PXL GREEN & TECH

LAPIN AMK
Lapland University of Applied Sciences

BACHELOR'S THESIS

SUPPLY AND STUDENTS' VIEWS ON ONLINE INTERNATIONAL STUDIES IN THE EU IN ENGLISH AT A HIGHER EDUCATION LEVEL RELATED TO BIOECONOMY, RENEWABLE ENERGY AND CIRCULAR ECONOMY

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Abstract

This Bachelor's thesis explores the supply of online international studies in the European Union, including the United Kingdom and Norway, with a focus on bioeconomy, renewable energy, and circular economy areas. Motivated by the increasing relevance of online education and the demand for sustainability-related knowledge and skills, Lapland UAS introduced this study to gather information on the availability and accessibility of online studies in these fields. The research delves into current educational needs, emphasizing the growing importance of bioeconomy, renewable energy, and circular economy topics in higher education, while also examining Finland and the EU's commitment to improving knowledge in these areas. Methodologically, a multi-faceted approach is used, involving online research and survey tools, to collect and analyze data. Online searches were done using various search engines and specialized websites, targeting relevant studies within the specified fields. Microsoft Excel is utilized for data compilation and analysis, facilitating systematic organization and visualization of information. Additionally, a survey among forestry and construction students gathers insights into their preferences and perceptions regarding online studies in sustainability-related fields. This combined methodology aims to provide a comprehensive overview of online studies in bioeconomy, renewable energy, and circular economy within the EU area, offering valuable insights for educational institutions and policymakers to enhance sustainability education and promote global engagement in critical areas of sustainable development. The research for online international studies in English in the EU area (including the UK and Norway) related to the topics of bioeconomy, renewable energy, and circular economy provided 36 studies, all focusing on/or related to these areas to a certain extent. These studies included various aspects, with renewable energy being the most common subject, featuring different focuses such as technical engineering, urban planning, law, and finance. Circular economy followed closely, with bioeconomy often also being included in this topic, while sustainability was integrated into some studies. The distribution of studies across seven European countries revealed a noticable concentration in the UK, probably due to the native English language. However, other countries also demonstrated commitment to environmental education, however many courses fell out of the research perimeters due to them being in their native language. Analysis of study duration and tuition fees showed a diverse landscape, reflecting varied program structures and financial requirements. While the findings provided comprehensive insights into the academic landscape, it is essential to acknowledge potential limitations in capturing all relevant courses due to online availability or search methodology constraints. The survey among Lapland UAS students further helped the understanding by shedding light on their knowledge, perceptions, and preferences regarding these topics. The survey highlighted a strong interest in bioeconomy, renewable energy, and circular economy education, with students recognizing the relevance of these subjects for their future careers. The findings underscored the importance of integrating sustainability principles into educational curricula and providing engaging and accessible learning opportunities. Overall, the combined insights from the research and survey contribute to the current issue surrounding sustainable development education, with implications for both academia and industry.

1 Introduction

1.1 Problem statement

The landscape of higher education has undergone a serious transformation with the rise of digitalization, particularly through the development of online education platforms. This shift has been influenced by the global pandemic, which underscored the critical role of online education in maintaining continuity in learning. In the middle of this change, institutions across the European Union, have taken the opportunity to offer a diverse array of online studies covering various subjects, overstep geographical boundaries and traditional learning constraints.

However there remains a need for information of the availability and accessibility of online studies. Lapland UAS has therefor issued a request to gather information regarding subjects crucial for sustainability and economic development, such as the bioeconomy, renewable energy, and circular economy. These topics have acquired importance in addressing global challenges and fostering a sustainable future.

The topics of bioeconomy, renewable energy, circular economy are particularly interesting for the fields of forestry and construction. In forestry, students explore sustainable forest management practices aligned with bioeconomy principles and renewable energy integration, while circular economy concepts optimize resource use. Similarly, in construction, emphasis on renewable energy technologies and circular economy strategies aligns with industry shifts towards sustainability, empowering students to drive innovation and address environmental challenges.

Conducted in collaboration with Lapland University of Applied Sciences, this research is motivated by the institution's commitment to enhancing the educational experience of its students by offering them opportunities to broaden their understanding of sustainability-related topics. By using diverse research methodologies, including online searches and surveys targeting students, this study seeks to provide Lapland UAS with a comprehensive overview of the landscape of online studies in bioeconomy, renewable energy, and circular economy within the European Union (including UK and Norway).

1.2 Objectives

This thesis aims to delve into the supply of online studies at the higher education level within the European Union, with a specific focus on programs related to the previously mentioned domains bioeconomy, renewable energy, circular economy. The primary objective is to provide insights into the opportunities available for students to engage with these subjects. Furthermore, the research aims to probe into the perspectives and opinions of students regarding the competence and relevance of online studies in these thematic areas.

1.3 Research questions

What is the current supply of online studies in English in the EU area (including UK and Norway) at a higher education level related to the bioeconomy, renewable energy and circular economy and the opinion of students about them?

Sub questions:

- At which universities are these studies?
- What are the requirements to start these studies? At which level are these studies (bachelor or master)?
- What are the studies about? Which topic are they most related to?
- During what time of the year does the study take place? (Summer, winter)
- Why would the students be interested in doing such a study?
- When would the students like to do such a study? In their 3rd or 4th year? Winter or summer?

1.4 Use of AI

In this thesis, the artificial intelligence application “ChatGPT” (version GPT-4) was used. The application was used to give structure to parts of the text and to correct language in the parts abstract, problem statement, literature review, discussion and conclusion. The application was not used to write text from scratch as already manual written text by the author were used. The application was also not used in any of the research methods for finding online studies or for the survey. The author reviewed and rewrote the text produced by “ChatGPT”.

2 Literature review

2.1 Current education needs

In the current state of the world topics like the bioeconomy, renewable energy and circular economy are gaining in importance. Therefor Europe searches to promote education, training and skills across these topics(de Graaf et al., 2022). Finland has even constructed a bioeconomy strategy, “The Finnish Bioeconomy Strategy”(Peltonen, 2022) . In this strategy education and competence are brought up. Competence is highlighted as a crucial element in the bioeconomy, circular economy operating environment. That is why education is needed. In the bioeconomy, industrial and common technological development needs are identified, requiring a comprehensive approach in education and professional fields. The essential role of bioeconomy research and experts trained through this research are essential for innovation. The educational landscape has witnessed an expansion of bioeconomy-related studies in higher education institutions, offering specialized modules and open higher education opportunities. Challenges are identified in education and training, particularly in competence needs in the evolving bioeconomy. The working environment requires constant updates to competence, extending beyond natural sciences and bioeconomy specialization to include law and business-related skills. It is also underscored that the increasing significance of skills related to cooperation, business management, strategy implementation, and project work (de Graaf et al., 2022; Lucas et al., 2018; Peltonen, 2022).

2.2 Bioeconomy

The bioeconomy, a mixture of sectors like agriculture, forestry, fisheries, and biotechnology, has gained importance as a stimulant for sustainable development and economic growth. Historically, it has evolved from traditional biomass utilization to a broad approach integrating biotechnology and sustainable production processes. Key sectors within the bioeconomy include agriculture, forestry, fisheries, bioenergy, biotechnology, and waste management, all crucial in providing biological resources for sustainable goods, services, and energy. Drivers such as population growth, environmental concerns, and renewable resource demand fuel its growth, offering benefits like reduced reliance on fossil fuels, enhanced resource efficiency, and job creation. However, the bioeconomy faces challenges such as technological barriers, regulations, and socio-economic inequality. Policy and governance frameworks play a crucial role in supporting bioeconomy development, including incentives for research, bio-based product standards, and sustainability certification. Looking ahead, technological advancements in biorefineries, bio-based materials, and precision agriculture hold promise. Interdisciplinary collaboration and stakeholder engagement are necessary for realizing the bioeconomy's full potential and addressing emerging challenges, ensuring its contribution to global sustainable development agendas (Ferraz & Pyka, 2023; Tan & Lamers, 2021).

Finland and the European Union (EU) are deeply committed to improving bioeconomy initiatives. With its vast forest resources, Finland has positioned itself as a leader in bio-based innovation, investing in sectors such as bioenergy, biorefineries, and biomaterials to transition towards a sustainable bioeconomy (Peltonen, 2022). Similarly, the EU has prioritized bioeconomy within its sustainable development agenda, implementing strategies and funding programs to support

research, innovation, and investment in bio-based industries across member states. Through initiatives like the EU's Bioeconomy Strategy and funding from programs like Horizon Europe, both Finland and the EU are driving forward bioeconomy solutions to address climate change, improve resource efficiency and promote rural development (de Graaf et al., 2022).

2.3 Renewable energy

Renewable energy stands at the front of global efforts to combat climate change and transition towards sustainable energy systems. Renewable energy comes as many different of possibilities. Solar energy harnesses sunlight, while wind energy utilizes turbines to convert wind power into electricity. Hydroelectric, biomass, and geothermal energy sources further expand renewable energy. The drivers for renewable energy adoption include energy security, climate change mitigation, and economic benefits, such as job creation and rural development. Despite these advantages, challenges persist, including frequency, grid integration complexities, and policy uncertainties. Governments worldwide have responded with various policy mechanisms, such as renewable energy targets and financial incentives, to promote renewable energy deployment. Looking ahead, technological advancements in energy storage, grid modernization, and hybrid renewable systems hold promise for overcoming these challenges and enhancing renewable energy's contribution to sustainable development. By addressing key research gaps and innovation, renewable energy can play an important role in shaping a cleaner, more resilient energy future (European Renewable Energy Council, 2010; Hammons, 2009).

Both Finland and the European Union (EU) are pursuing renewable energy initiatives. Finland, using its abundant natural resources like forests and water bodies, focuses on expanding bioenergy, wind power, hydropower, and solar energy through policies like feed-in tariffs and investment subsidies. The EU, committed to transitioning to a low-carbon energy system, has set binding targets for renewable energy consumption by 2030 and supports member states with directives like the Renewable Energy Directive and funding programs such as Horizon Europe. Together, they aim to reduce reliance on fossil fuels, combat climate change, and foster sustainable energy ecosystems (European Commission, 2024).

2.4 Circular economy

The circular economy has emerged as a pivotal strategy to mitigate resource depletion and environmental degradation while fostering sustainable economic growth. Reviewing the literature shows its evolution from waste management to a more systematic approach on resource efficiency and waste reduction. Key principles of bioeconomy include designing out waste and pollution and promoting the reuse and recycling of materials. Implementation of the bioeconomy is done in different ways such as product redesign, remanufacturing, and sharing platforms. These implementations help the transition towards circularity, offering benefits such as resource conservation, reduced waste generation, and economic development. However, challenges such as fragmented value chains, technological limitations, and cultural barriers hinder the a widespread use. Policy and regulatory frameworks play a crucial role in promoting circular practices and stimulating market demand for sustainable products. Looking ahead, advancing technologies and fostering innovation are essential for scaling up circular business models and

embedding circularity principles into global supply chains (Ferraz & Pyka, 2023; European Parliament , 2023; Tan & Lamers, 2021).

Both Finland and the European Union (EU) are actively working on advancing circular economy initiatives. Finland, recognized for its leadership in this field, has developed a National Circular Economy Roadmap accentuating eco-design, resource efficiency, and waste minimization across sectors like manufacturing and construction. The country also fosters circular economy innovation through funding programs and innovation hubs. The EU has made circular economy a priority through initiatives such as the European Green Deal and the Circular Economy Action Plan. These efforts aim to transition towards a circular economy model that promotes sustainable production and consumption patterns, reduces waste generation, and supports economic and environmental benefits through measures like improved product design and increased recycling rates (CIRCCABC, 2024; Kari Herlevi, 2016).

2.5 International online studies

In today's evolving educational landscape, online international studies have emerged as an important way of crossing geographical boundaries and helping global engagement. Enabled by technological advancements, these programs offer students valuable opportunities to interact with diverse perspectives, cultures, and knowledge systems, improving communication skills. Moreover, they play a crucial role in nurturing global citizenship by teaching a sense of connectedness and responsibility by addressing global challenges. As our world becomes more and more connected, proficiency in worldwide communication and adaptability are essential skills for success, both academically and professionally. That is why online international studies not only prepare students for a globalized society but also contribute to breaking down barriers and creating a more developed and connected learning environment, underlining their importance in modern day education (Lucas et al., 2018; Rosendale & Gray-Rosendale, n.d.).

3 Methodology

This Bachelor's thesis uses a multi-faceted approach to gather and analyze data on online studies pertaining to the domains of bioeconomy, renewable energy, and circular economy. The methodology encompasses three primary components: online research, Microsoft Office tools for compiling data (specifically Excel), and survey tools (Webropol).

3.1 Online Research

The primary objective of the research is to compile a comprehensive list of online studies within the specified thematic areas. This is achieved through systematic online searching using search engines such as Google. Given the broad scope of the inquiry, various search terms and combinations are utilized to ensure inclusivity. The search criteria include but are not limited to keywords related to bioeconomy, renewable energy, circular economy, sustainable development, environmental studies, and green technology. Moreover, attention is paid to geographical limitations within the EU area, encompassing Norway and the UK, as well as the academic level of the studies, focusing on higher education institutions.

The process involves refining search queries to yield relevant results, considering nuances in language and terminology across different search engines. In these searches, studies need to be identified and their relevancy will need to be determined.

Upon identification of relevant studies, important information is extracted and compiled for further analysis. This includes details such as the name of the study, at which school, in which country, topic, duration, level of the degree, tuition fee, admission requirements and other relevant information.

Other than general search engines such as Google, some websites were used that provide a search engine for studies across the world. Websites such as educations.com and studiesportal.com. On these websites keywords such as bioeconomy can be used and filters can be set to only show the online studies in Europe in English (Keystone, 2024; *Studyportals.Com*, 2024).

3.2 Microsoft Office Tools for Compiling (Excel, Word)

To organize the gathered data systematically, Microsoft Excel is employed. A table format is used, with distinct columns representing different aspects of the studies such as location, prerequisites, duration, accreditation, course format, available resources, and any associated costs. This facilitates efficient sorting and comparison of the collected information, aiding in the subsequent analysis.

Furthermore, Excel's functionalities are utilized to perform basic statistical analyses and generate visualizations, providing insights into trends and patterns within the dataset. This analytical approach enhances the interpretability of the findings and enables the identification of key themes or areas of interest.

3.3 Survey Tools (Webropol)

In addition to the compilation of online studies, a survey is conducted to gauge the opinions and preferences of students, particularly those in the forestry and construction departments. The survey is designed to bring out insights regarding students' interest in online studies related to bioeconomy, renewable energy, and circular economy, as well as their motivations and preferences for such courses.

Key questions include inquiries about the students' motivations, preferred timing for online studies (e.g., during the academic year or summer break), preferred study formats , specific topic interests, perceived barriers to online learning, and suggestions for improvement.

Webropol, a survey-making tool provided by Lapland UAS, is used to make the survey. Anonymity is ensured to encourage candid responses, in this way preserving the privacy of participants.

The combination of these methodologies allows for a comprehensive exploration of online studies within the specified domains, complemented by insights from the target audience through survey analysis. Through repeated searches on the internet, the study aims to provide a robust understanding of the landscape of online education in the fields of bioeconomy, renewable energy, and circular economy, as well as actionable recommendations for future research and practice.

4 Results research

The research for online international studies in English in the EU area (including UK and Norway) related to the topics of bioeconomy, renewable energy and circular energy provided 36 studies. These were all studies about the given topics or related to them to a reasonable degree. The table with an overview of the studies can be found in attachment at the of the (Table 1).

Studies

Through research 36 studies were found. The topics of these areas are about or are related to the areas of bioeconomy, renewable energy, circular economy and additionally sustainability.

An overview of the studies with their name and topic can be found in the table in attachment at the end of the document.

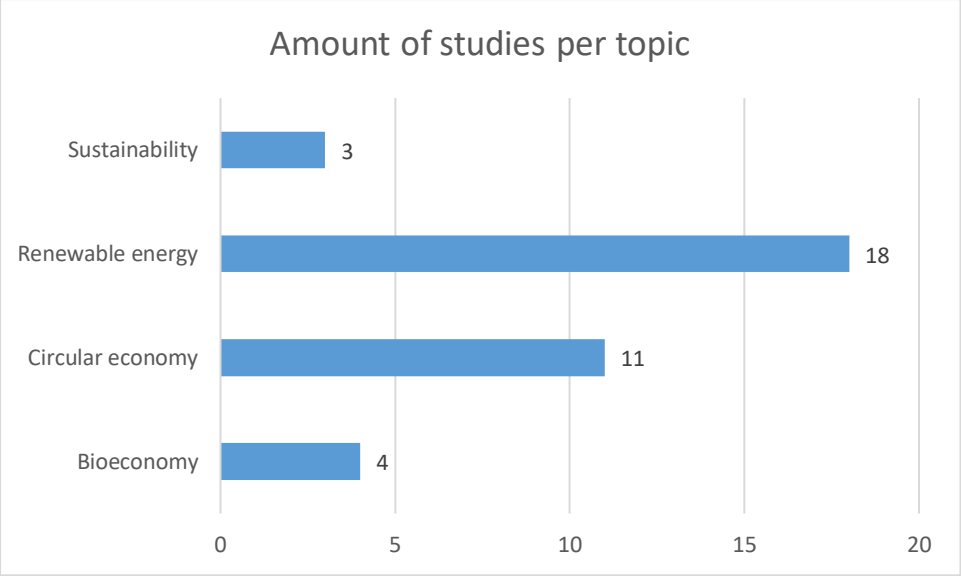


Figure 1: Amount of studies per topic

Out of the 36 studies, most were about or were related to renewable energy (18 studies) (Figure 1). The studies about renewable energy had many different focuses. Most of them focused on the technical and engineering aspects side of renewable energy. Some of the studies were specifically about a certain type of renewable energy, such as solar energy, wind energy or water energy. Urban planning, law and finance were also parts of renewable energy that were featured.

Circular economy the second most common subject (11 studies). However, it can be argued that circular economy and bioeconomy (4 studies) get combined in many studies, as both concepts correlate to each other and are similar in practice. Circular economy is however the most used term in these cases. The studies related to bioeconomy and circular economy vary on their focuses. There are studies on the topics in general, providing more information on the bioeconomy and circular economy. There are also studies that focus more on the business and

finance side of these topics. A final focus of some of these studies are the policies and laws related to the bioeconomy and circular economy.

The fourth topic that was the main focus of 3 of the studies is sustainability. In these studies the topics bioeconomy, renewable energy and circular economy are integrated in courses throughout the study. As these topics contribute to a sustainable world it is evident that they are included in the sustainability courses.

The collected studies are a mix of different topics related to bioeconomy, renewable energy and circular economy. Noticeable is also the focuses of the studies. As not all the studies are about the topics in general, but there are also focuses on policies, law, economics, business, engineering, etc.

Countries

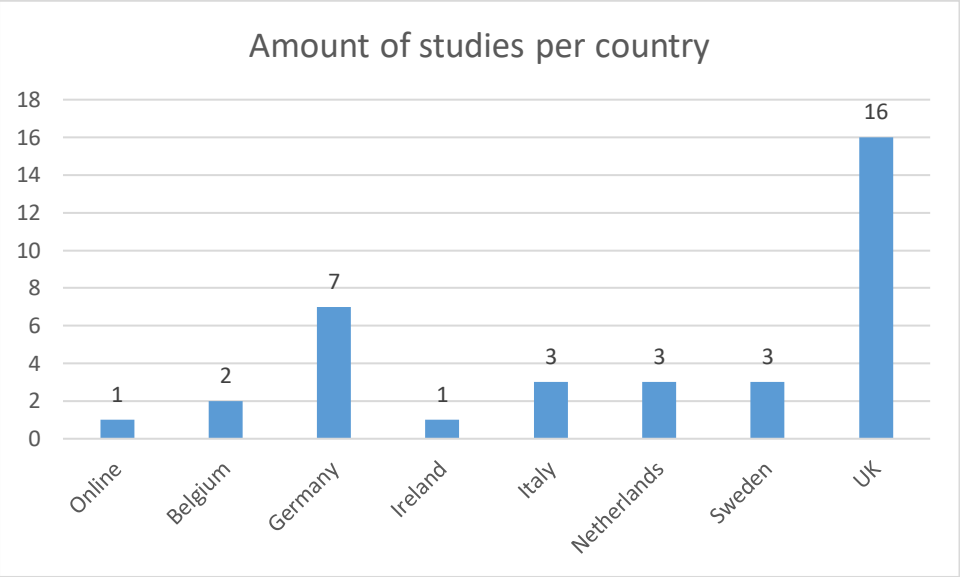


Figure 2: Amount of studies per country

The 36 studies found, came from 7 European countries (Figure 2). Of which the UK provided the most with 16 studies. As the main language in the UK is English, this is no coincidence. Germany follows with 7 studies. Italy, the Netherlands and Sweden all provided 3 studies. Belgium provided 2 studies and Ireland provided 1. There was also an online study from an online teaching institution not related to any physical university or college.

Degree level

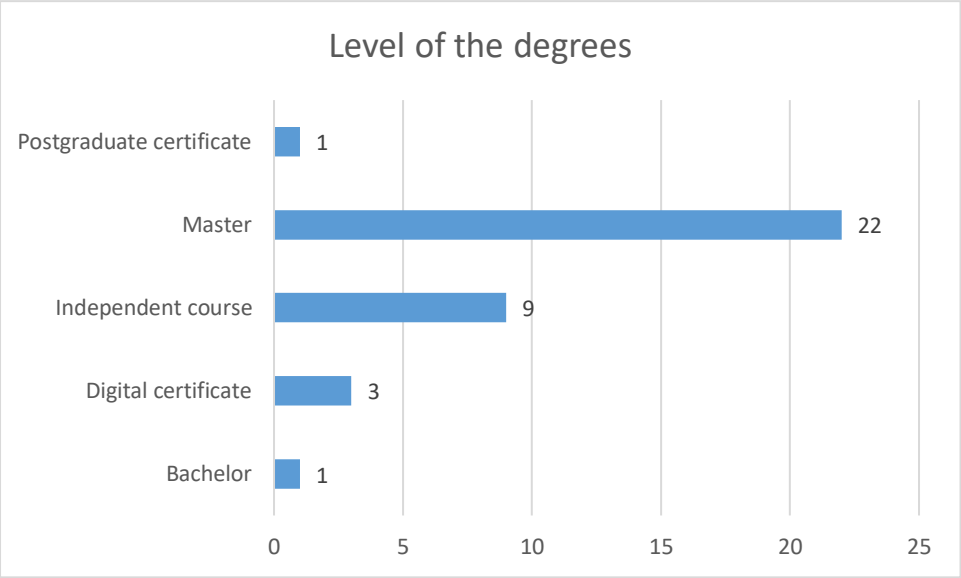


Figure 3: Level of the degrees

Of the 36 found studies most were at a master's degree level, with 22 studies (Figure 3). There were 9 independent courses, meaning that they were courses at a higher education level but without any degree level. Completing these courses, would mean you get some kind of certificate. There were 3 courses from which completing them a digital certificate would be awarded. There were also one postgraduate degree and one bachelor's degree level courses.

Duration

There is an overview of the duration in the table. The duration of the studies varied from self-paced to multiple years. The most common formats were studies that had a duration of a year of which there were 9. Other common formats were studies from 2 or 3 months and studies for a semester (6 months). Other formats went from self-paced to a couple of hours to a couple of years.

There are many different duration and formats of the studies.

Tuition fee

The tuition fees in the table are the fees for students from the EU and without scholarship. The tuition fees vary from free to more than 30.000 euro per year. The fees also vary from time period, as some are charged for the entire module and some are charged per month or year. The studies from the UK, have the highest average tuition fees going up to 30.000 euros and an average of 16.000 euros among the studies in the list. Germany follows as the second highest county with an average of around 10.000 euros without scholarships.

There were a couple of studies of without tuition fee or they were free of charge.

The fees cannot be compared to one another as not all the studies are in the same format or have the same duration.

Admission requirements

The admission requirements are not in the table because there was either nothing to add or the same requirements were needed for the studies.

For most of the master courses a bachelor's degree, in a field related to the topic such as engineering, forestry, construction, finance was needed. As well as an English test as proof of proficiency. In some cases, at least a year of work experience in a related field was needed.

For the postgraduate course a prior degree was also a requirement.

For the independent courses and the bachelor courses there were no relevant admission requirements other than proof of English proficiency.

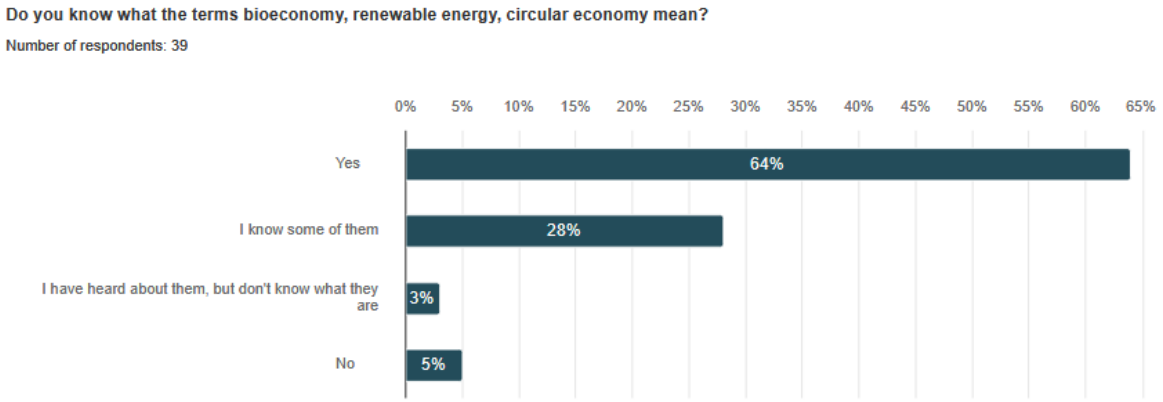
5 Results survey

5.1 Participation

The survey was sent to the students of the departments of forestry and construction of Lapland UAS at the beginning of April 2024. In the span of a month, there were 39 responses on the survey. Of which 18 (46%) were forestry students and 21 (54%) were construction students. The participants were mostly male (25 answers, 12 female). 21 participants were over 30 years old (54%) 9 were between 25 and 30 years old (23%), 7 were between 21 and 24 years old (18%) and 2 were between 18 and 20 years old (5%). 9 participants were in their first year of study, 6 in their second, 16 in their third and 11 on their fourth.

5.2 Knowledge about the topics

The first part of the survey is about the topics bioeconomy, renewable energy and circular economy. The questions aim to see how much the students know about these topics and how much these topics are handled in their classes.



	n	Percent
Yes	25	64.1%
I know some of them	11	28.2%
I have heard about them, but don't know what they are	1	2.6%
No	2	5.1%

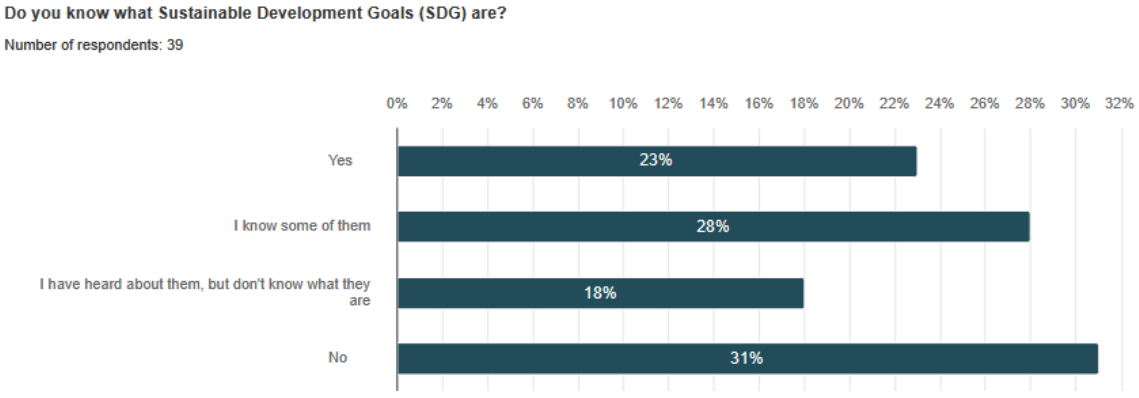
Figure 4: 1st question knowledge

The first question asks if the participants know the terms bioeconomy, renewable energy and circular economy.

Majority of the students say they know, with 25 participants saying they know all of them and 11 students saying they know some of them. One person answered they heard about them but do not know what they are. And two participants answered that they do not know these terms.

The second question is for the people that answered yes on the first question. And the questions ask the participants what keywords they associate with bioeconomy, renewable energy and circular economy.

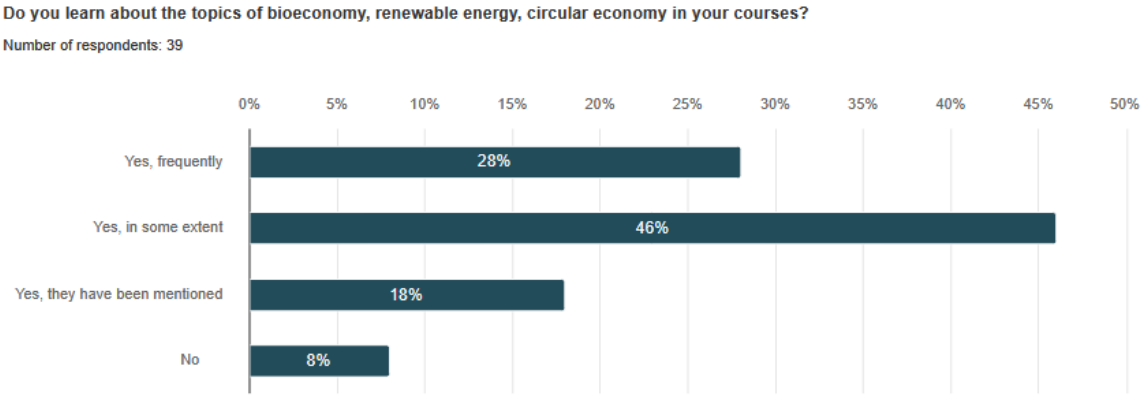
The participants in the survey associated a variety of keywords with the topics of bioeconomy, renewable energy, and circular economy. Common themes include renewable energy sources like solar and wind power, as well as the importance of recycling and upcycling materials. Sustainability and sustainable development emerged as crucial concepts, with an emphasis on responsible consumption and utilizing natural resources in a more sustainable manner. There was also a focus on bioenergy and bio-products, indicating a recognition of the potential of biological resources in driving economic activity. Additionally, participants highlighted the need for a greener future, with efforts to reduce reliance on non-renewable sources and address issues such as global warming and climate change. Overall, the responses underscore a collective desire for a more environmentally conscious approach to economic activity and resource management.



	n	Percent
Yes	9	23.1%
I know some of them	11	28.2%
I have heard about them, but don't know what they are	7	17.9%
No	12	30.8%

Figure 5: 3rd question knowlegde

The third question asks the participants if they know what Sustainable Development Goals (SDG) are. Most participants know at least some of the SDG's and some have heard about them but do not know what they are. With 9 participants saying yes, 11 saying they know some of them and 7 saying they have heard about them. 12 Participants did not know what SDG's are.



	n	Percent
Yes, frequently	11	28.2%
Yes, in some extent	18	46.2%
Yes, they have been mentioned	7	17.9%
No	3	7.7%

Figure 6: 4th question knowledge

The fourth question asks the participants if they learn about the topics bioeconomy, renewable energy and circular economy in their courses.

Majority of the answers said they do in fact learn about these topics as 11 participants answered with "yes, frequently", 18 participants answered with "yes, in some extent" and 7 participants answered with " yes, they have been mentioned". 3 participants said they haven't learnt about these topics.

Most of the participants have learnt about the topics bioeconomy, renewable energy and circular economy in their courses.

On a scale from 1 to 10, how important do you believe understanding the concepts of bioeconomy is for your future career or academic pursuits?

Number of respondents: 39

Min value	Max value	Average	Median	Sum	Standard Deviation
1.0	10.0	7.5	8.0	294.0	2.3

Figure 7: 5th question knowlegde

On a scale from 1 to 10, how important do you believe understanding the concepts of renewable energy is for your future career or academic pursuits?

Number of respondents: 39

Min value	Max value	Average	Median	Sum	Standard Deviation
1.0	10.0	7.9	8.0	310.0	2.3

Figure 8: 6th question knowledge

On a scale from 1 to 10, how important do you believe understanding the concepts of circular economy is for your future career or academic pursuits?

Number of respondents: 39

Min value	Max value	Average	Median	Sum	Standard Deviation
1.0	10.0	7.8	8.0	303.0	2.3

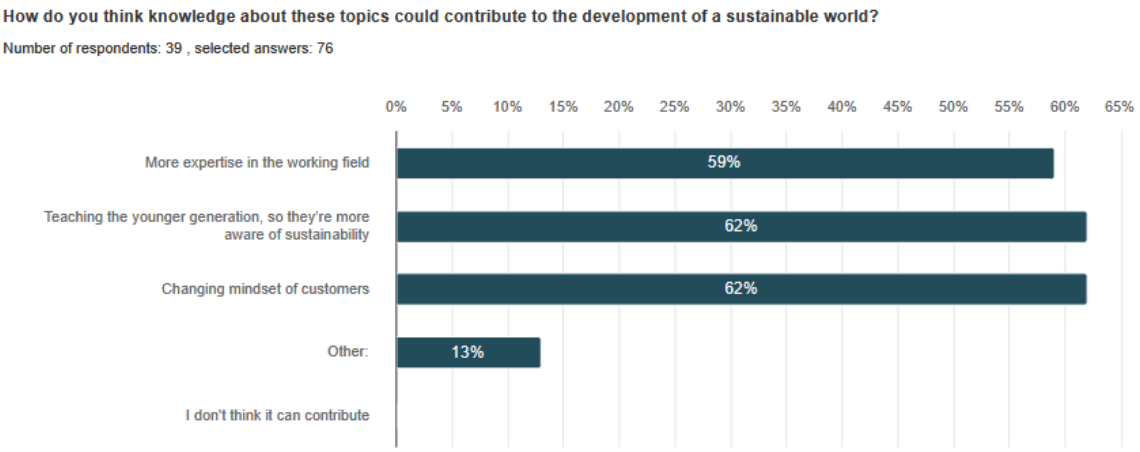
Figure 9: 7th question knowledge

The fifth, sixth and seventh question are about how important the students believe understanding the concepts of bioeconomy, renewable energy and circular economy are for their future careers or academic pursuits. The answers are on a scale from 1 to 10, with 1 being not important, 5 being important and 10 being very important.

For bioeconomy the average score is 7.5, which is the lowest of the three but means the participants find it important. For renewable energy, the average score is 7.9 which is the highest. And circular economy had an average score of 7.8. The participants find all these topics in between important and very important for their future careers.

The eighth question is about what aspects of the bioeconomy, renewable energy, and circular economy the participants are most interested in learning more about. The participants were able to give their own answers.

The participants in the survey expressed various interests in learning more about specific aspects of the bioeconomy, renewable energy, and circular economy. Some were keen on understanding the multiple uses of forests and the durability of wood products, recognizing their environmental benefits. Others sought knowledge on bio-based products, waste management, and resource efficiency, highlighting the importance of reducing strain on natural resources through circular economy practices. Green energy and sustainability were recurring themes, with a focus on passive energy conservation solutions, renewable energy opportunities, and the production of renewable energy. Additionally, interests extended to topics such as recycling, efficient material reuse in construction, and the application of these concepts in various industries like forestry and infrastructure engineering. However, some participants expressed little interest in these topics, while others were curious about specific applications such as renewable energy for cars and the circular economy of construction materials. Overall, there is a clear desire for deeper understanding and practical application of sustainable principles across different domains.



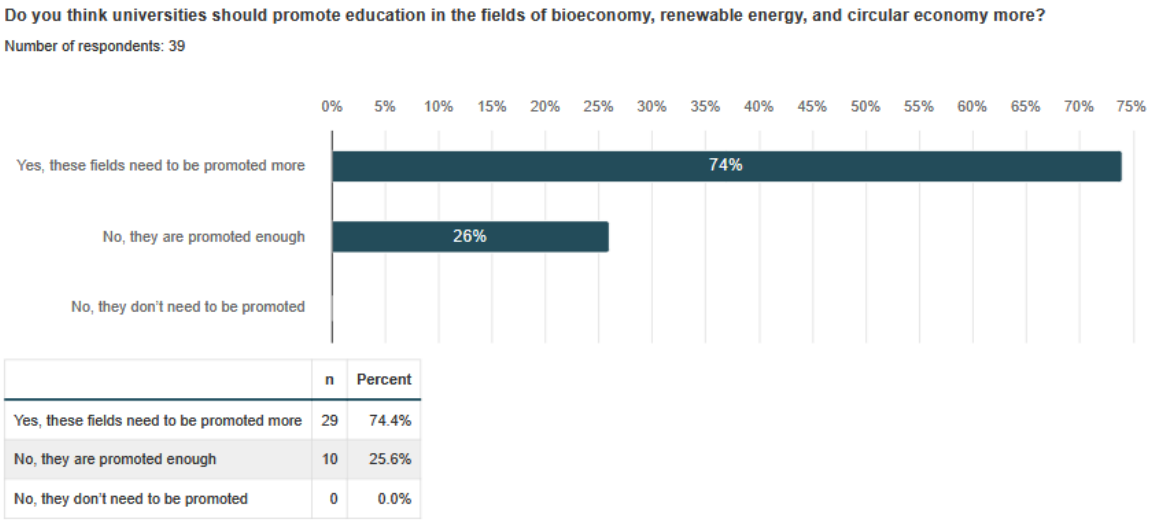
	n	Percent
More expertise in the working field	23	59.0%
Teaching the younger generation, so they're more aware of sustainability	24	61.5%
Changing mindset of customers	24	61.5%
Other:	5	12.8%
I don't think it can contribute	0	0.0%

Figure 10: 8th question knowledge

The ninth question asked how the participants think knowledge about these topics could contribute to the development of a sustainable world. This question was multiple choice and the participant could give their own answer as well.

The answers are evenly distributed with “More expertise in the working field”, “Teaching the younger generation, so they are more aware of sustainability”, “Changing mindset of customers” all got 23 and 24 answers.

A total of 5 participants had their own answers. These answers included making the older generation more aware of sustainability. 2 answers mentioned that the cost of a sustainable world would be lower and products could be cheaper. And other answers mentioned changing the mindset of the entire society regarding living, housing and economy.



	n	Percent
Yes, these fields need to be promoted more	29	74.4%
No, they are promoted enough	10	25.6%
No, they don't need to be promoted	0	0.0%

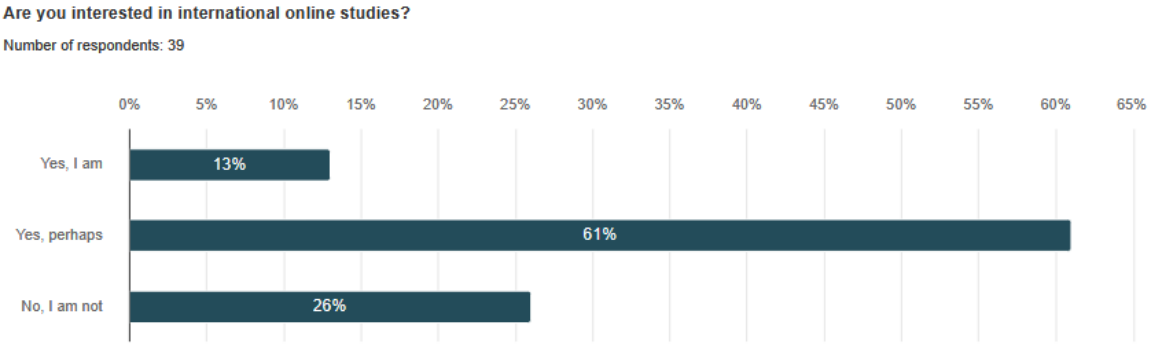
Figure 11: 10th question knowledge

The tenth question asks the participants whether they think universities should promote education in the fields of bioeconomy, renewable energy, and circular economy more.

Most of the participants answered, that these field need to be promoted more, with 29 answers. And 10 participants answered that these fields are promoted enough.

5.3 Opinions on international online studies

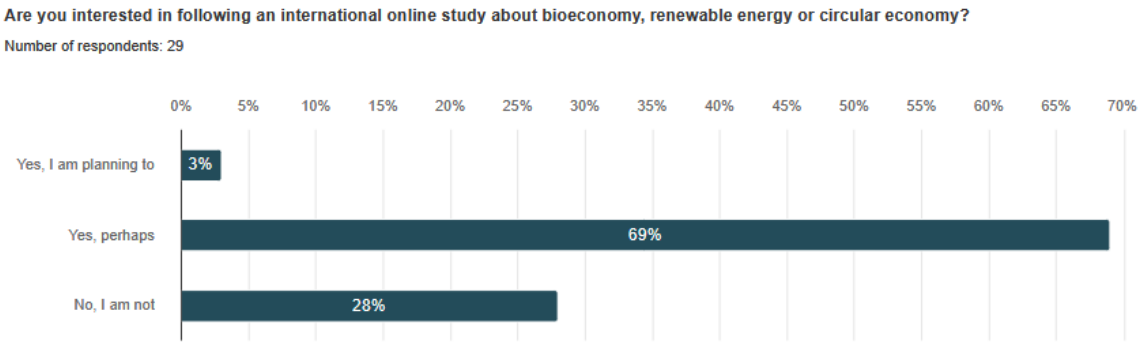
The second part of the survey is about online international studies regarding the topics bioeconomy, renewable energy and circular economy. The students are asked their opinions about them and about their willingness to do these studies.



	n	Percent
Yes, I am	5	12.8%
Yes, perhaps	24	61.5%
No, I am not	10	25.7%

Figure 12: 1st question studies

The first question asks if the participants are interested in international online studies. Majority of the participants answered that they were, with 5 answering “yes, I am” and 24 answering “yes, perhaps”. 10 participants answered that they were not interested.



	n	Percent
Yes, I am planning to	1	3.4%
Yes, perhaps	20	69.0%
No, I am not	8	27.6%

Figure 13: 2nd question studies

The second question was for the participants that answered yes in the first question. It asked if the participants were interested in following an international online study about bioeconomy, renewable energy or circular economy.

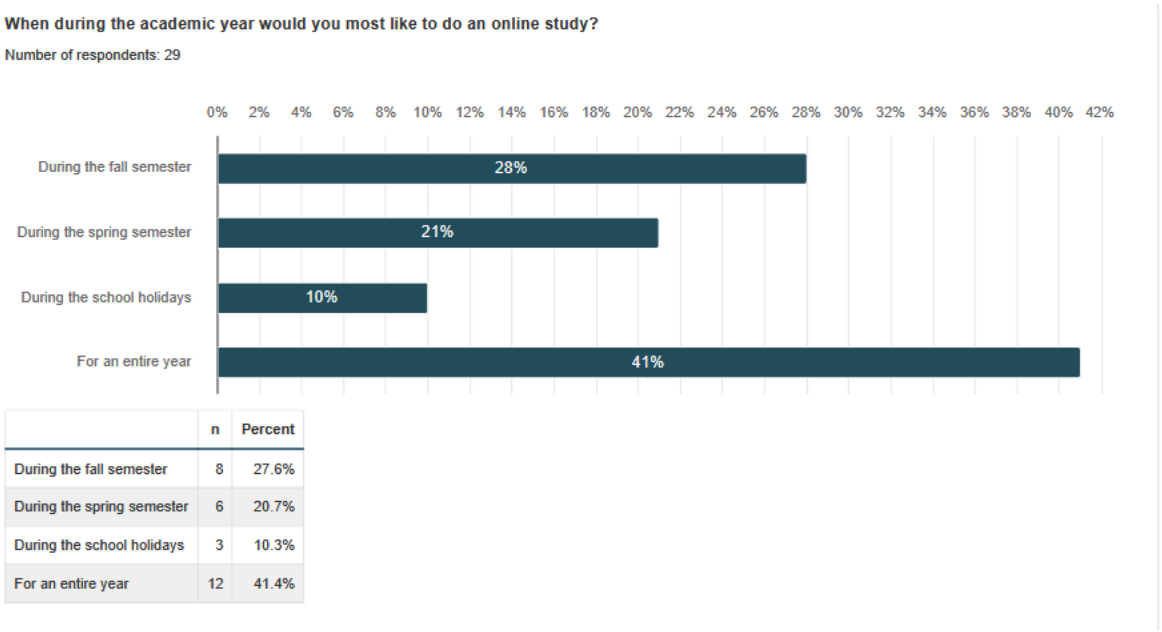
Of the 29 people that responded to this question 1 answered that they were planning to and 20 answered “yes, perhaps”. 8 participants responded that they were not interested in in an online study about these topics.

The third question was for the people that answered that they were not interested in international online studies, asking them why they are not interested.

The reasons for not being interested in international online studies varied among the participants. Some said graduation or completion of their current studies meant that further education is not a priority at this stage. Others mentioned time constraints due to work, family commitments, or a heavy workload. Some expressed a preference for focusing on national studies, feeling that they already have access to enough information and resources in Finland. Language proficiency and comfort were also factors for consideration, with some participants feeling that studying in English might be challenging for them. Other personal preferences, such as a desire to work locally or a preference for in-person learning, influenced their lack of interest in international online studies. Overall, the responses show various professional and personal factors influencing their decision not to pursue international online education at this time.

The fourth question was for the people that answered that they were interested in online international studies about the topics of bioeconomy, renewable energy or circular economy in the first and second question.

Participants expressed a range of reasons for their interest in studies about bioeconomy, renewable energy, and circular economy. Many answered a desire to enhance their expertise and understand the relevance of these topics to their own fields of study or professional interests. Some mentioned the increasing importance of these subjects in the future and the need for shifting mindsets towards more sustainable practices for the well-being of both individuals and the planet. Others saw international courses as opportunities to gain new perspectives and ideas from different countries, sustaining broader understanding and collaboration. Several participants highlighted the importance of these topics for society, mentioning the potential impact on politics and legislation. Overall, the responses show an understanding of the importance of bioeconomy, renewable energy, and circular economy in addressing global challenges and driving positive change.

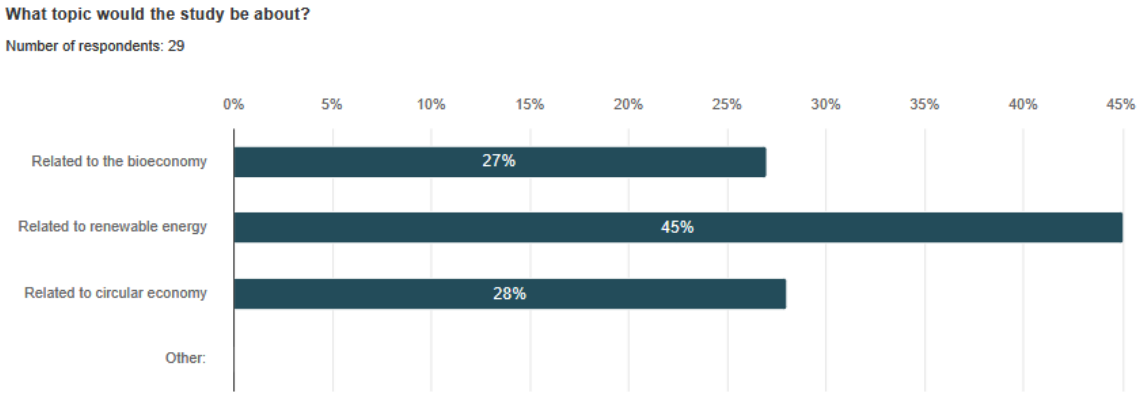


	n	Percent
During the fall semester	8	27.6%
During the spring semester	6	20.7%
During the school holidays	3	10.3%
For an entire year	12	41.4%

Figure 14: 5th question studies

In the fifth question the participants are asked when during the academic year they would most like to do an online study.

Most participants answered they prefer to do them for an entire year, with 12 answers. 8 participants would prefer to do them during the fall semester, 6 participants would prefer to do them during the spring semester and 3 participants would prefer to do them during the school holidays.

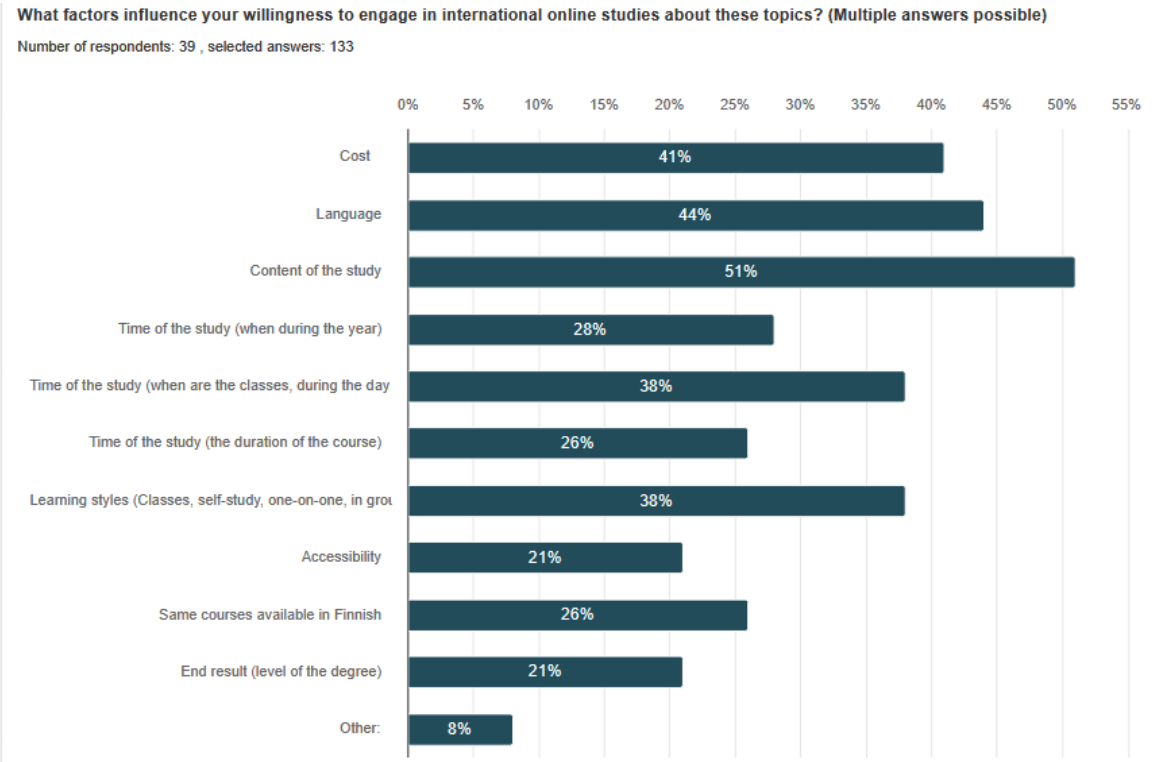


	n	Percent
Related to the bioeconomy	8	27.6%
Related to renewable energy	13	44.8%
Related to circular economy	8	27.6%
Other:	0	0.0%

Figure 15: 6th question studies

The sixth question asks the participants which topic they would like to study in an online international study.

Most of the participants answered renewable energy, with 13 answers. And both bioeconomy and circular economy got 8 answers.

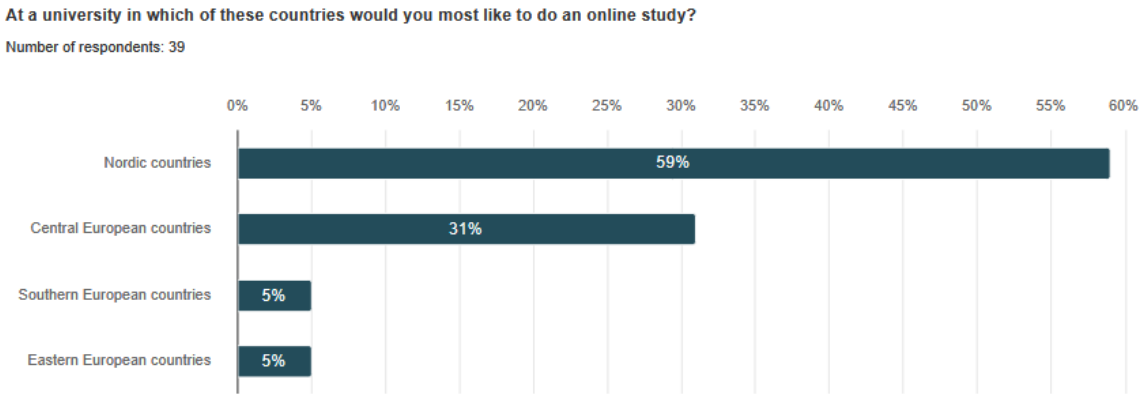


	n	Percent
Cost	16	41.0%
Language	17	43.6%
Content of the study	20	51.3%
Time of the study (when during the year)	11	28.2%
Time of the study (when are the classes, during the day or in the evening)	15	38.5%
Time of the study (the duration of the course)	10	25.6%
Learning styles (Classes, self-study, one-on-one, in groups,...)	15	38.5%
Accessibility	8	20.5%
Same courses available in Finnish	10	25.6%
End result (level of the degree)	8	20.5%
Other:	3	7.7%

Figure 16: 7th question studies

The seventh question asks the participants which factors influence their willingness to engage in international online studies about these topics. The participants could choose multiple answers.

The most chosen answer was the content of the study with 20 answers. Followed by the language of the study (17 answers) , cost (16 answers), time of study during the day (15 answers) and the learning styles used in the study (15 answers). Other factors such as time of study, accessibility and end result were deemed less important as they received fewer answers. There were also 3 answers added by the participants, these included an interest in the differences with other countries, the age of the participant and time in general.

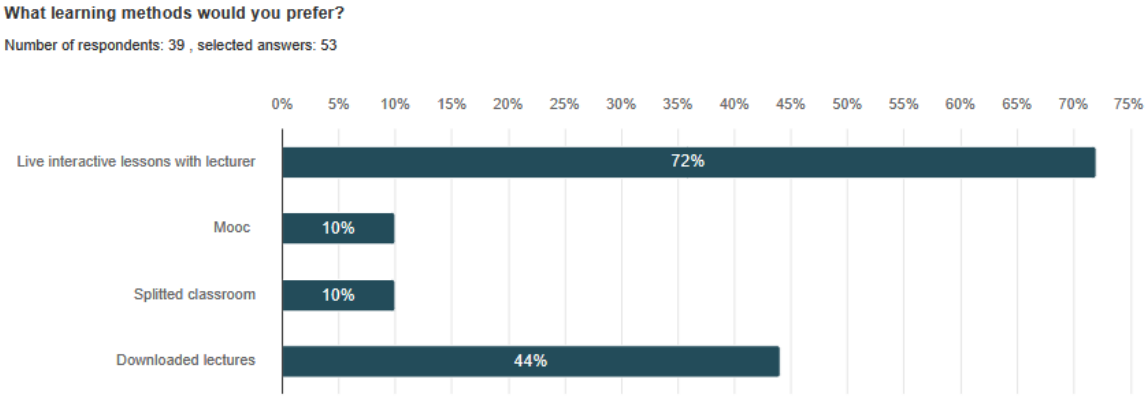


	n	Percent
Nordic countries	23	59.0%
Central European countries	12	30.8%
Southern European countries	2	5.1%
Eastern European countries	2	5.1%

Figure 17: 8th question studies

The eighth question asks the participants at a university in which country they would most like to do an online study.

There was a clear preference for Nordic countries, as they received majority of the answers with 23 answers. 12 participants answered Central European countries. And Southern and Eastern European countries both received 2 answers.

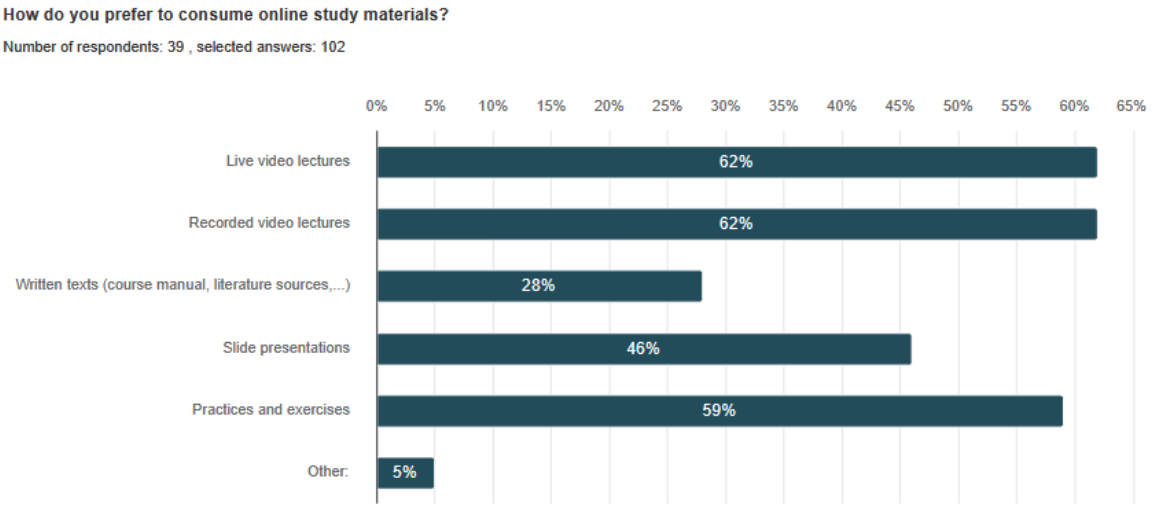


	n	Percent
Live interactive lessons with lecturer	28	71.8%
Mooc	4	10.3%
Splitted classroom	4	10.3%
Downloaded lectures	17	43.6%

Figure 18: 9th question studies

The ninth question asks the participants what learning methods they would prefer for these international online studies. Multiple answers could be selected with this question.

Most participants prefer live interactive lessons with a lecturer and downloaded lectures. With live interactive lessons receiving 28 answers and downloaded lessons receiving 17 answers. Mooc and splitted classrooms both received 4 answers.

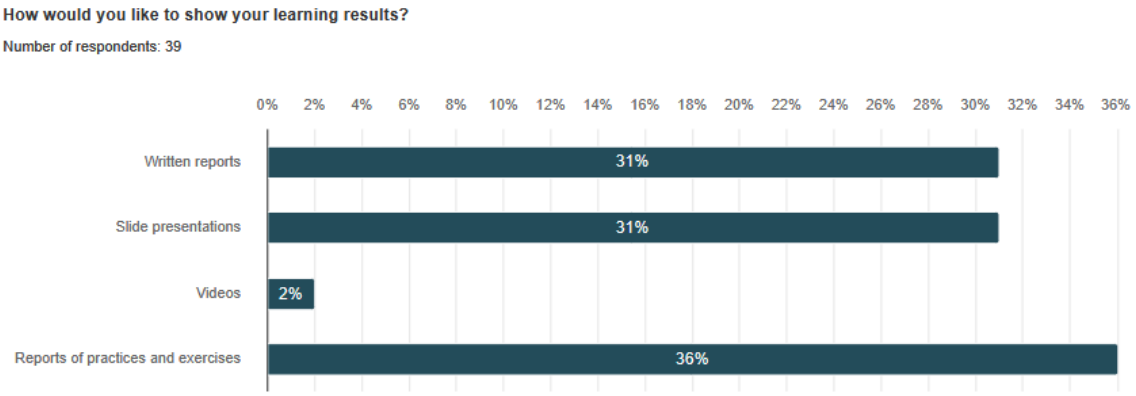


	n	Percent
Live video lectures	24	61.5%
Recorded video lectures	24	61.5%
Written texts (course manual, literature sources,...)	11	28.2%
Slide presentations	18	46.2%
Practices and exercises	23	59.0%
Other:	2	5.1%

Figure 19: 10th question studies

In the tenth question the participants were asked how they prefer to consume online study materials. Multiple answers could be chosen in this question.

Live video lectures and recorded video lectures were chosen most by the participants, with 24 answers. Followed by practices and exercises, with 23 answers. Slide presentations received 18 answers and written texts 11 answers. A participant also added that they would like to work in groups as well.



	n	Percent
Written reports	12	30.8%
Slide presentations	12	30.8%
Videos	1	2.5%
Reports of practices and exercises	14	35.9%

Figure 20: 11th question studies

The eleventh question asks the participants how they would most like to show their learning results.

Most participants would like reports of their practices and exercises, with 14 answers. Participants also preferred written reports and slide presentations, both received 12 answers. Videos were least liked, with only 1 answer.

Question twelve was an open question. It asked the participants what specific skills or competencies they hoped to gain from online studies in these areas.

Participants expressed a variety of specific skills and competencies they hope to gain from online studies in bioeconomy, renewable energy, and circular economy. Many seek a deeper understanding of solutions to environmental challenges, such as producing renewable energy and improving circular economy practices. Others aim to expand their knowledge base, stay updated on current developments, and learn new approaches to mitigating the impact of human activities on the planet. International understanding and exposure to diverse perspectives were highlighted as valuable outcomes, along with language proficiency and communication skills. Some participants want to acquire practical skills relevant to their professions, such as expertise in energy technology or forestry management. Overall, the responses demonstrate a need for comprehensive knowledge and practical abilities that can be applied to challenges in the real world and contribute to positive change in various sectors related to sustainability.

The final question asked the participants whether they had any suggestions or preferences regarding the format, duration, timing, etc of online courses in these subjects.

Participants answered with several preferences and suggestions regarding the format, duration, and timing of online courses in bioeconomy, renewable energy, and circular economy. Many suggested breaking down the broad topic into smaller parts to help learning and skill

development. Preferences leaned towards shorter, more intensive courses with interactive lessons to maintain focus, especially if offered in the evening but not too late. Flexibility was a recurring theme, with participants wanting the ability to study at their own pace and time, with options for flexible scheduling and the inclusion of breaks. Some showed their preference to the importance of practical aspects, such as goal-oriented tasks and insights from professionals working in the field, while others highlighted the desire for live, interactive classes during daytime hours. Overall, the responses indicate a preference for flexibility, interactivity, and practical relevance in online course offerings.

6 Discussion

Research

The research on online international studies within the European Union area, including the United Kingdom and Norway, provided a total of 36 studies related to bioeconomy, renewable energy, circular economy, and sustainability. These studies collectively contribute to the academic conversation surrounding sustainable development, fostering a deeper understanding and engagement with crucial environmental issues (de Graaf et al., 2022; Rosendale & Gray-Rosendale, n.d.).

Among the found studies, renewable energy was the most common topic, having 18 studies. These studies provided insights into various areas of renewable energy, including technical and engineering aspects, alongside considerations of urban planning, law, and finance. The availability of studies like these contribute to the advancement and innovation within the fields of renewable energy, paving the way for sustainable energy solutions (European Commission, 2024; European Renewable Energy Council, 2010).

Following renewable energy, circular economy was second most common subject, with 11 studies. Notably, circular economy and bioeconomy are often combined within these studies, with circular economy being the more frequently used term. The studies on bioeconomy and circular economy ranged from general overviews to more focused studies on business, finance, and policy aspects. The integration of these studies into course curricula highlights the relation between these topics within the broader context of sustainability education (Ferraz & Pyka, 2023; Parliament - wwweuroparleuropaeu, 2023; Raimo, 2023).

Sustainability was a topic of three studies, wherein bioeconomy, renewable energy, and circular economy were integrated. This integration underscores the approach to addressing environmental challenges within educational institutions, highlighting the importance of interdisciplinary solutions (Ferraz & Pyka, 2023).

The studies originated from seven European countries, reflecting a commitment to environmental education. The prominence of the United Kingdom as a source of studies can be attributed to its English-language offerings, making these programs accessible to international students. This however does not necessarily mean other countries do not focus on these topics. They may have more courses available in their own languages.

An examination of study duration and tuition fees reveals a diverse landscape reflective of varied program structures and financial considerations. While most studies follow conventional year-long formats, there exists a wide range of durations and tuition fees. However, it is worth noting that tuition fees can sometimes be high, potentially limiting access to these valuable educational opportunities.

Furthermore, it is important to acknowledge that the research may not have captured all applicable courses, either due to limitations in online availability or search methodology. This underscores the need for continued exploration and awareness-building within these fields of study.

In summary, the findings of this research shed light on the landscape of online international studies related to bioeconomy, renewable energy, circular economy, and sustainability within Europe. These studies, while contributing to the advancement of knowledge and innovation, also highlight the importance of accessible education and interdisciplinary collaboration in addressing environmental challenges on a global scale.

Survey

The survey conducted among students at Lapland UAS within the departments of forestry and construction provided valuable insights into their knowledge, perceptions, and preferences regarding bioeconomy, renewable energy, and circular economy. With 39 responses received over the course of a month, the participants were relatively even, consisting out of 46% forestry students and 54% construction students, with a majority being male. The age distribution varied, with a majority of participants over 30 years old, indicating a mix of both experienced and younger students engaging with the survey.

Regarding knowledge about the topics, the majority of participants demonstrated familiarity with bioeconomy, renewable energy, and circular economy concepts. Notably, most respondents associated these terms with various environmental and sustainable development-related keywords, indicating an understanding of their significance. Additionally, a decent portion of participants reported learning about these topics within their courses, highlighting the integration of sustainability principles in courses.

Participants recognized the importance of understanding bioeconomy, renewable energy, and circular economy concepts for their future careers. Their interests in learning more about specific aspects of these fields further showed their commitment to gaining deeper insights and practical skills relevant to sustainability and environmental well-being.

Regarding international online studies, a majority of participants expressed interest, emphasizing the potential benefits of gaining global perspectives and expertise in bioeconomy, renewable energy, and circular economy topics. While some answered logistical challenges or personal preferences as reasons for not pursuing international studies, others answered specific skills and competencies they hoped to acquire, such as expertise in energy technology or forestry management. Suggestions for course formats, durations, and timings highlighted the importance of flexibility, interactivity, and practical relevance in online learning experiences, showing a desire for engaging and accessible educational opportunities in these critical areas.

Overall, the survey findings provide valuable insights into the perspectives and preferences of students regarding bioeconomy, renewable energy, and circular economy education, indicating a strong interest in sustainable development topics and a desire for comprehensive and accessible learning opportunities to prepare for future careers and academic pursuits.

7 Conclusion

In conclusion, the research and survey conducted provide valuable insights into the landscape of online international studies related to bioeconomy, renewable energy, circular economy, and sustainability within Europe, as well as the perspectives and preferences of students regarding these topics.

The research uncovered a diverse supply of studies, highlighting the significant contribution of educational institutions to sustainable development. Renewable energy was focused on the most in these studies, showcasing the interdisciplinary nature of the field and its potential to drive innovation and progress towards sustainable energy solutions. Circular economy studies followed closely, often combined with bioeconomy, reflecting the connection of these concepts within sustainability education. Sustainability was also a topic in these studies, showing the integration of environmental principles across education.

The prominence of the United Kingdom as a source of studies shows the accessibility of English-language offerings to international students, though other countries may offer courses in their native languages. Additionally, the variation in study duration and tuition fees highlights the importance of accessibility and affordability in promoting equal access to education.

The survey findings complement the research by providing insights into student perceptions and preferences. The strong interest among students in gaining expertise in bioeconomy, renewable energy, and circular economy topics underscores the importance of integrating these subjects into educational courses. Students recognize the relevance of these topics for future careers and demonstrate a desire for engaging and practical learning experiences, particularly through international online studies.

Overall, the findings highlight the importance of continued exploration, awareness-building, and collaboration within these fields of study to address pressing environmental challenges and foster sustainable global practices. By combining research insights with student perspectives, this study contributes to the ongoing dialogue surrounding sustainable development and education, with implications for both academia and industry.

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9 Attachments

1. Do you agree for your answers to be used for research on the supply of online studies related to bioeconomy, renewable energy, circular economy? *

- ◯ I agree
- ◯ I do not want to take part

2. Do you know what the terms bioeconomy, renewable energy, circular economy mean? *

- ◯ Yes
- ◯ I know some of them
- ◯ I have heard about them, but don't know what they are
- ◯ No

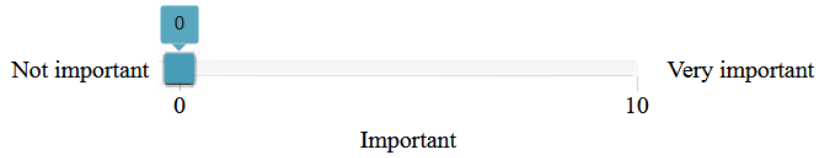
4. Do you know what Sustainable Development Goals (SDG) are? *

- ◯ Yes
- ◯ I know some of them
- ◯ I have heard about them, but don't know what they are
- ◯ No

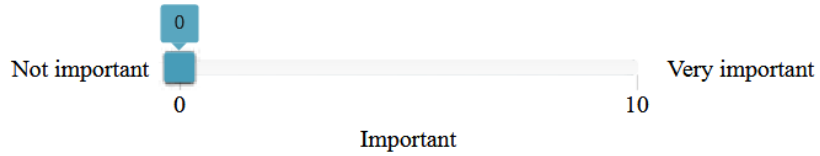
5. Do you learn about the topics of bioeconomy, renewable energy, circular economy in your courses? *

- ◯ Yes, frequently
- ◯ Yes, in some extent
- ◯ Yes, they have been mentioned
- ◯ No

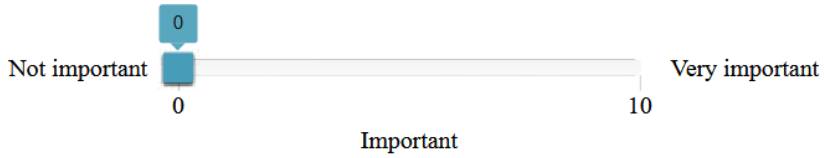
6. On a scale from 1 to 10, how important do you believe understanding the concepts of bioeconomy is for your future career or academic pursuits? *



7. On a scale from 1 to 10, how important do you believe understanding the concepts of renewable energy is for your future career or academic pursuits? *



8. On a scale from 1 to 10, how important do you believe understanding the concepts of circular economy is for your future career or academic pursuits? *



9. What specific aspects of the bioeconomy, renewable energy, and circular economy are you most interested in learning more about? *

10. How do you think knowledge about these topics could contribute to the development of a sustainable world? *

- ☐ More expertise in the working field
- ☐ Teaching the younger generation, so they're more aware of sustainability
- ☐ Changing mindset of customers
- ☐ Other: _____
- ☐ I don't think it can contribute

11. Do you think universities should promote education in the fields of bioeconomy, renewable energy, and circular economy more? *

- ○ Yes, these fields need to be promoted more
- ○ No, they are promoted enough
- ○ No, they don't need to be promoted

12. Are you interested in international online studies? *

- ○ Yes, I am
- ○ Yes, perhaps
- ○ No, I am not

13. Are you interested in following an international online study about bioeconomy, renewable energy or circular economy? *

- ◯ Yes, I am planning to
- ◯ Yes, perhaps
- ◯ No, I am not

14. Why are you not interested in international online studies? *

15. Why are you interested in studies about these topics? *

16. When during the academic year would you most like to do an online study? *

- ◯ During the fall semester
- ◯ During the spring semester
- ◯ During the school holidays
- ◯ For an entire year

17. What topic would the study be about? *

- ◯ Related to the bioeconomy
- ◯ Related to renewable energy
- ◯ Related to circular economy
- ◯ Other:

18. What factors influence your willingness to engage in international online studies about these topics? (Multiple answers possible) *

- ☐ Cost
- ☐ Language
- ☐ Content of the study
- ☐ Time of the study (when during the year)
- ☐ Time of the study (when are the classes, during the day or in the evening)
- ☐ Time of the study (the duration of the course)
- ☐ Learning styles (Classes, self-study, one-on-one, in groups,...)
- ☐ Accessibility
- ☐ Same courses available in Finnish
- ☐ End result (level of the degree)
- ☐ Other:

19. At a university in which of these countries would you most like to do an online study?

- ◯ Nordic countries
- ◯ Central European countries
- ◯ Southern European countries
- ◯ Eastern European countries

20. What learning methods would you prefer? *

- ☐ Live interactive lessons with lecturer
- ☐ Mooc
- ☐ Splitted classroom
- ☐ Downloaded lectures

21. How do you prefer to consume online study materials? *

- ☐ Live video lectures
- ☐ Recorded video lectures
- ☐ Written texts (course manual, literature sources,...)
- ☐ Slide presentations
- ☐ Practices and exercises
- ☐ Other:

22. How would you like to show your learning results? *

- ◯ Written reports
- ◯ Slide presentations
- ◯ Videos
- ◯ Reports of practices and exercises

23. What specific skills or competencies do you hope to gain from online studies in these areas? *

_____

_____

_____

24. Do you have any suggestions or preferences regarding the format, duration, timing, etc of online courses in these subjects? *

_____

_____

_____

_____

_____

25. What is your gender? *

- ◯ Male
- ◯ Female
- ◯ Prefer not to answer

26. How old are you? *

- ◯ 18-20
- ◯ 21-24
- ◯ 25-30
- ◯ Over 30

Table 1: Online international studies

	Name study	Institution	Country	Degree level	Topic	Duration	Tuition fee
1	MicroMasters Business and Operations for a Circular Bio-Economy	Wageningen University	Netherlands	Micro masters	Bioeconomy	6 months	/
2	MicroMasters® Program in Economics and Policies for a Circular Bio-Economy	Wageningen University	Netherlands	Micro masters	Circular bioeconomy	Self-paced	700 EUR
3	Introduction to Sustainable Bioeconomy	University of Padova	Italy	Independent course	Sustainable Bioeconomy	3 weeks	/
4	International Online Master in Sustainability and Circular Bioeconomy Management	Rome Business school	Italy	Master	Bioeconomy	/	/
5	MSc in Sustainable Energy Solutions	University of the Highlands and Islands	UK	Master	Renewable energy	1-3 years	9,990 EUR per year
6	Certified Expert in Climate & Renewable Energy Finance	Frankfurt School of Finance & Management - Sustainable World Academy	Germany	Independent course	Renewable energy finance	6 months	1700 EUR
7	MBA Renewables	Renewables Academy AG (RENAC)	Germany	Master	Renewable energy	5 semesters	16,000 EUR per year
8	MSc Energy for Smart Cities (SMCS)	KTH Royal Institute of Technology	Sweden	Master	Urban planning, energy management	2 years	15,000 EUR
9	MSc in Net Zero Communities	University of the Highlands and Islands	UK	Master	Renewable energy	1-4 years	9,720 EUR per year
10	Wind Energy Systems - Diplomas of Advanced Studies	Fraunhofer Academy	Germany	Diploma of Advanced Studies (DAS)	Renewable energy (wind energy)	1 year	6000 EUR

11	Certificates of Solar Energy Engineering	Fraunhofer Academy	Germany	Certificate of Advanced Studies (CAS)	Renewable energy (solar energy)	6-12 months	2,500 EUR per semester
12	Master of Science in Solar Energy Engineering	Fraunhofer Academy	Germany	Master	Renewable energy (solar energy)	4-7 semesters	25,000 EUR per course
13	Online Master of Science in Wind Energy Systems	Fraunhofer Academy	Germany	Master	Renewable energy (wind energy)	7-9 semesters	14,000 EUR per course
14	Solar Energy - Solar Technology and Its Use Worldwide (Free Online Course With Certificate)	Alison Free Online Learning	/	Digital certificate	Renewable energy (solar energy)	1-3 hours	/
15	Foundation Course: Design for Circular Economy	School of Sustainability	Italy	Independent course	Circular economy	8 weeks	1,500 EUR per course
16	Bioeconomy: how renewable resources can help the future of our planet	University of York	UK	Independent course	Bioeconomy	3 weeks	/
17	Postgraduate Certificate: Circular Economy – Business and Legal Frameworks and Opportunities (Leuven)	KU Leuven	Belgium	Postgraduate certificate	Circular economy	1 year	/
18	Industrial Engineering Energy Systems with Renewable Energies	AKAD Hochschulen	Germany	Bachelor	Industrial engineering (renewable energies	36 months	229 EUR per module
19	Renewable Energy Engineering MSc	Brunel University London	UK	Master	Renewable energy	3 years	25,000 pounds
20	Oil, Gas, and Renewable Energy Law	University of Aberdeen	UK	Master	Renewable energy law	1 year	17,800 pounds
21	Sustainable Energy Solutions	University of Glasgow	UK	Master	Renewable energy	1 year	24,100 pounds
22	Renewable Energy and Energy Management	Ulster University	UK	Master	Renewable energy	3 years	5,280 punds per year

23	The Mechanics of Renewable Energy	Middlesex University	UK	Master	Renewable energy	5 months	2,313 EUR
24	Renewable Energy Engineering	University of Aberdeen	UK	Master	Renewable energy	2 years	6,271 pounds per year
25	Renewable Energy Systems Technology	Loughborough University	UK	Master	Renewable energy	2 years	28,750 pounds per year
26	Circular Economy	University of Edinburgh	UK	Master	Circular economy	1 year	28,800 pounds
27	Circular Economy Leadership for the Built Environment	Atlantic Technological University	Ireland	Master	Circular economy	2 years	2,000 EUR per year
28	Innovation, Enterprise and Circular Economy	University of Bradford	UK	Master	Circular economy	2 years	23,605 EUR per year
29	Sustainability and Environmental Studies	University of Strathclyde	UK	Master	Sustainability (circular economy)	1 year	32,142 EUR
30	BioInnovation	Aberystwyth University	UK	Master	Circular economy	5 years	2,310 EUR per year
31	Sustainable Development in Practice	University of Surrey	UK	Master	Sustainable development (circular economy)	2 years	3,273 EUR per year
32	Circular economy masterclass	University of Exeter	UK	Independent course	Circular economy	2 months	2,045 EUR
33	Circular Economy for Materials Processing	KTH Royal Institute of Technology	Sweden	Independent course	Circular economy	2 months	Free
34	Circular Economy - An Introduction	Delft University of Technology	Netherlands	Independent course	Circular economy	2 months	Free
35	Policymaking for climate action and circular economy	Chalmers University of Technology	Sweden	Independent course	Circular economy and climate action	3 months	Free
36	Sustainable Minds	PXL University College	Belgium	Independent course	Sustainability	3 months	/