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Conflict cause analysis between stakeholders in a utility-scale PV plant and its policy improvement methods in Korea

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ABSTRACT

Despite the technological advances and the Korean government's ongoing efforts to expand the PV market, disputes related to the quality and performance of the utility-scale PV systems are not uncommon. Therefore, actual dispute cases in Korea are analysed to elicit their root causes and suggest effective remedies in this paper. This analysis focuses on the following three types of disputes caused by: (i) PV system installation quality, (ii) PV system performance degradation and (iii) natural disaster damage. Based on interviews and examination of the PV plants in dispute, it was drawn that conflicts between the stakeholders stem from limitations to utility-scale PV plants' evaluation and technical dispute management, lack of PV module reliability and lax contract terms for procurement. To mitigate the conflicts between domestic PV stakeholders, the following four policy improvements are suggested: improvements of PV plants' deployment procedure and quality assurance system that can detect failures of equipment in early stages, introduction of a government-led dispute settlement system, enforcement of strict quality standards for PV modules and provision of information on PV procurement specifications. The lessons and suggested remedies will help policy makers understand the domestic PV market and redesign the policies for mitigation of potential disputes.

1. Introduction

The increasing concerns about rising global energy demand and climate change impacts highlight the role of renewable energies which are clean and inexhaustible (Warner and Jones, 2017). In particular, among all renewable energy sources, photovoltaic (PV) energy is gaining worldwide interest because of its high potential, easy installation and long lifetime (Almonacid et al., 2011). Given these various advantages, rapid growth of the global PV market has been observed over the last decade. The world's cumulative PV capacity grew 48% per year over the last 10 years, reaching 303 GW in 2016 (REN, 2017). In Korea, as a result of the continued efforts for renewable energy deployment, the cumulative PV capacity totalled 4.5 GW in 2016 (KEA, 2017a). In particular, during the five years since the adoption of the Renewable Portfolio Standard (RPS) in 2012, 2.8 GW has been installed, which is approximately seven times larger than the total capacity installed in Korea during the past ten years (MOTIE, 2016). It is also expected that the domestic PV market will continue to grow rapidly, backed by the new energy transformation road map, announced in 2017 for a renewable energy target of 20% in total power generation by 2030 (MOTIE, 2017). To this end, 48.7 GW of renewable power capacities will be newly installed by 2030 in Korea and PV will account for about two-thirds of new renewable capacities added.

However, in spite of the advances of PV technologies and ongoing policy efforts of the Korean government, poorly installed and underperforming PV systems have caused various disputes between PV stakeholders, leading to many controversies in the domestic PV market. Commonly recognised market barriers related to PV technologies include technical skills (e.g., design and development, manufacturing, installation, operation and maintenance, etc.) and customers' negative perceptions about PV systems (Karakaya and Sriwannawit, 2015; Yaqoot et al., 2016). In particular, negative perceptions of the PV technologies have been pointed out as socio-technical barriers that hinder the diffusion of PV systems, by preventing potential customers or investors from making a positive decision to adopt PV systems (Karakaya and Sriwannawit, 2015).

Ultimately, the key to successful implementation of the energy transformation road map in Korea is to overcome the obstacles that prevent a dramatic increase in solar PV generation in the country. To this end, it is necessary to clearly understand the factors affecting the

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performance of the PV systems and the mechanisms that cause disputes among PV stakeholders. The factors affecting the performance of the PV systems have been widely studied and can be categorised into three groups: (i) construction factors, (ii) PV system factors and (iii) environmental factors (Fouad et al., 2017). Although extensive studies have been conducted on the technical problems in a PV system, there is insufficient research on the causes and solutions pertaining to such disputes, which poses a socio-technical barrier in the domestic PV market. Hence, it is necessary to identify the major causes of disputes between PV stakeholders and develop dispute mitigation measures in terms of improved PV policies.

This paper analyses the conflict causes between the stakeholders in utility-scale PV plants in Korea and suggests institutional remedies for dispute mitigation. The analysis focuses on three representative dispute cases in Korea caused by: (i) PV system installation quality, (ii) performance degradation of PV plants and (iii) PV system damage from natural disasters. To better understand the mechanism and elicit the root causes of such disputes, the diagnosis of the PV plant and interviews with the stakeholders have been carried out. In addition, technical and construction documents for the PV plants have been examined to identify other causes of PV system failures. Through the analysis of the conflict causes, the four factors found to be associated with the root causes of disputes are as follows: (i) poor evaluation system for the installed PV plants; (ii) limitations to technical dispute management; (iii) lack of PV module reliability; and (iv) lax contract terms for procurement. To mitigate the impact of potential PV conflicts, four policy improvement measures are suggested as follows: improvements of PV plants' deployment procedure and quality assurance system that can detect failures of equipment in early stages, introduction of a government-led dispute settlement system, enforcement of strict quality standards for PV modules and provision of information on PV procurement specifications. The lessons and dispute mitigation remedies presented in this paper will help the policy makers understand the circumstances that the domestic PV market has confronted and improve the PV policies or programs that can minimise the negative impacts of potential conflicts.

The structure of this paper is as follows: Section 2 explains the challenging situation and conflict issues pertaining to utility-scale PV market in Korea. Section 3 analyses domestic PV dispute cases and identifies the key factors that cause conflicts between stakeholders in utility-scale PV plants. In Section 4, the effective policy improvement measures to address the conflict issues are suggested. Finally, the conclusions are presented in Section 5.

2. New challenges and controversial issues in Korea's PV market

This section covers new challenges, namely, the urgent need for large-scale deployment of PV systems in Korea and addresses the controversial issues that hinder their diffusion. Section 2.1 discusses the challenging circumstances and perspectives pertaining to the Korean PV market. Section 2.2 discusses the conflict issues that may arise in the construction and operation stages of the PV plants and their impact on the PV market.

2.1. New challenges and perspectives for PV market expansion in Korea

Korea has strived to expand PV systems across the country in the past few decades. In particular, to achieve cost-effectiveness for wider PV deployment, the Korean government shifted its policy focus in 2012 from the subsidy-based Feed-in-Tariff (FIT) to the market-based Renewable Portfolio Standard (RPS) (MOTIE, 2016). As a result, during the five years since the adoption of RPS in 2012, the deployment of PV systems has been growing at a rate of 44.8% per year (KEA, 2017a). As shown in Fig. 1, the cumulative installed PV capacity reached 4502 MW at the end of 2016. The share of PV capacity, which had been 0.9% in 2011, increased to 4.3% by 2016 as shown in Table 1 (KEEI, 2018).

However, even if the deployment of PV systems significantly increased, their contribution to the national power mix, which still depends heavily on coal and nuclear power (70%), remains low (0.9%). Against this backdrop, in December 2017, the new Korean government announced an energy transformation road map that shifts its reliance from nuclear and coal power toward renewable energy (MOTIE, 2017). In response to this energy roadmap, nuclear power plants will be gradually phased out and construction of new coal power plants will be prohibited. The energy road map will raise the ratio of renewable power generation to 20% by 2030. In order to achieve this challenging goal, an additional 48.7 GW of renewable power capacity will be installed by 2030. In particular, PV (30.8 GW) and wind (16.5 GW) will account for more than 95% of the newly installed renewable capacities. To achieve the aforementioned ambitious target in PV sector, the Korean government (Ministry of Trade, Industry and Energy, MOTIE) is particularly focusing on the deployment of utility-scale PV systems that are relatively easy to install and free from environmental regulations compared to wind power (Lee, 2015; Lee and Yun, 2015). However, Korea still needs to overcome the existing barriers to high PV penetration, including limitations of grid access, NIMBY (not-in-my-backyard) sentiments of local residents, price competitiveness against other sources of electricity and conflicts between stakeholders caused by the unexpected PV system failures (MOTIE, 2017). In particular, it should be noted that the challenging issues in various areas that hinder the diffusion of PV systems still occur in the domestic markets regulated by the government (MOTIE). Therefore, appropriate measures should be taken to eliminate barriers to the diffusion of PV systems so that they may play a key role in achieving the goals envisioned in the new energy roadmap.

2.2. Conflict issues at the construction and operation stages of PV plants

In Korea, the governmental body, Korean Agency for Technology and Standards (KATS) affiliated with MOTIE, directly supervises the national quality assurance system for PV market. For assurance of the PV products' qualities, the public organization (Korea Energy Agency, KEA) carries out certification work as the only certification body and 5 testing laboratories designated by KEA perform the tests on PV products. However, despite the operation of the national quality system in PV sector, the disputes related to the poor installation quality and performance of the PV systems are not uncommon. Therefore, in order to avoid conflicts over the poor installation or unexpected power generation performance of PV systems, it is important to ensure that the plants are constructed to deliver optimum performance at the outset. However, Jaffar et al. (2011) highlighted that conflicts and disputes are inevitable in construction projects, which are typically marred by various technical uncertainties, low experience and contractual problems. Thus, there is a need to minimise the conflicts and disputes that may arise in the process of building the PV plants. Fig. 2 shows the procedure for the construction of the PV plants subsidised by the government in Korea (KESCO, 2017). In general, at the completion of a plant's construction, validation of the PV products (i.e., modules and inverters) and electrical safety inspection are carried out as shown in Fig. 2. The validation checks whether the installed PV components are certified according to Korean industrial standards (KS) and the PV systems meet the electrical safety standards. This basic assessment process for installed PV plants has some limitations with regard to sufficiently guaranteeing the construction quality. Given these limitations, the Korean PV market still faces a high possibility for conflict creation.

Not only the construction quality of the PV plants but also their performance degradation has become an urgent issue to be addressed at the operation stage in Korea. The underperformance of PV systems can be another cause of conflict among PV stakeholders, such as component suppliers, installation service companies and plant owners or investors. In the domestic PV market, lawsuits occurred due to serious degradation of power generation performance. Fig. 3 shows the distribution of