

# Trustworthiness and Responsible Research and Innovation: The Case of the Bio-Economy

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**Abstract** The approach of responsible research and innovation (RRI) has been proposed to support the introduction of technologies that touch upon socially sensitive issues. RRI is intended to help designers and manufacturers of new technologies identify and accommodate public concerns when developing a new technology by engaging with a wide range of relevant actors in an interactive, transparent process. However what this approach amounts to exactly remains elusive as of yet, i.e. it is unclear what its contribution to the societal embedding of new technologies should consist of exactly. The transition to a sustainable bio-economy that uses biomass as its main resource is a complicated trajectory involving many actors and touching upon societally sensitive issues such as the use of genetic modification. In this paper we pose the question in what way RRI can stimulate the development and diffusion of a sustainable bio-economy in The Netherlands and Europe. We claim that for the further development and diffusion of the bio-economy, trust among actors in the relevant value-chain is a prerequisite. RRI can play a pivotal part in the bio-economy by providing conditions for trustworthiness of actors and by enhancing trusting relationships. This can be achieved through

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instruments such as personal relationships, third person guarantors, institutions and the communication of values. From the application of RRI to the context of the bio-economy, lessons can be drawn for other socially intricate technological trajectories.

**Keywords** Trustworthiness · Responsible research and innovation · Bio-economy · Institutions

## Introduction

Technological innovations sometimes meet with societal resistance which in some cases leads to a disruption of its diffusion. Examples of technological innovations that have been hampered by social resistance are genetic engineering in Europe and underground CO<sub>2</sub>-storage in the Netherlands.

To support societally intricate technological trajectories, the approach of Responsible Research and Innovation has been proposed. RRI has been defined as:

A transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the ethical acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society). (Von Schomberg 2011, p. 9)

Responsible research and innovation is intended to help designers and manufacturers of new technologies identify and accommodate public concerns when developing a new technology by engaging with a wide range of relevant actors. We take such relevant actors to include other manufacturers and designers working in the bio-economy, in addition to the public at large. The assumption behind RRI is that if innovations are developed with an eye for social and ethical concerns, they will be (relatively) uncontested and will therefore diffuse better throughout society. RRI is supposed to diminish the risks of having innovations run aground due to social opposition in later stages of development, which would incur great costs (Von Schomberg 2011; Expert Group on the State of Art of Europe 2012).

Although the expectations of RRI as an approach to sustain the development of socially sensitive technologies are considerable (van den Hoven 2014), what RRI amounts to exactly remains difficult to define (Blok and Lemmens 2014). Parallels have been drawn with approaches such as technology assessment (TA) (Grunwald 2014) and ethical, legal and social assessment (ELSA) (Zwart et al. 2014). These latter approaches involve comparable interactive processes between societal actors and reflection on ethical and societal aspects of technological development.

The main difference between such approaches and RRI may be that RRI seeks to move beyond reflection and interaction towards active support of the societal uptake of innovations. Instead of aiming to protect society against unwanted consequences, RRI aims to address societal challenges through the use of technology, i.e. the goal of this approach is to produce societally desirable innovations that address specific public needs (Von Schomberg 2011). As such RRI is tied up with innovation

trajectories more closely than TA and ELSA. Whether this is indeed the most prominent distinction between TA and ELSA on the one hand and RRI on the other hand remains to be seen as RRI is still under construction. Its contribution to the process of innovation is not yet entirely clear (Blok and Lemmens 2014).

In this paper we consider whether the approach of RRI can support the further development of the bio-economy and if so, in what way? We will make some suggestion to operationalize the role of RRI in innovation trajectories with reference to the bio-economy. While studying the bio-economy we found that trustworthiness is of pivotal importance to the further diffusion of the bio-economy. As we will show, RRI can provide valuable support here through the use of some specific instruments. RRI in our view is not a goal in itself, but a way of organizing social interaction with the aim of stimulating trustworthiness.

This social interaction does not necessarily pertain to the public at large. Many technological trajectories also require the 'mutual responsiveness' of actors actively supporting and implementing innovations, such as manufacturers, suppliers and policymakers. This holds true especially for the bio-economy where collaboration between actors that did not previously co-operate, is essential. Farmers, chemist and energy producers will have to venture into new technological adventures together if biomass is to be used efficiently and without loss of resources.

For most of these actors, increased trustworthiness and trust is a desirable outcome of RRI processes. For some actors, trustworthiness is a prerequisite to partake in RRI at all. Therefore any instruments used to support RRI should create a minimal level of trustworthiness even if actors do not know each other or are suspicious of each other. We will give some suggestion on how such trustworthiness can be achieved as a precursor to actual RRI activities and how RRI can built on this initial trustworthiness. Lessons drawn from this case will be relevant to other socially intricate technological trajectories as well.

For this research we reviewed both popular and academic literature, interviewed several key actors in the development of a bio-economy in the Netherlands and organized three workshop with these actors. This allowed us to analyze empirical data gathered from the interviews and the desktop research with academic concepts and theory. We presented the resulting analysis in the workshops to actors in the bio-economy and could validate the findings and integrate their feedback in our conclusions.

## **Challenges to a Sustainable Bio-Economy**

The bio-economy is an economy where biomass is the main resource for energy, materials and chemicals and this resource is used with the utmost efficiency. Biomass can be obtained from food and feed crops, non-food crops, woody forest based sources and various types of wastes and residues, including the biodegradable fractions of municipal or industrial wastes. New uses of biomass such as for materials and energy contribute to the replacement of fossil fuels thereby combatting climate change and reducing our dependency on oil producing regimes (OECD 2009).

At this moment, the development of a bio-economy is in a critical stage. Many of the current applications such as biofuels and biogas mainly rely on subsidy schemes while the technology to convert the biomass needs maturing to achieve price reductions and increased sustainability. The transition to a bio-economy that can actually outcompete the use of fossil resources in a sustainable way without subsidies up to now remains largely an unfulfilled promise, not counting some applications such as the use of specific biobased specialty chemicals (International Energy Agency Bioenergy 2012).

For the bio-economy to enter a new, self-reliant stage of development requires more than technological innovations. It faces two major kind of social challenges. Firstly there are socially sensitive issues involved that need to be addressed to prevent social resistance (Asveld et al. 2011). Secondly the transition to a sustainable bio-economy requires changes in the social structures embedding the bio-economy (Bos-Brouwers et al. 2012) that can only be achieved with the support of relevant actors. Below we will explicate in more detail the nature of these challenges.

To some extent these challenges may be addressed through what might be called the core dimensions of RRI, namely inclusion, anticipation, reflexivity and responsiveness (Stilgoe et al. 2013; Owen et al. 2012), where inclusion refers to the inclusion of laypeople in decision making, anticipation refers to "...systematic thinking aimed at increasing resilience, while revealing new opportunities for innovation and the shaping of agendas for socially robust risk research." (Stilgoe et al. 2013, p. 1570), reflexivity demands actors to critically assess their own preconceptions and responsiveness refers to willingness to adapt an innovation to societal response.

Although those promoting the bio-economy may be helped by an attitude informed by the dimensions mentioned above in addressing the challenges facing a sustainable bio-economy, these dimensions fail to articulate what is essential in this phase of the bio-economy, which is trust. New technologies such as those associated with the bio-economy bring about risks and uncertainty, especially when their application can lead to far ranging social changes as is the case with bio-based technologies. Actors will only accept such risks and uncertainties if they trust the parties that control the relevant technologies.

Trust between individuals and/or collective actors is based on the decision of one party to rely on another party under conditions of risk. The trustor permits his or her fate to be determined by the trustee and risks that he or she will experience negative outcomes, i.e. injury or loss, if the trustee proves untrustworthy. (Bachmann and Inkpen 2011, p. 284)

In this paper we will mainly consider trust that goes beyond trust as an everyday thing. In our daily lives we continuously trust people we do not know, to not harm us. Such trust does not involve appraising the motives of the other person. We rely for instance on the postman to deliver our letters, without judging his intentions (O'Neill 2002). Such everyday trust might also be called system trust (Giddens 1990). System trust refers to a basic attitude of trust that we all need to be able to live in a society at all. This is what Giddens (ibid.) calls

‘ontological security.’ We can for instance only use money because we rely on other people acknowledging its value. Although system trust is indispensable for trustworthiness in the bio-economy—as it is indispensable to any social endeavour—it is not the focus of this paper. Our focus is on trustworthiness in an evolving setting where social relationships change, but the basic societal structures remain intact.

A person cannot be forced to trust another. This does not imply that trust cannot be managed. Although trust itself cannot be brought about in another person, it is possible to create conditions for trust, i.e. trustworthiness (cf. Meijboom et al. 2006). The transition to a full blown bio-economy calls for investment in the trustworthiness of actors involved.

## The Need for Trust in the Bio-Economy

### Need for Observability

Trust is first of all required because the main advantages of the bio-economy are difficult to observe. The key driver of the bio-economy: sustainability is not directly observable to potential adopters of bio-based applications. This forms an obstacle to the wide spread diffusion of the bio-economy. According to Rogers (2003), the relative advantage of an innovation needs to be observable for an innovation to diffuse successfully.

Additionally, sustainability and economic effects are under high scrutiny in this debate. Sustainability and economic effects on third world countries are major concerns for those criticizing the bio-economy. Any claims made in the debate on the merits of the bio-economy will therefore have to come from a trustworthy source to have any impact.

Although the indicators for the sustainability of biomass have been closely defined and are often very well measurable, they are not directly perceptible by most individuals. Consider for instance the reduction of CO<sub>2</sub> that cannot be perceived with the bare eye. Moreover, many of the sustainability effects of the bio-economy such as on the living conditions of small scale farmers take place in other countries and hence are also not observable by prospective consumers of biobased products in the Netherlands or Europe.

To sustain the diffusion of the bio-economy, these relative advantages have to be made observable in some way. Prospective consumers interested in sustainable products will have to rely on the testimony of other actors to judge whether biobased products are indeed sustainable. If these prospective consumers are to believe the testimonies of third parties, these third parties will have to be trustworthy in the eyes of the consumers. As Fokke Goudswaard, president of the Dutch Bio-energy platform and former advisor to the board of Eneco (a Dutch energy company) said: “The perception of citizens and consumers is important. This was a problem for the first generation biofuels. Eneco is therefore always looking for legitimisation of our activities in terms of sustainability” (interview dd. 6th March 2013).

## Advanced Genetic Technologies

Related to the above need for reliable information on sustainability, is the debate on advanced technologies that are potentially of great value to the bio-economy. Genetic engineering is expected to play a role in the bio-economy in various forms, both in the form of genetically engineered crops as in the form of engineered enzymes and microbial strains used in the fermentation process. Genetically modified (GM) crops are at present not allowed to be grown in the European Union (EU), with a few exceptions, but some genetically engineered crops dedicated to the production of energy are cultivated in other countries such as Brazil and the US (De Vriend and Stemerding 2011). The debate about this technology is still raging, with the EU still heavily divided on which crops, if any, to allow to be grown within its borders and 60 % of European inhabitants stating they feel 'uneasy' about GM-food (Eurobarometer 2010).

In the meantime another technology that could be considered a more 'extreme' version of genetic engineering: synthetic biology, is entering the stage of the bio-economy (Carlson 2010). Synthetic biology entails constructing new organisms by putting various genes together that express desired qualities, instead of adapting an existing organism such as happens with genetic engineering. A few applications of synthetic biology have been commercialized at present such as artemisinin used to combat malaria and vanilla flavour. Other applications are in the pipeline such as biofuels from algae produced through synthetic biology (Cha 2014; Wang et al. 2012).

The public debate on the desirability of synthetic biology is progressing along similar lines as the debate on genetic engineering. Clashing perceptions on what is just, natural and sustainable fuel the disagreements. Each party thereby stresses very different impacts of this technology. On the one hand high hopes accompany the advent of this new technology (see Carlson 2010). The director of Amyris, a leading synbio firm, Jay Keasling, testified before the US House of Representatives in 2010:

These new, advanced biofuels reduce the production of green-house gases, as they are derived from plants that use sunlight and atmospheric carbon dioxide to grow. These biofuels will reduce our dependence on foreign oil and could rejuvenate the U.S. agriculture economy, potentially making the American Midwest the new Middle East.

On the other hand some non-governmental organizations (NGOs) are very critical toward this technology. They warn that this technology will disrupt the livelihoods of many farmers in the 'Global South' and will lead to increased struggle for land and resources. They fear that this technology will exacerbate existing economic inequalities due to monopolies on knowledge and resources through patents. They state that in a similar way as with genetic engineering, synthetic biology gives large industry an instrument to control all biomass and turn it into products that suit their own specific needs rather than those of society at large. They point out that oversight and democratic control is lacking, while the risks are potentially enormous (Thomas 2013; Friends of the Earth 2010).

For the public at large it is difficult to assess these risks and benefits through first-hand experience. Again, they will have to rely on the testimony of third parties. Whether they perceive these third-parties (NGOs, governmental organisations, companies, media) to be trustworthy will considerably influence their perception of these technologies. These public perception will in turn influence the willingness of companies to apply these technologies. Trustworthiness in the context of advanced genetic technologies can be expected to have a big influence on the diffusion of the bio-economy.

### **New Collaborations, Fickle Resources**

A sustainable bio-economy requires actors to create new kinds of collaborations. If biomass is to be used with the utmost efficiency, all types of biomass resources will have to be considered for their most useful destination providing novel outlets from agriculture and forestry and their linked businesses, such as agricultural residues to be used for creating biofuels or wood chips from furniture factories and residues from wood management to be used in electricity plants. Ideally, the same biomass is used for multiple applications, for instance the edible part is used for food and the non-edible parts are used for fuels or materials and energy production. This implies that actors will have to use each other's waste stream leading to new kind of dependencies that do not always work out well at present.

New alliances involve new risks and concerns, not in the last place because the main resource is relatively unknown. "Co-operating with various parties is not always easy", says Peter Paul Schouwenberg, manager environment and regulatory affairs at RDW-Essent and responsible for the new pilot project Biobased Park Cuijk where several parties work together in a new alliance. "Everybody wants to make money but no-one wants to run any risks. It doesn't help that biomass is a very different resource than fossil oil. It is not yet a commodity. It is in many ways less predictable and therefore the profitability of any new endeavour is also less predictable." (Interview, 28th March 2013)

The fact that a sustainable bio-economy implicates a decentralised supply of resources further complicates control over the quality of the biomass. Unprocessed biomass should not be transported over long distances as this would amount to increased use of transport fuels, costs and impacts on the overall sustainability. Additionally, an efficient bio-economy collects and treats or uses waste streams of various industries so as to increase recycling. These guidelines imply a decentralised network of supply instead of one major supplier.

This decentralisation makes it more difficult to monitor the quality of the biomass. Residues from wood management in the Netherlands come for instance from many different sources that consist of small suppliers. According to Eppo Bolhuis, now chairman of the Board at Netherlands Organization of Biomass Boiler Suppliers and previously of het Bosschap that represented wood owners across the Netherlands, trust is a major problem in the wood residue supply chain because the price for residues from wood are higher than residues from factories. "So there will often be people who contaminate a shipment of woody biomass with factory biomass. It may even contain garbage such as plastic. This ends up in the incinerator

and will cause a problem for the operator because the installation cannot handle such material and additionally will release toxic substances. The supplier will pretend he didn't know anything about this. I have already witnessed a lot of conflicts in that context." (Interview Bolhuis, dd. 15th May 2013). Bolhuis expects that such problems would be less prominent if there would be only one, large supplier because such suppliers are more susceptible to demands for quality on part of their customers.

A comparable problem arises with biogas plants according to a Dutch documentary (KRO reporter, 16th November 2012). In these plants, livestock manure is often mixed with other, organic resources to create biogas. These plants are sometimes used as dump for all kinds of illegal waste with forged documents, said the chief commissioner Willekens, the national environment manager of the police, in the documentary. Also in the documentary Professor Lucas Reijnders calls for better monitoring of waste streams for biogas plants.

The above examples indicate the many changes in the social structure embedding the use of biomass and the difficulties surrounding these changes. Roles are shifting: parties that used to manage waste, need to switch to a role of supplier of resources. Waste handlers become suppliers, farmers become operators of small chemical factories or suppliers to the energy industry and the energy sector starts taking on residues from the agricultural industry. Additionally biomass is less predictable in qualities than fossil resources. To deal with these changes actors require new instruments to reduce uncertainty and increase predictability, i.e. they need to be able to trust one another on new grounds.

### **Impact on Local Living Conditions**

A fourth reason that trust is required in the bio-economy, stems from the fact that bio-economic innovations can have a considerable impact on the environment of people's homes. The bio-economy needs decentralized (pre)processing plants because the transport of biomass is relatively costly as it is much more voluminous with a much lesser energy density than fossil feed stocks. This implies that these plants which could provide some form of pretreatment to reduce volumes providing an intermediate product for further biobased manufacturing need to be densely dispersed in rural areas. These processing plants may use intricate chemical processes (WTC 2013).

Biogas plants are among the first biomass processing plants in rural areas. They show up on farms around the Netherlands. In these installations, manure is fermented so that it becomes gas. This gas can be used for the energy demand on the farm, for motor vehicles or it can be upgraded to natural gas standards. Since the energy yield of manure is not very high, other biomass is often blended into biogas plants.

People living in rural areas may object to processing plants near their homes as these may bring about new risks and disadvantages, such as chemical contamination or bad smells. The opposition against biomass plants, springs forth partly from the fact that (presently) local inhabitants have no direct benefit from the biomass plants, i.e. there is no relative advantage for this group. Aside from not being related to the



inhabitants, the benefits, such as the reduction of greenhouse gas emissions, are for society in general and not directly observable to them.

Concerned citizens may not trust the operators and developers of the plant to be able to adequately manage the risks. This may be due to a perceived lack of skills on part of the operators. For instance when farmers that have no formal training are expected to operate what is basically a small chemical plant (Heezen and Mahesh 2010). Additionally there may also be a perceived clash of interests such as in the case of the biogas plant in Foxhol, a Dutch village, where those opposing the plant suspected the city council and the developers of the plant to deliberately underestimate the size of the plant (Boonstra 2013). In the eyes of the local inhabitants, this underestimation allowed for the plant to be built close to the village of Foxhol, something the local inhabitants opposed.

At this stage in the development of the bio-economy, the plants present no observable, direct advantage but solely pose new risks to the inhabitants which can be said to be incompatible with their existing norms and values. Only when people trust the developers of such plants to consider the interests of the neighbors and to be able to adequately manage the risks, will they welcome such plants.

## Initiating Trustworthiness

As stated above, we cannot enforce a trusting attitude in other people. An operator of a biogas plant cannot force local inhabitants to trust that he is able to adequately manage the risk. But he can invest in his own trustworthiness by investing in those qualities that lead people to trust another person.

“(...) the concept of trust refers to a feeling that another person is caring, morally good and has positive intentions towards the person who trusts. This creates a willingness to accept vulnerability.” (Midden and Huijts 2009 p. 744). As such, trust serves as a means to reduce uncertainty related to risks by establishing some form of predictability in the behaviour of the trustee (Rousseau et al. 1998). This predictability can be derived from such qualities as ‘being morally good’ or ‘having positive intentions’ towards the person who trust.

How should actors go about achieving trustworthiness in the bio-economy and what role can RRI play? We argue that once people partake in processes of RRI, the dimensions of inclusion, anticipation, reflexivity and responsiveness will create trustworthiness where it was lacking previously. An attitude informed by the above dimensions should lead to a mutual understanding of each other’s values and motives and to action perspectives that each actors’ concerns and interests are taken into account (van den Hoven 2014). However, it may in some cases be problematic to get people to actually adhere to the above attitudes when actors do not trust each other enough to accept some degree of vulnerability that is implicated by being transparent and reflexive (Blok and Lemmens 2014). Therefore additional instruments are required at the organisational and institutional level.

There are basically three different types of relationships between actors in the bio-economy. These actors include individuals as well as organisations such as companies, NGOs, governmental organisations and citizen groups. Some of these

actors may not know each other. They will have to build a new relationship. Some of these actors may already know each other and trust each other. And some of these actors may already know each other and be suspicious towards each other.

When actors perceive the interests between them as diametrically opposed, they may be reluctant to be involved in a ‘transparent, interactive process.’ Such reluctance may exist between competing companies, or between companies and NGOs where companies suspect NGOs of seeking to twist the facts in order to press their specific point of view on the public at large and NGOs suspect companies of trying to trick them into supporting something they actually oppose (interview Danielle de Nie, 13 December 2013, Blok and Lemmens 2014). Additionally, concerned individuals opposing a biogas plant in their direct living conditions may be suspicious they may be manipulated into a more positive attitude while they get nothing in return.

In such cases, lofty promises about inclusion, responsiveness and transparency may be insufficient to persuade actors to get involved in any RRI effort at all. Additional instruments are needed to make individuals feel less vulnerable and hence willing to accept the risks of engaging with parties that might potentially hurt their interests, i.e. they need some guarantee that their interests are safe. Such guarantees can be said to create a minimal form of trustworthiness, one which is based on the supporting instruments, rather than on an assessment of motives and integrity of the other person himself. In our everyday life we rely for instance on the law as a minimal guarantee that other people will not harm our interests. This allows for everyday trustworthiness that enables our society to function (Giddens 1990).

Additionally it should be noted that for those relationships in the bio-economy that are new, trustworthiness can often not be built on so-called ‘anticipatory trust’ (Sztompka 1999, pp. 27–29; Rousseau et al. 1998) which comes about when there is a predictive pattern to someone’s behaviour. ‘Anticipatory trust’ arises when actors form a long standing relationship such as when you rent a house from someone over a longer period of time. You know what you can expect from your landlord in terms of responsiveness and quality of service. In such cases trustworthiness amounts to predictability and can be served by transparency and traceability. In cases such as in an evolving technological field such as the bio-economy, other methods will have to be employed to create an initial sense of trustworthiness.

Below we explicate the instruments that may create a minimal form of trustworthiness in cases where actors either have no other grounds to assess each other’s trustworthiness because they do not know each other or have reasons to consider each other untrustworthy and therefore unsuitable as partners in an RRI process. Additionally these instruments can serve as framing devices to guide the process of RRI and strengthen the initial trustworthiness. For this purpose we discern three levels: personal, organisational and institutional.

### **Personal Relationships**

New trusting relationships can be built on the basis of personal interaction. Personal interaction plays an important role in establishing trustworthy relationships in the bio-economy. The communication between some NGOs and some

energy companies benefits considerably from the quality of the relationships between individual representatives (interview Danielle de Nie, Stichting Natuur and Milieu dd 09-12-2013). Prior to engaging in collaborative efforts such as RRI processes, it may be useful to invest in personal relationships through informal networking events.

A factor that can considerably contribute to trustworthiness is a third-party guarantor (Coleman 1990): a third actor known and trusted by all parties involved. This actor provides a common ground between the other actors on which they can rely. On the social media site LinkedIn you can for instance ask someone you know to introduce you to a person that seems to be of interest to you, but with whom you are not yet acquainted. Having a party that is familiar to you both arrange the introduction, will increase the chance that the new person will trust you enough to engage with you. In the context of the bio-economy, various actors are available that can fulfil such a role as individual intermediates. In the Netherlands for instance, a Kennismakelaar (knowledge-brokers) is used to facilitate co-operation between various groups such as farmers and chemist.

However, in the context of the evolving bio-economy it is not feasible to achieve trust in all new relationships on the basis of personal interaction. There are two reasons for this. First there are simply too many individuals involved. Second the required trust does not attach mainly to individuals, but to a large extent to organisations such as companies and co-operations. An individual representative of an organisation can do much to increase the trustworthiness of that organisation, but an individual never equals the organisation as a whole. In the end the organisation itself has to emanate trustworthiness.

## Organisational

The perception that the other person is morally good can provide a ground for trust (cf. Midden and Huijts 2009, p. 744). In the case of new relationships it is important to communicate the kind of values that you act upon and how you interpret these values.

For organisations values based trust can be achieved by explicating and communicating moral identity, i.e. what are the corporate values and guidelines? Many established companies have identified their core values and guiding dimensions as part of their corporate identity (e.g. big energy companies such as RDW-Essent and Eneco). However in the evolving bio-economy new actors emerge such as the “Biogas vereniging Achterhoek”, innovative, start-up synthetic biology companies (e.g. Amyris does not have a core values tab on its corporate website) or a branch of new suppliers such as those delivering woody biomass. These actors often lack such explicated values and guidelines. In view of trustworthiness it can be expected to pay off to invest in such core values and guidelines for all actors involved. This allows actors an initial assessment of each other’s trustworthiness prior to engaging in RRI activities. Such corporate identities may not suffice to create trustworthiness, as they can be ‘empty words’, but they might provide an indication of what others may expect of the company.

## Institutional

Institutions can provide a basis for trustworthiness as is this is basically an agreement on shared norms and values:

Similar to a personal guarantor in the case of interaction-based trust, institutions help to establish a world in common (Garfinkel), i.e. shared explicit and tacit knowledge between the trustor and the trustee. In these circumstances, an individual or collective actors finds good reasons to trust another actor, individual or collective, because institutional arrangements are, like a third party guarantor, capable of reducing - which is not the same as eliminating! - the risk that a trustee will behave untrustworthily. (Bachmann and Inkpen 2011, p. 285)

An example of such an institution is a Non-Disclosure Agreement (NDA). These often serve as a means to guarantee minimal trustworthiness. All parties signing this agreement are prohibited from sharing any information beyond the confines of that specific collaboration. A NDA is very effective to create initial minimal trustworthiness. However, as we will see further down, to enhance and build on this minimal trustworthiness, it is less effective. It should therefore always be accompanied by other instruments.

Bachmann and Inkpen (2011) define institutions quite broadly: “Institutions are relatively stable bundles of commonly accepted explicit or implicit rules of behaviour to which most people orient their behaviour.” (ibid, p. 286) Institutions can be practices such as marriage, or explicit rules for behaviour such as the law, but they can also be informal rules such as routines within an organisation or teaching styles.

Three forms of institutionalisation can be useful in building trust in the bio-economy: certification, codes of conduct and formal establishment of new roles. These instruments can both support the dimensions of inclusion, anticipation, reflexivity and responsiveness and lead to better results through these dimensions. By aiming to produce such formal results, actors are forced to concoct a shared moral framework or alternatively become wiser about unbridgeable points of view.

### *Certification*

Certification is a way through which institutions communicate norms. “Standardizations efforts are highly conducive to managing risk and to building trust among business partners.” (Bachmann and Inkpen 2011, p. 291). The bio-economy is teeming with labels aiming to communicate the sustainability effects of various products. Many of these labels are based on norms that have been established in collaboration with a wide range of actors, such as banks, energy producers, chemical sector, farmers and NGOs (Gereffi et al. 2001). A norm that serves as a reference point for Dutch actors is the NTA8080 [Dutch Normalisation Institute (NEN) 2008].

However, not all labels have been equally well received by NGOs. Some are criticized for insufficient monitoring (Biomass Watch, 2010). The labels that do

receive the support of NGOs can be said to contribute considerably to the credibility of sustainability claims (interview Harold Pauwels, employee of the Dutch Normalisation Institute, dd 25th March 2013).

In relation to consumers, NGOs often serve as a third party guarantor. NGOs continue to gain high trust in many societies. In the Netherlands trust in NGOs increased last year (2014 Edelman Trust Barometer). NGOs are considered to be a disinterested party: they have no incentive to harm the interests of consumers and citizens. The relevant NGOs in the bio-economy advocate a public good, namely sustainability. For many people, most NGOs live up to the requirements of being caring, morally good, with good intentions and competent. There may be exceptions when NGOs campaign only for specific aspects of sustainability or use means that other people find unacceptable.

Non-governmental organizations already play substantial part in the bio-economy by advising companies and taking part in discussions on the bio-economy. They are indispensable for communicating the impact on sustainability of the various uses of biomass. Claims on the effect of biobased applications on sustainability that are supported by NGOs are usually considered more credible by the general public.

For continued or increased trustworthiness in the bio-economy it is essential that the role of NGOs is facilitated by the other actors. At present NGOs can only co-operate closely with companies under the provision of a non-disclosure agreement (NDA). However this undermines the critical role they can play as they either cannot make crucial information public about new to developed biobased products, or they cannot co-operate with companies and act as a third party guarantor (Interview Danielle de Nie, 09-12-2013).

### *Codes of Conduct*

Another way to explicate and hence institutionalize shared norms are codes of conduct (Bachmann and Inkpen 2011). Especially in new forms of collaboration, codes of conduct may support the formation of trustful relationships. A new to establish biomass processing facility such as a pig flat or a biogas plant may communicate a code of conduct with the local inhabitants to show the intentions and moral convictions of the operators. They can express how they see their responsibility with regard to the environment of the plant. Additionally codes of conducts can be used among companies seeking to establish new forms of collaboration. They can serve as a way to establish a common ground of norms, values and guideline for behaviour. This will enhance mutual trustworthiness as each party knows what to expect of the other.

### *Formal Roles*

As said above, the bio-economy gives rise to many new roles. The requirements, legal obligations and rights for the new roles in the bio-economy have in many cases not been explicated yet as they are new and still evolving. This implies there is little room for so-called role-trust (Kramer 1999). Role trust occurs when individuals

trust another person because of the role he occupies. A role can signify specific skills and behaviour, such as the role of the president of a meeting or the treasurer of an association.

Because a role explicates what can be expected of another person, it can form a basis for trust.

The formal establishment of new roles implies that any new responsibilities that arise in the bio-economy, such as farmers operating small chemical facilities or waste managers becoming suppliers are assigned a formal category that denotes the requirements for this role, such as education as well as the rights and obligations. For instance only those actors that comply with the requirements for supplying woody biomass to energy facilities may do so. Such categories may be established for instance by the Dutch Normalisation Institute.

## **Enhancing Trustworthiness: The Role of Responsible Research and Innovation**

We argue that the dimensions of inclusion, anticipation, reflexivity and responsiveness can be supportive in the effort to create and built on trustworthiness, but that these dimensions need to be framed in concrete instruments to enhance mutual trustworthiness. The bio-economy is already teeming with interactive processes in the form of network events and discussion meetings. Mutual trustworthiness requires that these efforts lead to some tangible end product that formalizes whatever was agreed upon. If otherwise productive exchanges remain but easy words, their propensity to lead to increased trustworthiness is limited as they have no meaning outside of the original exchange or may even undermine trust building because they are unproductive. Therefore such agreements should be formalised or institutionalised. Even if they are incomplete and do not cover all possible sources of conflict, they do still mark what is agreed upon and can hence serve as a basis for trust.

Vice versa, institutions that have been established with these dimension as guiding principles, can be expected to be more effective in their goal. As such, the four dimensions of anticipation, reflexivity, inclusion and responsiveness are indispensable to arrive a forms of institutionalisation that can create trustworthiness.

### **Anticipation**

Anticipation involves systematic thinking aimed at increasing resilience, while revealing new opportunities for innovation and the shaping of agendas for socially robust risk research. (Stilgoe et al. 2013, p. 1570)

Anticipation can sustain trustworthiness in a sustainable bio-economy. Firstly anticipation is essential for formulating new roles that may occur in the bio-economy. Actors should take into account any expected future developments in the bio-economy and accommodate these in the definition of required skills. Anticipation is furthermore important for arriving at sustainability norms that can withstand

the test of time and do not require to be changed continuously. If roles and norms can exist over a longer period of time this will increase predictability within the social structure of the bio-economy and therefore mutual trustworthiness among relevant actors.

## Reflexivity

Responsible research and innovation asks for reflexivity in actors implying that they critically assess their own preconceptions. Aside from reflexivity on the part of particular actors, Stilgoe et al. (ibid.) also argue for reflexivity on the part of institutions. They term this latter form of reflexivity ‘second-order reflexivity’, following Schuurbiens (2011). “Mechanisms such as codes of conduct, moratoriums and the adoption of standards may build this second-order reflexivity by drawing connections between external value systems and scientific practice.” (Stilgoe et al. 2013, p. 1571) This implies that institutions should reflect public values in their designs. A code of conduct for the operators of a biogas plants should for instance refer to participation in decision making by local inhabitants if they indicated that this is important to them.

Forms of institutionalisation that we identified earlier as instruments for conditions for trust among actors, can also be seen as instruments for reflexivity. Standards and code of conducts stimulate the reflection the relation between one’s own values and that of external parties. We argue that this does not only hold for organisations (as institutions) but also for individual actors. Reflexivity can thus be expected to contribute to trustworthiness among actors by stimulating awareness and communication about each other’s values. Hence institutionalisation becomes a tool to increase both reflexivity as well as predictability in the context of innovation.

## Participation

Stilgoe et al. (2013) also refer to the already widely established practice participation of laypeople in the development of new technologies. Also in the bio-economy, participation of many actors in various decision fora is standing practice, such as for the certification of sustainable biomass. There is an ongoing debate on the norms for sustainable biomass as well as on the quality of the labels monitoring these norms. The norms itself are in the Netherlands debated by the Committee Corbey and in supporting committees for the NTA8080 norms. A variety of actors such as representatives from the energy sector, NGOs, the financial sector, the chemical industry and from universities take part in these debates.

For all the other efforts in institutionalisation as mentioned above, including a wide range of (possibly affected) parties can increase trustworthiness, for instance the inclusion of local inhabitants in formulating the code of conduct for biomass processing facilities. Including the voices of those who are affected by new technological development will increase trustworthiness as this shows that there is a willingness to take the interests of these parties into consideration. Additionally RRI can help the various actors in the value chain to come up with a new model to allow for the continued collaboration with NGOs that moves beyond the confines of a NDA.

## Responsiveness

Lastly the dimension of responsiveness is needed to assure actors that their interests are indeed taken into account. For Meijboom et al. (2006) responsiveness is about showing a deliberative attitude.

Considering a partner in the agri-food sector trustworthy requires not just some kind of reflection and explication of one's norms and values, but also the deliberative attitude to explain and engage in critical discussion on these dimensions and their impact: i.e. responsiveness. (Meijboom et al. 2006, p. 440).

Stilgoe et al. (2013) take responsiveness one stage further by also demanding a willingness to change an innovation: "Responsible innovation requires a capacity to change shape or direction in response to stakeholder and public values and changing circumstances." Especially in a setting that is continuously evolving and where the learning curve on social values is steep such as in the bio-economy, a responsive attitude is crucial to trustworthiness. Although it may sometimes be difficult to achieve in light of investment costs, the imperative put forward by Stilgoe et al. (2013): the willingness to adapt technologies, will probably lead to the high form of trustworthiness as it shows 'positive intentions towards the person who trusts' (Midden and Huijts 2009). The public outcry over using food crops for fuel has for instance intensified the policy support for fuels from non-edible parts of crops and algae. This shows a willingness to adapt to public values.

However such willingness should always be accompanied by the imperative to reflect and explain one's dimensions, i.e. it should not be an 'empty' move just to avoid public outcry, but a decision based on values that are fundamental to an organisation, otherwise the organisation still risks to lose trust because it is no longer predictable with reference to its values.

## Conclusion

Responsible research and innovation can be a useful approach for creating trustworthiness in technological trajectories that involve complex social transitions and touch upon socially sensitive issues such as the transition to a sustainable bio-economy. RRI can be used to build trust among relevant actors, but it needs to be supported by specific, concrete instruments in order to create minimal trustworthiness prior to the actual practice of RRI. These concrete instruments can be used as a frame within which to conduct RRI, i.e. they may provide the tangible outcomes of a RRI process that shapes the direction of the exchanges between various actors. This may be true for other, socially intricate technological trajectories as much as it is for the bio-economy.

Firstly, actors will need to exhibit some initial, minimal form of trustworthiness to be able to engage in any meaningful exercise with other parties, be it an business opportunity or a process of RRI. Instruments such as investing in personal relationships, a third party guarantor and communicating fundamental values can be



conducive to this aim. Secondly, RRI can build on this initial trustworthiness but should be embedded by forms of institutionalisation such as code of conducts, formalisation of roles and certification schemes. These latter instruments appear to be applicable to the bio-economy. Other forms of institutionalisation may be suited to other technologies, depending on its features and stage of development.

Mutual trustworthiness among key actors is essential for the success of the bio-economy. Trust is needed because firstly, the BBE is very complex and its main benefits or relative advantages such as sustainability and long term economic perspectives for society in general lack direct observability. This makes it difficult for many people to judge the bio-economy on its merits by their own perceptions. They will need to trust the claims of other parties such as companies and NGOs about the supposed negative and positive effects of the bio-economy. This is especially relevant in relation to contested technologies such as genetic engineering and synthetic biology.

Secondly the bio-economy reshuffles existing social structures as it aims to redirect existing material flows. Additionally biomass as a resource is less predictable than fossil resources, leading to more uncertainty about possible economic gains and risks. Actors will only accept these uncertainties and risks if there is sufficient ground for mutual trust. Trustworthy actors are predictable and hence decrease uncertainties.

Thirdly, the bio-economy will impact on local living conditions by introducing a decentralised network of biomass processing plants that bring about new risks. Local inhabitants will only accept these risks if they trust the operators of these plants to be able to adequately manage the risks and if they trust these operators to take the interests of inhabitants into account.

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