

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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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 818478.

Document information			
Project name:	BE-Rural		
Project title:	Bio-based strategies and roadmaps for enhanced rural and regional development in th EU		
Project number:	818478		
Start date:	1 st April 2019		
Duration:	36 months		

Report:	D3.3: Summer school curriculum and materials	
Work Package:	WP3: Education, awareness & engagement	
Work Package leader:	STRATH	
Task:	Task 3.3 Teachers' summer school on sustainability and the bioeconomy	
Task leader:	STRATH	
Responsible author(s):	Elsa Joāo (STRATH)	
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Planned delivery date:	M24	
Revised delivery date:	M27	
Actual delivery date:	M27	
Reporting period:	RP2	

Dissemination level of this report

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PP	Restricted to other programme participants (including the Commission Services)	
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СО	Confidential, only for members of the consortium (including the Commission Services)	

ACKNOWLEDGMENTS & DISCLAIMER

Thanks must first go to the more than 100 participants of the bioeconomy summer school, which took place over three days on 25th May, 1st June and 8th June 2021, without whom this summer school would not have been possible. The participants' input and discussions generated very interesting ideas presented in this report.

Many thanks to Rachel Moir (Skills Programme Manager, IBioIC) who organised, chaired and delivered Day 3 of the summer school, sharing the innovative work that IBioIC is doing with schools and University education in Scotland.

We are most appreciative to the guest speakers for their presentations on 8th June 2021: Debbie McCreath (Public Affairs Manager, IBioIC), Graeme Rough (Head of STEM programmes, Scottish Schools Education Research Centre), and Dr Jo Sadler (Leaders in Science Founder and BBSRC Discovery Fellow, University of Edinburgh). The sharing of their experience and expertise was very valuable and inspirational.

Thanks as well to Neli Georgieva and Stefan Kah (from the European Policies Research Centre), who helped with the Q&A and discussion on Day 1 and Day 2 respectively. An important thanks must go to Neil Cochrane (University of Strathclyde), who tested the two Qualtrics online surveys to make sure they were clear and working, and to Clément Robijns and Lily Teitelbaum (both from BIOCOM), who helped with the registration and the web page for the summer school. Finally, thanks to Fiona Inglis (student on the MSc Sustainability and Environmental Studies) for the beautiful graphs used in her self-transformation sustainability project that were shared with the summer school attendees.

Several people reviewed a draft of this document and many thanks are due to their ideas and insights: Holger Gerdes and Zoritza Kiresiewa (both from Ecologic Institute), Raluca-Ioana lorgulescu (Institute for Economic Forecasting, Romanian Academy), Ludmila Metzova and Martin Stoyanov (Bulgarian Industrial Association - Union of the Bulgarian Business) and my husband Andrew Thompson.

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Joāo, E. (2021): Outcome of the summer school for teachers interested in developing bioeconomy curricula – materials and discussion results. BE-Rural Project, https://be-rural.eu/.

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 multilanguage 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 (Joāo, 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 B	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	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	
KC AD RUL	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.	Romani a	Dr Carmen Pauna pauna_carmen@ip e.ro	
SDEWESSKOPJE	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 M acedoni a	Emilija Mihajloska emilija.mihajloska @sdewes.org sdewes.skopje@s dewes.org	
SILAVA	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@si lava.lv	
NATIONAL MARINE FISHERIES RESEARCH INSTITUTE	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.g dynia.pl	

BULGARIAN INDUSTRIAL ASSOCIATION Union of the Bulgarian Business	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
		environmentally sound development of marine fisheries.		

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 Environmental Engineering (CEE) and (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 (Joāo, 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/.



BE-Rural	BE-Rural	BERural
Био-базирани стратегии и патокази за подобрен рурален и регионален разкој во EУ	BE-Rural: Bologiczne strategie i many drogowe na rzacz lepszago rozweju doszarów wiejskich i regionów w UE	Strategii bioeconomice și foi de parcurs pentru intensificarea dezvoltării runale și regionale în UE
Едукативни материјали за одржливост, циркуларна економија и биоекономија за основни и средни училишта и универзитети	Materiały edukacyjne na temat zrównoważonego rozwoju, gospodarki cyrkularnej i biogospodarki dla szkół i uczelni	Materiale didactice în domeniul dezvoltării durabile, al economiei circulare și al bioeconomiei destinate învățământului primar, secundar și terțiar
уни 200 година Елза Жово Округорани и продокта у продокта за истранувања и исоводин на Средноста у мира Доректа за истранувања и исоводин на Европоста у мира Доректа у Продокта за истранувања и исоводин на	Carevise 200 Elsa João veve be-caral es	Lung 2020 Privat fleange In cabu programului printo censtere y inverse al Uniori Europere Classif 2020 pri custeaului de fleange n. 6.64418.

Figure 3: The educational resources in the different languages available in web page https://berural.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 (Joāo, 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).



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.



Area wells he some of the	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.
	"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.
Easier word search- 10 hidden words R E N E W & B L E M A N A S O T I H C T Q L N O I T & 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 & 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	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.

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).

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

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.



Figure 8: Educational events in Bulgaria



Figure 9: Educational events in Latvia



Figure 11: Educational events in Poland



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, ¼ were organisers of these events and ¾ 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.

		2. What kind of teacher are you?	
		Pre-school teacher	(4) 4%
		Primary school teacher	(10) 11%
1. Have you used zoom before?		Secondary (high-school) teacher	(50) 53%
Yes	(90) 95%	University lecturer	(8) 8%
No	(5) 5%	I am not a teacher	(23) 24%

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.

3. Have you heard Sustainable Deve	d of the United Nations lopment Goals (SDGs) 58%	; ? (55) 58%
No	42%	(40) 42%
4. How much do y	ou know about sustair	nability?
Nothing		(1) 1%
Very Little	59%	(17) 18%
A little	_	(38) 40%
A lot		(35) 37%
Very much	41%	(4) 4%

	(12) 13%
78%	(12) 13%
	(49) 52%
	(20) 21%
330/	
	78%

6. How much do you know about the bioeconomy?		
Nothing		(5) 5%
Very Little	75%	(21) 22%
A little		(45) 47%
A lot	350/	(22) 23%
Very much	23%	(2) 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 biobased 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):

- 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).



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 bieconomy, 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:



sserc

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.



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

- 16.40 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 Polices 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.

-Rural

Speakers Bios (continued)



Rachel Moir (Day 3)

Rachel manages IBioIC'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 IBioIC's Public Affairs strategy, as IBioIC's Public Affairs Manager, and looks after all of IBioIC'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 IBioIC. Prior to joining IBioIC 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 IBioIC 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 biobased 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 (noting) 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	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc
Sustainability	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc
Circular economy	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc

- **Q9.** Overall, on a scale from 1 (not satisfied) to 5 (extremely satisfied) how satisfied are you with Day 1 of the summer school?
 - o Not satisfied (1)
 - o A little satisfied (2)
 - o Satisfied (3)
 - o Very satisfied (4)
 - o 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?
 - 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. 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)
 - (1) o
- A little satisfied (2)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 Very satisfied (4)
- o A little satisfied (2)
- o Extremely satisfied (5)
- o Satisfied (3)

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	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc
Understanding sustainability	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc
Understanding of circular economy	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc

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

- o Yes
- o No
- o 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?





Bioeconomy around the world Bioeconomy Policies around the Worl	Jobs and the bio-based sectorColspan="2">Colspan="2" <td cols<="" th=""></td>	
A SUSTAINABLE B DE DE CONDEMY DE RE URDER DE REURDER STEMATHERING THE CONNECTION RETWEET DE REURDER Maintes and 9 seconds): <a hrefs:="" wstch?v="RIM_htems</a" www.youtube.com=""> Maintes and 9 seconds): <a hrefs:="" wstch?v="RIM_htems</a" www.youtube.com="">	Constraints of the entry o	
Biomass knowledge is critical Biomass is the physical basis of the bioeconomy Comparing the physical basis of the bioeconomy operates within safe ecological limits. Very importantly, it is fundamental that the bioeconomy operates within safe ecological limits. Comparing the physical basis of food production but may be important for biodiversity. For example, marginal lands may not be used for food production but may be important for biodiversity. Et (2019), Biomass - Knowledge for policy, https://sc.europa.eu/hnowledge4policy/bioeconomy/topic/biomass.em	Q&A Any questions in the chat?	
Day 1 outline programme Velcome - plus about Dr Eta Jolio and the University of Strathclyde - Monte - plus about Dr Eta Jolio and the University of Strathclyde - Monte - plus about Dr Eta Jolio and the University of Strathclyde - Monte - plus about Dr Eta Jolio and the University of Strathclyde - Monte - plus about Dr Eta Jolio and the University of Strathclyde - Monte - plus about Dr Eta Jolio and the University of Strathclyde - Monte - plus about Dr Eta Jolio and the University of Strathclyde - Monte - plus about Dr Eta Jolio and the University of Strathclyde - Monte - plus about Dr Eta Jolio and the University of Strathclyde - Monte - plus about Dr Eta Jolio and the University of Strathclyde - Monte - plus about Dr Eta Jolio and the University of Strathclyde - Monte - plus about Dr Eta Jolio and the University of Strathclyde - Other view University - 15:45 CET (2:30-2:45pm UK time) - Discussion on how can bioeconomy learning be integrated in school teaching Utility - 17:10 CET (4:15-4:30pm UK time) - Discussion on how can bioeconomy tearning be integrated in school teaching Utility - 10 CET (4:15-4:30pm UK time) - Fill ffeedback survey about Day 1 of the summer school - Q&A, summary day 1, and link to day 2	<section-header><section-header><section-header><section-header><section-header><section-header><section-header><section-header><section-header><section-header><section-header></section-header></section-header></section-header></section-header></section-header></section-header></section-header></section-header></section-header></section-header></section-header>	
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Q&A	Day 1 outline programme
Any questions in the chat?	14.00 - 15:30 CCT (1:2.30pm UK time) • Welcome - plus abut DF Els Jolas and the University of Strathclyde • About the BF-Rural Project • Introduction to the Summer School • Key principles of biseconomy • About the GF-Rural Project • 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 (2:45-4.15pm UK time) • Key principles of sustainability and the UN SDGs Overview bioeconomy events in each region • Discussion on how can bioconce by US-Frural Overview bioeconomy events in each region • Discussion on how can bioconcomy UK time) • Fill feedback survey about Day 1 of the summer school • Q&A, summary day 1, and link to day 2 • O&A, summary day 1, and link to day 2
BE-Rural Educational Materials	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 (all in here: https://be-rural.eu/resources/ Deliverable 3.2: João, E. (2020): Educational materials (all in here: https://be-rural.eu/resources/ Deliverable 3.2: João, E. (2020): 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.	BE-Rural educational materials include four main type of resources:
>> Also available in <u>Bulgarian, Romanian, Macedonian, Polish</u> , and <u>Latvian</u> .	Output 1 - Review of 100 existing free online educational resources Output 2 - Power point slides for presentations with notes for teachers
	Output 2 - Vorte point inter to prestruction mannees to recently Output 3 - Workshops, quizzes and games
Bandbard relation in sublicity Bandbard re	Output 4 - Proposed extracurricular activities (e.g. school clubs)
BE-Rural Educational Materials	Existing Educational Materials
Output 1 - Review of 100 existing free Durble ducational resources	Of the 100 listed reter videos or include videos. Many of the videos inguiges available in aubitities. Video (1 minute and 57 seconds): Intro/Liveovide.com/watch?=2xxXOMED4 Languages for ubob tities for video include: Bilgarian, Latvian, Meedonian, Polish and Romanian
Review available in Fighth, Bugstan, Latvian, Medenkina, Pulish and Romanian (all where therein Schemerker Generation)	Existing Educational Materials
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BE-Rural Educational Materials	BE-Rural Educational Materials
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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)









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





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	1. green garden
	2. trips from time to time combined with optional courses; 12 th grades; waste turned into
	different products (manure into seedling pots)
	3. to taste similar products: organic and usual ones
2	1. entrepreneur education high-school education
	biology, economy and geography common activities
	3. non-formal education, drawing contest
3	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 were 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	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	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	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 snow pupils/students the creation of a bioproduct and its use
7	3. Invite experts/lecturers to speak about the bioeconomy/bioproducts etc.
/	1. New extracurricular activity each year
	2. Visiting the most successful bloeconomy in rural area
	3. Link circular economy from urban schools with the bioeconomy from rural schools by
0	changing the teaching place for children norm time to time
0	2. workshapps in along with recycloble materials
	2. WORKSHOPS III Class with recyclable materials
0	1. circular activity laboratory access, excursions to bio practice places
9	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	1 Bioeconomy products from region/country + Visits/Discussions with local entrepreneurs
10	 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?

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

		-	
Subject teaching.	Extra curricular	Art	Business
Workshops creating	activities, like	Craft	Economics
or using new	school clubs.	Design	Entrepreneurship
materials.	Events, grants &	Biology	Geography
Laboratory access.	tory access. Competitions ool trips. Industry talks.	Computin	g Psychology
School trips.		STEM	Sociology
Site visits.	Industry projects.		

Group	Best ideas for how to implement teaching of bioeconomy in your school/country
Bulgaria	A: How to incorporate the teaching of bioeconomy in schools/ universities?
	 Incubating business ideas – start-ups/ scale-ups;
	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
	B: Where best to incorporate the teaching of bioeconomy in different subjects?
	 Entrepreneurship, management, regional/ rural development
	2. Social sciences
	3. Vocational schools
Latvia	A: How to incorporate the teaching of bioeconomy in schools?
	1. Learning startups - teaching enterprises
	 https://jalatvia.lv/bsmu https://jalatvia.lv/bnews/news/770 (video); Cultural heritage
	- Martindiena https://fb.watch/5S2wZSXpIB/ and https://youtu.be/ftlhygF8y_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.
	B: Where best to incorporate the teaching of bioeconomy in different subjects?
	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 –			
	3 Languages – different texts about interesting biobased products			
North	A: How to incorporate the teaching of bioeconomy in schools?			
Macedoni	1. Educational field trips			
а	2. Direct involvement of the students in research and presentations			
	3. School clubs (composing, games, organic rood, organic textile)			
	B: Where best to incorporate the teaching of bioeconomy in different subjects?			
	1. Science (Biology, Chemistry) 2. Business and economy			
	3. Ecology			
Croatia	A: How to incorporate the teaching of bioeconomy in schools?			
and	1. Extra curricula implementation			
Siovenia	3 Sustainable school / kindergarten buildings are examples of good practice for all			
	community			
	R: Where best to incorporate the teaching of bioeconomy in different subjects?			
	1. Vocational subject			
	2. Socio dimension			
	3. Head teacher class			
Romania	A: How to incorporate the teaching of bioeconomy in schools?			
(group 1)	1. Extracurricular activities, like school clubs.			
	2. At biology classes - VIIIth form (13-15 years old children)- we have some classes			
	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?			
	1. Entrepreneurial education			
	2. Biology, chemistry, Sciences in general, English class			
Romania	A: How to incorporate the teaching of bioeconomy in schools?			
(group 2)	1. Extracurricular activities, symposia, round tables			
	2. Workshops-examples of good practice, exchange of experience with professionals			
	3. course hours – optionals			
	1. Technological disciplines, Biology, Geography, Chemistry, Economics etc.			
	2. Sustainable Development (SDV)			
	3. Personal development			
Romania	A: How to incorporate the teaching of bioeconomy in schools?			
(group o)	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			

STEM experiments.

Group

Romania (group 4)

Best ideas for how to implement teaching of bioeconomy in your school/country		
2021, beginning with 9th Class).		
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 star Should not wait for the local initiatives!	rt!!!	
 B: Where best to incorporate the teaching of bioeconomy in different subjects? 1. In food processing (food Industry and public catering) - Yes 2. Entrepreneurship – Yes 		
 In energy producing (renewable energy, classic energy producing) YES Chemistry / Biology - 		
5. Material producing (construction materials,) - YES		
 A: How to incorporate the teaching of bioeconomy in schools? 1. New compulsory subjects, e.g. Sustainable Development, Circular Econor Bioeconomy 	ny,	
2. Extracurricular clubs, with practical applications		
 Partnerships with local companies that use principles of bioeconomy (for stude practice) 	ent	
3: Where best to incorporate the teaching of bioeconomy in different subjects?		

- B: Where best to incorporate 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
In economic disciplines (Entrepreneurship, Economics)

		4. In economic disciplines (Entrepreneurship, Economics)
I	Romania	A: How to incorporate the teaching of bioeconomy in schools?
	(group 5)	1. During practical activities
		2. During extracurricular activities
		3. Multidisciplinary and interdisciplinary activities
		B: Where best to incorporate the teaching of bioeconomy in different subjects?
		 Health education classes from small classes to college
		 At the faculty within the Faculty of Economics / Business, Engineering, Ecology and Environmental Protection,
		3. Establishing a new course / new study discipline
ľ	Romania	A: How to incorporate the teaching of bioeconomy in schools?
	(group 6)	1. Competitions.
		2. Workshops creating or using new materials.
		3. Extracurricular activities, like school clubs.
		4. Laboratory access.
		B: Where best to incorporate the teaching of bioeconomy in different subjects?
		2 Art / Design
		3. Biology and STEM.
1		

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?

	2. What country do you work?		
		Bulgaria	(8) 10%
		Croatia	(3) 4%
		Latvia	(2) 2%
Did you attend Day 1 of the summer sc lay?	hool on 25	North Macedonia	(4) 5%
ttended the full 3.5 hours of Day 1	(52) 63%	Poland	(0) 0%
ttended less than the 3.5 hours of Day 1	(14) 17%	Romania	(56) 68%
d not attend Day 1	(16) 20%	Other	(9) 11%
How did you find out about the BE-Rui hool?	ral summer	4. Participants in Day 1 suggeste bioeconomy topic in every subject	d to "incorporate ct".
om school management	(25) 30%	What high school subjects are relevant to incorporate bioeconomy? (pick all that apply) (Multiple Choice)	
om a colleague	(10) 12%	Art and Design	(20/82) 24%
om a friend	(5) 6%	Biology	(49/82) 60%
om school inspector	(14) 17%	Business and Entrepreneurship	(51/82) 62%
om BE-Rural	(16) 20%	Chemistry	(30/82) 37%
om POWER4BIO	(1) 1%	Computing	(6/82) 7%
om BIQEAST	(0) 0%	Engineering	(32/82) 39%
		Geography	(33/82) 40%
om social media (e.g. WhatsApp, Facebook)	(3) 4%	Physics and Mathematics	(6/82) 7%
m the internet	(5) 6%	Sociology and Psychology	(13/82) 16%
er	(3) 4%	Technology	(39/82) 48%