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Bioenergy Project Activities Through the Structural Funds Programme and the Investment Plans in Finland

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ABSTRACT

The EU's regional and structural policy has been ongoing in Finland since 1995. The goal of the regional and structural policy is to equalise the developmental and welfare differences between regions and ensure the sustainable growth and competitiveness of the European Union and its member countries. This study is a review of regional and structural policy programme project activities targeting the bioenergy sector during the funding period 2021-2027. A total of 155 bioenergy projects have been launched with a total budget of 64 million euros. The projects focused particularly on biorefining, with biogas and biocoal as end products. The Structural Fund project activities were focused in particular in Eastern and Northern Finland, but more investments were made in Southern and Western Finland. As of 2025, bioenergy investment project proposals worth 10,246 million euros with an employment impact of 6,600 person-years have been submitted, half of which have already received investment or an investment decision has been made. The most significant of these investments are biorefinery and bioproduct factory investments.

Keywords: bioenergy, database, project, strategies, regional, rural development.

INTRODUCTION

The EU's regional and structural policy has been ongoing in Finland since 1995. The goal of the regional and structural policy is to equalise the developmental and welfare differences between regions and ensure the sustainable growth and competitiveness of the European Union and its member countries. Previous programme project periods have seen positive GDP growth per capita at the NUTS2 regional level [1]. However, at the NUTS3 level, the variation in growth effects was large, according to the researchers who analysed the programme results [2, 3]. Also, at the EU level the growth effect was not as obvious; impact varied across countries [4] and the desired income convergence across regions has not occurred [5]. One conclusion was that the growth impact of the funds would be enhanced by better targeting them based on understanding of the realistic growth potential of different regions [6].

This study is a review of regional and structural policy programme project activities targeting the bioenergy sector during the new funding period 2021-2027. The programme of the latest period includes the actions of the European Regional Development Fund (ERDF), the European Social Fund Plus (ESF+) and the Just Transition Fund (JTF). A significant portion (35%) of ERDF funding must be allocated to climate measures. In Finland, the activities of the JTF fund are based on the goal of halving the energy use of peat by 2030. The goal is to end the use of peat for energy by 2035. The fund compensates for the adverse socio-economic and environmental effects of ending the energy use of peat. The programme's funding consists of EU funding and national funding. The programme's public funding is EUR 3.159 billion, of which EUR 1.935 billion is EU funding and EUR 1.224 billion is national counter-funding [7]. Funding is granted by the regional councils, the Centres for Economic Development, Transport and the Environment (ELY Centres) and the Finnish Food Authority.

Bioenergy projects are included in the programme's action lines: Innovative Finland (ERDF), Carbon-Neutral Finland (ERDF) and Finland for a Just Transition (JTF). The goal of Carbon-Neutral Finland (ERDF) is to promote energy efficiency and circular economy, as well as to reduce greenhouse gas emissions. Funding is also allocated to measures to prepare for climate change. The goal of Just Transition Finland (JTF) is a regionally just transition from peat by diversifying livelihoods, adapting the industry's workforce and correcting adverse environmental effects. The implementation of the programme follows the “do no significant harm” principle, which means that projects that significantly damage the environment cannot be funded. The increase in the use of bioenergy is based on regional conditions and is in line with the no significant harm principle in terms of climate change mitigation and adaptation and improving biodiversity. For example, the harvesting of forest bioenergy aims to increase forest growth and carbon sequestration. Natural diversity and the preservation of biodiversity are priorities. The ash from wood used for energy is used to fertilise forests. These measures aim to ensure the sustainable use of bioenergy.

MATERIAL AND METHODS

Project Information Database

Project-specific information is saved in the project information service maintained by the Ministry of Economic Affairs and Employment of Finland, which contains 5,880 projects in the current project period (2021-2027) [8]. This study concerns the situation as of April 2025. The following indicator data have been set as a target for the entire project period for all policy lines: 627 new companies created with support, 206 research organisations participating in joint research projects, 20,273 companies in collaboration with research institutes, 15,047 new jobs created with support, 2,738 SMEs making product and process innovations, 5,473 innovations developed by networks and innovation ecosystems involving products or services, 550 new solutions promoting emission reductions and 919 demonstrations promoting the circular economy or high-level bioeconomy.

The database was searched using keywords to map all bioenergy-related projects. The keywords were various words beginning with "bio" as well as forest biomass and forest bioeconomy. A total of 155 such projects were found. Group projects with multiple implementers each form their own separate project. The total funding allocated to the projects was 64 million euros, of which 95% was public funding and the remaining 5% was private

funding. EU and national co-funding accounted for 72% of the funding, and the rest of the public funding involved self-financing by the project implementers (universities, municipalities, etc.) [8]. Therefore, the implementing agency of the projects was also listed. The assessment was done regionally, because provincial programmes and the priorities of smart specialisation play a key role in the implementation.

The bioenergy projects are classified based on type (stage of the bioenergy value chain), such as biomass supply, bioterminals, biorefining and bioenergy. Based on this analysis, it was possible to assess how much and which types of bioenergy projects were implemented in different regions and what kind of regional impact they will have. Projects funded under the programme are required to have measurable output and result indicators. Result indicators include both short-term and long-term effects. Output indicators included new companies created with support, research organisations participating in joint research projects, and companies in collaboration with research institutions. Result indicators included new jobs created with support, SMEs making product and process innovations, innovations developed by networks and innovation ecosystems involving products or services, new solutions promoting emission reductions and demonstrations promoting the circular economy or high-level bioeconomy.

Investment Intentions for Bio-based Projects

The data dashboard maintained by the Confederation of Finnish Industries (EK) organises companies' green investment project proposals by technology, location and project stage. Monitoring began in 2021 [9]. Bio-based investments were selected for this study. The employment impact of the projects has also been assessed. The content of the data dashboard is indicative in many ways – the list is not comprehensive, and not all investment projects listed now will be implemented. On the other hand, new project plans are constantly being announced. The data is updated as companies announce and communicate new projects. The data is supplemented by crowdsourcing, meaning anyone can suggest adding a new project, after which the project's progress is assessed by EK.

RESULTS

Projects in the 2021-2027 Funding Period

The JTF fund covered 70% of bioenergy projects and the rest were ERDF-funded projects. Most of the projects were related to various biorefining processes. The share of bioenergy (heat/electricity) projects itself was very small. Projects related to bioterminals have larger budgets, meaning their share in monetary terms is larger (Table 1).

Table 1: Number of projects and funding by project type.

	n	%	MEUR	%
Biomass supply	40	26	10.5	16
Bioterminals	16	10	21.8	34
Biorefining	90	58	28.3	44
Bioenergy	9	6	3.3	5
Total	155		64.0	

Biorefining includes solid (biocoal, 42 projects), gaseous (biogas, 44) and liquid (green chemicals, 3 and pyrolysis oil, 1). Biocoal and biogas were equally significant in terms of both

the number of projects and budgeting. Biomass procurement includes forest chips, forest industry by-products, agrobiomass and biowaste. Agrobiomass (22) and forest chips (12) were most frequently involved in biomass supply projects. Projects related to forest chips have larger budgets, so the difference between these project types in terms of budgeting is not very large.

Educational organisations were responsible for almost half of the projects (Fig. 1). The majority of educational organisations were polytechnics (applied universities,), 58%), while universities accounted for 39% and vocational colleges for 3%. Municipalities and companies typically have one project each, while educational institutions and research institutes may have several projects. Among the actors, the Natural Resources Institute Finland (Luke) has the most projects (13), followed by the University of Oulu (11) and Savonia University of Applied Sciences (8). Based on the participants, the programme has brought together companies, research institutes, and universities to develop research and innovation.

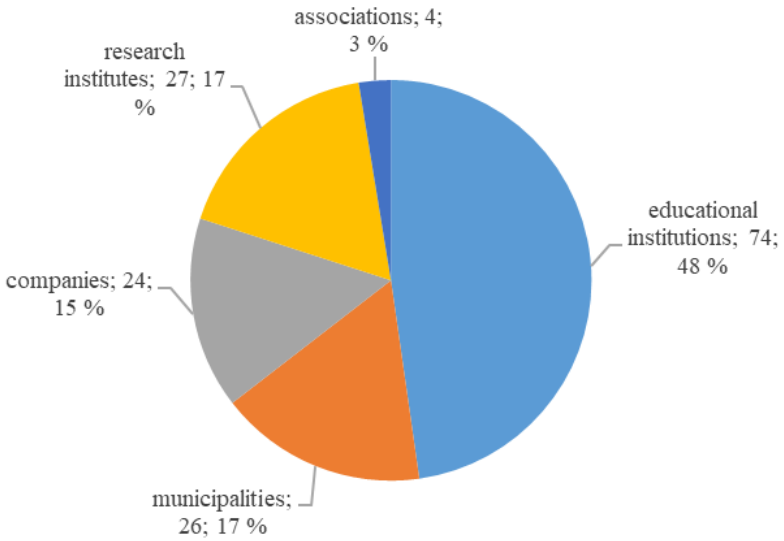

Figure 1: Organisations implementing projects.

Most of the projects were implemented in Northern and Eastern Finland. The share in Western and Southern Finland was clearly smaller (Table 2).

Table 2: Regional distribution of projects.

Area	n	%	MEUR	%
Northen Finland	50	32	22.7	35
Eastern Finland	60	39	26.4	41
Western Finland	28	18	8.8	14
Southern Finland	17	11	6.1	10
Total	155		64.0	

This is because more funding was allocated to these regions based on the regions' development needs and specific characteristics and the EU's funding criteria. Among the individual regions (NUTS3), the highest numbers of projects were in Northern Savo (in Eastern Finland, 31

projects) and Northern Ostrobothnia (in Northern Finland, 22). The map (Fig. 2) depicts the four major regions (NUTS2) and the provinces (NUTS3) which make them up.

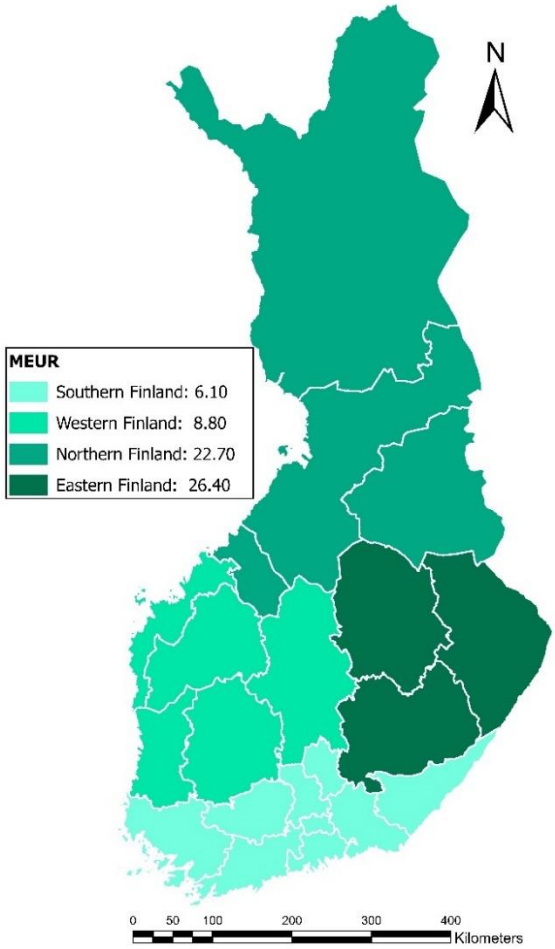

Figure 2: Distribution of EU regional funding among major regions (NUTS2) in Finland.

Project Output and Result Indicators for the Project Period 2021-2027

The indicator data was based on project-specific promises. Estimates are based on the situation in the project portfolio as of April 2025. For all projects, the output indicators presented included an estimate of new companies created with support (54), research organisations participating in joint research projects (183) and companies in collaboration with research institutes (832). The result indicators included new jobs created with support (190), SMEs making product and process innovations (187), innovations developed by networks and innovation ecosystems involving products or services (261), new solutions promoting emission reductions (13), and demonstrations promoting the circular economy or high-level bioeconomy (27). Two of the output indicators, research organisations participating in joint research projects and companies in collaboration with research institutes, overlapped between different projects, as many research organisations were represented in different projects, as were different companies (Table 3). This explains why the indicator number for these is so high. Other indicators are independent on the results of different projects and can be added together. There were quite a few bioenergy investments, as well as bioenergy-related research projects.

There were also quite a few biomass procurement projects, which is used in the production of bioenergy in particular, but also in production involving bioprocesses.

Table 3: Output and result indicators.

Output indicators	
New companies created with support (I)	54
Research organisations participated	183
Companies collaborated with researchers	832
Results indicators	
New jobs created with support (II)	190
SMEs innovated (III)	187
New innovations, products or services (IV)	261
New solutions promoting emission reductions	13
Circular economy or bioeconomy demonstrated	27

Based on the indicators, biorefining offers the most jobs and innovation opportunities (Table 4). Biogas and biocoal are equally important when measured by the indicators. In biomass supply forest chips offer the most jobs and agrobiomass the most innovation opportunities. Bioterminals play a significant role in job and industry creation, while the role of bioenergy was minor in all indicators.

Table 4: Selected indicators by project type (Roman numerals denote previous table).

	I	**II**	**III**	**IV**
Biomass supply	6	36	48	76
Bioterminals	18	64	6	9
Biorefining	28	66	123	172
Bioenergy	2	24	10	4
Total	54	190	187	261

Main Content of the Projects

Biomass supply includes forest chips, forest industry by-products, agrobiomass and bio-based wastes. The projects focus on the shift from peat to biomass by exploring environmentally friendly plant species, wetland cultivation, energy wood from forests, and improving waste management. Peat will be replaced in energy production and in other applications such as animal bedding. Bioterminal projects focus on the development of multimodal bioterminals by enhancing bioenergy logistics, recycling and sustainable practices. Existing and future biorefineries will increase the need for biomass and require bioterminals to increase availability and security of supply.

Biorefining consists mainly of biogas and biocoal projects. Biocoal projects focus on biocoal production and utilisation activities by improving soil health, water purification and carbon sequestration, contributing to climate goals and biodiversity. Biogas projects focus on various biogas solutions to enhance energy self-sufficiency and nutrient recycling aimed at enhancing sustainability and resource efficiency. A special focus is on farms with sustainable agricultural practices and value chains for various biogas end-users. Bioenergy refers to energy produced from biomass-based feedstocks. The projects address, among other things, energy storage

solutions connected to bioenergy production and final disposal solutions for ash generated in connection with bioenergy production.

Bio-based Investments in Finland

According to EK's data dashboard, there were 146 bio-based investment projects worth over 10 billion euros, with an employment impact of 6,600 person-years (Table 5). Biogas projects were the most common, and the plants typically produce methane for transportation needs from agricultural waste and other organic materials. The biorefinery and bioproduct projects were the most significant in terms of investments and employment impact. Biorefinery projects include pulp mills with integrated production of biofuels or separate biofuel production plants implemented as a stand-alone plant solution. Their purpose is to produce bio-based renewable fuels such as lignin, bioethanol, biomethanol, biokerosene or biogas. Bioproduct projects included various significant investments and developments in the forestry and bioeconomy sectors across Finland, highlighting advancements in technology and production capacity. Bioenergy projects involve pellet plants that replace fossil fuels.

Table 5: Bio-based investments and jobs.

Theme	n	Invest., MEUR	Jobs
Biorefinery	12	6,600	775
Bioproducts	34	2,519	4,200
Biogas	79	808	1,498
Bioenergy	5	275	na
Biocoal	6	44	128
Total	146	10 246	6 601

There are many uncertainties surrounding the implementation of investments. The timing of investments, shown in Figure 3, is based on the plans announced in connection with the projects. The year 2030 also includes investment proposals for which no completion year was given. About half of the projects have been launched and have reached an investment decision. About 10% are in the preliminary study phase and 40% are in the design phase.

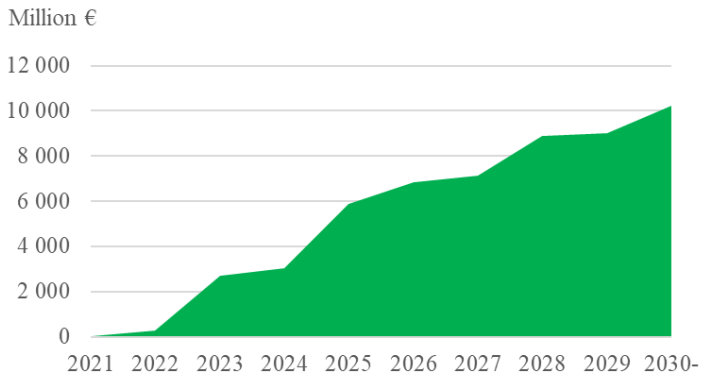

Figure 3: Annual increase in bio-based investments.

There is a lot of annual variation in investments, with the years 2023 and 2025 standing out as investment peaks due to single biorefinery and bioproduct investments (Fig. 4). Biogas

investments have increased significantly in recent years, whereas bioenergy and biocoal investments have not been proposed for the period until 2030.

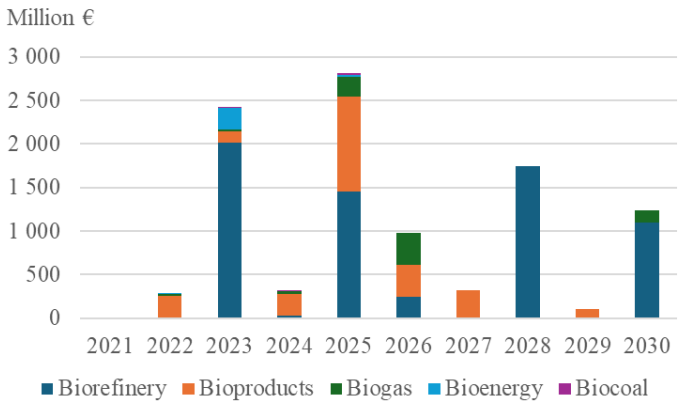

Figure 4: Annual bio-based investments or investment proposals.

The colours on the map (Fig. 5) represent different investment statuses. The sizes of the spheres represent the size of the investment, the largest of which are the 1–2-billion-euro biorefinery and forest industry bioproducts projects.

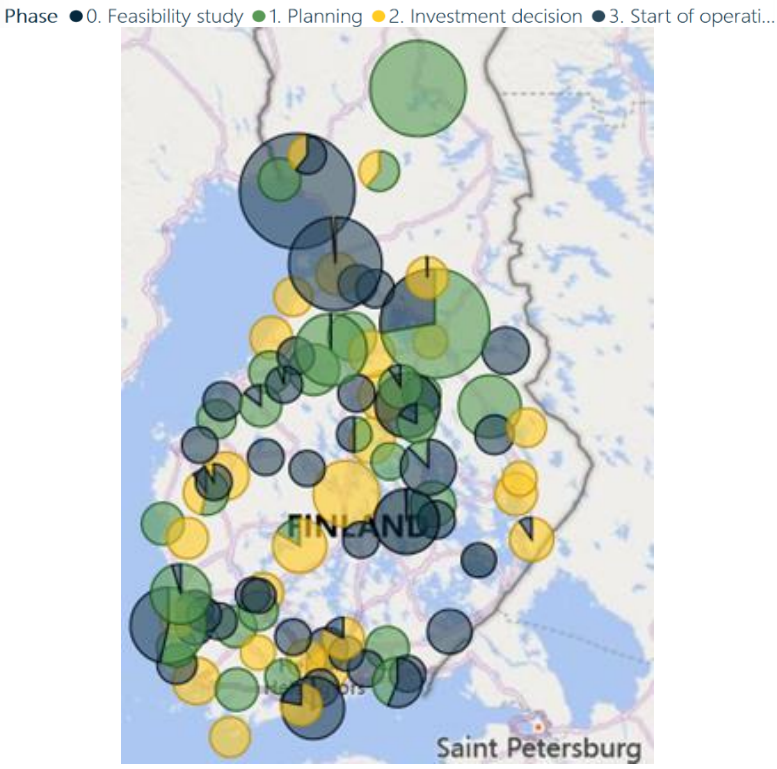

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Figure 5: Geographical distribution of investments [9].

These projects are mainly located in Northern Finland, whereas biogas investments are in Western and Southern Finland. Biocoal projects were the second most common research topic,

but their share of investment was quite small. Bioenergy and, more broadly, the bioeconomy are seen as an opportunity for Eastern Finland, where wind power investments have not progressed due to a lack of permits.

DISCUSSIONS

The Role of Bioenergy Projects

The share of bioenergy projects (155) in the entire project portfolio is quite small, less than three percent, while the total number of projects was 5,880 at the time of review. We are about halfway through the funding period, but typically the funding period starts a little later and projects can still be implemented after the funding period ends. In the previous project period (2014-2020), there were a total of 8,832 ERDF projects. This means that the number of projects will increase significantly in the new project period. The new source of funding is JTF, which accounts for approximately one third of the project portfolio of ERDF and JTF projects. The following values for the indicators are targeted during the project period: 6,817 new jobs created with support, 336 new solutions promoting emission reductions, 2,837 supported companies and 5,311 companies collaborated with researchers. The indicators for bioenergy projects will be higher than their funding share if project activities progress in the latter part of the period in line with the beginning of the period. One reason for this is the JTF projects, which aim to provide compensatory measures for the end of peat use. Bioenergy is typically seen as a first-stage replacement method for energy peat in existing combustion boilers. Bioenergy serves as a transitional energy form. The transition to biomass requires extensive logistical arrangements, implemented in cooperation with municipalities, SMEs and energy producers. This includes the planning and establishment of a biomass logistics and bioterminal network to enable entrepreneurship and employment linked to bioenergy. The second-stage transition is to non-combustion-based forms of energy production (solar, thermal storage, geothermal energy, wind energy and green hydrogen economy), which requires new investments to change the energy production system. The goal will be achieved by reforming the economy and diversifying the workforce's skills in other renewable energy sectors.

The Funding of Bioenergy Projects

The European Regional Development Fund (ERDF) and the Just Transition Fund (JTF) are only one type of source of funding for bioenergy projects. The European Agricultural Fund for Rural Development, which implements the European Union's Common Agricultural Policy (CAP), is a particularly important source of funding for rural bioenergy projects. The latest CAP plan is for the period 2023-2027. European Territorial Cooperation (Interreg) supports cooperation across national borders through project funding. One of its focuses is a Greener Europe, which also includes bioenergy projects sharing knowledge and learning from the innovative and sustainable solutions of others. Other national funding sources are foundations, ministries, Centres for Economic Development and Regional Councils. Business Finland funds research that produces results for use by Finnish companies in their export businesses. The Research Council of Finland funds high quality scientific research. International funding sources include Horizon Europe, which is the European Union’s flagship programme for Research and Innovation (2021-2027). Several funding opportunities are available for the Nordic countries through the Nordic Council of Ministers. Bioenergy projects can therefore be implemented using a wide variety of financial instruments, which have different funding criteria in terms of theme and geographical area.

Organisations Implementing Projects

Previous studies have shown that there are a limited number of actors in the regions who can apply for ERDF funding and who have solid experience in project activities [10]. This study highlighted the significant role of educational institutions. For example, 50% of R&D- projects at universities of applied sciences have been financed through structural funds in recent years [11]. In the previous project period, structural fund projects played a significant role, especially in renewing the infrastructure of university research and expertise environments. They created internationally attractive research environments [12]. The role of municipalities is also significant because municipalities are the basic units of regional development in Finland and the key themes of the structural funds, such as the development of economic activity and employment issues, are an integral part of the basic activities of municipalities. In the previous project period, significant differences were observed in the project activities of different municipalities, which were primarily influenced by financial, personnel and time resources [13]. Typically, smaller municipalities implemented fewer projects, but smaller municipalities can also be active project actors if the organisation has strong project expertise and project activities are part of the municipality's long-term strategic development. In municipalities, the definition of strategic goals is based on the municipality's own strong will, and structural funding is utilised according to how structural fund projects fit into the municipality's strategic goals and other activities [14]. In addition to implementing structural fund projects themselves, municipalities play an important role as financiers of projects implemented by other organisations. The possibility of companies participating is limited by the de minimis condition for funding. A single company can be granted de minimis support of a maximum of 200,000 euros over three tax years.

Investments in the Bioenergy Sector

Biogas was the most common investment target. It was also the most common project type among the structural fund projects. Biogas projects are often linked to regional development projects and due to their size are well suited to this funding programme. Biocoal projects were the second most common research target, but their share of investments was quite small, although the investments had been put into operation or an investment decision had been made for them. Project activities indicate that there is interest in the topic and that new investments are expected. There were many bioterminal projects in the structural funds programme, but they were not on the EK investment platform. In practice, investments have been made in bioterminals, but they were not listed on this service, which is a shortcoming that needs to be corrected. There were quite a few bioenergy investments, as well as bioenergy-related research projects. There were quite a few projects related to biomass supply, which serves the production of bioenergy, but also biorefining. The most significant investments were made in biorefineries and bioproduct factories, but any possible project activities are mainly carried out using other financial instruments.

Financing through structural funds is more suitable for operations at the beginning of the processing chain such as biomass supply and bioterminals, or for smaller applications such as biogas and biocoal production. The structural fund project activities particularly targeted Eastern and Northern Finland, but investments were directed more at Southern and Western Finland. The purpose of the structural fund is to even out economic differences between regions, and this is justified in this respect, although disagreements arose during the preparation phase

of the programme period, particularly regarding the distribution of funding between the provinces [15]. The most significant R&D impacts have been achieved in areas where R&D funding from other sources is scarce and corporate R&D activity is low. Without public support, regional development would be weaker [16]. At the same time, larger urban innovation clusters are also thought to spread knowledge to their surroundings [17].

Future Outlook for Bioenergy Investments

There was a significant number of bioenergy investment in EK's data dashboard, but their share of the total investment plans for the green transition is less than four percent. A total of 293,399 million euros worth of green transition investment plans were presented in April 2025. Offshore wind power and onshore wind power accounted for 66% of the investments, with an equal share for each. The next most significant investment targets were hydrogen (8%), electricity transmission grids (5%) and data centres (4%). 31,077 million euros worth of investments had been launched or an investment decision made, which represents 11% of the entire project portfolio. The corresponding share in bioenergy projects was 50%, 5,095 million euros, meaning that their implementation was more likely than other investment projects. Of these, 80% were projects that had already started, as monitoring began in 2021. They particularly concerned bioenergy, biocoal and bioproduct factory projects.

Gaia (1.11.2024 Sweco) assessed the regional economic impacts of the green projects on the EK's data dashboard based on the situation in 2024 [18]. The expected value of bio-industry investments was 6 billion euros and the maximum value was 9 billion euros. The GDP impact on the expected value of investments was 25 billion euros, tax revenue 3 billion euros and the number of jobs 3,000. The higher regional economic impacts of the bioproduct and bioenergy sectors compared to other sectors are due to the higher domestic content of the sector (80%).

The Green Transition Situation Report, created by AFRY, described the outlook for different sectors [19]. In the bioeconomy sector, challenges are particularly pronounced in investments in large and medium-sized facilities. The biggest challenges identified were the availability of financing and subsidies and partially underdeveloped markets. In bioeconomy projects, the availability of sustainably sourced feedstocks is also a limiting factor. However, EU regulation (RED II and III) is accelerating the use of biofuels as a replacement for fossil fuels, and also accelerating investments in biofuel plants. The addition of biogas to the distribution obligation in Finland in 2022 has clearly promoted investments related to the processing of transport fuel. The expansion of emissions trading to transport fuels (ETS 2) and possible new EU emissions targets for 2040 could further promote investments. The wide range of uses for biocoal in a variety of applications has increased interest in the material. However, the biocoal market is only just developing, and carbon sequestration and the associated voluntary emissions trading market could increase the attractiveness of biocoal.

CONCLUSIONS

Bioenergy project activities in Finland, funded through the EU's regional and structural policy programme for the period 2021-2027, have had significant regional impacts. A total of 155 bioenergy projects with a budget of 64 million euros have been launched, focusing on biorefining, biogas and biocoal production. The projects have been particularly concentrated in Eastern and Northern Finland, with investments also made in Southern and Western Finland.

The Structural Funds aim to balance investment activity between regions, and as of 2021, bioenergy investment projects worth 10,246 million euros with an employment impact of 6,600 person-years have been submitted, with half already receiving investment or decided upon. The most significant investments are in biorefinery and bioproduct factory projects.

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