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Solutions for Our Climate

Forest biomass:

Burning the bridge to a renewable future

° ISSUE BRIEF

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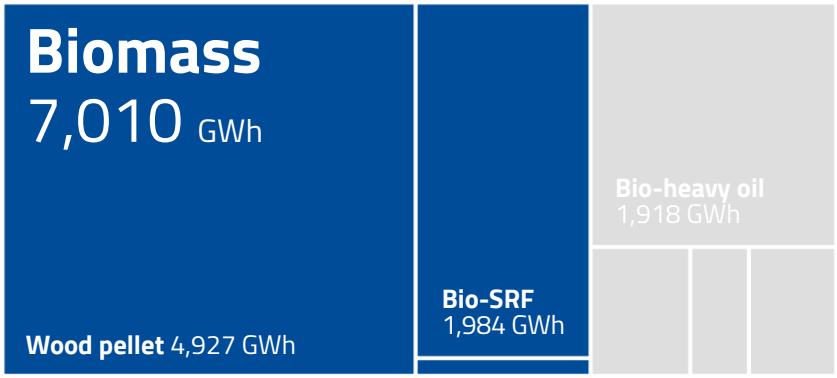
Solutions for Our Climate (SFOC) is an independent policy research and advocacy group that aims to make emissions trajectories across Asia compatible with the Paris Agreement 1.5°C warming target.

- Biomass energy emits more CO2 than coal or gas, despite being touted as zero emission fuel
- Biomass accelerates deforestation and climate change and is incompatible with 2050 net zero goals
- No sustainable sourcing is available in Korea —RE100 members are advised to use wind and solar energy

Biomass is solid fuel made of wood, such as timber and forestry residues, shredded and processed to small pellets or chips. In South Korea, wood pellets are the most common type of biomass [Figure 1] and burned either in a mixture of (co-fired with) coal or instead of coal in (dedicated biomass) thermal power plants to produce electricity.

Figure 1. Biomass accounts for 72% of total bioenergy electricity



In 2020 | Korea Energy Agency New and Renewable Energy Center, 2021

Under the current Renewable Portfolio Standard (RPS) system, solid biomass is categorized as renewables along with other forms of bioenergy, receiving renewable energy credit (REC) weightings even higher than wind or solar in some cases. [a1] After solar PV (52%), biomass (19%) has the second largest share in the renewable energy mix in S. Korea, with its proportion over twice that of wind (8.5%).[2]

Biomass emits more carbon dioxide than coal

According to the carbon accounting rules of the Intergovernmental Panel on Climate Change (IPCC), adopted by the S. Korean Ministry of Environment in its Public Notice, **biomass emits more greenhouse gases (GHGs) per unit of energy than coal, oil, or gas** [Table 1].[3] Case studies both in S. Korea and abroad also found that the

[a] Subject to fuel and facility types, biomass receives REC weightings of 0.25–2.0 while wind and solar PV respectively receive those of 1.2–2.5 and 0.5–1.6.

carbon intensity of a biomass power plant is greater than that of a common coal power plant [Table 2].[4]

° Table 1. Biomass has a higher emissions factor than coal, oil, or gas

Unit: kgGHG/TJ

	Biomass	Coal (bituminous)	Oil	Gas (LNG)
CO_2	112,000	94,600–96,100	69,300–77,400	56,100
CH_4	30	1	3	1
N_2O	4	1.5	0.6	0.1

Ministry of Environment Public Notice No. 2021-278

° Table 2. Korean biomass power plant emits more carbon dioxide than coal or gas power plant

	Fuel input (1,000 ton)	Electricity generated (GWh)	CO_2 emissions (1,000 ton)	Carbon intensity (kg/MWh)
Dedicated biomass Yeongdong 1	438	842	976	888[b]
Coal Yeongheung 5 & 6	5,202	12,980	11,002	848
Gas Incheon combined cycle	465	3,088	1,279	414

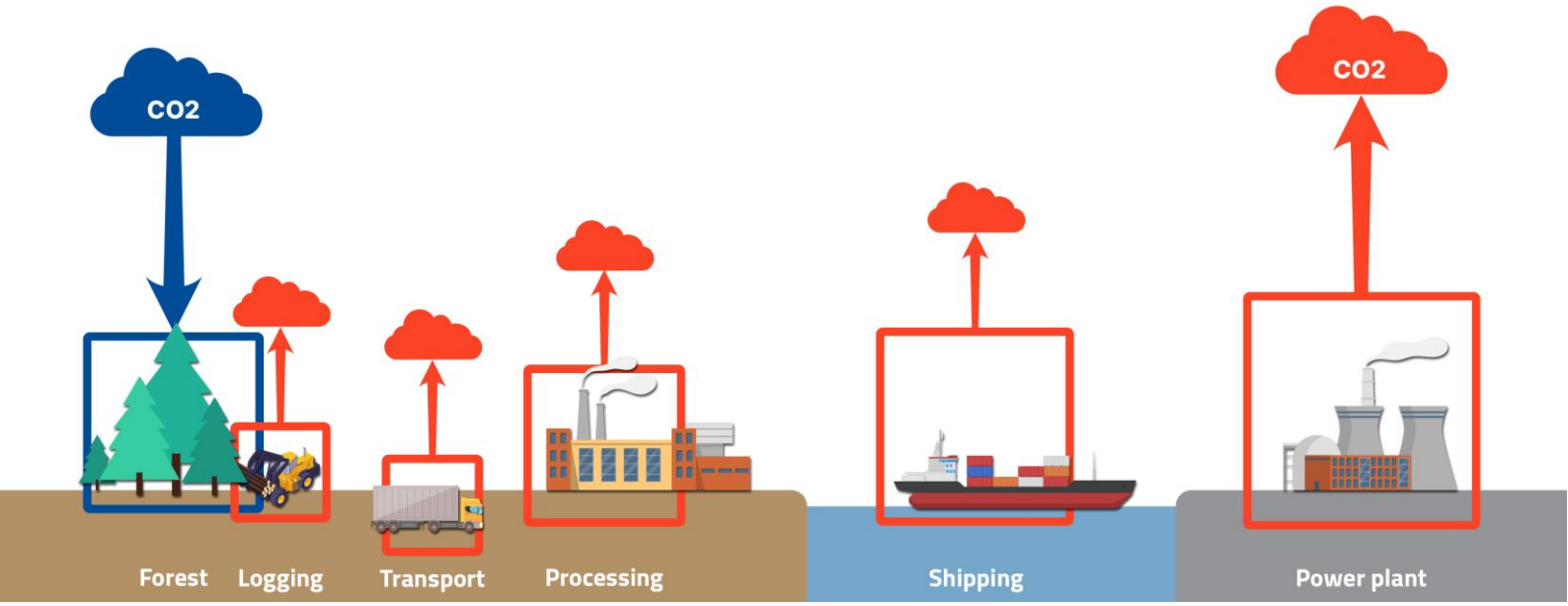
In 2019 | Estimated using South-East Power and Korea Midland Power's submissions to the Office of National Assembly Member Lee So-young, 2020

The high emissions from biomass are inevitable as wood used as fuel is inherently inefficient due to its low calorific value and high moisture content. To produce the same amount of energy output, more wood needs to be burnt, emitting greater volumes of GHGs especially when compared with electricity generated from other energy sources [Figure 2].[5]

However, because the IPCC carbon accounting rules calculate carbon dioxide emitted from the combustion of biomass as zero, policymakers and utility operators often mistake biomass power for zero emission energy or exploit such misunderstanding to readily meet their emission reduction targets. The industry thus claims that co-firing biomass in existing coal-fired power plants reduces carbon emissions or that dedicated biomass power plants are a carbon neutral energy source.

[b] Because the GHG emissions of biomass are accounted as zero at the point of combustion as per the IPCC Guidelines for National Greenhouse Gas Inventories, the carbon intensity of Yeongdong 1 declared by the utility was only 26 kg/MWh. Using the additionally available data, including fuel input, calorific value, and moisture content, SFOC derived the carbon intensity estimate of 888 kg/MWh in reference to the tier 3 GHG emissions accounting methodology of the Ministry of Environment Public Notice No. 2021-278.

° Figure 2. Biomass emits greenhouse gases throughout supply chain



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The rationale behind this confusion is that biomass emissions are to be included once in the Agriculture, Forestry and Other Land Use (AFOLU) sector at the point of logging, and not again in the Energy sector, to avoid double-counting. This way, forest loss—regardless of its cause including biomass burning—can be more readily accounted in the same sector responsible for tracking changes in carbon stocks—forests. **As IPCC made it clear, "the approach of not including these emissions in the Energy Sector total should not be interpreted as a conclusion about the sustainability, or carbon neutrality of bioenergy."**[6]

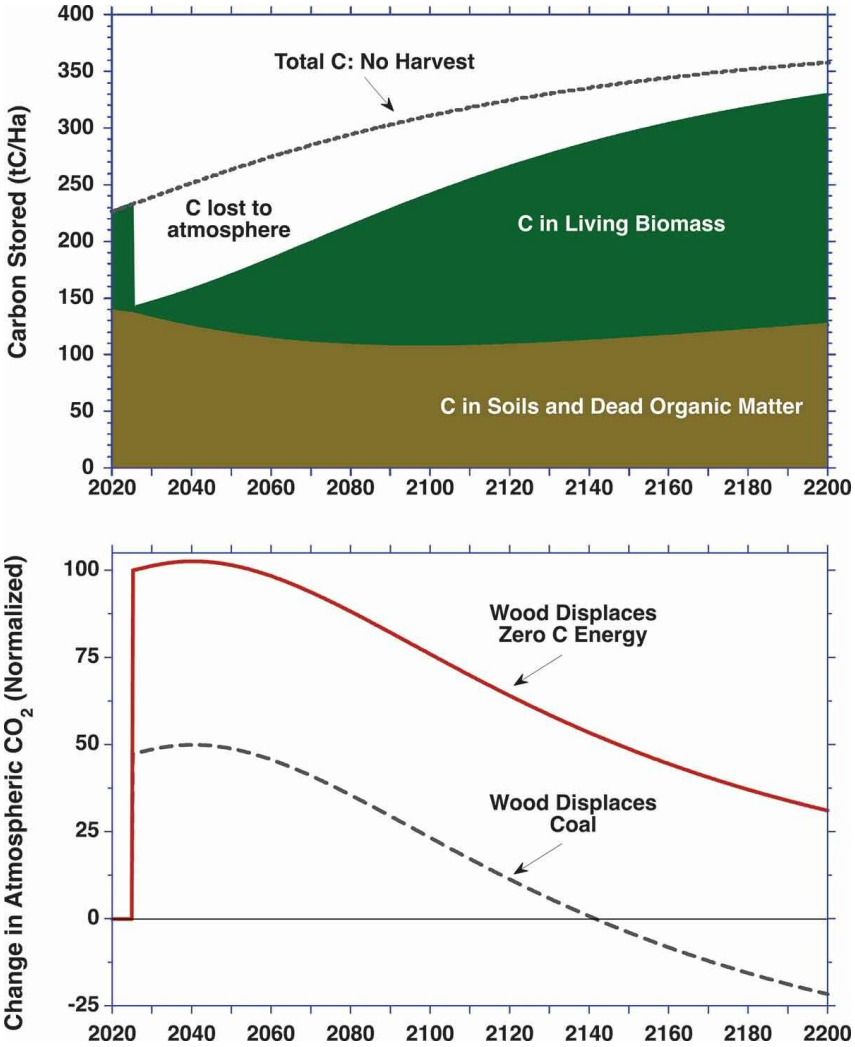
° Biomass fuels the climate crisis

Burning biomass immediately increases atmospheric GHG concentrations, leading to further climate change. Even with the assumption that new trees would be planted where the old ones were logged, the fact remains that the carbon would have stayed fixed within the trees if they had not been burned.[7] Thus, the carbon neutrality myth claiming that biomass releases only the carbon dioxide the tree has absorbed earlier overlooks the fact that burning wood further exacerbates the climate crisis that could have been avoided in the first place.

Furthermore, there is no guarantee that new trees would survive from natural disasters, such as forest fires, pests, and diseases, or development projects. **Even under the premise that the trees do grow intact, it would take at least decades to over a century for them to reabsorb all the carbon released at a point in time.** In the meantime, GHGs remaining in the atmosphere continue to accelerate climate change, causing irreversible

changes on a global scale [Figure 3].[c8] Long carbon payback periods indicate that biomass is not a viable energy source for climate change response, especially in the context of the Paris Agreement goal to limit the global temperature rise to 1.5 °C and the IPCC Sixth Assessment Report's [9] predictions of such a rise by the end of the 2030s. For these reasons, the European Academies' Science Advisory Council has advised to stop the use of biomass, [10] and over 500 scientists around the world sent a joint letter to the leaders of the E.U., U.S., Japan, and S. Korea.[11]

° Figure 3. Changes in aboveground and atmospheric CO2



From a 50-year-old oak-hickory forest in the southcentral US | Sterman et al., 2022

° Biomass destroys forests worldwide

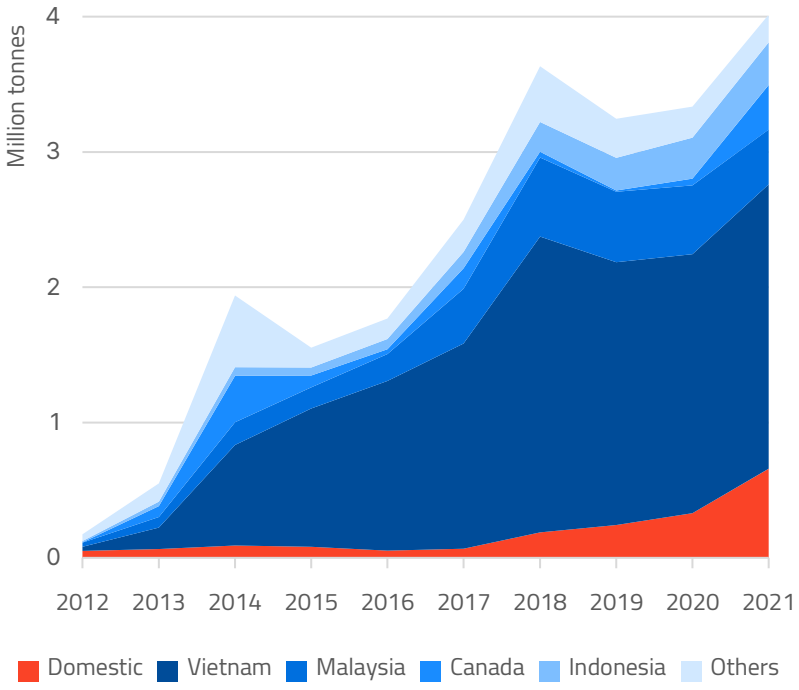
S. Korea imported over 80% of wood pellets in 2021, mostly from Vietnam, Malaysia, Canada, and Indonesia [Figure 4]**.**[12] These pellets are often produced and distributed along untraceable supply chains riddled with illegal practices, including the deforestation of natural forests in sourcing countries. [13] Disputes with local and

[c] The carbon payback periods of biomass vary subject to feedstock types—such as forestry residues or roundwood—fuel efficiency, forest regeneration period, and other environmental conditions. When biomass is substituted for coal, Sterman, et al. estimated the payback periods to be 44–104 years in their 2018 study and 115 years in the 2022 study. Laganière, et al. (2017) estimated those to be over 30 years and impossible to incur carbon benefit within a century when compared with natural gas. In S. Korea, Choi (2021) estimated the payback to be 70 years using mathematical modelling.

indigenous peoples for violating the right to land and various types of environmental pollution caused by wood pellet mills are also frequently reported, for which Korean companies are directly and/or indirectly responsible.

All wood pellets imported to S. Korea are subject to demonstrate legality in accordance with the regulation to promote legal timber trade; however, the document-based procedure lacks due diligence requirement and heavily relies on third-party certification schemes, such as the Forest Stewardship Council (FSC) and Programme for the Endorsement of Forest Certification (PEFC). These voluntary certifications are vulnerable to frauds and false reporting, sometimes even employed to greenwash deforestation. Whilst major economies are advancing their regulations on forest-risk commodities and supply chain due diligence to tackle forest loss, S. Korea has not yet to effectively enforce basic legality requirements.[14, 15]

° Figure 4. S. Korea imports 83% of wood pellets



Korea Customs Service Trade Statistics

° Figure 5. Roundwood at wood pellet factory in S. Korea and clear-cutting in Canada

Chungcheongbuk-do | SFOC, 2021

British Columbia | Conservation North, 2020

In terms to domestically sourced wood pellets, 29% was made of roundwood,[16] **and 76% of what was not roundwood, 'unused forest biomass'—which is supposed to be genuine forest residues—was produced through destructive clear-cutting in 2020.**[17] The 2021 National Assembly's audit on state administration criticized the poor management practices, revealing that even the wood verified as unused forest biomass included roundwood or had volumes overstated [Figure 5].[18]

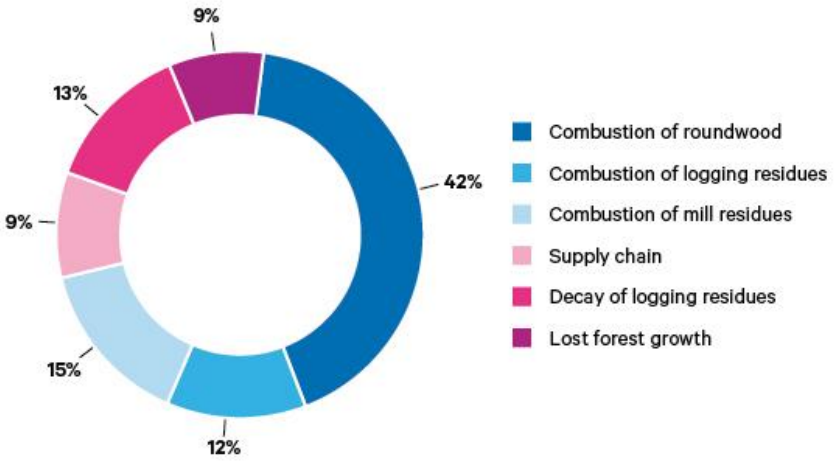
Despite the growing concerns over biomass GHG emissions and domestic deforestation risks, unused forest biomass supply skyrocketed 57 times since the introduction of the aggressive expansion policy in 2018.[19] In fact, the government's forestry roadmaps treat biomass energy as key to climate change response, contradicting the scientific consensus that the use of wood should be prioritized to make high value and lasting products to sequester carbon for longer periods. These cascading use principles are supposed to limit burning wood for fuel to only when all the other options are exhausted, but little is known about how they are observed in the industry.

° No good biomass to burn in S. Korea

For biomass to be recognized as clean renewable energy on par with wind and solar, it needs to demonstrate effective GHG emission reduction capability and avoid deforestation and environmental pollution in sourcing and processing sites. In the complete absence of study or policy to satisfy either of these conditions, all types of bioenergy, including solid biomass, are maintaining their renewable status in S. Korea.

Life-cycle assessments (LCAs) to estimate the GHG emissions of biomass are yet to be conducted in S. Korea, let alone the introduction of sustainability criteria remotely similar to the inadequate ones in the E.U. Since the biomass industry imports most of the feedstocks, their GHG emissions are accounted in sourcing countries, not in S. Korea. Tracing emissions from wood burned as biomass energy back to the AFOLU sector is virtually infeasible and incurs the climate justice complication of shifting S. Korea's emission reduction responsibilities to the sourcing country. In fact, recent research found that 69% of biomass emissions occurs at the stages of combustion [Figure 6].[20]

° Figure 6. Biomass-associated emissions of UK power plant

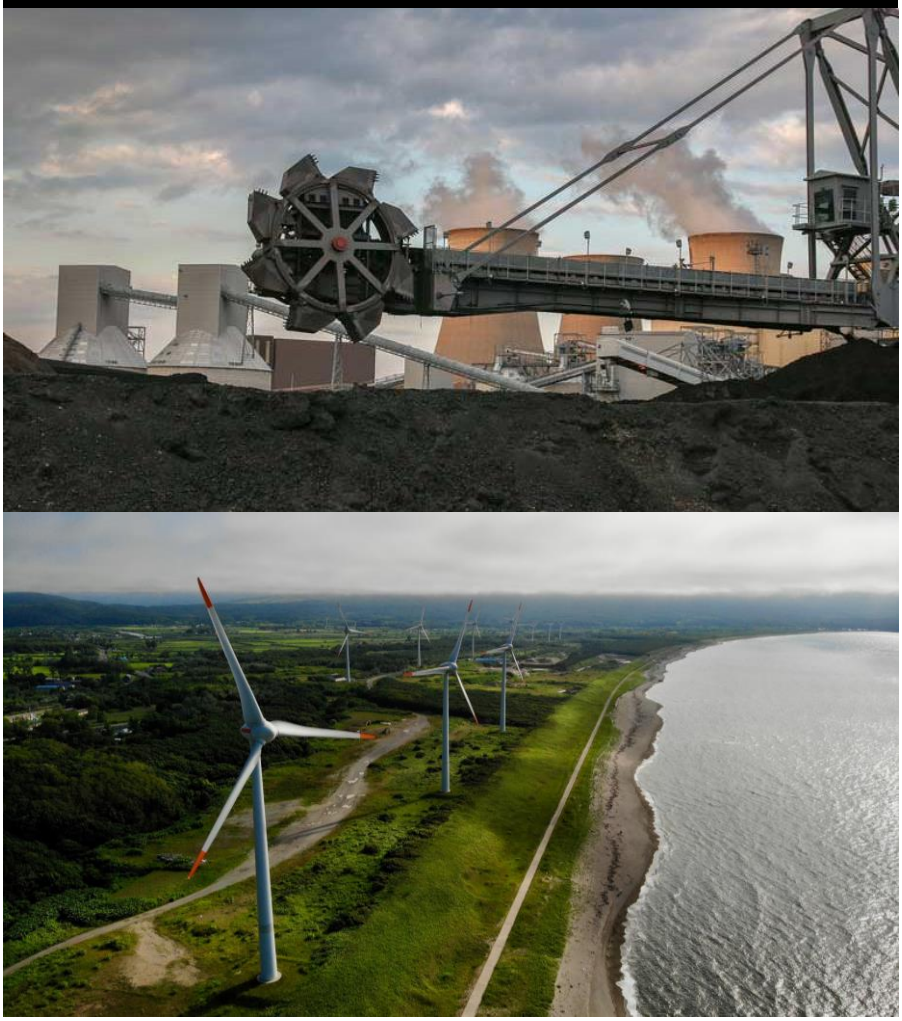


For US-sourced wood pellets burnt at Drax powerplant in 2019 | Brack et al., 2021

The only type of biomass energy that could be considered sustainable is when logging and sawmill residues that could not be utilized otherwise are collected in small scale and used to supply heating in the same region.[21] However, small scale and distributed biomass by definition is not intended for producing industrial electricity thus deemed unfit for most companies seeking a renewable energy source.

Regardless of feedstock type, biomass is essentially the same kind of fuel as coal as both must be burnt in power plants, resulting in massive GHG emissions. Rapidly elevated atmospheric GHG levels make it impossible to reach carbon neutrality within a meaningful period, even when new trees are planted. Biomass electricity in S. Korea cannot guarantee sustainability whether the feedstocks are imported or domestically produced. 100% renewable energy should be achieved through clean renewable energy uptake like wind and solar, not through burning our forests [Figure 7].

° Figure 7. 100% renewables through wind and solar, not biomass



Top: Drax biomass power plant, UK | #ODF, VisualHunt Bottom: Ken, Unsplash

° References

[1] Solutions for Our Climate, 2020. Can Biomass Qualify as Renewable Energy? The State of Biomass Policy in South Korea. https://forourclimate.org/sub/data/view.htmlidx13

[2] Korea Energy Agency New and Renewable Energy Center, 2021.「2020년 신재생에너지 보급통계(2021년 공표)」 https://www.knrec.or.kr/biz/pds/statistic/view.do?no=61

[3] Ministry of Environment Public Notice No. 2021-278.「온실가스 배출권거래제의 배출량 보고 및 인증에 관한 지침」의 '[별표 10] 2006 IPCC 국가 인벤토리 가이드라인 기본 배출계수 (제15조제1항 관련)'

[4] Brack, D., 2017. Woody biomass for power and heat. Chatham House. https://www.chathamhouse.org/2017/02/woody-biomass-power-and-heat; Estimated using Korea South-East Power and Korea Midland Power's submissions to the Office of National Assembly Member Lee So-young, 2020.

[5] Booth, M., 2014. Trees, trash, and toxic: How biomass energy has become the new coal. Partnership for Policy Integrity. https://www.pfpi.net/trees-trash-and-toxics-how-biomass-energy-has-become-the-new-coal

[6] IPCC Task Force on National Greenhouse Gas Inventories, 2021. Q2-10, FAQs. https://www.ipcc-nggip.iges.or.jp/faq/faq.html

[7] Sterman, J. D., Moomaw, W., Rooney-Varga, J. N., & Siegel, L., 2022. Does wood bioenergy help or harm the climate? Bulletin of the Atomic Scientists, 78:3, 128–138. DOI: 10.1080/00963402.2022.2062933

[8] Laganière J., Paré, D., Thiffault, E., & Bernier, P. Y., 2017. Range and uncertainties in estimating delays in greenhouse gas mitigation potential of forest bioenergy sourced from Canadian forests. GCB Bioenergy, 9, 358–369. DOI: 10.1111/gcbb.12327; Sterman, J. D., Moomaw, W., Rooney-Varga, J. N., & Siegel, L., 2022. Does wood bioenergy help or harm the climate? Bulletin of the Atomic Scientists, 78:3, 128–138. DOI: 10.1080/00963402.2022.2062933; Sterman, J. D., Siegel, L., & Rooney-Varga, J. N., 2018. Does replacing coal with wood lower lower CO2 emissions? Dynamic lifecycle analysis of wood bioenergy. Environmental Research Letters, 13. DOI: 10.1088/1748-9326/aaa512; Choi, S. 2021. A mathematical programming method for minimization of carbon debt of bioenergy. Clean Technology, 27:3, 269–274. DOI: 10.7464/ksct.2021.27.3.269

[9] IPCC, 2021. Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. DOI:10.1017/9781009157896.001

[10] Norton, M., Baldi, A., Buda, V., Carli, B., Cudlin, P., Jones, M. B., Korhola, A., Michalski, R., Novo, F., Oszlányi, J., Santos, F. D., Schink, B., Shepherd, J., Vet, L., Walloe, L., & Wijkman, A., 2019. Serious mismatches continue between science and policy in forest bioenergy. GCB Bioenergy, 11:1256–1263. DOI: 10.1111/gcbb.12643

[11] Kim, M., 2021. 과학자들 "바이오에너지, 화석연료 대체 못해" 공동성명. The Hankyeoreh. https://www.hani.co.kr/arti/society/environment/984187.html; WWF, 2021. 500+ scientists tell EU to end tree burning for energy. https://www.wwf.eu/?2128466%2F500-scientists-tell-EU-to-end-tree-burning-for-energy

[12] Korea Customs Service. Trade Statistics. https://unipass.customs.go.kr/ets/

[13] Stand.earth, 2020. Canada's growing wood pellet export industry threatens forests, wildlife and our climate. https://www.stand.earth/publication/canadas-growing-wood-pellet-export-industry-threatens-forests-wildlife-and-our-climate

[14] Greenpeace International, 2021. Destruction: Certified. https://www.greenpeace.org/international/publication/46812/destruction-certified/

[15] Advocates for Public Interest Law, Solutions for Our Climate, & Korea Federation for Environmental Movements, 2022. Importing Deforestation: Forest-risk Commodity Supply Chains and Due Diligence Legislation in South Korea. https://forourclimate.org/sub/data/view.htmlidx74

[16] Korea Forest Service, 2021.「2020년 기준 목재이용실태조사」

[17] Korea Forest Service's submission to the Office of National Assembly Member Lee So-young, 2021.

[18] Seo, B., 2021. [국정감사] 과도한 미이용 바이오매스 REC 가중치. Space & Wood Magazine. http://www.imwood.co.kr/news/articleView.html?idxno=26157; Choi, Y., 2021. [단독] 멀쩡한 원목이 땔감으로 둔갑…산림청 '산림바이오매스' 구멍 숭숭. NewsPim. https://www.newspim.com/news/view/20211019001225

[19] Korea Forest Service. 미이용 산림바이오매스 공급(이용)량. https://www.forest.go.kr/kfsweb/kfi/kfs/cms/cmsView.do?mn=NKFS_02_01_11_07_03&cmsId=FC_003565

[20] Brack, D., Birdsey, R., & Walker, D., 2021. Greenhouse gas emissions from burning US-sourced woody biomass in the EU and UK. Chatham House. https://www.chathamhouse.org/2021/10/greenhouse-gas-emissions-burning-us-sourced-woody-biomass-eu-and-uk

[21] 기후 · 생태위기 대응 시민연대, 2022.「산림 · 생태 바이오에너지 제20대 대선 공동 정책 제안서」 https://forourclimate.org/sub/data/view.htmlidx68