BioInnovation Application Guide

Med stöd från: VINNOVA Sveriges innovationsmyndighet, Energimyndigheten, FORMAS, Strategiska innovationsprogram

Initierat av: Skogs Industrierna, IKEM, TEKO Sveriges Textil- & Modeföretag, BioInnovation

BIO INNOVATION

BIOINNOVATION APPLICATION GUIDE

BioInnovation is a strategic innovation program that aims to strengthen the Swedish competitiveness and contribute to the conversion to a circular biobased economy. Projects for development of biobased products, materials and chemicals funded from the program need to pay attention to three important aspects – Technology, Market and Sustainability – in order to best contribute to increasing the added value in the Swedish biobased sector.

Purpose and target group

The BioInnovation Application Guide is aimed at those who work with an application for one of our calls for proposals, and for the external assessors whom Vinnova uses in evaluating applications.

The document defines a number of key concepts so that they can be interpreted and used in a similar way in applications and by assessors, and it provides suggestions for tools for describing applications' ambition regarding technology, market and sustainability.

BioInnovation's calls for proposals include a call text and an application template. The call text is published on Vinnova's website and sets out the conditions for each call. The call text should be read very carefully. The call text includes an application template – that template determines which parts of the application guide are applicable for each call.

General advice to applicants

- Read the call text carefully – read the call text and the application template before the application guide
- Take the TRL, MRL and SRL descriptions seriously – sweeping wording is not enough, but claims must be strenghtened and have objective grounds
- Strengthen the credibility of descriptions and arguments, for example through key diagrams / key figures with references
- Only state what the application template requests – long additional descriptions do not ease the assessment

More information

If you have questions of an administrative nature for your application, we recommend that you contact Vinnova's administrator. If you have questions of a different nature, such as content, you are welcome to contact BioInnovation's program manager or officers at Vinnova. Contact information can be found at www.bioinnovation.se.

BioInnovation 2019-02-01.

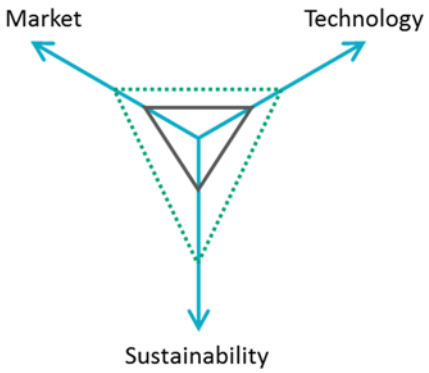
Projects in BioInnovation shall make a transfer in three aspects

Projects in BioInnovation shall realize opportunities in the bioeconomy by contributing to and benefitting from the conversion to a biobased economy. A clear effect of a project in BioInnovation shall be a transfer with respect to the aspects Technology – Market – Sustainability. The transfer is described with the scales TRL, MRL and SRL that are introduces on the following pages.

The use of TRL aims to state what specific technology and associated technical maturity level are the project's starting point, and to state what TRL gap that the project will bridge.

The use of MRL aims to state what market hypotheses with economical perspectives are the project's starting point, and to state what MRL gap that the project will bridge.

The use of SRL aims to state how the project's market hypotheses relate to environmental and social perspectives, and to state what SRL gap that the project will bridge.



EXAMPLE OF A PROJECT'S EXPECTED TRANSFER WITH RESPECT TO THE ASPECTS TECHNOLOGY – MARKET – SUSTAINABILITY.

Of course, the three aspects are not independent of each other, and it may even be that an increase in two of them may result in a decrease in the third. It is important to clearly describe the effects of the expected transfer.

The three aspects are discussed in the following sections, as well as how a desired transfer in them should be described. It is, of course, the case that an individual actor or organization may find it difficult to take a position on or describe all three aspects in the way that is requested. It can then be an indication that the consortium needs to be expanded to cover the breadth of competencies the project needs for successful implementation.

Note that the concepts TRL, MRL and SRL in the call text and application template always refer to the descriptions in this application guide, even if other descriptions can be found on the Internet.

The aspect Technology

The aspect Technology is described with Technology Readiness Level (TRL) according to the EU commission definition[1] in the table below. This TRL scale must be used, but the applicant should as far as possible concretize how the respective TRL level is achieved and who made the assessment. This can be done in different ways. A good example of how to provide such information is given by the US Department of Defense. It is briefly described in the section Examples of TRL tools below.

TRL	**Description**
TRL 1	Basic principles observed
TRL 2	Technology concept formulated
TRL 3	Experimental proof of concept
TRL 4	Technology validated in lab
TRL 5	Technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL 6	Technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL 7	System prototype demonstration in operational environment
TRL 8	System complete and qualified
TRL 9	Actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

[1] Annex G of the General Annexes to the Horizon 2020 Work Program 2016/2017

The aspect Market

The aspect Market is described with Market Readiness Level (MRL) according to a subjective estimate of the project's understanding of customer and market based on a *Market Value Proposition*.

There are relevant tools to use to assess and describe MRL levels. NABC and KTH Innovation Readiness Level™ are two examples of such tools. They are briefly described in the section Examples of MRL tools below. It is fine to use them or other tools. The applicant must always strengthen his claims.

MRL is not an unambiguous and generally accepted scale, and BioInnovation uses a simple model according to the table below.

MRL	**Understanding of customer and market based on a Market Value Proposition**
MRL 1	A hypothesis on customer and market needs is formulated Existing solutions/products are described An overview of the right and opportunity for commercialization is described
MRL 2	Critical functions for a solution or product have been delivered to and tested on potential customers A more detailed picture of right and opportunity for commercialization has been developed A business concept has been described, e.g. according to the NABC model Customer and market needs have been confirmed through interviews or practical tests
MRL 3	Key customer relations and partnerships that confirm unique properties or functions have been established Ownership with documented right and opportunity for commercialization is investigated A business concept is confirmed against a number of potential customers and has an estimated commercial potential Product testing or test sales are ongoing

The term customer *in the table above should be interpreted broadly, and refers to the one to which the offer is directed. The customer is thus the one who has the need that the offer is intended to satisfy, and who is prepared to pay or invest. Customer does not therefore have to be an end customer.*

The road to commercialization is an iterative learning process, not a technical development process. In this respect, a project in BioInnovation can typically take the approach from one milestone to the next, and is thereby expected to generate lessons and bases for decision-making for the next step towards a commercialization.

The aspect Sustainability

The aspect Sustainability is described with Sustainability Readiness Level (SRL) according to a subjective estimate of how the project's results contribute to a more sustainable society based on a *Sustainability Value Proposition*.

There are relevant tools to use to assess and describe SRL levels. Some are briefly described in the section Examples of SRL tools below. It is fine to use them or other tools. The applicant must always strengthen his claims.

MRL is not an unambiguous and generally accepted scale, and BioInnovation uses a simple model according to the table below.

SRL	**Understanding of customer and market based on a Sustainability Value Proposition**
SRL 1	There is a hypothesis on how the solution/product contributes to increased sustainability in relation to existing solutions/products A general analysis has been carried out from a sustainability perspective
SRL 2	Critical functions for a solution or product have been delivered to and tested on potential customers, which provides a concrete basis for quantifying how these contribute to increased sustainability A more detailed analysis has been carried out from a sustainability perspective
SRL 3	Key customer relations and partnerships that confirm unique properties or functions have been established Product testing or test sales are ongoing A comprehensive system analysis has been carried out from a sustainability perspective

About BioInnovation

BioInnovation is a strategic innovation program with focus on a Swedish circular bioeconomy. All the program's efforts should contribute to and benefit from such a development. The road there goes through broad collaboration, and winners are both climate and environment as well as Swedish competitiveness and exports.

Vision and mission

The program’s vision is that Sweden has made the conversion to a biobased economy by 2050.

To achieve this, the program's mission is to create the best conditions for increasing the added value in the Swedish biobased sector.

Raw materials

BioInnovation funds projects whose raw materials come from the forest, fields, water or residual streams.

Delimitations

Projects within BioInnovation are largely expected to bridge a TRL gap that lies within the span TRL 2-7. There are no delimitations for MRL and SRL.

BioInnovation does not fund projects that primarily aim to develop animal feed, food or pharmaceuticals, and not projects that primarily work with raw materials supply.

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Basic concepts

Biobased economy

BioInnovation follows the definition of biobased economy formulated by the Swedish Research Council Formas[2]:

The conversion to a biobased economy involves a transition from an economy that is largely based on fossil raw materials to a resource-efficient economy based on renewable raw materials produced through the sustainable use of ecosystem services from land and water.

A biobased economy is an economy based on:

- *Sustainable production of biomass to enable increased use in a number of different societal sectors. The purpose is to reduce the climate impact and the use of fossil raw materials.*
- *An increased added value of biomass, while minimizing energy consumption and utilizing nutrition and energy from the end products. The purpose is to optimize the value of ecosystem services and contributions to the economy.*

BioInnovation allows the concepts of bioeconomy and biobased economy to merge, and usually uses bioeconomy.

Circular economy

In the definition of circular economy, BioInnovation is inspired by a report from the Investigation on circular economy ("Utredningen cirkulär ekonomi") [3], and formulates this definition:

Circular economy is an economy where waste in principle does not occur and which has the potential to be ecologically, economically and socially sustainable.

A circular economy is an economy based on:

- *Keeping resources in the society's cycle as long as possible by circulating products, components and materials. The purpose is to optimize resource utilization.*
- *Managing finite resources, balancing the use of renewable resources, and returning resources to nature's own cycles in a sustainable way. The purpose is to preserve and strengthen the natural capital.*
- *Designing processes, products and materials for reuse and recycling. The purpose is to help man act circularly.*

[2] Forsknings- och innovationsstrategi för en biobaserad samhällsekonomi, Formas, Report R2:2012
[3] Från värdekedja till värdecykel – så får Sverige en mer cirkulär ekonomi, SOU 2017:22

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APPENDIX: EXAMPLES OF TRL, MRL AND SRL TOOLS

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FORMAS
Strategiska innovationsprogram
Initierat av:
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Examples of TRL tools

Technology Readiness Assessment Guidance

The U.S. Department of Defense has developed an in-depth description of the TRL levels, and supplemented it with examples of which supporting information can be used to substantiate alleged TRL levels[4]. This is the starting point for their assessment and development decisions.

TRL	Definition	Description	Supporting Information
1	Basic principles observed and reported	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development (R&D). Examples might include paper studies of a technology's basic properties.	Published research that identifies the principles that underlie this technology. References to who, where, when.
2	Technology concept and/or application formulated	Invention begins. Once basic principles are observed, practical applications can be invented. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions. Examples are limited to analytic studies.	Publications or other references that outline the application being considered and that provide analysis to support the concept.
3	Analytical and experimental critical function and/or characteristic proof of concept	Active R&D is initiated. This includes analytical studies and laboratory studies to physically validate the analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.	Results of laboratory tests performed to measure parameters of interest and comparison to analytical predictions for critical subsystems. References to who, where, and when these tests and comparisons were performed.

[4] Technology Readiness Assessment (TRA) Guidance. U.S. Department of Defense, April 2011 (full report: https://www.gao.gov/assets/680/679006.pdf, summarizing table: https://www.ncbi.nlm.nih.gov/books/NBK201356/)

TRL	Definition	Description	Supporting Information
4	Component and/or breadboard validation in laboratory environment	Basic technological components are integrated to establish that they will work together. This is relatively “low fidelity” compared with the eventual system. Examples include integration of “ad hoc” hardware in the laboratory.	System concepts that have been considered and results from testing laboratory-scale breadboard(s). Reference to who did this work and when. Provide an estimate of how breadboard hardware and test results differ from the expected system goals.
5	Component and/or breadboard validation in relevant environment	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so they can be tested in a simulated environment. Examples include “high-fidelity” laboratory integration of components.	Results from testing laboratory breadboard system are integrated with other supporting elements in a simulated operational environment. How does the “relevant environment” differ from the expected operational environment? How do the test results compare with expectations? What problems, if any, were encountered? Was the breadboard system refined to more nearly match the expected system goals?
6	System/subsystem model or prototype demonstration in a relevant environment	Representative model or prototype system, which is well beyond that of TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high-fidelity laboratory environment or in a simulated operational environment.	Results from a laboratory testing of a prototype system that is near the desired configuration in terms of performance, weight, and volume. How did the test environment differ from the operational environment? Who performed the tests? How did the test compare with expectations? What problems, if any, were encountered? What are/were the plans, options, or actions to resolve problems before moving to the next level?
7	System prototype demonstration in an operational environment	Prototype near or at planned operational system. Represents a major step up from TRL 6 by requiring demonstration of an actual system prototype in an operational environment (e.g., in an aircraft, in a vehicle, or in space).	Results from testing a prototype system in an operational environment. Who performed the tests? How did the test compare with expectations? What problems, if any, were encountered? What are/were the plans, options, or actions to resolve problems before moving to the next level?

TRL	Definition	Description	Supporting Information
8	Actual system completed and qualified through test and demonstration	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental test and evaluation (DT&E) of the system in its intended weapon system to determine if it meets design specification.	Results of testing the system in its final configuration under the expected range of environmental conditions in which it will be expected to operate. Assessment of whether it will meet its operational requirements. What problems, if any, were encountered? What are/were the plans, options, or actions to resolve problems before finalizing the design?
9	Actual system proven through successful mission operations	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation (OT&E). Examples include using the system under operational mission conditions.	OT&E reports.

Examples of MRL tools

NABC

NABC is a systematic method developed at Stanford Research Institute to support development, assessment and presentation of ideas and innovations. It consists of four parts that together define the approach's *Market Value Proposition*.

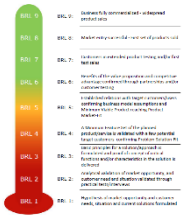
NABC: An important customer or market need addressed by a unique approach with compelling benefits when compared against the competition or alternatives.

Need	What are the customer's needs? A need should relate to an important and specific customer or market opportunity, with market size and end customers clearly stated. The market should be large enough to merit the necessary investment and development time.
Approach	What is the compelling and unique solution to the specific customer need? As the approach develops through iterations, it becomes a full proposal or business plan, which can include market positioning, cost, staffing, partnering, deliverables, a timetable and intellectual property (IP) protection.
Benefits (per cost)	What are the customer benefits of the approach? Each approach to a customer's need results in unique customer benefits, such as low cost, high performance or quick response. Success requires that the benefits be quantitative and substantially better - not just different.
Competition	Why are the benefits significantly better than the competition? Everyone has alternatives. You must be able to tell the customer why the solution represents the best value. To do this, you must clearly understand the competition and the customer's alternatives. You must be able to clearly state why the approach is substantially better than that of the competition. The answer should be short and memorable.

It is not enough to fill in an NABC with sweeping formulations – it must be confirmed against potential customers and the claims must have factual grounds. Short, factual and quantitative information is preferred.

KTH Innovation Readiness Level™

KTH Innovation at the Royal Institute of Technology has developed a model, KTH Innovation Readiness Level™ [5], that assesses innovation development in six key areas, each with a scale 1-9 that resembles the TRL scale. The image gives an indication of how the scale is designed.



[5] https://kthinnovationreadinesslevel.com/about/

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Examples of SRL tools

Global Reporting Initiative and UN Global Compact

A solid material has been produced jointly by the Global Reporting Initiative, which issues standards for the design of sustainability reporting, and the UN agency United Nations Global Compact. The material is based on the UN's 17 goals for sustainable development (Sustainable Development Goals, SDGs) and its 169 targets. The purpose of the material is to show how sustainability can be business-driving and how sustainability reporting can be an effective way of communicating in line with SDGs.

The document *Business Reporting on the SDGs: An Analysis of the Goals and Targets*[6] analyzes all 17 SDGs and 169 targets, and provides a uniform mechanism for sustainability reporting in a comparable and effective way.

The document *Integrating the SDGs into Corporate Reporting: A Practical Guide*[7] offers a structured approach to help companies choose which SDGs and targets to report on and how reporting can be used to drive action.

The documents are intended to be used together to support a structured and effective selection that communicates intentions and results in sustainability issues. The documents are thus also valuable sources of description of sustainability arguments for new products and services – this by providing support in the selection of relevant SDGs and targets, as well as examples of business-driving sustainability communication.

Lighter

Inspiration can also be obtained from the strategic innovation program Lighter, which has developed tools and support for its context[8].

LCA

A life cycle analysis (LCA) is a basis for decision making for product and process development, which can also be used in marketing to tell about the environmental performance of a product or process. There are many environmental issues to consider, and life cycle analyses make it possible to handle several of them in parallel. In order to make relevant comparisons, it is very important that functional units and system boundaries be correctly chosen.

A life cycle analysis should be done as early as possible in order to make wise decisions at different choices of path, based on good information. In the beginning, one can do a screening LCA where sources with the greatest environmental impact are identified, and where assumptions are made for what is not yet known. As one learns more about the product or process, the life cycle analysis can be refined. A complete LCA provides the basis for an environmental product declaration, and provides a complete picture of the entire life cycle.

To make a life cycle analysis, special software, access to databases, and specific competence are required. Normally, collaboration with specialized consultants or institutes is necessary.

[6] https://www.unglobalcompact.org/library/5361
[7] https://www.globalreporting.org/resourcelibrary/GRI_UNGC_Reporting-on-SDGs_Practical_Guide.pdf
[8] https://lighterarena.se/sv/meny/om-lighter/hallbarhetsarbete (only available in Swedish)

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