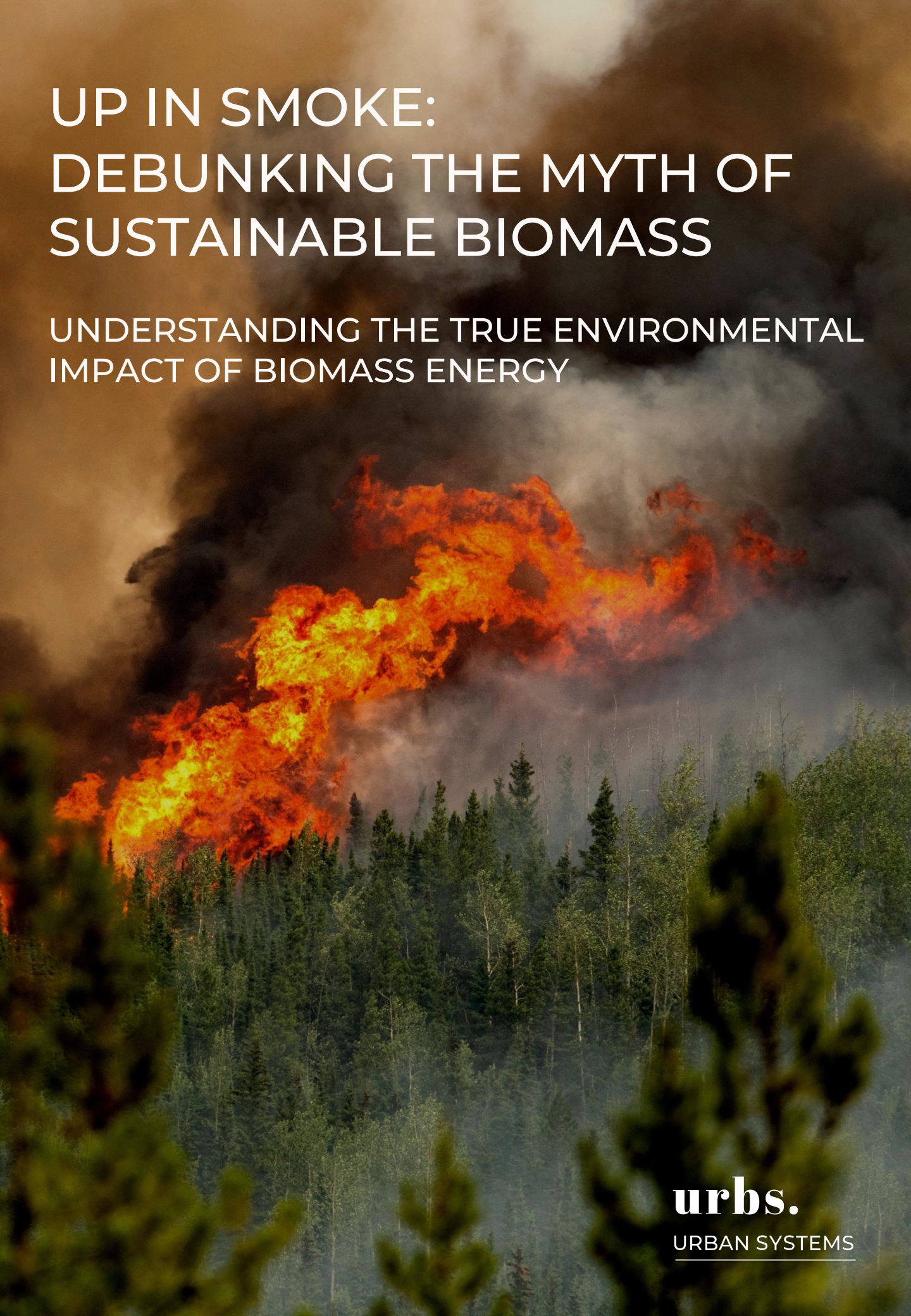
UP IN SMOKE: DEBUNKING THE MYTH OF SUSTAINABLE BIOMASS

UNDERSTANDING THE TRUE ENVIRONMENTAL IMPACT OF BIOMASS ENERGY



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URBAN SYSTEMS

OVERVIEW

This white paper provides a critical examination of biomass energy, challenging its reputation as a clean and sustainable energy source. Focusing on Sweden's reliance on biomass for heating and fuel, the document understands the actual emissions, carbon sequestration debates, and broader environmental impacts associated with biomass combustion. It aims to dispel prevalent myths, revealing the significant ecological consequences beyond carbon emissions and advocating for a more informed and cautious approach towards biomass energy use. Through detailed analysis, it calls for reevaluation of biomass's role in sustainable energy strategies.

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IMPORTANCE OF PROPER BIOMASS ACCOUNTING FOR REAL ESTATE

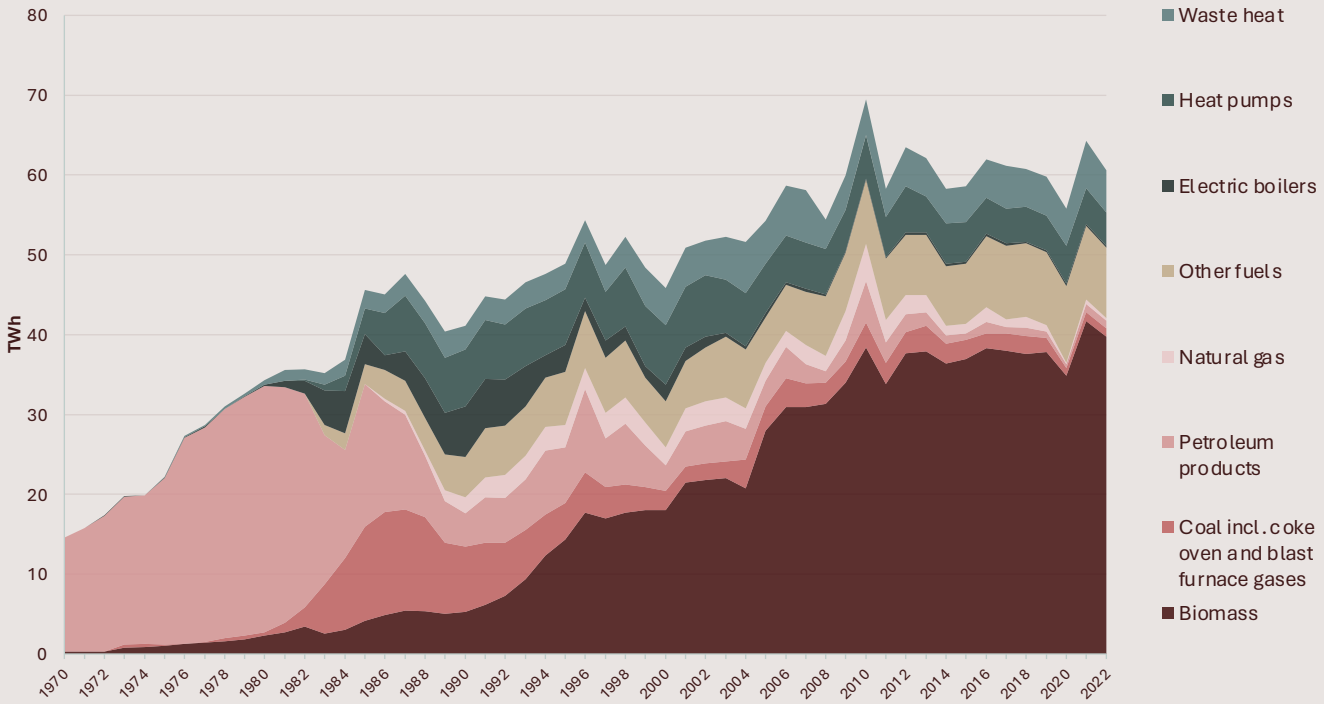
Biomass energy is integral to Sweden's approach to sustainable heating and energy production, particularly within the real estate sector through district heating systems. Despite the widespread adoption of biomass, driven by the country's ambitious renewable energy targets, the classification of biomass as a "clean" energy source is subject to considerable debate. This whitepaper aims to dissect the myths and facts surrounding biomass use, guided by key statistics and policy insights, to unveil its real environmental and efficiency impacts.

66%

OF SWEDEN'S HEAT AND FUEL PROVISION FOR DISTRICT HEATING IN 2022 RELIED ON BIOMASS [2]

Around a third of the total energy use in Sweden in 2022 came from biomass. 60% of heat demand in buildings being met by district heating, and over 2/3 of that relying on biomass. This is especially important because 57% of Sweden's land is forestland which is seen as an energy resource and long-term carbon cycling during the burning of biomass may not be accounted for. [1, 2]

The widespread use of biomass demands a deeper understanding to separate the myths from the facts about biomass use, its corresponding, the carbon sequestration capacities of forests, and its consequential effects.



BIOMASS AS THE MAJORITY INPUT FUEL IN SWEDEN'S DISTRICT HEATING NETWORK IN 2022, AND ITS INCREASING USE SINCE THE PAST SIX DECADES [2]

THE BIG MYTH OF SUSTAINABLE BIOMASS

Biomass is a clean, carbon-neutral fuel source due to its renewable nature.

> "WITHIN THE SCOPE 1 CONVERSION FACTORS FOR BIOFUELS, THE CO_2 EMISSIONS VALUE IS SET AS NET '0' TO ACCOUNT FOR THE CO_2 ABSORBED BY FAST-GROWING BIOENERGY SOURCES DURING THEIR GROWTH.
>
> - UK GOVERNMENT [3]"

The Carbon Risk Real Estate Monitor (CRREM) tool developed by the EU uses the UK Government's Scope 1 conversion factors for biofuels set CO_2 emissions from biomass as net '0', assuming the CO_2 absorbed during growth balances out emissions from combustion. This makes biomass accounting for real estate problematic, since the emissions from biomass are considered zero. [3]

However, the idea that CO_2 emissions from biomass combustion are entirely offset by the CO_2 absorbed during the growth of trees oversimplifies the complex dynamics of carbon absorption and emission, overlooking the nuances of biomass's actual environmental impact.

THE TRUE UNDERLYING FACTS

The reality is that biomass is not a zero-carbon energy source and often depletes forests that are carbon sinks to produce energy.

> "BIOMASS FIGHT LEAVES EU RENEWABLE ENERGY TALKS IN A DEADLOCK [4]"

It is important to understand the true emissions behind biomass burning and the limited ability of forests to sequester the carbon released due to combustion.

This whitepaper is structured to systematically debunk the myths associated with biomass use and it uses scientific data and key statistics to show the real environmental and efficiency impacts of biomass-based energy.

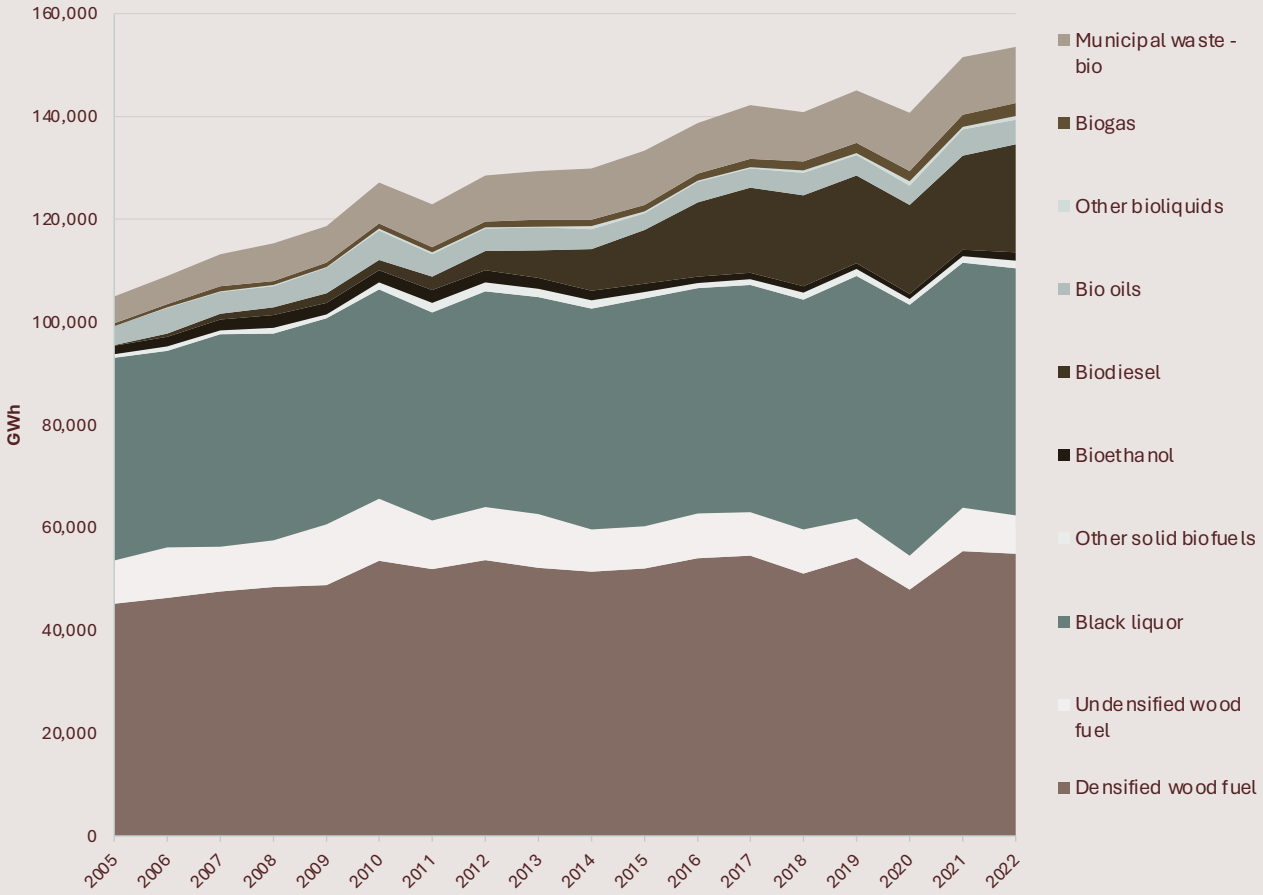
WHAT IS CONSIDERED BIOMASS?

The composition and sources of biomass as an energy resource have evolved significantly over time. Common perceptions often limit biomass to by-products of wood processing, such as wood chips, sawdust, and end-of-life wood products. This section aims to expand the understanding of what constitutes biomass, emphasizing the diversity of sources and the implications of their use in Sweden's energy mix.

MYTH

Biomass energy primarily comes from the use of leftover wood materials like wood chips, sawdust, and other wood by-products, suggesting a recycling of waste products into energy.

In 2022, wood fuels, mainly consisting of wood chips and sawdust, accounted for 41% of the biomass used in district heating in Sweden, reinforcing the perception that biomass is predominantly wood-based waste.[2]



FUEL SOURCES OF BIOMASS [2]

FACT

The reality of biomass sourcing in Europe is far more complex and diverse. Not only does it include a range of domestic sources, but it also involves significant imports of biomass, such as wood pellets and tall oil, from various countries. This diversity raises questions about the sustainability and carbon footprint of the biomass used.

Beyond wood chips and sawdust, wood pellets and briquettes constitute 16% of the biomass sources for district heating, highlighting the varied nature of biomass. Historically, biomass was co-fired with fossil fuels to leverage tax benefits. This practice changed in 2004, reflecting a shift in policy and biomass use strategy.[1]

In 2022, the European Union (EU) was expected to import 6 million metric tons of wood pellets, which marked an increase from 5.428 million metric tons in the previous year and 4.681 million metric tons in 2020. Sweden produced an estimated 1.8 million metric tons of wood pellets in 2022 and ranked as the 6th largest consumer of pellets in the EU with 1.5 million metric tons. [5]

Moreover, primary solid biofuels including firewood, wood chips and pellets make up 97% of the total heat generation from so called “renewable sources” in Sweden according to the International Energy Agency. [6]

EU 27 IMPORTERS OF WOOD PELLETS (1,000 METRIC TONS)		
	2021	**2022**
NETHERLANDS	2 742	3 104
DENMARK	3 225	2 660
ITALY	2 124	1 916
BELGIUM	945	1 142
FRANCE	661	755
GERMANY	404	477
LATVIA	593	355
AUSTRIA	413	346
POLAND	234	289

WOOD PELLET IMPORTS INTO THE EUROPEAN UNION [5]

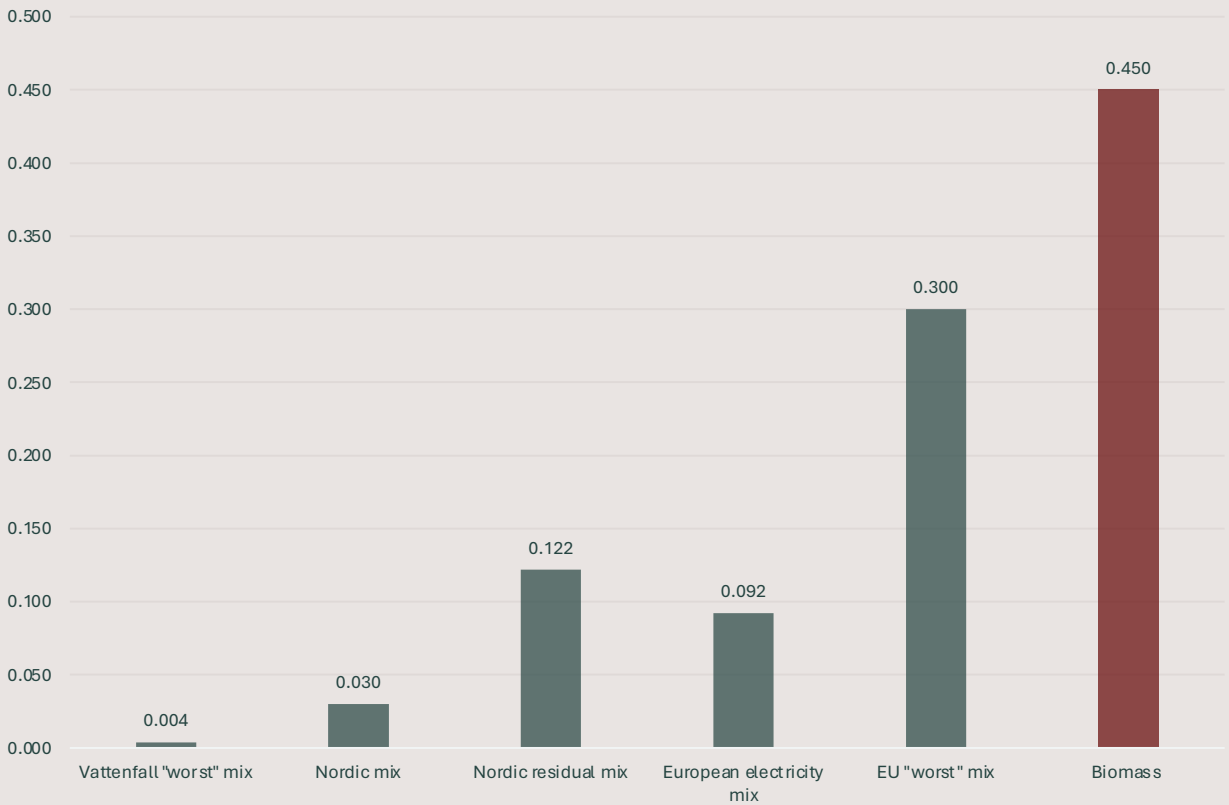
IMAGES SHOWING FULL TREE TRUNKS AT BIOMASS PLANTS [7]

TRUE OVERALL EMISSIONS FROM BIOMASS

The debate over biomass as a renewable energy source often hinges on its carbon emissions profile. While biomass is frequently touted for its potential to achieve net-zero emissions, the reality is significantly more complex and contingent on various factors, including the biomass source, the forest from which it is harvested, and the methods of harvesting and processing. An important concept to understand is the carbon payback period and carbon debt, which refers to the time it takes for a forest to recapture the carbon dioxide emitted from biomass combustion. This period is critical because it influences the overall climate impact of biomass energy. Long carbon payback periods could negate the short-term benefits of switching from fossil fuels to biomass.

MYTH

Biomass energy is widely perceived as having net-zero emissions, based on the assumption that the carbon dioxide released during combustion is offset by the carbon dioxide absorbed by the plants during their growth phase.



TRUE EMISSIONS FROM BIOMASS IN TCO_2 PER KWH OF ENERGY DELIVERED [8]

FACT

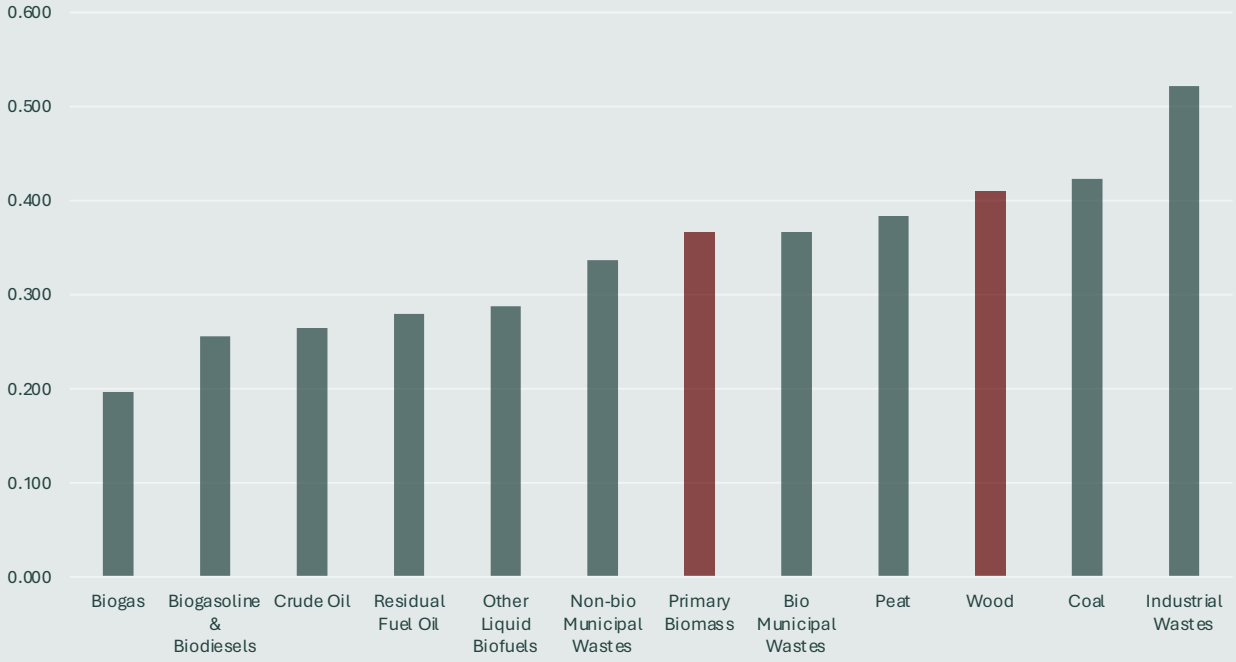
The emissions from biomass depend heavily on the source material, the area of forest it is harvested from, and the specific processes of harvesting and processing. Contrary to the net-zero assumption, biomass can contribute significant greenhouse gas emissions, challenging its viability as a clean energy source.

Achieving carbon neutrality for forest biomass can take decades to centuries, depending on forest type and harvesting methods, potentially resulting in up to 40% higher carbon emissions emissions than fossil fuels. [9]

Research has shown that burning wood releases more CO_2 than coal or other fossil fuels because wood contains more carbon per unit of energy produced, even if burned at the same combustion efficiency. Additionally, the smokestack emissions CO_2 from biomass are 50% more than coal per unit of energy produced [10]

It is important to consider various methods exist for calculating biomass emissions, including life-cycle analysis (LCA) and direct monitoring. These methods consider the entire supply chain, from cultivation and harvesting to combustion, highlighting the disparities in emissions accounting and emphasizing the need for standardized practices.

50%
MORE SMOKESTACK EMISSIONS FROM BIOMASS INCINERATION THAN COAL PER UNIT ENERGY PRODUCED [10]



EMISSIONS FROM DIFFERENT FUEL TYPES ACCORDING TO THE IPCC [11]

THE ‘CARBON SEQUESTRATION CAPACITY OF FORESTS’ ARGUMENT

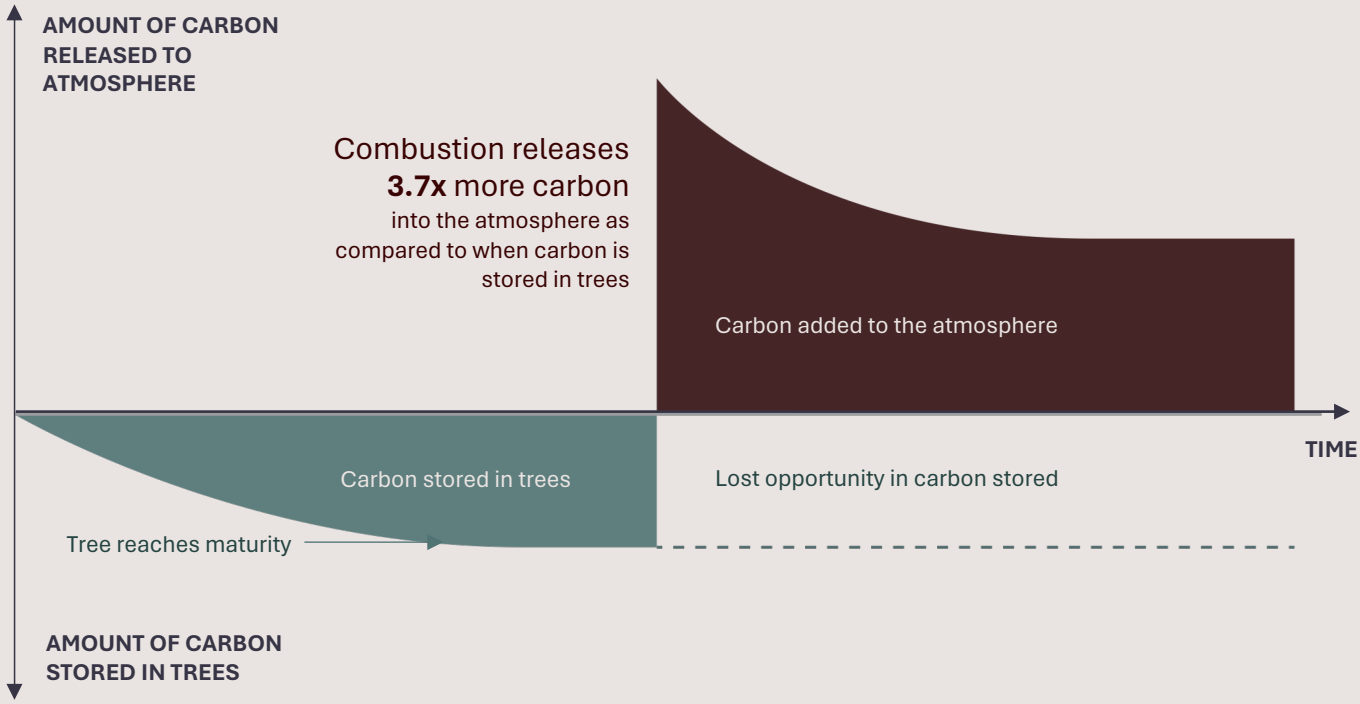
The capacity of forests to sequester carbon is a critical component in the global strategy to mitigate climate change. A common belief is that the use of trees for biomass energy can be offset by the carbon they sequester during their growth, leading to net-zero emissions. However, the true impact of forest biomass on carbon sequestration and emissions is influenced by various factors, including forest management practices, tree species, and the timing of harvests.

THE MYTH OF NET-ZERO EMISSIONS ARISES FROM ERRORS IN GREENHOUSE GAS ACCOUNTING RELATED TO BIOENERGY

MYTH

Trees harvested for biomass sequester carbon at a rate that matches their removal, resulting in a cycle of net-zero emissions.

This perspective assumes an ideal scenario where the growth and harvesting of biomass do not negatively impact the forest's overall carbon sequestration capacity.



GRAPHICAL REPRESENTATION OF A TREE THAT STORES CARBON AND HOW MUCH IS RELEASED ON MATURITY, ESTIMATED BASED ON THE EXAMPLE OF A PINE TREE. [12, 13]

FACT

The time taken to offset the carbon dioxide added to the atmosphere by wood burning is a long duration and cannot be reversed by forest regrowth within the next 20 years until the 2045 net-zero target of Sweden.

In 2010, the Massachusetts Government commissioned the Manomet Center for Conservation Sciences to understand the environmental impacts of biomass, leading to groundbreaking findings on carbon debt. This study illuminated the long-term climatic repercussions of using biomass for energy, revealing that, contrary to previous beliefs, biomass could be more harmful to the climate than coal in the first 45-75 years of use. These conclusions of the study hint at an even more extended period before biomass energy's climate impacts align with those of coal, largely due to a series of underlying assumptions. Subsequent research has supported these findings, indicating that achieving carbon emission parity with fossil fuels might extend up to 200-300 years. [15]

Research by the United States' Environmental Protection Agency's (EPA) analysis on the lifecycle of CO_2 emissions reveals that approximately half of the CO_2 emitted today will be absorbed by oceans and terrestrial vegetation within the next 30 years. Another 30% of these emissions will be removed over the span of several centuries, while the remaining 20% will gradually diminish, requiring thousands of years to fully dissipate from the atmosphere. [16]

Moreover, the environmental impact of biomass is further complicated by the CO_2 emissions from replanted clearcuts. Despite the rapid growth of young trees, a replanted clearcut can emit more CO_2 than it absorbs for up to 20 years. This is attributed to the accelerated activity of soil microbes, which break down dead plant material and release CO_2, especially after an area has been logged. [17]

This evidence highlights the complex dynamics and long-term environmental considerations of biomass energy, challenging the assumption of its neutrality or benefit in the context of climate change mitigation.

200 YEARS

THE MINIMUM YEARS TAKEN TO REPAY THE CARBON DEBT FROM BURNING WOOD BIOMASS FOR ENERGY ACCORDING TO A STUDY LED BY M.I.T. [14]

45-75 YEARS

BIOMASS IS MORE HARMFUL TO THE PLANET THAN COAL IN THE THE FIRST 45-75 YEARS OF USE ACCORDING THE THE MANOMET CENTER STUDY [15]

20 YEARS

YEARS FOR WHICH A REPLANTED CLEARCUT CAN EMIT MORE CO_2 THAN IT ABSORBS DESPITE THE RAPID GROWTH OF YOUNG TREES. [17]

THE BIOPHYSICAL EFFECTS OF CHOPPING DOWN TREES - SUSTAINABLE FOREST MANAGEMENT

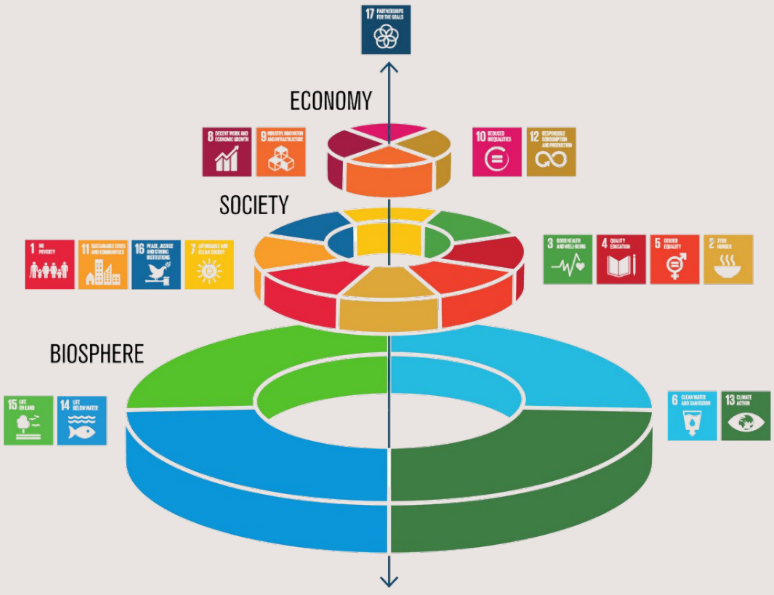
FORESTS ARE NOT JUST TREES. THE REALITY IS THAT THE USE OF FORESTS FOR BIOMASS HAS PROFOUND BIOPHYSICAL IMPACTS, WHICH CAN UNDERMINE THE FORESTS' CAPACITY TO SERVE AS CARBON SINKS, BIODIVERSITY RESERVOIRS, AND PROVIDERS OF ECOSYSTEM SERVICES. SUSTAINABLE FOREST MANAGEMENT IS CRUCIAL TO MITIGATING THESE IMPACTS.

The practice of utilizing forests for biomass not only diminishes the potential for renewable energy but also bears significant biophysical impacts on aspects such as biodiversity loss and ecosystem services. Consequently, these impacts could compromise forests' roles in climate change mitigation and biodiversity conservation if not managed sustainably.

Biodiversity within these forests is crucial for ecosystem resilience and climate change adaptation. A 10% loss in tree species diversity can lead to a 3% loss in forest productivity. This loss in productivity incurs costs five times greater than what is currently spent on global forest conservation efforts.

Additionally, forests are invaluable for their ecosystem services, including water regulation, soil quality maintenance, climate modulation, and raw material supply, becoming an important part of the ecosystem services. The World Economic Forum estimates the value of the global ecosystem services to be $ 44 Trillion. [18]

Consequential effects of alterations in forest cover can affect the climate by changing albedo (the reflectivity of the Earth's surface), influencing cloud formation, and modulating atmospheric greenhouse gases.



GRAPHIC BY STOCKHOLM RESILIENCE CENTER SHOWING THE UN SUSTAINABLE DEVELOPMENT GOALS LINKED ECOLOGICALLY, SOCIALLY & ECONOMICALLY, WHERE THEY ARE BOUND BY THE BIOSPHERE, I.E., THE BIOPHYSICAL LIMITS OF THE PLANET. [19]

CONCLUSION

A TONNE OF CARBON RELEASED IS A TONNE OF CARBON RELEASED.

The comprehensive analysis provided by the white paper clearly demonstrates that biomass, while widely used under the guise of being a clean energy source, carries significant overlooked emissions. The real emissions associated with biomass combustion debunk the prevailing misconceptions about its carbon neutrality and carbon sequestration capabilities. Moreover, we have highlighted the broader environmental consequences that extend beyond mere carbon emissions figures, such as biodiversity loss and ecosystem degradation.

Given these insights, it becomes imperative to approach the adoption of biomass-based energy solutions with an increased awareness. Decision-making in this context must be thoroughly informed, integrating all the critical facts presented, to truly assess the sustainability and environmental impact of biomass energy. It is crucial for stakeholders, especially real estate owners and policymakers, to adopt a more strategic and foresighted approach towards energy choices.

Moving away from biomass entails not only reevaluating energy sources but also advocating for and implementing policies that support sustainable alternatives. For real estate owners, this transition could drive the adoption of more environmentally friendly technologies, such as all-electric solutions, which in turn could set a precedent for industry-wide changes. At the policy level, incentivizing clean energy solutions and revising regulations to accurately account for the full lifecycle emissions of all energy sources could significantly impact how energy sustainability is measured and achieved. Such shifts would not only contribute to reducing carbon emissions but also to preserving biodiversity and ensuring the long-term health of ecosystems. Through informed decision-making and policy reforms, real estate owners have the potential to lead by example, influencing broader societal and environmental outcomes.

SOURCES

1. Greenhouse gas reporting: conversion factors 2023 https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2023
2. Euractiv, Biomass fight leaves EU renewable energy talks in a deadlock https://www.euractiv.com/section/biomass/news/biomass-fight-leaves-eu-renewable-energy-talks-in-a-deadlock/
3. The introduction and expansion of biomass use in Swedish district heating systems, https://www.sciencedirect.com/science/article/pii/S0961953416302793
4. Energimyndighetn Energy in Sweden - Facts and Figures 2023 https://www.energimyndigheten.se/en/news/2023/energy-in-sweden---facts-and-figures-2023/
5. United States Department of Agriculture, https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Wood%20Pellets%20Annual_The%20Hague_European%20Union_E42023-0034.pdf
6. International Energy Agency, https://www.iea.org/countries/sweden/renewables
7. World Wide Fund for Nature (WWF), https://www.wwf.eu/?9519941/mythbuster-forest-biomass
8. Svenska Kyl & Värmepumpföreningen, https://skvp.se/aktuellt/nyheter/nyhetsarkiv/fjarrvarme-vs-varmepumpar--bilden-kan-nyanseras
9. European Academies' Science Advisory Council (EASAC), https://easac.eu/publications/details/multi-functionality-and-sustainability-in-the-european-unions-forests
10. Energy Justice Network, Biomass Incineration and Climate, http://www.energyjustice.net/files/biomass/climate.pdf
11. International Panel on Climate Change. 2006. "2006 IPCC Guidelines for National Greenhouse Gas Inventories." Tables 2.2-2.5. http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html
12. Frontiers in, Older Eastern White Pine Trees and Stands Accumulate Carbon for Many Decades and Maximize Cumulative Carbon, https://www.frontiersin.org/articles/10.3389/ffgc.2021.620450/full
13. Ecometrica, One Tonne of Carbon, https://ecometrica.com/assets/one_tonne_carbon_tree_discussion_paper_3.pdf
14. Does wood bioenergy help or harm the climate?, https://www.tandfonline.com/doi/full/10.1080/00963402.2022.2062933
15. Woody Biomass Energy, https://www.manomet.org/project/woody-biomass-energy/
16. US Environmental Protection Agency, https://www.govinfo.gov/content/pkg/FR-2009-04-24/pdf/E9-9339.pdf
17. Center for Biological Diversity, https://www.biologicaldiversity.org/programs/climate_law_institute/pdfs/Swamped_THP_Comments.pdf
18. World Economic Forum, https://www.weforum.org/publications/new-nature-economy-report-series/
19. Stockholm Resilience Center, https://www.stockholmresilience.org/research/research-news/2017-02-28-contributions-to-agenda-2030.html

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