

# **Innovative education for the biobased economy**

## **Chapter 4**

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A new thematic field – such as the transition towards a biobased economy – requires innovation within education. Educational institutes might use the momentum of innovation to take steps towards digital learning methods and open educational resources. Moreover, the biobased society requires an interdisciplinary and cross-sectoral approach, which can be learned in interdisciplinary teams working on a real-life problem, as discussed in more detail in Chapter 2.

### **1. Towards a biobased economy and a circular economy**

Meeting the material and energy needs of a growing global population will increasingly require resources with biobased origins; biomass is also a source of food for humans and feed for animals. The challenge is to use resource efficiency to meet these sometimes conflicting needs. A biobased society also offers new economic opportunities for the agrifood and chemistry sectors, in particular, but there is new crossover between existing sectors as well. Furthermore, biobased raw materials offer new material characteristics for chemistry. To reach a biobased economy, new knowledge and expertise are required.

Today's economy is linear. Materials are taken from nature, turned into something else, used and then disposed of. The process starts all over again by taking virgin materials from nature. This creates two problems: it depletes nature and leaves society with a considerable amount of waste. A transition towards a circular economy, also known as cradle-to-cradle approach, is required. The circular economy features two circles: an inorganic circle that includes metals, non-degradable plastics and building materials, and an organic circle that includes composting.

#### **What is biomass and how can it be used to make products?**

Biomass is all plant and animal material, both raw and processed. Resources are agricultural, food and feed production, forestry, and natural and aquatic resources. Aquatic resources include weeds, duckweed and algae. Biomass is a collection of valuable ingredients. It contains sugars, starches, cellulose, lignin, proteins, oils, fats and other specific ingredients. Using mechanical (biotechnical), chemical and thermochemical processes, biomass can be refined and converted into new building blocks for innovative products such as paints, plastics, composites, building materials and fuels.

#### **Education for a biobased economy**

It will take a generation to transition from a fossil-based to a biobased society. Today's students will be part of the transition during their working career. If teachers are able to inspire this current generation of students, they can help speed up this transition. The biobased economy is a perfect stepping stone for inspiration. It inspires young people and universities are seeing growing numbers of students choosing a 'greener' education programme.

Wageningen University did a market survey among secondary school students in 2011. The term biobased economy was unfamiliar to them. But when explained, more than 70% became enthusiastic and 40% of them were interested in following a biobased programme. There is certainly potential for biobased curricula in education.

In recent years, educational institutes have begun to see the relevance of bringing the biobased

economy into classrooms. They have already started developing new courses, minors and programmes on the biobased economy. Some schools incorporate this topic into existing programmes while others create new programmes from scratch.

Incorporating a new topic in education also creates opportunities for new innovative formats. In the Netherlands, new teaching material is frequently offered in a digital format.

### **New skills: a systems approach and cross-sectoral mindset**

As stated before, new educational material on the biobased economy should include:

- A solid disciplinary knowledge base
- The ability to work in an interdisciplinary team
- A cross-sectoral mindset

Research organisations, such as Wageningen University & Research, conduct numerous research programmes to contribute to a faster transition from a fossil-based to a biobased society. Within this research, different disciplines work together through an interdisciplinary, holistic approach, as experts believe that is the key to success. Better crops and new products will be designed by interdisciplinary teams, taking into account the socioeconomic, ethical and environmental aspects related to biomass production and carbon capture in an international context. A technological solution alone does not guarantee success on the market.

Wageningen University defined learning objectives for biobased education. First, students should learn a discipline – become a good chemist, a good process engineer or a good agronomist. Second, they should be able to relate their expertise to the bigger picture. In other words, they must be able to work in an interdisciplinary setting, and often a cross-sectoral setting as well. To learn to work in an interdisciplinary way, students must first broaden their horizons to understand the basics of other disciplines. Without understanding the basics, it is very difficult to cooperate with other disciplines and master a systems approach.

Moreover, new business opportunities are relevant for students. Chemistry students should realise that plastic can be made from sugar as well as from oil. Agriculture students should realise that their market extends beyond the sugar company and the food business. Sugar can be used to make other products, such as the building blocks for plastics. This gives farmers more outlets for their product. However, if a farmer wants to enter this new market, they will also need to know that it involves a continuous supply instead of a seasonal one and more strictly defined specifications. This new cross-sectoral mind-set is a crucial part of the learning process.

### **Sharing knowledge and educational resources**

#### **Cooperation between agricultural and chemical engineering**

To develop new learning methods, Wageningen University works in close collaboration with other partners, such as the Centre for Biobased Economy (CBBE). CBBE is a Dutch collaboration between Wageningen University and seven universities of applied sciences. Some of these educational institutes are 'green' and have a specific background in food and agriculture. Other CBBE partners have a background in chemical engineering. Both are relevant for the biobased economy.<sup>1</sup>

The centre's main objective is to develop teaching materials and incorporate these into the academic system. Its second objective, applied research, is carried out at the universities of applied sciences in

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<sup>1</sup> <http://edepot.wur.nl/394087>

order to develop more knowledge within the schools. One particular research line involves the PhD tracks for teachers. The third objective involves stimulating cooperation with the industry, which involves students helping companies to address specific issues. These projects offer great learning opportunities for students, lecturers and companies alike.

The different Centre for Biobased Economy schools have developed new biobased economy courses and minors – some obligatory and some optional. During the teacher days, experiences, materials and inspiration are shared. In the Netherlands, the network tries to cover the whole educational landscape, from primary school to lifelong learning for professionals – including teachers. All digital material is made available online.<sup>2</sup> Several MOOCs<sup>3</sup> have been developed.

### **Open educational resources: Wikiwijs<sup>4</sup>**

Wikiwijs, a nationwide initiative on open educational resources (OER)<sup>5</sup> was designed as an environment in which all teachers in the Netherlands, from primary education to higher education, can (co-)develop, share, revise and use digital learning materials, published under an open licence.

Digital learning materials are more than digital textbooks. The site and community are designed to support a variety of educational materials including tests, labs, simulations and practice materials.

One main principle of Wikiwijs is using the “wisdom of the crowds” (Wikipedia 2012). Therefore, Wikiwijs should become “for, from and by teachers”. A second main principle of Wikiwijs is that the learning materials should be openly accessible.<sup>5</sup>

The CBBE developed the “Introduction to the Biobased Economy” Wikiwijs arrangement so all Dutch schools can use it – completely or partly. The learning module is set up for first year undergraduate students at universities of applied sciences and is available through the educational platform *Wikiwijs leermiddelenplein* (<https://www.wikiwijsleermiddelenplein.nl/>). Because the wiki module is an introductory course, it can be used by technology students as well as business and economic students. The method is very flexible. The teacher can choose the relevant part for his or her students, depending on interest and background. Teachers can add any examples and background information they want to make the course specific to their own region or incorporate the latest news.

The wiki provides a short overview of all aspects of the biobased economy. Besides text, pictures, video and animations are also included, and the teacher can easily combine the resources with their own material. The wiki includes also tests and self-assessment tools.

The learning objectives for the students were set while developing the wiki. Students should be able to understand the basic principles of the biobased economy, circularity of chains, the potential value of biomass from land or an aquatic source and gain a basic understanding of processing possibilities. In all, the module is estimated at a 2 ECTS study load.

### **Co-creation between students and organisations – Academic Consultancy Training**

Often, civil society and public or private organisations have specific consultancy and research queries and have no time or resources to address them. Students and teachers can help with this.

Within Wageningen University, the Academic Consultancy Training (ACT) course was developed.

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<sup>2</sup> <http://www.kennisnetbiobased.nl/nl/biobasedeconomy/onderwijs.htm>

<sup>3</sup> Massive Open Online Courses (e.g. <https://www.edx.org/micromasters/wageningenx-biobased-sciences-sustainability> and <https://www.coebbe.nl/content/mooc-biobased-economy-introduction-1>)

<sup>4</sup> The Wikiwijs learning method is an initiative of SLO Nationaal Expertisecentrum voor Leerplanontwikkeling and Stichting Kennisnet

<sup>5</sup> [http://www.robertschuwer.nl/download/Wikiwijs\\_maturation.pdf](http://www.robertschuwer.nl/download/Wikiwijs_maturation.pdf)

During the ACT project students work jointly in multidisciplinary teams of five to seven students addressing specific queries set by societal and private organisations. The ACT teams are supported by an academic advisor that is responsible for the academic quality of their work and by a coach guiding the team process. Almost one thousand Wageningen University & Research students are involved in ACT projects every year and provide academic consultancy services to various societal and private organisations in the Netherlands and abroad. Students participating in the ACT course are almost at the end of their Master's programme and have a background in social sciences, plant sciences, environmental sciences, animal sciences, agro-technology and food sciences.

The objective of the ACT is to master professional skills, such as project management and customer focus. Students will already have sufficient disciplinary expertise to start the project. They work in teams of five to seven on cases commissioned by companies, institutes, governments and non-governmental organisations. Students will invest approximately 220 hours per person over an eight-week period, equivalent to 1,000-1,500 working hours per student team. In the first three weeks, the students spend 40 hours each on writing a proposal and project plan. The practical work for the project is carried out in the following four weeks, based on a 42-hour working week. The project is finalised in a presentation and a written report. The presentation is given at the customer's place of business.

One example is a team of students who looked into the feasibility of managing biomass waste. The assignment was from a regional governmental organisation "De Wolden Hoogeveen". The research questions were: What methods can be used to extract chemical compounds out of the grass in this region, and can the grass be used as fuel or soil conditioner?

For the students, it was an enriching experience. Besides new knowledge, they learned to work as a group, set up a research plan, discuss with the client and present the results. For the regional government the project was also inspiring and useful to further regional development.<sup>6</sup>

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<sup>6</sup> For more information (in Dutch) <http://www.wur.nl/nl/Expertises-Dienstverlening/Faciliteiten/Onderwijsloket-WUR/Voorbeelden/Milieuwetenschappen-studenten-werken-aan-biomassa-vraagstuk-in-Zuid-West-Drenthe.htm>