

Early assessment of sustainability for synthetic biology and biomanufacturing projects

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Claims of environmental, societal, and economic sustainability are often made for synthetic biology and biomanufacturing projects. But how can potential sustainability performance and challenges be considered in project development at an early stage when there is latitude to modify approaches?

This question was tackled in a joint workshop held in October 2020 involving researchers from the [Manchester Responsible Research and Innovation \(RRI\) group](#) and research fellows from the [Future Bio-Manufacturing Research Hub](#) (Future BRH). The Future BRH is a national biomanufacturing programme centred at the Manchester Institute of Biotechnology (MIB) that is developing innovative synthetic biology technologies for high-value manufacturing “to sustainably produce pharmaceuticals, chemicals and materials.”

The workshop aimed to collaboratively develop a tool to facilitate early consideration of a project’s sustainability. The resulting insights could then input into decision-making processes.

Ahead of the workshop, a template was designed to guide the early consideration of sustainability (spanning economic, social and environmental considerations) in Future BRH projects. The template separated aspects of the project according to sustainability dimensions and life cycle stages, addressing issues related to:

- feedstock* (sources, availability, cost, geography, community and environmental impacts);
- process* (extraction/purification, cost, intellectual property, industrial disruption, and consumer responses); and
- product/outcome* (functionality, characteristics, cost, market competitiveness, geography, community, consumer response, environmental, and end-of-life implications).

The table (below) shows part of the template for one of the life cycle stages (Product/Outcome).

Life-cycle stage	Aspect and example questions	Response	Peer-review (traffic-light and comment)
Product/ Outcome	Economic Would it be competitive in the market?		
	Social How will consumers respond to this product?		
	Environmental What would its end-of-life look like for the product?		

Workshop Structure

The workshop tested this approach with the Research Fellows. The workshop was structured in three successive parts:

- *Step 1.* The researchers split into two mixed groups consisting of members from the RRI group and FBRH. Each group then selected an appropriate project to pilot the approach on. Then, the researchers worked collaboratively through the sustainability assessment template in the context of the selected project. Participants were encouraged, where they did not yet have an answer for a particular aspect, to instead offer a plan for how they could go about assessing or gathering data on that aspect. This took about 40 minutes.
- *Step 2.* Once the templates were complete, the two groups swapped sheets and offered peer review comments. To support this process, participants were encouraged to give 'traffic light' scores corresponding to each response offered according to these criteria:
 - **Green:** This project looks good for this aspect given current understanding.
 - **Amber:** there is not enough yet known to judge whether this project/target will deliver satisfactorily for this aspect.
 - **Red:** The current evidence suggests this project will face problems for this aspect.

The two projects reviewed received a mix of scores – none scored green on all aspects, with both receiving amber and red scores on selected dimensions.

- *Step 3.* The two groups joined back for an open feedback discussion on the results and on the usefulness of the process, potential modifications and future directions.

Reflections and future directions

The process was found to be useful and engaging by all involved and the opportunity to consider these issues at the start of a project was welcomed. The peer-review process was also seen as beneficial in reducing the bias of assessing one's own project.

It was acknowledged, however, that there may be inevitable bias in assessing projects internally. Hence, the potential to include more external participants was raised. The approach also needs more focus on identifying how high-level and systemic sustainability issues and challenges can be translated into explicit actions for researchers. We plan to refine the approach based on the workshop experience and feedback and then re-test with other Future BRH projects.

The workshop provided space for researchers to reflect on the wider impacts of their research. We anticipate that such continued engagement and collaboration will help to integrate responsibility and sustainability considerations. Going forward, we will communicate our findings and the refined tool to other researchers and the wider community.

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The Manchester Responsible Research and Innovation (RRI) Group works with the Manchester Synthetic Biology Research Centre (UKRI Biotechnology and Biological Sciences Research Council Award BB/M017702/1) and the The Future Biomanufacturing Research Hub (FBRH) at the University of Manchester (UKRI Engineering and Physical Sciences Research Council, Award EP/S01778X/1) in research, engagement and collaboration to anticipate, prepare for, or mediate impacts of synthetic biology technologies in society, economy, and the environment.

The Early Assessment of Sustainability workshop was held online (via Zoom) on 22 October 2020. The full template used for the workshop is available [here](#).

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