Institute of Soil Science
and Plant Cultivation
State Research Institute

New Strategies on Bio-Economy in Poland

BioEcon

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Report on new interdisciplinary strategy

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Summary

The ERA Chair and the other members on the Management Board have conducted a joint analysis of IUNG's research, objectives and strategy. Thus, the ERA Chair got familiar with the Institute's strengths, weaknesses, and goals. Concrete research endeavours were analysed and key points in the strategic plan outlined. Further, a detailed analysis of the activities and national collaborations of IUNG were conducted in order to build on all existing strengths and connections for the creation of a solid research and innovation strategy seeking high performance and regional impact. The key aspects and milestones in the new interdisciplinary strategy were jointly agreed, thus IUNG's strategy was reviewed with the corrective opinion and ideas of a leading scientist and manager. This report includes key aspects and milestones of interdisciplinary strategy.

Included in the objectives of BioEcon (see WP3) are to set the grounds for the implementation of the new interdisciplinary strategy for research and innovation leading to the development of a sustainable bioeconomy in Poland, taking into full consideration the regional development aspect reflected by the S3, the existing potential in the country, and the needs already expressed by Public authorities and to develop a plan for full implementation of ERA priorities. IUNG management and researchers are willing to break the status-quo and embrace structural changes that will increase the excellence of the institute and make it attractive for mobility of international researchers of high capacity. The management has already vision of what and how to change, and under the guidance of the ERA chair, the desired transformation can be successfully implemented.

WP3 includes setting up the interdisciplinary strategy vision and objectives, setting up an action plan for a refined interdisciplinary research and innovation strategy implementation, analysis of the structural changes needed in the institution to implement ERA priorities.

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1 Introduction

Concerns over climate change, resource depletions and the economic development of rural communities have led to the development of European, national and regional strategies for the development of alternative ways to power our economy while still getting all the products and well-being that a functional economy provides. The support for robust and sustainable bioeconomy strategies is gaining momentum all over the world, particularly in those countries where agriculture still plays a large role.

Poland's agricultural sector still plays a large role domestically and internationally. According to the EC, Eurostat and DG-Agri (2016), predominantly rural regions in Poland contribute to a significant share of the territory and population (48% and 33%, respectively) and economy in terms of both GVA (24%) and jobs (33%). Clearly, a more proportional value could be made that increases its share in GDP. Internationally, Poland ranks among the 20 largest agricultural producers, both in terms of physical output (e.g. 32Mt of cereals) and in terms of value ($bn 16 in 2014). The potential, therefore, for Poland to support bioeconomy strategies is large and that is the focus that will be explored in this report, although from a more research and innovation perspective.

This report contains the interdisciplinary strategy for research and innovation leading to the development of a bioeconomy in Poland. It is one deliverable of Work Package 3 of the project BioEcon.

1.1 Vision, Objectives and Scope for the Interdisciplinary Strategy

The vision of the interdisciplinary strategy is two-fold: 1) By 2020, IUNG and Department of Bioeconomy and Systems Analysis will be a leading reference for bioeconomy sustainability research, aligned with major world players in policy and academia, through its expertise and rich collaborations with the local industry; and 2) By that time, Poland (and particularly Lubelskie) will be at the forefront of bioeconomy research and implementation.

The objective of this strategy is to serve as a master plan of how IUNG can support the development and implementation of a sustainable bioeconomy in Poland, in terms of research and innovation, and taking into account the regional development reflected by the RIS3, and other local conditions and objectives, as well as ERA priorities. In terms of IUNG, the objectives are to develop capabilities in the Department of Bioeconomy and Systems Analysis and IUNG; to deepen and strengthen collaboration with industry; to increase research output with e.g. scientific papers; and to ensure the success of the department in the future.

Fundamental changes to the way of IUNG operating will be recommended and analysed so that the excellence of the institute can be increased and it attracts highly skilled researchers from all over the world.

The present strategy covers the country of Poland, although focus lies in the Lubelskie region. It also includes Europe as a second level of focus. Similarly, the scientific objective of identifying sustainable bioeconomy strategies for the country will not disregard the potential economic and environmental effects that may occur outside the borders of Poland. The temporal scope is June 2020 (and beyond), which is the time by which the BioEcon Project ends. The present strategy is to be regarded as a living document and is subject to change.

The present strategy will be aligned as much as possible with the ERA Priorities, which are:

1. More effective national research systems – including increased competition within national borders and sustained or greater investment in research
2. Optimal transnational co-operation and competition - defining and implementing common research agendas on grand-challenges, raising quality through Europe-wide open competition, and constructing and running effectively key research infrastructures on a pan-European basis
3. An open labour market for researchers - to ensure the removal of barriers to researcher mobility, training and attractive careers
4. Gender equality and gender mainstreaming in research – to end the waste of talent which we cannot afford and to diversify views and approaches in research and foster excellence
5. Optimal circulation, access to and transfer of scientific knowledge including via digital ERA - to guarantee access to and uptake of knowledge by all.

Particular emphasis is put onto ERA Priorities 3 and 4 (see Deliverable 3.3).

2 Analysis of current situation

2.1 Overview of IUNG

The fundamental goal of the Institute is to provide scientific grounds for development of crop production as well as supply methods to protect agricultural ecosystems. The Institute is involved in scientific, research-development, implementation and extension activities, basically organized in two main fields: “Crop Plants research” and “Environmental research”.

Crop Plants research combines the work of 5 departments performing studies on biological, biochemical and agrotechnical aspects as well as development and improvement of crop production technologies. “Environmental research” is conducted by 5 departments performing studies of the adverse effects of environmental agents on humans and animals. The principal aim of the departments is to assess the impact of agriculture on environment. Studies are often carried out in close interdisciplinary cooperation between individual departments. Detailed research activities are given in Deliverable 3.3, including the common areas that are pertinent to Bioeconomy research and which could serve as a basis for strengthening research collaboration between the different departments.

A summary of IUNG, its importance nationally and internationally and the wide array of activities taking place in IUNG are described in detail in the BioEcon project documentation (Annex 1 to the Grant Agreement, description of the Action, Part B). In essence, and of particular relevance to this strategy, it is noteworthy that IUNG has a solid cooperation with:

i) Public bodies (e.g. Ministry of Agriculture and Rural Development, Ministry of the Environment, Ministry of Energy and Local governmental units),

ii) Industry (over 30 industrial partners, among which: fertiliser producers, manufacturers of agricultural machinery, manufacturer of plant protection products, Chemical Plants, Heat and Power Plants, National Sugar Company, Polish Biogas Plants, Enterprises for Implementation and Application of Biotechnology and Genetic Engineering, distracters of plant protection products, fertilizers and gardening accessories,

iii) Research entities (over with 30 universities and research institutes in Poland. Collaborators from abroad include entities in Austria, Belgium, Czech Republic, Egypt, Estonia, Finland, France, Georgia, Germany, Greece, Italy, Hungary, Lithuania, Norway, Spain, Sweden, Switzerland, the Netherlands, UK and USA,

iv) Participations in Global Research Alliance, Central European Bioenergy Centre, Organic Food Valley Cluster, Lublin Eco-Energy Cluster, Farmers regional organisation of Zamość region, Association of Potato Growers in Luboń, Lublin regional self- government farmers organisation, The Agricultural Advisory Centre in Brwinów and its Branch Offices in Poznań, Kraków and Radom (CDR), National Centre for Farming Education, and Regional Farmers Advisory Centres High visibility

The good reputation of the Institute, its increasing activity as well as its position in the scientific world is documented by the following concrete results:

- 54 members of the Institute research staff were nominated by the President of Poland to the professor position during 52 years of IUNG activity,
- 185 Ph.D. dissertations and 67 habilitations were defended
- 35 books were written by IUNG scientists,
- 60 monographs were issued over last 10 years,
- 2,000 scientific papers were published by IUNG scientists over the last 10 years,
- in the last 10 years, 8 licenses were received and 10 new plant varieties were introduced,
- 2 scientific journals are edited by IUNG: Polish Journal on Agronomy and Studies and reports (in Polish) and one monograph series
- IUNG scientists are active in standardisation activities on the international and on the national level
- IUNG represents Poland at COST domain "Food and Agriculture"
- Over 20 international conferences and workshops were organized in IUNG in the last 10 years
- 16 national conferences and 67 national workshops organised in 2009-2013
- 5 recent workshops related to bio-economy and system analysis
- Scientists of IUNG are the members of Editorial Boards of a number of internationally recognized journals;
- Scientists of IUNG are actively working in the Committees of International Societies. 62 scientists are members of International Societies.
- IUNG scientists received 57 awards on national level
- 50 researchers from the Institute were awarded, over the last 10 years, by international bodies with scholarships

The institute is composed by the following academics:

- Professors: 18 (6 of which are women, or 33%)
- Associate Professors: 9 (4 of which are women, or 44%)
- Assistant Professor (adjuncts): 37 (20 of which are women, 54%)
- Assistants: 7 (2 of which are women, or 29%)
- Total academics: 71 (32 of which are women, or 45%)

2.2 Analysis of stakeholders in Poland

2.2.1 Analysis of the environment

The strategic documents on regional and national development strategy were collected and discussed during several meetings. Initial meetings with stakeholders were conducted to establish common collaboration paths with the IUNG-PIB and other joint initiatives on local, regional and national level. Based on conducted activities, the key stakeholders are being selected for future collaboration. The links to important for future work institutions at regional

level like: Foundation for Development of Lubelskie Region and Lublin Business Club were established.

The good cooperatives with Marshal Office of Lubelskie Region was established (several meeting and personal communication). The main responsibility of the Marshal Office of Lubelskie Region is to support the activities regarding the regional economic and innovation policies. The Office is responsible for design and implementation of the Development Strategy of the Lubelskie Region for 2014-2020 (with a perspective to 2030) and the design and implementation of the Regional Operational Programme for 2014-2020, which is the most important financial instrument supporting innovation and R&D activities.

The parallel, communication with following nongovernmental organizations related to bioeconomy was lunch: Polish Chamber of Waste Management (Polska Izba Gospodarki Odpadami), National Chamber of Waste Management (Krajowa Izba Gospodarki Odpadami), Polish Chamber of Natural Technologies and Products (Polska Izba Technologii i Wyrobów Naturalnych), National Chamber of Biofuels (Krajowa Izba Biopaliw), National Council of Agricultural Chambers (Krajowa Rada Izb Rolniczych), Polish Association of Crop Producers (Polski Związek Producentów Roślin Zbożowych), Agricultural Society in Zamość, and Network in Support of Agricultural Innovation.

For the collaboration with SME dealing with bioeconomy more intensive collaboration was established in frame of Eco-Energy Cluster (LKE) and Milk Farmers Association from Podlaskie Region.

The BioEcon project was also invited to the initiatives of Puławski Park of Science and Technology (PPNT) to create partnership with the of City Puławy in creating Regional Centre for Bioeconomy in Puławy. The partners of PPNT are: University of Maria Curie Skłodowska in Lublin, Institute of New chemical Synthesis, The Azoty Group (the biggest fertiliser company in Poland – brand in Pulawy).

2.2.2 Initiation workshop

The Initiation workshop took place in Pulawy from 21st to 22nd of June 2016. 155 participants attended the workshop, including representatives of Ministry of Agriculture and Rural Development (2), Ministry of Science and Higher Education (1), Ministry of Economy (1), Regional Authorities (2), Business representatives (20), Research Institutes and Universities (113), Agricultural Advisory Centres, Lubelskie Framers Chamber. During the workshop 26 oral presentations and 54 posters were presented.

2.2.3 Interaction with policy makers

During the workshop organised by the Ministry of Science and Higher Education in Warsaw (01.07.2016), the BioEcon project concept was presented to policy makers from: the Ministry of Development, the Ministry of Agriculture and Rural Development, the Ministry of Energy and future actions in field of development of the bio-economy in Poland by each individual Ministry were discussed. During the meeting, the representative of European Commission

proposed to present BioEcon project with the statement about bioeconomy perspective in Poland at the workshop "EU Cohesion policy regions: the potential of biomass to bio-based products" in Brussels (07.09.2016). In the workshop participated dr Rafał Pudełko and dr Jerzy Kozyra. Dr Kozyra was proposed by Ministry of Education as a candidate for Scientific Committee of the BBI JU (BIO BASED INDUSTRIES Joint Undertaking).

On the regional level, the meeting with Marshal Office officers was organised by IUNG-PIB-PIB in Puławy (11.08.2016). During the meeting, common future collaboration in the field of bio-economy in Lublin Region was discussed and future activities were planned. The regular meetings on topics relating to the bio-economy was proposed to communicate about BioEcon results.

2.2.4 Research plan with industry

Several ad-hoc interviews with industrial stakeholders form Eco-Energy Cluster (LKE) were conducted. The collaboration with one of the biggest informatics companies in Poland (ASSECO) was launched. We have also taken under consideration the cooperation with Azoty Group – the biggest polish fertilizers that express to support bio-product sector and Farmers Milk Producers Group from Podlaskie Region – the most successful region in recent years in milk production development sector – in supporting strategies for development of environmental practices at farm level.

2.2.5 Synergies with research structures

To involve other research institutes in collaboration with IUNG-PIB, the Bioeconomy Department took part in preparation of 3 proposals of BIOSTRATEG "Polish national strategic programme" announced by The National Centre for Research and Development. The proposed projects involve University of Warmia and Mazury in Olsztyn and other Research Institutes.

2.2.6 Formation of a cluster

During the conducted meetings with LKE, the management board oh LKE proposed to include bioeconomy projects within the structure of existing LKE program, to start collaboration with the existing SME and other organisation in the field of bioeconomy, instead of creating a new cluster. The first lunched project within LKE and BioEcon framework was named: SMART GMINA. In this project the LKE partners will contact and offer for local administration support in developing their strategy for increase energy efficiency and increasing of use of renewable energy. The BioEcon team will build the model for such service for local administration (collaboration) based on two case studies for Partnership Zielawa Valey (5 municipalities) and Tomaszów Lubelski District (13 municipalities).

2.2.7 Database development

The stakeholders' database was elaborated using an internet survey, as well as phone interviewing. The GIS database (regional, for 16 regions) consists of the following groups of stakeholders: Cement plants, Distilleries, Wood and paper plants, fruit and vegetable

processing plants, slaughterhouses and meat processing plant, Pellets producers, Composting plants. The other component of data base relate to Investments on renewable energy: wind farms, wind power plants, fans, biogas plants, agricultural biogas plants, sewage treatment plants, biomass power plants, biomass boiler houses, micro-biogas plants, waste dumping sites, bioenergy plants, heat and power plants, plantations of willow, osier willow, artichoke, Miscanthus (numbers pending).

2.3 Analysis of existing research outputs and databases

BioBoost (7FP) The overall objective of this project is to pave the way for de-central conversion of residual biomass to optimised, high energy density carriers, which can be utilised in large scale applications for the synthesis of transportation fuel and chemicals or directly in small-scale combined heat and power (CHP) plants. The project addresses the complete value chain from feedstock potential, the investigation of pyrolysis and hydrothermal carbonisation conversion technologies, the optimisation of transport and logistics to the exploitation of the energy carrier and its by-products. The techno/economic and environmental assessment includes the complete supply chain.

During the project the Geoportal was developed to present a results of biomass potential assessment. The geoportal includes different types of maps and databases to perform different environmental and economic analysis. Within the project a second tool was also developed called “BioBoost Navigator” which was designed and developed based on techno/economic and environmental assessment of biomass potentials. The experience gained in project and developed tools can allow to proceed more detail analyses on regional scale.

S2Biom(7FP) Sustainable supply and delivery of non-food biomass to support a “resource-efficient” Bioeconomy in Europe. The research work in S2Biom will provide the concentrated capacity (human resources and modelling tools, databases) efforts that are needed to mobilize sustainable resources and prioritise resource efficient biomass value chains by developing balanced biomass policy frameworks which interrelate energy, economy, agriculture, climate change, nature conservation and ecosystem services.

Proficiency (7FP)- The main objective of the PROFICIENCY project was to strengthen IUNG’s excellence through fostering technological, human and partnership capacity, but most of all through a complete reshaping of its internal organisation. The team have established cooperation with AUA, KIT, Research Studio – iSPACE.

Cooperation with those units have profit us with BioBoost project and few impact factor publications. The knowledge and tools (Autarkic Spatial Energy Clusters Optimisation, ASECO) and spatial decision support system (web-SDDS) will allow as to prepare different case studies.

There will also be extensive collaborations with other departments in IUNG (See Deliverable 3.3).

2.4 A Global Overview of Bioeconomy Strategies and Visions

Staffas et al. (2013) summarised the existing documented bioeconomy strategies as follows:

2.4.1 OECD – The Bioeconomy to 2013: Designing a Policy Agenda

- Published in 2009 as the outcome of an interdisciplinary foresight project on BE and biotech.
- Analysis of future biotech developments in agriculture, health and industry.
- The vision is to use biotech to increase sustainability of food, feed and fibre production, improve water quality, improve health for people and animals, maintain biodiversity.

2.4.2 EU – Innovating for Sustainable Growth: A Bio-economy for Europe

- Two documents provide a policy and technical foundation: Communication, setting the scene, and a working document, presenting the action plan in detail.
- The bio-economy encompasses the sustainable production of renewable biological resources and their conversion and that of waste streams into food, feed, bio-based products such as bioplastics, biofuels and bioenergy.
- It includes agriculture, forestry, fisheries, food and pulp and paper production, as well as parts of chemical, biotechnological and energy industries.
- Global approach regarding societal changes.

2.4.3 USA – National Bioeconomy Blueprint

- Definition: A bio-economy is based on the use of research and innovation in the biological sciences to create economic activity and public benefit.
- Objectives include support of R&D investments for a BE, facilitate transitions from lab to market, reduce regulation barriers, identification of and support for development of public-private partnerships.
- Predominantly a political document.
- Driving forces are economic growth, societal benefits, health and environment.

Table 1. Overview of bioeconomy strategies and policies (Staffas et al., 2013)

Country or region	Publication year	Document title	Source	Focus: Technical and/or political	Measureable targets	Priority areas
OECD	2009	The Bioeconomy to 2030: Designing a Policy Agenda	Organisation for Economic Cooperation and Development (OECD)	T	No	Biotechnology, agriculture, health and industry
EU	2012	Innovating for Sustainable Growth: A	European Commission (EC)	P, T in a working document	Economic targets and scenarios	Food, resources, innovation and skills

		Bioeconomy for Europe		accompanying the strategy		
USA	2012	National Bioeconomy Blueprint	White House Administration	P	Yes, qualitative	Biotechnology
Canada	2009	The Canadian Blueprint: Beyond Moose and Mountains	BioteCanada	P	Yes, qualitative	Biotechnology
Germany	2011	National Research Strategy: Our Route Towards a Biobased Economy	Federal Ministry of Education and Research	T	Yes, quantitative	Agriculture, health, food and energy
Finland	2011	Distributed Bio-Based Economy: Driving Sustainable Growth	Finnish Innovation Fund (SITRA)	P	Yes, qualitative	Efficient resource use and biomass refining
Sweden	2012	Swedish Research and Innovation Strategy for a Bio-based Economy	Swedish Research Council for the Environment, Agricultural Sciences and Spatial Planning (FORMAS)	T	No	Efficient resource use and research gaps
Australia	2008	Biotechnology and Australian Agriculture	ACIL Tasman	T, explanatory	No	Agriculture and biotechnology

2.4.4 Canada – The Canadian Blueprint: Beyond Moose and Mountains

- Published by BioteCanada.
- Not a national document, but treated as such. (Interestingly, the state of BC has an official BE strategy and committee.)
- Focuses almost solely on biotech and life science: biological tools and products related to treatments, diagnostics, foods, energy, chemicals and materials
- Five-year goals about stimulation of new capital formation, achieving world leading position in biotech research and commercialization of innovations, creating a new, enabling operational environment to align governmental policies, regulations, research and commercialization efforts.

2.4.5 Germany – Strategy: Our route towards a Biobased Economy

- Bioeconomy encompasses all sectors and related services which produce, process or use biological resources in whatever form.
- The BE combines highly research- and knowledge-intensive economic activities in agriculture, forestry and food sectors with innovative use of renewable raw materials for material and energy use.

- Germany wants to meet its responsibilities for global nutrition as well as protection of the climate, resources and environment.
- Clear and straightforward document emphasizing the importance of R&I in all relevant sectors. Offers illustrating examples of solutions.
- Clearly points out the importance of cross-sectorial activities.

2.4.6 Finland – Driving Sustainable Growth

- There is a need for a comprehensive systematic approach in natural resource issues that takes account of different phenomena and the mutual linkages and interactions of individual actions on both national and multinational levels.
- Finland is developing an official national strategy and vision on the bio-economy, which is expected in 2013.
- This "pre-official" document highlights both national and global perspectives, and the use of the expression "glocal" links different levels of activity on the bioeconomy.
- The document also acknowledges a scarcity of resources, the need to address consumption patterns, and the possibility of a self-sufficient society in Finland in terms of nutrients, food and energy.

2.4.7 Sweden - Research and Innovation Strategy for a Bio-based Economy

- In a bio-based economy (or bio-economy), an increased added value for biomass materials, concomitant with a reduction in energy consumption and recovery of nutrients and energy as additional end products are the corner stones.
- The objective is to optimize the value and contribution of ecosystem services to the economy.
- Change in consumption habits and attitudes and a prioritisation and choice of measures.
- Cross-industry collaboration in research and development
- Acknowledges a conflict of objectives concerning land use (production and environmental interests), showing an awareness that biomass is a limited resource.

2.4.8 Australia - Towards the Development of a Vision and Strategy for the Application of Biotechnology to Australian Agriculture

- Not an official national strategy, but treated as such. The purpose is to inform the Australian Government on how to move forwards on biotechnology in agriculture.
- Refocus the current regulation of GM from an input-based process to an output-based process, to ensure consistency across emerging biotechnologies and to reduce regulation burden and compliance costs.
- It maps the current situation, identifies opportunities and threats, and policy recommendations.

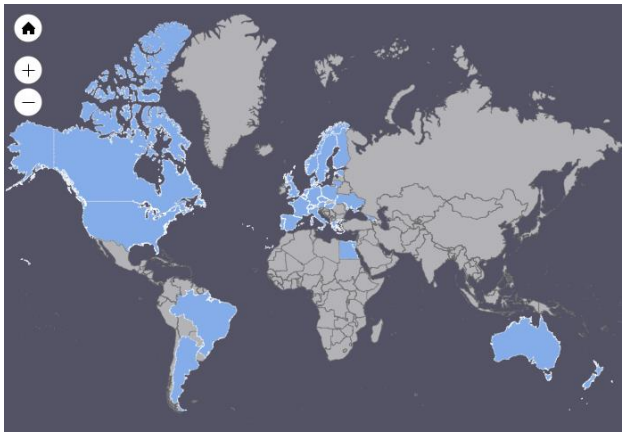
- Interestingly, there is a web portal on the bio-economy in Australia maintained by the Commonwealth Scientific and Industrial Research Organisation. It defines the bio-economy, lists projects and discusses key issues.

In addition to the above, strategies and visions for the bio-economy are under development in significant countries and economies around the world:

- Russia: It has an innovation plan and a bio-economy plan for 2030.
- China: It has a three step bio-economy growth plan from 2007 to 2020.
- Brazil: It has a document on how it can act in developing the bio-economy, both nationally and globally.
- Malaysia: It has launched a bio-economy initiative and a national biomass strategy with three phases from 2005 to 2020.

2.5 Bioeconomy research in Poland and abroad

This section aims at analysing the interdisciplinary research and innovation strategies for bioeconomy of partner research centres and countries, such as Finland and Germany, as well as identifying synergies with other research establishments in Poland and in Europe, which could be explored further.



2.5.1 Poland

Since one of the main task of BioEcon is to promote the development of bioeconomy in the country, particular attention is given also to the Polish institutions with whom synergies in this field are considered particularly beneficial for success of the project.

Warsaw University of Technology/Faculty of Building Services, Hydro and Environmental Engineering *(Nowowiejska 20, 00-653 Warsaw)*
https://www.is.pw.edu.pl/index.php/en/faculty

The Faculty is a part of the Warsaw University of Technology, one of the largest and highest-ranking in Central Europe. The Faculty of Building Services, Hydro and Environmental Engineering conducts its principal educational and scientific mission along with applied

research and services in a wide range of disciplines related to environmental engineering and to the bioeconomy development.

University of life sciences in Lublin / Faculty of production engineering *(13 Akademicka Street, Lublin)*
http://www.up.lublin.pl/research/

The main topics related to the development of bioeconomy are: bio-fuels and renewable energy sources; starting internal combustion engines, logistics, processing and storage of agricultural products and food, macro- and micro-technologies in sustainable regional development, physical and chemical properties of raw materials and agricultural products; water erosion of soil and water and sewage management, process automation in the food industry.

Lodz University of Technology *(116 Żeromskiego Street 90-924 Lodz)*
https://www.p.lodz.pl/en/welcome-lodz-university-technology
The Lodz University of Technology was directly involved in the construction of the so called "Polish Bioeconomy Technology Platform" (PTPB; Polska Platforma Technologiczna Biogospodarki) that brings together over 60 business partners, research institutions and universities.
The main mission of PTPB is:

- networking and events in the bioeconomy
- chance of dynamic development of the bioeconomy
- increase the competitiveness of bioeconomy industry
- integration of intellectual and research potential with bioeconomy plants
- intersectoral integration for the development of the bioeconomy in Poland.

The main activity of the cluster is concentrated in the following areas: functional foods, biopolymers and bioplastics, biorefineries and biofuels, maritime bioeconomy, forest bioeconomy and wood-based industries, primary production, biotransformations, the impact on climate and new, bio-based materials used to wrap or protect goods.
Other research areas identified at the Lodz University of Technology/ Faculty of Process and Environmental Engineering related to the bioeconomy development are:
Biotechnology and environmental management; Improvement of bioproduct separation methods; designing and improvement of biotechnological equipment; kinetics, modelling and optimization of biotechnological processes; biochemical and thermal utilization of solid wastes and sewage sludge; unit processes and operations in environmental engineering; atmospheric protection engineering; thermal and calorimetric analysis; environmental management.

Institute of Agricultural and Food Economics - National Research Institute
http://www.ierigz.waw.pl/

The Institute of Agricultural and Food Economics - National Research Institute is an independent scientific and research center with 60 years of scientific achievement and

experience in analyzing economic and production processes in the Polish agriculture and food economy. The institute is organize in department, each of which can cover a strategic role for bioeconomy development in Poland:

- General Economics Department;
- Economics of Farm Holdings Department;
- Food Industry Economics Department;
- Social and Regional Policy Department;
- Market Research Department;
- Agricultural Accountancy Department;
- Horticultural Economics Department;
- Agricultural Finance Department;
- Mathematics Application in Agricultural Economics Department.

Since May 2004 the Institute has acted as the FADN Liaison Agency, which entails collecting farm accountancy data within the European system. FADN (Farm Accountancy Data Network) is a tool that facilitates the programming and implementation of the Common Agricultural Policy in 27 EU Member States. The collaboration between IUNG and the Institute of Agricultural and Food Economics/ Agricultural Accountancy Department (already started as one of the firsts outcome of BioEcon) cover therefore a fundamental role in data collecting and in the implementation of new strategies for the development of bioeconomy in Poland.

2.5.2 Germany

University of Hohenheim/Research Center for Bioeconomy *(Wollgrasweg 43, 70599, Stuttgart)*
https://biooekonomie.uni-hohenheim.de/en/researchcenter

University of Honenheim claims that is has made “bioeconomy its focus for research & teaching”, and that it ranked no.1 in “Agricultural Research and Food Sciences” in the 2016 National Taiwan University (NTU) ranking. They aim to further develop the following research fields: securing global food supply, bioenergy and renewable resources, overall sustainable development.

Bioeconomy Research Baden-Württemberg
http://www.bioeconomy-research-bw.de/en/111938

The Bioeconomy Research Program Baden-Württemberg was designed to support the research and networking bioeconomy strategy of Baden-Wurttemberg. It consists of three research networks in the areas of biogas, lignocellulose and microalgae, along with integrative activities: the competence network modeling the bioeconomy, the graduate program BBW ForWerts and accompanying research activities in social sciences and ecology. It is closely linked with the University of Hohenheim. Moreover, the Bioeconomy Research Baden-

Württemberg coordinates the 2nd International Bioeconomy Congress, taking place in Stuttgart (Hohenheim University), September 12-13, 2017.

University Bonn/Institute for food and resource economics *(*Nußallee 21, 53115, Bonn)
http://www.ilr.uni-bonn.de/index_e.htm

Particular relevant in the field of bioconomy are the researches carried on in the field of Economic modelling for energy and agricultural policy analysis, Land Use Change impacts and Life Cycle Assessment methodologies. Several studies are focus on the impacts of agricultural, environmental and trade policies on the agricultural sector, the environment and rural areas based on quantitative analysis with different types of economic simulation models.

Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB-Potsdam, *Max-Eyth-Allee 100, 14469, Potsdam)*
https://www.atb-potsdam.de/en/meta2/contact.html

ATB-Potsdam is structured in 6 research departments. Those doing bioeconomy-related work are the Dept. of Bioengineering and the Dept. of Technology Assessment & Substance Cycle. Their research work covers LCA, biogas, biogasification, use of biochar, cost-benefit assessments, biobased products and overall organic waste management, among others. They own one of Europe's largest bioplastic pilot-scale lab, in addition to a modern biogas lab. They are member of the MACSUR network.

Thunen Institute (Bundesalle 50, 38116 Braunschweig)
https://www.thuenen.de/en/

Formerly known as "FAL" (Federal Agricultural Research), the Thunen Institute performs research "targeted at developing concepts for a sustainable, ecologically viable and competitive agriculture & food economy, forestry & wood economy, fisheries & aquaculture". They have a long tradition within agricultural research in Germany (broadly covering all sub sectors of agriculture), in spite of their new structure from 2008. Many of their publications, however, are in German. Among their recently published work figures publications on grasslands, land use and management, the effect of windmills on pollinators. They are member of the MACSUR network.

IINAS (Heidelberger Str. 129 1/2. D-64285 Darmstadt, Germany)
http://iinas.org/about.html

The International **In**stitute for Sustainability **A**nalysis and **S**trategy (IINAS) is an independent transdisciplinary research organization defining themselves as a think tank. IINAS focuses on integrated analysis, participatory modeling and strategy development for key sustainability issues such as biodiversity, climate change, employment, land use, and resource efficiency.

With regard to energy, resource efficiency and material flows, IINAS addresses both supply and demand side issues, e.g. sustainable consumption. Their analysis addresses key quantitative environmental indicators such as greenhouse gas and air emissions, resource use (land, raw materials, primary energy, water), wastes as well as costs and employment effects. They have among others developed the GEMIS model and database. Their main clients are governmental agencies throughout Germany and Europe, and they perform several projects connected to biomass & overall bioeconomy.

Karlsruhe Institute of Technology (KIT)

https://www.kit.edu/research/helmholtz_programs.php

KIT performs research and teaching within renewable energy and indirectly, bioeconomy. Their area of research covers: "energy efficiency, materials and ressources", "renewable energies", and "storage systems" for future renewable energy systems. They cover bioeconomy through addressing its role for sustainable future renewable energy systems, with a clear focus on technology.

2.5.3 Denmark

*Aarhus University (*Nordre Ringgade 1, 8000 Aarhus*)*

http://www.au.dk/en/

Aarhus University teaches and performs research on bioeconomy. Several departments are doing research work on bioeconomy. The key ones are: Department of Agroecology, School of Engineering (relatively new group), Department of Environmental Science. The research lines they respectively focus on are: biorefineries, with focus on the feedstock side (management practices with lower GHG emissions and nutrient losses, new technologies/practices to increase overall DM yield, organic agriculture, livestock farming & manure management, LCAs, new protein sources, etc.); technologies integrating biomass and fluctuating power (they are responsible for Denmark's unique research-dedicated biogas plant); resource flows in the environment / sustainable energy & environment (they mostly perform studies directly commissioned by the Danish Ministry of Food and Environment). One key study from the Dept. of Agroecology is the famous +10M tonnes plan, showing how additional biomass can be produced without negative effects on the environment, really much used by the Danish authorities.

Agro Business Park A/S (*Niels Pedersens Alle 2, 8830 Tjele*)

http://www.agropark.dk/

Through involved in several national & EU research projects, ABPs' bioeconomy focus is mostly within "innovation". ABP is a science park specializing in knowledge based innovation and entrepreneurship within agriculture, bioenergy, environmental technologies and food

processing. ABP is well-connected within the Nordic/Baltic countries and organizes a lot of business-to-business meetings, innovation competition & workshops within the various sectors of bioeconomy. A (still) small but fast-growing strategic player in the Danish/Nordic bioeconomy arena.

*2.-0 LCA Consultants (*Rendsburggade 14, 9000 Aalborg*)*
http://lca-net.com/about/who-we-are/

A consulting company performing a variety of bioeconomy-related work, among others foundation work for assessing the environmental impacts of land use changes. As their name indicate, their major focus is LCA, and some of their latest bioeconomy-related research work include an assessment of the consequences of biowaste management, LCA of milk, LCA of microalgal biorefinery. Through some of their staff members, they are affiliated with Aalborg University.

Copenhagen University (*Nørregade 10, DK-1017 Copenhagen K*)
www.ku.dk

Copenhagen University teaches and performs research on bioeconomy. Several departments are doing research work on bioeconomy. The key ones are within the Faculty of Sciences, namely: Dept. of Plant and Environmental Sciences and Dept. of Food and Resource Economics (IFRO). The former covers a variety of topics/fields such as LCA, biobased materials, organic waste management, biochar, etc,. The latter covers topics such as green certificates, sustainable diets, public attitudes & willingness-to-pay. Copenhagen University also coordinates the BioValue Spir platform, a consortium of universities, large & small businesses aiming at "making sustainable solutions for biorefinering technologies", which ends in 2018. Moreover, the Centre of Macroecology, Evolution and Climate is performing work on planetary boundaries and the role of biological processes and biodiversity on the cycling of carbon in the upper ocean and how this impacts food webs and the global carbon cycle. The Sustainability Centre, through not a research centre in itself, is a consortium of active researchers organizing, among others, public lectures and events, such as the International sustainability science congress of 2014.

Denmarks' Technical University (DTU, Anker Engelunds Vej 1, 2800 Kgs. Lyngby*)*
http://www.dtu.dk/

DTU teaches and performs research on bioeconomy. DTU is doing work within bioeconomy mostly through the following entities: DTU Environment & DTU Management Engineering. The former includes research on biogas, waste and biowaste management, bioenergy and energy conversion technologies, LCA, MFA. The latter encompasses work on Life Cycle Impact Assessment methods, on sustainable diets, and on energy system analysis (integration of bioenergy with overall renewable energy systems). DTU-Environment developed a tool called Easetech, which models waste management and bioenergy and helps performing LCA for

these systems, with a focus on material flow. A training course on this tool is running every year since ca. 2009 and attracts PhD students and professionals from all over the World.

University of Southern Denmark (SDU, *Campusvej 55, 5230 Odense M.*)
www.sdu.dk

SDU teaches and performs research on bioeconomy. SDU is doing work within bioeconomy mostly in the department of Chemical Engineering, Environmental Technology and Biotechnology. This emcompasses the following research areas: LCA, MFA, waste management, manure management, biogas, energy system analysis, industrial symbiosis, micro algae, natural bio-products (pharmaceuticals & nutraceuticals, among others).

*Danish Energy Agency (*Amaliegade 44, DK-1256, Copenhagen K*)*
www.ens.dk

The Danish Energy Agency administers energy and supply in Denmark as well as climate initiatives. Their work within bioeconomy includes mostly bioenergy and the use of biowaste for energy. The bioenergy work includes the so-called Danish Biogas taskforce, which is probably one of the Worlds' most comprehensive work on biogas and biomethane. Though most information is published in Danish, some reports are also available in English.

Energinet.dk (*Tonne Kjærsvej 65, DK-7000, Fredericia*)
http://www.energinet.dk/EN/Sider/default.aspx

Energinet.dk is the Danish Transmission System Operator (TSO) and owns the Danish electricity and gas transmission system. Their main task is to maintain the overall short-term and long-term security of electricity and gas supply. Their bioeconomy work mostly relates to the role of biomass in future flexible and sustainable renewable energy systems. The focus is Denmark, and its interacttion with the European neighboors on the gas/electricity grid.

Aalborg University (AAU, Fredrik Bajers Vej 5, Aalborg*)*
http://www.aau.dk/

AAU teaches and performs research on bioeconomy. AAU is doing work within bioeconomy mostly through the Dept. of Planning, which includes work on LCA and Life Cycle Impact Assessment, Energy System Analysis, issues of land use changes and behaviorial changes, among others.

Novozymes (*Copenhagen*)
https://www.novozymes.com/en/sustainability

Novozymes is one world-leading company in the production of enzymes. Through their sustainability department, among others, Novozymes is involved into bioeconomy research, with a focus on processes, technologies and applications requiring the use of enzymes (biorefineries for e.g. second generation biofuels, etc.). They perform LCA for their products, showing how the use of enzymes (among other within bioeconomy applications) results in an overall enhanced environmental performance in comparison to not using the enzymes. They also performed research on land use changes.

2.5.4 Canada

Institute of Research & development for the Agri-Environment (IRDA,* 2700 Einstein street, Quebec*)
https://www.irda.qc.ca/en/

IRDA is a non-profit research corporation whose mission is to engage in agri-environmental research, development and transfer activities that foster agricultural innovation from a sustainable development perspective. Their work is highly experimental, as they have access to important experimental facilities (long-term experiments on fields, animal farms, and a well-equipped analytical chemistry & olfactometry laboratory). They own a mobile GHG laboratory and a unique facility (BABE laboratory) consisting of 12 identical & independently ventilated chambers allowing to have 12 independent replicates when testing technologies related to livestock production (e.g. manure management). They also work with LCA, biomass combustion & pyrolysis (including biochar), manure management, among others.

CIRAIG (*3333 Queen-Mary Road, Montreal*)
http://www.ciraig.org/en/

CIRAIG is a centre of expertise in life cycle issues, working closely with industries and governments. They have 4 priorities areas: training, research, transfer, communications. Their work includes: LCA, Impact Assessment, Social & Socioeconomic assessment, and the development of tools to operationalize life-cycle thinking for partner-specific applications. They are really active and known in the international LCA community. They have expertise with assessing the impacts of land use changes, among other with the use of general equilibrium model to this end (GTAP, more specifically), as well as with biodiversity issues, and issues related to freshwater use.

Centre for research and innovation in the bio-economy (CRIBE,* Suite #206, Whalen Building 34 Cumberland St. N., Thunder Bay, ON*)
http://www.cribe.ca/

CRIBE is an independent, not-for-profit research corporation created by the Government of Ontario, with the mandate to find novel uses for forest biomass; to bring the forest industry beyond the traditional markets of newsprint, pulp and lumber. The research at CRIBE further

strives to establish links between the forestry sector of Ontario's North and the chemical, energy, pharmaceutical, auto, aerospace, and plastics industries of the South. In other words, their work essentially focusses on forestry products and their transformation to bio-based products and bioenergy.

University of British Columbia (UBC, *Vancouver, BC Canada V6T 1Z4*)
http://www.ubc.ca/

UBC teaches and perform high-level research within bioeconomy, in particular in the Institute for Resources, Environment and Sustainability. Their research team involves internationally renowned geographers; hence they are really active in GIS-work. They among other cover issues of modelling biomes and land use changes, sustainable water management, organic agriculture, global food security. Current research themes touch upon issues of governance, decision making and risk analysis in the context of built environment and energy systems, ecosystem services and water resources. Their publication list include an important number of publications in journals such as Nature and Science.

2.5.5 France

*ELSA (*Montpellier, France*)*
http://www.elsa-lca.org/?lang=en

ELSA is a multidisciplinary research group in LCA and industrial ecology that has been created by five funding institutions (CIRAD, Ecole des Mines d'Alès, INRA, Irstea, Montpellier SupAgro). They work with impact assessment in LCA (particularly freshwater use, but also toxicity impacts related to e.g. pesticides), and LCA on overall issues relating with the environmental impacts of agriculture. In other words, their work is within the heart of bioeconomy, though they do not focus very much on technologies. They also work on the development of the Life Cycle Inventory database "Agribalyse".

INRA/Rennes (AgroCampus Ouest, *147 rue de l'Universite, 75338 Cedex 07*)
http://www6.rennes.inra.fr/

The research work at INRA/Rennes covers a broad variety of aspects related to agriculture overall. Though they do not seem to have a LCA group as such, a lot of LCAs are performed in their "ASAE" group. They also work on multi-criteria analysis, and impact assessment (among other on fresh water issues). They also have a focus on sustainable intensification. They are involved in the development of numerous software tools and/or databases, including Syst'N to assess nitrogen losses, Nutting to assesses nitrogen & phosphorus retention in water bodies, GeoSAS, Agribalyse and Territ'Eau, to assess rural landscape water quality. Besides research, they are also teaching within bioeconomy. They are member of the MACSUR network.

2.5.6 Finland

Natural Resources Institute Finland (LUKE; *Latokartanonkaari 9 FI-00790 HELSINKI, Finland)*
https://www.luke.fi/en/

The Natural Resources Institute Finland promotes bioeconomy and sustainable use of natural resources. Researchers and specialists working in Luke are employed to provide new solutions towards the sustainable development of the Finnish bioeconomy and the promotion of new biobased businesses. The aim of the institute is to "build a society based on bioeconomy". LUKE is one of the most multi-disciplinary research institutes in our industry worldwide. The institute carries out statutory government work monitoring natural resources, certify plant production, inspect control agents, store genetic resources, produce data on greenhouse gases, support natural resource policies and produce Finland's official food and natural resource statistics.

Finnish Environment Institute (*Mechelininkatu 34a P.O.Box 140, FI-00251 Helsinki)*
http://www.syke.fi/en

The Finnish Environment Institute (also known as SYKE) is both a research institute, and a center for environmental expertise. The research is focused on changes in the environment and seeks ways to control these changes. Particular relevance in the research work carried on at the institute is given by long-term environmental monitoring and wide-ranging research results. The research program is to assess environmental problems from a multi-disciplinary perspective, by integrating socio-economic considerations into scientific research.
The most relevant research fields related to bioeconomy in which the institute operates are:

- Climate change mitigation and adaptation
- Sustainability of consumption and production
- Sustainability of land use and the built environment
- Sustainable management of the Baltic Sea and freshwater resources
- Maintaining ecosystem services and biodiversity

2.5.7 Italy

JRC – ISPRA (*Via Enrico Fermi 2749, I - 21027 Ispra (VA))*
https://ec.europa.eu/jrc/en/about/jrc-site/ispra

The Directorate for Sustainable Resources in Ispra is one of the six scientific directorates of the Joint Research Centre. Its mission is to create, manage and make sense of scientific knowledge for EU policies related to the sustainable use of resources, encompassing environmental, economic and social dimensions.
Particularly focuses on food security, land, soil, water, forests, raw materials, fisheries, biodiversity and ecosystem services it also monitors and analyses agricultural production, and supports the development of a sustainable bioeconomy in Europe.

One of the most relevant mission carried on by JRC is to support the implementation of policy measures and to develop analyses scenarios for biomass supply and demand with short–term (2020), medium-term (2030) and long-term (2050) perspectives.
The building of a comprehensive and coherent framework to handle the complexity of the issues at stake requires integration across sectors and policies, and calls for state-of-the-art biomass-related data, knowledge and modelling tools. The collaboration with JRC can provide data, models and analyses of EU and global biomass potential, supply, demand and related sustainability of bioeconomy.

CREA (Council for Agricultural Research and Agricultural Economics Analysis) / Center of policies and Bioeconomy, *Via Po 14, 00198 Rome)*
http://www.crea.gov.it/
The merger of the Agricultural Research Council (CRA) and the National Institute of Agricultural Economics (INEA) – two agencies that previously operated under the supervision of the Ministry of Agricultural, Food and Forestry Policies – gave rise to **CREA –** the **Council for Agricultural Research and Agricultural Economics Analysis.**
The reorganization was promoted to ensure and enhance the intervention and action areas of the two bodies by paying greater attention to the needs of the productive world, agro-food industry and bioeconomy. The Center of policies and bioeconomy of CREA support and promote interaction between policy makers and stakeholders.

Research Center for Renewable Energies CREAR – University of Florence (Italy)
http://crear.bluefactor.it/
The Research Center for Renewable Energy (CREAR) of the University of Florence merges into a single body various Departments of the Florence's University (as Energy Engineering, Agriculture, Forestry, Chemistry, Earth Science, etc), thus being a real multi-disciplinary Institution. CREAR currently coordinates various EU and National funded projects in the field of biofuels and bioenergy, as well as is carrying out research contracts with the biofuel Industry.

University of Milano (*Via Festa del Perdono 7, 20122 Milano)*
http://www.unimi.it/
The University of Milan cover different strategic department related with bioeconomy development. Several analyses at national level are conduct currently at the Department of Economics Management and Quantitative Methods in the field of bioenergy and climate change mitigation strategy. The holistic approach proposed in several articles published in peer review journals could contribute significantly to investigate rebounded effects of bioeconomy.

2.5.8 Greece

Agricultural Universities of Athens/Department of agricultural economics and rural development (*Ιερά Οδός 75, TK 11855, Athens)*
http://www.aoa.aua.gr/en/

The characteristic of the Department is that it combines areas of expertise derived from both the sciences and the humanities, providing therefore a new framework for evaluating environmental and social impact of bioeconomy. On one hand, the agro-technical knowledge is essential for the evaluation of management intervention at the level of agricultural enterprises and the economic value of general measures of agricultural policy; on the other hand, decision-making and the formation of policy of an agro-technical nature are not possible without the knowledge of the principles and mechanisms of economics. The most relevant researches related to bioeconomy are conduct in the field of biofuels (bioethanol, biodiesel) and biogas. Particular relevance in the bioeconmy strategies evaluation is the multi-criteria methodology to support public decision-making adopted in several studies carried on this field.

Technical University of Crete/School of Environmental Engineering (*University Campus, Akrotiri, 73100, Chania)*
https://www.enveng.tuc.gr/index.php?lang=en

The research carried on at the department of Environmental Engineering aims to develop innovative solutions to the environment's most daunting challenges. Particular attention is given in the field of waste management and circular economy. Several analysis are conducted in the field of biofuels, both at national and European level.

2.5.9 The Netherlands

Wageningen University and Research (WUR; *Droevendaalsesteeg 4, 6708 PB Wageningen*
http://www.wur.nl/en.htm)

Wageningen University & Research is actively closing the loop by working on all chains of the Circular & Biobased Economy, through fundamental research, applied research and education. The Wageningen University is involved in several European projects devote to the development of bioeconomy and cover several strategic research field in the area of bioeconomy:

- Biorefinery
- Biobased chemicals
- Biobased materials
- Bioenergy
- Crops for the biobased economy
- Economy and sustainability

Utrecht University (*Heidelberglaan 8, 3584 CS Utrecht)*
https://www.uu.nl/en

Two strategic divisions, strictly correlated with bioeconomy, have been identified inside the Utrecht University:

- The Academy of Ecosystem Services,

that acts as a platform to provide solutions to issues related to ecosystem services and to stimulate the exchange between science and practice. The Academy supports evidence-based conservation strategies, creates opportunities for interdisciplinary and integrative research, connects teaching and research activities and facilitates long-term research programmes. The main interdisciplinary research topics are four: greening value chains, optimizing land use, understanding ecosystem dynamics and biodiversity conservation.

- The Copernicus Institute of Sustainable Development,

that is the scientific institute for sustainability research and teaching of Utrecht University. The research carry on aims to promote the transition to a sustainable society through scientific excellence in a multi-disciplinary environment. Four research groups are identified: Energy and Resources, Environmental Governance, Environmental Sciences and Innovation Studies.

2.5.10 Austria

International Institute for Applied Systems Analysis (IIASA; *Schlossplatz 1 - A-2361, Laxenburg)*
http://www.iiasa.ac.at/

The International Institute for Applied Systems Analysis (IIASA) is an international scientific institute that conducts research into the critical issues of global environmental, economic, technological, and social change. Remarkable contributions strictly correlated to the bioconomy development can be found in the follows research areas:

- Advanced Systems Analysis
- Air Quality and Greenhouse Gases
- Ecosystems Services and Management
- Energy
- Evolution and Ecology
- Risk and Resilience
- Transitions to New Technologies
- Water
- World Population

Finally, IIASA provides a datasets and models on energy, climate, population and land cover, developed by the institute and its international research network. IIASA models and tools are developed in collaboration with partners to tackle challenges at global, regional, national, and

sub-national levels. The institute also acts as a convening hub to compare, improve, and unify models.

Joanneum University / Institute of Energy, Transport and Environmental Management *(Werk-VI-Strasse 46, 8605 Kapfenberg)*
https://fh-joanneum.at/en/institut/energy-transport-and-environmental-management/

The Institute is part of the Department of Building, Energy & Society. The thematic challenges confronted by the Department include sustainable urban design in terms of transport and energy and new energy strategies, including those related to bioeconomy.

University of Natural Resource and Life Science *(Gregor-Mendel-Straße 33, 1180 Vienna)*
https://www.boku.ac.at/en/universitaetsleitung/rektorat/stabsstellen/oeffentlichkeitsarbeit/themen/allgemeine-infos-zur-boku/

The University of Natural Resources and Life Sciences, the Alma Mater Viridis, perceives itself as a teaching and research center for renewable resources, giving a considerable contribute to the implementation of strategies focused on the conservation and protection of environmental resources. Connecting natural sciences, engineering and economic sciences, the university aims to increase knowledge of the ecologically and economically sustainable use of natural resources, all evaluable as key sectors for bioeconomy. The research is focused on: Forestry and Wood Science, Water Management, Agriculture, Food Chemistry and Biotechnology, Natural Resources Management and Ecological Engineering, Landscape Design and Landscape Planning, Environment and Bio-Resources Management.

Austrian Institute of Economic Research *(WIFO; 1030 Vienna, Arsenal, Object 20)*
http://www.wifo.ac.at/en

Possible collaborations are identified with the research group of Environment, Agriculture and Energy, one of the five research groups present at the Austrian Institute of Economic Research. This Research group uses models to analyse current policies in the fields of energy, climate and agriculture. One of its priorities is investigating the role of technological change to foster sustainable development. Its primary research competences are:

- Climate, energy and farming policies in Austria and the EU
- Environmental technologies and ecological innovation
- Sustainable consumption, sustainable production and measures of welfare

Bioeconomy Austria *(Herrengasse 13 A-1010, Wien)*
http://www.bioeconomy-austria.at/en/

Bioeconomy Austria aims at concentrating all Austrian efforts to push and promote the national bioeconomy development process. Furthermore, Bioeconomy Austria provides a

platform for coordination and capacity building to relevant stakeholder interested in biotechnological innovation. Bioeconomy Austria organized also the workshop on a Bioeconomy RTI Strategy for the Danube Region (Vienna, 14th March 2016).

2.5.11 Portugal

Center for Industrial Ecology (University of Coimbra, Coimbra, Portugal)

http://www2.dem.uc.pt/CenterIndustrialEcology/

The Center for Industrial Ecology (CIE), at the University of Coimbra, is a research group in the multi-disciplinary field of Industrial Ecology. The CIE develops and applies tools to measure and enhance the sustainability of products and systems supported by life-cycle thinking. The CIE is actively involved in the Energy for Sustainability Initiative at the University of Coimbra and is part of ADAI-LAETA (Associated Laboratory for Energy, Transports and Aeronautics). The CIE promotes scientific research, development and innovation to support industry, public authorities, organizations, and consumers towards sustainable production and consumption. The CIE takes a holistic and systematic approach to the analysis of sustainable systems by exploring trade-offs and synergies between economy, environment and society. The CIE has assembled a multidisciplinary team of faculty, researchers, doctoral/Master's candidates, and visiting scholars. Research is carried out in collaboration with other Portuguese institutions and with international partners mainly in Europe, the United States and Latin America. The CIE team has experience in both research and technical projects in the field of Industrial Ecology and provides expertise in:

- Life-cycle management
- Life-cycle sustainability assessment (LCSA)
- Environmental life-cycle assessment (LCA), Social LCA, and Life-Cycle Costing (LCC)
- Dynamic LCA, multi-objective optimization, and other extended life-cycle approaches
- Carbon, water, and environmental footprints
- Eco-design
- Urban metabolism
- Circular Economy

Their expertise is applied in the following areas:

- Energy: renewables (bio-energy, bio-fuels, solar, and others), natural gas, electricity
- Transportation: sustainable mobility, vehicle components and systems (electric vehicles, trains, fleet analysis, batteries), power trains
- Buildings and Sustainable Architecture: building components, pre-fabricated architecture, sustainable construction and retro-fit, thermal insulation, sustainable urban development

- Agri-food and Forestry: fruits, vegetables, vegetable oils, animal-derived products, sustainable diets, wood-based materials, land-use change
- Waste Management: waste cooking oil, beef tallow, demilitarization, anaerobic digestion, building waste management
- Packaging

The founding director of CIE, Prof. Fausto Freire, is on BioEcon's advisory board. It is foreseen that several outcomes from the utilization of the synergies that exist between the Department of Bioeconomy and Systems Analysis and CIE in the field of sustainability assessment of bioeconomy strategies (e.g. carbon footprinting of biofuels and multiple objective optimisation of land use).

University of Aveiro *(Centre for Environmental and Marine Sudies, CESAM, Aveiro)*
http://www.cesam.ua.pt

Associated Laboratory since 2005, CESAM includes around 500 researchers, 190 of whom with a PhD degree, and five departments of the University of Aveiro: Environment and Planning, Biology, Physics, Chemistry and Geosciences; it also includes members from the Faculty of Sciences, of the University of Lisbon. CESAM's mission is to develop fundamental research in the Coastal and Marine Environment, understood in an integrated manner involving the atmosphere, biosphere, hydrosphere, lithosphere and anthroposphere. The ERA Chair has a contact (Prof. Ana Claudia Dias), who leads research on the Life Cycle Assessment of forestry systems.

The Biomass Centre for Energy (Miranda do Corvo)
http://www.centrodabiomassa.pt/index.php/en

The Biomass Centre for Energy (CBE) was created in 1988 through a project launched by the Secretary of State for Energy. This project was included in the national energy policy, namely within the energy diversification and the use of natural resources in Portugal. The Biomass Centre for Energy is a non-profit, privately owned, scientific and technical association for technological support and development. It's endowed with public utility, juridical independence and technical, administrative and financial autonomy, providing its owns assets. CBE has been functioning for more than 20 years in the area of biomass for energy purposes as well as a broad curriculum of national and European cooperation studies. This experience allows a scientific and technical expertise in biomass issues, which is of high valuable to the BioEcon project.

2.5.12 Sweden

KTH Royal Institute of Technology *(Stockholm, Sweden)*
The Department of Sustainable Development, Environmental Science and Engineering (SEED) works extensively with bioeconomy systems, particularly related to algae systems and associated technology. There is also high expertise in SEED in Life Cycle Assessment and

biobased systems, such as bioenergy, food and biochar. The ERA chair has close contacts with SEED which no doubt will be used to mutual benefit (IUNG's and KTH's).

IVL Swedish Environmental Research Institute (Stockholm, Sweden)

http://www.ivl.se/english/startpage.html

The Swedish Environmental Research Institute (IVL) has a broad environmental profile. They combine applied research and development with close collaboration between industry and the public sphere. Their research is characterized by interdisciplinary science and systems thinking. IVL was jointly founded in 1966 by the Swedish state and national business interests — with a view of carrying out research on industrial air and water issues. Today they are an environmental agency concentrating on the interaction between ecological, economic and social perspectives. They employ almost 250 engineers, behavioural scientists, chemists, marine biologists, biologists, political scientists, journalists, business developers and economists, almost a third of which have doctorates. Their vision is a sustainable society. Several of IVL researchers, including Michael Martin, Mathias Gustavsson and Louise Staffas work on bioeconomy sustainability issues and have a close collaboration with the ERA Chair Holder.

Swedish University of Agricultural Sciences (SLU; Uppsala, Sweden)

http://www.slu.se/en/departments/southern-swedish-forest-research-centre/research-school-forest/

The research school "Bioeconomy-adapted forest management" is a joint initiative of the Faculty of Forest Sciences at Swedish University of Agricultural Sciences (SLU) and representatives of major employers in Swedish forest sector. The overarching goal of the research school is to secure the future competence supply for the Swedish forest-based bioeconomy. The mission of the research school is to ensure a qualitatively and quantitatively adequate competence and recruitment base for the needs of smart, sustainable and inclusive growth of Swedish forest-based bioeconomy. Their vision is that the research school will provide a dynamic and flexible national platform for cross-sectorial dialogue and collaboration in questions related to sustainable management and utilization of forests; offer internationally renowned higher education and RDI for the needs of a strong Swedish and global bio-economy; and promote modern leadership and equality in Swedish forest research and forest sector. Several contacts have been made with SLU.

2.5.13 United Kingdom

Biotechnology and Biological Sciences Research Council (BBSRC, Polaris House, North Star Avenue, Swindon, Wiltshire SN2 1UH)

http://www.bbsrc.ac.uk/research/briefings/bioeconomy/

Funded by the Government's Department for Business, Energy and Industrial Strategy (BEIS), BBSRC is one of seven Research Councils that work together as Research Councils UK (RCUK).

BBSRC is engaged in securing a strong development of the bioeconomy in UK. Research activities are carry on in the fields of farming, food, biofuels, chemicals and pharmaceuticals. As part of on-going work to ensure that the UK effectively harnesses its world-class research and innovation base to develop the bioeconomy, the three Bioscience Leadership-associated Councils (Industrial Biotechnology Leadership Forum, Agri-tech Leadership Council and Synthetic Biology Leadership Council) instigated a high-level portfolio review of relevant investment from across the Research Councils, Innovate UK, Government Departments and Devolved Administrations.

Government Department for Business, Energy & Industrial Strategy (*1 Victoria Street, London SW1H 0ET)*
https://www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy

The aim of the Department for Business, Energy & Industrial Strategy is to produce a strategy which will encourage a world leading bioeconomy which is appropriate to the UK's industrial structure and availability of natural resources. This strategy will involve many different sectors across the economy and will need to take account of other objectives, such as decarbonisation, sustainability and food security.

National Non-Food Crop Center (*York Science Park, Innovation Way, York YO10 5DG)*
http://www.nnfcc.co.uk/

The National Non-Food Crops Centre (NNFCC) is a non-profit Research and Technology Organisation (RTO). NNFCC was originally established by the UK Government in 2003 to provide expert and impartial advice to business and the public sector on the development of the bioeconomy. The main research areas are in the fields of feedstock (biomasses), bioenergy, biobased products, biorefining, biofuels and biogas.

University of Edinburg/ School of Social & Political Science (*Chrystal Macmillan Building, 15A George Square, Central Campus, Edinburgh EH8 9LD)*
http://www.ed.ac.uk/studying/postgraduate/degrees/index.php?r=site/view&id=769

The University of Edinburg is involved in the new strategies development for bioeconomy in UK. The Graduate School of Social & Political Science organizes the postgraduate master in Management of Bioeconomy, Innovation & Governance. The research activities cover in the field of bioeconomy related to aims of BioEcon are:

- agricultural biotechnology
- sustainable food and animal production
- genetic databases
- biofuels and energy-related developments.

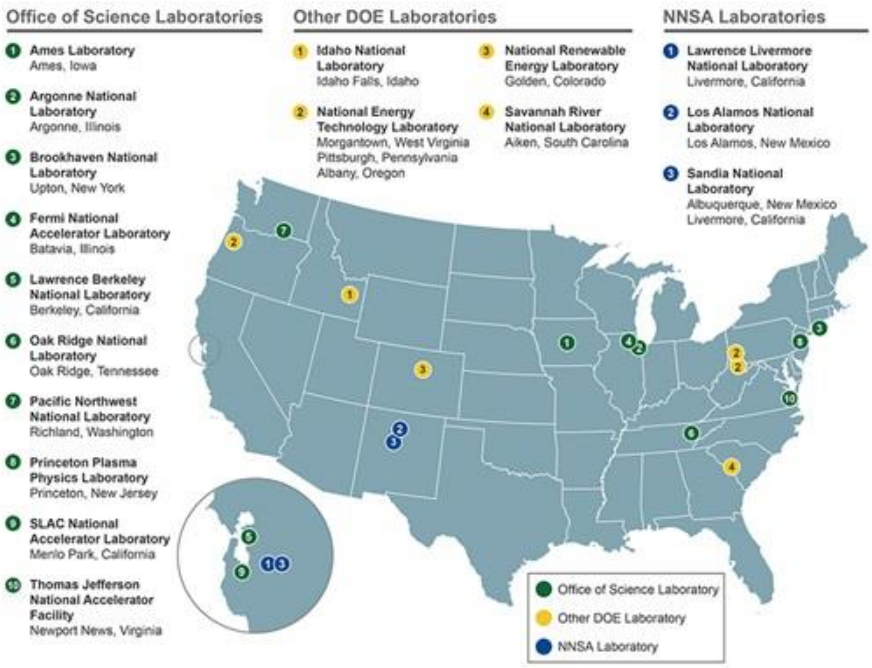
Newcastle University/Centre for Synthetic Biology and the Bioeconomy (*Newcastle University, NE1 7RU)*
http://www.ncl.ac.uk/csbb/

The Center for Synthetic Biology and the Bioeconomy brings together leading academic experts in key areas for the commercial exploitation of synthetic biology. These areas include biofuels, bioremediation, biosensors and chemical process engineering, with the aim to build synthetic biology tools, methodologies and approaches. In the recent years the Center is establishing a large network of industrial partners from North East England, the UK and internationally.

2.5.14 USA

Department of Energy, Bioenergy Technologies Office (DoE, Washington, USA)
https://energy.gov/eere/bioenergy/bioenergy-technologies-office

DoE hosts a conference every year focuses on bioeconomy issues, although previously it focused solely on biomass and bioenergy. More importantly, the DoE published the billion-tonne report (The 2016 Billion-Ton Report: Advancing Domestic Resources for a Thriving Bioeconomy), the latest is the third in a series of Energy Department national assessments that have calculated the potential supply of biomass in the United States. The report concludes that the United States has the future potential to produce at least one billion dry tons of biomass resources (composed of agricultural, forestry, waste, and algal materials) on an annual basis without adversely affecting the environment. This amount of biomass could be used to produce enough biofuel, biopower, and bioproducts to displace approximately 30% of 2005 U.S. petroleum consumption and would not negatively affect the production of food or other agricultural products. There are 17 national laboratories that form part of DoE, some of which deal with bioenergy issues (e.g. Oak Ridge, Argonne, NREL). The leader of the bioeconomy programme is also a National Team Leader of the IEA Bioenergy Task 38 (see below), of which the ERA Chair Holder is also part.



Bioeconomy Institute (Michigan State University, MSU, Michigan, USA)
http://bioeconinst.msu.edu

The MSU Bioeconomy Institute provides chemical pilot plant scale-up production and conducts sponsored research and testing for both for-profit and not-for-profit entities of all sizes. They conduct research that supports the emerging bioeconomy, including biofuels, bio-based specialty chemicals and biomaterials. To date, it has conducted successful production runs for four high technology start-up firms and one publicly traded corporation. It also offers business incubation opportunities and extensive laboratory space rental, as well as educational programming and training. The Institute also houses a biobusiness incubator and serves as a home to "embedded" researchers from private and public sector collaborator organizations. These activities support Michigan State University's general mission triad of research, teaching, and service-outreach, and specifically advance MSU efforts to promote the economic development of Michigan, the region, and the nation. Their areas of work are technology-focused so, despite the institute's interest, it is not foreseen a closer collaboration with IUNG.

2.5.15 Brazil

Brazilian Agricultural Research Corporation *(EMBRAPA, Ministry of Agriculture, Livestock, and Food Supply)*
https://www.embrapa.br/en/international

EMBRAPA has focused extensively on all aspects associated to bioeconomy, given Brazil's natural endowments, which makes it one of the most developed bioeconomies in the world and particularly bioethanol research is well developed. Their work on bioeconomy issues is expressed in events, publications, news, webpages, products, processes and services, projects

and even videos. The ERA chair holder has contacts here too and research cooperation has been excellent.

CTBE: Brazilian Bioethanol Science and Technology Lab (Campinas, Sao Paulo)

http://ctbe.cnpem.br

The Brazilian Bioethanol Science and Technology Laboratory (CTBE) undertakes high-level research and develops technology in the area of biofuels, and is well poised to address the global challenges of the bioeconomy. The CTBE focuses on enabling economically feasible and scalable fuel production based on biomass with minimal impact on the food chain, water supply, land use, and the environment. By recognizing biorefinery as a key supporting technology, it pursues the integration of first- and second-generation ethanol production, electricity, and products derived from green chemistry using sugarcane as primary feedstock. The main research interests of the CTBE are: New technologies for sugarcane plantation and harvesting; Improving biomass production using "omics" technologies, i.e. genomics, proteomics, and metabolomics; Physicochemical pretreatment of biomass, mostly from sugarcane; Establishing the process for fermenting of pentose sugars; Increasing of efficiency of hydrolytic enzymes, including biosynthetic biology; Producing of renewable chemical building blocks. Again, links have already been established between CTBE and IUNG, mainly through the IEA Bioenergy (see below) by the ERA Chair Holder.

2.5.16 European Commission: Directorate-General for Research and Innovation

(Directorate F – Bioeconomy; B-1049 Brussels – Belgium)

http://ec.europa.eu/research/bioeconomy/index.cfm?pg=about

The Bioeconomy Directorate of DG Research and Innovation defines, implements, monitors and evaluates the EU Research and Innovation policy and initiatives to address Horizon 2020's societal challenge "Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the Bioeconomy". The Directorate's long term objective is to increase by 2020 the deployment of innovative solutions for a sustainable and globally competitive European Bioeconomy on land, sea and water.

The Directorate covers three main research areas: Bio-based products and processing, Agri-food chain and Marine Resources. Synergies can be established in the first two areas, focusing on support bioeconomiy policies providing investigations useful to ensuring coherence between research and innovation objectives and the relevant EU policy objectives. In addition, the Bioeconomy Directorate works closely with a large number of other Directorates-General of the European Commission. The most relevant collaborations in the field of bioeconomy and covering a strategic role inside the project are established with:

- Directorate-General for Agriculture and Rural Development (DG AGRI), in the fields of:
  - Organic farming
  - Quality products
  - Food and nutrition security
  - Sustainable forest management

- Joint Research Centre (JRC), in the fields of:
  - Soil research
  - Chemical and bio-monitoring data
  - The Bioeconomy Observatory
- Directorate-General for Climate Action (DG CLIMA), in the fields of:
  - Land based GHG mitigation (non-CO2 emissions from Agriculture and CO2 emissions from LULUCF sector)
  - Adaptation of agriculture and forestry to climate change
- Directorate-General for Energy (DG ENER), in the fields of:
  - Renewable energy (i.e. bioenergy) contribution to climate and energy policy frameworks.

2.5.17 International Energy Agency (IEA) Bioenergy

IEA Bioenergy is an organisation set up in 1978 by the International Energy Agency (IEA) with the aim of improving cooperation and information exchange between countries that have national programmes in bioenergy research, development and deployment. The International Energy Agency acts as energy policy advisor to 28 Member Countries plus the European Commission, in their effort to ensure reliable, affordable, and clean energy for their citizens. Founded during the oil crisis of 1973-74, the IEA's initial role was to co-ordinate measures in times of oil supply emergencies. As energy markets have changed, so has the IEA. Its mandate has broadened to incorporate the "Three E's" of balanced energy policy making: energy security, economic development, and environmental protection. Current work focuses on climate change policies, market reform, energy technology collaboration and outreach to the rest of the world, especially major producers and consumers of energy like China, India, Russia and the OPEC countries. Activities are set up under Technology Collaboration Programmes. These are independent bodies operating in a framework provided by the IEA. There are 42 currently active Technology Collaboration Programmes, one of which is IEA Bioenergy. There are 10 tasks focusing on different aspects of bioenergy:

32 Biomass Combustion and Co-firing

33 Gasification of Biomass and Waste

34 Direct Thermochemical Liquefaction

36 Integrating Energy Recovery into Solid Waste Management Systems

37 Energy from Biogas

38 Climate Change Effects of Biomass and Bioenergy Systems

39 Commercialising Conventional and Advanced Liquid Biofuels from Biomass

40 Sustainable biomass markets and international bioenergy trade to support the biobased economy

42 Biorefining in a future BioEconomy

43 Biomass Feedstocks for Energy Markets

The ERA Chair Holder has links to all these tasks, particularly to Task 38, given that it aims to:

1. Promote the sustainable use of biomass and bioenergy through increased understanding of the climate change impacts of biomass production and utilisation for energy;
2. Revise and promote the updated 'standard methodology' for the calculation of life cycle climate change impacts, incorporating current and emerging issues, technologies and topics;
3. Work in cooperation with other IEA Bioenergy Tasks to assess the climate change impacts of new bioenergy technologies and production systems; and
4. Aid decision makers in devising policy and selecting mitigation strategies that optimise climate change benefits by disseminating the results of the above-mentioned activities.

2.5.18 Fertilizer Associations

Fertilizer Europé (*Avenue E. Van Nieuwenhuyse 4-6, B-1160 Brussels*)
http://fertilizerseurope.com/

Fertilizers Europe represents the major fertilizer manufacturers in Europe. They are structured into 4 committee: agriculture, trade & economic, technical, statistics. They work on issues such as the Emission Trading Scheme, general policy within agriculture, and produce reports on the state-of-the-art technologies and issues within the fertilizations sector.

International Fertilizer Association (IFA, *49 avenue d'Iéna, France*)
http://www.fertilizer.org/

This organization is structured in 4 committees: Agriculture, Production and International Trade, technical & SHE, Communications and Public Affairs. They produce a free of charges statistical database on the historical production, trade and consumption of N, P2O5 and K2O, by country, region, and worldwide (by fertilizer type). They also publish market outlook on global fertilizer supply and trade, but these can be accessed only through membership.

2.6 Analysis of RTD policies for transfer of knowledge and regional development

In the context of Europe 2020, smart specialisation emerges as a key element for innovation policies. Regional innovation strategies for smart specialisation (RIS3) can be defined as integrated, place-based economic transformation strategies that: 1) concentrate public resources on innovation and knowledge-based development priorities, challenges and needs, 2) outline measures to stimulate private RTD investment 3) build on a region's capabilities, competences, competitive advantages and potential for excellence within European and global value chains, 4) foster comprehensive stakeholder involvement and encourage governance innovation and experimentation, 5) are evidence-based and include sound monitoring and evaluation systems.
In a nutshell, regional innovation strategies for smart specialisation involve a transformation agenda based on four Cs:
• Choices: RIS3 is about the selection of a few investment priorities based on a process of entrepreneurial discovery to identify promising areas for specialization.
• Competitive advantage: RIS3 builds on current regional economic specialisation and mobilises talent by matching RTD+i and business needs and capacities.
• Critical mass: RIS3 aims at developing world class excellence clusters and providing arenas for related variety and cross sectoral links which drive specialised technological diversification aiming at increased connectivity between regions.
• Collaborative leadership: RIS3 is the result of a collective endeavour involving not only the academic world, public authorities and the business community, but also innovation users.
Source: EU Regional Policy: RIS 3 Guide. 2011.

2.6.1 National RIS3

Through BioEcon, IUNG contributes to 4 out of 5 thematic areas identified in the national RIS3. Furthermore, it contributes to 8 of the 18 national smart specializations or key challenges. See items in **red and bold**:

I) HEALTHY SOCIETY

1) Medical engineering technologies, including medical biotechnologies
2) Diagnosis and treatment of civilization diseases and personalized medicine
3) Production of medicinal products

II) AGRI-FOOD, FORESTRY-TIMBER AND ENVIRONMENTAL BIOECONOMY

4) Innovative technologies, processes and products of the agri-food and forestry-timber industry
5) Healthy food (high quality and organic production)
6) Biotechnological processes and products of household chemistry and environmental engineering

III) SUSTAINABLE ENERGY

7) High efficiency, low-emission and integrated energy production, storage, transmission and distribution systems
8) Smart and energy efficient construction

9) Environmentally-friendly transport solutions

IV) NATURAL RESOURCES AND WASTE MANAGEMENT

10) Modern technologies for sourcing, processing and use of natural resources and production of substitutes thereof

11) Minimising waste, including waste unfit for processing and use of waste for material and energy purposes (recycling and other recovery methods)

12) Innovative technologies for processing and recovery of water and reducing its consumption

V) INNOVATIVE TECHNOLOGIES AND INDUSTRIAL PROCESSES

13) Multifunctional materials and composites with advanced properties, including nanoprocesses and nano-products

14) Sensors (including biosensors) and smart sensor networks

15) Smart grids and geo-information technologies

16) Electronic based on conducting polymers

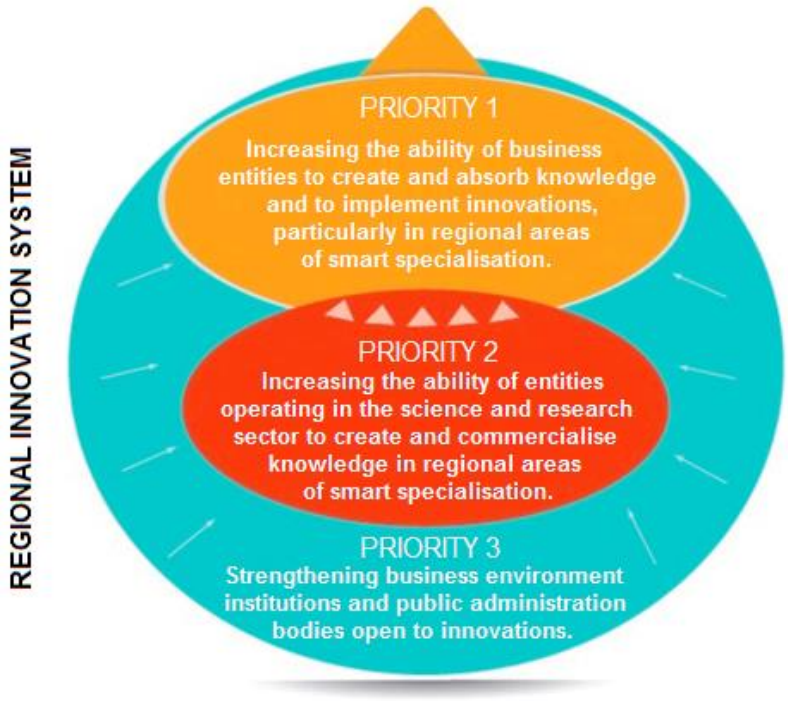
17) Automation and robotics of technological processes

18) Optoelectronic systems and materials

2.6.2 Regional RIS3

The eastern Polish region of Lubelskie has smart specialisation at the heart of its economic development strategy for the 2014-2020 period, and eco-innovation is playing a significant role in this. Lubelskie was a partner in the FRESH Interreg IV C European Union project, which aimed to embed and integrate eco-innovation into regional development policies. The priorities of the region are embedded in its mission and vision of the RIS LV 2020:

popularization of selective, smart specialisation based model of development and implementation of creative innovation leading to transformation of endogenous development potential of the Lubelskie Voivodeship.



Furthermore, The RIS LV 2020 objectives are:

• developing territorial capital, especially in the areas of smart specialisation

• strengthening the regional research and innovation system to be based on the quadruple helix that joins together all stakeholders interested in the cooperation

• incorporating the region into the national as well as international chain of innovation and cooperation network

• developing effective instruments to support innovation and competitiveness of the voivodeship economy

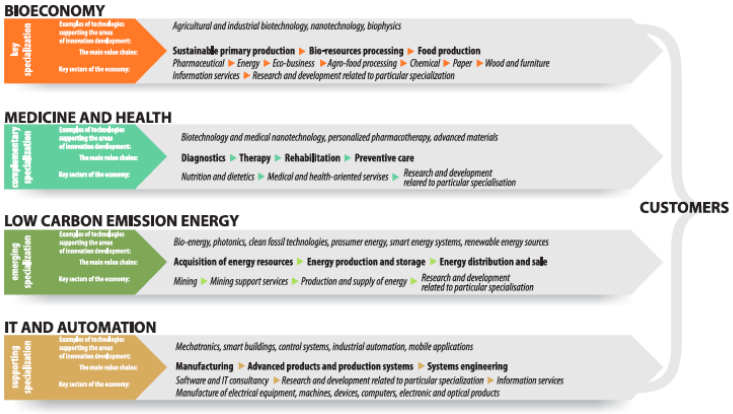
• stimulating dynamic advantages of the location, especially in the form of:

– strengthening business environment institutions,

– developing market services for business and

– developing financial markets significant to the increase in demand for innovation from all companies, both these located in regional and supraregional smart specialisation areas and these operating outside of such areas.

The four areas of smart specialisation in the Lubselskie voivode ship are: 1) Bioeconomy; 2) Medicine and Health; 3) Low Carbon Emission Energy and 4) IT and Automation (see figure below). Clearly, two the region's areas of smart specialisation (#1 and #3) are very much aligned with IUNG.



The external political, economic, social and technological (PEST) supporting the development of these two areas, bioeconomy and low carbon emission energy, have been identified as the following:

Political factors (P)	Economic factors (E)	Social factors (S)	Technological factors (T)
Bioeconomy			
• Recognizing bioeconomy as a strategic sector of the economy in Europe. • Recognizing the development of bioeconomy as an objective of the *Europe 2020* Strategy, cohesion policy and rural development policy by 2020. • Supporting bioeconomy in the EU Framework Programme for Research and Innovation *Horizon 2020*.	• High value of the bioeconomy market in Europe (with annual turnover of EUR 2 billion and 22 million jobs). • Rapidly increasing demand for products and services produced in the bioeconomy sectors (food, energy, medicines). • Strong position of Poland in food production on the European market. • Developing new models of cooperation to increase the added value of products and services provided in the supply chain.	• Multi-sectoral development of bioeconomy will contribute to ensure food security and rational use of natural resources. • Using bioeconomy in the process of modernizing agricultural sector and creating jobs outside agriculture. • Creating demand for highly qualified personnel and expertise in multi-sector development of bioeconomy.	• Great potential of bioeconomy to introduce new ideas and implement innovation, which provides return on investments in R&D activities. • Development of new knowledge and innovation based on the Key Enabling Technologies, including biotechnology (white and green), nanotechnology, advanced materials. • Functioning of 8 European Technology Platforms defining strategic fields of research in the most important sectors of bioeconomy development.
Low-carbon emission energy sector			
• Promotion of development of low-carbon emission energy arising from the implementation of long-term EU policy on development of low-carbon emission economy in Europe. • The low-carbon emission energy sector is treated preferentially in the main EU and national planning documents of a given country.	• Enormous development potential of the low-carbon emission energy market in Europe and Poland. • The need to implement the EU Directive on renewable energy sources. • Keeping the right market balance in the production of energy from renewable and conventional resources. • Significant opportunities to support investment projects in the low-carbon emission energy sector from public funds in the years 2014-2020.	• Growing social awareness of the need for and benefits of the low-carbon emission energy industry development in Poland. • Development of various forms of civic (prosumer) energy industry. • Growing demand for new jobs, knowledge and competence in the field of low-carbon emission energy industry and the related technologies. • New opportunities and ways to use local resources for energy purposes. • Improvement in energy security and the availability of new energy sources to the public.	• Involvement in European-wide process of implementing the Strategic Energy Technology Plan (i.e. the SET Plan). • Development of low carbon technologies within 8 European Technology Platforms and research related to foresights and national research programmes. • Continuous process of convergence of energy technologies with information technologies (e.g. in the area of smart grids development).

For Lubelskie, the RIS3 approach means building on its strength as one of Poland's main agricultural regions. The region takes advantage of its agricultural resources by having Lubelskie smart specialisation strategy specialising mainly in the bio-economy - in food

production and bio-resources processing. In fact, Lubelskie already has a solid bio-economy foundation, as 45% of its employment is in, or related to, bio-based production - including food, feed, fertiliser and bio-energy.

For its food sector, Lubelskie has identified a number of broad objectives:

- to invest in research that will lead to improved food quality and processing;
- to carry out more food processing in the region, rather than exporting food for processing elsewhere, and thereby increasing value added in the region;
- to develop new and Lubelskie-branded food products;
- to use green energy for food processing; and
- to apply sustainable farming practices.

Linked to this is a focus on development of biodegradable products - such as food packaging - based on local resources. In this focus area, Lubelskie plans to build on its academic resources - the region is host to a number of universities and technology institutes - to improve skills for eco-design of products, to promote research into new bio-based materials, and to support projects that transform biodegradable materials into high-value products.

Lubelskie is also putting its agricultural know-how to work in terms of energy production by, for example, promoting bioenergy.

The present strategy is fully compliant with the national and regional plans for smart specialisation.

2.7 SWOT analysis for bio-economy development

2.7.1 Strengths

Development of capability in IUNG

IUNG focuses its research developments on the needs of end-users, such as government agencies, advisory centres, farmers' organisations and policy makers, aided by a continuous review process. IUNG researchers provide different kinds of expertise to several ministries (see Overview of IUNG i): Ministry of Agriculture and Rural Husbandry, Ministry of Environment, Ministry of Economy, regional authorities. In addition, IUNG participates in many national clusters, as well as as Polish experts in the works of the EC bodies. IUNG by the Directive of the Ministry of Agriculture is responsible for providing certificates for entities trying to distribute any kind of fertilizer to be used in agriculture.

High visibility within the ERA and European programmes

Good reputation and positioning in the scientific world: 34 governmental and 25 bilateral co-operation agreements were signed by IUNG in the last decade, enabling common research programmes, exchanges of scientists and PhD students, participation to numerous international conferences, international projects under the FP4, FP5, FP6 and FP7 and other international projects.

Excellence of researchers

The academic composition of the institute (see Section 3.1) is very experienced in research and has been trained in European and American centres of excellence. The department of bioeconomy and system analysis is composed of 15 researchers, from a PhD-student level to full-professorship level, distributed in a balanced manner. Similarly, the gender balance is appropriate. Furthermore, the human capital of the department is high and all researchers appear to get along in a friendly manner.

Location

The region and the country as a whole offer a tremendous potential for bioeconony implementation, particularly due to its large resource endowments, e.g. agricultural land use.

Effective management

IUNG has mechanisms in place that ensure its finances, strategy development, research projects, research programmes and scientific activities, as well as the associated research results and orientation, are managed properly. Budget management is highly mastered. The General Director (supported by the internal Advisory Team) is responsible for the Institute's strategy development. The Advisory Team tasks include also the evaluation of the internal research projects. The Scientific Council (30 internal and external board members) evaluates research programmes and scientific activities. Therefore, research results and orientations are constantly scrutinised within IUNG.

Modern technical support and infrastructure and accreditation of the facilities

Modern equipment provides IUNG with a good reputation and visibility within Universities, Agricultural schools and other Institutes in Poland. The Central Laboratory of IUNG was awarded Accreditation Certificate of Testing Laboratory No. AB 339 by the Polish Centre for Accreditation, in August 2001, and meets requirements of the standard PN-EN 45001:1993 and ISO/IEC Guide 25:1990.

Long-term Research

The Institute has long-terms plans. For example, it takes part of a long-term programme financed by the Ministry of Agriculture entitled "The sustainable development of crop production and management of agricultural areas in Poland". The department of bioeconomy and systems analysis has solid plans for future proposals that, if they succeed, will ensure the long-term survival of the department.

2.7.2 Weaknesses

Human capacity

There is a need of international researchers who can guide the institute in raising the quality of their research and performance. IUNG has already addressed this issue partly, through BioEcon, and has employed four international researchers (two of which in senior positions), who can guide the institute, and particularly the department, towards higher standards of scientific research, including publications.

Communication

Communication appears to be an issue, as researchers find it challenging to communicating in a written manner, particularly in English, and digitally (instead of orally). This affects all

departments, and despite it being a lesser problem in the department of bioeconomy and systems analysis, it still exists.

Finances

The salaries offered by IUNG are unsatisfactory to hire prominent researchers, as they see higher salaries in other (European) countries. The uncompetitive salaries hinder the recruitment of world-class researchers.

Interdisciplinarity

There is insufficient coordination across individual departments. The department of bioeconomy and systems analysis is creating a new interdisciplinary group which aims to better connect all other departments of the institute. In addition, a common database of test results is currently lacking, and the results achieved in one department are not necessarily made accessible to another department in an easy manner.

Innovation management

At the moment, there is no system for collecting, storing and re-using research results. A common strategy to use the experimental facilities by different departments is also lacking.

Insufficient coordination with business

Despite the wide array of industry collaborations that IUNG has, our work could be better coordinated with that of the private sector.

Incomplete laboratory

In terms of research on bioeconomy and systems analysis, field equipment for greenhouse gas emissions measurements exists at the institute but perhaps more could be purchased.

Insufficient integration in ERA in the field of bioeconomy and systems analyses

IUNG is not collaborating yet extensively with other research centres in the field of bioeconomy and systems analysis, although promising collaborations are starting to emerge.

2.7.3 Opportunities

New department focused on an increasingly important topic

The newly-formed department of bioeconomy and systems analysis meets the increasing demand for robust research on the implications on the environment, economy and society of shifting towards a bio-based economy. There are not many research centres in the world with the capability and expertise that the department is developing, making it well-placed to answer topical questions on the subject, from national and supranational governmental bodies.

Reliable partner for Polish authorities

IUNG is able to meet the needs from the Ministry of Agriculture for systemic modelling/forecasting work, and the existing long-term collaboration between the ministry and IUNG is illustrated by the grant it receives every 5 years to do consultation for the ministry.

Collaboration with EU and non-EU partners

Due to the extensive worldwide network that the ERA team have in the field of bio-economy and system analysis, collaboration arrangements can be made with easiness.

Securing research funds

The same reasons ensures that our department is well placed to secure national and EU finds for research.

Involvement in smart specialisation (S3):

Due to the alignment that IUNG now shares with national and European policies on smart specialisation, particular because bioeconomy takes a prominent role in the national and regional RIS3, IUNG can contribute to the transformation of the national economy through its modernization, structural transformation, diversification of products and services and creating innovative socio-economic solutions which also support transition to a resource-efficient economy.

2.7.4 Threats

Brain drain

The migration of educated young people abroad and problems with recruiting qualified people in science is the main threat to IUNG. It is important that IUNG creates the conditions that make researchers want to stay in the institute.

Limited funds

Existing funds are limited for coordinating and supporting activities of the new interdisciplinary strategy of IUNG to a large extent, including the purchasing of high-tech equipment for the bioeconomy model of IUNG.

High competition

Given the existence of several established research centre in agricultural research, the acquisition of funds is difficult due to competition from European countries which have more resources to develop their research capabilities.

2.8 Outcomes of analysis

Through the analysis of resources in IUNG, as well as Lubelskie region and Poland as a whole, the prospects for a sustainable implementation of bioeconomy strategies are very good. The suitable context in which governments across the world, as well as industry, research organisations and other stakeholders, make our endeavour highly likely to succeed. The outcomes of the above analysis fall under the following issues:

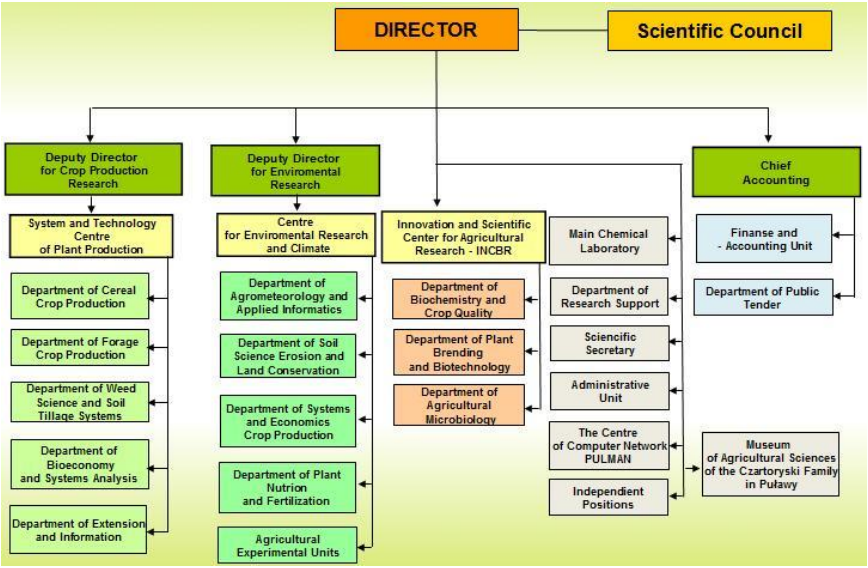
- a specification of the range of bio-economy issues that are central to the research problem that can be solved by systems analysis methods;
    - Lack of knowledge
        - on biofeedstock-resource pathways
            - Manure → Compost or Biogas?
            - Straw → Compost or Biogas or CHP?

        - Vegetable oil → Food or biodiesel?
        - Management → Organic or intensive production?
        - Trees → Sink or burn for energy?
      - Effects on food prices
      - Effects on farmers' income
    - Lack of established technologies and markets
    - Risk aversion
    - How to support industry development efficiently?

- how they interact with one another to sustain the problem;
    - Land is limited → crops compete
    - Lack of knowledge results in the adoption of known technologies and markets
    - Catch 22 (feedstocks and markets)
    - Potential vastly underutilized → significant opportunities exist

- how these interactions can be modified to deliver an implementable, synergistic solution;
    - Develop knowledge with modelling and experimental work
    - Set up and implement pilot projects on the whole biomass chain
    - Strengthen ties with industry and involve them in research projects
    - Develop knowledge on economics of biobased production and other incentives for the uptake of this mode of production

- institutional structures (responsible for collaboration scientists from particular departments will be chosen)
    - A detailed analysis of the different departments within IUNG and how these may collaborate with the Department of Bioeconomy and Systems Analysis is included in Deliverable 3.3.



- procedures for improvement of the research support by administrative departments will be established.
    - Administration already good
    - Researchers do research, let admin do admin
    - Bioeconomy and Systems Analysis benefits from an extensive admin support
    - Raise more autonomy and skills in, for example, communication in English.

3 IUNG's New Interdisciplinary strategy plan for research and innovation

3.1 Overall approach

The objective in developing an interdisciplinary strategy is to fully develop and start the implementation of the new interdisciplinary strategy of IUNG in compliance with Polish and Lubelskie RIS3 under the guidance of the ERA Chair. It comprised of three phases: an initial mapping of activities, an exploratory phase, and a research agenda and action plan. The latter is expressed here.

Through the BioEcon project, IUNG will be able to answer every need identified and propose measures to cope with the weaknesses identified in the SWOT by proposing concrete activities within the Action Plan (Section 3.3). Section 4 covers, as well as Deliverable 3.3 covers structural changes necessary for the implementation of a sustainable and successful strategy that will make IUNG a driving force in bio-economy in the region and elsewhere, through constructive dialogue with all stakeholders, common projects under the SF and H2020 and reinforcing research performed by the ERA chair team (including joint projects with industrial partners), increase of visibility in ERA and capacity to participate in international research projects.

3.2 Research agenda for Interdisciplinary bioeconomy research

The scientific aim of BioEcon is to identify sustainable bioeconomy strategies for Poland. To this end, the necessary methodological capability will have to be developed, so that IUNG is strategically placed to provide robust policy support for Bioeconomy-related issues.

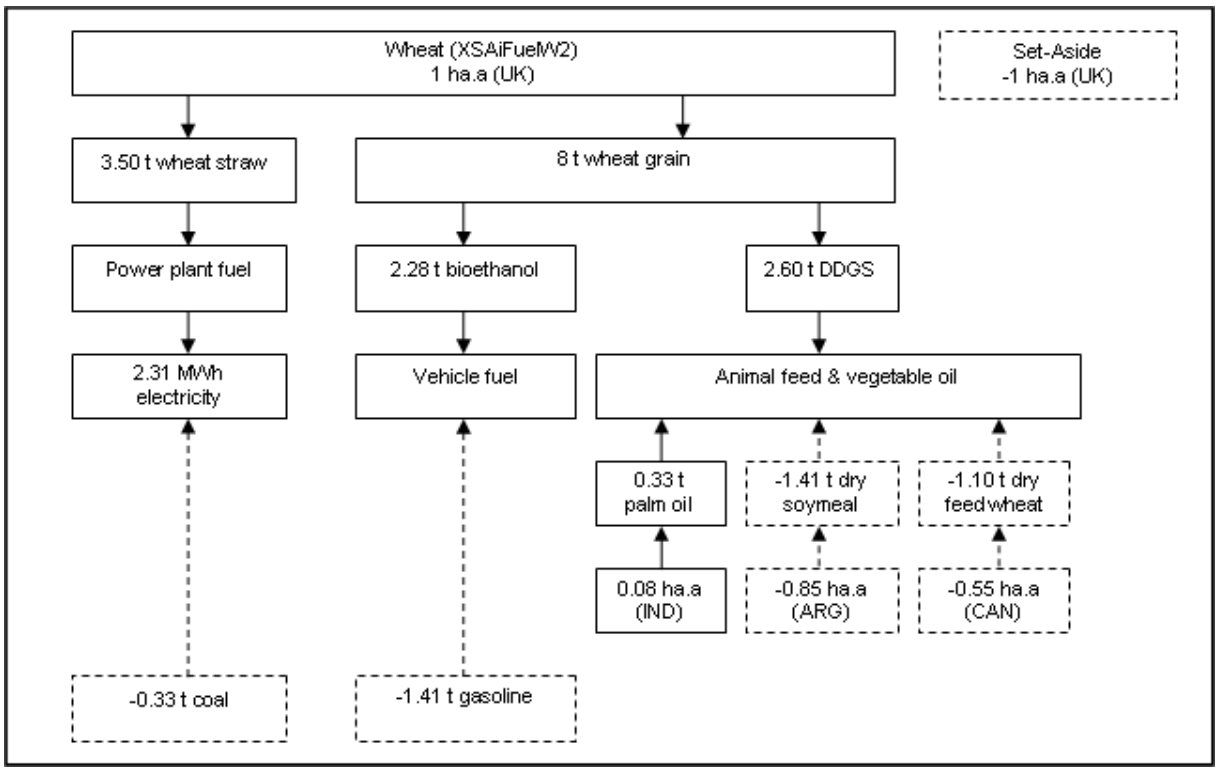
By coupling environmental systems analysis tools, such as Life Cycle Assessment, with economic tools, such as those under economic-equilibrium modelling (with FADN data) and geographical information systems, IUNG will be able to shed light on a range of topical issues, for which answers remain elusive. Strength can be drawn from the expertise and data gained in previous projects, such as BioBoost, which quantified biomass resource potentials in Europe. The integration of state of the art whole-systems modelling of environmental and socio-economic impacts is foreseen, which can answer a range of pertinent Bioeconomy-related questions, such as:

- What is the optimal land-use mix in Poland that maximises climate-change mitigation worldwide?
- What are the most sustainable uses of biomass: food, feed, fuel, biomaterials, biochemical or carbon sink? How can the land-use mix be optimised in Lubelskie and Poland?
- To which end should biomass be processed into: e.g, energy, bioproducts, bochemicals in a biorefinery?
- What are the most efficient policy instruments that simultaneously achieve a desired level of greenhouse gas emissions and a minimum income to e.g. farmers?
- What are the impact of a carbon tax?
- How much can energy from biomass (e.g. biogas) can contribute to renewable energy targets?
- What options are there for utilizing under-utilized agricultural residues, such as straw and manure? What are the environmental and economic implications of doing so?

Bioeconomy Strategies

Competing land uses	Crops	Substitution effects	Marginal producers
Food	Wheat Oilseed Rape Sugar Beet	Wheat Oil Palm Sugar Cane	Canada Indonesia Brazil
Feed	Wheat Barley	Feedwheat	Canada
Fuel -Ethanol -Biodiesel -Electricity and/or Heat	 Wheat, Sugar Beet Oilseed rape, algae Miscanthus, Willow SRC, 9 forestry crops	 Gasoline + Animal feed* (DDGS) Diesel + Animal feed* (rape cake) Coal and/or Natural Gas (marginal feedstocks)	Argentina (soymeal), Indonesia (vegetable oil) and Canada (wheat)
Timber	Scots Pine, European Larch,	Some coal (forestry residues)	
Carbon sink	Sitka Spruce, Douglas Fir, English Oak, Beech, Ash, Sycamore, Silver Birch		

The building of an integrated model would allow Poland to prioritise agricultural resource use, including land, with regard to environmental and economic objectives, and estimate indirect and rebound effects (i.e. environmental and socio-economic impacts occurring outside the borders of Poland). Eventually, the model can be applied to a different (larger) regional scope (e.g. the European union), making IUNG an attractive partner for research consortia. The optimisation model with linear programming will shed light on how to best use agricultural resources, such as land, manure, crop and crop end use (e.g. ethanol, biodiesel, electricity, hear, soil incorporation, etc.) relative to a range of objective functions (e.g. maximising farmer's income or minimising life cycle climate change impacts). The model, therefore, will include Polish data on e.g. crop gross margins. It will also tell us about the trade-offs associated with using competing crops (oil, sugar, starch, lignocellulosic herbaceous and woody). The bioeconomic model can therefore estimate the environmental and socio-economic effects of policy shocks, like taxes or subsidies.



The agenda is divided into three large parts: 1) Identification of bioeconomy strategies; 2) characterisation of strategies and 3) testing.

1) **Identification of bioeconomy strategies**
   All bioeconomy strategies are to be identified for food, feed, transport fuel, biomass for electricity and biogas. All the permutations for feedstocks x end use need to be made explicit.

2) **Characterisation of strategies**
   The environmental and socio-economic characterisation of strategies is done when the model is applied to the above strategies. The characterisation can focus on both midpoint and endpoint levels and have a global scope so that indirect effects, like indirect land use change, are captured.

3) **Testing**
   An important part of our agenda is to collaborate with stakeholders in industry, as well as farmers and local/national governments. The Stakeholder plan (see WP4) includes the application of our model to different stakeholders: Azoty, Eco-Energy Cluster (e.g. Smart Gmina) and the Regional Dairy Cooperative in Piatnica.

This agenda is flexible enough to allow for improvements throughout time.

3.3 Action plan

The following preliminary action plan was developed and is to be interpreted as a tentative plan that serves as a basis for a more elaborated one.

Date	Action
March 2017	Submission of first paper attempting at model integration
July 2017	FADN data secure. Application of model to Poland.
November 2017	Common projects with industry up and running
March 2018	Biomass resource potentials estimated. Several papers submitted.
July 2018	Strategies clearly identified and characterised.
November 2018	Optimisation modelling performed.
March 2019	Several papers submitted. Pilot projects running.
July 2019	Data collected from industrial partners and included in model.
November 2019	Model run again under different objectives and constraints.
February 2020	Events transferring research outputs performed. Papers submitted.
June 2020	PhD thesis completed. Future research funds secured.

ERA team research outputs:

- 2 journal papers per person and year, e.g.:
  - Bartoli *et al.* Modeling Land Use Change and Greenhouse Gas Emissions Combining Consequential LCA with a Partial Equilibrium Approach: The Case of Biogas in Lombardy
  - Borzecka-Walker M *et al.* Analysis of location capabilities of biomass pre-treatment plants or bioenergy facilities.
  - Pudelko R *et al.* Optimisation of FP, CP and HTC power plants localisation according to feedstock base in EU27.
  - Brandão M *et al.* Potential for climate change mitigation from the displacement of fossil fuels by the use of energy crops in EU 27.
- 14 publications per year
- Submission of research applications every year (7/year)

- At least one conference paper per person

Plan for partner, stakeholder and user engagement

- Involvement as much as possible
- Communication flowing both ways (through interactive website)
- Meetings, roundtable foreseen under WP4
- WP7 solely dedicated to dissemination and exploitation
- Inputs from partners, stakeholders and users to be taken seriously and relationship strengthened
- Outputs tailored to their needs
- Contingencies

3.4 Link closely to national or international research and innovation activities

The close collaboration with eco-energy clusters ensures the promotion of renewable energy. Cooperation with the clusters also ensures the exchange of experiences and knowledge, as well as implementation of joint innovative activities. The cooperation between the cluster members increases competitiveness and improves the efficiency with which the entities in the cluster operate their alternative renewable-energy sources, as well as improving energy efficiency in Poland. All partners are interested in particular cooperation for the creation and implementation of innovative solutions to technical, technological and organizational renewable energy systems and energy efficiency.

3.5 Dissemination, communication and exploitation plan

Subject to intellectual property and exploitation considerations, it is anticipated that all project results will be rapidly and appropriately disseminated both within the consortium and outside the consortium. BioEcon's WP7 includes a plan to manage the dissemination of the project results and their exploitation.

Our dissemination, exploitation and communication approach is based on the understanding that dissemination is not just spreading information but is also interacting and communicating with all stakeholders. The work programme was designed in a way which fully integrates this notion, involving more than one work packages and activities of dissemination and exploitation character. The measures developed during the project ensure very good dissemination and do not confine only to the dissemination work package (WP7). Many of the tasks involve intensive collaboration with stakeholders and will build on the already existing alliances of IUNG with big key structures, networks and clusters in the region for the

maximisation of dissemination of results. Within BioEcon project we have developed preliminary draft plan for the exploitation and dissemination of results within the project proposal itself. The plan is regularly updated during the implementation of the project. The concrete dissemination and exploitation activities are carried out. The operational plan defines very clear guidelines for the dissemination activities, including all operational elements of dissemination. The BioEcon project results will be disseminated to the relevant targets groups (stakeholders) with appropriate content and in a timely manner.

The BioEcon operational plan consists of the following elements:

1. Subject of dissemination

The bioeconomy is still very little known in Poland, only a few institutions are engaged in the study of these assumptions. Generally, they are considered as individual cases not as a whole system. During the coming 2017 we want to reach as many people as possible and make them aware of the bioeconomy issues that we work on. Present it as interacting cases where many actors can play an important role. There are several cases of symbiosis cooperation that we have learned from other EU projects and share them with Polish stakeholders to engage them in similar thinking.

2. Stakeholders (target groups)

Internal stakeholders

This is the project team and other persons involved in the implementation of the project. The main internal stakeholders which will be addressed:

- Project Management Board
- Advisory Board
- Work package Leaders

External stakeholders

Institutions and persons that will benefit from the outcomes of the project and act as "opinion makers" (usually policy makers, public bodies, researchers, aeronautics companies and scientists) in aeronautics:

- Ministry of Economy
- Ministry of Science and Higher Education
- Ministry of Agriculture and Rural Development
- Lubelskie Marshal Office
- Lubelskie Provincial Office
- Local and Regional Authorities
- Research Institution
- Business sector

3. Key messages

In a bioeconomy, our needs for energy and materials are met with biomass sources from the agricultural and forestry sectors, as well as organic wastes, such as municipal wastewater, food waste and manure, contributing to a circular economy, and aiding the transition towards a low-carbon economy. As opposed to our current fossil-based economy, a bioeconomy is powered by clean and safe energy to meet the demand for the food, energy and other products we consume every day, using more bioenergy and less fossil fuels that what we do at present. Therefore, a bioeconomy is an efficient, innovative, and sustainable way to meet our needs. The bioeconomy connects biomass suppliers to all industries of the economy. Biomass suppliers include agriculture, but also forestry as well as any organic waste streams, such as municipal wastewater, food waste, manure, etc. In other words, a bioeconomy endeavours to use, for the food and products we consume every day, more bioenergy and less fossil fuels. And it strives to do it in an efficient, innovative, and sustainable way.

One of the main goals of the project is to consolidate the stakeholder's familiarity with the concept of the bio-economy and the following key words will be used in dissemination materials:

- bioeconomy
- biomass potential
- energy plants
- renewable energy.

4. Dissemination methods

Logo

Logo was design and will be placed on all materials related to the project.

BioEcon

Leaflets

The project leaflet will introduce the project to interested people and potential stakeholders. It will be very useful during the first year for involving stakeholders in the BioEcon project. It will be produced in Polish and English.

Posters/Roll Up

Posters will be present on conference/workshops and will contain information about the project or will contain information on specific parts of the project. The template of the poster is available.

The Roll Up contains general information about project and was prepared in two languages: Polish and English.

Presentations

Presentations will be prepared for conference/workshops and will contain information about the project or will contain information on the specific parts of the project that are presented.

The template of presentation are available.

E-newsletters

E-newsletters will be created in order to optimize the contents and increase the number of recipients included in the mailing list. It will contain more detailed information on the project developments. There will be 12 e-newsletters over the period of 5 years.

Website

The website will support all the project activities. The first version of the website was ready after six months (outlining the contents of the project) and it will be updated during the project implementation and for at least 2 years after the end of its lifetime. The website will include all relevant information about the project, contain links, and act as a gateway to the Platform. The website will be maintained with content management system with user-friendly navigation and architecture. The PR team will update the website during the entire project lifetime whenever new documents are created and developments arise. http://biogospodarka.iung.pl/bioecon/

Bioeconomy platform

The platform will start from bringing together the knowledge gained in IUNG in the area of the Knowledge Based BioEconomy (KBBE) with the aim to improve exchange and cooperation between Polish universities, stakeholders and ministry. The platform will be established as networking platform with a mutual learning dimension and a strategic dimension. It will address issues of overarching strategic importance, such as the identity and role of bioeconomy, the synergy between national, intergovernmental and European research programmes, and modalities for collaboration. The platform based on internet tools will also work actively fulfilling the mission of informing people (RSS feeds, social networking sites). The platform will be programmed by a subcontracted company.

Film/Video clip

The video clip will be targeted to Supporting Structures for information and motivational purposes. A short version (3 min) in M10 and long version (10 min.) in M24 are foreseen.

The first short film

Available in polish: https://www.youtube.com/watch?v=MdZLc0Z0ljo&t=11s
Available in English: https://www.youtube.com/watch?v=GEstdr-O1SE

Workshop/Seminars/Training

The institute will organize workshops for students, researchers and project team on the topics relating to bioeconomy and GIS. In addition, the ERA Chair and the BioEcon Team will prepare seminars for researchers of the Institute and the Department of Bioeconomy and Systems Analysis.

Conference

IUNG will organise four conferences during the project life time, one of which is international: International conference on Bioeconomy for agriculture. The conferences will be attended by approximately 100 people from the whole of the European Union. Sessions in these conferences will include eight invited key speakers each. The conference will be organised in month 36. Two international workshops will be organized on GIS and bioeconomy for agriculture. The international workshops intend to gather around 30-50 people each (months 24, 42). Final Promotional conference: the conference will be organised in month 60. The expected number of participants will be 100. Representatives from the Institute and industrial and research partners as well as stakeholders will attend the event. There will be 12 key speakers. At this event the results of the project will be disseminated, promotional materials distributed and sustainability issues addressed.

Meetings with policy makers and local authorities

Project Team will organize face-to-face communication with national and regional authorities (Lublin district in particular) on concrete agenda in order to discuss the implementation of RIS3 objectives, funding for research and innovation, further collaboration between IUNG and the ministries for the development and operation of a platform for direct dialogue with stakeholders and public institutions and systematisation of research databases, the national and local government support to IUNG's interdisciplinary strategy for systems analysis and bioeconomy, which can serve as a basis for the development of a national strategy on bioeconomy.

Publications

Project results are disseminated via publications in scientific and trade journals as well as via presentations at conferences and other events.

The department of Bioeconomy and Systems Analysis complies with similar rules as the BioEcon project. The Logo was design after the establishment of the Department. Logo is pleased on all promotional materials.

The Institute of Soil and Plant Cultivation has a Department of Extension and Information which is responsible for Department of Extension and Information is responsible for converting the results of the Institute's scientific research into best agricultural practices and managing the publication and promotion of the Institute's achievements. It compiles leaflets, training materials and promotion guidelines for advisors, pupils, students and farmers, as well as larger publications – thematic atlases and agricultural dictionaries. The Department of Extension and Information organizes and provides full

support for the conferences, workshops and other scientific events which take place in the Institute. Every year, it is responsible for coordinating the organization of Open Days and the participation of IUNG-PIB in the Lublin Science Festival. It presents the output of the Institute at the international agricultural fair in Poznan and in Kielce, at national and local events organized by agricultural advisory centres, agricultural chambers, schools and publishers. The Department of Extension and Information cooperates closely with all the editorial boards of the Institute's publishing series – the Polish Journal of Agronomy, IUNG-PIB Studies and Reports, Scientific Monographs and Treatises. Department of Extension and Information includes a printing section which provides all the printed materials required by the Institute.

3.5.1 Intensive dialogue with policy makers and stakeholders

The work programme is designed so as to foster a very intensive collaboration between research institutes, policy makers and industry. At a series of meetings and roundtables with policy makers, concrete measures will be discussed to support an RTD policy that fosters a sustainable regional development-based bioeconomy. Particular ways to integrate bioeconomy methods in the regional and global research, as well as innovation policy aspects and implementation plans are considered. The stipulated roundtables and meetings with the industry will enable partners to set a value proposition for a business model that is based on the needs of stakeholders and to develop a joint research plan. At the roundtables with other research entities, synergies will be explored in order to meet the existing demand for research and innovation in the region.

As part of the project, a web platform on bioeconomy was built to facilitate the dialogue with national authorities and with stakeholders. The purpose is to solve the problem with research dispersion in the country, ensure sustainability in terms of policy, to systematize the existing contacts with different groups of stakeholders, and to facilitate the constant need for analysis and communication between scientists and researchers.

It is envisaged that an official registration of a cluster with members and a web page, including a forum for discussion, will take place as part of WP4. The cluster will be vertical: from fundamental research to a product on the market. Every member can ask questions in the forum, and other members will have the competence to answer – thus problems can be addressed online. The product transferred from IUNG to the market will be disseminated in the cluster network.

3.6 Innovation management strategy

The innovation management strategy involves the upgrade of the Technology Transfer Office at IUNG – a necessary means to ensure sustainability and enhance exploitation of results: promotion of scientific progress and newly-developed knowledge and technologies into tangible products; collaboration with the industry; effective management and transfer of intellectual property to the industry.

Building capacity for innovation management for successful technology transfer is a main objective of the project. T5.1. involves the training of 2 experts, one of which will be newly recruited to deal with the transfer activities in the long term and to participate in the development of the business model in the first year. A detailed IPR policy covering various aspects possible is developed under the project (ref. T5.2)

3.6.1 Development of a business plan and a business model

To ensure the sustainability of the future activity, a business model and a business plan will be developed in WP7. The business model will describe the interdisciplinary strategy of IUNG in a comprehensive way, based on the information collected in previous WPs. The development of such a business model is crucial in order to ensure successful exploitation of research results.

3.7 Management and collection of the research data generated

The project will collect the following data:

- EU scale: (Published and public data of projects related to renewable energy and bioeconomy: e.g.: BEE, RENEW, FutureBiomass, BIOBoost, S2Biom; Pan-European Research Centres: EEA (European Environmental Agency), JRC (Join Research Centre), IIASA (International Institute for Applied Systems Analysis), European Forest Institute; EUROSTAT, FAOSTAT, FORESTAT; ESA (European Space Agency); Important the other data sources: OpenStreetMAp (org); National or regional Statistical Offices, Euro_Global_Map; Published peer-reviewed scientific articles, information, maps;
- National (PL) scale: Statistical data (GUS – National Statistical Office), ARMA (Agency for Restructuring and Modernisation of Agriculture); Spatial data – CODGiK (Documentation Centre of Geodesy and Cartography); Research Centres: IUNG – Data on Rural Space and Environment, National Research Institute of Animal Production, Institute of Technology and Life Sciences (ITP), Forest Research Institute, IERiGŻ (Institute of Agricultural and Food Economics), FADN.
- Standards: Knowledge base will be stored in a SQL database linked with GIS server (geographic information system standards). All data will be in accordance with the Infrastructure for Spatial Information in the European Community (INSPIRE Directive 2007/2/WE, 14.03.2007).

3.7.1 Exploitation of data

For the team: the database (statistical and spatial) will be used for systems analysis and as a input for models. For the public: the result will be published and disseminated, among others, via an internet browser and geoportal. Sources data will be available after request or directly via internet tools for registered users. The team will be available to carry out analyses commissioned by business and public administrations. An important part of remodelling the results will be participating in national and international projects.

3.7.2 Preservation of data

The project is aims for a wide dissemination of results and source data. However, sensitive data and data protected by licences or the intellectual property law will be strictly preserved and stored on servers not connected to the internet. All data and information will be shared or disseminated according to: i) properly licensed, ii) the law national law, iii) INSPIRE-Directive 2007/2/WE.

3.8 Strategy for knowledge management and protection.

IUNG is a publisher of 3 open-access series: “Polish Journal of Agronomy” - a national scientific journal; “Monography, theses and dissertations”, “Studies and reports IUNG-PIB” - the series publish peer-reviewed studies in the field of agronomy and agricultural environment, made in the framework of the tasks of the multiannual programs of IUNG.

3.9 Communication activities for transferring results and developing the region

In addition to the round tables (11), meetings and workshops with policy makers, industry and research structures, and the extensive communication and dissemination platform of national impact, the project is endowed with additional communication outlets: PR team, public website presenting the project to a wide public audience; a set of dissemination tools; organisation of a minimum of 2 international conferences, 2 international workshops.

4 Recommended changes for IUNG

- Objective
  - increase the excellence of the institute
  - make it attractive for the mobilization of international researchers of high capacity
- IUNG management and researchers are willing to break the status-quo and embrace structural changes
- The management has already vision of what and how to change, and under the guidance of the ERA chair, the desired transformation can be successfully implemented.
- Already included in Del 3.3
- Communication

5 Conclusions

The prospects for implementing sustainable bioeconomy strategies in Poland are significantly promising. IUNG has developed the scientific expertise over the years to enable the identification of optimal strategies and the estimation of associated impacts. Furthermore, IUNG's strong network with regional and national stakeholders makes it very well placed to lead this paradigm shift.

The success in playing a key role in this transition is within IUNG's grasp, and some changes can help IUNG fulfil this role. At a very basic, but important, level is that the objectives of the ERA team, Department of Bioeconomy and Systems Analysis, IUNG and stakeholders are aligned. All ships must sail in the same direction!

If this is achieved, there is no doubt of the potential that IUNG gains in this role, in Poland and abroad, which will make it a European and global authority of bioeconomy sustainability issues.