
Can Biomass Qualify as Renewable Energy?

The State of Biomass Policy in South Korea



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Solutions For Our Climate (SFOC)

Solutions for Our Climate (SFOC) is an independent policy research and advocacy group that aims to decarbonize Korea's power sector. SFOC's primary mission is to align Korea's power sector emissions trajectory so that it is compatible with the Paris Agreement 1.5°C warming target. SFOC is led by legal, economic, financial and environmental experts with experience in energy and climate policy.

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Glossary of Acronyms

Bio-SRF	Bio Solid Refused Fuel
CO ₂	Carbon Dioxide
FBEA	Forest Biomass Energy Association
GHG	Greenhouse Gas
IGCC	Integrated Gasification Combined Cycle
IPCC	Intergovernmental Panel on Climate Change
KEC	Korea Energy Corporation
KEPCO	Korea Electric Power Corporation
KFS	Korea Forest Service
KPX	Korea Power Exchange
KRW	Korean Won
MOTIE	Ministry of Technology Industry and Energy
MWH	Megawatt Hour
PV	Photovoltaics
RECs	Renewable Energy Certificates
RPS	Renewable Energy Portfolio Standard
RPS-ICS	Renewable Energy Portfolio Standard Implementation Cost Settlement
SFOC	Solutions For Our Climate
VOC	Volatile Organic Compounds, or organic chemicals that easily become vapors or gases

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Table of Contents

Executive Summary	4
1. Introduction: The Rise of Biomass Power and Renewable Energy Policy in South Korea	7
2. The State of Biomass in Korea: Mega biomass power projects dominate the scene	10
3. Drivers of Biomass Power: How utilities benefit from biomass through policy and lobbying	16
- Driver 1: RPS policy and by-laws	16
- Driver 2: RECs and RPS Implementation Cost Settlement (RPS-ICS)	18
- Driver 3: Energy and Forestry Industry lobbying	20
4. Major Issues of Biomass Energy	21
- Biomass increases greenhouse gas emissions.	21
- Biomass RECs are disrupting the renewable energy market.	22
- Imported fuel drives environmental destruction and the degradation of forests everywhere.	24
- Biomass does not help reduce air pollution.	27
5. Conclusions and Recommendations	29
Appendix	31

Executive Summary

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Biomass is jeopardizing Korea's renewable energy sector and negating global efforts to reduce greenhouse gas emissions. The rapid growth of biomass energy in Korea has shown a threatening trajectory, yet the root causes of this predicament remains unattended. This report aims to enhance the understanding of biomass power policy, and to analyze major socioeconomic, political and environmental drivers of problems associated with biomass power in South Korea (referred as "Korea" hereafter). In this report, Solutions for Our Climate (SFOC) has included key policy recommendations to address the problems associated with biomass.

The capacity of biomass power generation in Korea has been rapidly increasing since 2012, reaching about 1,500 MW (excluding the installed capacity of 3 MW and under) as of 2019. Most of this capacity comes from biomass co-firing that burns biomass within coal power plants, accounting for 72% (1,068 MW), and the rest, 28% (424.6MW) originates from dedicated biomass. As capacity increases, electricity generation has also been growing. Electricity generation from woody biomass grew 61 times over the six-year period from 106,023 MWh in 2012 to 6,490,437 MWh in 2018. This is equivalent to an annual increase of 160 percent, which is much higher than that of global biomass energy growth which was around 2 percent per year between 2010 and 2018. The increased demand for biomass is directly attributable to increased feedstock imports. According to the Food and Agriculture Organization of the United Nations, Korea became the world's 3rd biggest importer of wood pellets in 2018, after the United Kingdom and Denmark, recording 3.4 million metric tons of wood pellet imports in the same year alone¹.

The underlying reason for the rapid development is institutional support, including subsidies, as Korean law recognizes biomass as a green renewable source. Some have argued that biomass can become an alternative energy to coal and gas, based on the assumption that carbon neutrality is theoretically possible. This argument has served as the basis on which policymakers have justified the rapid development of biomass power in Korea.

However, considering recent research on greenhouse gas emissions and recent trends in the

1. FAO, 2019, "Global Forest Products Facts and Figures 2018", retrieved from <http://www.fao.org/3/ca7415en/ca7415en.pdf> in March 2020.

renewable energy market, the ‘green’ myth of biomass is likely to be dispelled soon. Recent research shows that biomass energy does not constitute an effective response to climate change, nor does it provide solutions to air pollution problems. Furthermore, it can lead to other environmental disasters. 1) First, a large quantity of renewable energy certificates (hereinafter “REC”) issued from biomass are negatively affecting the competitiveness of the renewable energy market. This damages the economics of other environmentally sound renewable energy sources such as solar and wind and discourages utilities from investing in solar and wind projects (‘hampering the healthy expansion of renewable energy’). 2) Rapidly increasing demands for biomass could result in increased threats to forests of exporting countries and Korea, causing illegal logging, deforestation, and ecosystem degradation (‘environmental degradation’). 3) Lastly, per unit of energy, biomass power plants emit more carbon dioxide than coal plants, and cutting down older trees and replacing them with saplings reduces the amount of carbon stored in that forest, even under a best-case scenario in which harvested trees are immediately replanted. Similarly, burning biomass pollutes our air (‘high greenhouse gas emissions and air pollution’).

Biomass is an unsuitable alternative to fossil fuel in tackling climate change. It can take anywhere from decades to more than a century for biomass energy to begin to deliver any climate benefit. Even when biomass energy is generated by burning forestry residues—the leftovers from logging operations, like tree-tops and limbs—the result is increased CO₂ in the atmosphere that lasts for several decades. Unfortunately, the world does not have so much time to wait given that our carbon budget is running out.

Nevertheless, biomass energy is supported by various forms of subsidies under the Korean renewable energy support scheme. During 2014-2017, biomass was the most subsidized renewable energy source in terms of Renewable Energy Credit (REC) issuance, constituting approximately 40% of all RECs issued during that time frame. The RPS Implementation Cost Settlement, which practically serves as a subsidy for renewable energy development, that biomass utilities received from the government has climbed to 1.8 trillion KRW, equivalent to 1.5 billion US dollars in 2018.

Recognizing the criticism on biomass co-firing, the government revised the Management and Operation Guidelines for New and Renewable Energy Supply and Renewable Portfolio Standard in 2018 (MOTIE Notice No.2018-130, June 26, 2018. “RPS Operating Guidelines” hereafter)². This has resulted in the reduction of REC weightings for biomass, however the revision appears to be highly ineffective and insufficient. According to Schedule 2 of the above guideline, not only utilities already in operation but also all other utilities in the pipeline will continue to benefit from higher RECs from the previous ruling, as long as they have submitted construction plan approval requests before mid-2018. This deadline

2. For more details of the RPS Operating Guideline, visit the following website: <http://www.law.go.kr/행정규칙/신-재생에너지%20공급의무화제도%20및%20연료%20혼합의무화제도%20관리-운영지침>

was extended in 2019 until June 2019 to allow more power plants to apply for an exception to this revision.

In addition, it is highly problematic that the Korean government is promoting large-scale production and utilization of biomass residues. The revised RPS operating guidelines grant higher REC weights for biomass residues, so called “un-used biomass” —a weighting of 2.0 for dedicated facilities and a weighting of 1.5 for co-fired facilities. Due to this generous REC weighting, domestic production of unused biomass has nearly quadrupled during the first half of 2019 compared with the last half of 2018. In addition to these skewed weightings, the definition of un-used biomass is ambiguous at most, and the eligibility criteria has been extended to allow more round wood from forestry operations to qualify. Furthermore, it is concerning that verification processes for un-used biomass lack rigor, and a quality management system is missing, which in turn, allows companies to game the system.

To address these issues, we propose the following policy recommendations:

First, the issuance of RECs for biomass co-firing should be stopped altogether. It is reasonable to suspend the RECs from all existing co-firing facilities retrospectively. Given the typical size of investments for co-firing plants, their legal benefits that may be infringed upon by the suspension of biomass RECs are considered insignificant. According to the Office of Auditor General, MOTIE has overestimated the cost of construction and operation for biomass co-firing power plants, as much as 15 times of actual costs in 2015³. This has caused the government to overcompensate biomass co-firing facilities in the past years through the RECs and the RPS Implementation Cost Settlements.

Second, for the same reason, the issuance of RECs to large-scale, dedicated biomass power plants should be ended. Most of these companies are known to have already recovered the investment costs of converting their nearing to retire coal power plant units into biomass. As an exception, some small facilities that solely utilize locally produced and sustainably sourced un-used biomass feedstocks could still qualify. The government may also consider introducing a greenhouse gas (GHG) emissions threshold for biomass-burning power stations, similar to the United Kingdom's new policy in 2018, in order to rule out the use of imported wood pellets for electricity production.

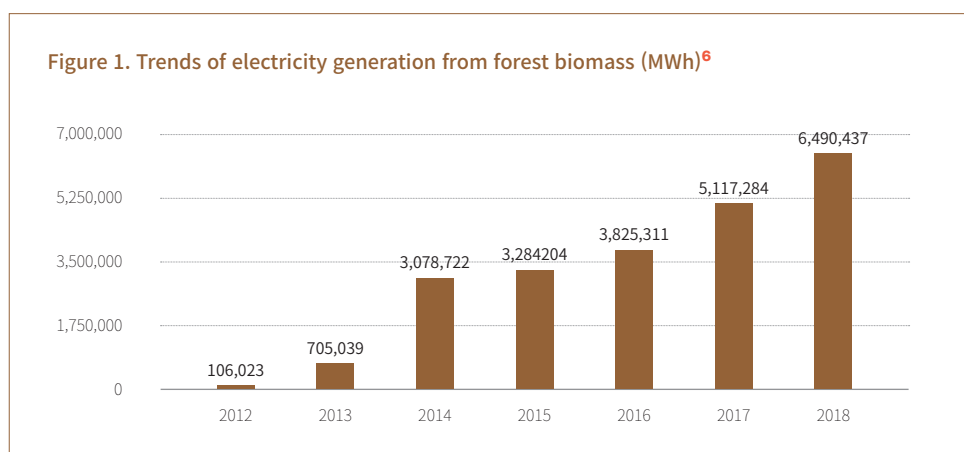
Third, even in the case of small-scale, un-used biomass facilities, strict quality standards should be established to prevent un-used biomass production from damaging domestic forests in Korea. Any such certification and verification processes must be carried out independently and objectively.

3. Republic of Korea Office of Auditor General, 2017. “Audit Report – New Growth Vehicle Energy Projects Implementation Status”. (Original title: 신성장동력 에너지 사업 추진 실태 감사 보고서). Retrieved from http://www.motie.go.kr/motie/gov3.0/gs/govauditopen/bbs/bbsView.do?bbs_seq_n=185&bbs_cd_n=9

1. Introduction:

The Rise of Biomass Power and Renewable Energy Policy in South Korea

Biomass is one of the most subsidized renewable energy sources in Korea. According to the Ministry of Trade, Industry and Energy (MOTIE), during 2014 - 2017, about 40 percent of the total Renewable Energy Credits (RECs) were issued from bioenergy alone on average, exceeding the number of RECs from solar and wind. Despite the government's effort to boost renewable energy production up to 20 percent by 2030 ("RE 3020 Plan"), solar and wind energy still lags behind. In 2018, solar and wind power accounted for 11% and 3% of total renewable energy production respectively, and 17.7% and 4.7% of total renewable energy generation respectively⁴. This is considered miniscule compared with the total electricity production as the share of renewable energy ranged from 2-3 percent in the last five years. For further reference on Korea's latest renewable energy statistics, see Appendix I: Renewable Energy Production and Power Generation Statistics for 2018 by sources. In comparison, bioenergy accounts for 24.4% of total renewable energy production and 16.7% of total renewable energy generation. Consequently, Korea's power generation from biomass has grown sixty-one (61) times in 2018 compared with 100,000 MWh in 2012. This is equivalent to an annual average growth rate of 160%. To put it in perspective, an average global biomass energy growth rate was only at 2% per year between 2010 and 2018⁵. See Figure 1 for more details.



4. Republic of Korea Energy Corporation (KEC), 2019, New and Renewable Energy Distribution Statistics for 2018 (Original title: 2018년 신재생에너지 보급 통계 잠정치 (2019년 공표) 결과 요약). Retrieved from https://www.knrec.or.kr/pds/pds_read.aspx?no=291&searchfield=&searchword=&page=1

5. REN21, 2017, Renewables 2017: Global Status Report, Paris: REN21 Secretariat, <http://www.ren21.net/gsr-2017/> (accessed 14 Nov. 2019) p.45.

6. KEC, 2019, op. cit., edited (Note: forest biomass includes wood pellets, wood chips, and bio-SRF)

The main driver of the demand for biomass is Korea's unique Renewable Energy Portfolio Standard (RPS) policy that is backed by a industry lobby. According to the RPS policy and the RPS Operating Guideline, large utilities (utilities of 500 megawatt or greater installed capacity) must meet a minimum threshold for renewables from their operations through generating renewable electricity, purchasing renewable electricity or procuring Renewable Energy Credits (RECs). The RPS quota for year 2019, for example, was six percent of total electricity generation and the 2020 quota is 7 percent (see Table 1). The policy sets eligibility for biomass as a renewable energy source, and co-firing of biomass was proven to be the simplest and cheapest option for electric utilities to fulfill their RPS quota. Consequently, instead of investing in true renewable sources that bring down emissions such as solar and wind, most large utilities opted for co-firing of biomass. This drove up the installed capacity of biomass in Korea significantly. Consequently in 2019, Korea has a total of 1,600 MW installed capacity of biomass (including co-fired and dedicated), and 1,200 MW in pipeline, according to the MOTIE.

Table 1. Trends of Renewable Energy Portfolio Standard Quota⁷

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Renewable Energy Production/ Total Production (%)	2	2.5	3	3	3.5	4	5	6	7	8	9	10

In order to verify their compliance with the RPS requirements, utilities must submit RECs issued by the Korea Energy Corporation, and RECs from renewable sources carry different weights. The REC multiplier schedule has recently been revised in 2018 that lowered the RECs from biomass co-firing; however, Korea's biomass energy demand is still on the rise due to the exception rules in the updated RPS law and implementing ordinance. Such loopholes allowed both dedicated and co-fired biomass plants that are currently operating, as well as all utilities in the pipeline, to enjoy higher RECs, nullifying the effects of the revision. A strong industry lobby has been the key driver of the inclusion of exception rules.

Other forms of subsidies also exist. In the electricity market, "RPS Implementation Cost Settlement" is provided as a type of environmental subsidy with the RPS mandated utilities. The government pays back a portion of the RPS implementation costs associated with acquiring RECs for utilities to meet their quota. For example, in 2018, the government paid 1.8 trillion KRW as a RPS implementation subsidy, which is equivalent to about

7. Republic of Korea, 2018, New and Renewable Energy Development, Utilization, and Distribution Law and its Implementing Ordinance, Annex 2 (original title: 신에너지 및 재생에너지 개발, 이용, 보급 촉진법 시행령 별표 2)

1.5 billion US dollars⁸. Furthermore, MOTIE has provided subsidies on retrofitting and upgrading nearing retirement coal power plants, further encouraging the industry drive to biomass power. Thanks to the aforementioned policy initiatives, utilities like Korea Electric Power Corporation (KEPCO), a state-run company and its subsidiaries, have been fulfilling their RPS quota almost exclusively through biomass, meeting approximately 70 percent of their requirements from biomass co-firing only in 2015 (Inspector General Office, 2016).

Biomass poses serious threats to the economy and environment of Korea and abroad. First, Korean biomass is highly dependent on foreign imported feedstock and it endangers forest ecosystems of exporting countries where illegal logging and deforestation is already a serious threat. Second, a large sum of RECs issued for biomass is disrupting the renewable energy market, harming solar and wind industries, and diverting resources from them. Equally important, biomass plants are polluting our air and likely increasing greenhouse gas emissions – undermining the government’s ambitions to achieve emission reduction targets.

The objective of this report is to assess the major drawbacks of biomass energy and seek policy solutions. Chapter 2 introduces the current state of play of biomass in Korea; chapter 3 analyzes key policy and stakeholder drivers that influenced such trends; chapter 4 summarizes the major issues of biomass energy; and chapter 5 presents policy and legal recommendations to address the adverse impacts of biomass.

8. Yeji, Lee. "KEPCO has paid approximately 1.8 trillion KRW for RPS Implementation Cost Settlement." *Electric Times* 27 Jun. 2019: Web <http://m.electimes.com/article.php?aid=1561619899181596002> (last accessed 8 Mar 2020)

2. The state of biomass in Korea: Mega biomass power projects dominate the scene

Electricity generation from biomass has grown rapidly since the beginning of the RPS policy in 2012, well exceeding the scheduled growth set by the government. While other renewable sources such as solar and wind continue to fall behind the schedule set by the RE 3020 Plan, biomass has outpaced its planned goal since 2016 because of low construction and operation costs involved with biomass. See below Table 2 for more details.

Table 2. “Renewable Energy 3020 Plan” RPS Policy Goals by Source (Unit : %)⁹

Eligible RE Source	2012	2016	2020	2025	2030	Annual growth rate
Solar heat	0.3	0.2	1.1	2.8	3.8	26.5
Solar PV	2.7	7.7	13.4	17.1	20.8	23.0
Wind	2.2	2.5	5.9	12.4	19.1	23.8
Bioenergy	15.1	19.5	25.1	22.4	19.2	11.2
Hydro	9.2	4.3	3.2	2.2	1.8	0.3
Geothermal	0.7	1.1	2.1	3.3	4.3	21.0
Marine (tidal & wave)	1.1	0.7	0.5	0.3	0.2	0.3
Waste	67.8	61.7	40.2	30.2	22.7	3.3
Ocean thermal	0.0	0.0	2.1	2.8	3.2	46.7

In 2019, the installed capacity of biomass (including dedicated and co-fired biomass) in Korea was about 1,600 MW¹⁰, with an additional 1,130 MW in pipeline. According to MOTIE, 27 utility companies were operating 66 commercial biomass power plant units in South Korea in 2019. The majority of biomass energy in Korea is co-fired — approximately 72 percent — and only 28 percent comes from dedicated biomass.

9. Korea Energy Corporation, 2019, “2018 New and Renewable Energy White Paper” (original title: 2018 신재생에너지 백서).

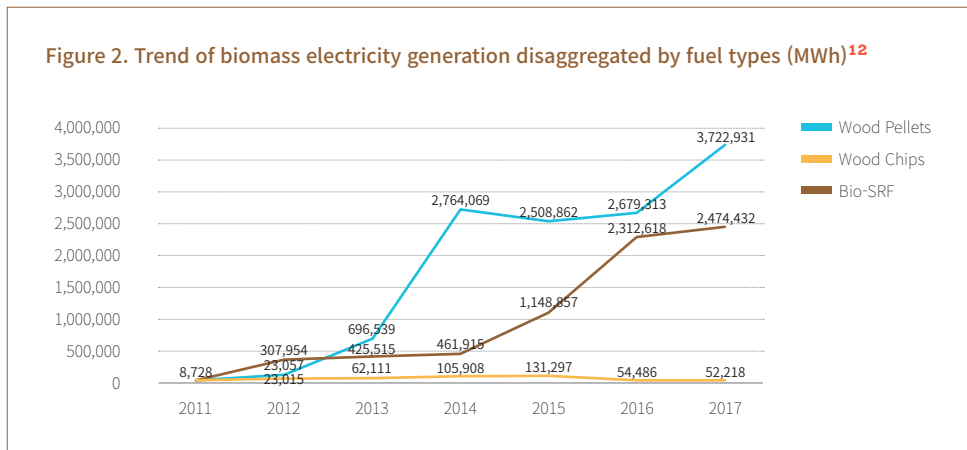
10. After excluding biomass units of 3MW or less, the total installed capacity was 1,522 MW in 2019.

Table 3. Biomass Power Plants in Korea over 3 MW installed capacity (2019)¹¹

Company name	Power plant name	Dedicated/Co-fired	Installed capacity (MW)	Avg. co-firing rate	Biomass capacity (MW)
Korea South-East Power Co.(KOEN)	Yeongdong Unit 1	Dedicated	125	100%	125
	Samcheonpo Units 1-6	Co-fired	3,360	3%	101
	Yeosu Unit 2	Co-fired	340	3%	10
	Yeongheung Units 1-6	Co-fired	5,520	3%	166
Korea East-West Power Co.(EWP)	Donghae Biomass	Dedicated	30	100%	30
	Seokmun Biomass	Dedicated	38.9	100%	38.9
	Donghae Units 1,2	Co-fired	400	10%	40
	Dangjin Units 1,2	Co-fired	1,000	2%	20
Korea Southern Power Co.(KOSPO)	Hadong Units 1-8	Co-fired	4,000	4%	140
Korea Western Power Co.(WP)	Taeon Units 1-8	Co-fired	4,000	3%	120
Korea Midland Power Co.(KOMIPO)	Boryeong Units 1-6	Co-fired	3,000	5%	150
	Boryeong Units 7-8	Co-fired	1,000	5%	50
SangGong Energy	Wonju Green Cogen	Dedicated	9.3	100%	9.3
Korea District Heating Corporation	Daegu Woodchip Renewable Energy	Dedicated	3	100%	3
GS EPS	GS Dangjin Biomass	Dedicated	105	100%	105
GunJang Energy	GE4 Cogen	Co-fired	250	34%	85
Sejong Green Power	Happy city Janggun Cogen	Dedicated	5	100%	5
Egon Energy	Egon Energy Cogen	Dedicated	8.5	100%	8.5
Junju Paper	Junju Paper Biomass Unit 1	Dedicated	15	100%	15
Junju Power	Junju Power Biomass Unit 2	Dedicated	32.4	100%	32.4
Suntec Energy	Suntec Biomass	Dedicated	3	100%	3
E-well Energy	Jeju Topyeong Biomass	Dedicated	3	100%	3
SunChang Energy	Sunchang Biomass	Dedicated	3.3	100%	3.3
OCISE	OCISE	Co-fired	303	50%	151.5
Hanhwa Energy	Gunsan Hanhwa Energy	Co-fired	99	30%	29.7
KimCheon Energy Service	Kimcheon Energy Service	Co-fired	n/a	100%	3
DaeLim Energy Green Power	Pyeongtack Poseung Biomass	Dedicated	43.2	100%	43.2
GS PoCheong Green Energy	GS Pocheon Green Energy	Co-fired	n/a	n/a	17
Gumho Petrochemical	Gumho Yeosu Cogen	Co-fired	144.97	10%	14.5
Sum of Co-fired			1,097.7 MW		
Sum of Dedicated			424.6 MW		
Total Biomass			1522.3 MW		

The most salient actors of biomass energy are state-run companies and large corporations, or in other words, conglomerates. As shown in Table 3, KEPCO's subsidiaries operate large-scale co-fired power plants and dedicated biomass plants, accompanied by some private companies who own large-capacity co-fired facilities. Most private companies investing in biomass are affiliated with Korean conglomerates. Except for the power plants of Korea South-East Power Co., Ltd. (hereinafter referred to as “KOEN”) and GS EPS (hereinafter referred to as “GS EPS”), most of the dedicated biomass power plants are 100 MW or under.

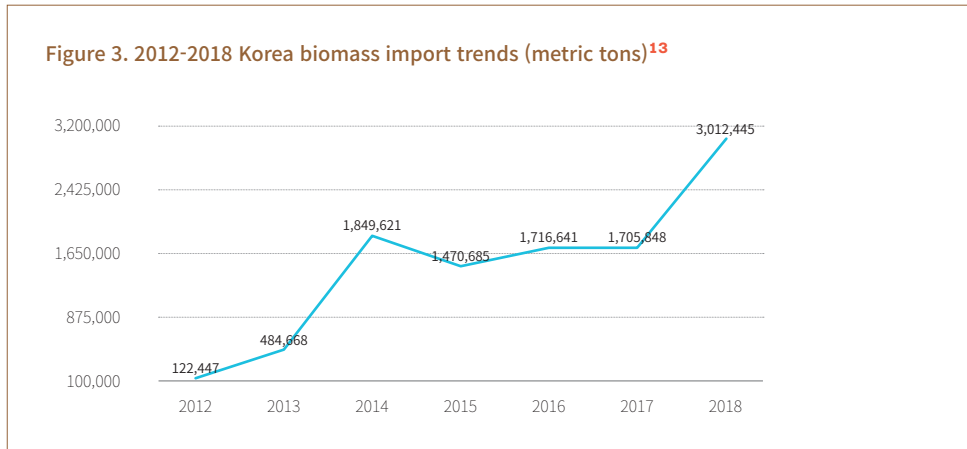
Almost all biomass plants utilize imported wood pellets as main feedstock, but a substantial amount of imported and domestic bio-Solid Refused Fuel (bio-SRF) is also used to generate power. Bio-SRFs typically contain waste wood and agricultural residues such as palm kernel and nut shells. Wood chips are less frequently used to generate biomass power in Korea. Below Figure 2 illustrates the quantity of biomass power generation from different feedstock sources in Korea.



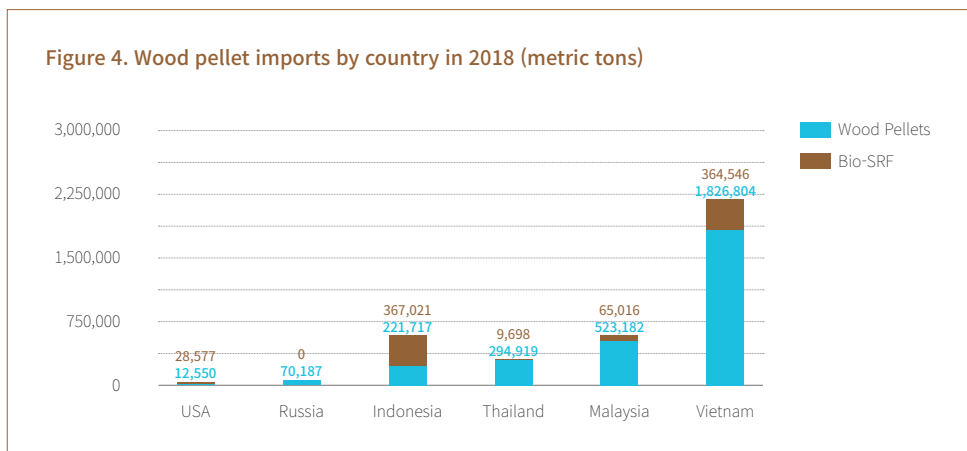
The Korean biomass sector has spent 460 million dollars on importing 3.4 million metric tons of wood pellets in 2018 alone. The import dependence of Korean biomass energy is unacceptably high. Utilities burned on average 98% imported wood pellets, compared with only 2% of domestically sourced ones from 2015 to 2018. The majority of imported feedstock originate from Southeast Asian countries, such as Vietnam, Malaysia, Thailand, Indonesia, but also from Russia and the USA. As demonstrated in the below Figure 3, the imports of wood pellets has increased more than 25 times in the last six years, from about 120,000 tons in 2012 to over 3 million tons in 2018. A recent paper published by

11. Compiled from following sources: 1) Korea Forest Service. 2018. "Domestic timber market monitoring since the application of new RECs for domestic roundwood" (original title: 국산원목 REC 가중치 적용에 따른 국내 목재시장 변화 모니터링). 2) Data received through a formal information disclosure request to MOTIE from National Assembly Member Mr. Seonghwan Kim in July 2019; 3) Korea Power Exchange (KPX). 2014-2019 Power Plants Construction Status (original title: 발전소 건설현황). retrieved from <https://www.kpx.or.kr/www/selectBbsNttList.do?bbsNo=125&key=89>.
 12. KEC. 2017/2018. "2016/2017 New and renewable energy supply statistics" (original title: 2016/2017 신재생에너지보급통계).

the Environmental Paper Network (EPN) has drawn attention to this threatening growth trajectory, as Korea is projected to have the fastest biomass import growth rate by 2027 (EPN, 2019).



As shown in Figure 4, most wood pellets imported to Korea originate from Vietnam, while imports from other Southeast Asian countries are also significant. Korea also imports biomass from Russia and the United States. As several new biomass power plants are currently under construction and/or have approvals for future construction, biomass feedstock import is likely to increase in the future.



In contrast to Korea, globally, most biomass is used to supply heat for buildings and industrial facilities rather than to produce electricity. According to REN21, a renewable energy think tank, the final energy consumption for globally produced biomass is the

13. According to the Korea Energy Economics Institute, a leading economics research agency, the temporary decline observed in wood pellet imports in 2015 was due to falling oil prices and rising temperatures.

highest in building heating (25.5%), while only 2.1% of biomass energy produced was used for power generation¹⁴. On the other hand, most biomass feedstock ends up being burnt for power generation in Korea. In 2016 for example, out of a total of 1.9 million tons of wood pellets consumed in Korea, about 90% of them were consumed at industrial operations, in this case, power generation¹⁵. The OECD data shows an unequivocal trend: as it is shown in Table 4, Korea's share of biomass in the share of primary energy production was more than three times higher than that of the OECD average.

Table 4. Comparison of Renewable Energy Generation by primary energy sources (Korea vs. OECD)¹⁶

Renewable Energy Generation as in Primary Energy (GWh)		
Source	S. Korea	OECD
Hydro	2,847	1,412,467
	17.90%	54.40%
Geothermal	0	51,193
	0.00%	2%
Solar PV	5,123	220,418
	32.30%	8.50%
Solar thermal	0	9284
	0.00%	0.40%
Marine energy	496	1,015
	3%	0.00%
Wind	1,683	605,454
	10.60%	23.30%
Bioenergy	5,551	265,362
	34.90%	10.20%
Wastes	184	33,072
	1.20%	1.30%
Sub-total Renewables	15,884	2,598,265
Sub-total Wastes	636	54,871
Total	16,520	2,653,136

Despite the global trend of reducing biomass, biomass energy continues to increase in Korea. According to the Ministry of Trade, Industry and Energy (MOTIE) and Korea

14. REN21, 2017, Renewables 2017: Global Status Report, Paris: REN21 Secretariat, <http://www.ren21.net/gsr-2017/> (last accessed: 8 Mar, 2020)

15. Heesun Lee et al. 2015. "Optimizing waste and bioenergy distribution by end use (II): forest biomass" (original title: 폐자원 및 바이오에너지의 용도별 적정 배분방안(II): 목질계 바이오매스를 중심으로). Korea Environment Institute

16. Estimated year of completion based on initial submission plans to MOTIE. Some updates may have been made but not shared with public, therefore there is possible discrepancy.

Power Exchange (KPX), a total of 1,130 MW biomass power plants are scheduled to be built between 2020 and 2021, most of which are dedicated biomass power plants. Table 5 summarizes biomass power plants in pipeline, disaggregated by their fuel, combustion methods and capacity.

Table 5. Biomass Power Plant Construction Plans in Pipeline as of 2019¹⁷

Est. completion year	Feedstock	Company	Biomass unit	Dedicated/ Co-fired	Total Capacity (MW)	Biomass Capacity (MW)
2020	Wood pellet	Korea South-East Power(KOEN)	Yeongdong Biomass Unit 2	Dedicated	200	200
	Wood pellet	Korea Midland Power(KOMIPO)	Gunsan Bio	Dedicated	200	200
	Wood pellet	Gunjang Energy	SMG Bio	Dedicated	100	100
	Wood pellet	Pohang New and Renewable Energy	Pohang Bio	Dedicated	110	110
	Wood pellet	Yeongdeok Green Energy	Biomass-fired plant	Dedicated	9.9	9.9
2021	Wood pellet	Korea Hydro and Nuclear Power (KHNP)	Kwangyang Green Energy	Dedicated	220	220
	Wood pellet	CGN Daesan Electricity	Daesan Biomass	Dedicated	110	110
	Wood chip	GS EPS	GS Dangjin Bio Unit2	Dedicated	105	105
	Wood chip	Yeosu Green Energy	Cogeneration	Co-fired	250	50
	Wood chip	GS Pocheon Green Energy	GS Pocheon Cogeneration	Co-fired	169.9	25.5
Not specified	n/a	Korea East-West Power Co.(EWP)	Honam Fire Power	n/a	n/a	n/a
	n/a	Korea East-West Power Co.(EWP)	Seokmun Energy	n/a	n/a	n/a
	n/a	GS Energy	GS Energy	n/a	n/a	n/a
	n/a	Gimcheon Energy	Gimcheon Energy	n/a	n/a	n/a
	n/a	An-In Fire Power	An-In Fire Power	n/a	n/a	n/a
	n/a	Korea District Heating Corporation (KDHC)	Korea District Heating Corporation (KDHC)	n/a	n/a	n/a
	n/a	GS Donghae Electricity	GS Donghae Electricity	n/a	n/a	n/a
	n/a	Posco	Pos Power	n/a	n/a	n/a
Total Installed Capacity in Pipeline: 1,130 MW						

17. Korea Energy Corporation, 2019, "2018 New and Renewable Energy White Paper"

3. Drivers of Biomass Energy: How utilities benefit from renewable energy policy and solidifying them through lobbying



Driver 1: RPS policy and by-laws

The main policy driver for biomass energy is the RPS policy prescribed in the “New and Renewable Energy Development, Utilization and Distribution Law” (hereunder, “New and Renewable Energy Law”). The law recognizes biomass as an eligible renewable energy source, and the utilities of mandatory compliance (500MW or greater in installed capacity) can burn biomass within their existing coal power plants to meet their quota instead of investing in solar or wind. To verify their compliance with the RPS requirements, utilities are required to submit Renewable Energy Certificates (RECs) that are issued by the Korea Energy Corporation using the REC multiplier schedule under the RPS law.

According to the RPS policy, RECs issued for forest biomass (wood pellets and wood chips) are eligible for REC multipliers, 1.5 for dedicated and 1.0 for co-firing until 2018 and later revised to 0.5 for dedicated and zero for co-firing. In addition, the revised law includes a new ruling for biomass residues which can be roughly translated as “un-used biomass” in English, granting REC multiplier of 2.0 for dedicated, and 1.5 for co-fired biomass. Below Table 6 compares the REC weightings for biomass before and after the RPS law revision.

Table 6. Biomass RECs Comparison – Before and After the 2018 REC Revision¹⁸

Feedstock	Source	REC (Dedicated)		REC (Co-fired)	
		Before	After	Before	After
Wood pellets	Roundwood or residues	1.5	0.5	1.0	0
Wood chips	Roundwood or residues	1.5	0.5	1.0	0
Bio-SRF	Waste wood and agriculture wastes	1.5	0.25	1.0	0
Un-used wood pellets and wood chips	Residues, results of thinning, street trees and pest-affected trees	1.5	2.0	1.0	1.5

18. Republic of Korea, 2018, Mandatory New and Renewable Energy Supply Law and the Management and Operation Ordinance of Mandatory Fuel Mix Requirements (original title: 산·재생에너지 공급의무화제도 및 연료 혼합의무화제도 관리·운영지침 (산업통상자원부고시 제2018-130호, 2018. 6. 26., 일부개정)

Table 7. Transitional Provision (Exception Rules) of the 2018. 6. 26. Revision of REC Schedule¹⁹

Cat.	Commercial Operation Date	Approval of Construction Plan	Feedstock	Dedicated/ Co-fired	Applicable RECs due to Transitional Provision
Under construction or ready to build	After Jun 26, 2018	Before Jun 26 2018	Wood chip, wood pellet, bio-SRF, and roundwood	Dedicated	1.5
	After Jun 26, 2018	Before Jun 26 2018	Wood chip, wood pellet, bio-SRF, and roundwood	Co-fired	1.0
In commercial operation	Before Jun 26 2018	Before Jun 26 2018	Wood chip, wood pellet, bio-SRF, and roundwood	Dedicated	1.5
	Before Jun 26 2018	Before Jun 26 2018	Wood chip, wood pellet, bio-SRF, and roundwood	Co-fired	1.0
Planned to build but did not begin construction	After Jun 26 2018	Before Jun 30 2019	Wood chip, wood pellet, roundwood	Dedicated	1.0
	After Jun 26 2018	Before Jun 30 2019	Bio-SRF	Dedicated	0.5
	After Jun 26 2018	Before Jun 30 2019	Wood chip, wood pellet, bio-SRF, and roundwood	Co-fired	0
New biomass	After Jun 26 2018	After Jun 30 2019	Wood chip, wood pellet, roundwood	Dedicated	0.5
	After Jun 26 2018	After Jun 30 2019	Bio-SRF	Dedicated	0.25
	After Jun 26 2018	After Jun 30 2019	Wood chip, wood pellet, bio-SRF, and roundwood	Co-fired	0
All	Not applicable	Not applicable	Un-used Biomass (Domestic only)	Dedicated	2.0
	Not applicable	Not applicable	Un-used Biomass (Domestic only)	Co-fired	1.5

Although the revised law suspends or significantly reduces subsidies for new biomass plants being planned in the future, it does not apply retrospectively to existing power plants, nor to the power plants in pipeline. The “Transitional Provisions” of the 2018 revision have granted higher RECs for all biomass plants in pipeline as long as their construction plan is approved by mid-2018. Furthermore, the government has given an extension until mid-2019 for those who wish to submit their plans for dedicated biomass or co-fired biomass, granting them leeway to be excluded from the list of entities covered by the revised law. It is highly problematic that the revision was done in a patchwork, gradually allowing more utilities to enjoy benefits set by the previous law, rather than applying the new law in retrospect.

19. Korea Forest Service. 2019. Forest/Forestry Outlook No. 9 “Wood pellet supply trends and forecast” (original title: 목재펠릿 수급 동향과 전망).

To help understand the exception rules, SFOC has summarized every case scenario under the 2018 June RPS law revision and analyzed the actual effects of the law as it applies to different cases. Out of twelve categories, only three (see “New biomass”, highlighted in yellow in Table 7) will actually be affected by the revision, and all the rest remain unaffected, still enjoying higher RECs.

Driver 2: RECs and RPS Implementation Cost Settlement (RPS-ICS)

The above section examined how current and past renewable energy laws have favored biomass through granting higher REC multipliers. In this section, we will discuss how utility companies have been benefiting from RECs and RPS implementation cost settlement (RPS-ICS) support. First, all five KEPCO subsidiaries have shown clear dependence on biomass RECs to meet their RPS requirements. For example, the majority of KOEN’s RECs originate from biomass that once climbed up to 85% of its total issued RECs. Similarly, most other companies on average supplied their RECs through biomass between 40% and 90% range in the last six years. In addition to RECs, these companies receive cash payments in the form of RPS Implementation Cost Settlements (RPS-ICS). For example, in 2018, KOEN alone has received 106 billion KRW, equivalent to approximately 90 million US dollars as its RPS-ICS payment from biomass.

Table 8 summarizes the total number of biomass RECs issued (in 1,000s), the proportion of biomass RECs out of all RECs issued (percent), and the amount of the RPS-ICS paid (billion KRW) annually from 2013 to 2018 using the examples of five KEPCO subsidiaries. The number of RECs and the amount of RPS-ICS from biomass demonstrate how biomass subsidies have aided large biomass utilities in profiting from their biomass operations while meeting their RPS quota.

Table 8. KEPCO's Biomass Related RECs and RPS Implementation Cost Settlement 2013-2018²⁰

Company	Category	2013	2014	2015	2016	2017	2018
Korea South-East Power Co.(KOEN)	No. of biomass RECs (1,000)	395	1,363	1,018	1,037	1,100	1,304
	Biomass RECs/ All RECs	80%	85%	77%	75%	74%	65%
	RPS-ICS from biomass (billion KRW)	19	84	86	90	76	106
Korea Midland Power Co.(KOMIPO)	No. of biomass RECs (1,000)	68	426	318	375	380	520
	Biomass RECs/ All RECs	82%	67%	45%	45%	45%	51%
	RPS-ICS from biomass (billion KRW)	3.9	26	27	32	6.9	21
Korea East-West Power Co.(EWP)	No. of biomass RECs(1,000)	128	507	635	634	577	526
	Biomass RECs/ All RECs	46%	70%	61%	52%	45%	39%
	RPS-ICS from biomass (billion KRW)	7.3	31	49	55	34	14
Korea Southern Power Co.(KOSPO)	No. of biomass RECs(1,000)	270	582	594	548	401	412
	Biomass RECs/ All RECs	90%	64%	49%	43%	41%	32%
	RPS-ICS from biomass (billion KRW)	15.4	36	50	47	7.8	16
Korea Western Power Co. (WP)	No. of biomass RECs (1,000)	101	379	469	467	311	230
	Biomass RECs/ All RECs	10%	23%	28%	21%	12%	8%
	RPS-ICS from biomass (billion KRW)	5.8	23	40	40	6	9

20. The data in this table was received through a formal information disclosure request to MOTIE from National Assembly Member Mr. Seonghwan Kim (June 2019). It may contain potential calculation mistakes by the KEPCO subsidiaries (marked in red in Table 8).

Driver 3: Energy and Forestry Industry Lobby

Biomass industry lobby groups have dominated biomass policy discussions in Korea, and have wielded strong influence over policy revisions and new policies regarding biomass. They include large-scale private utilities, Korea Electric Power Corporation (KEPCO) subsidiaries, and the Forest Biomass Energy Association (FBEA). Big utility companies have lobbied the government in order to include their business operations in the exception rules of the 2018 REC revision, which has led to the patchwork of the Transitional Provision of the revised 2018 REC schedule as it was shown in Table 7. FBEA is a member-based interest group advocating for the use of woody biomass for power generation. Its members include wood pellet producers and importers/traders of wood pellets, wood chips and bio-SRF. The association produces biomass statistics including domestic and import volume of biomass on behalf of KFS, and it prepares most of the biomass energy related reports available in Korean. The association has a big presence in renewable energy conferences, media and forums and meetings advocating their industry interest to expand biomass energy in Korea. FBEA has also played a key role in introducing new RECs for un-used biomass during the 2018 REC revision and setting the un-used biomass production target by the Korea Forest Service.

4. Major Issues of Biomass Energy



We have assessed the main policy and stakeholder drivers of the exponential growth of biomass energy in Korea in the above chapter. This chapter aims to assess major issues and risk factors associated with biomass energy to learn why biomass should not be considered as renewable energy.

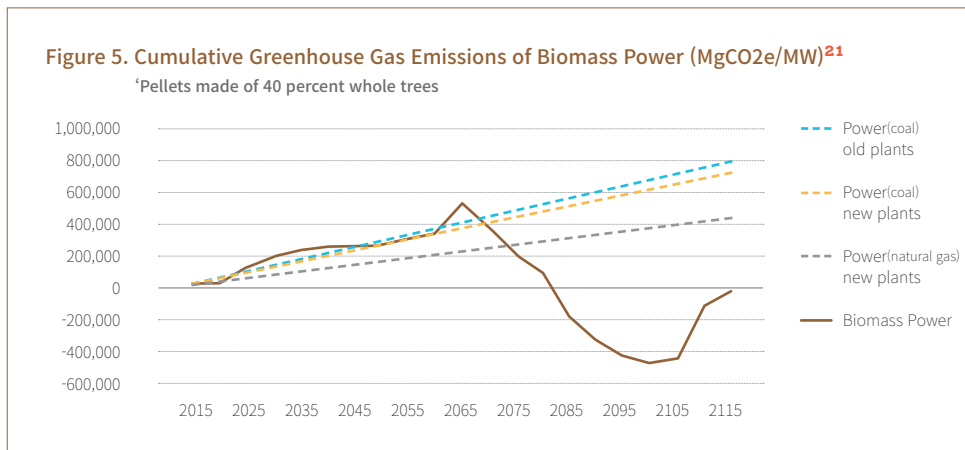
Biomass increases greenhouse gas emissions.

Some argue that biomass can tackle climate change. In other words, they think biomass is carbon neutral because the amount of carbon dioxide emitted from biomass burning is, in theory, equal to the amount of carbon dioxide absorbed when trees grow back. This has been so far one of the most important grounds on which policymakers have justified the development of biomass. In addition, the biomass sector often argues that only a small amount of greenhouse gases are emitted during the harvesting and production of biomass. However, this argument is misleading as it overlooks or intentionally ignores the following key facts:

First, biomass looks green on paper because its emissions data only reflects the amount of greenhouse gas emissions generated by the production and transportation of biomass within Korea, assuming zero emissions during the burning of biomass during the industrial process. However, in reality, biomass releases more greenhouse gases than coal during the combustion process. According to the IPCC Guidelines for Accounting National GHG Inventory, prepared by the Intergovernmental Panel on Climate Change (IPCC), CO₂ emissions at the stage of combustion are 112,000 kg/TJ for solid biomass, and 96,100 kg/TJ for bituminous coal. The reason why these emissions are omitted is not because biomass is “carbon neutral”, but because of an arbitrary counting convention, in order to prevent “double counting” of emissions when estimating national inventories.

Second, the greenhouse gas emissions accounting from biomass energy generation does not include the significant amount of greenhouse gas emissions emitted during international transport and shipping. Recognizing this problem, the government of the United Kingdom has introduced a lifecycle emissions standard for future renewable energy projects, limiting future biomass projects’ access to renewable energy subsidies.

Third, the notion of “carbon neutrality” of biomass needs to be corrected. The Natural Resources Defense Council (NRDC), a U.S.-based nonprofit, analyzed the amount of time required for biomass generation to become carbon neutral (see Figure 5). According to their recent study, in the beginning of the biomass plant operation, cumulative emissions are larger than those of coal power plants. Compared to similarly sized coal power plants, biomass has had a greater amount of cumulative greenhouse gas emissions in the first 55 years. Consequently, it takes approximately 70 years for biomass power generation to reach carbon neutrality.



Per unit of energy, biomass power plants emit more carbon dioxide from their smokestacks than coal plants. Cutting down older trees and replacing them with saplings reduces the amount of carbon stored in that forest, even under a best-case scenario in which harvested trees are immediately replanted. This means it can take anywhere from decades to more than a century for biomass energy to begin to deliver any climate benefit²². Even when biomass energy is generated by burning forestry residues—the leftovers from logging operations, like treetops and limbs—the result is increased CO₂ in the atmosphere that lasts for several decades²³.

Biomass RECs are causing disruptions to the renewable energy market.

The excessive amount of RECs issued for biomass energy is (1) encouraging the utility companies to participate in biomass business instead of investing in other renewables, despite the technology advancement in the solar and wind sector, and (2) lowering the

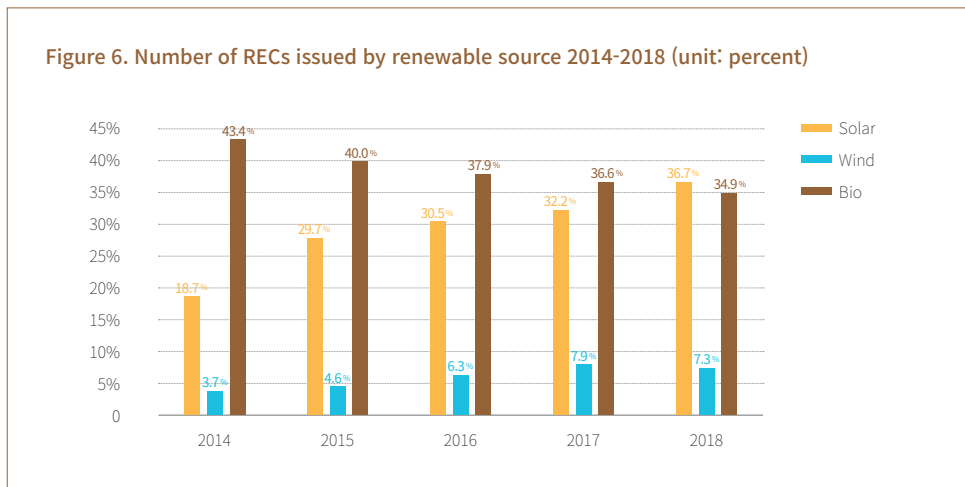
21. Natural Resources Defense Council, 2015, “Think Wood Pellets are Green? Think Again,” NRDC Issue Brief May 2015 IB: 15-05-A

22. European Academies’ Science Advisory Council (EASAC), 2018, “Commentary by the European Academies’ Science Advisory Council (EASAC) on Forest Bioenergy and Carbon Neutrality”, https://easac.eu/fileadmin/PDF_s/reports_statements/Carbon_Neutrality/EASAC_commentary_on_Carbon_Neutrality_15_June_2018.pdf (last accessed March 2020).

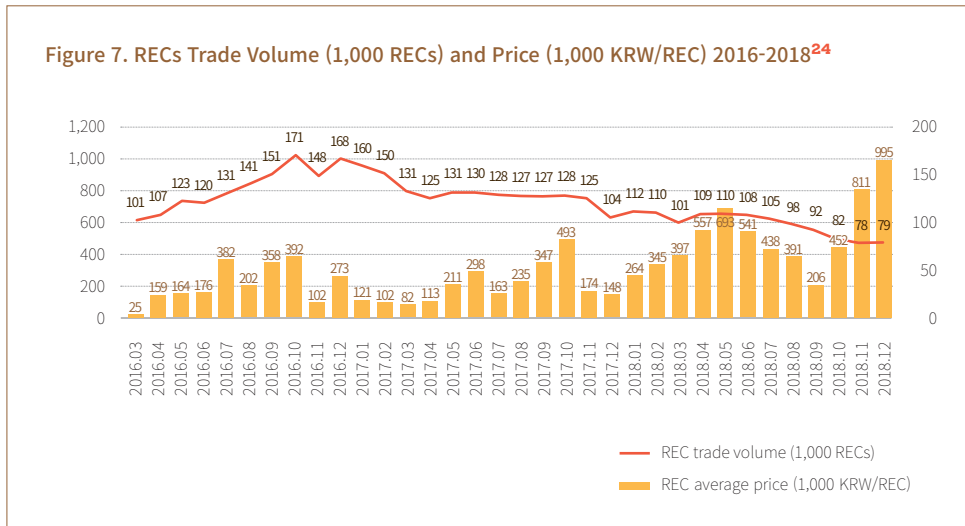
23. Booth, M. S., 2018, “Not carbon neutral: Assessing the net emissions impact of residues burned for bioenergy.” *Environmental Research Letters* 13(3): 035001. <http://iopscience.iop.org/article/10.1088/1748-9326/aaac88>

price of RECs by providing a surplus in the RECs market, which is likely to negatively affect the economics of other environmentally sound renewable energy such as solar and wind.

As mentioned earlier, bioenergy has been the number one source of RECs in Korea in the last several years. According to the Korea Energy Corporation, the average RECs issued for bioenergy generation accounted for almost 40 percent of the total RECs issued during 2014 and 2018, the highest among all renewable energy sources (see Figure 6). In addition, as shown in Appendix 3, KEPCO companies depend on biomass development as a core solution for their RPS obligations. The low investment cost and high level of REC weighting applied to biomass development may have facilitated this behavior.



Large sums of RECs flowing from biomass operations are disrupting the renewable energy market. According to the Korea Energy Corporation, the spot market price of RECs stood between 100,000 KRW and 170,000 KRW during 2016-2017, but continued to fall afterwards, with an average price standing at 97,000 KRW in 2018 (see Figure 7). In October 2019, the spot market price of RECs fell to 54,000 KRW, and small solar energy operators, including the National Solar Photovoltaic Association and the National Association of Solar Photovoltaic Power Operators, have raised their voices on RECs market failure. According to these groups, overcompensation of RECs for the biomass sector has contributed to an excess supply of RECs, in turn, worsening the downward market trends in 2018. Table 9 illustrates the supply and demand of RECs in the last few years.



MOTIE later explained that the lack of balance in supply and demand of RECs as a main reason for the REC spot market crash demonstrates the changes in surplus RECs over time(see Table 9). Considering biomass is the number one source for RECs issuance in Korea, it is not difficult to draw a link between the rapid increase in biomass generation and the decrease in the price of RECs.

Table 9. Mandatory RECs required for RPS compliance vs. actual number of RECs surrendered²⁵

Category (1,000 RECs)	2016	2017	2018	2019(est.)	2020(forecast)
RPS Compliance Requirements(A)	16,970	18,975	23,692	28,015	32,839
RECs Surrendered(B)	16,163	20,897	26,982	33,446	40,165
Surplus RECs(B-A)	-807	1,922	3,290	5,431	7,326

Imported fuel that drives environmental destruction and forest degradation everywhere.

As seen above, Korea’s dependence on imported biomass is about 98 percent, mainly from Vietnam, Malaysia and Indonesia. As the demand for biomass energy rises due to policy drivers in Korea, the integrity of forests in export countries is at risk. To see how destructive biomass electricity is to our environment and climate, one needs to look no

24. Korea Energy Corporation. 2019. "Korea RPS Policy Trends and Diagnosis" [presentation on November 8th 2019 at Korea Electricity Forum] (original title: 국내 RPS 제도 현황 및 진단(2019. 11. 8. 전력포럼의 이상훈 한국에너지공단 신재생에너지센터장 발표자료))

25. Korea Solar PV Association . 2019. "A decline in REC Price and Problems" [presentation on 25 October 2019 at Korea New and Renewable Energy Academy]. (original title: "REC가격하락 현황과 문제점).

further than the sourcing practices of Enviva, the largest wood pellet manufacturer in the world and supplier to energy giants like Drax Power in the UK. Significant and troubling evidence shows that mature hardwood forests in the U.S. Southeast are logged to supply Enviva²⁶. These investigations, conducted by local groups, spotlight the vast quantities of the most carbon-intensive types of biomass, including whole trees, entering the industry's supply chain. These unsustainable sourcing practices not only liquidate carbon stocks, but damage biodiversity in a region where the Atlantic coastal plain is designated as a global biodiversity hotspot.

Similar disasters could occur in Southeast Asian countries, for example, Vietnam, Korea's largest import source of wood pellets. Vietnam's wood pellet exports have increased by an average of 420,000 tons per year since 2012, when the RPS system began in Korea. In particular, pellet exports increased by more than 720,000 tons per year in 2017 and 2018. According to Korea Forest Service, Vietnam exported 1.83 million tons of wood pellets to Korea in 2018, accounting for 67 percent of its total production (see Figure 8).

Vietnamese wood pellets are mainly produced as by-products of the furniture industry; however, there is high uncertainty around the original source of wood for the furniture industry in Vietnam. According to the recent study commissioned by the Chatham House, a think tank in the UK, one-fifth of Vietnam's total timber imports are considered to be at high risk of deforestation, sourced from illegal sources in neighboring countries²⁷. Moreover, according to Future Metrics, a wood pellet industry consulting company, Vietnam's furniture industry by-products are expected to be short to meet the Korea's rapidly growing demand for wood pellets. Such shortage could lead to increased pressure on plantation and natural forests within and around Vietnam. It can also escalate the supply chain risk and the risk of falsified certificates. To reduce the price, some producers may try mixing in agricultural wastes or waste wood. A similar attempt was caught in 2014 when the customs department discovered large quantities of Vietnamese pellets made of rice husks. Later, when certificates for pure wood contents were mandated, falsified documents were found in Vietnamese pellets imported to Korea²⁸.

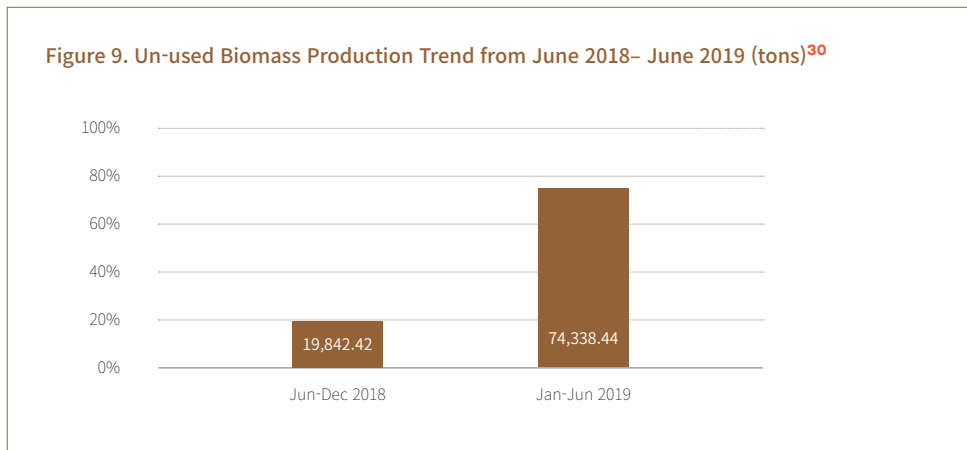
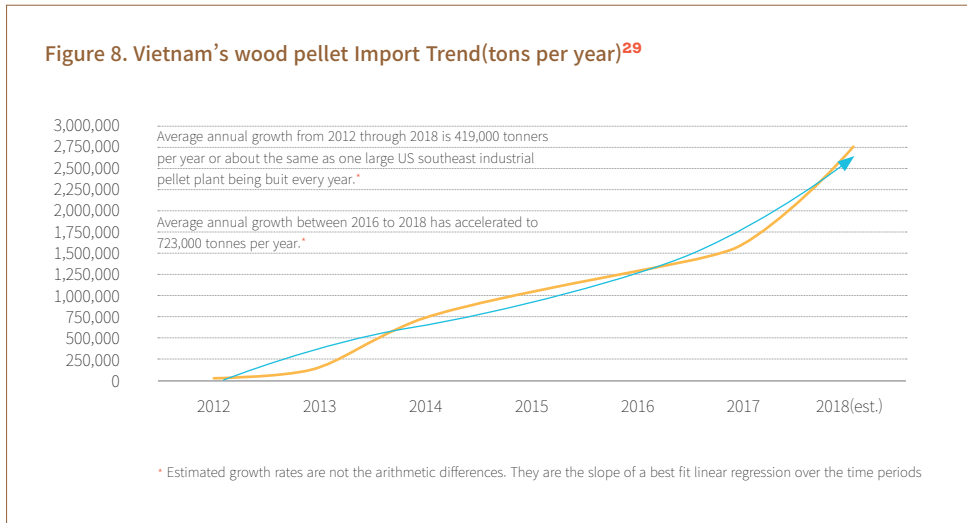
Korea's biomass policy could influence the health of domestic forests too. Prior to the REC revision, biomass production from domestic roundwood was prohibited to prevent the competition in the domestic wood market. However, such a ban was lifted after the revision. As such, all existing and pipeline utility companies can utilize wood pellets made from domestic roundwood and quality for RECs. Moreover, the REC revision in 2018

26. Dogwood alliance et al., 2019, "Global markets for biomass energy are devastating U.S. forests", <https://www.nrdc.org/sites/default/files/global-markets-biomass-energy-06172019.pdf> (last accessed: 8 March 2020)

27. Dawson, S. Illegal Wood Import and Re-Export: The Scale of the Problem and the Response in Thailand, South Korea and India (No. 2014/01), Energy, Environment and Resources (EER PP); Chatham House: London, UK. Available online: https://www.chathamhouse.org/sites/default/files/home/chatham/public_html/sites/default/files/20140400IllegalWoodThailandSKIndiaLawson.pdf (accessed on 8 March 2020).

28. Tim Portz, "Southeast Asia's Low-Cost Pellet Player", Biomass Magazine, 2015.11.17 <http://biomassmagazine.com/articles/12542/southeast-asiaundefined-low-cost-pellet-player> (last accessed: 8 March 2020)

introduced new REC multipliers for un-used biomass. Un-used biomass production has been on a sharp rise in anticipation of the increased demand for higher RECs. As shown in (see Figure 9), domestic un-used biomass production has nearly quadrupled between the second half of 2018 and the first half of 2019. Large utilities such as KEPCO subsidiaries have already secured long term purchase agreements with un-used biomass producers, driving this demand even further.



29. Future Metrics. 2019. “2018 White Paper Wood Pellet Market Analysis and Forecast”. Retrieved from <https://www.futuremetrics.info>.

30. This data was received through a formal request for information disclosure to Korea Forest Service from National Assembly Member Mr. Hyunkwon Kim in July 2019.

Despite the rapid growth of un-used biomass, the rule of the game remains unclear. The definition of un-used biomass lacks clarity and invites interpretation. Few people know that half of the defined categories of un-used biomass actually include roundwood. The manual issued by Korea Forest Service lacks proper verification and field inspection processes. To prevent large scale forest degradation for un-used biomass production, the government should strengthen the overall management and supervision system, including enforcing on-site inspections, issuing penalties for non-compliance, and setting a fuel quality standard for un-used biomass.

Biomass does not help reduce air pollution.

Burning biomass emits pollutants such as carbon dioxide, sulfur oxide, nitrogen oxide, ash, and particulate matters, and unfortunately these emissions are not lower than those of other fossil fuels. As shown in Table 10 KOEN's Yeongdong Unit 1, a dedicated biomass plant, produces more particulate matters and nitrogen oxides per unit of electricity generated, compared with its natural gas power plants. The biomass plants listed below burn wood pellets only. However, other plants burn bio-SRF which contains waste wood and agricultural by-products. Power plants that burn Bio-SRF are known to generate much worse air pollution and even VOCs.

Table 10. Pollutants Emissions Per Unit of Electricity Generated: A comparison between dedicated biomass power plants vs. LNG plants³¹

2018	PM2.5 ³² (kg/MWh)	CO2 ³³ (kg/MWh)	SOX (kg/MWh)	NOX (kg/MWh)	Ash (kg/MWh)
KOEN Yeongdong Unit 1 (Dedicated biomass)	0.08	18.88	0.05	0.59	0.02
EWP Donghae Biomass (Dedicated biomass)	0.06	26.23	0.05	0.48	0.02
KOEN LNG 1 (Old)	0.05	523	-	0.58	-
KOEN LNG 2 (New)	0.01	343	-	0.07	-

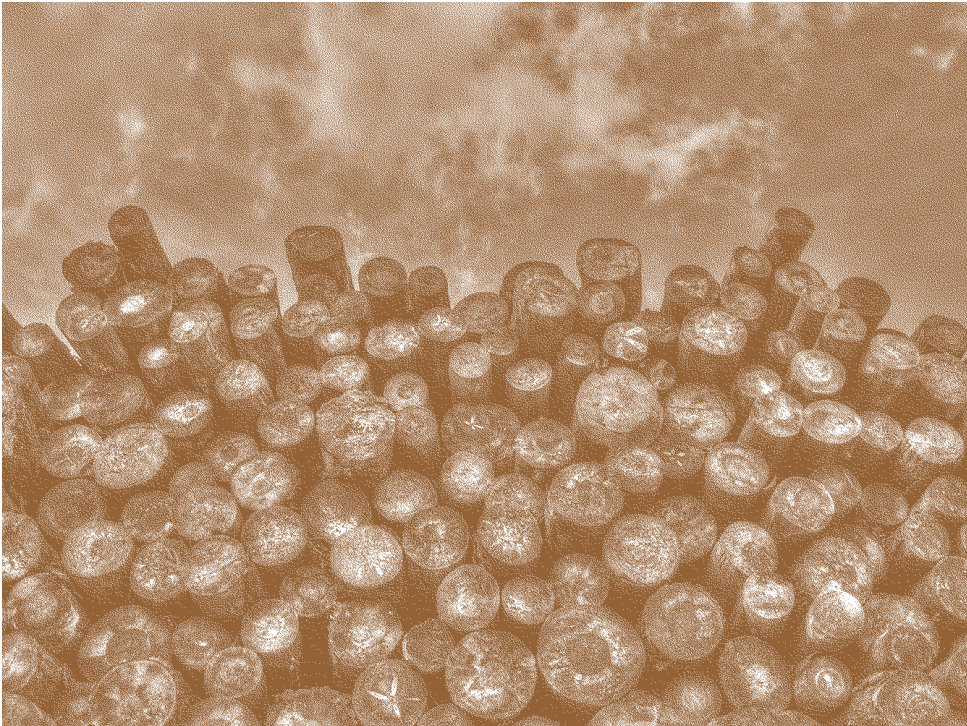
Despite the problems and threats stated above, biomass is largely considered carbon neutral and a suitable transitional energy source for Korea's renewable future. The biomass industry has engineered and spread such misconceptions, and the government

31. This data was received through a formal request for information disclosure to KOEN and EWP from National Assembly Member Mr. Seonghwan Kim in July 2019.

32. Particulate matters are calculated using the following equation based on the recommendations by Korea Ministry of Environment: $PM2.5 = (SOx \times 0.345) + (NOx \times 0.079) + (Ash \times 0.66)$

33. The CO2 emissions here do not include emissions from burning biomass according to the IPCC guideline. This number only includes domestic transport.

has been receptive to a strong industry lobby. Meanwhile, there has been a major absence of civil society engagement in the previous biomass policy discussions. Consequently, the biomass industry was able to influence the REC schedule according to their needs. As most environmental groups are relatively small and poorly funded in Korea, few environmental groups have had the bandwidth to promote the biomass agenda to address these underlying policy issues and social misconceptions.



5. Conclusions and Recommendations

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In chapters 1 to 4, we have examined the current status and problems related to biomass development in Korea. We have assessed the policy drivers of biomass energy development and identified the major threats of large-scale biomass energy. In this chapter, we will recommend relevant measures that are needed to address these problems.

Biomass energy has been growing at a rapid pace, permitting high REC multipliers to biomass development within the RPS policy. Obligated utilities under the RPS policy have been seeking to easily comply with renewable energy supply obligations through burning biomass rather than investing in environmentally robust renewable sources such as solar and wind power. This has made the nation's major power generation businesses avoid and neglect solar and wind power. An increase in biomass development could cause environmental destruction in Vietnam and other biomass exporting countries, and threaten our own forests in Korea due to the high REC weighting to un-used biomass developments. In addition, biomass is an ineffective source of energy as it takes 55 to 70 years to become carbon neutral. Recognizing that the climate budget for humanity does not allow us that much time, we need to ramp up climate actions and invest in energy sources that significantly reduce greenhouse gas emissions in the next decade or two. We urge the Korean government to implement the following recommendations to address the adverse impacts of biomass and to respond to climate change proactively.

First, we recommend stopping the issuance of RECs for biomass co-firing for all commercially operating power plants and those in pipeline. The most important policy signal that led to the increase in biomass development in the country was biomass RECs. As such, the government should revise the laws to no longer grant RECs for cofiring regardless of its status. Since co-fired biomass power generation is mostly carried out within the coal power plants owned by power companies without much investment involved, the possible legal benefits of affected entities to which this suspension of RECs issuance may infringe upon are considered insignificant. More importantly, the office of the auditor general has already urged the government to revise the incentive structures, recognizing that co-fired biomass plants have been overcompensated for their RPS Implementation Cost Settlements and their RECs were overestimated compared to their true cost of construction and operations.

Second, RECs for large scale dedicated biomass power should be eliminated or significantly reduced, considering that most of these companies are known to have already recovered the investment costs of converting their nearing to retire coal power plant units into biomass. In addition, given that these large power plants burn a substantial amount of mostly imported biomass that increases the greenhouse gas emissions from its source to power generation, in principle, large scale dedicated biomass should not qualify for renewable energy subsidies. As such, with an exception for small-scale, locally and sustainably sourced un-used biomass facilities, RECs for all other dedicated biomass power plants must be suspended. The government should also consider introducing a greenhouse gas (GHG) emissions threshold for biomass-burning power stations, similar to the United Kingdom's new rule in 2018.

Third, even for small-scale, dedicated biomass facilities that utilize un-used biomass, a strict management and certification system are required for the production and use of biomass residues. This is to ensure that small-scale, un-used biomass production does not compromise the environmental integrity of our forests. As we discussed above, the rapid increased demand of un-used biomass for biomass power is already showing early signs of threatening the health of domestic forests. Therefore, we recommend establishing a rigorous management and certification system to effectively manage the quantity and quality of un-used biomass. In addition, the government of Korea must introduce appropriate safeguard measures to make sure the certification process for domestically produced un-used biomass are done independently and objectively.

Appendix 1

Renewable Energy Production and Power Generation Statistics for 2018, by sources

Table A1-1. New & Renewable Energy Production Statics for 2018, by sources ³⁴

Source	2017		2018p		Change between 2017-18		Contribution (%)	
	Production	Share(%)	Production	Share(%)	Production	Ratio(%)		
Total Primary Energy Supply (1,000 toe)	302,065	100.00	307,304	100.00	5,239	1.73	-	
New and Renewable Energy	16,448,386	5.45	17,799,383	5.79	1,350,997	8.21	100.0	
Renewable energy	15,861,222	5.25	17,060,552	5.55	1,199,330	7.56	88.8	
New energy	587,164	0.19	738,831	0.24	151,667	25.83	11.2	
Renewable Energy	Solar thermal	28,121	0.2	27,395	0.2	△ 725	△ 2.6	△ 0.1
	Solar PV	1,516,349	9.2	1,977,148	11.1	460,799	30.4	34.1
	Wind	462,162	2.8	525,188	3.0	63,026	13.6	4.7
	Hydro	600,690	3.7	718,787	4.0	118,097	19.7	8.7
	Marine	104,256	0.6	103,380	0.6	△ 876	△ 0.8	△ 0.1
	Geothermal	183,922	1.1	205,464	1.2	21,542	11.7	1.6
	Hydrothermal	7,941	0.0	14,725	0.1	6,784	85.4	0.5
	Biomass	3,598,782	21.9	4,350,670	24.4	751,887	20.9	55.7
	Waste	9,358,998	56.9	9,137,795	51.3	△ 221,203	△ 2.4	△ 16.4
New energy	Fuel cell	313,303	1.9	376,304	2.1	63,001	20.1	4.7
	IGCC	273,861	1.7	362,527	2.0	88,666	32.4	6.6

34. Republic of Korea Energy Corporation (KEC), 2019, New and Renewable Energy Distribution Statistics for 2018 (Original title: 2018년 신재생에너지 보급 통계 잠정치 (2019년 공표) 결과 요약). Retrieved from https://www.knrec.or.kr/pds/pds_read.aspx?no=291&searchfield=&searchword=&page=1

Table A1-2. New & Renewable Power Generation Statistics for 2018, by sources ³⁵

Source	2017		2018		Change		Contribution (%)	
	Generation	Share(%)	Generation	Share(%)	Generation	Ratio(%)		
Total Power Generation	577,335,572	100.00	593,638,503	100.00	15,505,281	2.82	-	
New and Renewable Energy	46,623,321	8.08	52,052,217	8.77	5,428,896	11.64	100.00	
Renewable Energy	43,868,299	7.60	48,585,263	8.18	4,716,964	10.75	86.89	
New energy	2,755,022	0.48	3,466,954	0.58	711,932	25.84	13.11	
Renewable Energy	Solar PV	7,056,219	15.1	9,208,099	17.7	2,151,880	30.5	39.6
	Wind	2,169,014	4.7	2,464,879	4.7	295,865	13.6	5.4
	Hydro	2,819,882	6.0	3,374,375	6.5	554,492	19.7	10.2
	Marine	489,466	1.0	485,353	0.9	△ 4,113	△ 0.8	△ 0.1
	Biomass	7,466,664	16.0	8,697,600	16.7	1,230,936	16.5	22.7
	Waste	23,867,053	51.2	24,354,957	46.8	487,904	2.0	9.0
New Energy	Fuel cell	1,469,289	3.2	1,764,948	3.4	295,659	20.1	5.4
	IGCC	1,285,733	2.8	1,702,006	3.3	416,272	32.4	7.7

35. KEC 2019, Ibid.

Appendix 2

Biomass imports to Korea (tons) by fuel type and country of origin ³⁶

Year	Wood Pellets			Bio-SRF			Total import quantity ³⁷ (ton)
	Total imports	Countries	Import per country	Total imports	Countries	Import per country	
2012	122,447	Russia	41,731	NA	-	-	122,447
		Malaysia	30,698		-	-	
		Vietnam	30,296		-	-	
		Indonesia	8,933		-	-	
		China	3,648		-	-	
		Japan	3,546		-	-	
		Canada	2,646		-	-	
2013	484,668	Vietnam	157,226	NA	-	-	484,668
		Canada	79,795		-	-	
		Russia	76,941		-	-	
		Malaysia	78,420		-	-	
		USA	32,018		-	-	
		Indonesia	33,534		-	-	
		China	10,220		-	-	
2014	1,849,621	Vietnam	742,794	NA	-	-	1,849,621
		Canada	344,261		-	-	
		China	287,063		-	-	
		Malaysia	168,336		-	-	
		Thailand	110,752		-	-	
		Indonesia	62,729		-	-	
		USA	61,977		-	-	
2015	1,470,685	Vietnam	1,022,809	449,296	Vietnam	184,942	1,919,981
		Malaysia	153,959		Indonesia	235,300	
		Canada	87,743		Malaysia	29,054	
		Russia	84,070		-	-	
		Indonesia	59,977		-	-	
		Thailand	35,118		-	-	
		USA	18,847		-	-	

Year	Wood Pellets			Bio-SRF			Total import quantity (ton)
	Total imports	Countries	Import per country	Total imports	Countries	Import per country	
2016	1,716,641	Vietnam	1,255,401	1,447,571	Vietnam	912,850	3,164,212
		Malaysia	199,102		Indonesia	400,705	
		Russia	125,841		Malaysia	127,764	
		Indonesia	75,854		Thailand	2,866	
		Canada	35,263		USA	3,386	
		Thailand	20,508		-	-	
		NewZealand	3,578		-	-	
2017	1,705,848	Vietnam	889,108	1,121,632	Vietnam	660,308	2,827,480
		Malaysia	343,016		Indonesia	366,950	
		Russia	127,913		Malaysia	63,025	
		Canada	120,163		Canada	31,349	
		Indonesia	114,865		-	-	
		Thailand	94,597		-	-	
		USA	10,615		-	-	
2018	3,012,445	Vietnam	1,826,804	837,294	Vietnam	364,546	3,849,739
		Malaysia	523,182		Indonesia	367,021	
		Thailand	294,919		Malaysia	65,016	
		Indonesia	221,717		USA	28,577	
		Russia	70,187		Thailand	9,698	
		Canada	39,669		Australia	2,436	
		USA	12,255		-	-	

Source: FFS and MOE

36. Selected top importing countries are reported here. Bio-SRF imports were not reported from 2012 to 2014 because the same HS code was used for both wood pellet and bio-SRF until they were fully separated in 2016.

37. Disclaimer: There is limitation associated with import-export data on biomass. We believe the import data is incomplete because the aggregate value does not match up with the total volume of biomass utilized by utilities, even after subtracting domestic production.

Appendix 3

KEPCO Subsidiaries' Biomass Energy Generation, RECs and RPS Implementation Cost Settlement ³⁸

A3-1. Korea Southern Power

Category	2012	2013	2014	2015	2016	2017	2018	Total
Biomass Power Generation (MWh)	83,010	270,063	582,276	594,042	547,942	423,130	389,500	2,889,963
No. of RECs	115,405	301,066	908,773	1,205,183	1,262,404	983,086	1,308,294	6,084,211
No. of biomass RECs	83,010	270,063	582,276	594,042	547,942	400,983	411,647	2,889,963
Total RPS-ICS (W/year)	11,602,000,000	40,094,000,000	81,096,000,000	146,316,000,000	190,462,000,000	122,548,000,000	152,726,000,000	744,844,000,000
RPS-ICS for biomass (W/year)	2,684,000,000	15,404,000,000	35,988,000,000	50,356,000,000	47,401,000,000	7,773,000,000	15,808,000,000	175,414,000,000

A3-2. Korea East-West Power

Category	2012	2013	2014	2015	2016	2017	2018	Total
Biomass Power Generation (MWh)	12,165	94,281	423,659	557,588	555,536	490,533	446,132	2,579,894
No. of RECs	71,938	278,150	720,432	1,033,899	1,227,201	1,292,498	1,365,442	5,989,560
No. of biomass RECs	12,165	127,912	506,591	635,014	633,630	577,294	525,508	3,018,114
Total RPS-ICS (W/year)	12,880,609,686	54,017,566,452	138,348,141,948	266,822,513,712	317,877,859,353	263,271,932,295	293,462,088,756	1,346,680,712,202
RPS-ICS for biomass (W/year)	393,306,615	7,295,972,568	31,310,363,346	48,619,873,152	54,814,064,040	33,393,447,928	13,951,225,436	189,778,253,085

38. The data presented here is a summary product of the information received from KEPCO subsidiaries through freedom of information act (Formal request made by the National Assembly member Mr. Seonghwan Kim in June 2019).

A3-3. Korea Midland Power

Category	2012	2013	2014	2015	2016	2017	2018	Total
Biomass Power Generation (MWh)	10,820	68,117	426,149	318,202	375,294	379,598	520,298	2,098,478
No. of RECs	15,299	83,570	635,616	700,203	828,330	850,781	1,028,081	4,141,880
No. of biomass RECs	10,820	68,117	426,149	318,202	375,294	379,598	520,298	2,098,478
Total RPS-ICS (W/year)	11,912,000,000	48,264,000,000	234,368,000,000	339,752,000,000	507,224,000,000	413,032,000,000	447,064,000,000	2,001,616,000,000
RPS-ICS for biomass (W/year)	350,000,000	3,884,000,000	26,339,000,000	26,973,000,000	32,467,000,000	6,894,000,000	20,899,000,000	117,806,000,000

A3-4. Korea South-East Power

Category	2012	2013	2014	2015	2016	2017	2018	Total
Biomass Power Generation (MWh)	-	333,527	1,362,903	1,017,794	1,037,252	866,155	930,269	5,547,900
No. of RECs	61,882	494,918	1,596,570	1,321,926	1,379,310	1,494,229	2,010,509	8,359,344
No. of biomass RECs	-	395,163	1,362,903	1,017,794	1,037,252	1,099,347	1,303,640	6,216,099
Total RPS-ICS (W/year)	44,624,735,300	1,012,008,088,377	1,292,611,891,961	1,448,113,722,575	1,540,823,542,960	1,591,703,327,508	2,269,979,380,914	9,199,864,689,595
RPS-ICS for biomass (W/year)	-	19,024,046,553	84,235,582,818	86,276,361,792	89,730,527,392	75,751,973,352	105,661,248,734	460,679,740,641

A3-5. Korea Western Power

Category	2012	2013	2014	2015	2016	2017	2018	Total
Biomass Power Generation (MWh)	66,122	101,337	378,599	469,341	467,226	310,961	229,863	2,023,449
No. of RECs	666,524	1,016,634	1,651,340	1,659,893	2,251,728	2,599,958	2,955,113	12,801,190
No. of biomass RECs	66,122	101,337	378,599	469,341	467,226	310,961	229,863	2,023,449
Total RPS-ICS (W/year)	22,434,443,961	51,607,477,377	92,268,958,422	133,876,948,286	172,620,983,664	197,140,225,000	237,629,539,422	907,578,576,132
RPS-ICS for biomass (W/year)	2,137,790,382	5,780,161,143	23,399,689,794	39,785,097,888	40,418,786,808	6,027,668,024	8,977,643,698	126,526,837,737

Appendix 4

Forest Biomass Energy Statistics in Korea ³⁹

Category	2012	2013	2014	2015	2016	2017	2018
Biomass Energy Production (toe)	22,371	148,764	649,571	692,972	807,141	1,079,747	1,369,473
Biomass Power Generation (MWh)	106,023	705,039	3,078,722	3,284,204	3,825,311	5,117,284	6,490,437
Total No. of RECs issued	192,753	1,009,295	3,469,914	3,723,679	4,278,066	6,047,029	7,766,730
No. of RECs issued to biomass	111,437	782,594	3,206,972	3,442,059	3,993,094	5,715,299	7,361,416
Total RPS-ICS from biomass (W/yr)	6,231,897,243	57,535,239,300	213,479,530,956	311,622,257,370	358,817,440,944	373,548,661,832	532,221,976,140
Total weight of Biomass feedstock(ton/yr)	97,549	518,619	1,991,595	2,267,501	2,744,008	3,733,043	4,820,194

39. The calculation of biomass energy production(toe) is based on the Korea Energy Law (Implementation Ordinance, Annex). Low Heating Value (1toe=1/0.211MWh); and forest biomass includes wood pellets, wood chips, and bio-SRF (waste wood).



Solutions for Our Climate (SFOC) is a Korea-based non-profit established in 2016 that advocates for stronger climate and air policies. SFOC is led by legal, economic, financial, and environmental experts with experience in energy and climate policy and works closely with domestic and overseas nonprofit organizations.

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