

Optimising energy efficiency finance in emerging economies in Southeast Asia

Verena Streitferdt

Institute for Sustainable Futures
University of Technology, Sydney

A thesis submitted for the degree of a Doctor of Philosophy

July 2016

Certificate of original authorship

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as part of the collaborative doctoral degree and/or fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Verena Streitferdt, 22nd of July 2016

Abstract

This thesis investigates the relationship between public and private sector efforts to optimise energy efficiency finance initiatives in an emerging country context, using Thailand as a case study.

Demand-side energy efficiency measures could significantly reduce pressures on energy systems in emerging economies in Southeast Asia while at the same time reducing greenhouse gas emissions. Rapidly increasing energy needs, combined with dependence on fossil fuel imports have put energy systems in the region under pressure. Due to high urbanisation growth rates, and comparatively inefficient industries, demand-side energy efficiency measures could be part of the solution.

The lack of external energy efficiency finance for industry and building owners is a major barrier, but reports and country examples contain mixed messages about how to best overcome this challenge. The dominant discourse around energy efficiency finance originates from international organisations who advocate for the public sector to focus all efforts on maximising private sector investments. However, developed country experience and some emerging country examples, suggest that the problem is more complex. Therefore, this thesis focuses on how to optimise energy efficiency finance.

Thailand serves as a case study due to the range of energy efficiency initiatives designed and implemented in that country since the early 1990s. Transition studies and Multi-Level Perspective, were chosen as the theoretical framework and heuristic tool for the analysis. Qualitative data in the form of interviews with forty-eight experts from government, the private sector and academia form the core of this research. The research found that in Thailand, after more than 10 years of public sector support for energy efficiency finance initiatives, success in the private sector has been limited. Challenges identified include: (1) a lack of de-risking measures (2) renewable energy projects receiving most funding; (3) lack of guidance from the Central Bank of Thailand and (4) missing cross-coordination with relevant ministries to create additional demand for energy efficiency finance services. Suggestions for next steps are provided.

The main finding from this research is that EEF in an emerging country context will never be transitioned 100% to the private sector, but will be reliant on long-term consistent support from the public sector. Policy makers and international organisations must therefore carefully evaluate the existing framework conditions before choosing which energy efficiency finance initiatives to support. The Multi-Level Perspective analytical framework could provide such an analytical tool to further unleash the energy efficiency potential in Southeast Asia.

Acknowledgements

I would like to thank the following agencies for providing me with financial support during my research: The University of Technology, Sydney for the UTS President's Scholarship, the Hildegard-Dinter Association for a travel fund, the Thai-German programme: Energy Efficiency Development Plan (TGP-EEDP) implemented by the 'Deutsche Gesellschaft für Technische Zusammenarbeit' (GIZ) and the Energy Research Centre of the Netherlands (ECN) for some short-term work opportunities in Thailand. One of the project workshops was co-hosted by Nexant, an international consulting firm, at its Bangkok regional office and another was co-hosted by an EU SWITCH-Asia Programme: Greening the Thai Automotive Industry.

My supervisory team saw the best and worst of me during the three and a half years of this endeavour. Their persistence, commitment and knowledge brought me here, so I am forever grateful to: Pierre Mukheibir, for always being available, process-orientated and cheerful; Timon Wehnert, for ad hoc deep analytical discussions at the most exquisite places; Mick Paddon for introducing me to social research and perfecting my English skills with his impeccable vocabulary; and David Crossley for work inspiration, crucial content insights and sharing with me his expansive network in Thailand and the rest of Asia. I cannot express enough how grateful and privileged I feel to have had this support, and in my next job I will miss having the 'four wise men' around me. Also, I would like to thank John Revington for providing a grammatical and typographic edit of the final thesis draft.

Also, my sincere thanks go to the professors, Dr. Surapong, Dr. Menke and the colleagues at the Joint Graduate School of Energy and Environment (JGSEE), King Mongkut's University of Technology in Thonburi and to the Thai-German programme: Energy Efficiency Development (TGP-EEDP) (GIZ) for their support. JGSEE graciously hosted me during my field trips. The JGSEE team and professors welcomed me to join professorial lunches and activities, and provided contacts and references. In particular, I would like to thank my three research assistants, Khun Phapada, Khun Krib and Khun Pan. Without their constant reflection and attentiveness this research would not have been possible. TGP-EEDP also provided me with a work space and due to their insightful discussions and contacts this research received its rich data. In particular, my gratitude goes to Khun Monthon for giving me analytical support, to Tom for facilitation to the programme director Milou Beerepot for her thought-provoking comments. Finally, I would like to thank Peter Du Pont for co-publishing with me a paper and all his support during my research.

In Berlin, in particular I would like to thank the Wuppertal Institute for Climate, Environment and Energy for hosting me during my three-month writing internship. Their collegial feedback during roundtables and joint lunches was invaluable. In particular, thanks to Florian Mersmann for MLP brainstorming, Shritu Shrestha for best lunches and Kristina Wagner for her flexible and competent assistance.

Thanks also to my medical support team who kept my health going, especially in the last two years after I contracted dengue fever. Thanks to Margaret for continuously re-energising my body after another dengue relapse, to Trish and Adrienne for nurturing food and conversations, to Tienne, Sinden and Paul for keeping my body and mind

flexible, and to Mira for helping me to experience again the joy of exercise through her contemporary dance classes.

Being a gypsy, friends at home and far afield are the nurturing ground on which I thrive. Internationally, I would like to say thanks to Jana for accountability and park yoga, to Kerstin for constant reflection and diet tips, to Anna for being the best Cambodian host and German adventurer, to Mari for her big Italian wedding, to Budi for her taste buds, to Michael for hosting and reflection time, to Odit for inspiration and to Bernie for long friendship and consistency.

In Berlin, I would like to thank Birgit for an alternative home, to Bere for bike and lunch escapes, to Alex for accommodation and insightful discussions, to Astrid and Kofi for the best rooftop terrace pizza experience, to Juergen and Anja for shelter and kids' distraction, to Silvia for fun activities and best conversations, to Anja for her clear mind, and to Manolo and Christian for Berlin adventures.

In Thailand, my particular thanks go to Martina and Nikola for incredible experiences, such as their newly born son Silvan, good food and great conversations, to Hala for hosting me, for sharing her network and for ad hoc dinners and coffees, to Robert for fun jogs and eating activities, and finally to Khun Ampawa for her hospitality, friendship and passion for her work on sustainable energy.

In Australia, very special thanks go to my flatmates for their hospitality and patience; to Ro for her continuous friendship, regardless of my constant travelling, our invaluable discussions around politics, gender and beautiful walks in Sydney and its surroundings; and to Jay and Louise for hosting me on and off in their beautiful Bronte home, distracting my mind with sharing beautiful 'film' moments, pinning me down to work and also giving me warnings to rest when they saw my health decline.

Further, I would like to thank the community of the Institute for Sustainable Futures and the Faculty of Social Sciences, in particular my pod neighbours Dana, Louise, Emilia, Tanja and Isabel for friendly smiles and chats; Jessica and Tara for friendship and hot chocolates; Chrisanthi and Matt for being loyal writing buddies; Reba for best lunch breaks; Reza for calming walks and delicious Iranian food; Laure-Elise for sharing her worries which made mine seem small; and Judy for coffees and walks and being a life inspiration. Besides university, I would like to thank Doris for best girls' outings; Jerome for shelter and calm perspectives; Janina for her passion for dance, her friendship and her open mind; Austin, Cenk and Alex for lovely memories; and Toni for her adaptiveness and sharing with me a beautiful new experience.

Faraway but always with me in spirit I also would like to thank: my family. The whole family 'Moritz' for our yearly meetings which give me the feeling of groundedness; Dorit and Lothar for cheering calls; my dad and Lucia for our skype conversations; my brother Tobi for wheelchair traveller and time management tips; and my mum, for inspiration, commitment and beautiful spa experiences when most needed – without your constant support I would not be here.

But finally, and most importantly I would like to thank the many Thai and Thai-based international professionals who participated in the interviews and roundtable discussions. Their sharing of their deep experiences with Thailand's energy efficiency policies and programs was invaluable to the success of this research.

I dedicate this thesis to **love** and **hope**:

Love for my brother, Tobias, as without our shared passion for travel this PhD would never have become reality, and

hope to Southeast Asia that it will demonstrate to the world that prosperity and resource efficiency can be achieved together.

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List of relevant publications

The analysis of the public energy efficiency finance mechanisms in Thailand discussed in Chapter V of this doctoral thesis have been published and are under review. The publications are listed below:

- 1) Streitferdt, V. & Chirarattananon, S. 2015, 'Energy Efficiency Finance Support in Thailand: Lessons learned from the Energy Efficiency Revolving Fund', *Journal of Sustainable Energy & Environment*, vol.6, pp. 21-26.
- 2) Streitferdt, V., Chirarattananon, S. & Du Pont, P. 2016, 'Lessons learned from Studying of Public Initiatives to support Energy Efficiency Financing in Thailand from 1992 to 2014', *Energy Efficiency* () 1-19. DOI: 10.1007/s12053-016-9492-1

List of acronyms

ADB	Asian Development Bank
AFD	French development agency
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of South East Asian Nations
BOI	Board of investment
CHUEE	China Utility-Based Energy Efficiency Finance Programme
CIMB	Commerce International Merchant Bank
CSR	corporate social responsibility
DANIDA	Denmark's development cooperation
DEDE	Department of Alternative Energy Development and Energy Efficiency
DFID	Department for International Development
DSM	demand-side management
EE	energy efficiency
ECFT	Energy Conservation Foundation of Thailand
EECT	Energy Efficiency Centre of Thailand
EEDP	Energy Efficiency Development Plan
EEF	energy efficiency finance
EforE	Energy for Environment Foundation
EGAT	Electricity Generating Authority of Thailand
EERF	Energy Efficiency Revolving Fund
EERS	Energy Efficiency Resource Standards
ENCON	energy conservation
EPC	energy performance contracts
EPPO	Energy Policy and Planning Office
ESCO	energy service company
ESC	energy supply contracts
ESI	electricity service industry
FTI	Federation of Thai Industries
GEF	Global Environment Facility
GHG	greenhouse gas
GIZ	German technical development cooperation
GS - EPCs	guaranteed savings – energy performance contracts
IDB	Inter-American development Bank
IFC	International Finance Corporation
IFCT	Industrial Finance Corporation of Thailand
IMF	International Monetary Fund
IPEEC	International Partnership for Energy Efficiency Corporation
IPCC	Intergovernmental Panel on Climate Change

JGSEE	Joint Graduate School for Energy and Environment
KfW	Kreditanstalt für Wiederaufbau
ktoe	kilotonne of oil equivalent
kWh	kilowatt hour
MEA	Metropolitan Electrification Authority
MLP	multi-level perspective
NAMA	nationally appropriate mitigation action
NEPO	National Energy Policy Office
OECD	Organisation for Economic Cooperation and Development
PEA	Provincial Electrification Authority
PTT	Petroleum Authority of Thailand (PTT) Public Company Limited
RE	renewable energy
SS – EPCs	shared savings – energy performance contracts
SME	small and medium enterprises
SME Bank	Small and Medium Enterprise Development Bank of Thailand
SOP	Standard Offer Program
TGO	Thailand’s Greenhouse Gas Organisation
TGP-EEDP	Thai-German programme: Energy Efficiency Development Plan
THB	Thai Bath
TIS	technology innovation systems
TM	transition management
UK	United Kingdom
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organisation
US	United States of America
USAID	US Foreign Assistance programme
UTS	University of Technology, Sydney

Glossary

Asian developing and emerging economies	Asian developing and emerging economies are characterised by rapid economic growth, high urbanisation, and high levels of poverty (APERC 2013). This definition deliberately includes both developing and emerging economies, as energy systems are especially challenged during the transition from a developing to an emerging economy. They differ for example in the support they receive from international organisations.
Demand-side energy efficiency measures	These are measures which reduce the energy consumption of consumers, for the same productive output, or providing higher energy services or production for the same amount of energy consumption. Energy Efficiency measures include improvements to the existing infrastructure stock of industry and buildings as well as the provision of energy-efficient solutions for new projects in the industry and building sectors (Selmet 2012).
De-risking measures	These are measures which help investors and EE service providers to manage specific types of risks. These measures can be, for example, loan guarantees, insurance, or foreign exchange/liquidity facilities. The public sector could directly provide the finance or provide the finance to a financial institution at a subsidised rate (Venugopal 2012).
Energy efficiency	Energy efficiency is defined in this thesis either consuming less energy for the same productive output, or providing higher energy services or production for the same amount of energy consumption (Selmet 2012).
Energy efficiency finance	Energy efficiency finance means funding energy efficiency projects for demand-side measures within the industry, building, residential and public sectors (Taylor 2012).
Energy efficiency finance initiatives	EEF initiatives are public and private sector efforts to provide financial tools to provide external EEF to customers in the industry and building sectors (Taylor 2012). Some have defined these as supply-side policies to support EEF. However, due to the confusion about the terms demand-side and supply-side energy efficiency the term supply-side policies will not be used in this thesis.
Energy efficiency projects	Energy efficiency projects are projects that use less energy for the same service than previously consumed (previous performance). This can be measured compared to the existing practice of that industry or standards (if available in the country).
Energy supply contracts	In ESC, the ESCO provides specific energy efficiency services for an agreed fee. In this model maintenance and operation stays with the ESCO company and the customer pays the ESCO for the electricity for a

long period of time (10-15 years). The output is measured in verified megawatt hours provided to the customer by the ESCO, but does not involve a performance contract (MacLean & Purcell 2014; Würtenberger 2012).

External energy efficiency finance	External EEF here means all funding that does not directly come from corporations' earnings, but always uses third parties to mobilise finance. These third parties could for example be banks, leasing companies, ESCOs (Taylor 2012).
Framework conditions	National circumstances in a country that influence EEF initiatives: electricity sector (electricity price, EE regulations, institutional set-up); finance sector (institutional set-up, regulations), but also external pressures or underlying cultural and political circumstances. The framework conditions in the theoretical language used are the landscape and the regime(s) level.
Framework conditions	These are the national circumstances in a country that influence EEF initiatives. For the electricity sector, they include: electricity prices, EE regulations, institutional set-ups. For the finance sector, they include: institutional set-up, and regulations. They also include external pressures or underlying cultural and political circumstances. The framework conditions in the MLP framework are defined at the level of the landscape and the regime(s).
Guaranteed savings – energy performance contracts	In guaranteed savings – energy performance contracts the ESCO guarantees to the customer a certain amount of energy savings; any revenues that are generated beyond those energy savings are kept by the ESCO (Crossley & Wang 2013).
Landscape	Landscapes are defined by transition studies as external pressures and non-changeable framework conditions. Thus the landscape is defined as the 'whole set of impacts outside the level of niches and regimes, which have influence' (Lachman 2013, p.271). It also includes the 'deep structural relationships' of society (Baker, Newell & Phillips 2014, p.794). So, in this research landscape conditions can include (1) fluctuations in oil prices; (2) financial crises; (3) national, regional or international political pressures (e.g. from the IMF); (4) the political system, (5) corruption and (6) cultural characteristics.
Niche	A niche is a protected space where technological innovation can evolve and develop towards penetrating the dominant market structures (Kemp, Schot & Hoogma 1998). For this research, energy efficiency finance for the building and industry sectors is defined as the 'radical social innovation', and the niche is defined as the existing EEF initiatives (Witkamp, Raven & Royakkers 2006, p.2).

Private sector energy efficiency finance models	Energy efficiency finance models are defined as primary transaction structures that have been created by the private financial sector to reap the business opportunities of the EE investment niche market (MacLean & Purcell 2014; Würtenberger 2012).
Public energy efficiency finance mechanisms	Public energy efficiency finance mechanisms (PEEFMs) are 'arrangements amongst institutions and market players to finance and implement energy efficiency projects' (Kats et al. 2012). In this thesis the focus is on external funding that leads to EE implementation by the industry and commercial building sector (Taylor 2012).
Regime	A regime is 'a variety of mutually reinforcing and entrenching cognitive, social, economic, institutional and technological processes that sustain existing trajectories of development' (Smith, 2007:p.428). So, in this research the electricity and the financial regimes are the core focus of the analysis.
Shared savings energy performance contracts	Under the shared savings energy performance contract model the ESCO and the customer share the cost savings from implementing the EE measures at an agreed percentage for a fixed number of years (Crossley & Wang 2013).

