

NanoFabNet

international Hub for sustainable
industrial-scale Nanofabrication

NanoFabNet Implementation Roadmap for EU-Project Collaboration





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Acronyms Listed in Document	
CEN	European Committee for Standardisation
CSA	Coordination and Support Action
DW	Development Workshop
EC	European Commission
INISS-nano	International Network Initiative on Safe & Sustainable Nanotechnology
ISO	International Organisation for Standardisation
LCA	Life Cycle Assessment
NM	Nanomaterial
NSC	NanoSafetyCluster
OECD	Organisation for Economic Co-operation and Development
P2Ps	Public-to-Public Partnerships
PPPs	Public-Private-Partnerships
RGC	Risk Gouvernance Council
RRI	Responsible Research & Innovation
SDG	Sustainable Development Goal
SOP	Standard Operating Procedure
WP	Work Package

1. Foreword

The *NanoFabNet* Project aims to set up a self-sustaining once-stop-shop for all matters and concerns pertaining to sustainable nanofabrication and its successful incorporation into the complex, large-scale high-value industries by bringing together governmental and academic laboratories with large industries and SMEs, and thereby offering a coordination space for past, current and future collaborative nanofabrication projects (incl. both EU-funded projects and initiatives, as well as public-to-public partnerships (P2Ps) and public-private-partnerships (PPPs)): the *NanoFabNet* Hub.

The *NanoFabNet* ultimately aims to become an international hub for sustainable nanofabrication whose structure, business model, detailed strategies and actions plans are designed, agreed and carried by its partners and stakeholders. The *NanoFabNet* Hub is a virtual collaboration space, and will be a self-sustained platform that aids any interested actor or stakeholder in accessing expert knowledge about ethical, safe and sustainable nanofabrication. Moreover, a registered *NanoFabNet* secretariat at the centre of the Hub will provide an accountable executive that secures its economic sustainability.

The digital platform itself of the *NanoFabNet* Hub will be hosted on *NanoFabNet*'s website¹ and is an important tool for nanotechnology professionals and entities.

The *NanoFabNet* Hub envisages to stand for:

- i. a well implemented, guided approach to high levels of safety and sustainability,
- ii. trusted technical reliability and quality, and
- iii. compliance with and drive of harmonisation, standardisation and regulation requirements, amongst all of its members as well as along their nanofabrication value chains.

The Hub is envisaged to be an open structure and the elements, which it will deal with, will be developed, agreed and validated by its members and stakeholders. Therefore, already during the *NanoFabNet* Project lifetime, continuous consultations have been conducted by engaging with the *NanoFabNet* stakeholders, and the resulting feedback and responses have been used to make sure that the value the Hub will create is stakeholder-driven and focused. This will ensure the foundation for an increased identification of the members and stakeholders with the *NanoFabNet* brand and the Hub itself, supporting the need and importance of the existence of such a Hub, as well as its activities, information and services.

The official online launch of the *NanoFabNet* Hub will occur in 2022.

2. Purpose of the *NanoFabNet* Implementation Roadmap for EU-Project Collaboration.

2.1 Purpose

The '*NanoFabNet Implementation Roadmap for EU-Project Collaboration*' is framed within WP3 – *Development, Incorporation & Optimisation of NanoFabNet*, of the *NanoFabNet* Project. The main goal of WP3 is to gather, grow and nurture an initial loose group of stakeholders into a formally registered organisation, defined and carried on by its stakeholders. The establishment of the 5-Year-Strategy of the *NanoFabNet* Hub is one of the main activities to be done within this WP. The 5-Year-Strategy of the Hub will be composed by 6 implementation roadmaps or action plans: i) the *NanoFabNet* Strategy & Implementation Roadmap for sustainability in Nanofabrication, ii) the *NanoFabNet* Validation, Harmonisation & Standardisation Action Plan, iii) the *NanoFabNet* Strategy & Implementation Roadmap on Infrastructures, Knowledge & Skills Development, iv) the *NanoFabNet* Communication &

¹ *NanoFabNet* website: <https://www.nanofabnet.net/>.

Visibility Strategy, v) the *NanoFabNet* Implementation Roadmap for EU-Project Collaboration, and vi) the *NanoFabNet* Implementation Roadmap for International Cooperation.

Some of the information on which this report builds is already contained or related to other deliverables of the *NanoFabNet* Project. Specifically, some of the information of the following deliverables have been used for this report:

- Deliverable 1.1 - Methodology for Stakeholders' Identification & Profiling
- Deliverable 2.1 –Report on the Concepts and Disciplines of Sustainability in Nanotechnology & Nanofabrication
- Deliverable 3.1 – *NanoFabNet*'s 1st Development Workshop
- Deliverable 3.2 – *NanoFabNet*'s 2nd Development Workshop
- Deliverable 4.1 - Report on the Challenges & Opportunities in the Validation, Harmonisation & Standardisation of industrial-scale nanofabrication

2.2 Expected Impact

As a part of the *NanoFabNet*'s 5-Year-Strategy, this report contributes that the *NanoFabNet* Hub can offer its stakeholders and members a clear landscape about the current EU-funded projects that deal with the field of nanofabrication and nanotechnology sustainability, as well as establish a set of activities that will help and support the collaboration among EU-funded projects, in the field of sustainable nanofabrication. Through an active dialogue with and consultation of the stakeholders about their expectations and needs in this field, the *NanoFabNet* team has received valuable information about the challenges and barriers pertaining to sustainable nanofabrication, as well as suggestions about potential actions or activities that the Hub could offer to help the stakeholders to overcome those.

This report will specifically highlight actions and challenges to be overcome to increase collaborations between EU-funded projects as a means of addressing the challenges and opportunities and developing the corresponding actions by the *NanoFabNet* Hub; the resulting roadmap is intended to define the current landscape of EU-funded projects and define actions that the stakeholders have identified as useful to enhance and improve the collaborations among the EU-funded projects in the field of sustainable nanofabrication.

The digital platform of the *NanoFabNet* Hub itself will be the tool that will provide support to the different stakeholders for their on-going and future collaborations between EU-funded projects. It will ensure that a network of existing EU-funded projects concerned and/or focused on sustainable nanotechnology and nanofabrication will be established, which will solve common issues in the most efficient manner, strengthening the Research & Innovation (R&I) capacity of Europe in this sector, by cross-fertilisation of projects outcomes, tools and strategies.

It is expected that until the end of the *NanoFabNet* Project, some cross-project collaborations between EU-funded projects will rise; these collaborations could then be traced back to their connection through the *NanoFabNet* community due to specific activities undergone by this. This list of collaborations will go on to inform the community after the end of the Project and will surely grow once the *NanoFabNet* Hub is officially launched and established.

3. Roadmap Overview & Methodology

3.1 Roadmap Overview

The *NanoFabNet* Implementation Roadmap for EU-project collaboration seeks to inspire as well as provide help to EU-funded projects dealing with sustainable nanofabrication.

The roadmap includes a series of core components to advance its goal in a meaningful way (see Figure 1):

- State a clear **vision** of what *NanoFabNet* aims to achieve in relation to EU-project collaboration
- **to establish a mapping of the current landscape of EU-projects** dealing with sustainable nanotechnology and nanofabrication, as a departing point
- to establish an **active dialogue with *NanoFabNet*'s stakeholders and analyse their feedback** about which are their needs, challenges or barriers, when talking about EU-project collaboration in the field of sustainable nanofabrication, and
- **to identify activities and actions**, by which the *NanoFabNet* Hub will help the stakeholders to improve their collaboration with EU-funded projects, so that the most significant impact of those is achieved and also by unlocking and overcoming the challenges that those projects face.

Central to the effectiveness of a process like this, are the efforts to advance its key enablers:

- **Partnerships & Collaborations:** these are critical to unlocking the full potential of any EU-funded project. New and innovative collaborative models must be identified to bring together or put in contact different EU-projects alongside other stakeholders like industry, policy makers and civil society, incl:
 - the development and advancement of an EU-funded project implementation roadmap, related parties need to explore: cross-project visions, opportunities and challenges, pooling knowledge and resources and be able to co-create new ones.
- **Data & Knowledge Generation:** obtaining access to reliable and timely data or state-of-the-art knowledge is a key component to successfully achieve the aims and goals of any research and innovation (R&I) project. Data is needed to understand the starting point of any project. In all likelihood, the data or knowledge a project requires may not exist for all targets and indicators, and - even when it does exist - it may exist in varying levels of quality and accessibility. This must be addressed through actions related to capacity building and by enabling channels of data-exchange between projects, such as envisaged by the GO FAIR-initiative².
- **Innovation:** many times, the solutions or needs related to sustainable nanofabrication may either not yet exist or be in very early stages of development. In part, the technological innovation and the scaling up of new processes and/ or products continuously arise from R&I projects and is transforming and advancing the field of sustainable nanofabrication. Therefore, supporting the innovation capacity of the EU-funded projects through enhancing and facilitating collaboration among them is crucial to move forward in the right direction and timely manner. This will help to put Europe in an advanced position in the field of sustainable nanofabrication.

² GO FAIR: <https://www.go-fair.org/fair-principles/>

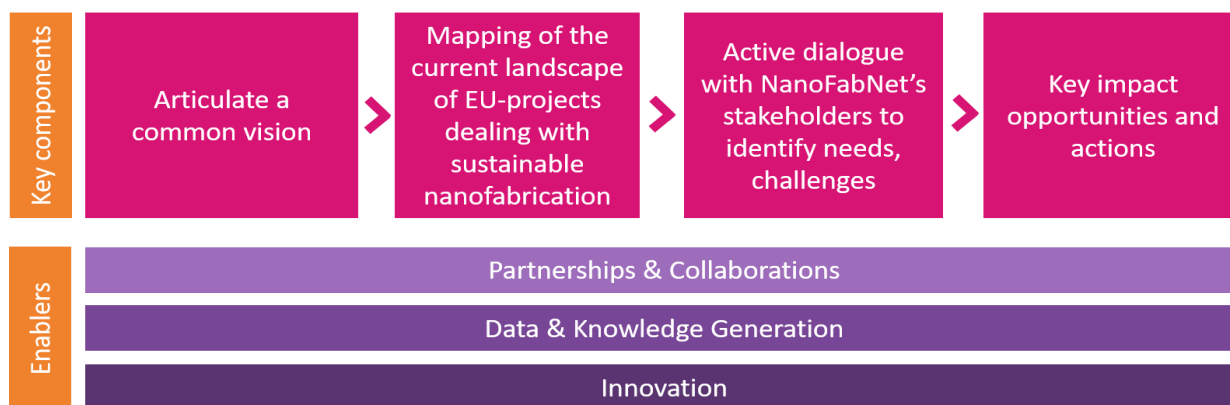


Figure 1: Key components and enablers of the *NanoFabNet* Implementation Roadmap for EU-project collaboration.

3.2 Methodology

The *NanoFabNet* Implementation Roadmap for EU-project collaboration has been created using information that has been gathered through different activities performed within the *NanoFabNet* Project, like:

- **Mapping** and listing of former and current **EU-funded projects relevant for the sustainable nanofabrication field**,
- **Active dialogue with *NanoFabNet*'s stakeholders** maintained during the 1st and 2nd DWs, including a posterior analysis from the feedback,
- **Integration of complementary actions planned and/or undergone with other R&I initiatives** like the NanoSafety Cluster³ (NSC), the EURONanoLAB initiative⁴ and EURAMET⁵, to develop collaborations to widen and strengthen the sustainable nanofabrication field across Europe.

4. Articulating a common vision.

The *NanoFabNet* Project, on behalf of the future *NanoFabNet* Hub is seeking the views of its stakeholders about challenges, synergies and cross-fertilisation between the fields of nanotechnology and sustainability with the aim of ***identifying opportunities for added value at the level of EU-project collaboration, that will help on solving and overcoming the barriers and challenges without unnecessary duplicity of efforts.*** By doing so, the *NanoFabNet* Hub aims to ***make more effective use of current resources and knowledge and create the best ecosystem for projects dealing with sustainable nanofabrication.***

In order to explain which have been the boundaries used and considered to map the current landscape of EU-projects dealing with sustainable nanotechnology and nanofabrication (see Section 5) a brief introduction of *NanoFabNet* own concept of Sustainable Nanofabrication is provided below to the reader. (More detailed information about this concept can be consulted at the *NanoFabNet* Project Deliverable 2.1 – Report on the Concepts and Disciplines of Sustainability in Nanotechnology & Nanofabrication).

³ NanoSafety Cluster: <https://www.nanosafetycluster.eu/>

⁴ EURONanoLAB: <http://euronanolab.eu/>

⁵ EURAMET: <https://www.euramet.org/>

4.1 The *NanoFabNet* Concept of Sustainable Nanofabrication⁶.

Within The European Green Deal⁷, the EC aims to transform the European Union's economy for a more sustainable future and to implement the United Nation's 2030 Agenda and the Sustainable Development Goals (SDGs). At present, however, the concept of sustainability is not so well defined. New policy proposals seek gradually bring clarity to the definition of sustainability (*Van Humbeeck, 2021*).

The *NanoFabNet* Project has defined its own concept of Sustainability in Nanotechnology and Nanofabrication⁹, that will be also adopted and promoted within the *NanoFabNet* Hub. This concept rests on 3 strong and well-identified pillars (see Figure 2: *The three pillars of the NanoFabNet Project concept of Sustainable Nanofabrication*).

These pillars are:

- i) Environment, Health & Safety issues in Nanotechnology & Nanofabrication,
- ii) Life Cycle Sustainability (LCA) in Nanotechnology & Nanofabrication, and
- iii) Ethics and Governance issues in Nanotechnology & Nanofabrication.

4.1.1 *Pillar 1 - Environment, Health & Safety issues in Nanotechnology & Nanofabrication?*

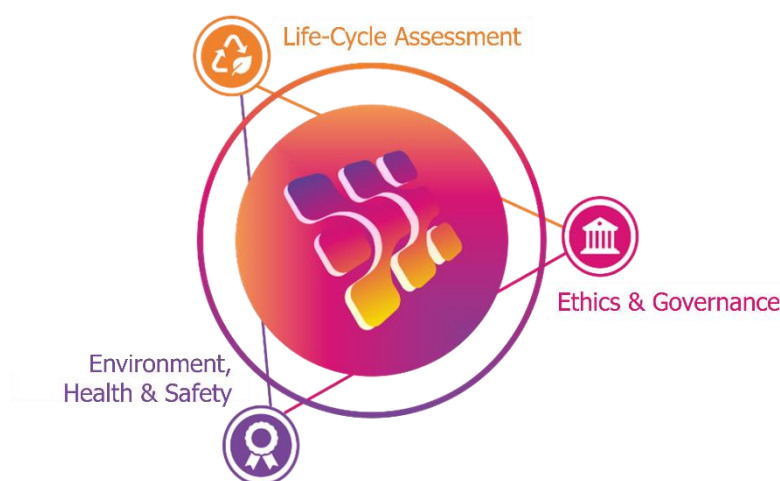


Figure 2: The three pillars of the *NanoFabNet* Project concept of Sustainable Nanofabrication.

Due to the rapid increase of new technology developments using engineered nanomaterials (NMs), safety aspects must be fully understood and addressed to ensure that a new technology is not only safe in itself but also offers substantial improvement to human health and environment protection, while still remaining competitive (*Savolainen K. 2013*). More specifically, the nanotechnology field is assisting to a rapid shift from first (passive nanostructures), second (products containing active

nanostructures), third (integrated nano-systems) to fourth generation of nano-devices (heterogeneous molecular nano-systems that allow the manufacture of molecular devices “by-design”). This fast evolution makes even more complex the task of guarantying the safety as well as improvement to human health and protection of the environment.

The ultimate goal of the scientists addressing the safety of NMs in their research is to assure: i) the safety of the handling of these NMs, ii) the manufacture of products incorporating NMs, iii) their safe use by the final user, and iv) their disposal (i.e. safety throughout their entire life cycle).

⁶ NanoFabNet Project Deliverable 2.1 – Report on the Concepts and Disciplines of Sustainability in Nanotechnology & Nanofabrication.

⁷ The European Green Deal. https://ec.europa.eu/info/publications/communication-european-green-deal_en

Another important issue that needs to be approached and considered is the need of collaborations, with organisations like the Organisation for Economic Co-operation and Development⁸ (OECD), the International Organisation for Standardisation⁹ (ISO) and the European Committee for Standardisation¹⁰ (CEN), in order to be able to provide harmonised and standardised protocols and tools for each phase of the safety assessment.

Last but not least, when analysing this pillar, it becomes clear with the above-mentioned points that the public acceptance towards the development and consequent use of nano-enabled products would increase if manufacturers could demonstrate their safety. This would happen naturally, if regulatory bodies could guide NM manufacturers by providing them with clear and harmonised regulations, and if consumers perceived the product as “safe” (i.e. implicitly referring to a compromise between risks and benefits of related products).

4.1.2 Pillar 2 - Life Cycle Sustainability in Nanotechnology & Nanofabrication?

Besides the importance of the concept of safety, there are many nanotechnology stakeholders (e.g. policy makers, funding agencies, consumers or investors) pushing towards to apply the concept of “sustainable innovation” during the process of development of new solutions/products/processes in the nanotechnology field. The term of sustainability in this context usually refers to a certain long-term balance that needs to be accomplished to ensure the capacity for human civilisation and the biosphere to co-exist.

4.1.3 Pillar 3 - Ethics and Governance issues in Nanotechnology & Nanofabrication?

Nanotechnology offers revolutionary promises to very different fields (e.g. health, human-wellbeing, environmental enhancement and impact) like has never been the case before. This has led social expectations associated with nanotechnology to shape the public debate about it, and has in some cases, aroused strong social opposition, due to concerns about issues like privacy, autonomy, social divide, human enhancement. On the contrary, the nanotechnology and sustainable nanofabrication fields are themselves more concerned about complex governance and regulation issues, due to the impact those could have on promoting both, their economic development and their safety and sustainability.

This pillar takes into account the understanding of ethics and governance issues in nanotechnology and nanofabrication; a detailed description of the related concepts and tools can be found in the ‘*Report on the Concepts and Disciplines of Sustainability in Nanotechnology & Nanofabrication*’ of the *NanoFabNet* Project.⁹ Among the different terms defined in the latter, one very important one to be considered and highlighted when talking about R&I projects, is the concept of “Responsible Research & Innovation” (RRI). This term is used by the European Union's Framework Programmes to describe the kind of scientific research and technological development process they want to promote and ensure within the EU. RRI is an approach that anticipates and assesses potential implications and societal expectations with regard to research and innovation, with the aim to foster the design of inclusive and sustainable research and innovation.¹¹ By integrating and considering the RRI concept within the *NanoFabNet* concept of sustainable nanofabrication, it will be ensured that (representatives of) all impacted societal actors (i.e. researchers, citizens, policy makers, business, third sector organisations) have opportunities to contribute to the R&I process underpinning

⁸ Organisation for Economic Co-operation and Development (OECD); (<https://www.oecd.org/about>)

⁹ International Organisation for Standardisation (ISO); (<https://www.iso.org/home.html>)

¹⁰ European Committee for Standardisation (CEN); (<https://www.cencenelec.eu>)

¹¹ EU Responsible Research & Innovation (<https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation>; accessed: 25th June 2021).

sustainable nanofabrication, and that both the process and its outcomes of the R&I process will be better aligned, with the values, needs and expectations that society has with regard to the field of nanotechnology and nanofabrication.

Another important concept that must be considered in this pillar are the Sustainable Development Goals (SDGs) since nanotechnology is associated with the SDGs as a key enabling technology (KET) that is able to contribute significantly to achieve them.

Finally, nanotechnology crosses many areas, disciplines and responsibilities, so it is not unexpected that the governance of nanotechnology extends to many levels, and incorporates many different actors from supranational arenas (like the EU or the OECD), as well as national governments, and companies, research institutes, financial bodies, to name but a few of the many nanotechnology expert stakeholders. Important nanotechnology governance questions are related to the concern about funding, knowledge transfer, regulation (in particular soft regulation), but also transparency, responsibility and trust. Early public engagement, participatory and deliberative democracy are therefore important features of nanotechnology governance. One way to help achieve a level of reliable governance that find wide-spread acceptance, is the early and participatory public engagement through their participation in EU-funded projects.

5. Mapping of the current Landscape of EU-funded Projects related to Sustainability in Nanotechnology and Nanofabrication

In order for Europe to build a sustainable, fair and more resilient place and consolidate its global leadership in human-centred innovation and sustainable solutions, Europe needs a strong research, education and innovation foundation, grounded in scientific excellence and competitive innovation policies for European citizens and businesses. Its future prosperity and well-being will largely depend on it. The COVID-19-pandemic and its consequences are highlighting the importance for Europe and the world to be better prepared for and more resilient to systemic shocks, and for Europe to reinforce its open strategic autonomy¹² and its internal cohesion. The EU has stepped up to these challenges and is using the *momentum* to accelerate the twin green and digital transitions and associated transformation of its economy, industry and society. Like this, Europe will be able to come up with answers to challenges that tested in recent years the core values and principles of the EU as a community.¹³

The three pillars that are considered under the *NanoFabNet* concept of sustainable nanofabrication,⁹ briefly introduced in Section 4.1, are the overarching concepts that encompasses the mapping of EU-funded projects undergone within the *NanoFabNet* Project. The analysis performed resulted in a tremendous number of projects that in one or another form are related to the field of sustainable nanotechnology and nanofabrication (the full list of EU-funded projects can be found and consulted through the EC CORDIS database¹⁴). This document specifically lists and mention only some groups of projects that have been considered of highest relevance. It is a non-exhaustive list (see ANNEX – A1: Non-exhaustive list of EU-funded projects related to the field of sustainable nanofabrication) considering the high number of EU-funded projects that directly or indirectly tag issues related to sustainability and nanotechnology.

The current mapping of EU-funded projects that are concerned with aspects related to sustainable nanofabrication shapes a landscape in which some of the projects may only contribute to one of the pillars of *NanoFabNet* sustainable nanofabrication concept, or may contribute to two or even all three

¹² Open strategic autonomy' refers to the term 'strategic autonomy while preserving an open economy', as reflected in the conclusions of the European Council 1 – 2 October 2020.

¹³ [Horizon Europe Strategic Plan \(2021 – 2024\)](#)

¹⁴ EU CORDIS website (<https://cordis.europa.eu/>; accessed: June 2021)

pillars of the concept. The mapping has brought together 54 EU-funded projects, most of them funded under the past H2020 EU Work Programme (2014-2020), and which are currently still running and under development. This non-exhaustive list will, of course, be expanded and more projects studying different aspects related to sustainable nanofabrication will be identified and added to the mapping in the coming months within the *NanoFabNet* Project.

Within the current landscape it can already be seen that there is a significant number of EU-funded projects that are contributing actively to provide new knowledge that will have an impact on one or more of the three pillars of the *NanoFabNet* concept of sustainability in nanotechnology and nanofabrication (see ANNEX – A1: Non-exhaustive list of EU-funded projects related to the field of sustainable nanofabrication).

6. Active Dialogue with *NanoFabNet* Stakeholders to identify Needs and Challenges

One of the first steps of the *NanoFabNet* Project at its start, was the selection of an initial list of appropriate stakeholders that could contribute to the creation of the Hub.¹⁵ This initial list has been gradually growing and *NanoFabNet* is since then continuously engaging its stakeholders, in order to obtain their guidance and feedback about specific themes concerning the Hub; the Project consequently aligns the design of the activities of the future Hub.

The *NanoFabNet* stakeholders have participated actively in the two *NanoFabNet* Development Workshops (DWs), which the Project organised, since its start, in March 2020. Those DWs together with other complementary activities (e.g. surveys sent to the community asking for feedback regarding specific issues) have permitted the Project to move on in the creation and development of the design of the *NanoFabNet* Hub.

In order to organise the DWs, the *NanoFabNet* consortium conducted the following steps:

- i. Identification of an initial core of stakeholders right at the beginning of the Project,
- ii. Invitation of the stakeholders to the 1st DW and presentation of the *NanoFabNet* Hub concept,
- iii. Expansion of the initial stakeholder's list during the first year of the Project, and
- iv. Invitation of the expanded list of stakeholders to the 2nd DW and presentation of work and results achieved during the first year of the Project.

ANNEX – A2: Fact Sheet of the 2nd *NanoFabNet* Development Workshop – Some Figures and Highlights presents some of the key information that was gathered from the dialogue with the *NanoFabNet* stakeholders and that the *NanoFabNet* team has analysed. The outcome of this has helped to define the actions that the Hub could implement in order to maximise and improve EU-funded project collaboration in the field of sustainable nanofabrication, described in the Section 7.

7. Key Impact Opportunities and Actions

Successful collaboration implementation among EU-funded projects is often a big issue, and for many different reasons. Collaboration plays a big part in the success of any project, not only within the different project partners but also with external actors or stakeholders. The EU is searching for solutions to help increase efficient and effective communication among EU-funded projects. The projects themselves seek ways of being aware about what is being developed in other projects, that

¹⁵ *NanoFabNet*'s project Deliverable 1.1 - Methodology for Stakeholders' Identification & Profiling (CO).

could be complementary, synergistic or an enabler for themselves, without disclosing sensitive information detrimental to further exploitation of results.

As collaboration can mean many different things, the first step in any successful collaboration strategy is to define the exact problem that collaboration is supposed to solve and the second step is to agree on how to will implement the agreed collaboration in a successful manner. Therefore, in this case, a shared understanding about EU-funded project collaboration needs to be agreed.

To the question of ‘*What does successful collaboration looks like?*’ there is no silver bullet, no right or wrong, and certainly no “one-size-fits-all” answer to this question. Coming to a shared understanding is often an iterative process that comes about through the sharing of ideas and talking things through. Every EU-funded project, or even single participants of those, might see collaborations differently, and every single case could have different goals on how to implement this collaboration. In some cases, it can be understood as the sharing of results among different projects, without creating competition among them and avoiding duplicity of efforts. For others, collaboration among EU-funded projects might imply activities to identify topics or specific fields where further research is still needed. This shall lead, in some occasions, to the design and creation of new funding schemes that helps to develop further the identified topics. In many cases, collaboration among EU-funded projects happens when efforts coming from different EU-funded projects join to solve questions around a specific topic. The active participation of the different kind of stakeholders in different EU-funded projects can also lead to new collaborations, in the future, through the design and creation of new projects (e.g. after exchanging knowledge around a common topic or goal in a workshop).

In order to improve the collaborations between EU-funded projects, in the field of sustainable nanofabrication, the *NanoFabNet* has identified a list of goals, activities and actions, that will be implemented and carried out through the *NanoFabNet* Hub. The expected outcomes of the different actions might help the community to overcome identified challenges to meet the goals.

GOAL 1. Increase the productivity of EU-funded projects

There is currently lots of information (e.g. reports, documents, data) produced by the different EU-funded projects which is available in too many different repositories, databases and/or webpages. This makes it hard to find and digest the needed information for most players. While information is often available, the waste of time to gather all the information to know the ecosystem and activities in a certain field, is still a fact. To increase the overall productivity of the EU-funded projects related to the sustainable nanofabrication field, the *NanoFabNet* will establish a framework that might help the projects to align certain project tasks or activities. To do so, the following challenges need to be addressed:

To get access to easy and organised information about EU-funded projects (e.g. project start and ending dates, partners, main aim, expected outcomes, results), including specific capabilities and/or expertise resulting from the different projects.

- **Specific action:** the *NanoFabNet* digital platform will create a repository of EU-funded projects related to the sustainable nanofabrication field, that will contain all relevant information about the EU-funded projects included in it.
- **Outcome:** The user will save time when searching for information that might help him to know about the existing of other EU-funded projects, as well as to establish the best channel to contact with them.

To get access to a centralised place where everyone involved in any EU-project can talk about its project, share ideas and/or update other projects on specific progress achieved within a given EU-funded project.

- **Specific action:** The *NanoFabNet* digital platform will create a dedicated space on the portal that will permit networking and exchange of information between the users.
- **Outcome:** The *NanoFabNet* Hub will allow EU-funded projects to communicate and work together digitally. This will help rise new opportunities of collaboration among the different stakeholders, no matters which type (industry, academy, civil groups, associations, etc). Moreover, it will permit cutting down the number of resources, or by profiting them the best.

To be able to connect to experts of the sustainable nanofabrication field and related topics.

- **Specific action:** Organisation of webinars and/or workshops centred to share good practices and state-of-the-art knowledge in the field of sustainable nanofabrication.
- **Outcome:** The webinars/workshops will provide access to experts, as well as state-of-the-art information related to the three pillars mentioned in Section 4.1. This will enable participants of EU-funded projects to save time when they look for experts or good practices that could support or help them to solve some of the challenges they face in their day-by-day work.

To get access to an updated repository of research infrastructures related to the sustainable nanofabrication field.

- **Specific action:** The *NanoFabNet* digital Hub will create a repository of research infrastructures involved in the sustainable nanofabrication field. It will contain all relevant information about those research infrastructures (capabilities, type of services, type of equipment, etc.).
- **Outcome:** This repository of sustainable nanofabrication related research infrastructures will permit the user to save time and gain confidence when looking for the right research infrastructure it might need to perform a specific activity in an EU-funded project.

GOAL 2. Adequate financing programs

The challenges tagging sustainable nanofabrication issues are complex and interconnect different type of fields. In most cases the full and complete development of the technologies that a given EU-funded project proposes cannot be covered by a single project lifetime. It is of utmost importance that the results coming out from a project can be further be developed in a later stage (e.g. covered by another complementary funding programme or with one designed to further mature an existing proof of concept). Some of the challenges that EU-funded projects might face in this process of searching for the correct funding are:

To get an easy and fast access to information about existing specific funding programmes and calls related to and interesting for the sustainable nanofabrication field.

- **Specific action:** The digital platform of the *NanoFabNet* Hub will include an area on its portal where specific funding information, relevant and interesting for the sustainable nanofabrication community, will be accessible.
- **Outcome:** Users will save time when looking for the most adequate funding scheme for the development of their projects.

The design of the forthcoming funding schemes should consider inputs and points of view coming from all different stakeholders of the field (i.e. academics, industry, civil society and government). This will help on creating novel funding schemes and/or modalities that will consider at the time of design all relevant topics that have been identified as relevant to push forward the complex field of sustainable nanotechnology and nanofabrication, avoiding duplicities and gaps that are not covered.

- **Specific action:** The *NanoFabNet* Hub will organise discussion forums, around this theme, engaging citizens, industry, governments and researchers, in order that all relevant points for

the different type of stakeholders of the sustainable nanofabrication field, are approached accordingly.

- **Outcome:** By counting with all relevant actors of the sustainable nanofabrication field defining the most important points and objectives for the field for the coming years, will be a sound foundation for the work to follow. The investments programs coming out will be more ambitious and will cover all relevant type of disciplines and knowledge. This will permit the correct and optimal development of EU-funded projects in the field, as well as the diffusion of their results, in a later stage into the relevant industries and the society as a whole.

GOAL 3. Optimal collaboration among the different stakeholders

Current EU-funded projects, sometimes are not aware of the results/methods/knowledge developed within other related funded-projects, granted in complementary and/or synergistic calls of the EC. The *NanoFabNet* Hub aims to support the active dialogue among all sustainable nanofabrication related EU-funded projects. Therefore:

All the different expert communities and EU-projects, related to sustainable nanofabrication, need to be brought together, regularly, in order to be able to exchange actions/results/knowledge.

- **Specific action:** the *NanoFabNet* Hub will organise networking events, where EU-funded projects will benefit of a space where they might present results and join forums to discuss specific topics, challenges they face, seek for complementary and/or synergistic projects, etc.
- **Outcome:** By sharing discussions about specific topics, share resources and knowledge, seek for relevant or missing information, the necessary trust and confidence among the different parties will grow and foster the creation of new collaborations to design new projects, irrespective of the country or sector to which the different parties belong.

GOAL 4. To enhance the impact of the outcomes of the EU-funded projects in the field of sustainable nanofabrication

The sustainable nanofabrication R&I community of Europe is excellent on providing scientific methods, results and knowledge. However, it often fails to reach the implementation and translation of those into the industry community. To some extent it also fails in bringing into the light already achieved challenges by science to the civil society. Currently, a high number of EU-funded projects are working on topics related to sustainable nanofabrication. In order that those projects reach the highest impact, the *NanoFabNet* Hub aims to support them by overcoming the following challenges:

The transfer of the knowledge generated within a project to the right target group, as well as to contact to relevant industry partners to translate and exploit results of a project

- **Specific action:** the digital platform of the *NanoFabNet* Hub will contain a market-place that will help to products, services and/or results coming out from EU-funded projects, have a place to be shown and exposed.
- **Outcome:** the users of the *NanoFabNet* digital platform will get the opportunity to look for the right partners for the exploitation (or on the other way around, be the exploiters) of results coming out from EU-funded projects.

To enhance the awareness of civil society about the results and outcomes of the different EU-funded projects.

- **Specific action:** the *NanoFabNet* Hub will help to translate very technical subjects related to the sustainable nanofabrication field, coming out from EU-funded projects, into non-technical and easy to understand content highlighting their advantages, consequences or the impact of those on the societal, environmental or economical field.

- **Outcome:** the civil society will gain a deeper understanding of the sustainable nanofabrication field, its advantages, consequences or the impact it may have on the societal, environmental or economical field.

GOAL 5. Access to top-quality and trained personnel for the development of the projects.

EU-projects dealing with topics related to sustainable nanotechnology and nanofabrication needs to cover and tackle with a wide range of disciplines (e.g. biology, chemistry, engineering, ethics, physics.) It is of utmost importance to have access to high qualified and trained personnel, not only in one discipline but in some at the same time, in order to achieve the complex goals that this type of projects have to achieve. The *NanoFabNet* Hub will support the sustainable nanofabrication field and its EU-funded projects to overcome the related challenges, by providing:

Access to high quality training materials/webinars in topics relevant for sustainable nanofabrication and ensure well-balanced research teams by providing the opportunity to learn complementary knowledge or disciplines.

- **Specific action:** the *NanoFabNet* Hub will organise, through its digital platform, topic-specific training webinars, as well as provide training material, related and useful for EU-funded projects of the sustainable nanofabrication field. The platform will also provide information about inter-laboratory stages opportunities that might arise in the different EU-funded projects. This will be accessible for all type of users (e.g. students, PhD-students, post-doctoral researchers, senior researchers).
- **Outcome:** all these activities should provide exchange of new and state-of-the-art knowledge to the students and/or researchers of the EU-funded projects that participate and provide them the opportunity to broaden their professional skills and capacities in a higher number of complementary disciplines.

8. Partnerships & Collaborations, Data & Knowledge Generation and Innovation

As already described in Section 3.1 and shown in Figure 1, central to the effectiveness of a process like a collaboration framework between EU-funded projects, there are enablers that increase the effectiveness of the process, when aligned with its key components. Therefore, not only single EU-funded projects are important for the *NanoFabNet* Hub, but also other type of actions that will support knowledge generation and innovation.

Currently, in the field of nanotechnology, there is a plethora of initiatives in the EU, active on the topics of sustainability, safety and governance. An initial screening to identify the most important ones has been done to begin with, and – far from an exhaustive list - the resulting Table 1 lists those initiatives, already approached by *NanoFabNet* due to their relevance and existing collaborations with them. *NanoFabNet* will expand this list, by connecting and collaborating with many other initiatives during the rest of the *NanoFabNet* Project lifetime and specially after the launch of the *NanoFabNet* Hub.

The digital platform of the Hub will – in turn - guarantee that some data will be stored and accessible in different repositories so that stakeholders and members will be able to access and consult it, when necessary. In the cases in which direct storage of the data is not an option (due to several different issues) the digital platform will connect the user directly to the right database or link him to it. This part is extremely important in order to guarantee that the knowledge generated in the field of sustainable nanofabrication and its related themes, is and will remain accessible in a centralised and easy to check way. This will ensure that further developments in the field by any interested party, can build on previous knowledge and/or contribute to expand it. Moreover, this will save time and avoid the users to search through internet from scratch.

Table 1: List of EU-initiatives already in close collaboration with NanoFabNet, active in sustainability, safety and governance criteria in the nanotechnology field and/or provide nanofabrication facilities to support fast-track to results.

INITIATIVE	SHORT DESCRIPTION
NanoSafety Cluster¹⁶ (NSC)	The NSC is a high-profile platform for the coordination of nanosafety research in Europe. It provides strategic direction for the EU and Members States, improves synergies between on-going and new projects, collects the outputs and data from completed projects and promotes FAIR data (i.e. Findable, Accessible, Interoperable and Reusable). The NSC integrates and synthesises current and emerging nanosafety knowledge to provide a consistent message to stakeholders including academics, industry and civil society.
Risk Governance Council (RGC)	The RGC for nanomaterials (NMs) is still under development by three H2020-funded research projects (Gov4Nano ¹⁷ , NANORIGO ¹⁸ and RiskGone ¹⁹). It will aim to support the translation of research advances into regulation and industrial practice, and to integrate research, development and innovation (R&D&I) processes in nanotechnology in a holistic way. These projects aim to design and implement a broadly accepted among stakeholders, scientifically based risk governance framework for NMs by filling identified gaps of the existing efforts (<i>Isigonis, 2020</i>). The <i>NanoFabNet</i> Hub will make sure to have close relation as well as collaboration and communication with the outcoming definitive RGC. This will be possible due to the direct connection to two of the three projects (Gov4Nano and RiskGone) sharing some of their partners also with the <i>NanoFabNet</i> Project.
EUOnanoLAB²⁰	EUOnanoLAB is a distributed research infrastructure consisting of over 40 state-of-the-art academic nanofabrication centres across Europe. Its main vision is to accelerate research in the micro- and nanotechnology sector by enabling the transformation of a fragmented landscape of nanofabrication facilities into an integrated knowledge base supporting scientific excellence and providing researchers a fast-track to results. It helps to create innovative solutions to societal challenges in the fields of energy, environment, transport, health and general wellbeing.
EURAMET²¹	EURAMET aim to develop and disseminate an integrated, cost effective and internationally competitive measurement infrastructure for Europe, always taking into account the needs of industry, business and governments. EURAMET support their members to meet their national requirements and to establish a balanced European measurement infrastructure. To enhance benefits of metrology to society is one of the highest priorities for EURAMET and its members.

¹⁶ The EU Nanosafety Cluster; Initiative of the European Commission Directorate-General for Research and Innovation (<https://www.nanosafetycluster.eu>; accessed: June 2021)

¹⁷ Gov4Nano Project; EU H2020 (<https://www.gov4nano.eu>; accessed: June 2021)

¹⁸ NanoRIGO Project; EU H2020 (<https://www.nanorigo.eu>; accessed: June 2021)

¹⁹ RiskGONE Project; EU H2020 (<https://riskgone.wp.nilu.no>; accessed: June 2021)

²⁰ EUOnanoLAB; (<http://euronanolab.eu>; accessed: June 2021)

²¹ EURAMET; (<https://www.euramet.org>; accessed: June 2021)



9. Conclusion & Plan for the Future

One of the ambitions of the *NanoFabNet* Hub is to become a central one-stop-shop for collaborations among EU-funded projects dealing with sustainable nanotechnology and nanofabrication, by providing them the necessary information, as well as networking opportunities and facilities that may be useful for them and that will save Europe from unnecessary duplicity of effort and/or funding in this field, and solve its challenges. The *NanoFabNet* will connect the different experts needed along the entire development chain of sustainable nanofabrication in all relevant sectors (e.g. transport, health, ICT, advanced materials, etc.) and consequently will help the EU-funded projects to solve challenges that might arise during a project lifetime.

This report provides a first map of EU-funded projects dealing with topics related to sustainable nanofabrication, and highlights several activities and actions that are planned to be conducted within the *NanoFabNet* Hub; the list of activities will be increased and adjusted to additional stakeholder needs, once the Hub is successfully launched in 2021.

Moreover, specific actions will be complemented with those that are being planned in the different topics that are of central interest to the *NanoFabNet*, like validation, standardisation and harmonisation activities, ethics, infrastructures for sustainable nanofabrication and international cooperation (i.e. INISS-nano²²; (Falk, 2021)); all of these will be further elaborated in the 5-year strategy of the *NanoFabNet* Hub.

²² INISS nano: International Network Initiative on Safe and Sustainable Nanotechnologies (INISS-nano).

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ANNEX – A1: Non-exhaustive list of EU-funded projects related to the field of sustainable nanofabrication

Project Acronym	Call – Topic Identifier	Aim	To which Pillar of the <i>NanoFabNet</i> Sustainable Nanofabrication own concept they contribute		
			Pillar I EHS	Pillar II LCS	Pillar III Gov., Ethics & Regulation
SIENNA	Swafs – 18 – 2016	SIENNA focuses on ethical and human rights challenges posed by human genomics, human enhancement and human-machine interaction technologies such as robots and smart devices. While these technologies offer significant benefits to individuals and society, they also present significant ethical challenges, e.g., in relation to human autonomy, equality, personal liberty, privacy, and accountability. In collaboration with a variety of stakeholders, SIENNA will identify and assess the ethical and socio-economic issues, public opinions, legal regulation and human rights implications of each technology. It will produce a framework for each of the three technologies that will form the basis for the development of research ethics protocols, professional ethical codes, and better ethical and legal frameworks.			
LIV:IN	Swafs – 06 – 2017	In the LIV:IN project, major industry leaders from the ICT sector join forces to co-create more responsible approaches to innovation for the first time. LIV:IN builds on the premise that recognition of the value of RRI among industry is necessary for achieving the aim of the call “to progress further in integrating RRI in industrial contexts”. The project follows an opportunity-oriented approach in order: i) activate industry leaders, experts and citizens to experiment with responsible ways of co-creating innovations; ii) build capacity for RRI implementation and develop tools that are applicable across industry sectors; and iii) transform attitudes towards RRI from risk to opportunity. LIV:IN will demonstrate the added value of RRI in the area of smart future living.			
PANELFIT	Swafs – 22 – 2017	Changes in the regulation of ICT research and innovation are opening up a new scenario. It is expected that stakeholders, policy makers, and end users adapt to them as soon as possible. This, however, might be hard, especially for SMEs. PANELFIT is firmly committed to facilitating this adaptation process by producing a set of editable, open access Guidelines, validated by two data protection agencies. Once produced, they will serve as operational standards able to reduce the ethical and legal issues posed by ICT technologies while promoting innovation and market growth, enabling high-quality job creation and ensuring an adequate level of privacy and security/cybersecurity.			
SHERPA		SHERPA project will investigate, analyse and synthesise our understanding of the ways in which smart information systems (SIS; the combination of artificial intelligence and big data analytics) impact ethics and human rights issues. It will develop novel ways of understanding and addressing SIS challenges, evaluate with stakeholders, and advocate the most desirable and sustainable solutions.			
SMARTFAN	NMBP – 04 – 2017	SMARTFAN proposes the development of “smart” material and product architectures, with integrated functionalities, that will interact with their environment and react to stimuli by employing biomimetic, self-sensing, actuating and damage-repairing technologies. Their smartness is based on bio-inspired engineering and the use of: i) low- and high-grade carbon fibres (CF), ii) CF reinforced polymers (CFRPs), and iii) nano-/micro- composites with special physicochemical properties, in order to develop smart (bulk) materials, applied on intelligent structures.			

Project Acronym	Call – Topic Identifier	Aim	To which Pillar of the NanoFabNet Sustainable Nanofabrication own concept they contribute		
			Pillar I EHS	Pillar II LCS	Pillar III Gov., Ethics & Regulation
Oyster	NMBP – 07 – 2017	OYSTER brings Europe’s first-class laboratories and SMEs to take existing nanoscale characterisation technologies towards widespread utilisation in process optimisation and model validation. It achieves this by sharing metadata in an Open Innovation Environment, where new paradigms of multi-scale contact mechanics are validated on selected application-oriented reference materials through continuous interaction with the European Materials Characterisation Council (EMCC). This way, OYSTER generates wider agreement over adhesion measurement protocols by multimodal Atomic Force Microscopy and high-speed nanoindentation. OYSTER will implement the triangle of modelling, characterisation and manufacturing to the wider context of industrial exploitation specially through small and medium enterprises, stakeholders’ networks such as EMCC, European Materials Modelling Councils (EMMC) and European Pilot Project Network (EPPN), and international standard organisations.			
PANBIORA	NMBP – 12 – 2017	The PANBioRA project will provide a more intelligent way of selecting the most suitable biomaterial for potential implants. Thus, possible post-implantation complications will be mitigated and reduced. The main objective is to develop a method to allow the cost- and time effective assessment of: i) a new biomaterial under healthy or disease conditions or ii) patient-specific testing of a given biomaterial. To achieve this PANBioRA will develop a modular system using cross-disciplinary techniques that will predict the patient-specific response to a given biomaterial. The testing system will integrate different technologies (refined, miniaturised versions of existing methods and new evaluation technologies) into a single instrument that will be able to perform multiple analyses on cell and micro-tissue levels.			
BIORIMA		BIORIMA aims to develop an integrated risk management (IRM) framework for nano-biomaterials used in Advanced Therapeutic Medicinal Products (ATMP) and Medical Devices (MD). The BIORIMA RM framework is a structure upon which the validated tools and methods for materials, exposure, hazard and risk identification/assessment and management are allocated plus a rationale for selecting and using them to manage and reduce the risk for specific NBM used in ATMP and MD.			
n-TRACK	NMBP – 15 – 2017	n-TRACK develops a safe and highly sensitive multimodal nanoimaging agent enabling non-invasive, quantitative and longitudinal stem cell tracking and whole body biodistribution			
GRACIOUS	NMBP – 28 – 2017	GRACIOUS develops a highly innovative science-based framework to enable practical application of grouping, leading to read-across and classification of nanomaterials and nanoforms.			
PATROLS	NMBP – 29 – 2017	PATROL will deliver advanced and realistic tools and methods for nanomaterial safety assessment. It will provide an innovative and effective set of laboratory techniques and computational tools to more reliably predict potential human and environmental hazards resulting from engineered nanomaterial (ENM) exposures. These tools will minimise the necessity of animal testing and will support future categorisation of ENMs in order to support safety frameworks.			
Gov4Nano	NMBP – 13 – 2018				

Project Acronym	Call – Topic Identifier	Aim	To which Pillar of the NanoFabNet Sustainable Nanofabrication own concept they contribute		
			Pillar I EHS	Pillar II LCS	Pillar III Gov., Ethics & Regulation
RiskGone		The general aim of all three projects and by collaborating with each other, is to prepare the ground for setting up a single and unique Nano-Risk Governance Council in Europe.			
NanoRigo					
NanoSolveIT	NMBP – 14 – 2018	All three projects are developing models and predictive tools that the RGC will use once established. (NanoSolveIT : develops an <i>in silico</i> Integrated Approach to Testing and Assessment (IATA) for the environmental health and safety of NMs; NanoInformaTIX : create a comprehensive, sustainable, multi-scale modelling framework for exposure and (eco)-toxicity of Engineered Nanomaterials (ENM) to facilitate cost-effective risk assessment, less reliant on animal testing, and to support the design of safer materials and products; NanoCommons : is the European Nanotechnology Community Informatics Platform that will bridge data and disciplinary gaps for industry and regulators.			
NanoInformaTIX					
NanoCommons	INFRAIA-02-2017				
INTEGRITY	Swafs – 02 – 2018	Scientific research is not immune to scandal and dishonesty. In fact, research misconduct – inappropriately adjusting, excluding, altering or making up data – is moving up the political agenda. Building a culture of integrity is vital, characterising both individual researchers and the institutions in which they work. The EU-funded INTEGRITY project will build a teaching philosophy that focuses on the empowerment of students. The curriculum will be interactive, compelling and effective. It will also include innovative training and mentoring, and cover a wide range of research fields – from computer sciences to social sciences and humanity.			
Path2Integrity		Improving research integrity and doing this holistically as new techniques emerge are among the many new tasks that today's researchers are facing. Path2Integrity will build and introduce necessary, ethical patterns in this field. It will develop role models and rotary role-playing exercises for adolescents. The aim will be to increase their sensitivity to accept or reject different norms in research. A campaign based on scientific facts will be conducted, and backed by an instructions' handbook. It will be a great help in the development of practical based education.			
SOPs4RI	Swafs – 03 – 2018	The role of science is crucial for European development and future goals. Research systems and institutions need to ensure that research of the highest quality and integrity is carried out, in order to reduce waste and maintain public trust. The EU-funded SOPs4RI project will work to collate and create policies and procedures to support this aim. Focussing on European research-performing organisations and research-funding organisations, it will assist in the development and validation of standard operating procedures and guidelines.			
PRO-Ethics	Swafs – 16 – 2019	Participatory practice and real-life experiments have gained popularity in the last decades. They allow the democratic involvement of populations in desired change or innovation in people's lives and environments. However, as there are many techniques or ways for conducting experimental practices, legal or ethical rules are needed in order to protect participants or other citizens from dangers or unfairness resulting from such experiments. PRO-Ethics will, through a deep dialogue, create an ethics framework for such activities by formulating principles, criteria, good practices and proposals for fairness and			

Project Acronym	Call – Topic Identifier	Aim	To which Pillar of the NanoFabNet Sustainable Nanofabrication own concept they contribute		
			Pillar I EHS	Pillar II LCS	Pillar III Gov., Ethics & Regulation
		transparency of used methods. This framework will be tested and validated in 11 practical cases in several fields and different cultural and local conditions.			
CHALLENGES	NMBP – 08 – 2019	All 6 projects seek the development of new process analytical technologies (PATs) for different applications or fields. CHALLENGES : develops real time nano-characterization related technologies; NanoBAT : develop novel GHz nanoscale electrical and dielectric measurements of the solid-electrolyte interface and applications in the battery manufacturing line; NanoPAT : develop PATs for industrial nanoparticle production; NanoQI : deals with multimodal X-ray and hyperspectral thin-film nano-material evaluations and quality imaging; PAT4Nano : develops PATs for real-time physical and chemical characterisation of nanosuspensions; RealNano : develops in-line and real-time nano-characterisation technologies for high yield manufacturing of flexible organic electronics.			
NanoBAT					
NanoPAT					
NanoQI					
PAT4Nano					
RealNano					
ASINA	NMBP – 15 -2019	The main goal behind all four projects is to develop and validate low-cost techniques for delivering an integrated exposure-driven risk assessment and the associated design of the required post-use monitoring. HARMLESS : will provide novel tools, guidance and decision support for balancing functionality versus risk to ensure that the next generation nanomaterials will be harmless; DIAGONAL : will bring SbD knowledge and tools to a development stage which can be implemented in them multi-component nanomaterials (MCNMs) and High aspect-ratio NMs (HARNs) related industries Sunshine : it will develop and implement Sustainability-and-Safe-by-Design (S&SbD) strategies for products enabled by MCNM, including HARNs.			
SbD4Nano					
SabyNA					
SABYDOMA					
HARMLESS	NMBP – 16 – 2019				
DIAGONAL					
Sunshine					
NanoHarmony	NMBP – 34 -2019	Has the mission to support the development of Test Guidelines and Guidance Documents for eight endpoints where nanomaterial-adapted test methods have been identified as a regulatory priority.			

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			Pillar I EHS	Pillar II LCS	Pillar III Gov., Ethics & Regulation
Nanomet		It aims to standardise test methods to characterise the properties that are specific to nanomaterials. It will also investigate the adaptations needed to existing testing and assessment methodologies.			
LEE-BED	NMBP-01-2018	It brings together world leading European RTOs to establish and Open Innovation Test Bed (OITB) to de-risk and accelerate the development and manufacturing of NMs and lightweight embedded electronics for the benefit of European industry.			
OASIS		It gathers together 12 pilot lines for the industrial production of nanoscale structures in unprocessed form, intermediate products with nanoscale features and nano-enabled products. These modular services will provide companies, particularly to SMEs, to gain access to unique facilities and knowledge without high capital investment.			
SAFE-n-MEDTECH	NMBP-02-2018	It provides innovative open access platform to companies and reference laboratories, the capabilities, know-how, network and services required for the development, testing, assessment, upscaling and market exploitation of nanotechnology-base medical and diagnosis devices.			
FlexFunction2Sustain	NMBP – 03 – 2019	It is the first European initiative aiming to support the industry with a sustainable open innovation ecosystem that will enhance innovation for nano-functionalised flexible plastic and paper surfaces and films.			
INNOMEM		The INNOMEM project is developing a sustainable OITB as a single-entry point for industrial partners inside or outside Europe who are interested in nanomembranes. These are synthetic structures that mimic biological membranes and are used as filters at the molecular level.			
NextGenMicrofluidics		It is in charge of creating an OITB for the upscaling of microfluidic devices based on nano-enabled surfaces and membranes.			
NewSkin		This project is creating an OITB to provide companies and users access to the physical facilities, capabilities and services required for the development, testing and upscaling of industrial and consumer products exploiting nano-enabled surfaces and membranes.			
BIONANOPOLYS	NMBP – 04 – 2019	It addresses the nano-enabled bio-based materials sector to respond specific risks in order to achieve a climate-neutral EU by 2050. Among them, it addresses acceptance of new technologies, seasonal sustainability of feedstocks and associated legislation. This OITB will offer cutting edge pilot lines to produce nano-enabled biobased materials with multifunctional properties, validation for those developed materials in different sectors (packaging, cosmetic, medical, foam, nonwoven, coating, 3D printing, textiles and cellulose-paper).			

Project Acronym	Call – Topic Identifier		Aim	To which Pillar of the NanoFabNet Sustainable Nanofabrication own concept they contribute		
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BIOMAC	NMBP–06-2020		BIOMAC is an OITB created for the upscaling of upscaled processes across the supply and value chain that covers from the utilization of biomass sources followed by the production of biobased nanoparticles and different building blocks and produces biopolymers for the strategic sectors of Food Packaging, Construction, Automotive and Printed Electronics. This OITB will offer services that cover the assessment of regulation & safety, sustainability, circularity and market potential among with modelling, process control, standardization and characterization; accessible at fair conditions and cost.			
IM-PRESSME			This OITB is intended to be for upscaling nano-enabled biomaterials and processes that focus on (nano)cellulose, bioplastics and natural fibres, combined with nanotechnology approaches to tailor biobased materials with properties and functionalities (barrier, antibacterial properties, improved corrosion or chemical resistance, etc.) that equal or outperform their fossil counterparts at competitive prices. It gathers 16 pilot lines, organized in routes and processes for feedstock conversion (PLA, PHA, fibre-based, cellulose-based), formulation and transformation and processing of bio-based material to high added value products. It will offer services including equipment and methods for processing, fast and accurate/reliable characterization, scaling up, nanosafety, eco-design and circular economy assessment (recyclability and biodegradability) and product certification among others.			
PHOENIX			It is an OITB devoted to provide all services (development, upscaling, manufacturing and marketing) for enabling nano-pharmaceuticals innovative products production.			
Life NanoExplore	LIFE17 ENV		The Life NanoExplore project is working to develop and demonstrate the feasibility of an integrated approach to conduct biomonitoring studies, characterise exposure levels and elucidate possible health effects deriving from exposure to engineered nanomaterials (ENM) in indoor workplaces and urban areas. It promotes a harmonized approach to overcome current data gaps and barriers limiting the implementation of the REACH regulation and the use of human bio-monitoring data in the protection of human health and the environment when dealing with particles in the nanometer range (1-100 nm) by combining long series of robust data on the concentration of ENMs measured by a wireless sensor network (WSN) of monitoring devices, appropriate biomarkers, and a tailored designed data management application. This approach addresses current environmental, health, and safety questions about ENMs, providing stakeholders from government, industry, NGOs, or the general public, with reliable data on the concentration and effects of particles in the nanometer range (1-100 nm).			
SocKETs	NMBP – 38 – 2020		Under the EU-funded SocKETs project, they are advancing KETs with the aim of developing a digital toolbox that prioritises societal expectations and concerns. The project will test, prototype, evaluate and distribute tools of co-creative citizen and societal engagement, from the laboratory and innovation networks of innovators, to the science museums of civil society. Its overall goals are to analyse KETs’ potential for and challenges of contributing to the resolution of societal challenges and to identify the priorities of citizens and societal stakeholders for these technologies			

Project Acronym	Call – Topic Identifier	Aim	To which Pillar of the <i>NanoFabNet</i> Sustainable Nanofabrication own concept they contribute		
			Pillar I EHS	Pillar II LCS	Pillar III Gov., Ethics & Regulation
HYBRIDA	Swafs – 28 –2020	Organoids are miniaturised and simplified versions of organs produced in vitro – derived from cells. This technology has been developed to study diseases and treatments in a laboratory. But organoids brought disruption to the dualistic normative framework related to health and life science research. Since it is not clear whether it should be categorised as a subject or an object, three uncertainties must be overcome: conceptual (ontological), epistemological/ methodological, and regulatory. The EU-funded HYBRIDA project will study these uncertainties in organoid research with the goal to develop a conceptual and regulatory framework that will allow to overcome dualism. The aim is to build a comprehensive ethical dimension for organoid-based research and resulting technologies.			
TechEthos	Swafs – 29 –2020	The TechEthos project will review emerging technologies and the ethical issues these raise. It will also explore the views and attitudes held by researchers, industry and the public. The project will also develop an ethics framework and identify how to best support the research community in integrating the ethics dimension into their research. To develop operational guidelines, TechEthos will engage with the public to capture societal awareness about new and emerging technologies.			
ROSIE	Swafs – 30 –2020	ROSIE project will develop tools to ensure ethics and research integrity in open science and citizen science. As a multidisciplinary project, it will bring together leading experts and organisations in the field to explore, engage, guide and equip. Specifically, it will identify the ethical, social and legal challenges of open science. It will also create a community of practice and develop operational guidelines to support stakeholders in understanding responsible innovation.			
RECIPES		RECIPES project will analyse how the precautionary principle is applied in the EU and improve its future application with recourse to participatory methods. It will find ways to reconcile innovation and precaution to foster social awareness and responsibility in research and innovation. The project will build effective cooperation between science and society and link scientific excellence with social awareness and responsibility.			
CompSafeNano	MSCA-RISE-2020	CompSafeNano's overarching objective is thus to drive the development of integrated and universally applicable nanoinformatics models, with broad domains of applicability across NMs compositions and forms, that are directly usable by industry, especially SMEs, and regulators for NMs risk assessment and decision making. CompSafeNano will establish an extended safe-by-design paradigm that includes environmental sustainability (life cycle assessment) based on in silico predictions with experimental testing to validate the results.			

ANNEX – A2: Fact Sheet of the 2nd *NanoFabNet* Development Workshop – Some Figures and Highlights

The 2nd *NanoFabNet* DW was the event during which most information could be gathered from *NanoFabNet* stakeholders and that is currently being used to work on follow up activities and tasks that need to be done during the second year of the Project until the launch of the *NanoFabNet* Hub. Some of the information that arose during the DW is shown and defined in the figures and text below.

- The stakeholders that attended the 2nd *NanoFabNet* DW can be grouped into different categories depending on their professional background (i.e. academia, governmental, industry, NGOs and other) (Figure 3a), and they had different degree of knowledge about sustainability (Figure 3bError! Reference source not found..

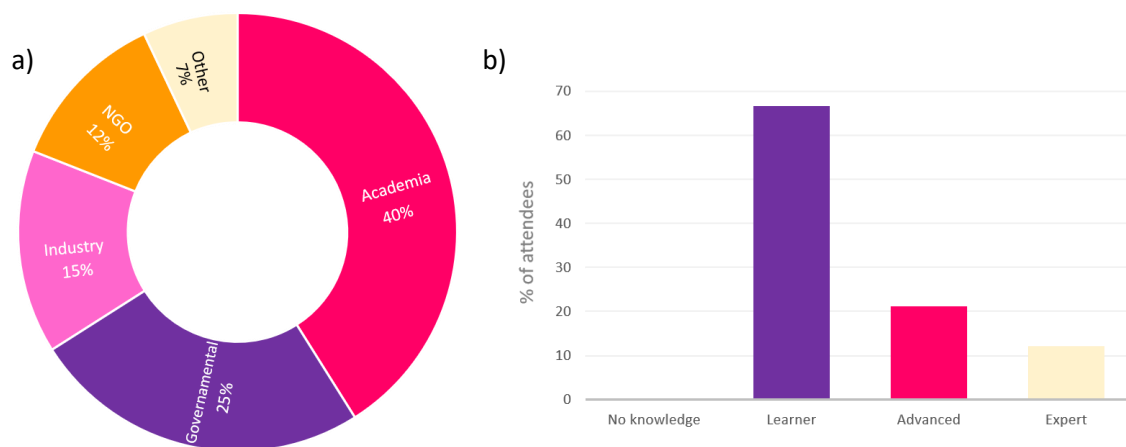


Figure 3: Background of the stakeholders attending the 2nd *NanoFabNet* Development Workshop

The 2nd *NanoFabNet* DW was held during two days, conducted in two parallel sessions on each day, dealing with different topics to discuss and brainstorm (i.e. Sustainability, Validation, Harmonisation & Standardisation, Ethics, Infrastructures & Skills, and *NanoFabNet*'s Hub global communication & Structure).²³

Main outputs to highlight from the different sessions are summarised as follows:

- Regarding **Sustainability** the *NanoFabNet* stakeholders suggested that the most important topics today they deal with related to sustainability are LCA, followed by circular economy, health issues and climate change (see the word-cloud of Figure 4a). Most of the attendees had never conducted any evaluation on environmental or human health risk assessment, LCA, life cycle costing or social cycle assessment, and from those who actually had conducted them those concerning human and/or health risk assessment and LCA were the more common ones (Figure 4b). The *NanoFabNet* stakeholders suggested that the *NanoFabNet* Hub should contribute to raising awareness towards sustainability guidance documents and concepts by primarily disseminating the information and results provided by projects, through events, publications and access through a database. Also training activities and workshops were considered to be optimal activities to be performed and organised by the Hub (Figure 4c). Finally, they also stated to use scientific publications and OECD guidelines, as well as ISO

²³ For more information on the agenda and details of 2nd *NanoFabNet* Development Workshop, consult the *NanoFabNet* Project Deliverable 3.2 (CO).

standards, as the most frequently consulted information when they searched guidance in sustainability related issues (Figure 4d).

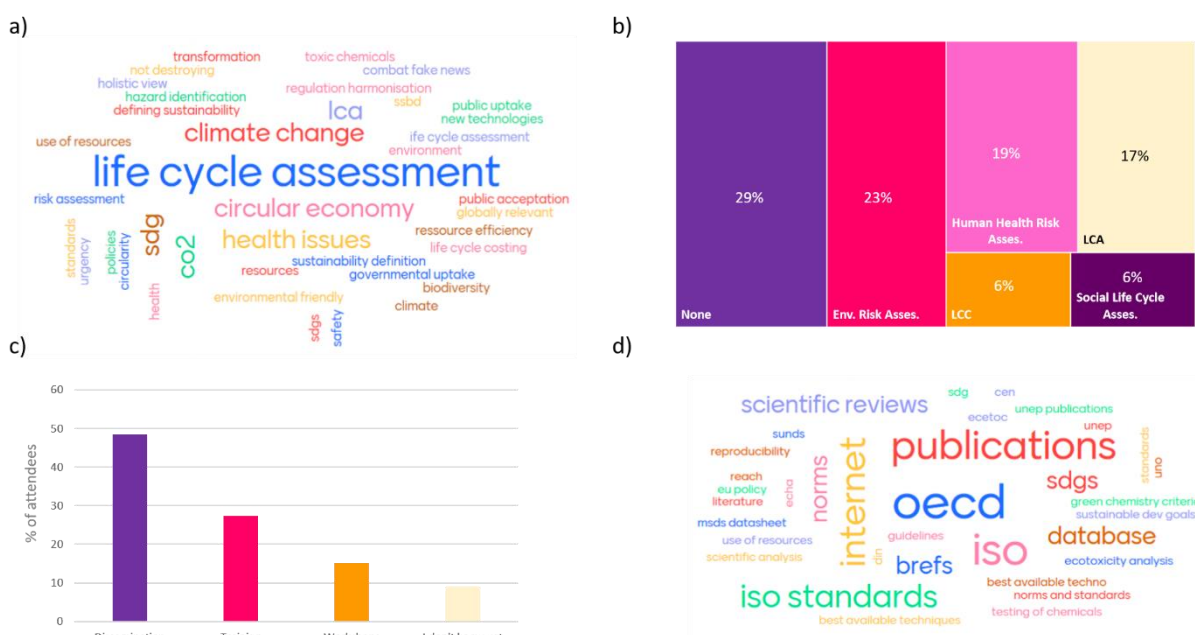


Figure 4: Results of the audience poll during the 2nd *NanoFabNet* Development Workshop on questions pertaining to sustainability.

- Regarding **Validation, Harmonisation & Standardisation in sustainable nanotechnology and nanofabrication** it flourished that the *NanoFabNet* stakeholders felt that the most relevant barriers, for the introduction of nanofabrication in the industrial ecosystem, the lack of harmonisation and standardisation in the field (Figure 5a). From the 1st *NanoFabNet* DW and a previous survey, conducted by the *NanoFabNet* Project, the *NanoFabNet* consortium already knew that metrology and characterisation were the most important themes for the *NanoFabNet* stakeholders and moreover, that there was a real need to provide demonstrations of the competences in metrology and characterisation (e.g. a certified training program). The stakeholders also claimed in the survey that the *NanoFabNet* Hub could help on: i) identifying relevant partners for characterisation, ii) offer guidance to find and access characterisation infrastructures, and iii) should offer training. Building on this previous information, during the 2nd *NanoFabNet* DW, the stakeholders pointed out that the community of sustainable nanofabrication was lacking a database of characterisation facilities and research infrastructures. Another highlighted point during the dialogue in the 2nd DV was that the *NanoFabNet* Hub should help to gather a critical mass of stakeholders that could jointly contribute to harmonisation and standardisation (Figure 5b) by providing access to updated information about standards, among others. *NanoFabNet* stakeholders showed high interest in the possibility of participating in inter-lab comparisons, to validate methods or standard operating procedures (SOPs) (Figure 5c), as well as opined that *NanoFabNet* could be useful and help in the process of harmonising, validation and transferring methods to standards (Figure 5d). Finally, most of the stakeholders agreed that *NanoFabNet* should broaden the VAMAS²⁴ activities (Figure 5e).

²⁴ Versailles Project on Advanced Materials and Standards (VAMAS). (<http://www.vamas.org>)

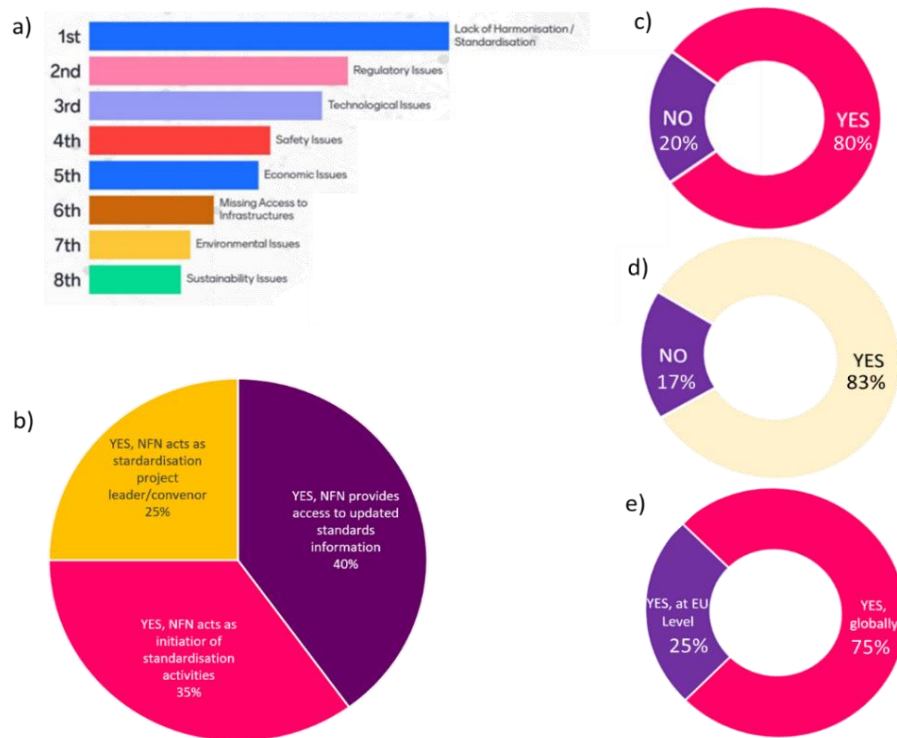


Figure 5: Results of the audience poll during the 2nd NanoFabNet Development Workshop on questions pertaining to validation, harmonisation and standardisation.

- Regarding **infrastructures & skills**, most NanoFabNet stakeholders were either users or providers of research or industrial infrastructures and they most of stakeholder were interested in both type of infrastructures, research and industrial ones (Figure 6a-6c). Their foremost interest was the use of the infrastructures for characterisation, analysis and metrology as well as for fabrication purposes, more than for synthesis of NMs (Figure 6b). One of their major interests when talking about skills in nanofabrication resulted in being training and access to experts, followed by access to instrumentation (Figure 6d). The NanoFabNet stakeholders stated that they used in the same degree colleagues' recommendation and professional networks, when they were looking for an adequate infrastructure (much more than searching using Google) (Figure 6e). Finally, the most important type of information they looked for during their searches about infrastructures were instrumentation, access rules and/or conditions and list of services they provide. (Figure 6f).

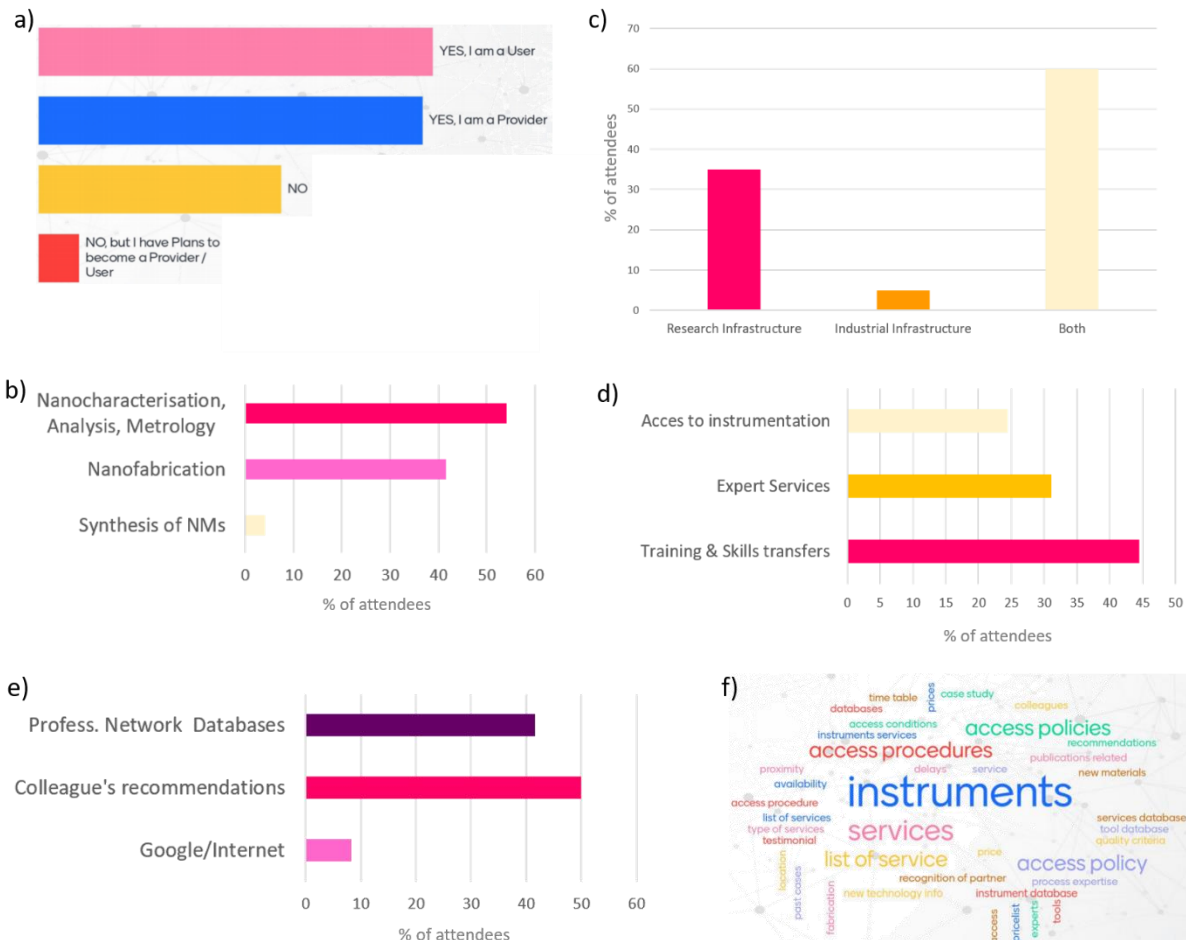


Figure 6: Results of the audience poll during the 2nd *NanoFabNet* Development Workshop on questions pertaining to infrastructure, knowledge and skills.

- During the session of **Ethics**, when asking the stakeholders about their understanding under the term “ethical issues”, a high variety of different concepts appeared (e.g. societal acceptance, freedom of choice, ethical guidelines). During the session most of the *NanoFabNet* stakeholders stated that they were concerned about those ethical issues that impact in the context of their activities related to nanotechnology and/or nanofabrication (Figure 7a). Most of them also considered that the available tools to approach ethical issues were insufficient (Figure 7d). The stakeholders also suggested that new “nano-ethics” tools were needed, remarking that current ethics in other fields (e.g. biomedical ethics, business ethics, etc) are not sufficient (Figure 7b). Most of the stakeholders considered that civil society should have a voice during the developments in the field of nanotechnology/nanofabrication. Some aspects, like more openness of research or more civil dialogue, among others, needed to be improved and the *NanoFabNet* Hub could consider to approach those aspects to ensure that nanotechnology and nanofabrication serve for a better future (Figure 7e).

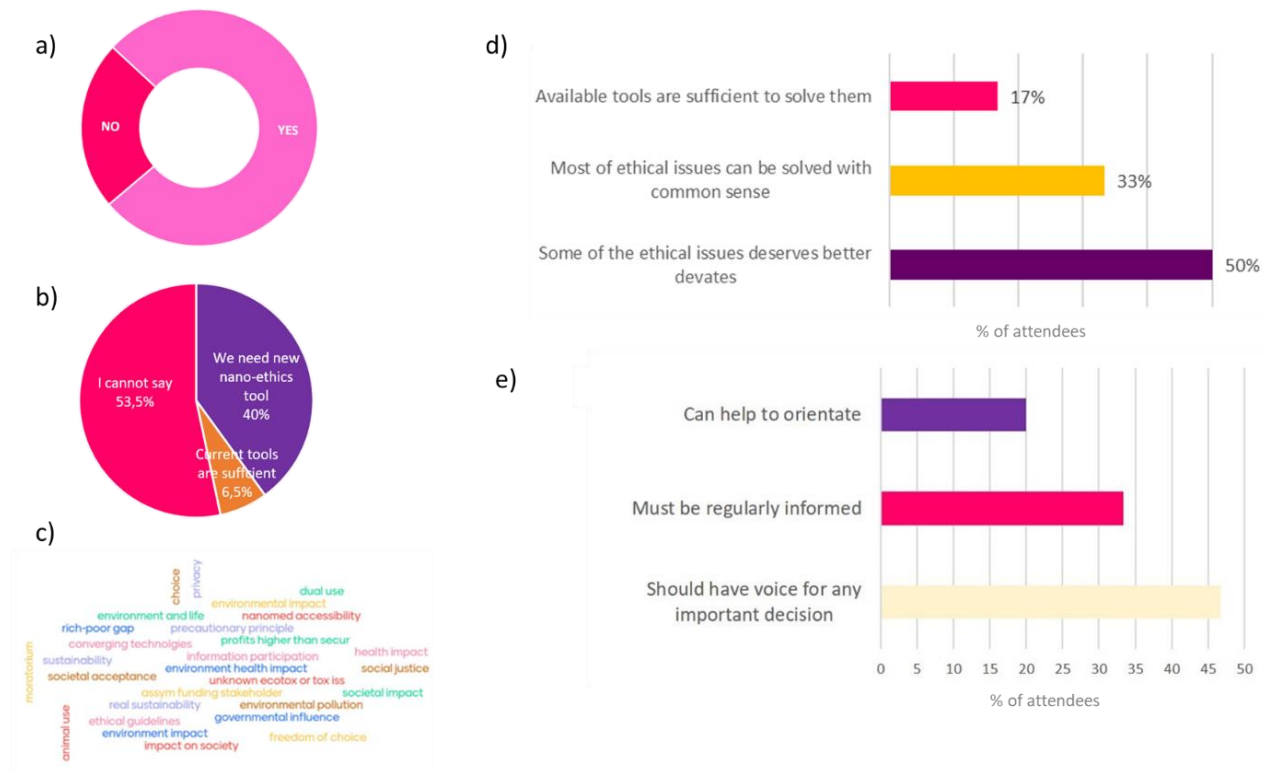


Figure 7: Results of the audience poll during the 2nd NanoFabNet Development Workshop on questions pertaining to ethics.

- Regarding the topic of **global communication and the structure of the NanoFabNet Hub**, the dialogue with the stakeholders was performed using a whiteboard-like virtual tool in order to make the dialogue as creative and open as possible. Both sessions, the one dedicated to global communication, as well as the one dedicated to the structure of the Hub, were transversal sessions and therefore they were done during both parallel sessions on both days.



NanoFabNet
international Hub for sustainable
industrial-scale Nanofabrication