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Renewable Energy in Trade Wars: Solar Power in South Korea's Energy Mix and the Impact of Protectionism

By June Park

Abstract[1]

This paper examines the impacts of global competition in solar panel production and the conflict of domestic interests among solar-related industries in the U.S. on South Korea's solar-focused renewable energy policy. Examining the Moon Jae-in administration's energy policy amid the impact of the U.S. safeguard on South Korean solar panels, the paper argues a) the U.S. safeguard is a hindrance to South Korea's path forward on solar panel production, and b) Moon's sole focus on sustainability and his ambitious solar energy target will result in further adoption of lower-cost Chinese solar panels, foregoing the opportunity to upgrade South Korean panels. As South Korean firms announce their decisions to relocate to the U.S. to avoid U.S. safeguard tariffs, the paper recommends the destinations of South Korean solar panel exports be diversified and the goals of South Korean energy policy be centered on balancing cost, stability, and sustainability. The paper does not necessarily recommend a full-fledged drive on expanding solar energy use in South Korea; rather, it calls for the strategic reevaluation of energy policy upon which a clear and sound strategy for solar energy should be formulated.

Key Words: *solar energy, safeguard, United States, China, South Korea*

Introduction

The global energy market is in transition and is significantly impacted by the ongoing trade war between China and the United States. Notwithstanding the rebound in recent months, the steady decline of oil prices from 2014 coupled with the shale gas revolution from 2011 has made renewable energy an attractive option for many countries around the world, bringing on a shift in energy policy even for petrostates of the Gulf. Among the various sources of renewable energy—hydro, solar, wind, biomass, and geothermal—the price of solar panels and the cost of solar power generation have declined significantly between 2009 and 2017, in large part due to China's drive-down of the solar photovoltaic (PV) cell and module prices.[2]

As solar power usage increases globally, the race to the bottom on solar is unfolding. On April 26, 2017, the Chief Restructuring Officer of Suniva, Inc.[3] requested for global safeguard relief pursuant to Sections 201-202 of the U.S. Trade Act of 1974, with the support from SolarWorld Americas, Inc. On September 22, 2017, the U.S. International Trade Commission determined that there have been injuries to the U.S. solar industry due to increased imports of PV cells and modules.[4] On January 22, 2018, the U.S. announced a 30 percent safeguard duty on Chinese and South Korean solar panels,[5] though it was not the first attempt at targeting Chinese PVs.[6] In tandem with the U.S. decision, on July 30, 2018, India, the world's third largest solar panel market, imposed a safeguard duty on Chinese and Malaysian solar PVs.[7] South Korea responded first to the U.S. by filing a complaint in the WTO (**DS545**, filed May 14, 2018). China followed suit, filing a complaint (**DS562**, filed August 14, 2018). As of November 2018, a panel has been established for South Korea's complaint, while China is still in the preliminary stage of consultations with the United States (Table 1).[8]

As one of the major solar panel producers on the global market, South Korea's solar PV industry has been adversely affected by the U.S. safeguard, but analyses on whether and to what extent the safeguard would impact solar energy use and development

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Table 1. Major Cases of U.S. Trade Remedy Investigations and WTO Disputes on Solar PVs and Responses from U.S. Trading Partners

Parties	Type	Preliminary Tariffs	Final Tariffs	Responses	Amount of Levy (%)
U.S.-China	Antidumping duty	March 2012	October 2012	China files a WTO complaint on U.S. CVD measures (May 25, 2012) **DS437: United States — Countervailing Duty Measures on Certain Products from China**	24 percent to 36 percent (AD) 14.78 percent to 15.97 percent (CVD)
U.S.-China, Taiwan	Countervailing duty	May 2014	December 2014	Unnamed MOC official criticizes the decision and calls for the U.S. to act on shared interests: "The frequent adoption of trade remedies cannot resolve the United States' solar industry development problems. We hope the United States can prudently handle this investigation, quickly end investigation procedures and create a good environment for competition in the global solar industry."	26.71 percent to 78.42 percent (AD-China) 27.64 percent to 49.79 percent (CVD-China) 11.45 percent to 27.55 percent (AD-Taiwan)
U.S.-India	WTO Dispute (February 6, 2013) **DS456: India — Certain Measures Relating to Solar Cells and Solar Modules** The U.S. raised concerns on Indian measures relating to domestic content requirements for solar cells under the Jawaharlal Nehru National Solar Mission ("NSM").	NA	NA	Counter-WTO dispute by India (September 9, 2016) **DS510: United States — Certain Measures Relating to the Renewable Energy Sector** India raised issues regarding U.S. measures relating to domestic content requirements and subsidies in the renewable energy sector instituted by the governments of the following states: Washington, California, Montana, Massachusetts, Connecticut, Michigan, Delaware and Minnesota.	
U.S.-China	Safeguard duty	October 31, 2017	January 22, 2018	China files WTO dispute (August 14, 2018) **DS562: United States — Safeguard Measure on Imports of Crystalline Silicon Photovoltaic Products**	30 percent
U.S.-Korea	Safeguard duty	October 31, 2017	January 22, 2018	Korea files WTO dispute (May 14, 2018) **DS545: United States — Safeguard measure on imports of crystalline silicon photovoltaic products**	30 percent

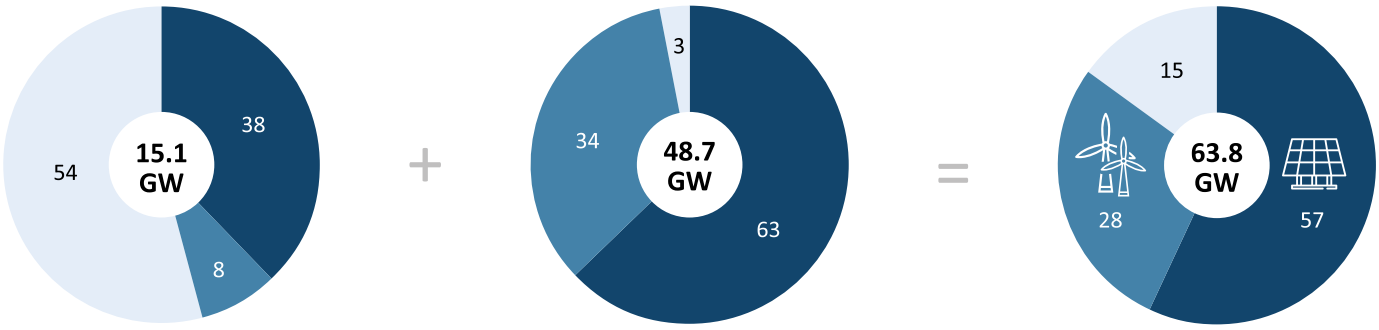
Source: By author based on news reports and press releases by the USITC, USDOC, and the WTO.

in South Korea remains inadequate. To provide an answer to that question, this paper investigates the impact of the safeguard on South Korean solar panel exports and attempts to provide an assessment of the current South Korean energy policy, with a focus on solar energy use in the context of renewable energy development.

From the onset, the Moon administration has emphasized environmental sustainability without sufficient consideration to maintaining a stable supply and cost of energy. In December 2017, the Moon administration proclaimed via the Renewable Energy 3020 (신재생 에너지 3020) policy that it will attempt to increase renewable energy use to 20 percent by 2030 up from the current 7 percent (2016 estimates). In terms of total power production, this means an increase from the current 15.1 gigawatts (2017 figures) to the 2030 target of 63.8 gigawatts (Figure 1).[9] The emphasis on sustainability has mainly been centered around a) closing down coal and nuclear power plants and b) purchasing more natural gas.[10]

However, the trilemma of energy policy for many economies is achieving balance among all three components—sustainability, stability (or security), and cost. South Korea is not an exception to this trilemma (Figure 2). In the current stage, it is not clear whether the South Korean solar industry would be strategically incorporated into the Renewable Energy 3020 Action Plan, despite South Korea's high solar panel production and exports before the U.S. safeguard ($1.3 billion in sales to the U.S., based on 2016 figures).[11] It is also unclear whether the exponential increase of solar energy use would be implemented with realistic goals in mind, considering the current South Korean energy mix (Figure 3) and the placement of renewables in South Korea's electricity generation mix (Figure 4). Thus far, the administration has only indicated that a full action plan would be announced by end of August 2018, but the full agenda has yet to arrive.[12] As concerns are mounting regarding the Renewable Energy 3020 plan, the administration has been soliciting applications by external organizations for research funding to be allocated to

Figure 1: Renewable Energy 3020 Goals for Provision of Facilities (Unit: Percentages)



Current Capacity in 2017

New Capacity (2018-2030)

- Residential buildings, offices, cars
- Solar farms in rural areas
- Small-scale energy cooperatives and businesses
- Large-scale projects

2030 Plan

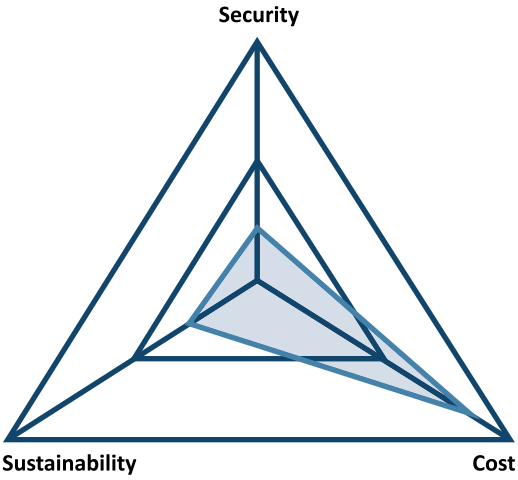
Solar Power | Wind Power | Hydro, Bio, and Waste

- Strengthening the competitiveness of energy developing companies
- Establishing the Overseas Resource Development Fund to fund energy development projects in addition to giving government loans and guarantee
- Environmental sustainability policy measures include: the expansion of renewable energy with targets until 2030
- The shift from government-financed feed-in tariffs (long term contracts to renewable energy producers) to a renewable portfolio standard in 2012 to create new demand for renewable energy
- Proposal to support of R&D
- Deregulation for solar PV installations

Source: Ministry of Trade, Industry and Energy (2018)

Figure 2. Energy Sustainability Balance and Energy Trilemma Index Rankings – South Korea

ENERGY SUSTAINABILITY BALANCE
South Korea



ENERGY TRILEMMA INDEX RANKINGS
South Korea

	2011	2012	2013	2014	2015
Energy Performance	**73**	**72**	**85**	**70**	**78**
Energy Security	92	89	103	98	101
Social Equity	39	32	49	25	20
Environmental Impact Mitigation	81	86	85	85	94
Contextual Performance	**22**	**21**	**16**	**22**	**22**
Political Strength	41	41	37	40	40
Societal Strength	27	26	26	31	32
Economic Strength	12	11	9	13	14
Overall Rank	**55**	**54**	**64**	**55**	**54**

Source: Ministry of Trade, Industry and Energy (MOTIE) / https://trilemma.worldenergy.org/#!/country-profile?country=Korea%20(Republic)&year=2018 / https://trilemma.worldenergy.org/reports/countryProfile/2018/Korea%20(Republic).pdf

large-scale research on deploying the 3020 scheme.[13] In short, a realistic renewable energy policy has yet to be delivered, and current policies are at best based on Moon's political narrative of achieving environmental sustainability.[14]

This paper's main criticism of Moon's energy policy amid ongoing trade conflicts concerning solar panels is that the current policy prioritizes political goals, particularly environmental sustainability, over stable, affordable energy produced by Korean companies.[15] This is best demonstrated by the government's inability to deliver affordable energy for residential and industrial use during the massive heat wave in the summer of 2018. Meanwhile, in terms of projects, Moon has been fixated on building a Russian gas pipeline to the Korean Peninsula, despite South Korea's earlier commitments via long-term contracts for U.S. shale gas shipments,[16] to fulfill Moon's foreign policy goals—namely, the New Northern Policy encompassing economic cooperation with North Korea, China, and Russia. Moon's launch of the solar energy farm in the reclaimed land of Saemangeum in North Jolla Province has also come under scrutiny, not only due to the lack of economic feasibility of the proposed project, but also the low likelihood of it benefitting South Korean solar panel producers.[17] Moreover, forgoing nuclear power generation and coal power generation simultaneously is perhaps the most significant fault in the current policy, simply to fulfill Moon's presidential campaign pledges is far from a logical approach toward achieving optimal energy policy or energy efficiency.[18] The most recent Intergovernmental Panel on Climate Change (IPCC) report (Global Warming of 1.5°C) recognizes that nuclear power—as non-fossil fuel energy—is required in order for the world to keep global warming to below 1.5 degrees.[19]

By examining the case of South Korean solar industries caught in a trade conflict and scrutinizing the case in the context of Moon's energy policy, the paper calls for a diversification of energy sources in South Korea with a clearer strategy and balance of energy sustainability, stability, and cost. Following this introduction, the paper proceeds as follows: the second section investigates trade protectionism on solar PVs and its impact on South Korea's renewable energy policy. The third section addresses interests in the U.S. solar industry and compares the impact of the U.S. safeguard on Chinese and South Korean solar industries based on comparisons of their solar strategies. The Moon administration's Saemangeum project is also scrutinized in this section. Lastly, the paper examines the policy implications for South Korea's solar energy production going forward and calls

for the diversification of export destinations besides the U.S. for solar panels, while also advocating for a balanced energy mix for an optimal, yet attainable solar energy policy.

Trade Protectionism on Solar PVs and South Korea's Renewable Energy Policy

There is an intricate link between trade and climate policy, particularly government subsidies as well as trade remedies that are used to support or discourage certain sources of energy use. In the past decade, the solar industry has been globalized and prices have declined. Political economy scholars and energy analysts have sought to explain this price decline from different angles. In explaining the global shift in solar energy, the majority of explanations contend that Chinese government subsidies helped the expansion of Chinese solar PV manufacturing, allowing Chinese solar firms to boost their global competitiveness while increasing renewable energy production in China.[20] U.S. subsidies on solar have also existed in the form of tax breaks, and have led to further deployment of PVs.[21] In Germany, under the *Energiewende* (energy transition) program, tax incentives on solar were deployed from 2000, across a 20-year guaranteed feed-in tariff scheme, though they are currently declining due to concerns from lawmakers over the rising costs of the program.[22] However, as the cost for solar energy production declines, solar farms without government subsidies are on the rise in different parts of Europe—a region where there are higher proportions of people concerned about climate change—which is rooted in long-term government support that is now paying off.[23] In this regard, South Korea is relatively late to the game for planning a renewable energy plan including solar and wind as well as a feed-in tariff funding scheme (Table 2 and Table 3).

For the Moon administration, the thinking process on South Korea's energy mix appears to have been in large part influenced by the Fukushima nuclear plant disaster of 2011 in Japan and China's rapid and proactive pursuit of solar energy over the past

Table 2. World Share of Renewable Energy Capacity, Solar and Wind (2016)

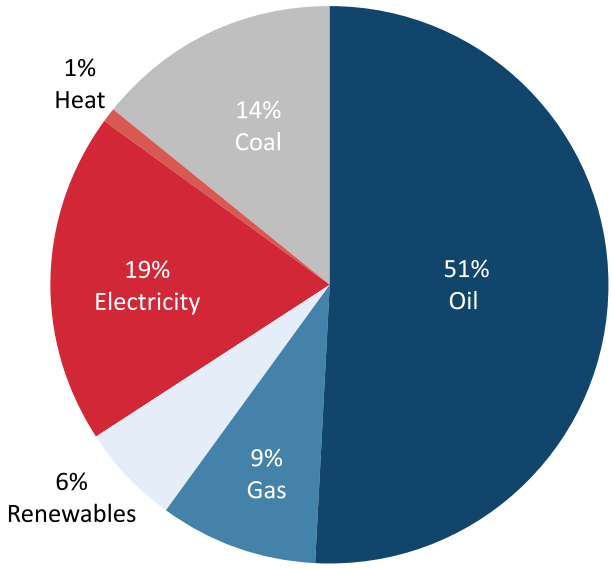
Country/Region	Solar (%)	Wind (%)
US	13.4	17.6
Canada	0.9	2.5
Mexico	0.1	0.8
Total North America	**14.4**	**20.9**
Total South & Central America	**1.0**	**3.6**
France	2.4	2.5
Germany	13.7	10.6
UK	3.9	3.3
Italy	6.4	2.0
Spain	1.8	4.9
Turkey	0.3	1.1
Others	6.5	9.8
Total Europe & Eurasia	**35.0**	**34.2**
Total Middle East	**0.5**	**0.1**
Total Africa	**0.8**	**0.8**
China	25.9	31.7
India	3.0	6.1
Japan	14.2	0.7
Australia	1.8	1.0
Others	3.5	0.9
Total Asia Pacific	**48.4**	**40.4**

Source: CEIC. Note: Unit is Megawatts (MW), share as of 2016.

Table 3. World Share of Renewable Energy Consumption (2016)				
Country/Region	Hydro (%)	Solar (%)	Wind (%)	Geothermal, Biomass and Others (%)
US	6.5	17.1	23.8	15.1
Canada	9.7	0.9	2.8	1.8
Mexico	0.7	0.1	1.1	1.3
Total North America	**16.9**	**18.1**	**27.8**	**18.2**
Brazil	9.6	-	3.4	9.1
Argentina	1.0	-	0.1	0.4
Chile	0.5	0.8	0.2	0.9
Others	6.1	0.8	1.0	2.8
Total South & Central America	**17.1**	**1.5**	**4.7**	**13.3**
Russian Federation	4.6	-	-	0.1
Norway	3.6	-	0.2	-
France	1.5	2.5	2.2	1.3
Germany	0.5	11.5	8.1	9.2
UK	0.1	3.1	3.9	5.3
Italy	1.0	6.9	1.8	4.6
Spain	0.9	4.1	5.1	1.1
Turkey	1.7	0.2	1.7	1.0
Others	8.3	6.1	10.4	13.2
Total Europe & Eurasia	**22.2**	**34.4**	**33.5**	**35.8**
Total Middle East	**0.5**	**0.7**	**0.1**	**-**
Total Africa	**2.8**	**1.4**	**1.2**	**1.1**
China	28.9	19.9	25.1	13.1
India	3.2	3.6	4.7	2.9
Japan	2.0	14.9	0.7	4.7
Australia	0.4	2.1	1.4	0.6
Others	5.9	3.4	0.9	10.4
Total Asia Pacific	**40.4**	**43.8**	**32.8**	**31.6**

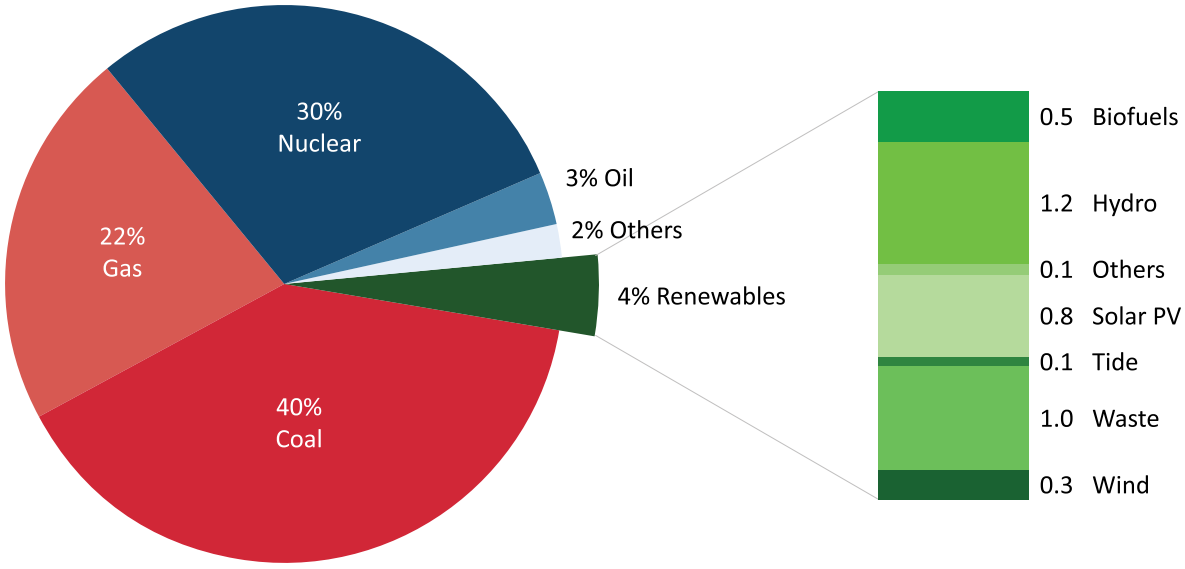
Source: CEIC. Note: Unit is Terawatt hours (TWh), share as of 2016.

Figure 3. South Korean Final Energy Consumption (2016)



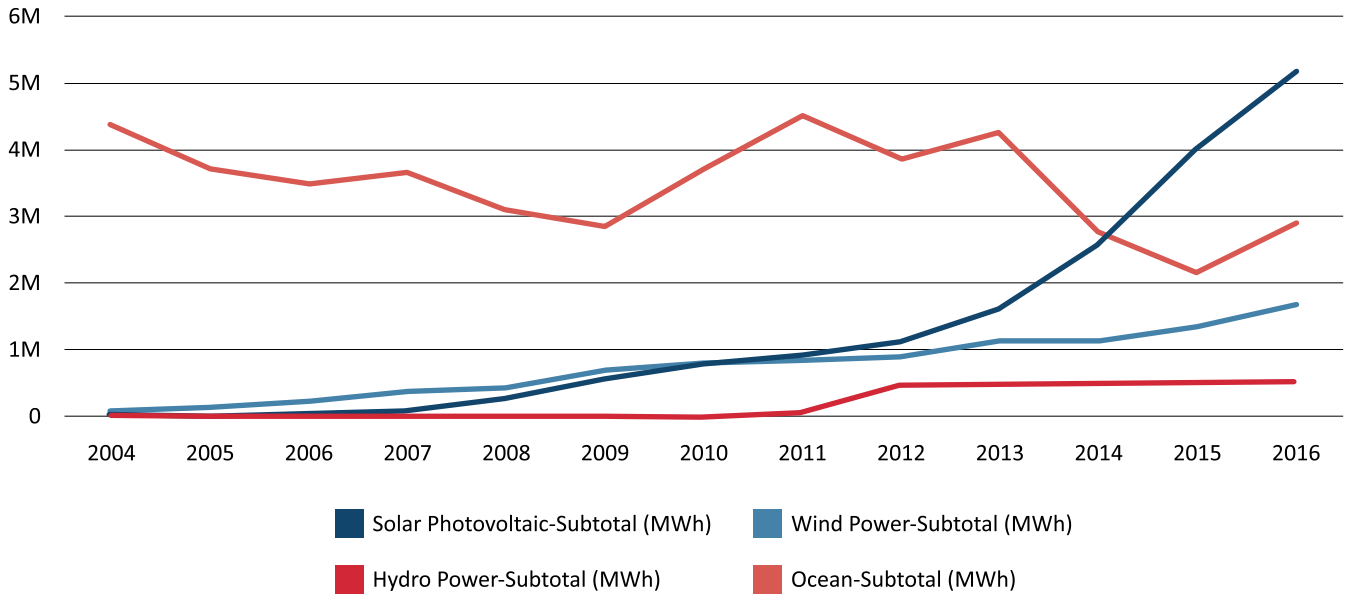
Source: Korea Energy Statistical Information System (KESIS, 2017)

Figure 4. South Korean Electricity Generation Mix (2016)



Source: Korea Energy Statistical Information System (KESIS, 2017)

Figure 5. South Korean Generation of Renewable Energy (2004-2016)



Source: Korea Energy Agency (2018). Unit is Megawatt hours (MWh).

decade (Table 2 and Table 3). Ironically, Japan is not considering a complete phase-out of nuclear energy as part of its energy mix – the contrary. The idea that South Korea has fallen behind not only its neighbors but also the world in terms of renewable energy production (Figure 3, Figure 4, and Figure 5) has propelled the Moon administration's drive for the Renewable Energy 3020 scheme intended to catch up with the global renewable energy trend. Climate change, as articulated by several IPCC reports and the Paris Agreement, is clearly impacting livelihoods around the world, but South Korea has not shown to the world that it is completely on board by policy implementation vis-à-vis Paris. Moreover, the urge to do something different from the previous administration on energy policy is evident in Moon's plan, as the increase of fine dust in everyday life in South Korea and the outcry regarding public respiratory health has been central to the discussion in the country in recent years. The answer for the Moon administration has been phasing out coal and nuclear power, while pushing for the acceleration of renewable energy production.

Given the limited five-year term for the South Korean presidency, it is not difficult to figure out the reasons for Moon's ambitious energy agenda. The issue with the acceleration on 3020 is that in the absence of consideration for elevated electricity bills and the tight market for solar panel exports, the administration's rapid push for solar power production will cause massive imports of low-quality, cheaper Chinese solar panels at the expense of the South Korean solar PV industry. Meanwhile, growing power demand in South Korea has resulted in rising electricity bills. Without a plausible solution to the rising electricity bills, the current plan may exacerbate this issue.[24] The Korea Electric Power Corporation (KEPCO), South Korea's largest electric public utility company, ran an operating loss in the first quarter of 2018.[25] In other words, there are complications with Moon's strategy that is mainly characterized by nuclear power phase-outs (Table 4) and a push for solar energy at a rash, unprecedented speed—mainly due to the fact that renewable energy cannot adequately fill in for nuclear energy.

Complications with Moon's Strategy of Phasing Out Nuclear Power Plants

Delving further into the case of solar protectionism, arguments as to why protectionism is on the rise for renewables have specifically pointed to the role of coalition politics swayed by advocacy groups for institutional mechanisms of trade remedies (i.e., antidumping and countervailing duties, and safeguards). In the U.S., trade remedies have allowed for domestic manufacturers and congressional members to form a protectionist coalition

while sidelining the free trade coalition of solar PV firms in the United States.[26] Admittedly, U.S. industrial policy still favors fossil fuels over renewables. On the one hand, the U.S. government has made solar panels more expensive via tariffs on imports of solar products from abroad, but on the other has provided tax breaks for the solar industry.[27]

The accelerated trade conflicts on solar carry considerable policy significance for South Korea, not only in that South Korean solar PV producers are affected by U.S. safeguards, but also in that South Korean exports to the U.S. are discouraged, strapping Korean solar producers for time in finding alternative platforms amid fierce global competition (Figure 6). Ironically, the South Korean solar industry is hit hard by being forced to compete with Chinese products in South Korea under the Renewable Energy 3020 Plan. South Korean statistics show that Chinese PV imports are more competitive in pricing than those produced by South Korean firms, and have begun to take over the South Korean PV market.[28] In this regard, the U.S. safeguard on solar PV has not only served as a catalyst for trade wars and exacerbated tensions in the renewable energy sector, but has also provided challenges for the South Korean solar industry. The next section explains why.

Winners and Losers: Divided Interests on Solar in the U.S. and the Impact of the U.S. Safeguard on South Korea and China

The U.S. safeguard on imported solar PV is a landmark decision that is impacting the global solar market. The response from the U.S. to falling solar PV prices due to low Chinese pricing is protectionism in the name of domestic PV and module production jobs. What is not captured in the U.S. decision is the acknowledgement of the binary construction of the solar industry, i.e., installation (services) and production of PVs (goods) by companies such as Suniva[29] and SolarWorld[30] that have pushed for the safeguard to be imposed. By way of the safeguard, the U.S. government is protecting PV producers over PV installation workers, at least in the short- and medium-term while the safeguard is in place.[31]

Ideally, the South Korean solar PV industry should look for alternative markets in response to the U.S. safeguard, but the industry appears to have chosen the option of relocating factories to the U.S. in an effort to avoid the safeguard tariffs.[32] While the relocation of solar PV production lines may create manufacturing jobs in the U.S., it remains to be seen whether it will revitalize PV installation. With India also implementing safeguards on solar, both Chinese and South Korean producers are scrambling to find other export destinations. As a consequence, large-scale South Korean PV producers have acquiesced to U.S. demands, while smaller scale PV producers that cannot compete with low-cost Chinese PV are conducting layoffs. Meanwhile, China's response to the U.S. safeguard has been government subsidy cuts on solar PV production, which has resulted in the fall of polysilicon price, adversely impacting South Korean producers relying on Chinese polysilicon.[33] Four months into the Chinese decision on solar subsidy cuts, the Chinese National Energy Agency (NEA) announced a revised plan to increase solar energy deployment to at least 210GW by 2020 in an effort to support to Chinese solar

Table 4. Moon's Campaign Pledges and Nuclear Power Plant Phase-Outs

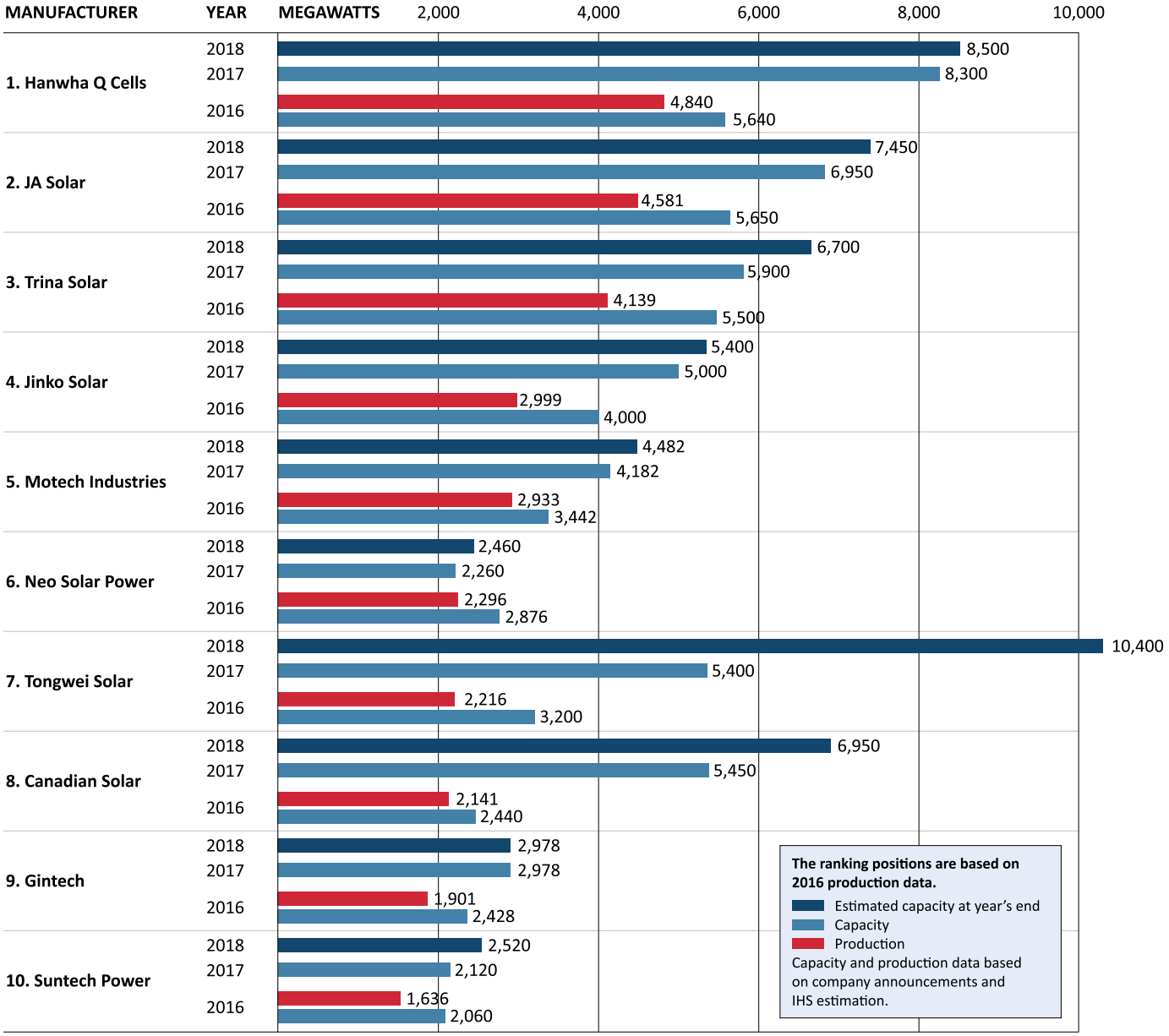
Moon's Campaign Pledges on Nuclear Power	South Korea's Nuclear Reactors Over 30 Years Old			
• Scrap plans to build new reactors • Ban operation extension of old reactors and shut down Wolsung-1 reactor • Suspend construction of Shin Kori 5, 6 reactors • Re-examine policies on spent nuclear fuel and waste • Cut utility price in areas with nuclear power plants • Elevate the status of NSSC as a presidential commission	**Reactor**	**Operation Start Date**	**Expiration**	**Number of Breakdowns (as of end of 2016)**
	Kori-1	April 29, 1978	June 18, 2017 (Permanently closed)	131
	Wolsung-1	April 22, 1983	November 2022	56
	Kori-2	July 25, 1983	August 2023	65
	Kori-3	September 30, 1985	September 2024	53
	Kori-4	April 29, 1986	August 2025	45
	Hanbit-1	August 25, 1986	December 2025	42
	Hanbit-2	June 10, 1987	September 2026	54

Source: Nuclear Safety and Security Commission (NSSC), Korea Hydro & Nuclear Power (KHNP), and Korea Atomic Industrial Forum (KAIF) (http://www.kaif.or.kr/?c=nws&s=5)

module industry.[34] As the record shows, regardless of whether Chinese subsidies on solar are in place, Chinese dumping of manufactured PV is rising, not only in South Korea but noticeably in energy-deprived North Korea, where antidumping rules are not in place.[54] South Korea has yet to take antidumping measures against Chinese PVs, and it is highly unlikely that the Moon administration will take such actions against China at a time when it is longing for China's participation in its New Northern Policy and economic cooperation scheme with North Korea.[36]

The dilemma in South Korean public policymaking regarding further adoption of solar in the South Korean energy mix lies in the two following realities. The first is that South Korea is coming to the game later than many other solar PV producing

Figure 6. Top 10 PV Suppliers (2016-2018)



Source: IHS Market

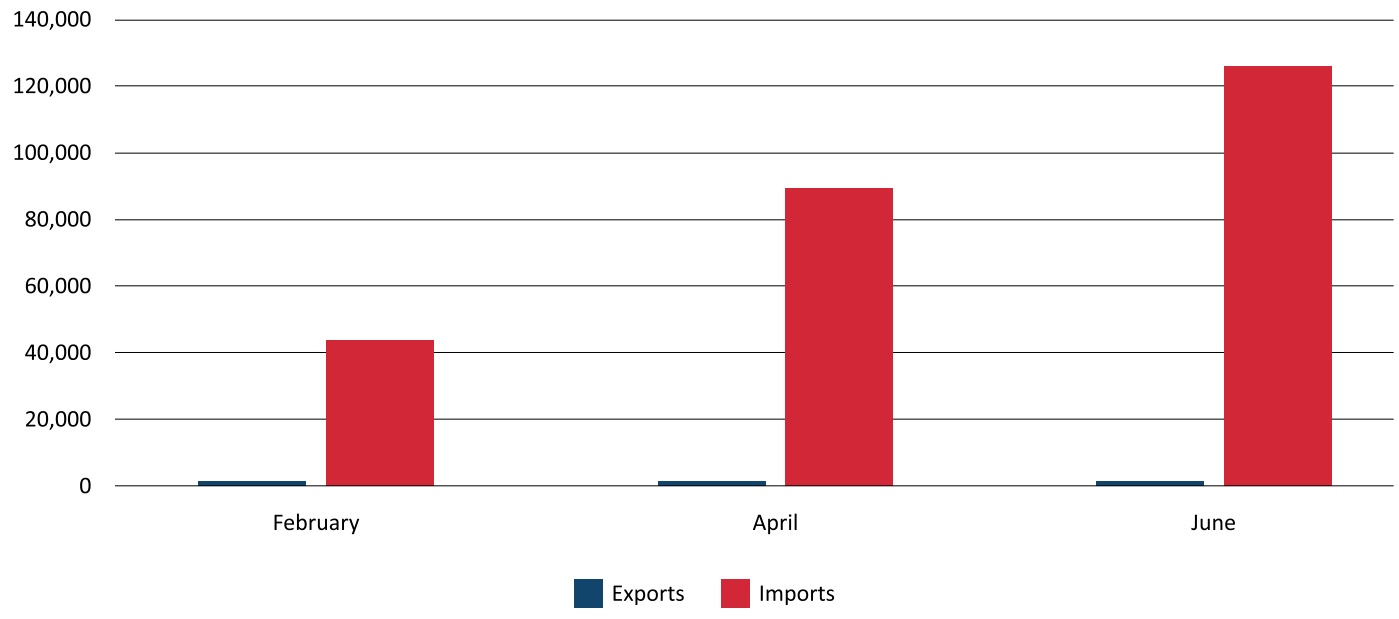
competitors—only about 1.2 percent of total power generation comes from solar in South Korea.[37] The realization that South Korea is a latecomer appears to be not only the driver of the 3020 Renewable Energy Policy but also behind the speed at which the Moon government is trying to catch up. The second is that a hastened adoption of solar in South Korea to reach a target goal within a fixed timeframe, irrespective of PV quality inspection, will only encourage the adoption of PVs based on lower cost, both by public and private South Korean solar power plant operators seeking cost optimization. At first glance, Moon's push to accelerate renewable energy adoption appears to be an opportunity for South Korean solar PV producers. However, since the imposition of U.S. safeguards, South Korea has been importing more solar modules from China than it is exporting there (Figure 7). In light of the external challenges, Moon's push for renewables could undermine the domestic solar industry in South Korea.

In this context, solar PV producers will be the losers in South Korea whereas installers will be the winners. The opposite is true in the short-term in the U.S. in the aftermath of the safeguards, as they benefit the PV producers and decrease installation worker jobs. Both situations are drastic effects of policy actions that yield unbalanced, unintended consequences. If Moon disseminates solar panels throughout the country under the 3020 Plan, the percentage of solar energy use will go up nationwide, but the PV production industry may be wiped out due to cheaper Chinese products unless South Korea pledges to regulate the quality and conditions of PV installation to differentiate from Chinese PVs, provides subsidies, or announces a safeguard on solar PVs just as the U.S. and India have. South Korean PVs may be superior to Chinese PVs in technology and quality, but the price war is an uphill battle for South Korean producers.

An additional issue arises from simply pushing for widespread solar PV installations in South Korea. While increasing the proportion of renewables in the energy mix will diversify energy sources, it will also increase the number of disputes regarding the quality of the solar panels and/or installation services, already on the on the rise, which is a hindrance to achieving efficient solar power generation.[38] Without a threshold on the quality of the installation process and PVs, a simple increase of the number of PV cells and modules will not automatically lead to the goal of solar energy increase in the energy mix, let alone energy efficiency, in the long run.

Most recently, on October 30, 2018, the Moon administration suddenly announced plans for a wind and solar farm project in Saemangeum, the reclaimed coastal land in North Jeolla

Figure 7. Imports and Exports of South Korean Solar Modules vis-à-vis China (Unit=Thousands of USD)



Province.[39] The Moon administration plans to spend roughly about 10 trillion KRW on the renewable energy farm, of which 6 trillion KRW would be spent on solar to generate a 3 gigawatt offshore and onshore solar farm across 38.29 square kilometers. The crux of the issue is that because of the climate, the solar farm will only be used about 15 percent of the total time. The expected yield of 0.7 gigawatts per day is even less than the amount of an LNG plant yielding 0.8 gigawatts per day at only 30 percent of the cost.[40]

How the Saemangeum area should be used has been a source of domestic dispute in past decades. Moon's sudden announcement caused a rift in South Korean media as he spoke at the opening ceremony of the renewable energy farm, compounded by concerns over energy efficiency and cost, let alone environmental concerns regarding water temperature rise under the solar panels that may contaminate the surrounding lakes during typhoon seasons in the summer.[41] Ironically, 20 years after the project's planned completion date in 2022 the site may be rezoned for industrial use.[42]

Conclusion & Policy Implications

South Korea's renewable energy 3020 scheme comes at a time of transition in the global energy market—one in which oil prices are on the decline and there is increased competition among major shale gas producers, while Asia has become the main energy consumer. Gulf petrostates such as Saudi Arabia and the United Arab Emirates are diversifying their economies to break away from a heavy reliance on oil exports. In the meantime, the world's biggest energy consumer, China, is heavily investing in diversified energy sources, ranging from its oil liquefaction projects in the Middle East, domestic nuclear power plant building, pipeline natural gas imports from Russia and shale gas imports from the U.S., and renewable energy projects largely focusing on solar—all intended to shy away from coal. As a country with limited energy sources, South Korea's pursuit of renewable energy had been a long overdue policy direction.

Nonetheless, the current state of South Korea's renewable energy plan under the Moon administration raises questions. First and foremost, a balanced perspective on the energy mix to overcome the energy trilemma is not visible. Sustainability is not the only goal in a country's energy plan, but also energy stability and cost. Specifically, on Moon's plans for solar energy production, deregulation of installation laws may seem a priority, but must be accompanied by thorough cost and benefit analysis for installation. The creation of an institutional mechanism for domestic solar installation disputes is also in need if the Moon administration were to accelerate the speed of installation across the country.

South Korea's solar PV export destinations will benefit from diversification. The U.S. safeguards on solar will put a strain on South Korea's domestic development of solar panel production, forcing many companies to move production to the United States. While the relocation of production facilities in response to U.S. protectionism is unavoidable, South Korea has potential markets other than the U.S., China, and India that remain to be explored. Mexico, Algeria, Brazil, Egypt, Saudi Arabia and the United Arab Emirates all have or are poised to adopt renewable energy plans with a strong interest in solar. Turning to alternative buyers in the Gulf region would be a step toward exploring new markets for South Korea, particularly for small and medium-sized enterprises (SMEs) making PVs. In this process, the government's role would be to foster R&D in SMEs for globally marketable technologies catered to the solar industry and to ensure intellectual property protection.

In the meantime, instead of being fixated on the North-South relationship which may raise false hopes for economic cooperation, the Moon administration must take on a clear strategy as to how South Korea will go forward in its future renewable energy planning, with the composition of the appropriate and optimal energy mix balancing the three components of sustainability, cost, and stability for South Korea. Without sound policy implementation at the domestic level, Moon's intended economic cooperation with North Korea may have difficulty yielding positive results.

Endnotes

[1] This work was supported in part by a grant from the National Research Foundation of Korea ('Cooperation and Integration of Economic and Social Community in East Asia', Project Grant Number: NRF-2016S1A5B8924523)

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[4] News Release 17-133, "Crystalline Silicon Photovoltaic Cells (Whether or Not Partially or Fully Assembled into Other Products)", September 22, 2017, https://www.usitc.gov/press_room/news_release/2017/er0922ll832.htm.

[5] Press Release, "President Trump Approves Relief for U.S. Washing Machine and Solar Cell Manufacturers," The U.S. Trade Representative, January 22, 2018, https://ustr.gov/about-us/policy-offices/press-office/press-releases/2018/january/president-trump-approves-relief-us.

[6] It is worth noting that the European Union was the first to impose restrictions on Chinese PV in July 2013 via the EU's antidumping investigation which led to trade barrier restrictions (TBR) to protect European manufacturers, to which China responded with tariffs on EU wine. Such policy moves by the EU, however, were deemed to have stimulated Chinese manufacturers to reorganize their domestic and international operations in response, rendering the trade barriers ineffective and inefficient, see Killian J. McCarthy, "On the influence of the European trade barrier on the Chinese PV industry: Is the solution to the solar-dispute 'successful?'" *Energy Policy* 99, (2016): 154-157. The EU tariffs on Chinese PV ended on September 3, 2018, raising concerns by European PV manufacturers regarding the potential flood of cheaper Chinese PVs, see "EU ends trade controls on Chinese solar panels," Reuters, August 31, 2018, https://www.reuters.com/article/us-eu-china-trade/eu-ends-trade-controls-on-chinese-solar-panels-idUSKCN1LG1QM.

[7] "India Proposes Safeguard Duty on China, Malaysia Solar Cells," *Bloomberg*, July 17, 2018, https://www.bloomberg.com/news/articles/2018-07-17/india-slaps-25-safeguard-duty-on-chinese-malaysian-solar-cells.

[8] Based on Article 4 of the Marrakesh Agreement, the consultation stage can take up to 60 days, and as the U.S.-China trade war continues, the Chinese case lingers on past the initial 60 days. Aligned with the counter-safeguard WTO complaint, China has simultaneously filed a case against the U.S. regarding certain U.S. states and municipalities' adoption of subsidies on renewable energy, see DS563: United States — Certain Measures Related to Renewable Energy, https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds563_e.htm.

[9] "Announcement of the Renewable Energy 3020 Action Plan(재생에너지 3020 이행계획(안) 발표)," Ministry of Trade, Industry and Energy, December 17, 2017, https://www.gov.kr/portal/ntnadmNews/1279625.

[10] Prior to the Moon administration's renewable energy policy schemes, South Korea had pushed on for the deployment of renewable energy since 2002 which yielded mediocre results, owing to intra-industrial conflict, inconsistent policy shifts and policy designs, and these conditions remain as obstacles. Ambitious policy agenda-setting and target goals were suggested by public administration scholars that believed nuclear and thermal power generation should be replaced by renewables in the long-term, citing South Korea's lack of natural resources of coal and uranium. Installation of an independent body to regulate renewable energy and deploying feed-in-tariffs (FIT) for renewables was suggested, see Yoon Jong-han and Sim Kwang-ho, "Why is South Korea's renewable energy policy failing? A qualitative evaluation," *Energy Policy* 86, (2015): 369-379.

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[12] MOTIE, "재생에너지 3020 이행계획(안) 발표 -'제2회 재생에너지 정책협의회'개최를 통해 의견수렴" http://www.motie.go.kr/motiee/presse/press2/bbs/bbsView.do?bbs_seq_n=159996&bbs_cd_n=81.

[13] The first round of calls for research projects on informatization of electrical power by MOTIE was announced in April 2017, http://www.motie.go.kr/motie/ne/announce2/bbs/bbsView.do?bbs_cd_n=6&biz_anc_yn_c=Y&bbs_seq_n=64236; the second round of calls disseminated in October 2018, http://www.motie.go.kr/motie/ne/announce2/bbs/bbsView.do?bbs_cd_n=6&biz_anc_yn_c=Y&bbs_seq_n=65040; Both calls were administered by the Renewable Energy Policy Office of Korea New Renewable Energy Center (KNREC).

[14] Meanwhile, the policy recommendation from economic scholars on South Korea's renewable energy policy was to reduce the uncertainty about renewable energy adoption with accurate long-term demand forecasting with consideration to increasing renewable energy supply and related industrial growth (i.e., heating, transport, construction), which have yet to be delivered by the Moon administration, see Huh Sung-yoon and Lee Chul-yong, "Diffusion of renewable energy technologies in South Korea on incorporating their competitive interrelationships," *Energy Policy* 69, (2014): 248-257.

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[16] South Korea's long-term LNG contracts with Qatar and Malaysia among many other natural gas suppliers to South Korea will expire by 2024.

[17] "Moon's Saemangeum solar project under criticism," *The Korea Times*, October 31, 2018, https://www.koreatimes.co.kr/www/tech/2018/11/325_257943.html; "Saemangeum solar energy project to benefit only foreign firms," *The Korea Times*, November 5, 2018, https://www.koreatimes.co.kr/www/tech/2018/11/693_258179.html.

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[25] "As power demand grows, renewable energy doesn't reach its potential," *Korea Joongang Daily*, August 20, 2018, http://koreajoongangdaily.joins.com/news/article/article.aspx?aid=3051740.

[26] Llewelyn Hughes and Jonas Meckling, "The politics of renewable energy trade: The US-China solar dispute," *Energy Policy* 105, (2017): 256-262.

[27] Robert Y. Shum, "The coming solar trade war: Obstacles to decarbonization from a political-economy conflict," *The Electricity Journal* 30, (2017): 49-53; Jeffrey Ball and Dan Reicher, "Making Solar Big Enough to Matter," *The New York Times*, March 21, 2017, https://www.nytimes.com/2017/03/21/opinion/making-solar-big-enough-to-matter.html; Frey E.F., Mojtahedi S., and Mojtahedi S, "The impact of solar subsidies on California's non-residential sector," *Energy Policy* 122, (2018): 27-35.

[28] It is reported that 98 percent of South Korea's imported solar modules (one module is an amalgamation of 60 or 72 solar PV cells) are from China, and an estimated 70 to 80 percent of the solar cells and modules used at South Korean solar power plants are of Chinese origin, see "저가공세' 중국에 안방 내준 韓태양광산업," *MK News*, July 31, 2018, http://news.mk.co.kr/newsRead.php?sc=30000001&year=2018&no=481236. In rebuttal to this report, MOTIE laid out figures over a different timeframe, from 2015 to early 2018, stipulating that 71 percent of the solar PV installations in South Korea are of South Korean origin, see https://www.gov.kr/portal/ntnadmNews/1550885. At the 2018 South Korean government audit of state affairs, additional critiques on environmental degradation owing to the rapid expansion of panel installations in mountainous areas were raised in tandem with criticisms on the continued exponential increase in the adoption of Chinese PVs in parallel to the 3020 scheme, "[단독] 脫원전 어부지리? 한반도 뒤덮는 中태양광," MK News, October 11, 2018, http://news.mk.co.kr/newsRead.php?year=2018&no=634002.

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