



Examining the impacts of Feed-in-Tariff and the Clean Development Mechanism on Korea's renewable energy projects through comparative investment analysis

Bonsang Koo

Department of Civil Engineering, Seoul National University of Science and Technology, 232 Gongneung-ro, Nowon-gu, Seoul 01811, South Korea

ARTICLE INFO

Keywords:

Clean Development Mechanism
Feed-in-Tariffs
Certified Emission Reductions
Sustainable Development

ABSTRACT

Renewable energy projects in Korea have two avenues that provide subsidies to increase their financial viability. Feed-in-Tariffs (FITs) offer cost based prices for renewable electricity to compete with conventional energy producers. The Clean Development Mechanism (CDM) issues certified emission reduction (CER) credits that generate additional revenues, enhancing renewable projects' return on investment. This study investigated how these subsidies impact the financial returns on Korea's CDM projects. An investment analysis was performed on four cases including solar, hydropower, wind and landfill gas projects. Revenues from electricity sales, FITs and CERs were compared using financial indicators to measure their relative contributions on profitability. Results indicate that CDM is partial towards large scale projects with high emission reductions. Moreover, conflicts with FIT schemes can deter small scale, capital intensive projects from pursuing registration. The analysis highlights CDM's bias for particular project types, which is in part due to its impartiality towards carbon credit prices. It also reveals that Korea, a key benefactor of CDM, is susceptible to such biases, as demonstrated by the disproportionate distribution of issued CERs. Improving incentives for bundled, small scale projects, CER price differentiation, and excluding domestic subsidies during additionality testing are proposed as possible reforms.

1. Introduction

With 97% of its primary energy reliant on fossil based imports, Korea is the world's ninth largest energy consumer (British Petroleum, 2015) and also one of the top global emitters of greenhouse gases (GHG) (Energy Information Administration, US, 2015). Accordingly, Korea has strived to adopt new and renewable energy (NRE) technologies to rely less on fossil fuels and transition into a self-sustaining and clean energy based economy. As early as 2001, Korea formulated the National Basic Plan (NBP) for renewables, through which various programs were deployed to support and accelerate renewable energy development and investment.

Results have thus far been slow but steady; the percentage of renewables providing Korea's total primary energy supply (TPES) has reached 4.4%, a 2.4% point increase from a decade ago. In the fourth National Basic Plan of 2016, Korea has set a new target, raising the TPES deployment rate to 11% by 2035.

Apart from domestic support, the Clean Development Mechanism (CDM) has been another avenue for Korea to accelerate the development of its renewable projects. The CDM is a global emission

reductions scheme under the Kyoto Protocol which enables a non-Annex I country to generate additional revenue for reducing GHGs by obtaining Certified Emission Reduction (CER) credits and selling them to governments or private entities in industrialized countries (i.e., Annex I countries).

However, the CDM has been criticized on multiple fronts (Bakker et al., 2011) including, the apparent leniency on sustainable development goals (Olsen, 2007; Sutter and Parreño, 2007); the unequitable distribution of regional and sub-regional projects (Cosbey et al., 2006; Van Asselt and Gupta, 2009; Winkelman and Moore, 2011); and paradoxically, being marginal in terms of its financial impact for the more commercially challenged projects (Schatz, 2008; Wara, 2007; Wara and Victor, 2008).

As for regional biases, Korea is viewed as a country to have reaped the benefits of CDM (Schmid, 2013; Winkelman and Moore, 2011). Indeed, Korea has been an active participant in CDM projects since its ratification in 2002, and to date, it is the third highest issuer of CERs overall, after China and India, and seventh in the total number of projects registered in the Asia & Pacific region (UNEP/Riso, 2016).

However, not all project types benefit from the CDM equally

Abbreviations: CDM, Clean Development Mechanism; CERs, Certified Emission Reductions; CDM EB, CDM Executive Board; FIT, Feed-in-Tariff; GWP, Global Warming Potential; PoA, Programme of Activities; PDDs, Project Design Documents

E-mail address: bonsang@seoultech.ac.kr.

<http://dx.doi.org/10.1016/j.enpol.2017.01.017>

Received 13 May 2016; Received in revised form 21 November 2016; Accepted 11 January 2017

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Table 1
Deployment initiatives and programs for renewables in Korea.

Initiatives	Divisions	Overview
Deployment support programs	General deployment	Support partial installation costs for buildings and facilities using renewables for self-use.
	1 Million green homes Regional deployment	Support partial installation costs for single and multi-housing units using renewables for self-use. Support partial installation costs to regional and local governments using renewables on public facilities and properties (incl. infrastructure).
Capacity building	Public green buildings	Mechanism requiring 5% of construction costs to be allocated to renewables installation for government buildings that have gross floor area over 3,000m ²
	Feed-in-tariff (FIT)	A policy mechanism to improve the investment feasibility of renewable energy projects by providing a cost-based price for the renewable electricity they supply to the grid, if and when their prices are lower than the standard prices offered in the market.
	Renewable Portfolio Standard (RPS)	RPS mechanism places an obligation on electricity supply companies to produce a specified fraction of their electricity from renewable energy sources. RPS went into effect in Korea in 2012.
Financing and taxes	Finance support	Long term, low interest finance support for developers and energy providers to reduce initial investment costs and improve financial feasibility on commercialized renewable energy products
	Tax exemptions	Corporate tax exemptions for investment in renewable energy infrastructure

(Cormier and Bellassen, 2013). This study posits that the incentive scheme of CDM is geared towards large scale projects with high emission reductions, and tested this hypothesis by performing investment analyses using empirical data of Korea's actual projects. Specifically, the study selected four projects, one each from solar, wind, hydropower and landfill gas, and evaluated the relative contribution of Korea's Feed-in-Tariffs (FITs) and CERs on their profitability using the Internal Rate of Return (IRR) and Net Present Value (NPV) as the base indicators.

The goals of the analysis were to 1) determine whether the subsidies assisted in making projects financially viable, 2) enable a quantitative comparison of their impact, and 3) determine which project types benefited the most from the subsidies.

The investigation sheds light on the consequences of CDM's bias towards particular project types. It also provides empirical evidence on incentive conflicts that exists with Korea's domestic deployment policies, which may actually deter certain projects from registering as CDM projects. Finally, the analysis provides the basis for supporting recommendations for CDM improvement.

The paper is organized as follows. Section 2 discusses the main renewable deployment programs available in Korea, with a focus on FITs. The section also explains how the subsidies are calculated using CDM's additionality requirements, followed by a brief summary of Korean CDM projects executed to date. Section 3 presents a two-step process devised to execute the investment analysis and the results for four case projects. Section 4 provides an extensive discussion of the results, followed by Section 5, which offers concluding remarks.

2. Research background

2.1. Renewables in Korea

According to the World Research Institute (WRI, 2016), Korea is ranked ninth in terms of annual carbon emissions with 618,000 kg tons of CO₂ per year, and sixth in terms of carbon dioxide emissions per capita, with 12.3 t of CO₂ per year.

Recognizing the need for a sustainable alternative, Korea has strived to promote the adoption of renewable energy technologies. Since 2001, the Korean government developed the National Basic Plans for New and Renewable Energies plan, which include targets for progressively increasing the total primary energy supply (TPES) with renewables, and various deployment programs to foster investment in renewable energy projects. The main deployment programs include support for green buildings and housing sectors, subsidies for renewables through FIT and Renewable Portfolio Standards (RPS), and financing support and tax exemptions (Table 1).

As a result, the primary energy deployment from renewables in 2014 is at 4.08%, a 2.0% point improvement from 2004, having steadily increased on average by 0.12% points per year. Project wise, the major contributors has been from waste (59.8%) and bio energy (24.5%), followed by hydropower (5.0%), solar (4.7%), and wind (2.1%) projects (Hwang, 2014).

The most recent 4th National Basic Plan, announced in 2014, includes a new target for providing 11% of the primary energy with renewables by 2035 (Hwang, 2014). It also shifts concentration from waste energy and wind to solar energy, especially for small scale, residential housing projects.

2.2. Korea's Feed-in-Tariffs

Feed-in-Tariffs (FIT) is the main policy mechanism that provides subsidies for renewables in Korea, and is described here in more depth. The goal of FIT is to offer cost-based compensation to energy producers, for the renewable electricity they supply to the grid. FITs have the effect of providing price certainty and long-term contracts that help finance renewable energy investments. This enables diverse technologies (wind, solar, biogas, etc.) to be developed and provides investors a reasonable return.

Tables 2, 3 show renewables eligible for FIT and the standard prices applied, which are updated annually by the Ministry of Trade, Industry and Energy (MOTIE) of Korea. For solar energy, FIT prices are applied based on their duration and power capacity. For others (i.e., wind, hydropower, waste and bio energies, tidal and fuel cells), FITs are based on their capacity and by selecting either a fixed or variable pricing scheme.

FIT subsidies are calculated by multiplying the electricity amount supplied and the difference between the stated base prices and the System Marginal Price (SMP). In Korea, the SMP is the unified, short-term price at which electricity providers sell their electricity to KEPCO,¹ the largest electric utility owned by the Korean government.

2.3. CDM and additionality

In addition to domestic deployment programs, the CDM allows additional revenue to be generated through the sales of CERs issued. For Korea, it is the only globally established mechanism that provides monetary incentives for emission reductions in renewable energy projects.

To be issued CERs, projects must first be registered. The key

¹ Korea Electric Power Corporation.

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