

Bio-based strategies and roadmaps for enhanced rural and regional development in the EU



Outcome of the summer school for teachers interested in developing bioeconomy curricula – materials and discussion results

June 2021

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EXECUTIVE SUMMARY

BE-Rural organised a virtual summer school for teachers interested in developing curricula and educational material on the bioeconomy (<https://be-rural.eu/events/teachers-summer-school/>). The summer school was jointly run by Dr Elsa João (University of Strathclyde in Glasgow, Scotland) and Rachel Moir (Skills Programme Manager, Industrial Biotechnology Innovation Centre). The dates, times and themes for each day were as follows:

- Day 1 – Tuesday, 25 May 2021, 14:00-17:30 CEST – Introduction to the bioeconomy and overview of the bioeconomy educational resources developed by BE-Rural.
- Day 2 – Tuesday, 1 June 2021, 14:00-17:30 CEST – Bioeconomy of different sectors (e.g. fisheries, agriculture) and how best to integrate bioeconomy teaching in schools in Bulgaria, Latvia, North Macedonia, Poland and Romania.
- Day 3 – Tuesday, 8 June 2021, 14:00-17:30 CEST – Developing the industrial biotechnologists of the future: the innovative work of IBioIC with Scottish schools.

This report includes the material presented during the summer school (that are also available for download on the BE-Rural website). In addition, and most importantly, it includes results of the polls carried out and data generated from the discussion sessions. The report also includes a summary of the results of attendees' feedback questionnaires.

The summer school aimed to inspire attendees about the bioeconomy and emphasized novel ways to maximise the potential of bioeconomy of different sectors (agri-food, fisheries & aquaculture, forestry, and herbs and essential oils for cosmetics and pharmaceutical industries). The importance of avoiding reaching ecological limits, the importance of sustainability, the importance that bioeconomy does not compete with food production and does not affect biodiversity, were all covered.

The contribution of the Scottish Industrial Biotechnology Innovation Centre (IBioIC) in the summer school was very important. IBioIC connects industry, academia and government with the aim to accelerate new biotechnology processes and products, and part of their activities involve innovative initiatives for the development of skills in the bio-based sector. These initiatives can be adapted for implementation in other countries, so it was relevant to hear from what IBioIC is doing.

The summer school had the active participation of more than 100 attendees from 12 countries, including the five main target countries (Bulgaria, Latvia, North Macedonia, Poland and Romania), but also from other countries such as Croatia and Slovenia. The summer school had a wide range of educators attending and all enjoyed and benefited from the summer school: pre-school teachers, primary school teachers, high school teachers and University lecturers. The reason for this appreciation was due to the new material presented, but also how it was delivered. Attendees appreciated the speakers, the interactivity, the discussions between participants, and enjoyed the experience overall. Participants also found the BE-Rural educational materials useful and interesting.

The main aim of the summer school was to enthuse participants about the bioeconomy, so participants would be more likely to try and integrate bioeconomy teaching in the curriculum. Therefore, it is reassuring and exciting to see that most said they will endeavour to integrate bioeconomy teaching in their school. Very importantly the summer school provided a platform for teachers to discuss how best to integrate the teaching of bioeconomy in their schools. Data resulting from these discussions included 108 ideas, which are listed in this report and many are recommendations for schools. Finally, it is gratifying to hear how many of the attendees expressed how they were "inspired" and how some said that they would present the importance of bioeconomy teaching in school management meetings.

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Abbreviations

BBSRC	Biotechnology and Biological Sciences Research Council
CEST	Central European Summer Time
EMF	Ellen MacArthur Foundation
ESD	Education for Sustainable Development
EU	European Union
HND	Higher National Diploma
IB	Industrial Biotechnology
IBioIC	Industrial Biotechnology Innovation Centre
GBS	Global Bioeconomy Summit
GDPR	General Data Protection Regulation (EU)
NGO	Non-Governmental Organization
OIP	Open Innovation Platform
SDG	Sustainable Development Goal
SSERC	Scottish Schools Education Research Centre
STEM	Science, Technology, Engineering and Mathematics
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
UNRIC	United Nations Regional Information Centre

1 Introduction to report and summary of summer school

The EU aims to build the world's leading bioeconomy (Bell *et al.*, 2018), within a framework of sustainability and considering ecological limits (European Commission, 2018). One key aspect is related to raising awareness about the potential of the bioeconomy and the bio-based sector (i.e. the sector that incorporates businesses and associations that self-identify as bio-based or bioeconomy - Leipold and Petit-Boix, 2018). In order to facilitate further learning and wider multiplier effects (i.e. reaching a wider audience than those attending individual events), BE-Rural organised a summer school for teachers interested in developing curricula on the bioeconomy. This report includes all the material presented in the BE-Rural 3-day virtual summer school. In addition, and most importantly, this report includes the summaries of the Q&A and discussion sessions, the results of the polls carried out, and a summary of the results of the attendees' feedback questionnaires.

The summer school was held in English and took place online, over three consecutive Tuesdays, on 25 May, 1 June and 8 June 2021. The summer school was promoted via the web page BE-Rural (2021a), which informed interested people that all the attendees would receive a CPD (Continuing Professional Development) certificate, and the programme shown in Annex I.

The summer school was jointly run by Elsa João (University of Strathclyde in Glasgow, Scotland) and Rachel Moir (Skills Programme Manager, IBioIC), and had the participation of two other members of the BE-Rural team and three guest speakers (see short biographies in Annex II). The University of Strathclyde has a long history of the teaching of sustainability (since 1992) and is involved in teaching circular economy and bioeconomy since 2016. The IBioIC connects industry, academia and government with the aim to accelerate new biotechnology processes and part of their activities involve innovative initiatives for the development of skills in the bio-based sector.

The theme of each day was:

- Day 1: Introduction to the bioeconomy and overview of the bioeconomy educational resources developed by BE-Rural (run by Dr Elsa João, University of Strathclyde).
- Day 2: Bioeconomy of different sectors (e.g. fisheries, agriculture) and how best to integrate bioeconomy teaching in schools in Bulgaria, Latvia, North Macedonia, Poland and Romania (run by Dr Elsa João, University of Strathclyde).
- Day 3: Developing the industrial biotechnologists of the future: the innovative work of IBioIC with Scottish schools (run by Rachel Moir, Skills Programme Manager, IBioIC).

Although the expectation was that all people would attend all three days, it was also possible for attendees to attend just one or two of the days.

The summer school was primarily targeted at teachers in the five OIP regions (Vidzeme and Kurzeme in Latvia; Szczecin and Vistula Lagoons in Poland; Covasna in Romania; Stara Zagora in Bulgaria; and Strumica in North Macedonia), although other attendees were welcome. Due to the COVID-19 pandemic, the summer school was run online using the platform zoom. Interestingly, the online format increased the opportunity of people attending. Although the initial plan was for the summer school to have only 15-20 teachers, in the end 294 people registered to attend, with a high predominance (80%) from people from Romania (see figure 1). One of the feedback questions about the summer school was to try to understand why such a high number of Romanians attended. It seems to be a combination of "Romanians are always receptive to the new" and good promotion: "The invitation was sent to our Regional School "Inspectorat" (an organization that manages teachers), so I would say the big number of Romanian participants is a result of good PR".

With this high interest, one of the special things about the summer school was that it brought all these teachers together, albeit online. Therefore, the summer school was organised to be highly interactive and asked participants to discuss in small groups how they may implement the teaching of bioeconomy. While the discussion groups on Day 1 mixed participants from different countries (see section 6), in Day 2 the groups were based on country and language (see section 7). This allowed the discussion to focus on development of curricula and educational material on the bioeconomy for specific countries. It also allowed participants to discuss in their own language. Groups were asked

for a summary of what they discussed, which could have been written in their own language as well, which was then translated to English for inclusion in this report (an innovative and collaborative multi-language approach).

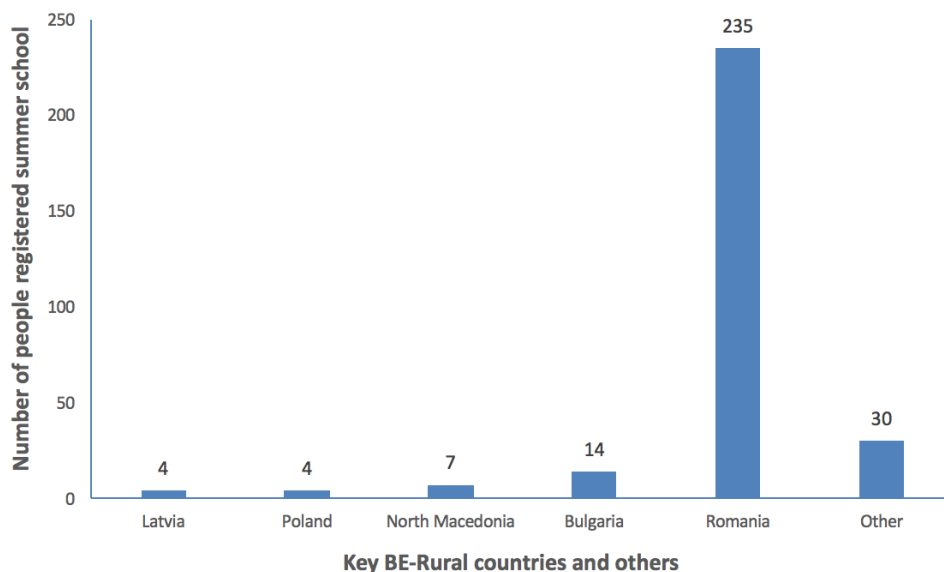


Figure 1: Number of people who registered to attend for each of the five OIP countries, and “other” not from these five countries.

In addition to Bulgaria, Latvia, North Macedonia, Poland and Romania, people registered from Croatia, Czech Republic, Estonia, Germany, Greece, Slovenia and UK (the “other” in figure 1).

This report starts by providing an overview of BE-Rural and its geographical context in section 2. It then discusses in section 3 the work done by the University of Strathclyde and by IBioIC to develop education skills in the bio-based sector. The summer school relies heavily on the educational resources developed by BE-Rural (João, 2020) and this report provides an overview of these resources in section 4. Section 5 provides an overview of the educational events carried out in the five OIP countries. Sections 6-8 provide an overview of the materials and discussion results for days 1-3 respectively. Section 9 evaluates the results of the feedback survey from attendees about the summer school overall, and finally section 10 ends the report with conclusions.






2 About BE-Rural and its geographical context


European regions are diverse – economically, ecologically and culturally. These areas are home to a wealth of ecosystems and resources, where the bioeconomy carries the promise of opportunities for rural employment and sustainable growth (BE-Rural, 2020b; Colmorgen *et al.*, 2020). This transition towards a new, bio-based regional economy requires the active involvement of a broad spectrum of stakeholders and the sustainable use of agricultural, forest and marine ecosystems. Building on this idea, the overall goal of BE-Rural is therefore to realise the potential of regional and local bio-based economies by supporting relevant actors in the participatory development of bioeconomy strategies, roadmaps and business models (see Abhold *et al.* 2019). One of the ambitions of BE-Rural is to increase awareness and understanding of sustainability and the bioeconomy through education (BE-Rural, 2020a). BE-Rural tried to realise this ambition with four main activities: a) development of educational materials (see section 4 and João, 2020); b) pop-up stores with bio-based products (Griestop and Mannhardt, 2019); c) educational events in the five OIP regions (see section 5 and BE-Rural, 2021b); and d) the summer school for teachers interested in developing curricula on the bioeconomy, as described in this report.

BE-Rural focused on establishing Open Innovation Platforms (OIPs) within selected regions in five countries: Bulgaria, Latvia, North Macedonia, Poland and Romania. These countries were selected because of their underutilised potential to harness the bioeconomy (Colmorgen and Khawaja, 2019).

Each of these regions have an OIP facilitator, which are also some of the BE-Rural partners (see Table 1). Following the BE-Rural principle of co-creation (Abhold *et al.* 2019), the OIP facilitators, together with the other BE-Rural partners, promoted the summer school in their region. All BE-Rural partners also provided ideas of what the summer school should be about and how it should run.

Table 2: The five BE-Rural partners that are the OIP facilitators, and respective key person contacts

Logo	Name and web link	Mini description	Country	Person
	Bulgarian Industrial Association – Union of the Bulgarian Business (BIA) https://en.bia-bg.com	Voluntary, non-governmental organisation, representing over 100 sector-oriented organisations, over 100 regional & local bodies, scientific organisations, universities, and other companies.	Bulgaria	Martin Stoyanov martin@bia-bg.com
	Institute for Economic Forecasting (IPE) http://www.ipe.ro/	Carries out research projects on a range of fields – economic modelling and forecasting, policy evaluation, empirical studies and long-term and short-term forecasts.	Romania	Dr Carmen Pauna pauna_carmen@ipe.ro
	International Centre for Sustainable Development of Energy, Water and Environment Systems – Macedonian Section (SDEWES-Skopje) https://www.sdewes.org	Provides scientific support for policy-making in sustainable development, green economy and better governance, climate change, water and environment systems, low emission development strategies, and energy.	North Macedonia	Emilija Mihajloska emilija.mihajloska@sdewes.org sdewes.skopje@sdewes.org
	Latvian State Forest Research Institute (SILAVA) http://www.silava.lv/	National research organization with the main goal of to get new knowledge, based on scientific methods, and developing the innovative technologies to promote the sustainable development and competitiveness of forest sector.	Latvia	Dagnija Lazdiņa dagnija.lazdina@silava.lv
	National Marine Fisheries Research Institute (NMFRI) https://mir.gdynia.pl/	Provides knowledge based on scientific activity, research & development, supporting economically sustainable &	Poland	Marcin Rakowski mrakowski@mir.gdynia.pl

 <p>BULGARIAN INDUSTRIAL ASSOCIATION Union of the Bulgarian Business</p>	<p>Bulgarian Industrial Association – Union of the Bulgarian Business (BIA) https://en.bia-bg.com</p>	<p>Voluntary, non-governmental organisation, representing over 100 sector-oriented organisations, over 100 regional & local bodies, scientific organisations, universities, and other companies.</p>	<p>Bulgaria</p>	<p>Martin Stoyanov martin@bia-bg.com</p>
		<p>environmentally sound development of marine fisheries.</p>		

The five OIP regions, each with its own sectoral focus, can be seen in Figure 2: Vidzeme and Kurzeme in Latvia; Szczecin and Vistula Lagoons in Poland; Covasna in Romania; Stara Zagora in Bulgaria; and Strumica in North Macedonia (BE-Rural, 2020a). The summer school is an important contributor to helping facilitate the participatory development of regional bioeconomy strategies (the overall ambition of BE-Rural).



Figure 2: The regions involved in the BE-Rural project: a) the geographical location, b) the sectoral focus (modified from BE-Rural, 2020a)

3 About the University of Strathclyde and IBioIC, and their links to education skills in bioeconomy and sustainability

The summer school was jointly run by the University of Strathclyde and IBioIC - Industrial Biotechnology Innovation Centre, both based in Glasgow, Scotland, UK. The University of Strathclyde is one of the nine partners of the BE-Rural consortium (BE-Rural, 2021c), and the IBioIC is part of the BE-Rural peer group (created to complement the technical expertise of the project participants – see BE-Rural, 2021d). This section gives an overview of the University of Strathclyde and IBioIC, and their links to education skills in bioeconomy and sustainability.

3.1 The University of Strathclyde and its links to education skills in bioeconomy and sustainability

The University of Strathclyde is a leading technological university in the UK, which was founded in 1796 as a 'place of useful learning', and undertakes internationally excellent research, education, and knowledge exchange with business and society. The University's Strategic Plan "Vision 2025" (University of Strathclyde, 2020) puts sustainability at its heart and makes a clear commitment to deliver against the Sustainable Development Goals (SDGs) across all areas of activity, including research, teaching and operational matters.

Two University units are involved in the BE-Rural project: the European Policies Research Centre (EPRC) Glasgow (part of Faculty of Humanities & Social Sciences) and the Department for Civil and Environmental Engineering (CEE) (part of the University's Faculty of Engineering). EPRC Glasgow (<https://www.strath.ac.uk/humanities/governmentpublicpolicy/europeanpoliciesresearchcentre/>) specialises in regional and rural development in Europe, including regional innovation strategies, administrative capacity building, EU Cohesion policy strategies and implementation, European territorial cooperation, EU Competition policy, and financial instruments.

Dr Elsa João had overall responsibility for the summer school. She belongs to the Department for Civil and Environmental Engineering (CEE) (<https://www.strath.ac.uk/research/subjects/civilenvironmentalengineering/>). CEE delivers world-class research, education and knowledge exchange. CEE provides Masters (MSc) degrees in Sustainability & Environmental Studies, Environmental Engineering, Environmental Entrepreneurship, Hydrogeology and Civil Engineering. The MSc in Sustainability & Environmental Studies was launched in 1992, making it one of the oldest sustainability MSc degrees in the UK, and has the circular economy and bioeconomy at its heart since 2016. This MSc offers a cross-disciplinary approach to the study of environmental management, policy, climate crisis, circular economy, sustainability and bioeconomy. All MSc students in the department can choose an Independent Study class in Collaboration with Industry, which allows students to carry out a project of interest to industry and gives students practical experience on environmental responsibilities within a business (see here for the projects in the academic session 2020-21: <https://www.engage.strath.ac.uk/event/782>).

3.2 IBioIC and its links to education skills in the bio-based sector

The Industrial Biotechnology Innovation Centre was created in 2014 to fulfil the aims of the National Plan for Industrial Biotechnology to grow the industrial biotechnology sector in Scotland to over £900 million in turnover, with 200 companies operating in the sector by 2025 (see IBioIC, 2021).

IBioIC is recognised as a European centre of excellence for industry-led research through its support for collaborative industry/academic projects and initiatives. IBioIC has also developed bespoke training programmes at PhD, MSc and HND (Higher National Diploma) level to ensure the industry has the necessary skilled workforce to innovate in Scotland (<https://www.ibioic.com/skills>).

In addition to skilling the workforce of the future in formal programmes, IBioIC also has the responsibility for up and cross skilling the existing workforce, to ensure that this dynamic and developing bio-based sector can respond rapidly to change. Inspiring the future generation to work in industrial biotechnology is essential to the success of the sector. Awareness of the science and engineering that underpins industrial biotechnology is not well understood by school children and those that influence their career choices. It is important to the IBioIC Skills Team that this is addressed on a long-term basis, in alignment with the National STEM Strategy (Scottish Government, 2017) and the National Plan for Industrial Biotechnology (Scottish Enterprise, 2019).

There are opportunities for our student cohorts (MSc and PhD) and industry members to participate in training and events to bring industrial biotechnology to life. As an example, IBioIC assist in delivery of the Leaders in Science, a cascade learning programme that engages PhD students as mentors to help secondary school students to develop workshops and expand their science leaderships skills. The secondary school pupils then deliver their workshop to primary school pupils who get to learn about

science in a fun and engaging way. Further to this, IBioIC's PhD students are also encouraged to undertake a minimum of two days of public outreach per year and this can include school visits, science festivals or days delivering content at Science Centres (<https://www.ibioicctp.com/general-project-requirements>). This demystifies industrial biotechnology to the public and also engages children in how relevant the science is in the world around them.

4 Summary of educational resources developed by BE-Rural and used in the summer school

BE-Rural developed educational materials on sustainability, circular economy and bioeconomy for schools, colleges and universities (João, 2020). The aim was to have educational resources that could be used by teachers and therefore these educational resources were an important component of the summer school. These educational resources are mostly aimed at high school teachers (i.e. those teaching pupils in the age range 12-18) in the five countries of Eastern Europe (see Section 2) to help them teach their pupils on bioeconomy, circular economy and sustainability. The regional context influenced the educational resources in terms of content and case studies and, as each region has a different sectoral focus (e.g., fisheries, forestry and agriculture; this has also determined the development of the educational resources. The educational materials are available in the following languages: English, Bulgarian, Latvian, Macedonian, Polish and Romanian (see Figure 3) and they are all available in the web page <https://be-rural.eu/resources/>.





Figure 3: The educational resources in the different languages available in web page <https://be-rural.eu/resources/>: a) English, b) Bulgarian, c) Latvian, d) Macedonian, e) Polish and f) Romanian

It is possible to envisage that geography, biology, environmental studies, technology or business could integrate some of these resources as part of their teaching, but teachers have to comply with approved curriculums so they may not always have time to do alternative classes. Therefore, educational resources are presented in a modular basis and is up to the teachers to decide how to adapt them. How teachers may or may not be able to use these educational resources was an aspect discussed in the summer school (see sections 6 and 7).

These educational resources can also be used at higher education levels (e.g. colleges and universities), other countries, and as a help for businesses. The sustainability implications of the bioeconomy, and of specific bio-based products, permeates all the educational materials and explicit reference is often made to the Sustainable Development Goals (SDGs) (UN General Assembly, 2015).

The BE-Rural educational materials (João, 2020) include four main type of resources, and these are summarised in sections 4.1-4.4 below:

- Output 1 - Review of 100 existing free online educational resources
- Output 2 - PowerPoint slides for presentations with notes for teachers
- Output 3 - Workshops, quizzes and games
- Output 4 - Proposed extracurricular activities (such as school clubs or societies)

As mentioned, all these outputs are available in English, Bulgarian, Latvian, Macedonian, Polish and Romanian, and they are all available in the web page <https://be-rural.eu/resources/>.

4.1 Overview of Output 1 - Review of 100 existing free online educational resources

The review of 100 existing free online educational resources is organised into three main themes: Bioeconomy, Circular Economy and Sustainable Development Goals/Sustainability/Sustainable Development. The idea of this review is to show that many resources are already freely available. Very importantly, the list shows the language of the resource (e.g. EU resources that are available in all 24 EU languages and in the cases of videos spoken in English that have as many as 17 different languages available in subtitles). For each resource ideas are included on how they may be used in the classroom, sometimes with a lesson plan (see Figure 4).

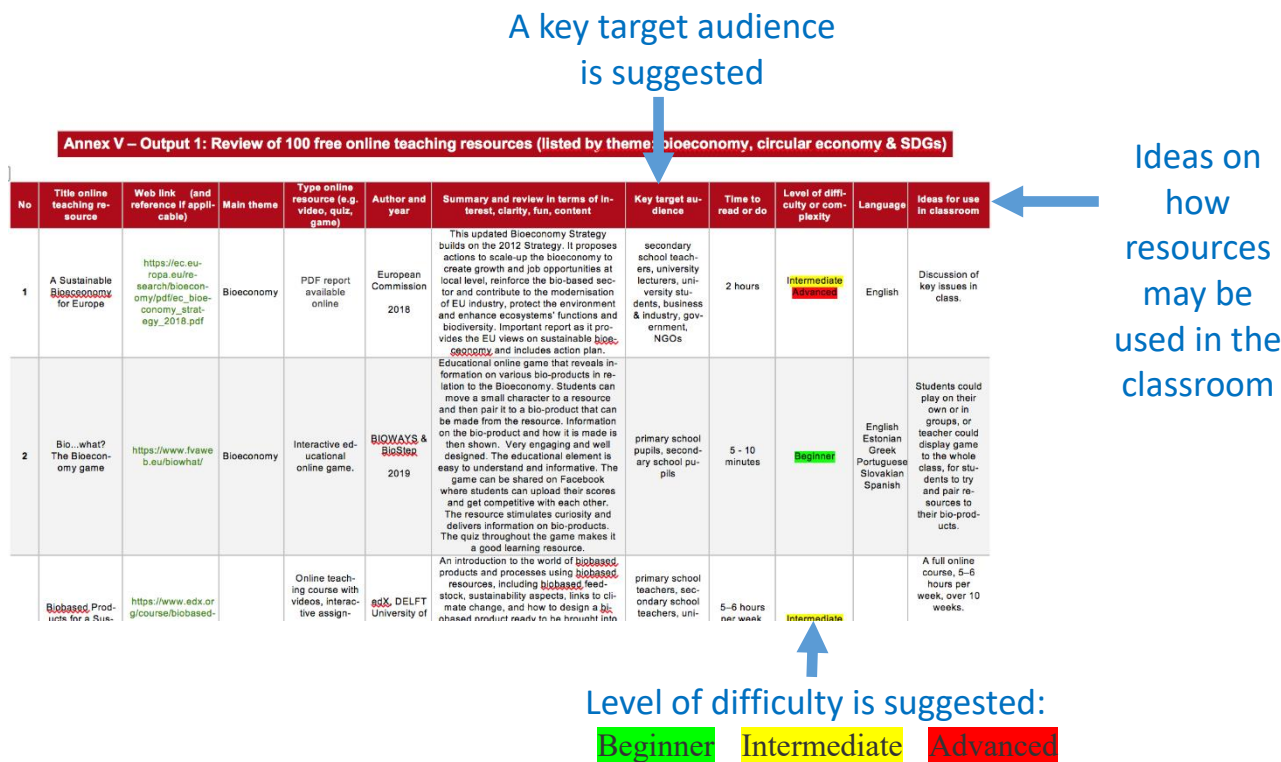


Figure 4: Snapshot of the review of 100 existing free online educational resources, showing key features (modified from João, 2020).

The level of difficulty or complexity is suggested and colour-coded: **Beginner**, **Intermediate**, **Advanced**. In some cases, more than one level of difficulty is proposed as some resources have different components of different complexity, plus it is possible to use the same resource in either a simpler or in a more complex way.

A key target audience is suggested. Although these educational resources are mainly for high school students, they are not exclusively for them. In the interest of flexibility and wider applicability, some of the resources are also recommended for primary school students and University students. Plus, some resources are recommended for teachers, lecturers, business & industry, government and NGOs, who may even be interested in getting a certificate for one of the training courses listed.

For each resource the type of online resource is specified (e.g. video, quiz, downloadable pdf document, game, app) and, if possible the time it takes to use a resource. To help teachers decide if any of these resources would be of interest in their teaching a summary and review is included for each resource specifying content, interest, clarity and fun.

Although many of the concepts presented are effectively timeless, a date has been included for each resource. They are all from the last 10 years – 77 produced or updated between 2015 and 2020, and 23 between 2010 and 2014. Of the 100 listed resources, 53% are either videos or include videos. Videos can be an effective teaching resource because they allow students to visualize concepts. Mitra *et al.* (2010, p. 405) suggest that “videos can provide useful material for students to engage with, but it needs to be used as part of an overall blended learning approach”.

4.2 Overview of Output 2 - PowerPoint slides for presentations with notes for teachers

One key content of the educational resources are the PowerPoint slides created for the teachers. The following sets of PowerPoint slides are included with the educational resources:

1. What is the bioeconomy: opportunities, challenges and solutions

2. Key principles of sustainability and links to bioeconomy
3. Intro to the Sustainable Development Goals (SDGs) and their links to bioeconomy
4. Key principles of the Circular Economy and links to the bioeconomy
5. Agriculture and the bioeconomy
6. Forest bioeconomy
7. Bioeconomy in the fisheries sector
8. New technologies for processing herbs and producing essential oils for cosmetics and pharmaceutical industries

The slides include notes for teachers, comments and links (see Figure 5).


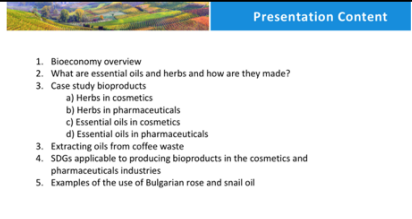

Slide	Notes for teacher, comments and links
	<p>Notes to the teacher: Teacher's name to go in the space in the space at the bottom left of the slide. Explain that this presentation introduces the new technologies for processing herbs and producing essential oils for the cosmetics and pharmaceutical industries.</p> <p>Excluding the video, the outline slide and this first slide, there are 11 slides – so these slides should take between 11 and 22 minutes to present, depending on amount of explanation.</p>
	<p>Notes to teachers: Explain the structure of the lecture to students to set the scene on what will be covered.</p> <p>The lecture provides information on the processing of essential oils and herbs for use in the cosmetics industry and gives some examples of how these are currently being used. Links to the Sustainable Development Goals (hereafter SDGs) are also made to highlight the additional socioeconomic benefits which creating bioeconomies in these industries bring.</p>

Figure 5: Snapshot the slides created, showing notes for teachers, comments and links.

The PowerPoint slides include two topics dedicated to sustainability and SDGs because the links between bioeconomy and Sustainability/SDGs are so key (see for example, European Commission, 2018; Gomez San Juan *et al.*, 2019; Heimann, 2019). The teacher can choose as many or as few slides from the sets as needed. The slides have been made with rich imagery and include links to videos (some listed in Output 1) and in some cases use the Mentimeter tool (Mentimeter, 2020).

4.3 Overview of Output 3 - Workshops, quizzes and games

In addition to the lecture slides (see section 4.2), the learning materials include games related to bioeconomy, sustainability, the SDGs, and the circular economy. The games are flexible and should be able to be played by anyone aged 12 and above (including adults) with no prior knowledge on bioeconomy. More complex learning can be achieved by adding discussion time after each game. They can also be played as part of extracurricular activities (see section 4.4). Simplifying some of the games (e.g. the Bioeconomy Word Search Puzzles) would make them suitable for younger children. Figure 6 presents the overview of the games, quizzes and puzzles specifically created for the BE-Rural educational resources. As an outcome of the summer school, BE-Rural has printed these games to send to the teachers who attended the three days of the summer school.

	<p>Workshop and Card Game “Business Match” – Aims to familiarise participants with five circular business models and enables them to recognise these in daily life by using 25 company case studies. Aim of the game is to match each company to one of the five circular business models. The game can be played in three different ways, and can be played individually or in groups. It takes 15-30 minutes depending on how the game is played and the amount of discussion.</p>
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	<p>Game “Sustainability and SDGs Heatwave” – Players answer sustainability and SDGs quiz questions and gain and lose points in the process. Four or five players compete against each other using one playing board. The game takes around 20-25 minutes.</p>																																																																																																			
	<p>“BE-Match” and “SDG-Link” Games - One set of cards for two games – To inspire participants about innovative products made of biological resources. These workshops or classroom activities were created to introduce 35 bioproducts, which can substitute traditional products in our daily life, and to inspire the potential of the bioeconomy industry. The activities also encourage discussion on the links of these 35 bioproducts to the SDGs. Participants could play the “BE-Match” Game first, followed by the “SDG-Link” Game, either in the same day or in different days. Both games take between 15 to 30 minutes.</p>																																																																																																			
<p>Easier word search– 10 hidden words</p> <table border="1" data-bbox="343 862 582 1041"> <tr><td>R</td><td>E</td><td>N</td><td>E</td><td>W</td><td>A</td><td>B</td><td>L</td><td>E</td><td>M</td><td>A</td></tr> <tr><td>N</td><td>A</td><td>S</td><td>O</td><td>T</td><td>I</td><td>H</td><td>C</td><td>T</td><td>Q</td><td>L</td></tr> <tr><td>N</td><td>O</td><td>I</td><td>T</td><td>A</td><td>V</td><td>O</td><td>N</td><td>N</td><td>I</td><td>G</td></tr> <tr><td>E</td><td>R</td><td>U</td><td>T</td><td>L</td><td>U</td><td>C</td><td>A</td><td>U</td><td>Q</td><td>A</td></tr> <tr><td>S</td><td>U</td><td>S</td><td>T</td><td>A</td><td>I</td><td>N</td><td>A</td><td>B</td><td>L</td><td>E</td></tr> <tr><td>G</td><td>R</td><td>A</td><td>S</td><td>S</td><td>L</td><td>A</td><td>N</td><td>D</td><td>T</td><td>G</td></tr> <tr><td>N</td><td>E</td><td>G</td><td>A</td><td>L</td><td>L</td><td>O</td><td>C</td><td>U</td><td>V</td><td>O</td></tr> <tr><td>F</td><td>E</td><td>R</td><td>T</td><td>I</td><td>L</td><td>I</td><td>S</td><td>E</td><td>R</td><td>G</td></tr> <tr><td>A</td><td>I</td><td>N</td><td>O</td><td>D</td><td>E</td><td>C</td><td>A</td><td>M</td><td>X</td><td>M</td></tr> </table>	R	E	N	E	W	A	B	L	E	M	A	N	A	S	O	T	I	H	C	T	Q	L	N	O	I	T	A	V	O	N	N	I	G	E	R	U	T	L	U	C	A	U	Q	A	S	U	S	T	A	I	N	A	B	L	E	G	R	A	S	S	L	A	N	D	T	G	N	E	G	A	L	L	O	C	U	V	O	F	E	R	T	I	L	I	S	E	R	G	A	I	N	O	D	E	C	A	M	X	M	<p>Bioeconomy Word Search Puzzles – can be played by people of all ages, individually or in groups, and can be done in any language. It also can be done with different levels of complexity to suit the audience (depending on the complexity of the words, and numbers of rows and columns). Students themselves can be asked to create the word puzzles.</p>
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Figure 6: Overview of the games, quizzes and puzzles created for the educational resources.

4.4 Overview of Output 4 - Proposed extracurricular activities (e.g. school clubs or societies)

Finally, the education resources include suggestions for extracurricular activities (such as school clubs or societies) that can provide a unique opportunity to bring new or additional content in terms of bioeconomy, circular economy, and/or SDGs and Sustainability. In a situation where teachers are constrained by the curriculum that they need to deliver, and may not have space to add extra content within class time, extracurricular activities could provide the possibility of students being involved in these themes. Further, students can take leadership of these. Extracurricular activities hold great potential for embedded learning and can also be critical for students with disabilities (see Pence and Dymond, 2015).

Decisions on extracurricular activities should really come from students and teachers, who should decide what interests them and which activities are applicable to their school’s resources, education level and infrastructure. Figure 7 shows a sample of the ideas included in João (2020) for extracurricular activities related to bioeconomy, circular economy and SDGs, which could take place at lunch time or after school and last about 45-60 minutes (for a full set of ideas check João, 2020).

<p>Welcome to the “Trash is Gold” Club First meeting - students could see three short videos: one on bioeconomy, one on CE and one on SDGs. Students could decide club name and agree activities to be done over the year.</p>	<p>Games and Quizzes Play with the wide range of games and quizzes on bioeconomy, CE and SDGs. Could compete in groups. Could vote for best quiz and game. Could create new games and quizzes.</p>	<p>Champion a Champion Many organisations are winning sustainability, bioeconomy or circular economy awards. Students pick award winning organisations and tell the club what that company is about and why they won a prize.</p>	<p>Get creative Students to do arts and crafts using bioproducts and other recyclable materials. Companies could be asked to donate left-over products. An art exhibition could be organised & prize given.</p>
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Figure 7: Example of extracurricular ideas related to bioeconomy, circular economy & SDGs

Extracurricular activities could be a weekly, bi-weekly or monthly theme that changes each time, depending on staffing and resources at the school. Alternatively, each of the activities in Figure 7 could be used to form a stand-alone club. For example, the club could purely be a Sustainable Cooking Club, which highlights ways to reduce food waste and use seasonal, local produce. This teaches valuable life skills and highlights messages about reducing energy consumption through the importation of food. However, it is recognised that not every school will have cooking facilities, and this is why these activities are provided as a framework to be moulded and adapted by individual schools according to their resources.

These practical activities are important as they can work together with the lecture material presented in section 4.2 to consolidate learning and transform abstract concepts into tangible actions. Ultimately, it is hoped that incorporating at least a few of these activities into school clubs will encourage a greater engagement with issues relating to the bioeconomy and inspire students to bring knowledge and sustainable practices back to their homes. These activities also show that social innovations and sufficiency are no less important than technological innovations, in the transformation towards a more sustainable bioeconomy.

5 Summary of the educational events in the OIP regions

The five OIP regions carried out 18 educational events in the respective national language on the broad theme of 'Sustainability and the Bioeconomy', where the translated educational materials described in section 4 were used. The events took place between September 2020 and April 2021, with more than 520 participants in total, and provided a real-live test of the BE-Rural educational materials before the summer school took place. The educational events involved schools, college, university pupils, students and/or teachers. The specific focus of these events was tailored to the interests and needs of each region, both in terms of sub-themes, and in terms of target group, e.g. age group, educational level, students/pupils and/or teachers. Some events were in-person events while other were online due to the COVID-19 pandemic. Figures 8-12 provide a summary of the events carried out for each OIP region.

The web page <https://be-rural.eu/events/educational-events/> (BE-Rural, 2021b) provides detailed information about each event. Feedback of these events has showed that the BE-Rural bioeconomy games (see section 4.3) were very popular. In addition, feedback noted that "in further trainings we believe that more emphasis could be placed on the relationship between the bioeconomy and the principles of sustainable development" (Stara Zagora's Event on 2 March 2021) and "it was of great benefit to emphasize the importance of the sustainable development goals by highlighting the most important ones for the bioeconomy" (Strumica's event on 18 February 2021). These last points were picked up for action in the summer school, and links between the bioeconomy and sustainability were covered in detail during the summer school.



Educational events in Stara Zagora region, Bulgaria

THREE EDUCATIONAL EVENTS IN THE STARA ZAGORA REGION

- ❖ Two online events held by the **Trakia University**
 - 25 January 2021 - 27 participants
 - 26 January 2021 - 27 participants
- ❖ One physical event held by the "**Knyaz Simeon Tarnovski**" **Trade High school**
 - 2 March 2021 - 70 participants

OVER 120 EXTERNAL PARTICIPANTS

Харта от черупките на краставици

- ▶ Понятието на стойна икономика (2017) на английски език, версия 2.0 и 2.1 (OECD, 2018; (Kovatcheva и др., 2018).
- ▶ Стара Метрополитанска администрация, март 2018 - на английски - 4.2, английски през английски (The Economist, Тона, 2018).
- ▶ За да започне работата на крави, Биологична продукция (17 ноември 2018) (Lipchik, 2018).
- ▶ Анд от черупките на кравиците крави се произвежда мляко, което отпадъчен продукт може да се използва.

Дефиниране на понятието „биоекономика“




Биоекономиката представлява устойчивото и иновативно използване на Биосферата и Биологичното знание за производствено осигуряване, фуражи, промишлени продукти, Биосенергия, екологични и други услуги. Като такава, тя има функцията да осигурява достъпно храна с подходящо качество, както и материално и устойчиво използване на възобновяемите ресурси, достъпни за увеличаващото се население.

Биоекономиката може да се разглежда като отговор на глобалните предизвикателства чрез своята способност на икономия, оптимизи на възобновяемите ресурси, биологично знание, иновации и чрез козметични подходи, които дават добър смисъл на веригите на стойност и на връзките на стойността



Кристина Иванова, Стара Загора
Стайна Прохорова, Младост

Figure 8: Educational events in Bulgaria



TEACHERS and other interesents online.
 1. First educational event, online, 21.08.2020.
 Records of video education posted on LSFRI Silava website - <https://youtu.be/TJ9LrTMKCV4> and indroduction with materials in latvian (6.04.2021.) <https://youtu.be/nHuvk-SkD7s>

Open air fair/exhibition visitors «Bioeconomy come to Jelgava»
 2. Promoting of education materials and short introduction how to use them, open air fair, 18.09.2020.

Attendies of Side by side Vidzeme innovation week
 3. Educational event for schools, life long , high schools teachers, online, 22.02.2021.
<http://innovation.vidzeme.lv/lv/pasakumi/2021-02-22/bioekonomikas-speles-skolas-darba-kolektivos-un-draugu-loka.html>

Promoting of education materials and records from online events in Forest sector conference (January 2021 and Science night April 2021)
<http://www.silava.lv/73/section.aspx/1118>, <https://www.zinatniekunakts2021.lv/main-feed>






Figure 9: Educational events in Latvia



TEACHERS
 1. First educational event, online, 8 participants, 18.02.2021
 2. Second educational event, online, 6 participants, 25.02.2021

STUDENTS
 1. First educational event for high school students, online, 94 participants, 15.03.2021
 2. Second educational event for high school students, hybrid, 10 participants, 24.03.2021
 3. Third educational event for pupils, online, 74 participants, 26.03.2021
 4. Fourth educational event for pupils, online, 25 participants, 26.03.2021

presentations quizzes polls videos → More than 200 students and teachers

Цел 1: Нема сиромаштија
 Биоекономијата може да придонесе за елиминација на сироти локалните природни ресурси.

Цел 2: Нема глад
 Биоекономијата може да придонесе за одржливи инвестиции во земјоделството на локалните ресурси и подобрување на квалитетот и

Цел 3: Добро здравје
 Биоекономијата може да придонесе за добро здравје преку развојот есенцијалног нутриента, но и преку навлажување на загаданото на в општествена фискална терена.

Шумарска технологија:
 Поддржане уреди за сепanje на дрва - **Бројер Инт ДОО**
 • Поддржане уреди за сепanje дрва именујат функционален бројер со мотор на бензин или електричен и може да работи без надоместок само на територија.
 • За употреба на сепanje и преработка мале капацитети (до околу 17 кубни метри) и може да се користи на 100% ниво работи.
 • Ефикасноста на сепanje и преработка мале капацитети на дрвеностружича и дрвеностружича може да се зголеми преку процесот на преработка.
 • Ефикасноста на сепanje и преработка мале капацитети на дрвеностружича и дрвеностружича може да се зголеми преку процесот на преработка.



Figure 10: Educational events in North Macedonia



TEACHERS
 1st educational event, Kadyń, 6 participants, 18.02.2021


STUDENTS
 2nd educational event for high school students, Nowy Dwór, 20 participants, 05.03.2021
 3rd educational event for primary school pupils, on-line, 34 participants, 09.03.2021
 4th educational event for University students, online, 36 participants, 19.04.2021

presentations quizzes games workshops → Near 100 students and teachers

Biogospodarka i gospodarka cyrkularna
 Istota, wyzwania i przedsiębiorstwa




Figure 11: Educational events in Poland



Educational events in Covasna region, Romania

TEACHERS AND UNIVERSITY STUDENTS
1. First educational event, online, 35 participants, 10.03.2021

HIGH SCHOOL STUDENTS
2. Second educational event for high school students, online, 33 participants, 11.03.2021
3. Third educational event for technological high school students, online, 31 participants, 12.03.2021

CLOSE TO 100 PARTICIPANTS: TEACHERS, UNIVERSITY STUDENTS AND HIGH SCHOOL STUDENTS

Another educational event aimed at business people was part of the 3rd SWG Meeting, on 9.12.2020, with 33 participants online.

Figure 12: Educational events in Romania

According to the survey done at the end of Day 1 (see Annex III), of the 75 people who answered the survey, the majority (83%) had not attended one of these events and therefore would be taking part of a BE-Rural event for the first time. Of the 13 people that had already attended one or more of these educational events, $\frac{1}{4}$ were organisers of these events and $\frac{3}{4}$ were attendees.

6 Day 1 summer school overview, materials and discussion

Day 1 of the summer school took place on 25 May 2021 and had the overall theme of “Introduction to the bioeconomy and overview of the bioeconomy educational resources developed by BE-Rural”. Elsa João ran the day with the support of Neli Georgieva, who monitored the questions and comments in the zoom chat. PowerPoint slides used in Day 1 are in Annex IV. The topics covered were:

- Introduction to the Summer School
- Brief overview of the BE-Rural Project
- Key principles of bioeconomy
- About bioproducts
- Small group discussion using the Power4Bio catalogue of bioeconomy solutions
- Key principles of sustainability and the UN SDGs
- Overview of educational resources developed by BE-Rural
- Overview of BE-Rural bioeconomy events in each region
- Discussion on how can bioeconomy learning be integrated in school teaching

In total, around 185 people participated in Day 1 and most attended at least 3 hours of the summer school (see Figure 13).

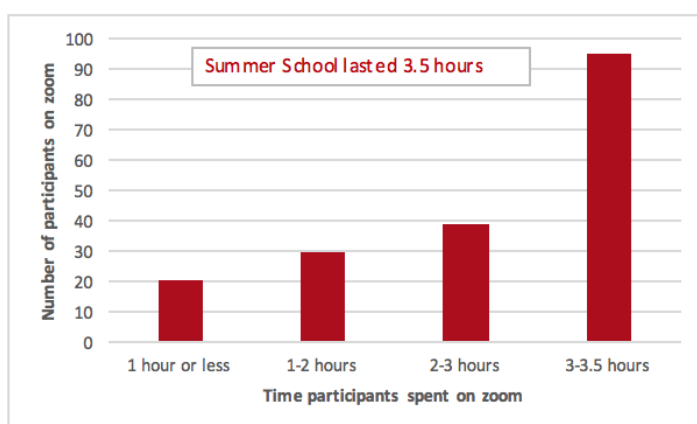


Figure 13: Amount of time spent in the Day 1 zoom by the approximate 185 participants

Note that it is possible that people who attended less than 1 hour actually attended the whole time. This is because when people change name in zoom, zoom records it as separate person. So if initially someone was called “iPhone” and then changed it to their actual name, there is no way to tell if this is the same person or not (as no unique identifier, like email, is recorded). Therefore, numbers are indicative rather than definitive. Note as well that some of the zoom “participants” were essentially dormant, so although they were logged in, they did not answer polls, did not join breakout groups, and did not contribute to comments and questions in the chat.

At the very start of the summer school some zoom polls were carried to determine knowledge of zoom, the type of audience, and their knowledge on Sustainable Development Goals (SDGs), sustainability, Circular Economy and bioeconomy. The knowledge questions were repeated in Day 3 (see section 9 for the results).

Not everybody who was online replied to the zoom poll. Of the 95 people who replied to the zoom polls at the start of Day 1, nearly all had used zoom platform before, and more than half were high-school teachers, but there were also primary, university and even pre-school teachers. Plus, some attendees were not teachers (see Figure 14). According to the survey done at the end of Day 1 (see Annex III), the non-teachers included researchers, advisers to Ministry of Agriculture, University students and bioeconomy policy experts.

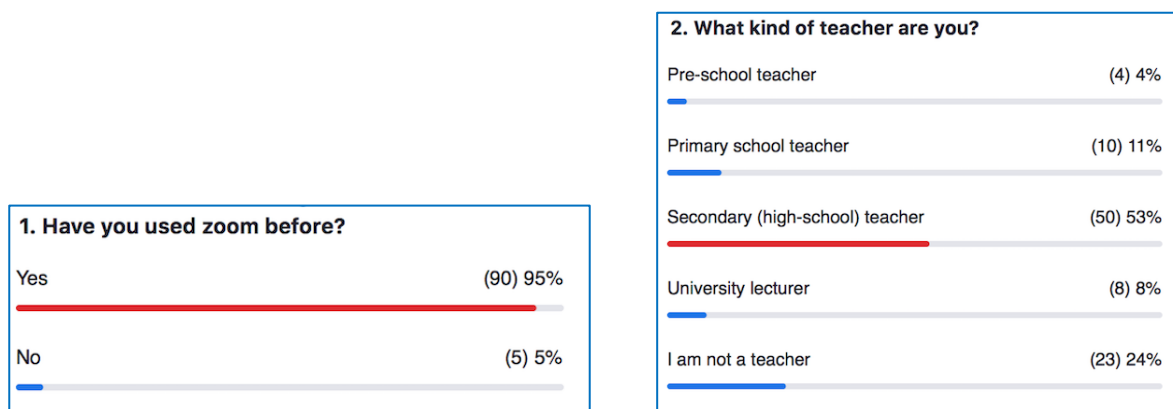


Figure 14: Poll result at the start of Day 1 on use of zoom and kind of teacher (n = 95).

Participants were asked if they had heard about the Sustainable Development Goals (SDGs) and interestingly 42% said that they had not. While with regards to knowledge of sustainability, 59% said that they had not much knowledge, and with regards to knowledge of Circular Economy and bioeconomy, 78% and 75% respectively said that they did not have much knowledge (Figure 15). In that sense this is the ideal target audience, as the summer school covered key principles of bioeconomy in Days 1-3, key principles of sustainability and SDGs in Day 1, and key principles of circular economy in Day 2.

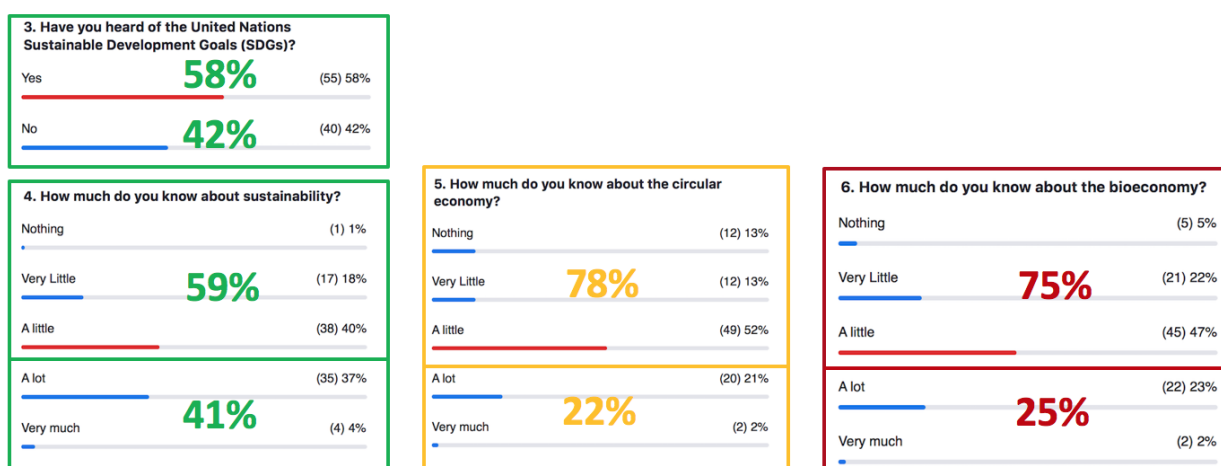


Figure 15: Knowledge on Sustainable Development Goals (SDGs), sustainability, bioeconomy and Circular Economy at the start of the summer school (n = 95).

The main aim of the summer school was to enthuse participants about the bioeconomy so participants would be more likely to try and integrate bioeconomy teaching in the curriculum. With this in mind, even before presenting definitions, which can be boring and confusing, the topic “key principles of bioeconomy” started with three examples that were called “The magic of bioeconomy”. The three examples chosen were textiles from waste milk, oils that may replace palm oil from coffee waste, and 3rd generation biofuels from engineered crops such as algae (see Figure 16 and Annex IV for Day 1 slides).

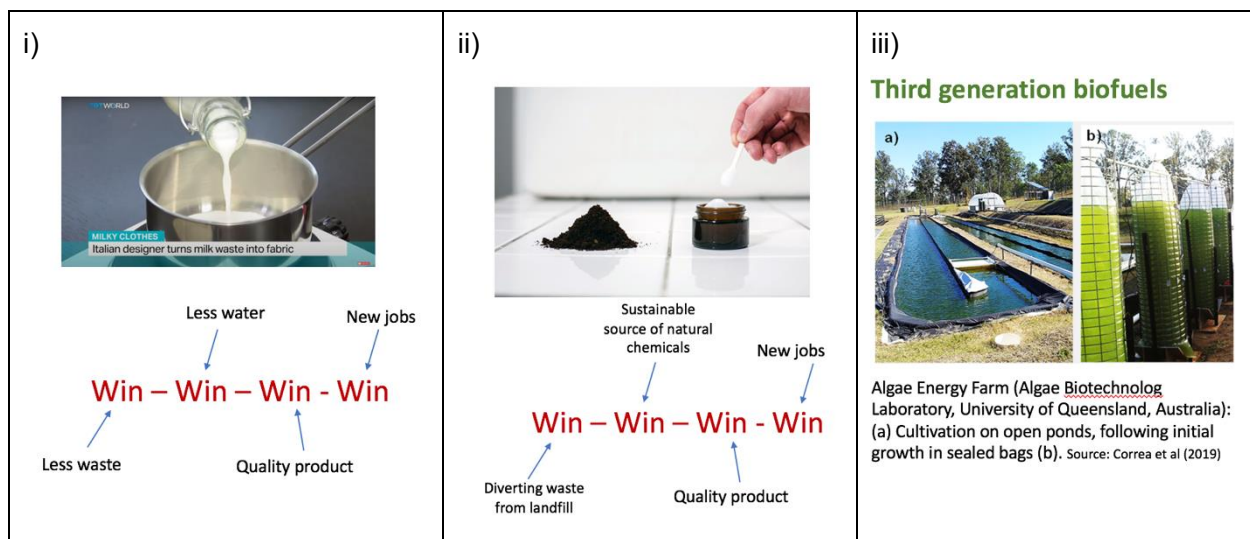


Figure 16: The three examples chosen to illustrate “the magic of the bioeconomy”: i) milk fibre from waste milk, ii) oils from coffee waste, and iii) 3rd generation biofuels from algae.

The aim of these contrasting examples was to spark interest and curiosity, and to make the key principles of bioeconomy clearer. Videos were also used to add interest and clarity, and as examples of the kind of resources that could be used with students (see Annex IV for slides used in Day 1). The link to the European Bioeconomy Strategy was strongly emphasised and it was explained how the European Commission is taking steps towards a sustainable bioeconomy and has a bioeconomy strategy to promote the bioeconomy and to avoid reaching ecological limits (European Commission, 2018).

A glossary of key terms was presented (see Box 1) to ensure that everybody understood the different terms associated with the bioeconomy to be used during the three days of the summer school.

Box 1: Glossary of key terms, all taken from the Bioeconomy Glossary of the EU’s Knowledge Centre for Bioeconomy (EC, n.d.), except where specified.

Bio-based - Derived from biomass

Bio-based product - Product wholly or partly derived from biomass

Bio-based sector - The sector that incorporates businesses and associations that self-identify as bio-based or bioeconomy (Leipold and Petit-Boix, 2018)

Bioeconomy or Bio-based Economy- The sustainable production of biomass and the conversion of biomass into value added products, such as food, feed, bio-based products and bioenergy. It includes the sectors of agriculture, forestry, fisheries, food and pulp and paper production, as well as parts of chemical, biotechnological and energy industries.

Biomass - The biodegradable fraction of products, waste and residues from biological origin from agriculture, including vegetal and animal substances, from forestry and related industries,

fisheries and aquaculture, as well as the biodegradable fraction of waste, including industrial and municipal waste of biological origin

Biotechnology - The application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.

Further development of the bioeconomy should be based on strong sustainability principles (Gibson, 2013; Morrison-Saunders and Pope, 2013; Pope *et al.*, 2004), therefore Day 1 covered the key principles of sustainability and the Sustainable Development Goals (SDGs), and their links to bioeconomy. The difference between weak and strong sustainability was explained and the “wedding cake” model of the SDGs, that emphasises how the economy and society are integral part of the biosphere, was shown (see Figure 17).

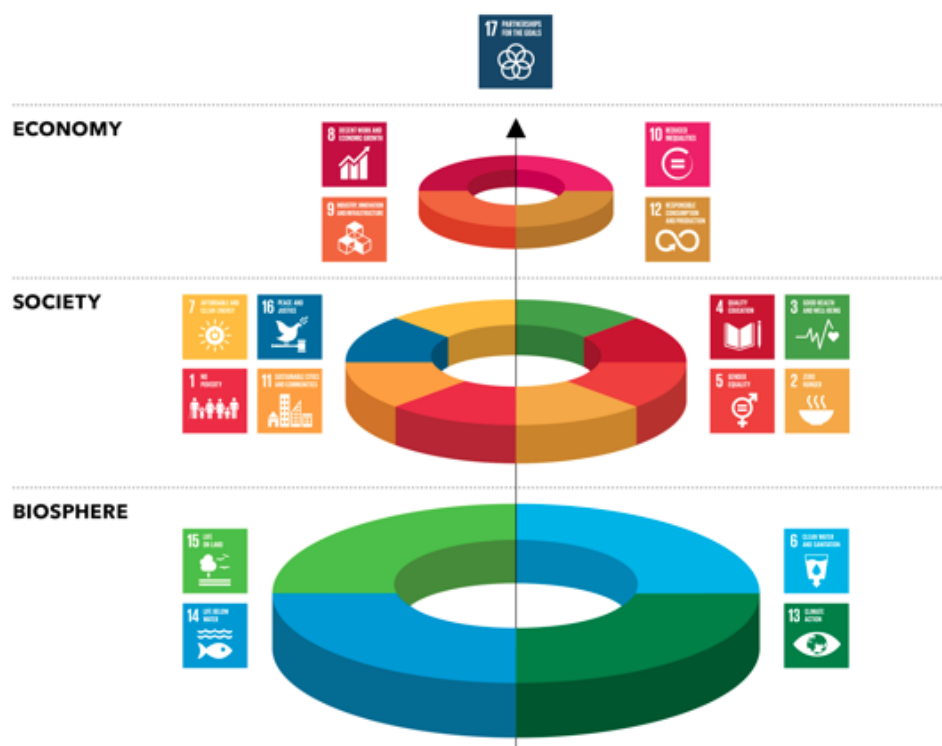


Figure 17: New way of viewing the economic, social and ecological aspects of the SDGs, as proposed by Johan Rockström and Pavan Sukhdev from the Stockholm Resilience Centre.

Source: Azote Images for Stockholm Resilience Centre, Stockholm University.

The brief overview of the BE-Rural project was similar in content to section 2 of this report, the overview of educational resources developed by BE-Rural was similar in content to section 4 of this report, and the overview of BE-Rural educational events in each region was similar in content to section 5 of this report.

It was very important that the summer school showed how many resources are out there ready to be used by teachers. Output 1 of the BE-Rural teaching resources reviewed 100 existing free online educational resources (see section 4.1) and during the summer school some of the existing resources were highlighted. The summer school presented two highlights of existing educational resources for the teaching of bioeconomy, and two highlights of existing educational resources for the teaching of sustainability (see Annex IV for Day 1 slides) as follows:

➤ Bioeconomy teaching

- Biovoices - The Book for Kids - What's bioeconomy? <https://www.biovoices.eu/book/concept/>
- *The BLOOM School Box*, <https://bloom-bioeconomy.eu/schoolnetwork/schoolbox/>.

➤ Sustainability teaching

- Manitoba Council for International Cooperation (2018): Sustainable Foundations: *A Guide for Teaching the Sustainable Development Goals*, http://mcic.ca/pdf/SDG_Primer_FINAL.pdf
- UNESCO (2019): Sustainable Development Goals - Resources for educators. UNESCO, <https://en.unesco.org/themes/education/sdgs/material>

Finally, a key aspect of the summer school was to create dialogue and an exchange of ideas between participants. The main aim of the summer school was to inspire participants to try to integrate bioeconomy teaching in the curriculum and therefore allowing participants to discuss ideas was fundamental. During Day 1 there was three points in which participants were put into small groups (using the zoom breakout rooms function):

1. **At the very start** when participants were asked to introduce themselves. This also made sure participants understood how to use zoom breakout rooms and was important to start the dialogue between participants.
2. **In the middle**, before the break, small group discussion on bioproducts using the Power4Bio catalogue of bioeconomy solutions.
3. **And at the end**, a mini snowball discussion was done on “If you had all the money, time and resources you needed (e.g. 1 million EUR, 2 full days each week, and you were the education minister of the country), what would be the best ways for bioeconomy learning to be integrated in school teaching?”

The mini snowball discussion started with each individual thinking on their own, and then people worked in ten groups using a PowerPoint file as a common white board, where all groups could write their ideas (see Annex VII for the 33 ideas participants wrote). The four stages were:

- a) Individually write 3 best ways for bioeconomy learning to be integrated in school teaching (5 min)
- b) Discuss in small groups – discuss and agree only three best ways (15 min).
- c) Write the three points in PowerPoint slide with your group number (3 min).
- d) Each group to present slide in plenary (1 minute per group).

In addition to the group discussion, participants were also asked in the survey for their main ideas about developing curricula and educational material on the bioeconomy for their school. Some of the ideas were as follows:

- Developing curricula and educational material on the bioeconomy is something achievable. If done well, it can have a significant impact on the sustainable development of the economy.
- We need to engage our students in innovative projects with impact on bioeconomy.
- Learning-by-doing and promote children’s innovation.
- Greater involvement in bioeconomy-related projects and creating separate subject dedicated to bioeconomy in the schools.
- Organise events about bioeconomy.
- We need more extracurricular activities in the field of bioeconomy.
- Connect the needs of the community with the opportunity of bioeconomy.
- Determine where best to incorporate the teaching of bioeconomy in different subjects.

The ideas above were then picked up for further discussion in Day 2 (see section 7). Finally, Day 1 concluded by presenting what to expect in Day 2. Importantly, the summary of what was covered in Day 1 was renamed as “What to do before Day 2”, to try and create action from attendees to look at the material covered (see Figure 18).

What to do before Day 2

- Watch videos with subtitles in your language
- Check BE-Rural education materials in your language
 - <https://be-rural.eu/resources/>
- Look at the maps and data of SDGs and their targets around the world
 - <https://dashboards.sdgindex.org/map>
- Check these UNESCO resources
 - <https://en.unesco.org/themes/education/sdgs/material>
- Check the learning scenarios of the BLOOM School Box
 - <https://bloom-bioeconomy.eu/schoolnetwork/schoolbox/>

Figure 18: Summary slide of content of Day 1 rephrased as “What to do before Day 2”

According to the survey that participants filled at the end of Day 1 (see Annex III), 96% of the participants who answered the survey were either “very satisfied” or “extremely satisfied” with the first day of the summer school (see Figure 19).

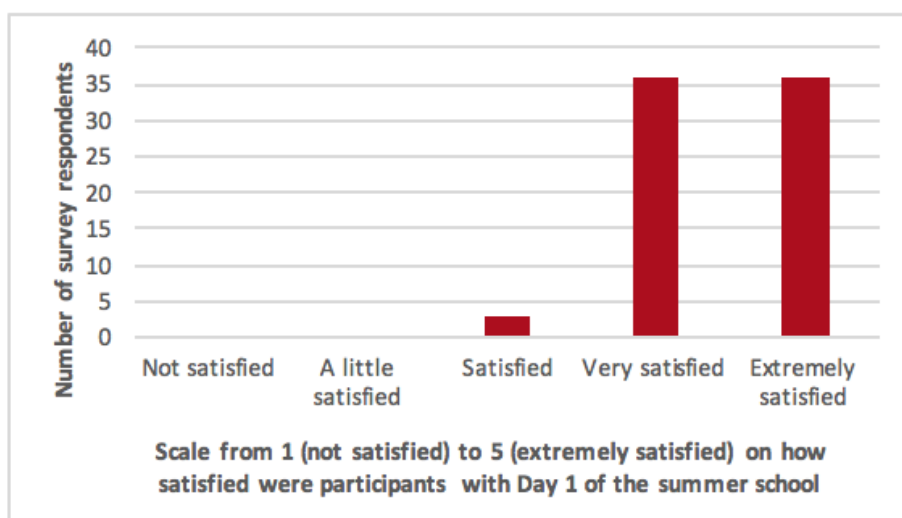


Figure 19: Answer to the question “Overall, on a scale from 1 (not satisfied) to 5 (extremely satisfied) how satisfied are you with Day 1 of the summer school?” [n = 75]

When asked what was the best thing about Day 1 of the summer school many attendees mentioned “lots of useful information for implementation in activities with students”, “practical videos of application of bioeconomy” and “did not get bored, inspirational, great presenter”. Three people enjoyed “speaking English” and interestingly 37% thought that the best thing about the summer school was the interaction, exchange of opinion and group work.

When asked what they did not like about Day 1, the majority said “I liked everything”. A couple of people asked for more time filling the survey (and that was taken into account in Day 3) and only three people found the 3.5 hours too long, and therefore the length of each day is probably just right. When asked what was missing in Day 1 of the summer school that participants would like to be covered in Days 2 or 3 of the summer school, the majority of participants said that nothing was missing but one person mentioned circular economy, and one person mentioned the importance to highlight even more that bioeconomy is about innovative uses of waste streams from primary production. Both these points were covered in Day 2 of the summer school.

7 Day 2 summer school overview, materials and discussion

Day 2 of the summer school took place on 1 June 2021 and had the overall theme of “Bioeconomy of different sectors (e.g. fisheries, agriculture) and how best to integrate bioeconomy teaching in schools in Bulgaria, Latvia, North Macedonia, Poland and Romania”. Elsa João ran the day with the support of Stefan Kah, who monitored the questions and comments in the zoom chat. PowerPoint slides used in Day 2 are in Annex V. The topics covered were:

- Summary of Day 1 of the Summer School
- More about the BE-Rural Project and the different working packages
- Key principles of circular economy
- Connecting student learning with industry projects, lessons from Strathclyde
- Novel ways to maximise potential of bioeconomy of different sectors
- Discussion on teaching bioeconomy in each of the five innovation regions, grouped by country and language

Day 2 started with a zoom poll with four questions:

1. Did you attend Day 1 of the summer school on 25 May?
2. What country do you work in? [needed to sort country discussion groups at the end of Day 2]
3. How did you find out about the BE-Rural summer school?
4. What high school subjects are relevant to incorporate bioeconomy?

Of the 82 people who answered this start of the day poll, there were 16 people who had not attended Day 1 (see Annex IX) and therefore it was important to consider that for some people this was essentially their first day of the summer school. Most (59%) respondents said they heard about the summer school from school management, school inspectors or a colleague. But there were also other places where they heard about the summer school. Finally, it was interesting to see the wide range of school subjects where respondents felt it was relevant to incorporate bioeconomy.

Day 2 started once again with “The magic of bioeconomy”, in terms of innovative and surprising examples. The two examples presented, using illustrative videos, was the case of rubber tires from Russian dandelions, and bricks from mycelium.

Besides covering key principles of circular economy and bioeconomy, links to useful resources were presented, just like in Day 1. Participants were told about the European Circular Economy Stakeholder Platform (<https://circulareconomy.europa.eu/platform/en>) and, in addition to the educational materials developed by BE-Rural, it highlighted existing educational resources for the teaching of Circular Economy as follows:

- Ellen MacArthur Foundation (2017) ready-made lessons for school & college students ages 12-19 to learn about circular economy
- STEM Learning (2019) 1-year course for target ages of 11-14, 14-16 and 16-19 on “System Reset: Design and Technology for a Circular Economy”
- The Circular Classroom - <https://circularclassroom.com>

How is the University of Strathclyde teaching circular economy, sustainability and bioeconomy in collaboration with industry was shared with participants, plus how the innovative self-transformation student exercise is run was also explained. Although not specific to bioeconomy, participants were also reminded about the eco-schools programme, that has run since 1994 and now involves 56,000 schools in 70 countries (<https://www.ecoschools.global>). Eco-schools could be used as a framework for bioeconomy, circular economy and sustainability events at schools. It was noted that North Macedonia does not seem to have an Eco-School National Office and this is something North Macedonian participants could act upon.

The summer school then emphasized novel ways to maximise the potential of bioeconomy of different sectors (agri-food, fisheries & aquaculture, forestry, and herbs and essential oils for cosmetics and pharmaceutical industries) and once again mentioned that it is critical that the bioeconomy does not compete with food production and does not affect biodiversity.

Day 2 ended with an important discussion, continuing from the discussion of Day 1, on how best to implement the teaching of bioeconomy in the participants’ schools. This time the discussion groups

were based on country and language. This allowed the discussion to focus on development of curricula and educational material on the bioeconomy for specific countries. It also allowed participants to discuss in their own language. Groups provided a summary of what they discussed (see Annex VIII), which could have been written in their own language and, if that was the case, it was then translated to English. Participants wrote ideas under the two headings A and B as shown in Figure 20, that captures some of the discussion in Day 1 and was used for inspiration for the discussion in Day 2.

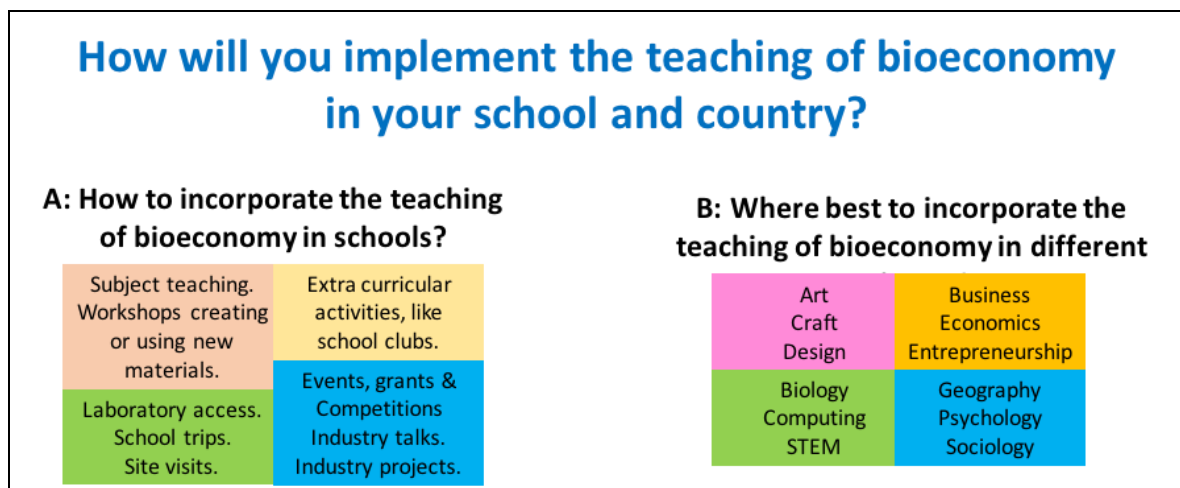


Figure 20: Figure that captures some of the discussion in Day 1 and was used for inspiration for the discussion in Day 2

Annex VIII presents the 75 ideas from the ten groups. It is hoped that some of these ideas will be taken forward by the teachers. According to a zoom poll at the end of Day 2, 93% of the participants who answered the poll were either “very satisfied” or “extremely satisfied” with the second day of the summer school (see Figure 21).

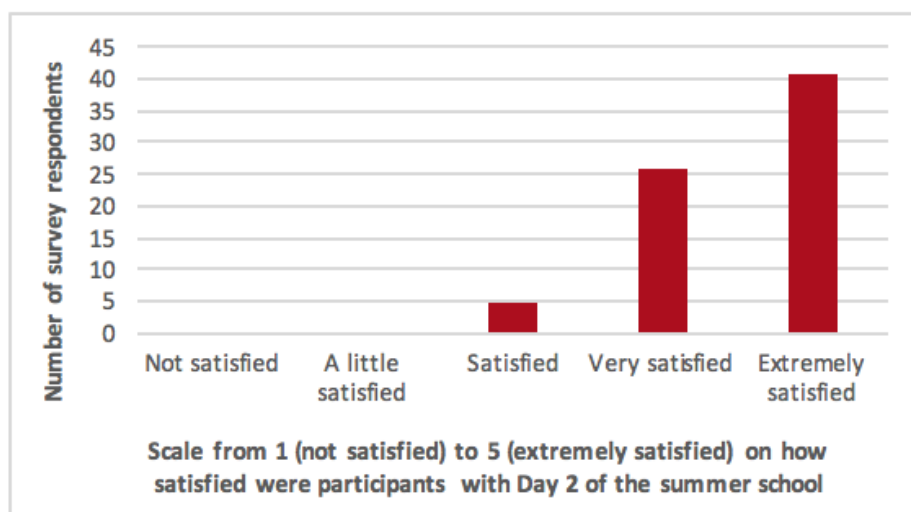


Figure 21: Answer to the question “Overall, on a scale from 1 (not satisfied) to 5 (extremely satisfied) how satisfied are you with Day 2 of the summer school?” [n = 72]

At the end of Day 2, once again participants were asked to check the material covered in Day 2 before Day 3, but in addition they were also asked to check three key documents specifically related to bioeconomy education:

- Bioeconomy Education. Factsheet #2. (European Bioeconomy Library, 2019).
- How to shape education for a sustainable circular bioeconomy? Conclusions from the GBS2020 Workshop on Education, training & capacity building. (Global Bioeconomy Summit, 2020).

- Global Environmental Issues and the Circular Bioeconomy (published in the journal “*The Science Teacher*” (Smith and Rudnicki, 2020).

8 Day 3 summer school overview, materials and discussion

Day 3 of the summer school took place on 8 June 2021 and had the overall theme of “Developing the industrial biotechnologists of the future: the innovative work of IBioIC (Industrial Biotechnology Innovation Centre) with Scottish schools.” Rachel Moir (Skills Programme Manager, IBioIC) ran the day with the support of Elsa João, who monitored the questions and comments in the zoom chat. PowerPoint slides used in Day 3 are in Annex VI. Day 3 was designed to have a different feel from Days 1 and 2, as the different topics covered were presented by different presenters as follows (see Annex II for the speakers’ mini biographies):

- Introduction to IBioIC – who we are, what we do (**Rachel Moir**, Skills Programme Manager, IBioIC).
- Scottish Bioeconomy Strategy and its context in a school setting (**Debbie McCreath**, Public Affairs Manager, IBioIC).
- Engagement strategies with STEM (**Graeme Rough**, Head of STEM programmes, Scottish Schools Education Research Centre).
- Leaders in Science Programme (**Dr Jo Sadler**, Leaders in Science Founder and BBSRC Discovery Fellow, University of Edinburgh).
- Inclusive STEM, Social Mobility Foundation and other initiatives (**Rachel Moir**, Skills Programme Manager, IBioIC).
- Concluding slides about the summer school – what next? (**Dr Elsa João**, University of Strathclyde).

Following an introduction to IBioIC by Rachel Moir, Debbie McCreath covered the politics of industrial biotechnology and the bioeconomy from a Scottish perspective (see Figure 22).

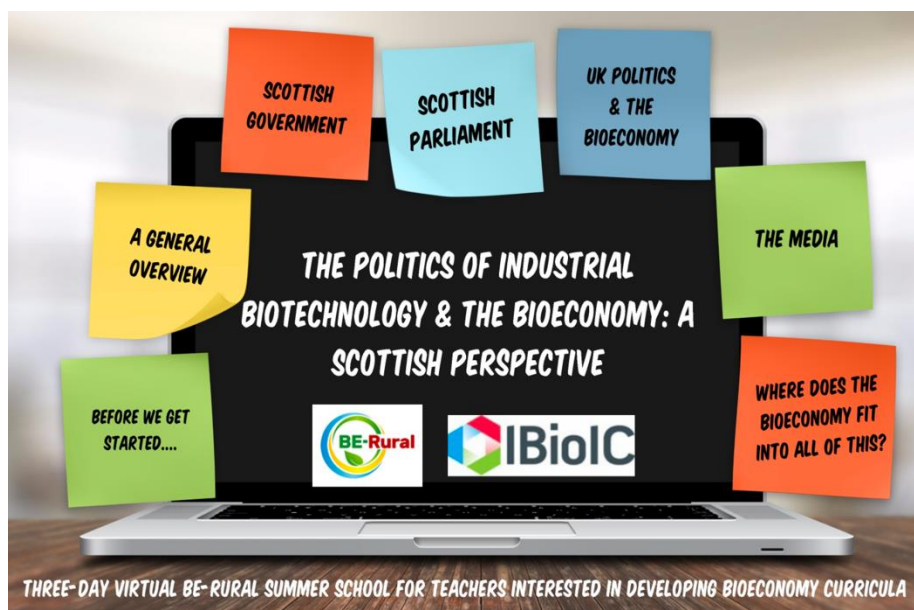


Figure 22: Opening slide from the presentation of Debbie McCreath (IBioIC)

Debbie McCreath used the interactive presentation software Mentimeter, that allows a presenter to get real-time input from participants with live polls, quizzes and word clouds (see Figures 23 and 24). Importantly a teacher can use it for free, if Mentimeter is used to create only one word cloud slide and three multiple choice quiz questions (check <https://www.mentimeter.com/features>).



Figure 23: Icebreaker question using Mentimeter word cloud (Debbie McCreath's presentation)

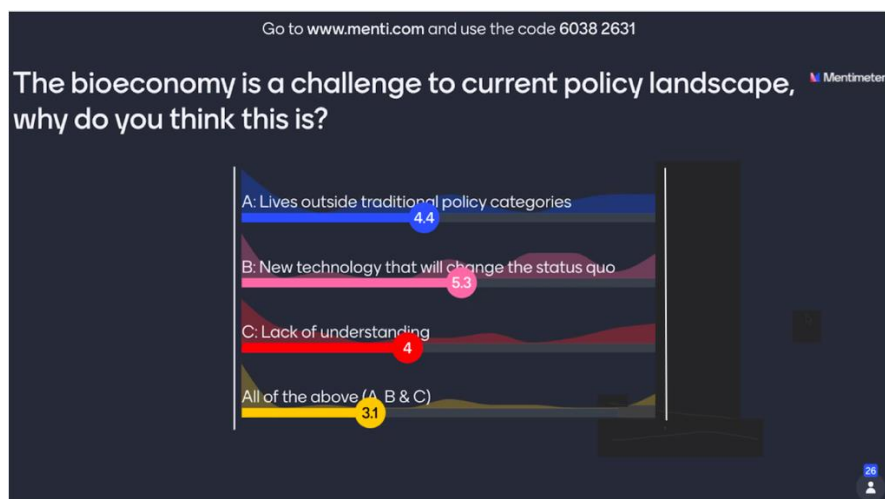


Figure 24: Bioeconomy scale question using Mentimeter (Debbie McCreath's presentation)

Following Debbie McCreath's presentation, Graeme Rough (Head of STEM programmes, Scottish Schools Education Research Centre - SSERC) presented the work of the SSERC - a not-for-profit company set up for the benefit of Scottish Education (<https://www.sserc.org.uk>) - and the innovative engagement strategies they do with STEM (Science, Technology, Engineering and Mathematics) areas of the curriculum. Although most of the work of SSERC is Scottish-based, some of the initiatives are expanding internationally and all attendees can benefit from these. Graeme Rough discussed:

1. STEM Ambassador Programme - <https://www.stem.org.uk/stem-ambassadors>
2. Teacher placements with industry and Education/Industry Partnerships (EIP)
3. ENTHUSE Partnerships - two-year collaboration between STEM Learning, a funder and 6-10 schools or colleges – <https://www.stem.org.uk/employers/enthuse-partnerships>
4. Young STEM Leader Programme - <https://www.youngstemleader.scot> (which aims to launch the "International Young STEM Leader" from 2023)

Interesting that SSERC refers to "educators" rather than "teachers", as they support not only primary and secondary school teachers, but also school technicians, childminders and early years practitioners (see Figure 25).

SSERC is the “go to” organisation for STEM professional learning in Scotland, offering a broad portfolio of services supporting STEM learning which are not available from any other source:

- 1

Provision of Career Long Professional Learning (CLPL) for childminders, early years practitioners, primary and secondary school teachers and school technicians.
- 2

The Advisory Service provides ongoing health and safety guidance for the Scottish education community to support safe STEM-based activities in the classroom environment.
- 3

Wider STEM engagement activities including liaison lead for STEM Ambassadors in Scotland, teacher placements into industry and the Young STEM Leader programme.



Vision:

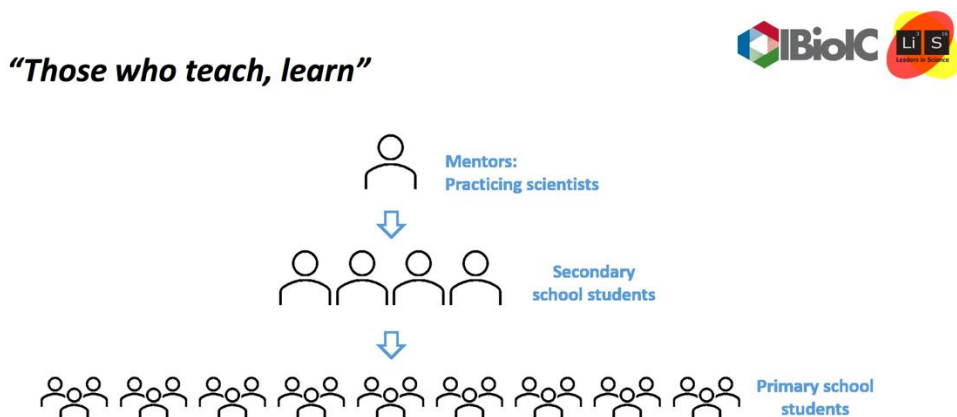
SSERC is internationally recognised as a centre of excellence for STEM learning and support.



Figure 25: The Scottish Schools Education Research Centre (Graeme Rough’s presentation)

Following Graeme Rough’s presentation, Dr Jo Sadler (University of Edinburgh) discussed the innovative “Leaders in Science Programme”. What was particularly interesting about this presentation is that Jo Sadler is the person who founded this programme in 2015, when she was a PhD student. So participants could ask questions about the challenges of creating such a programme.

The Leaders in Science (LiS) outreach programme promotes STEM engagement in local schools while helping to develop scientific communication and leadership skills of young scientists (www.leadersinscience.co.uk). The LiS schools outreach programme is led by graduate scientists (e.g. PhD students or equivalent) using a cascade learning as illustrated in Figure 26.



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Figure 26: The cascade learning of Leaders in Science programme (Jo Sadler’s presentation)

Importantly, Day 3 concluded with a talk about Inclusive STEM by Rachel Moir (IBioIC), covering the work of Social Mobility Foundation (<https://www.socialmobility.org.uk>), Speakers for Schools

(<https://www.speakersforschools.org>), Equate Scotland (<https://equatescotland.org.uk>), Kibble (<https://www.kibble.org>), among others.

Day 3, and therefore the whole 3-days online BE-Rural summer school, ended with a short presentation by Dr Elsa João on next steps, and asking participants to keep in touch (Figure 27) and let us know:

- How are you using the BE-Rural bioeconomy educational materials?
- How are you implementing the teaching of bioeconomy in your school and country?
- What bioeconomy events are you organizing or taking part?

Figure 27: Asking BE-Rural summer school participants to keep in touch

According to the survey that participants filled at the end of Day 3, 93% of the participants who answered the survey were either “very satisfied” or “extremely satisfied” with the third day of the summer school (see Figure 28).

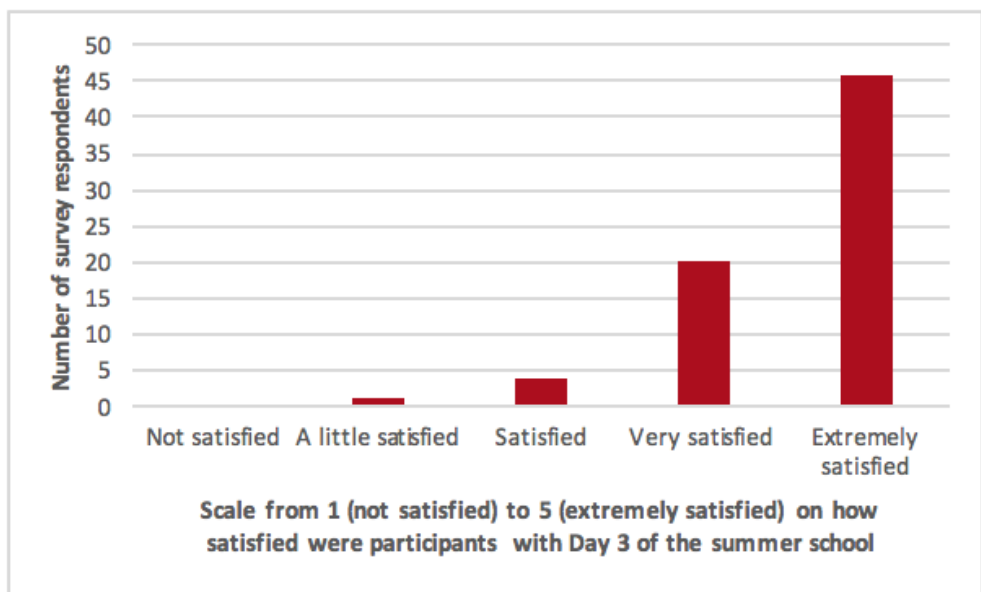


Figure 28: Answer to the question “Overall, on a scale from 1 (not satisfied) to 5 (extremely satisfied) how satisfied are you with Day 3 of the summer school?” [n = 71]

9 Feedback from attendees about the summer school overall

At the end of Day 3 participants filled a Qualtrics online survey about the whole summer school (see Annex III). According to this final feedback survey, 97% of the participants who answered the survey were either “very satisfied” or “extremely satisfied” with the summer school overall (see Figure 29).

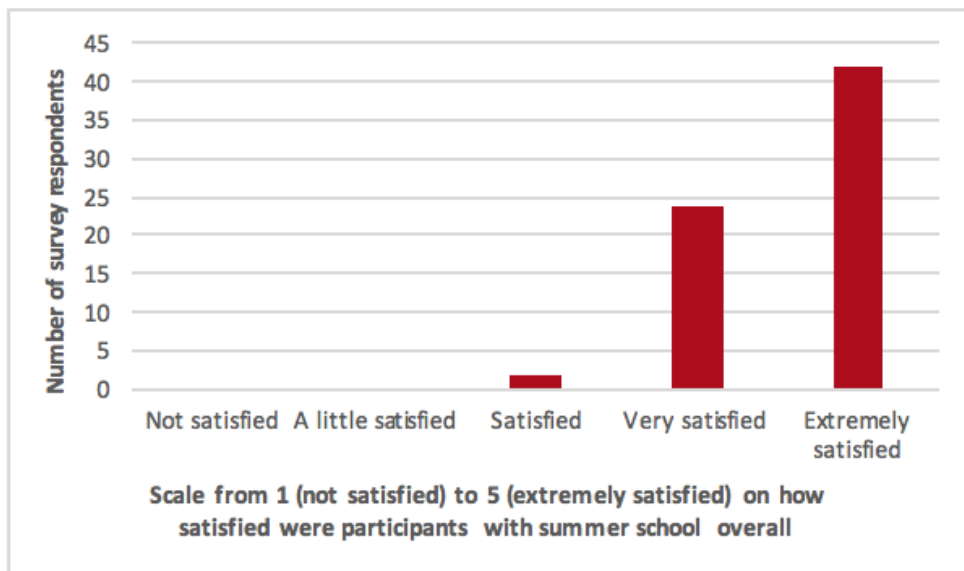


Figure 29: Answer to the question “Overall, on a scale from 1 (not satisfied) to 5 (extremely satisfied) how satisfied are you with the whole BE-Rural summer school?” [n = 68]

The reason for this appreciation was both due to the new material and how it was presented. Attendees liked the speakers, the interactivity, the discussions between participants and enjoyed the experience overall. One person said “the atmosphere was extraordinary!”, which is especially impressive given that the summer school was delivered online. Box 2 includes some quotes showing the range of people who benefited from the summer school.

Box 2: Quotes showing the range of people who benefited from the summer school

“I was extremely satisfied with the interesting presentations and people who attended this summer school and with the educational tools and information that I learnt through out this course. All of this will help me in the future to improve the quality of my teaching in the school that I work at.” (Secondary chemistry teacher, North Macedonia)

“Although I am teaching English as a foreign language, I have found many interesting pieces of information and a lot of ideas to be later applied in my classes or in extracurricular activities.” (Secondary English teacher, Romania)

“Extremely satisfied because the course has new ideas, new experiences, very useful for me.” (Primary school teacher, Romania)

“The provided information is interesting and I liked the presenters' approach.” (University Lecturer on regional policy and environmental economics, Bulgaria)

“Because all the discussions were great, everything that I heard was very interesting, some thing were actually very new for me, others were things that I am interested in. I have a big interest for STEM activities, for ecological activity, for bioeconomy, but I feel I can't do very much because I teach in the kindergarten, but I always try, I even developed an optional in my class with STEM activities. So, that's why I liked this course very much and the information and ideas from it.” (Pre-school teacher, Romania)

Participants were also asked how taking part on the summer school helped participants gain a better understanding of what bioeconomy, sustainability and circular economy are. Reminder that at the start of the summer school, the knowledge on all of these subjects was small (see section 6 and Figure 15). Figure 30 shows that the summer strongly contributed to the increase of knowledge of the participants in all these areas, with most participants stating either that “my knowledge has increased a lot” or “my knowledge has increased very much”.

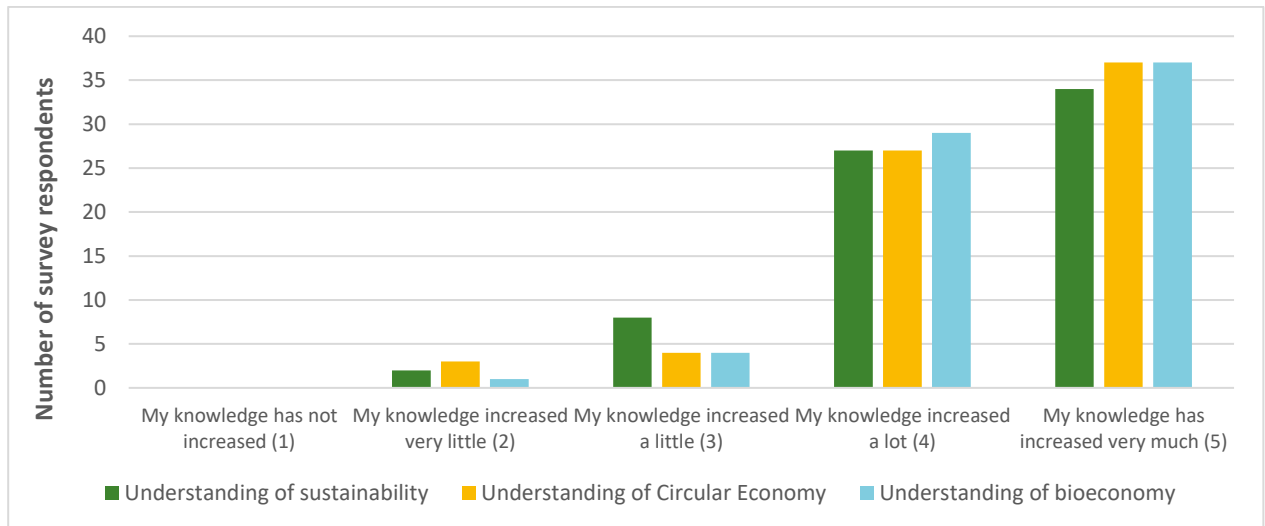


Figure 30: Answer to the question “On a scale from 1 to 5 (where 1 is “my knowledge has not increased” and 5 is “my knowledge has increased very much”) has taking part on this summer school helped you to gain a better understanding of what bioeconomy, sustainability and circular economy are?” [n = 71]

As a “litmus test” of the main aim of the BE-Rural summer school, which was to enthuse participants about the bioeconomy so participants would be more likely to try and integrate bioeconomy teaching in the curriculum, participants were asked if they plan to integrate bioeconomy teaching in their school (Yes, No, Maybe). It was reassuring and exciting to see that most said “Yes” (see Figure 31).

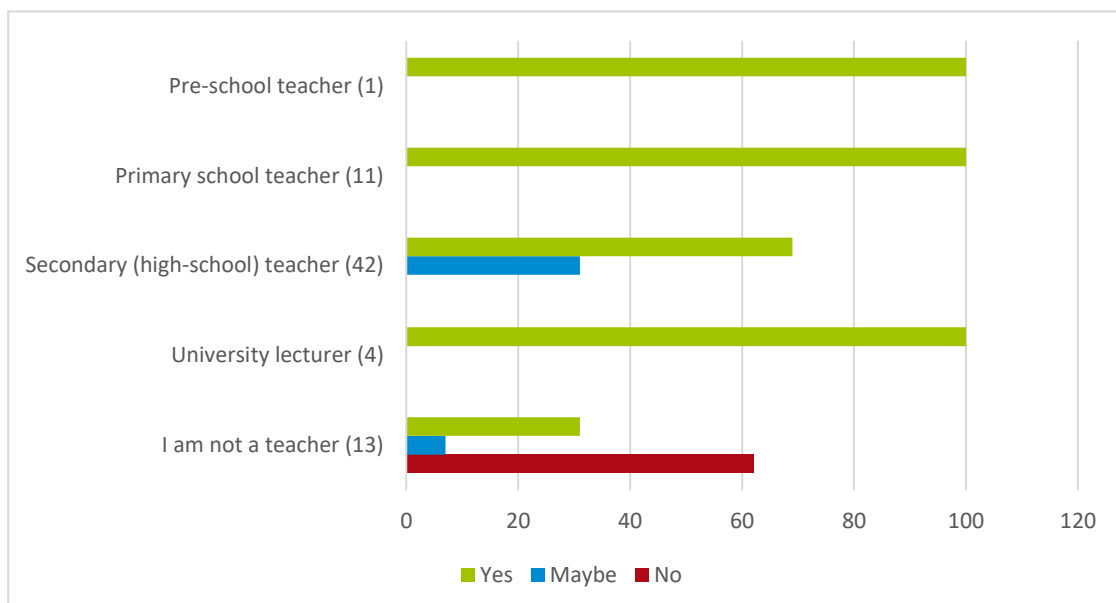


Figure 31: Percentage of respondents for each category and how they answered the question “Do you plan to integrate bioeconomy teaching in your school?” [n = 71]

It is interesting that the majority of the high-school teachers, all primary school teachers, all university lecturers, and the pre-school teacher, all said that they plan to integrate bioeconomy teaching in their school. The high-school teachers who answered “Maybe” said it depended of the high school management and approval, school curriculum and student options, subjects to be taught, and maybe in the future with a new portfolio.

Only non-teachers said “No”, because they were not teachers. Although some non-teachers did say they would integrate bioeconomy in teaching, these included PhD students who are contributing to University teaching. Plus, a non-teacher who was a Ministry Councillor, said “Maybe” depending on future research and education national curricula.

Some of the high school teachers said that in addition to integrating bioeconomy teaching in classes and in extracurricular activities, they would also “present the concept in our teachers' meetings and highlight the benefits”, which was good to hear as it would further spread the message to other teachers and school management.

10 Conclusions

The 3-day BE-Rural virtual summer school for teachers interested in developing curricula and educational material on the bioeconomy was a resounding success. This was for several reasons:

- The summer school had the active participation of more 100 attendees from 12 countries, including the five main target countries but also people from Croatia and Slovenia for example.
- Participants found the BE-Rural educational materials useful and interesting.
- Participants enjoyed the summer school very much - 97% of the participants who answered the survey were either “very satisfied” or “extremely satisfied” with the summer school overall.
- The summer school has a wide range of educators attending and all enjoyed and benefited from the summer school: pre-school, primary school, high school and universities.
- The reason for this appreciation was due to the new material and also how it was presented. Attendees liked the speakers, the interactivity, the discussions between participants and enjoyed the experience overall. One person said “the atmosphere was extraordinary!”.
- Most participants said that taking part on the summer school helped participants gain a better understanding of what bioeconomy, sustainability and circular economy are.
- The main aim of the summer school was to enthuse participants about the bioeconomy, so participants would more likely try to integrate bioeconomy teaching in the curriculum, and therefore it is reassuring and exciting to see that most said “Yes” when asked if they plan to integrate bioeconomy teaching in their school.
- Very importantly the summer school provided a platform for teachers to discuss how best to integrate the teaching of bioeconomy in their schools. Data resulting from these discussions includes 108 ideas which are listed in this report, and many are recommendations for schools.
- Finally, it is good to hear how many of the attendees expressed how they were “inspired” and how some said that they would present the concept in school management meetings.

This report has been written as a record of what was covered in the summer school in terms of content and in terms of the results of the discussions. In addition, the report has also been written in such a way that if someone wants to run a similar summer school, a similar format can be used.

Finally, we do hope that the teachers keep us informed on their bioeconomy initiatives in their schools. We hope teachers will let us know how they are using the BE-Rural bioeconomy educational materials, how they are implementing the teaching of bioeconomy in their school and country, and what bioeconomy events they are organizing or taking part.

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Annex I – Programme used to promote the summer school

Three-day virtual teachers' summer school on the bioeconomy

- Day 1 - Tuesday 25 May 2021, 14:00-17:30 CET
- Day 2 - Tuesday 1 June 2021, 14:00-17:30 CET
- Day 3 - Tuesday 8 June 2021, 14:00-17:30 CET



A 3-day summer school for teachers interested in developing curricula and educational material on the bioeconomy, as part of the BE-Rural Project (<https://be-rural.eu/>). The summer school is primarily targeted at teachers in the five innovation regions (Vidzeme and Kurzeme in Latvia; Szczecin and Vistula Lagoons in Poland; Covasna in Romania; Stara Zagora in Bulgaria; and Strumica in North Macedonia) but other attendees are welcome.

The summer school is jointly run by Dr Elsa João (University of Strathclyde in Glasgow, Scotland) and Rachel Moir (Skills Programme Manager, IBIoIC). The University of Strathclyde has a long history on the teaching of sustainability (since 1992) and is involved in teaching circular economy and bioeconomy since 2016. IBIoIC connects industry, academia and government with the aim to accelerate new biotechnology processes and products. Part of their activities involve innovative initiatives for the development of skills in the bio-based sector.

Programme

Day 1 - Tuesday 25 May, 14:00-17:30 CET

Introduction to the bioeconomy and overview of the bioeconomy educational resources developed by BE-Rural

Dr Elsa João (Department of Civil and Environmental Engineering, University of Strathclyde), with the support of Neli Georgieva (European Policies Research Centre)

14:00 – 14:15 – Welcome – plus about Dr Elsa João and the University of Strathclyde. About the BE-Rural Project. Introduction to the Summer School.

14:15 – 15:10 – Key principles of bioeconomy – plus Q&A

15:10 – 15:30 – About bioproducts and small group discussion

15:30 – 15:45 – *Break*

15:45 – 16:15 – Key principles of sustainability and the UN SDGs

16:15 – 16:45 – Overview of educational resources by BE-Rural. Overview bioeconomy events in each region

- 16:45 – 17:15 – Discussion on how can bioeconomy learning be integrated in school teaching. Presentations by participants.
- 17:15 – 17:30 – Fill feedback survey about Day 1 of the summer school. Q&A, summary Day 1, and link to Day 2

Day 2 - Tuesday 1 June, 14:00-17:30 CET

Bioeconomy of different sectors (e.g. fisheries, agriculture) and how best to integrate bioeconomy teaching in schools in Bulgaria, Latvia, North Macedonia, Poland and Romania.

Dr Elsa João (Department of Civil and Environmental Engineering, University of Strathclyde), with the support of Stefan Kah (European Policies Research Centre)

- 14:00 – 14:15 – Welcome back from Dr Elsa João and the University of Strathclyde. Introduction to Day 2 of the Summer School
- 14:15 – 14:40 – Summary of what was covered in Day 1 of the Summer School. More about the BE-Rural Project and the different working packages
- 14:40 – 15:30 – Key principles of circular economy – plus Q&A
- 15:30 – 15:45 – *Break*
- 15:45 – 16:15 – Connecting student learning with industry projects, lessons from Strathclyde
- 16:15 – 16:45 – Novel ways to maximise potential of bioeconomy of different sectors (agri-food, Fisheries & aquaculture, forestry, herbs and essential oils for cosmetics and pharmaceutical industries) – plus Q&A
- 16:45 – 17:15 – Workshop on teaching bioeconomy in each of the five innovation regions, grouped by country and language. Presentations by participants.
- 17:15 – 17:30 – Short poll about Day 2. Q&A, summary Day 2, and link to Day 3

Day 3 - Tuesday 8 June, 14:00-17:30 CET

Developing the industrial biotechnologists of the future: the innovative work of IBioIC (Industrial Biotechnology Innovation Centre) with Scottish schools.

Chair: Rachel Moir (Skills Programme Manager, IBioIC), with the support of Dr Elsa João (Department of Civil and Environmental Engineering, University of Strathclyde)

- 14:00 – 14:20 – Introduction to Day 3. Introduction to IBioIC – who we are, what we do (Rachel Moir, Skills Programme Manager, IBioIC) – plus Q&A.
- 14:20 – 14:50 – Scottish Bioeconomy Strategy and its context in a school setting (Debbie McCreath, Public Affairs Manager, IBioIC) – plus Q&A with speaker.
- 14:50 – 15:25 – Engagement strategies with STEM (Graeme Rough, Head of STEM programmes, Scottish Schools Education Research Centre) – plus Q&A.
- 15.25 – 15.30 – Pre-break Q&A and discussion
- 15:30 – 15:45 – *Break*
- 15:45 – 16:20 – Leaders in Science Programme (Dr Jo Sadler, Leaders in Science Founder and BBSRC Discovery Fellow, University of Edinburgh) – plus Q&A

- 16:20 – 16:40 – Inclusive STEM, Social Mobility Foundation and other initiatives (Rachel Moir, Skills Programme Manager, IBioIC) – plus Q&A
- 16:40 – 17:10 – Concluding slides about the 3-days summer school, final zoom polls, and participants to fill feedback survey about summer school overall (Elsa João)
- 17:10 – 17:25 – Final Q&A considering content of the 3-days of the summer school
- 17:25 – 17:30 – Close (Rachel Moir, IBioIC and Dr Elsa João, University of Strathclyde)

Annex II – Speakers Bios of the summer school

Three-day virtual teachers' summer school on the bioeconomy

- Day 1 - Tuesday 25 May 2021, 14:00-17:30 CET
- Day 2 - Tuesday 1 June 2021, 14:00-17:30 CET
- Day 3 - Tuesday 8 June 2021, 14:00-17:30 CET



Speakers Bios (in order of appearance)



Dr Elsa João (Days 1, 2 & 3)

Senior Lecturer in the Department of Civil and Environmental Engineering at the University of Strathclyde (Glasgow, Scotland), and the director of MSc in Sustainability and Environmental and MSc in Environmental Entrepreneurship. Elsa has expertise in the areas of Strategic Environmental Assessment (SEA), Environmental Impact Assessment (EIA), enhancement of positive impacts, sustainability, bioeconomy and the circular economy. Her current research focuses on how enhancement can improve project design and strategic planning and how best to implement the circular economy. She set up the first postgraduate class on the Circular Economy at the University of Strathclyde. Part of the BE-Rural project (2019-2022).



Neli Georgieva (Day 1)

Research Associate at the European Policies Research Centre based at the University of Strathclyde in Glasgow (Scotland) and TU Delft (the Netherlands). Within EPRC, Neli is involved in comparative research dedicated to regional, rural and Cohesion policy, with focus on countries in CEE. She has supported processes of stakeholder engagement for the development of regional bioeconomy strategies as part of H2020 project BE-Rural and Power4Bio projects. Previously, Neli worked with regional authorities across Europe as part of a Brussels-based network, where her work focused on building inter-regional cooperation and knowledge exchange in the field of industrial modernisation and sustainable chemical production.



Stefan Kah (Day 2)

Research Fellow at the European Policies Research Centre, based at the University of Strathclyde in Glasgow (Scotland) and TU Delft (the Netherlands). He specialises in research and knowledge exchange in the area of EU Cohesion policy, as well as regional and rural development more widely. In terms of the bioeconomy, he was involved in the Horizon 2020 BioSTEP (2015-2018) and BE-Rural (2019-2022). BioSTEP aimed at promoting stakeholder engagement and public awareness for a participative governance of the European bioeconomy. A native German speaker, he covered the case study of Saxony-Anhalt. He has prior professional experience from working for the INTERACT Programme in Vienna, a regional development agency in Graubünden (Switzerland) and for the International Commission for the Protection of the Alps (CIPRA) in Liechtenstein.

Speakers Bios (continued)



Rachel Moir (Day 3)

Rachel manages IBIoC's Skills Programme which develops and delivers training opportunities from Higher National Qualifications to PhD level. Since obtaining her MSci in Forensic and Analytical Chemistry and MSc in Environmental Studies, both from University of Strathclyde, Rachel has gained over 10 years' experience working as a project manager in the public, private and third sectors. This includes managing a programme of joint public and private sector scientific research projects for the third sector organisation SNIFFER; managing a £2million IT system implementation project within the education sector at SQA; and working on large infrastructure projects such as M74 link and Forth Replacement Crossing with a global engineering company.



Debbie McCreath (Day 3)

Debbie leads the IBIoC's Public Affairs strategy, as IBIoC's Public Affairs Manager, and looks after all of IBIoC's government relations, strategic communications, policy development, political activity, media, general reputation management as well as all of the wider stakeholder engagement, events, marketing and communications activity for IBIoC. Prior to joining IBIoC Debbie worked for industry leading trade association the Food and Drink Federation, lobbying on behalf of its 300+ FMCG (Fast-Moving Consumer Goods) members on issues including diet and health, sustainability and market competitiveness.



Graeme Rough (Day 3)

Graeme is Head of STEM Programmes at SSERC (Scottish Schools Education Research Centre). All 32 Scottish Local Authorities are members of SSERC (in existence since 1965) offering a broad portfolio of services, principally in support of the STEM (Science, Technology, Engineering and Mathematics) areas of the curriculum. Before joining SSERC in 2019, Graeme was the Faculty Head of Science at Wallace High School in Stirling where he spent twelve years delivering the Scottish Science/Physics curriculum. He graduated in Physics at The University of Glasgow and prior to his time in teaching he worked in industry, spending six years in Mechanical Services Engineering.



Dr Jo Sadler (Day 3)

Joanna Sadler is a Research Fellow and Principle Investigator at the University of Edinburgh, Scotland. She combines her multidisciplinary background in chemistry and biotechnology to develop bio-based technologies to degrade and upcycle post-consumer plastic into high value small molecules. During her PhD studies, Joanna founded the Leaders in Science (LiS) outreach programme to promote STEM engagement in local schools. Joanna now collaborates with IBIoC to run LiS in Scotland, where it currently operates across two cities to help develop scientific communication and leadership skills of young scientists.

Annex III – Blank surveys used to provide feedback on the summer school

Two Qualtrics surveys were done: one at the end of Day 1 and one at the end of Day 3. The same GDPR information was used for both surveys.

GDPR information used in the surveys for Day 1 and Day 3:

AIM of the surveys about the summer school on bioeconomy - Survey to get feedback from the attendees of the BE-Rural 3-day summer school for teachers interested in developing curricula and educational material on the bioeconomy. Comments received will be summarised in a report explaining outcome of the summer school, but will do so in an anonymous and confidential way. We will also write down comments, suggestions, ideas and questions that participants had during the summer school (e.g. zoom chat). We will ask participants for their names so we can connect all the comments when analyzing the data but the summer school report will present comments in an anonymous and confidential way. Raw data will be protected during project and destroyed at the end of the research.

ABOUT BE-Rural (<https://be-rural.eu/>) - BE-Rural is exploring the potential of regional and local bio-based economies and support the development of bioeconomy strategies, roadmaps and business models. The project focuses on Open Innovation Platforms (OIPs) within selected regions in five countries: Bulgaria, Latvia, North Macedonia, Poland and Romania.

DATA Protection - By agreeing to fill this survey, you consent to BE-Rural collecting, processing, and using your personal data given within this activity for the sole purposes of research undertaken in the Horizon 2020 BE-Rural project (Grant Agreement no. 818748). Participation is voluntary and your input will be kept confidential for a period of five years before its destruction. Should you require further information or wish to exercise your rights under the EU GDPR (e.g. to access, rectify, or delete your data), please contact the BE-Rural team via University of Strathclyde Data Protection Officer. Personal data and any input submitted will not be disclosed, shared with or sold to any third party.

RESEARCHER contact details - Dr Elsa João, University of Strathclyde, elsa.joao@strath.ac.uk

- I understand the purpose of the survey and how my input will be used in the project.
- I understand and give consent to release my personal data for internal use of project.
- I understand that I can withdraw my consent to participate at any time.
- I understand that any information I provide will be made anonymous and I would not be personally identified in any reports, papers or other documents produced in relation to this project, unless I give explicit consent to do so.
- I consent to being a participant in the project.
- I consent to being audio and video recorded as part of the project.

By clicking here I confirm that I am over 18, I agree that my data can be used for the reasons stated above and opt-in to data collection and analysis

Feedback at the end of Day 1 BE-Rural Summer School

Q1. Your name

Note: Data will be treated in an anonymised way but we need your name to connect all the comments when analyzing the data.

Q2. What is the **country** where you are working?

Q3. What is your **region** where you are working?

Q4. What kind of teacher are you?

- o Pre-school teacher
- o Primary school teacher
- o Secondary (high-school) teacher
- o University lecturer
- o I am not a teacher (please specify what is your job)

Q5. How did you find out about the BE-Rural summer school?

Q6. If you are from Romania, do you know why so many people from Romania registered to attend the summer school?

Q7. Did you attend some of the BE-Rural education events in your region?

- No
- Yes - if yes, which one(s)? - please specify ...

Q8. Before today, on a scale from 1 (nothing) to 5 (very much), how much did you know about these topics?

	1. Nothing	2. Very Little	3. A little	4. A lot	5. Very much
Bioeconomy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sustainability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Circular economy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q9. Overall, on a scale from 1 (not satisfied) to 5 (extremely satisfied) how satisfied are you with Day 1 of the summer school?

- Not satisfied (1)
- A little satisfied (2)
- Satisfied (3)
- Very satisfied (4)
- Extremely satisfied (5)

Q10. What was the best thing about the Day 1 of the summer school?

Q11. What did you not like about the Day 1 of the summer school?

Q12. What was missing in Day 1 of the summer school that you would like to be covered in Day 2 or Day 3 of the summer school?

Q13. What is the main idea you had today about developing curricula and educational material on the bioeconomy for your school?

Q14. Any other comments?

Feedback at the end of Day 3 BE-Rural Summer School

Q1. Your name

Note: Data will be treated in an anonymised way but we need your name to connect all the comments when analyzing the data.

Q2. What is the **country** where you are working?

Q3. What is your **region** where you are working?

Q4. What kind of **teacher** are you?

- Pre-school teacher
- Primary school teacher
- Secondary (high-school) teacher
- University lecturer
- I am not a teacher (please specify what is your job): ...

Q5. Which days of the summer school did you attend? [pick one or more]

- I attended Day 1 on 25 May
- I attended Day 2 on 1 June
- I attended Day 3 on 8 June

Q6. Overall, on a scale from 1 (not satisfied) to 5 (extremely satisfied), how satisfied are you with **Day 3 only** of the summer school?

- o Not satisfied (1)
- o A little satisfied (2)
- o Satisfied (3)
- o Very satisfied (4)
- o Extremely satisfied (5)

Display This Question: If Q5. Which days of the summer school did you attend? [pick one or more] = I attended Day 1 on 25 May
Or Q5. Which days of the summer school did you attend? [pick one or more] = I attended Day 2 on 1 June

Q7. Overall, on a scale from 1 (not satisfied) to 5 (extremely satisfied), how satisfied are you with the **whole BE-Rural summer school?** [reply even if you missed one of the days]

- o Not satisfied (1)
- o A little satisfied (2)
- o Satisfied (3)
- o Very satisfied (4)
- o Extremely satisfied (5)

Display This Question: If Q7. Overall, on a scale from 1 (not satisfied) to 5 (extremely satisfied), how satisfied are you... = Not satisfied (1)

Q8. Explain **why you were not satisfied** with the whole BE-Rural summer school?

Display This Question: If Q7. Overall, on a scale from 1 (not satisfied) to 5 (extremely satisfied), how satisfied are you... = A little satisfied (2)

Q9. Explain **why you were a little satisfied** with whole BE-Rural summer school?

Display This Question: If Q7. Overall, on a scale from 1 (not satisfied) to 5 (extremely satisfied), how satisfied are you... = Satisfied (3)

Q10. Explain **why you were satisfied** with the whole BE-Rural summer school?

Display This Question: If Q7. Overall, on a scale from 1 (not satisfied) to 5 (extremely satisfied), how satisfied are you... = Very satisfied (4)

Q11. Explain **why you were very satisfied** with the whole BE-Rural summer school?

Display This Question: If Q7. Overall, on a scale from 1 (not satisfied) to 5 (extremely satisfied), how satisfied are you... = Extremely satisfied (5)

Q12. Explain **why you were extremely satisfied** with the whole BE-Rural summer school?

Q13. On a scale from 1 to 5 (where 1 is 'my knowledge has not increased' and 5 'my knowledge has increased very much') – **has taking part on this summer school helped you to gain a better understanding** of what bioeconomy, sustainability and circular economy are?

	1. My knowledge has not increased	2. My knowledge increased very little	3. My knowledge increased a little	4. My knowledge increased a lot	5. My knowledge increased very much
Understanding of bioeconomy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understanding sustainability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understanding of circular economy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q14. Do you plan to integrate bioeconomy teaching in your school?

- Yes
- No
- Maybe - it depends of... (please add)

Display This Question: If Q14. Do you plan to integrate bioeconomy teaching in your school? = Yes

Q15. How do you plan to integrate bioeconomy teaching in your school?

Display This Question: If Q14. Do you plan to integrate bioeconomy teaching in your school? = No

Q16. Why will you not integrate bioeconomy teaching in your school?

Q17. Any other comments?

Annex IV – Slides used Day 1



https://be-rural.eu

Three-day virtual BE-Rural summer school for teachers interested in developing bioeconomy curricula

Day 1 – 25 May 2021 – Introduction to the bioeconomy and overview of the bio-economy educational resources developed by BE-Rural



Dr Elsa João, University of Strathclyde, Scotland



https://be-rural.eu

Day 1 outline programme

14:00 – 15:30 CET (14-2:30pm UK time)

- Welcome – plus about Dr Elsa João and the University of Strathclyde
- About the BE-Rural Project
- Introduction to the Summer School
- Key principles of bioeconomy
- About bioproducts and small group discussion
- Q&A

Break (15:30 – 15:45 CET) (2.30-2.45pm UK time)

15:45 – 17:15 CET (12:45-4:15pm UK time)

- Key principles of sustainability and the UN SDGs
- Overview of educational resources by BE-Rural
- Overview bioeconomy events in each region
- Discussion on how can bioeconomy learning be integrated in school teaching

17:15 – 17:30 CET (4:15-4:30pm UK time)

- Fill feedback survey about Day 1 of the summer school
- Q&A, summary day 1, and link to day 2

Welcome!



Dr Elsa João
(elsa.joao@strath.ac.uk)



The University of Strathclyde (founded in 1796 as 'a place of useful learning'), is a leading technological University with around 23,000 students from more than 100 nations.

University of Strathclyde launches consultation to name **flagship building after inspirational women**



Senior Lecturer, Department Civil and Environmental Engineering, University of Strathclyde, Glasgow, Scotland
<https://www.strath.ac.uk/engineering/civil-environmental-engineering/>

Director MSc in Environmental Entrepreneurship and MSc in Sustainability and Environmental Studies - that accepts students from all backgrounds.

- University lecturer in the UK since 1992.
- Expertise in **Environmental Impact Assessment (EIA), Strategic Environmental Assessment (SEA), enhancement of positive impacts, sustainability, bioeconomy, Circular Economy and Writing Skills.**
- First degree: Environmental Engineering (New University of Lisbon, Portugal).
- Master (USA) and PhD (UK) in Geography

<https://www.strath.ac.uk>

About the BE-Rural Project

BE-Rural - Bio-based strategies and roadmaps for enhanced rural and regional development in the EU (April 2019 – March 2022)

BE-Rural supports

... regional stakeholders in **5 countries**:

- Bulgaria:** Stara Zagora
- Latvia:** Vidzeme and Kurzeme
- North Macedonia:** Strumica
- Poland:** Szczecin and Vistula Lagoons
- Romania:** Covasna



The goal of BE-Rural is to realise the potential of regional bio-based economies by supporting relevant actors in the participatory development of bioeconomy strategies and roadmaps.

This includes educational activities and resources.

<https://be-rural.eu/innovation-regions/>

Sectors of BE-Rural



Vidzeme and Kurzeme, Latvia: focus on the potential of by-products of **forest management** (i.e. young forest stand thinning, short rotation coppice and forestry plantations, removing overgrowth in abandoned agricultural lands).

Szczecin Lagoon and Vistula Lagoon, Poland: focus on small-scale **fisheries**, specifically the sustainable use of underused and low-value fish species in the lagoons.

Covasna, Romania: focus on addressing fragmented value chains and implementing the **circular economy** concept within the county's industrial sectors (i.e. wood and furniture, textiles, agro-food, mechanical engineering, green energy).

Stara Zagora, Bulgaria: focus on new technologies for the application of **essential oils and herbal plants** in the cosmetics and pharmaceutical industry, combined with tourism activities.

Strumica, North Macedonia: focus on the use of **agricultural residues**, specifically the by-production of organic materials from agricultural activities, as a source of energy for domestic and industrial purposes.

Regional & country facilitators

- BULGARIAN INDUSTRIAL ASSOCIATION** - Union of the Bulgarian Business (BIA), Bulgaria
<https://en.bia-bg.com>
- Institute for Economic Forecasting (IPE)**, Romania
<http://www.ipe.ro/>
- International Centre for Sustainable Development of Energy, Water and Environment Systems – Macedonian Section (SDEWES-Skopje)**, North Macedonia
<https://www.sdewes.org>
- Latvian State Forest Research Institute (SILAVA)**, Latvia
<http://www.silava.lv/>
- National Marine Fisheries Research Institute (NMRI)**, Poland
<https://mri.gdynia.pl/>

Virtual 3-day summer school

Day 1 - Tuesday 25 May, 14:00-17:30 CET
Introduction to bioeconomy and overview bioeconomy educational resources developed by BE-Rural
Dr Elsa João (University of Strathclyde), with the support of Neil Georgieva (European Policies Research Centre)

Day 2 - Tuesday 1 June, 14:00-17:30 CET
Bioeconomy of different sectors (e.g. fisheries, agriculture) and how best to integrate bioeconomy teaching in schools in Bulgaria, Latvia, North Macedonia, Poland and Romania.
Dr Elsa João (University of Strathclyde), with the support of Stefan Kah (European Policies Research Centre)

Day 3 - Tuesday 8 June, 14:00-17:30 CET
Developing the industrial biotechnologists of the future: the innovative work of IBioIC (Industrial Biotechnology Innovation Centre) with Scottish schools.
Chair: Dr Kirsty Robb (RapidBio Senior Scientist, IBioIC), with the support of Dr Elsa João (University of Strathclyde)

At the end of each day there is a short survey for attendees to fill in - important for the CPD (Continuing Professional Development) certificate of the participation in summer school.

Virtual 3-day summer school

Day 3 will be run by IBioIC



Industrial Biotechnology Innovation Centre

IBioIC supports companies in their innovation journey working across the bioeconomy.

<https://www.ibioic.com>

Summer School Speakers



- Dr Elsa João**
Senior Lecturer, Department of Civil and Environmental Engineering, University of Strathclyde (Scotland)
(Day 1, 2 and 3)
- Neil Georgieva**
Research Associate, European Policies Research Centre based at University of Strathclyde (Scotland) & TU Delft (the Netherlands)
(Day 1)
- Stefan Kah**
Research Fellow, European Policies Research Centre, based currently at Strathclyde (Scotland) & TU Delft (the Netherlands)
(Day 2)
- Rachael Blott**
R&D Operations Manager, IBioIC - Industrial Biotechnology Innovation Centre (Glasgow)
(Day 3)
- Debbie MacIntosh**
Public Affairs Manager, IBioIC - Industrial Biotechnology Innovation Centre (Glasgow, Scotland)
(Day 3)
- Christine Ross**
Head of STEM programme of the Scottish Schools Education Research Centre (SSEERC)
(Day 3)
- Dr Jo Scoble**
Research Fellow and Principal Biologist at the University of Edinburgh, Scotland
(Day 3)

Summer School Attendees




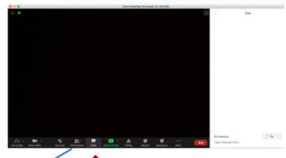








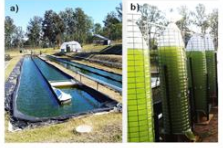

Plan A (before pandemic) – do a summer school in person, in Glasgow, Scotland, for 15-20 people.

Plan B (after pandemic) – do a virtual summer school, with more than 15-20 people



Country	Number of people
Latvia	4
Poland	4
Macedonia	7
Bulgaria	14
Romania	235
Other	30

Total of 294 people!

<p style="text-align: center;">Using zoom</p> <p style="text-align: center;">First things first!</p> <p style="text-align: center;">In zoom, rename your name as:</p> <p style="text-align: center;">Name (Country)</p>	<p style="text-align: center;">Using zoom</p> <div style="display: flex; justify-content: space-around;"> <div style="width: 45%;"> <p>1. We will use polls</p>  </div> <div style="width: 45%;"> <p>2. We will use the chat function</p>  </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="width: 45%;"> <p>3. Can raise hand</p>  </div> <div style="width: 45%;"> <p>4. We will use breakout groups</p>  </div> </div>
<p style="text-align: center;">First breakout group</p> <p style="text-align: center;">This course is also a way for attendees to interact with each other</p> <p style="text-align: center;">In small groups, introduce yourself using zoom breakout rooms (5 minutes task):</p> <p style="text-align: center;">Your name</p> <p style="text-align: center;">What is your work</p> <p style="text-align: center;">What makes you happy</p>	<p style="text-align: center;">Day 1 outline programme</p> <p>14:00 – 15:30 CET (1-2:30pm UK time)</p> <ul style="list-style-type: none"> Welcome – plus about Dr Elsa João and the University of Strathclyde About the BE-Rural Project Introduction to the Summer School Key principles of bioeconomy About bioproducts and small group discussion Q&A <p>Break (15:30 – 15:45 CET) (2:30-2:45pm UK time)</p> <p>15:45 – 17:15 CET (12:45-4:15pm UK time)</p> <ul style="list-style-type: none"> Key principles of sustainability and the UN SDGs Overview of educational resources by BE-Rural Overview bioeconomy events in each region Discussion on how can bioeconomy learning be integrated in school teaching <p>17:15 – 17:30 CET (4:15-4:30pm UK time)</p> <ul style="list-style-type: none"> Fill feedback survey about Day 1 of the summer school Q&A, summary day 1, and link to day 2
<p style="text-align: center;">The magic of bioeconomy - 1</p> <div style="text-align: center;">  <p>3 minutes video https://www.youtube.com/watch?v=d6RUh7FGnUM</p> </div>	<p style="text-align: center;">The magic of bioeconomy - 1</p> <div style="display: flex; justify-content: space-around;"> <div style="width: 45%;">  </div> <div style="width: 45%;"> <p>Water saving:</p> <p>1 kilo of milk fibre – 1 litre of water</p> <p style="text-align: center;">Vs</p> <p>1 kilo of cotton – 15 litres of water</p> </div> </div> <div style="text-align: center; margin-top: 10px;"> <p>Special properties of milk fibre:</p> <p>antibacterial and anti-allergic</p> </div> <div style="text-align: center; margin-top: 10px;"> <p>Win – Win – Win – Win</p> <p>Less water → New jobs</p> <p>Less waste → Quality product</p> <p>New industry and new jobs</p> </div>
<p style="text-align: center;">The magic of bioeconomy - 2</p> <div style="display: flex; justify-content: space-around;"> <div style="width: 45%;">  <p>1.20 minutes video https://www.youtube.com/watch?v=lc7dYahSCTM</p> </div> <div style="width: 45%;">  <p>1.20 minutes video https://www.youtube.com/watch?v=lc7dYahSCTM</p> </div> </div>	<p style="text-align: center;">The magic of bioeconomy - 2</p> <div style="display: flex; justify-content: space-around;"> <div style="width: 45%;">  <p>Win – Win – Win – Win</p> <p>Sustainable source of natural chemicals → New jobs</p> <p>Diverting waste from landfill → Quality product</p> </div> <div style="width: 45%;">  <p>Award winning company from Glasgow, set up by Strathclyde Business School students https://revive-eso.com</p> </div> </div>
<p style="text-align: center;">The magic of bioeconomy - 3</p> <p>Third generation biofuels</p> <p>Third generation biofuels (e.g. engineered crops such as algae), present the best possibility for alternative fuel because they don't compete with food. Algae can grow in areas unsuitable for 1st and 2nd generation crops, which would relieve stress on water and arable land used. Plus it can be grown using sewage, wastewater, and saltwater.</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="width: 45%;"> <p>Note:</p> <p>First generation biofuels (e.g. rape oil, sunflower oil, beet sugarcane, corn, potatoes) - main drawback: come from biomass that is also a food source.</p> <p>Second generation biofuels (e.g. agricultural and forest residues) come from non-food biomass, but still compete with food production for land use.</p> <p>Source: Corrao, D., Hawthorne, B., Fargione, J., Hill, J., Pongratz, R., Thomas-Hall, S. and Falck, M. (2019). Towards the regeneration of sustainable fuel production systems. <i>Renewable and Sustainable Energy Review</i>, 107, 255-263</p> </div> <div style="width: 45%;">  <p>Algae Energy Farm (Algae Biotechnology Laboratory, University of Queensland, Australia): (a) Cultivation on open ponds, following initial growth in sealed bags (b).</p> </div> </div>	<p style="text-align: center;">What is the bioeconomy?</p> <p>European Bioeconomy Strategy</p> <p>The European Commission is taking steps towards a sustainable bioeconomy and has a bioeconomy strategy to promote the bioeconomy and to avoid reaching ecological limits.</p> <p><i>"To be successful, the European bioeconomy needs to have sustainability and circularity at its heart."</i> (European Commission, 2018, p. 4)</p>  <p>The Bioeconomy...</p> <ul style="list-style-type: none"> Is the production of goods, services, or energy from biological material as the main resource. Is strongly linked to sustainability as biodegradable resources are often used and waste is often completely designed out of the system. Can avoid the depletion of resources for future generations and protect the stability of the planet. <p><small>European Commission (2018), A sustainable Bioeconomy for Europe: strengthening the connection between economy, society and the environment. Updated Bioeconomy Strategy. Directorate General for Research and Innovation, October 2018. https://ec.europa.eu/bioeconomy/en/bioeconomy_strategy_2018.pdf</small></p>

Bioeconomy around the world

Bioeconomy Policies around the World

- dedicated bioeconomy strategy
- bioeconomy-related strategy
- bioeconomy-related strategy, dedicated strategy under development

As of March 2019

Jobs and the bio-based sector

EU Bioeconomy Jobs by Sector (2015)

Sector	EMPLOYMENT (thousands)	TURNOVER (billion EUR)	VALUE ADDED (billion EUR)
AGRICULTURE	9.2	380	174
FORESTRY	0.5	50	24
FISHING AND AQUACULTURE	0.2	12	7
FOOD, BEVERAGES AND OTHER AGRI-MANUFACTURING	4.5	1,953	339
BIO-BASED TEXTILES	1.0	105	28
WOOD PRODUCTS AND FURNITURE	1.4	174	47
PAPER	0.6	187	46
BIO-BASED CHEMICALS AND PHARMACEUTICALS, COSMETICS AND FERTILISERS	0.4	177	56
LIQUID BIOFUELS	0.03	12	3
BIOELECTRICITY	0.01	11	3

The 2015 employment numbers in the EU for the bioeconomy sectors. These industries reached close to **18 million jobs** and added value back to the economy that reached approximately **€621 billion**.

Source: European Commission (2018), *A Sustainable Bioeconomy for Europe: Strengthening the Connection between Economy, Society and the Environment. Updated Bioeconomy Strategy*. Directorate-General for Research and Innovation. https://ec.europa.eu/research/bioeconomy/strategy_2018.pdf

Warning: The bioeconomy can also have negative impacts in local jobs. The quality of work and livelihoods of rural communities depend on direct access to land and water for food production, community and cultural life. So if production of bioproducts effects livelihoods of rural communities, then that would be an unacceptable negative impact.

It is critical that investments in the bioeconomy do not increase inequalities in income, power and access to resources, such as land and water.

What is the bioeconomy?

Video (2 minutes and 9 seconds): https://www.youtube.com/watch?v=RFRN_hHhKk
Languages for sub-titles for video include: Bulgarian, Latvian, Macedonian, Polish and Romanian

Key terms linked bioeconomy

Bio-based - Derived from biomass.

Biomass - The biodegradable fraction of products, waste and residues from biological origin from agriculture, including vegetal and animal substances, from forestry and related industries, fisheries and aquaculture, as well as the biodegradable fraction of waste, including industrial and municipal waste of biological origin.

Bio-based product or bioproduct - Product wholly or partly derived from biomass

Bioeconomy or Bio-based Economy - The sustainable production of biomass and the conversion of biomass into value added products, such as food, feed, bio-based products and biorenergy. It includes the sectors of agriculture, forestry, fisheries, food and pulp and paper production, as well as parts of chemical, biotechnological and energy industries.

Biotechnology - The application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.

Bio-based sector - The sector that incorporates businesses and associations that self-identify as bio-based or bioeconomy (Leipold and Petit-Boix, 2018)

Sources:
 European Commission (n.d.), *Bioeconomy Glossary*. Knowledge Centre for Bioeconomy. https://ec.europa.eu/research/bioeconomy/glossary_en
 Leipold, S. and Petit-Boix, A. (2018), *The circular economy and the bio-based sector - Perspectives of European and German stakeholders*. *Journal of Cleaner Production*, 201: 1125-1137.

Biomass knowledge is critical

Biomass is the physical basis of the bioeconomy

- Knowledge on biomass production, availability and use is key.
- Measuring biomass availability is important because it is limited, which can potentially lead to competition for biomass between different biomass-using sectors.
- Very importantly, it is fundamental that the bioeconomy operates within safe ecological limits.
- It is critical that the bioeconomy does not compete with food production and does not affect biodiversity. For example, marginal lands may not be used for food production but may be important for biodiversity

EC (2019), *Biomass - Knowledge for policy*. https://ec.europa.eu/knowledge4policy/bioeconomy/topic/biomass_en

Q&A

Any questions in the chat?

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Bioeconomy resources

So what can the bioeconomy use as resources?

- Discarded Shells and Fish Skin from Fisheries
- Aquafaba (the water leftover from cooking chickpeas)
- Algae and Seaweed
- Milk Protein
- Mushroom Roots
- Coffee Grounds
- Wheat Bran
- Plants
- Insects
- Wood
- Elephant Poo

From these resources, bioproducts are created.

Discussion on bioproducts

In small groups, explore and discuss this bioproducts catalogue (5 min task)

Catalogue of bioeconomy solutions
 Finding key information of promising bioeconomy solutions

Access in here: <https://www.bio-based-solutions.eu/#/>

Key: TRL (Technology Readiness Level) - the maturity of a technology ranging 1 (low) - 9 (high). Values TRL6-TRL9 included in catalogue (TRL6 = prototype demonstration).

This catalogue, created by Power4Bio, is an online database with factsheets on existing bio-based solutions chosen from the application fields of biorenergy, biomaterials, biochemicals, and food & feed. The catalogue intends to be used by stakeholders in a region to get an overview of available promising options to convert a wide range of biomass feedstock into an array of bio-based products, paying special attention to solutions ready to be deployed at small-scale in rural areas. The solutions shall inspire regions to replicate them in their local context.

POWER4BIO
 REGIONS FOR BIOECONOMY
<https://power4bio.eu>

Q&A

Any questions in the chat?

Break



Back at:
15:45 CET
(2.45pm UK time)



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Sustainability diagrams



Weak vs Strong sustainability



Weak Sustainability

- Assumes that man-made capital is of equal value, can take the place of natural capital.
- Allows for the depletion of natural resources, so long as such depletion is replaced by increases in human-made capital (e.g. by investing royalties from depleting mineral reserves in factories).
- It allows trade-offs.

Strong sustainability

- Requires that all forms of capital must be maintained independently of one another.
- Existing natural stocks must be retained, e.g. timber stocks, as the functions they perform cannot be replaced.
- Limits substitution of environmental capital by human-made capital and allocates some resources as critical natural capital (stock) to survival.
- It imposes thresholds.

UN Sustainable Development Goals (SDGs)

- The SDGs came into effect in January 2016.
- The 17 SDGs contain 169 specific targets.
- The aim is to try and reach these targets by 2030.
- Achieving the SDGs requires the partnership of governments, private sector, civil society and citizens.



<https://sdgs.un.org/goals>

UN Sustainable Development Goals (SDGs)



After the summer school, check UN resources on SDGs
<https://sdgs.un.org/goals>

SDGs 'Wedding Cake Model'

New way of viewing the economic, social and ecological aspects of the SDGs
(proposed by Johan Rockström and Pavan Sukhdev, Stockholm Resilience Centre)

- The economy and society are integral part of the biosphere (which relates to the concept of "strong sustainability").
- All SDGs are directly or indirectly connected to each other.
- Goal 17 is the global partnership required for sustainable development.



Wedding Cake model of the Sustainable Development Goals - 1:41 min video
<https://www.youtube.com/watch?v=Wu8xvzIPRHM>

Links between SDGs and Bioeconomy

Sustainable Development Goals are affected by bioeconomy activities

A sustainable bioeconomy has the potential to advance several SDGs.

However, there can also potential negative effects that should be eliminated or reduced. For example, "increased demand for land can lead to land grabbing, displacements, unequal distribution of land considering soil quality, and loss of communal land" (Heimann, 2019, p. 52)



Blue arrow: Socioeconomic targets.
Green arrow: Ecological targets.
Red arrow: Clean industry & economic targets.

Source: Heimann, T., 2019. Bioeconomy and SDGs: does the bioeconomy support the achievement of the SDGs? *Earth's Future*, 7(1), pp.43-57. ¹⁸

Interactions among Sustainable Development Goals (SDGs)

This assessment reveals the relative importance of the potential trade-offs and the co-benefits by mapping the summed scores of influencing (horizontal) and influenced (vertical) interactions among SDGs. Figure also shows important gaps in knowledge where certain cells are left blank.



This figure is based on 65 global assessments comprising UN reports and international scientific assessments, as well as 112 scientific articles published since 2015 with explicit reference to the SDGs.

Source: Independent Group of Scientists, supported by the Secretary-General (2019), *Global Sustainable Development Report 2019: The Future is Now – Science for Achieving Sustainable Development*, United Nations, New York.
<https://www.un.org/sustainabledevelopment/global-sustainable-development-report-2019/>

SDGs around the world

Exercise on SDGs achievement around the world


Sustainable Development Report Dashboards 2019
Transformations to Achieve the Sustainable Development Goals



Access this site <https://dashboards.sdgindex.org/map> and pick a country of your choice to check their SDGs achievement (including the 169 targets).

Q&A

Any questions in the chat?



<https://be-rural.eu>

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BE-Rural Educational Materials

BE-Rural developed these educational materials (all in here: <https://be-rural.eu/resources/>)

Deliverable 3.2: João, E. (2020): [Educational materials on sustainability, circular economy and bioeconomy for schools, colleges and universities](#).

>> Also available in [Bulgarian](#), [Romanian](#), [Macedonian](#), [Polish](#), and [Latvian](#).



BE-Rural Educational Materials

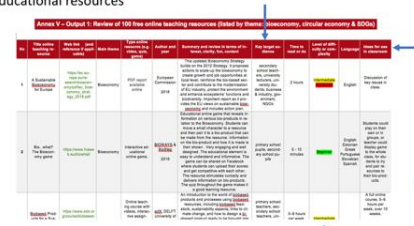
BE-Rural educational materials include four main type of resources:

- Output 1 - Review of 100 existing free online educational resources
- Output 2 - Power point slides for presentations with notes for teachers
- Output 3 - Workshops, quizzes and games
- Output 4 - Proposed extracurricular activities (e.g. school clubs)

BE-Rural Educational Materials

Output 1 - Review of 100 existing free online educational resources

A key target audience is suggested



Ideas on how resources may be used in the classroom

Level of difficulty is suggested:


- Basic
- Intermediate
- Advanced

Review available in English, Bulgarian, Latvian, Macedonian, Polish and Romanian (all in here: <https://be-rural.eu/resources/>)

Existing Educational Materials

Of the 100 listed resources, 53% are either videos or include videos.

Many of the videos spoken in English have as many as 17 different languages available in subtitles.



Video (1 minute and 57 seconds): <https://www.youtube.com/watch?v=2wWkOMRTs4>

Languages for sub-titles for video include: Bulgarian, Latvian, Macedonian, Polish and Romanian

Existing Educational Materials


Two highlights of existing educational resources for bioeconomy

BLOOM School Box have 11 innovative learning scenarios which have already been tested in a classroom setting (e.g. "Examining the thermal properties of bio-based building materials").

<https://bloom-bioeconomy.eu/schoolnetwork/schoolbox/>

The Biovoices' book for children aged 6-7 about bio-based products and bioeconomy

<https://www.biovoices.eu/book/concept/>



Existing Educational Materials

Two highlights of existing educational resources for sustainability

Sustainable Foundations

A GUIDE FOR TEACHING THE SUSTAINABLE DEVELOPMENT GOALS

UNESCO resources for educators of early childhood care and education, primary education, & secondary education.


Available in English, Bulgarian, Latvian, Macedonian, Polish and Romanian (all in here: <https://be-rural.eu/resources/>)

BE-Rural Educational Materials

Output 2 - Power point slides for presentations with notes for teachers

Power point slides on:

- What is the bioeconomy: opportunities, challenges and solutions
- Key principles of sustainability and links to bioeconomy
- Intro to the Sustainable Development Goals (SDGs) and their links to bioeconomy
- Key principles of the Circular Economy and links to the bioeconomy
- Agriculture and the bioeconomy
- Forest bioeconomy
- Bioeconomy in the fisheries sector
- New technologies for processing herbs and producing essential oils for cosmetics and pharmaceutical industries



Available in English, Bulgarian, Latvian, Macedonian, Polish and Romanian (all in here: <https://be-rural.eu/resources/>)

BE-Rural Educational Materials

Output 3 - Workshops, quizzes and games

Workshop and Card Game "Business Match"

Easier word search - 10 hidden words

Game "Sustainability and SDGs Heatwave"

Bioeconomy Word Search Puzzles

Available in English, Bulgarian, Latvian, Macedonian, Polish and Romanian (all in here: <https://be-rural.eu/resources/>)

"BE-Match" and "SDG-Link" Games - One set of cards for two games

BE-Rural Educational Materials

Output 4 - Proposed extracurricular activities (e.g. school clubs or societies)

- Activities could run weekly, bi-weekly or monthly.
- Decisions on extracurricular activities should come from students and teachers, in terms of interests and what is possible and relevant for their school.

Using the chat, write your views on these suggestions or add new ideas for extracurricular activities on bioeconomy or sustainability.

Available in English, Bulgarian, Latvian, Macedonian, Polish and Romanian (all in here: <https://be-rural.eu/resources/>)

Welcome to the "Team in Charge" Club First meeting - students could see three short videos: one on bioeconomy, one on CE and one on SDGs. Students could discuss club name and agree activities to run during the year.	Games and Quizzes Play with the wide range of games and quizzes on bioeconomy, CE and SDGs. Could compete in groups. Could vote for best quiz and game.	Champion a Champion Many organisations and writers sustainability, bioeconomy or circular economy awards. Students pick award-winning organisations and tell the club what they like about it.	Get creative Students to do arts and crafts using bioproducts and other recyclable materials. Companies could be asked to donate left-over products. An exhibition could be organised & prize awarded.
Conclude the Club Each club member to bring how they can be more circular and sustainable at home and in the things they do. Then they share ideas and successes with the club.	Ethical fashion Think of the environmental and social impacts of the fashion industry and what can be done about it. Can you do some clothes from recycled materials?	Sustainable Cooking Learn about not-waste cooking techniques and batch cooking, so no food is wasted. Think about using seasonal and local produce. Any entrepreneurial ideas related to food waste?	Swap PB A community swap meet is a great way to give away something you do not need and get something you want in return. Bring books, clothes, etc. Swapping clothes is an alternative to fast fashion!
Grow food from scraps Some fruits and vegetables that you can't eat can be used to grow plants from scratch! Lettuce, celery, ginger, pineapple, garlic, onions, basil, apples, spring onions. Give it a try!	Visit an eco visit out Invite an industry expert to come and talk to the club in person. Could you also create what the club is doing? Could it qualify your visit with some of your work?	News and Views Write about what the club and the school is doing about bioeconomy, circular economy and SDGs. Can you engage with the local community or what have you learnt?	SDG Achievements What can your school do to achieve some of all of the SDGs which SDG would the club champion? Can you do posters showing what the school is doing?
What job will career? What skills/qualifications would be needed to pursue a career in the bioeconomy? Explore the bioeconomy career opportunities.	Repair Fast Organise event where people bring broken items that need repairing and they learn to repair them from people who volunteer to help. Repair bikes, clothing. Reduce waste and create repair skills.	Life on land This is SDG15 - what can we do to achieve it? What bioproducts we can get from forestry and agriculture? What about essential oils from plants to be used in cosmetics and medications?	Life below water This is SDG14 - what can we do to achieve it? What bioproducts we can get from fisheries? What art work we can do with this theme? How can we reduce plastics in the sea?

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Educational events

The five OIP regions have carried out a series of educational events where the BE-Rural educational materials were used.

Educational events in Strumica region, North Macedonia

TEACHERS

- 1st educational event, online, 8 participants, 18.02.2021
- 2nd educational event, online, 6 participants, 25.02.2021

STUDENTS

- 1st educational event for high school students, online, 94 participants, 15.03.2021
- 2nd educational event for high school students, hybrid, 10 participants, 24.03.2021
- 3rd educational event for pupils, online, 74 participants, 26.03.2021
- 4th educational event for pupils, online, 25 participants, 26.03.2021

presentations, quizzes, polls, games, videos

Educational events in Polish Lagoons region

TEACHERS

1st educational event, Kadyń, 6 participants, 18.02.2021

STUDENTS

- 2nd educational event for high school students, Nowy Dwór, 20 participants, 05.03.2021
- 3rd educational event for primary school pupils, on-line, 34 participants, 09.03.2021
- 4th educational event for University students, online, 36 participants, 19.04.2021

presentations, quizzes, games, workshops

Near 100 students and teachers

Educational events in Covasna region, Romania

TEACHERS AND UNIVERSITY STUDENTS

- 1st educational event, online, 35 participants, 10.03.2021

HIGH SCHOOL STUDENTS

- 2nd educational event for high school students, online, 33 participants, 11.03.2021
- 3rd educational event for technological high school students, online, 31 participants, 12.03.2021

CLOSE TO 100 PARTICIPANTS: TEACHERS, UNIVERSITY STUDENTS AND HIGH SCHOOL STUDENTS

Another educational event aimed at business people was part of the 3rd SWG Meeting, on 9-12.2020, with 33 participants online.

Educational events in Latvia

TEACHERS and other interests online.

- 1st educational event, online, 21.08.2020.

Records of video education posted on SFRI Sīviņa website - (<https://youtu.be/7l9LCTMKcVA> and introduction with materials in Latvian (6.04.2021.) <https://youtu.be/nHwK5K07s>)

Open air fair/exhibition visitors «Bioeconomy come to Jelgava»

2. Promoting of education materials and short introduction how to use them, open air fair, 18.09.2020.

Attendees of Side by side Vidzeme innovation week

3. Educational event for schools, life long , high schools teachers, online, 22.02.2021. <http://innovation.vidzeme.lv/hj/pasakumi/2021-02-22/bioekonomikas-speles-skolas-daiba-kolektivos-un-draugu-loka.html>

Promoting of education materials and records from online events in Forest sector conference (January 2021 and Science night April 2021)

<http://www.zinatsekunaks2021.lv/main-feed>

<https://www.zinatsekunaks2021.lv/main-feed>

Educational events in Stara Zagora region, Bulgaria

THREE EDUCATIONAL EVENTS IN THE STARA ZAGORA REGION

- Two online events held by the Trakia University
 - 25 January 2021 - 27 participants
 - 26 January 2021 - 27 participants
- One physical event held by the "Knyaz Simeon Tarnovski" Trade High school
 - 2 March 2021 - 70 participants

OVER 120 EXTERNAL PARTICIPANTS

Mini-Snowball discussion

If you had all the money, time and resources you needed (e.g. 1 million EUR, 2 full days each week, and you were the education minister of the country), what would be the best ways for bioeconomy learning to be integrated in school teaching?*

- Individually – write 3 best ways for bioeconomy learning to be integrated in school teaching (5 min).
- Discuss in **small groups** – decide only three 3 best ways (15 min).
- Write the three points in slide (3 min) – choose slide number according to group number - see link for the white board in the zoom chat.
- Each group to present slide in **plenary** (1 minute per group).

What to do before Day 2

Watch videos with subtitles in your language

Check BE-Rural education materials in your language

<https://be-rural.eu/resources/>

Look at the maps and data of SDGs and their targets around the world

<https://dashboards.sdgindex.org/map>

Check these UNESCO resources

UNESCO resources for educators of early childhood care and education, primary education, & secondary education. <https://en.unesco.org/themes/educators/sdg-materials>

Check the learning scenarios of the BLOOM School Box

<https://bloom-bioeconomy.eu/schoolnetwork/schoolbox/>

Annex V – Slides used Day 2



https://be-rural.eu

In zoom, rename your name as:

Name (Country)

Three-day virtual BE-Rural summer school for teachers interested in developing bioeconomy curricula

Day 2 - Tuesday 1 June - Bioeconomy of different sectors (e.g. fisheries, agriculture) and how best to integrate bioeconomy teaching in schools in Bulgaria, Latvia, North Macedonia, Poland and Romania



Dr Elsa João, University of Strathclyde, Scotland



https://be-rural.eu

In zoom, rename your name as:

Name (Country)

Day 2 outline programme

14:00 – 15:30 CET (1-2:30pm UK time)

- Welcome back from Dr Elsa João and the University of Strathclyde
- Introduction to Day 2 of the Summer School
- Summary of Day 1 of the Summer School
- More about the BE-Rural Project and the different working packages
- Key principles of circular economy

Break (15:30 – 15:45 CET) (2:30-2:45pm UK time)

15:45 – 17:15 CET (2:45-4:15pm UK time)

- Connecting student learning with industry projects, lessons from Strathclyde
- Novel ways to maximise potential of bioeconomy of different sectors
- Workshop on teaching bioeconomy in each of the five innovation regions, grouped by country and language

17:15 – 17:30 CET (4:15-4:30pm UK time)

- Short poll about Day 2 of the summer school
- Q&A, summary day 2, and link to day 3



Welcome back!



Dr Elsa João
(elsa.joao@strath.ac.uk)

Senior Lecturer, Department Civil and Environmental Engineering, University of Strathclyde, Glasgow, Scotland
<https://www.strath.ac.uk/engineering/civilenvironmentalengineering/>

Director MSc in Environmental Entrepreneurship and MSc in Sustainability and Environmental Studies, that accept students from all backgrounds.



UNIVERSITY OF STRATHCLYDE
CENTRE FOR SUSTAINABLE DEVELOPMENT

The University's Strategic Plan, Vision 2025, puts sustainability at its heart and makes a clear commitment to deliver against the SDGs across all areas of activity, including research, teaching and operational matters.



Convenor of Sustainable Strathclyde

The University of Strathclyde (founded in 1796 as 'a place of useful learning'), is a leading technological University with around 23,000 students.
<https://www.strath.ac.uk/workwithus/centreforsustainabledevelopment/>



Virtual 3-day summer school

Day 1 - Tuesday 25 May, 14:00-17:30 CET
Introduction to bioeconomy and overview bioeconomy educational resources developed by BE-Rural
Dr Elsa João (University of Strathclyde), with the support of Neil Georgieva (European Policies Research Centre)

Day 2 - Tuesday 1 June, 14:00-17:30 CET
Bioeconomy of different sectors (e.g. fisheries, agriculture) and how best to integrate bioeconomy teaching in schools in Bulgaria, Latvia, North Macedonia, Poland and Romania.
Dr Elsa João (University of Strathclyde), with the support of Stefan Kah (European Policies Research Centre)

Day 3 - Tuesday 8 June, 14:00-17:30 CET
Developing the industrial biotechnologists of the future: the innovative work of IBioIC (Industrial Biotechnology Innovation Centre) with Scottish schools.
Chair: Rachel Moor (Skills Programme Manager, IBioIC), with the support of Dr Elsa João (University of Strathclyde)

Day 1 and Day 2 slides are in links in here:
<https://be-rural.eu/events/teachers-summer-school/>



Using zoom

1. We will use polls

1. Have you used zoom before?

Yes (90) 95%

No (5) 5%

(Poll result at the start of day 1; n = 95)

2. We will use the chat function



3. Can raise hand



4. We will use breakout groups

[Notice green button to share screen, if needed in group discussion]



Summer School Speakers



Dr Elsa João
Senior Lecturer, Department of Civil and Environmental Engineering, University of Strathclyde (Scotland)
(Day 1, 2 and 3)



Neil Georgieva
Research Associate, European Policies Research Centre based University of Strathclyde (Scotland) & TU Delft (the Netherlands)
(Day 1)



Stefan Kah
Research Fellow, European Policies Research Centre, based University of Strathclyde (Scotland) & TU Delft (the Netherlands)
(Day 2)



Rachel Moor
Skills Programme Manager, IBioIC - Industrial Biotechnology Innovation Centre (Glasgow)
(Day 3)



Debbie McCreath
Public Affairs Manager, IBioIC - Industrial Biotechnology Innovation Centre (Glasgow, Scotland)
(Day 3)



Graeme Rough
Head of STEM programme of the Scottish Schools Education Research Centre (SSE/ERC)
(Day 3)



Dr Jo Sadler
Research Fellow and Principle Investigator at the University of Edinburgh
(Day 3)



Summer School Attendees

2. What kind of teacher are you?

Pre-school teacher	(4) 4%
Primary school teacher	(10) 11%
Secondary (high-school) teacher	(50) 53%
University lecturer	(8) 8%
I am not a teacher	(23) 24%

(Poll result at the start of day 1; n = 95)

People who are not teachers included researchers, advisers to Ministry of Agriculture, PhD students, and bioeconomy policy experts.



Total of 294 people registered!

Key Be-Rural Countries and others



Results of the polls at the start of Day 1 (n = 95):

3. Have you heard of the United Nations Sustainable Development Goals (SDGs)?

Yes **58%** (55) 58%

No **42%** (40) 42%

4. How much do you know about sustainability?

Nothing (1) 1%

Very Little **59%** (57) 59%

A little (28) 29%

A lot (33) 34%

Very much **41%** (39) 41%

5. How much do you know about the circular economy?

Nothing (12) 12%

Very Little **78%** (74) 78%

A little (48) 50%

A lot (50) 52%

Very much **22%** (21) 22%

6. How much do you know about the bioeconomy?

Nothing (5) 5%

Very Little **75%** (71) 75%

A little (45) 47%

A lot (23) 24%

Very much **25%** (24) 25%



What we covered on day 1

1. About bioeconomy



Videos have subtitles in your language
<https://www.kno-soltec-solutions.eu/>

2. About bioproducts



<https://www.kno-soltec-solutions.eu/>

3. About weak vs strong sustainability, and UN SDGs



Check SDG & targets around the world
<https://dashboards.sdgindex.org/map>

4. BE-Rural educational materials in Bulgarian, English, Latvian, Macedonian, Polish & Romanian

Output 1 - Review of 100 existing free online educational resources
Output 2 - Power point slides for presentations with notes for teachers
Output 3 - Workshops, quizzes and games
Output 4 - Proposed extracurricular activities (e.g. school clubs or societies)

<https://be-rural.eu/resources/>

5. We also discussed how bioeconomy learning can be integrated in school teaching – to be continued today!

In day 1, 37% of you thought that the best thing about the summer school was the interaction, exchange of opinion & group work!

BE-Rural Bioeconomy Games

BE-Rural will print these games and send them to the teachers who attended the three days of the summer school. You will get an email after the summer school, at the end of June.



Workshop and Card Game "Business Match"



Game "Sustainability and SDGs Heatwave"



"BE-Match" and "SDG-Link" Games - One set of cards for two games

Available in Bulgarian, English, Latvian, Macedonian, Polish and Romanian (all in here: <https://be-rural.eu/resources/>)

What we covered on day 1

The magic of bioeconomy, in terms of innovative and surprising examples

From this...



To this...




Video 2:55 minutes
<https://www.youtube.com/watch?v=H8XODAJAmg>

What we covered on day 1

The magic of bioeconomy, in terms of innovative and surprising examples

What is this brick made of?

Discuss in small groups and then write in the chat (4 minutes, so you have time to introduce each other too)



What we covered on day 1


The magic of bioeconomy, in terms of innovative and surprising examples

What is this brick made of?

Is made of mycelium.

<https://youtu.be/Hc5gOrwdlso>
<https://youtu.be/Hc5gOrwdlso> (Video 1 min)

<https://www.youtube.com/watch?v=H8XODAJAmg>



Q&A

Any comments or questions in the chat?



Day 2 outline programme

14:00 – 15:30 CET (1-2:30pm UK time)

- Welcome back from Dr Elsa João and the University of Strathclyde
- Introduction to Day 2 of the Summer School
- Summary of Day 1 of the Summer School
- More about the BE-Rural Project and the different working packages
- Key principles of circular economy

Break (15:30 – 15:45 CET) (2:30-2:45pm UK time)

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- Connecting student learning with industry projects, lessons from Strathclyde
- Novel ways to maximise potential of bioeconomy of different sectors
- Workshop on teaching bioeconomy in each of the five innovation regions, grouped by country and language

17:15 – 17:30 CET (4:15-4:30pm UK time)

- Short poll about Day 2 of the summer school
- Q&A, summary day 2, and link to day 3

Bioeconomy in a rural setting

Bioeconomy is very important for local feedstock producers



Video explains how focusing on bio-resources, e.g. aquatic biomass, can enhance the lives of people who live in the areas where the resources are found. Video also mentions how bioeconomy may help with gender imbalance and lack of diversity in the job market.

Video from Iceland (2 minutes and 52 seconds): <https://youtu.be/Jf1NRz2fCg?list=UUY-frt3uTqgVZw-DLuo5bA>
Languages for sub-titles for video include: Bulgarian, Latvian, Macedonian, Polish and Romanian


About the BE-Rural Project

BE-Rural - Bio-based strategies and roadmaps for enhanced rural and regional development in the EU (April 2019 – March 2022)

BE-Rural supports

... regional stakeholders in **5 countries**:

- Bulgaria:** Stara Zagora
- Latvia:** Vidzeme and Kurzeme
- North Macedonia:** Strumica
- Poland:** Szczecin and Vistula Lagoons
- Romania:** Covasna








The goal of BE-Rural is to realise the potential of regional bio-based economies by supporting relevant actors in the participatory development of bioeconomy strategies and roadmaps.

This includes educational activities and resources.

<https://be-rural.eu/innovation-regions/>

Regional & country facilitators

 <p>BULGARIAN INDUSTRIAL ASSOCIATION (BIA), Bulgaria https://en.bia-bg.com</p>	<p>Main BE-Rural Contact Martin Stoyanov martin@bia-bg.com</p>
 <p>Institute for Economic Forecasting (IPE), Romania http://www.ipe.ro/</p>	<p>Dr Carmen Pauna pauna_carmen@ipe.ro</p>
 <p>International Centre for Sustainable Development of Energy, Water and Environment Systems – Macedonian Section (SDEWES-Skopje), North Macedonia https://www.sdewes.org</p>	<p>Emilija Mihajloska emilija.mihajloska@sdewes.org sdewes.skopje@sdewes.org</p>
 <p>Latvian State Forest Research Institute (SILAVA), Latvia http://www.silava.lv/</p>	<p>Dagnija Lazdina dagnija.lazdina@silava.lv</p>
 <p>National Marine Fisheries Research Institute (MIFRI), Poland https://mir.gdynia.pl/</p>	<p>Marcin Rekowski mrakowski@mir.gdynia.pl</p>

About the BE-Rural Project



Home About BE-Rural Bioeconomy Innovation Regions News Resources Events Contact

DELIVERABLE

Deliverable 1.1: Abdoh K., Gerdes H., Kresinska Z., Davies S. (2019). Sustainability and Participation in the Bioeconomy: A Conceptual Framework for BE-Rural.

Deliverable 2.1: Colmorgen, F., Khawaja, C. (2019). Small-scale technology options for regional bioeconomies. Small-scale technology options for regional bioeconomies.

Deliverable 2.2: Anzaldúa, G., Abdoh K., Araujo A., Chobotaryk A., Cosmina D., Diaconescu T., Dimov L., Duli, N., Iorgulescu, R., Kresinska Z., Lazdina D., Makarewicz K., Makarewicz M., Mihajloska E., Myjleski A., Pizani C., Pivkina, I., Rakowski M., Schock M., Szalacka, O., Tostzack J., Zifjari, E. (2019). The macro-environment surrounding BE-Rural's Open Innovation Platforms.

Deliverable 2.3: Khawaja, C., Colmorgen, F., Rutz, D. (2019). The bioeconomy potential of BE-Rural's DIP regions.

Deliverable 2.4: Colmorgen, F., Khawaja, C. (2019). Business models for regional bioeconomies.

Deliverable 2.5: Colmorgen, F., Khawaja, C., Rutz, D. (2020). Handbook on regional and local bio-based economies. >> Also available in Bulgarian, Latvian, Macedonian, Polish, Romanian and German.

Deliverable 3.1: Griestop L., Manhardt B. (2019). Briefing Paper: Concept for a pop-up store with bio-based products and participatory events.

Deliverable 3.2: Janko, E. (2020). Educational materials on sustainability, circular economy and bioeconomy for schools, colleges and universities. >> Also available in Bulgarian, Romanian, Macedonian, Polish, and Latvian.

Deliverable 4.1: Davies, S., Kah, S. (2019). Briefing paper: Knowledge exchange and capacity building for the bioeconomy in rural areas.

Deliverable 5.1: Anzaldúa, G., Araujo, A., Torrey, J. (2020). Briefing paper: Analysing market conditions and designing business models within BE-Rural's DIPs.

https://be-rural.eu/resources/

<h3>BE-Rural conceptual framework</h3>  <p>BE-Rural's key principles of participatory bioeconomy development:</p> <ul style="list-style-type: none"> Co-creation: Facilitating the active involvement of a broad spectrum of stakeholders and citizens in the development of strategies. Openness & Inclusiveness: Ensuring that all relevant stakeholder groups will have the opportunity to engage. Sustainability: Designing a bioeconomy that promotes the sustainable use of agricultural, forest and marine ecosystems. Transparency: Documenting and evaluating all participatory activities. <p>BE-Rural as Action Research:</p> <ul style="list-style-type: none"> Not objective knowledge but reflexive Alternative roles for researchers: <ul style="list-style-type: none"> Sharing openly with participants Being explicit about what we're doing Being explicit about our values & norms Reflecting on an ongoing basis <p><i>Quintuple Helix Approach as applied in BE-Rural</i></p> <p>https://be-rural.eu/resources/</p>	<h3>Knowledge exchange and capacity building</h3>  <p>BE-Rural makes use of existing experiences:</p> <ul style="list-style-type: none"> National and regional bioeconomy strategy-building processes <ul style="list-style-type: none"> Dialogue/consultation, co-production of knowledge, citizen participation in decision-making The EU's Smart Specialisation Strategy approach <ul style="list-style-type: none"> Identifying and reaching agreement on regional strengths ("Entrepreneurial discovery process") EU Rural Development Policy <ul style="list-style-type: none"> E.g. bottom-up development involving the local population: LEADER and Community-led Local Development (CLLD) <p>Learning from good practice examples from across the EU:</p> <ul style="list-style-type: none"> Germany: Baden-Württemberg's Sustainable Bioeconomy Strategy Spain: <ul style="list-style-type: none"> Catalonia's Biolab Ponent, a rural Open Innovation Living Lab Tajo-Salor-Almonte's (TAGUS) Smart LEADER approach Finland: Oulu region's Bioeconomy LEADER Tour Scotland: Scotland's Industrial Biotechnology Strategy <p>Briefing paper: Knowledge exchange and capacity building for the bioeconomy in rural areas</p> <p>Authors: Sara Davies, Stefan Kuhn</p> <p>https://be-rural.eu/resources/</p>
<h3>Briefing paper: Analysing market conditions & designing business models in BE-Rural's OIPs</h3>  <p>Impulse and guidance document to prepare the relevant BE-Rural Open Innovation Platform (OIP) stakeholders for the development of specific bio-based business models in the regions and the analysis of market potential. You find it here.</p> <p>Target groups Mainly entrepreneurs/owners of bioeconomy businesses or innovators operating in the OIP regions, but also science and academia, investors or decision makers.</p> <p>Content</p> <ul style="list-style-type: none"> Summary previously assessed regional context and technological options Indications on the process of business development including selection of involved stakeholders and timeline Specific guidance on the exercises to be carried out, including assessment templates <p>This paper proposes the involvement of a diverse set of stakeholders with expertise and interest in the development of bio-based businesses in the regions. The group (task force) carrying out this assessment shall also include at least one entrepreneur/business owner, who is interested in willing to apply the proposed methodology in order to further develop their business model.</p> <p>https://be-rural.eu/resources/</p>	<h3>Handbook on regional and local bio-based economies</h3>  <p>Independent and easy to understand handbook, giving a broad overview on local and regional bioeconomies in seven local languages and filling knowledge gaps in the project's target regions and beyond. You find it here.</p> <p>Target groups decision-makers, investors, farmers, foresters, landowners, small bioeconomy industries, science and academia, civil society representatives</p> <p>Content</p> <ul style="list-style-type: none"> Basics about the regional bioeconomy Options for the use of biomass in a regional bioeconomy Business models for a regional bioeconomy Sustainability impacts of the bioeconomy <p>Linkages between the different sections are made in order to show the complexity of the bioeconomy.</p> <p>The bioeconomy must be understood as a versatile concept that has to be adapted to regional circumstances!</p> <p>Handbook available in Bulgarian, English, Latvian, Macedonian, Polish, Romanian and German.</p> <p>https://be-rural.eu/resources/</p>
<h3>Day 2 outline programme</h3>  <p>14:00 – 15:30 CET (1-2:30pm UK time)</p> <ul style="list-style-type: none"> Welcome back from Dr Elsa João and the University of Strathclyde Introduction to Day 2 of the Summer School Summary of Day 1 of the Summer School More about the BE-Rural Project and the different working packages Key principles of circular economy <p>Break (15:30 – 15:45 CET) (2:30-2:45pm UK time)</p> <p>15:45 – 17:15 CET (2:45-4:15pm UK time)</p> <ul style="list-style-type: none"> Connecting student learning with industry projects, lessons from Strathclyde Novel ways to maximise potential of bioeconomy of different sectors Workshop on teaching bioeconomy in each of the five innovation regions, grouped by country and language <p>17:15 – 17:30 CET (4:15-4:30pm UK time)</p> <ul style="list-style-type: none"> Short poll about Day 2 of the summer school Q&A, summary day 2, and link to day 3 <p>https://be-rural.eu</p>	<h3>European Bioeconomy Strategy</h3>  <p><i>"To be successful, the European bioeconomy needs to have sustainability and circularity at its heart" (European Commission, 2018, p. 4)</i></p> <p>With the new bioeconomy strategy, the European Commission supports initiatives at national and regional level to develop an efficient and sustainable bioeconomy, and this includes providing guidance on how best to operate the bioeconomy within safe ecological limits.</p> <p>European Commission (2018), A Sustainable Bioeconomy for Europe: strengthening the connection between economy, society and the environment. Updated Bioeconomy Strategy. Directorate-General for Research and Innovation, October 2018. https://ec.europa.eu/eurois/bioeconomy-2018-2030.pdf</p>
<h3>What is the circular economy?</h3> <p>Circular economy is a systems-based concept that is restorative and regenerative by design. It aims to keep products, components and materials at their highest utility and value at all times, while waste is designed out of the system.</p> <p>Circular economy is therefore a framework for the development and management of a sustainable, 'waste-as-resource' economic system (rather than a 'zero-waste' economic system).</p>	<h3>What is the circular economy?</h3> <p>Waste is a resource in waiting!</p>
<h3>What is the circular economy?</h3> <p>Circular economy is thus featured as a reaction to the conventional linear 'make-use-dispose' economy.</p> <p>It is the opposite of a throwaway society.</p>  <p>Image used: https://community.materialtrader.com/cms/wp-content/uploads/2019/02/linear-vs-recycling-vs-circular-economy-doodle.jpg</p>	<h3>What is the circular economy?</h3> <p>The Circular Economy is based on three principles:</p> <ol style="list-style-type: none"> 1. Keep products and materials in use 2. Design out waste and pollution 3. Regenerate natural systems <p>Read here: https://www.ellenmacarthurfoundation.org/explore/the-circular-economy-in-detail</p>

What is the circular economy?

Re-thinking Progress: The Circular Economy

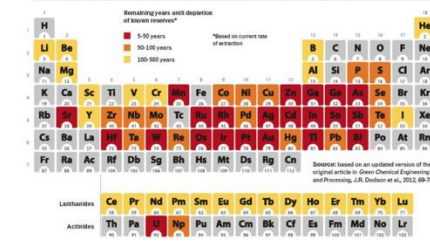


<https://youtu.be/zCRKvDyyHml>
(video 3:48)

Note: Choose "Auto-translate" to get subtitles in Bulgarian, Latvia, Macedonian, Polish, Romanian and other languages.

Motivation for circular economy

Figure 1 | Elemental un-sustainability – how we are running out of traditional mineral resources as seen by diminishing reserves through increased and different use patterns



Remaining years until depletion of reserves:

- 5-50 years (Red)
- 50-100 years (Orange)
- 100-500 years (Yellow)

Source: based on an updated version of the original article in Green Chemical Engineering and Processing, J.B. Chilton et al., 2012, 18(7).

Motivation for circular economy

Circular Economy Gains

- Net economic benefit of **€1.8 trillion** by 2030 (7% GDP) (Mckinsey Centre for Business and Environment, 2015, *A circular economy vision for a competitive Europe*).
<https://www.mckinsey.com/business-functions/sustainability/our-insights/europes-circular-economy-opportunity>
- The **European Commission** has adopted a new Circular Economy Action Plan (CEAP) for a "For a cleaner and more competitive Europe"
- https://ec.europa.eu/environment/strategy/circular-economy-action-plan_de

Circular Economy in Europe



European Circular Economy Stakeholder Platform
<https://circulareconomy.europa.eu/platform/en>

A Roadmap for Developing Romania's Strategy for the Transition to a Circular Economy 2020-2030

Circular catering services from Pļavinas in Latvia - <https://www.plavinnovads.lv/>

POLISH CIRCULAR HOTSPOT
<http://circularhotspot.pl>

Ellen MacArthur Foundation



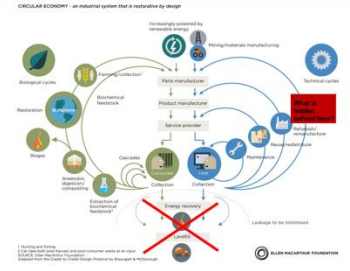
Ellen MacArthur broke the record for the amount of time it took to sail solo around the world in 2005 at the age of 29.

Ellen MacArthur's trip sailing alone around the world inspired her to think about the global economy and the finite amount of natural resources upon which we run our world.

The **Ellen MacArthur Foundation** was established in 2010 with the aim of accelerating the transition to the circular economy. Since its creation the charity has emerged as a global thought leader, establishing the circular economy on the agenda of decision makers across business, government and academia.

<https://www.ellenmacarthurfoundation.org>

Butterfly diagram

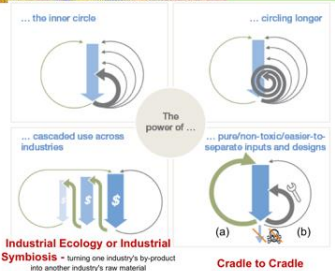


CIRCULAR ECONOMY – an industrial system that is restorative by design

1. Closing the loops
2. Closing the loops
3. Closing the loops

© ELLEN MACARTHUR FOUNDATION

Butterfly diagram



... the inner circle ... circling longer

The power of ...

- ... cascaded use across industries
- ... pure/non-toxic/easier-to-separate inputs and designs

Industrial Ecology or Industrial Symbiosis = turning one industry's by-product into another industry's raw material

Cradle to Cradle

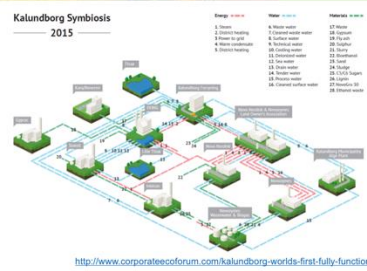
(a) biological nutrients, designed to re-enter the biosphere safely and build natural capital.

(b) 'technical nutrients', designed to circulate at high quality without entering the biosphere.

SOURCE: Ellen MacArthur Foundation circular economy team

Industrial Symbiosis

Kalundborg Symbiosis 2015




1. Steam
2. Sewage
3. Heat
4. Sludge
5. Sewage
6. Heat
7. Sewage
8. Heat
9. Sewage
10. Heat
11. Sewage
12. Heat
13. Sewage
14. Heat
15. Sewage
16. Heat
17. Sewage
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21. Sewage
22. Heat
23. Sewage
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25. Sewage
26. Heat
27. Sewage
28. Heat
29. Sewage
30. Heat

Located 110 km (68 miles) west of Denmark's capital Copenhagen, Kalundborg is a city with a population of 16,343 (1 January 2015) and home to world's first fully working industrial symbiosis (check article written on 29 Aug 2016).

<http://www.corporateecoforum.com/kalundborg-worlds-first-fully-functional-industrial-symbiosis/>

Butterfly diagram



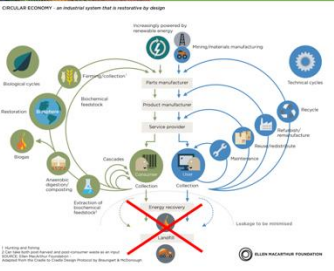
CIRCULAR ECONOMY – an industrial system that is restorative by design

1. Closing the loops
2. Closing the loops
3. Closing the loops

© ELLEN MACARTHUR FOUNDATION

Write in the zoom chat

Butterfly diagram



CIRCULAR ECONOMY – an industrial system that is restorative by design

1. Closing the loops
2. Closing the loops
3. Closing the loops

© ELLEN MACARTHUR FOUNDATION

“Think again” Circular Economy

1. Think again recycling



<https://youtu.be/RX14rA-tylo>
(Video 0:57 min)



Note: Choose “Auto-translate” to get subtitles in Bulgarian, Latvia, Macedonian, Polish, Romanian and other languages.

“Think again” Circular Economy

2. Think again design

PuzzlePhone



1. Start 2. Connect 3. Start

“Think again” Circular Economy

3. Think again Economy

- The *Sharing Economy* in which assets (physical and intellectual) or services are shared between individuals and organisations, either free or for a fee, typically by means of the Internet.
- Focus is on use availability (access) more than ownership



CE Business Models

Keeping products and materials in use, by design, for as long as possible to get the maximum value from them

Hire and Leasing
Hire or leasing of products as an alternative to purchasing (e.g. <https://mudjeans.eu/>)

Performance / Service System
Providing a service based on delivering the performance outputs of a product where the manufacturer retains ownership, has greater control over the production of a product, and therefore has more interest in producing a product that lasts. (e.g. <http://www.egglighting.com/>)

<https://www.zerowastescotland.org.uk/content/what-are-circular-economy-business-models>

CE Business Models

Keeping products and materials in use, by design, for as long as possible to get the maximum value from them

Incentivised Return
Offering a financial or other incentive for the return of ‘used’ products. Products can be refurbished and re-sold (e.g. disposable camera)

Asset Management
Maximising product lifetime and minimising new purchase through tracking an organisation’s assets, planning what can be re-used, repaired or redeployed at a different site.

Collaborative Consumption/Sharing Economy
Rental or sharing of products between members of the public or businesses, often through peer-to-peer networks.

Rent A Goat®

Long Life
Products designed for long life, supported by guarantees and trusted repair services.

CE Macro, Meso & Micro Levels

There is consensus within the literature that in order to transition to a CE, key CE principles need to be applied at three levels of the production and consumption systems; namely the micro, meso and macro levels (Ghisellini, Cialani and Ulgiati, 2016).

The **micro** level exists at the individual company or product level, whilst above this the **meso** perspective applies over particular industries. Finally, the **macro** level of the CE is implemented by whole cities, regions or nations.

Ghisellini, P., Cialani, C. and Ulgiati, S. (2016). A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner Production*, 114: 11-32..

Existing CE Teaching Resources

Schools & colleges resources
Challenge your students to rethink the ‘take-make-dispose’ economy and build a system that works long-term

For younger children
Teachers Activities!

Lesson plans

Whole 1-year course for target ages of 11-14, 14-16 and 16-19 on “System Reset: Design and Technology for a Circular Economy”
<https://www.stem.org.uk/resources/collection/3927/system-reset-design-and-technology-circular-economy>

<https://www.ellenmacarthurfoundation.org/resources/learn/schools-colleges-resources>

Existing CE Teaching Resources

WELCOME TO THE CIRCULAR CLASSROOM!

An innovative educational toolkit for upper secondary high school educators and students to integrate circular thinking into the classroom.

FOR EDUCATORS
This toolkit provides a range of activities and resources to help you integrate circular thinking into your lessons and to engage your students in the circular economy.

FOR STUDENTS
This toolkit provides a range of activities and resources to help you integrate circular thinking into your lessons and to engage your students in the circular economy.

<https://circularclassroom.com>

Q&A





Any comments or questions in the chat?

Break



Glasgow

Back at:
15:45 CET
(2.45pm UK time)

 <p>Day 2 outline programme</p> <p>14:00 – 15:30 CET (1.2-30pm UK time)</p> <ul style="list-style-type: none"> Welcome back from Dr Elsa João and the University of Strathclyde Introduction to Day 2 of the Summer School Summary of Day 1 of the Summer School More about the BE-Rural Project and the different working packages Key principles of circular economy <p>Break (15:30 – 15:45 CET) (2.30-2.45pm UK time)</p> <p>15:45 – 17:15 CET (2.45-4.15pm UK time)</p> <ul style="list-style-type: none"> Connecting student learning with industry projects, lessons from Strathclyde Novel ways to maximise potential of bioeconomy of different sectors Workshop on teaching bioeconomy in each of the five innovation regions, grouped by country and language <p>17:15 – 17:30 CET (4.15-4.30pm UK time)</p> <ul style="list-style-type: none"> Short poll about Day 2 of the summer school Q&A, summary day 2, and link to day 3 	 <p>Day 1 participants ideas</p> <p>Some of the participants' ideas from Day 1, on developing curricula and educational material on the bioeconomy for your school?</p> <ul style="list-style-type: none"> Developing curricula and educational material on the bioeconomy is something achievable. If done well, it can have a significant impact on the sustainable development of the economy. We need to engage our students in innovative projects with impact on bioeconomy. Learning-by-doing and promote children's innovation. Greater involvement in bioeconomy-related projects and creating separate subject dedicated to bioeconomy in the schools. Organise events about bioeconomy. Connect the needs of the community with the opportunity of bioeconomy.
 <p>CE Class at Strathclyde</p> <p>Class "Circular Economy and Transformations towards Sustainability"</p> <ul style="list-style-type: none"> Created by Dr Elsa João, from Department of Civil & Environmental Engineering at the University of Strathclyde, in 2016. Class is open all all MSc and MEng students at Strathclyde for all departments, but could easily be adapted to be delivered to undergraduate students or high school students. Each weekly two-hour session is a mixture of lecture and workshop/case studies to make class as practical as possible. Class runs over 10 weeks (but as part of an existing class 1-2 hour overview may be enough). Class runs collaboratively with other academic staff, including from other departments (7 contribute). And, critically, is rich in industry contacts input (11 contribute). Class includes bioeconomy. 	 <p>CE Class at Strathclyde</p> <p>We had 141 students on the CE class in 2020-21 from 19 different programmes</p> <ol style="list-style-type: none"> MSc Sustainability and Environmental Studies (42) (*) MEng Civil and Environmental Engineering (17) MSc Sustainable Eng: Renewable Energy Systems and the Environment (14) MSc Industrial Biotechnology (IBioC) (13) MSc Environmental Engineering (12) MEng Mechanical Engineering (8) MSc Environmental Entrepreneurship (7) MSc Civil Engineering (5) MEng Civil and Environmental Engineering - Engineering Academy (4) MEng Civil Engineering (4) MSc Civil Engineering with Industry (4) MEng Mechanical Engineering with International Study (3) MSc Urban Policy and Analysis (2) MEng Aero-Mechanical Engineering (2) MEng Aero-Mechanical Engineering - Engineering Academy (1) MRes Climate Change Adaptation (1) MSc Advanced Mechanical Engineering with Energy Systems (1) MSc Satellite Data for Sustainable Development (January) (1) MSc Sustainable Engineering: Chemical Processing (1) <p>(*) class compulsory for this MSc, optional for all others.</p>
 <p>Programme CE Class</p> <p>Week 1 – Key principles of Circular Economy and bioeconomy. Case study presentation: Closing The Loop on Coffee Shop Waste (Revive-Eco, Glasgow https://revive-eco.com)</p> <p>Week 2 – Key principles of sustainability and the Sustainable Development Goals (SDGs).</p> <p>Week 3 – Key Principles of Life Cycle Assessment (LCA) (Zero Waste Scotland).</p> <p>Week 4 – Two talks: a) Risks and opportunities of circular projects (Mabbett & Associates Ltd). b) How best to support the Scottish construction and built environment sector to be more circular? (Zero Waste Scotland)</p> <p>Week 5 – Transitioning to a circular economy: the Macro, Meso and Micro level (Circular Economy Policy Analyst)</p> <p>Week 6 – Bioeconomy principles, the BE-Rural and POWERBIO European projects. Case study presentation: applications of biogrouting in civil and geotechnical engineering.</p> <p>Week 7 – Two talks: a) Beneficial reuse of dredged canal and harbour sediment and its contribution to CE. b) The circular economy of plastic and its sustainability and the issue of microplastics.</p> <p>Week 8 – Circular Glasgow and Circle Assessment Tool for Businesses (Circular Glasgow, Glasgow Chamber of Commerce, www.circularglasgow.com)</p> <p>Week 9 – Two talks: a) Extending product life through repair, refurbishment and remanufacture (Department of Design, Manufacture and Engineering Management, University of Strathclyde). b) The role of geoengineering, carbon capture and storage, and mine water heating in the circular economy.</p> <p>Week 10 – Design for Value Workshop: Construct for Deconstruction with Conscious Sequestration.</p> <p>Key: Red – presentation by academic staff; yellow – presentation by industry contact</p>	 <p>Assignments CE Class</p> <p>The most important thing about this class are the assignments!</p> <p>Assignments have been designed to develop tacit knowledge. Students learn by doing!</p> <p>Explicit knowledge - can be easily written, verbalized and transmitted to others (e.g. textbooks, power point slides, words a teacher says).</p> <p>Tacit knowledge - is difficult to transfer to another person by speaking or writing, like learning to ride a bike.</p> <p>Tacit knowledge has been described as "know-how" – as opposed to the explicit knowledge of "know-that" (facts).</p> 
 <p>Assignments CE Class</p> <p>More fundamentally, I wanted students to contribute to CE and sustainability via the assignments!</p> <p>Assignment 1 Database of most interesting papers linked to Circular Economy, Bioeconomy or Sustainability. Each student writes one entry in a database on a unique paper, including a 300 words review of the paper – "would you recommend others to read it and why?". This is a resource for all students to use (3% final mark). https://docs.moodle.org/311/en/Database_activity</p> <p>Assignment 2 Group coursework – create a new circular business model or a new bioproduct (group report worth 47% of the final mark).</p> <p>Assignment 3 Individual report evaluating self-transformation towards sustainability and circularity (worth 50% of the final mark).</p>	 <p>Assignments CE Class</p> <p>Group work – create a new circular business or new bioproduct</p> <p>This can be done with students of any age. The added complexity for older students, comes from the evaluation of the proposed new business of bioproduct.</p> <ol style="list-style-type: none"> Create a new business that adopts CE principles to disrupt the sector. As an example, one student last year thought of a new company that she called "Circular Pizza" where a pizza delivery service would use reusable boxes (and would keep pizzas warm), instead of the usual cardboard boxes that you throw away as soon as the pizza arrives. The idea was that the pizza delivery service would give the pizza to the customer but take the reusable boxes away. Give relevant title for company/business and explain clearly what this company is about and in what context would this company/business operate (e.g. country, region). For new bioproduct, also evaluate potential performance. Undertake a SWOT analysis of the business with regards to its potential for disruption. Evaluate how the new business relates to at least two Sustainable Development Goals (SDGs) and their targets. Critical analysis looking at the new company in a systemic way – e.g. how creating this company may affect other companies (in a positive or negative way) and how new company may be affected by the context where it will run. Evaluate how new bioproduct or new circular business will contribute to environmental improvement (e.g. reduction of GHG Emissions, water consumption, waste, pollution, or valorisation product currently going to waste) Optionally, a) compare the new company/business with another traditional 'linear' company that the CE company you created might be competing with. b) evaluate social and/or economic effects (e.g. could the new product/company create more local jobs or improve the local economy? Would the new product/company require a skilled workforce?).
 <p>Assignments CE Class</p> <p>Individual report evaluating self-transformation towards sustainability and circularity</p> <p>Inspiration came from attending this conference:</p>  <p>Students love this assignment and inspectors of our degrees have praised this assignment.</p> <p>"Transformations" means transformation to sustainability and at the conference everybody was talking about "self-transformation". You need to start with the "self"!</p> <p>https://www.transformationscommunity.org</p>	 <p>Assignments CE Class</p> <p>Individual report evaluating self-transformation towards sustainability and circularity</p> <p>Students write report evaluating own transformation with regards to increasing circularity & sustainability in their own activities (up to students to decide what to do, e.g. plastics, textiles, food waste, water).</p> <p>This is an assignment not just on change but, very importantly, on trying to measure that change.</p> <p>This can be done with students of any age. The added complexity for older students, comes from the evaluation of the self-transformation.</p>

Assignments CE Class

Individual report evaluating **self-transformation** towards sustainability and circularity

What tools to use to measure change?
These are some of the tools /indices/measurements students used previously (but this is not a complete list – for example reduction of micro plastics may be added too):

- Analysis of plastic packaging (amount and how recyclable it is)
- Carbon emissions calculations **kgCO₂e/time**
- Carbon Footprint (**C₂e/kg**)
- Causal Loop Diagram
- GHG Emissions (**kg gasCO₂/kg product**)
- Land Use (**km²/kg product**)
- Meadows (1999) twelve leverage points]

- Photos before and after
- Plastic Waste (No.)
- Price (£)
- SDGs (and their targets)
- Water Use, including virtual water (L/kg product)
- Weight (Kg)

Check online calculators:

- <https://www.watercalculator.org>
- <https://waterfootprint.org/>
- <https://www.carbonfootprint.com/calculator.aspx>
- <https://footprint.wwf.org.uk/#/>

Assignments CE Class

Individual report evaluating **self-transformation** towards sustainability and circularity

This can be done with students of any age. The added complexity for older students, comes from the evaluation of the self-transformation.

Baseline study on food waste done by student before transformation

Assignments CE Class

Individual report evaluating **self-transformation** towards sustainability & circularity

1. Measure and evaluate the **situation at the start**.
2. Create **change**.
3. Measure and evaluate the **situation as it evolves over time**, up till the end of the time period (important to have several time periods - data gathering could be daily or weekly).
4. Select and justify the choice of several ways (or tools) to model and **measure change**.
5. Critically evaluate **how useful**, accurate, robust were the ways (or tools) used to measure change (based on the work done and in literature review).
6. Two **causal loop diagrams** needed of your own system: one for the start and one for the end. You are doing a self-transformation and trying to determine how "you" can make a difference.
7. Important to evaluate what does the change that you achieved (for one person in a few weeks) mean if **extrapolated to a longer time period** and/or more people.
8. Although references should be used to add robustness to the analysis done, the assignment must **not have a literature review** section.
9. A very important section is the **methodology** as you need to explain and justify the methods used to collect the data and measure change.
10. **Appendices** may be needed to support the calculations done and data collected.

Assignments CE Class

Individual report evaluating **self-transformation** towards sustainability & circularity

Causal loop diagrams done by one of the students on food waste

Assignments CE Class

Individual report evaluating **self-transformation** towards sustainability & circularity

Students are asked to use **photos to present evidence of change**
To be done in a robust way: with notes explaining what the photo shows; all photos stating location, date and time (date must be verified by photographing newspaper or phone or ipad with date next to subject), and orientation (if relevant). Scale is important when comparing photos at the different points in time.

Food waste

Water reduction

Plastic packaging

Bulk cooking & meat to vegetarian

Assignments CE Class

Individual report evaluating **self-transformation** towards sustainability & circularity

Impact my systems interventions have had on the Sustainable Development Goals
Organised by impact from highest to lowest

SDG impacts on food waste self-transformation done by student

Industry project class

Class "Independent Study in Collaboration with Industry"

Students carry out projects of interest to industry contacts. There are no lectures. Class is the project, and students write a report for industry and present a poster.

Since I created this class in 2012, students have carried out **259 industry projects** for more than **113 industrial contacts**. This is a very useful and symbiotic link between students and industry – industry gets work done for free; students gains valuable skills and improve CV.

Industry project class

Class "Independent Study in Collaboration with Industry"

Posters that student do are presented at **Engage with Strathclyde events** in May every year check this year's event here: <https://www.engage.strath.ac.uk/event/778/>

In 2021 the poster event was an online event, so you can see all the posters for the industry project in here: https://www.engage.strath.ac.uk/image_vault.php

Images of Research Event

Engage with Strathclyde events - <https://www.engage.strath.ac.uk/>

Check the "Images of Research" - <https://www.imagesofresearch.strath.ac.uk/2021/gallery.php>

Images of Research showcases University of Strathclyde's research of staff and students to the public and industry.

Successful entries feature as part of an interactive year-long exhibition and then on to a number of art galleries, museums and public spaces.

This guide to creating image and text explains the process: <https://www.imagesofresearch.strath.ac.uk/hints.htm>

Industry project class

News
Student's idea has oil & gas firm's PPE waste problem covered

7 May 2021

Big idea - covers could not be reused for primary purpose of safety (fire protection) but could be re-used as an insulation layer, after removal of company logo.

As part of a class assignment for her MSc Environmental Entrepreneurship in Practice programme, Department of Civil and Environmental Engineering student Louise Thomson, from Dunoon, worked with the company to identify opportunities to reuse waste.

She has spent the last 6 months of studying old protective overalls to annual training centres where they could be used as insulation layers during exercise.

Louise said: "The overalls are not damaged but a bit worn out, or they have old branding on them so they can still find a viable reuse of life."

"So while they might not be suitable for use for their original purpose of safety and protection, they can be used as an underpinning of insulation layers in their next recycling training centres."

Better option

Technique returns the old overalls to the supplier Reuse Safety @ Survival, who remove the company's branding then send them to safety training centres operated within the Fire Training Group, including Home, BabyHome, Police and Army Training.

To date she has helped to prevent 300 used overalls from going to waste.

<https://www.strath.ac.uk/whystrathclyde/news/strathclyde-studentsideahasoilgasfirmspewasteproblemcovered/>

Award winning schools

Awarding Sustainability Excellence Since 2004

Established in 2004, the Green Gown Awards recognise the exceptional sustainability initiatives being undertaken by universities and colleges. With sustainability moving up the agenda, the Awards have become established as the most prestigious recognition of best practice within the further and higher education sector.

International Green Gown Awards – 2021 Finalists

Announcing the 2021 International Green Gown Award Finalists

We are delighted to reveal the finalists of the 2021 International Green Gown Awards. We have 51 Finalists from 23 countries from around the world.

The winners will be announced on 17 July 2021 as part of the United Nations High Level Panel of Experts. Find out more about the [2021 Green Gown Awards](#).

The International Green Gown Awards are endorsed by United Nations Environment and are supported by The Association of Commonwealth Universities (ACU), Universitat de València, Universitat de Lleida and International Association of Universities (IAU).

Award winning schools

Eco-Schools <https://www.ecoschools.global>

Eco-Schools is the largest global sustainable schools programme - it starts in the classroom and expands to the community by engaging the next generation in action-based learning.

The programme's greatest achievement is equally the fact that it involves generation after generation of sustainably minded, environmentally conscious people. These individuals will carry the behavioural patterns they learn under the aegis of Eco-Schools with them through life, in turn teaching the next generation the habits to make a difference.

BULGARIA

Bulgarian Blue Flag Movement
Българско Движение "Син Флаг"
National Operator: Petya Yordanova
Mail: petya_j@yahoo.com

ROMANIA

Carpathian-Danubian Centre of Geocology
Central Carpato-Danubian de Geocologie
National Operator: Razvan Dinca
Mail: cdcdg@gmail.com

56 000
Schools

70
Countries

LATVIA

FEE Latvia
Vides Izglitiba fonds
National Operator: Daniels Truksans
Mail: ekoskolos@viefonds.lv

POLAND

FEE Poland
Fundacja dla Edukacji Ekologicznej
National Operator: Agnieszka Pabis
Mail: janewal.ecs.org.pl@fee.org.pl / pabisaga@gmail.com

Note: North Macedonia does not have a National Office listed here: <https://www.ecoschools.global/national-offices>

Q&A

Any comments or questions in the chat?

Day 2 outline programme

14:00 – 15:30 CET (1-2:30pm UK time)

- Welcome back from Dr Eija Robo and the University of Strathclyde
- Introduction to Day 2 of the Summer School
- Summary of Day 1 of the Summer School
- More about the BE-Rural Project and the different working packages
- Key principles of circular economy

Break (15:30 – 15:45 CET) (2:30-2:45pm UK time)

15:45 – 17:15 CET (2:45-4:15pm UK time)

- Connecting student learning with industry projects, lessons from Strathclyde
- Novel ways to maximise potential of bioeconomy of different sectors
- Workshop on teaching bioeconomy in each of the five innovation regions, grouped by country and language

17:15 – 17:30 CET (4:15-4:30pm UK time)

- Short poll about Day 2 of the summer school
- Q&A, summary day 2, and link to day 3

Bio-based sectors

EU Bioeconomy Jobs by Sector (2015)

Sector	EMPLOYMENT (millions)	NUMBER OF BUSINESSES	VALUE ADDED (billions)
AGRICULTURE	9.2	380	174
FORESTRY	0.5	50	24
FISHING AND AQUACULTURE	0.2	12	7
FOOD, BEVERAGES AND OTHER AGRO-INDUSTRIALS	4.5	1,153	233
BIO-BASED TEXTILES	1.0	103	28
WOOD PRODUCTS AND FURNITURE	1.4	174	47
PAPER	0.6	187	46
BIO-BASED CHEMICALS AND PHARMA, CERAMICS, PLASTICS AND RUBBER	0.4	177	56
LIQUID BIOFUELS	0.03	12	3
BIOELECTRICITY	0.01	11	3

The 2015 employment numbers in the EU showing the different bioeconomy sectors.

These industries reached close to **18 million jobs** and added value back to the economy that reached approximately **€621 billion**.

Source: European Commission (2018). A Sustainable Bioeconomy for Europe: strengthening the connection between economy, society and environment. Updated Bioeconomy Strategy. Directorate-General for Research and Innovation. https://ec.europa.eu/research/bioeconomy_strategy_2018_en

Bio-based sectors of BE-Rural

Kurzeme, Latvia: focus on the potential of by-products of forest management (i.e. young forest stand thinning, short rotation coppice and forestry plantations, removing overgrowth in abandoned agricultural lands).

Srećno Lagoon and Vitula Lagoon, Poland: focus on small-scale **fisheries**, specifically the sustainable use of underused and low-value fish species in the lagoons.

Covansa, Romania: focus on addressing fragmented value chains and implementing the **circular economy** concept within the country's industrial sectors (i.e. wood and furniture, textiles, agro-food, mechanical engineering, green energy).

Stara Zagora, Bulgaria: focus on new technologies for the application of **essential oils and herbal plants** in the cosmetics and pharmaceutical industry, combined with tourism activities.

Strumica, North Macedonia: focus on the use of **agricultural residues**, specifically the by-production of organic materials from agricultural activities, as a source of energy for domestic and industrial purposes.

BE-Rural Educational Materials

Output 2 - Power point slides for presentations with notes for teachers

Power point slides on:

1. What is the bioeconomy: opportunities, challenges and solutions
2. Key principles of sustainability and links to bioeconomy
3. Intro to the Sustainable Development Goals (SDGs) and their links to bioeconomy
4. Key principles of the Circular Economy and links to the bioeconomy
5. Agriculture and the bioeconomy
6. Forest bioeconomy
7. Bioeconomy in the fisheries sector
8. New technologies for processing herbs and producing essential oils for cosmetics and pharmaceutical industries

Slide

Notes for teacher, comments and links:

Notes to the teacher:
Teacher's notes to go in the space in the slide at the bottom left of the slide. Explain that this presentation introduces the new technologies for processing herbs and producing essential oils for the cosmetics and pharmaceutical industries.

Excluding the video, the outline size and the first slide, there are 11 slides - so these slides should take between 11 and 22 minutes to present, depending of amount of explanation.

Notes to teachers:
Explain the structure of the lecture to students to set the scene on what will be covered.

The lecture provides information on the processing of essential oils and notes to go in the space in the slide at the bottom left of the slide. Explain that this presentation introduces the new technologies for processing herbs and producing essential oils for the cosmetics and pharmaceutical industries.

Available in English, Bulgarian, Latvian, Macedonian, Polish and Romanian (all in here: <https://be-rural.eu/resources/>)

Biomass is key for bioeconomy

Biomass is the physical basis of the bioeconomy

The bioeconomy makes use of many different biomass resources, from crops to forests to microorganisms. Without these feedstocks, there would be no bioeconomy.

Bio-based - Derived from biomass.

Biomass - The biodegradable fraction of products, waste and residues from biological origin from agriculture, including vegetal and animal substances, from forestry and related industries, fisheries and aquaculture, as well as the biodegradable fraction of waste, including industrial and municipal waste of biological origin.

Bio-based product or bioproduct - Product wholly or partly derived from biomass

Bioeconomy or Bio-based Economy - The sustainable production of biomass and the conversion of biomass into value added products, such as food, feed, bio-based products and biorefinery. It includes the sectors of agriculture, forestry, fisheries, food and pulp and paper production, as well as parts of chemical, biotechnological and energy industries.

Biotechnology - The application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.

Bio-based sector - The sector that incorporates businesses and associations that self-identify as bio-based or bioeconomy (Leipziger and Peit-Box, 2018)

Sources:
European Commission (2018). Bioeconomy. Directorate-General for Research and Innovation. https://ec.europa.eu/research/bioeconomy_strategy_2018_en
Lipziger, S and Peit-Box, A (2018). The circular economy and the bio-based sector - Perspectives of European and German stakeholders. *Journal of Cleaner Production*, 201: 1125-1137.

Examples of bioeconomy feedstocks (or raw materials)

Agri-food sector

- Animal produce
- Animal manure
- Apples
- Bean varieties
- Berries
- Barley
- Beeswax
- Beet
- Canola
- Cotton
- Coffee beans
- Corn/maize
- Citrus fruits
- Dairy produce
- Flax
- Grapes
- Grass
- Nuts
- Miscanthus
- Mushrooms
- Olive varieties
- Onions
- Potatoes
- Rapeseed
- Rice
- Rye
- Sunflower
- Tomatoes
- Tobacco
- Wheat
- Whey

Forestry sector

- Bamboo
- Bark
- Branches
- Black liquor
- Cellulose
- Hardwood
- Lignin
- Leaves
- Post-consumer wood
- Softwood
- Sawdust
- Stumps
- Wood pellets

Fisheries & aquaculture sector

- micro and macro algae (also potentially beach-cast algae)
- water plants (also from aquaponics)
- fish (including low-grade fish and fish by-products: bones, skin, oils, heads, viscera, tails, fins, scales, mince, blood, fish excrements)
- crustaceans (including by-products: shrimp tails, crab shells)
- shellfish (including by-products: scallops shells, mussel shells)
- other invertebrates (including jellyfish)

Bio-based Industries Consortium (2019). Examples of bioeconomy feedstocks. https://ec.europa.eu/knowledge4policy/glossary/feedstock_en

Seeking novel ways to maximise potential of biological resources

The central theme of the bioeconomy requires us to look at the way we process certain products and how we can **maximise the potential** of the resources contained therein.

Farming, forestry and aquaculture processes create both **intentional produce** (e.g. fruit, vegetable) and **indirect waste** (e.g. orange peels, wheat straw)

For example, for every 450 grams of cocoa beans, farmers produce 12 times as much biomass because of the cocoa shell (Wright, 2019).

Indirect waste is as an opportunity and a resource.

Wright, A., 2019. Scientists around the world are turning agricultural waste into food, packaging and silicone products. *GreenBiz*. <https://www.greenbiz.com/article/scientists-around-the-world-are-turning-agricultural-waste-into-food-packaging-and-silicone-products>

Biovale. 2020. *The Bioeconomy*. <https://www.biovale.org/the-bioeconomy/>

Seeking novel ways to maximise potential of biological resources

Must **maximise** the potential of the resources!

Coffee waste → Extracting oils as an alternative to palm oil, e.g. in beauty products

<https://revive-eco.com>

Seeking novel ways to maximise potential of biological resources

Must **maximise** the potential of the resources!

Coffee waste → Soil conditioning (Low value!) → Logs for burning (Low value!)

<https://www.bio-bean.com/coffee-logs/>

Seeking novel ways to maximise potential of biological resources

Must **maximise** the potential of the resources!

Coffee waste → Extracting oils as an alternative to palm oil, e.g. in beauty products → Soil conditioning → Logs for burning

<https://revive-eco.com>

Plus, after extracting the oils, the leftover grains can still be used to condition soil and/or to create briquettes for burning. A cascading of uses – from maximum value to less value.

Seeking novel ways to maximise potential of biological resources

Bio-innovation in the **Agri-food sector**

- This is a **grass-fed mobile biorefinery** that separates the grass into juice and fibre.
- The **juice** can be turned into a dry protein-rich cake that can be absorbed more easily by cows so it generates less emissions from their digestion process or from feeding them other feed, like soy beans.
- The **leftover fibre** can be processed into a sustainable alternative to synthetic fertiliser or used as a more efficient supply of fuel for anaerobic digesters.
- This technology aims to **decrease emissions and reduce dependence on imported protein**.

Phys.org (2019) Ireland's first grass-fed biorefinery. Phys.org, 15 May 2019. <https://phys.org/news/2019-05-ireland-grass-fed-biorefinery-road-farmers.html>

Seeking novel ways to maximise potential of biological resources

Bio-innovation in the **Fisheries & aquaculture sector**

Innovative packaging design made of seaweed

Water you can eat!

For example, **Ooho!** is an edible and tasteless sustainable packaging made from a combination of brown seaweed and plants.

In 2019, London marathon runners were given edible seaweed pouches filled with a sports drink instead of plastic bottles.

<https://www.ooho.com>

Seeking novel ways to maximise potential of biological resources

Bio-innovation in the **Forestry sector**

Suitable for decentralised use on a small-scale, thus creating **new income streams**

From a simple and flexible pyrolysis solution to produce **biochar, oil, solid fuels and syngas from biomass residues**

To a new biocomposite material that can be **pressed and moulded into different shapes**. This new bioproduct uses mycellium as a bonding agent for the biomass particles (e.g. sawdust).

Biogreen © <http://www.biogreen-energy.com/>

Pyrolysis = thermal decomposition of materials at high temperatures in an inert environment.

These examples and many more can be found in: Colmorgen, F., Khawaja, C. (2019): *Small-scale technology options for regional Bioeconomies*. BE-Rural Project, <https://be-rural.eu>

Seeking novel ways to maximise potential of biological resources

Bio-innovation in **herbs and essential oils for cosmetics and pharmaceutical industries**

Technologies

Supercritical Fluid Extraction (SFE) using CO₂ as the solvent can gain a high yield of extraction from herbs at lower temperatures. This has less harmful environmental and health impacts than organic solvents.

Bioproducts

Herbal Cosmetics Bioproducts

Bielenda Algae Face Mask - 100% brown algae extract (Algininate). Algal blooms removals as possible source material.

Essential Oils in Cosmetics Products

Gdynia Baltic Collagen 'Exclusive Cream' - Uses freshwater and saltwater fish skins to retrieve natural collagen. Thus reducing fishery waste whilst creating a dermatologically advantageous product.

<https://www.bielenda.com/bioproducts/02-cosmetology/02-bielenda-algae-face-mask>

<https://www.gdynia.com/bioproducts/02-cosmetology/02-gdynia-baltic-collagen-exclusive-cream>

Bioeconomy challenges: **Resource Provision and Biodiversity loss**

Knowledge on biomass production, availability and use is key

Measuring biomass availability is important because it is limited, which can potentially lead to **competition for biomass between different biomass-using sectors**.

It is critical that the bioeconomy **does not compete with food production and does not affect biodiversity**. For example, marginal lands may not be used for food production but may be important for biodiversity

It is therefore fundamental to carry a **biodiversity assessment**.

The Bioeconomy Consultants (2018), *Big Economy Challenges - PART 2*. <https://www.nrfcs.co.uk/news-big-bioeconomy-challenges-2>

Biodiversity assessment

Five important things to do when carrying out a biodiversity assessment:

- Identify major constraints, high risk areas, and significant impacts on biodiversity and ecosystem services at the outset, seeking alternatives to avoid them. Only when impacts are unavoidable should measures to minimize, restore, offset biodiversity loss, and compensate for lost ecosystem goods and services be addressed.
- Use appropriate local specialists with explicit Terms of Reference and integrate social, economic and biodiversity considerations. Assess indirect, induced and cumulative impacts on biodiversity as well as direct impacts; these impacts are often more harmful than direct or "footprint" impacts.
- Engage with interested and affected parties—including indigenous peoples—to identify and evaluate impacts and to determine how traditional knowledge and local cultural practices can contribute to any biodiversity initiative.
- Take a precautionary approach when baseline information is poor, or there is uncertainty about impacts or the effectiveness of mitigation. Good monitoring, research and adaptive responses are crucial for managing impacts on biodiversity.
- Seek to make a lasting net positive contribution to biodiversity conservation in the affected area through interventions beyond "no net loss."

Brownlie, S. (2013), IAA fast tips No. 5 - Biodiversity Assessment. International Association for Impact Assessment (IAIA). <https://www.iaia.org/files/tips>

Projects need to think about net positive outcomes

Impacts on Natural Habitats

Break-Even Point

Contribution

Restore & Offset Impacts

Minimize Impacts

Avoid Impacts

No net loss

Net positive outcomes

NPI Alliance (2015), *Net Positive Impact for biodiversity: The conservation case*. Gland, Switzerland: IUCN. https://www.iucn.org/sites/default/files/import/download/npis_-_conservation_-_01_2016_1.pdf

<h3>Mitigation hierarchy</h3> <p>When considering negative impacts, the mitigation hierarchy must be always considered</p> <p>Source: CSBI (2015)</p> <p>The mitigation hierarchy is a tool to prevent the negative impacts of development projects. And, if prevention is not possible, then to remediate any impacts. It has a sequence of four key actions—avoid, minimize, restore and offset. Avoid is the most preferred action and offset is the least preferred one.</p> <p><small>CSBI (2015). A cross-sector guide for implementing the mitigation hierarchy. Prepared by the Biodiversity Consultancy on behalf of IPCEA, ICMV and the Equator Principles Association. Cambridge UK. (Summary, which includes the diagram above, available in English, Italian, French, Russian and Spanish.)</small></p>	<h3>Bioeconomy & climate crisis</h3> <h4>Bioeconomy and climate change mitigation</h4> <p>“Bioeconomy offers great opportunities to realising a competitive, circular and sustainable economy with a sound industrial base that is less dependent on fossil carbon.</p> <p>A sustainable bioeconomy also contributes to climate change mitigation, with oceans, forests and soils being major carbon sinks and fostering negative CO₂ emissions.”</p> <p>Scottish Highlands</p> <p>Bell et al. (2018, p. 25)</p> <p>Bell, J., Paula, L., Dodd, T., Németh, S., Nanou, C., Mega, V. & Campos, P. (2018) EU ambition to build the world's leading bioeconomy: Uncertain times demand innovative and sustainable solutions. <i>New Biotechnology</i> 40: 25–30.</p>
<h3>Q&A</h3> <h2>Any comments or questions in the chat?</h2>	<h3>Day 2 outline programme</h3> <p>14:00 – 15:30 CET (1-2:30pm UK time)</p> <ul style="list-style-type: none"> Welcome back from Dr Eija Rebo and the University of Strathclyde Introduction to Day 2 of the Summer School Summary of Day 1 of the Summer School More about the BE-Rural Project and the different working packages Key principles of circular economy <p>Break (15:30 – 15:45 CET) (2:30-2:45pm UK time)</p> <p>15:45 – 17:15 CET (2:45-4:15pm UK time)</p> <ul style="list-style-type: none"> Connecting student learning with industry projects, lessons from Strathclyde New ways to maximise potential of bioeconomy of different sectors Workshop on teaching bioeconomy in each of the five Innovation regions, grouped by country and language <p>17:15 – 17:30 CET (4:15-4:30pm UK time)</p> <ul style="list-style-type: none"> Short poll about Day 2 of the summer school Q&A, summary day 2, and link to day 3
<h3>Day 1 Mini-Snowball discussion</h3> <p>In Day 1 of the Summer School, we discussed the following in small groups:</p> <p>If you had all the money, time and resources you needed (e.g. 1 million EUR, 2 full days each week, and you were the education minister of the country), what would be the best ways for bioeconomy learning to be integrated in school teaching?”</p>	<h3>Day 2 follow-up discussion</h3> <p>Today, Day 2 of the Summer School, we want you to discuss:</p> <h4>How will you implement the teaching of bioeconomy in your school and country?</h4> <p>We are going to group you by country and language, and we are happy for you to discuss in your own language.</p> <p>You can write your thoughts either in English or in your own language (as we will then translate to English).</p>
<h3>Day 2 follow-up discussion</h3> <h4>How will you implement the teaching of bioeconomy in your school and country?</h4> <p>Based on the themes resulting from the Day 1 discussion, discuss in small country groups:</p> <p>A: How to incorporate the teaching of bioeconomy in schools?</p> <ul style="list-style-type: none"> Subject teaching. Workshops creating or using new materials. Laboratory access. School trips. Site visits. Extra curricular activities, like school clubs. Events, grants & Competitions. Industry talks. Industry projects. <p>B: Where best to incorporate the teaching of bioeconomy in different subjects?</p> <ul style="list-style-type: none"> Art Craft Design Business Economics Entrepreneurship Biology Computing STEM Geography Psychology Sociology <p><small>STEM = Science, Technology, Engineering, Mathematics</small></p>	<h3>What to do before Day 3</h3> <p>Watch videos with subtitles in your language</p> <p>Check existing schools and colleges resources to challenge students to rethink the “take-make-dispose” economy and build a system that works long-term</p> <p>And, for younger children</p> <p>Ready-made lessons for students ages 12-19</p> <p>Whole 1-year course for target ages of 11-14, 14-16 and 16-19 on “System Reset: Design and Technology for a Circular Economy”</p> <p>Check BE-Rural bioeconomy educational materials and other BE-Rural resources in your language</p> <p>Both of these are available in Bulgarian, English, Latvian, Macedonian, Polish and Romanian:</p> <p>https://be-rural.eu/resources/</p> <p>https://circularclassroom.com/</p>
<h3>What to do before Day 3</h3> <h4>Check these two documents</h4> <p>https://gh2020.net/wp-content/uploads/2021/03/Report_Workshop_education_GBS2020.pdf</p> <p>https://www.ift-bbi.eu/download/02_factsheet_bioeconomyeducation.pdf</p>	<h3>What to do before Day 3</h3> <p>Smith and Rudnicki (2020, p. 10) ask “How then do high school teachers prepare their students for this future?”</p> <p>This is their answer:</p> <p>“One response is that the circular bioeconomy is something that applies to most fields in STEM and business. Sustainability and the circular bioeconomy cannot be relegated to their own fields of study. For instance, by first understanding its principles, a student can quickly understand how the study of chemistry can focus on subfields that can lead to new bio-based chemicals that replace petroleum in plastics. The technologies we choose matter. Education in the circular bioeconomy incorporates STEM disciplines into our renewable natural resources.</p> <p>In physics and math classes, one way to contextualize lessons is to investigate how a mass timber building offers natural insulation by focusing on the heat losses of bio-based and non-renewable building materials. Lessons might also be interdisciplinary, combining fields of biology, chemistry, environmental science, engineering, statistics, and entrepreneurship, such as 3-D printing a bio-based plastic created from potato starch.”</p> <p>Smith, R and Rudnicki, M (2020), Global Environmental Issues and the Circular Bioeconomy. <i>The Science Teacher</i>, 87 (8): 10-11. https://www.nsta.org/science-teacher/science-teacher-aprilmay-2020/global-environmental-issues-and-circular-bioeconomy</p>

























Annex VI – Slides used Day 3

Five sets of slides used in Day 3:

- Rachel Moir (Skills Programme Manager, IBioIC)
- Debbie McCreath (Public Affairs Manager, IBioIC)
- Graeme Rough (Head of STEM programmes, Scottish Schools Education Research Centre)
- Dr Jo Sadler (Leaders in Science Founder and Research Fellow, University of Edinburgh)
- Dr Elsa João (University of Strathclyde in Glasgow, Scotland)

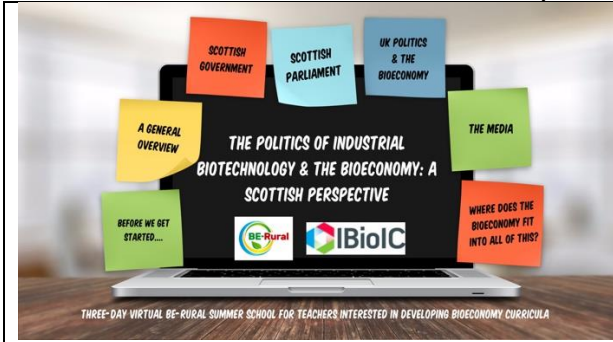
Rachel Moir (Skills Programme Manager, IBioIC)

 <p>Developing the industrial biotechnologists of the future: the innovative work of IBioIC with Scottish schools.</p> <p>Three-day virtual BE-Rural summer school for teachers interested in developing bio-economy curricula</p> <p>Rachel Moir IBioIC Skills Programme Manager 8th June 2021</p> <p>www.IBioIC.com</p>	<p>Agenda</p>  <p>14:00 – 14:20 – Introduction to Day 3. Introduction to IBioIC (Rachel Moir, Skills Programme Manager, IBioIC)</p> <p>14:20 – 14:50 – Scottish Bioeconomy Strategy and its context in a school setting (Debbie McCreath, Public Affairs Manager, IBioIC)</p> <p>14:50 – 15:25 – Engagement strategies with STEM (Graeme Rough, Head of STEM programmes, Scottish Schools Education Research Centre)</p> <p>15:25 – 15:30 – Pre-break Q&A and discussion</p> <p>15:30 – 15:45 – Break</p> <p>15:45 – 16:20 – Leaders in Science Programme (Dr Jo Sadler, Leaders in Science Founder & Chancellor's Fellow, University of Edinburgh)</p> <p>16:20 – 16:40 – Inclusive STEM, Social Mobility Foundation and other initiatives (Rachel Moir, Skills Programme Manager, IBioIC)</p> <p>16:40 – 17:10 – Concluding slides about the 3-days summer school, final zoom polls, and participants to fill feedback survey about summer school overall (Elsa João)</p> <p>17:10 – 17:25 – Final Q&A considering content of the 3-days of the summer school</p> <p>17:25 – 17:30 – Close (Rachel Moir, IBioIC and Dr Elsa João, University of Strathclyde)</p> <p>www.IBioIC.com</p>
<p>What is Industrial Biotechnology?</p>  <p>Please click on Speaker View to see the video in full size</p> <p>https://www.ibioic.com/about/#what-is-industrial-biotechnology</p> <p>www.IBioIC.com</p>	<p>The complexity of Industrial Biotechnology</p> 
<p>What can Industrial Biotechnology do?</p> 	<p>IBioIC Remit</p>    <p>Industry Academia Hub Government</p> <p>Why?</p> <ul style="list-style-type: none"> • Grow the Bioeconomy in Scotland • Reduce dependency on carbon intensive feedstocks • Increase sustainable manufacturing <p>www.IBioIC.com</p>
 <p>A networking and support organisation, set up in 2018 to stimulate the growth of the biotechnology sector in Scotland</p> <p>Connects industry, academia and government to bring biotechnology products and products to the global market</p> <p>PHD CTP, CPD, MSC, HND, STEM, Annual conferences, Member events, Open access centres, FlexBio, RapidBio</p> <p>www.IBioIC.com</p>	<p>Skills</p>  <ul style="list-style-type: none"> • 70 PhD students in current cohort • All PhDs have an industry partner • All students must undertake 2 days of STEM engagement per year  <p>www.IBioIC.com</p>

<h3>Skills</h3>  <ul style="list-style-type: none"> • Higher National Diploma (HND) programme <ul style="list-style-type: none"> • Approx. 15 HND students per year • Across three colleges • Option to go onto technical career or articulate to university • Supported through the Retain and Inspire programme. • MSc Programme <ul style="list-style-type: none"> • 30 students per year (funded) • All students undertake an industry placement • Cross-institution delivery • Other projects: <ul style="list-style-type: none"> • STEM resource development • Internships <p>www.IBioIC.com</p>	<h3>Projects</h3>  <ul style="list-style-type: none"> • 100 + collaborative industrial projects funded • >£25 million in leveraged funding   <p>www.IBioIC.com</p>
<h3>Network building</h3>  <ul style="list-style-type: none"> • Over 120 industry members and 25 Academic partners • Networking through annual conference, member events, consortia building and sector based activities.   <p>www.IBioIC.com</p>	<h3>Industrial membership</h3>   <p>www.IBioIC.com</p>
<h3>Academic partners</h3>  <p>■ Health ■ Marine ■ Industrial ■ Agriculture</p>  <p>www.IBioIC.com</p>	<h3>Open access centres</h3>  <ul style="list-style-type: none"> • Equipment Centres • Fermentation facility • DSP facility • Expert Bioprocess staff • Part of the BioPilotsUK group    <p>www.IBioIC.com</p>
  	<h3>FlexBio</h3>   <p>www.IBioIC.com</p>
   <h3>Inclusive STEM</h3> <p>Rachel Moir IBioIC Skills Programme Manager 8th June 2021 Three-day virtual BE-Rural summer school for teachers interested in developing bioeconomy curricula</p> <p>www.IBioIC.com</p>	<h3>Are we all equal?</h3>  <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>We know the jobs of the future are in STEM, yet it is estimated only 25% of women make up Scotland's STEM industries.</p> </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Better-off pupils are significantly more likely to go to university than their more disadvantaged counterparts, with the inequality between the two groups now standing at 18.8%.</p> </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Ethnic minority men are 28% less likely to work in STEM than white men</p> </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>With a population of 469,365 in 2018, the Highlands and Islands is characterised by population sparsity, an ageing population and net out-migration of young people. The working age (16-64) population is expected to fall and make-up a lower share of the total population by 2040 (54% compared to 61% in 2018).</p> </div> <div style="border: 1px solid black; padding: 5px;"> <p>Disabled STEM students 57% less likely to take up postgraduate STEM study than non-disabled students</p> </div> <p>www.IBioIC.com</p>

<h3>Why do we need to address inequalities?</h3>  <p>National Plan for Industrial Biotechnology sets out ambitious targets of a £900m turnover and over 200 companies active in industrial biotechnology by 2025.</p>  <p>www.IBioIC.com</p>	<h3>Social Mobility Foundation</h3>  <ul style="list-style-type: none"> • Aims to make a practical improvement in social mobility for young people • It does this through provide opportunities, and networks of support for 16-17 year olds who are unable to get them from their schools or families. • Scottish branch based in Glasgow • Aspiring Professionals Programme offers tailored support across 11 career sectors: Accountancy, Architecture, Banking & Finance, Biology & Chemistry, Business, Digital, Engineering & Physics, Law, Media & Communications, Medicine, and Politics. <p>www.IBioIC.com</p>
<h3>Speakers for Schools</h3>  <ul style="list-style-type: none"> • Aim is to end educational inequality by giving all young people access to the same prestigious networks available to the top fee-paying schools in the UK <ul style="list-style-type: none"> • Inspiration programme • Experience programme   <p>www.IBioIC.com</p>	<h3>Newton Rooms</h3>  <ul style="list-style-type: none"> • Designed to inspire more young people to become interested in Science, Technology, Engineering and Mathematics (STEM), and encourage them to study these subjects in school and beyond. • Being created in the Highland region by the Science Skills Academy, a partnership project led by Highlands and Islands Enterprise (HIE) with £3m from the Inverness and Highland City-Region Deal.  <p>www.IBioIC.com</p>
<h3>Equate Scotland</h3>  <ul style="list-style-type: none"> • National expert in gender equality throughout the STEM sectors. • Funded by the Scottish Government to deliver our work without charge to students and women • Aim to make a tangible and sustainable change, enabling women studying and working in these keys sectors to develop, by supporting their recruitment, retention and progression <p>www.IBioIC.com</p>	<h3>Kibble</h3>  <ul style="list-style-type: none"> • Kibble supports at risk children and young people (aged 5-26) across the UK. Many of the young people we care for have experienced significant trauma in their lives and Kibble offers dedicated care and support to help them move forward. This includes residential and community support, as well as dedicated schools and wellbeing services. • New initiative with National Manufacturing Institute Scotland (NMIS) <ul style="list-style-type: none"> • supporting care experienced young people into employment through opportunities in STEM • Highlighting opportunities within the manufacturing sector and the accessible routes to employment. <p>www.IBioIC.com</p>
<h3>Engagement with college sector</h3>  <ul style="list-style-type: none"> • Known pathway for access to further education by low income groups • IBioIC work with colleges by providing student mentorship and development of STEM materials for engagement school leavers.   <p>www.IBioIC.com</p>	<h3>Higher National Diploma in Industrial Biotechnology video</h3>  <p>Please click on Speaker View to see the video in full size</p> <p>www.IBioIC.com</p>
<h3>The outcome?</h3>   <p>www.IBioIC.com</p>	 <p>Thank you for listening!</p> <p>rachel.moir@ibioic.com</p> <p>www.ibioic.com</p> <p>www.IBioIC.com</p>

Debbie McCreath (Public Affairs Manager, IBioIC)



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- WORLD OF COVID POLITICS - IMPACT ON BIOECONOMY?
- SUSTAINABILITY: COP26 & NET ZERO

THE SCOTTISH GOVERNMENT

- CIVIL SERVICE: THE PERMANENT POLITICIANS
- QUIZ TIME - WWW.MENTI.COM CODE 6038 2631
- WHERE DOES INDUSTRIAL BIOTECHNOLOGY FIT IN THE SCOTTISH GOVERNMENT?
- MINISTERS OF THE SCOTTISH GOVERNMENT... ➔

MINISTERS OF THE SCOTTISH GOVERNMENT

Cabinet Secretary for Education and Skills
Shirley-Anne Somerville MSP

Responsibilities:

- COVID-19 Education and Development recovery
- School standards, quality and improvement
- School infrastructure and staffing
- Admissions, and closing the attainment gap
- Reform of the curriculum
- National Improvement Framework
- Teaching profession
- Raising barriers to education and supporting digital inclusion
- Bullying and measures to combat bullying
- Protection of vulnerable groups

Supporting the Cabinet Secretary for Education and Skills

Minister for HE & FE, Youth Employment and Training
Jamie Hepburn MSP

Responsibilities:

- Young Person's Guarantee
- Apprenticeships
- Non-advanced vocational skills
- Youth Employment
- Further education and colleges
- Higher education and universities
- Science and STEM Science, Technology, engineering and mathematics
- Youth work
- Wellbeing access

MINISTERS OF THE SCOTTISH GOVERNMENT

Cabinet Secretary for Finance & the Economy
Kate Forbes MSP

Responsibilities:

- Scottish budget, budgetary monitoring and reporting
- Fiscal policy and taxation
- Exchequer & the public finances
- Economic Strategy
- National Strategy for Economic Transformation and Council for Economic Transformation
- Wellbeing economy
- Enterprise agencies
- Employment policy
- A day working week
- Just Transition (with CS Net Zero)
- Scottish National Investment Bank
- Scottish Futures Trust (SFT)

Supporting the Cabinet Secretary for Finance & the Economy

Minister for Business, Trade, Tourism & Enterprise
Ivan McKee MSP

Responsibilities:

- Business, industry and manufacturing
- Retail Strategy
- Tourism and hospitality
- Life sciences
- International trade and export policy
- Scottish Green Ports
- Economy national challenge competition
- Bankruptcy and Accountant in Bankruptcy
- Regional economic forums

MINISTERS OF THE SCOTTISH GOVERNMENT

Minister for Just Transition, Employment and Fair Work
Richard Lochhead MSP

Responsibilities:

- Just Transition planning and delivery, including the work of the Just Transition Commission
- Co-ordination of Sector Just Transition plans and monitoring frameworks
- Long term Labour market strategy, the living wage
- Fair Work
- PACE
- Employment programmes
- Women's employment
- Crisis Investment and Strategy
- Green Growth Accelerator

Supporting the Cabinet Secretary for Finance & the Economy

Cabinet Secretary for Rural Affairs and Islands
Mairi Gougeon MSP

Responsibilities:

- Crisis government co-ordination on islands
- Islands Brand
- Carbon Neutral Islands
- Food and drink supply chain
- Scottish Food Agency
- Agriculture
- Fisheries and aquaculture
- Animal welfare
- Cruising

MINISTERS OF THE SCOTTISH GOVERNMENT

Minister for Just Transition, Employment and Fair Work
Richard Lochhead MSP

Responsibilities:

- Trade and inward investment
- Office of the Chief Economic Adviser
- City and Regional Growth Deals
- Scottish Fiscal Commission
- Enterprise, Innovation and Increasing Productivity
- Government Investments (Private, Pensions, BIFIs)
- Digital Economy, Strategy, Participation and Connectivity (inc. 100% Broadband and Connecting Scotland)
- Revenue Scotland
- Green Jobs Fund
- Women's Business Centre
- Rural Entrepreneur Fund

MINISTERS OF THE SCOTTISH GOVERNMENT

Cabinet Secretary for Rural Affairs and Islands
Mairi Gougeon MSP

Responsibilities:

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- Carbon Neutral Islands
- Food and drink supply chain
- Scottish Food Agency
- Agriculture
- Fisheries and aquaculture
- Animal welfare
- Cruising

MINISTERS OF THE SCOTTISH GOVERNMENT

Minister for Just Transition, Employment and Fair Work
Richard Lochhead MSP

Responsibilities:

- Trade unions
- Green Skills Hub for the Future Commission
- Low Carbon Economy

<h3>MINISTERS OF THE SCOTTISH GOVERNMENT</h3> <p>Supporting the Cabinet Secretary for Rural Affairs and Islands</p> <p>Minister for Environment, Biodiversity and Land Reform Mairi McAllan MSP</p> <p>Responsibilities:</p> <ul style="list-style-type: none"> Land Reform & Land Use Royal Botanic Gardens Environmental Quality Natural Resources, Peatland and Floods Scottish Land Commission Waters Nation Drinking Water Quality Regulator Private Water Forestry & Woodlands Forestry and Land Scotland Scottish Forestry EU Support and Related Services Forest Research (Cross Border Services) Environmental and climate justice Crown Estate Scotland Marine planning National Parks and natural heritage Plant Health GM  <p>www.MSP.com</p>	<h3>MINISTERS OF THE SCOTTISH GOVERNMENT</h3> <p>Cabinet Secretary for Net Zero, Energy and Transport</p> <p>Michael Matheson MSP</p> <p>Responsibilities:</p> <ul style="list-style-type: none"> Cross government co-ordination of Net Zero policy Climate risk and environmental protection CO2 delivery Biodiversity Sustainable development Circular Economy, including implementation of the Deposit Return Scheme Cross government co-ordination of infrastructure (gates, investment, & Commission) Cross government delivery of 20 minute neighbourhoods Renewable energy industries Energy and energy connectivity National public energy agency Heating and Domestic Energy Transformation Heat networks Fuel Poverty Physical and marine environment Flood prevention & coastal erosion Scottish Environmental Protection Agency NatureScot Zero Waste Scotland Water quality and Scottish Water Strategic Transport Projects Review  <p>www.MSP.com</p>
<h3>MINISTERS OF THE SCOTTISH GOVERNMENT</h3> <p>Supporting the Cabinet Secretary for Net Zero, Energy and Transport</p> <p>Minister for Transport Graeme Dey MSP</p> <p>Responsibilities:</p> <ul style="list-style-type: none"> Public transport Decarbonising public transport Active travel Ferry Services – Inc. CMAI Low carbon transport and infrastructure Roads and road safety Motorways and Trunk Roads Future Transport Funds Transport Information Scottish Canal Freight industry Islands Connectivity Plan Maritime Policy including ports and canals Aviation & Air Services (including NAAI) Scottish & The Bridge Authorities Transport & Travel strategy Sea Services Concessionary Fares and Bus Services  <p>www.MSP.com</p>	<h3>MINISTERS OF THE SCOTTISH GOVERNMENT</h3> <p>Supporting the Cabinet Secretary for Net Zero, Energy and Transport</p> <p>Minister for Business, Trade, Tourism & Enterprise Ivan McKee MSP</p> <p>Responsibilities:</p> <ul style="list-style-type: none"> Business, investment and manufacturing Trade and investment City Centre International trade and export policy Scottish Investment Bank Business and investment in Scotland Regional enterprise agency Business responsibility and employee-owned businesses International trade and investment  <p>www.MSP.com</p> <p>Minister for Environment, Biodiversity and Land Reform Mairi McAllan MSP</p> <p>Responsibilities:</p> <ul style="list-style-type: none"> Land Reform & Land Use Royal Botanic Gardens Environmental Quality Natural Resources, Peatland and Floods Scottish Land Commission Waters Nation Drinking Water Quality Regulator Private Water Forestry & Woodlands Forestry and Land Scotland Scottish Forestry EU Support and Related Services Forest Research (Cross Border Services) Environmental and climate justice Crown Estate Scotland Marine planning National Parks and natural heritage Plant Health GM  <p>www.MSP.com</p>
<h3>THE SCOTTISH PARLIAMENT</h3> <ul style="list-style-type: none"> MEMBERS OF THE SCOTTISH PARLIAMENT <ul style="list-style-type: none"> QUIZ TIME - WWW.MENTI.COM CODE 6038 2631 SCOTTISH PARLIAMENT COMMITTEES LEGISLATION IN THE SCOTTISH PARLIAMENT CROSS PARTY GROUPS 	<h3>UK POLITICS & THE BIOECONOMY</h3> <ul style="list-style-type: none"> DEVOLVED VS RESERVED <ul style="list-style-type: none"> QUIZ TIME - WWW.MENTI.COM CODE 6038 2631 UK MINISTERS & UK CIVIL SERVICE BIOECONOMY POLICY AT THE UK LEVEL PROCESS AT WESTMINSTER
<h3>THE MEDIA</h3> <ul style="list-style-type: none"> IMPORTANCE OF 'BEING SEEN' IN THE MEDIA IMPORTANCE OF MESSAGING CHANGING MEDIA LANDSCAPE <ul style="list-style-type: none"> QUIZ TIME - WWW.MENTI.COM CODE 6038 2631 	<h3>WHERE DOES THE BIOECONOMY FIT INTO ALL OF THIS?</h3> <ul style="list-style-type: none"> THE BIOECONOMY IS A CHALLENGE TO CURRENT POLICY LANDSCAPE - WHY? <ul style="list-style-type: none"> QUIZ TIME - WWW.MENTI.COM CODE 6038 2631 NATIONAL PLAN FOR INDUSTRIAL BIOTECHNOLOGY BIOECONOMY STRATEGY & BIOMASS CONSULTATION

Graeme Rough (Head STEM programmes, Scottish Schools Education Research Centre)

Introduction to SSERC

To inspire, enthuse and support STEM educators for the benefit of all learners

Graeme Rough
Head of STEM Programmes

www.sserc.scot
@SSERCSTEM

1 Provision of Career Long Professional Learning (CLPL) for childminders, early years practitioners, primary and secondary school teachers and school technicians.

SSERC is the “go to” organisation for STEM professional learning in Scotland, offering a broad portfolio of services supporting STEM learning which are not available from any other source:

- 1 Provision of Career Long Professional Learning (CLPL)** for childminders, early years practitioners, primary and secondary school teachers and school technicians.
- 2 The Advisory Service** provides ongoing health and safety guidance for the Scottish education community to support safe STEM-based activities in the classroom environment.
- 3 Wider STEM engagement activities** including liaison lead for STEM Ambassadors in Scotland, teacher placements into industry and the Young STEM Leader programme.

Vision:
SSERC is internationally recognised as a centre of excellence for STEM learning and support.

2 The Advisory Service provides ongoing health and safety guidance for the Scottish education community to support safe STEM-based activities in the classroom environment.

Health & Safety

Sealed radioactive source disposal

When the Environmental Authorisation (Scotland) Regulations 2012 were introduced, there was a subtle but important change to legislative governing bodies. Approval of sealed radioactive sources with a maximum activity of 200 kBq or higher, outside disposal sites (SDA), is now required for all sealed sources directly to be disposed of. One reason for this is that it is not possible to store sealed sources in schools. Sealed sources are used to remove metal waste for recycling. The metal is stored in a separate container. Sealed sources are used to remove metal waste for recycling. The metal is stored in a separate container. Sealed sources are used to remove metal waste for recycling. The metal is stored in a separate container.

Health & Safety

Dissection of animal materials in school

We receive enquiries about animal material dissection on a regular basis from both teachers and technicians. Many of these simply ask, “What are we allowed to do?” Our answer is that dissection of animal material is permitted if it is obtained from animals that have been slaughtered for human consumption. Such material may be obtained from butchers, abattoirs, or fishmongers. The dissection materials must be fresh or, if they

3 Wider STEM engagement activities including liaison lead for STEM Ambassadors in Scotland, teacher placements into industry and the Young STEM Leader programme.

- STEM Ambassador Programme
- Teacher Placements and EIPs
- ENTHUSE Partnerships
- Young STEM Leader Programme

Over 5,000 STEM Ambassadors in Scotland

Engaging STEM experiences for schools, community and youth groups

Over 30 years

3 Wider STEM engagement activities including liaison lead for STEM Ambassadors in Scotland, teacher placements into industry and the Young STEM Leader programme.

SSERC EIPs (Education/Industry Partnerships) contributing to the local community.

Caledonian Engine Services

3 Wider STEM engagement activities including liaison lead for STEM Ambassadors in Scotland, teacher placements into industry and the Young STEM Leader programme.

ENTHUSE PARTNERSHIPS STEM LEARNING

- Increased attainment in STEM subjects, narrowing the gap for disadvantaged students
- Increased interest in STEM careers; more students interested in working in STEM industries
- Increased understanding of STEM careers; more students aware of the qualifications and routes to progress in STEM

Bucksburn and Dyce learning communities in Aberdeen

The focus here is on building a consistent approach to maths and numeracy learning and teaching via a series of professional learning events for teaching staff in the primary and secondary schools in both clusters. The hope is that there is an increased achievement and attainment in numeracy for learners across primary and secondary. The partnership is supported by BP and La Salle Education.

This partnership launched in early 2021 and is making excellent progress with our series of professional learning events underway.

Shawlands, Cumbernauld and St Mungo's Academies, Brannock and Barrhead High Schools in the West of Scotland

Staff and pupils in these five secondary schools are working together with Jacobs, going on a journey of enhanced career-based learning, finding out the many STEM-linked opportunities and pathways that exist beyond school. As the learning takes place, young people in these schools will lead careers learning events to peers, gaining Young STEM Leader Awards as a result.

After extensive planning this partnership will officially launch on 10th June 2021 and we are inviting those involved in STEM education to join us to find out more and meet our team.

3 Wider STEM engagement activities including liaison lead for STEM Ambassadors in Scotland, teacher placements into industry and the Young STEM Leader programme.

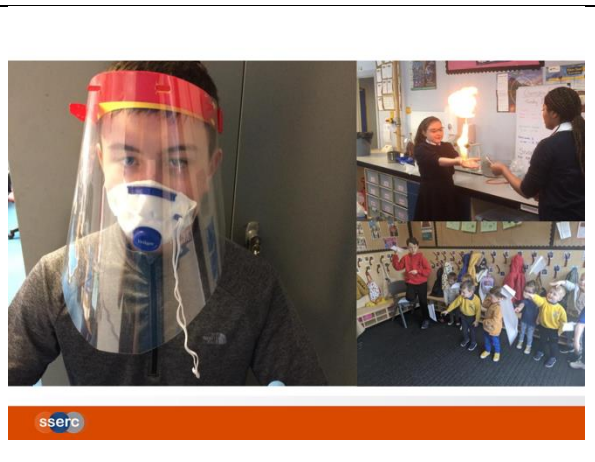

Inspiring and developing young people through STEM

Welcome to the Young STEM Leader Programme (YSLP), an exciting opportunity for young people in Scotland.





sserc

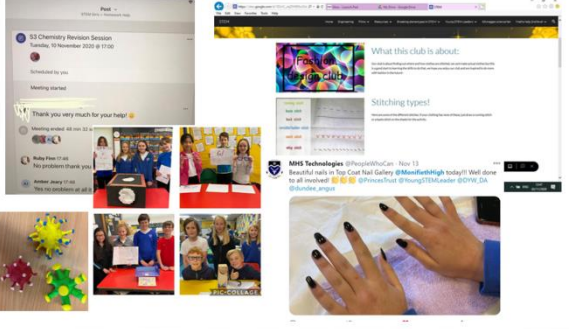



MillburnScience @millburnscience · Oct 27
#YoungSTEMLeaderWeek @YoungSTEMLeader @MillburnAcademy our 56 stem leaders helping the 52 pupils increase and deliver different presentations to demonstrate the process of fertilisation.

BScience @Science88 · Oct 30
To celebrate #YoungSTEMLeaderWeek our leaders @loggathigh got involved with us 51s as they designed and created their own solution! Well done everyone they look AMAZING! #YoungSTEMLeader

YOUNGSTEM led by sserc
STEM VIP INTERVIEW
Dr Craig Peake
Company: Greenleaf

sserc



33 Chemistry Revision Session
Friday, 10 November 2023 @ 11:00

Thank you very much for your help!

What this club is about:
Stitching types!

MHS Technologies @PeopleWhoCan · Nov 15
Beautiful results in Top Coat Nail Gallery @MauldunHigh today!! Well done to all involved! @sserc @sserc @YoungSTEMLeader @SSRC @sserc @sserc

sserc

Opportunities

- SSERC International membership
- International Young STEM Leader
- Organisation visits
- Education/industry partnerships

enquiries@sserc.scot

sserc


Contact

Please make contact if you have any further questions, comments or you would like to progress with opportunities.

enquiries@sserc.scot

sserc

Dr Jo Sadler (Leaders in Science Founder and Research Fellow, University of Edinburgh)



https://be-rural.eu

Dr Joanna Sadler


University of Edinburgh (UK)

joanna.sadler@ed.ac.uk

Three-day virtual BE-Rural summer school for teachers interested in developing bioeconomy curricula

Leaders in Science
Science for the next generation

www.leadersinscience.co.uk
@USScotland




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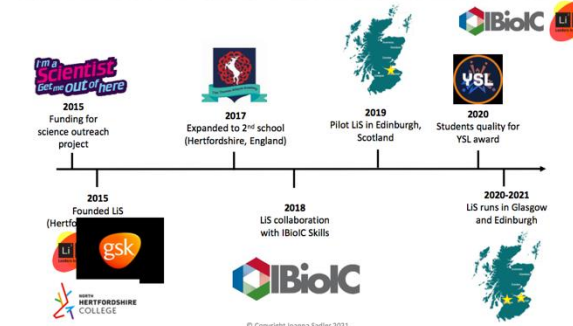
What is Leaders in Science?

- Schools outreach programme
- Led by graduate scientists, PhD students or equivalent
- Cascade learning through the generations

"If you can't explain it to a six year old, you don't understand it yourself"



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2015 Funding for science outreach project

2015 Founded LIS (Hertfordshire)


2017 Expanded to 2nd school (Hertfordshire, England)

2018 LIS collaboration with IBioIC Skills

2019 Pilot LIS in Edinburgh, Scotland

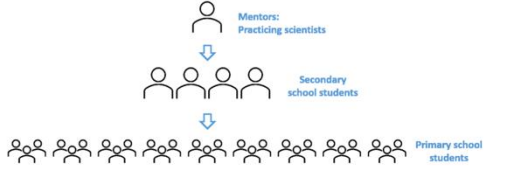
2020 Students quality for YSL award

2020-2021 LIS runs in Glasgow and Edinburgh



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"Those who teach, learn"



Mentors: Practicing scientists

Secondary school students

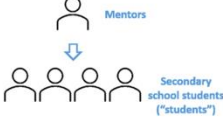
Primary school students



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How does it work?

Part 1



Mentors

Secondary school students ("students")

Aims

- Inspire students beyond school curriculum
- Develop communication, leadership and teamwork skills of mentors

Content


- Mentor training
- Weekly sessions with students
- Off-curriculum science workshops
- Brainstorming sessions
- Leadership, communication and teamwork skills workshops

Outcomes for Mentors

- Confidence
- Teamwork, leadership, communication skills
- Rewarding to see students develop

Outcomes for Students

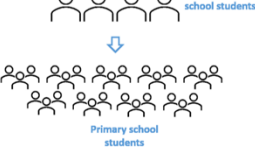
- New scientific learning
- Scientific 'role-models'



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How does it work?

Part 2



Secondary school students

Primary school students

Aims

- Inspire primary school students with hands-on workshops
- Develop communication, leadership and teamwork skills of students

Content


- Mentors help students develop workshops
- Students deliver workshops in local primary schools
- Reflection and feedback
- Repeat workshops
- Programme wrap-up and reflection

Outcomes for Students

- Confidence
- Teamwork, leadership, communication skills
- Experience of working with younger children

Outcomes for Primary school students

- Fun workshops
- Scientific 'role-models' for primary school students




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How does it work?

Example schedule...

Term 1

Week	Content
1	Introductions
2	Workshop 1
3	Brainstorming and discussion on workshop 1
4	Workshop 2
5	Brainstorming and discussion on workshop 2
6	Leadership and teamwork workshop
7	Workshop planning 1
8	Workshop planning 2
9	Workshop practice 1
10	Workshop practice 2




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How does it work?

Example schedule...

Term 2

Week	Content
1	Final practice
2	Primary school visit 1
3	Feedback and reflection
4	Primary school visit 2
5	Student-led debate
6	Wrap-up and feedback
7	Awards evening



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What do the mentors say?

"Having the pressure of making sure we delivered good quality material to the college students was a big step outside my comfort zone. That was a great thing for me and my work (specifically scientific presentations) benefitted tremendously."

"It was really quite a special experience for me teaching the students various aspects of science... - it's how I imagine a proud parent feels!"

"The Leaders in Science programme has been a very rewarding experience...it has also been a delight watching the students increase in confidence with each session"

"Mentoring for Leaders in Science helped me grow in confidence, transformed the way I communicate science and opened my eyes to rewarding careers in science outside of the lab"



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What do the teachers say?

"Seeing my class develop in confidence last session was one of the highlights of my teaching career and I'd love to continue the project!"

Secondary school teacher, 2020

"It was fantastic watching the students so engaged in these interactive workshops"

Primary School Teacher, 2019



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Resources



Leaders in Science
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www.leadersinscience.co.uk

Resources for students



Download Leaders in Science course log book here
Useful websites for workshop ideas
Site Visit Teachers Guide
University of Kansas Resources for Science Classes
Science Skills website
Science Bus
Work on Science activities
A Mentorship Guide to Teachers
Comments you can do with activities from around the house - special thanks to Michelle for spotting them
Thank you to everyone who has got in touch with us about useful ideas they have found! If you'd like us to add another link to the page, please let us know via the Contact page
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Resources



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www.leadersinscience.co.uk

Blog



KEEP LEARNING FROM HOME'S IDEAS TO GET YOU STARTED...
Posted on March 20, 2020

So school's been closed and you're learning from home. There's been a huge amount of change in the last couple of weeks and you may still be adjusting to having your classroom at home. Thanks to the amazing power of the internet (thanks again to science and engineering!) there are lots of great websites out there to help.

One thing all of this has really highlighted is just how important scientists are to society. All those like this, it is the scientists that governments are turning to for advice, and the scientists that the public are relying on to develop better testing, cure and vaccines for Covid-19.


Maybe this has inspired you to think about becoming a scientist one day? Or maybe you would like to learn more and expand your knowledge beyond what you get taught at school?

If so, here are some great online games, books and activities to get you started. If you come across more that you'd like to add to this list, please Tweet us @IBioICUK or drop us a line through our contact form right at hand.

1. **Protein and DNA: three machines your hands hold** (this one's new)
2. **Love Chemistry?** This interactive periodic table has a video for each element! Cool!

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Resources



Leaders in Science

Activity log book

Programme structure
Workshop planning tools
Feedback surveys



Log Book

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Resources



Mentor resource pack

Programme structure
Feedback surveys

Mentor Resource Pack

Contents

- INTRODUCTION _____ 2
- QUESTIONNAIRE _____ 3
- PROGRAMME STRUCTURE _____ 4
- QUESTIONNAIRE _____ 5
- PROGRAMME FEEDBACK _____ 7



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Mentors at Ross High School 2019





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Students present at IBioIC Conference

© Copyright Joanna Sadler 2021

Primary school workshops 2020




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Primary school workshops 2020





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Awards night (Hertfordshire)




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Thank you



Leaders in Science
Science for the next generation


IBioIC

Mentors past and present



Collaborator schools and teachers

Students



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Dr Elsa João (University of Strathclyde in Glasgow, Scotland)



Final words about the 3-day virtual BE-Rural summer school for teachers interested in developing bioeconomy curricula

25 May, 1 June an 8 June 2021



Dr Elsa João, University of Strathclyde, Scotland

What next?

All the materials for the summer school (like handouts with the slides) are in links in here: <https://be-rural.eu/events/teachers-summer-school/>



All the attendees will get a CPD (Continuing Professional Development) certificate in July or August 2021.

What next?

A report about the summer school (including results of all the discussions) will appear in this page in July 2021 with the title: **Deliverable 3.3 - Outcome of the summer school for teachers interested in developing bioeconomy curricula – materials and discussion results.**



<https://be-rural.eu/resources/>

What next?

BE-Rural will print these bioeconomy games and send them to the teachers who attended the three days of the summer school. You will get an email after the summer school, at the end of June.



Available in Bulgarian, English, Latvian, Macedonian, Polish and Romanian (all in here: <https://be-rural.eu/resources/>)

"BE-Match" and "SDG-Link" Games - One set of cards for two games

What next?

The most important thing about "what next?" is... **You!**

We are very interested in hearing from you!

How are you using the BE-Rural bioeconomy educational materials (available in Macedonian, English, Latvian, Macedonian, Polish or Romanian)

How are you implementing the teaching of bioeconomy in your school and country?

What bioeconomy events are you organizing or taking part?

Contact: **Clément Robijns**, BE-Rural Communication & Events, c.robijns@biocom.de

What next?

Get in touch with your regional & country facilitator

 <p>Bulgarian Industrial Association – Union of the Bulgarian Business (BIA) Bulgaria https://en.bia-bg.com</p>	<p>Main BE-Rural Contact: Martin Stoyanov martin@bia-bg.com</p>
 <p>Institute for Economic Forecasting (IPE), Romania http://www.ipe.ro/</p>	<p>Dr Carmen Pauna pauna_carmen@ipe.ro</p>
 <p>International Centre for Sustainable Development of Energy, Water and Environment Systems – Macedonian Section (SDEWES-Skopje) https://www.sdewes.org</p>	<p>Emilija Mihajloska emilija.mihajloska@sdewes.org sdewes.skopje@sdewes.org</p>
 <p>Latvian State Forest Research Institute (SILAVA), Latvia http://www.silava.lv/</p>	<p>Dagnija Lazdina dagnija.lazdina@silava.lv</p>
 <p>National Marine Fisheries Research Institute (NMFRI), Poland https://nmr.gdynia.pl/</p>	<p>Marcin Rakowski mrakowski@mir.gdynia.pl</p>

Stay tuned with BE-Rural!

We're active on:



BE-Rural
@BE_Rural
BE_Rural

We also have a quarterly newsletter!




Sign up at <https://be-rural.eu>

What next?

Before a final discussion, spend 10 minutes just now to fill short feedback survey about summer school overall – link in zoom chat

This short survey for attendees to fill in is important for the CPD (Continuing Professional Development) certificate of the participation in summer school.

Final discussion

Final Q&A considering content of 3 days of summer school

Any comments or questions in chat?

How will you implement the teaching of bioeconomy in your school and country?

A: How to incorporate the teaching of bioeconomy in schools?

- Subject teaching
- Workshops creating or using new materials
- Laboratory access
- School trips
- Site visits

B: Where best to incorporate the teaching of bioeconomy in different subjects?

- Art
- Craft
- Design
- Biology
- Computing
- STEM
- Business Economics
- Entrepreneurship
- Geography
- Psychology
- Sociology

What next?

If you have any questions, comments or suggestions, just send me an email:

Dr Elsa João
[elsa.joao@strath.ac.uk](mailto:(elsa.joao@strath.ac.uk))

Annex VII – Results of Day 1 discussion on "If you had all the money, time and resources you needed, what would be the best ways for bioeconomy learning to be integrated in school teaching?"

In Day 1 discussion was organised in a mini snowball format where attendees were asked to individually write the three best ways for bioeconomy learning to be integrated in school teaching and then, in small groups, decide only the three best ways (i.e. if there were five people in a group, 15 items needed to be reduced to three). There were ten mixed-country groups and below are their ideas.

Group	Best ways for bioeconomy learning to be integrated in school teaching
1	<ol style="list-style-type: none"> 1. green garden 2. trips from time to time combined with optional courses; 12th grades; waste turned into different products (manure into seedling pots) 3. to taste similar products: organic and usual ones
2	<ol style="list-style-type: none"> 1. entrepreneur education high-school education 2. biology, economy and geography common activities 3. non-formal education, drawing contest
3	<ol style="list-style-type: none"> 1. curriculum, introducing in high school, competitions, programs and grants in order to develop bio based business for Young people 2. practical activities on summer time, have camps where we can teach children how to get in touch with natural earth resources, vegetables, natural fibers and so on. 3. visits on bio farms with high school children or gymnasium and see procedures held there
4	<ol style="list-style-type: none"> 1. Bioeconomy should be mainstreamed across different subjects (e.g. biology, geography, etc.) to be taught by teachers in a collaborative manner. 2. In line with the notion of sustainable development, involve/target different sectors (including entrepreneurs) in the educational activities. Organize field trips to producers. 3. Teaching environmental and societal awareness, then, does not only influence the students in the classroom, but it provides future generations with the skills, tools and training to understand and prepare for a complex and interconnected global reality. For example, students that perceive the relevance of sustainability issues at the school level are then able to apply this understanding in their community, and perhaps to the entire planet. These transformative learning processes fostered in class allow for students (and teachers, for that matter) to think and develop the innovations needed for a deeper connection with nature.
5	<ol style="list-style-type: none"> 1. Create a curriculum with 17 goals or implemented 17 goals in existing curriculum of biology, chemistry... in every school and in kindergarten. 2. school organic gardens and "kids cooking for kids" 3. Task for students (project working): Find waste characteristic of area and explore technology to reduce it.
6	<ol style="list-style-type: none"> 1. Showing students/pupils in an interactive the way, the entire life cycle of a bioproduct by offering hands-on experience, e.g. school trips to factories which make such bioproducts. 2. Personal example – teachers show pupils/students the creation of a bioproduct and its use 3. Invite experts/lecturers to speak about the bioeconomy/bioproducts etc.
7	<ol style="list-style-type: none"> 1. New extracurricular activity each year 2. Visiting the most successful bioeconomy in rural area 3. Link circular economy from urban schools with the bioeconomy from rural schools by changing the teaching place for children from time to time
8	<ol style="list-style-type: none"> 1. excursions (visit with children on factories which integrate bioeconomy) 2. workshops in class with recyclable materials 3. optional classes about how to recycle different materials
9	<ol style="list-style-type: none"> 1. circular activity, laboratory access, excursions to bio practice places 2. put some part of bioeconomy topic in every subject 3. different materials recycling activities, followed by visits to places where materials are used 4. green house with organic products 5. extracurricular activities, or transdisciplinary ones, in order not to have waste foods (new recipes, other uses) 6. compulsory subjects (topics) about bioeconomy, beginning with the primary school
10	<ol style="list-style-type: none"> 1. Bioeconomy products from region/country + Visits/Discussions with local entrepreneurs 2. Biomaterials not used nearby/ available locally = Waste Audit Individual + at community scale 3. Practical experiments + Impact of economy in our lives

Annex VIII – Results of Day 2 discussion on "How will you implement the teaching of bioeconomy in your school and country?"

Day 2 saw the continuation of the discussion of Day 1, but this time the groups were based on country and language. This allowed the discussion to focus on development of curricula and educational material on the bioeconomy for specific countries. It also allowed participants to discuss in their own language. Groups provided a summary of what they discussed (see table below), which could have been written in their own language and, if that was the case, it was then translated to English. Note that there were no attendees from Poland and due to the large number of Romanians they had six groups.

Participants were provided with this figure to inspire discussion, and were asked to agree three ideas for A and three ideas for B:

How will you implement the teaching of bioeconomy in your school and country?

A: How to incorporate the teaching of bioeconomy in schools?

Subject teaching. Workshops creating or using new materials.	Extra curricular activities, like school clubs.
Laboratory access. School trips. Site visits.	Events, grants & Competitions Industry talks. Industry projects.

B: Where best to incorporate the teaching of bioeconomy in different

Art Craft Design	Business Economics Entrepreneurship
Biology Computing STEM	Geography Psychology Sociology

Group	Best ideas for how to implement teaching of bioeconomy in your school/country
Bulgaria	<p>A: How to incorporate the teaching of bioeconomy in schools/ universities?</p> <ol style="list-style-type: none"> 1. Incubating business ideas – start-ups/ scale-ups; 2. Internships (students, early stage researchers); 3. Guest lecturers from the practice; 4. Grants/ competitions for promising students; 5. Short-term exchanges in the network; 6. Field trips 7. Hackathon 8. Role playing games <p>B: Where best to incorporate the teaching of bioeconomy in different subjects?</p> <ol style="list-style-type: none"> 1. Entrepreneurship, management, regional/ rural development 2. Social sciences 3. Vocational schools
Latvia	<p>A: How to incorporate the teaching of bioeconomy in schools?</p> <ol style="list-style-type: none"> 1. Learning startups - teaching enterprises - https://jalatvia.lv/bsmu https://jalatvia.lv/bnews/news/770 (video); Cultural heritage - Mārtiņdiena https://fb.watch/5S2wZSXpIB/ and https://youtu.be/ftlhyqF8v_U (video) 2. Learning by doing in all kind of activities is the best! 3. For primary school walking around the school area to assess the bioresources available around and to think application to them. <p>B: Where best to incorporate the teaching of bioeconomy in different subjects?</p> <ol style="list-style-type: none"> 1. in Math to calculate costs of biobased products.

Group	Best ideas for how to implement teaching of bioeconomy in your school/country
	3. in Design and technologies to create biobased products from production waste – leftovers of real production. 3. Languages – different texts about interesting biobased products.
North Macedonia	A: How to incorporate the teaching of bioeconomy in schools? <ol style="list-style-type: none"> 1. Educational field trips 2. Direct involvement of the students in research and presentations 3. School clubs (composting, games, organic food, organic textile) B: Where best to incorporate the teaching of bioeconomy in different subjects? <ol style="list-style-type: none"> 1. Science (Biology, Chemistry) 2. Business and economy 3. Ecology
Croatia and Slovenia	A: How to incorporate the teaching of bioeconomy in schools? <ol style="list-style-type: none"> 1. Extra curricula implementation 2. Industry / school / government partnership 3. Sustainable school / kindergarten buildings are examples of good practice for all community B: Where best to incorporate the teaching of bioeconomy in different subjects? <ol style="list-style-type: none"> 1. Vocational subject 2. Socio dimension 3. Head teacher class 4. STEM
Romania (group 1)	A: How to incorporate the teaching of bioeconomy in schools? <ol style="list-style-type: none"> 1. Extracurricular activities, like school clubs. 2. At biology classes - VIIIth form (13-15 years old children)- we have some classes for this topic in our curricula 3. Experiments of all kinds, based on previous information (site visits) 4. Organise events, like cooking events 5. Projects to involve students 6. Inviting people involved in bioeconomy to explain/share knowledge to Ss (our trainer) 7. Practical activities B: Where best to incorporate the teaching of bioeconomy in different subjects? <ol style="list-style-type: none"> 1. Entrepreneurial education 2. Biology, chemistry, Sciences in general, English class 3. Technologies
Romania (group 2)	A: How to incorporate the teaching of bioeconomy in schools? <ol style="list-style-type: none"> 1. Extracurricular activities, symposia, round tables 2. Workshops-examples of good practice, exchange of experience with professionals in the field, profile camps 3. course hours – optionals B: Where best to incorporate the teaching of bioeconomy in different subjects? <ol style="list-style-type: none"> 1. Technological disciplines, Biology, Geography, Chemistry, Economics etc. 2. Sustainable Development (SDV) 3. Personal development
Romania (group 3)	A: How to incorporate the teaching of bioeconomy in schools? <ol style="list-style-type: none"> 1. In the next year, 2021 – 2022, the Summer School Participants, thanks to the obtained Certificate, could ask at the Regional / Local Education Authority to introduce an optional course in Curricula with adjusted topics according to the Region? Commune (e.g. Mountain zone or Forest one, etc) . 2. For Technologic High Schools = CDL (Curricula for Local Development Course in cooperation with an NGO), not for Theoretical High Schools (only improving to specific Focus, Chemistry, etc). It must be taken into consideration the New Education Plan (from September

Group	Best ideas for how to implement teaching of bioeconomy in your school/country
	<p>2021, beginning with 9th Class).</p> <ol style="list-style-type: none"> 2. For 5 –8 Classes, there is an Integrated Curricula: teachers may propose a new Topic (including Bioeconomy) 3. !!! At least, in Romania, should be compulsory all these subjects ... at least, for start!!! Should not wait for the local initiatives! <p>B: Where best to incorporate the teaching of bioeconomy in different subjects?</p> <ol style="list-style-type: none"> 1. In food processing (food Industry and public catering) - Yes 2. Entrepreneurship – Yes 3. In energy producing (renewable energy, classic energy producing) YES 4. Chemistry / Biology - 5. Material producing (construction materials,) - YES
Romania (group 4)	<p>A: How to incorporate the teaching of bioeconomy in schools?</p> <ol style="list-style-type: none"> 1. New compulsory subjects, e.g. Sustainable Development, Circular Economy, Bioeconomy 2. Extracurricular clubs, with practical applications 3. Partnerships with local companies that use principles of bioeconomy (for student practice) <p>B: Where best to incorporate the teaching of bioeconomy in different subjects?</p> <ol style="list-style-type: none"> 1. In small classes, starting with class I (Knowledge of the environment) 2. In technical disciplines, through laboratory works and other experiments - high school level 3. In Biology and Chemistry / Medicine - gymnasium + high school / university level 4. In economic disciplines (Entrepreneurship, Economics)
Romania (group 5)	<p>A: How to incorporate the teaching of bioeconomy in schools?</p> <ol style="list-style-type: none"> 1. During practical activities 2. During extracurricular activities 3. Multidisciplinary and interdisciplinary activities <p>B: Where best to incorporate the teaching of bioeconomy in different subjects?</p> <ol style="list-style-type: none"> 1. Health education classes from small classes to college 2. At the faculty within the Faculty of Economics / Business, Engineering, Ecology and Environmental Protection, 3. Establishing a new course / new study discipline
Romania (group 6)	<p>A: How to incorporate the teaching of bioeconomy in schools?</p> <ol style="list-style-type: none"> 1. Competitions. 2. Workshops creating or using new materials. 3. Extracurricular activities, like school clubs. 4. Laboratory access. <p>B: Where best to incorporate the teaching of bioeconomy in different subjects?</p> <ol style="list-style-type: none"> 1. Projects for children (Biodiversity, Bioeconomy, LeAf for example). 2. Art / Design. 3. Biology and STEM. 4. STEM experiments.

Annex IX – Results of Day 2 zoom poll questions

Day 2 started with a zoom poll with four questions and 82 people replied:

1. Did you attend Day 1 of the summer school on 25 May?
2. What country do you work?
3. How did you find out about the BE-Rural summer school?
4. What high school subjects are relevant to incorporate bioeconomy?

