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SET4BIO

RENEWABLE FUELS AND BIOENERGY FOR A LOW-CARBON EUROPE – ACCELERATING THE IMPLEMENTATION OF THE SET-PLAN ACTION 8

Horizon 2020, Grant Agreement no. 884524

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EXECUTIVE SUMMARY

As part of catalysation and implementation of the SET Plan Action 8 – Renewable Fuels and Bioenergy in Europe, the SET4BIO Innovation Challenge has been developed and mobilised to support creation of innovations that stimulate increased production and use of bioenergy and renewable fuels. Thus, contributing to the implementation of the EU Green Deal vision.

This report provides an account of the first instalment of the SET4BIO Innovation Challenge, from early development and design to the final event and jury driven assessment of the participating teams contributions. It focuses on the how the SET4BIO Innovation Challenge 2021 was operated, the teams admitted, the events performed, as well as lessons learned from running the first Innovation Challenge using the SET4BIO scheme.

For the SET4BIO Innovation Challenge a staged contest driven process has been developed, including contest rules, outreach plan, challenge prize, event approach, assessment criteria as some of the key building blocks. This repeatable process developed can be re-used to mobilise additional support for the SET Plan Action 8. The deliverables in WP3 provide a complete description of the scheme to support re-use and adoption in the coming years.

PARTNERS

RISE - Research Institutes of Sweden AB, Sweden	
SINTEF - SINTEF Energi AS, Norway	
FNR - Fachagentur Nachwachsende Rohstoffe e.V., Germany	
CIRCE - Fundacion Circe Centro de Investigación de Recursos y Consumos Energéticos, Spain	
VTT – Teknologian tutkimuskeskus VTT Oy, Finland	
ETA – ETA Florence Renewable Energies, Italy	

Statement of Originality
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Content

Introduction

The aim of D3.2 "Experiences from the SET4BIO challenges" is to provide a description of the first instalment of the SET4BIO Innovation Challenge, from launch to its final stages. It constitutes a portrayal of the activities that have been performed in Work Package 3 (WP3) "Innovation Challenge" during M11-M24 in the project, with a focus on the challenge execution performed via Task 3.2 "Validate and showcase SET4BIO innovation challenges".

The document focuses on the experiences from the SET4BIO Innovation Challenge anno 2021 from the final marketing activities to the final event and jury driven assessment of the participating teams' contributions. In the two prior completed reports, D3.1 "Innovation Challenge in SET4BIO" and D3.4 "Identification of topics for SET4BIO Innovation Challenge", the design of the challenge is presented as well as an account of the model used to set the objectives for the challenge.

D3.2 is structured as follows. Chapter 1 focuses on an overview of the SET4BIO Innovation Challenge anno 2021 in terms of structure, design and objectives. Using this as a basis, Chapter 2 explains an account of the work activities performed during M11 until M14 in the project to attract and select participants to the challenges. It also includes a presentation of the teams that completed the challenges. Chapter 3 includes an account of the experiences from running the first instalment of the SET4BIO Innovation Challenges M14-M20. Chapter 4 provides an account of lessons learned for showcasing the SET4BIO Innovation Challenge and a brief discussion about effects and potential impact (M20-M24).

Together with D3.1 and D3.4, this report serves as a presentation of the structure of the SET4BIO Innovation Challenge anno 2021 and is designed as a repeatable model to be re-used to further mobilise support to the implementation of the SET Plan Action 8 – Renewable Fuels and Bioenergy in Europe.

1 Chapter 1 – SET4BIO Innovation Challenge anno 2021 – an Overview

The design of the SET4BIO Innovation Challenge is described in-depth in D3.1"Innovation Challenge in SET4BIO" and is accessible via the ETIP Bioenergy webpage[1]. As an open innovation contest, the challenge is directed towards creating innovations that stimulate increased production and use of bioenergy and renewable fuels. It sets out to engage innovators in developing innovative proposals for solutions that stimulate and increase the possibility of producing and using bioenergy and renewable fuels by also implementing the EU Green Deal.

To selected innovators (i.e. participating teams or entrants), the SET4BIO Innovation Challenge provided the following major opportunities:

- Accelerating the development of their solution via virtual events;
- An assessment of the solution with a final demonstration day;
- Opportunities of being matched with potential funding opportunities.

[1] www.etipbioenergy.eu/set4bio/innovation-challenge

The challenge was divided into three major phases: pre-challenge, accelerating phase and beyond-the-challenge. As depicted in Figure 1, the challenge, took place between April 2021 and January 2022, and provided a set of virtual events to support participating teams to develop their concepts throughout the challenge process towards the final. Each event was preceded by a preparation phase in which the teams worked with their concepts in association to the theme of the event.

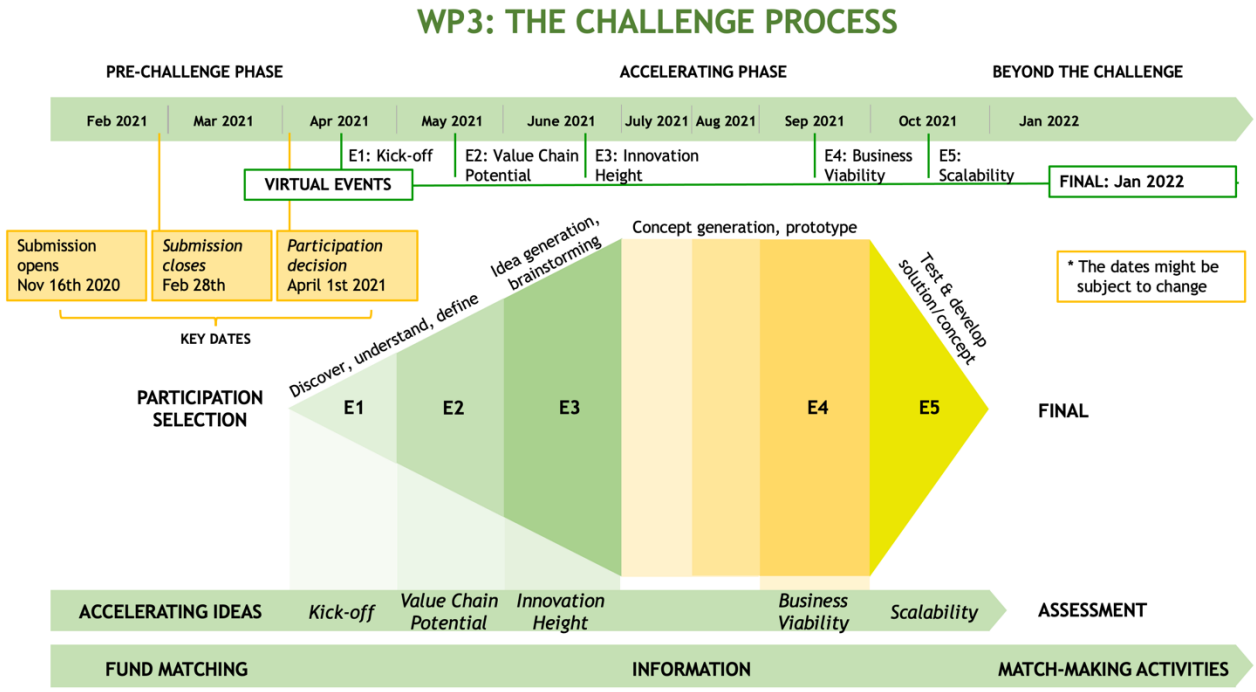


Figure 1: SET4BIO Innovation Challenge anno 2021

The following major activities constituted the challenge process:

- Application for participation.
- Screening of applicants: A screening of concepts was conducted by the organisers to select the most promising concepts to be accepted to enter the challenge.
- Virtual kick-off: At this stage, information to the entrants, including more information about the challenge to be addressed in the SET4BIO initiative, the value chains in focus, and general information about the challenge were provided through a dedicated event.
- Virtual events: Four virtual events to support the entrants in developing the concepts were scheduled. The events focused on value chain contribution, innovation height, business viability and scalability, respectively. Each virtual event was preceded by a preparation phase and followed by a post-event phase to ensure concept acceleration.
- Final event: The presentation of concepts by the entrants to the jury was done. The evaluation of best concepts was performed by a jury and the winners were officially presented and communicated.

Continuously throughout the one-year process, the selected teams were offered to:

- receive feedback from key stakeholders within the sector, acting as board of mentors, in regard to their solution;
- gradually receive relevant information in regard to funding, creating a basis for future

matchmaking.

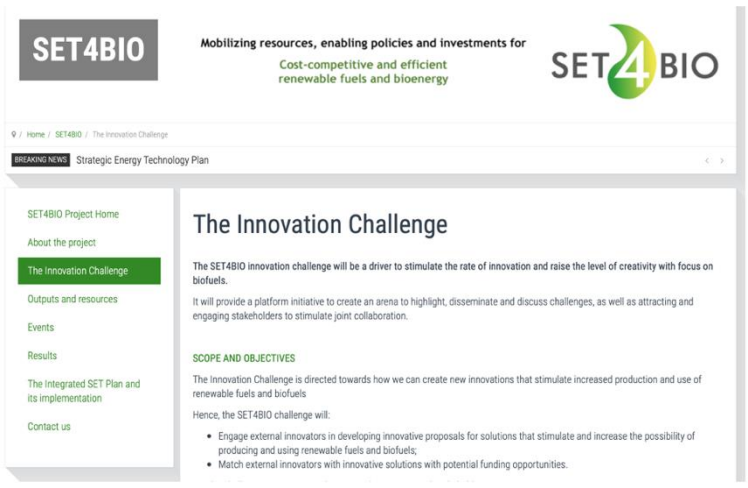
At the final event, the participating teams with their solutions were ranked and the top three awarded the so-called Seal of Excellence. The Seal of Excellence indicates the solutions potential in terms of the four evaluation criteria: value chain contribution, innovation height, business viability and scalability. Aside from visibility of the teams in different media channels and communication material, the Seal of Excellence comprises important supporting documentation for the teams in continuous development of their offerings, for instance in relation to funding agencies, potential customers and partners.

2 Chapter 2 – Engaging Participants and Preparing the Challenge

In this chapter, the process to enroll teams to the challenge is described and how teams were assessed and selected. As a final part, the chapter includes a description of six of the teams invited to the Innovation Challenge.

From mid-November 2020, the SET4BIO webpage enabled interested teams of innovators to submit applications for participation. After submission deadline, these submissions were reviewed using three criteria: relevance of the concept to the challenge scope, its perceived potential and the innovators capacity to deliver and scale the solution. Selected teams were then invited to the SET4BIO Innovation Challenge process, officially starting in April 2021.

2.1 ENROLLMENT OF TEAMS



The Innovation Challenge was launched in fall of 2020 through systematic outreach from the SET4BIO project to potential teams, i.e. marketing activities towards potential teams to submit applications for participation. A first step in this process was to define the target group for the challenge which is further described in the deliverable D3.4 Identification of topics for SET4BIO Innovation Challenge".

External innovators with a promising concept focusing on technology development and market introduction of value for the sector were deemed as one of two groups of candidates to reach and attract to the challenge. The benefits of participation were determined as that the challenge provided such teams an acceleration process including the access to an extended network with expertise in the area of renewable energy and biofuels that support development and market introduction. The second hands-on value for this group was that participation provided support and guidance in developing a sound business model with a focus on market introduction. A third benefit was that the acceleration program through the events supports the teams to inform about and understand potential funding opportunities that if enabled will support the teams to take further steps in developing their solution.

The second type of target group was defined as innovators with a higher technology readiness level with a proven concept aiming to scale the business and/or diffuse into new markets.

For this target group, benefits of participation included exposure towards potential customers and stakeholders through co-branding in media, events and at exhibitions throughout the challenge. Also, the challenge provided guidance and tools to increase the business impact and reach higher scalability.

For both groups participating in the challenge exclusive supportive events were conducted that facilitated the development of their submitted concept. In addition, access to information about funding opportunities was provided and the possibility to be matched with funding agencies to have an impact on the European market.

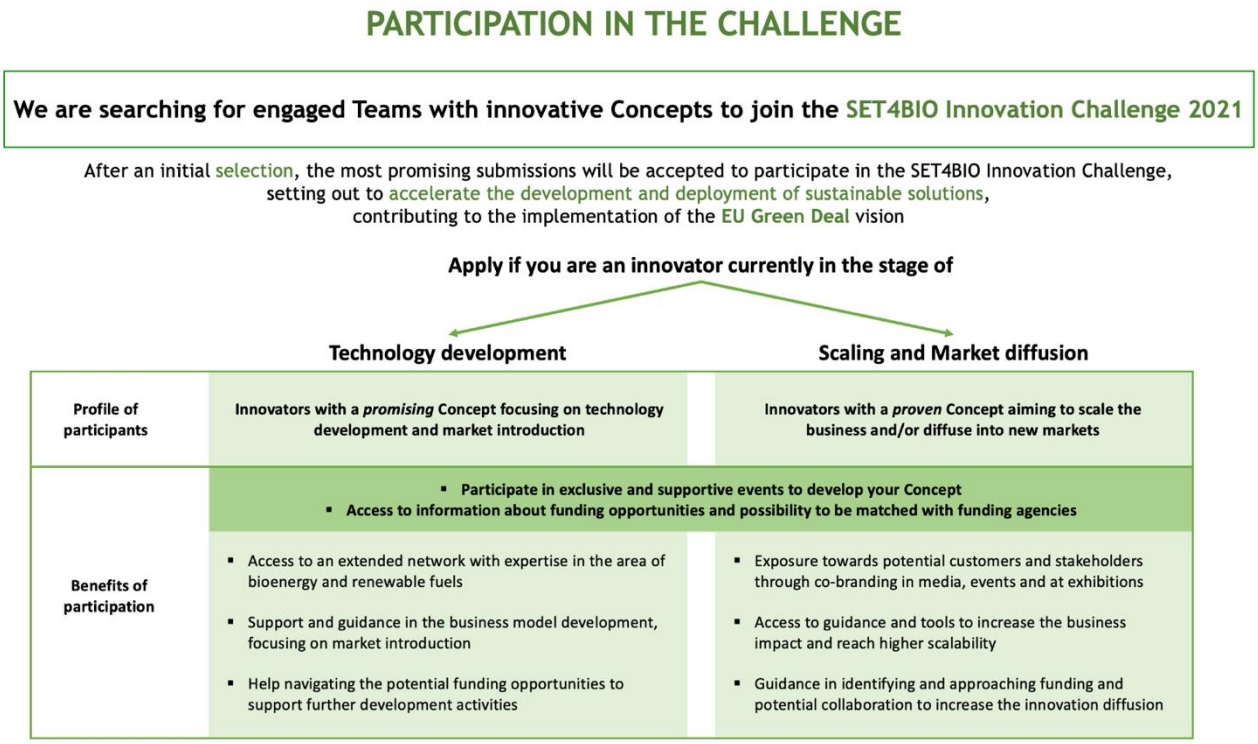


Figure 2: Benefits of participation for the two primary target groups for SET4BIO Innovation Challenge

Utilizing the ETIP Bioenergy web page[2] as the core communication platform, WP6 with the project partner ETA as lead applied multiple communication channels to reach out with communications about the SET4BIO Innovation Challenge. This included newsletters, LinkedIn posts and short movies.

The marketing activities continued throughout February 2021 resulting in 13 teams submitting proposals for participation with a total of 101 potential participating team members.

2.2

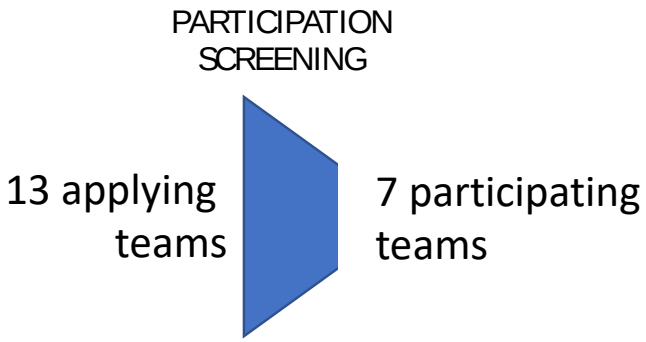
2.3 PARTICIPATION SELECTION

The 13 proposals were submitted using an electronic form at the SET4BIO webpage. Each

[2] www.etipbioenergy.eu/set4bio/innovation-challenge

application included an overall description about the concept as well as an account of the team members constituting the team. The concept was described as follows:

- An account of the problem addressed and how the solution could mitigate or solved the problem in question (250 words);
- An account of how the solution can add value to one or several of the value chains that acted as a framework to focus and delimit the challenge (250 words);
- A self-assessment how close the solution was at that stage to market introduction: early design, development, or in deployment phase (with a comment of 100 words);
- An account of the idea that the team had to fund the development and launch of the solution; including a description of past or ongoing fund raising activities (250 words);
- An account of relevant experiences and competences within the team with relevance to the solution and the SET4BIO Innovation challenge as a whole.



The submitted proposals were evaluated by the organizing committee. The screening was initiated by a kick-off meeting in which the organizing committee did an overall assessment of contribution to identify proposals that did not meet the overall rules for participating in the challenge. An assessment template was provided to the committee members to be used to screen and rank the submitted and initially accepted proposals in accordance with their relevance, perceived potential, and the teams capacity to accelerate the solution through participation in the challenge. The participation selection was performed throughout March 2021 and participation decisions were communicated April 1st 2021. The acceptance letter included an overall account of the assessment performed by the committee as well as an invitation to participate in the challenge and the kick-off event on April 12th 2021. The rejection letter included a motivation of the rejection as well as an overall account for the result of the assessment of the submitted proposal. In total, six proposals were rejected and seven teams were invited to participate in the SET4BIO Innovation Challenge.

2.4

2.5 SELECTED TEAMS

By including the submission requirement for each team to describe the status of their solution, e.g. in design, development or deployment, and the requirement to relate the solution to at least one of the 6+2 value chains defined, a target area was set for the challenge. Such a conceptualised target area enhanced the efficiency to screen and position the submitted proposals in relation to the overall aim with the challenge. It also supported the organizing committee to ensure that the selected participants constituted an appropriate mix of teams in the challenge.

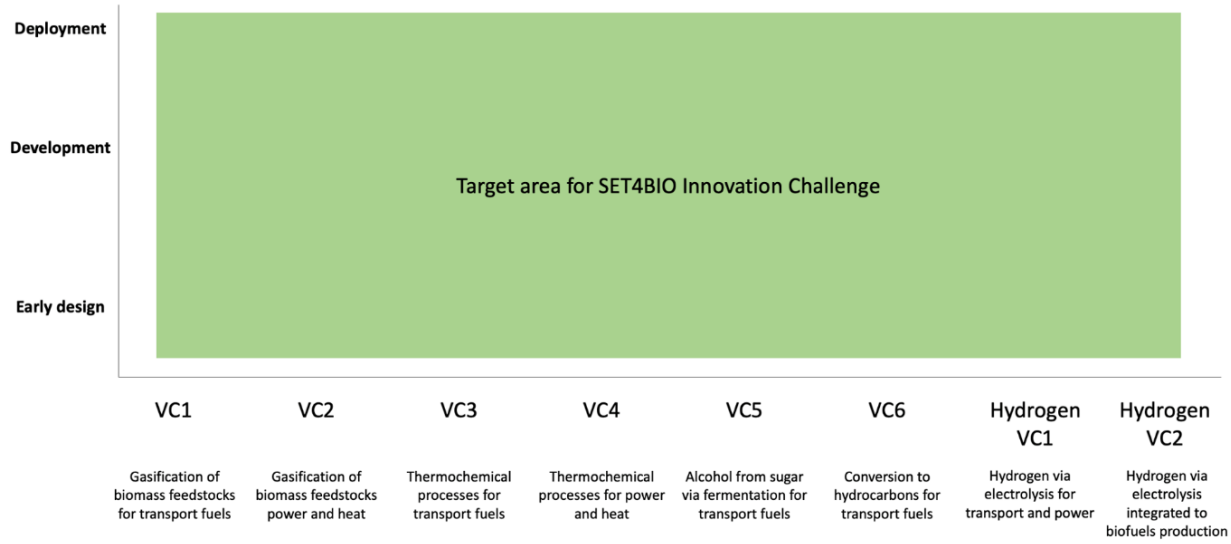


Figure 3: Target area for the SET4BIO Innovation Challenge 2021

In all the seven teams invited to participate in the challenge, with team members from seven countries in Europe in the early design and development phase. The teams also covered with their solution most of the value chains used to scope the challenge, with an emphasis on techniques for conversion to hydrocarbons for transport fuels. The coverage of in total six value chains of the in total 6+2 value chains was regarded as great success for the first version of the challenge, as it created a wideness in the challenge in terms of potential solutions and value.

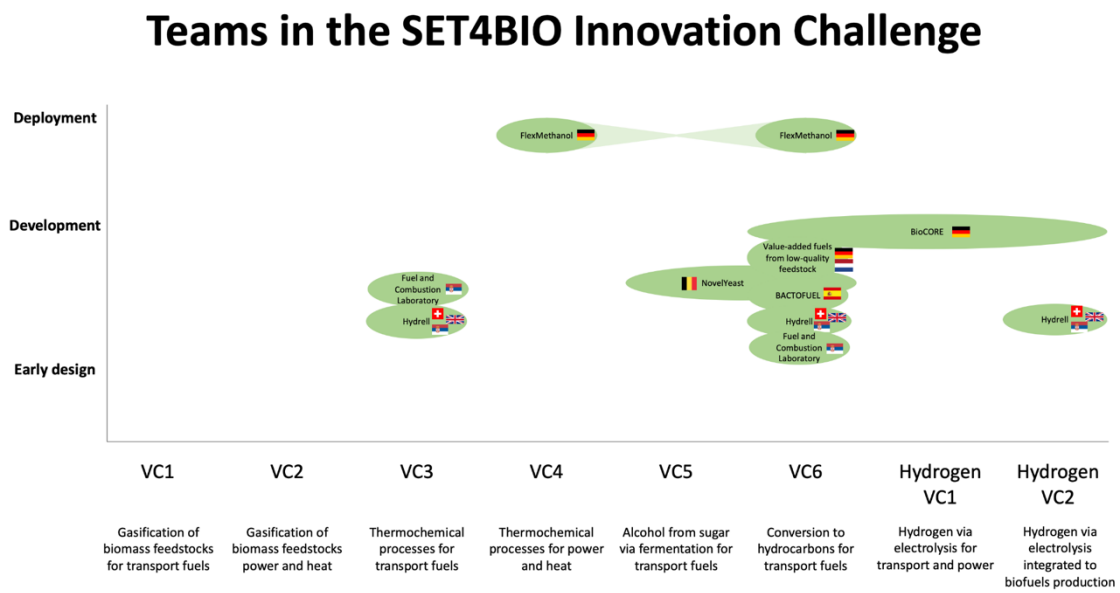


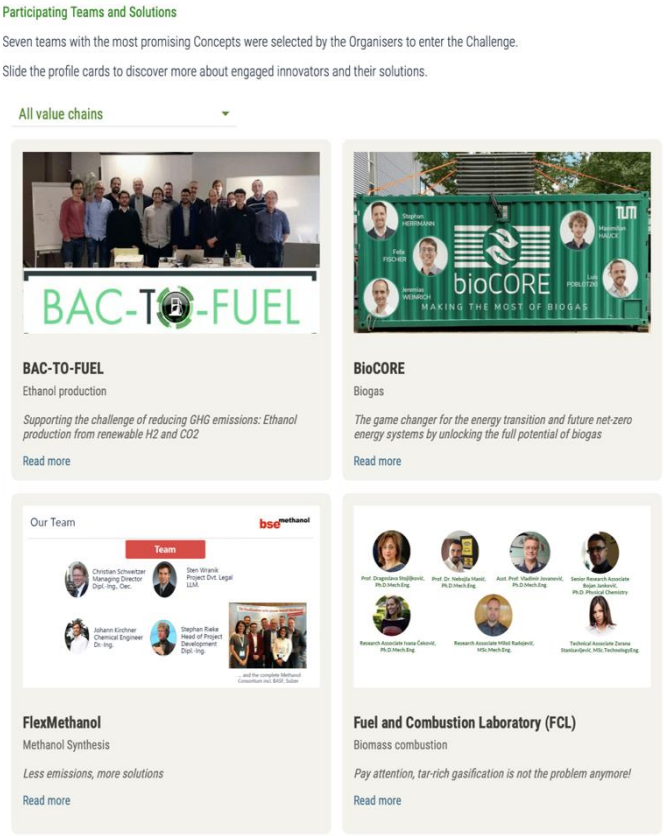
Figure 4: Teams invited in the SET4BIO Innovation Challenge in relation to value chains and innovation stage

In the following sections, six of the seven teams are presented. The seventh team withdrew the participation during the challenge. Additional information about the teams are available on the

SET4BIO webpage[3].

2.5.1.1 TEAM BAC-TO-FUEL

The team of BAC-TO-FUEL is formed by experts in the fields of materials chemistry, computational chemistry, chemical engineering, microbiology and bacterial engineering. Four universities, one SME and one independent research institute coordinate the development of the technology. Universidade de Santiago de Compostela (responsible for the development of the AQCs), Lancaster University (study of the theoretical calculation of the AQCs geometry), Technical University of Berlin (responsible for the photocatalysis process and the coupling of both technologies (photocatalysis processes and Bioelectrochemical synthesis), Wageningen University (genetically modification of the bacteria), VITO (responsible for the bioelectrochemical system design and the coupling of both technologies and NANOGAP (responsible for the synthesis of the AQCs, and responsible for the dissemination, communication and exploitation of the results). Together, the aim is to boost the technology to the market in the short term.



BAC-TO-FUEL aims to respond to the global challenge of finding new sustainable alternatives to fossil fuels by developing, integrating and validating a disruptive prototype system at TRL5, which is able to transform CO2/H2 into ethanol in a sustainable and cost-effective way that: 1) mimics the photosynthetic process of plants using novel inorganic photocatalysts (atomic quantum clusters), which are capable of producing hydrogen in a renewable way from photocatalytic splitting of water in the presence of sunlight; 2) uses enhanced bacterial media to convert CO2 and the renewable hydrogen into biofuels (ethanol for transport) using a novel electro-biocatalytic cell which can handle fluctuations in hydrogen and power supply lending itself to coupling to renewable energy technologies.

2.5.1.2 TEAM BioCORE

The team behind BioCORE consists of five members: Stephan Herrmann is the inventor of BioCORE and has many years of experience in the development and evaluation of innovative power plant concepts. Felix Fischer, Maximilian Hauck and Jeremias Weinrich also have a strong background in different energy-related topics and have technically realized the prototype. Luis Poblotzki came

[3] www.etipbioenergy.eu/set4bio/innovation-challenge

on board because of his experience in control algorithms and data analysis. The team complements each other perfectly and has developed the container-based plant from scratch to automated operation. From day one it was their goal to bring BioCORE to the market.

The BioCORE process employs a novel system design for high-temperature solid oxide cells with subsequent catalytic methanation and CO2 separation. It can be operated either as fuel cell (SOFC), producing electricity, or as electrolysis (SOEC) unit in the first economically viable power-to-gas process. It can switch between both modes within <1min and thus make a considerable contribution to stabilizing the energy system. In SOFC mode the highly innovative BioCORE technology electrochemically converts valuable biogas into electricity with maximum efficiency (80% electrical – twice as efficient as conventional combustion engines), with the additional option to capture the CO2, thereby enabling net negative CO2 emissions on a large scale. During SOEC operation, BioCORE plants produce pure hydrogen or convert CO2 into synthetic natural gas. By inserting the produced gases into the existing natural gas infrastructure, the BioCORE technology also solves the problem of long-term energy storage. The team aims to revolutionize the biogas market using BioCORE. Existing biogas plants will be retrofitted and made fit for the future through the use of the standardized and highly efficient BioCORE plants. These plants support the electricity and gas sector in a demand-oriented, decentralized and resource-saving way. Standardized, mass-produced, containerized systems enable the best possible economic and energetic use of the locally available biogas potential. Beyond biogas, BioCORE also aims to be the leading technology for other future markets, such as the hydrogen economy, as well as power supply for data centers or ships.

2.5.1.3 TEAM FlexMethanol

The FlexMethanol Team consists of industrial engineers and economists, chemical engineers, legal and market experts and project developers. Part of the experienced lead team are Christian Schweitzer (managing director), Sten Wranik (managing director), Dr. Johann Kirchner (head of process engineering), Stephan Rieke (head of electro-chemical) with professional background in all relevant disciplines like industrial plant construction, CO2/H2 to methanol process, global market development and regulatory framework setting. Among others, the team built and operates a flexible methanol plant directly connected to an electrolyzer and a wind power plant. Implementation of the first industrial FlexMethanol 10 plant started in 2021.

The teams catalytic process converts CO2 from futile streams, e.g. of the biomass processing for instance from fermentation or flue gases like incineration into methanol. The required hydrogen can be utilized flexibly without gas storage, which enables the linkage of two worlds: power and resources/fuels. The solution enables to store renewable power permanently, which can then be used globally as renewable fuel. As such, the methanol technology reduces the technical risk by using pure gases. Solid wastes like tars are not existing in the FlexMethanol process. The flexible methanol plants are designed in standard sized skids, modular and therefore scalable to any needs. The teams offering is along the full value life cycle from engineering of power-to-methanol plants, catalyst supply, FlexMethanol skids supply, logistic and offtake of methanol to best value markets as well as applications like methanol power trains.

2.5.1.4

2.5.1.5 TEAM Fuel and Combustion Laboratory (FCL)

Fuel and Combustion Laboratory (FCL) Team represents a synergy of the Faculty of Mechanical Engineering in Belgrade – Fuel and Combustion Laboratory (FCL) and the Department of Physical Chemistry – Institute Vinča. It consists of three professors, two research associates, one research assistant, and one technical associate. Their research encompassed fuels, thermochemical processes and their modeling, energy efficiency and renewable energy sources – biomass&biofuels, environmental protection, emission measurement, process&equipment design for emission

monitoring, and experimental techniques for physicochemical characterization of solid, liquid and gaseous products from thermochemical conversion processes.

"BioFUT-Biomass Feedstock for Utilization in Transport". The FCL's concept aims to investigate the gasification of biomass feedstock listed in Part A of Annex IX under RED II Directive, in a lab-scale reactor, to produce high-quality gasification products suitable for the further production of advanced biofuels – synthetic fuels and their deployment as transportation fuels. Due to the undeveloped biomass market and the inconsistency of biomass quality in Serbia, gasification product composition and yield vary. Opposite to the conventional approach, ideally, tar-free gasification, the FCL's approach is focusing on the optimization of the gasification process to produce heavier hydrocarbons (≥ C6) – tar-rich gasification. This is particularly interesting for feedstock prone to tar formation to match the biomass quality in the existing gasification plants. Tar yield increase could be stimulated through the utilization of different biomass feedstock/mixtures and gasifying agents commonly used in Serbia, and the matching of the process parameters, especially equivalence ratio (ER) and gasification temperature, with the application of the fundamental experimental research (low TRL), comprehensive thermodynamic and kinetic analysis, and possible application of different catalysts, including minimum CAPEX/OPEX investments. This novel concept could significantly contribute to knowledge utilization into existing gasification systems in Serbia with potential system improvements/scaling, Serbian energy transition towards the European Green Deal, incentivizing sector coupling/sector integration, and improvement and harmonization of the Serbian legislation with the EU's existing framework, energy dependency reduction, valorization and value chain extension, as well as local job and income creation.

2.5.1.6

2.5.1.7 TEAM Hexem

Michael Siegert has significant technical experience in microbiology and bio-electrochemistry. Michael has over ten years of experience in microbial electrolysis research. He is inventor of two of Hexem's key patents to be exploited by Hexem. Michael also has many years of experience in building companies. Miroslava Varničić has been on board of Hexem early on. She has profound experience in bio-electrochemistry through her PhD at the Max-Planck-Institute in Germany. Her leadership experience in her current position as scientific project manager at the Belgrade Institute for Metallurgy and Technology makes her the perfect fit to lead Hexem's R&D team.

Hexem has developed a wastewater treatment technology that allows the recovery of energy, nutrients and clean water at a much smaller footprint and price than competing technologies. Using the Hexem technology, users have an incentive to treat their wastewater by saving >30% of their total operating costs. Users are in the food and beverage industry such as breweries, wineries, dairies and other producers of high strength wastewater. Hexem has developed a TRL 5 prototype in their workshop at a local wastewater treatment plant in Switzerland, which can treat 200 l/day. The Hexem solution is based on microbial electrolysis of organic and inorganic matter present in wastewater. This electrolysis is assisted by specialized microbes living on the surface of the electrodes. Methane evolving in the microbial electrolysis process is collected and processed. Hexem's commercial products are based on modular cylindrical reactors making the system compact, flexible and portable. Hexem's intellectual property includes two PCT applications, covering the reactor and electrode design, the control algorithm and software, as well as the removal of ammonia with simultaneous production methane gas.

2.5.1.8

2.5.1.9 TEAM NovelYeast

NovelYeast bv is a spin-off company from the research group of Prof. Johan Thevelein at VIB/KU Leuven, Belgium. It aims to exploit the extensive knowledge and technical know-how gained during 35 years with yeast research and with the many industrial applications of yeast for the development and commercial implementation of superior industrial yeast strains for the bio-economy and for diverse other fields. The team has worldwide contacts and collaborations with companies active in this sector, in particular in the field of bio-based chemicals and biofuels production with yeast-based cell factories.

The conversion of lignocellulosic biomass into biofuels and bio-based chemicals poses several challenges, with xylose utilization, inhibitor toxicity and the high cost of the lignocellulolytic enzyme cocktail standing out as major issues. NovelYeast has developed an inhibitor-tolerant industrial yeast strain with high xylose utilization capacity that allows for complete fermentation of all glucose and xylose in lignocellulosic hydrolysates in a short time. In addition, it has expressed multiple, secreted lignocellulolytic enzymes in this yeast strain, which allow for reduction of the enzyme requirement and for increase of the ethanol yield.

3 Chapter 3 – Experiences from Running SET4BIO Innovation Challenge 2021

In this chapter, experiences are presented from running the SET4BIO Innovation Challenge from April 2021 to January 2022. The challenge was designed as a staged innovation process (see D3.1 "Innovation Challenge in SET4BIO") providing three key values to the admitted teams. Core in the challenge was a structured process to support the teams to accelerate the development of their proposed solutions. The support was provided theme-based via the four support events arranged throughout the challenge, including funding matching opportunities. Additional values were the assessment of the solution with a final ceremony where the submitted final contributions had been reviewed and assessed by a jury composed by experts from the field.

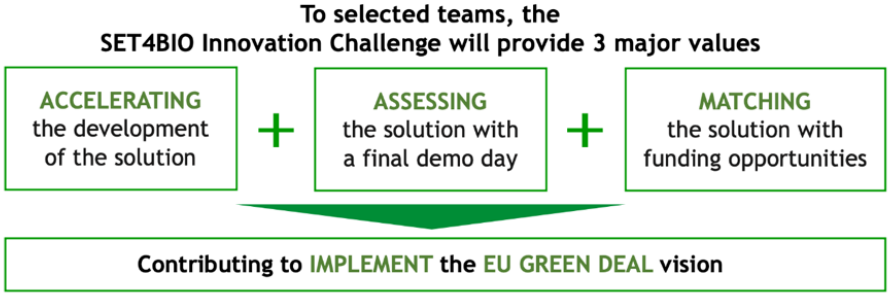


Figure 5: The three core values to selected teams

The challenge started with a kick-off that that had as main objective to formally launch the challenge, introduce participants in the structure and share information between participants about the contributing teams focus and solutions. The acceleration phase occurred between May and October 2021 and was facilitated through four theme-based virtual events addressing four topics to support the teams to further develop their solutions. The first event focused the value chain potential, and was thus an event focused the adherence of the team's solution to the 6+2 value chains used to frame the challenge (see D3.4 "Identification of topics for SET4BIO Innovation Challenge"). The innovation height event stimulated the teams to position their solution on their specific market landscape and stimulate them to motivate the level of novelty in their solution. Business viability aimed to support the teams to further develop their business plan for the solution

and the fourth event tasked the teams to develop a strategy to scale the solution and develop a tentative funding plan.

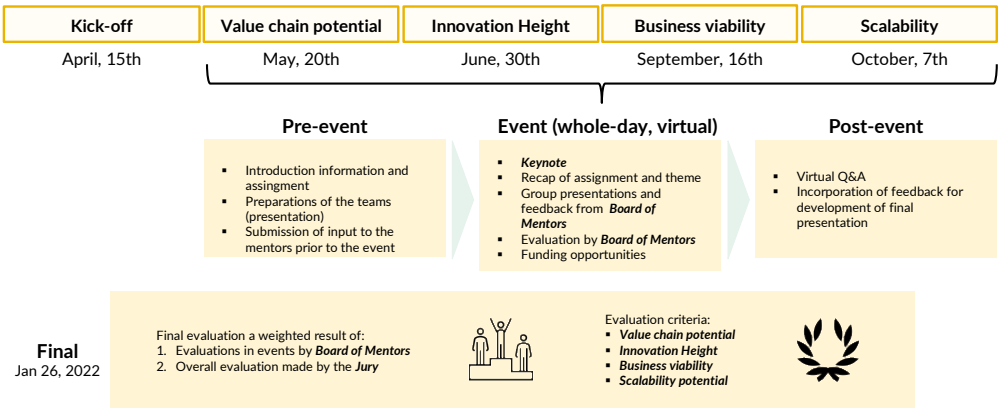


Figure 6: Themes of Support in the Innovation Challenge

Two weeks prior to each event, the teams were tasked to prepare participation on the event. An assignment based on the theme for the event was then introduced to the teams which required them to develop their solution to meet the requirements for the event.

The events were organized as a whole-day online event with a short keynote introduction in relation to the topic for the event. Each team was then tasked to present their solution in relation to the prepared assignment. The board of mentors with expertise within the addressed topic commented and questioned the teams after each presentation in order to facilitate a constructive dialogue supporting the teams to further evolve their solution. After lunch funding opportunities were presented and the whole-day event was wrapped up with a shared learned lessons section.

Figure 7: Event structure

After each event, the teams received written comments from the board of mentors and the shared material from the event in terms of keynotes and funding information. Feedback from the teams regarding the challenge process were also collected after each activity.

3.1 VIRTUAL EVENT 1: KICK-OFF

Originally, the Innovation Challenge was designed as an on-site challenge process with the aim to arrange physical events requiring participating teams to travel to a specific event location. COVID-

19 restrictions changed the setup and forced the project to organize the SET4BIO Innovation Challenge as a virtual innovation process, following the original structure, however without physical meetings. Zoom was chosen as virtual platform with the ETIP Bioenergy webpage as main marketing and communication platform.

The decision letter for participation were distributed on April 1st 2021 together with an invitation to the seven teams that passed the selection stage criteria. The kick-off event was a half-day event and held on April 15th. It was moderated by Ludvig Lindlöf, RISE Research Institutes of Sweden. Project manager Patrik Klintbom, RISE Research Institute of Sweden, gave a welcome keynote explaining the background to the challenge as well as the SET4BIO project. Anders Hjalmarsson Jordanius, RISE Research Institute of Sweden, addressed the values of organizing innovation as a contest and also described the logic of the challenge based on themed-events that linked together creates an facilitating process with the aim to support the teams to accelerate their solutions from multiple viewpoints.

Each team was tasked to present themselves during the kick-off in terms of participants, problem addressed and a brief introduction to the solution with focus on technique used and value to field of bioenergy and renewable fuels.

The organizing committee was presented together with the funding team supporting fund matchmaking throughout the process. In parallel to this the structure of the events was described, with both a focus on the team solutions and funding opportunities.

<table>
<tr><th>Grants</th><th>Equity</th><th>Loans</th><th>Others (e.g. guarantee)</th></tr>
<tr><td>Innovation Fund
Just Transition Fund
Clean Energy Transition Partnership
EUREKA
KICInnoEnergy</td><td>Private equity investments and funds
Marguerite II
BEV
ECBF</td><td></td><td></td></tr>
<tr><td colspan="2">EIC Fund</td><td></td><td>InvestEU</td></tr>
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<tr><td colspan="4">Modernisation Fund</td></tr>
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The funding part of the kick-off was dedicated to a presentation of SET4BIO Deliverable 1.2 “Institutional and competitive funding opportunities” (by Judit Sandquist, SINTEF) and SET4BIO Deliverable 1.3 “Private Financing Opportunities” (by Paola Mazzuchelli, CIRCE), as well as a presentation by the European Commission (Maria Georgiadou, DG RTD) on “EU R&I policy on biofuels, renewable fuels and bioenergy”, including Horizon Europe.

The objective of this first funding webinar was to provide the teams with general information about the overall financing framework at European level, available for bioenergy and biofuels related projects and to learn about relevant funding instruments with a focus on Horizon Europe.

3.2 VIRTUAL EVENT 2: VALUE CHAIN POTENTIAL

The first theme-based event of the SET4BIO Innovation Challenge after the kick-off focused on Value Chain Potential. The event comprised interesting presentations from the participating teams, feedback from a board of experts and presentations about funding opportunities. The event was an all-day event held May 20th 2021, moderated by Ludvig Lindlöf, RISE Research Institutes of Sweden.

The event was attended by the seven participating teams who all presented their solutions with a

particular focus on their value chain potential. Furthermore, the board of experts contributed with their extensive knowledge and provided valuable feedback to the participating teams, focusing on their solutions' value chain potential. The board of experts consisted of Patrik Klintbom, Chair ETIP Bioenergy and senior researcher at RISE Research Institutes of Sweden, Luc Pelkmans, Technical Coordinator at IEA Bioenergy, and Johanna Mossberg, Department Manager for the Department of Biorefinery and Energy at RISE Research Institutes of Sweden and board member of Svebio. The feedback was both given during the event by the mentors and also distributed in written form thereafter, a format that was then repeated after each event. Some example of comments provided were:

- At what scale would you imagine that your process would be applied?
- It was suggested that it might be of interest to couple to aviation sector to be able to scale up – elaborate on this potential.
- What is the added value with focusing on both the (two) parts that you are doing (the photocatalytic process and hydrogen)?
- Since an option is to use a chemical way for producing hydrogen, do you have a specific advantage of your chosen process?
- Do you still emit part of CO2 in your solution?

Three interesting presentations were held about funding opportunities associated to private finance to support European innovation, presented by Nuno Quental (European Innovation Council - Financial instruments at European Commission), Jacopo Losso (EBAN- European Business Angels Network Director of Secretariat), and Leon Pulles (Senior Investment Advisor and Managing Partner at Energy Investment Management BV). The main objective of this activity was to learn about relevant funding instruments available from the private sector mainly in the form of equity.

3.3 VIRTUAL EVENT 3: INNOVATION HEIGHT

Following the first theme-based event in the SET4BIO Innovation Challenge, the second event focused on the theme Innovation Height. This event was also a whole-day event and was held on June 30th 2021. The teams had been given the assignment of mapping their solutions in relation to other solutions available on the market. In the presentation during the event, they were assigned to describe the novelty of their solution through a visual mapping of their solution in relation to a sample of competing existing technologies/companies. The aim was to challenge the teams to visualise their position of the technology to thereby train them to illustrate and argue for the technological edge in relation to a few benchmarks. Such benchmarks could include, but were not limited to, performance, energy efficiency, feedstock (e.g. is there available feedstock, in amounts required for successful operation?), geographical dependency (e.g. regional, local, national), or TRL level. The event was specifically not about the commercial potential, but the technological edge of the solution developed.

The event started with presentations of this task by the teams. Feedback was given by Patrik Klintbom (RISE Research Institutes of Sweden), Antti Arasto (VTT) and Judit Sandquist (SINTEF) to identify potential challenges and opportunities in relation to the innovation height of the solutions. Examples of comments provided by the mentors during the event and in written comments post-event were:

- Will you use electricity to boost the biogas production, and by this reduce the number of process units?

- Do you use the electricity to create a more suitable conditions for the microbes? As energy balance?
- Is your production rate higher than your competitors? Can you compare it to the electricity use?
- As aviation fuels need to be certified, have you tried a TRL test on your fuels?
- Do you have any results from your ethanol and methanol processes?
- Regarding scalability of the technology, what do you see as the main challenges of scaling the reactor (scaling of the catalyst) to industrial level?
- One of the challenges is the end-product recovery. Do you have any novel or good solutions to this challenge?
- Please elaborate a bit on what the technical advantages are compared to other solutions already in the market.
- Is this process a catalyst process?
- Are you aiming mainly at a small-scale plant production, or do you also aim for large-scale plant production?
- How flexible is your process exactly?

Marion Perelle (European Commission - EU Innovation Fund), Juan Antonio Magaña-Campos, (EIB financing and advisory solutions for sustainable energy) and Lisa Lundmark (Clean Energy Transition Partnership - Swedish Energy Agency) presented opportunities in relation to public funding for the participating teams. The main objective of this activity was for the teams to learn about relevant funding instruments mainly in the form to grants and loans. These funding presentations were highly appreciated by the teams.

3.4 VIRTUAL EVENT 4: BUSINESS VIABILITY

The third theme-based event focused on business viability of the participants' solutions. The teams had been given the assignment to describe how viable their solution is in relation to a commercial aspect. The focus was on how the team's business model fits into both the current and the future business landscape, focusing on the commercial aspects of their solution, rather than the technical ones. In their presentation, they were assigned to display their business model using for instance any of the following tools:

- Business model canvas
- Value proposition canvas

The event was arranged on September 16th 2021 and started out in presentations of this assignment by the teams. Feedback was given by Patrik Klintbom (RISE Research Institutes of Sweden), Erik Furusjö (Luleå University of Technology) and Judit Sandquist (SINTEF) to identify potential challenges and opportunities in relation to the commercialisation of the solutions. Examples of comments provided by the mentors to the teams were:

- Unclear business proposal to potential customers; sharpen the value proposition to ensure alignment to the impressive technical solution developed
- Suggestion to analyse and map the ecosystem of actors that could benefit from the solution
- A map of potential competitors on a European level
- An analysis of investments needed in order to scale the solution
- Investigate the possibilities to enhance the team with business experts that also are familiar with the specific bioenergy field
- Think about communication and how to visualise the anticipated values with the solution.
- How do you know that the small farmers can afford it? No worries about the bigger bio

plants, but do the small farmers have support in Germany for this investment?

- As the investment needs to be done upfront to the installation, this may be a challenge for the small farmers.
- It sounds like you have two different markets. Going for both high efficiency and high flexibility does not go together. Just having higher efficiency is interesting without higher storage. If you are going into storage aspects, meaning going into the flexibility market, are you sure that your farmers are interested of that?
- How is your process compared to others? Is it cheaper or better?
- You mentioned alcohols to jets several times, but what does this mean for your certificate? Do you need a new one?
- Concerning different markets there may be more difficult to update your certificate to other sectors. Right now, it seems that your product brings more value to the aviation sector.
- But there are several changes ongoing in for example the shipping sector, so let's see if there will be a ketchup effect. The politics impacts a lot on the technology.
- How will you finance the first plant? Convince someone else to invest or finance it yourself?

3.5

Support and tips were provided to the teams on how to look for funding opportunities with in-depth presentations on:

- Services for entrepreneurs by Marcin Lewenstein from InnoEnergy
- EUREKA funding opportunities and its accelerator program by Peter Chisnall from EUREKA

3.6

The main objective of this activity was for the teams to learn about relevant funding instruments as well as related accelerator and business support services, as provided by InnoEnergy and EUREKA.

3.7 VIRTUAL EVENT 5: SCALABILITY

The final theme-based whole-day event was organized on October 7th 2021. The focus at this event was project financing plan and scalability, including information about strategies for technology diffusion. The assignment given prior to the event aimed the teams to develop a develop a strategy for growth using a provided toolbox for scalability strategy development. The activity also included a co-creation session to discuss potential funding strategies for implementation of their solution ideas.

During the event, the teams were invited to present their ideas for a financing plan for their project, on the basis of the information previously received. This session was aimed at being a co-creation session, where the SET4BIO experts provided a first feedback on the financing plan proposed by the teams. In order to prepare for the session, the SET4BIO Innovation Challenge teams were requested to answer the following questions in their presentation:

- What TRL would your project reach at the end of the current stage?
- What are the main obstacles you have encountered so far in further developing your project. Are these financial issues related to the lack and/or difficulty in obtaining funds?
- What type of financing would you need to further develop it and bring it to the market? Grants, equity or loans

- Estimate of the needed amount
- International/European vs. national fund. What would you believe would be more appropriate for you?
- Would you need support from a business accelerator?
- What type of other support would you think you would need?
- In the previous match-making sessions a series of instruments were presented to you. Did you find any interesting? Why?

Examples of comments provided by the mentors on the financial plans and scalability approach were:

- For one of the teams select one of two options, either licencing the technology (sales through engineering companies) or direct sales to end-customer.
- Important to find the right partners to help you innovate in the industry. The team cannot be too afraid that the bigger player might steal their technology/ideas, stimulate cooperation is important to be able to scale.
- Customers that grow are important. Or customer that have a larger customer base. One strategy can be that you need to talk to customers locally and use this as a springboard.
- Larger industries already have their running plants. What is your unique selling point compared to the other? Perhaps it is more compromised, but is it cheaper? Being much more compact Is a unique selling point. There is a market both for large plants, and for smaller plants, the latter is also a unique selling point.

3.8

3.9 VIRTUAL EVENT 6: FINAL

The final sprint of the challenge started on October 8th and ended on December 1st 2021. The teams were then assigned to submit their final concept description of their solutions for final review and ranking. Submitted material from each team was then distributed electronically to the jury members via the virtual assessment board developed for the innovation challenge.

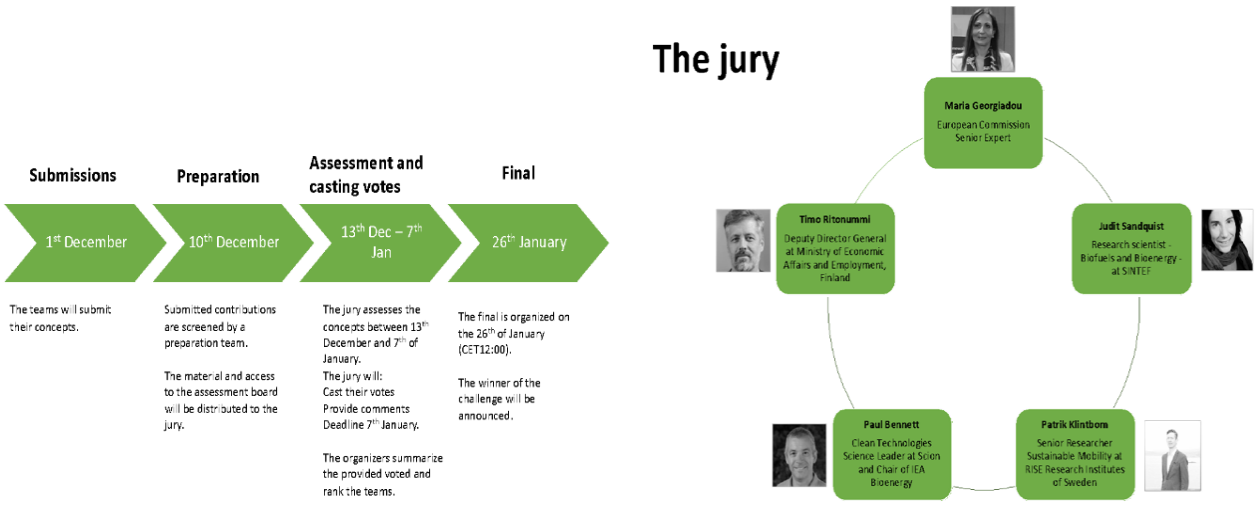


Figure 8: The SET4BIO Board of Jury

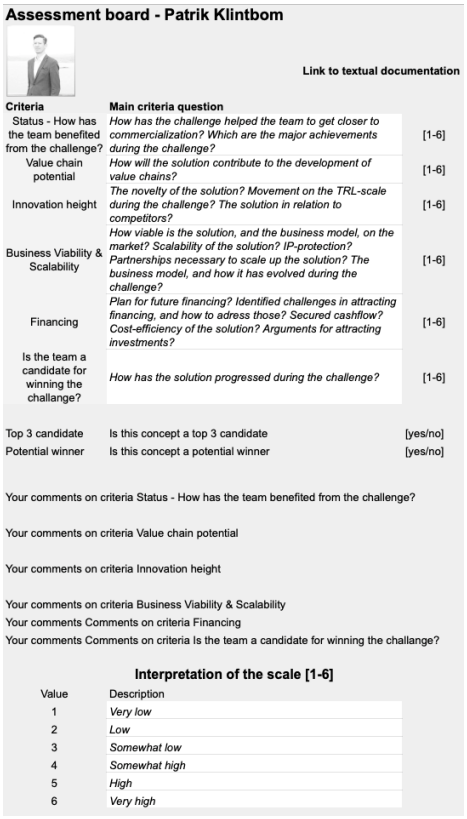
The jury consisted of Maria Georgiadou (Senior Expert, European Commission), Timo Ritonummi (Deputy Director General, Ministry of Economic Affairs and Employment, Finland), Judit Sandqvist (Senior Research Scientist, SINTEF, Norway), Paul Bennet (Clean Tech Science Leader IEA Bioenergy), and Patrik Klintbom (RISE Research Institutes of Sweden). The organizing committee of the Innovation Challenge facilitated the preparation of the jury assessment and supported the

organization of the final event.

The submitted contributions were screened and integrated in the assessment board on December 10th, which resulted in the assessment of six contributions. One of the seven team withdrew participation prior to the second half of the challenge. Assessment was done both individually by the jury members and also discussed during jury meetings at two occasions between December 13th 2021 and January 7th 2022.

The assessment board had been developed in the fall of 2021 using Google Drive and consisted of a criteria structured segment with six main criteria to be used to rank each concept description using the scale 1-6, where 6 states that the team concept completely meets the criteria, and 1 that the concept fails to meet the criteria. The first criteria was labelled *Status* and operationalised into two questions:

- How has the challenge helped the team to get closer to commercialization?
- Which are the major achievements during the challenge?



Assessment board - Patrik Klintbom

Link to textual documentation

Criteria	Main criteria question	
Status - How has the team benefited from the challenge?	*How has the challenge helped the team to get closer to commercialization? Which are the major achievements during the challenge?*	[1-6]
Value chain potential	*How will the solution contribute to the development of value chains?*	[1-6]
Innovation height	*The novelty of the solution? Movement on the TRL-scale during the challenge? The solution in relation to competitors?*	[1-6]
Business Viability & Scalability	*How viable is the solution, and the business model, on the market? Scalability of the solution? IP-protection? Partnerships necessary to scale up the solution? The business model, and how it has evolved during the challenge?*	[1-6]
Financing	*Plan for future financing? Identified challenges in attracting financing, and how to adress those? Secured cashflow? Cost-efficiency of the solution? Arguments for attracting investments?*	[1-6]
Is the team a candidate for winning the challange?	*How has the solution progressed during the challenge?*	[1-6]
Top 3 candidate	Is this concept a top 3 candidate	[yes/no]
Potential winner	Is this concept a potential winner	[yes/no]

Your comments on criteria Status - How has the team benefited from the challenge?

Your comments on criteria Value chain potential

Your comments on criteria Innovation height

Your comments on criteria Business Viability & Scalability

Your comments Comments on criteria Financing

Your comments Comments on criteria Is the team a candidate for winning the challange?

Interpretation of the scale [1-6]

Value	Description
1	*Very low*
2	*Low*
3	*Somewhat low*
4	*Somewhat high*
5	*High*
6	*Very high*

It measured to what degree the team had evolved as consequence of being a part of the Innovation Challenge. This criterion was especially of value as the Innovation Challenge due to its staged approach aimed to accelerate the participants contribution to the SET4BIO vision and the implementation of the SET-Plan.

The second criteria was labelled *Value chain potential* and was operationalised into one question:

- How will the solution contribute to the development of value chains?

The main goal of the SET4BIO Innovation Challenge was anchored in the extensive work performed to develop the value chains of increasing use and production of bioenergy and renewable fuel in Europe. The framework was thus used as an anchor to ensure that the teams strive towards supporting the implementation of the value chain. Hence this criterion measured how the solution contributed to the overall goal of the competition.

Being an innovation challenge, the third criteria *Innovation height* was used to assess the novelty of the solution but also if and how progress was made during the challenge to ensure innovation height:

- The novelty of the solution?
- Movement on the TRL-scale during the challenge?
- The solution in relation to competitors?

Business Viability and *Scalability* was woven into one criterion to assess both the business aspect

of the solution but also the team's capacity and plan to scale their solution. It was operationalized into a set of assessment questions:

- How viable is the solution, and the business model, on the market?
- Level of scalability of the solution? IP-protection?
- Partnerships necessary to scale up the solution?
- The business model, and how it has evolved during the challenge?

As the challenge had included a funding matching activity in each event as a parallel track to the acceleration of the team's solutions, the jury in addition assessed the final contribution in terms of *Financing*. This order aimed to rank the teams progress from the perspective of creating an investment model to move from concept to an implemented solution. The criteria were operationalized into five sub-questions:

- Has the team developed a plan for future financing?
- Are challenges identified in attracting financing, and how to address those?
- Has cashflow been addressed?
- Cost-efficiency of the solution?
- Arguments for attracting investments?

The assessment board also included a final ranking segment to support the board member to state if he or she assessed the candidate as top 3 and as a potential winner of the challenge. It also included open segments for the board members to document assessment statements and comments in regard to the different criteria. This in turn supported the jury members in the discussion when comparing assessments, and, to provide overall motives for the final ranking, their joint decision and feedback to the participating teams.


SET4BIO

SET4BIO Innovation Challenge

This certifies that

Team Name

has successfully participated in the SET4BIO Innovation Challenge.
With the support of key European stakeholders, Value-added fuels has gone through the accelerated process of further developing what has the potential to become an innovative solution in the area of bio-fuel and renewable energy.

Patrik Klintbom
Coordinator and Chairman of the Jury

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 884524

The final event was arranged on January 26th 2022 as a virtual half-day event. During the event, each team presented their solutions together with a Q&A to stimulate a dialogue between participants and the team. Keynotes were also arranged regarding clean tech, and in relation to the value of organizing the Innovation Challenge as a staged innovation contest. A panel was performed to discuss reflection about innovation for sustainability through innovation contests and funding opportunities was also addressed in a speech by Paula Mazzuccheli (CIRCE). After the presentations, the board of jury presented the outcome of the assessment, and the overall winners of the Innovation Challenge were announced.

The jury had reached the decision to declare two of the participants as runners up: BAC-TO-FUEL and NovelYeast.

Team NovelYeast

- Feedback from the jury:
  - Strengths: If the concept works it would solve an important problem. Good market potential. They used the challenge well. A good IP and cash flow strategy. Yeast engineering is important in many ways going forward.
  - Recommendations:
    Cardboard waste might be limited in availability. Too much optimism on the feedstock availability could be a big risk, it would be advisable to make the process more feedstock robust and identify competitive uses according to the cascading use and waste hierarchy. How will the tech progress in the TRL scale? Not clear why depending on industrial partners please develop that further.

Team BAC-TO-FUEL

- Feedback from the jury
  - Strengths: The flexibility of the business proposal, both ethanol, hydrogen and CCUS. Many relevant sectors and good understanding of market potential. Open spirit of the team. High novelty and innovative!
  - Recommendations:
    The technological aspects to produce the fuel is complex. Further work should consider technology integration it appears challenging. IP protection and cash flow needs to be carefully handled.

The winner of the SET4BIO Innovation Challenge with the motivation that the solution is a truly well set and innovative concept. Strong efficiency benefits (+20%) compared to competitors. Combining processes in a good and innovative way. Links both gas and power market. The concept has good flexibility and a clear description how it would work. Clear fit with the EU Energy System Integration Strategy.

Figure 9: The winners of SET4BIO Innovation Challenge 2021

The recommendations from the jury to bioCORE were that claims of benefits need to be proven, especially the cost efficiency. Additional extensive work is required on the proof of concept. Outsourcing strategy is not convincingly presented yet, and capital expenditures (CAPEX) can be challenging. How does the CAPEX and scale up develop over time for the team? It was suggested by the SET4BIO jury for the team to focus on upscaling and ensure CAPEX.

Diploma representing Seal of Excellence were distributed to the teams and this concluded the SET4BIO Innovation Challenge 2021.

4 Chapter 4 – Lessons Learned and Discussion

In this chapter, lessons learned for the different steps in designing and running the SET4BIO Innovation Challenge 2021 are provided. The lessons have been conceptualised and structured using parts of the framework adopted by the project to organize the challenge as a contest (Hjalmarsson et al. 2017). The used phases for analysis have been the stages in the pre-contest phase as well as the stages in the contest phase in the framework used. Further lessons will be presented in relation to the post-contest phase for SET4BIO innovation challenge as data about this stage is collected during the completion of D3.2.

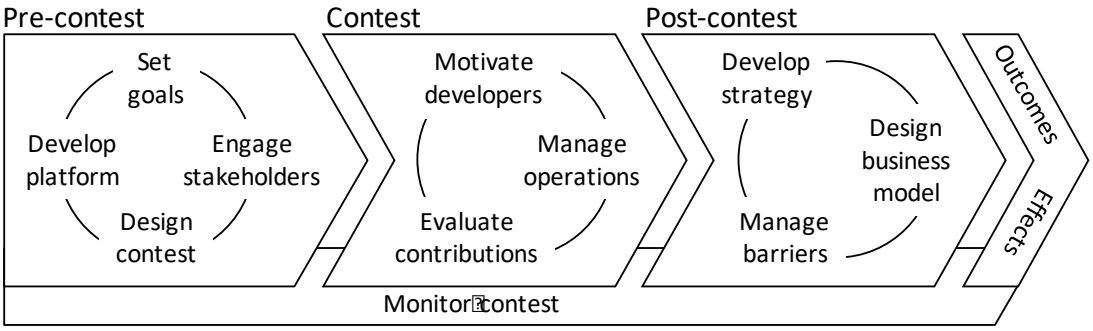


Figure 10 Framework used to analyse lessons learned from the SET4BIO Innovation Challenge (Hjalmarsson et al. 2017)

4.1 LESSONS LEARNED - DESIGNING SET4BIO INNOVATION CHALLENGE 2021

Hjalmarsson et al. (2017) propose that designing an innovation challenge prior to the contest should be focused on four iterative step that acts as guidelines for the organizing committee to develop a contest that meets the overall intended effects with the contest process. Key in the design is the setting of the goals for the contest which then could be used to frame the challenge and be used as keystone for support and assessment, both key components for operating any contest with an innovation theme.

4.1.1.1 Lessons learned in setting goals and engaging stakeholders

The primary lesson discovered in setting the goals for SET4BIO Innovation Challenges is the enormous value that the predefined value chains for bioenergy and renewable fuels, had for framing and defining the goals for this specific challenge. This conceptualised outline of the value chains, developed prior to the SET4BIO project, created a cornerstone for efficient design of the target area for the challenge. As this resource was in place and publicly accessible for the teams it created both a component to

1) communicate the purpose with the contest to teams, and hence make marketing and communication efficient to attract team,
2) systematically select the most appropriate teams to be admitted into the challenge.

Organizing the contest to create value to implement the value chain also made it efficient to mobilize and engage the network of engaged parties within the field of bioenergy and renewable fields as promotors for the challenge. This in turn supported preparation and marketing of the SET4BIO Innovation Challenge. The value chains acted as a key component on the arena to discuss and advance the bioenergy field, which supported the engagement of stakeholders to contribute to the challenge despite not being a formal partner in the SET4BIO project.

In a situation where a formalized framework of (for example) value chains do not exist, the lesson learned is that extensive preparation work prior to the contest must be done in order to formalize a conceptualised keystone for the challenge at hand. This to 1) anchor challenge objectives, 2) define intended effects with the challenge, and 3) also be able to use this as a base for communication and marketing.

4.1.1.2 Lessons learned regarding designing the contest

Can an innovation challenge be organized without a monetary prize for the winner? The SET4BIO Innovation Challenge 2021 shows that this is possible. The key to success here seems to be exclusiveness and accessibility to resources. If a challenge is organized without a monetary prize as a pull for participation, then acceptance to participate must be regarded as a prize for the participants. Through the acceleration component in SET4BIO, the admitted teams were able to advance their solutions with support from resources and knowledgable experts on a level, which was not accessible for solution providers outside the contest at a so low cost. Hence, organizing an innovation challenge does not require a monetary prize to attract participants, if participation can be framed as exclusive and provide values that exceeds the cost for participation. In the SET4BIO Innovation Challenge, this was created through the acceleration program, which was enhanced with the funding matching offer presented at each theme-based event. The selection for participation also enhanced the exclusiveness in participation and supported the organizing committee to ensure that the most promising teams received the resources and supporting values that were pooled to the Innovation Challenge. A Seal of Excellence to the final winner act as an adding incentive for participation, but the key pull for participation is the anticipated value for the teams in the half to a one-year acceleration phase.

In the SET4BIO Innovation Challenge 2021, this was conceptualised as follows; to selected innovators, the SET4BIO Innovation Challenge provides the following major opportunities:

- Engage innovators in developing innovative proposals for solutions that stimulate and increase the possibility of producing and using bioenergy and renewable fuels by also implementing the EU Green Deal vision.
- Accelerating the development of their solution via five virtual events.
- Assessing the solution with a final demonstration day.
- Match innovators with innovative solutions with potential funding opportunities.

An assumption to be tested in future challenges is to explore if it is even easier to attract more participants if a monetary prize could be awarded as a complementing pull. To achieve this, the funding sources of prize money need to be studied prior to contest launch, and the rule framework

governing the challenge must be developed and aligned with the regulation structures connected to the funding sources.

4.1.1.3 Lessons learned regarding developing a communication platform

If there is no interest from the potential entrants in the target area to participate, then an innovation contest such as the SET4BIO Innovation Challenge fails. A key lesson from the SET4BIO Innovation Challenge 2021 is that the communication platform benefits from being integrated as a part of a wider communication platform that address the topic that is in the focus for the Innovation Challenge. For SET4BIO this meant being a part of the ETIP Bioenergy communication platform, which enabled the challenge to be integrated in the resources, processes, and capabilities that over time has been developed to promote bioenergy and renewable fuels. An innovation challenge that does not have or receive such access need to develop a communication platform from zero both in terms of technology but also user network, which will require extensive funds and also the endurance to reach out to both stakeholders needed to deliver value in the challenge and potential entrants to attract to the challenge. A key lesson, for efficient communication and marketing on a budget, is hence to ensure that the innovation challenge is operationalized in an established platform for communication with strong connections to the topic in focus for the challenge.

4.2 LESSONS LEARNED - LAUNCHING SET4BIO INNOVATION CHALLENGE 2021

Launching the SET4BIO Innovation Challenge was performed as a roll-out process. In August 2020, the main design of the challenge was approved by the project management team. This design was in addition presented at the IWG8 work session in September 2020 with the purpose to both anchor the approach chosen and engage stakeholders to start marketing the official launch of the challenge in October 2020. This was followed up by a final decision to start recruiting teams to the challenge. A set of lessons learned regarding engaging stakeholders and selecting participants to be admitted to an innovation challenge has been identified.

4.2.1.1 Lessons learned in engaging stakeholders

The years 2020 and 2021 were dominated by COVID-19. The SET4BIO Innovation Challenge was originally designed as a staged innovation contest with both virtual online activities and on-site physical meetings. The outbreak of COVID-19 challenged and risked this whole design. A daring decision was made in August 2020 to run the challenge as scheduled despite COVID-19, but switched to a complete virtual setup. This was in August 2020 viewed as a risk for the challenge and the project, as physical on-site meeting was viewed by the organizing committee as an enabler for enrolment of teams as well as the success of individual events throughout the challenge. In retrospect, the experience shows that transforming the SET4BIO Innovation Challenge to a virtual format instead increased interest and participation from teams in the target area. The rationale here is that teams often have limited resources for travel and participation, often involve innovators distributed on multiple locations and entrepreneurs that are engaged in parallel initiatives. To run an innovation challenge digitally and via a virtual setup consequently lower the threshold for such teams to participate in a staged innovation challenge over time. This is an important lesson learned for future challenges, meaning that efforts and resources on venues and travel instead can be used to ensure participation of key experienced experts as board of mentors and members in assessment boards. Knowledge sharing is made efficient through a virtual collaboration arena, and through facilitated discussions using online meeting and conference functionality. Going digitally supports innovative teams to efficiently participate compared to an on-site arrangement.

4.2.1.2 *Lessons learned selecting participators*

As previously described, a key component in organizing an innovation challenge without a monetary prize, is to design the formal admittance to the challenge as a part of the challenge prize. This requires consequently that assessment is not only done to determine and rank the participants during the final stages of the contest. Assessment is also a key component in selecting the teams that should be allowed to enter the challenge. Lesson learned here is the importance to organize the entry process as an idea application task ,which is described in section "Participation Selection", structured through the formalized rules for participation that governs the complete challenge. This enables the organizing committee to assess the idea from a set of enrolment criteria supporting the judgment of both acceptance of entrants and rejection of teams that to some extent or not meets the enrolment criteria. Secondly, an important lesson here is to have in place an efficient process to assess, decide and communicate the participation selection outcome. The rationale here is that the time between submitting a proposal to the challenge and releasement of the accept or reject decision has from an organizing committee perspective several risks. First, there is a risk that the potential entrants are engaged in other supporting activities and despite acceptance chose to decline participation. Secondly, this phase is the first impression that the participating teams get of the innovation challenge. Their first impression of the challenge will affect their level of activity in the first events, if they are admitted to the challenge. An efficient and well-prepared execution of participation selection as well as the kick-off will define the overall tone for the first phases in the innovation challenge and have a direct effect on the prioritization that the participating teams make in order to complete the assignments that drives that challenge. This in turn will have an impact on the quality of output and the level of progress the teams will reach through the acceleration phase.

4.3 LESSONS LEARNED - RUNNING SET4BIO INNOVATION CHALLENGE 2021

The SET4BIO Innovation Challenge took place from April 2021 to January 2022. It engaged seven teams from a total 13 submitted proposals. An innovation challenge that is staged and is operated over time requires both activities to motivate continual participation and actions to manage operations from start to end. A set of lessons learned has been identified in relation to this phase.

4.3.1.1 *Lessons learned in motivate participants*

Key motivation for continual participation in a staged innovation challenge is based on 1) the teams' appreciation of the values that they receive throughout the acceleration phase of the challenge 2) the perceived value of the assessment of the final contributions that they will submit.

Lessons learned in respect to values throughout challenge is the importance of an explicit structure for the events that act as a backbone for the challenge. In the SET4BIO Innovation Challenge, the first event focused on the 6+2 value chains to which the innovators should add value through their solutions. This event was both viewed as the single most important event by the participating teams and the most difficult to prepare. Most of the teams had developed their solution with no formal prior connection to the value chains. The challenge for them was to understand and incorporate their solutions in the logic of the value chains. Since prominent representatives for the value chains contributed in the first event, this motivated the participants to explicitly connect their solutions to the value-chains and in a constructive climate discuss strengths and weaknesses with their solutions in respect to the value chains.

To be able to motivate participants in an innovation challenge over time, it is important to staff supporting events with acknowledge advocators and experts that attract and stimulate

participating teams to contribute. It is in the crossover between the participating team's contribution and the participating experts' feedback on that contribution that incentive over time is formed for team to participate. The lesson is that the advertisement of specific advocators participation during the challenge will most certainly increase the likeliness of a high number of submitted proposals with high initial quality, as well as engaged team participation throughout the challenge. The value is created in the access for the participating teams to collaborated with the knowledgeable advocators and experts. An access that is not possible if they are not a part of the innovation challenge.

4.3.1.2 Lessons learned manage operations

The SET4BIO Innovation Challenge anno 2021 followed an event-driven approach. Each of the four core events in the challenge consisted of pre-event as well as post-event activities. Each event followed a four-week cycle and was structured following a generic event model developed within WP3 for the SET4BIO Innovation Challenge, see figure 11.

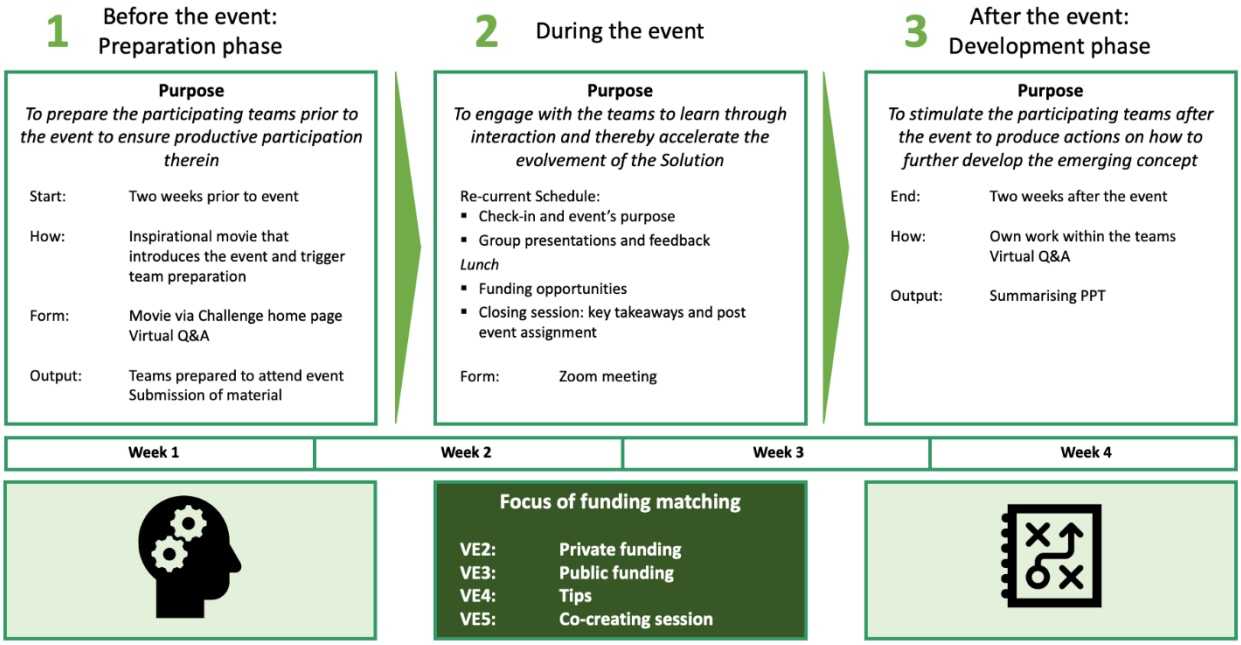
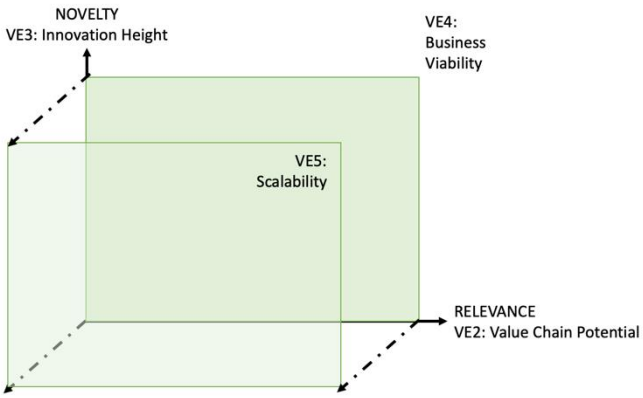


Figure 11 The generic event model applied

Two weeks prior to the event, the participating teams were requested to prepare input to the event. The purpose was to prepare the participating teams prior to the event to ensure productive participation therein. This was triggered by an inspirational movie, access to a toolbox, or the announcement of a participating expert, together with instructions to the team how to prepare. A virtual Q&A was provided to support the team during the two-week preparation phase. Each event involved a board of mentors that was be engaged based on their expertise related to the specific theme for the event. The board of mentors consisted of three to six mentors, and most of them only participated in one or two events as they were engaged based on their expertise on a specific topic. The head of the board of mentors, Patrik Klintbom, was a regular participant on the board and attended all events with the specific objective to create a red thread between the events in terms of the gradual assessment of the teams. The logic between the events was that the first one, after the kick-off, focused on the relevance that the proposed concept has in relation to the prioritized value chains that constitute the scope for the challenge. The events thereafter aimed to stimulate innovation height in the solution, followed by business viability and scalability.

Utilizing these criteria, it was then possible to place the different contributions within the challenge "box" (see below) to differentiate them and also rank them. It will also be possible to trace how the contributions evolve over time, which is a key lesson to be able to manage the challenge as an operation.

Initially it was planned that each of the teams was invited to present individually to the board of mentors while the other teams are waiting in the lobby. An ongoing-assessment was performed to investigate both the teams view of the challenge structure and also the interest and possibility to alter to a presentation with the other teams as audience to facilitate cross-team learning and contribution. The teams favoured this model already from the beginning of the challenge, which resulted in that the planned model of individually presentation before the board of mentors was changed to an open session.



The open presentation by the team was followed by questions from the board based on the submitted material as well as the presentation given. The board of mentors ranked the contributions provided by the teams during an individual session done in parallel to the funding opportunity activity that followed the acceleration session. The ranking was not communicated to the teams between the sessions, only implicitly through general and specific feedback on their solutions. The decision to not have an open leader board was based on a mindful decision to downplay the contest mode in the challenge and instead promote sharing, constructive feedback and learning cross-teams. Each event was instead closed by key takeaways from the day and information what will happen after the event. The lesson here is that challenges over time can be designed as a contest-driven sharing and learning process and not purely has to be developed as a contest to drive acceleration and progress.

The individual events were each followed by a post-event phase with the purpose to stimulate the participants to organize actions that enabled them to develop their contributions further based on the feedback provided during the events and through the tools and knowledge acquired. This work was be stimulated through written comments from the board of mentors to each team, summarizing the feedback, as well as the provision of links and open resources related to the methods and tools introduced prior to and during the specific event. Midterm interviews with each team was also conducted to assess the challenge process based on the participants viewpoints and incorporated in the evolving design of the challenge scheme.

4.3.1.3 Lessons learned in regard to the evaluation of the final contributions

The teams participated in the SET4BIO Innovation Challenge were evaluated by a prominent jury prior to the final event, which was composed of representatives of organisers and stakeholders of the challenge. The jury evaluated the concepts based on the criteria presented in section "Virtual event 6: Final" in this report. In addition, a more formal sequence of the challenge and important lesson learned was to develop and facilitate a virtual and distributed evaluation process with high level of efficiency. The members of the jury were distributed cross Europe and New Zeeland, which required the organizing committee to construct a virtual based assessment tool and linked

it to a facilitated process to coordinate the evaluation work done by the jury individually. The tool both distributed the team contributions and facilitated ranking of the contributions given the criteria for the contest. The tool is developed to be generic and can be used in future challenges when the scheme for SET4BIO Innovation Challenge 2021 is reused for future instalments.

4.4 SET4BIO INNOVATION CHALLENGE 2021: PROJECTED EFFECTS AND ACHIEVED IMPACT

The SET4BIO Innovation Challenge 2021 was both a success in terms of a generic scheme developed and as a specific innovation challenge. In respect to the latter, the challenge accelerated seven participating teams to develop their solutions and contribute to the increase the possibility of producing and using bioenergy and renewable fuels by also implementing the EU Green Deal vision.

It also showcased the possibilities with the contest-format as organizing mechanism to promote and advance innovation within Europe cross-nations. The project thus not only deliver a successful instalment of an innovation challenge, but also provide key resources to reuse when the format is repeated to promote bioenergy but also other initiatives in EU's Green Deal vision.

5 Chapter 5 – Final notes

This report provides an account of the instalment of the SET4BIO Innovation Challenge anno 2021, from early development and design to the final assessment and last assessment. It serves as a continued display of the architecture of the SET4BIO Innovation Challenge anno 2021 and is presented as a repeatable model to be re-used to further mobilise support the implementation of the SET Plan Action 8 – Renewable Fuels and Bioenergy in Europe. For preparing this report, the following deliverable/s have been taken into consideration. D3.1 "Innovation Challenge in SET4BIO" provide an account of the design and launch of the challenge and D3.4 "Identification of topics for SET4BIO Innovation Challenge" provide an in-depth account of the process to design the specific topic for the first instalment of the challenge, and thus a more detailed description of the process to set the goals for the challenge.

D#	Deliverable title	Lead Beneficiary	Type	Dissemination level	Due date (in MM)
D3.1	Innovation Challenge in SET4BIO	RISE	Report	Public	M24
D3.4	Identification of topics for SET4BIO Innovation Challenge	RISE	Report	Public	M12

6 References

Hjalmarsson, A., Juell-Skielse, G., Johannesson, P. (2017): Open Digital Innovation: A Contest Driven Approach. Springer-Verlag, Berlin Heidelberg, Germany.