companies. This is certainly true in Cambodia and it is easy to be swept up in the paradigm. Most people working in energy, whether that be fossil fuel related or renewable energy, are carried along with the imagery. We tend not to stop and ask the questions about our relationship with energy, or alternatives to this dominance, as prompted by Frigo (2017) and other scholars, such as Shove and Walker (2014). Even organisations that are promoting alternative and more environmentally benign forms of energy in Cambodia continue to use the discourse of energy for the economy stating that, "zero emissions electricity can drive the rapidly growing economy with cheaper and less pollution than coal, gas or oil" (Participant 11). Because, ultimately, we know that industrialization does not stop on this earth today. We understand the paradigm that this is what governments want, because it aligns with people's growing demand for electricity, as described in the example above of solar home systems in off grid areas in Cambodia. This is what is expected but we do not stop to question the underlying dominance of this growing demand in our advocacy for a clean energy future, and how inequities with transitions to a low carbon energy system may indeed persist, as identified in

a literature review by Johnson et al. (2020). Johnson et al. (2020) identify several inequities in the literature in the pursuit of renewable energy projects, the most significant of which are related to land loss, particularly with hydro developments and biofuels. Solar energy has also been shown to create a deepening of wealth divides in the literature, with families in sub-Saharan Africa being stuck in debt, due to repayments on solar systems (Johnson et al., 2020, p. 9). Issues of unequal access in Cambodia will also be discussed further in Chapter 8. Ultimately, with the pursuit of renewable energy, we are often replicating the same high consumption society that we are familiar with, albeit a lower carbon version. Unintentionally, we may also be furthering and deepening inequities in the pursuit of increasing energy, even low carbon sources.

The question then becomes, how does the industrialized path of development and increasing energy use that we know is destructive to the earth and climate change? What questions need to be asked for this hegemonic and rigid path to change? Smith and High (2017, p. 5) implore us to also be reflective and ask from an ethnographic perspective "whose voices are being heard?" For Cambodia, I question whether it is too late for change in the path of high industrial energy demand. Illich (1974, p. 9) mentions China, India and Burma in his work from forty six years ago, stating that they could choose to stay within some form of energy limit, which would have the effect of forcing a loss on the "rich" with their vested interests. Of course, we now know that this is too late with India, China and, soon Burma (now Myanmar), which are on the same path of industrial development that sees enormous consumption of both fossil, nuclear and renewable fuelled power. This development of nations cannot be separated, of course, from the exploration, production and distribution of fossil fuels that Frigo (2017, p. 15) rightly points out is wrapped up in private profit for multinational companies, who scan the globe for new sources of energy. This insatiable drive for profit from energy sources does not stop and therefore the need to consume more energy, in our energy paradigm will also continue.

This chapter has explored growing energy needs through interviews with transnational energy actors in Cambodia, by utilising fieldwork observations of daily life in Phnom Penh, and considering the issues in relation to the relevant literature. The chapter has discussed the relationship between increasing energy consumption and changes occurring in Cambodia, with what people are using energy for, and the sources of energy they are using, including wood and batteries. Chapter 6 will further explore issues of energy excess in cities such as

Phnom Penh and contrast this with the limitations that also exist when the demand for power exceeded supply between March and May in 2019, thus, leading to daily outages. There are ethical challenges in questioning energy consumption and the path of energy development within Cambodia, particularly as there is such a large gap, with many people still having insufficient amounts of electricity to use in their daily lives. There are certainly aspects of energy gluttony in Cambodia in some sectors of the economy, but this is largely a result of the concentrated infrastructure that perpetuates this consumption. The high rise buildings and roads with increasing traffic is not balanced overall in society, with many people still limited in how much energy they have access to and use. In that respect, the statement from Illich (1974, p. 5) that "equity and energy can grow concurrently only to a point" and that above a certain threshold "energy grows at the expense of equity" is as valid today as it was forty six years ago in Cambodia. This statement is likely to become increasingly valid across many societies in the near future, not just those that are considered developing. It is also imperative to consider the issue of energy growth and equity from an intergenerational perspective, as well as ensuring that, in our pursuit of more renewable energy, we are not also entrenching further inequities.

Chapter 6: Energy Crisis or Excess?

6.1 Introduction

Between March and May in 2019, Phnom Penh experienced a significant shortage of energy to meet the level of daily demand. The shortfall was reported as being approximately 400MW of electricity capacity (Khouth, 2019a; Taing, 2019). The Government of Cambodia attributed the shortage to increased demand and drought in the country, which led to a lack of generation from the country's hydroelectricity dams that make up approximately 50 percent of energy generation in Cambodia in 2018 (Chea, 2019c; Electricity Authority of Cambodia, 2018c; Taing, 2019). However other factors reported in the media included the increase in energy use from the construction sector in Phnom Penh, with statements from the Prime Minister, Hun Sen, that there was a 700 percent increase in construction in the first two months of 2019 (Turton, 2019). It is certainly the case that the skyline has changed significantly in Phnom Penh, even over the period of this research, with an increasing number of new buildings and more construction occurring each time I returned to Cambodia (Figure 3). Several factors were reported that contributed to drought in the region, such as El Nino, climate change and the effects of upstream dams on the Mekong River System, particularly in China, but also in Laos. The dams further upstream of the Mekong withhold flows of water to lower basin countries such as Cambodia and Vietnam (Lovgren, 2019), thus affecting electricity generation due to their reliance on hydroelectricity.

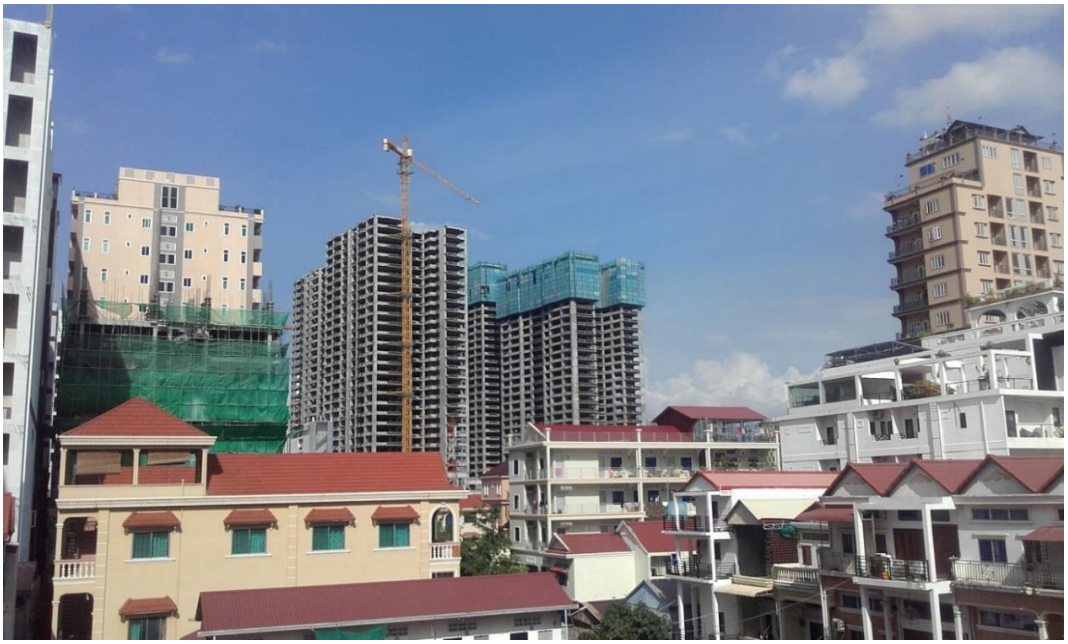

Figure 3. Construction in Sangkat Boeng Trabaek, Phnom Penh (July, 2019)

Claims were also made in Cambodia that the power cuts were an intentional strategy for the government to justify increasing hydroelectricity in the country, particularly the Stung Cheay Areng Dam, in Koh Kong province (Gerin & Keo, 2019). The Prime Minister, Hun Sen, strongly refuted these claims and threatened to cut off electricity to whoever was making this assertion (Gerin & Keo, 2019; Sokhean, 2019a; Turton, 2019). As will be discussed later in this chapter, the energy crisis in Cambodia appears to have had the opposite effect of the claims made, with the announcement of several utility scale solar PV farms and what appears to be a longer term policy by the Government of Cambodia to move away from large scale hydroelectricity on the mainstream Mekong. On 31 July 2019, National Geographic also reported doubts being expressed by Cambodian officials about plans for two Chinese constructed dams on the Mekong. The article noted that Cambodia was instead wanting to increase solar energy generation (Lovgren, 2019). A text search query conducted in NVivo on 35 English language articles sourced throughout the period of the power outages also showed references to solar across the 24 of the 35 articles. Official reasons as to why the power cuts occurred were provided by the Managing Director of Electricite du Cambodge (EDC), Keo Rattanak, at an energy vision event hosted by the American Chamber of Commerce in Phnom Penh on 5 July 2019. Keo apologised for the prolonged power cuts over this time period and placed a positive political spin on reasons for the power cuts. Keo stated the three contributing factors for the outages were: political stability in the country since the election in 2018 (which led to increased investment and growth), the prolonged drought in Cambodia and, reduced tariffs and electrification in the country leading to increased demand (Keo, 2019). Keo noted that, prior to the election, the Prime Minister had stated that electricity tariffs would be reduced in the country and the reduction of tariffs in January 2019 led to increased demand "overnight" due to lower prices. Keo stated that people "rushed to buy" refrigerators, laundry machines and air conditioners (Keo, 2019).

6.2 Daily life in Phnom Penh under extended power shortages

To mitigate the shortage in energy generation, EDC implemented a strategy of load shedding, creating power outages that ranged from six to eight hours per day. The load shedding schedule varied depending on the location and it was reported that industrial areas were not affected (Khuon, 2019). Other areas, like the NagaWorld Casino complex, were apparently not affected by the power cuts at all, while some of the poorest neighbourhoods in Phnom

Penh were receiving only a few hours of electricity per day (Hutt, 2019). There were also reports from Radio Free Asia and among people in Phnom Penh that high ranking officials' residences were unaffected by the power outages, along with casinos and Chinese financed businesses (Gerin & Keo, 2019). From personal experience, throughout the period of power outages in Phnom Penh, the apartment I resided in, which was owned by a Cambodian family, was experiencing power outages for around six hours per day, with the exception of Sundays and public holidays. The outages were scheduled either in the morning or the afternoon and alternated each day. Power was continuous throughout the evening. As the power outages occurred during the hottest part of the year in Cambodia, it was practically impossible to stay indoors at times when outages occurred, with no power for fans or air conditioning. Many of the apartments in Phnom Penh are heat sinks during the day, with no shading or insulation to shield the buildings from the midday heat. Thus, energy use in Phnom Penh from many apartment blocks is significant and is likely to increase as more energy inefficient apartments are being built. Several of the apartment blocks in Phnom Penh, where large numbers of foreigners resided, had generators, so residents in these apartment blocks were unaffected by the daily power outages in their homes. However, many of these residents also had higher tariffs throughout the year, up to 35c kWh, whereas the household tariff where I resided was lower, at 25c kWh. Several foreigners I spoke with in Phnom Penh also avoided using air conditioning as much as possible throughout the year in these apartments due to the high cost of electricity.

Along with the power outages also came widespread water shortages across Phnom Penh, with many residents, particularly those located above ground floor level, not having access to water in their homes or businesses at certain times. There were minimal English language media sources reporting on the water shortages in Phnom Penh, with the media only mentioning water shortages briefly in the broader context of the energy shortages. For example, an article on the effects of the blackouts on small vendors quotes a small business owner who states; "water and electricity are important for us to operate. It is not only electricity, sometimes there isn't even water to use for my business" (Cheng, 2019b). In discussions with Cambodian and foreign residents, it was clear that many people were affected by the water shortages, particularly Cambodian residents. The Australian Associated Press also reported on the water shortages that occurred in Phnom Penh and provinces, with the announcement of a collaboration with an Australian company and private companies in Cambodia to provide access to clean water (Hunt, 2019). Another English media sourced

article also noted clean water shortages in several provinces, but did not mention Phnom Penh (Khouth, 2019b). It was difficult to determine the exact causes of the water shortages in Phnom Penh at this time as there was minimal information; however, as noted by Nye (2010, p. 27), the extension of electricity into everyday life and the interconnection of electricity underpinning all other networks results in blackouts affecting other networks such as water systems, railroads and sewerage systems. The water shortages in the provinces were mostly attributed to the drought across Cambodia, but in a city such as Phnom Penh the water shortages were connected to the energy shortage due to the use of pumps to distribute mains water. This resulted in low water pressure across Phnom Penh, and no water available from taps at times.

I was also personally affected by water shortages due to living on the third floor of the house where I resided. I would describe these months of electricity and water shortages in Phnom Penh as rather extreme due to their effects on so much activity that we take for granted in cities today. The heat and humidity in Phnom Penh at this time also added to the harshness of the situation, which rendered air conditioning and fans useless each day without power. This was partially mitigated throughout these months by moving to places such as cafes and working spaces that had generators, and it became a fact of daily life for most people in Phnom Penh that there would be around six hours per day without electricity and the services that electricity provides. The other interesting thing about this time was that many people were talking about the power cuts. We were all comparing notes on who had electricity and water, who did not and how hot and disruptive it all was. One can start to picture a dystopian society forming, with masses of buildings being constructed all over Phnom Penh, completely unsuited to the climate, with no insulation or shading and rendered uninhabitable through a lack of water and electricity. Nye (2010) also makes the important point that:

> Even when a blackout is apparently a random event, it is a cultural disruption. It is not just the electrical system that breaks down; the social construction of reality breaks down too. People must improvise temporary solutions to new problems, and often they must do this with strangers. (Nye, 2010, p. 33)

When initially trying to uncover the reasons for the lack of water on the floor I lived, the owners of the house attributed the lack of water to climate change. The Climate Risk Index in 2011 ranked Cambodia as the second highest country at risk worldwide due to their limited capacity to prevent economic losses and protect human lives from climate change events (Smajgl et al., 2016, p. 536). The energy crisis in Cambodia, certainly highlighted these risks

with drought contributing to the lack of electricity and water. Indeed, the Prime Minister appealed to people to reduce their use of power and water and to use generators (Cheng, 2019b; Khuon, 2019). There is significant awareness of climate change among the population in Cambodia, and the government also speaks of climate change and acknowledges the detrimental effects of a changing climate to Cambodia. This is not surprising given the subsistence nature of many peoples' lives, the connection for most Khmer families to the provinces, and the reliance on rainfall for agriculture and electricity in the country. In the situation in the house, however, climate change did not entirely explain why water was available on the ground floor of the house and not on the upper floors. With further discussions through language barriers, water was being pumped to tanks on the roof, which then flowed down to the apartments. Without the mains supply pumping sufficient water, the owners of the house provided buckets to use for storing water and soon after purchased an electric pump to pump water to the tanks on the roof. The electric pump resolved the water shortage issue on the upper floors, as they were able to turn the pump on when power was available. Throughout the energy shortages, many homes, apartments and businesses were required to resolve the issues of water and energy services themselves, with, ironically, the use of more energy with generators and electric pumps at significant additional cost and hardship for residents and businesses. The small business community in Phnom Penh found the power outages particularly difficult and it had a significant impact on their ability to attract customers, as expressed by a vendor in the Tuol Tompoung Market who stated that, "Without electricity, the market is very dark, it has no air, and it is very hot. Nobody wants to shop" (Cheng, 2019b).

To attempt to resolve the energy crisis as it was occurring, the Government of Cambodia tried to source additional power from Thailand, Laos and Vietnam; however, Vietnam was experiencing the same issues with limited generation from their hydroelectric plants and initially was unable to provide additional power requirements to Cambodia (Khuon, 2019). Additional power capacity of approximately 90MW was eventually sourced from Thailand and Laos to assist with shortages (Lipes, 2019). The English media in Cambodia also discussed plans by the government to lease a 200MW floating power ship from Turkey. In early April, it was reported that the Cambodian government had negotiated the terms of the contract and the Prime Minister was quoted as saying "Negotiations were successful for the lease of the power ship to supply Phnom Penh's [electricity] needs. We will use the [power ship] for no less than three years" (Chea, 2019d; Cheng, 2019a). However, one week after the

Cambodian government signed the contract for the leasing of the Turkish power ship, the media reported that this was cancelled due to the high cost that would need to be subsidised and the fact it would not arrive to Cambodia in time to meet the energy shortfall (Kunmakara, 2019). The Managing Director of EDC confirmed that the contract for the Turkish power ship had been cancelled due to the cost of USD 200 billion over the term of the contract and noted that "we advocated for a change in direction" by making the case to the Prime Minister to invest in a 400MW liquefied natural gas (LNG) and heavy fuel oil (HFO) plant that Cambodia will own (Keo, 2019). The LNG/HFO power plant will be built in Kandal province and the agreement was with two Chinese companies on an engineering, procurement and construction contract (Chhut, 2019; Hin, 2019).

Over the time of the power outages, the government also announced an additional 80MW hydro power dam in the province of Pursat, as well as two 60MW solar PV plants; one in Kampong Chhnang and another in Pursat province. An expansion of an existing solar PV project in Kampong Speu was also approved to provide additional electricity (Kunmakara, 2019; Lipes, 2019). A Chinese company was also reported to be investing in an additional 200MW solar PV project, however this has not been verified (Chea, 2019b). Keo did note that over the next two years, out to 2021, approximately 400MW of solar will be built in Cambodia, up from the current 70MW currently installed in Bavet and Kampong Speu (Keo, 2019). Thus the 200MW investment from China, would bring the total of solar installed to approximately 390MW if all projects announced at this time go ahead.

For many people in Phnom Penh, the power outages did not stop all daily activities. Cooking in Cambodia is mostly prepared on gas or wood stoves in homes and on the streets. Likewise with refrigeration, on the streets of Phnom Penh, it is very common to see red ice boxes at small stores and street vendors using these boxes with ice to store cold drinks for sale (Figure 4). Nye (2010) also discusses how the displacement of sources of light and power such as wood, gas, kerosene and candles in earlier electric systems in New York happened gradually. At times of blackouts in the earlier electrical system many major buildings and department stores often had stand-alone generating plants and homes had multiple sources of light and energy (Nye, 2010, p. 15). Larger chain stores in Phnom Penh, like Brown Coffee, Joma and Starbucks were also self-sufficient with generators, and many people flocked to these places during the outages for the air conditioning. Participant 20 (2019) also confirmed that people in Cambodia do not always abandon previous fuels as they get wealthier, but rather they add

new fuels to their energy mix. As an example, rice cookers are widely used where electricity exists, however, wood, charcoal or gas may also continue to be used for cooking different dishes (Participant 20, 2019).

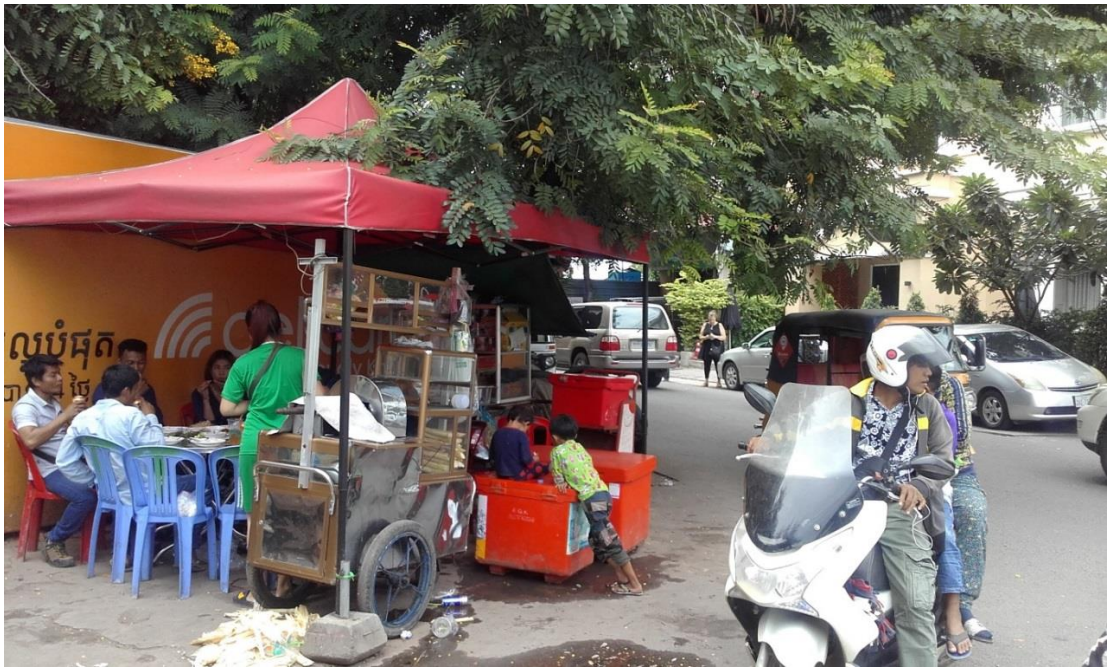

Figure 4. Sugar cane juice street vendor with ice boxes, Phnom Penh (August, 2019)

Throughout the power outages in Phnom Penh, most street vendors could continue their daily activities and many villages in Cambodia that did not have access to grid electricity were unaffected by the power outages. It was reported by Participant 14 that the village where the solar micro grid system was installed was completely unaffected by the power outages (refer to Chapter 7). Participant 14 also noted that the village had better electricity access than Phnom Penh during this time. Goldthau (2014, p. 136), discusses some of the advantages of decentralised energy systems, including efficiency gains, lower grid losses as well as improved flexibility and security when significant outages affect centralised and more complex networks. However, there can be instances where decentralised and intermittent renewable energy, such as solar or wind, can have negative stability effects on the national network, or even regionally with interconnected networks. In transitioning away from carbon intensive and nuclear energy, Germany's *Energiewende*, has caused grid stability issues in Poland, the Netherlands and the Czech Republic due to wind energy spilling over to these countries, which have now placed transformers on their borders to prevent disruption to their networks (Buchan, 2012, p. 5).

6.3 Cambodia situated in an interconnected region

Cambodia is at the stage of significantly expanding their electricity network, as discussed in previous chapters, and that expansion has seen more isolated Rural Electrification Enterprises (REEs) connect to the national grid. Instead of generating their own power, most REEs, of which there are over 300, are licensed as private distributors and are purchasing power from the main network owned by EDC (Keo, 2019). In 2007, the consumption of electricity from REEs was at 1.2 percent due to REEs generating their own power from diesel and fuel oil, which was normally around USD 1 per kWh. Consumption from REEs has now reached 34 percent of all demand in the country, up from 29 percent in 2016 (Electricite du Cambodge, 2016; Keo, 2019). This has obviously added to the increase in electricity demand in Cambodia and combined with the increased electrification of villages, was stated as one of the official reasons for the outages (Keo, 2019). Nye (2010, p. 16) discusses how utilities have discovered the benefits of linking systems in regional networks as socio-technical systems expanded. Prior to these linkages, one power station that experiences an outage or accident may be out of production for a long time. In the case of Cambodia, had it not been for the linkages with Vietnam, Thailand and Laos in particular – to provide additional power, Cambodia would have found itself in a more serious position in terms of not having enough energy to meet the daily demand. Phnom Penh may have seen itself plunged into darkness, rather than just having scheduled daily outages that were much easier to plan around and manage. The experience in Cambodia with the outages shows that there are advantages to having less reliance on the overall electricity system in the case of street vendors and some areas without grid connected electricity, who experienced minimal effects on their daily lives from the outages. However, the experience also showed the benefits of having an interconnected network regionally with Vietnam and Laos to provide additional power when needed for the growing energy needs of Cambodia.

A study by Huang et al. (2019) on the preparedness of the ten member states of ASEAN to absorb renewable energy on their grids found that Cambodia has the least reliable grid of all ASEAN states and, along with Myanmar and Vietnam, was the least prepared to accommodate distributed renewable energy with the current infrastructure (Huang et al., 2019, pp. 715, 719). Six indicators were used in the study by Huang et al. (2019) to determine "grid flexibility" for renewable energy. These included, grid reliability, load profile ramp,

electricity market access, forecasting systems, proportion of natural gas in the generation mix and diversity of renewable energy. The load profile ramp refers to the rate of demand increase at any one time and the amount of 'flexible' installed capacity to provide power to meet demand in a short period of time, such as gas, hydropower and sources such as geothermal, biomass, biogas and waste to energy (Huang et al., 2019, p. 714). Electricity market access refers to the interconnections currently operating within countries, for example Cambodia has interconnectors with Thailand, Vietnam and Laos, which at this stage are mostly for energy imports and not energy exports from Cambodia. Forecasting systems are used to predict intermittent wind and solar energy on the grid to enable utilities to balance energy flows on the network. For example, the Australian Energy Market Operator operates the Australian Wind Energy Forecasting System and the Australian Solar Energy Forecasting System on the National Electricity Market (Australian Energy Market Operator, 2019).

The study by Huang et al. (2019, p. 716), however, also showed that Brunei, Laos and Cambodia scored better than other nations such as Indonesia, Philippines, Myanmar and Malaysia, on electricity market access. In Cambodia's case the interconnections with Vietnam, Thailand and Laos in particular, proved to be essential in providing additional power to Cambodia during the outages. On all other indicators, however, Cambodia scored poorly. Huang et al. (2019), point out that the lack of infrastructure in Cambodia and Myanmar may also allow these countries to incorporate renewable energy more easily, and balance energy flows in the region through electricity trading (Huang et al., 2019, p. 720). Laos had the highest score in relation to load profile ramps and electricity market access (Huang et al., 2019, pp. 715, 717). As Cambodia is currently an importer of energy, this could be perceived as positive for Cambodia due to the potential for Laos to provide grid stability, if there were an increase of renewable energy within Cambodia. In addition, the areas where Cambodia is weak, in grid reliability, forecasting systems, proportion of natural gas and the diversity of renewable energy, are all areas that could be improved. However, talk of grid stability, does not negate the issues around dams that besiege Cambodia, which are also affecting Laos where extensive dam developments are occurring on the Mekong, as Laos positions itself to be the "Battery of Asia" to provide hydroelectric power to Cambodia, Thailand, China and Vietnam (Chattranond, 2018).

EDC's Managing Director, also made the point that the recently announced LNG/HFO plant would provide stability for increased renewable energy on Cambodia's grid, stating that "it

would be better to invest in a 400MW LNG/HFO plant that would be good for renewables in the longer term and we could own it for at least 30-50 years" (Keo, 2019). Although this statement may sound like empty rhetoric, there is actually truth in the ability of a gas plant to provide stability and an enabling environment for renewable energy on the grid, as highlighted in the study by Huang et al. (2019). The detrimental aspects of a HFO/LNG plant, however, relate to the reliance on imported energy in the form of oil and gas and the continued use of fossil fuels. Forecasting systems are also something that could be developed in Cambodia with assistance from countries that have wind and solar energy forecasting systems, such as Australia or within ASEAN, particularly the Philippines (Huang et al., 2019, p. 717). Given the support that forecasting systems offer for integrating renewable energy on networks, it may be beneficial for Cambodia to consider this, starting with a solar energy forecasting system, given the planned increase in solar generation on the network.

As for the power outages in Cambodia and the potential for this crisis to advocate for change in the energy sector in Cambodia, EDC's Managing Director committed the EDC to moving away from large scale hydroelectricity on the mainstream Mekong, stating that:

> I am committed as long as I work at EDC to not see any hydropower on the Mekong mainstream. Every day I stay in this seat, I will do my upmost to make sure that the mainstream Mekong will not be part of the big dams that would have serious repercussions to folks downstream. (Keo, 2019)

There was acknowledgement of the effects of climate change in the form of drought in Cambodia, and a strong commitment to go ahead with the two 60MW utility scale solar PV projects to provide additional and much needed energy generation. The two 60 MW solar PV projects in Pursat and Kampong Chhnang were also committed to by the government at the National Assembly on 1 July 2019, along with an 80MW hydroelectric dam on the Anlong Krouch river in Pursat (Sokhean, 2019b; Sun, 2019). Although the dam in Pursat is not on the mainstream Mekong, reported impacts of the dams are still significant and include flooding of land that will impact on the homes and farmland of 347 families, as well as 600,724 hectares of forest land (Sokhean, 2019b; Sun, 2019). In addition to the two solar projects and 80MW hydroelectric dam, the government has not ruled out additional coal generation in Cambodia, with EDC's Managing Director at the energy vision event stating, "Coal and hydropower continue to be the backbone of our supply. We still need coal because it's important for grid stability – and cost reduction" (Keo, 2019). This was followed up by quoting the former US state Senator of Illinois and President Trump, who stated that, "coal is

the cleanest, least costly option": however, Keo disputed Trump on the first part of this quotation that it is the cleanest, saying:

> We know it's not the cleanest. But at this junction, Cambodia cannot afford to eliminate coal from our generation mix, because to do so would destabilise our grid and would not bode well for cost reduction. (Keo, 2019)

The announcement of an additional hydroelectricity dam and potentially additional coal generation in Cambodia may appear to be business as usual, however, in context, the fact that EDC and the Government of Cambodia are willing to commit to up to 400MW of solar PV (or 12 percent of current generation) on the Cambodian network is significant. It is perhaps a replacement for one or two hydroelectric dams or coal fired power stations and it is possible that with these small beginnings, the Government of Cambodia will continue to increase the amount of solar generation. There was also discussion of wind power, with a question asked at the energy vision event by a company undertaking wind energy studies in Cambodia. The representative asked if EDC would be willing to consider wind energy on the network if there were no destabilisation of the grid. Keo (2019) responded positively, reiterating EDC's main concerns of grid stability and lower costs.

Overall, recent policy and media discourse suggests Cambodia is already altering its energy mix away from coal and hydro, towards more solar PV. The power outages in 2019 starkly highlighted the limitations with hydroelectricity in the dry season and the need to diversify energy sources in the country. An acknowledgement of climate change by the government and people in Cambodia also conveys an understanding that drought in Cambodia will continue into the future, leaving hydroelectric sources vulnerable, as well as the livelihoods of many people reliant on the Mekong river. The fact that solar PV projects were announced while the power outages were continuing could be seen as a political move – however, as discussed here, the solar PV projects that were discussed in the media and by EDC's Managing Director were approved by the National Assembly and there seems to be little doubt that, at a minimum, the two 60MW solar PV projects will proceed to prevent a repeat of the power outages experienced in 2019. Obviously, much more could be done in Cambodia to reduce demand from the household sector, as well as improving energy efficiency in buildings instead of continuing to provide additional generation for ever increasing demand. However, the path of development and increasing electrification in Cambodia make that a more unrealistic prospect. The government in Cambodia rarely

discusses energy efficiency, however, in some final parting words to all of us at the energy vision event, Keo stated:

> EDC is committed to more supply to you, please help by using less if possible. We do not generate to please use more. We only try to generate because there is need out there. One way to preserve, to help is energy conservation. So I appeal to all of you and your members to please help to spread the message of using less power if possible. Only by conserving energy will we be able to meet the demand responsibly. (Keo, 2019)

The appeal to conservation ethics and efficiency in response to an energy crisis appears reasonable, however I am not sure how many of us in that room took this plea seriously in the tropical heat of Phnom Penh, with most new buildings in Phnom Penh not designed to be at all comfortable without air conditioning and fans. As discussed by Shove (2017), perhaps this final point felt so out of place and tokenistic to me because EDC were not engaging with the causes of increasing electricity demand in Cambodia, in particular the significance of the amount, and type of construction that was occurring in Phnom Penh (Shove, 2017, p. 781). In that sense, thinking that those of us in the room could somehow influence the fate and path of energy demand in the country by 'using less power' in the context of having experienced two and a half months of no power for six hours each day, was a partial detachment from the processes that were actually driving energy demand in Cambodia (Shove, 2017, p. 784). These drivers, according to Keo (2019), include increased electrification with the expansion of the grid, increased investment (and hence construction) and reduced tariffs. In adding to this paradox, the main priorities of the government, stated at the meeting, were to reduce tariffs, ensure reliability and to continue expanding electrification for the country, all of which, in the view of Shove (2017, p. 785), continue to reproduce "unsustainable concepts of service" and ultimately contribute to increased dependence on electricity.

This chapter provides additional context to the changing energy landscape in Cambodia and further discourse from EDC's Managing Director, Keo Rattanak on the extended power outages in 2019. Through interviews with transnational actors and fieldwork observations in Cambodia, I came to see EDC as operating on the regime level of the transition literature. Therefore, the response by EDC to the power outages in Cambodia is an important part of the discourse to understand the perspective of influential energy actors in the country, particularly at a time when several new power projects were announced in an attempt to resolve the power shortages. The announcement of new power projects, including solar at a time of shortages, assists in answering the question of how transnational energy actors influence energy development in the country. Under the circumstance of these power outages,

the transnational energy actors interviewed for this research had no visible impact or influence on the decisions that were made at this time. The chapter then highlights that decisions on power development came from other external (landscape) factors, in this case growing energy demand and a lack of electricity to keep up with the pace of that demand. That fact, in and of itself, as well as landscape factors globally, such as the reduced cost of solar PV and the speed at which a solar farm can be constructed, allowed the Cambodian government to see solar as a viable and practical solution to the energy crisis. This is not to dismiss the work of transnational energy actors in Cambodia, which may have had some influence in paving the way for more acceptance of utility scale solar PV. That may well be the case; however, transnational actors interviewed in Cambodia were not involved in the decisions made for additional power at this time. Additionally, commitments given by Keo to prevent further hydroelectric dams on the mainstream Mekong came from a stated concern about the effect of dams on people "downstream", presumably in Cambodia from further comments discussed in Chapter 8. This concern about people highlights discourses by EDC on issues of energy justice and equity and begins to lead to the conclusions made in this thesis about the importance of equity in energy development for Cambodia.

Chapter 7: Growing energy consumption in a micro grid energy project

7.1 Introduction and context

This chapter describes a micro grid solar project developed by a transnational energy actor in Cambodia. An employee of the organisation was interviewed in Cambodia in 2018 and 2019 and is referred to throughout this thesis as Participant 14. The project is an example in Cambodia of a niche-level electrification project that is filling the gap in energy services in rural Cambodia. At the time of interviews with Participant 14, the organisation was operating outside of formal licencing arrangements for Rural Electrification Enterprises (REEs) in Cambodia. The licenses are administered by the Electricity Authority of Cambodia (EAC) and I am aware that Participant 14's organisation has made further progress with the EAC, and the organisation appears to receive support from EAC to operate in Cambodia. The micro grid project described in this chapter will assist in answering the question of how transnational energy actors in Cambodia influence energy policy and provision in Cambodia. The micro grid project is located in a village in rural Cambodia and the system operates on direct current (DC), as opposed to alternating current (AC), thus DC appliances are required at this project site and other project sites in Cambodia that use the technology from Participant 14 (2018 & 2019).

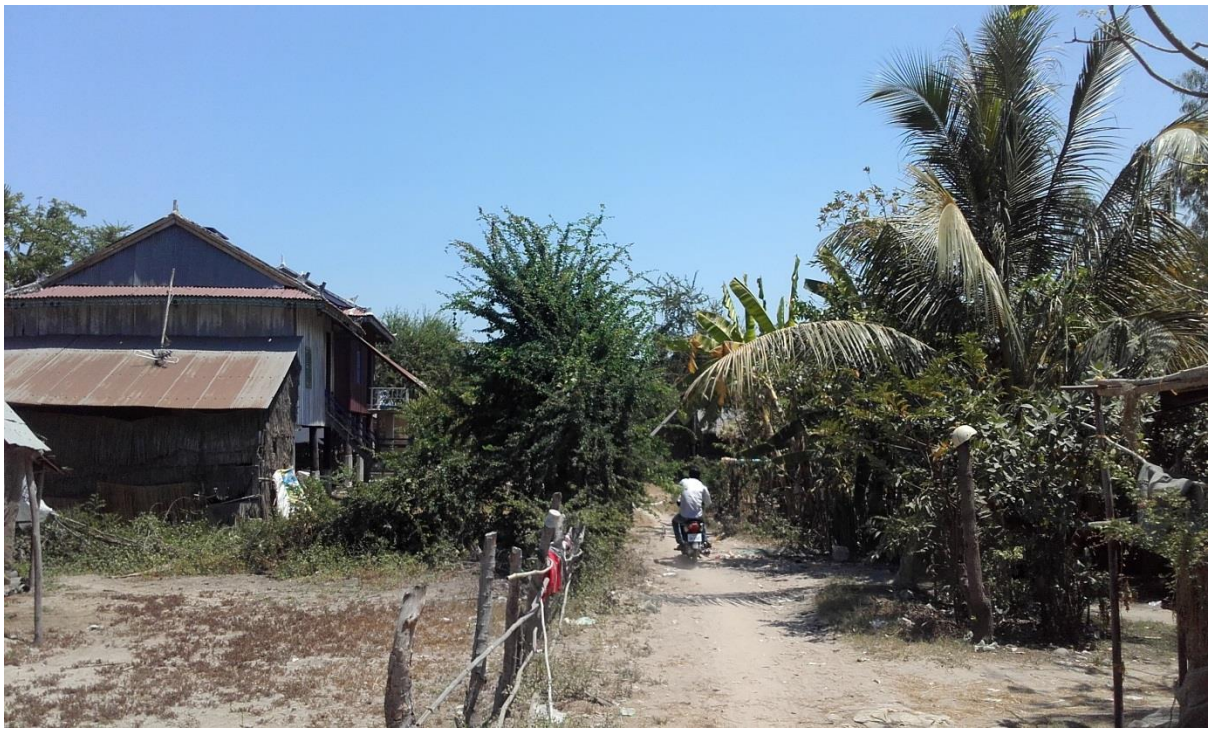

Figure 5: Solar micro grid project site visit (March 2019)

The project has been described by the development agency that manages the project funding as a base of pyramid project in a rural province of Cambodia that is not connected the electricity grid (Participant 18, 2019). Prior to the installation of the system, the village had limited energy access and people were using expensive diesel fuel, kerosene for lighting, lead acid batteries for charging electronics and wood and charcoal for cooking. Batteries were also regularly taken to charging stations for recharge (Participant 14, 2018 & 2019). The base of pyramid concept claims that "poverty can be alleviated through financially profitable activities" Kolk et al. (2014, p. 351). From the outset, the project had limitations to overcome for any organisation offering energy services to the community. This includes low paying capacity of residents and low energy demand, which makes the return on investment for energy providers limited (Bhattacharyya, 2018, p. 2). A point made by Participant 14 was that "critical to the energy companies actually making a payback from the network is building load" (Participant 14, 2018 & 2019). This comment was made in relation to Participant 14 providing DC appliances to residents at the project site – for the purpose of ultimately building load to make the project viable. This point about increasing consumption at the project site will be discussed further in this chapter.

The power sector in Cambodia consists of a national grid owned and operated by Electricite du Cambodge (EDC), a state owned utility, with approximately 24 separate power systems (Electricity Authority of Cambodia, 2018b; Heng, 2015). Outside of the national grid exist approximately 270 distribution licensees, who, increasingly as the national grid expands, purchase electricity from EDC to resell to households and businesses (Electricity Authority of Cambodia, 2018b, p. 18; World Bank, 2018b, p. 5). Other licensees in Cambodia include special purpose transmission licenses, retail licenses and consolidated licences with combinations of generation, transmission and distribution (Electricity Authority of Cambodia, 2018b, p. 18). Power purchased through EDC from the national grid mostly consists of hydro and coal generation, imported power from Vietnam, Thailand and Laos and a small percentage of fuel oil and solar – 2, and less than 1 percent respectively (Economic Research Institute for ASEAN and East Asia, 2019, p. 2; Electricity Authority of Cambodia, 2018c). Prior to expansion of the grid, REEs used diesel or heavy fuel oils and charged varying tariffs from USD 0.40c kWh to 1.00 kWh, which was much higher than tariffs in urban areas. Some REEs continue to use diesel and heavy fuel oils and the tariff is calculated

based on this (Economic Research Institute for ASEAN and East Asia, 2019, p. 41). Heng (2015) notes that many REEs are small, locally owned businesses that operated small diesel grids or battery charging services to local households and businesses, with many of the REEs only operating for 4 to 12 hours per day (Heng, 2015, p. 411).

The tariff across Cambodia is now relatively standardised and ranges from USD 0.12c kWh to 0.24c kWh. However, the Economic Research Institute for ASEAN report states the lowest tariff for larger energy consumers is approximately 16.8c kWh (Economic Research Institute for ASEAN and East Asia, 2019, p. 42; World Bank, 2018b, p. 5). An electricity tariff of 16.7c kWh was also given by Keo (2019) at the energy vision event. Differences in tariffs do remain, and are higher for smaller consumers, areas with less electricity coverage as well as for foreign residences. In Phnom Penh, tariffs also differ depending on whether a building is old or new. For older buildings, the tariff is 25c kWh, and for newer buildings, the tariff is 35c kWh (Participant 2, 2017). Tariffs are also reduced when over 50 percent of villages in the licenced area are electrified, presumably reflecting economies of scale. Further reductions in tariffs occur for medium and larger consumers of electricity (Economic Research Institute for ASEAN and East Asia, 2019, pp. 41-42). Off grid power, such as that in the project site, is higher than the tariffs for licensed areas, which is reflective of the cost to provide power to some off grid areas in Cambodia. A study of 3,300 households in rural and urban areas across Cambodia in 2017 found that 97.6 percent of Cambodian households have access to at least one source of electricity. The study also found that 13.2 percent of those off grid are using a solar home system and 11.5 percent are using rechargeable batteries alone (Dave et al., 2018, pp. 9-13). Batteries at the project site were previously recharged using diesel generators and often the batteries would require replacement after 12 months, due to lack of charge controllers (Participant 14, 2018 & 2019), as previously discussed in Chapter 5.

7.2 Levels of energy access and solar home systems in Cambodia

To provide perspective on the levels of energy access in Cambodia, the multi-tier framework measures energy access through seven characteristics that include, capacity, availability, reliability, affordability, health and safety, quality and formality. The tiers range from 0 to 5 with tier 0 reflecting a lack of electricity access, or access is available for fewer than four hours each day (Dave et al., 2018, p. 3). Tier one access reflects at least four hours of electricity is available each day, enough to power lighting, phone charging and a radio or

approximately 3-49 watt. Tier 2 access reflects at least four hours of electricity per day and is enough to power low load appliances such as lighting, television, computers and fans, or approximately 50-199 watts. Tier 3 access is at least eight hours of electricity per day, which is enough to power medium load appliances such as refrigerators, freezers, water pumps and rice cookers or approximately 200-799 watts. Tier 4 access reflects at least 16 hours of electricity per day and is enough to power high load appliances such as washing machines, hair dryers, toasters and microwaves, or approximately 800-1999 watts. Tier 5 access reflects 23 hours of electricity supply and the capacity is enough for high load appliances such as air conditioning and water heaters, or approximately 2000 watts or more (Dave et al., 2018, pp. 3-4).

There are, however, some problems with using the World Bank's multi-tier framework for energy access as a measure of energy services as noted by Groh et al. (2016, p. 28), who state that applying this framework to energy access could provide a lower tier ranking for an energy service that is superior. Participant 14 stated that the project site was experiencing better energy services than the majority of residents in Phnom Penh through the energy outages between March and May 2019 (Participant 14, 2018 & 2019). This would be the case with the daily power outages that occurred through the energy crisis if we are only considering the amount of electricity available during the day. Groh et al. (2016, pp. 28-30) suggest that what actually needs to be measured is not consumption but the energy services provided, such as lighting, communication, thermal comfort and entertainment.

Across rural and urban Cambodia, most households (63 percent) are considered to have tier 3 electricity access according to the multi-tier framework, which includes at least eight hours of electricity access per day. Households that use off grid power are mostly located in tiers 0-2 and these are usually rural households. Reliability and quality of energy are the main issues that prevent households in tier 3 from reaching higher tier access 4 or 5 and rural grid connected households are most affected by reliability (Dave et al., 2018, p. 29). The major barrier for households that are not connected to the grid is distance from the grid. Other significant barriers include, high connection costs, expensive tariffs and complicated administration processes (Dave et al., 2018, p. 58). Households are required to pay the costs of connecting to the electricity grid and prices range from USD 75 to 300 (Participant 8, 2017; Participant 11, 2018; Participant 13, 2018; Participant 14, 2018 & 2019). However,

EDC also provide interest free loans up to a maximum of 480,000 Cambodian Riel (approximately USD 120) through the Rural Electrification Fund to allow poorer households to connect to the grid and this includes wiring, material and labour costs. The loan is paid back through monthly instalments to the electricity provider (Electricite du Cambodge, 2019). This loan, however, may not cover the full connection costs in some areas.

Approximately 80 percent of households who use a solar home system are located in a village with no electricity access and most of these are considered tier 2 for access to electricity (Dave et al., 2018, p. 31). The study found that many households with solar home systems are at tiers 0-2, with around 15 percent of homes having fewer than four hours electricity access per day. The study recommends that systems be improved to move households into a higher tier (Dave et al., 2018, p. 34). The study also found that half of all solar users (51 percent) were satisfied with the system, with only 10 percent of households unsatisfied. Around 40 percent were neutral and the main maintenance issue was related to battery failure (Dave et al., 2018, p. 35). This provides confirmation of the comments made by interview participants about battery failure. Several interview participants also noted there was a lack of trust in solar products due to the failures that regularly occurred, mostly as a result of the purchase of component based systems that did not include charge controllers (Participant 1, 2017; Participant 6, 2017; Participant 8, 2017; Participant 17, 2018). The failures often occurred with smaller 60-70 watt systems, which had a failure rate of approximately 50 percent (Participant 6, 2017). This was most likely due to a combination of low quality PV panels and battery failure; as people added additional appliances and energy use grew beyond the capacity of the system.

Other failures were due to faulty installations and often warranties for solar PV were not honoured (Participant 6, 2017). Lack of project follow up from NGOs have also contributed to low trust in solar products in the past as systems were donated to villages, but no ongoing maintenance or training was carried out (Participant 4, 2017). Participant 18 (2019) administered the Good Solar Initiative in Cambodia, a program that tried to improve the perception of solar energy in the community. The Good Solar Initiative, funded by Participant 19, began in January 2016 and ended in late March 2019 (Participant 18, 2019). The initiative aimed to resolve issues with quality of products and maintenance through offering certified products on the market, microfinancing, training, awareness raising about product quality, as well as maintenance support (Participant 8, 2017; Participant 18, 2019).

The Good Solar Initiative was not a great success in Cambodia for several reasons and Participant 18 (2019) stated that, overall, about 25 percent of the expected results were achieved with many of the objectives of the program being unreachable. One issue was the 72-hour response time for after sales service and the difficulty in being able to travel to remote areas to provide service or maintenance on systems in this limited timeframe. This program strikes me as a particularly Western thought out program that was difficult to apply in the Cambodian context. As observed by Participant 3 (2017), the quality framework for certification of products and installers in Cambodia was a step too high, with many products and installers being unable to meet the requirements, including the administrative aspect of the program. Participant 3 (2017) recommended that 'lighter touch' certification would be more appropriate for Cambodia.

Several interview participants also discussed a common issue that occurred in Cambodia with growing energy consumption that often led to failure of solar home systems. Households that have access to some electricity, for example a small 100 watt system, which is enough to power lights, TV and a fan, will often add additional load to their system. Battery failure will then occur due to deep discharging of the batteries (Participant 6, 2017; Participant 18, 2019). A more concerning practice that occurs in Cambodia is when people use batteries for fishing, to provide an electric shock to fish (Participant 17, 2018). This practice, called electrofishing is illegal, and is a significant threat to fisheries in Cambodia (Campbell et al., 2020; Sok, 2014). Maintenance and capacity of local technicians is also limited in Cambodia (Participant 3, 2017). However, system users are likely to know how to fix simple electrical issues (Participant 7, 2017; Participant 14, 2018 & 2019).

7.3 Matching energy systems with needs

Byrne et al. (2009, pp. 81, 88) discuss what they refer to as a sustainable energy utility using the work of Lovins soft energy path, which matches renewable energy systems and scale to end user needs rather than centralised or 'hard path' systems that do not match needs, but instead favour specific centralised technologies, such as coal or nuclear. The sustainable energy utility aims to overcome what Byrne et al. (2009, pp. 88-89) refer to as 'energy obesity', the excessive consumption of energy and thus creating an entire new energy regime, based on actual use and the idea of a 'commons' to protect the interests of communities, rather than the interests of energy producers. The theory behind a sustainable energy utility is

that it would naturally lead to less focus on the technical and more on the social and indeed a focus on the energy needs of people (Byrne et al., 2009, p. 89). Participant 14 also had a similar view of energy systems when noting how the company did not continue to roll out their technology in Cambodia when they found that the smart grid controllers they initially developed at 250 watts were too limited, based on feedback from the community. Participant 14 states:

> Yeah, because from a typical engineer's perspective – I make products to fit this market, right? But actually, it should always be the other way around. You should understand the market demand – especially in a community that's – more vulnerable communities you're working in. You shouldn't be forcing it on them. (Participant 14, 2018 & 2019)

As will be discussed further in this chapter, Participant 14's organisation have gained a great deal of knowledge about energy in rural communities in Cambodia from this project and other work they are doing in the region. However, it is worth understanding the longer term benefits to communities and overall to Cambodia with this type of energy project. As stated by Participant 14, subsequent to the comment made above that, "the community sort of put up with us testing the appliances" that "they're under an understanding that they've helped us and get benefit from it" (Participant 14, 2018 & 2019). One of the reasons that energy use was growing in this community was due to Participant 14's organisation, selling the community more DC appliances, and the reason for selling the community more appliances, was for the project to be viable. It appeared to be a circular logic, but it is based on a philosophy by the company of *productive use*. Participant 14, when asked if the system met the energy needs of the community, states:

> At the moment, your question is does it meet their needs – it does. And when you sell them more appliances, if they take them [inaudible] some houses may need more power. The limitation is not total capacity of the network, but it's actually the output of the controller. The maximum output is 250 watts. The next edition of the controller [1.2kW] has three load ports, firstly to eliminate blackouts, reduce consumption in times of low solar generation and in the event of payment default, can reduce electricity to essential services rather than cutting them off completely. (Participant 14, 2018 & 2019)

Byrne et al. (2009, p. 88) do not dismiss the challenge in implementing a type of sustainable energy utility, particularly if considering the growth of both energy consumption and CO_2 emissions in parts of Asia today. For example, China emitted the highest level of CO_2 emissions globally from 2017 data, followed by the United States and India (Global Carbon Project, 2018). However, on a per capita basis, based on CO_2 emissions data from 2014, the US ranked 14th in regards to emissions per capita, with China ranking 48th globally and India 140th. Australia also has high per capita CO_2 emissions, ranking 15th in the world with the

highest per capita emissions coming from Qatar (Carbon Dioxide Information Analysis Center, 2017). It should also be noted that emissions data can be subject to uncertainty, both in the way estimations are calculated based on carbon fuels consumed and in the accuracy of reported emissions data by individual states (Marland et al., 2009; Parliament of Australia, 2010). With increasing electrification in Cambodia, we can see that the same system of energy obesity continues and a reliance on centralised energy systems prevails. Cambodia appears to be on the same path; however, Cambodia also faces energy shortages, both on the national and local, village level scale.

Many solar home systems that may have been considered 'soft path' in scale in Cambodia have been overwhelmed by meeting the growing energy needs for residents located off the main grid. Larger, centralised 'hard path' systems that include hydroelectricity and coal are also not meeting energy needs at the present time due to significant growth in electricity demand of some 18 percent annually between 2010 and 2016 (Economic Research Institute for ASEAN and East Asia, 2019), and a need for additional generation capacity in Cambodia, as discussed in the previous chapter. Byrne et al. (2009), also discuss larger scale renewable energy generation as being part of the same centrist solution that feeds energy supply into ever increasing demand. For Cambodia, where some areas of the country are isolated and thus costly for grid extension, increasing electrification is not reaching everyone. On the other hand, small solar home systems have also proved inadequate to meet the energy needs of households, with some people remaining with tier 2 access. A solution to the energy access gap is therefore not obvious; however, the solar micro grid project discussed in this chapter, may provide one innovative way for energy provision. Likewise larger scale hydroelectricity generation in the country is also inadequate in meeting urban needs due to the continual threat of drought in the country as the energy outages showed (Hutt, 2019). Part of the problem appears to be a lack of consideration of actual energy needs in the country in rural and urban areas. Both centralised and smaller scale generation have failed to sufficiently consider the needs of households when installing either soft or hard path systems. This research has noted that energy needs grow when households have access to even a small amount of electricity and this pattern is being observed with both on and off grid electricity. This knowledge can be utilised to supply more appropriate systems to rural and urban households in Cambodia.

7.4 Challenges with energy access in rural Cambodia

Participant 14's organisation, received European Union (EU) development funding to 'test' their technology in Cambodia with the aim of electrifying 750 homes in Cambodia. The focus of power provision for Participant 14's organisation, is in areas that are more difficult for the grid to reach. In the case of the project site, it is located in an area that is cut off from the main town by a large body of water. At the time of writing, 106 homes have been connected using the technology from Participant 14 (2018 & 2019); however, it is likely that more homes have been connected since I visited one of the project sites. Participant 14's organisation also works with a local partner organisation, which is the energy distributor and undertakes billing at the project site (Participant 14, 2018 & 2019). There are distinct challenges to providing solar home systems to the rural households in Cambodia that are discussed by the solar energy industry in Cambodia, Firstly there are the upfront capital costs that for many households in Cambodia are still a significant cost (den Heeten et al., 2017, p. 8), which often require microfinance. Without microfinancing, many households cannot afford a solar home system. In 2017, the Government of Cambodia put a cap on interest rates for microfinance loans at 18 percent per year (Meta et al., 2017), as interest rates for microfinancing in Cambodia were very high at 2-2.5 percent per month (or 30 percent per year). This interest rate cap led to micro financiers targeting larger markets (Kinsay, 2017), rather than the solar home market, which resulted in the solar home system market in Cambodia becoming unviable for organisations as people were not accessing loans to purchase the systems. The most popular solar home system size in Cambodia was 135 watts, which cost approximately USD 800 with an inverter, lead acid battery, full installation and wiring included. Without an inverter or installation included, this reduced the system cost to approximately USD 420. A system this size will usually provide enough power for a TV, DVD player, fans, lighting and charging of mobile phones (Participant 6, 2017).

Bhattacharyya (2018, p. 6) discusses challenges for organisations providing electricity to base of pyramid customers. The term base or bottom of the pyramid was conceived by Prahalad and Hart as a way for companies to be able to profitably serve the poor (Dembek et al., 2019). Understandably the concept received criticism, with its focus on selling to the poor, potentially displacing local businesses and selling things to people who may neither need or afford what was being sold (Dembek et al., 2019, p. 367). In Cambodia at least, this concept was used several times in the interview with Participant 18, who, in the context of discussions about the terms of the funding program, asked "how to develop the base of pyramid market"

and further, “to understand the base of pyramid market” (Participant 18, 2019). The term was not specifically used by Participant 14; however, the philosophy of increasing energy use to make the project viable was apparent as noted and will be discussed further. Challenges for people who are considered at the bottom of the pyramid include, low income residents who are often employed in seasonal activities, which is the case for the rice farmers at the project site, who have two growing seasons per year for rice. However, during the 2019 drought in Cambodia, the Ministry of Environment in Cambodia asked farmers to have only one growing season that year due to the lack of water (Haider, 2019). Other challenges for people considered at the base of the pyramid include a lack of access to credit or funding, which has also occurred in the Good Solar Initiative program in Cambodia when micro-finance institutions rejected loans to approximately 70 percent of customers from one company in the solar home market, due to the limited ability of customers to pay back the loan (Participant 18, 2019). The lack of income for base of pyramid customers, results in electricity demand being low, thus leading to lower returns on the capital investment for businesses or organisations willing to provide electricity to these consumers. These are the challenges that Participant 14 and the local partner have faced in supplying electricity at the project site. Participant 14 is attempting to partially resolve this issue by providing residents with *productive use* appliances, according to the employee of Participant 14 interviewed.

An analysis of the design of solar home systems for future energy needs in Cambodia by den Heeten et al. (2017) looked at 111 solar home system users in Cambodia and found that the mean energy consumption was 310Wh per day, with most energy consumed at night (den Heeten et al., 2017, p. 8). This corresponds to usage patterns in the project site where, at the moment, residents at each household are limited to 250 watts consumption due to the smart grid controller, as discussed earlier in this chapter (Participant 14, 2018 & 2019). As this was a trial site for Participant 14’s organisation, the company has developed new smart grid controllers that will be used at future sites, which are 1.2 kW to allow for increased energy use. From field notes taken at the project site, it was noted that residents are adapting to limitations on power and finding that, at times of high cloud cover, they will conserve energy during the day to allow usage at night. This adapting to cloud cover and conservation of energy to ensure usage at night, is what Geerts et al. (2014, p. 123) terms a flexibility in energy demand that we have lost in many Western societies, including Australia. Geerts et al. (2014) discuss how in Western societies undergoing renewable energy transitions, we are trying to leave consumption largely unchanged, while significantly transforming the

production side of energy. This is problematic as we can currently see in South Australia, with high levels of solar energy during the day, to the point where it is not being used (Davies, 2020). Western societies appear to be finding it difficult to shift energy use to navigate natural limits and changing intermittent renewable energy sources. In contrast, residents at the project site are acutely aware of the limitations of their solar system.

Finally, the other challenge for providing off grid power in Cambodia relates to licensing as an independent power producer in Cambodia. Gaining a license to provide power to communities in Cambodia is difficult to obtain from the EAC unless the person or organisation already has a track record of providing power in the country. The local partner of the project does not operate under a distribution license in Cambodia. They are essentially operating in a 'grey zone' with the knowledge of the EAC and the EDC (Participant 18, 2019). Participant 14's organisation appears not to need a license as they refer to themselves as the technology company only. The local partner, who undertakes the billing for Participant 14's organisation, is also not limited by the tariffs that must be charged in Cambodia, due to not having a license. The tariffs at the project site, therefore, reflect the cost of generation in off-grid areas and is thus higher than on-grid electricity costs. Participant 14, expressed caution about stating the tariffs at the site, therefore I have not included the actual tariff charged here for that reason. It is noted however, that in recent developments in Cambodia (November 2020), Participant 14's organisation was working with the Ministry of Mines and Energy (MME), and it appears that a grid tariff is being offered for rural areas that will be receiving the technology in the future. This is likely to be a subsidy from the Cambodian government and not a reduction in the cost of electricity provision with the use of the technology from Participant 14. I am not yet aware of the tariffs reducing for this particular project site, however, electricity tariffs in Cambodia are higher than for neighbouring countries and rural areas have higher tariffs than urban areas due to the higher cost of generation, imported diesel fuel and local distribution network losses (Economic Research Institute for ASEAN and East Asia, 2019). The issue of billing is also a limitation when providing energy services in rural areas of Cambodia. There is no residential postal service within Cambodia, so mailing of bills to electricity users does not occur. The company providing the energy service has to employ people to go to villages to collect the bills, which is time consuming and can be dangerous, as there have been accounts of bill collectors being robbed (Participant 10, 2018).

7.5 Solar micro grid project site

The project site is located in a rural area, approximately 90 kilometres south of Phnom Penh, with the nearest town to the site electrified. The project site itself, however, is quite isolated and is cut off by a large body of water and rice paddies that require a boat to cross. In the wet season the site is even more isolated; however, boats regularly move back and forth to the area that links with the road (Figure 6). The licensed distributor that provides power in the region has not been prepared to provide power to the small village, due to the connection and supply costs for an area with limited consumption. Bhattacharyya (2018, p. 2) also notes that where grid extension would have been the dominant solution in the past, it is not cost effective for utilities to extend grid services to low demand areas. Thus, options for power generation for the project site are limited, which is why Participant 14's organisation became involved as a potential solution to this and other underserviced areas in Cambodia. In the village itself, there are approximately 40 homes connected to the micro grid system. The project started as a demonstration site with five homes connected. Participant 14's organisation also has two other project sites with households connected to a solar PV micro grid (Participant 14, 2018 & 2019).

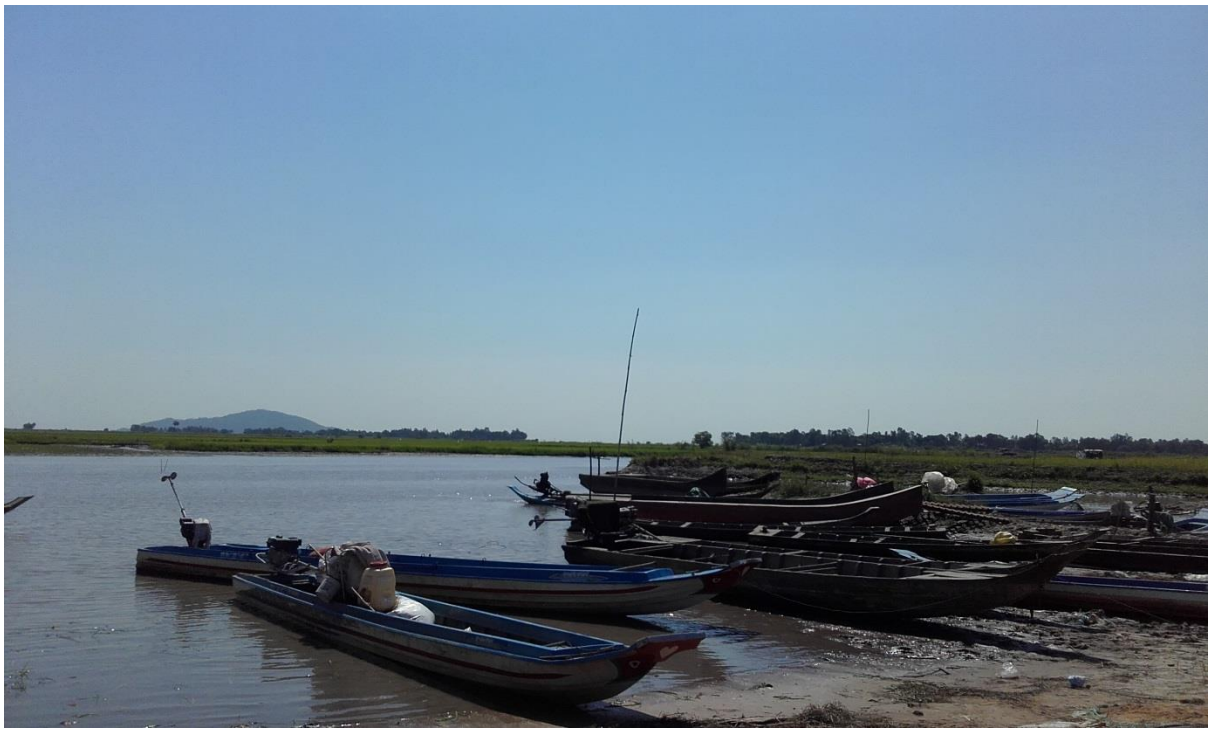

Figure 6. Access to project site via water body (March 2019)

This section will briefly describe the micro-grid system and will not detail all the engineering aspects of the micro-grid system designed by Participant 14's organisation, as this chapter is relying on information provided through interviews and discussions with Participant 14, Participant 18 and two residents at the project site. Participant 18, as noted, manages the project funding for the solar micro grid project. The funding, provided by an EU development agency, is for business ideas, models and products that address poverty, for which Participant 14's organisation received funding. Thus, there are limitations with this example due to the partial information provided from Participant 14 and what can be discussed due to commercial interests and anonymity for residents at the project site. It is noted, however, that Participant 14's organisation had an 'unofficial' or a verbal agreement from the EAC to operate in the country at the time of the site visit in 2019. Part of the reason for EAC cooperation is due to the increasing discourse and targets for electrification of all villages in Cambodia by 2020 supplied by the grid and 'other sources' (Royal Government of Cambodia, 2014) as well as the target to provide 70 percent of households with access to 'grid quality' electricity by 2030 (Electricite du Cambodge, 2015).

There is therefore recognition from the Government of Cambodia that some areas, in villages like the project site, are difficult to electrify due to the cost of extending the grid and low electricity consumption, which make the site unprofitable for the state owned utility, EDC and for many REEs. Knuckles (2016) confirms this is the case, stating that for most countries grid extension in off grid areas remains unviable for governments and utilities without funding from international donors or lenders. Over the longer term, if tariffs are uniform, it is also difficult for utilities to recoup the investment costs (Knuckles, 2016, p. 67). This is certainly the case with Cambodia, and what this research has shown is that, although grid extension is occurring in Cambodia, there are many rural areas, such as the project site, that remain disconnected from the electricity network due to their location and costs to extend the electricity network to these areas. The Government of Cambodia is also receiving donor funds and loans from the EU through Agence France de Development (AFD) of Euro 29 million for a grid modernization project working with EDC (Electricite du Cambodge, 2018). Approximately Euro 30 million in financing is also being provided from the German development bank KfW for transmission infrastructure, transformer stations and the connection of villages to the network (KfW, 2017). Other international donors and funders in the electrical network include the Asian Development Bank, Japan International Cooperation Agency (JICA) and the Exim Bank of China (Participant 19, 2019).

Within the National Strategic Development Plan for Cambodia, the government encourages private sector investment in the electricity sector, including generation, transmission and distribution assets (Royal Government of Cambodia, 2014). However, the government is also concerned about the cost of electricity and there are statements from institutions and actors in Cambodia committed to lowering electricity prices, for both industrial and domestic use (Keo, 2019; Royal Government of Cambodia, 2014, p. 47). In addition, statements considering the "inadequate" supply of electricity see this as an obstacle to Cambodia's industrial development (Royal Government of Cambodia, 2015b). This has led to the Government of Cambodia implementing lower uniform tariffs across Cambodia, to the point where some REEs find themselves unable to break even, due to the high costs of supplying power in some rural areas (Participant 10, 2018). In some respects, to expect the private sector to invest in supplying power to areas of Cambodia that are unprofitable with no incentives is unrealistic; however, there is a reliance on the private sector, in particular for rural areas.

Mini or micro-grid systems vary in their technology, but usually consist of generation (in this case solar PV), a distribution network, storage and items such as inverters and controllers (Bhattacharyya, 2018, p. 4). The micro-grid system at the project site produces DC electricity for consumption direct from the solar PV panels, thus there is no requirement for an inverter to change the output to AC. Participant 14's organisation is able to provide power to the village as DC, as the area is completely off the main electrical grid. All appliances used in the village are DC appliances, which are readily available in the Cambodian market; however, Participant 14's organisation has provided certain DC appliances such as fridge/freezers, DC phone chargers and most recently four cricket incubators rated at 80 watts each (Participant 14, 2018 & 2019). The reason Participant 14's organisation chose to provide power as DC was to lower the capital costs of the system and to remove inefficiencies in the conversion of DC to AC. The micro-grid system is wholly DC with boosted voltage lines. The solar PV capacity at the project site is approximately 5kW and the aim of Participant 14's organisation is to provide power to residents for 24 hours a day. Each house also has a 12 volt, DC maximum output 250 watt smart grid controller, lead acid batteries and DC appliances. The smart grid controllers provided are manufactured in China from the technology developed by Participant 14's organisation. As noted, inverters are not required due to the DC output of the system.

Hossain et al. (2014, p. 134) have divided micro grids into three categories that include, facility micro grids (for example power for an industrial site), remote grids (independent systems for remote power supply) and utility micro grids (used to support power quality and reliability on the grid). Under the categories identified by Hossain et al. (2014), the project site is a remote micro grid, which has, as a feature, limited power use for customers (Hossain et al., 2014, p. 134). Participant 14, felt that in terms of tier access as classified under the World Bank's multi-tier framework, their system is more likely to fall within tier 4 access, which is at least 16 hours of electricity access per day for each household. However, this is based on their claim of 24 hours of electricity access and not the ability of the system to provide between 800 to 2000 watts of electricity to each household per day. The micro grid system that is currently installed would be unable to meet the criteria of tier 4 under the multi-tier framework. However, as noted by the Participant 14, the system is scalable, so it is not out of the question. Participant 14 also noted that the multi-tier framework does not consider new technology and this is also noted by Groh et al. (2016, p. 22 & 30) in their critique of the framework, stating that it does not consider innovative decentralised energy solutions or indeed DC efficient appliances.

There are a few houses at the project site that do not have solar PV panels and only use the energy stored in the battery. The system is considered a "distributed micro-grid", as power can be shared from house to house, depending on needs within the system. For example, if house A is generating more power from the solar PV and house B is close in distance and requires additional power to charge the battery, the algorithms in the system will send power directly to the battery at house B. This results in a much more efficient system as power is not 'wasted' across the entire system, but instead is shared when and where it is required. The algorithms on the micro grid system are designed to send energy to the closest battery where additional recharge is needed. As with any distribution of energy, the further energy travels, the more energy is lost. The entire system is also remotely monitored, so the engineering team with Participant 14's organisation has full visibility of when there are problems in the system and an alert system is in place. This means that Participant 14's organisation can often resolve technical issues from a distance, provide advice to residents or have someone visit the site to resolve technical issues if required. In this way, the issues with operation and maintenance that often plague solar home systems and remote area power supplies elsewhere are much easier to deal with. The software used by Participant 14's organisation also offers

predictive maintenance, which reduces overall operational expenses (Participant 14, 2018 & 2019).

Several households in the village pay approximately USD 5 per month for their electricity supply; however, there are also fixed packages available of USD 15 and 20 per month (Participant 18, 2019). The more residents pay, the more appliances they can power. Residents can consume over the fixed amount: they are just required to pay more and receive a notification that they are going over their fixed consumption. Consumption in the village is low and Participant 14 has a goal to build the load in the community through the provision of productive appliances, which can vary, but, as stated, residents were recently provided with cricket incubators to earn additional income. Current power consumption in the village is for the use of lighting, fans, TVs, phone charging and refrigerators/freezers. Bhattacharyya (2018, pp. 2-3) discusses the use of mini-grids around the world and the hindrance of "progress" with this technology due to the limited integration of productive use of electricity with mini grid technology. The term productive use, of which Participant 14 also spoke, refers to utilising energy for productive activities: in other words, creating value, often through increasing the ability to earn income (Terrapon-Pfaff et al., 2018). Participant 14 discussed productive load through the recorded interviews in the context of the new smart grid controller the company were developing, which has three load ports, one at 35 watts for essential services such as lighting, called the "essential" port. The "household" port at 350 watts for household appliances and the "productive" port at 1.2kW. The power at the site can then be switched off remotely, with Participant 14 stating:

> So then basically what happens is these three load ports can be individually remotely connected or disconnected. For example if in rainy season there is no sun for 10 days – they can remotely cut off productive load, but essential services remain. (Participant 14, 2018 & 2019)

Another interviewee, Participant 12 (2018), also discussed productive use, noting the circular logic of increasing consumption to consume more. He states:

> What the off grid solar community is concerned about is that, we're selling products to people which improve livelihood, improve quality of life for them, it's not necessarily productive – okay, some are plugging their fridge into our system. Productive use. Sometimes powering their business a few more hours in the evening. Productive use. These cases are not the majority. So how do you – you succeed in business by selling to people again and again. And you can only do that if you're helping them make more money. Otherwise, you have to wait a very long time before you can sell to them again. And so, the industry is very much interested in productive use applications. So, can we make water pumps work? Can we get refrigerators down in cost? What else can we do, that can make enable people to earn more money because – they can buy more stuff. (Participant 12, 2018)

It is acknowledged here that many communities in rural Cambodia consume such low levels of electricity, as discussed in Chapter 5, that there is a need for people to have access to additional energy to meet their needs. However, the logic of transnational energy actors and development agencies in promoting productive use is questionable, particularly as this appears to be a logic transplanted to communities in Cambodia. There is a seemingly benign wish to improve people's lives, but there is limited evidence that productive use does in fact improve people's lives, as noted by Terrapon-Pfaff et al. (2018) in an impact evaluation of 30 small scale renewable energy projects. Terrapon-Pfaff et al. (2018, p. 208) make several recommendations for small scale renewable energy projects, one of which is to find out who will and who will not benefit from productive use in energy services, so projects do not inadvertently increase inequality. This point is also made by Ahlborg (2017) who found in a case study of a mini hydro electrification project in in the Ludewa district of Tanzania, that class and gender inequality was reproduced through the project.

Participant 14's organisation, has partnered with a local organisation for the installation of the system and the local partner acts as the distributor, while also collecting bills in the community. Participant 14's organisation, as the technology developer, retains the technology brand. Bills collected by the local partner are supposed to be collected on a monthly basis; however, sometimes this is left for two months. According to Participant 14, it can be problematic for residents to pay two months electricity consumption if the local partner has not billed residents in the previous month. In research on business models for mini-grid projects at the base of pyramid markets, Knuckles (2016) notes that one way mini grid developers can reduce costs and increase viability is to work through an intermediary who manages and maintains the grid, thereby providing more flexibility for the developer to expand operations into other areas (Bhattacharyya, 2018, p. 6; Knuckles, 2016, pp. 77-78). This appears to be the strategy for Participant 14's organisation, which is expanding its micro-grid operations both within Cambodia and in other South East Asian nations.

While at the project site, I had discussions with one resident, through a Cambodian employee of Participant 14's organisation, who translated the conversation. When I asked if the resident were satisfied with the micro grid system and had enough power, the response was that it was "enough for now"; however, they noted that sometimes the power was off (particularly in the wet season with excessive cloud cover). The resident confirmed that, 90 percent of the time,

the system is ok and meets his needs. When asked what they would like more power for, the resident was unsure and repeated that he was happy with the power provided – but he may like more in the future. However, cost was also an issue and he was aware that increased electricity use would result in higher electricity bills. In the wet season, the resident conserved power in the system during the day (when it is not generating much due to cloud cover), so he has power at night. I asked if the system worked ok in the evening when he did this and he said yes, he has enough energy for TVs, fans and lights in the evening. Nye (2010, p. 14) looked at the history of blackouts in the United States and how prior to electrification, societies would undertake certain activities in the day time and the night time was relegated to the dark. Although the project site is not dark in the evenings, there appear to be some limitations in the micro grid system to providing 24 hours of power, as stated by Participant 14, particularly in the wet season. Residents are, adapting their power needs to certain periods of time. In this case, the resident chose to have power at night for lighting, TVs and a fan, so he would conserve the limited power he has during the day in the wet season.

One of the main issues of concern for the resident I conversed with at the project site was the billing process in place. This was also noted by Participant 14 who stated:

> The only thing we get an issue on is the bill delivery. They won't be able to see how much they're using. Sometimes they can get two months bill in one go – and that's a big hit for a household. (Participant 14, 2018 & 2019)

There was no household metering at the project site, so the residents' could not see or know how much energy they were using. Participant 14's organisation had an online system that residents can check, but the resident stated this was too complicated for him and he did not understand the online format. The local partner, which undertakes the billing, did not provide any visibility of power used in kWh on the resident's bill. The resident said that sometimes he and his neighbour would be using the same amount of power with lighting and fans, however, his neighbours' bill may be more expensive than his. Other residents in the village are going to the resident I spoke with and questioning him why they are paying more, however, he does not have the answer because he has no visibility on the power he has actually used and this lack of visibility was creating a lack of trust. Participant 14 stated that the first five houses in the village were provided with cheaper power because they were demonstration users – so this is likely to be the reason why his power is cheaper, as he was one of the first residents. Participant 18 also expressed concern about this aspect of the

project and the lack of transparency for residents that could ultimately lead to a lack of trust in both Participant 14's organisation and the local partner.

Lack of trust has been known to create problems in decentralised renewable energy projects, as highlighted in the study previously mentioned by Ahlborg (2017). Based on research from an electrification project in Tanzania, Ahlborg (2017, pp. 134-135) found that trust for the organisation that was involved from the start of the project, who also happened to be the donor, was ok. However, there was a level of distrust with the local utility due to perceptions of corruption. The way the local utility dealt with non-payment of bills also led to accusations of corruption, as some people were cut off from their electricity supply. This was seen by people in the village as fair if the person cut off could afford to pay, but was considered unfair when people who could not afford to pay were cut off. The local utility, however, stated their case as applying the rules equally, regardless of particular roles in society (Ahlborg, 2017, p. 136). Ultimately, Ahlborg found that the provision of power also had unintended consequences and reproduced social hierarchies for those who could afford to pay and those who could not. For the project site in Cambodia, no power had been cut off for non-payment by residents and it appears that with the new smart grid controllers developed by Participant 14's organisation, people will be able to maintain essential lighting and a small amount of power in the case of defaults on payments.

To address the issue of visibility of billing, while we were in the village, an employee of Participant 14's organisation showed some residents a Facebook group where the local partner had posted bills for each house, showing the power used in each bill. When I asked the resident if he used Facebook, he said no, however his children did. Participant 14 stated that residents are engaging with the Facebook group and are also providing real time feedback on any issues that are occurring with the system. Participant 14 stated they are responsive to faults, as they have constant visibility of the system output and the engineers can often pinpoint what the fault may be. I was informed that the system has a 99 percent network up time and most faults can be fixed remotely, or residents may be advised how to fix issues as they arise. When there are problems with the system, for simple electrical issues, several residents know how to provide fixes, but sometimes the problem are not obvious. When asked about the issue of visibility of power, Participant 14 noted that the new 1.2kW smart grid controllers have a metering interface, so residents will be able to see the power being used in the future. At the time of visiting the project site, these new, larger smart grid

controllers were not available for the project site. However, some of the existing controllers have started to have faults and may be replaced by the newer 1.2kW controllers. It is not clear if all of the 250 watt controllers in this particular project site would be replaced. When asked, this was an issue still being considered by Participant 14.

Water in the village is provided from the river and stored in large ceramic pots. The water from the river is collected for washing and showering; however, the resident I spoke with would like an electric pump for running water. I was informed that the micro grid system does not have enough power to pump water. A solar water pump would probably be the optimal solution in this village, however affordability is also an issue. Participant 14 discussed undertaking a water purification project to purify the water in the river for drinking in this village (however the residents were not informed of this yet). Residents are currently drinking bottled water. I asked the resident if he would drink the water and he stated no. I asked the Cambodian employee why that is and he stated that the resident does not trust the water. Participant 14 then stated that they were still considering the water purifying project, and noted that for residents to drink the water would just require 'education', however, this remains to be seen. The water purifying systems are a low consumption item of approximately 50 watts, but would contribute to increasing the load. In regards to income, the resident is a rice farmer for three months of the year. He sells the wet rice to wholesalers and keeps the seeds. He has three types of rice. This income, however, is not enough for the year and for another three months of the year (from October to December) he earns income from fishing. The Ministry of Fishing does not allow fishing in the breeding season (the wet season from May to October).

Two other issues were noted when walking through the village. One resident mentioned that her house lights were flickering. I asked if this was perhaps just the light globe, but Participant 14 stated that it was more likely to be the installation that was completed by the local partner. Participant 14 showed me the installation inside the house and expressed concerns about safety, with the loose cables to the light globes throughout the house. Another issue that was raised by another female resident was that she mentioned two Cambodian men came to the village and asked about her solar PV system saying they wanted to do an inspection. She did not know who they were and they did not state where they were from. Participant 14 was unaware of this visit and stated that they should be informed of who is going out, so residents can be informed officially. While we were there, Participant 14 made

some calls and found it was people working with Participant 18, who were doing inspections of the installation, relating to the Good Solar Initiative. Although there appeared to be tensions in the above situation between with Participant 14, the local partner who did the installation, and Participant 18 who did not advise residents about the inspection, it was positive to see that the issue around the inspection was followed up whilst I was there. There was genuine concern from Participant 14 about who the visitors were. It also highlights issues for the project with perceptions of safety from the resident who was a woman and concerned about men she did not know coming to the village. This was a very valid concern and it was good to see that Participant 14 took this concern seriously. In this case, it would appear that Participant 18 needed to communicate more with Participant 14 to advise the resident, however, it would also be helpful to know how residents feel about unknown visitors to their village.

7.6 Discussion

Questioning what energy is for, as Shove and Walker (2014) do, is essential for Cambodia, in particular in rural areas, such as that discussed in this chapter. Participant 14's organisation is focused on providing electricity for productive use and the same philosophy of base of pyramid, or creating a market for more consumption. Often solar home systems that are provided in Cambodia are undersized and do not entirely meet the growing energy needs of people, as their energy use increases as soon as people have access to some power. Even at the project site, the resident I spoke with was conserving power to ensure he had power at night. However, Participant 14 was focused on providing additional appliances to increase the load in order for the project to be profitable. Viewing it from this perspective and circularity, it can be seen to be a strange logic. A survey of energy use was carried out by Participant 14's organisation prior to the design of the micro grid system; however, the organisation looked mostly at the cost of electricity, how often people were charging batteries, how much it cost to recharge – including the travel to take the battery for recharging. This information was then calculated to present to residents on how much they "really do spend on electricity", with Participant 14 noting, "they think they're spending, $6 a month, realistically they're spending $12 a month" (Participant 14, 2018 & 2019).

Some of the energy practices of residents at the project site have been discussed in this chapter; however, there are limitations with this, as I was unable to effectively gauge what

the future energy needs at the site would be. My question around what the resident would like additional power for in the future was met with uncertainty, however, the resident did note that an electric pump would be something he would want. This was considered to be unfeasible by Participant 14, stating simply that the system did not have enough power for an electric pump. It was clear, however, that whilst at least one resident in the village wanted an electric pump, the focus of Participant 14 was on appliances. Solar pumping systems also exist on the market in Cambodia, thus it does not have to be connected to the micro grid system to meet the needs of this particular resident. In terms of cooking, it is unclear if the residents in the village continue to use wood fuel; however, it is likely they would use this in addition to the use of electricity for the DC rice cookers. Despite the increased electrification of Cambodia and the prevalent use of gas for cooking, wood fuel makes up approximately 60 percent of primary energy within Cambodia (Participant 20, 2019). It was noted by Participant 20 that even when people in Cambodia have access to other fuels for cooking, such as gas or electricity, they will continue to use wood fuel in some instances. Nye (2010) also notes that traditional sources of fuel, such as wood, kerosene, candles and lamps were not immediately displaced with the advent of electrical power in the United States in the late 19th century as "electricity was not deeply embedded in everyday life" (Nye, 2010, p. 15). This point on renewable energy fuels not replacing coal and other fossil fuels in a hurry is also made by York and Bell (2019), as discussed in the literature review.

In terms of understanding how this niche level solar project is influencing energy policy and provision in Cambodia, the EAC have informally offered Participant 14's organisation a list of additional sites that they could potentially operate in, to provide power to areas that are not being serviced by the national grid. However, this is still in progress and it is not clear if the Government of Cambodia sees a long term future for micro grid systems of this type, or if they are seen as a short term solution to provide power to people in areas that are difficult to service due to their location. Participant 14 stated that, in terms of policy change, this is not their goal; however, they do work with intergovernmental organisations such as the UNDP in Cambodia who advocate for policy change. Due to the higher tariffs for consumers of this type of electricity in comparison with the uniform tariff that exists for REEs, the Government of Cambodia may face some criticism from rural areas that are unable to access the grid, with the continued discourse of lower electricity prices. The data that Participant 14's organisation has collected from the project site could provide information about energy use in rural areas

to begin to answer the question of, what is energy for? This information is likely to be invaluable in actually documenting energy use in rural areas of Cambodia.

As discussed by Shove and Walker (2014, pp. 53-55), there is a need to engage more on the practices of energy use and potential changes to these practices over time, instead of building the infrastructure based on the reproduction of all industrial societies. Due to a need to remain somewhat commercially viable, Participant 14 was focused on increasing consumption in the village with the use of 'productive' appliances. However, the organisation also prioritised the purchase of energy efficient appliances due to the limitations in the current capacity of the micro grid system. Energy use at the project site at the time of visiting in March 2019 is for lighting, fans, fridge/freezers, TVs, phone charging, incubation of crickets and cooking (rice cooker). The village also had rice milling machines that were not run on the micro grid system, but on diesel fuel when milling was required. The micro grid system developed by Participant 14's organisation was designed with several factors in mind: one being to reduce capital costs (hence the supply of DC electricity) and to reduce electricity losses in the distribution of energy between houses, as DC systems have higher efficiencies than AC micro grids because they have no inverter or transformer losses (Hossain et al., 2014, p. 135).

From a technical perspective, the micro grid system with its use of DC electricity is the antithesis of the homogeneity of centralised AC electrical systems and the bureaucracy and standardisation associated with these systems (Nye, 2010, p. 16). In that sense, it would appear that there is more scope to consider the actual energy needs of residents, over technical requirements. However there are limitations also with being outside of the regulations and policy that go with centralised AC systems, as discussed by Bhattacharyya (2018, p. 14) and Urmee et al. (2009, p. 355). These limitations were also seen at the project site and included tensions with the local partners around installation and billing, some dependency on donor funds for project viability, uncertainty with operations due to a lack of 'legitimacy' under EAC regulations, and a lack of transparency and project evaluation. There also appeared to be some holding back of information from Participant 14 and concern about a negative image. Ideally, the Government of Cambodia would work together with Participant 14's organisation, the local partner and Participant 18 to undertake project evaluation with the goal of finding appropriate and affordable solutions to the limited electricity access in rural areas, particularly with a view to understanding the perception and views of the communities themselves. The voices of the community need to be heard more in

this project, particularly at the project site visited, which is considered a ‘test’ site, but also from other villages in Cambodia where Participant 14’s organisation is expanding the technology. It should be noted here also that since writing this chapter, I am aware that Participant 14’s organisation is more engaged with EAC. This type of project has the potential to assist the Government of Cambodia in meeting their electrification targets and positively influencing policy in the country. Participant 14 also has the opportunity to provide much needed information to the Government of Cambodia on growing energy needs, within the local context.

Chapter 8: Transnational energy discourse in Cambodia

8.1 Discourse by energy actors in Cambodia

The following chapter will focus on energy discourse by transnational energy actors interviewed in Cambodia and discourses from an energy industry event in Phnom Penh, where the Managing Director of Electricite du Cambodge (EDC), Keo Rattanak spoke of a vision of energy for the country. The timeframe for this research captures a period of rapid development and increasing electrification for the country. As recently as 2015, Cambodia was widely reported as having some of the lowest electrification rates in Southeast Asia, with official statistics reporting that 68 percent of the population had access to electricity in 2015 (World Bank, 2020). Cambodia is now considered one of the fastest electrifying countries in the region and recent official statistics note that 93 percent of the population has access to electricity (World Bank, 2020). The speed of electrification was confirmed by several participants through this research, with one participant noting it was difficult to find areas in Cambodia that did not have what is termed, 'last mile distribution' (Participant 17, 2018). Last mile distribution covers the electricity lines that extend to households and, in Cambodia, it is the Rural Electrification Enterprises (REEs) who have responsibility for investing in this last mile distribution to households (Participant 11, 2018).

The official electrification rate does not tell the entire story, as some villages that are considered electrified do not extend electricity to individual households, largely due to grid connection costs (Participant 8, 2017; Participant 13, 2018; Participant 17, 2018). In the case of villages that have been electrified, particular households may not be able to afford to pay the connection fee, which ranges from USD 75 to 300 (Participant 8, 2017; Participant 11, 2018; Participant 13, 2018; Participant 14, 2018 & 2019). However, there was also one report of connection costs as high as USD 500 (Participant 12, 2018), and as low as USD 30 to 50 by the government, although it was noted by Participant 17 (2018), that this low cost often excluded wiring.

The state owned utility, EDC provides interest free loans to connect to the electricity grid through the Rural Electrification Fund (REF) and a program called Power to the Poor. The loan amount is to provide funds for households to connect to the grid, where the grid is located. The loan, is paid to the REE, which is then responsible for collecting the repayments from the household (Electricite du Cambodge, 2015). The loan amount cannot exceed

480,000 Riels (approximately USD 120), which in some cases may not cover the cost of connection. It has also been noted that it can be difficult for REEs to access loans from EDC (Participant 11, 2018). Some households in Cambodia are also at a disadvantage due to being further away from the grid infrastructure and these areas may require a transformer or last mile distribution line, which adds additional costs. Because of the limited return on investment, REEs have not yet extended to these areas (Participant 10, 2018; Participant 13, 2018).

This chapter includes an analysis of text from the energy vision event held in Phnom Penh, which I attended in July 2019, where Keo spoke of priorities for energy in Cambodia. The text from the energy vision event was transcribed in note form and verbatim in some sections. As discussed in Chapter 3, I was unable to source interviews with government representatives or EDC through my research, thus the inclusion of EDC's Managing Director's speech at the energy vision event overcomes those challenges to some extent. At the end of this event, I raised a question to Keo, asking how electricity could be provided to rural areas where there is low demand and a lack of incentives for REEs to electrify areas that are difficult to reach. Keo suggested I set up a meeting with EDC or the REF to discuss rural electrification further, which I tried to do through the Australian Embassy, as they offered assistance with this after the event. Despite several emails via Australian Embassy staff to a representative from the REF, this meeting did not eventuate and I was due to leave the country in the month after the energy vision event. As I was unable to source an interview with EDC or the REF, which administers the Power to the Poor program, it is unclear what the uptake of this program is.

The starting point of this research was to understand how discourses articulated by actors in the renewable energy industry and international development agencies in Cambodia influence energy development in the country. A secondary question asked how the energy needs of people are considered (or not) in energy planning for the country. I also set out to understand what viable options for decentralised and diverse renewable energy could contribute to affordable and sustainable energy supply in Cambodia. As discussed in the introduction, my initial premise was that decentralised options for community energy supply would be beneficial in the absence of having no access to grid electricity. Findings from this research in this period of time in which Cambodia is rapidly electrifying are that solar home systems – which often range in size from 80 to 250 watts – do not always sufficiently meet the energy needs of people and they sometimes come at significant expense. One interview participant,

however, noted the larger off grid system sizes of 1-5kW they provided (Participant 4, 2017) are likely to have more benefits in terms of meeting people's energy needs. However, in the case of the solar micro grid, developed by Participant 14's organisation, a transnational energy actor in Cambodia (Chapter 7), people's energy use was considered a great deal more in this project than from simple solar home systems.

There are several reasons for many of the smaller solar home systems not meeting people's energy needs. One aspect was the growing energy needs of people. It was stated by several participants that energy use grew in rural areas once people had access to some electricity. People usually increased the number of appliances to their small solar home systems, and often these additional appliances were more than the system had the capacity to power. Secondly, the quality of products coming into the market in Cambodia, was not always high quality and they were also expensive. In general, there was a lack of trust in solar products due to issues of quality. The Good Solar Initiative, as discussed in Chapter 7, attempted to resolve the poor reputation of solar, with limited success. The lack of charge controllers with the lead acid batteries used with solar panels, and the increased appliances (load) often caused a reduced lifespan of the batteries to approximately two years. Lastly, maintenance issues were raised by several participants, even though people could generally fix simple electrical issues, and they often installed the solar home systems themselves. However, there were some issues that were not obvious to fix.

An important point to add here is that the interview participants who provided this information about solar home systems were mostly transnational organisations operating in Cambodia. As will be discussed further in this chapter, although connection costs to the grid were generally high for people, the cost of small solar home systems were often higher than grid connection ranging from USD 500-700. Some cynicism was also expressed about the expatriate solar sector in Cambodia with one expatriate participant noting that:

> If you're cynical about solar home systems, it's a bunch of expats, westerners come to Cambodia, manage to convince the government and NGOs that this is a good idea. They've gotten poor villagers to buy very expensive solar systems that are really you know, well technology is developing very, very rapidly. (Participant 13, 2018)

In addition, several participants interviewed noted that the solar home systems market was no longer viable; however, one participant felt that solar home systems "have a bright future in Cambodia", where technology will improve and systems will be cheap enough "even for the

poorest Cambodian" (Participant 17, 2018). Another participant noted that he thought that the solar homes system market was "on its last legs" until hearing that EDC had contracted a local, Cambodian owned solar company to provide 14,000 solar home systems per year. The systems are subsidized by EDC and they will also replace the battery for USD 25. The system size is an 80 watt panel and 70 Ampere hour (Ah) battery (Participant 14, 2018 & 2019). I was unable to source an interview with the local Cambodian-owned solar company; however, it appears that an 80 watt system may experience similar issues, with people adding more appliances and not having enough power to meet their growing energy needs. The experience of transnational renewable energy actors in Cambodia most likely speaks to a lack of consideration of the energy needs of Cambodians and the local context in which people live their lives. This is not to say that all transnational renewable energy actors in Cambodia operate in this way, as some have taken the time to understand the local context, such as Participant 14 in the case of the solar micro grid. However, the experience of most companies interviewed who provide solar home systems was that the market is no longer viable.

Among several interview participants there was a distinct lack of discussion about the cost of electricity for people, even though the cost of electricity and keeping electricity tariffs low is a significant priority for the government and EDC. One transnational company sold, delivered and installed solar home systems and offered what they called 'post pay' systems, where people pay for the electricity monthly, after usage. The organisation had people sign contracts for two to three years and payments on these systems were USD 25 to 30 per month, which is very high for people in Cambodia.[2] Debt started accumulating on these systems for this company as people were not always paying. There were various reasons for non-payment, including that people would change phone numbers regularly to take advantage of various phone deals and payments were made through ID numbers, presumably connected to the phone number. If people did not pay the monthly payment, their systems would be cut off. Some people would pay the incorrect ID number and have their systems disconnected, even if they did actually pay the money. Repayment rates for this particular company reduced significantly and the company are no longer providing these systems, but they are still chasing debts (Participant 12, 2018). The employee interviewed from the same company

[2] Available statistics on the average monthly income in Cambodia in 2017 were 194,700 Riels (USD 47.5), however, in rural areas it was 174,900 Riels (USD 43). In Phnom Penh for 2017, monthly income was 2833 Riels (USD 70). It is noted however that these statistics are not sufficiently accurate, particularly if people are employed in small businesses or in agriculture. Incomes also fluctuate throughout the year (National Institute of Statistics, 2017, pp. 75-77).

observed that, “Here, people like to own things.” However, the company initially tried a rental model. The employee then noted:

> People would take it, ‘cause there's no risk. But after [inaudible] a little while, people would say can we buy now? Because it's in our house. We want you to get out. And also there is an aspiration [inaudible]. It's the same as like you know people who buy cars on hire purchase. It's not really theirs [inaudible] that's the same. What solar companies like us want to do, is see energy as a service. Because it doesn't make sense that a poor person should have to buy their own system, whereas we just turn on the tap and it’s there. The challenge is whether we could get a model which works. (Participant 12, 2018)

The above quotation needs to be taken in the context of the preceding discussion (Participant 12, 2018), which related to a mini grid project that had failed previously in Cambodia due to non-payment for the electricity (Participant 10, 2018). However, it is interesting to note the assumptions go from “people want to own things”, with people asking to buy the solar systems, to then stating that solar companies “like us” want to see “energy as a service” and challenges for the company in finding a model that works. Instead of perhaps considering the provision of systems that people can buy and own as they have expressed an aspiration for. It also speaks to what Von Schnitzler (2013, p. 671) describes as the precariousness of “living prepaid” and perhaps the desire for people in Cambodia to move beyond this precariousness of existence and actually “own things”, as described. Particularly as people’s electricity was cut off when they did not pay the monthly fee of USD 25 to 30 per month, which is high for many people in Cambodia. The employee noted that “we just turn on the tap and it’s there”, however, they can also turn off the tap and people are left without electricity. It is no surprise that this particular company were still chasing debts. These issues occurring in Cambodia also speak to the reliance on the private sector for energy provision. It is problematic when expatriate and transnational companies are coming into the country with their own goals to see “energy as a service”, without considering the aspiration for people wanting their own autonomy and to be free of a precarious existence and being beholden to private companies for energy services.

Given that several interview participants noted that people in Cambodia often put together their solar systems themselves, there may be questions to be raised about whether there is actually a need for transnational energy actors offering solar home systems in Cambodia. One interview participant, when discussing how people meet their own energy needs in villages by using car batteries, solar panels and generators, asked, “why is everyone making such a fuss about supplying them with electricity?” (Participant 7, 2017). It is certainly a relevant

question to ask, particularly with the mistakes that appeared to have been made by some transnational companies providing solar home systems in Cambodia at high cost. Some interview participants commented on this issue, with the most common point being made that people want some form of electrification (Participant 10, 2018; Participant 13, 2018). Participant 10 (2018), a Cambodian energy actor, was quite resolute in stating that people wanted grid electricity, noting that "even though there are four blackouts a day, it's high quality." This point was clarified further by Participant 10 (2018) that the "high quality" was due to the amount of power available: an estimated, "2300 watts", enough to power several appliances at the same time, such as a fan, TV and lamp (Participant 10, 2018). Grid electricity is a significant increase on the limited amount of power available from many solar home systems operating in Cambodia at around 80 to 250 watts. Other participants made the important point that biomass retains a significant share of the primary energy mix, it is easy for people to use and is likely to remain a significant part of the energy mix for some time (Participant 19, 2019; Participant 20, 2019). Only one transnational energy actor specifically stated that people want solar home systems, anecdotally referring to a "guy" who stated that if the grid came, he would still use solar (Participant 8, 2017).

In any case, it appears that there has been some natural attrition for several transnational renewable energy actors over the time of this research, with many recognising that the solar homes market is no longer viable. With increasing grid electrification of villages, the need for off grid systems is lessening, except in those areas more difficult to reach and on some islands. As one participant noted, "this island will never be connected" (Participant 14, 2018 & 2019). There is a risk, however, that 'new' transnational renewable energy companies will come to Cambodia with little to no understanding of peoples' energy needs, hoping to bring power to the people and offer low quality products that are expensive. The likelihood is, though, they will find the solar home systems market is saturated, as noted by Participant 3 (2017) when discussing solar lighting in Cambodia.

Where interview participants and other transnational energy actors in Cambodia discussed the cost of electricity, it often related to grid connected solar and the lower cost that solar generation on the grid could provide in comparison with coal (Participant 11, 2018; Participant 13, 2018). However, as discussed in Chapter 7, Participant 14's organisation was quite focused on the cost of electricity for people for the trial site, as well as other areas they were expanding to. The tariff for the micro grid system was, however, significantly higher

than the national grid tariff. Several participants discussed power purchasing agreement (PPA) prices, which is the price that EDC will pay companies for solar PV generation from various projects. Participants stated projects ranging from 6.5c to 9.1c per kilowatt hour (kWh) for PPA prices for previous solar projects throughout Cambodia (Participant 4, 2017; Participant 13, 2018; Participant 14, 2018 & 2019). More recent figures, however, show that the prices being quoted now are much lower and solar PV can be an affordable source of much needed generation for the government, which will be discussed further. Several of the companies interviewed are starting to move away from the solar homes market to grid connected solar PV and this has come with its own challenges for companies who would prefer to avoid agreements with EDC and deal directly with factory owners, for example.

Other discussions of electricity costs centred on Cambodia's regulated, standard tariff of 19c kWh. There was some criticism of this tariff from a REE participant, who stated he was "just breaking even", as he was required to purchase electricity from EDC for 16c kWh, received a 3c kWh subsidy from the government and was required to provide everything else in the distribution line with the remaining funds (Participant 10, 2018). Other criticisms of the regulated tariff were related to the cost of generating electricity in rural areas and that mini grids, located off grid, cannot operate at this cost (Participant 14, 2018 & 2019). There was a sense from this participant that cost-reflective tariffs were required; however, this does not address the issue of affordability of electricity for people, particularly in rural areas. It is understandable that there is concern about cost reflective tariffs from energy actors, as supplying energy to rural areas, particularly off grid, is often more expensive.

The other main finding from this research relates to the question of how discourses articulated by actors in the renewable energy sector and international development agencies in Cambodia influence the path of energy development. This research found significant challenges for the transnational renewable energy and international development sector to influence energy development in Cambodia and a general lack of engagement and access to the most influential energy actor, EDC and to a lesser extent, the Ministry of Mines and Energy (MME). It was observed that the transnational actors interviewed do have engagement with representatives from the Ministry of Economy and Finance (MEF), who were the only government representatives present at two energy dialogue meetings I attended in Phnom Penh in 2019. The convener of these meetings – Participant 11 – stated in the minutes that, "MEF is the lone government representative" and asked how the energy sector

can facilitate further engagement with the government. Ear (2012, p. 27) states how MEF is one of the key ministries for governance and growth in Cambodia, along with the Ministry of the Interior, Ministry of Commerce and the Office of the Council of Ministers. However, despite MEF being a key ministry, it would appear that representatives who attend meetings have minimal influence, as stated by Participant 15 (2018), who, when developing the stalled Environmental and Natural Resources Code of Cambodia, stated that on a follow up meeting with EAC and EDC that the government representatives were at "a much lower level – In fact two participants from EAC and EDC were only advisors" (Participant 15, 2018). Comments about lower level staff from EDC, rather than higher level staff with more influence, attending an arranged delegation were also echoed by Participant 11 (2018).

EDC, as a state owned utility, could be considered a regime actor of the multi-level perspective in the transition literature and the electricity system itself as the regime, with its rules and regulations (Geels, 2010). In researching energy transitions in Cambodia, I came to see EDC functioning within this existing technical regime described by Geels (2010) and other organisations such as, Participant 14's organisation operating at the niche level. Geels (2010, p. 498) describes a "common pattern" of "outsiders or entrepreneurs" developing innovations outside of the incumbent regime. Participant 14's organisation was one of the few organisations that were able to connect with EDC and stated they had met with some people within EDC in our initial interview. The ability of Participant 14's organisation to have access to EDC and their continued engagement with the Electricity Authority of Cambodia (EAC), where other expatriate energy actors have failed, appears to be due to the company offering a novel and relatively affordable solution to rural electrification, in areas that were difficult for the grid to reach, (refer to Chapter 7). Part of Keo's response to my question about rural electrification supports this view, as he showed interest in finding affordable solutions to rural electrification in areas where the grid may not be feasible, stating:

> But, there are instances in small pockets of communities where access will take a long time or it's not quite feasible. That is the reason why we could explore different subsidies scheme that would enable REF to channel a fund to provide something – and that something can be diesel, or it can be diesel, plus solar energy or it can be battery plus solar. But battery plus solar is expensive. We have received proposals from some companies – a US company that has an experiment pilot project in Indonesia for example, some of the remote islands. That mini grid solar battery is close to $1 per kWh. And it wouldn't work for Cambodian poor to pay $1. So different schemes are being devised and perhaps if you are doing research in that area, you are more than welcome to come to us, to talk to REF for example to understand more and what we are doing. (Keo, 2019)

There are criticisms of the hierarchical multi-level perspective of regime and niche actors in the transition literature, as it leaves little room for movement and ongoing practices to influence the regime (Geels, 2011, p. 37). However, in the context of Cambodia, the society is arguably hierarchical, demonstrated through Khmer language and greetings such as the *sampeah* to denote respect to people in higher positions, such as the king, monks, government officials and the older generation (Karbaum, 2015, p. 233). Karbaum (2015, p. 244) also states that there is no evidence of hierarchical preferences in Cambodian society changing with modernization. However, Din (2020, p. 20) makes the important observation that there is a generational gap and lack of representation of the younger population within government and among decision makers in the country. This is reflected in the language and narratives of officials in Cambodia, which continue to influence and shape identity for younger people in Cambodia (Din, 2020, p. 19). Some of these narratives include struggles against colonial rule, US imperialism and the removal of the Khmer Rouge regime, which conveys endurance and success for the ruling Cambodian People's Party (CPP) (Peou, 2018, p. 44).

An example of the ability to access and use hierarchical relationships for the public good is shown in the case of the rehabilitation of the Phnom Penh water supply (Hughes, 2013). Hughes (2013) states how the success of rehabilitation of the Phnom Penh water supply was attributed to the agency, the Phnom Penh Water Supply Authority, as being able to work in a 'bubble' free of political pressure or interest. However, Hughes presents a reality that was more precisely related to Ek Sonn Chan, the head of the water authority's access to hierarchical state relations, rather than his insulation from it (Hughes, 2013, p. 146). This, Hughes states, "put Ek in a position to negotiate and defend his agency as his own personal domain of power" (Hughes, 2013, p. 146). Clearly, Ek is also a reformer, as demonstrated in the story of him cutting off the water supply of a military general who refused to pay his bill, as well as ensuring that staff were paid sufficient salaries to avoid corruption (Ek, 2009; Hughes, 2013, pp. 147-148). Thus, in relation to the regime level in Cambodia, it is inherently hierarchical and the ability to influence a regime actor such as EDC appears to be based on relationships, loyalties and networks within the state (Hughes & Un, 2011, p. 72; Karbaum, 2015, p. 244). A reformist agenda with the support of the regime, although it appears rare, would suggest that the provision of services for the public good can occur in Cambodia.

Although Cambodian society and governance structures are hierarchical, paradoxically, Cambodia is also relatively open to various actors coming to Cambodia and starting a business or an NGO. As described by Strangio (2014, p. 193), at the time of the UNTAC mission in early 1992, Cambodia became an "aid industry mecca", with hundreds of NGOs converging on Phnom Penh. Strangio (2014) states that little has changed two decades on, with more than 2,600 NGOs registered with the government, 80 percent of which are local. This apparently thriving civil society sector has been described as somewhat of a mirage as NGOs operate within defined limits and anyone stepping over those limits may find themselves in conflict with the authorities (Strangio, 2014). However, Norén-Nilsson and Eng (2020) reflect that much has changed in Cambodia since NGOs were described as either a polarising force, advocating for land and human rights, contrasting with NGOs who worked with the government to fill gaps in service provision. One significant change appears to be that international NGOs with expatriate staff have often been replaced with Cambodian leaders (Norén-Nilsson & Eng, 2020, p. 110). This, along with a recognition by the CPP of the need to engage young people, has led to what Norén-Nilsson and Eng (2020) describe as Cambodian civil society elites, who are "more politically engaged and enmeshed than the previous generation of expatriate NGOs, and who navigate a variety of organisational forms, including networks, mass organisations and platforms" (Norén-Nilsson & Eng, 2020, p. 110).

For the energy sector and participants interviewed as part of this research, many worked for transnational organisations in Cambodia, employing expatriates and few Cambodian staff. Although there are also local energy actors in Cambodia, particularly the REEs and some solar energy companies, there were difficulties in sourcing interviews with these actors. Some transnational energy actors in Cambodia have had somewhat of an open book to operate in Cambodia and this has not always been positive. For example, cases of solar home systems having high failure rates, low power output and, at times, solar home systems being more expensive than grid connection. One interview participant in reference to a solar company operating in Cambodia and concern about ethical practices, stated, "they think that Cambodia is still the cowboy land" (Participant 10, 2018).

Despite the challenges and tensions of transnational energy actors in Cambodia, there is potential space and opportunity for actors outside the regime to create pockets of change in what could otherwise be a very direct energy transition that has followed the well-worn path of centralised energy generation dominated by coal and, in the case of Cambodia,

hydroelectricity and imported fuel oil (Economic Research Institute for ASEAN and East Asia, 2019). However there is also a risk with too much reliance on the private sector for energy infrastructure, that the cost of electricity will not be prioritised. As discussed by Turnheim and Geels (2012), private actors have very few incentives to address societal issues and there is a risk of increasing electricity costs in Cambodia with an overreliance on the private sector for infrastructure. Private ownership of electric power facilities is also established in the Electricity Law of Cambodia 2001 and is also promoted in the National Strategic Development Plan 2014 – 2018 (Electricity Authority of Cambodia, 2001; Royal Government of Cambodia, 2014, p. 156). In many respects, although participants in the renewable energy sector in Cambodia may feel discouraged about the path of energy development taking place, throughout the period of this research, I observed a significant shift in the openness to solar PV generation on the grid (see Chapter 6).

There is also a coming together of transnational renewable energy actors in Cambodia to form a stronger coalition of advocates during the period of this research. Although some interview participants and energy actors in Cambodia present at the EDC energy vision event agitated for more openness to renewable energy, this research suggests that there is movement on the regime level, with EDC being open to solar energy on the grid. This was also acknowledged by one interview participant, who stated that EDC are talking more of solar than they had been six months prior (Participant 9, 2017). Several participants also expressed the need for better regulations for solar companies to connect to the grid (Participant 4, 2017; Participant 9, 2017; Participant 15, 2018). Two participants stated that there was no need to export solar generation to the grid, they just wanted to open up the industry to allow self-consumption of solar (Participant 4, 2017; Participant 9, 2017). These statements were made prior to the introduction of regulations for grid connected solar, which require that all grid connected solar has a PPA in place with EDC. Medium and high voltage consumers can use solar PV for their own consumption, provided they comply with certain conditions, as outlined in the regulations, which includes zero export to the electricity grid (Electricity Authority of Cambodia, 2018a).

Openness to solar energy by EDC is largely for practical reasons and a need for more power relatively quickly, as discussed in Chapter 6. As a result, solar energy may yet play a significant role in the future of Cambodia's grid system. However, challenges remain, such as the ability of the renewable energy and the development sector to work with EDC to find

solutions to concerns about intermittent generation and energy affordability. There was agreement from interview participants about the need for additional generation in the country, particularly in the dry season when the capacity of hydro generation was lower (Participant 10, 2018; Participant 13, 2018). One participant whose agency did work more closely with EDC also acknowledged the need for imports of electricity from countries such as Thailand for the "stability" of Cambodia's grid (Participant 19, 2019). However, there was also concern about the 'take or pay' contracts Cambodia has in place with countries such as Vietnam, where electricity is purchased on a longer term contract (Participant 10, 2018).

Energy actors interviewed in Cambodia also largely express what Hajer (1996) refers to as modernist thinking, described as techno-institutional fixes that enable progress and do not require structural change (Hajer, 1996, p. 32 & 33). This can be seen from interview participants in their acknowledgement of the need for more energy to service the growing economy, the focus on PPA prices for solar and the belief that there are simple fixes to the resistance by EDC to solar energy on the grid. For example the following discourse presents an economic view of what would be required to enable more solar energy on the grid:

> "Subject to the government wanting to look at this further, but we talk about an economic impact analysis on you know, to see what would be the effect of introducing solar and other [inaudible] at various levels of the network. And there's a couple of elements you know, one is the fact that solar can be a cheaper source of generation, but if it's developed by the government, you know you need off take agreements again and you may have to guarantee some financing or at least government guarantees of the off take contracts right?" (Participant 13, 2018)

As will be discussed in the next section, concerns articulated by EDC are largely related to reliability and affordability of electricity that are viable concerns, which countries such as Australia and Germany have been facing in the process of energy transition. There may also be an unspoken element with EDC, relating to having control over a particular domain (in this case the electricity sector) and the main political priorities for the Government of Cambodia are to ensure affordable and reliable electricity for people and businesses. Despite EDC constantly articulating these priorities, there is a significant lack of mutual understanding between energy actors interviewed in Cambodia and EDC. However, as the grid was perceived to be unreliable by interview participants and has shown to be predictably unreliable in the period of this research through the extended power outages (see Chapter 6), questions do remain about the storyline of reliability. Particularly if this is used to limit solar generation on the electrical grid in Cambodia. Reliability discourse is characteristic of

industrialization and increasing energy demand and, as stated by Walker in Rinkinen et al. (2019, p. 73), is "symbolic of strength and economic power."

Chester and Elliot (2019, p. 108) also state that framing energy around issues of security, relegates environmental concerns as secondary to 'affordable and reliable' supply of energy. However, this view could also be challenged, as renewable energy is not guaranteed to save the planet, with growing energy demand largely adding to energy supply, rather than replacing it, hence having minimal impact on reducing fossil fuel use (York & Bell, 2019). This trend has also been observed in most energy transitions throughout history; when new sources of energy generation are introduced, traditional sources of energy are still used, even if the new sources become dominant (Smil, 2016; York & Bell, 2019). This point was also made by Participant 20 (2019) in relation to the use of charcoal and wood fuel in Cambodia, who stated:

> I don't know if you are familiar with the energy matter theory where people would, when they become wealthier and wealthier then they switch, from one fuel to another. Well, we actually observed that this theory is wrong. What happens here at least is that when people get wealthier they increase the mix of fuels. So they would add up new fuels to their energy mix but they don't abandon previous fuels. So obviously the use of charcoal will decrease when people get wealthier because they will use like electricity for cooking rice because they have an electric rice cooker. They will use maybe a small LPG burner for specific dishes but then charcoal will remain part of the energy mix. Even wood could remain part of the energy mix. (Participant 20, 2019)

As wood fuel remains a significant primary energy source – up to 60 percent (Luukkanen et al., 2015; Participant 20, 2019), it is important to recognise that simply replacing fuels across Cambodia is not a realistic or simple proposition, particularly with growing energy demand in the country. The use of wood fuel in industry in Cambodia is discussed further in the next section.

8.2 Discourse by a regime actor – Electricite du Cambodge

This section provides context to the broader political landscape in Cambodia, by enabling an understanding of the discourse from EDC, which has significant influence on energy development in Cambodia. The section confirms the main themes in the discourse of EDC are of reliability and affordability of electricity, which constitute two aspects of the energy trilemma: security, affordability and decarbonisation (Rinkinen et al., 2019). The inability to engage with EDC was a significant theme expressed by interview participants, with several participants holding the view that EDC were mostly concerned about losing money if they

allow too much solar generation. As will be discussed in this section, EDC state their concern about solar was related to issues of reliability and affordability. The use of reliability as reasoning for limiting solar PV on the grid could be said to be a simple storyline (Hajer, 1996) that reflects a view of some detrimental effects that significant amounts of distributed solar PV can have on an electricity network. This simple storyline, however, does not capture the full nuance of what EDC are concerned about, which also includes affordability. Nor does it capture the complexity that occurs with solar generation on an electricity network, responding to supply and demand in real time. Hajer (1996, pp. 61-63) refers to how actors will take these simple storylines, such as reliability, and fill in the gaps according to what they know. Only one interview participant in Table 5, below, acknowledged the reality of frequency and voltage control on the grid for EDC.[3] Other interview participants also raised some relevant concerns related to EDC being able to just disconnect installed solar at will, as there is no clear process for installing solar PV on the electricity network in Cambodia (Participant 4, 2017; Participant 9, 2017; Participant 10, 2018).

The meaning of this simple storyline of reliability used by EDC is perceived quite differently by interview participants, with several participants interpreting the discourse of reliability and affordability as really being about concerns with losing profit in the face of widespread use of solar. Some participants, however, did acknowledge the difficulty of having intermittent generation on the grid, while others suggested that EDC simply did not like solar. As discussed by Hajer and Versteeg (2005, p. 177), actors using simple storylines assume a level of mutual understanding; however, in this instance and as will be discussed further, this mutual understanding between EDC and energy actors in Cambodia is not occurring. Several energy actors in Cambodia are also using a simple storyline of profit or that EDC are not 'green' to describe EDC's reluctance to fill all roofs in Cambodia with solar PV. Neither the story of reliability, nor a profit motive, provides the full picture. Hajer (1996) refers to how discourse coalitions that form around a storyline may never meet or follow the same strategy. They can, however, gain political power by sharing the same storyline, even as they may have very different views or reasons for supporting their chosen cause (Hajer, 1996, p. 13).

[3] Frequency refers to how many times voltage cycles every second. The frequency of the power system in Australia is 50 Hertz (Hz), meaning voltage cycles 50 times every second (AEMO, 2020a). Maintaining a constant balance of supply and demand on electrical networks is required to maintain equilibrium and is essential for the safety of all equipment on an electrical network, including household appliances. For further information about frequency control, refer to AEMO (2020b). On ways to manage frequency in high renewable energy scenarios, refer to Obaid et al. (2018).

Before discussing the discourse of EDC, Table 5 provides a summary of discourses from interview participants about EDC.

Table 5 – Interview participants' discourse on EDC

Interview participant	Profit motive	Security & reliability	EDC not 'green'	Difficult to engage EDC
Participant 3	Need to demonstrate that connecting solar will not make them lose business.		Why would they work with us? We are based on green side of technology.	Tried to approach through work with limited success.
Participant 4		Need regulations to connect solar.		EDC could come any day and disconnect solar.
Participant 9		EDC don't want many injections of solar into the grid.	EDC don't want solar. They say, "you can have your solar, but we will cut you off the grid."	I don't know EDC. They're not talking that much. Hard to talk with them.
Participant 10	EDC are concerned that solar farms will take away their business.			Trying to get EDC to work with us. EDC have all the power, not EAC.
Participant 13	Government wants to ensure EDC makes return on transmission investments and they don't want to get stuck with off-take agreements.	Recognition by EDC that solar can be a lower cost alternative for power than current generation.		
Participant 15				EDC not involved in development of environmental code. Tried to engage.
Participant 18	Distributor has no right to generate power themselves. Have to buy the power from the market, from EDC.			
Participant 19		They're scared by the intermittent generation. Interconnection would assist frequency and voltage control.		Works regularly with EDC on specific projects. Providing financial and technical assistance.

The statements made by participants relating to profit are likely to resonate with some organisations, such as Global Witness who reported that Hun Sen's daughter, Hun Mana is

director of Cambodia Electricity Private, which they describe as "Cambodia's second largest domestic electricity supplier" (Global Witness, 2016, p. 15). Cambodia Electricity Private sells power to EDC (Electricity Authority of Cambodia, 2019, p. 74), as do most independent power producers in Cambodia. What is considered Cambodia's second largest domestic electricity supplier by Global Witness is a total of 48MW of electricity (Electricity Authority of Cambodia, 2019, p. 74). This is a relatively small amount of electricity generation that is currently being eclipsed by various hydro and solar projects in the country, such as solar projects being developed by SchneiTec Renewable Co Ltd, described as a "joint venture between Chinese and local partners" (Hin, 2020). A webinar presentation from the Australian Government's Austrade, states that a total of 230MW of solar projects owned by SchneiTec have been approved for development across Cambodia (Austrade, 2019). According to this same presentation, foreign investors cannot own land, but they can enter into a joint venture with a Cambodian national (Austrade, 2019), which appears to be the arrangement that has occurred with SchneiTec.

Knowing that foreign investors cannot own land, but are required to enter into a joint venture with a Cambodian national puts the issue of who can develop larger scale solar projects into greater perspective. A question raised by a transnational energy actor in Cambodia raised the issue of land, in particular relating to the low price of 6c kWh to develop a solar project in Cambodia and stated that, "solar systems may use up a lot of land." The transnational energy actor then asked how to incorporate the cost of land acquisitions and construction. The response by Keo was revealing:

> Cambodia is still blessed with a lot of land – believe it or not. You may see headlines about land grab, about land protest, but we do have a lot of land that can be used for agriculture and industry expansion, as well as energy development. (Keo, 2019)

This statement is also discussed further in section 8.3; however, it would appear that renewable energy projects, like most developments in Cambodia are likely to involve patronage networks as described by Hughes and Un (2011) and Springer (2015). Therefore, the ability of transnational energy actors to undertake projects in Cambodia is restricted, and transparency of decisions made is likely to be limited. Land acquisitions for renewable energy projects are likely to be another aspect of development projects that require an equity lens, rather than being immune to criticism as described by Blunt and Lindroth (2012) in their discussion of development assistance, which is often presented in a "misleadingly favourable light" (Blunt & Lindroth, 2012, p. 473).

As discussed in the introduction, Advisors in Cambodia receive the honorary title of Excellency, which indicates a personal, rather than official relationship to a powerful office holder, or long term service to the CPP (Hughes & Un, 2011, p. 73). The title of Excellency is not uncommon with party members and it is a respected title in Cambodia (Pak, 2011, p. 176). Keo, at the energy vision event was transparent of his personal relationship with the Prime Minister, Hun Sen, referring to a conversation about hydropower, he states:

> I had a very good conversation with the Prime Minister personally in the last three weeks. I got reassured by the Prime Minister that, and he said in his own words, and I quote "this is not about the Vietnamese complaining about our plans for development on the Mekong. It is our own people who are concerned about this and we have to make sure that we don't touch these resources." And I was pleased with that kind of comment and I will make sure that this is translated into policy. (Keo, 2019)

This statement by Keo is transparent in stating a personal relationship with the Prime Minister and provides a positive outlook on the Prime Minister to suggest he is listening to the concerns of people in Cambodia, by not developing more hydropower dams on the mainstream Mekong. This consensus seeking approach by the Prime Minister and by extension the CPP, aligns with comments from Norén-Nilsson and Bourdier (2019, p. 3), that it is an attempt to limit opposition and protest in Cambodia. It appears for the time being that there are no more plans for dams on the mainstream Mekong. However, this does not negate the displacement that has already occurred as a result of dam developments in Cambodia. The Lower Sesan II dam officially opened in December 2018 and has been described as the "largest and most environmentally and socially damaging hydropower dam built in Cambodia" (Baird & Green, 2019, p. 367).

8.3 Reliability and affordability storylines

The following section describes how a senior manager of EDC, engages with and responds to some of the issues raised by people working for transnational organisations in Cambodia. The Managing Director of EDC, Keo, in his discussion at the energy vision event, noted that future energy policy needs to address the following: sufficient supply [of energy], a reliable grid, lower costs and minimal impact to the environment. Tariff reductions were also discussed throughout the event, with Keo (2019) stating that tariffs had reduced from 2008 in Cambodia and now people are paying 16.7c kWh instead of 22c kWh in 2008. This tariff of 16.7c kWh varies from that presented earlier in this chapter by Participant 10 (2018), who stated the regulated tariff is 19c kWh. The tariff structure differs depending on consumption

levels and whether it is a rural or urban area. People who consume less have lower tariffs overall; however, the grid tariff in rural areas is consistent, regardless of consumption at 21c kWh (Economic Research Institute for ASEAN and East Asia, 2019, p. 43). However, EDC's Managing Director, states that uniform tariffs are now the norm in Cambodia for all provinces that are connected to the grid and that this has improved with electrification and lower use of diesel generators, which are more costly (Keo, 2019).

My own tariff for electricity while living in Phnom Penh was 25c kWh and this was less than many expatriates paid; often 35c kWh for newer buildings in the capital. As stated by one expatriate business consumer:

> In Cambodia, each building has a separate tariff. So what happens with new buildings, the tariff is 35c [kWh] and old buildings pay 25c [kWh]. So, I don't know how they control it, how they manage it. (Participant 2, 2017)

It should be noted here that many apartment buildings in Phnom Penh have generators, thus the additional tariff appears to be a decision by the building owner, who may incur additional costs in times of power outages. However, the EAC also have a "foreigners' residence" tariff of 740 Riels per kWh (US 18c). It is the same tariff as the higher consumption tariff, if using 201 kWh or above per month (Electricity Authority of Cambodia, 2019, p. 34).

EDC's focus on affordability was consistent with government policy and with the most recent quasi-government policy document, the Cambodia Basic Energy Plan (Economic Research Institute for ASEAN and East Asia, 2019). The Basic Energy Plan clearly sets out that the energy supply in Cambodia aims to have the following conditions: affordability, accessibility, security, safety and transparency of the market (Economic Research Institute for ASEAN and East Asia, 2019, p. iii). The Basic Energy Plan has been signed off by the Minister of Mines and Energy in Cambodia. It also has a heavy focus on reliability and energy security with 91 instances of the terms 'reliability' and 'security' found from a word frequency query. Through an NVivo text search, the Basic Energy Plan contains an overall coverage of 17 percent of content relating to reliability and security, which suggests significant focus on these issues for energy. The Basic Energy Plan for Cambodia goes further to state the projected generation mix of coal, hydroelectricity and 10 percent renewable energy, "will maintain affordability and security." It is also worth noting that the plan recommends the household electrification rate should increase from 70 percent to 95 percent in 2030 (Economic Research Institute for ASEAN and East Asia, 2019, p. xix). EDC's Managing

Director, Keo stated that village electrification in the country is now at 88 percent and this figure continues to increase. As discussed however, this percentage is unlikely to include all households in the villages counted.

A word frequency query of Keo's speech and answers at the event was undertaken using NVivo and identified the top fifty words used from coded text. The three most common topics of discussion by Keo at the energy vision event were: solar, grid and tariffs. Seeing that 'grid' and 'tariffs' were topics that came up a number of times was not surprising, given the focus of the government on electrification and affordability of energy. In a word frequency query, 'solar' was cited 80 times, in comparison with the two other most frequent discussion points, 'grid', mentioned 66 times, and 'tariffs' 59 times. Although solar was frequently discussed by Keo, the context of this discussion is important to note. The following quotation in relation to rooftop solar PV from Keo, highlights the significance for EDC of affordability and reliability.

> There are instances in the United Kingdom, Germany and parts of the United States, where rooftop can also drive costs for non-rooftop users. We don't want that situation either. It's going to take a different type of conversation, and it's probably going to divert attention away from key priority areas. So after this election, I have made grid reliability as the first priority that I want to do. Imagine at the cost of today. And perhaps [inaudible] one or two years later, but then you have unreliable power supply, would you trade it off? I don't think so. So, this is [inaudible] to our policy consideration, when we contemplate a new direction. (Keo, 2019)

The solar industry in Cambodia has advocated for the allowance of solar PV on rooftops, without the need for PPAs, as discussed previously. However, the Cambodian government is wary of too many rooftops filled with solar, as noted in the above quotation, citing problems that have occurred in the UK, Germany and the US, where solar PV can drive costs for non-rooftop users. There is some accuracy in this comment, as state based incentives for solar PV, such as feed in tariffs in Australia, have been shown to be a form of cross subsidy from non-solar households to solar households (Chapman et al., 2016, p. 1267). Although the electricity retailer is liable for the cost of feed in tariffs in the first place, the cost of this subsidy for solar households is then passed through to all consumers on their electricity bill from retailers (Chapman et al., 2016, p. 1275; Simpson & Clifton, 2016). This then creates inequitable outcomes for non-solar households through increased electricity bills and, in general, has the most impact for people experiencing hardship or on low incomes (Simpson & Clifton, 2016, p. 264). Modelling conducted on electricity markets in the UK, Ireland and Australia by Chesser et al. (2018, p. 37), also shows a correlation between increasing amounts of

residential solar PV and higher residential electricity prices. This then creates a feedback loop of higher prices, leading to more solar adoption. The increasing costs for people who cannot mitigate high electricity prices on the grid through the use of solar also occurs because costs for utilities do not decrease with the increase of solar PV. Because the fixed costs of transmission and distribution are recovered over a long period of time, this cost is thus passed to consumers (Chesser et al., 2018, pp. 41-42).

Sovacool et al. (2019) describe these new energy injustices, noted above, as distributive justice, that is, relating to the equitable distribution of social and economic benefits and cost and justice as recognition, identifying how vulnerability and marginalisation may be increased through low carbon transitions (Sovacool et al., 2019, p. 589 & 591). There is a risk that these forms of energy injustices could also occur in Cambodia and there is a need for all energy actors in the country to have some critical reflection on the changing energy landscape to support an equitable transition. As also stated by Sovacool et al. (2019), interview respondents in their research were not aware of injustices that were occurring in Germany, the UK, France and Norway. However, Sovacool et al. (2019) identified 120 distinct injustices occurring in low carbon transitions in those countries and concluded that many of these injustices are 'hidden', particularly at first (Sovacool et al., 2019, p. 612). Some of the injustices incurred in Germany include higher energy prices for all, which has also been confirmed in energy transitions in California and Australia (Monyei et al., 2019). As this research has also shown, solar home systems in Cambodia have not always been affordable and ensuring affordability of energy services for people has not always been a priority for expatriate energy actors in Cambodia. Thus, Keo has a valid point, in stating concerns about increasing costs for non-solar users, such that expatriate energy actors in Cambodia would benefit from having this critical awareness and attempting to find some mutual understanding with EDC on this issue.

The second point Keo notes is the priority of grid reliability. This is a significant barrier for what is now largely termed variable renewable energy or intermittent sources of energy, such as solar and wind. It is not necessary however, to conflate solar with unreliable power supply as Keo does. Keo further uses this as a trade-off, asking the audience if they would prefer an unreliable power supply. It's an interesting question to pose, given this event was held just one month after experiencing power outages every day in Phnom Penh over two and a half months between March and May 2019. The power outages that did occur were effectively

load shedding[4] caused by a lack of power generation and increased demand, mostly from the construction sector, as discussed in Chapter 6. Additional generation from solar has the potential to assist with power outages to some extent, if nothing else but to provide some much needed additional energy generation. Keo goes further in his discussion of solar and the grid stating that Cambodia's grid infrastructure is new and that more rooftop solar will destabilise the grid.

> Now, people may say what about solar rooftops? Our grid is very nascent. Very infant. We are not under any illusion that we can do more with uncontrolled expansion of solar on rooftops. So from a utility perspective, we are trying to caution the growth of solar rooftops. You may have tons of reasons to [inaudible] and I can be quite outrageous in that statement. But believe me, when we look at the stability of the grid which should be of interest to industry. You don't want power to be up and down. You don't want power cuts to be unpredictable. (Keo, 2019)

The storyline of reliability and security is a familiar discourse coalition of utilities and governments globally. The UN have also co-opted this discourse in SDG7 pertaining to energy to "ensure access to affordable, reliable, sustainable and modern energy for all" (UN DESA, 2015a). This storyline is also not surprising, as found by Bryant et al. (2019), who undertook content analysis of government strategy documents from 21 state and federal governments in Australia and the European Commission. They analysed 63 documents and found that most of the energy discourse was to provide "reliable, affordable and secure energy to citizens" (Bryant et al., 2019, pp. 43-45). Hajer (1993, p. 48) discusses how discourse coalitions dominate if two conditions are met: firstly, that central actors are persuaded by this discourse or forced to accept it and secondly, if the discourse is institutionalized within policies and practices. It would appear that actors around EDC are persuaded by this discourse or, at the very least, forced to accept it. However, EDC has some work to do in convincing several of the interview participants that reliability is a valid argument due to the perception (and reality) of power being fairly unreliable in the country (albeit improving). Reliability has been institutionalised within policies, as noted above through the Basic Energy Plan, which prioritises the concepts of reliability and security. In addition, the Basic Energy Plan sets out the future energy mix in Cambodia as comprising coal, hydroelectricity and only ten percent of renewable energy (Economic Research Institute for ASEAN and East Asia, 2019). The Electricity Law of Cambodia 2001 also states the

[4] Load shedding is when demand for power exceeds supply and power needs to be cut to areas to maintain a balance of the system as a whole. See, Harrison (2019).

"rights of consumers to receive the reliable and adequate supply of electric power services at reasonable cost" (refer to Table 2). Thus, the narrative of reliability dominates EDC's representations at this time, despite and perhaps accentuated by the frequent power outages.

The statements from interview participants involved with energy in Cambodia do not challenge the storyline of reliability excessively, but nor do they provide a contemporary response to some of the challenges seen globally, with renewable energy being introduced into the energy mix, particularly in relation to affordability. Issues of affordability of electricity for people in Cambodia were marked by what was not said by interview participants, rather than what was said. As discussed, the main focus from interview participants was related to PPA prices for solar. Prioritising equity and affordability of electricity for people in Cambodia may provide more legitimacy for transnational energy actors in Cambodia and may assist in building relationships with regime actors such as EDC. The concerns from EDC are not insurmountable for energy actors in Cambodia and there may be options for energy actors to address issues of affordability with renewable energy, while also challenging the story of reliability. The solar energy industry in Cambodia, particularly those organisations that have been working in Cambodia long term have, arguably, had an influence on the use of solar in the country. Without the early adopters of this technology in Cambodia, it is unlikely there would be the level of solar installed on the grid at this point in time. In addition, dominant discourses, such as those reproduced by EDC around reliability, can remain the same for decades, but then be contested when "societal needs change and alternative constellations appear with discourses that are adapted to these changing circumstances" (Bosman et al., 2014, p. 46).

Given that affordability is a key concern of EDC, it is valid to question the value of ever increasing reliability. Particularly as discussed in Chapter 6, throughout the power outages in Phnom Penh, life largely continued as normal for a significant amount of people in the country. Certainly, there were inconveniences and some businesses did struggle with the continued power outages (Cheng, 2019b); however, there is not the same expectation of a 'reliable' electricity supply in Cambodia as there would be in Australia. What was evidenced on the streets of Phnom Penh in the two and a half months of power outages in 2019 is that people could still cook food, keep drinks cool with ice boxes and generally function, even with four to five hours of power cuts per day. Granted, much of this activity remained due to the reliance on wood fuel, which is often used in ice making and for cooking (Participant 20,

2019). Several key industries in Cambodia also use wood fuel, including the garment sector, brick industry, salt refining, tobacco curing, rubber processing, ice making and food processing (Participant 20, 2019). Participant 20 (2019) did note that several of the industries using wood fuel are difficult to approach to discuss their use of wood. The use of wood fuel is unregulated in Cambodia and there is interest in connecting these sectors to solar energy. However challenges ensue with this, as stated by Participant 20 (2019):

> It's not only domestic cooking that uses biomass as a fuel but many, many very key economic sectors like industrial sectors use biomass. The main reason for this being that it's completely unregulated and so it's very cheap because it's completely illegal. (Participant 20, 2019)

Deforestation is a significant issue in Cambodia and, although some factories will use wood fuel due to being isolated from the grid, many do not connect as it is cheaper not to (Participant 20, 2019; Thompson, 2016). The illegality of the use of wood fuel in industries such as garment factories is fuelling not only energy use in the sector, but also organised crime, as tracked by a conservation NGO in Cambodia. Some of the garment brands in Cambodia using illegal wood were international brands such as Gap and Timberland (Thompson, 2016). In addition, Ear (2012, p. 50) states how Cambodia's "recent" growth has been partially based on extraction in the forestry sector and poor governance is likely to have assisted in the extraction of natural resources. The solar energy industry in Cambodia was also actively advocating for the use of solar in factories; however, as pointed out by Participant 20 (2019), the use of wood in factories is mostly thermal energy, for heat and steam. In garment factories, the use of wood fuel is for ironing, dyeing, washing and hot water (Participant 20, 2019). The UNDP also states that the use of wood boilers in garment factories is common due to the low cost of wood in comparison with grid electricity and generators (Ploechl et al., 2015, p. 21).

A representative of a large international garment brand was present at the energy vision event in Cambodia. The company representative raised the following question to Keo:

> As you are probably aware, most major brands have signed commitments to be climate neutral by at least 2030. So the importance of energy is very important. Could you explain a little bit more please, plans for rooftop regulations in Cambodia at the existing rather restrictive landscape that exists? – International garment brand representative.

The response from Keo was to refer part of his question to the EAC to explain the regulations released in 2018 for connecting solar PV to the grid, as discussed in Chapter 4. Keo also took

the opportunity to state again that, "EDC's grid system is very, very infant" and again used the discourse of stability of the grid, noting:

> Taking into account the fact our grid stability is important to EDC, the utility and to all of you. Because stable grid gives everyone the benefits, and we would still allow that to happen by making sure that, the political aspect is taken into account and also the issue of free ride is properly considered. (Keo, 2019)

The point about 'free ride' was further elaborated, as solar driving costs up for non-solar users, as previously discussed in this chapter, although Keo also concedes that:

> There are a couple of conditions where rooftop solar can be nurtured and won't have a problem. For example, now we are short of power. It would make perfect sense for EDC to see some contribution from rooftop for example, but just like [inaudible] mentioned in his introductory remarks, what are some of the short term gains and what are some of the long term implications. (Keo, 2019)

Keo does not fully elaborate on what those conditions "where rooftop solar can be nurtured" are, but promoting the use of solar energy for consumption of electricity in the garment sector would appear to be a logical approach to take. Aside from international companies with brand names to protect, there appears to be minimal incentive at this time for finding a replacement for wood fuel for thermal energy (heat and steam)[5] in the garment and other industrial sectors. As also stated by Participant 13 (2018) when discussing what the inner workings of EDC may be:

> Yeah I mean and that's what we're trying to figure out as well because understanding this, and using solar which would shave off day time peaks, it would also act more efficiently in the dry season when hydro is lower. You know you're basically flattening the demand curve right? So you're potentially delaying or even avoiding investments in new generation capacity. And that should be a big plus for the government, the country. (Participant 13, 2018)

It is clear that there is some mutual agreement here between EDC and energy actors in Cambodia that solar energy makes sense, simply from the point of view of having additional energy generation. However, there appear to be two main barriers to using solar in the garment sector in Cambodia. One is the regulations on connecting solar PV that only allow for medium and high voltage customers, and two is the use of fuel wood in this industry, which is a cheap source of energy for industrial processes that require thermal energy.

[5] The Australian Renewable Energy Agency (ARENA) undertook a study on renewable energy options for industrial process heat, which is currently sourced mostly by gas and coal in Australia. The authors found that solar thermal has potential, but there was industry reluctance to adopt the systems due to various factors. Other technologies, such as concentrated solar systems, were more expensive. Bioenergy such as bagasse (sugar cane), landfill gas, forest residues, agricultural waste, etc., was viable if sourced close to the point of production. Refer to ARENA (2019) *Renewable energy options for industrial process heat.*

There is also a need to address climate change globally, particularly as Cambodia is a country that is vulnerable to the effects of climate change (Smajgl et al., 2016). Promoting the idea of renewable energy to resolve climate change or as a 'green' alternative generation source is one approach to creating change in Cambodia's energy sector, but does it respond to EDC's concerns and is it actually effective? EDC's storyline about reliability is in fact more nuanced and Keo talks of the "uncontrolled expansion of solar on rooftops", which would appear to be exactly the situation that has occurred in Australia; however, solar PV was actually incentivised in Australia, rather than uncontrolled. It should also be stated here that Keo participated in a tour to Australia to "study how Australia is doing business and repositioning for the future of renewable in Australia" (Keo, 2019). Keo further states that he "got quite a lot of insights from that trip" and thanked the now former Australian Ambassador to Cambodia, Angela Corcoran, who was present at the event (Keo, 2019). It would appear that many of the insights Keo gained from the tour in Australia are those that he raised at the event about solar on rooftops. There is a need to acknowledge the challenges that extensive amounts of solar can have on an electricity network and incorporate new knowledge that has come from energy transitions occurring in Australia and Germany. As discussed by Hajer (1996), there is somewhat of an exclusion of new knowledge in the work of groups such as the Intergovernmental Panel on Climate Change, which leads to less flexibility in responses to environmental issues. This has the effect of centralizing knowledge within certain institutions, actors and technologies and limiting the ability to review policies that may need adjusting according to the new knowledge (Hajer, 1996, p. 278).

To provide some context on where new knowledge is occurring in energy transitions and concerns stated by Keo about "uncontrolled" solar, lessons can be taken from the present time in Australia. The Australian Energy Market Operator (AEMO) are sounding a warning bell that South Australia will very soon experience minimum demand due to the extensive amount of household solar PV being generated into the grid (AEMO, 2020c) On the surface, it would appear that minimum demand should not be a problem, as it means fewer fossil fuels are needed to provide power. However, it is creating problems for the electricity grid and, without enough storage or an ability to export excess electricity to other states, solar is generated during the day, which coincides with when household demand is at its lowest in South Australia. The current intermediate solution for South Australia is for the distributor, SA Power Networks, to have the ability to switch off household solar in the event of a potential blackout (Harmsen, 2020). For Cambodia, however, demand appears to be fairly

constant throughout the daytime hours, and rather than 'solar shedding', Cambodia has the opposite problem of load shedding due to too much demand, particularly in the dry season. So, again, the storylines of reliability and affordability from EDC do contain new understandings, but Cambodia is far away from the type of situation that is occurring in Australia at this time. However, due to awareness of issues that are being faced in Australia, I am reluctant to dismiss concerns about EDC being not 'green' or motivated by profit (Participant 3, 2017; Participant 10, 2018). Of course, there may be aspects of reality in those statements, but it is not the entire story.

Discussions about grid connected solar, uncontrolled solar and reliability may well lead to questions about the value of having centralised grids, which was the view I held at the beginning of this research and hence one of the interests for this research. There is awareness that the well-worn path of industrial and economic development tends to accelerate the need for more energy, particularly non-renewable energy, in the initial stages of development (Nguyen & Kakinaka, 2019). This has been the case in Cambodia and increasing electrification since the beginning of this research has precipitated that trend further. The Schumacher (1973), small is beautiful or decentralised approaches to systems of production, as discussed by Hajer (1996, pp. 84-86), appeared to be an ideal model for society, against the dominance and destruction of growth at all costs. However, there are several challenges for this approach in Cambodia. Firstly, a society that rejects growth is not the reality in Cambodia. On outward appearances, it would seem promising to see Cambodia throw off the bonds of 'least developed' country status (Royal Government of Cambodia, 2014; UN Department of Economic and Social Affairs, 2015), the grief of the Khmer Rouge and forge their own path – however influenced and financed by China it is (Heng, 2015; Sato et al., 2011). Notwithstanding the ecological destruction of growth and construction heaped upon constant construction in Cambodia, there is an energy and life that comes with the need for more electricity and it appears unstoppable.

Perhaps some people may prefer to return to a time in Cambodia when there was less consumerism, and many people do still live simply, with less electricity. But there appears to be no going back for Cambodia from where it is now and the way forward for energy appears to be the same path that most industrialised societies have followed, albeit an accelerated version. Cambodia does have the benefit of more advanced and affordable renewable energy technologies, so they can utilise these benefits to their advantage, while watching energy

transitions in other countries like Australia and Germany closely. We should also ask, what do people in Cambodia want and what sort of energy future do they envision for themselves? As previously discussed, several interview participants stated that people want grid electricity. This is not at all surprising, given it is often more affordable and provides sufficient energy to meet growing energy needs. Participant 12 (2018), also made the point that:

> The grid continues to expand. And whether or not you are getting the grid doesn't matter. What matters if you think you're are getting the grid, right? Continuing expansion of like cheap, low quality, low price, solar. And if you take... if you skip all the useful components. You buy a battery and you buy a solar panel. You got electricity. Right? That's cheap. (Participant 12, 2018)

The grid is expanding and that is what people are seeing. They will wait for the grid to come and, in the meantime, they can source their own electricity from a cheaper solar panel with a battery. That would also ensure that people own the system and it is affordable; however, lower quality products may breakdown sooner. It may not be a lot of electricity, in comparison with the grid, but it is likely to be an interim solution, before the grid arrives as expected. Sharma (2020, p. 309) also found similar aspirations for people in Bihar, a rural area India where millions of families did not have access to electricity. A solar micro grid project was set up in one of the villages by external actors to the state, including Greenpeace India and civil society organisations. The project was envisioned by the external actors to provide electricity for many purposes: residential, commercial and agricultural. However, expectations of energy demand were not met with the system provided, prices were higher than the grid and, "there was no financial rationale for using solar energy" (Sharma, 2020, p. 316). The project culminated with non-users of the system protesting when a Minister came to the village, stating, "we do not want fake energy, give us the real one", referring to grid electricity as "the real one" (Sharma, 2020, p. 313). For many people, the solar micro grid was an alternative to supplement their energy supply and for others it "was merely a stop-gap measure" (Sharma, 2020, p. 321).

The grid was the second most frequently discussed topic by Keo (2019) at the energy vision event in Phnom Penh and much of this discussion related either to expanding the grid, solar on the grid, or reliability of the grid. Keo (2019) also discussed rural electrification at the event, in particular the REF that started in 2007 in collaboration with the World Bank, but faced bankruptcy in 2012. Keo then stated:

> So I made the case to the government that we should put REF under EDC and make REF as the power sector Red Cross that will help channel grant aid for people in rural areas so that equity issue is addressed, especially rural areas are promoted, especially women and businesses in rural areas. (Keo, 2019)

As discussed earlier in this chapter, the solar homes market looked to become obsolete in the face of increasing electrification and the lack of solar home systems meeting peoples' growing energy needs. However, EDC contracted a Cambodian company to provide 14,000 solar home systems that were relatively small in size, approximately 80 watts (Participant 14, 2018 & 2019). Keo also confirmed that system sizes ranged from just 5 watts to 80 watts. As discussed in Chapter 5, energy needs in Cambodia grow quickly when people have access to electricity. Therefore, it is likely that similar limitations will be felt for villages that received the solar home systems from EDC: that as soon as their energy use grows beyond lighting, charging appliances and fans, the systems will be limited. Keo also stated in relation to the "expanded program" that:

> "the expanded program to make sure in the near future that solar home system will allow them to cook, three meals a day. So it will help them to curtail their activity in terms of encroaching on forested areas, the mangroves and fish need to spore, in the flooding season." (Keo, 2019)

Presumably the ability to cook relates to the use of rice cookers, which correlates to tier 3 access in accordance with the multi-tier framework discussed in Chapter 7. Tier 3 access provides for what is termed 'medium load' of 200 to 799 watts. This is enough to power an air cooler, fridge, freezer, food processor, water pump and rice cooker (Dave et al., 2018). Discussing the encroachment on forested areas with the use of wood fuel for cooking is, in many respects, a recognition of deforestation and concern about fish stocks, thus suggesting environmental awareness. However, the removal of mangrove areas in Cambodia has been attributed to various factors such as salt pans, charcoal production, urbanisation, resort development and the harvesting of select trees for fuelwood (Sharma et al., 2020). These issues are beyond the scope of this thesis to discuss, but it is unclear if providing people with tier 3 energy access would resolve the main drivers of mangrove deforestation in Cambodia. As previously discussed, former sources of energy are not completely discarded when people have access to other forms of energy (Participant 20, 2019; Smil, 2016; York & Bell, 2019). In addition, the use of fuel wood and charcoal may not be the most significant driver of deforestation of mangrove forests in Cambodia.

Other ways that EDC talked of solar was in relation to a 400MW heavy fuel oil and LPG plant, to be built by Chinese firms under an engineering, procurement and construction (EPC) contract (Chhut, 2019; Hin, 2019). The plant was given a positive spin by Keo, who used it as an opportunity to say that it was helping to open the path to solar. This again plays into the story line of security and reliability and that power plants, like oil, gas and hydro, are needed to "back up the renewable."

> And putting 400MW in Phnom Penh will also allow us to provide further opportunities for solar farms to take shape, because we can use this gen-set to back up the renewable. This is the main reason that we believe 400MW investment is important, even if we have to run the heavy fuel oil for perhaps [inaudible] years. (Keo, 2019)

Walker describes 'keeping the lights on' as a common narrative for talking about a secure electricity supply (Rinkinen et al., 2019, p. 70). Walker also states how, with this narrative, demand is non-negotiable and not to 'keep the lights on' would be a disaster (Rinkinen et al., 2019, p. 68). The narrative of 'keeping the lights on' is also discussed by Curran (2012) as directly correlating to security, reliability and affordability. This narrative is used by those who dismiss renewable energy as not being able to achieve energy security because of the nature of renewable energy as 'intermittent'(Curran, 2012, p. 240). However, Curran (2012) notes how renewable energy contributes to energy security in other ways through the diversification of energy sources, decentralisation of infrastructure and through lower emission generation. Some of these counter arguments were used by participants in Cambodia with one participant stating that aggregating distributed generation to act as a single power plant could be a cheaper source of generation for the government (Participant 13, 2018). The discourse of having a secure and reliable electricity supply is so common largely because it has credibility that it is rarely questioned. We do not hear governments or utilities promoting unreliable and insecure electricity supplies for their nations. Politically, it is a death sentence for many governments. Hajer (1996, p. 60) describes how this discursive dominance is achieved due to it being persuasive and because the counter narrative is not convincing. The counter narrative of an unreliable energy system is not appealing and although a renewable energy powered utopia may be preferred by many, it has never been demonstrated to the industrial scale of our societies. Part of the difficulty of the renewable energy sector to be persuasive is due to the nature of industrial society, where a focus on growth and continuous power output for industry is unquestioned. Thus, reliability discourse is "routinely reproduced" and energy actors in Cambodia have been unable to interrupt this reproduction to any significant extent (Hajer, 1996, p. 60). Given that Cambodia is rapidly

industrialising with increasing energy needs and unquestioned growth, it is far from surprising that reliability discourse is dominant.

Keo also noted that Cambodia is still using coal generation and that this would continue; however, stating that they know it is not the cleanest source of energy available. The reasoning, again, was related to reliability and that not to use coal would 'destabilise' the grid. Cost reduction was also noted as a factor to continue with coal, with Keo stating that solar was certainly a preferred option for the future – just not now.

> We know it's not cleanest. But at this junction, Cambodia cannot afford to eliminate coal from our generation mix, because to do so would destabilise our grid and would not bode well for cost reduction. Now I stated at this junction. In the future, we wish to see more renewables come online, especially solar parks. (Keo, 2019)

EDC are fully aware of the issues that can be created from too much solar on the grid, as mentioned in this chapter; however, there is an openness to solar from EDC in the form of larger scale developments where they have some control over the output. The push by the renewable energy industry in Cambodia to allow for solar PV on roofs in certain Special Economic Zones is a question that was raised at the EDC event, querying whether there will be regulations from the Electricity Authority of Cambodia to allow that. The company representative pushed this query further, noting a study done by the UNDP and pre-empting that the concern from EDC is related to a profit motive, whilst offering to compensate EDC for any loss of income. The response by Keo (2019) was resounding, and there was a sense in the response that the UNDP were not welcome to study tariffs in the country.

> Knowing the UNDP is doing tariff studies is quite a departure. I'll take it as a compliment. The issue for EDC is not so much about compensation. I keep stressing the grid stability. When we put a number, 12 percent or a goal to strive towards 20 percent of solar, we want to win that it is like that, because then we know what to do with the grid. If not taken properly, it should be a problem for the grid. That's why with these things you want to make sure that, although the compensation is one thing that is a small factor in the calculation, but the real stuff is – you don't want Cambodia to have 40 percent right now. It would be destabilising, trust me. (Keo, 2019)

The above question by an energy actor and the response by Keo point to a real lack of mutual understanding. There is almost a weariness about this response by Keo, noting that "I keep stressing the grid stability." The use of reliability or stability of the grid as a storyline from EDC is not allaying the full context of concerns and it is not helpful for energy actors in Cambodia to dismiss these claims or to state that these issues can be resolved as easily as installing a battery, although that may assist. As we see in Australia, there are issues to be

addressed, both with grid stability and affordability for people that actors in Cambodia would do well to address. Perhaps 'uncontrolled' rooftop solar, as described by Keo, really is not the right path for Cambodia at this time. There is, however, an openness and willingness for solar in Cambodia from the government and this is in part due to a need for additional generation and solar is a cheaper form of generation that can be built quickly. As an added incentive, it assists the government to have some 'green' credentials, as solar energy is largely seen as a benign form of electricity generation with minimal impact on the environment.

Bryant et al. (2019), in their analysis of 63 energy strategy documents across the European Commission and Australia, discuss the "energy rhetoric gap", which they identify as a lack of discussion of the financial viability of the current business models of utilities. They also identify a lack of engagement with new business models to complement increasing renewable energy. There is also a gap in the discourse of EDC and the Government of Cambodia on this topic; however, Keo does state, "at the end of 2020 we will undertake a thorough reassessment how much more room, from a fiscal standpoint, we can do more tariff reduction" (Keo, 2019). On the whole, however, despite the common viewpoint from energy actors that EDC were motivated by profit and concerned about losing business to solar, the discourse points towards seemingly minimal concern about EDCs financial viability. This lack of concern about financial viability is likely to reflect on EDC's level of control over decisions in the energy market in Cambodia. It is also worth considering a previously discussed point about the lack of incentives for the private sector to consider beneficial social outcomes (Turnheim & Geels, 2012).

The commonly used term for the phenomenon of utilities losing business from the rise of distributed solar generation is called the death spiral (Costello & Hemphill, 2014). The discourse from EDC, however, does suggest more concern from EDC about reliability, security and affordability of electricity, rather than of losing business. The concept of the death spiral for utilities arose around the 1980s, initially from dissatisfaction from customers about increasing electricity prices, due to utilities constructing ever increasing generation to meet growing electricity demand (Costello & Hemphill, 2014). The concern was that higher prices would lead to fewer sales of units of electricity and the stage is then set for a feedback loop of higher electricity prices and fewer sales (Costello & Hemphill, 2014, p. 8). The concept of the death spiral has moved beyond utilities building increasing generation to increasing distributed generation through household solar PV. The theory is that the death

spiral can lead to the same issue for utilities of fewer sales of units of electricity and generally higher prices overall, thus creating a feedback loop and the dreaded death spiral (Costello & Hemphill, 2014, p. 8).

However, Costello and Hemphill (2014, p. 10) also state that the death spiral is more of a concern for utilities in environments that are competitive and for utilities with fixed costs and limited regulations. It also presumes that utilities have no ability to adapt to a changing environment (Costello & Hemphill, 2014, p. 20). This would explain to some extent why EDC does not appear to be overly concerned about their revenue, as they are able to control the environment. As the state owned electricity provider, there is little competition, except where EDC allows and can control it. This would also explain why EDC is less concerned about larger solar PV installations, which are required to have a power purchasing agreement with EDC, and why EDC proactively attempts to limit household solar PV through regulations, such as those implemented by the Electricity Authority of Cambodia and discussed in Chapter 4 (Electricity Authority of Cambodia, 2018a).

The issue of tariffs and affordability of electricity is significant for Cambodia and this was a common discussion point for Keo. Unlike energy actors interviewed for this research, who mostly commented on energy prices in relation to PPA prices, the discussion from Keo was more directly related to electricity tariffs for people and industry. Out of the 41 instances of tariffs, comments about generation costs for various sources of energy were only made twice by Keo of his own volition. Several questions from members of the audience, however, did elicit responses from Keo about the generation costs of solar and wind about which he was generally quite positive. A representative from a private developer of wind farms that had been conducting feasibility studies in Cambodia, asked about the prospects of integration of wind into the grid, if it were not destabilising. Keo, in his response, noted that one test for any renewable energy on the grid in Cambodia is to ensure it is not destabilising and the second test is financial. He stated:

> I alluded you to the fact that there is a current meeting with ADB for a 60MW solar farm. I expect, this solar farm project will produce a tariff at less than 6 cents. That will become the new benchmark for renewable in Cambodia. So if, wind power project can give roughly the same tariff more or less, you are going to be one of my guests. (Keo, 2019)

Two interview participants, however, did raise concerns that some of the solar projects being implemented were financed by loans from ADB and bid at such low prices that outside

companies found it difficult to compete (Participant 4, 2017; Participant 13, 2018). Participant 13 (2018) clarified this further, noting that:

> I think what ADB or what the government has proposed is for the government to buy the land, to buy and presume the ADB providing loans to the government to purchase the land and to build the transmission and interconnection infrastructure so that the solar park developer will only have to pay for the panel... They'll have to build and finance the panels and simply the solar bit of it. So they're really trying to push the price down. (Participant 13, 2018)

Tensions about the inability for outside companies to compete were also apparent in another question raised at the event. The questioner asked about the use of land for solar projects and the discrepancy between a PPA price of 6c kWh and the cost of land acquisitions and construction. Keo's response to this question was very matter of fact and made it quite clear that it is EDC and the Government of Cambodia that will control and choose who develops energy projects in the country. Keo states:

> Cambodia is still blessed with a lot of land – believe it or not. You may see headlines about land grab, about land protest, but we do have a lot of land that can be used for agriculture and industry expansion, as well as energy development. We have been approached by some company to do floating solar – on hydro power reservoir. But I have not given any support to that because I would like my hydro reservoir to be clean and to be used for eco-tourism. We still have land for example in Kampong Chhnang, Pursat, Siem Reap and the north east is very cheap. And in fact, the 60MW 7.6c per kWh project is just 45 minutes from here, by car. Speaks volume about the land [inaudible] that is still rural. The ADB project with EDC, we expect the costs to come down to about 5 plus cents - 6 for sure we expect. Because we have acquired the land, by ourselves – we give the developer no headache about land. And we give the interconnection facility, 1.5 kV [kilovolts]. (Keo, 2019)

Specific land use issues raised in the above quotation are beyond the scope of this thesis, but there are obviously many intersections with land and energy development in the country – both with issues of deforestation, and with the use of land for energy developments. Keo's comments about not providing support for floating solar due to stating that he "would like my hydro reservoir to be clean" speaks to what Hajer (1996) refers to as belief systems, and it appears to be an individual belief. Keo also clearly indicates that this is his preference with the use of "I would like", not the government or people of Cambodia would like. People in Cambodia may, however, also hold this view. It is unclear why Keo holds this view, but his comments about mangrove destruction and fisheries, could point to concern about the impact this may have on water bodies in the country. A study by Haas et al. (2020) found that there is an optimal coverage of floating solar PV on hydropower reservoirs of approximately 40 – 60 percent. Above that percentage, the level of algal blooms decline to levels that may be harmful to the health of the water body, as well as reducing the revenue of the hydropower

plant. As noted, it is unclear why this view is held by Keo, but it could relate to multiple aspects, including hydropower revenue, health of ecosystems and potential impacts on tourism, as stated by Keo.

Floating solar is an area that several energy actors are advocating for in Cambodia, as evidenced at an Energy Dialogue meeting I attended in Phnom Penh in April 2019. Minutes from this meeting were taken, but are not included in this thesis to ensure the confidentiality of people present at this meeting, some of whom were not participants of the research. Two energy actors at this meeting promoted floating solar and stated the benefits due to the lack of land needed and that it was minimally more expensive than rooftop solar. They noted that additional costs are mitigated by the lack of land needed. One international NGO suggested a pilot project or trial of floating solar. Only one person present at this meeting, a Cambodian working for a foreign government, asked about changing water levels and the environmental impacts of floating solar. His question was not answered at this meeting.

8.4 Challenges for transnational energy actors to influence energy development in Cambodia

One of the most significant themes that emerged from the interview data was the challenges for the renewable energy industry to engage with decision makers on energy development in Cambodia. As discussed, one of the crucial decision makers in relation to energy identified through this research is EDC, so this section will discuss the challenges for the industry to engage with EDC. Other influential organisations in Cambodia in relation to energy include the MME. Participants, 9, 13, 15 and 19 had engaged with MME on various occasions, however, Participant 20 (2019), who had been in Cambodia for an extensive period, over decades, discussed the changes that have occurred over time with Ministry counterparts, particularly MME:

> Well, first, our main governmental counterpart historically has been the Ministry of Mines and Energy, which I guess initially worked well just because of the people were our human points in this ministry which seem to be quite sensitive to the topic of biomass energy.
>
> However, things have changed. People have changed. Priorities have changed and nowadays, Ministry of Mines and Energy is very, very focused on electricity. I mean they do seem to have a long way to go to be able to meet the demand. So they are really, really completely not interested at all anymore in biomass energy (Participant 20, 2019).

Some in the renewable energy industry expressed a lack of understanding by EDC and where their interests lay. As noted by Participant 9 (2017), "I don't really know EDC in the end. It's hard to be able to talk with them." This lack of engagement with EDC was raised several times with interview participants. Another participant noted that the Australian Department of Foreign Affairs and Trade (DFAT) and the Asian Development Bank (ADB) were focusing incorrectly on the Electricity Authority of Cambodia (EAC) instead of EDC, thinking that the regulator has power as is the case in Thailand. Participant 10 (2018) stated: "And that's a pitfall because the regulator in Cambodia does not have any power. EDC has all the power." When asked if the participant felt that the EAC are more approachable than EDC, the response was yes, "because they speak more English" (Participant 10, 2018).

Another interview participant, when asked if they work with EDC much, noted that they had tried to approach EDC through their work, and had difficulty in doing so as they worked on the "green side of technology" and asked "why would they care to work with us?" (Participant 3, 2017). This same participant also stated that they would need to show that connecting solar energy to the grid will not make them [EDC] lose business (Participant 3, 2017). A similar comment about solar farms taking away EDC's business was also made by Participant 10 (2018), and is the same comment as was made by a business owner at the energy vision event discussed previously. As discussed, concern about losing income was emphatically denied by Keo (2019). There may be an element of truth to the comments from interview participants about EDC losing business; however, it does appear to be overstated, as there is also value for EDC in having lower cost solar generation on the grid.

Discourse from Keo and energy actors in Cambodia relating to the issue of land and how EDC are crowding out any ability for some private actors to be able to compete with low PPA prices provides an alternative, perhaps unspoken, aspect to EDC's control over solar developments in the country. In particular, EDC project significant influence over the market and political power to prevent significant changes or outside influence in the energy market. This particular factor of 'influence' was identified by Arranz (2017), who examined factors that led to regime destabilisation and resistance in past energy and transport technological transitions. Arranz (2017, p. 136) describes factors of destabilisation and forms of resistance in previous transitions across a range of industrial and non-industrial countries. Several factors of destabilisation are identified, including health and lifestyle (pollution, hygiene), economic fundamentals (scarcity of resources, population growth), centralised power

(bureaucracy, powerful lobbies, knowledge and capacity), ideals (progress, equality, etc.). These are just a few of the more relevant factors of destabilisation identified by Arranz (2017, p. 136) and can be seen in what is currently occurring in Cambodia: in particular, scarcity of resources, concerns about pollution, centralised power and ideals of progress. In addition and perhaps more interesting are the forms of resistance, such as challenging of evidence, risk aversion, influence and moral/political suasion (Arranz, 2017).

As can be seen in Table 1 (Chapter 2) Arranz (2017) identified a form of resistance that he termed 'influence' from the entrenched monopoly in the example of Hong Kong's electricity provider, which was dominated by coal and oil prior to the oil crisis of 1973 (Moss & Francesch-Huidobro, 2016). This research has shown that EDC influence direct control over Cambodia's energy market; however, unlike Hong Kong, Cambodia's market is also open to other actors and states, particularly in relation to power imports from Vietnam, Thailand and Laos. There could also be said to be a challenging aspect from EDC, towards expatriate energy actors in Cambodia, by finding fault with the calls for more solar on the grid. However, the situation in Cambodia is slightly different from that identified by Arranz (2017) and I would interpret EDC's resistance with their discourse of reliability, affordability and to some extent equity, as incorporating new knowledge of challenges occurring with energy transitions in countries like Australia. Rather than 'finding fault' as identified by Arranz (2017), EDC have identified and articulated new challenges and knowledge that arise with the inclusion of renewable energy. What is particularly interesting about EDC's discourse is the inclusion of equity as a concern, with the statement of "where rooftop can also drive costs for non-rooftop users" as well as the statement "It's going to take a different type of conversation" (Keo, 2019).

As discussed, most interview participants stated that the trepidation from EDC about having too much solar on the grid was related to losing income and a profit motive. However, it appears that the reality is a bit more nuanced and is more about controlling development on the grid. Having control over the solar that is introduced into the grid, allows EDC to ensure that it can manage the frequency and voltage on the grid at this early stage of grid development or "nascent" grid as it is described by Keo. In addition, there is the risk, as stated by Participant 13 (2018), that too much solar will lead to less demand for electricity. As Cambodia has long term contracts in place to purchase power from Vietnam and Laos, lower electricity demand from increased solar may leave Cambodia purchasing redundant

power. The power outages in 2019 in Cambodia also led to an announcement by the Government of Cambodia of the purchase of 2400MW of power from a coal plant to be constructed in Laos, beginning in 2024 (Chea, 2019a; Ha, 2020). The contract is reportedly for 30 years and there are concerns about the longer term impact for Cambodia purchasing power at a price that may ultimately be higher than the cost of solar generation within Cambodia (Asia News Network, 2019). If the purchase of power is a take or pay contract, it means that whether Cambodia needs the power or not, they still have to pay (Participant 13, 2018).

Transboundary power purchasing also has the potential to create injustices for people in Laos, such as the loss of land and livelihoods with increased hydro developments. Marks and Zhang (2019, pp. 298-299) discuss how power developments in Laos foster the construction of shopping malls across the border in Bangkok and that these developments embody notions of progress and modernity for Thailand. Transboundary power purchases are beyond the influence of the participants interviewed and are happening quickly at vast scale. Added to this challenge and the ability to influence energy development in the country, is the scale and speed of the development that is occurring. It is not difficult to see the purchasing of power from Laos by Cambodia, having the potential to create similar inequitable outcomes for people in Laos. Cambodia also imports electricity throughout the year from Vietnam, which is needed "to stabilise the grid", alongside the need for additional power in the dry season when hydro generation in the country is below its rated capacity (Participant 13, 2018). As electricity demand in Cambodia is growing quickly, with an average annual growth rate of 18 percent between 2010 and 2016 (Economic Research Institute for ASEAN and East Asia, 2019), more energy is needed now as the power outages in 2019 showed. It is promising that there is an openness to solar PV on the grid, even if EDC wished to control this through power purchasing agreements with the developers. However, the push for continued economic growth in Cambodia has led the scramble for additional power. This need for speed legitimizes the purchase of coal fired power from Laos, with minimal consideration of the impacts of this decision on both people in Laos and in Cambodia if power prices increase significantly in the future.

One of the most significant challenges for interview participants in influencing energy development in the country is strongly related to the lack of access that they have with influential decision makers, such as EDC. As discussed by Kooij et al. (2018, p. 53), access

to energy markets or institutions of political decision making determines whether actors are able to participate and hence have influence over decisions being made. In the case of Cambodia, this research has shown that most interview participants have limited access to the most influential decision maker, EDC. However, during this research – from the initial interviews in 2017 to the most recent in the country in 2019 – there was a shift in the collaboration of expatriate and also Cambodian energy sector actors in Cambodia. From observations, this collaboration was significantly influenced by Participant 11, a clean energy advocacy entity. In the period this research was conducted, Participant 11 (2018) was instrumental in bringing together various stakeholders in the country in attempts to influence energy development and create a form of 'grassroots initiatives' for renewable energy.

Although it is positive that energy actors in Cambodia are working together more as a coalition, energy actors in Cambodia may need to have a "different type of conversation" as stated by (Keo, 2019) and discussed earlier. In particular, actors interviewed for this research would be wise to consider equity and affordability issues further with the technology choices they promote. Various lessons have been learnt from energy transitions in Australia and Germany, particularly regarding equity and affordability, as articulated by Keo. Focusing on a 'profit motive' or that 'EDC are not green' may miss an opportunity to influence energy development in Cambodia effectively towards a more sustainable path. This research has identified that EDC's concerns about reliability and affordability are valid and also that their forms of resistance cannot be wholly attributed to a profit motive or that they are not interested in sustainability. The discourse analysis undertaken in this research shows that EDC are not overly concerned with issues of losing business as they have market control and influence in Cambodia. This is currently not being threatened. In addition, to maintain legitimacy among the population in Cambodia, EDC needs to provide affordable and preferably reliable electricity to people. Expatriate energy actors in Cambodia have not shown that they can effectively achieve this with many of the solar homes systems that have been provided to communities. Thus, energy actors in Cambodia advocating for an energy transition would be best placed to understand the concerns of EDC and actively work to offer solutions that achieve the same goals and aspirations of affordability and reliability of energy supplies in Cambodia over the long term.

To conclude, this chapter has analysed discourses articulated by various actors in the energy and international development sector in Cambodia to determine the influence that these actors

have on energy development in the country. My research found that, among several expatriate actors working on energy in Cambodia, there was a lack of discourse about the cost of electricity for people, even though this was a stated priority for the government and EDC. Several energy actors interviewed in Cambodia have provided solar home systems to people who lacked access to electricity; however, these systems were often expensive, did not meet people's growing energy needs and the systems regularly experienced battery failure. An overall lack of trust in solar, as well as increasing electrification in the country, has rendered the solar homes market less viable. However, some expatriate energy actors are still operating in this market and navigating their businesses towards either grid connected solar, or an 'energy as service' model in areas that are not grid connected, even as people have expressed a desire for ownership over systems. Challenges for expatriate energy actors have occurred with attempts to increase grid connected solar in the country, through regulations that restrict the export of solar to the grid and a significant lack of influence with the main energy actor, EDC. EDC are open to larger scale solar projects amid a need for more power, however there is a reluctance from EDC to have 'uncontrolled solar' due to concerns about 'reliability' and increased costs for non-solar households. This research furthers understandings about various energy actors in Cambodia and the challenges they face in attempting to move the energy sector towards a more sustainable path. This research also contributes to the energy transition literature in the context of Cambodia as a least developed country that is rapidly industrialising with growing energy needs. The following chapter will discuss this contribution further, address the limitations of the study and make recommendations for future research in Cambodia.

Chapter 9: Prioritising equity in Cambodia's energy development

9.1 Conclusion and main findings

This thesis has investigated the factors influencing energy development in Cambodia and how discourses articulated by transnational energy and development actors, within the renewable energy sector are shaping the course of energy infrastructure and policy in the country. Using techniques of discourse analysis (Hajer, 1996), I investigated the influence of transnational actors on energy development in Cambodia through policy documents, English language articles and semi-structured interviews with professionals working within the renewable energy and development sector in Cambodia. I also employed ethnographic processes with fieldwork observations in Phnom Penh and observations of a rural village level electrification project in southern Cambodia. Perspectives from influential energy actors at the regime level in Cambodia were also examined by analysing discourse by the Managing Director of Electricite du Cambodge (EDC), Keo Rattanak, at the energy vision event in Phnom Penh.

The path of energy development in Cambodia today is shaped by regional and global influences of industrialization and modernization (Wong, 2012; Yang et al., 2018). This development model promotes and necessitates high electricity consumption, particularly in some sectors of the economy in Cambodia, such as construction, as discussed in Chapter 6. However, paradoxically this 'excess' of energy consumption has also lead to a scarcity of energy to fulfil human needs, as discussed in the context of the energy shortages in Phnom Penh. Research for this thesis began with a comprehensive literature review providing the context of development and industrialization from the post-World War II period to contemporary Cambodia in an era of sustainable development. I reviewed and applied theories of development, modernization and more recent scholarship on energy transitions and energy justice to provide a historical context to the many factors influencing energy development in Cambodia. This beginning provided an important grounding in history and influential global trends in addressing the research question of how discourses voiced by transnational energy and development actors have influenced energy development in Cambodia.

The main findings demonstrated through this thesis are that the transnational energy actors interviewed in Cambodia have limited influence, and there is a lack of mutual understanding

in their engagement with decision makers on energy development in Cambodia. Exceptions to this influence did occur, in the case of projects that provided power in rural areas that may take a long time to be connected to the grid (as discussed in Chapter 7) and in the need for additional power in the short term (Chapter 6). In both instances, this thesis showed that influential state actors, such as EDC, are open to solar energy when it serves their identified needs. Nevertheless, several factors were identified that contributed to transnational energy actors lack of influence in Cambodia in Chapters 5 and 8. One of these factors was the restricted usefulness of solar home systems in Cambodia due to the limited power output of small systems and their expense. With growing energy consumption when people have access to electricity, issues with battery longevity were soon apparent, as people added additional appliances to their solar home system. Many of the systems provided by energy actors in Cambodia also frequently cost more than grid connection. When energy was offered as a "service" (Participant 12, 2018), the tariffs and monthly payments were, at times, significantly higher than grid tariffs. This was also the case for the solar micro grid project discussed in Chapter 7, which had significantly higher tariffs for residents than the grid, but was lower in comparison with previous costs of energy for battery recharging and diesel use.

There was also a lack of discourse from transnational energy actors about the cost of electricity for people; however, this was a stated priority for influential state energy actors (Chapter 8). The research identified the EDC as a regime actor in Cambodia, was not threatened by solar developments or solely motivated by profit because it had significant influence over power developments in the country. The form of resistance to technological change that EDC exhibited in Cambodia can be likened to what Arranz (2017, p. 136) terms simply as "influence" (discussed in Chapter 2). This infers that EDC has direct control (and influence) over the energy market in Cambodia and in this way, it can prevent or allow change at its own discretion. Keo (2019) expressed support for solar energy in the country, but also expressed valid concerns about reliability and energy affordability. Resistance toward the "uncontrolled expansion" (Keo, 2019) of solar from EDC was met with economic and techno-rationalist responses from transnational energy actors. Energy actors interviewed spoke of Power Purchasing Agreement (PPA) prices, grid connected solar and how solar energy was a cheaper form of power generation for Cambodia; however, there was minimal discussion on the cost of energy for people. Meanwhile, EDC spoke of reliability and affordability of electricity for people and industry as main priorities. It is likely that the

benevolence in EDC seeking affordable and reliable electricity for people is also an attempt to seek consensus and limit opposition as identified by Norén-Nilsson and Bourdier (2019).

In response to questions from transnational actors in Cambodia about the potential for rooftop solar in Cambodia, Keo (2019) referred to cases of rooftop solar driving costs for non-rooftop solar customers in the UK, Germany and the United States, stating: "We don't want that situation either. It's going to take a different type of conversation" (Keo, 2019). When issues of energy affordability were raised, it appeared that these concerns were not acknowledged or taken up as an issue to be solved by many transnational energy actors in Cambodia. Some actors interviewed felt that EDC were motivated by profit, as discussed in Chapter 8, hence the expansion of solar energy on the grid would impact on that profit. However, through discourse articulated by Keo (2019), it was clear that a significant concern for EDC was the reliability of the grid that EDC needed to manage, and stated concerns about potential distributional impacts of increasing rooftop solar in Cambodia. This thesis has shown that there are equity and justice issues to be considered on the journey towards renewable, or low carbon energy transitions, as evidenced through recent literature and discussed throughout this thesis (Ansarin et al., 2020; Golubchikov & O'Sullivan, 2020; Johnson et al., 2020; Mastropietro, 2019; Monyei et al., 2019; Sovacool et al., 2019). Thus, comments by Keo are accurate and current, reflecting issues that are occurring for many developed economies undergoing energy transitions and low carbon developments. In arguing for equity considerations in climate policy, Klinsky et al. (2017, pp. 171-172) also make the important point that equity issues can enable inaction for climate change policies and it is essential that people are not further disadvantaged through low carbon technology and policies. It is therefore prudent for transnational energy actors in Cambodia to have that "different type of conversation" (Keo, 2019), and consider equity issues in any recommendations made on technology paths for Cambodia.

For rural electrification, demand in Cambodia is growing in response to the supply of electricity as people add more appliances to solar home systems when they have access to some electricity. The additional load on small solar home systems causes problems when batteries were discharged beyond the rated depth. This leads to batteries having a very short life span; however, it is an issue that could be resolved by the inclusion of a charge controller that serves to prevent deep discharging of the battery. Charge controllers were not provided for smaller solar homes systems, as additional components in the system increased the cost

for rural electrification. Many solar home systems that were provided in Cambodia were often expensive, either through higher tariffs, or through repayments on the systems, which left people with debt. Many of these systems were also too small, ranging in size from 80 to 250 watts, with the most popular size being approximately 135 watts, at a cost of USD 450 and up to USD 800 – depending on the components provided (Participant 6, 2017). These solar home systems were not only expensive, but they also did not meet people's growing energy needs and the systems were likely to break down, due to the aforementioned battery failure.

Some energy actors in Cambodia provided solar homes systems on a 'pay as you go' or post-pay basis, where the service cuts out if a bill or payment is not made. As highlighted by Von Schnitzler (2013) and discussed in Chapter 8, this type of arrangement can entrench a precarious existence and, in the case of Cambodia, on the post pay or debt financing systems, some people may be left with costs to pay for a solar home system, that no longer functions, or provides very limited electricity. It is acknowledged, however, that lessons have been learnt from transnational energy actors in Cambodia, but with further electrification in the country and a lack of trust in solar (Participant 3, 2017), many people are likely to reject solar home systems in preference to having grid electricity (Participant 10, 2018). Grid electricity is also significantly more affordable than many of the solar homes systems provided, with grid connection costs ranging from USD 75 to 300 (Participant 8, 2017; Participant 11, 2018; Participant 13, 2018; Participant 14, 2018 & 2019). There are, some areas of Cambodia where connection to the grid is not feasible or would take a long time to reach, as acknowledged by Keo (2019). It is in these areas where the Participant 14's organisation, a niche level transnational actor, has provided power to villages that were previously using lead acid batteries that required frequent recharging and unaffordable diesel systems. At the time of visiting the project site discussed in Chapter 7, the community were mostly satisfied with the solar micro grid system provided by Participant 14's organisation, as it was an improvement on batteries and the expensive diesel they had relied upon before. There were, however, some concerns about transparency and visibility of energy use in the community, as many people in rural areas do not have their own meters (Participant 6, 2017). Thus, there was some lack of trust detected, which has the potential to unravel projects if not addressed.

The methodology and theory of discourse analysis used in the research is discussed in Chapter 1. Chapter 3 provides further discussion about the methods used, including the

textual analysis of six main policy documents and the sourcing of interview participants in Cambodia. Chapter 3 also introduced a solar micro-grid project as a fieldwork observation of a niche level energy project in Cambodia. Energy related policy documents in Cambodia were analysed in Chapter 4 and coded to capture broad thematic nodes (Appendix 1). Several of the policy documents analysed contained aspirational statements of development to move beyond the status of a 'least developed' country, according to UN classifications. Poverty reduction and developing the capacity of institutions, as well as providing further education and training for people in Cambodia were also common themes throughout the policy documents. However, as discussed in Chapter 4, claims of a commitment to poverty reduction in the policy documents is contestable, when there is a clearer commitment to ensuring a stable business environment for investors (Springer, 2015). Industrial development was referred to in several of the policy documents, with electrification of the country a key priority and the industrial development policy noting that a lack of "stable electricity supply at a competitive price" is a challenge for industrial development (Royal Government of Cambodia, 2015b). Equity was a core theme of the evolving Rectangular Strategy, on which Cambodia's National Strategic Development Plan is based. However, a reliance on the private sector for energy infrastructure was also apparent in the policy documents. As noted by Turnheim and Geels (2012), private actors have minimal incentives to address societal issues and an overreliance on the private sector for infrastructure may place Cambodia at risk of higher electricity prices in the future, and thus limit goals for equity and poverty reduction in the country.

The policy documents indicated that economic growth and development appears to be a fundamentally fixed path that Cambodia is following. Examples of black boxing (Hajer, 1996, p. 272) were also apparent in the climate change strategy, where even as Cambodia faces the prospect of increased disasters with climate change, economic growth will continue as an unquestionable reality. Energy development in the policy documents also reflect a focus on energy *for* the purpose of development, and not necessarily for the energy needs of people, thus reflecting the fixed and hegemonic nature of industrialization. There is, however, a noted focus on rural electrification and the costs of electricity for people and industry alike in the policy documents. The Electricity Law 2001 is a substantial piece of legislation that includes consumer protection as a fundamental principle, ensuring that consumers receive "reliable and adequate supply of electric power services at reasonable cost" (Electricity Authority of Cambodia, 2001, p. 6). Any private entity supplying electricity in Cambodia is also required

to have a licence that is issued by the Electricity Authority of Cambodia (EAC). However, in some cases, as discussed through this thesis, this does not occur and it is unfortunate that some consumers in Cambodia have paid more than they should have for the supply of solar energy.

On growing energy needs, Chapters 5 and 6 provided an understanding of what growing energy demand in Cambodia looks like. Chapter 5 questioned the increasing demand for electricity in a city such as Phnom Penh for the purpose of serving an industrialised development pathway, rather than the fulfilment of actual energy needs of people and society. Chapter 5 showed this contrast between increasing energy demand in Phnom Penh, a city in the midst of a building boom, while cooking with wood fuel is commonly seen on the streets of Phnom Penh and some rural areas still have limited electricity access. Chapter 7 also questioned the motive of some transnational actors to provide energy for productive use, which has as its core logic, selling products to people to increase electricity consumption. The purpose of increasing electricity for productive use was to enable the profitability of the 'solar as a service' model offered by some transnational actors and the circular logic of helping people to "earn more money", so "they can buy more stuff" (Participant 12, 2018). There is limited framing or questioning of energy use, to ask, what is energy for? Chapters 5 and 7 go some way to answer this question in Cambodia, however, more research needs to be undertaken to understand the interactions with energy and technology from the perspective of people and industry in Cambodia. First hand voices, representations and perspectives on energy from Cambodian people is missing from this thesis, which is a limitation. I have attempted to resolve this, by understanding second-hand accounts of issues that people are experiencing in Cambodia from interview participants and also through direct observations in the country.

The interviews with transnational energy actors in Cambodia provide a discursive understanding of the work and anticipated progression of solar energy development as perceived by these actors. The imagined solar energy future of energy actors is met with some resistance by EDC who operate on the regime level in Cambodia and have considerable influence, of which they exert over the energy sector. The transnational actors interviewed attempt to disrupt this, mainly through the provision of off grid electricity, firstly through solar home systems and, more recently, as that market falls away, through grid connected solar projects. Transnational energy actors interviewed in Cambodia were mostly focused on

renewable energy supply – for Cambodia to embrace renewable energy as a form of sustainable development and for people and industry to have access to power. At the national level, energy demand is growing quickly. New buildings appear in the skylines of Phnom Penh and Sihanoukville with significant frequency and the construction and development appears unstoppable. Power for the most part over the years prior to 2019 was reasonably consistent in meeting demand according to interview participants; however, there was never really a view of power supply in Cambodia as being reliable per se. The energy crisis, or perhaps more accurately, the growing energy excess, combined with drought in the country caused two and a half months of daily load shedding across Phnom Penh between March and May, 2019. Chapter 6 discusses these outages and is a stand-alone chapter observing daily life in that time and how the Government of Cambodia attempted to resolve the shortages through the various decisions reported in the English language press at the time. There was talk of a 200MW floating power ship from Turkey to come to the rescue, which was quickly scrapped and replaced by discussions of more solar and a commitment to a 400MW liquefied natural gas and heavy fuel oil plant to be built in Kandal province (Chhut, 2019; Hin, 2019). Overall, the period of electricity outages had a relatively positive impact on solar, with several larger solar projects being announced at this time.

9.2 Significance and limitations of research

This thesis provides an original contribution to knowledge in the energy transition literature by furthering understandings of the discourse of transnational energy actors attempting to increase renewable energy in Cambodia, and the resistance they face from regime actors in the country. As discussed by Hansen et al. (2018), the transition literature emerged from Europe, specifically the Netherlands and Germany, thus understanding the context and factors in non-Western countries that create resistance by regime actors in Cambodia contributes to an identified gap in the transition literature by Hansen et al. (2018, p. 202). In addition, Hansen et al. (2018, p. 201), discuss the fragmented nature of niche level projects in countries such as Kenya, where there is no cultivation and sharing of information about niche level projects. The lack of development of niche level projects in countries like Cambodia suggests that these projects are not likely to be transformative. The niche level project discussed in Chapter 7, has the potential to be transformative and provide electricity to areas that are unlikely to be electrified in the near future. However, the cost to supply electricity is higher at the project site discussed in Chapter 7. Therefore, providing affordable electricity

for people is likely to require additional support from the state, potentially in the form of a tariff subsidy. If that were to occur, it would be prudent for Participant 14's organisation to openly share information about lessons learnt at each project site, to ensure capacity within state institutions is developed.

Attempts by transnational actors to influence energy development in Cambodia towards a more sustainable path come at a time of increasing energy demand in the country and region. Many of the participants interviewed face resistance in their attempts to provide seemingly logical, techno-economic solutions for energy supply; however, these solutions do not always sway influential state actors in the country. This thesis provides a necessary seeking of answers for this resistance and demonstrates that there is a stated focus by state actors on ensuring affordable access to electricity for people and industry behind their simple storylines. However, transnational energy actors and state actors in Cambodia are limited in their ability to achieve mutual understanding through the use of simple storylines. The seeming benevolence of state actors in achieving development, energy access and affordability, may also create injustices elsewhere in the case of infrastructure projects both in Cambodia and Laos, which have the potential to displace people from their land and livelihoods. This research did not examine issues of cosmopolitan justice in depth, but it is an area of recommended future research, particularly as energy development increases in both Cambodia and Laos.

This thesis suggests issues of equity and justice are prioritised in energy planning for Cambodia and the region. As discussed in Chapters 2 and 8, energy injustices and the further entrenching of disadvantage also occur with renewable energy transitions, despite how benign these sources of energy may appear and the seemingly greater good of low carbon development. The renewable energy sector is not immune to, or excluded from considering equity issues. In fact, it is suggested that transnational energy actors in Cambodia, NGOs and development agencies discuss these issues further in the public realm in Cambodia, and prioritise equity and affordability of electricity as a central theme of Cambodia's development plans (refer to Chapter 4) and as prioritised by regime actors such as EDC. From this discourse, transnational energy actors working towards a renewable energy transition can attempt to find mutual understanding on these issues with influential state actors in the country, particularly with EDC. Actors such as EDC have raised issues that do

need to be addressed in Cambodia, particularly in relation to affordability of electricity for people.

Transnational energy actors in Cambodia may also benefit from incorporating the local context more, instead of suggesting solutions from countries such as Australia and Europe that have seen significant increases in electricity prices, impacting on the most disadvantaged (Chapman et al., 2016; Mastropietro, 2019). In relation to equity concerns, EDC's Managing Director, voiced concerns about reliability and affordability with increasing renewable energy on electricity networks in the UK, Germany and the United States (Chapter 8). Dismissing these concerns or offering transplanted solutions from developed countries will arguably not work for the benefit of people in Cambodia. Ultimately, pushing solar on the grid when there is resistance may be counterproductive at this time. It may be better for transnational energy actors committed to an energy transition in Cambodia to really listen to the concerns of state actors such as EDC and cut through the lack of mutual understanding identified in this thesis. Most importantly listening to people in Cambodia about their own view of energy development in the country is also important for any transnational energy actor in Cambodia. Renewable energy actors in Cambodia may find themselves being further locked out of discussions with influential actors in Cambodia if they do not attempt to address these issues, or understand some of the reasons behind influential actors' reluctance to wholly embrace a renewable energy transition.

This thesis has focused on transnational actors in Cambodia, involved in the renewable energy and development sector only. The transnational actors interviewed are not a homogenous group, but are individuals and organisations who utilise discourse and storylines (Hajer, 1996, p. 69) in their advocacy for more renewable energy in Cambodia. Over the time of this research, there was a coming together of many of the transnational actors to achieve a common goal of increasing renewable energy in Cambodia. The limitation in this thesis, is therefore, its focus on energy discourse articulated by transnational actors who are mostly working on renewable energy projects. Discourse from other actors, such as Participant 10 (2018) from a Rural Electrification Enterprise, and Participant 7 (2017), an anthropologist, are included. However, representations by other voices are missing, including sectors and actors that I was unable to access, such as those in the coal and hydroelectricity sector, or the finance sector, such as the World Bank and ADB. Following the flows of finance and the patronage networks across the energy sector in Cambodia may lead to other conclusions;

however, this was beyond the scope of this research. Also interviews with local actors beyond the EDC would be useful in understanding the diversity of views on energy development in the country. As a non-Khmer speaker in Cambodia, I was unable to survey street vendors in the country or discuss the niche level project discussed in Chapter 7 with people living at the project site, except with translation assistance. The ability to converse in Khmer would likely have provided additional insights and nuance to answer the secondary question of how the energy needs of people are considered in Cambodia and this is a limitation of the research. However, it is also acknowledged that this type of research would have required further ethics approval to survey the broader community in Cambodia.

9.3 Recommended future research

Based on the research discussed in this thesis, there is limited understanding of the equity and justice impacts of the energy transition that Cambodia is undergoing through electrification. As Cambodia follows an increasingly industrialised path of development, future research could ask, how does electrification of the country and interconnection with the region impact energy access, affordability and livelihoods for people in Cambodia? This line of questioning would necessarily require further understanding of energy practices in Cambodia and interactions with energy sources and technologies from the perspective of Cambodian people. Such research could be done by Cambodian scholars. Undertaking this research would also require further investigation into Cambodia's energy market, and widening the research to other, potentially more influential actors such as ADB, the World Bank, Chinese institutions and global firms that are active and successful in the Cambodian and regional power sector. To gain a fuller picture of the energy sector in Cambodia and an understanding of its influential actors, it is recommended to extend the research on energy actors out to Laos, at a minimum. Although Cambodia also has agreements in place to purchase power from Vietnam and Thailand, it is particularly pertinent to understand agreements and perspectives of stakeholders in Laos, where it appears Cambodia will be purchasing a significant amount of electricity in the near future. This thesis has raised equity and justice implications regarding energy development in Cambodia, which could be researched further from an equity perspective and by applying an energy justice model to Cambodia and the region. This approach would assist in understanding how transnational and local actors working on renewable energy projects in Cambodia can help to ensure that equity is a fundamental principle in the technology choices for people.

Further research is also suggested on transnational and local niche actors in Cambodia and following up on the projects discussed in this thesis, specifically the rural electrification project discussed in Chapter 7. Understanding the longer term prospects and influence of actors involved in rural electrification and their interaction with state actors at the regime level would extend the transition literature out to niche actors in developing country contexts. This type of research may provide avenues for Cambodian actors to support innovation and rural electrification on a broader scale.

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Appendices

Appendix 1 – Cambodian policy coded themes

Appendix 1 - Cambodian policy documents NVivo coded themes

Coded theme	Number of files	Number of references
Governance and institutions	6	221
Poverty	4	170
Capacity, information and education	5	160
Electricity supply and energy	6	148
Economy and development	5	139
Investment, trade and markets	6	125
International cooperation (incl. ASEAN and China)	4	115
Sustainability	5	114
Adaptation, resilience and disaster risk reduction	5	109
Equity, equitable	5	99
Environment, natural resources and livelihoods	5	86
Financing, funding and aid	6	82
Industrial sector	5	72
Infrastructure	5	60
Gender and health	4	54
Growth and progress	4	53
Solar, renewable energy	4	50
Green and carbon economy	5	47
Electricity consumers, tariffs and affordability	4	37
Science, Technology, R&D	5	37
Employment and labour	2	35
Energy efficiency	5	27
Energy security and reliability	6	21
Development aspirations (from LDC)	3	19
Decentralisation	4	17
Technology transfer	4	17
MDGs and SDGs	3	17
Rural development	2	16
Water, waste and wastewater	3	16
Land	5	15
Special economic zones	1	13
Metering	2	4
Mini-grids	2	4
Batteries	1	2
Nuclear power	1	2