



# Bioeconomy and Genome Editing: A Comparison Between Germany and the Netherlands

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## Abstract

This chapter examines the extent to which strategies for bioeconomic transformation have been developed in Germany and the Netherlands and how they differ in content. The analysis is based on national bioeconomic strategies as well as official statements and press releases published by the governments, ministries, and independent scientific advisory bodies and institutes of both countries until the end of 2019. The potential that both countries attribute to genome editing for the development of a post-fossil (agricultural) economy is the primary interest of the analysis. The interest of the analysis is also directed towards the way in which both countries have so far participated in the discourse on the legal classification of genome editing by the European Court of Justice. The legal classification plays a decisive role in the discourse, since stricter regulation can require genome edited organisms to undergo time- and cost-intensive approval procedures and labelling as genetically modified. For a better understanding of the discourse, the chapter also describes the general attitude towards biotechnologies in both countries in the past and illustrates insights into the social acceptance of the new biotechnological methods from first surveys carried out in both countries.

## Keywords

National bioeconomic strategies · Genome editing · Social acceptance

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## 1 Introduction

The concept “bioeconomy” describes a form of economy “where the basic building blocks for materials, chemicals and energy are derived from renewable biological resources”.<sup>1</sup> According to the *Knowledge Based Bioeconomy* (KBBE) of the *European Commission* (EC) the transformation from open to closed material cycles and the increase in biomass production should ensure global food security for the growing world population.<sup>2</sup> Therefore, the establishment of a bioeconomic strategy pursues socio-economic goals, such as strengthening the economy by means of research funding and the occupation of future markets.<sup>3</sup> In the context of a bioeconomic transformation, a wide range of measures and approaches are being discussed,<sup>4</sup> including biotechnology and especially the new molecular biological techniques of *genome editing* (GE).<sup>5</sup> CRISPR/Cas, which was presented in 2012, is considered to be the best known method of GE. Compared to previous molecular biological methods, CRISPR/Cas is supposed to allow a fast, targeted and cost-effective modification of the gene structure.<sup>6</sup> The basic method of GE is the cut at a defined position on the double-stranded DNA using so-called *molecular scissors* and the subsequent mutation of a single base or entire base sequence introduced by the cell’s own repair mechanisms.<sup>7</sup> The potentials and risks of GE for the bioeconomy are examined in this chapter from a comparative perspective between Germany and the Netherlands. These two countries were the focus of the *Bioeconomy and Modern Biotechnologies: Ethical, Legal and Social Aspects* retreat week in September 2019, which was funded by the German *Federal Ministry of Education and Research*. According to the *Fraunhofer Institute for Systems and Innovation Research* (ISI), Germany, through the *National Research Strategy BioEconomy 2030* (NRSB) formulated in 2010, is taking an “international pioneering role”<sup>8</sup> in bioeconomy, while according to Bosman and Rotmans, the Netherlands is more likely “a laggard rather than a frontrunner in Europe”, partly because of its greater dependence on fossil fuels.

In the following, the relevance of bioeconomy on the political, economic and scientific level in Germany and the Netherlands will be explained first. The overview shows which bioeconomy strategies have been developed in the two countries, to what extent they differ from each other and what potential is ascribed to GE for the development of a post-fossil economy. Subsequently, the analysis focuses on the

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<sup>1</sup>McCormick and Kautto (2013, 2589); cf. also Pietzsch (2017, VII).

<sup>2</sup>Cf. Albrecht et al. (2010).

<sup>3</sup>Cf. Kiresiewa et al. (2019).

<sup>4</sup>Cf. Lewandowski (2018).

<sup>5</sup>Cf. German Bioeconomy Council (2019a).

<sup>6</sup>Cf. Knott and Doudna (2018).

<sup>7</sup>Cf. Siebert et al. (2018).

<sup>8</sup>Fraunhofer Institute for Systems and Innovation Research (2017), II, “international pioneering role” (own translation).

way in which both countries have contributed and continue to contribute to the European discourse on the legal classification of GE by the *European Court of Justice* (ECJ). The legal assessment plays a decisive role in the discourse<sup>9</sup> since *genome edited* organisms have to go through time- and cost-intensive approval procedures due to regulation and have to be labelled as *genetically modified* (GMO). Regulation is not a ban, but a marketable application is made considerably more difficult or often practically impossible. Today, the majority of European consumers are sceptical about products labelled as GMOs. As a consequence of strict regulation, some scientists fear economic consequences for the European market and a blockade of innovation.

For a better classification of the discourse, the previous general attitude towards biotechnologies in both countries is also briefly presented and discussed. The findings from the comparison of the countries will be summarised and possible conclusions for the further course of the discourse will be derived. The analysis is based on official bioeconomic strategies and statements as well as press releases published by the governments, ministries, state and independent scientific advisory bodies and institutes of both countries until the end of 2019. More recent developments in the discourse from 2020 are not considered in our analysis.

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## 2 Bioeconomy in Germany

In order to achieve the goal of a bio-based economy, German policymakers are pursuing the NRSB and the *National Policy Strategy on Bioeconomy* (NPSB), which was adopted by the Federal Cabinet in 2013. In addition to these two national strategies, the German states have developed different political strategies and funding measures at the federal level. In addition to state research funding programmes, there are also funding measures that are jointly financed by individual states and the federal governments. While some federal states have a broadly based research landscape on bioeconomy clusters and offer extensive research programmes, smaller states in particular appear to be keen to provide targeted support for the sale of individual bio-based products.<sup>10</sup> In Central Germany, for example the Bioeconomy cluster for the promotion of integrated material and energy use of non-food biomass for the production of materials, chemicals and products was established in 2012. The transformation process towards a bioeconomy, which began with the abandonment of lignite, was thus supported by the *Federal Ministry of Education and Research* in Central Germany with 80 million euros up to 2017 (of which 50% was provided by industry).

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<sup>9</sup>Siebert et al. (2021).

<sup>10</sup>Cf. c/o BIOCUM AG (2020b).

## 2.1 National Research Strategy Bioeconomy 2030

Under the leadership of the *Federal Ministry of Education and Research*, a bioeconomic strategy was developed together with five other ministries, which provided a total of 2.4 billion euros for research and development up to the end of 2017. The NRSB has formulated two strategic goals with the vision of creating a “natural cycle-oriented, sustainable bio-based economy that carries the promise of global food supplies that are both ample and healthy, and of high quality products from renewable resource”.<sup>11</sup> Firstly, Germany is to become a dynamic research and innovation location for bio-based products, energies, processes and services in international comparison. Secondly, research in Germany should also assume responsibility for feeding the growing world population and for climate, resource and environmental protection. Both goals are to be achieved with the help of sustainable agricultural production, the production of healthy and safe food and the industrial use of renewable raw materials, the expansion of biomass-based energy sources, international cooperation and cross-field measures.<sup>12</sup> The NRSB has thus initiated a change from technology- to mission-oriented research and development funding, which is geared towards overcoming social challenges.<sup>13</sup> The ISI, which evaluated the NSFB in 2017, assigns Germany an international pioneering role in the bioeconomy.<sup>14</sup> Taking into account a worldwide increasing use of genetic engineering and in order to achieve global food security, the NRSB proposes a “responsible handling of genetically modified plants”.<sup>15</sup> In order to adapt crops to future requirements with regard to agriculture and forestry, a great need for innovative research approaches is also identified.<sup>16</sup> Under the name *Plant 2030*, the *Federal Ministry of Education and Research* is bundling specially funded research activities for applied plant research. These currently include the funding initiatives *Plant Breeding Research for the Bioeconomy*, *Plant Biotechnology for the Future* and various funding projects of the transnational programme, e.g. *PLANT-KBBE or Bioeconomy International*, in which public research institutions and companies from the plant breeding and bioeconomy sectors cooperate. The NRSB pointed out the possible potential of genome analysis methods at an early stage. Despite the promises of innovative biotechnologies, it also warned against glorifying technical progress as an end in itself. Rather, a careful analysis of ethical, legal and social aspects, a comprehensive formation of public opinion and participation as well as a strengthening of the dialogue and interaction between science, industry and the public are recognised as urgent.<sup>17</sup>

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<sup>11</sup> Federal Ministry of Education and Research (2010, p. 3).

<sup>12</sup> Cf. *ibid.*

<sup>13</sup> Cf. Fraunhofer Institute for Systems and Innovation Research (2017).

<sup>14</sup> Cf. *ibid.*

<sup>15</sup> Federal Ministry of Education and Research (2010, p. 23).

<sup>16</sup> Cf. Federal Ministry of Education and Research (2020, p. 16).

<sup>17</sup> Cf. Federal Ministry of Education and Research (2010).

CRISPR/Cas is mentioned for the first time in the NRSB in the official announcement on 12 April 2017 for the promotion of research projects in plant research on *Crops for the future*.<sup>18</sup> Compared to established methods CRISPR/Cas is considered to have “enormous potential”<sup>19</sup> to realise significant progress, as it is seen to be easier, more precise, faster and cheaper to use. In order to support the German bioeconomy, the *Federal Ministry of Education and Research* promotes therefore the development of “forward-looking exploratory technological approaches which can markedly improve or accelerate molecular precision breeding of crops using optimized or novel CRISPR/Cas systems and other advanced genome editing techniques”.<sup>20</sup>

## 2.2 National Policy Strategy on Bioeconomy

The objectives or guiding principles of the NPSB, which were developed under the leadership of the *Federal Ministry of Food and Agriculture* and are closely linked to the sustainability strategy of the Federal Government and the NRSB, are as follows: (1) Food security also has priority in the global context over the production of raw materials for industry and energy; (2) the use of pathways with a higher value-added potential is to be given preference in the further shaping of the framework conditions of the bioeconomy; (3) where possible and sensible, cascaded and coupled use of biomass should be implemented; (4) the securing and strengthening of the competitiveness of the bioeconomy in Germany and the growth potential on international markets must always be taken into account; (5) well-trained and informed specialists are indispensable for the competitiveness of the bioeconomy; (6) the opportunities and framework conditions for the use of key technologies and their transfer to economic use must be improved; (7) the bioeconomy must take account of growing societal demands on the way in which production is carried out—this applies to environmental, climate, nature and animal protection and to compliance with social standards; (8) the application of sustainability standards in producer countries, especially those with weak governance and weak institutions, must be expanded and efforts must be made to monitor compliance with them and (9) close cooperation between political, economic, scientific, environmental and social actors is necessary for the development of the bioeconomy.<sup>21</sup>

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<sup>18</sup>Cf. Federal Ministry of Education and Research (2017).

<sup>19</sup>Ibid., 1.

<sup>20</sup>Ibid., 2.

<sup>21</sup>Cf. Federal Ministry of Food and Agriculture (2014, p. 21).

### 2.3 Bioeconomy Council

In order to ensure the implementation of both strategies, the *German Bioeconomy Council* (previously the *Bioeconomy Research and Technology Council*) was founded in 2009 by the *Federal Ministry of Education and Research* and the then *Federal Ministry of Food, Agriculture and Consumer Protection*. The independent and honorary body, consisting of 17 members, advises the German government on research and development in the knowledge-based bioeconomy, the creation of positive framework conditions for a bio-based economy, improved education and training in the bioeconomy and social dialogue.<sup>22</sup> By 2019, the advisory body, which was newly constituted at the beginning of its second term of office in 2012, had issued over 80 publications, including BÖRMEMO 07 on 16 January 2019, a statement on the regulation of GE by the European Court of Justice. In addition to the potential of GE for the breeding of high-yielding and resistant plants and the development of more environmentally friendly production methods, the *German Bioeconomy Council* includes the risk of ignorance and the danger of a European competitive disadvantage through regulation in its assessment of the ECJ ruling.<sup>23</sup> It also calls for a new law on genetic engineering and a constructive discourse on new biotechnologies for society as a whole. In the *German Bioeconomy Council's* recommendation for a further development of the NRSB, biotechnologies continue to make a significant contribution to the development of “high-tech solutions and products based on the fusion of biotechnologies with sensor, nano, information and cognitive technologies”.<sup>24</sup> It goes on to say: “This was not considered six years ago. The new biotechnologies, such as CRISPR/Cas, require scientific assessment and societal discourse”.<sup>25</sup> The expiry of the NRSB in July 2019 marked the end of the second term of office of the *German Bioeconomy Council*, which, however, recommends that the Federal Government further develop the advisory structure, in particular, the establishment of a German bioeconomy platform.<sup>26</sup>

### 2.4 National Bioeconomy Strategy

In order to build a bridge between technology, ecology and efficient management, to interlink the individual departments even more closely, to consolidate science-based foundations and to pursue sustainability in a concrete and consistent manner, the *Federal Ministry of Education and Research* and the *Federal Ministry of Food and*

<sup>22</sup>Cf. German Bioeconomy Council (2019a).

<sup>23</sup>Cf. German Bioeconomy Council (2019b).

<sup>24</sup>German Bioeconomy Council (2016, p. 7), “high-tech solutions and products based on the fusion of biotechnologies with sensor, nano, information and cognitive technologies” (own translation).

<sup>25</sup>Ibid., 7, “This was not considered in this way 6 years ago. The new biotechnologies, such as CRISPR/Cas, require scientific evaluation and societal discourse” (own translation).

<sup>26</sup>Cf. German Bioeconomy Council (2019c).

*Agriculture* are currently working on an overall strategy for the bioeconomy for the German government.<sup>27</sup> The aim of the strategy is to promote the sustainable design of agricultural and forestry production and the development of innovative, bio-based alternatives to existing products and processes. Cross-border cooperation was defined in advance as a new core topic. In order to identify the priorities for the follow-up programme of the NRSB and NPSB, the *Federal Ministry of Education and Research* has organised various events with representatives from science, industry, politics and civil society since 2016. In June 2019, the *Federal Ministry of Education and Research* asked selected stakeholders to submit their comments on the *National Bioeconomy Strategy* (NBS).

In the statement of the *German Forum on Environment and Development* (GFED), which consists of numerous German environmental and development associations, it was welcomed that “selectively central ideas of the sustainability debate”,<sup>28</sup> such as biodiversity and climate protection, soil fertility, distributive justice, sufficiency and a possible conversion of the economic system are taken up in the Federal Government’s draft. However, these are “insufficiently or not at all”<sup>29</sup> taken into account in the research funding of the intended political framework conditions. The GFED also misses in the draft an “indefinite commitment of the Federal Government to the precautionary principle and a clear statement against agro-genetic engineering in future bioeconomy research”<sup>30</sup> and criticises the Federal Government for research that is too open to technology with regard to GE and synthetic biology. In contrast, the draft was received comparatively positively by the German *Biotechnology Industry Association* (BIO-Deutschland) which welcomes the integration of the NBS into other initiatives of the German government such as the Sustainability Strategy or the High-Tech Strategy 2025 and the numerous mentions of biotechnology as a key technology for the bioeconomy.<sup>31</sup> However, with reference to the potential of new molecular biological techniques in agriculture, it is critically noted that the term *genetic engineering* is not mentioned in the entire draft: “Traditional mutation breeding is also genetic engineering as the ECJ clarified a year ago”.<sup>32</sup> It is further argued that genetic engineering has the potential to provide answers to pressing issues such as increasing global warming and scarcity of resources. Particularly against the background of the public debates on this topic, some of which are “partly rather emotional and not very factual”,<sup>33</sup> the

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<sup>27</sup> Cf. Federal Ministry of Education and Research (2018).

<sup>28</sup> German Forum on Environment and Development (2019, p. 1), “selectively central ideas of the sustainability debate” (own translation).

<sup>29</sup> Ibid., 1, “insufficiently or not at all” (own translation).

<sup>30</sup> Ibid., “clear commitment of the Federal Government to the precautionary principle as well as a clear statement against agro-genetic engineering in future bioeconomic research” (own translation).

<sup>31</sup> Cf. Biotechnology Industry Association (2019).

<sup>32</sup> Ibid., 7, “Even traditional mutation breeding is genetic engineering, as the ECJ made clear a year ago” (own translation).

<sup>33</sup> Ibid. “rather emotional and not very objective” (own translation).

biotechnology industry association continues: “a mention of genetic engineering processes in a bioeconomy strategy [is] indispensable”.<sup>34</sup>

### 3 Bioeconomy in the Netherlands

Focused mainly on food processing, chemicals, oil refining and electrical engineering, the Dutch economy is the sixth largest in the European Union.<sup>35</sup> The agricultural sector in particular, which employs only 2% of the labour force, is highly technological and produces a significant surplus for export.<sup>36</sup> Products from greenhouse production, e.g. tomatoes and vegetables, but also processed products such as starch, sugar and lactic acid are particularly noteworthy. In the Netherlands, bioeconomic potential can still be found in horticultural products such as ornamental plants or landscape woods and in the chemical industry, where many companies have already recognised the impending economic change and are focusing on bio-based chemicals and biopolymers.<sup>37</sup> At present, 50 of the 321 biotechnology companies are already generating a large part of their profits from the bioeconomy. The government sees considerable potential in GE, in particular, for the breeding of high-yielding and resistant organisms and the associated sustainable production of biomass, which in turn is of great importance for the bioeconomic transformation.<sup>38</sup> The Dutch Farmers’ Association also has a positive attitude towards GMOs, but points to the resistance of many customers, especially in the important sales market in Germany.<sup>39</sup>

While in Germany the aim is to promote the bioeconomy on a broad basis, the Netherlands defines priority economic sectors in which a bioeconomic transformation should be promoted. These mainly include the five sectors of agriculture and food, chemicals, energy, life sciences and horticulture. To implement its bioeconomic strategies, the Netherlands follows a bottom-up approach, often led by industry through so-called *triple-helix cooperation* (also known as *cluster networks* in Germany) between scientific institutions, companies and the government at the state or regional level. With the aim of facilitating contacts between the individual areas and overcoming regulatory obstacles, the bio-based delta in the southwest of the Netherlands, for example has been established where a purely bio-based economy is to be established. The Dutch bioeconomy strategy now links more than 40 governmental, environmental and civil society organisations,

<sup>34</sup> Ibid. “it is essential that genetic engineering processes be mentioned in a bioeconomic strategy” (own translation).

<sup>35</sup> Cf. Bosman and Rotmans (2016).

<sup>36</sup> Cf. Netherlands Environmental Assessment Agency (2014).

<sup>37</sup> Cf. c/o BIOCUM AG (2020a).

<sup>38</sup> Cf. *ibid.*

<sup>39</sup> Cf. *ibid.*



employers' associations, trade unions and financial institutions.<sup>40</sup> Overall, the available biomass in the Netherlands theoretically covers the national demand for food, feed, transport and chemicals.<sup>41</sup> Even though the structures and strengths of the Dutch economy thus provide a good basis for bioeconomic transformation and the government is also setting the course for a greener economy, according to Bosman and Rotmans, the potential of biomass is not yet fully exploited due to the country's heavy dependence on fossil fuels.<sup>42</sup> Gas reserves in the Netherlands will probably come to a standstill over the next 15 years, making it an important driver for the bioeconomic turnaround. Its increasingly costly production has already led to considerable earthquakes and accidents in the north of the Netherlands, further increasing the pressure for transformation towards a bioeconomy.<sup>43</sup>

### 3.1 Werkgroep Businessplan Bioeconomy

In its *Werkgroep Businessplan Bioeconomy* (WBBE), the Netherlands formulates the goal of becoming a future centre of excellence of a global bioeconomy on the basis of renewable raw materials. By 2050, the Netherlands aims to be one of the world's leading countries in the bioeconomy, focusing on its own strengths: "A highly developed [bioeconomy] uses green resources firstly in the production of food and feed and only afterwards (or simultaneously in the case of waste products) for chemicals, materials and energy".<sup>44</sup> While the share of renewable energies was still 5.6% in 2014, their share in energy production is to increase to 14.5% by 2020 and to at least 40% by 2040. It is also assumed that one in three technical students will be employed in the bioeconomy by 2030. In a version of the WBBE updated in 2018, the *Dutch Ministry of Economics and Climate Policy* formulates the following eight pillars for a bioeconomic transformation: (1) the use of resources within the planetary boundaries; (2) stopping climate change; (3) greater opportunities for new jobs and businesses; (4) sustainable resource management; (5) the establishment of a stable and predictable legal framework; (6) greater cooperation in the value chain; (7) a long-term research and innovation agenda and (8) a regional strategy for the efficient use of existing biomass and agricultural land.<sup>45</sup>

The presentation of the content of bioeconomic strategies is now followed by an analysis of the participation of both countries in the discourse on GE. The general social attitude towards biotechnology and genetic engineering will also be discussed.

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<sup>40</sup>Cf. Elyse (2015).

<sup>41</sup>Cf. Netherlands Enterprise Agency (2017).

<sup>42</sup>Cf. Bosman and Rotmans (2016).

<sup>43</sup>Cf. *ibid.*

<sup>44</sup>*Ibid.*, 2.

<sup>45</sup>Cf. Ministry of Economic Affairs and Climate Policy (2018).

## 4 Participation of both Countries in the Discourse on GE

Differences in the way the topic of GE is discussed in Germany and the Netherlands exist mainly on a political and social level. Since the development of GE, the government in the Netherlands has been more active in the discourse on GE than the German government. While the German government has hardly taken an official position on GE, the Dutch government has published numerous statements and press articles.<sup>46</sup> Especially with regard to the ruling of the ECJ published in July 2018, the Netherlands tried to express its support for the use of GE in advance with various statements at a national and European level on regulation in the discourse. They also tried to exert increased pressure on the EC in order to obtain a ruling by the ECJ as soon as possible. In Europe, the Dutch government, which traditionally has a liberal attitude towards biotechnology, was the first to seek discussion with other EU member states in order to discuss a possible interpretation of the regulations on GMOs:

[...] the Dutch authorities see no need to await the Court's rulings on the interpretation of European legislation for initiating a policy debate on New Plant Breeding Techniques. To the contrary, the Dutch authorities see a pressing need to address the underlying issues at stake in the short term, which includes making the implementation of the Directive more workable in view of ongoing technical and scientific developments.<sup>47</sup>

The attempt to obtain an exemption for GE in accordance with the Deliberate Release Directive 2001/18/EC and the reform of the current Genetic Engineering Act met with a positive response among the European member states. The active and official influence of the Netherlands on the discourse on GE is contrasted by the German Federal Government's attitude, which is hardly noticeable in public. In the period prior to the ECJ ruling, there is hardly any information about the German government's position on GE. Clues to the position of the *Federal Ministry of Food and Agriculture* can be found, inter alia, in isolated interviews with Federal Minister Julia Klöckner according to ECJ case law. She commented on the regulation as follows: "I think it is factually wrong to lump classical green genetic engineering together with CRISPR/Cas".<sup>48</sup> In order to start a broader discussion on GE in Germany, as in the Netherlands, Carina Konrad (Free Democratic Party/Germany) called on the German government to respond to the appeals from science and research: "She [Ms. Klöckner] now has to recognise the signals and act".<sup>49</sup>

The fact that the Netherlands and Germany could come closer together in the future with regard to their positions on GE was demonstrated at the meeting of the EU Council of Agriculture Ministers in May 2019, where, at the request of the

<sup>46</sup>Cf. Ministry of Infrastructure and Water Management (2017); Smit (2018).

<sup>47</sup>Ministry of Infrastructure and Water Management (2017, 2).

<sup>48</sup>Herrmann (2018), "To lump classical green genetic engineering together with CRISPR/Cas is, in my opinion, factually incorrect" (own translation).

<sup>49</sup>Karberg (2019), "It must now recognise the signals and act" (own translation).

Netherlands, the revision of the current genetic engineering law was also on the agenda, in addition to a discussion on a common agricultural policy.<sup>50</sup> According to the Dutch proposal for discussion, organisms obtained by GE should be distinguished from those obtained by classical genetic engineering. After Estonia had initially endorsed this proposal, 12 other Member States (Belgium, Cyprus, Finland, France, Germany, Greece, Italy, Portugal, Slovenia, Spain, Sweden and the United Kingdom) followed suit. According to the State Secretary of the *Federal Ministry of Food and Agriculture*, Hermann Onko Aeikens, Germany is generally open to a discussion on genetic engineering law.<sup>51</sup> If this is taken into account against the background of the nationwide ban on the cultivation of genetic engineering agreed in the coalition agreement and the, sometimes conflicting, positions of the Minister of Agriculture Julia Klöckner and the Minister of the Environment Svenja Schulze, it is questionable, according to the biochemist and molecular biologist Prof. Dr. Klaus-Dieter Jany, whether and to what extent Germany will actively support an adjustment of the genetic engineering legislation at the EC in the future.<sup>52</sup> While Ms. Schulze rejects CRISPR/Cas as a breeding method and advocates regulation by the ECJ, Ms. Klöckner advocates plant breeding that is open to new technologies.<sup>53</sup> Mr. Aeikens also emphasises that the Federal Government in Germany will only make a new push at a European level on GE when the Christian Democratic Union, Christian Social Union and Social Democratic Party agree on a common line.<sup>54</sup> While German politics thus still seem to wait and see, the *National Academy of Sciences Leopoldina*, the *Union of the German Academies of Sciences and Humanities* and the *German Research Foundation* formulated for the first time concrete proposals for the reform of the current genetic engineering guidelines in a joint position paper from 4 December 2019. Entitled *Towards a scientifically based, differentiated regulation of genome-modified plants in the EU*, the paper recommends that the EC amend European genetic engineering law in a timely manner, discuss each breeding method in a differentiated manner and thus create a “long-term perspective for appropriate regulatory management of new breeding technologies”.<sup>55</sup> The opinion considers the new molecular breeding methods to be an important contribution to the bioeconomy in the coming years, in order to make “agriculture more productive, less pesticide-intensive and more climate-adapted through traits such as drought and heat tolerance”.<sup>56</sup> Further indications that the pressure on politicians will increase fundamentally and that genetic engineering law will have to be reconsidered or revised are provided by the European citizens’

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<sup>50</sup> Cf. Council of the European Union (2018).

<sup>51</sup> Cf. Jany (2019).

<sup>52</sup> Cf. *ibid.*

<sup>53</sup> Awater-Esper (2019).

<sup>54</sup> Cf. Agra Europe (2019).

<sup>55</sup> German National Academy of Sciences Leopoldina, Union of the German Academies of Sciences and Humanities and German Research Foundation (2019, 76).

<sup>56</sup> *Ibid.*, 54.

initiative *Grow Scientific Progress* (GSP), which is seeking to reform current plant breeding legislation in the EU.<sup>57</sup> The initiative, which is made up of German and Dutch students from Wageningen University, aims to achieve a more liberal legal approach to the new molecular biological methods and could promote a future rapprochement between both countries with regard to biotechnology in agriculture.

On the political, economic, scientific and social level, applications of biotechnology have so far been discussed more optimistically in the Netherlands than in Germany.<sup>58</sup> A 2010 Eurobarometer survey showed that 53% of the Dutch population expects biotechnology to have a positive impact on our future lives, while only a quarter of those surveyed expect negative effects.<sup>59</sup> When asked specifically about genetic engineering, 57% of the Dutch population rejected the use of foreign genes and 46% rejected the use of related genes. In comparison, 69% and 47% of the German population rejected the use of foreign or related genes. Furthermore, according to the *Federal Ministry of the Environment, Nature Conservation and Nuclear Safety* and the *Federal Agency for Nature Conservation*, in 2009 85% of Germans considered a ban on genetic engineering in agriculture to be very or rather important.<sup>60</sup> Whether there is a connection between the development of GE and the recently declining number of those who agree unconditionally (“very important”) to a ban on genetic engineering in agriculture cannot be conclusively answered here. One of the first more comprehensive surveys of public attitudes to GE in Germany was conducted by the Federal Institute for Risk Assessment in September 2019. With the aim of obtaining a more differentiated consumer opinion on the application of GE in the field of nutrition and human health, 20 interested German consumers were brought together with representatives from politics, science, industry and civil society. In a process lasting several days, a comparatively balanced mood regarding the potential and risks of GE was identified.<sup>61</sup> The 20 participants formulated the following demands on German politics: (1) retention of the precautionary principle; (2) freedom of choice for consumers; (3) freedom of information and transparency; (4) priority of social aspects over economic interests; (5) reform of patent law: no patent protection on living organisms; (6) liability regulations for unexpected damage by the producer and (7) labelling of genetically modified food. The survey shows that scepticism towards biotechnology still exists in German society. However, there seems to be a certain willingness to overcome this scepticism if decision makers openly communicate the risks.

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<sup>57</sup> Cf. *Grow Scientific Progress* (2019).

<sup>58</sup> Cf. Durant et al. (1998).

<sup>59</sup> Cf. European Commission (2010).

<sup>60</sup> Cf. Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and Federal Agency für Nature Conservation (2017).

<sup>61</sup> Cf. German Federal Institute for Risk Assessment (2019).

## 5 Conclusion

In this chapter, the development of the bioeconomy in Germany and the Netherlands was described, what importance is currently attributed to GE in this context, and how it might develop in the future. Germany is an international pioneer in the bioeconomy and, through its bioeconomy strategies, has a basic political, scientific and economic structure that forms an important basis for bioeconomic transformation. The *German Bioeconomy Council*, which is an important advisory body supporting the development of the bioeconomy in Germany, should be highlighted in this context. The Netherlands, too, has set itself high targets for 2050, which have been advanced by industry and others. GE, and in particular CRISPR/Cas, is seen as having great potential for the bioeconomy in both countries, which is also referred to in the bioeconomy strategies. Overall, the Netherlands has so far been more active or publicly perceived in the discourse on GE than Germany. Independently of each other, the Dutch government and the *German Bioeconomy Council* are in favour of a new European genetic engineering law, which should be adapted to the state of scientific knowledge and should examine each GE procedure individually.

It remains to be seen what relevance CRISPR/Cas and other similarly invasive genetic engineering methods will have in the future in the German bioeconomic strategy. It must be considered that GE is on the one hand seen as having the potential to trigger significant innovations as a “biological revolution”<sup>62</sup>; on the other hand, there are critical voices, such as that of the German Member of the Bundestag Harald Ebner (*Alliance 90/The Greens*), who sees CRISPR/Cas as a “one-dimensional technical apparent solution”<sup>63</sup> that does not provide sustainable answers to complex problems such as food security and even reduces the social acceptance of the bioeconomy. The statements of the GFED and BIO-Deutschland on the draft of the Federal Government on the hitherto unpublished NBS also show expectations of the role of GE in the future German bioeconomy that are difficult to reconcile. However, the discussion on GE in Germany also gives the impression that the social and political mood with regard to the application of biotechnology in agriculture is no longer exclusively critical or hostile and that uniform positions, which in the past could be found among actors such as the German party Alliance 90/The Greens or organic agriculture, seem to be softening.

For both countries, much will ultimately depend on whether the European Directive 2001/18/EC is amended and the Genetic Engineering Act is reformed. Whether or not majorities can be won at the political level will depend to a large extent on the new EC under the direction of Ms. Ursula von der Leyen. Ms. Petra Bosch of the *European Seed Association* explains: “I think, in the most positive way, a new regulation would be possible by the end of this legislative term of the new Commission and Parliament”<sup>64</sup>. In the event of a (partial) deregulation of GE, it

<sup>62</sup>German Bioeconomy Council (2019b, p. 2), “biological revolution” (own translation).

<sup>63</sup>Denkhausbremen (2018), “one-dimensional technical sham solution” (own translation).

<sup>64</sup>Haas (2019), “I think that the most positive way forward would be to have a new regulation in place by the end of this legislative period of the new Commission and Parliament” (own translation).

seems likely that both countries will make greater use of the new techniques as a tool for bioeconomic transformation. Whether the new EC will wait until the end of its legislative period in 2024 is difficult to predict at this point in time.

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