REFOLUTION
Unlocking the potential of biofuels

Sustainability and Responsibility in Refolution biofuel research project context

Fueling change: the importance of citizen involvement in the discussion on biofuels

Webinar

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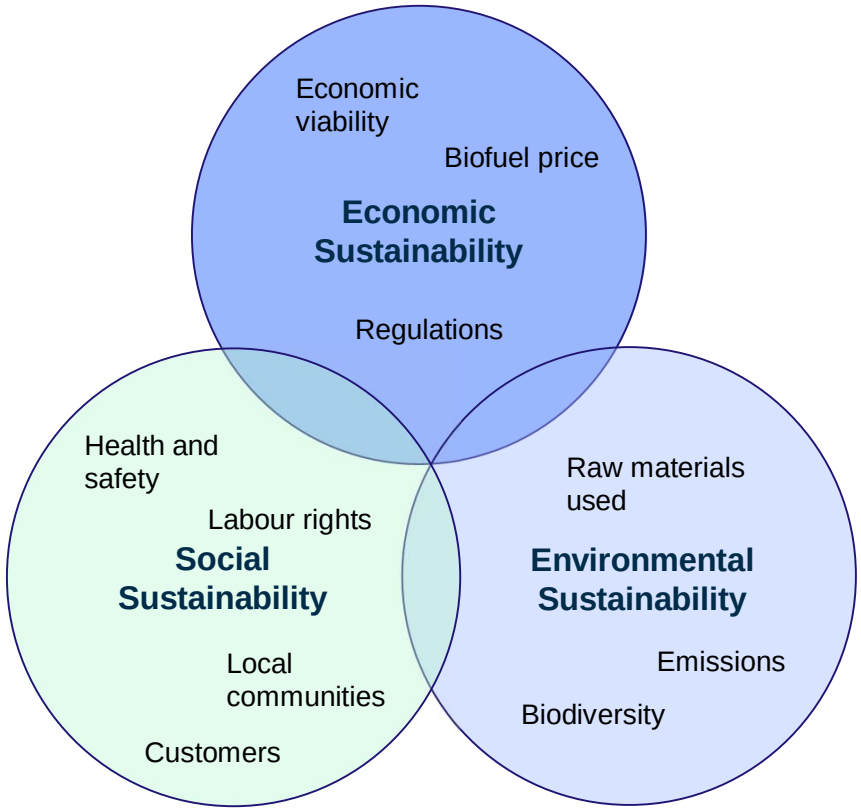
Refolution RRI framework: sustainability-oriented approach to biofuels

- We wanted to engage the whole consortium and beyond to working towards sustainable biofuels, harnessing the knowledge of scientists and other stakeholders.
- Responsible Research and Innovation (RRI) as a starting point:
  - → Focus on reflexive, engaging and inclusive responsibility process.
  - → Utilising insights from experts and other stakeholders.



RRI is about: including all actors, and considering specific key issues and process dimensions

Source: RRI-tools.eu

RRI Capacities

1. **Anticipate and analyse** 
   - Involves carefully examining both intended and potential unintended consequences of research activities, addressing environmental, health-related, economic, and social impacts.
   - Can utilize methodologies like foresight, horizon scanning and scenarios.

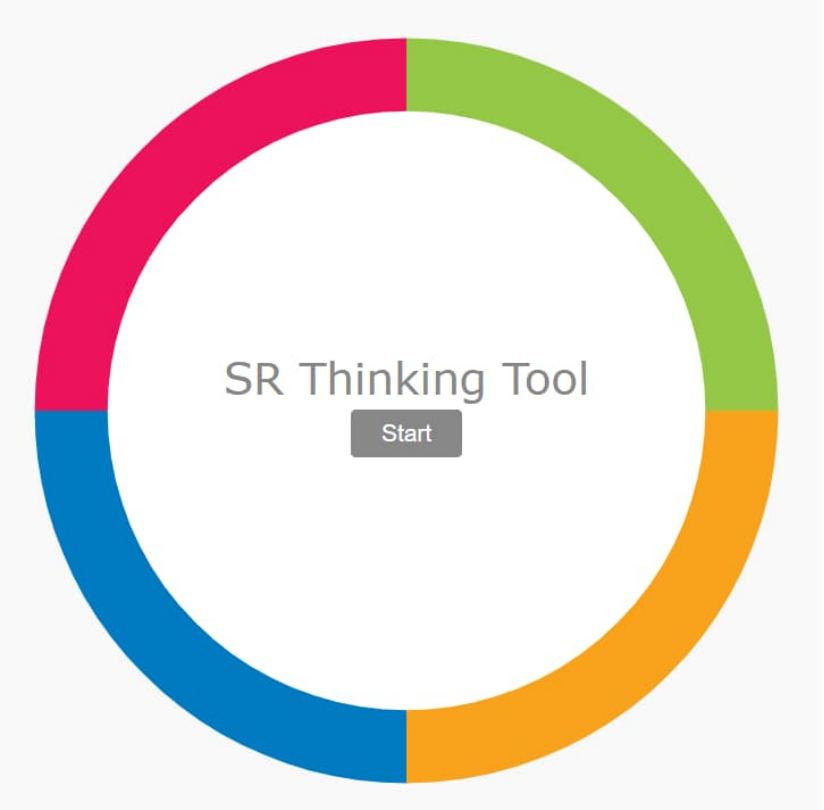
2. **Reflect and reason** 
   - Involves reflecting on the motivations, assumptions, and commitments that underpin research projects.
   - The key is adopting a reflexive mindset and being open to alternative framings and questioning initial assumptions.

3. **Engage and include** 
   - Actively involving relevant societal actors in research and innovation activities from the outset.
   - Ensures an ongoing, open dialogue about both desirable and undesirable outcomes, broadening the perspectives that guide research and innovation activities.

4. **Act and respond** 
   - Responsiveness requires a willingness to learn from practical experience and the ability to translate this learning into improved, more responsible research and innovation solutions.
   - Acting in the phase of societal and environmental challenges arising, capability to adapt to changes in the operating environment.

Societal Readiness Thinking tool

- An RRI tool developed under the EU-funded project NewHoRRIzon.
- Utilizes a model based on four distinct gates
    1. Research design and problem formulation
    2. Implementation, data collection and testing
    3. Data analysis and evaluation
    4. Launching and disseminating
- Poses reflexive questions for project partners, guiding towards impactful responsibility work.
- Access at: www.thinkingtool.eu



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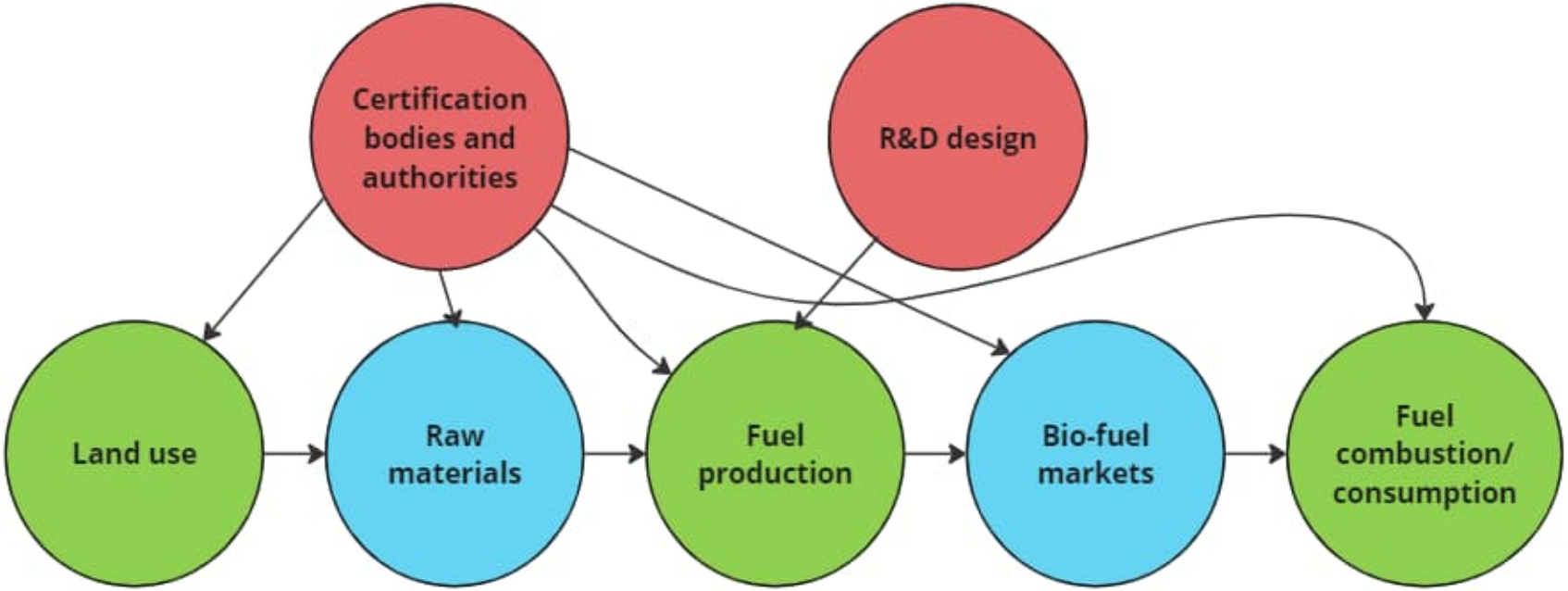
Biofuel value chains in Refolution context



Refolution RRI framework – reflective discussion tool

RRI process

- Based on engagement of stakeholders and reflexive discussions around sustainability topics.
- Three distinct phases:
  1. RRI discussions internally with Refolution scientists
  2. RRI discussions with external expert stakeholders
  3. RRI discussions with wider public, e.g. passengers and consumers
- Building understanding about the sustainability and responsibility of biofuels.

Reflexive questions

Value chain	Raw materials	Fuel production	Biofuel markets	Fuel combustion/consumption
Thinking Tool	Impacts	Transparency and openness	Relevance	Risks
Anticipate & Analyse				
Reflect & Reason				
Engage & Include				
Act & Respond				

Refolution RRI Framework

RRI (Responsible Research and Innovation)	Raw materials, land use	Fuel production	Bio-fuel markets	Fuel combustion/ Fuel consumption
Anticipate & Analyze Opportunities: Foresight Horizon scanning Scenarios	Which raw materials are likely to be available, inexpensive and sustainable in the future?	How can we ensure that biofuel production is possible and will be accepted in existing refineries with Refolution methods in the future?	What is likely to be the role of biofuels in the future sustainable fuels markets?	How should the infrastructures in transportation, airports, ports etc. change in the future to facilitate for growing usage of sustainable fuels?
Reflect & Reason Consideration: Ethical assessment Multidisciplinary	How could intense competition between different uses of raw materials be avoided or dealt with?	How is the energy intensivity of production methods likely to influence biofuel production? How could this challenge be tackled?	How should the public discourse around biofuels change? What new knowledge and information could we bring to the public awareness?	Do we know enough about the overall environmental impacts of burning biofuels (accounting for CO2 & non-CO2 emissions, biodiversity, pollution, etc.)?
Engage & Include Alternatives: Open innovation Focus groups	Could dialogue be established about the different uses of biomass raw materials? Who could be included in such conversations?	How can we ensure acceptability of biofuel production, especially locally near sites of production?	Which stakeholders are important in ensuring a sustainable production chain of biofules with Refolution methods?	How could we work towards making fuel sustainability a selection criteria for travellers?
Act & Respond Capacities: Regulation Standards Societal challenges	How do we ensure that the processes developed in Refolution can be used with the most sustainable raw materials possible to produce good quality fuels?	What can we do to ensure that switching from traditional fuels to biofules is possible fast enough? What is needed from other stakeholders?	How are the regulations that affect biofuel production and market price changing?	What is and/or should be done in Refolution to ensure the safety of the produced fuel, making sure it does not cause any dangers during storage or usage or harm the engines?

Societal Readiness Thinking Tool	Anticipate & analyse	Reflect and Reason	Engage & Include	Act & Respond
Impacts	How may the results of this project be used in the education of future generations of researchers and engineers?	Is it possible to change the problem formulation or project design in response to changing stakeholder viewpoints or unforeseen ethical issues arising throughout the project?	At which phases in the project will stakeholder involvement have the most crucial impact, and why?	To what extent will you be able to predict the long-term societal outcomes of the project?
Transparent documentation & open access publishing	How may your results contribute to the public interest in and understanding of science?	How do you plan to communicate the uncertainty of your research?	What do people not participating in the project (teachers, students, museums, civil society organizations) need to know about the data analysis and evaluation of project results to learn about/engage with the outcomes of your work?	Did you document your data analysis / evaluation in an intelligible and transparent way, and how?
Relevance of the project	Can you think about beneficial applications of results beyond the original scope of your work?	Why should this project be done?	How can you ensure that interested stakeholders understand the purpose and approaches of the project?	With whom do you plan to share the results of your work?
Risks	Can you imagine possible scenarios of misuse of your results? Can you imagine possible scenarios where the outcomes of your project may be misrepresented or misinterpreted in the public discussion?	What are the potential barriers to making documentations of data collection and testing publicly accessible (e.g. intellectual property rights, competing interests)?	Have the results been discussed with different types of stakeholders to allow for alternative interpretations?	Does your project involve any risks of negative impacts, and which?

Land use and raw materials

Results:

- Cascade principle is conceived to be important in prioritising the use of raw materials: only material that can not be used for e.g. food or construction, should be used for biomass production.
- Waste material that would otherwise be burned or end up in landfills was seen as perfect material for biofuels in terms of sustainability. E.g. combination of plastic and biowaste could be readily available in the near future.
- For ensuring the best possible use of raw materials, market solutions were deemed the best. Economic incentives should be created, but subsidies alone likely won't have strong enough influence.
- According to the participants, competition between different uses of raw materials should not be avoided – instead, it should be ensured market creates sustainable solutions.

Fuel production

Results:

- Local acceptance was deemed important, as scaled up production will inevitably have significant effects on local communities. Local acceptance could be built around showing positive externalities and building public understanding about biofuels e.g. through education.
- Greenwashing was currently seen as a problem – more reliable, open and honest information is needed.
- Markets are likely to accept any technological solution that is working and profitable – as long as policy is stable enough to encourage investments in expensive industrial sites.
- The participants predict that the transition will be slow, as development and adoption of new industrial streams is inevitably slow.

Local acceptance

Greenwashing

Market-driven solutions in technology

Slow transition

Bio-fuel markets

Results:

Aviation/marine vs. other mobility
Different solutions

- Participants predict that biofuels will likely be common on aviation and marine transport, but road transport might move on to alternative directions.
- More stable and simpler legislation was called for.
- More accurate information and compelling messages for the wider public were requested. It should be ensured that facts are correct and properties of the newest forms of biofuels are discussed.

Hope for simple legislation

Accurate information to public

Fuel consumption/combustion

Results:

- The participants felt that biofuels need to be compatible with existing infrastructures to be accepted.
- The unresolved question of cost was critically discussed. Depending on voluntary extra payments from customers will probably not lead to widening use of biofuels, but companies also won't pay a premium for biofuel if not compensated. Therefore, according to the participants, subsidising system might be the best way to accelerate biofuel usage.
- More knowledge about biofuels was called for. Public knows little about the production of biofuels, and even for experts more understanding of raw material production is needed.

Compatible with existing infrastructures

Costs with subsidies, not in prices

More knowledge to public

Key takeaways from biofuel expert discussions

More reliable and open information about biofuels is needed to build trust towards the technology and counter greenwashing.

Market solutions are seen as the most promising in scaling up sustainable biofuel solutions. Financial incentives need to be in place, and strong enough.

Cascading principle is conceived to be crucial in finding sustainable raw materials and moving forwards from the food versus fuel conversation.

Using biofuels is currently more expensive than fossil-based alternatives. Participants felt that solutions to fair distribution of the costs should be found, e.g. through biofuel mandates (prices up for everyone) rather than voluntary extra fees.

The future of biofuels is closely linked to the future of other technologies. For aviation and marine transport, no plausible alternatives were recognised, supporting the prediction of scaling-up biofuels. For road transport other technologies might prevail.

The most interesting and valued sustainability indicators to cover in addition to GHG emissions – preliminary ideas

1. **Global warming** potential
2. **Particle emissions** (from transports etc.)
3. **Water use,** especially in southern Europe
4. **Biodiversity** because plenty of biomass will be used
5. **Land-use** efficiency and impacts to arable land
6. **Energy consumption**
7. CO2 efficiency related to carbon footprint, **biogenic carbon** and its movement to valuable fuel and not to other fractions

Result highlight: VISION 2050 – for the roadmap

In 2050, more than 40 pyrolysis upgrading plants are operational in Europe producing in total around 5 million tonnes per year of sustainable biofuels for mostly marine and aviation applications.

The upgrading plants have certainty of supply, and pyrolysis plants can sell to multiple buyers. There are established criteria for pyrolysis and SPO oil quality and logistics of transporting pyrolysis oil are established. The resulting biofuels meet the highest sustainability criteria, and they are certified for use in aviation and marine applications.

Picture made with Bing Dall-E Image Creator

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THANK YOU!

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Project Partners

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