

Chapter 1

Financing Renewable Energy in the Developing Countries of the EAS Region

Fukunari Kimura,

Shigeru Kimura

Youngho Chang

Yanfei Li

April 2016

This chapter should be cited as

Kimura, F., S. Kimura, Y. Chang, and Y. Li (2015), 'Financing Renewable Energy in the Developing Countries of the EAS Region', in Kimura, S., Y. Chang and Y. Li (eds.), *Financing Renewable Energy Development in East Asia Summit Countries*. ERIA Research Project Report 2014-27, Jakarta: ERIA, pp.1-11.

Chapter 1

Financing Renewable Energy in the Developing Countries of the EAS Region

Fukunari Kimura,

Shigeru Kimura, Youngho Chang, Yanfei Li

1. Background

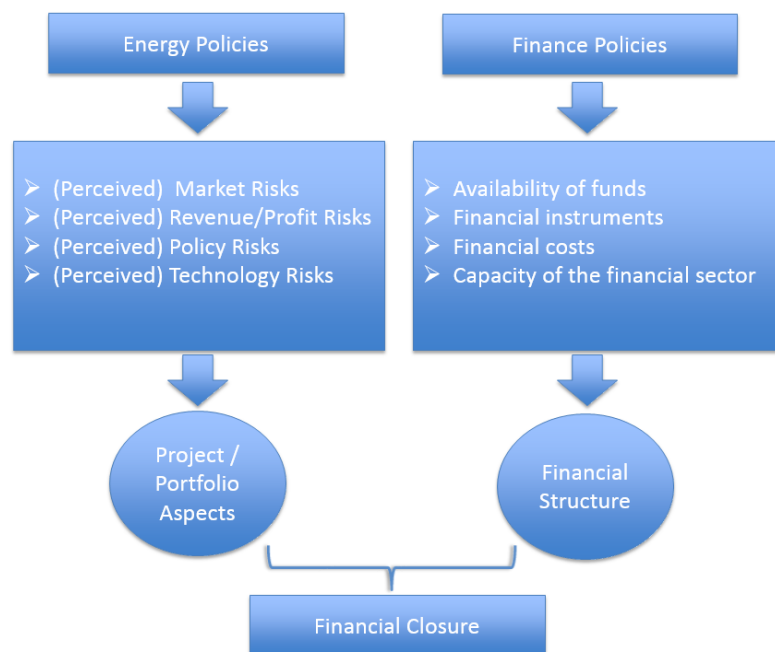
The East Asia Summit (EAS) region is still experiencing significant growth in energy demand, especially in the form of electricity, at faster rates than the world average. This is mainly driven by industrialisation, urbanisation, motorisation, and increases in per capita income (ERIA, 2015). Investment in energy infrastructure in this region is not likely to be satiated in the coming decades (IEA, 2014). When it comes to investment in clean energy, especially new and renewable energy, the challenge is that it not only has to compete for financial resources with conventional thermal energy, but also with other infrastructure projects such as highways, airports, ports, railways, utilities for water and gas. Renewable energy projects typically come with a relatively low internal rate of return (IRR), which is a financial measure of the feasibility and profitability, due to current renewable energy technologies and costs of production.

How to promote investment in new and renewable energy in the region therefore has different policy implications here from elsewhere for the following reasons: (1) economic development needs massive amounts of additional energy supply; (2) newly developed energy supplies should be as clean as possible; and (3) public financing is already tight and private financing prioritises other high-IRR projects. So what can be done in this respect? Besides the well-known policy tools and financial tools for renewable energy adoption, a new and different strategy might be needed to promote renewable energy as much as possible in the region.

2. Supportive policies for renewable energy

Figure 1.1 is a summary of policy tools identified in the literature (IRENA, 2014; REN21, 2014). Basically, investors make the final investment decision based on the risk-return prospects of a project or a portfolio of projects. On the one hand, energy policies, by reducing the risks and improving the expected revenue, help improve such aspects to incentivise commercial and private investors. On the other hand, a lucrative project cannot be undertaken if there is a shortage of financial means to mobilise and secure the financing at reasonable cost. Therefore, policies to enhance the availability and affordability of financial resources are also needed.

Figure 1.1: Supportive Policy Framework for Renewable Energy Investment



Source: Prepared by the authors.

Table 1.1 summarises the full list of energy and finance policies.

Table 1.1: Energy Policies and Finance Policies

Energy Policies	FIT / FIP	Financial Policies	Banking regulations (sustainability requirements)
	RPS / utility's obligations		Public financing scheme
	REC		Carbon financing
	Auctions / Tendering		Technical assistance and capacity building to the financial sector
	Self-supply regulations		Competitive and transparent financial markets, especially bond markets and stock markets
	R&D Investment		Financial instrument innovations
	Net-metering		
	Grid connection and access to transmission		
	Competitive energy market pricing		
	Carbon tax / carbon cap and trade		
	Regional energy market integration and grid interconnectivity		
	Licensing		
	Construction risks related regulations		
	RE targets		
	Long-term policy (Policy uncertainty)		
	PPA and supportive customers		
	RE resource data		
Technical assistance and capacity building			

Note: FIT = feed-in tariff; FIP = feed-in premium; PPA = power purchase agreement; R&D = research and development; RE = renewable energy; REC = renewable energy certificate; RPS = renewable portfolio standard. Source: Prepared by the authors.

Energy policies are mainly concerned with the siting, planning, construction, grid access, operation, pricing, sales, and internalisation of environmental impacts of renewable energy projects. Finance policies ranges from providing public finance to incentivising private sector financing. As the key obstacle to financing is the reducing and sharing of risks involved in a renewable energy investment, various financial tools, supported by corresponding policies, could be devised, as summarised in Table 1.2.

Table 1.2: Financial Tools for Renewable Energy Investment

Private / Commercial	Public Financing
Equity / Balance sheet financing	R&D support
Debt / loans	Grants
Bonds	Soft loans
Credit facilities	Loan facilities
Insurance	Credit enhancement
Project finance	Credit lines
Lease finance	Guarantees
Refinancing	Incubators
Angel investor	Public VC funds
Venture capital	Public equity funds
Private equity	
Mezzanine finance (tax equity, passive equity, preferred equity, convertible debt)	
Development banks / Import-export banks	
Carbon financing	

R&D = research and development; VC = venture capital.

Source: Prepared by the authors.

3. Challenges for developing countries in the East Asia Summit region

While the common methods and policy framework to promote renewable energy investment have been well-established and are well known, the developing countries in the East Asia Summit (EAS) region face specific challenges due to their unique economic, demographic, geographical, and technological characteristics. This project aims to study these challenges in depth.

One unique challenge for the developing countries in this region is the need for electricity in the rural and remote (island) areas for relatively small communities, especially those that have not been electrified and have no grid access. Other challenges include the lack of local capacity for installation, operation, and maintenance; the lack of experience with renewable energy projects in both the utility sector and the financial sector; the lack of reliable data on renewable energy resources; the lack of mature and flexible financial markets as well as financial tools; a vertically integrated electricity market; and the lack of markets for renewable energy and its environmental products such as carbon credits,

renewable tax credits, and renewable energy certificates (APEC, 1998).

With significant policy support, especially feed-in tariffs (FIT) and/or feed-in premiums (FIP), together with fast decline in the costs of solar photovoltaic (PV) power and wind turbines, utility scale solar and wind projects have already seen massive installation in developing countries, especially China and India. The Association of Southeast Asian Nations (ASEAN) countries are making steady progress in this regard too, but their FIT and/or FIP programmes face greater challenges from the existence of fossil fuel and electricity subsidies, the lack of infrastructure, the lack of regulatory frameworks (especially connection rules and pricing mechanisms), the lack of experience and capacity, the lack of coordination amongst stakeholders, and vested interest in the energy market structure (IEA, 2010; ERIA, 2015; IRENA, 2014; Kumar and Shretha, 2012).

At the same time, when it comes to the distributed generation of renewable energy, commercially viable business models and financial structure are largely missing in all these developing countries. Even though supportive policies have been devised, progress in this sub-sector is much more limited compared with utility scale projects. One key barrier stems from the various difficulties faced by the financial sector in financing small-scale projects with long payback periods (REN21, 2014).

Above all, although advanced renewable energy technologies, such as high-altitude wind power (kinetic energy), wave and tidal energy, advanced solar PV, advanced energy storage (lithium-based graphene and fuel cell), liquid hydrogen production and supply (including solar chemical–artificial photosynthesis), and advanced bio-fuel are still being developed, mostly in developed economies, the developing Asian countries stand a chance to make the best use of the existing mature renewable technologies. Wider adoption of these technologies as well as the development of relevant industries could be done for the good of clean energy development and also for the good of economic growth and moving up the industrial value chain. China and India set up examples in commoditising solar PV and wind turbine technologies (World Bank, 2014).

Such issues concerning renewable energy development in the developing countries of the EAS region justify our research project to explore a suitable policy portfolio for these countries to maximise the benefits and seize the opportunities offered by renewable energy technologies. In the following section, we summarise the studies in this project to address the most pressing issues of renewable energy investment in this region and we

explore how policies should be chosen to work together optimally.

4. Studies

The first two chapters first provide an overview of policy options to promote the financing and investment of renewable energy. This is followed by a comprehensive scan of the adoption of these policies in each developing country in the region, as well as an assessment of the effectiveness of these policies.

Chapter 2, titled 'Renewable Energy Policies in Promoting Financing and Investment among the East Asia Summit Countries: Quantitative Assessment and Policy Implications' presents a renewable energy policy index study led by Prof Youngho Chang of Nanyang Technological University. From a project investor's point of view, all policy options to support the investment of renewable energy are categorised into five groups based on their main objectives: market, uncertainty, profitability, technology, and finance. It subsequently applies this framework to assess what policies from each group have been used in each country to help create a market for renewable energy, reduce risks relating to the investment, maximise potential profits, develop and adopt new technologies, and provide access to financial resources. It then compares the scoring of each country's policies against a selected benchmark, which is whether a country has been considered successful in implementing policies to promote renewable energy investment and financing.

Chapter 3, titled 'Assessment of Instruments in Facilitating Investment in Off-grid Renewable Energy Projects – Global Experience and Implications for ASEAN Countries', is a study lead by Dr Xunpeng Shi of the Energy Studies Institute, National University of Singapore. This study focuses on the effectiveness of policies to promote the investment in and facilitate the financing of off-grid renewable energy projects. Specifically, it quantifies the feasibility, sustainability, and replicability of these policies to assess their effectiveness. Each instrument was evaluated in terms of the three dimensions by experts from ASEAN countries with various backgrounds, including policymakers, industrial players, and other relevant stakeholders in renewable energy investment.

The next four chapters look into the micro-structure of projects or firms for the investment and financing of renewable energy. Both Thailand and China, as the leading countries in the adoption of renewable energy in the region, provide ample cases and data

to identify factors for the financial success of renewable energy businesses in this region.

Chapter 4, titled 'Business Models and Financing Structures for a Rapid Scale-up of Rooftop Solar Power Systems in Thailand', is a study contributed by a research team led by Prof Sopitsuda Tongsovit of the Energy Research Institute, Chulalongkorn University. Thailand is a leading country in solar energy development in Southeast Asia. But despite policies that have successfully promoted utility-scale solar energy projects, rooftop systems have made limited progress. This study examines how policies could facilitate the innovative business models and financing options of the rooftop systems in Thailand, including the roof rental model, the PPA model, the leasing model, the community solar model, and the solar loan model. The internal rate of return (IRR) and levelised cost of electricity (LCOE) of these models are compared with the existing buying model for rooftop solar in Thailand.

Chapter 5, titled 'Analysis of Distributed Solar Photovoltaic (DSPV) Power Policy in China' and Chapter 6, titled 'Innovative Business Models and Financing Mechanisms for Distributed Solar PV (DSPV) Deployment in China' are studies contributed by the team led by Prof Sufang Zhang of the North China Electric Power University. Chapter 5 reviews the history of DSPV policies and identifies the key constraints in China. Chapter 6 subsequently zooms in on the micro-level structures for DSPV investment in China – the business models and the financing mechanisms. It provides a comprehensive review and analysis of the advantages and disadvantages of each business model under the current policy framework and proposes improvements and enhancement of these policies to better support innovations in both business models and financing mechanisms in the context of China.

Chapter 7, titled 'Exuberance in China's Renewable Energy Investment: Rationality, Capital Structure, and Implications with Firm-level Evidence', is a contribution from a team led by Prof Dayong Zhang of Southwestern University of Finance and Economics. The authors examine the efficiency of renewable energy policies in general and in China and quantitatively assess if firms responded to the policies with overinvestment at the current stage of market and technology development, based on the economics of finance – the Q-model. It turns out that firms' investment decisions in response to policies depend on their own capital structure and thus some firms do overinvest or irrationally expand in renewable energy.

The readiness of technologies, industries, markets, and the availability of

comprehensive data on renewable energy resources are critical technical factors for the economic and financial performance of renewable energy projects. Accordingly, policies should provide support in terms of these aspects as well. In the following two chapters, one study is devoted to the impacts of upstream policies on renewable energy technologies and manufacturing of renewable energy equipment; the other study presents evidence on the importance of high-accuracy data on renewable energy resources in real projects.

Chapter 8, titled 'The Impacts and Interaction of Upstream and Downstream Policies for the Solar Photovoltaic Industries of China' is a study conducted by a team led by Prof Hongwei Wang of the Chinese Academy of Social Sciences. This study provides a comprehensive review of the supportive policies for both the upstream and downstream solar PV industry. It then conducts a quantitative assessment of the impacts and interactions of these policies. The study confirms the intuition that downstream policies are in fact effective in bringing down the cost of solar PV production upstream and subsidies provided upstream are not equally effective in lowering the cost of electricity generated from solar PV.

Chapter 9, titled 'Retail Electricity Tariff and Mechanism Design to Incentivise Distributed Generation', is a study conducted by Prof Ramteen Sioshansi of Ohio State University. Building on an in-depth review of international experiences with distributed renewable power generation, this study addresses the market design issues related to existing incentive schemes to promote renewable energy adoption. The key issue is the system cost allocation and potential cross-subsidies between grid customers with and without distributed renewable energy systems. The problem becomes more visible when the penetration rate of distributed renewable power generation increases – a medium- to long-term policy issue. Real time pricing and two-part tariffs with demand charges are proposed to resolve the issue and work together with existing incentive mechanisms such as FIT and quota-based obligations.

Chapter 10, titled 'Financing Solar PV Projects: Energy Production Risk Reduction and Debt Capacity Improvement', is a study conducted by Dr Pacudan Romeo of the Brunei National Energy Research Institute. This study, using a Brunei Darussalam case, reveals the financial implications of high-quality solar energy resource data for renewable energy projects. Ground-measured solar energy resources of the project site turn out to significantly reduce the estimated uncertainty of energy production of a solar PV facility.

The reduced uncertainty results in a high debt coverage ratio of a solar PV project, reducing the overall financial costs.

The readiness of financial markets and the availability of financial resources remove the final constraints on the investment and financing of renewable energy, when the energy market policies are put in place and are in good shape. Our project this year especially emphasises the relevance and importance of an established bond market for renewable energy in the region, considering the need for large-scale, long-term financing as well as the features of bonds such as flexibility and low costs.

Chapter 11, titled 'Bond Financing for Renewable Energy in Asia', is a contribution from Dr Thiam Hee Ng of the Asian Development Bank. This study emphasises that the importance of bond financing increased after the Basel III rules were announced. The private investors in this region especially need the bond market as a tool to package renewable energy investment into asset packages they are familiar with, considering the fact that a large portion of the surplus capital from this region is invested in low-yield assets in the developed world. Specially, a market for green bonds should be developed in the region, as a dedicated financing tool for renewable energy investment.

Chapter 12, titled 'Utilising Green Bonds for Financing Renewable Energy Projects in Developing Asian Countries', is a study contributed by a team led by Ms Jacqueline Tao of the Energy Studies Institute, National University of Singapore. This study provides an in-depth review of the development process of green bonds in deriving a roadmap for this region. A Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis is also conducted to analyse the advantages and viability of green bonds in the region.

Chapter 13 titled 'Renewable Energy Policies and the Solar Home System in Cambodia', is a contribution from Dr Phoumin Han of the Economic Research Institute for ASEAN and East Asia. Solar home systems (SHS) are found to be competitive in the rural and remote areas of Cambodia where the grid has not reached. SHS is already half as cheap as other means of electricity supply in these areas, and two-thirds cheaper if government subsidies are considered. However, a lack of availability of equipment at competitive market prices, high upfront costs, a lack of capacity building especially training of technicians for installation and maintenance, and a lack of small entrepreneur business models, are barriers to the wider adoption of SHS in rural Cambodia. The experiences from Cambodia are especially relevant to how low-income economies could promote the

adoption of renewable energy technologies.

5. Policy implications in brief

To summarise, this ERIA report highlights policies that address the following issues regarding more effective promotion of renewable energy investment in the region.

1. Viable and innovative business models and financial mechanisms/structures, especially for distributed generation from renewable sources
2. Market creation through the implementation of market-based mechanisms
3. Stability of policies and the need for renewable energy legislation
4. Availability of high-quality and high-accuracy renewable energy resource data and other technical assistance to reduce the uncertainty of renewable energy production
5. Electricity market design which internalises not only the positive externality of renewable energy but also its negative externality (especially the impact on the grid capacity and grid balancing)
6. Improvement in the availability of financial resources in the region through market creation and enhancement of innovative financial instruments, such as green bonds, which may be familiar and attractive to Asian investors.

It should be noted that this report does not claim to be comprehensive in its coverage of the issues related to policies on the financing and investment of renewable energy, but to highlight the currently most critical and imminent issues in the region. This study is thus meant to complement the existing literature in this area.

References

- Asia-Pacific Economic Cooperation (APEC) (1998), *Guidebook for Financing New and Renewable Energy Projects*, Singapore: APEC Energy Working Group, Expert Group on New and Renewable Energy Technologies.
http://www.apec.org/~media/Files/Groups/EWG/98_ewg_guideproj.pdf (accessed 19 August 2015)
- International Energy Agency (IEA) (2010), *Deploying Renewables in Southeast Asia*. Paris: IEA.
- International Energy Agency (IEA) (2014): *World Energy Investment Outlook 2014 – Special Report*. Paris: IEA.
- International Renewable Energy Agency (IRENA) (2014), *Evaluating Renewable Energy Policy: A Review of Criteria and Indicators for Assessment*. Abu Dhabi: IRENA.
- Kimura, S. and Han Phoumin (2015), *Energy Outlook and Energy Saving Potential in East Asia*. ERIA Research Project Report 2014-33, Jakarta: ERIA
- Kumar, S. and P. Shrestha (2012), 'ASEAN Experiences on Policy and Regulation for Renewable Energy', Asian Institute of Technology, 5th Capacity Building Programme for Officers of Electricity Regulatory Commissions, 18–23 October, IIT Kanpur and Bangkok.
- Renewable Energy Policy Network for the 21st Century (REN21) (2014), *Renewables 2014 Global Status Report*. Paris: REN21.
- World Bank (2014), *Building Competitive Green Industries: The Climate and Clean Technology Opportunity for Developing Countries*. Washington, DC: International Bank for Reconstruction and Development/World Bank.

