

The Politics of Environmental Technology Choice for Rural Electrification in Northern Thailand

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Abstract: *The emphasis on using ‘environmental’ technologies for rural development is a defining feature of sustainable development. The perceived benefits attributed to such technologies relate to their capacity to mitigate environmental problems alongside the promotion of social and economic development. However, the success of these technologies in bringing about socially equitable and environmentally efficient outcomes remains unscrutinised. This report addresses this gap in the literature by examining the stated introduction of an environmental technology for rural electrification in northern Thailand. This study argues that contrary to the programme objectives that allude to a sustainable development rationale, the introduction of the solar electric systems led neither to beneficial environmental outcomes nor to a socially sustainable technology transfer. Moreover, it is evident that these programmes were not designed to consider, much less meet, the most basic energy needs of the communities that they purported to serve. To explore why this situation might have arisen, the motivations of previous rural electrification programmes are considered: an analysis of which reveals a highly politicised, ethnically divisive state-serving agenda. Given the inability of the chosen technology to fulfil its objectives, it is concluded that this programme might have been directed by similar state-serving agendas—with the addition of the appearance of promoting environmentally sustainable development.*

Keywords: sustainable development, rural electrification, Thailand, hill tribes, solar technology

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Conservation and Society, Pages 265–279

Volume 3, No. 2, December 2005

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THAI RURAL ELECTRIFICATION POLICY

THE THAI'S GOVERNMENT'S plans for rural electrification were drawn up in the late 1960s with the help of USAID (United States Agency for International Development) consulting teams. The major programme, the Thai Accelerated Rural Development (ARD), implemented in the 1970s, was promoted to allay national security concerns (Hayes n.d.; USAID 1969). Policy statements during this time confirm the intention to use electrification as 'an aid to counter insurgency and to improve security in rural areas' (Lucas 1987: 461). The ARD programme explicitly ranked potential electrification project areas on the basis of development potential together with national security factors.

One year after these plans were finalised, the state approved the recommended electrification proposals, and USAID provided the funding. The goal of this master plan was to provide electricity to every village within a twenty five-year period (Chullakesa 1991). In this plan, five-year working schedules were devised, each focusing on a particular region, with priority given to the 'more economically backward and politically unstable regions' (Vorate and Barnes 1997: 4). These plans first targeted the northeast of the country, then the southern and the northern regions. In 1975, the timeframe for the electrification project was reduced to 15 years, with the regional phases overlapping each other by two years.

The expansion of the electric grid, in combination with other infrastructure development, became a vital factor in enhancing communication and thus facilitating greater state control in outlying regions. At its peak, electrification accounted for more than half of government expenditure on infrastructure (Fan et al. 2003). A secondary objective of this infrastructural expansion in the north was to relocate the ethnic minority communities to higher, less fertile lands, who were practising traditional swidden cultivation for decades.

To further explore the role of electrification in Thai rural development, the next section examines how infrastructure expansion formed the basis of the relationship between the state and rural people, especially the northern ethnic minority communities. Given the high percentage of the northern ethnic minorities affected by the electrification programmes discussed here, the following section briefly discusses the history of the northern ethnic minorities' relationship with the Thai state.

Territorialisation Strategies: Bangkok's Expansion North

The present day contemporary society in northern Thailand came into existence with the expansion of infrastructure during the 1960s. The advantages of this expansion into the northern communities were wide-ranging as roads greatly facilitated the movement of people and resources. For many rural farmers, commercial farming and other mechanised activities increased profits and replaced subsistence farming. However, detrimental outcomes also oc-

curred from these developments. These negative outcomes disproportionately affected the ethnic minority communities who found their subsistence lifestyles challenged by new economic pressures.

These changes also allowed greater control of highland areas through the creation of negative ethnic stereotypes, the promotion of western scientific principles and physical displacement of the ethnic minority communities. The state has been eager in the past to find ways by which to control the inhabitants of the remote northern regions, a significant proportion of whom were ethnic minorities who had inhabited these regions for hundreds of years (Wyatt 1984). Territorialisation processes (strategies that work to reinforce other nation-building activities by strengthening a common identity and shared beliefs within a defined region) were used by the state to form an ethnically-based Thai identity. These processes created a Thai national identity and ideology – from which northern ethnic minorities were excluded.

The ethnically distinct groups living in the northern and northeastern provinces of Thailand form one per cent of the population of the country. There are large disparities in social status and economic development between these groups, but the most obvious social and political inequality is between these northern ethnic minorities *en masse* and the lowland Thai majority (Sturgeon 2000). The dire social and economic condition of the majority of the northern ethnic minorities is in stark contrast to the lowland Thai population.

Until the 1960s, the northern ethnic minorities had lived in relative geographic and cultural isolation from the lowland Thai, and were largely unaffected by national development policies (Van Roy 1971; Kunstadter and Kunstadter 1993). After this time, and due to their lack of non place-based lifestyles, lack of national identity and lack of assimilation of lowland customs or ideology, the state considered the northern ethnic minorities susceptible to infiltration and ideological influence by communism and a threat to the stability of the central government's hegemony (Kunstadter and Kunstadter 1993).¹

In Thailand, negative stereotypes were used to entrench the separation of northern ethnic minorities from the ethnic lowland Thai majority – consolidated through the use of the state-constructed 'hill tribe' category. This collective term, invented by the central government, was used disparagingly to contrast the ethnic minority from the lowland Thai. For many lowland Thai, less generous descriptions would associate the *chao khao* with a primitive, backward, less civilised people who must be modernised and integrated into the national economy (McKinnon 1989; Kunstadter and Kunstadter 1993; Kampe 1997; McCaskill and Kampe 1997; Lohmann 1999).² The use of the concept of a 'lowland' Thai ethnically-based identity allowed the centralised authority to solidify its control through territorial claims in the central plains, northeast and some northern areas of the territory. The strategy was to suppress and delegitimise pre-existing territorial claims over people and natural resources.³

A related territorialisation was to employ new scientific practices to document and define the land and the communities living there (Vandergeest and

Peluso 1995; Scott 1998). These processes include mapping and census activities which allow the creation of natural and human resource inventories (creating the enabling conditions for resettlement if necessary). In turn, these practices resulted in numerous economic and political advantages for the state due to the relative ease of being able to count, tax, conscript and monitor sedentary communities (Anderson 1991; Lohmann 1999; Vandergeest and Peluso 1995).⁴ These practices enabled the state to have greater control over its population using techniques that mimicked those of the colonising forces in neighbouring countries. These projects also allowed the state to identify which areas of its territory were most threatened by civil unrest.

Sato (2000) highlights the difficulties posed by the reclamation of remote areas by the state and the challenges encountered by the state in its efforts to reduce the ethnic minorities' dependency on the forest. Western science, promoted through the colonial powers, presented the centralised government with new methods to penetrate frontier zones.⁵ The advent of scientific forestry facilitated reclassification of upland areas to be critical resource zones, a vital part of the nation's ecosystem. Under the guise of national security and the need for international cooperation, the government revised boundaries and laid claim to new frontier areas, gradually displacing local tribes.

The resettlement of highlanders to lowland areas was another general policy approach adopted by the Thai state. Resettlement was facilitated by providing schools and health centres to entice the reluctant communities to move into state-controlled areas.⁶ The Thai military's border resettlement programmes also relocated a disproportionate number of ethnic minority villages. The rationale provided at the inception of these programmes was to tackle the opium problem and protect national integrity.

Decades on, the rationale of village relocation was switched through the environmental orthodoxies of sustainable development, which reflects the changing priorities of the state. It is this connection with relocation that is of interest in the state's decision to select a particular solar energy technology the Solar Battery Charging Stations (SBCS) for these projects as opposed to the decentralised Solar Home Systems (SHS) technology that is used in the majority of other similar projects worldwide.

The efforts of the Thai state to legitimise its authority in regions occupied by northern ethnic minorities have manifested themselves in various rural development policies. In the 1960s, one of the key aspects of the rural development policies and territorialisation strategies was social reorganisation. These include changes in community structure and local political administration. Provision of electricity was also an important element in enforcing centralised control of these previously remote areas (Bello et al. 1998) as this allowed the state to more easily access—and consequently secure and monitor—a much larger number of border communities. It is important to understand how these processes simultaneously facilitate the expansion of surveillance networks in areas that may not be under strong state control. The modern legitimising dis-

course for aggressive state interventions into the lives of northern ethnic minorities has continued in the late twentieth century through lectures on environmental conservation and sustainable development.⁷ From the discussion above, it would be reasonable to consider that any state-led rural development programme in northern Thailand will have a significant ethnic dimension.

RURAL DEVELOPMENT AND ELECTRIFICATION

In order to contextualise the choice of the solar technology programme, it is useful to briefly review the perceived role of electrification in rural development. The significance of this issue is that electrification is frequently misidentified as central to fuelling progress and prosperity in industrialised nations and it is often simplistically asserted that increasing energy use spurs social development and modernisation (IEA and OECD 2002). This view has encouraged the belief that the use of electricity can be causally related to an increase in living standards and economic development. Consequently, in many less developed countries, rural electrification is consistently championed as the answer to many development policy challenges such as poverty alleviation, urban migration, economic development and even national security concerns (IEA and OECD 2002).

Increased energy use, however, does not necessarily bring about a rise in living standards of the people. Several studies have, in fact, asserted that there is no easily identifiable direct connection between per capita energy use and living standards (Nader and Beckerman 1978; Scott-McDonald 1984; Zomers 2001). The relationship between energy and economic development is much more complex due to the intricate pattern of interactions between these variables, and further compounded by the difficulty of accurately measuring them (Weizsäcker et al. 1997). Rural electrification is not necessarily a catalyst for rural development in less developed countries. In many cases, it correlates only weakly with increased employment opportunities and has limited economic impacts, especially for the rural poor (Fluitam 1983; Desai 1988; Munasinghe 1990; Foley 1992).

Despite the absence of a direct causal connection between the provision of electricity and economic development, the rural development policies that promote electrification continue unabated. Given such apparent complexities relating rural electrification and social objectives, any sustainable development programme involving the use of an environmental technology for rural electrification should recognise these issues and carefully consider the wider social and political context of its introduction.

Solar: A Real Alternative for Rural Electrification?

Recent advances in the hardware design of solar electric systems have allowed them to compete economically with traditional electricity extension in

some niche situations. Due to the renewable energy source used by solar electric systems, they are considered to be much more environmentally sound than extending grid connections or using diesel generators and are, therefore, generally promoted by sustainable development programmes for remote applications.

There are two main designs that use solar electric systems for remote power: an individual solar home system (SHS) and village scale solar battery charging station (SBCS). Both the designs provide the opportunity to expand the capacity of rural electrification to areas previously inaccessible to traditional grid extension techniques. It is estimated that over a million individual SHS are providing electricity for remote communities worldwide, as of 2004 (Green 2004a). These systems vary in size, some of the larger individual arrays have the potential to run domestic lights, small fans, televisions or tape players although the amount of electricity they generate is not sufficient to run a range of appliances such as refrigerators or sewing machines (Kapadia 2004).⁸

One factor that is important for the social and technical sustainability of the SHS is the individual responsibility felt by the owner for his system's use. The individual nature of the SHS means that users can easily remove and re-install the system or sell the hardware. It also allows private industry to distribute the SHS through a variety of models.

Centralised SBCS installations differ from SHS in that their solar arrays are centrally located in a village and the power supply is shared among users who bring their batteries to the charging station. Only a few countries have installed SBCS in rural areas. There are several factors that work against the choice of centralised SBCS in comparison to the individual SHS. First, every user has to regularly charge the battery by carrying it to the nearest charging station. Transporting the battery in this manner increases both the chance of damage (a major expense) and accidents from battery acid spillage. The procedure is also inconvenient because the batteries are heavy and cumbersome, resulting in sub-optimal battery charging practices, thus severely reducing battery life. Secondly, unlike the individual solar panels in SHS—which are impermanently fitted on individual houses and can be easily relocated—the SBCS, with its battery charging house and centralised solar array, tends to fix villages at the SBCS installation site. One consequence of the Thai programme was that the state attempted to coerce some villagers into relocating in order to qualify for the SBCS. On two occasions, I was informed by villagers that the decision to install a station in their village was contingent on the village relocating to a place that was more favourable in the view of the state. An informant in a village located in the extreme northern border region of Thailand revealed that state agents said that they would provide government services if the village relocated. Ironically, this village was within a few hundred metres from a main road and could have been hooked up to a mainline grid electricity supply quite easily (Green 2004b).

It is interesting to note that a majority of the systems installed with international donor funding are of the individual SHS design, unlike the state-funded SBCS projects examined here (Green 2004b). A major difference between these systems is that while the SBCS fixes the system (and therefore the village) in a specific location, the SHS allows much greater individual flexibility to be moved with the household. It is thus reasonable to conclude that the government made a prior assessment as to where these systems must be located as a way of controlling villages—through careful selection and provision of basic services. This factor may have been a decision in selecting the system, which on paper, was likely to provide a lower level of end user satisfaction and so on the surface, does not make intuitive sense.

Thai SBCS Programmes

Primary and secondary sources were used to collect data for the research presented here. The data were collected through interviews in Bangkok and Chiang Mai. I interviewed people in over 30 villages in northern border communities involved with the SBCS programmes for discussion about their energy needs and their understanding of the technology, and to evaluate the technological sustainability of the stations.⁹ Owing to seasonal variations in northern Thailand, I visited villages in several phases of their agricultural cycle to understand the various difficulties they experience in these different seasons.

As of 2005, the Thai programmes are the only major users of the SBCS for remote solar electrification in the world. This programme began in the late 1980s and consists of approximately 1600 installations,¹⁰ two-thirds of which are located in the northern border provinces of Thailand, locations which have a high percentage of ethnic minorities.¹¹ When fully operational, the Thai SBCS can provide a limited power supply suitable for home lighting or a small black and white television. Appliances requiring greater power or an alternating current, such as refrigerators or power tools, cannot be used with these solar battery-charging systems.

The objectives that drove the state-led SBCS programmes reflect broad sustainable development priorities such as reduced greenhouse gas emissions; increased energy security and fuel source diversity, and increased experience with alternative energy technologies and renewable fuels (DEDP 1995; Phan-I-nakul 1997; PWD n.d; PWD 1998; Thongsathitya n.d). In addition, these outcomes were expected to occur along with an increase in income-generating activities, education opportunities and social development as well as improvements in living standards.

I found that a high percentage (60%) of the SBCS systems had technical problems that would have compromised the ability of the villagers to use the systems (Greacen and Green 2001; Green 2004b). The following section discusses the ability of the SBCS programme in meeting its objectives given this level of technical failure.¹²

The SBCS systems did little to promote change from the use of fossil fuels to the use of electricity for basic energy needs such as household lighting. Consequently, kerosene and candles were the dominant fuels for household lighting. In principle, fuel switching could have resulted in beneficial health effects for villagers due to a reduction in airborne particulates inside homes.¹³ However, if a reduction in health problems associated with traditional sources of fuel was of serious concern, a more substantial result would have occurred by implementing an energy programme that focused on replacing firewood cooking with fuel-efficient gas stoves. This issue relates back to the lack of performing an energy needs assessment of these villagers before decisions on technology choice were made.¹⁴

If the solar systems were working to full capacity, they would have had the potential to provide better quality household light than candles or kerosene lamps, thus facilitating activities such as children's efforts to do homework at night. However, in the majority of the northern ethnic minority villages, educational opportunities for children are extremely limited. In this context, the non-availability of adequate lighting scarcely seems to be one of the most critical constraints to children's education. Indeed, villagers noted that increasing household incomes (which would have reduced the need for children to be working during the day) would have been a more important factor in promoting opportunities for children to improve their education.

The electricity supplied by the batteries charged from the SBCS had little impact on income-generating activities in the villages. The SBCS might have been able to encourage income generation and rural development if their use enabled villagers to operate appliances such as hand tools, refrigerators, milling equipment or electricity for heating resistance loads such as for irons. However, the limited power supplied from the SBCS stations could not easily be used to power these appliances. Even if an electricity supply could promote new activities, without reliable access to raw materials, distribution channels and a market to sell to, the insecurity involved in entering into a new enterprise would make this choice unacceptably risky for many of the poorer villagers. Of particular concern, there is no evidence that these systems have improved poverty levels for the poorest members of the communities. Some households decided not to join the user groups because they could not afford the start up fees and ongoing associated costs. Additional evidence for this problem comes from noting the fact that some villagers who did join the SBCS programme quickly sold the donated hardware because the cash was more valuable to them.¹⁵

One final objective related to the SBCS' ability to reduce the need to electrify rural areas with traditional grid extension. However, government documents suggested that they considered the SBCS programmes as a step in pre-electrification, and, therefore, it is not legitimate to view these projects as reducing this need.¹⁶ Moreover, 90% of the solar systems installed in Thailand have received state subsidies, a situation that has hindered the development of

private energy service companies to provide SHS leasing schemes similar to those that have proved successful in other countries (Wade 1994). These subsidies also discourage private sector involvement in new solar programmes and serve as strong disincentives to commercialising rural electrification through solar generated electricity in Thailand.¹⁷

There are several unusual features of the SBCS programme that have not been covered so far. First, the technology was not chosen in response to assessed energy needs, a standard practice at the initiation of a rural energy project. Indeed, the state did not even perform an analysis of the energy needs that would have enabled an energy programme to be designed that best suited the basic energy needs and reduced energy poverty in the target areas. Second, this 'environmental' technology programme substantially lacked actual environmental benefits because it did not displace an appreciable amount of fossil fuel use. Third, these programmes continued to be implemented for over a decade, despite their lack of technical sustainability. Fourth, the centralised SBCS hardware configuration is an anomaly in the context of the use of individual SHS hardware configuration used elsewhere. Finally, the state chose to subsidise and implement these programmes in regions of the country with the highest proportion of ethnic minorities, many of whom are not Thai citizens—for whom the state has no obligation to serve.

How might we understand the apparent inconsistency between the ongoing promotion of the SBCS programmes despite their inability to satisfy the programme objectives? Clearly, we have seen that the objectives that drove the SBCS programme contrast markedly with the rationales that justified rural electrification programmes during the preceding two decades. These earlier objectives (as discussed in the previous section) explicitly laid out in rural development policy documents of the time, indicated the state's intent to use electricity, among other practices, as a means of social control.¹⁸

DISCUSSION

What might the state's motivation be for promoting the SBCS programmes? Given that the SBCS systems could not fulfil their own programme objectives, could there be other reasons for their choice and implementation?

The SBCS programme appears to fit within a trend seen in sustainable development activities that approach the use of environmental technologies in a technocentric fashion. In the rural energy sector, these activities are exemplified by the priority currently given to the expansion of rural electrification programmes using renewable energy technologies where the options for other energy technology choices are extremely limited. The push toward the use of decentralised electricity-generating technologies in remote areas using solar electric systems in particular has been accelerated by the introduction of these increasing affordability of these technologies.

The preceding analysis of SBCS in northern Thailand reveals that, contrary to popular perceptions, the use of an environmental technology in a sustainable development programme can yield outcomes that are neither environmentally beneficial nor socially sustainable. I discussed the prior motivations for rural electrification in order to contextualise the SBCS programme and questioned the legitimacy of environmental agenda that was used to promote it. This approach revealed a major inconsistency between the SBCS programme objectives and previous rural electrification objectives promoted by the state. We saw how earlier rural electrification policies were driven by a need to facilitate nation-building strategies through expanding the centralised state's reach into the rural areas of the country. I suggest that despite the potential environmental credentials of the SBCS, there is little difference in the actual outcome from these programmes for the intended beneficiaries than from earlier rural electrification programmes.

Over the last 30 years the Thai state consistently promoted large, centralised grid electrification programmes. Alongside rural electrification, other rural development policies—such as the expansion of transport infrastructure—were advanced. In both instances, the state developed these policies to promote a distinct and explicit set of policy objectives: increased state control of border regions and populations; sedentarisation and 'domestication' of rural communities; reduction of threat of communism and expansion of lucrative commercial activities, such as monocropping and logging. Together, these strategies enabled the surveillance of ethnic minority people, dissemination of lowland Thai ideology and state propaganda to remote areas directly (e.g. through increased use of television) and indirectly (e.g. through an increased number of military-coordinated development programmes) which in turn served to assimilate northern ethnic minorities into lowland Thai culture. One evident intention of such policies was gradual erosion of traditional subsistence lifestyles and replacement with a market economy.

In the provinces with high percentages of northern ethnic minorities, state implemented rural development programmes clearly favoured the state's agenda over the development priorities of northern ethnic minorities.¹⁹ The manner in which these solar electrification systems were implemented was akin to the non-participatory rural electrification programmes of the 1960s. In this case it appears that the technology may have given the state an instrument to facilitate their control over ethnic minorities—seen in one case by using the offer of an electric system to attempt to control village location. This then begs the question of whether we might speculate that the explicit objectives of 'taming backward areas' from the earlier wave of rural electrification, might form a set of unwritten objectives for the new SBCS rural electrification policy of the 1980s. The apparent incongruity between the community-serving objectives of these SBCS programmes and the explicitly state-serving agenda that drove previous rural electrification programmes would then be partially explained.

There appears, therefore, to be a problem with the choice of a system that could serve to further enforce state policies of controlling village locations (permanent SBCS vs moveable SHS) and the wish to have the most 'successful' systems installed.

This problem is compounded by the likelihood of individual beliefs and actions in the implementation of some of these rural electrification policies. Individuals within the state who promoted and implemented the policies may have genuinely believed in rural upliftment or the inherent value of environmental technologies. Another reason for the choice of the SBCS may have been due to corrupt practices by companies promoting a particular technology. It is likely that the final implementation may be a combination of state policy and some or all the factors above.

Over the past two decades, solar electric technologies have been championed in the literature as key tools to enable sustainable development through rural electrification. If designed and implemented successfully, the solar electric programmes could play a vital role in promoting rural electrification policies that increase local capacity and self-sufficiency while simultaneously forging a new sustainable energy path. This analysis of the Thai solar electric systems, has however, highlighted the need for a more critical assessment of state-led environmental technology programmes implemented under the rubric of sustainable development. Failing to perform this critical analysis, the risk is that such environmental technology programmes—as has been the case with many previous top-down technocentric development programmes—will fail to achieve local environmental and social objectives, and worse, further entrench unjust rural development policies.

Notes

1. Radio broadcasts in northern ethnic minority languages were originally initiated to respond to a perceived imminent communist threat (FAO 2002).
2. Similarly, the name Meo (sometimes Miao) used by lowland Thai is a pejorative term for the Hmong (Tapp 1989: 26).
3. In the past and at the behest of certain state agents, over-sensationalised media reports led many lowland Thai to have pejorative views about these ethnic minority communities. These negative stereotypes are still prevalent today, for example, where high level officials consider it appropriate to publicly voice these beliefs (Ritchie and Yang 2000). For example, Lohmann (1999: 8) quotes the Director General of the Royal Forestry Department who suggested that the solution to the 'hill tribe problem' was to 'sterilize them by force so that they cannot increase their numbers any further.
4. The implementation of an official land titling system, national identity cards and the creation of national forest areas also helped enable the state

to impose their conceptions of space and politics to shore up their control of people living in previously non-aligned areas of the country.

5. The state could 'neutralise potential security threats' by the incorporating border regions and simultaneously keeping them as 'frontiers' for the resettlement of lowland people (Peluso et al 1995: 197).
6. Schools and health centres were valued by the state for their ability to act as collectors of demographic data about villages and sites for dissemination of propaganda (Tapp 1989).
7. Sustainable development programmes can allow the state to assert its authority over communities located in areas of environmental concern as a means to further their ability to control security in politically sensitive remote border regions.
8. This is because these appliances require an alternating rather than a direct current.
9. The provinces I visited included: Petchabun, Mae Hong Son, Chiang Rai, Chiang Mai, Phisanulok, Tak and Nan. Another 32 surveys from other villages in these provinces provided additional data.
10. At a cost of approximately US\$11 million.
11. This fact suggests an apparent reversal of policy, due to the fact that the state has previously discriminated against the northern ethnic minorities through its rural development policies.
12. The objectives of the SBCS programme include: benefit the environment through low-polluting technology; reduce imported conventional energy by using indigenous alternative energy, such as solar energy; encourage commercially viable rural development, provide villages with electricity; reduce [traditional electricity] connection burden; promote private industry sector investment; alleviate poverty; provide increased opportunity for children's education; provide alternative fuel which is better for health and sight compared to traditional sources of energy (paraphrased by author from Thai language objectives see previous refs).
13. Particulate exposure and negative health impacts resulting from wood burning and kerosene lamps are most severe for women, the elderly and children who spend the longest time inside the house near the open fires (Smith 2002).
14. The prevalence of energy needs for cooking and heating—arguably the two primary aspects of energy poverty in rural Thailand—highlight the curious nature of the choice by the state to introduce the SBCS programmes in the first place given that the basic energy needs of the majority of the poorer rural communities cannot be met by the provision of a limited, non-productive electricity supply. If the SBCS programmes had truly hoped to use the alleviation of energy poverty as one strategy to address broader poverty, we would expect to find rural energy programmes that clearly respond to village-based energy use needs analyses. Several discussions that I had with both male and female villagers about energy needs suggested

that gas or more efficient charcoal and biomass stoves for cooking were a higher priority than this limited electricity supply, especially amongst the poorer villagers (Green 2004b).

15. A further concern with these SBCS projects is that battery replacement was the most expensive component of the system over its lifetime, a cost that has been shifted from the state to the villagers.
16. The Provincial Energy Authority considers that the SBCS may encourage greater electricity consumption increasing the use of electric appliances, and directly improving the economics of traditional grid extensions (Green 2004b).
17. Moreover, taxes on imported unassembled solar modules, can be as high as 35 per cent, and other components for module assembly (such as float glass), strongly discourage the growth of the local module assembly industry.
18. Surveillance techniques and population reduction techniques for northern ethnic minorities as well as concerns over border security issues were openly discussed in government documents at the time (Green 2004b).
19. Priorities for these people consist primarily of gaining citizenship rights and the concomitant rights, such as work permits, ability to travel out of the province, health services and other state sector benefits.

REFERENCES

- Anderson, B. 1991. *Imagined Communities: Reflections on the Origin and Spread of Nationalism*. Verso, London.
- Bello, W., S. Cunningham and L. Poh. 1998. *A Siamese Tragedy. Development and Disintegration in Modern Thailand*. Zed Books, London.
- Chullakesa, C. 1991. PEA's Experience in Rural Electrification in Thailand. Paper presentation *Proceedings of Asia Energy 1991: First Asian International Conference on New Renewable Energy Infrastructure and Policy Planning, Technology and Equipment*. Bangkok.
- DEDP. 1995. *Photovoltaic Battery Charging Stations for Non-Electrified Villages in Thailand*. Ministry of Interior, Bangkok.
- Desai, V. 1988. Rural Electrification: Review of Regional Experiences. In: *Rural Energy Planning: Asian and Pacific Experiences* (ed. K. Ramani). Asian and Pacific Development Centre, Kuala Lumpur.
- Fan, S., S. Jitsuchon, and N. Methakunnavut. 2003. *Impacts of Public Investments on Poverty Reduction in Thailand*. International Food Policy Research Institute, Washington DC.
- FAO. 2002. *Case Study on Education Opportunities for Hill Tribes in Northern Thailand*. FAO, Bangkok.
- Fluitam, F. 1983. *The Socio-Economic Impact of Rural Electrification in Developing Countries: A Review of Evidence*. Geneva, International Labour Organisation.

- Foley, G. 1992. Rural electrification in the developing world. *Energy Policy* (Feb).
- Greacen, C. and D. Green. 2001. The role of bypass diodes in the failure of solar battery charging stations in Thailand. *Solar Materials and Solar Cells* 70(2):141–149.
- Green, D. 2004a. Thailand's solar white elephants. *Energy Policy* 32(6):747–760.
- Green, D. 2004b. Power Games: The Politics of Solar Electrification in Northern Thailand. Ph.D. Thesis. UC Berkeley, USA.
- Hayes, P. n.d. *Social and Political Issues in Rural Energy Development*. International Development Research Centre, Canada.
- IEA and OECD. 2002. *World Energy Outlook*. IEA/OECD, Paris.
- Kampe, K. 1997. Indigenous Peoples of Southeast Asia. In: *Development or Domestication? Indigenous Peoples of Southeast Asia*. (eds. D. McCaskill and K. Kampe), pp. 1–25. Silkworm Books, Chiang Mai.
- Kapadia, K. 2004. *Productive Uses of Renewable Energy. A Review of Four Bank-GEF Projects*. World Bank, Washington DC.
- Kunstadter, P. and S. Kunstadter. 1993. Population Movements and Environmental Changes in the Hills of Northern Thailand. In: *Patterns and Illusions* (eds. G. Wijeyewardene and C. Chapman), pp. 17–56. ANU, Canberra, Thames and Hudson, London.
- Lohmann, L. 1999. *Forest Cleansing. Racial Oppression in Scientific Nature Conservation*. The Corner House, UK.
- Lucas, N. 1987. *Energy Policies in Asia: A Comparative Study*. McGraw-Hill, Singapore.
- McCaskill, D. and K. Kampe. 1997. *Development or Domestication. Indigenous Peoples of Southeast Asia*. Silkworm Books, Chiang Mai.
- McKinnon, J. 1989. Structural Assimilation and the Consensus: Clearing Grounds on which to Rearrange our Thoughts. In: *Hill Tribes Today: Problems in Change* (eds. J. McKinnon and B. Vienne), pp. 483–501. White Lotus-Orstom, Bangkok, Thailand.
- Munasinghe, M. 1990. *Energy Analysis and Policy*. Butterworth, London.
- Nader, L. and S. Beckerman. 1978. Energy as it relates to the quality and style of life. *Annual Review of Energy* 3:1–28.
- Peluso, N., P. Vandergeest, and L. Potter. 1995. Social aspects of forestry in Southeast Asia: a review of postwar trends in the scholarly literature. *Southeast Asian Studies* 26(1):196–218.
- Phan-I-nakul, S. 1997. *Photovoltaic Program of the Thai*. Public Works Department, Bangkok.
- PWD. 1998. *Project of SBCS*. (In Thai). PWD, Bangkok.
- PWD. n.d. *Characteristics of Project* (In Thai). PWD, Bangkok.
- Ritchie, M. and B. Yang. 2000. Evicted and excluded: The struggle for citizenship and land rights by tribal people in northern Thailand. *Cultural Survival Quarterly* 24:3.

- Sato, J. 2000. People in between: Conversion and conservation of forest lands in Thailand. *Development and Change* 31:155–177.
- Scott, J.C. 1998. *Seeing Like a State: How Certain Schemes to Improve the Human Condition have Failed*. Yale University Press, New Haven.
- Scott-McDonald, J. 1984. An Evaluation of Rural Electrification Policy: Thailand, a Case Study. Ph.D. thesis. Northern Illinois University, Chicago.
- Smith, K. 2002. In praise of petroleum? *Science* 298:1847.
- Sturgeon, J. 2000. Practices on the Periphery: Marginality, Border Powers and Land Use in China and Thailand. Ph.D. thesis. Yale University.
- Tapp, N. 1989. *Sovereignty and Rebellion: The White Hmong of Northern Thailand*. Oxford University Press, Singapore.
- Thongsathitya, A. n.d. *Photovoltaic Battery Charging Station in the Off Grid Rural Villages Project*. DEDP, Bangkok.
- USAID. 1969. *Mobile Development Units*. USAID, Washington DC.
- Vandergest, P. and N. Peluso. 1995. Territorialization and state power in Thailand. *Theory and Society* 24:385–426.
- Van Roy, E. 1971. *Economic Systems of Northern Thailand: Structure and Change*. Cornell University Press, Ithaca.
- Vorate, T. and D. Barnes. 1997. *Thailand's Approach to Rural Electrification: How was it Successful?* ESMAP, Washington, DC.
- Wade, H. 1994. *Project Development and Management for Photovoltaic Based Rural Electrification*. Asian Institute of Technology, Bangkok.
- Weizsäcker, E. von, A. Lovins and L. Lovins. 1997. *Factor Four: Doubling Wealth, Halving Resource Use: The New Report to the Club of Rome*. Earthscan, London.
- Wyatt, D. 1984. *Thailand: A Short History*. Yale University Press, New Haven.
- Zomers, A. 2001. *Rural Electrification*. Ph.D. thesis. University of Twente.