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Solar PV and poverty alleviation in China: Rhetoric and reality

Sam Geall, Wei Shen, and Gonbuzeren

Energy Transformations – China

Solar PV and poverty alleviation in China: Rhetoric and reality

In 2014, China announced an ambitious plan to help alleviate rural poverty through deploying distributed solar photovoltaic (PV) systems in poor areas. The solar energy for poverty alleviation programme (SEPAP) initiative aims to add over 10 GW capacity and benefit more than 2 million households from around 35,000 villages across the country by 2020. This working paper traces the emergence and implementation of the initiative through discourse analysis of policy documents. Then, through a case study in the remote and largely pastoralist county of Guinan, in Qinghai province on the Tibetan plateau, we illustrate the constraints on implementing SEPAP and contested local perspectives on the buildout of ostensibly low carbon infrastructure for electricity generation. The working paper illustrates the limits of a top-down energy infrastructure push without incentive mechanisms for non-state actors or independent oversight of a "command and control" system.

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Acronyms

CDB	China Development Bank
CADB	China Agriculture Development Bank
CCTV	China Central Television
CPAD	State Council Leading Group Office of Poverty Alleviation and Development
CREEI	China Renewable Energy Engineering Institute
CSR	Corporate Social Responsibility
EU	European Union
FIT	Feed-in-tariff
Mtce	Million tonnes of coal equivalent
NEA	National Energy Administration
PAO	Poverty Alleviation Office
PRC	People's Republic of China
PV	Photovoltaic
REDP	Renewable Energy Development Project
SEPAP	Solar Energy for Poverty Alleviation Programme
SHP	Small Hydro Power
US	United States

1. Introduction

In 2014 Chinese leaders and state energy regulators announced an ambitious plan to help alleviate rural poverty through deploying distributed solar photovoltaic (PV) systems in poor areas. The initiative, which is positioned as an integral component of China's political campaign to eradicate poverty by 2020, aims to add over 10 GW capacity and benefit more than two million households from around 35,000 villages across the country by 2020. The policy aims to generate additional annual income of over 3,000 RMB for each household, mainly through rooftop and small-scale solar systems.

From an environmental perspective, the deployment of solar PV can help to mitigate the worst effects of climate change and air pollution by avoiding the greenhouse gases and other pollutants emitted by coal burning, which still make up the largest share of China's energy mix. China's central government has in recent years supported a shift away from fossil fuels for these reasons, as well as moving the country towards a position of technology leadership and restructuring domestic industries towards services, innovation and higher value production.

Although this Working Paper focuses on a specific Chinese policy approach, it hopes to inform perspectives on energy access and development in other contexts. Much of this literature is dominated by engineering and economics, a 'hardware financing' approach, with less attention to the socio-cultural or political dimensions of these questions (Watson *et al*. 2012; Ockwell and Byrne 2016; Newell and Bulkeley 2016). Literature informed by the field of socio-technical transitions (Ulsrud *et al*. 2015; Tyfield *et al*. 2015; Ahlborg and Sjöstedt 2015; Ockwell and Byrne 2016; Rolffs *et al*. 2015; Baker *et al*. 2014; Power *et al*. 2016; Newell and Mulvaney 2013; Newell and Phillips 2016) has brought greater socio-cultural and evolutionary dimensions to the context of energy transitions, and more recent studies also call for greater attention to political dimensions of energy transitions (for example Meadowcroft 2011; Geels 2014; Kern 2011; Scrase and Smith 2009).

In this paper, we trace the emergence and implementation of the solar energy for poverty alleviation programme (SEPAP) by identifying its social, political and economic rationales through a comprehensive analysis of policy documents. Then, through a case study in a county in Qinghai province, one of the more isolated and underdeveloped regions of western China, this paper aims to identify the main challenges for implementing SEPAP and benefitting rural residents in China and to suggest some tentative wider conclusions regarding the dynamics of energy and development policy in China, particularly in the northwest and Tibetan Plateau.

The paper is divided into four sections. First, it provides a historical review of rural electrification, poverty alleviation, and the development of the solar energy industry in China. This illustrates that the current development stage of the solar energy industry; the high degree of rural electrification; and the growing income gap between rural and urban populations are the three major factors driving the SEPAP initiative since 2014. Second, it focuses on existing policies around SEPAP by identifying major policy objectives, institutional development, and implementation routes. It also provides a discourse analysis of policy documents to illustrate the key actors and their interests in promoting this initiative.

Third, it presents a case study of one of the counties where SEPAP has been implemented in Qinghai Province to investigate the implementation process on the ground. The case study involved brief but intensive field investigation and semi-structured interviews with local stakeholders in October and November 2016. Based on the findings of the policy analysis and case study, the final section discusses the theoretical and practical implications of SEPAP, with particular focus on the role of solar energy in the future energy landscape in rural China, in terms of the energy ladder for rural households and potential for clean energy transition.

2. Research Context

To understand the drivers and the implications of SEPAP, it is worth understanding three major contexts: the persistence of rural poverty in China, in the context of a political push for poverty alleviation; the overcapacity and curtailment in China's solar energy industry, and consequent need to encourage distributed solar PV installation; and the current situation for rural electrification, where previous technological preferences, particularly small hydro, are no longer viable.

2.1 The Rural-Urban Income Gap

Since initiating market reforms in 1978, China experienced unprecedented economic and social development, with GDP growth averaging nearly ten per cent a year over the past three decades. Along with this rapid economic growth came a dramatic increase in household incomes in both rural and urban areas, which lifted more than 800 million people out of poverty (World Bank 2017).

However, incomes in rural areas rose far slower than in urban areas. The average per capita disposable income in urban areas increased from 343 RMB in 1978 to 31,195 RMB in 2015, whereas in rural areas, this figure rose from 134 RMB to 11,422 RMB (National Bureau of Statistics 2016). Throughout the economic reform era, the urban-rural income ratio in China was around 3:1, much higher than the international average of 1.5:1 to 1.6:1 (Knight and Song 1999), even before non-monetary variances in education, medical care, and other social welfare gaps between rural and social areas are taken into account.

The rural-urban income gap is exacerbated by unbalanced economic development between provinces. China's less developed western regions have a higher rural-urban income gap, with some provinces reaching a 4: 1 ratio (Xinhua News Agency, 2010). According to China's current poverty standard (annual net per capita income of 2,300 RMB in 2010 prices), there were currently 56.30 million poor in rural areas in 2015 (State Council, 2015). The majority this population live in western inland provinces.

Since President Xi Jinping came to power in 2012, poverty alleviation has been elevated to be amongst the highest development priorities in China. Xi has paid many visits to the poorest townships and villages across China and thus signalled a commitment to combat poverty. As a consequence several crucial policy documents have been issued since 2013, echoing this determination to tackle widening inequality and income gap (State Council 2013). In 2014, the Government announced that each year on 17 October 'Poverty Alleviation Day' would be marked to coincide with the United Nations International Day for the Eradication of Poverty. Before Poverty Alleviation Day in 2015 Xi formally announced the goal of eradicating poverty completely in China by 2020 (Xinhua News Agency, 2015).

However, addressing the remaining population under the poverty line is a difficult 'last mile problem'. As the case study below illustrates, the majority of this population is located in the most remote and isolated areas of China. Data on the numbers of these households and their income are often outdated and incomplete. As discussed further below, a section of this population is also nomadic and therefore hard to locate and monitor statistically. Local environmental and geographic conditions can make it difficult to improve significantly local livelihoods in a sustainable manner, beyond government subsidies and temporary material assistance.

Recent poverty alleviation programmes in China are typically designed with two major criteria: the so-called 'precision' (精准 *jingzhun*), and the 'industrial' (产业 *chanye*) requirements. The former emphasises government subsidies and assistance spent on the basis of precise and comprehensive data, so that specific households or villages can be targeted and helped. The latter, 'industrial', approach emphasises the improvement of industrial or productive capabilities of underdeveloped localities by developing creative and innovative industrial facilities, so that these households and villages can become self-sustaining in the long run. SEPAP emerged as an example of this combined approach.

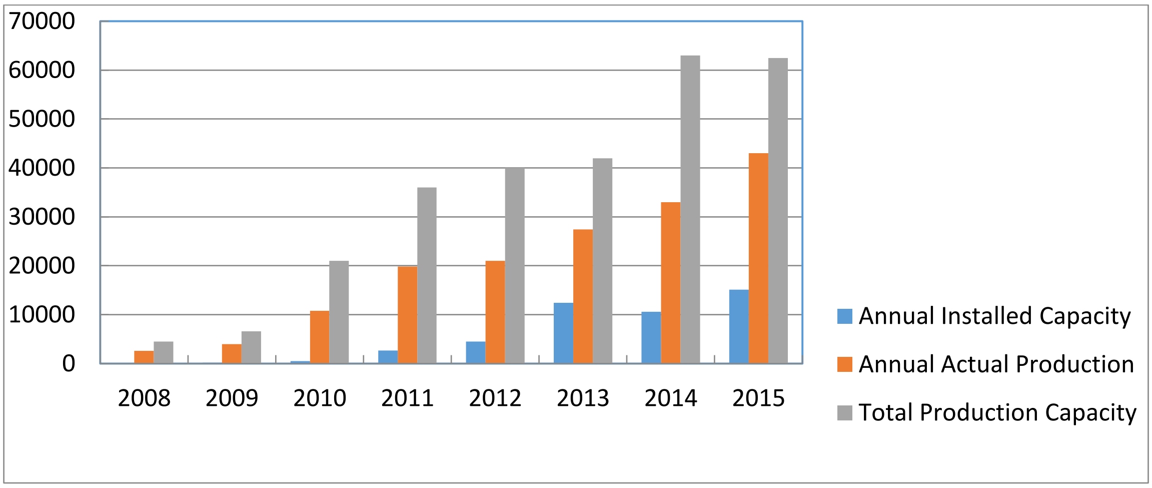
2.2 China's Solar Energy at a Crossroads

The second major driver for SEPAP emerges from the solar energy industry itself. China's solar PV sector experienced dramatic growth over the past decade. Initially, the industry was largely export oriented, with the dominant share of solar panels produced for overseas markets in Europe, particularly Germany and Spain (Zhang *et al* 2014). However, declining orders in the wake of the financial crisis, combined with trade disputes in the European Union (EU) and United States (US) in 2008 over alleged Chinese 'dumping' of cheap PV panels, and a fall in the price of polysilicon which hit companies that had hoarded the material, led some Chinese solar manufacturers to the brink of collapse (Urban *et al.* 2016).

China's Central Government therefore focused on opening the domestic solar energy market as a rescue strategy for the manufacturing sector. Strong supportive measures, such as a favourable feed-in-tariff (FIT), government pilots, subsidy programmes and concessional bidding projects were designed and implemented in a top-down manner to expand solar power generation capacity (Chen and Lees 2016). In addition, the development of solar energy was welcomed by many local governments and large energy utilities and manufacturing corporations as a new site for market opportunities and local economic development (Harrison and Kostka 2013; Shen 2016). Multiple interests, therefore, aligned in promoting this 'strategically important' industry (State Council, 2013b).

The rescue plan was successful (see Figure 2.1). By 2013, China had become the world's leading market for solar energy producers; by the end of 2015 it had reached a total installed capacity of more than 43.18 GW (National Energy Administration 2016a). Over 15 GW was installed in 2015 alone, or more than a quarter of the total installation of solar capacity around the globe that year (International Energy Agency 2016a). Production capacity was boosted even further. In fact, the domestic installation of 15 GW only consumed an estimated one-third of China's total manufacturing capacity (National Energy Administration 2016a). There is, therefore, a persistent over-capacity issue in the solar energy industry.

Figure 2.1 Development of China's Solar Energy Sector, 2008 to 2015 (MW)



Source: National Energy Administration and China Photovoltaic Industry Association

Furthermore, the rapid expansion of solar installation has outpaced grid connections. Most of this new capacity is in poorer western provinces where solar resources are ample, but local energy consumption is low. Long-distance transmission of this electricity to demand centres in the east is neither economically viable nor technologically practical. As a result, curtailment is rampant (Shen 2016). In 2015, the western provinces of Gansu or Xinjiang had over 25 per cent curtailment rates for solar energy production. This rose as high as 39 per cent in Gansu and 52 per cent in Xinjiang over the first six months of 2016 (National Energy Administration 2016a; National Energy Administration 2016b).

The Central Government has adjusted its policies in response to curtailments and declared that provinces with severe curtailment problems are no longer allowed to build new solar plants. Instead, regulators encourage small-scale, distributed solar systems, where the energy produced can be consumed locally (National Energy Administration 2015a). Such distributed systems have long been favoured by Chinese regulators and viewed as the best model for the solar energy sector in China.

In 2014, the National Energy Administration (NEA) announced an ambitious distributed PV target of 7 GW. However, actual installation lagged at around 26 per cent of this target, mainly because investors favour large-scale solar parks, as such capital-intensive investments provide more stable financial returns in the long run. This market preference for large-scale projects led policymakers to design incentives to promote distributed systems, but with limited success. In 2015, more than 90 per cent of China's newly installed solar capacity was from large scale projects (National Energy Administration, 2016a) and distributed systems remained far below the government's expectations. This, therefore, provides an important context for SEPAP, which received support from both poverty-alleviation and energy-focused officials, who found a compatible strategic vision that could benefit residents while helping to absorb overcapacity and increase distributed solar PV generation.

2.3 Trends in Rural Electrification

To understand SEPAP, it is not only necessary to consider poverty alleviation targets and solar energy development, but also the history of rural electrification to date. In 1949 at the founding of the People's Republic of China, less than 10 per cent of China's rural population had access to electricity. Since then, the Party and Government have attached great political importance to expanding electrification as an aspect of rural modernisation.

This had reached 99.8 per cent by 2013 (Bie and Lin, 2015) and in December 2015, the last 39,800 people living without electricity in the most remote counties of Qinghai Province were reportedly connected, representing 100 per cent electrification in China (National Energy Administration 2015b). Achieving the 100 per cent target between 2013 and 2015 apparently cost central and local governments more than US$4 billion. The state owned grid and utility companies were the major implementation agencies, but given the long distances and high altitudes the project was beyond any plausible commercial viability.

Renewable energy played an important role in earlier decades of rural electrification. China's rural energy landscape was dominated for a long time by small hydro power (SHP) stations (Huang and Yan 2009). At the end of 2014, there were over 47,000 SHP stations across China, with an installed capacity of 73 GW, or more than 25 per cent of the total hydropower capacity of the country (Bie and Lin 2015; China Energy Magazine 2015). Most of these SHPs are located in the central and southwest provinces, where hydro resources are abundant (Li *et al*, 2005), and produce electricity for local communities or are interconnected for regional or mini-grid networks. Most of these stations have access to the national grid in case peak adjustment is needed. Interestingly, the rapid development of SHP stations since the late 1970s was the result of a bottom-up approach, where local governments and power companies were given considerable autonomy to plan, invest in, implement and maintain these projects (Bie and Lin 2015; Peng and Pan 2006), which were popular not only due to their electricity generation benefits, but also for agricultural irrigation, flood control and more.

However, since 2012 the construction of SHP stations has slowed down as the hydro potential in many provinces has been exhausted and it is increasingly difficult to locate new sites for SHP construction. The remaining rural areas without electricity tend to have limited hydro resources. As a result, solar PV systems have emerged as a leading option to continue rural electrification. Although solar PV has long been identified as an economically viable option for remote and isolated communities (Byrne *et al*. 1998;

Byrne *et al*. 2007), it typically played a minor role in rural energy systems apart from in solar water heating systems (Zhang *et al*. 2009). This perception may be changing, however, as prices fall and remote areas see the benefits of reliable energy generation that does not rely on imported fuels (Byrne *et al*. 2007).

Rising electrification rates also resulted in significant changes to energy consumption patterns in rural areas. The proportion of non-commercial energy consumption (mainly biomass sources such as firewood, dung or straw) in total rural energy has dropped from 70 per cent in 1979 to 30 per cent in 2007 (Liu *et al*. 2013), whereas the consumption of commercial electricity increased enormously, from 3.1 million tonnes of coal equivalent (Mtce) in 1979 to 101.99 Mtce in 2007. Still, as suggested in Section 2.1, there is great disparity between provinces and regions not only due to the complex distribution of energy sources (both fossil fuels and renewables) but also social and economic factors, with per capita consumption of commercial electricity significantly lower in the underdeveloped areas of northwest China (Zhang *et al*. 2009).

3. Policy Frameworks

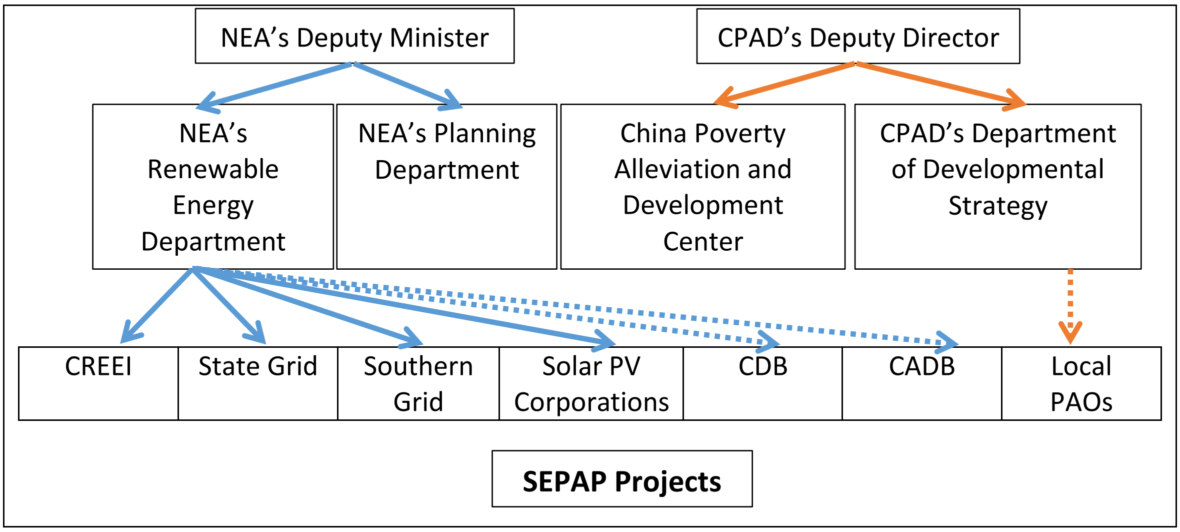
Although the potential of renewable energy technologies in enhancing rural residents' energy consumption and living standard had been long discussed in academic literature (cf. Byrne *et al*. 1998: Byrne *et al*. 2007; Wang and Qiu 2009; Zhang and Kumar 2011) the emergence of policy frameworks in China that could apply these technologies in rural areas relied on the particular social, economic and political constellation described in the preceding sections. The following sections describe and analyse the framework that emerged.

3.1 Policy Design and Institutions

Two elite decision-making bodies, the NEA and the State Council Leading Group Office of Poverty Alleviation and Development (CPAD), initiated and led SEPAP. It also involved the China Renewable Energy Engineering Institute (CREEI), which took charge of overall technical design and quality control, the two grid monopolies (State Grid and Southern Grid), and two policy banks, China Development Bank (CDB) and China Agriculture Development Bank (CADB), which are expected to provide financial support for the programme.

This led to the establishment of a multi-tiered governance structure (see Figure 3.1). From the figure it is clear that although SEPAP is co-governed by NEA and CPAD, the decision-making power largely resides in the NEA, and in particular its Renewable Energy Department, since most of the implementation agencies (grid companies, solar corporations, and policy banks) are either directly or indirectly regulated by this department (illustrated by the blue arrows), while CPAD only play a supporting and monitoring role, with no administrative authority over the these agencies apart from the local poverty alleviation offices (PAOs).

Figure 3.1 Governance Structure of SEPAP



3.2 Policy Developments Since 2014

In 2014 the NEA and CPAD issued two joint policies that kicked off SEPAP. The first policy, in October 2014, set out the multiple purposes of SEPAP, which included 'reducing poverty, expanding the solar PV market, enhancing rural employment and income, and transforming rural lifestyles' (NEA and CPAD 2014a). Therefore, it should be noted that from the beginning, SEPAP was defined as a programme that combined industrial, development and social policy goals within one instrument. The policy also set out two options for its implementation. The first option was to install rooftop solar PV systems for poor households currently registered with the CPAD. The second option is to develop solar PV power stations near these counties or villages by utilising non-arable land and rooves of greenhouses. The SEPAP would be financed by both government subsidies, and corporate donations as an aspect of their corporate social responsibility (CSR) activities.

The second joint policy was released in November 2014, with detailed measures on developing pilot SEPAP projects in six provinces (NEA and CPAD 2014b). This policy announced 30 counties in the provinces of Ningxia, Anhui, Shanxi, Hebei, Gansu and Qinghai would be appointed as pilot areas for SEPAP. Under the policy, each county should compile comprehensive data on its poor households, energy supply and consumption, and grid connection quality. Provincial governments should establish dedicated teams to work out implementation plans for different counties. Once these plans are approved at central government level, they should be carried out by county governments via an open bidding process. Financial support comes from provincial governments' poverty alleviation funds or policy banks' preferential loans. Under the policy, NEA and CPAD should also design a monitoring and quality control mechanism to supervise the construction and maintenance of the project activities. However, the local pilots are encouraged to identify suitable business models to construct and operate these facilities and distribute benefits among stakeholders.

In March 2015 NEA's Renewable Energy Department issued guidelines (initially developed by CREEI) for pilot provinces and counties to compile SEPAP implementation plans (NEA 2015c). This document specified all pilot project should be established by the end of that year, and another three provinces were added: Inner Mongolia, Yunnan and Xinjiang. It also prescribed a financial model where 70 per cent of household-level projects and 40 per cent of village solar plants (with collective ownership) would be supported by government subsidies, with the remainder covered by loans from policy banks and corporate investments or donations. It also suggested over 50 per cent of the revenues from village solar plants be distributed among poor households in these villages. Additionally, the document set the policy goal of guaranteeing an additional annual income of 3,000 RMB per household for more than 20 years.

Since Xi Jinping's December 2015 vow to eradicate poverty in China by 2020, SEPAP was elevated from pilot programme to national campaign and received the highest level of political endorsement. In a joint official statement of the CPC and State Council, SEPAP is mentioned as a promising option to generate income for poor households in rural areas (CPC and State Council 2015). Then in early 2016, Xi paid a visit to a pilot SEPAP village in Anhui Province. Subsequently, the programme was expanded to include 16 provinces, 471 counties and two million households (NDRC 2016). In August 2016 CADB issued a dedicated policy regarding the preferential financial arrangement, with up to 10 per cent discount from the central bank's base rate when lending to SEPAP projects. In October NEA announced the first batch of approved SEPAP projects in 14 provinces with a total capacity of 5.16 GW (NEA and CPAD 2016), and in December the 13th Five Year Plan for the Electricity Sector re-emphasised the importance of SEPAP and urged provinces and localities to establish a reliable long-term management scheme for the operation of SEPAP projects and benefits distribution among poor households (NEA 2016a). Meanwhile NEA also suggested the implementation of SEPAP was a good opportunity to upgrade rural grid networks in remote areas (NEA 2016b).

3.3 Policy Analysis

Despite the political importance attached to SEPAP, closer examination reveals four particular concerns about its design worth considering, even before we consider implementation based on the fieldwork below. First, the pilot stage of the programme was very short and lasted less than a year. This gave regulators little time to assess the successes and failures of the pilots before it was elevated to a national programme – traditionally an essential part of most policy experiments in China (Heilmann 2008a; Heilmann 2008b). Second, the idea to combine renewable energy and poverty alleviation is timely, ambitious and creative, but its governance structure suggested that energy regulators, rather than development officials, took the lead. Energy regulators typically have skills in supply-side management and experience in promoting industrial capacity, for solar panels and large solar plants for example, but they possess limited knowledge regarding local contexts, or poverty and development issues, particularly at the grassroots, village level.

Third, are the lack of arrangements for financing and post-construction maintenance. No additional budget or funding was allocated from either central or local government. The funds came from existing renewable energy subsidies and poverty alleviation funds, which were both already strained, even before the introduction of SEPAP. It is unrealistic to assume gigawatt-scale facilities can be built through corporate donations alone, and policy banks have shown only cautious support so far for the initiative, with a very marginal discount rate for SEPAP projects. Even if SEPAP projects can be constructed, it is questionable how solar projects will be maintained for over 20 years, as local counties and villages are not technologically capable of running plants by themselves and maintenance costs can run high particularly in these remote areas.

Fourth, there is no monitoring system in place to supervise the distribution of benefits to poor households. The murky reality of village governance in China means this represents a serious challenge for the implementation and accountability of SEPAP particularly where it relates to the actual income increase for villagers. A 'precision' strategy here may be helpful for the central government to identify the poorest households, but it would do little to protect them if the local bureaucracy wish to take the lion’s share of the profits generated from SEPAP projects. It is with these concerns from the policy review that we started our field study in one of the pilot SEPAP counties in Qinghai Province, as illustrated in the case study below.

4. Case Study of Guinan County in Qinghai Province

To further explore the dynamics of policy implementation and the relationship between solar PV and (energy) poverty, two of the co-authors (Sam Geall and Gongbu Zeren) conducted scoping fieldwork in Guinan County, Qinghai Province, on the Tibetan Plateau in north-western China, which is situated in Hainan Tibetan Autonomous Prefecture, south of Qinghai Lake (also known as Kokonor).

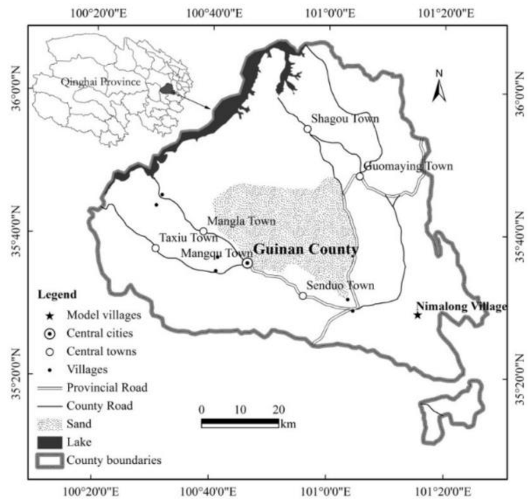
4.1 Introducing Qinghai and Guinan

Figure 4.1 Qinghai Province

Source: Wikimedia

Qinghai (Figure 4.1) is one of China's poorer provinces, with an average gross national product per capita of 41,252 RMB, 17.5 per cent less than the national average, and accounting for only 0.3 per cent of the country's overall economy (Climatescope 2015) and is a net electricity exporter, accounting for four per cent of the country's electricity generation (Lawrence Berkeley National Laboratory 2012). The province also has a somewhat unusual energy profile compared to the rest of the country: coal accounted for only 13 per cent of installed capacity by year-end 2014, and in terms of generation, 68 per cent of the total 60TWh power produced in Qinghai came from large hydropower. The balance was supplied by other renewables (10.5 per cent) and coal (21 per cent) (Climatescope 2015).

Figure 4.2 Guinan County, Qinghai Province



Source: Zhang *et al*. 2016

Guinan County (Figure 4.2) has been designated a pilot county for the implementation of SEPAP. It is also an interesting choice of fieldsite given its environment and climate context and the history of solar PV use in the region, including off-grid small-scale solar, as well as large, utility-scale installations.

From a global perspective, the Qinghai-Tibetan Plateau (known henceforth as the Tibetan Plateau) is critically important. Glaciers are in retreat in the Himalayas, where the rise in mean temperature has been higher than the global average (Matthew 2013) and the rate of glacial retreat has accelerated in the past century (National Research Council 2012). The plateau – sometimes referred to as the 'Third Pole' as it contains the largest store of fresh water outside the two polar regions – has a very significant influence on the region's climate, including its monsoons.

The region is also known as the 'Headwaters of Asia', as almost all of Asia's major rivers rise on the Plateau, providing water for some 1.3 billion people (Bandyopadhyay 2013). In Qinghai Province, these include the Yellow, Mekong and Yangtze Rivers. Other rivers rising on the Plateau include the Brahmaputra, the Ganges, the Indus, the Irrawaddy and Salween Rivers. Changes in water availability in the Himalayas due to climate change, as suggested in one fairly conservative forecast, could create population displacement, losses in agricultural harvests, damage to fisheries, disease outbreaks or regional conflict (National Research Council 2012).

The environmental situation is further complicated by the water-engineering and ostensibly low-carbon large-scale hydroelectric projects planned by countries on these rivers, including upstream nation China (Pomeranz 2013; Chellaney 2011), which on some watersheds are potentially complicated by the lack of water-sharing agreements. In the case of Hainan Prefecture, there are large hydroelectric dams built and under construction near the source of the Yellow River, the entirety of which runs through China. The Longyangxia dam, in neighbouring Gonghe County, has an installed capacity of 1280 MW and also boasts the world's first commercial operation of a large-scale solar PV-hydro hybrid system, which is also the world's largest solar PV installation, an 850-MW PV plant with hydropower helping to 'smooth the output curve' of the solar-generated electricity, which is intermittent due to cloud cover and time of day (Rogner 2015).

Around 60 per cent of the Tibetan Plateau's 2.5 million square kilometres (Qiu 2016) – and around 41 per cent of China's land (Foggin 2012) – are grasslands. These landscapes are traditionally home to nomadic pastoralists. China has some 260 pastoral counties, which accommodate about 39 million people (Miller 2002), many of these (although not all) in parts of the Tibetan Plateau. One estimate puts China's population of herders and agro-herders at 17 million (Li *et al*. 2014).

Guinan county is one such pastoral county, and 60 per cent of its area is rangeland (Feng *et al*. 2008). The county's land includes alpine steppes and alpine desert pastures that herders used for different seasonal pastures, as well as large areas of desert, some agricultural land and a small urban concentration, in the form of the county seat. It has a semi-arid climate, meaning droughts are major disasters that herders face. Herders mainly keep sheep while they also own some yaks. It has an average temperate of 4°C and mean elevation of 3,100m above sea level (Feng *et al*. 2008). The sustainability of its rangelands in the context of a warming climate and environmental degradation have become a critical concern for herders and others here, much as it has elsewhere in Qinghai and across China.

The prominent Chinese scholar, Hu Angang writes approvingly of Qinghai's political ambition to become an 'ecological province', noting that, 'Qinghai faces basic contradictions with respect to its development: it needs to develop its economy and reduce poverty, but it also has to implement environmental protection and instigate ecological construction' (Hu Angang 2017: 144). Of six, separate in-depth, semi-structured interviews with herders selected through convenience sampling in nomadic areas of Guinan county, all said they had seen similar negative changes in local climate and environment over their lifetime. One, an elderly former village headman (whose account was typical of those we heard), told us that compared to conditions during his youth, average temperatures in the region in summer and winter had risen and become more extreme; that precipitation has reduced and the rains come later in the year than previously; that the grasslands had suffered serious degradation, with increasing infestations of *pika*, a small mammal related to rabbits and hares, and vegetation cover decreasing; and springs and other water resources were drying up.

The causes of this degradation, however, are disputed. Some suggest the warming trend on the Tibetan Plateau has contributed to worsening desertification in these grassland areas, and suggest that grazing can help mitigate the negative effects of warming on rangeland quality. (Klein *et al*. 2007). Others suggest human activity, including over-grazing, are the primary drivers of grassland degradation (Feng *et al*. 2008). This latter thesis is the basis of the Chinese Government's 'ecological construction' policies, which encourage various strategies, including settlement of herders, grazing bans, rotational grazing systems and 'retiring livestock to restore the grasslands' programmes as part of environmental restoration and climate-change adaptation efforts (State Council of PRC 2008). Such programmes have been widely adopted, and, as some would diagnose it, have in turn had a further negative effect on the grassland ecosystem. For example, one study (Fan *et al*. 2014) concluded that nomad resettlement is 'poorly adapted to local ecosystem characteristics', and may therefore have negative impacts at larger scales.

The impacts of herder settlement policies are hotly debated, with some studies suggesting they may help nomads adopt new livelihoods and increase their incomes, with others arguing that settlement – and particularly, resettlement to cities – means that herders have no practical ways of maintaining pastoral ways of life (Li *et al*. 2014). The range of proposed policies and government approaches to herder settlement are wide and complex. In some cases, subsidies are provided for housing near winter pastures, as well as livelihood support, but herding is not directly restricted. In other cases, nomads are encouraged to move to the local township, rather than resettled to newly built homes.

In Guinan County there were examples of all these approaches: there was at least one settlement project, but also many households that had received livelihood subsidies (one household told us they received 1,800 RMB annually in payments-for-ecosystems-services subsidies, for example) or that had built new winter homes with some government support. Others had moved to the township. The leader of one of five groups that made up a village of 413 households in Guinan County, and therefore the *de facto* headman for 80 households, of whom 35 were still working as herders under a hybridised, informally collectivised system, said that when his two children went to school he faced a labour shortage in herding, and thus decided to move to the township, nearer to the school, selling his livestock and starting a handicrafts business – a fairly typical situation.

4.2 Solar PV in Qinghai

The Tibetan Plateau emerged over the past two decades as something of a test-bed for the use of solar energy in China. The region has some of world's best solar energy resources. There is wide geographical distribution, little cloud cover, with, on average, 275 to 330 days each year with more than six hours of sunshine, high radiant intensity and high altitude (Luo and Zhang 2012). By the end of 2015, Qinghai Province reportedly had an installed capacity of 5.6 GW of ground-mounted solar PV and an additional 2.8 MW of distributed PV (ChinaPower.com 2016).

At first, solar PV in China was developed and deployed principally for lighting and other off-grid products to expand energy access for traditionally nomadic populations on the plateau, for whom electricity would not previously have been available. In 1996 the Central Government introduced the Brightness Programme, which targeted off-grid communities across western China. From 2002 to 2007, the centrally planned Renewable Energy Development Project (REDP) sold more than 400,000 solar home systems benefiting two million individuals in north-western China (Sovacool 2012) including nomads in need of a portable, safe and sustainable energy supply.

Starting in 2009, as the burgeoning solar PV manufacturing industry struggled to stimulate the domestic distributed PV market, the Chinese Government promoted the distributed-PV-focused Golden Sun Programme as part of development on the Tibetan plateau. According to state media (CCTV 2013), some 93 'photovoltaic power stations' and 109,811 solar home systems were installed in Qinghai Province alone through that programme.

Herders in Guinan described two major poverty alleviation programmes that had distributed off-grid solar PV systems there since 2014. One purportedly came as a package, a white tent, a solar PV panel and solar cooker; the other, simply a solar PV panel. A certain quota of each were given to villages. They were then distributed according to a locally determined combination of lottery and need. The former package was intended for the poorest families. However, clearly other policies and previous generations of policy, as well as civil-society projects (these and Chinese Government projects were often difficult to distinguish, from the perspective of the aid recipients) had donated other solar PV products, including solar PV panels with lithium-ion batteries, for purposes including lighting and churning yak milk into butter. Some herders had also bought solar PV systems on the open market, and would often have more than one solar product, some bought and some donated.

Figure 4.3 Solar Cooker Seen Outside Herders' Winter Home in Guinan County

Source: Sam Geall

Development organisations, NGOs and philanthropists have long funded numerous off-grid solar energy projects on the Plateau. These have included solar cooker distribution programmes (Figure 4.3), which have the advantage of avoiding harmful indoor air pollution from biomass smoke. So closely associated have these particular off-grid solar products become with Tibetan livelihoods, in fact, that the Chinese artist Ai Weiwei used an array of solar cookers in an installation shown at the site of California's Alcatraz prison in 2014, widely seen as referring to Tibet and its contested political status. Other programmes have supported the installation of solar water heaters. However, in Guinan county we only observed these installed in the urbanised county seat. None of the herders we interviewed had solar water heaters and local herders and headmen told us that this was true across the whole area.

China's PV industry has, in general, seen a shift from locally focused development initiatives to expand off-grid energy access in China towards greater top-level ambitions to expand the domestic installation of utility-scale grid-connected solar PV. Recent approaches to solar energy in Qinghai, therefore, put emphasis on the development of large-scale, ground-mounted solar farms in the country's west, connected to demand centres in the urbanised eastern seaboard via ultra-high-voltage transmission lines built by State Grid (Mathews and Hao 2016) (see Figure 4.4). In this dominant narrative, China's west is cast as desert for exploitation (and implicitly, modernisation) through centralised and large-scale solar developments, analogous to the other major renewable energy projects in the region, such as wind power farms and large-scale hydropower projects.

Figure 4.4 State Grid Office Near Qinghai Lake

Source: Sam Geall

One herder referred to this memorably in an interview with us as the 'west-to-east energy diversion' (*xidiandongdiao*), deliberately echoing the enormous water engineering programme known as the 'south-to-north water diversion' (*nanshuibeidiao*). Importantly, in the case of development in Qinghai Province, this came at the same time as a general push towards encouraging sedentarised livelihoods with grid-connected homes. Therefore, we would expect in general a decrease in uptake of off-grid solar (seen for example in Sovacool 2012: 41).

Figure 4.5 10 MW Solar Power Plant in Guinan County

Source: Sam Geall

Indeed, on the grasslands of Guinan county, at the end of a dirt track next to the winter pasture – on 380 *mu* (around 25 hectares) of land owned by a local ethnically Han village, which had apparently not been used recently for herding, and immediately abutted a large desert – sat a newly built 10-MW solar farm, which was not yet connected to the grid (see Figure 4.5). There was a small, half-built control room next to the plant, which was fenced in and had 'no entry' signs. When we arrived, a group of around 30 labourers from Henan province were setting fires, burning the boxes the modules had arrived in (marked 'Jinko Solar', one of China's biggest PV producers). One told us the plant had been built by a Beijing-based company and that it was intended to export electricity to neighbouring regions and provinces via new transmission lines, which could be seen cutting across the pasture. Most significantly, she told us that the plant had been built under SEPAP, and that it would not have been built otherwise, given the current unlikelihood of obtaining permission for large grid-connected plants given ongoing problems with curtailment.

It is likely the plant was indeed cleared through SEPAP, since one model of its implementation is that a company agrees to donate money and/or a certain number of solar PV modules in exchange for permission to build a utility-scale project (Interview with CS 2016)[1]. A high-level environmental official in Beijing, on hearing about the plant, bluntly described it as one of many 'fake' solar plants in China (Interview with JF 2016)[2], in the sense that it did not constitute a genuine poverty-alleviation or small-scale project. Another Beijing-based expert at a Chinese government think-tank (Interview with PJ 2016)[3] said that SEPAP had proven impossible to implement as initially intended due to the high transaction costs and lack of additional funds, accounting for this type of workaround driven by local industry looking for a way to clear a project that would otherwise be rejected due to concerns about curtailments.

4.3 User Practices and Perspectives

In studying the aspects of solar PV rollout, and electrification more broadly, that may help meet the needs of the poor, it is necessary to understand better the energy needs, practices and experiences of those users – nomadic pastoralists, in this particular case – that SEPAP and related policies have targeted. Most important here, perhaps, is understanding the continued seasonal movement of herders in the county, which means that at least in this region of Qinghai, mobile, off-grid energy sources are as relevant and necessary for many local people as grid-connected electricity.

Of the herders we interviewed, all had permanent winter homes with grid-connected electricity. The earliest grid connection was in 1986 and the most recent was in 2007. Electricity was used in these homes for lighting, television, refrigeration and mobile phone charging. However, many reported that this supply still was, or had been until recently, unstable and prone to blackout. Significantly, all also spent at least two months a year in summer pasture – and in some cases also for weeks at a time collecting *cordyceps sinensis* (caterpillar fungus) on the grasslands – where they lived in tents and, without exception, used solar home systems for uses such as mobile-phone charging, watching television, butter churning and lighting (one herder also mentioned using it to power an electric blanket on cold nights).

As is mentioned above, China reports near total or total electricity connectivity across its population via the grid (World Bank 2012). However, as the persistence of seasonal movements implies, this should not necessarily suggest the end of a need for off-grid solar technologies. Perhaps more significantly, nor should it necessarily imply that the current structure of grid-based electricity approaches – including through the buildout of utility-scale solar PV in the northwest – benefits the poor and local communities. As we found and explain below, some current approaches seem oriented towards the needs of industry and urban demand centres, rather than to pastoral and rural communities there.

Every herder that we interviewed in Guinan, regardless of income or social status, exclusively used animal dung for space heating and cooking. As mentioned above, none had running water or a regular supply of hot water (though dung could be used for heating water when needed). Many had solar cookers, but these were not commonly used. Herders told us they used them on particularly hot days in summer, or encouraged older family members to use them, as they required less effort to operate and tend than a fire (see Figure 4.3 above).

[1] A Beijing-based researcher in the fields of energy and development.

[2] A Beijing-based official in environmental protection.

[3] A Beijing-based researcher at a high-level government think tank, in the fields of energy, climate and development.

Asked about the advantages and disadvantages of solar PV, one herder told us the disadvantage was that the panels could be bulky and inconvenient to move if you did not own or could not use motorised transport. Although this particular herder owned a car, his summer pasture was inaccessible by road, meaning his solar panels and batteries needed to be transported by animal. He also noted that if herders discarded the batteries after replacement (something that happened around every two years) they would pollute the grasslands. However, he said the advantages, that they were convenient for lighting, phone charging and watching television in the evenings when herding, far outweighed such drawbacks. In this, his opinion was typical. On the whole, herders held very positive opinions about small-scale solar PV technology and made frequent use of it during the summer. Additionally, many made use of solar PV butter churns all year round (see Figure 4.6).

Figure 4.6 Solar System Used for Butter Churning All Year Round

Source: Sam Geall

Herders' perspectives and opinions on various aspects of grid electricity infrastructure were more complex. A new hydroelectric dam, with an adjoining solar PV plant, was under construction very nearby submerging a large area of grassland, and some resented the destruction of what had been autumn pasture, even though herders had received compensation (apparently a total of 8,500 RMB). An older herder recalled the impact large-scale relocation had in the construction of the Longyangxia dam – built on the same upstream Yellow River tributary – in the mid-1980s.

A big impact was also felt in the construction of new transmission lines connected to the dam. The construction of large pylons and, consequently, heavy equipment driving through the grasslands, had led to lung diseases among sheep inhaling the dust this had thrown up according to herders. There were also small compensation payments made where the pylons destroyed grasslands. However, it was also believed that these transmission lines were taking power to neighbouring counties and prefectures, so there were few discernible benefits beyond one-off compensation payments, and a lasting downside in loss of land and animal deaths. One commented, 'there are more pylons than livestock now'.

Opinions about the large, utility-scale solar PV plant were also mixed. Many said it had no impact on their lives, positive or negative: they had not grazed the land that was lost nor would they use the electricity, which was being exported. However, some still thought it was a poor use of grassland that could have been herded and others feared an environmental impact on the grasslands from such a large scale installation, perhaps in a long-term warming effect caused by the large concentration of reflective panels.

4.4 Analysis

This initial, scoping fieldwork suggests that Guinan is a county that could benefit from SEPAP. It is a poor county, and residents could, for example, generate income by selling electricity to the grid from their permanent winter homes, since during the summer months, when there is the most sunshine and herders are typically out in the pasture, unused electricity would provide an additional income and a locally generated electricity source. However, seasonal movements also mean there is a continued need for off-grid solar energy sources, which central planners may have overlooked. Moreover, the large-scale exploitation of solar resources there, in the form of large-scale, ground-mounted PV plants connected to demand centres in eastern cities via ultra-high-voltage transmission, may be a net positive for the country, but should not be conflated with local development projects such as SEPAP.

However, these aspects have not been widely considered in academic literature or policy documents, as far as we are aware. Nor does the literature on energy, development, environment or wider cultural shifts in the region make much use of the sorts of practical observations and findings detailed here. Even in detailed assessments of the outlook and utilisation of solar PV in the Tibetan Plateau (cf. Luo and Zhang 2012; Wang and Qiu 2009), for example, there is no mention made of how seasonal movements may conflict with the appropriateness of year-round grid connection, or whether off-grid approaches might therefore present environmental or social benefits. Although herder settlement may create a preferable environment for the development of a year-round grid connection, it contradicts the seasonal nature of the pastoral production, which is still the main income source of local herders. Therefore, how renewable energy and poverty alleviation goals will align with local ecological and socio-cultural characteristics is an area that deserves more scrutiny.

Still, there are clues that these phenomena exist in the margins of a few papers, such as a monograph by Tsering Bum (Tsering 2016) that describes how the Beijing-headquartered environmental NGO Shanshui helped build, 'solar energy powered electric fences to prevent bear break-ins in Drido County communities' in Qinghai province, as well as his observations of nomadic uses of an improvised solar home system using a broken motorcycle battery, and also the use of solar radios. A review of the REDP programme (D'Agostino *et al*. 2011) also noted that former end-users of the programme said. 'that both are necessary, a grid connection for the winter home and an SHS for their nomadic needs. As discussed in several of the REDP documents, nomadic herders bring SHS to provide lighting for when they summer in the mountains'.

5. The Implications for SEPAP

There are several implications that can be drawn from this study of SEPAP. If it is to realise its ambitious goal of helping to eradicate poverty by 2020, it faces some big challenges in its design. These include, first, the need for greater finance and dedicated support from banking and market actors. On 9 December 2016, China Central Television (CCTV), the main state broadcaster, reported that Ningxia's pilot SEPAP projects have experienced significant delays in construction, with only a small fraction of projects completed. Even in those counties that did see roof-top panels installed, CCTV reported that residents would only receive 300 RMB in additional annual income, according to their contracts with the project developers, far less than the 3,000 RMB suggested in the NEA and CPAD joint policy.

It is clear that Central Government endorsement is not enough to implement SEPAP, without proper financial incentives for solar companies and policy banks. Some poor counties may attract companies to implement SEPAP by offering the opportunity to develop large scale solar parks there. Yet facing severe curtailment, these opportunities may be less tempting, and policy banks (CDB and CADB are currently expected to finance the whole 5.16 GW of capacity by themselves, around 120 billion RMB according to current market prices) are likely to be cautious about providing upfront financing where poor households and villages can provide little collateral for loans and the prospect of returns are uncertain. Widespread problems in rural areas with poor grid connections and delayed subsidy reimbursements may damage the viability of these projects. No commercial banks would be interested due to the risks associated with SEPAP projects.

Besides financial difficulties, another challenge for SEPAP is the accountability of the programme. Our case studies suggest that local households have little information or knowledge about these initiatives or their benefits. They are intended to be passive beneficiaries, with little negotiation power with project developers, officials, policy banks or grid companies. Monitoring the distribution of the returns from SEPAP activities throughout project cycle can be a challenging task. It should also be noted that the main regulator of SEPAP is NEA, who do not have direct supervision and authority power over local governments, even if they should be able to regulate industrial actors.

SEPAP is being implemented in the context of a vertically and horizontally fragmented bureaucracy. Various interests intersect and interact to affect its likely outcomes. SEPAP originated from a leadership-level ambition and an alignment of bureaucratic interests between energy and poverty alleviation regulators. However, the governance structure of the programme, the policy content, and the field investigation suggest that it is the energy regulators that have taken the lead in designing and promoting the policy process, and their priority interests, such as reallocating industrial capacity, are higher on the agenda.

The latest announcement, that over 5.16 GW capacity will be installed in the first phase of SEPAP, is only an example of such a policy preference. This power imbalance may have a profound impact on the implementation and policy outcome. As the regulator for industrial policies and sector development that usually focus on supply-side expansion (such as the manufacturing and investment capacities for renewable energy facilities, or upgrading grid services) NEA is not experienced or capable of managing demand-side dynamics at the local level (such as the actual needs and difficulties of the poor villages households, local corruption, land disputes, insufficient local data, and transparent reporting systems) which would eventually determine the success of SEPAP as a development rather than industrial project.

The case study showed that in regions of Qinghai there is great potential for the further expansion of clean and reliable energy access in rural and pastoral areas through solar PV, in a likely combination of off-grid and grid-connected systems, with particular emphasis on the need for mobility, where herders' livelihoods require seasonal movement, as well as through solar water heating and cleaner cookstoves or cooking and heating fuels, particularly where other poverty alleviation and development programmes can help to provide running water and sanitation. There may also be further unexplored potential upsides to off-grid solar PV programmes in terms of expanding energy access, mitigating air pollution, climate change and negative health effects of fuel burning, as well as improving disaster resilience and energy security in China, where grids are otherwise stretched thin over long distances.

The fact this has been overlooked suggests again the current mismatch between China's industrial policies and its development targets. Solar PV policy in China is still largely dominated by an emphasis on supply-side expansion in the form of such things as technology, manufacturing capacity, and wider renewable energy policy on the development of large-scale hydropower projects, particularly on the Tibetan Plateau. There is less focus on the demand side and, in this case, on poor households and mobile herders' communities. Where poverty alleviation is aligned with renewable energy deployment, the early benefits of such schemes as the Brightness Programme have either been largely overlooked as emphasis shifts towards grid connection, or poorly implemented due to local protectionism or inadequate policy design, as in the case of SEPAP.

Perhaps a vision of energy services that could serve the needs of the poor and help mitigate climate change at the planet's 'Third Pole' might need to start from a different set of assumptions about livelihoods and social-environmental systems in Tibetan regions than SEPAP or similar policies have previously taken into account. If it is assumed, for example, that seasonal movements and herding constitute a necessarily backward and/or environmentally destructive set of practices – or simply that their death is imminent and inevitable, as modernisation is conflated with sedentarisation or urbanisation – it becomes harder to see the potential of modern, mobile and decentralised energy systems forming part of a dynamic, hybrid model of energy, forming a pillar of conservation in threatened ecosystems where nomadic stewardship is a dynamic and important aspect of a threatened ecology in a warming climate.

6. Conclusion

In this paper, we analysed China's ambitious political plan of using solar PV technologies to promote poverty alleviation. The policy analysis and case study in Qinghai province suggested multiple interests at play among state regulators in promoting this initiative, and significant gaps between policy design and implementation, particularly with regard to funding, project maintenance and accountability. Since most SEPAP activities will not be commercially viable, and local fiscal and technological capacity is limited, innovative approaches are needed to make sure policy targets are met by 2020. Policy alliances among central regulators without sincere participation from key local, financial, and market stakeholders will face challenges at the implementation stages of these top-down initiatives, as these non-state actors' financial and technological resources are indispensable at project level. The lack of sufficient upfront capital is a good example of the need to create proper incentives to get policy banks, local budgetary departments, and solar corporations into policy networks. In addition, independent surveillance programmes that can monitor the accountability of the programme and provide feedback to the central policy makers are also necessary. In China's political context, it would be difficult to establish and legitimise these validating schemes, but they are crucial to prevent the top-down political ambition being mere rhetoric that does not produce benefits in reality for the targeted populations, as has been seen in various Chinese political campaigns in the past.

The case study also indicates that for most nomadic households that the programme is supposed to benefit, the plan to enhance their living standards by selling additional energy via grid connected solar systems is not being realised. SEPAP could instead consider local variety and context rather than prescribing unified project options from the top. Local communities should be better informed of the central government's intentions, and county and village governments should be permitted greater autonomy to select feasible project types that suit their own realities. Prior experience in small hydropower can be a role model in this regard, to integrate local knowledge into the SEPAP initiative. Finally, the integration of renewable energy technology and poverty alleviation is laudable, but an innovative concept, and needs to be further explored through other empirical cases, both within China and in other developing countries. Questions around combining industrial policies with development goals, and what governance structures or institutions may serve these multiple policy purposes well, are excellent research questions for future studies.

References

Ahlborg, H. and Sjöstedt, M. (2015) 'Small-scale hydropower in Africa: Socio-technical designs for renewable energy in Tanzanian villages', *Energy Research & Social Science* 5: 20–33

Baker, L., Newell, P. and Phillips, J. (2014) 'The Political Economy of Energy Transitions: The Case of South Africa', *New Political Economy* 19: 791–818

Bandyopadhyay, J. (2013) 'Securing the Himalayas as the water tower of Asia: an environmental perspective', *Asia Policy* 16: 45–50

Bhattacharyya, S. C. and Ohiare, S. (2012) 'The Chinese electricity access model for rural electrification: Approach, experience and lessons for others', *Energy Policy* 49: 676–687

Bie, Z. and Lin, Y. (2015) 'An Overview of Rural Electrification in China: History, technology, and emerging trends', *IEEE Electrification Magazine* 3.1: 36–47

Byrne, J., Shen, B. and Wallace, W. (1998) 'The economics of sustainable energy for rural development: A study of renewable energy in rural China', *Energy Policy* 26.1: 45–54

Byrne, J., Zhou, A., Shen, B. and Hughes, K. (2007) 'Evaluating the potential of small-scale renewable energy options to meet rural livelihoods needs: A GIS-and lifecycle cost-based assessment of Western China's options', *Energy Policy* 35.8: 4391–4401

CCTV (2013) 'Solar energy makes Tibetans' life easier on plateau, 12 June 2013, http://english.cntv.cn/20131206/103650.shtml (29 December 2016)

Chellaney, B. (2011) *Water: Asia's New Battleground,* Washington DC: Georgetown University Press

Chen, G. C. and Lees, C. (2016) 'Growing China's renewables sector: a developmental state approach', *New Political Economy* 21.6: 574–586

China Energy Magazine (2015) 'Small Hydro Power stations: Historical and Current Contributions', *China Energy News*, 12 October 2015, http://paper.people.com.cn/zgnyb/html/2015-10/12/content_1621497.htm (in Chinese) (13 April 2017)

ChinaPower.com (2016) 'China: Qinghai targets additional 7.1 GW of renewables in 2016' http://en.chinapower.com.cn/2016/01/05/content_3234.html (29 December 2016)

ClimateScope (2015) 'ClimateScope Report', http://2015.global-climatescope.org/en/ (12 April 12, 2017)

CPC and State Council (2015) 'Resolutions on battling poverty', http://www.nea.gov.cn/2015-12/08/c_134895715.htm (in Chinese) (6 April 2017)

D'Agostino, A. L., Sovacool, B.K. and Bambawale, M.J. (2011) 'And then what happened? A retrospective appraisal of China's Renewable Energy Development Project (REDP)', *Renewable Energy* 36: 3154–3165

Fan M., Li, W., Zhang, C. and Li, L. (2014) 'Impacts of Nomad Sedentarization on Social and Ecological Systems at Multiple Scales in Xinjiang Uyghur Autonomous Region, China', *Ambio* 43: 673–686

Feng, Y., Lu, Q., Tokola, T., Liu, H. and Wang, X. (2009) 'Assessment of grassland degradation in Guinan county, Qinghai Province, China, in the past 30 years', *Land Degradation & Development* 20.1: 55–68

Foggin, M. (2012) 'Pastoralists and wildlife conservation in western China: collaborative management within protected areas on the Tibetan Plateau', *Pastoralism: Research, Policy and Practice* 2:17

Geels, F. (2014) 'Regime Resistance against Low-Carbon Transitions: Introducing Politics and Power into the Multi-Level Perspective', *Theory Culture & Society* 31: 21–40

Harrison, T. and Kostka, G. (2013) 'Balancing Priorities, Aligning Interests: Developing Mitigation Capacity in China and India', *Comparative Political Studies* 47.3: 450–480

Heilmann, S. (2008a) 'From Local Experiments to National Policy: The Origins of China's Distinctive Policy Process', *The China Journal* 59: 1–30

Heilmann, S. (2008b) 'Policy Experimentation in China's Economic Rise', *Studies in Comparative International Development* 43.1: 1–26

Huang, H. and Yan, Z. (2009) 'Present situation and future prospect of hydropower in China,' *Renewable and Sustainable Energy Reviews* 13.6–7: 1652–1656

International Energy Agency (2016) *World Energy Outlook*, Paris: IEA

Jin, C. (2013) 'Impoverishment Risks Caused by the Ecological Resettlement Project', pp. 99–124 in L. Wang and L. Zhu (eds) *Breaking Out of the Poverty Trap. Case Studies from the Tibetan Plateau in Yunnan, Qinghai and Gansu*, Hackensack NJ: World Century

Kern, F. (2011) 'Ideas, institutions, and interests: Explaining policy divergence in fostering 'system innovations' towards sustainability', *Environment and Planning C: Government and Policy* 29: 1116–1134

Klein, J., Harte, J. and Zhao, X. (2007) 'Experimental warming, not grazing, decreases rangeland quality on the Tibetan Plateau', *Ecological Applications* 17.2: 541–557

Knight, J. B. and Song, L. (1999) '*The rural-urban divide: economic disparities and interactions in China*', Oxford: Oxford University Press

Lawrence Berkeley National Laboratory (2012) *China Energy Databook*, Berkeley CA: Lawrence Berkeley National Laboratory, https://china.lbl.gov/research-projects/china-energy-databook (12 April 2017)

Li, S. and Sicular, T. (2014)''The Distribution of Household Income in China: Inequality, Poverty and Policies', *The China Quarterly* 217: 1–41

Li, Y., Gongbuzeren and Li, W. (2014), *A review of China's rangeland management policies*, IIED Country Report, London: International Institute for Environment and Development

Li, Z., Tang, R., Xia, C., Luo, H. and Zhong, H. (2005) 'Towards green rural energy in Yunnan, China', *Renewable Energy* 30.2: 99–108

Liu, W., Spaargaren, G., Heerink, N., Mol, A. P. J. and Wang, C. (2013) 'Energy consumption practices of rural households in north China: Basic characteristics and potential for low carbon development', *Energy Policy* 55: 128–138

Luo, G. and Zhang, X. (2012) 'Universalization of access to modern energy services in Tibetan rural households–Renewable energy's exploitation, utilization, and policy analysis', *Renewable and Sustainable Energy Reviews* 16: 2373–2380

Mathews, J. and Hao T. (2015) *China's Renewable Energy Revolution*, Basingstoke: Palgrave Macmillan

Matthew, R. (2013) 'Climate change and water security in the Himalayan region', *Asia Policy* 16: 39–44

Meadowcroft, J. (2011) 'Engaging with the politics of sustainability transitions', *Environmental Innovation and Societal Transitions* 1: 70–75

Miller, D. (2002) 'The Importance of China's Nomads', *Rangelands* 24.1: 22–24

National Bureau of Statistics, RPC (2016) *China Statistics Yearbook 2015*, available at: http://www.stats.gov.cn/tjsj/ndsj/2015/indexch.htm (in Chinese) (6 April 2017)

National Development and Reform Commissions (2016) 'Opinions on the implementation of SEPAP', available at http://www.sdpc.gov.cn/gzdt/201604/t20160401_797335.html (in Chinese) (6 April 2017)

National Energy Administration (2015a) 'Mission accomplished for resolving the energy access problem for all Chinese', available at http://www.nea.gov.cn/2015-12/24/c_134948340.htm (in Chinese) (6 April 2017)

National Energy Administration (2015b) 'Notifications on issuing of the guidelines for SEPAP implementation', available at http://www.nandudu.com/article/18495 (in Chinese) (6 April 2017)

National Energy Administration (2015c) 'Opinions on accelerating the construction of energy projects in poverty areas to support the battle of eradicating poverty', available at http://www.escn.com.cn/news/show-294412.html (in Chinese) (6 April 2017)

National Energy Administration (2016a) 'Statistics on Solar Energy in 2015', available at http://www.nea.gov.cn/2016-02/05/c_135076636.htm (in Chinese) (6 April 2017)

National Energy Administration (2016b) 'The 13th Five Year Plan for the Electricity Industry', available at http://www.nea.gov.cn/xwfb/20161107zb1/index.htm (in Chinese) (6 April 2017)

National Research Council (2012) *Himalayan Glaciers: Climate Change, Water Resources, and Water Security*, Washington DC: The National Academies Press

NEA and CPAD (2014a) *Notification on implementing the plan of developing SEPAP project*, Public Notice, National Energy (2014) 447, National Energy Administration and China Poverty Alleviation and Development Centre, http://zfxxgk.nea.gov.cn/auto87/201411/t20141105_1862.htm (in Chinese) (7 April 2017)

NEA and CPAD (2014b) *Notification on organising and* developing *piloting SEPAP projects*, Public Notice, National Energy Commission (2014) 495, National Energy Administration and China Poverty Alleviation and Development Centre, http://www.21spv.com/news/show.php?itemid=11204 (in Chinese) (7 April 2017)

NEA and CPAD (2016) *Notification of the approval for the first batch of SEPAP projects*, , Public Notice, National Energy Commission (2016) 280, National Energy Administration and China Poverty Alleviation and Development Centre, http://zfxxgk.nea.gov.cn/auto87/201610/t20161017_2310.htm (in Chinese) (7 April 2017)

Newell, P., and Bulkeley, H. (2016) 'Landscape for change? International climate policy and energy transitions: evidence from sub-Saharan Africa', *Climate Policy,* 31 Mary 2016: 1–14, http://www.tandfonline.com/doi/full/10.1080/14693062.2016.1173003 (13 April 2017)

Newell, P. and Mulvaney, D. (2013) 'The political economy of the "just transition" ', *The Geographical Journal* 179: 132–140

Newell, P. and Phillips, J. (2016) 'Neoliberal energy transitions in the South: Kenyan experiences', *Geoforum* 74: 39–48

Newell, P., Phillips, J. and Pueyo, A. (2014) *The Political Economy of Low Carbon Energy in Kenya,* IDS Working Paper 445, Brighton: Institute of Development Studies.

Ockwell, D. and Byrne, R. (2016) Sustainable Energy for All: Innovation, Technology and Pro-Poor Green Transformations, Abingdon: Routledge

Peng, W. and Pan, J. (2006) 'Rural Electrification in China: History and Institutions', *China & World Economy* 14.1: 71–84

Pomeranz, K. (2013) 'Asia's Unstable Water Tower: The Politics, Economics, and Ecology of Himalayan Water Projects', *Asia Policy* 16: 4–10

Power, M., Newell, P., Baker, L., Bulkeley, H., Kirshner, J. and Smith, A. (2016) The political economy of energy transitions in Mozambique and South Africa: The role of the Rising Powers', *Energy Research & Social Science* 17: 10–19

Rogner, M. (2015) 'Case study: solar PV–hydro hybrid system at Longyangxia, China' International Hydropower Association, blog , http://bit.ly/2oCap8V (12 April 2017)

Rolffs, P., Ockwell, D. G. and Byrne, R. (2015) 'Beyond technology and finance: Pay-as-you-go sustainable energy access and theories of social change', *Environment and Planning A* 47: 2609–2627

Scrase, I., and Smith, A. (2009) 'The (non-)politics of managing low carbon socio-technical transitions' *Environmental Politics* 18.5: 707–726

Shen, W. (2016) 'Who drives China's renewable energy policies? Understanding the role of industrial corporations', *Environmental Development* 21: 87–97

Sicular, T., Ximing, Y., Gustafsson, B., and Shi, L. (2007) 'The Urban–Rural Income Gap and Inequality in China', *Review of Income and Wealth* 53.1: 93–126

Sovacool, B. (2012) 'Off-grid solar electrification for rural development: the implications of the Renewable Energy Development Project (REDP) in China', *International Journal of Regulation and Governance* 12.1: 19–48

State Council of the PRC (2008) *China's Policies and Actions for Addressing Climate Change,* Beijing: Information Office of the State Council of the People's Republic of China

State Council of the PRC (2013a) *Opinions on deepening the institutional reforms on income distribution,* State Council Policy No. 2016(6), Beijing: State Council of the PRC, http://www.gov.cn/zwgk/2013-02/05/content_2327531.htm (in Chinese) (7 April 2017)

State Council of the People's Republic of China (2013b) *Opinions on Promoting Healthy Development of Solar PV Industry*, Beijing: State Council of the PRC, http://www.gov.cn/zwgk/2013-07/15/content_2447814.htm (in Chinese) (13 April 2017)

State Council of the People's Republic of China (2015) *The Working Plan for the Poverty Alleviation during the 13th Five Year Plan*, Beijing: State Council of the PRC, http://www.cpad.gov.cn/art/2016/12/3/art_46_56101.html (in Chinese) (13 April 2017)

Tsering B. (2016) 'Guardians of Nature: Tibetan Pastoralists and the Natural World', *Asian Highlands Perspectives,* AHP Vol. 42

Tyfield, D., Ely, A. and Geall, S. (2015) 'Low Carbon Innovation in China: From Overlooked Opportunities and Challenges to Transitions in Power Relations and Practices,' *Sustainable Development* 23: 206–216

Ulsrud, K., Winther, T., Palit, D. and Rohracher, H. (2015) 'Village-level solar power in Africa: Accelerating access to electricity services through a socio-technical design in Kenya', *Energy Research & Social Science* 5: 34–44

Urban, F., Geall, S. and Wang, Y. (2016) 'Solar PV and solar water heaters in China: Different pathways to low carbon energy', *Renewable and Sustainable Energy Reviews* 64: 531–542

Wang, Q. and Qiu, H. (2009) 'Situation and outlook of solar energy utilization in Tibet, China', *Renewable and Sustainable Energy Reviews* 13.8: 2181–2186

Watson, J., Byrne, R., Morgan Jones, M., Tsang, F., Opazo, J., Fry, C. and Castle-Clarke, S. (2012) *What are the major barriers to increased use of modern energy services among the world's poorest people and are interventions to overcome these effective?,* Collaboration for Environmental Evidence Review 11-2004, http://bit.ly/2oHOXR3 (7 April 2017)

World Bank (2012) 'Access to electricity (% of population)', Washington DC: World Bank, http://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=CN (7 April 2017)

Xinhua News Agency (2015) *Work Together to Eliminate Poverty and Promote Common Development*, Xi Jinping's Keynote Speech at Poverty Alleviation and Development Summit 2015, available at: http://news.xinhuanet.com/mrdx/2015-10/17/c_134722059.htm (in Chinese) (13 April 2017)

Xinhua News Agency (2010) 'The wealth disparity is closing to the "red line" in China', *Economic Information Daily,* 10 May 2010, http://news.xinhuanet.com/fortune/2010-05/10/c_1283123.htm (in Chinese) (7 April 2017)

Zhang, L., Yang, Z., Chen, B. and Chen, G. (2009) 'Rural energy in China: Pattern and policy', *Renewable Energy* 34.12: 2813–2823

Zhang, S., Andrews-Speed, P. and Ji, M. (2014) 'The erratic path of the low-carbon transition in China: Evolution of solar PV policy', *Energy Policy* 67: 903–912

Zhang, X. and Kumar, A. (2011) 'Evaluating renewable energy-based rural electrification program in western China: Emerging problems and possible scenarios', *Renewable and Sustainable Energy Reviews* 15.1: 773–779

Zhang, Y., Min, Q., Zhao, G., Jiao, W., Liu, W. and Bijaya, D. (2016) 'Can Clean Energy Policy Improve the Quality of Alpine Grassland Ecosystem? A Scenario Analysis to Influence the Energy Changes in the Three-River Headwater Region, China', *Sustainability* 8.3: 231