

LIFE Environment and Resource Efficiency project

“Nutrient recycling circular economy model for large cities – water treatment sludge and ashes to biomass to bio-energy “

Project Acronym: NutriBiomass4LIFE
Project Number: LIFE17 ENV/LT/000310

Biomass supply from NutriBiomass4LIFE CE demonstration model for Vilnius renewable energy production report

WEB Report prepared by

UAB “Pageldynių plantacija”

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Preface

The purpose of this document is to provide insights on biomass supply from NutriBiomass4LIFE plantations for renewable energy production action (B3) during implementation of the project NutriBiomass4LIFE. During implementation of the NutriBiomass4LIFE project total 13127 cub m (loose) of energy chips were produced and supplied to Vilnius city biomass boilers to produce 7,8 GWh of heat energy for Vilnius city. The purpose of biomass supply from NutriBiomass4LIFE plantations for renewable energy production action (B3) was to demonstrate the circularity of developed CE economy loop, that CE model can serve municipal needs to supply renewable energy to its population and to gain insights from this action.

For the implementation of the NutriBiomass4LIFE project, a subsidy is awarded from the EU LIFE program, the EU's funding instrument for environment and climate action. The funding of the project also come from the Swedish Energy Agency and Ministry of Environment of the Republic of Lithuania.

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II. About the NutriBiomass4LIFE Project

The Nutribiomass4LIFE project was launched on 1 July 2018 and will be running until the end of September 2023. Within the framework of this project, 6 beneficiaries from Lithuania and Sweden aim to create and demonstrate the first of its kind on the EU level full scale self-sustainable closed loop circular economy model for large cities' nutrient rich waste - municipal wastewater treatment sludge and biomass ashes – recycling into renewable energy for city's needs via environment friendly biomass plantation phytoremediation filter. The circular economy model is based upon Vilnius city, the capital of Lithuania (550 thousand population).

The specific objectives of the project included:

- promoting resource efficiency through reuse of nutrients (less usage of mineral fertilizer) and decrease in transportation distances and flows;
- promoting waste management pyramid priorities via changing path from landfilling and incineration of nutrient rich waste towards reuse in biomass growth improvement;
- mitigation of food chain contamination risks via changing path of nutrient rich waste from uncontrolled usage in food crop growing towards 100% legally compliant and monitored non-food biomass yield improvement;
- creating new best practices for dried MWTS digestate usage for non-food biomass;
- developing new business models to make biomass growing / forestry on marginal and less suitable to agriculture soils economically attractive via substantial biomass yield improvement;
- promoting soil organic content improvement via bio-solids applications;
- promoting renewable energy production;
- promoting afforestation of less suitable for agriculture / marginal lands;
- contributing significantly to climate change impact reduction by sequestrating significant volume of CO2 in the whole circular economy model value chain, promoting renewable energy production, soil carbon content improvement;
- promoting of EU and national legislation and policies and contributing to their development by promoting safe and environment friendly reuse of nutrients from wastes.

The Coordinating beneficiary:

1. UAB "Pageldynių plantacija" (Lithuania)

Associated beneficiaries:

2. Forest and Landowners Association of Lithuania (Lithuania)
3. Lithuanian Research Centre for Agriculture and Forestry (Lithuania)
4. UAB "Kirtimu katiline" (Lithuania)
5. UAB "Vilniaus vandenys" (Lithuania)
6. Swedish University of Agricultural Sciences (Sweden)

For more information, please visit the project's website: www.nutribiomass.eu.

III. List of Abbreviations and Partner Acronyms

NutriBiomass4LIFE	EU LIFE project “Nutrient recycling circular economy model for large cities – water treatment sludge and ashes to biomass to bio-energy “, No. LIFE17 ENV/LT/000310
CE	Circular economy
CHP	Cogeneration heat and power
CO2	Carbon dioxide
CRCF	Carbon Removal Certification Framework
cub. m	cubic meter (m^3)
EU	European Union
EE	Estonia
FSC	Forest Stewardship Council®
g	gram, 1 kg = 1000 g
GWh	Gigawatt hours, 1 GWh = 1000 000 000 Wh
kg	kilogram, 1 t = 1000 kg
ha	hectare, 1 ha = 1000 square meters
km	kilometre, 1 km = 1000 m
LT	Lithuania
LV	Latvia
MW	Megawatt, 1 MW = 1000 000 W
MWh	Megawatt hours, 1 MWh = 1000 000 Wh
MWTS	municipal waste-water treatment sludge
NECP	National energy and climate plan
PE	UAB “Kirtimų katilinė”
PP	UAB “Pageldyniu plantacija”
RES	Renewable energy sources
RED III	Renewables Energy Directive, adopted by Council on October 9. 2023
r. or reg.	administrative district
sen.	regional units of administrative district
t	metric ton, 1 t = 1000 kg

Introduction

1.1 Purpose and Aim

The purpose of this document is to reveal the results of biomass supply from NutriBiomass4LIFE plantations for renewable energy production action (B3) during implementation of the project.

1.2 Structure

The document is divided into four main chapters:

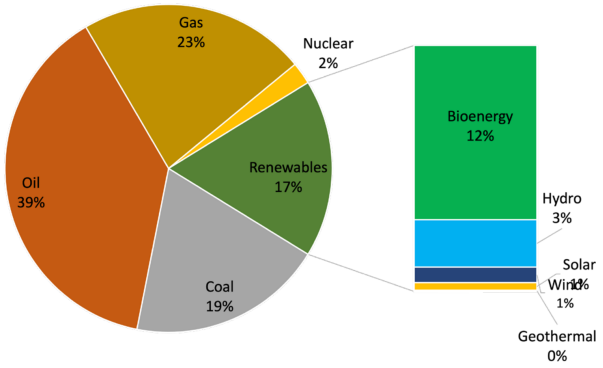
- Chapter 1 “The role of biomass energy” discusses biomass energy role in the EU and Lithuania.
- Chapter 2 “Biomass to renewable energy output” discloses biomass quantity and locations of biomass energy chip production.
- Chapter 3 “Biomass to renewable energy technology” discusses technologies for biomass harvesting, forwarding and chip production.
- Chapter 4 “Economics of biomass to renewable energy” discloses costs, revenue sources and financial results costs of energy chip production form biomass plantations.
- Chapter 5 “Carbon footprint” discloses CO_2 footprint of biomass energy chip supply.
- Chapter 6 “Policy” discusses policy and national legislation issues related to biomass energy.
- Chapter 7 “Continuation” discusses biomass to biomass energy production prospects.
- Chapter “Conclusions” provides key finding from biomass to renewable energy in Nutribiomass4LIFE project.

1 The role of biomass energy

Growth in the use of renewable energy sources (RES) has diverse benefits for society such as mitigating climate change, reducing the emission of air pollutants and improving energy security.

Biomass energy is the primary renewable energy source all over the world. Although during recent years we can see significant growth in other renewable sources, like wind and solar, biomass still holds appr. 70 % share among all global renewable energy sources.

Picture 1-1. Global final energy consumption, 2019



In October 2023 EU formally adopted an update of the Renewable Energy Directive that, among other measures, increases the binding 2030 target from 32% to 42.5%, with the aim of achieving 45%. Each Member State will contribute to this common target, while no targets were introduced for individual countries.

In 2022, the share of renewable energy in the EU reached, i.e. 23% increased by +1.1% from 2021. Among renewable energy sources in the EU, the largest by far is solid biomass. Solid biomass is widely used in electricity generation, industry and residential heating. Combined, it represented 41% of the total renewable energy supply in Europe in 2021. It is followed by wind (13%), hydropower (12%), liquid biofuels (8%) and biogas (6%). Heat pumps and solar photovoltaics each represented less than 6% of all renewables. However, they are the fastest growing sources, having increased by more than 13% between 2020 and 2021.

In Lithuania in 2022 renewable energy in final energy consumption increased by +1,5% and totalled 29,6% comparing to 28,1% in 2021. In Lithuania solid biomass has much higher share in total renewable energy mix than in total EU and has holds 78% share (2021). In 2022, in Lithuania wood fuel consumption declined almost by 9,5% which was the consequence of decline in wood biomass usage in CHPs, district heating and industrial boilers.

2 Biomass to renewable energy production

While developing project it was expected at the end of the project to harvest 300 ha of biomass plantations, already established before implementation of the project and to supply 39,4 GWh of biomass to be processed into renewable energy for Vilnius city. Due to Russian-Ukrainian war and followed energy crisis in the European Union, 2022 were very favorable for biomass for energy

suppliers as biomass for energy prices increased more than four times, but that also led to the shortage of biomass harvesting and chip production capacities.

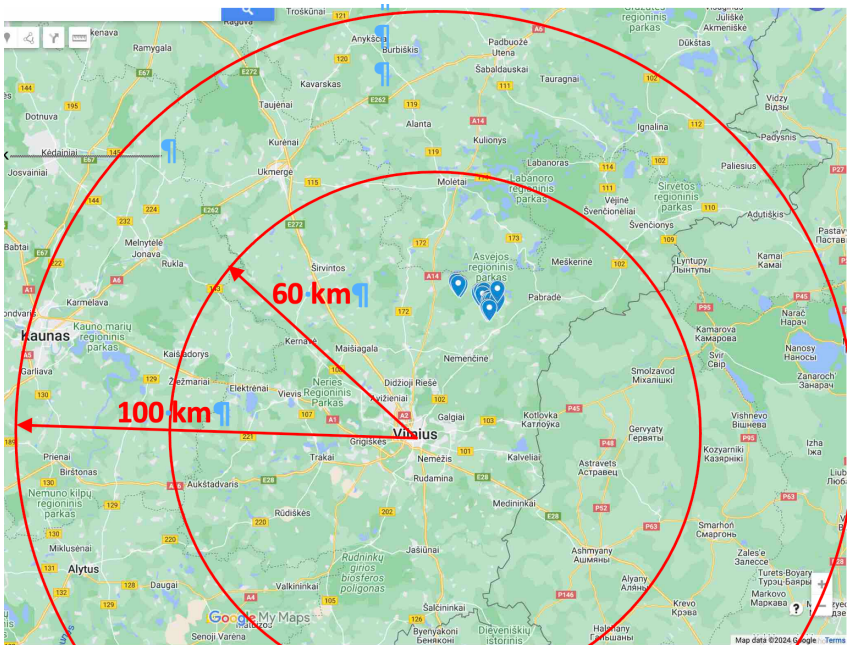
Unfortunately, we have not been able to benefit from this price hike as it was not possible to get biomass harvesting, forwarding and chipping services for targeted volumes and in time. As we decided to perform thinning instead of complete coppicing (clearcut), we had to arrange technological solution for that purpose and to engage harvesting companies for required operation. Harvesting could be performed after defoliation of poplars only from beginning of November till middle of January as due to the lack of frosts soil became too wet for forwarding of biomass. Due to these reason we were able to harvest only net 65 ha (total 128,9 ha) from which 7,8 GWh of energy chips were produced.

2.1 Location of biomass plantations harvested for renewable energy

During 2022/2023 total 16 biomass fields of 7-8 year age were harvested for biomass energy to demonstrate the circularity of developed NutriBiomass4LIFE CE economy loop, that CE model can serve municipal needs to supply renewable energy to its population.

All the harvested plantations are located in Vilnius district, Sužionys administrative unit, at 40 km radius or 60 km transportation distance from Vilnius biomass boilers.

Picture 2-1. Locations of poplar plantations, harvested for renewable energy production during 2022/2023 season



2.2 Biomass to renewable energy output

During 2022/2023 heating season total 128,9 ha of poplar plantations were partially (65 ha net) harvested to produce energy chips. The decision was taken to perform not full coppicing of older biomass plantations, but thinning by harvesting each the second row, or 50% of growing trees. The reason for thinning was taken, because poplar plantations are now only at the beginning of their fast growth cycle, therefore it is not economically reasonable to harvest plantations when they start to yield 20-30 cub m/ha per year.

During 2022/2023 heating season total 13127 cub m (loose) (or 4332 cub m solid) of wood chips were produced from harvested biomass plantations, which with 138 special trailers were transported to various Vilnius boilers for heat energy production, from which 7,8 GWh of heat energy were produced.

Average biomass chip production from thinning reached 63 cub/m ha (7-8 year old).

Table 2-1. NutriBiomass4LIFE poplar biomass harvesting for energy

Address	Land plot Unique No.	Plantation area, ha	Harvest-ing rate, %	No. of trailers	biomass harvested, loose cub. m	biomass harvested, solid cub. m
TOTAL		**128,94**	**50%**	**138**	**13127**	**4332,0**

All harvested poplar plantations for biomass energy productions were planted in 2015 and in 2016, i.e. before the project start, but are included into NutriBiomass4LIFE CE model. All 2015 year established plantations were heavily damaged by summer drought and early autumn frost, therefore survival rate and biomass yield of these plantations is lower.

The poplar clone, which was planted and harvested for bioenergy is Italian AF7. Although all the initial poplar plantations in Lithuania were established with AF7 clone as no other planting material was available at a larger scale at that time, later AF7 was rejected for further planting in Lithuania due to insufficient adaptability to Lithuanian climate:

- AF7 has long vegetation, therefor there is high risk that it may be damaged due to early autumn frost. Although with the changing climate we have less early autumn frost, still this risk exists. Especially it is vulnerable during the first year of growth.
- Bark of AF7 clone may be damaged during very cold winters at older years as well, especially when it is fertilized with sewage sludge which extends vegetation.
- AF7 clone is lest resistant to rust, which under Lithuanian conditions occur due to wet autumn.
- AF may be susceptible to bacterial canker.

Due to above mentioned reasons AF7 poplar clone has not been selected for biomass plantation establishment during NutriBiomass4LIFE project implementation.

3 Biomass to renewable energy technology

When biomass is sold for bioenergy production, usually biomass is sold on the roadside or directly supplied to boilers in the form of chips. Biomass plantation establishment for CE model action (B1) of NutriBiomass4LIFE project ended with poplar plantation establishment. For biomass to renewable energy action (B4) we assume technology and business cycle from standing wood in biomass plantations to delivery of chips to biomass boiler and renewable energy production from delivered chips, which from business point can be viewed as a separate business cycle. The technology of biomass to renewable energy production consists of:

- Thinning (harvesting)
- Forwarding
- Energy chip production
- Energy chip delivery to biomass boilers
- Heat production

3.1 Thinning

In Lithuania poplar plantations have been established at 1600 plants/ha and need to be thinned at 6-9th year of growth if to grow for 20-year rotation.

Thinning was done by harvesting each the second row of poplars with light excavator ant mounted tree shear to it, which collected and loaded harvested trees in small piles near remaining rows of poplars for easier collection by forwarder.

Picture 3-1. Thinning at age of 7 years (AF7 clone), Vilnius region.



3.2 Forwarding

After harvesting, poplars are collected with light forwarder and forwarded to the roadside for storing in large piles to be accessed by chipping machinery. Light machinery is preferably to be used for harvesting and thinning in order to avoid poplar root damage and soil compaction.

Picture 3-2. Poplar thinning biomass at the road site



3.3 Energy chip production - chipping

After poplar biomass was forwarded to the roadside, biomass was sold to chip producers, who have agreements with biomass boilers to supply chips. Then, chip producers, at their availability, chipped poplar piles into bioenergy chips using either chipping machinery stationed on the trucks or mounted on the tractors.

Picture 3-3. Energy chip production from poplar wood




3.4 Transportation of chips to the boilers

Produced biomass chips are transported by special chip trailers, where they are unloaded at boiler houses or at intermediary storage area. To transport 13127 cub m (loose) of biomass chips, 138 long trucks were engaged.

Picture 3-4. Unloading of chips from trailers at the boiler house of PE



3.5 Heat production at boiler house

Poplar biomass was sold on the roadside to bioenergy producers, who produce chips and deliver them directly to the boilers, based on biomass energy exchange auction results and signed contracts. Renewable energy (heat and combined heat and power) production at biomass boilers and CHPs, and delivering heat to local district heating networks is a separate business segment from biomass growing and biomass chip supply, and which is usually regulated by state.

Poplar energy chips were delivered for district heat production to multiple boilers in Vilnius city: PE, boilers of “Viniaus šilumos tinklai”, “Vilniaus kogenerecinė jėgainė” and boilers of Idex Baltic based on Baltpool energy exchange results. Total 7,8 GWh of heat were produced from poplar chips supplied.

Picture 3-5. Poplar chips burning for heat production at the boiler of PE



4 Economics of biomass for energy production

The economics of biomass to renewable energy defined by several key inputs:

- Thinning costs
- Forwarding costs
- Chipping costs
- Transportation costs
- Biomass sales revenues

4.1 Thinning costs

Thinning costs consist of poplar harvesting. In winter 2022/2023 poplar thinning was performed by the contractors, which included both harvesting and forwarding to the roadside services.

It is calculated that thinning-harvesting can be performed by light excavator with mounted tree shear at 70 cub m (solid)/day harvesting output. Poplar thinning-harvesting costs are composed of 10 l diesel/h light excavator fuel consumption (diesel price @ 1,5 eur/l), plus 150 eur / day / light excavator driver wage, 200 eur /day light excavator ((lease/maintenance) costs and 20% overhead costs. Total thinning-harvesting costs are **7,7 eur/cub m (solid)**.

4.2 Forwarding costs

It is calculated that biomass forwarding to the roadside costs are based at 65 cub m (solid)/day forwarding to the roadside volume. Poplar forwarding to the roadside costs are composed of 7 l diesel/h tractor consumption (diesel price @ 1,5 eur/l), plus 150 eur / day / tractor driver wage, 200 eur /day tractor ((lease/maintenance) costs and 20% overhead costs. Total transportation of biomass to road -side costs are **8,3 eur/cub m (solid)**.

4.3 Chip production costs

A chipping machine on average produces 1 truck of chips per one hour. Depending on chip transportation to boiler house flows, from 4 to 9 trucks /per day were loaded with chips at biomass plantation side.

It is calculated that chip production costs (service) were 7 **eur/cub m (solid)**.

4.4 Chip delivery costs

Chip delivery costs are calculated based on distance from biomass fields to biomass boiler, considering a number of deliveries per day.

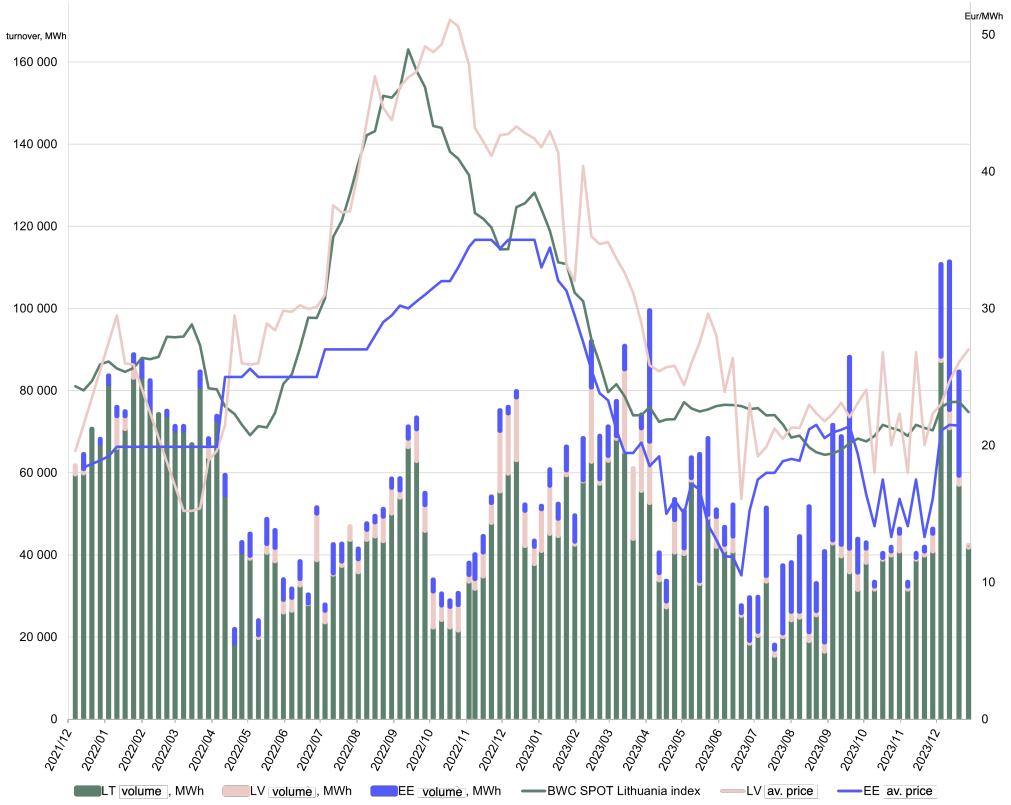
One truck can deliver up to 89-90 cub m (loose), which corresponds to 29-30 cub m (solid) chips. The price of transportation is charged appr. 1,5 eur/km for forward and back trip, or 3 eur/km one way trip. From harvested NutriBiomass4LIFE plantations till biomass boilers was appr. 60 km distance, therefore one truck could make 2 trips per day to deliver chips to the boilers at Vilnius city.

The cost delivery was **6 eur/cub m (solid).**

4.5 Revenues from biomass energy sales

Biomass energy chip sales to district heating networks, which operate biomass boilers, or private biomass boilers, which prices are regulated by the state, have to be execcuted through biomass energy exchange Baltpool. The sales contracts with biomass chips through biomass energy exchange Baltpool can be done on weekly (spot) or future supply basis.

Picture 4-1. Baltpool biomass energy chip prices Eur/MWh and turnover MWh



As it can be seen from Picture 4-1, the prices for biomass chips delivered at the boiler house were extremely volatile in 2022 and substantially decreased in 2023. The owners of biomass could highly benefit if they were able to sell biomass in the second half of 2022 when the prices peaked to 55 eur/MWh, while at the end of 2023 they decrease to 22-24 eur/MWh.

The price of biomass on the roadside typically has 75-85% share of SPOT Baltpool biomass energy chip prices Eur/MWh.

4.6 Financial result of biomass to bioenergy chips

Lithuanian biomass energy chip producers were under severe pressure from Byelorussian chip traders till 2021, as Byelorussian chips for long time were supplied at a very low price. Some of Lithuanian biomass energy chip producers went bankrupt or substantially decreased their production volumes, while Byelorussian energy chip traders with annual supplies of 1,6 million cub. m (solid) chips export to Lithuania gained up to 25% of total Lithuanian energy chip market, and in some areas like Vilnius and Kaunas approached to 50% market share.

The Russian war with Ukraine and shutdown of Byelorussian import substantially changed the market and improved profitability of biomass energy chip producers. 2022 were the most profitable year in the history of Lithuanian biomass energy chip producers, when net profitability reached 20-30% of the turnover.

Biomass energy chip producers, participating in Baltpool energy exchange auctions can benefit additionally from signing future contracts with biomass boilers, buying biomass at the roadside at the cheapest SPOT price during summer and selling it to the biomass boilers at the highest price during heating season.

5 Carbon footprint

Carbon footprint of biomass to renewable energy consists of several key inputs:

- Biomass harvesting - thinning
- Biomass forwarding
- Biomass chip production
- Biomass chip delivery to biomass boilers

5.1 Carbon footprint from biomass harvesting - thinning

Carbon footprint of biomass harvesting - thinning depends on the diesel fuel consumed by light excavator with mounted tree shear or small harvester and was based on the following assumptions:

- Harvesting – thinning output was 70 cub m (solid)/day.
- Diesel fuel consumption was 10 l/h per small excavator.
- Total 4332 cub m (solid) of biomass were harvested.

It is estimated that carbon footprint of biomass harvesting - thinning during NutriBiomass4LIFE project implementation **equaled to 13,2 tCO_2.**

Table 5-1. Nutribiomass4LIFE carbon footprint of biomass harvesting - thinning

		biomass harvested, cub m	CO2 footprint, t CO_2
1l diesel CO_2 emission factor, kg CO_2 /l	2,68		
Diesel consumption, l/cub m	**1,14**		
total		**4322**	**13,2**

5.2 Carbon footprint from biomass forwarding

Carbon footprint of biomass forwarding depends on the diesel fuel consumed by tractor with light forwarder and was based on the following assumptions:

- Forwarding output was 65 cub m (solid)/day.
- Diesel fuel consumption was 7 l/h per tractor.
- Total 4332 cub m (solid) of biomass were forwarded.

It is estimated that carbon footprint of biomass forwarding during NutriBiomass4LIFE project implementation **equaled to 10,0 tCO_2.**

Table 5-2. Nutribiomass4LIFE carbon footprint of biomass forwarding

		biomass forwarded, cub m	CO2 footprint, t CO_2
1l diesel CO_2 emission factor, kg CO_2 /l	2,68		
Diesel consumption, l/cub m	**0,86**		
total		**4322**	**10,0**

5.3 Carbon footprint from biomass chip production

Carbon footprint of biomass chip production depends on the diesel fuel consumed by chipper (truck or tractor) and is based on the following assumptions:

- Biomass chipping output was 1 truck or 30 cub m (solid)/h.
- Diesel fuel consumption of biomass chipper was 60 l per truck.
- Total 4332 cub m (solid) of biomass were chipped.

It is estimated that carbon footprint of biomass chipping during NutriBiomass4LIFE project implementation **equaled to 23,2 tCO_2.**

Table 5-3. Nutribiomass4LIFE carbon footprint of biomass chipping

		biomass chipping, cub m (solid)	CO2 footprint, t CO_2
1l diesel CO_2 emission factor, kg CO_2 /l	2,68		
Diesel consumption, l/cub m (solid)	**2,00**		
total		**4322**	**23,2**

5.4 Carbon footprint from biomass chip delivery

Carbon footprint of biomass chip delivery form biomass plantations to biomass boiler houses in Vilnius is based on the following assumptions:

- Long-haul trailer CO_2 emissions – 57g per t km
- Average weight of trailer load – 25 t

- Distance from biomass harvesting fields (Vilnius district, Suzionys sen.) to biomass boilers in Vilnius – 60 km.

It is estimated that carbon footprint of biomass chip delivery form biomass plantations to biomass boiler houses in Vilnius during NutriBiomass4LIFE project implementation **equalled to 11,8 tCO_2.**

Table 5-4. Nutribiomass4LIFE carbon footprint from delivery of biomass chips

items		No. of trucks	CO2 footprint, t CO_2
Long-haul trailer CO_2 emission factor, g CO2 /t km	57		
Transportation distances	km		
from Vilnius dist. Suzionys sen. to biomass boilers in Vilnius	60	138	**11,8**

The key factor in reducing CO2 emissions from delivery of biomass chips is reducing distance from biomass fields to biomass boilers.

5.5 Carbon footprint balance

Calculated CO_2 footprint balance from biomass to renewable energy supply (action B4) during NutriBiomass4LIFE project implementation **equaled to 58,2 tCO_2** and was composed of:

- CO_2 footprint from biomass harvesting – thinning, which equaled to **13,2 tCO_2**.
- CO_2 footprint from biomass forwarding from biomass plantation to roadside, which equaled to **10,0 tCO_2**.
- CO_2 footprint from poplar biomass chip production at roadside, which equaled to **23,2 tCO_2.**
- CO_2 footprint from biomass chip delivery from biomass fields to biomass boilers, which equaled to **11,8 tCO_2**.

6 Policy

6.1 Coherence with EU policies

6.1.1 Coherence with energy policies

On Oct. 9. 2023, the Council adopted the new Renewables Energy Directive (RED III), which set raised the 2030 target for the share of renewable energy in the EU's overall energy consumption from 32% to 42.5%.

RED III sets the following targets for RES in different sub-sectors:

- For heating and cooling, RED III sets a 49% indicative target for renewable energy share in buildings in 2030 as well as a binding annual increase of +1.1% from 2026 to 2030.
- For industry, the directive requires an annual increase for the use of renewable energy of +1.6% as well as a 42% share for renewable hydrogen used by industry in 2030.
- In transport, member states can choose between a binding target of a 14.5% reduction of greenhouse gas intensity from the use of renewables by 2030 or a binding share of 29% of renewables within final energy consumption in transport.

The same renewable energy directive sets certain standards for governance of environmental sustainability of bioenergy used in the EU, and provides tools that can be used to limit or minimize

risks to ecosystems related to biomass for bioenergy sourcing. This attempt comes with the tool of biomass for energy certification for sustainability criteria. Biomass plantations grown as agricultural crops are “agricultural plantations” and not considered a forest. In majority of cases biomass supplied form such “agricultural plantations” is considered sustainable, taking into account that they are not established on peatlands, grasslands with high biodiversity and not on former forest land.

6.1.2 Coherence with environmental and climate policies

The EU Biodiversity Strategy for 2030 (COM/2020/380), places an important objective for afforestation in the EU and also calls for a legislative instruments to restore degraded ecosystems, in particular those with the most potential to capture and store carbon and to prevent and reduce the impact of natural disasters. To minimize the risks of unintended impacts on biodiversity, afforestation interventions should be addressed in foreseen actions of the EU Biodiversity Strategy for 2030 including appropriate safeguards and guidelines to promote ecologically and economically sound interventions. Such biodiversity and environmental aspects are considered when establishing NutriBiomass4LIFE poplar plantations on agricultural land.

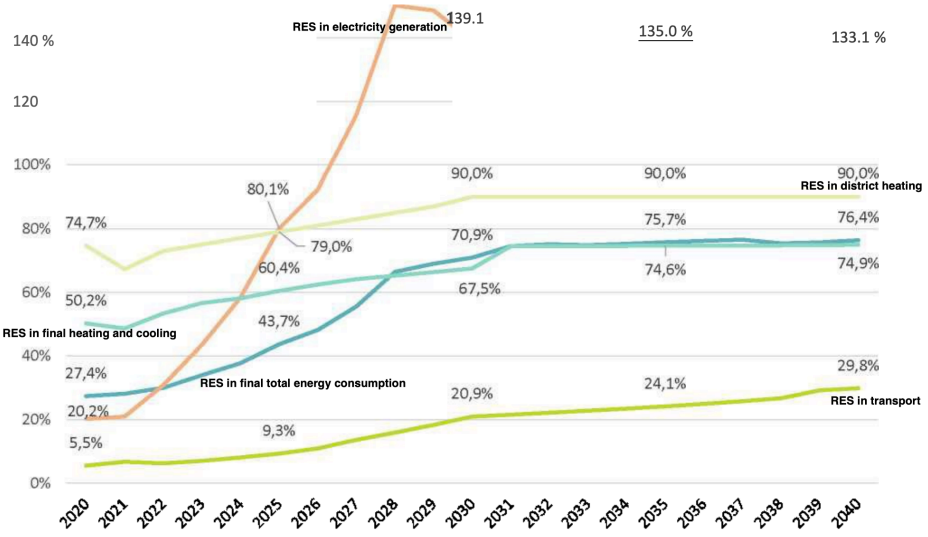
A risk exists of a potential mismatch between policy signals: RED stimulates bioenergy demand by economic operators (and forest bioenergy policies by counting forest bioenergy towards national renewable energy target), while LULUCF disincentivises countries to harvest beyond certain limits.

Biomass plantation establishing on marginal lands are fully coherent with EU environmental and climate policies. Such biomass plantations are much richer in biodiversity than any other cropland. Even comparing to grasslands, such poplar plantations on agricultural land are not less biodiverse than grasslands and in many cases can provide even higher biodiversity. In terms of climate change mitigation, NutriBiomass4LIFE poplar plantations are probably the most efficient carbon removal tool among all other agricultural practices. Biomass energy production from NutroBiomass4LIFE poplar plantations with the target to maximize carbon removal through extension of rotation periods and sourcing biomass according cascading wood use principles, sets the stage for plantation biomass usage for bioenergy on forest biomass usage principles: plantation biomass energy to be produced from thinnings and final harvesting residues.

6.2 Coherence with national policies

Biomass in Lithuania plays a key role in renewable energy production. In 2023 renewed National energy and climate plan foresees that 90% of the district heating sector will remain based on biomass (RES) – this includes a biomass share in municipal waste incinerated.

Picture 6-1. Targeted share of RES in gross final energy consumption and relevant sectors (NECP of Lithuania)



In the district heating system, several major changes are projected in the NECP of Lithuania. Vilnius CHP plant to be fully operational in 2023 (actually delayed to 2024) which will have heat production capacity of 240 MW (approximately 60 MW for the waste unit and around 180 MW for biomass). By 2030, new and upgrades of existing district heating installations of around 190 MW are expected.

It is expected that in short term biomass consumption for district heating will increase due to engagement of Vilnius CHP but in long term district heating production will decrease – by 11.3 % and 21.4 % in 2030 and 2040 respectively. This decrease is expected due to energy efficiency improvement measures (renovation of buildings, increasing consumer awareness, etc.) and efficiency gains in energy production.

The provisions of Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources on sustainability and greenhouse set stricter sustainability requirement for biomass usage in energy sector. From 1 May 2023, the Renewable Energy Act of Lithuania introduced the requirement for all market participants in the Lithuanian energy resources market to use only biomass that meets sustainability requirements when using biomass in installations for the production of electricity, heat and/or cooling with a total rated thermal input of 20 MW or more (according RED III it will be changed to 5 MW and more input). In addition to voluntary certification schemes for biomass, which are recognized by the European Commission, voluntary national scheme has been assigned to BALTPOOL, an energy exchange operator while selling biomass through the energy exchange.

All biomass supplied from NutriBiomass4LIFE plantations meet sustainability criteria of voluntary national scheme. In addition, in 2023, all NutriBiomass4LIFE plantations were certified for sustainable forest management under Forest Stewardship Council® (FSC®) certification requirements. It is assumed that FSC® certified biomass supplied for renewable energy production is in full compliance of sustainability criteria of voluntary national sustainability certification scheme.

7 Continuation

129 ha of older biomass plantations, established before startup of NutriBiomass4LIFE project, but included in NutriBiomass4LIFE project scope were thinned (harvested 50% of growing trees) to produce 7,8 GWh of biomass energy. In the next three years after project implementation, we will need to thin the remaining 600 ha of older biomass plantations, which will provide estimated 36GWh of renewable energy or on average 12GWh/year.

To implement thinning and deliver biomass for renewable energy production for Vilnius city we consider investing into harvesting, forwarding and chipping services to sell biomass chips directly to biomass boilers as external services are not reliable or are unavailable when are needed.

Conclusions

The key lessons we learned from nutrient from biomass to renewable energy action (B4) implementation of NutriBiomass4LIFE project:

- During 2022/2023 heating season total 13127 cub m (loose) (or 4332 cub m solid) of wood chips were produced from harvested biomass from 7–8-year-old poplar plantations which were delivered to various Vilnius boilers for heat energy production, from which 7,8 GWh of heat energy were produced. The key task of this action was to demonstrate closing of NutriBiomass4LIFE CE loop.
- The reasons why we do not produced 39,4 GWh of biomass chips as was initially planned were (1) the change in the strategy to grow biomass for longer rotation to maximize carbon removal and to implement cascading wood usage policy, (2) to perform thinning of biomass plantations instead of clear cut (coppicing) and (3) limited availability of external services for biomass harvesting, forwarding and chipping to perform services in time and at required quantity.
- Calculated CO_2 footprint balance from biomass to renewable energy supply (action B4) during NutriBiomass4LIFE project implementation equaled to 58,2 tCO_2
- The experience of implementation of biomass to renewable energy action showed that there is a need to invest into harvesting, forwarding and chipping services to sell biomass chips directly to biomass boilers as external services are not reliable or are unavailable in time. Only by direct supplying biomass boilers with energy wood it is possible to benefit from higher prices during heating season.
- Energy wood from biomass plantations is probably the most expensive biomass energy source if plantations are established exclusively for energy purposes. Longer rotation of biomass plantation, orientation towards industrial roundwood use and combination with carbon removal services may be much more valuable business and social model, providing renewable energy wood from thinning and harvesting residues, as well.