Mid-term report, Centre of Excellence Trees For Me,

2022–2024

Trees For Me

Contents

Chairman's message

As the Dean of the Faculty of Forest Sciences, I have the privilege to participate in many research programmes, e.g. Umeå Plant Science Centre (UPSC), Wallenberg Initiative for Forest Research (WIFORCE) and Trees for the Future (T4F). Trees For Me stands out in two respects. Firstly, Trees For Me has an outstanding interaction with stakeholders, while still being able to maintain academic independence. The list of stakeholders in Trees For Me is broad and impressive, and what is even more impressive is the stakeholder engagement in the Centre. There is no doubt that Trees For Me will contribute to diversifying forestry in Sweden which is an ambition shared by the forest stakeholders.

The second thing that stands out is that research in Trees For Me aims at improving operational forest management practices and production of energy and materials from forest biomass. The research conducted in Trees For Me is mostly applied, done in close collaboration with stakeholders which ensures rapid implementation of research results among practitioners.

The Centre of Excellence Trees For Me has just passed the half-way mark of its first phase. We start to see results being released from the PhD projects. I am very happy to see that results are professionally communicated to the wider society almost as soon as data from experiments have been analysed.

I have participated in many external events and webinars given by the Centre, and I am impressed by the presentation skills of the PhD students. I was especially impressed when I got to know that PhD students that do not have Swedish as their native language were presenting in Swedish in webinars geared to private forest owners in Sweden. This shows that the PhD studies are also about learning skills that will be useful for future careers.

The Trees For Me Centre of Excellence will be evaluated during 2025 and the Centre will submit an application for the second five-year period. I am convinced that this will be successful with even more engagement from organisations in the forest and energy sector than during the first phase of Trees For Me. Since I will serve as Dean for another three-year period, I look forward to working with Trees For Me during the coming years.

Göran Ericsson

Chairman of the Executive Board, Trees For Me

Dean of the Faculty of Forest Sciences, Swedish University of Agricultural Sciences (SLU)

This is Trees For Me

This is Trees For Me

Trees For Me (**Trees**, sustainable **FOR**est, **M**aterial and **E**nergy) is a Centre of Excellence focused on fast-growing broadleaf trees for sustainable forestry, materials and energy in Sweden.

Tree breeding

Silviculture

Material and energy

Societal transitions

Environmental impacts

The Centre is a platform where academia, government and industry/society come together to develop science-based, innovative solutions by combining expertise along the whole forest-based value chain. Future competence is to be built in a new forest biomass supply system for conversion to high-value material and energy products.

Research

Trees For Me coordinates an interdisciplinary research programme with the aim to advance the science beyond the state-of-the-art in the full value chain from seed to sustainable fuels and high value-added products from fast-growing broadleaf trees. The research is conducted within the work packages of tree breeding, silviculture, material and energy, societal transitions and environmental impacts.

Education

There are 12 PhD students and two post-docs that are financed by Trees For Me and an additional eight PhD students that are working with fast-growing broadleaves but financed by other sources. All PhDs started in the autumn of 2022 or winter of 2023, and many of the PhDs have now presented their mid-term report. Research papers have started to be published as a result of these PhD projects, but we expect many more to come during the next two to three years. The first thesis defence will take place in the autumn of 2026 and will be followed by many more during the winter of 2026/2027.

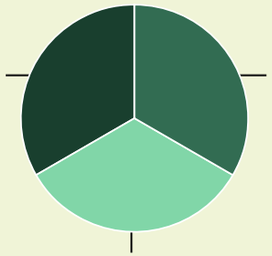
Many of the researchers in Trees For Me are course leaders for courses at the bachelor's and master's level and almost all of the PhDs, postdocs and researchers are involved in teaching. Trees For Me research results are already now extensively used in teaching, and this will only increase in the coming years as new research findings are presented.

One important goal for Trees For Me is to increase competence and knowledge in the forest sector about growing fast-growing broadleaves and the use of biomass from these trees in new products. Therefore, we have an extensive focus on communication and outreach activities including excursions, webinars, popular science articles and more. A large part of the research in the PhD projects is done in collaboration with stakeholders. This research collaboration is, of course, extremely important for the PhD projects, but it also results in an engagement from stakeholders in our research even before results are presented.

Collaboration

Trees For Me is financed by the Swedish Energy Agency and almost 50 societal actors, ranging from academia and companies to interest organisations.

The Centre is coordinated from the Swedish University of Agricultural Sciences (SLU) in Alnarp, Skåne.



1/3: partner organisations from the forest and energy sector

1/3: the Swedish Energy Agency

1/3: academic actors: Swedish University of Agricultural Sciences (SLU), Luleå University of Technology (LTU), Skogforsk, Umeå University (UmU), Uppsala University (UU)

Organisations

Private forest owner associations

- Mellanskog
- Norra Skog
- Södra

Energy companies

- Cortus Energy
- Harads Arctic Heat
- Skellefteå Kraft
- Uddevalla Energi

Public administration

- Nordic Forest Research (SNS)
- Nordic Joint Committee for Agricultural and Food Research (NKJ)
- Norrbottens skogsstrategi
- Skogsstyrelsen
- Skånsk skogsstrategi (Länsstyrelsen Skåne and Region Skåne)
- Smålands skogsstrategi
- Västerbottens skogsstrategi

Non-profits and other organisations

- Biosfärområde Vindelälven-Juhttátahkka
- Lantbrukarnas riksförbund (LRF)
- Naturskyddsföreningen Blekinge
- Naturskyddsföreningen Skåne
- Skogstekniska klustret
- Spillkråkan
- Svenska Jägareförbundet

Forest companies/forest owners

- Holmen
- Kopparfors Skogar
- Poppelbolaget
- SCA
- Skogssällskapet
- Stiftelsen Skånska Landskap
- Stora Enso
- Sveaskog
- Svenska Kyrkan
- Sydved

Other companies

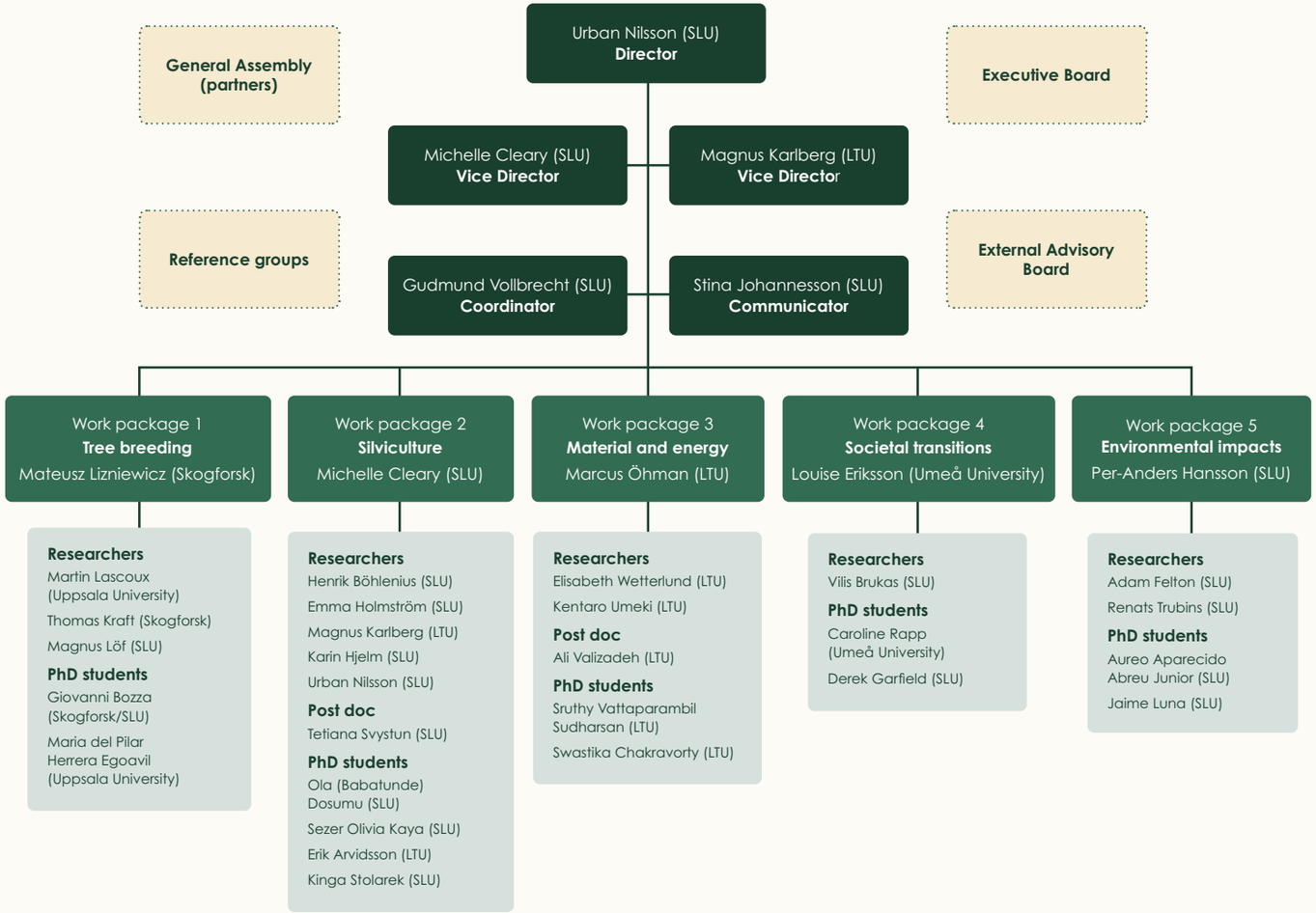
- Arevo
- Björkemar Construction & Consulting BCC
- Bracke Forest
- Organox
- Persson f.N.B
- Ramlösa plantskola
- Skogspodden
- SweTree Technologies
- Sydplantor
- TreeToTextile

See full list of partners: www.treesforme.se/en/collaboration

Management and governance

Trees For Me is managed by several steering groups consulting on academic and managerial issues.

All co-financing partners are represented in a reference group.



The first years in short
(2022–2024)

Research

16 peer-reviewed journal articles.

18 scientific conference contributions.

2 half-time seminars completed.

32 approved research funding applications, adding an additional 40 million SEK.

32 cropping experiments, four thinning experiments, four spacing experiments, seven mixed species experiments, nine group planting experiments.

All experiments except the mixed species experiments were installed in collaboration with partner organisations.

Education

Seven MSc and one BSc theses directly related to Trees For Me.

Course leaders for several bachelor's and master's courses, and teaching on many others.

Outreach

85 news articles and radio/TV features in external media.

31 webinars targeting partners, forest owners, advisors, researchers, and the general public.

25 own popular science articles.

1 948 registrations for webinars.

289 meetings and events with internal and external stakeholders.

40 other outreach activities, e.g. participation in external excursions, information and networking events, outreach to politicians, etc.

255 newsletter subscriptions, with an average open rate of 52% across eight newsletters.

263 followers on LinkedIn (starting date of page: 18 June 2024) and engagement rate of 13,2% (an engagement rate above 5% is considered excellent) between 18 June – 31 Dec 2024.

Director's input

The Director of Trees For Me and Professor in silviculture at the Swedish University of Agricultural Sciences (SLU), Urban Nilsson, shares his thoughts on the progress and future focus of the Centre.

What are your main take-aways from working with the development of Trees For Me during 2022–2024?

There are many things, but the most important would be that it is very inspiring to have the opportunity to work with so many engaged people. We have 12 PhD students and two postdocs in the Centre of Excellence and several more that are working with related topics. All students are extremely motivated, and it is a pleasure to work with them and see them grow as researchers, but also as persons. We also have more than 40 stakeholders that are partners in the Centre and their enthusiasm for growing fast-growing broadleaves or using the biomass for energy or other products is why I believe that Trees For Me will contribute to a big change in Swedish forestry. Without the partner organisations, we would be just another research programme but with them we can make a real difference.

The strong collaboration and engagement from the executive management team – Michelle Cleary (vice director), Magnus Karlberg (vice director), Gudmund Vollbrecht (coordinator) and Stina Johannesson (communications officer) – have been pivotal to the growth and success of Trees For Me.

What role can Trees For Me play in future forest research and practice, in Sweden and globally?

Trees For Me is a Centre of Excellence with the goal of enhancing competence and know-how in fast-growing broadleaves. When the PhD students have defended their theses, they will start working in the forest and energy sectors or in academia. They are the future leaders in this field. The goal for Trees For Me is also to enhance competence in the forest sector. We have had many communication activities aiming at implementation of research results in practical forest management and use of the raw material.

Communication will be intensified during the last two years of phase one, with several excursions, webinars and other activities. However, it goes both ways. The research questions start with practical problems, that are communicated to researchers during in-person or digital meetings. All research in Trees For Me is deeply rooted in practical problems, aiming to improve existing practices.

What are the main challenges which will be in focus in the future work of Trees For Me?

We should not fool ourselves to think that there are no challenges. An immediate problem is the availability of birch seedlings for planting. There are problems with both seed- and seedling production. While we have research projects studying this, the issue will not be solved during the first five-year period, and it requires cooperation with stakeholders to create the necessary infrastructure.

Another problem is damage to planted seedlings and trees. Browsing, in particular, can be quite intense in some geographic areas, and more research is needed on protecting seedlings from browsing. But other damage can also be problematic, both damage agents that exist today in Sweden that we do not consider a big threat to birch, but also introduced damage agents that may be serious threats in the future.

The choice of sites for planting birch is also high on the research agenda for the future. Climate change may result in a shift of sites that are suitable for birch, and we need to understand this shift to select the best sites for future fast-growing broadleaved stands.

Lastly, the current market for fast-growing broadleaves is almost entirely restricted to pulpwood that is relatively low paid compared to other products. More high-value products need to be developed to improve the economy of broadleaved stands.

How fun is it to be part of Trees For Me?

Being a part of Trees For Me is extremely fun. I have already talked about the enormous engagement from researchers and stakeholders. It is fun to work when other people are genuinely interested in what you are doing. It is also motivating to work with Trees For Me because I truly believe I'm not the only one who feels that we will make a real difference for the future.

The aim that more than 10% of the total planted seedlings are going to be broadleaved seedlings in the future is shared by many, and this collective commitment by the forest sector is necessary for it to come true. When this happens, it will have a big effect on the structure of the forest sector and contribute to sustainable forest production for the future. To increase the share of planted broadleaved seedlings is not only about diversification for future sustainable production, but it will have additional benefits such as adaption to climate change, enhanced biodiversity and the development of new products.

Urban Nilsson | Director of Trees For Me.
Photo: Torbjörn Esping.

Research

Research

The research conducted by Trees For Me spans 17 research projects and focuses on tree breeding, silviculture, material and energy, societal transitions and environmental impacts.

The 12 PhD students and two postdoctoral researchers are currently engaged in establishing experiments, completing data analyses, and disseminating early results from their projects. In 2023, a new greenhouse was built at the field station in Ekebo which is now used to facilitate the operational breeding of birch. Work on genomic selection of silver birch is ongoing, while several research projects focus on developing resilient and efficient forest management systems for fast-growing broadleaves. Additionally, research is focused on investigating efficient and sustainable thermochemical conversion processes based on these fast-growing broadleaf species.

Other projects focus on identifying combinations of fast-growing broadleaf species that may best achieve biodiversity goals for production forest lands, as well as investigating the overall climate impact of production chains based on these species. A major survey has been sent out to private forest owners to investigate their willingness to increase the use of fast-growing and other broadleaf species, as well as the factors influencing their decisions.

Even more relevant today

"There is a strong need to transform how we think about and use forests, to make sure they can continue to be used for the multitude of services they provide. Here, I think Trees For Me is very well-positioned and extremely well timed, as much of the motivation behind the Centre is even more relevant today, than when we started drafting the proposal."

Elisabeth Wetterlund | Research project leader in Trees For Me and Professor in energy engineering at the Division of Energy Science, Luleå University of Technology (LTU). Photo: Tomas Bergman.

Below the leaders of the research work packages present the latest updates from the respective projects.

Work package 1 – Tree breeding

PhD students

Giovanni Bozza, Maria Del Pilar Herrera Egoavil

Researchers and project leaders

Mateusz Liziniewicz, Martin Lascoux

Researcher in tree breeding and work package leader Mateusz Liziniewicz shares the latest updates from the research projects.

Overview

2024 was an intensive year for both operational breeding and research projects focused on genomic selection and flowering. New trials were established, new plant material was produced, and significant results were obtained from flowering experiments.

Trials and seed production

In northern Sweden, four new progeny trials were planted to test 65 full-sib crosses (with both parents known) from established breeding populations. A total of 14,000 seedlings were planted to identify superior genotypes for future breeding cycles and seed orchards to supply the forest sector. These trials are the first of their kind in northern Sweden since 1995 and will serve as a crucial resource for future breeding efforts. Additionally, new plants were produced for three demonstration experiments to be planted in 2026, showcasing the impact of breeding and selection. Surplus seedlings from the full-sib families will be propagated as rooted cuttings for clonal trials, which will be planted in 2026 to strengthen the foundation for genomic selection in northern Sweden.

In spring 2024, 100 new crosses were made within the breeding populations, with seeds to be used in upcoming trials.

Selection activities

In southern Sweden, 20 new genotypes were selected from 20 full-sib families in the 2014 progeny trials. These selections predominantly consist of crosses between populations that were created before the current breeding populations were finalised. They will be considered an additional breeding population alongside the four existing ones. These selected clones may serve as backups for standard breeding populations if some genotypes prove unsuitable for crossing.

Genomic selection

In 2024, material for the development of a screening array was genotyped. The data has been delivered, and ongoing analyses aim to create a SNP chip, which will later be used to genotype trees in breeding trials and select material for genomic breeding programmes.

Trials for genotyping in 2025 have been identified in both southern and northern Sweden, with collection protocols now established.

Flowering induction experiments

In spring 2024, two experiments were initiated to induce early flowering in birch trees. The first experiment tested the effects of continuous light (24/7), plant hormones, and genetic background on one-year-old birch seedlings, revealing that continuous light significantly promoted flowering, while ambient light did not. The second experiment examined two-year-old grafted birch clones under similar treatments, with preliminary observations suggesting that 24/7 light has a strong effect on flowering.

Over time, some flowers were aborted, but surviving structures will be analyzed for pollen fertility in the spring of 2025. Future studies will focus on testing a broader genetic population, optimizing plant growth regulator treatments with paclobutrazol, and thoroughly assessing the effects of CO_2 enrichment on flowering.

PhD student Giovanni Bozza treats birch seedlings with growth hormones in the new greenhouse in Ekebo. Photo: Mateusz Liziniewicz.

Solid scientific insights and practical guidance

"Having this network of young researchers from diverse backgrounds, working on different aspects of the same goal, is beneficial. Together, we will be able to provide solid scientific insights and practical guidance to support the use of fast-growing broadleaves in Swedish forestry."

Ola Dosumu | PhD student in Trees For Me and at the Swedish University of Agricultural Sciences (SLU). Photo: Ola Dosumu.

Knowledgeable about many different facets

"Through our joint meetings, we not only learn about our specific areas but also gain insight from one another into various aspects related to fast-growing species. This approach is extremely valuable as we become knowledgeable about many different facets of this topic."

Kinga Stolarek | PhD student in Trees For Me and at the Swedish University of Agricultural Sciences (SLU). Photo: Dusan Sadikovic.

Input to spark new ideas

"The interaction between different sectors helps finding practical solutions and creates opportunities for learning across disciplines. By visiting different sites together, new questions appear. Some of which can be answered on site, while other provide input to spark new ideas."

Erik Arvidsson | PhD student in Trees For Me and at Luleå University of Technology (LTU). Photo: Magnus Stenberg.

Work package 2 – Silviculture

PhD students

Kinga Stolarek, Erik Arvidsson, Ola Dosumu, Sezer Olivia Kaya. Affiliated: Alfred Deutgen, Andis Zvirgzdins, Iida Puurula, Joel Jensen, Luca Muraro, Michalina Grabowska

Post doctoral researcher

Tetiana Svystun (starting in 2025)

Researchers and project leaders

Karin Hjelm, Magnus Karlberg, Emma Holmström, Henrik Böhlenius, Michelle Cleary, Urban Nilsson. Affiliated: Felicia Dahlgren Lidman

The work package leader and Associate Professor in forest pathology, Michelle Cleary, shares updates from the silvicultural research.

Seedling production and stand establishment of birch

Four individual studies have been developed within the PhD project, "Seedlings and Regeneration Procedures for Future Birch Forests", to gain scientific knowledge and operational experience in increasing the regeneration success of silver birch in Sweden. The first study investigates the possible effect of fungi on seed germination. This project aims to enhance both seed germination and seedling health. A publication is planned for spring 2025.

The second study aims to optimise nursery practices for overwintering birch seedlings, as birch may need different conditions than conifer seedlings. The project has explored using short-day treatments to induce dormancy in birch seedlings and control their height growth. Additionally, we are testing various storage durations for birch seedlings in a freezer to determine the optimal storage period and its impact on seedling vitality.

The third project explores the potential for skipping winter storage by directly seeding seedlings at a specific time before planting. Due to its rapid growth, silver birch has shown promise for just-in-time production. However, birch seedlings produced in this manner may be more sensitive to improper handling. The desired outcome of this project is to generate research-based knowledge that will guide the optimal handling of birch seedlings, which can then be shared with interested parties. Additionally, the project is investigating a potentially new operational system for nursery seedling production specific to silver birch.

The fourth study focuses on optimising the planting of birch seedlings in Sweden across various climatic regions and site conditions. Key factors investigated include container size, planting date, site preparation methods, and fertilisation. Additionally, seedlings are planted at different times throughout the year and on clearcuts of different ages. The anticipated outcome of this project is to gain insight into the potential challenges in establisheing birch plantations, including both abiotic and biotic damage. This knowledge will contribute to the development of recommendations for effective solutions and technologies to improve establishment and reduce damage to birch seedlings.

Stand management

The goal of the stand management PhD project is to apply diverse management actions and assess the growth of birch in both monoculture and mixed stands. Additionally, the project aims to develop height and biomass functions for estimating the productivity of planted birch stands. The findings from these studies will contribute to knowledge required to develop silvicultural guidelines for planted birch in Sweden, ensuring the potential to grow highly productive birch stands that provide valuable products for the bioeconomy.

A study on how thinning strategies impact the productivity, perpetuity and profitability of mixed stands has been completed and published in the Scandinavian Journal of Forest Research. The study showed that at the end of the rotation period, spruce-dominated mixed stands exhibited similar growth and better economic outcome compared to spruce monocultures. However, a trade-off was observed between maintaining a high birch basal area, sustaining production and achieving good economic returns.

A manuscript on mixed forest dynamics and supplementary planting is currently under development. In an experiment on former agricultural land, Norway spruce and silver birch seedlings were either planted simultaneously or one year apart. Preliminary findings indicate that the growth of birch was only minimally affected when planted one year after spruce, whereas growth of Norway spruce was negatively affected when planted one year after birch. These preliminary results were presented at the IUFRO World Congress 2024 and at Trees For Me stakeholder meetings.

Four new thinning experiments in planted silver birch have been established in southern Sweden. At the time of establishment, trees were harvested for biomass sampling, and the biomass of different fractions will be compared with existing biomass functions. Additionally, thinning experiments in Sweden and Latvia have been measured, and results will be published during 2025. Lastly, measurements for constructing height development functions have been done and will be repeated during 2026.

Autonomous regeneration

This project focuses on sustainable, autonomous, mechanised regeneration of fast-growing broadleaves. The design space was explored through a thorough literature review, benchmarking as well as discussions and interviews with experts in various areas of forest management and forest technology, leading to a product specification. Based on this specification, various concepts were generated and evaluated in collaboration with Bracke Forest, with one concept ultimately selected for prototyping. The research in this project has since focused on the autonomous architecture for this selected concept.

So far, research on mission- and behaviour planner have been conducted. A method and tool have been developed for how to distribute mixed species seedlings on a regeneration area, taking species ratio choices into consideration. This tool can optimise biomass production for a given mixture of species. The autonomous forest regeneration vehicle must also be able to reach all pre-planned planting spots. Therefore, a path planning tool has also been developed. This tool utilises a genetic algorithm to derive an optimised path, minimising the travelled distance while covering the entire regeneration area in 3D for the autonomous vehicle to follow. To ensure the vehicle follows the predetermined path, a navigation system based on a pure pursuit

tracking algorithm has also been developed. This system has been validated on the AORO (LTU's 10-ton autonomous research vehicle platform).

The perception system is crucial in autonomous systems, and in forest regeneration there are a lot of properties, entities and objects that need to be identified in real time during operation. So far, detectors for identifying important visible obstacles, such as stumps, stones and logs, have been developed. The accuracy and robustness of this perception system have been tested and validated under realistic conditions. Some of the challenges addressed in this research project have been included in the Mechanical Engineering programme at Luleå University of Technology, such as in project courses. Results from the project have also been communicated to students at dedicated seminars.

Pests and pathogens on silver birch

Productivity expectations are not always met because of unanticipated problems with pests and diseases. Several individual studies have been developed within the PhD project focused on current and future risks to planted silver birch. In 2023, several experimental trials were initiated to investigate whether *Heterobasidion* root rot poses a threat to birch. Preliminary results suggest that the frequency of infection on birch stumps is rather low, which may be attributed to the presence of another fungus, *Ophiostoma quercus*, which is dominant and frequently associated with birch. The presence of this fungus may prevent the natural germination of *Heterobasidion* spores that land on stumps after cutting, but this hypothesis is being tested through a new series of *in vitro* and *in vivo* laboratory experiments.

Recent observations of damage and tree mortality in newly planted birch have prompted new investigations to further understand the extent of the problem, and causal agent of the damage. Early results from a field experiment established in 2024 indicate that the pine weevils *Hylobius abietis* and *Hylobius pinastri* primarily damage the bark and can girdle birch trees, while *Strophosoma melanogrammum* and *Otiorhynchus scaber* cause non-lethal damage to the leaves. Trees treated with mechanical protection (Hylonox) showed significantly lower mortality compared to untreated trees (2% vs. 16%). The study will continue for another year to assess if and how the trees recover and whether the damage persists. Additionally, plans are in place to investigate the variability of weevil damage across Sweden in a series of new field experiments including other commercially important tree species.

A future threat to European birch is the bronze birch borer (*Agrilus anxius*), an insect pest native to North America that has not (yet) been introduced to Europe. However, observations from several field experiments in North America, where native and exotic birch are planted together, suggest that if this insect were introduced, mass mortality of European birch species could be expected. To better prepare for such a biological invasion, rapid early detection tools are essential to intercept the pest before it establishes itself in a new country. In collaboration with an international team of researchers, an early detection tool was developed and field-validated, enabling rapid, point-of-use detection of bronze birch borer from environmental DNA (eDNA) samples. The study was published in the journal Environmental DNA and has received high attention from international forest pathology and entomology communities as well as plant phytosanitary agencies across the EU.

Pine weevil on birch seedling. Photo: Henrik Johansen.

Work package 3 – Material and energy

PhD students

Swastika Chakravorty,
Sruthy Vattaparambil Sudharsan

Post doctoral researcher

Ali Valizadeh

Researchers and project leaders

Marcus Öhman, Elisabeth Wetterlund,
Kentaro Umeki

PhD students, researchers and Marcus Öhman, work package leader and Professor in energy engineering, present the latest updates related to material and energy research.

Value chains based on fast-growing broadleaf species

Currently, strategies are being investigated to make increased shares of silver birch in Swedish forests attractive from an economic perspective. Different management strategies for birch and birch/spruce mixed forests have been evaluated, with a focus on integrating energy biomass and birch timber into the Swedish forest value chain. Specifically, the economic feasibility of energy biomass harvesting and precision thinning where thinning, optimised for each individual tree species, as well as the economic justification of active management for birch timber production, have been addressed.

Simulations indicated that introducing birch timber yields positive net revenue, and precision thinning can outperform traditional methods under favorable site conditions. However, practical challenges with precision thinning, such as machine route planning, remain. Thus, while theoretically promising as an economically viable management strategy, precision thinning requires further development before practical recommendation.

Thermochemical conversion processes

The concentrations of ash-forming elements and molecular composition of organic fractions in different tissues from a 19-year-old second-rotation poplar experimental site are being determined. The study follows different thinning treatments: untreated (6,000 stems per ha), light thinning (3,000 stems per ha), medium thinning (1,100 stems per ha), and heavy thinning (550 stems per ha). In each treatment, samples of stem wood, bark, and branches of trees with varying diameters (7, 15, and 25 cm) were collected and analysed for ash-forming elements,

Fredrik Granberg, CEO at LTU Green Fuels, presents the pilot plant for the gasification of bioproducts to syngas and green fuels, at study visit in Piteå in 2024. Photo: Stina Johannesson.

such as Ca, Mg, Na, K, Al, Fe, Si, S, P and Cl, as well as major macro-molecules in organic fractions, including cellulose, hemicellulose, lignin, and extractives. The highest concentrations of ash-forming elements were found in all tissues for Ca and K, followed by Mg and P. Compared to wood tissue, bark and branches contained higher amounts of ash-forming elements.

Preliminary results suggest that poplar biomass from these treatments exhibits fuel ash characteristics similar to those of forest fuels from conifer tree species, making the biomass suitable as a feedstock for thermochemical conversion methods. Growth conditions slightly affected the composition of different macro-molecules, with larger changes observed in the bark compared to stem wood. The high extractive fraction found in the bark can motivate the possibility of developing biorefinery value chains where extracted organic compounds could be refined into fine chemicals and bio-oil. Additionally, separated cellulose and lignin offer further opportunities to tailor conversion processes for various applications.

During the fall of 2023 and the spring of 2024, a complete value chain was followed based on a 19-year-old second-rotation poplar stand with a total production of 700 m^3 per ha. This stand was situated near the previously studied poplar experimental site. The value chain included harvesting, transportation, fuel preparation (crushing/milling) of the entire tree – including stem, bark, branches, and tops – followed by combustion in a local district heating plant with a medium-sized grate-firing biomass boiler. The fuel characteristics showed significantly better fuel quality than typical *Salix* assortments and were comparable to previously studied energy wood assortments from conifers and birch. According to the energy company, the handling and milling of poplar went smoothly, with no significant differences in operation or combustion performance compared to the ordinary fuel mixture.

During 2023, a four-day experimental combustion campaign was done with a 20% admixture of birch round wood to an ordinary fuel mix containing softwood sawdust and wood chips in a 50 MWth full-scale circulating fluidised bed situated in Lycksele. The combustion plant, owned and operated by Skellefteå Kraft, received 240 m^3fub of birch round-wood which was delivered by Sveaskog. The handling and milling of the birch round wood went smoothly, with no significant differences observed in the operation or combustion performance, such as thermal efficiency or gaseous emissions, when compared to the ordinary fuel mixture used.

Photo: Unsplash.

Strong network for future collaborations

"The mentorship programme and study trips with stakeholders gave me another perspective on putting my research into practice, exchanging knowledge and building a strong network for future collaborations."

Aureo Aparecido Abreu Junior | PhD student in Trees For Me and at the Swedish University of Agricultural Sciences (SLU). Photo: Aureo Aparecido Abreu Junior.

Added value to my experience as a PhD student

"Tree For Me has added value to my experience as a PhD student by providing a network consisting of other PhD students, researchers, and stakeholders. Meeting with stakeholders has been very valuable seeing that my project investigates different actors' perspectives on a large-scale increase of fast-growing broadleaves."

Caroline Rapp | PhD student in Trees For Me and at Umeå University. Photo: Ina Timm.

Produce and refine evidence-based knowledge that benefits stakeholders

"Being a PhD student within Trees For Me gives us an exceptional opportunity to engage in cutting-edge research supported by a broad network of forestry and energy institutions. This environment allows us to produce and refine evidence-based knowledge that directly benefits stakeholders and the general public in the forestry and energy sectors."

Jaime Luna | PhD student in Trees For Me and at the Swedish University of Agricultural Sciences (SLU). Photo: Jaime Luna.

Work package 4 – Societal transitions

PhD students

Caroline Rapp, Derek Garfield

Researchers and project leaders

Louise Eriksson, Vilis Brukas

Louise Eriksson, work package leader and Associate Professor in environmental psychology shares the latest updates from the research on societal transitions.

The focus within this work package is building a foundation for studying societal perspectives on fast-growing broadleaves. Two key projects were initiated: the first, "System innovations" began in October 2022, while the second, "Forest owners and stakeholders" started in January 2023.

The key approaches of these projects revolve around understanding system transitions, including the role of policy instruments, and utilizing psychological and geographical perspectives to understand stakeholders. The diverse activities in Trees For Me have been important when preparing for the first set of data collection in the projects. Interviews have been conducted with stakeholders to explore innovators and their business models. In addition, a large-scale survey of individual private forest owners in Sweden was carried out to explore adoption of fast-growing broadleaves and the conditions affecting the owners' decisions.

In 2024, the work has been primarily focused on data analyses and the dissemination of some preliminary findings to Trees For Me partners, the forest sector more broadly, and researchers.

In the "System innovations" project, qualitative data from stakeholders have been analysed to understand fast-growing broadleaf trees value creation, drawing on systems transition theories. The study identified six configurations ranging from small rural businesses producing birch beverages to industrial-scale production of hardwood textile pulp. Since the project reached its halfway point by October, the PhD student successfully completed the midterm seminar.

In the "Forest owners and stakeholders" project, survey data from forest owners have been analysed focusing on their interest in adopting improved birch. The transition towards more broadleaves has been studied using an integration of geographical and psychological perspectives. Results showed that both the owners' context – physical, social and relational – and their beliefs and emotions were key determinants of their interest in improved birch. In addition, interviews with both the forest and non-forest stakeholders have been initiated.

As part of their education, the PhD students have participated in courses focusing on social science theory and methods to prepare for the studies to be implemented in each of the projects. Research conducted in the projects has been disseminated at international conferences, including the 5th International Forest Policy Meeting in Helsinki and the 26th IUFRO World Congress 2024 in Stockholm. In the Trees For Me webinar series, one webinar focused on fast-growing broadleaf trees value creation, and another addressed the transition to more broadleaves in Swedish forests. Preliminary results were also presented and discussed during two reference group meetings and two meetings with the External Advisory Board, involving stakeholders and external researchers, respectively. Additionally, the researchers have participated in the Trees For Me energy study visit to Luleå as part of the centre activities.

Eye-opener for participating scientists and practitioners

"A wide scope and multidisciplinarity are important qualities of Trees For Me. Most research is nowadays conducted in small disciplinary silos but this is definitely not the case in our Centre. Trees For Me serves as an eye-opener for participating scientists and practitioners, enabling reflections on their endeavors in a larger context."

Vilis Brukas | Research project leader in Trees For Me and Professor of forest planning at the Swedish University of Agricultural Sciences (SLU). Photo: Pär Fornling.

Work package 5 – Environmental impacts

PhD students

Jaime Luna,
Aureo Aparecido Abreu Junior.
Affiliated: Emil Andersson,
Pierre van Rysselberge

Researchers and project leaders

Adam Felton, Per-Anders Hansson,
Renats Trubins

Per-Anders Hansson, work package leader and Professor at the Department of Energy and Technology, SLU, presents updates from the research projects related to environmental impacts.

Systems analysis and life-cycle assessment (LCA)

Due to the need to reduce greenhouse gas emissions, the short-term effects of changes in forest production and utilization systems are a significant interest from a climate perspective. The climate impact in this work is assessed through the temperature response over time, considering yearly fluxes of greenhouse gas emissions. The time-dependent LCA methodology includes effects of carbon dynamics in both soil and living biomass, value chain emissions, carbon stored in harvested wood products and potential substitution effects. Additionally, the methodology accounts for Albedo-related effects due to changes in land use.

The first study assessed the climate effects of improved birch genotypes with a 20% volume gain compared to non-improved genotypes over a fixed rotation length of 50 years. Also, the effects of changing the product portfolio from short-lived products, such as bioenergy or paper, to more long-lasting products, such as viscose and sawn wood, were evaluated. This study focused on different birch production scenarios at the site level, rather than comparisons with spruce or pine. The results show that both the use of higher yielding genotypes and the change to more long-lasting final products from the birch biomass have the potential to significantly reduce global warming across various time perspectives.

The effects of shifting to more long-lasting final products were comparatively higher but also depended on the proportion of biomass that could be utilised for sawn wood. Notably, these measures may be combined to achieve additional effects.

The next phase of the work assesses how transitioning from a conifer-dominated production forest to fast-growing broadleaves influences climate with distinct rotations and harvested wood product portfolios, including land use change. Potential sites with fast-growing broadleaf species and reference land use are also being identified for the planned land surface albedo assessment.

Biodiversity

The main aim of this project is to identify pathways to determine the biodiversity of, and increase habitat contribution from, the increased use of fast-growing broadleaves. To target those aspects of forest biodiversity that are directly coupled to the tree species themselves, and which represent important aspects of forest biodiversity, key groups such as epiphytic lichens, bryophytes and dead-wood dependent species have been selected for the study. The research includes three empirical projects and one systematic literature review.

For the lichen project, field surveys have been completed in 48 stands with fast-growing broadleaves located throughout southern Sweden. A total of 960 trees were sampled, identifying 122 lichen taxa, including two species newly recorded for Sweden as well as red-listed species. Most of the analysis has been completed, and the first manuscript is being drafted.

For the dead-wood dependent species, logs of European aspen (*Populus tremula*), hybrid aspen (*P. tremula x tremuloides*), hybrid poplar (*P. trichocarpa x maximowizcii* clone OP42; hereon "poplar"), naturally regenerated silver birch (*Betula pendula*) and improved birch (hereon "Ekebo birch", due to its provenance) were used. Three logs of each tree species/provenance measuring 1,5 meters in length and with a diameter ranging from 25 to 40 centimetres were placed at 24 sites located either near production stands, or "hotspots" for deadwood dependent species. The first year of data collection has been completed from 358 logs. Species have been sorted and are currently being identified by an expert. Additionally, a preliminary systematic review has been conducted, and preparations are underway for the bryophyte experiment scheduled for spring 2025.

A study was done on potential habitat availability for forest ants in fast-growing broadleaf stands, with a particular focus on the effect of former agricultural versus forest land on ant diversity. During the summer of 2024, ant populations were inventoried using traps and systematic searches in 20 stands of birch, poplar and hybrid aspen. Seventeen ant species were found in total, of which 15 had established colonies. Among these, three species were classified as generalists, six as typical open-field species and six as typical forest species. Ant populations are now analysed with respect to different environmental variables in and around the stands in order to better understand which factors influence ant species diversity.

Photo: Margot Richard, Unsplash.

Education

Education

Trees For Me provides postgraduate studies, with an interdisciplinary approach, which contributes to scientific and technical solutions for fast-growing broadleaf biomass and bioenergy. Future, excellent leaders are trained who will drive positive change in achieving energy and climate policy goals.

PhD education

PhD meetings

In addition to research activities earlier described, PhD students and postdoc researchers participate to internal meetings to discuss topics related to PhD studies and career development. Monthly online PhD meetings are held, alternating between sessions exclusively for PhD students and postdocs and sessions that also include the main supervisors from the Trees For Me PhD core group.

Topics discussed during these meetings include gender equality, working in an interdisciplinary setting, communicating research to the public, AI in research/education/science communication, how to become a leader in the Swedish forest sector, and perspectives and polarisation in the Swedish forest debate.

These meetings also provide an opportunity for stakeholder partners to present their organisations and possible career opportunities, as a way of increasing networking opportunities between the partners and PhD students/postdocs.

Study trips

Two larger study trips were organised for the PhD students, postdocs, supervisors, and other stakeholders during the Centre's initial period. The first study trip in 2023 took participants to Finland, where they engaged with research and partner representatives, as well as several other organisations from the Nordic-Baltic region, all of whom have a large interest in birch. Further details can be found under the Collaboration section. In August 2024, a study trip was arranged in Piteå and Luleå with a focus on the role of fast-growing broadleaves in the sustainable energy transition. The trip included visits to industrial and research sites such as Smurfit Westrock, Swerim, LTU Green Fuels and Luleå University of Technology.

Peder Fahlman guiding at Smurfit Westrock which produces paper packaging. Photo: Stina Johannesson.

Inclusive environment encouraging cooperation and personal growth

"Trees For Me has succeeded very well in creating an inclusive environment that encourages cooperation and personal growth. For stakeholders, the system with reference groups, mentorship programme and outreach activities has made it easy to choose a level of involvement and be a part of the Centre."

Anna Karlberg | Vice President Forest R&D, Stora Enso, and Executive Board member of Trees For Me.

Mentorship programme

All PhD students within and associated with the Centre were invited to participate in a mentorship programme. Eight students (mentees) signed up, and mentors were selected based on the mentees' specific requests. All mentors are professionals working outside of academia but with research experience. The programme officially started during the spring of 2024, and an online meeting with all mentees and mentors was held in September 2024. The nature of the interaction between each mentor and mentee, i.e. meeting frequency, focus of meetings and possible internship or other collaborations, is decided by the mentor and mentee. Follow-up meetings with all mentors and mentees are planned for twice a year.

Contribution to employability

Apart from providing opportunities to interact with potential employers at PhD/postdoc meetings, the PhD students have been given the option to present in Swedish at webinars targeting forest owners and others, to improve their Swedish language skills and facilitate future employability in the country. Several of the PhD students have done so in a very successful way.

Other education activities

The Centre also integrates top research expertise from academic and research institutes with relevant societal actors, governmental organisations, and industrial partners who will implement research results into practice. Training activities relevant to the forestry and energy sector and other practitioners are provided to advance the knowledge on sustainable biomass production and material use from fast-growing broadleaves.

Education for practitioners

A webinar series was initiated early in the development of the centre, to provide an easily accessible forum where forest owners, advisors, researchers and other stakeholders can get the latest research updates on fast-growing broadleaves. Additional educational activities for practitioners include excursions and field trips, both arranged by the Centre and in collaboration with relevant parties.

Initiatives and ideas are continuously considered related to outreach activities and dissemination of research results to relevant stakeholders. One example is an application to the Formas communication call 2024, submitted by the Centre in collaboration with the forest owner association Södra. The application focuses on knowledge sharing of research results on fast-growing broadleaves through the forest owners' existing digital planning tool.

Other academic teaching

Most of the researchers participating in Trees For Me are engaged in teaching at higher education levels, ranging from undergraduate to master's courses. They incorporate the Centre's research results on fast-growing broadleaves into their education programmes, ensuring that the latest findings are shared with students.

Collaboration

Trees For Me's extensive partner network, which includes almost 50 affiliated organisations from the forest and energy sectors, plays a pivotal role in the Centre's ability to reach its short- and long-term goals. Most of the partner organisations have shown a strong interest in the Centre's activities from the start and collaborate actively with the Centre, its researchers and PhD students in multiple ways.

Several of these organisations are engaged in research collaborations providing valuable input to management groups, reference meetings and fieldwork. These collaborations are always carried out with a strong commitment to maintaining academic independence in all research efforts.

An example of a collaboration that was highly appreciated by the participating PhD students, researchers and partner representatives is the study trip to Finland in August 2023. The week-long trip, organised and funded by Trees For Me, Nordic Forest Research (SNS), the Swedish University of Agricultural Sciences (SLU) and the Natural Resources Institute Finland (Luke), focused on enhancing the knowledge on birch breeding, birch nursery production, and silviculture and management of birch.

Representatives from five Nordic and Baltic countries met to discuss and exchange experiences on the potential of using more birch in the development of more sustainable and climate-resilient forestry. The study trip included visits to seed orchards and birch experiments arranged by Luke and to the international wood processing specialist, Koskisen Corporation.

Optimise the use of land and landscape in a complex world

"Trees For Me gives us a network where we can discuss questions on biodiversity and climate change, and how to optimise the use of land and landscape in a complex world where many different opinions have to cooperate."

Anders Ekstrand | Vice President of the Swedish Society for Nature Conservation (Naturskyddsföreningen) Skåne and partner representative in Trees For Me.

Practical application not only in Sweden but also in other Nordic countries

"Trees For Me conducts highly impressive research to support the cultivation of broadleaf trees, particularly silver birch. The research findings are well-suited for practical application, not only in Sweden but also more broadly across the Nordic countries."

Saija Huuskonen | Principal scientist at Natural Resources Institute Finland (Luke) and External Advisory Board member of Trees For Me (2022–2024). Photo: Onni Huuskonen.

The participants from the Nordic and Baltic countries in a silver birch stand on a study trip to Finland in 2023. Photo: Stina Johannesson.

Key performance indicators

Key performance indicators

To track the overall progress of the Centre, key activities are continuously monitored using key performance indicators (KPI) focused on publications, activities and achievements, outreach and added funding. This KPI review covers the period from the Centre's start date, 2022-01-01 until 2025-01-31.

Progression of key performance indicators

The research in the centre is primarily conducted by PhD students who began their studies in late 2022, with some also starting in 2023. This together with the typical delays in the peer review process, led to a scientific publication rate that started to increase in the later part of 2023 as illustrated by the progression shown in Fig. 1, where 16 **journal articles** are now recorded. A similar trend holds for the 18 scientific conference contributions, which were presented and subsequently published in the associated proceedings.

To disseminate results beyond the Centre's organisation, various outreach activities are carried out. Fig. 2 shows the progression of **popular science publications**, typically in the form of web articles, that have been produced at a consistent rate already from the start of the centre, reaching a total of 25 to date.

At the end of 2022 a webinar series was launched which has continued at a steady pace bringing the total of webinars to 31 plus one workshop (see Fig. 3). The interest for these **webinars** has been very high, as indicated by 1,948 registrations recorded between 2022 and 2024. Particular attention has been given to the webinars co-hosted with the Forest Agency which resulted in 1,040 registrations at 14 webinars held between November 2024 and January 2025.

In addition to webinars, media communication activities have also played a significant role in reaching stakeholders outside the Centre. As seen in Fig. 4, **media communication** efforts have steadily progressed up to the current level of 85 which mainly consists of articles in forestry magazines and radio events.

The Centre has also maintained an active presence on social media, with 80 posts published up until 2025. The engagement rate on the Centre's LinkedIn page between June 18 and December 31 was 13,2%, with 263 followers recorded in early 2025. In total, the Centre has registered 272 outreach activities since the start.

Figure 1. Journal Articles

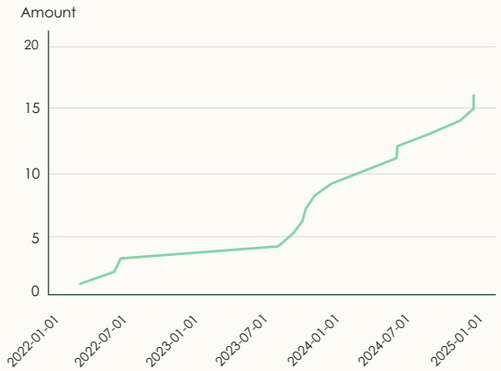


Figure 2. Popular Science Publications

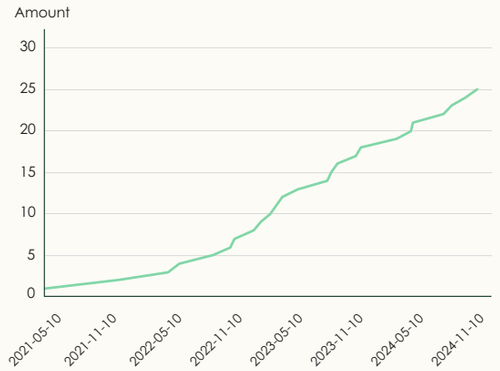
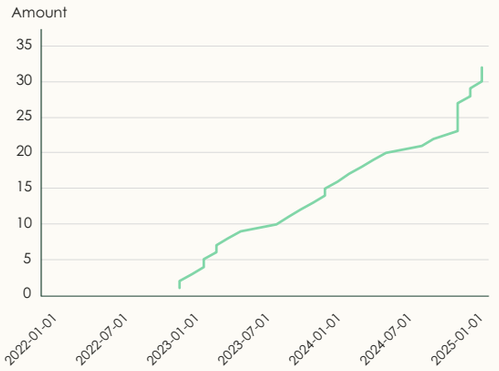


Figure 3. Webinars



Within the Centre, a total of 289 meetings have been registered. These include 134 Executive Management Team meetings, 54 Operative Management Group meetings, 22 PhD/post-doc meetings, 13 Executive Board meetings, 10 External Advisory Board meetings and 56 other meetings.

The stakeholders within Trees For Me (excluding the universities and research institutions) are actively contributing to various centre activities including reference group meetings, work package meetings, Executive Board meetings, workshops, seminars, excursions etc. Fig. 5 shows the progression of the **stakeholders'** involvement in these **activities**, totalling 162 events.

Already during the first years of the first phase of Trees For Me, results have been incorporated into university education infrastructure. Seven MSc and one BSc theses have been carried out with a direct connection to Trees For Me. In addition, results have been formulated into teaching material and used in three different courses.

To further accelerate the centre research, utilisation of results and knowledge transfer, additional funding from various organisations such as Formas, VINNOVA, KSLA, Interreg Aurora etc. have actively been applied for. Fig. 6 shows that 32 applications for **funding** were approved between late 2022 and 2024, summing up to more than 40 MSEK, increasing the Centre's total funding by 36%.

Figure 4. Media Communications

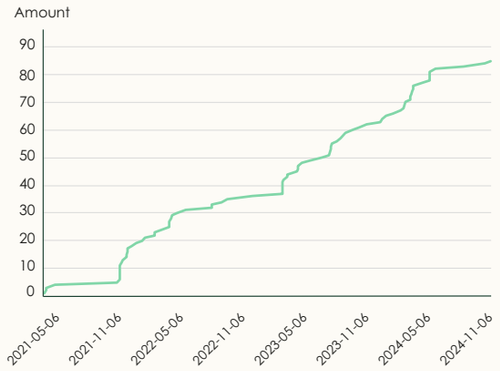


Figure 5. Stakeholder Activities

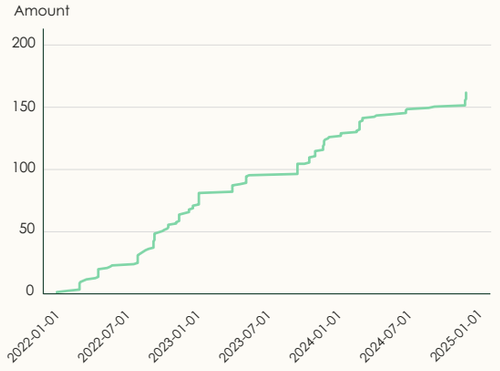
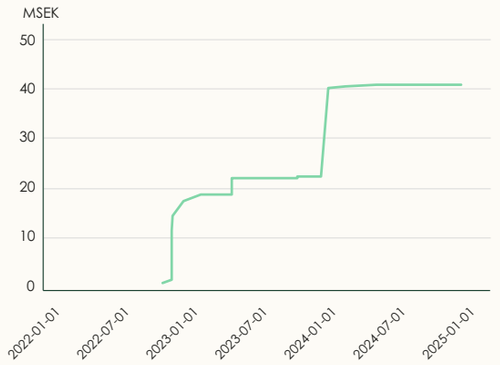


Figure 6. Added Funding



Goals – activities, outputs, outcomes, impacts (2022–2024)

Below are the logic model goals for activities, outputs, outcomes and impacts anticipated for Trees For Me and their progress during the first 3 years.

Table 1. Logic model activity goals and progress up to the end of 2024

Goals: Activity	Activity (until 2024)
14 PhDs and Postdocs running more than 50 projects together with stakeholders	12 PhD students and two Postdocs with more than 60 projects running together with stakeholders, fostering strong academic-industry collaboration.
More than 10 master thesis projects	Seven master theses were defended until now.
Short- & long-term field experiments	Field experiments covering both short- and long-term perspectives are now operational; long-term field experiments established at 31 sites across Sweden; and several new spin offs have been launched.
Lab and full-scale energy conversion experiments	Proof-of-concept - complete value chain from seed to products • combustion of round wood from birch in a 50 MWth full-scale circulating fluidized bed • combustion of poplar (chips from entire tree; 19-year old 2nd rotation poplar stand) in a medium-sized grate firing boiler.
Survey studies and LCAs	Stakeholder survey studies have been completed. LCA studies on birch production, considering the impact of various factors, have been successfully conducted.
More than 10 international research visits	More than 25 outgoing international research visits abroad from Trees For Me researchers and students, and five incoming international research visits from world-leading experts in the Centre's core research areas.

Goals: Activity	Activity (until 2024)
More than 10 cross-learning workshops and excursions	Over 280 collaborative learning events have been successfully held, fostering valuable exchanges between researchers and stakeholders, as well as between students and mentors.
PhD courses	Materials have been developed and used in three PhD courses.
Stakeholder seminars and 10 general assembly meetings	One web-based General Assembly (partner) meeting and two physical meetings held in Umeå and Remningstorp.
Four newsletters each year	Eight newsletters distributed, providing regular updates and insights on key developments and achievements
More than 25 popular science articles in industry magazines	More than 100 popular sciences articles and media communications have been featured, raising awareness and sharing key insights with professionals and the public. See separate list with communication activities.
Teacher exchange between disciplines	Annual travelling meetings arranged for Trees For Me researchers across the different disciplines within Sweden promotes academic growth, diverse learning perspectives and the 'One-centre' concept

Table 2. Logic model output goals and progress up to the end of 2024

Goals: Outputs	Outputs (until 2024)
Needs-based research along whole forest biomass and energy value chains	More than 60 projects are being conducted (and about 10 near completion) across the entire forest biomass and energy value chains, addressing key challenges and driving solutions for sustainable development.
40–60 high quality, high impact scientific publications	16 publications
Strategic excellence research infrastructure	The research infrastructure has been successfully established and is fully operational.
Strengthened national and international cross-learning and collaboration between and within academia and stakeholders	A webinar series was started with the aim of at least one popular scientific webinar per month. To date, 31 webinars have been delivered, receiving wide attention both nationally and internationally. Cross-learning have also been promoted in several excursions and in two study visits to Piteå/Luleå and Finland with all Trees For Me where students and researchers were accompanied by stakeholders.
A toolbox for large-scale plantations of fast-growing broadleaves	Efforts are ongoing to create a comprehensive toolbox to support large-scale plantation of fast-growing broadleaves, but it is too early to evaluate.
Trust among participants in the centre	Continuous information sharing and discussions via Teams, website, informal and formal PhD meetings, reference group meetings, and management team meetings.
Increased knowledge for creating a more stable and sustainable energy system	Significant progress has been made in three projects, expanding knowledge to support the development of a more stable and sustainable energy system.
Engaged stakeholders to RD&I and dissemination of results	Stakeholder engagement to the first General assembly (partner) meeting in Umeå and first webinar was around 70 participants from a wide variety of partners and stakeholders. Subsequent engagement on webinars and general assembly meetings has been high. Stakeholders have been actively engaged in the Executive Board, Reference groups, the mentorship programme for the students, and in preparation for field experiments.
Implementation of gender and equal opportunities	The gender balance among researchers and PhD students in the Centre is close to 40–60%, and gender and equal opportunities are considered in all Centre activities.
Profiling excellent research at international and national conferences	Trees For Me research presented at 18 international conferences and 12 national conferences.
Implementation of Trees For Me research results in practical operations	Initial tests on autonomous ground preparation and planting with Bracke Forest and in nursery production that will lead to measurable improvements in efficiency and effectiveness.
Education and awareness in society	See separate list with communication activities.

Table 3. Logic model outcome goals and progress up to the end of 2024

Goals: Outcome	Outcome (until 2024)
Excellent research infrastructure and competence, strengthening Sweden's transition to a sustainable energy system	The foundation for a strong research infrastructure and enhanced competence in sustainable energy has been laid, with several critical components already in place to drive Sweden's transition.
Large-scale FGB-plantations across Sweden and use of FGB for energy	Considerable progress has been made in establishing large-scale plantations of fast-growing broadleaves (FGB) across Sweden, with initial sites successfully planted and operational. The use of fast-growing broadleaves for energy production is being tested, with positive early results, but too early to evaluate.
Increased competence and experience in stakeholder organizations	Many of the stakeholders have been engaged in the different centre activities and thus continuously increasing their own knowledge.
Long-term collaboration between all partners in the programme	Collaboration activities have been promoted both in-between academic partners and with the other centre stakeholders (Executive Board, Reference groups, collaboration within research projects, mentoring programme, etc.)
Expanded international network	The External Advisory Board, including many international research connections, have had continuous engagement with the centre's researchers and students.
Increased funding for research	More than 40 million SEK of extra money for fast-growing broadleaf trees research.
Improved capability for research and innovation in forest energy systems	The competence build-up for all centre stakeholders is progressing and continued efforts are underway to further strengthen this capability.
Increased equality in forest and energy sectors and in education	Notable initiatives are seen that promote inclusivity and representation, though continued efforts are needed to address the remaining gap.
Integration of research knowledge into courses and study programmes	Research knowledge has been successfully integrated already into a number of courses at the Bachelors and Masters level, improving the relevance and depth of academic content.
Internationally known Centre of Excellence, attracting more research cooperation	The Centre has become internationally recognized. Increased visibility and interest from research collaborators has already been realized through requests for projects participation, funding reviews for research foundations and advisory positions in other Centres of Excellence.
Increased competitiveness for SMEs and societal benefits	Too early to evaluate.

Table 4. Logic model impact goals and progress up to the end of 2024

Goals: Impacts	Impacts (until 2024)
Biomass production and bio-energy from FGB is significantly contributing to sustainable energy and material system and a fossil-free welfare state.	Too early to evaluate.
Infrastructure and continued competence building in biomass production systems and bioenergy derived from FGB	The centre's Infrastructure and competence building in biomass production and fast growing broadleaf-based bioenergy are developing, but has not yet reached the level needed for full-scale deployment.
Spin-offs in terms of more research financing, stakeholder engagement and international collaborations, etc.	More than 40 million SEK have been added to research in FGBs; huge level of stakeholder engagement within our partner network and additional stakeholders have shown interest in Trees For Me; international collaboration has expanded within most all work pages.
Improved science-policy inter-face due to raised awareness among politicians/public	Too early to evaluate.
Excellent research is operational in practice.	Too early to evaluate.
Promote, attract, and retain RD&I investments for Sweden. Frontline position of the centre compared to other competing centres internationally	There are already additional investments to centre-associated research from different funding bodies. The centre has gained some international visibility, but further efforts are necessary.
More productive, efficient and profitable sector benefiting local communities	Too early to evaluate.
Strategic and scientific trust between academia and stake-holder organizations for long-term collaboration	The high level of stakeholder engagement suggests a strong foundation of trust has been successfully established between academia and stakeholders to facilitate long-term collaboration.
Future research and industrial leaders educated through Trees For Me carried forward to make a positive change in society	12 PhD students, two Postdocs and an extended network of junior researchers affiliated with Trees For Me are now being equipped with the skills and knowledge to create a sustainable and positive societal impact.


Trees
For Me