Lorenz Strimitzer

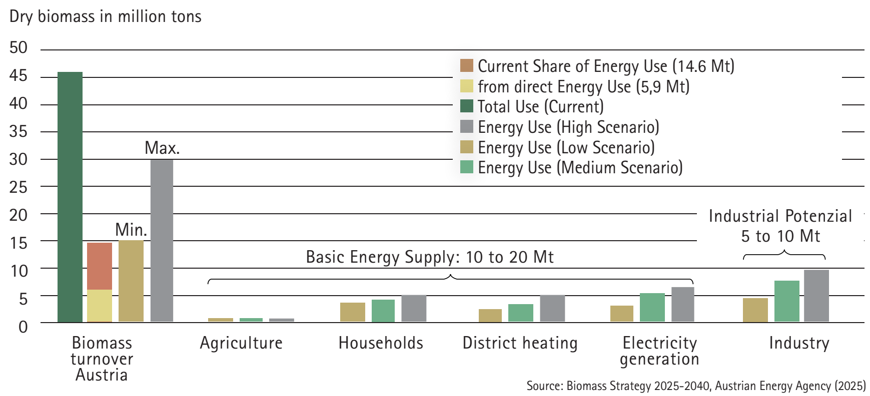
The New Biomass Strategy – Realising the Full Potential of Biomass

Biomass is the most important domestic energy source and is central to many parts of the energy system. However, after decades of growth, recent years have seen stagnation and uncertainty in certain areas, driven by the development of competing technologies and shifting societal support. In this context, it is crucial to emphasise the urgent need for a clean, domestic, and crisis-resilient energy supply. Against this backdrop, the Austrian Energy Agency has developed the Biomass Strategy 2025–2040 — a comprehensive framework outlining current and future uses of biomass, alongside its potential constraints. The strategy provides a coherent framework for phasing out fossil energy sources through the support of the bioeconomy.

Bioenergy as a Strategic Goal of National Energy Policy

Biomass has always played a fundamentally important role for humanity. In today's highly industrialized world, biomass serves an almost countless number of functions. Nevertheless, the full extent of biomass use in Austria, its current systemic relevance, and its potential contribution to the future energy system have, until now, been insufficiently recognized – or in some cases, largely overlooked. The Austrian Biomass Strategy directly addresses this gap, ensuring a thorough and comprehensive framework for biomass utilization in Austria. Given the urgency of current global challenges, the strategic promotion of bioenergy must be a key priority in national energy policy.

Biomass Use by Scenario



Source: Biomass Strategy 2025-2040, Austrian Energy Agency (2025)

In the medium and high scenarios, there is a significant increase in biomass use in local and district heating, electricity generation, and industry.

Biomass Flow Diagram as a Decision-Making Basis

As part of the study, a comprehensive inventory of biomass production, processing, and utilization in Austria was conducted for the first time. The collected influencing factors were summarized and presented in the form of a biomass flow diagram (see p. 2). It serves as a data foundation for future decisions regarding the development of biomass utilization in Austria. The diagram maps all input and output flows in tons as well as the sectors involved, and also includes the energetic use of biomass in Austria for the production of heat and electricity for transport, households, and industry.

Currently, 46 million tons of biomass are being used in Austria. The primary sources are Austria's forestry sector (9.7 million tons), arable land (10 million tons), grassland (4.6 million tons), green areas (3.1 million tons), and imports (19.1 million tons). Imports consist mainly of industrial

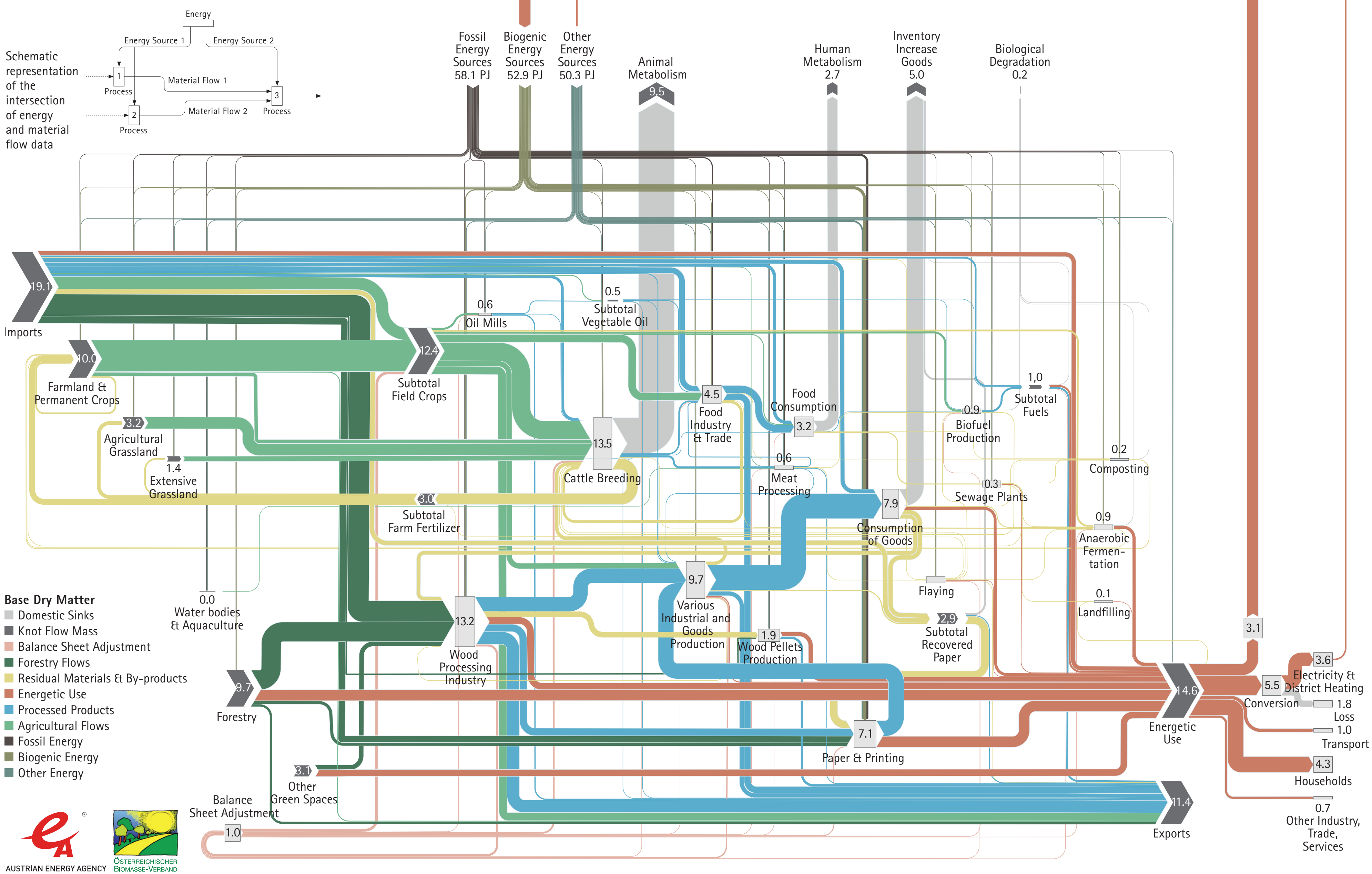
Chart 1: Biomass Use in the Scenarios (in PJ) by Biomass Type – Comparison

in PJ	Biomass Use 2022	Low Scenario	Baseline Scenario	Medium Scenario	High Scenario	Sc. 3 2045
Total Forestry Biomass	**195**	**202**	**216**	**248**	**291**	**201**
Wood imports for direct energy use (e.g., Industrial Pellets, Sawmill By-Products)		26	26	26	38	
Share of Energy Wood from Roundwood Imports		59	59	59	59	
Domestic Supply Woody Biomass		117	132	163	194	
Total Municipal and Industrial Biomass	**11,4**	**6,3**	**9,5**	**9,5**	**14,6**	**23**
Sewage Sludge		1,6	1,6	1,6	1,6	
Used Oil AT		1,9	3,0	3,0	3,4	
Biogenic Waste		2,8	4,9	4,9	9,6	
Total Agricultural Biomass	**13**	**42**	**75**	**93**	**144**	**188**
Agricultural Residues		18	35	53	63	
Cellulosic Energy Crops (Short-Rotation Coppice and Miscanthus)		0,5	0,5	0,5	20	
Manure		7	14	14	33	
Oilseed Crops		0,4	0,6	0,6	0,7	
Starch and Sugar Crops		2,4	3,5	3,5	4,1	
Total Imports of Biodiesel and Raw Materials for Biodiesel Production	18*	13	21	21	24	38*
Total	**237**	**250**	**301**	**350**	**450**	**450**
Total Share of Imports		15,6 %	15,4 %	13,3 %	13,7 %	

* Values for Total Biogenic Fuels
Source:
Forestry Biomass: Wood flow chart and Austrian Forest Inventory: Sc. „low" wood utilization as before with an increase in wood stocks; Sc. „medium" moderate depletion of wood stocks until 2040; Sc. „high" significant depletion of wood stocks until 2040; Baseline scenario maintenance of wood stocks at the 2022 level.
Sewage sludge: Martin Baumann et al. 2021: Renewable Gas in Austria 2040
Used Oil Austria: Own calculations based on: Dr. Heinz Bach, BMK 2024: Renewable Fuels and Energy Carriers in the Transport Sector in Austria 2023; UBA 2023: Energy and Greenhouse Gas Scenarios 2023
Biogenic Waste: Own calculations based on BMK 2023: Federal Waste Management Plan 2023
Agricultural Biomass: Own calculations based on Statistics Austria 2020: Agricultural Structure Survey
Manure: Own calculations based on Statistics Austria 2020: Agricultural Structure Survey
Oil Crops: Own calculations based on: Dr. Heinz Bach, BMK 2024: Renewable Fuels and Energy Carriers in the Transport Sector in Austria 2023; UBA 2023: Energy and Greenhouse Gas Scenarios 2023
Share of Imports: Own calculations based on: Dr. Heinz Bach, BMK 2024: Renewable Fuels and Energy Carriers in the Transport Sector in Austria 2023; UBA 2023: Energy and Greenhouse Gas Scenarios 2023
Sc. 3: Agri- and Residue Scenario: Forestry sector constant, utilization of 95% of agricultural potential, Austrian Biomass Association

Biomass and energy flows in Austria in 2022

in million tons of dry matter (DM) or PJ



and sawmill wood. After processing, a large portion of the resulting products is re-exported. As a result, Austria's total biomass exports amount to 11.4 million tons. Domestic processing and refinement of biomass generate substantial amounts of by-products, which are primarily used for energy purposes. The energetic use of biomass is another key component, amounting to approximately 14.6 million tons. This quantity is allocated across sectors according to energy consumption patterns. The primary applications of biomass for energy in Austria include its conversion into electricity and heat, as well as direct use in households. Around 3.1 million tons are required within the bioeconomy to meet its own energy needs. An analysis of the vertical (i.e. energetic) flows reveals that a notable amount of fossil energy – approximately 58 PJ – is still required for the production and processing of biomass.

Bioenergy scenarios for 2040

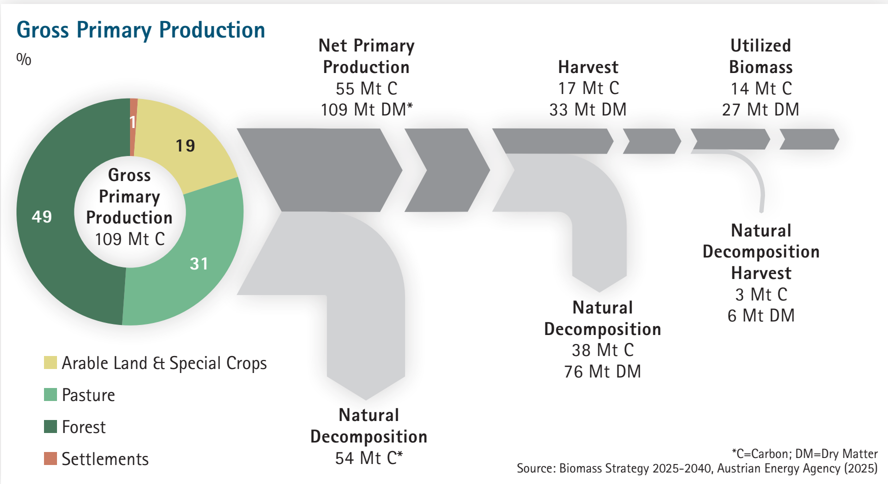
Based on the biomass flow diagram, bottom-up calculations were carried out to assess the available potentials and to develop cross-sectoral scenarios for future bioenergy use. The objective was to illustrate how fossil energy sources could be gradually phased out by 2040 – without compromising overall energy security. The scenarios further demonstrate the potential benefits of an expanded use of bioenergy, such as increased energy autonomy and a reduction in energy imports. They are grounded in a systematic analysis of the complex interdependencies between technological, economic, and societal factors that influence future energy and biomass demand, as well as the overall energy mix. For this purpose, a model based on final energy use data from Statistics Austria was developed, and future energy use scenarios were derived from it.

Based on the available data and underlying assumptions, a baseline scenario projecting biomass use of 300 PJ in 2040 was identified as the most probable development, reflecting an increase of approximately 50 PJ compared to the current level. To evaluate the range of possible actions and assess alternative development pathways, three additional scenarios were developed. These scenarios explore different variants of a future energy system, assuming biomass utilization of 250 PJ, 350 PJ, and 450 PJ, respectively. This allows for estimating the energetic and structural effects of both lower and higher biomass use levels (see Chart 1 on page 1).

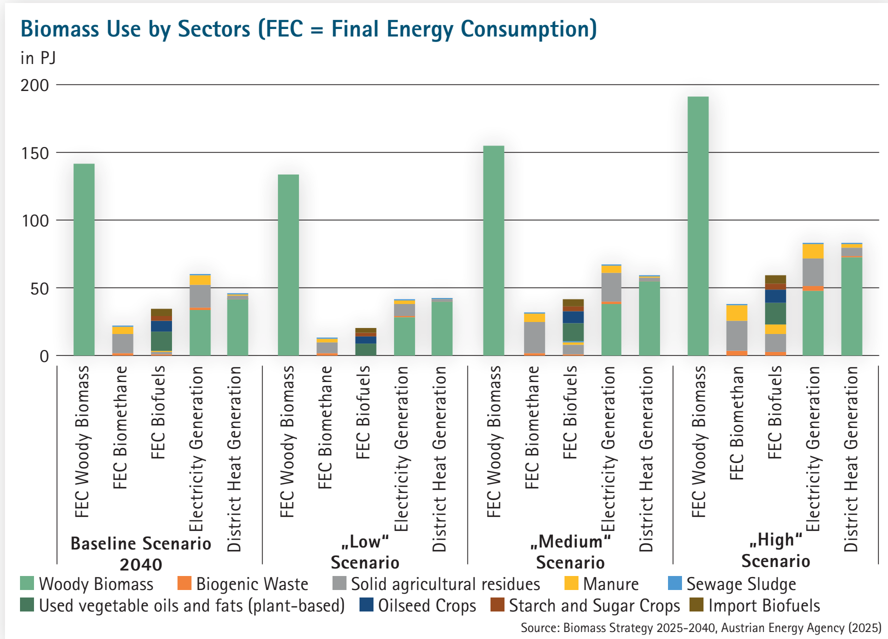
For clarity, the energetic biomass use in the scenarios was converted into dry matter to illustrate results by sector. The chart titled "Biomass Use by Scenarios" presents future developments relative to current energetic use. A significant increase in biomass utilization appears plausible in the "medium" and "high" scenarios, particularly for district heating, electricity generation, and the manufacturing sector. Within the 350 PJ scenario, maintaining bioenergy supply requires around 4 million tons (odmt) of biomass for individual household heating, 3.3 million tons for district heating plants, 7.7 million tons for commercial and industrial applications, and 5.4 million tons for combined heat and power (CHP) plants. Biomass quantities beyond these levels, up to the full exploitation of available potential, remain available for other applications.

Only One Third Statistically Recorded

The biomass flow diagram includes only those volumes captured by the available data sources, meaning that the flows reflect physically recorded quantities. However, this represents only a relatively small share of the total biomass grown or produced in Austria. To contextualize the recorded figures, Austria's gross primary production



The gross primary production of biomass, totaling 109 million tons of carbon, occurs almost half in forestry, with only 27 million tons being utilized by humans.



In the "high" scenario, biomass use for electricity and district heating generation is approximately equal—unlike in the baseline scenario, where a greater share of (agricultural) biomass is used for power generation.

was estimated. For this purpose, land use data („LUIcube") from Matej et al. (2025) were converted into tons of dry matter. According to the chart "Gross Primary Production," physical data capture covers only about one third of net primary production in Austria (33 million tons), with 27 million tons attributed to human use. As a result, 75% of Austria's net primary production (NPP) remains within natural ecological cycles.

Approximately 4.7 million tons of dry matter are used directly for energy in the form of domestically sourced wood chips and firewood, representing 4.3% of NPP. Based on an energy consumption of 161.3 PJ, greenhouse gas emissions attributable to the bioeconomy amount to 7.32 million tons of CO_2 equivalent.

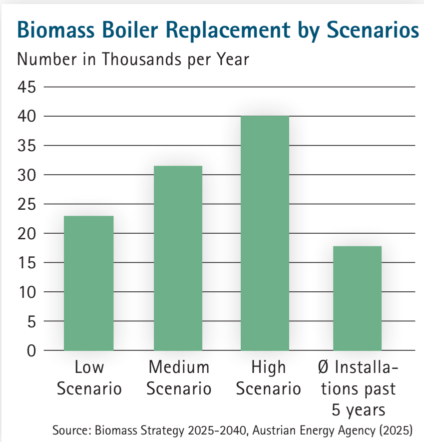
These figures represent a greenhouse gas reduction potential for the bioeconomy. However, the biomass produced and processed binds a multiple of these emissions. When converting the carbon mass of net primary production into CO_2, using a factor of 3.67, the result is an annual CO_2 sequestration of approximately 200 million tons.

Consequently, Austria's total net primary production binds nearly three times the country's annual greenhouse gas emissions, which currently total around 73 million tons. The biomass actually utilized contributes approximately 61 million tons to CO_2 sequestration. It is important to note that 99% of all biomass is grown on managed land. As managed forests tend to become net carbon emitters over the long term, sustainable and climate-resilient forest management is essential to safeguarding long-term carbon sequestration capacity. The projected energy use of biomass in 2040 — for the baseline scenario as well as the 250 PJ, 350 PJ, and 450 PJ scenarios — is shown in the chart "Biomass Use by Sectors".

Up to 40,000 Biomass Boilers Required Annually

Woody biomass will continue to be the dominant biogenic energy source in the future, primarily utilized for electricity generation and district heating. Biomethane production predominantly employs solid agricultural residues and manure as feedstocks. Biofuel production is mainly based on vegetable oils and fats, waste oils, as well as starch and sugar crops. In scenarios with increased biomass use, agricultural residues and manure become increasingly important input materials for fuel production. As biomass utilization rises, final energy consumption (FEC) increasingly shifts towards the transport sector, manufacturing, and other commercial and economic sectors.

A further focus was placed on modeling the space heating sector, where electrification and the expansion of district heating play pivotal roles. By 2040, around 75% of space heating demand is projected to be supplied by heat pumps and district heating systems. Nevertheless, a significant increase in biomass boiler installations remains necessary. Replacement rates and required new installations were quantified, showing that between 27,000 and 40,000 biomass boilers will need to be installed annually, depending on the scenario, to ensure a reliable heat supply.

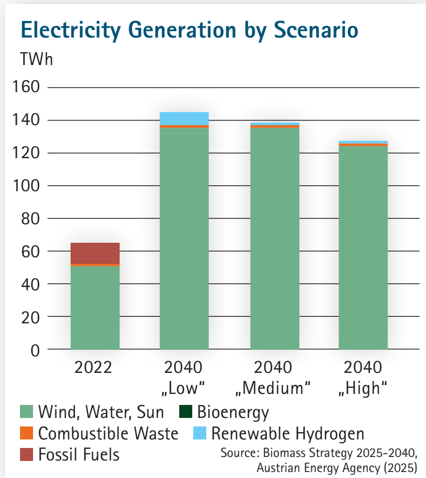


Depending on the scenario, between 27,000 and 40,000 biomass boilers need to be installed annually.

Enhanced System Stability

The ongoing phase-out of fossil fuels goes hand in hand with the increasing electrification of the energy system. In all scenarios examined, the majority of electricity generation is supplied by renewable energy sources—primarily wind power, hydropower, and photovoltaics.

A key factor shaping the electricity generation mix is biomass availability: the greater the supply of biogenic energy carriers, the more the demand for hydrogen in power generation is reduced. In scenarios with high biomass utilization, electricity demand from other sources declines as biogenic fuels are increasingly used directly to meet final energy consumption across multiple sectors. This results in an overall lower electricity generation requirement. The use of solid and gaseous biomass enhances system stability since biogenic power plants operate continously, unlike wind and solar, and, thus, make an important contribution to security of supply.



In scenarios with high biomass utilization, the demand for electricity from other sources decreases.

Pellet Boilers: Positive Impact on the Budget

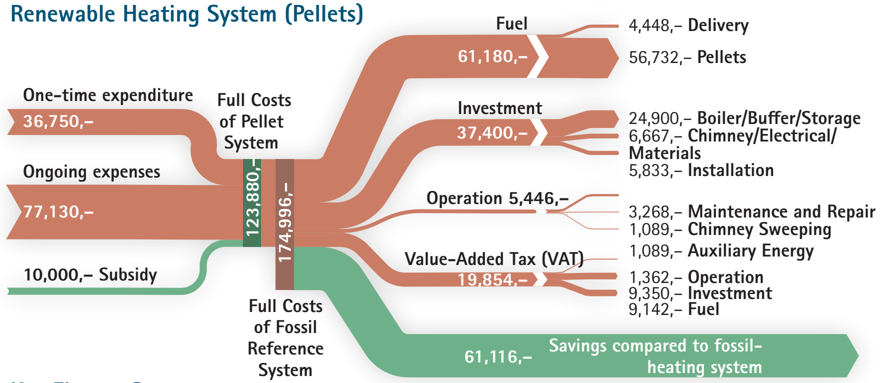
Bioenergy offers an excellent opportunity for a decentralized, secure, and renewable energy supply. Within the framework of the Biomass Strategy 2025–2040, it has been demonstrated that climate protection is technologically feasible, economically viable, sustainable, and practical. Additionally, the multiple co-benefits of bioenergy have been quantified.

Using the example of a typical pellet boiler, the monetary returns to the state – in the form of value-added taxes and payroll-related charges – associated with the installation and operation of the pellet boiler have been evaluated. The graphic "Renewable Heating System" on the following page illustrates the total costs of a pellet system, including the government revenues generated over an assumed operational lifetime of 20 years. These revenues amount to a total of €55,139. The analysis clearly demonstrates that bioenergy support yields a net positive fiscal impact for the government. In the case of a pellet heating system, subsidy costs are fully offset by value-added tax and payroll-related revenues well before the subsidies are completely paid out.

Fuel costs as a decisive factor

The graphic at the top right of page 5 exemplifies the cost flows of a small-scale, farm-based biomass heating plant, expressed in €/ton odmt of fuel input. Such facilities play a vital role in Austria's heat supply, particularly within rural communities. Realistic planning of district heating networks, a stable and transparent funding framework, and a strategic approach to securing heat consumers are fundamental to economic

Renewable Heating System (Pellets)



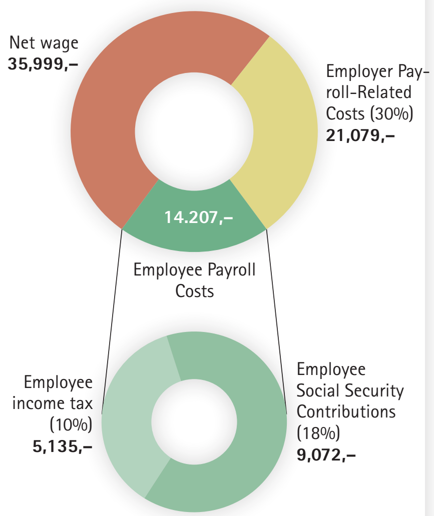
Key Figures System, Investment and Taxes

Investment Costs incl. VAT + Payroll-Related Costs	46.750 €
Ongoing Costs incl. VAT + Payroll-Related Costs	77.130 €
Pellet Demand	11,7 t/a
Pellet Price excl. Delivery	6 Cent/kWh
Assumed Operational Lifetime	20 Jahre
Government expenditure on one-time Investment Subsidy	10,000 €
Subsidy Rate on Investment costs	21 %
Subsidy Rate on Total System Costs	8 %
Government revenue from taxes over operational lifetime (VAT + payroll-related costs), included in full costs	**55,139 €**
Share of Total Tax Revenue in Net Sales	53 %
Total Labor Costs	71,284 €
Share of Payroll-Related Costs in Net Sales	34 %

CO_2 Key Figures

CO_2-Savings over 20 years	319 t CO_2
CO_2- Abatement Costs to the Government (with subsidy, excluding tax refunds)	31 €/t CO_2
CO_2-Abatement Costs to the Government (with subsidy, including tax refunds)	–142 €/t CO_2

Wages and Payroll-Related Costs in €



Assumptions:
53 working hours per year (including supply chain);
Average gross monthly salary: €3,586

Source: Biomass Strategy 2025-2040, Austrian Energy Agency (2025)

When purchasing a pellet boiler with a one-time incentive subsidy of €10,000, approximately €55,000 will flow to the government over the 20-year operational lifetime, primarily through VAT and payroll-related contributions.

viability. The illustration clearly underscores that fuel costs represent a primary driver of operational profitability. Consequently, guaranteed access to competitively priced fuel is indispensable for the long-term financial success of biomass installations.

Bioenergy: Crisis-Proof, Stable, and Climate-Neutral

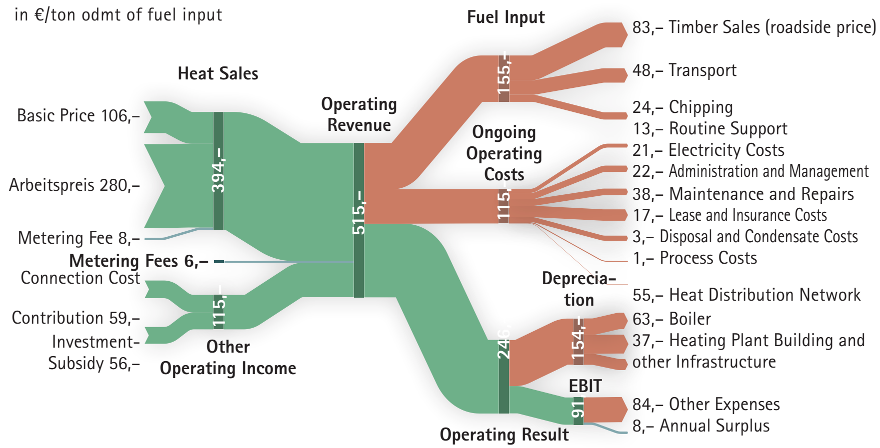
Currently, Austria's energy system is still significantly reliant on imports, with around 65% of its total energy consumption coming from abroad, the majority of which consists of fossil fuels. This heavy dependence poses critical challenges to supply security, price stability, and resilience amid geopolitical disruptions. The recent energy crisis has underscored the vulnerability of global energy markets and their direct consequences for Austria.

Accordingly, the overarching goal is to progressively decarbonize Austria's energy system by 2040 and eliminate reliance on fossil fuel imports altogether, ensuring a secure, sustainable, and autonomous energy future. A strengthening of Austria's basic energy security is to be ensured through the large-scale expansion of renewable energy sources, particularly domestically available biomass. The graphic "Energy Self-Sufficiency" exemplifies the composition of domestic and imported energy in the year 2040 under the baseline scenario. Of particular note is the sharp decline in import dependency compared to 2022. While green hydrogen and synthetic e-fuels will continue to be imported in moderate quantities, bio-based energy carriers and electricity will, for the most part, originate from domestic production. Depending on the scenario, the degree of energy self-sufficiency is projected to range between 89% and 94%.

Therefore, fully leveraging Austria's domestic biomass potential is crucial to ensuring a crisis-resilient, stable, and climate-neutral energy supply.

Cost Flows of a Small Biomass Heating Plant

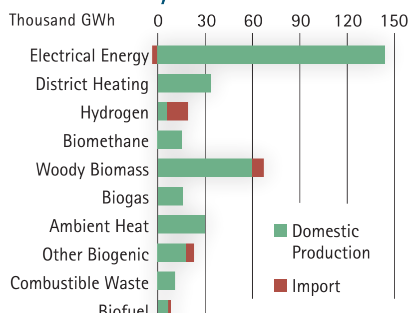
in €/ton odmt of fuel input



Heating plant: 0.85 MW fuel thermal capacity; 877 tons/year wood chip input
Source: Biomass Strategy 2025–2040, Austrian Energy Agency (2025)

The costs of energy wood are crucial to the economic viability of biomass district heating plants.

Self-Sufficiency Rate



Source: Baseline Scenario 2040, Biomass Strategy 2025–2040, Austrian Energy Agency (2025)

The energy self-sufficiency rate in 2040 is very high, except for hydrogen and e-fuels.

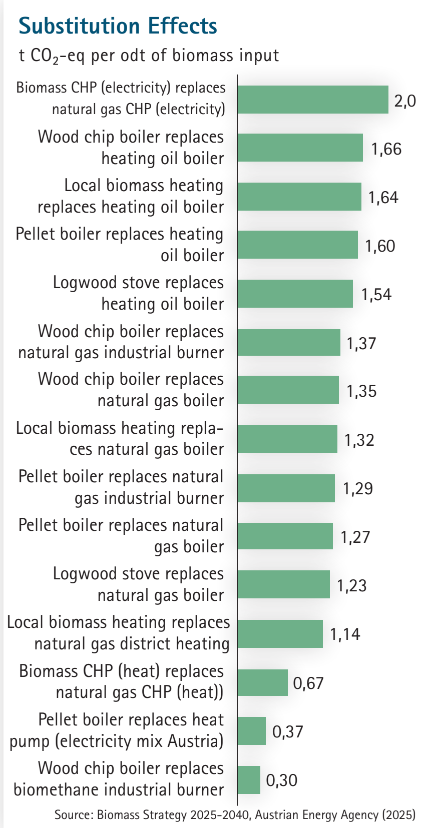
CO_2 Equivalents per kWh of Heat at End User (Including Indirect Upstream Effects)

Grams per kWh of Heat (as of May 2025) / Own calculations based on Sphera LCA and Ecoinvent	Heating Oil Boiler	Natural Gas Boiler	District Heating (Natural Gas)	CHP – Natural Gas (Heat)	Industrial Burner Natuarl Gas	Local Heating Biomass	Pellet Boiler	Logwood Stove	Wood Chip Boiler	Wärmepumpe Strommix AT	CHP Biomass (Heat)	Wood Gas HP Unit (Heat)	Industrial Burner Biomethane
Heating Oil Boiler	**329**	61	97	191	58	314	303	307	318	232	319	241	260
Natural Gas Boiler	-61	**268**	36	130	-4	253	241	246	257	170	258	180	199
District Heating (Natural Gas)	-97	-36	**232**	94	-39	217	206	210	222	135	222	144	163
CHP (Natural Gas (Heat))	-191	-130	-94	**138**	-133	123	112	116	128	41	128	50	69
Industrial Burner - Natural Gas	-58	4	39	133	**271**	256	245	249	261	174	261	183	202
Local Heating - Biomass	-314	-253	-217	-123	-256	**15**	-11	-7	5	-82	5	-73	-54
Pellet Boiler	-303	-241	-206	-112	-245	11	**26**	4	16	-71	17	-62	-42
Logwood Boiler	-307	-246	-210	-116	-249	7	-4	**22**	12	-75	12	-66	-47
Wood Chip Boiler	-318	-257	-222	-128	-261	-5	-16	-12	**10**	-87	1	-78	-58
Heat Pump - Electricity Mix AT	-232	-170	-135	-41	-174	82	71	75	87	**97**	87	9	29
CHP Biomass (Heat)	-319	-258	-222	-128	-261	-5	-17	-12	-1	-87	**10**	-78	-59
Wood Gas CHP Unit (Heat)	-241	-180	-144	-50	-183	73	62	66	78	-9	78	**88**	19
Industrial Burner - Biomethane	-260	-199	-163	-69	-202	54	42	47	58	-29	59	-19	**69**

Emission Factors of Heating Systems and Emission Changes from Switching Heating Technologies.

Substantial CO_2 Reductions

As part of the project, comparative life cycle assessments were conducted to evaluate heat delivery to end users across different technologies. The findings demonstrate that conventional biomass heating systems—such as pellet, wood chip, and logwood boilers—as well as biomass-based district heating, achieve CO_2-equivalent reductions of well over 200 grams per kilowatt hour of useful heat compared to natural gas. In the case of heating oil, the savings exceed 300 grams of CO_2 equivalents per kilowatt hour. In practice, this means that bioenergy systems offer substantial potential for reducing climate-relevant greenhouse gas emissions. Substitution effects, meaning emission reductions compared to fossil fuel reference systems, were also calculated for the examined scenarios. The results show that the energetic substitution effect alone is projected to reach between 18.5 and 26.2 million tons of CO_2 equivalents by 2040. In detail, the greenhouse gas reduction potential of biomass systems varies significantly depending on the specific field of application. High-efficiency systems, such as those used for space heating or in combined heat and power (CHP), offer significantly higher substitution potential than applications with high conversion losses, such as electricity-only generation. Bioenergy is typically used as a direct replacement for fossil fuels. The use of mixed substitution factors often leads to distorted results and should be interpreted with caution. For example, replacing an oil-fired boiler with a pellet heating system results in a substitution effect of 1.6 tons of CO_2 equivalents per ton odmt of fuel input. However, if the calculation is based on an average heat mix rather than the replaced heating technology, the result drops significantly to 1.1 tons. This has an even greater impact in the electricity sector: if a biomass CHP plant replaces a natural gas CHP plant in electricity generation, this results in substitution effects of over 2 tons of CO_2 equivalents per ton odmt

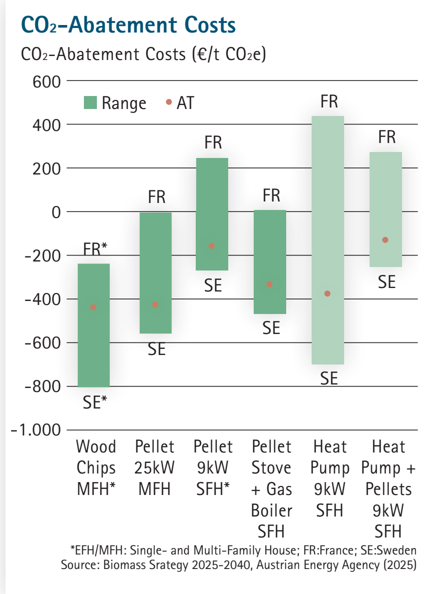


Systems with high efficiencies deliver the greatest substitution effects.

of fuel used. If, instead, an average electricity mix is used as reference point, the reduction potential falls to just 0.97 tons. In practical terms, using average mix-based reference values leads to a considerable distortion of results, especially in systems with a high share of renewable energy.

CO_2 Abatement Costs Exceeding €100,000

Biomass heating systems offer a substantial economic advantage for end users when replacing fossil-based heating technologies. As part of the project, the cost or monetary savings per ton of avoided CO_2 equivalent



Range of CO_2 Abatement Costs Compared to Natural Gas for Selected EU Countries

were calculated for various scenarios, in which fossil heating systems are replaced by biomass systems. The "CO_2 Abatement Costs" chart illustrates the range of CO_2 abatement costs compared to natural gas across selected EU countries. Country codes indicate the highest and lowest values observed, while the red marker highlights the value for Austria.

A multi-family building in Austria, for example, saves approximately €432 per ton of avoided CO_2 equivalent when replacing a gas boiler with a pellet boiler. The cost saving amounts to approximately €432 per ton of avoided CO_2 equivalent Over a system lifetime of 20 years, this replacement avoids 249 tons of CO_2 equivalents. In total, this results in monetary savings of €107,568. After discounting, the net present value amounts to €73,147.

Although CO_2 abatement costs are negative for many heating systems, financial support remains a crucial driver for accelerating the transition away from fossil-based heating. The replacement of functioning fossil systems is often hindered by high initial investment costs and the individual effort involved. These barriers can and should be addressed through well-designed incentive schemes.

This project has made several key contributions:

- It has established the most comprehensive data set on biomass in Austria and mapped out the potential of biomass for future energy transition modelling.
- It has evaluated the main co-benefits of biomass use, including CO_2 reduction, economic value creation, employment, and fiscal returns to the public sector.
- It has outlined a clear and sustainable pathway for the further development of biomass in Austria through to 2040. ■

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The biomass strategy sets a consistent framework for transitioning away from fossil energy sources by harnessing the potential of the bioeconomy.