NANO BLOC

ANTIVIRAL & ANTIBACTERIAL NANOCOATING SYSTEM

Whitepaper on Open Science

Experiences from the Horizon Europe NanoBloc project

This Project has Received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement No. **101057597**

About the **NanoBloc** project

The **NanoBloc** consortium of four leading universities & institutes, five companies (three small and medium sized enterprises and two large enterprises) and one standardization body is developing and upscaling (from Technology Readiness Level 3 to Technology Readiness Level 6) new 'made in Europe' antimicrobial, antifungal and antiviral coatings made by industrially scalable, green technology suitable for application on a variety of substrates- porous filter materials (air filtration units, face masks), textiles (protective clothing, mattress covers, aprons, wallpaper), and on a variety of high-traffic solid surfaces (doorknobs, handles, handrails, sanitaryware-taps, etc.).

One of the research lines focuses on thin coatings- <200 nanometres- deposited by Physical Vapour Deposition co-sputtering, formed by a glass and/or ceramic matrix (e.g. silica) capable of incorporating silver or other metal nanoparticles, which can be applied on countless substrates. These coatings allow a gradual release of ions without dispersing the nanoparticles in the surrounding environment and have demonstrated their effectiveness toward proliferation of bacteria, fungi and viruses including respiratory syncytial virus, influenza virus A and with demonstrated virucidal effect towards SARSCoV-2 on face masks. They can withstand temperatures up to 450 °C without altering their antimicrobial properties, thereby suited for thermal regeneration.

In addition, the project builds on previous works in obtaining coatings effective against a range of pathogens using technologies such as other types of sputtering, UV cured lacquers, sol-gel and electrophoretic deposition.

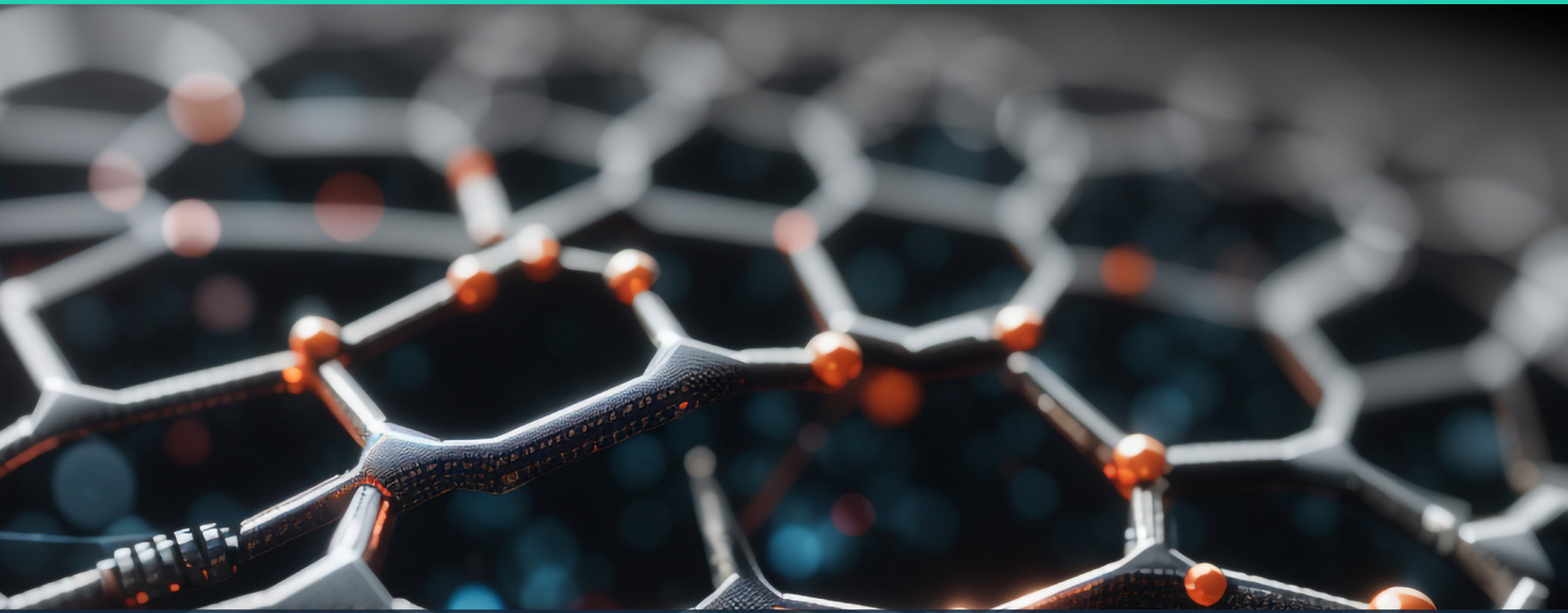
A key strength in our approach is in merging these research lines to obtain innovative products that will be brought to market by our industry participants.

New knowledge generated in the project on antiviral mechanisms and coating durability in operating conditions, is being used to select the most suitable technology for each application and to develop and up-scale effective and durable biocidal/virucidal coatings to relevant demonstrators with no toxic effects for health and environment.

This Project has Received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement No. **101057597**

Open Science is a pivotal element under Horizon Europe, the EU's key funding program for research and innovation. This approach to scientific research is designed to foster greater transparency, collabotration, and trust for the benefit of the scientific community and EU citizens. **Open Science** mandates under Horizon Europe are aimed at maximizing the impact of research by making scientific outputs accessible to all. This whitepaper discusses how we are complying with **Open Science** principles in the implementation of the **NanoBloc** project.

Contents



1. Introduction to the Concept of **Open Science**

Open science is an approach to research based on open cooperative work that emphasizes the sharing of knowledge, results and tools as early and widely as possible. It is mandatory under Horizon Europe, and it operates on the principle of being *'as open as possible, as closed as necessary'*.

1.1 What is **Open Science?**

Open Science is a research approach that prioritizes open collaboration and the early, widespread sharing of knowledge, results, and tools. This method is a cornerstone of Horizon Europe, which mandates the principle of being "*as open as possible, as closed as necessary.*" Under this guideline, some data and results can remain confidential if their disclosure could harm the researcher's legitimate interests, such as commercial exploitation of research findings or compliance with obligations like personal data protection outlined in the Grant Agreement.

Open Science aims at making scientific research, data, and dissemination accessible to all levels of society, amateur or professional. It encompasses practices such as publishing open research, campaigning for open access, encouraging scientists to practice open notebook science, and generally making it easier to publish and communicate scientific knowledge. The core principles of **Open Science** include transparency in experimental methodology, observation, and collection of data; public availability and reusability of scientific data; public accessibility and transparency of scientific communication; and using web-based tools to facilitate collaboration.

1.2 Key Concepts of **Open Science**?

Open Access

Open access is the practice of providing online access to scientific information that is free of charge and reusable by the user. This includes peer-reviewed publications and the data underlying these publications. Under Horizon Europe, while researchers are not obliged to publish their results, any publications must be made openly accessible.

Open Access to Research Data

Research data refers to the facts or numbers collected to be examined and serve as a basis for reasoning, discussion, or calculation. Open access to research data under Horizon Europe means that digital research data must be FAIR (Findable, Accessible, Interoperable, and Reusable).

Citizen Science

Citizen science involves the voluntary participation of non-professional scientists in various stages of research and innovation. This can include shaping research agendas, gathering and analysing data, and assessing research outcomes. Engaging citizens helps to democratize science and enhance its societal relevance and impact.

1.3 Open Science Practices Under Horizon Europe

Open Science practices are foundational to fostering an environment of transparency, collaboration, and rapid knowledge dissemination. These practices aim to make scientific research and its outputs accessible to all, facilitating widespread and early sharing of knowledge, tools, and methodologies.

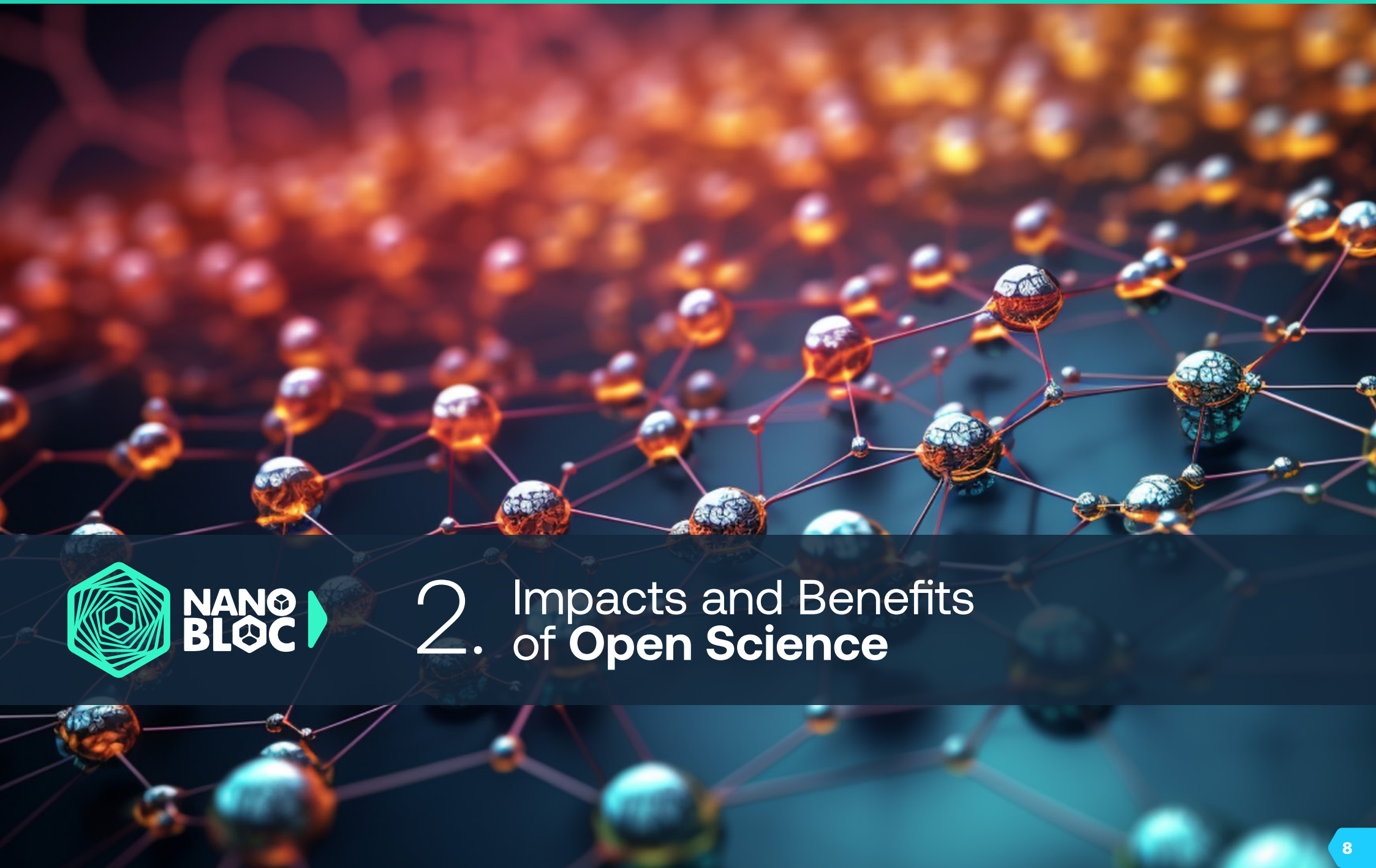
Projects that are funded under Horizon Europe must fulfil with two mandatory practices, and it is also positive to aim to fulfil a number of additional recommended practices.

Mandatory Practices

- **Open Access to Publications**: All peer-reviewed publications must be freely accessible.
- **Open Access to Research Data**: Data must be made accessible following the principle "as open as possible, as closed as necessary."

Recommended Practices

- **Involvement of All Relevant Knowledge Actors**: Including citizens in the research process.
- **Early Open Sharing of Research**: Sharing research outputs beyond publications early in the process.
- **Open Peer Reviews**: Participating in open peer review processes to enhance transparency and rigor.

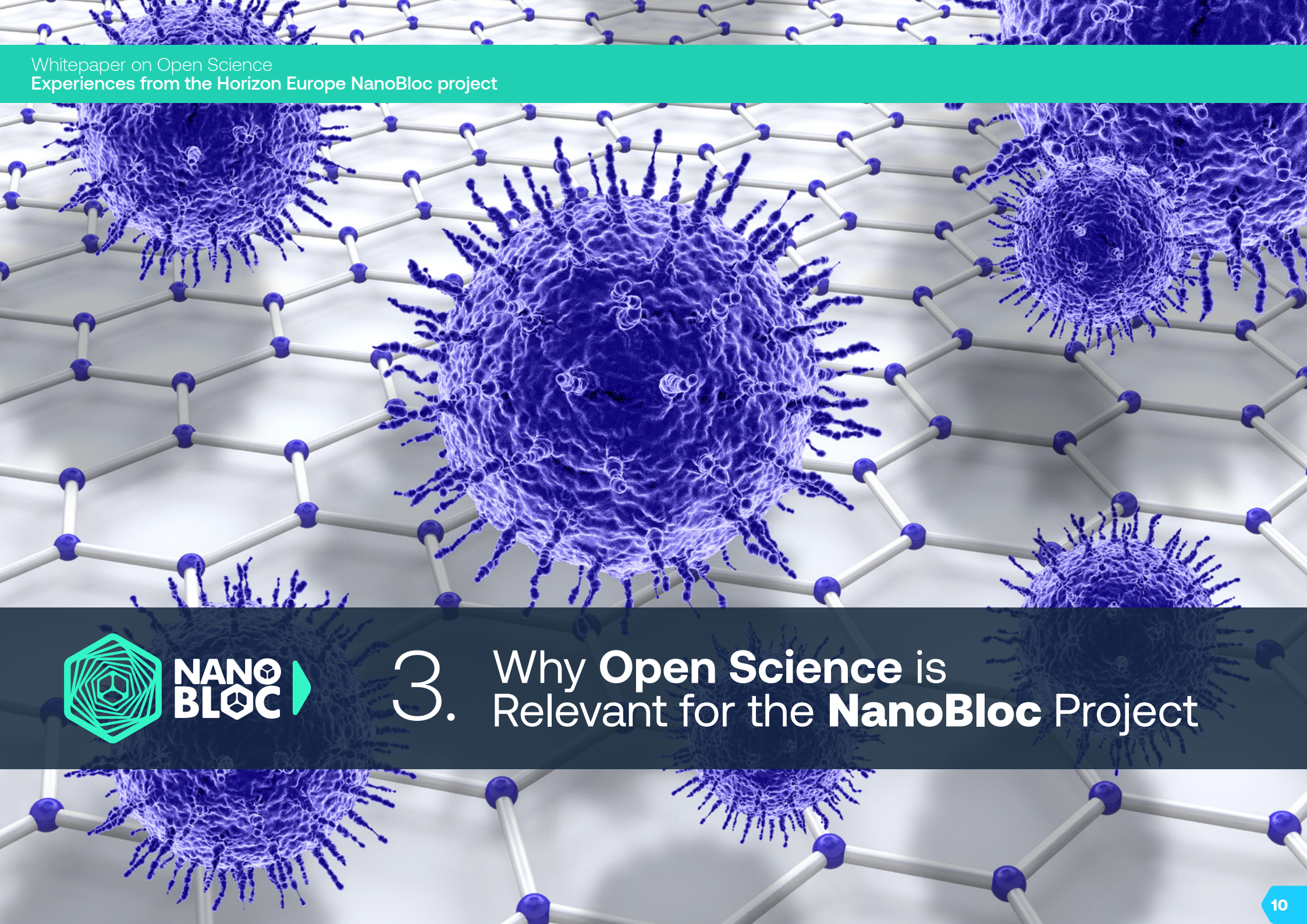


2. Impacts and Benefits of **Open Science**

Open Science promotes collaboration across various sectors including academia, industry, public authorities, and citizen groups. By engaging these diverse actors, Open Science fosters creativity, increases trust in science, and leads to more transparent and impactful research. The enhanced engagement also supports more efficient research processes and opens opportunities for global scientific collaboration.

Open Science has numerous impacts and benefits for the scientific community and society at large:

- **Increased Accessibility**: Open access to research publications and data ensures that anyone, regardless of their affiliation or location, can access and use scientific knowledge.
- **Enhanced Collaboration**: By making data and methodologies freely available, researchers can collaborate more easily, leading to faster scientific advancements.
- **Improved Reproducibility**: Transparency in research methods and data helps other scientists reproduce results, a cornerstone of scientific validation.
- **Accelerated Innovation**: Open Science accelerates the translation of research findings into real-world applications, promoting innovation.
- **Wider Impact**: Openly sharing research outputs maximizes the impact of research by enabling broader dissemination and uptake by various stakeholders, including policymakers, industry, and the public.
- **Equity in Knowledge Sharing**: It promotes inclusivity by ensuring that research knowledge is shared equitably, especially benefiting vulnerable groups, as well as researchers in developing countries.



3. Why **Open Science** is Relevant for the **NanoBloc** Project

The **NanoBloc** collaborative research project, with its focus on developing advanced antimicrobial coatings, can gain significantly from the principles of **Open Science**, whereby implementing Open Science practices enhances transparency, fosters collaboration, and accelerates the dissemination of knowledge.

Given the public health relevance of **NanoBloc's coatings** (e.g., their effectiveness against pathogens like SARS-CoV-2), making research findings publicly available can aid global efforts in combating infectious diseases.

By prioritizing open access to research findings, ensuring rigorous documentation and reproducibility, and involving a broad range of stakeholders, we aim to maximise the impact and societal benefit of our work. This commitment to openness not only supports the scientific community but also empowers the public and drives innovation in the fight against antimicrobial resistance.

Open dissemination of results and methodologies can build trust among stakeholders, including regulatory bodies, healthcare providers, and the public, ensuring that the technologies developed are credible and reliable. Open access to **NanoBloc's research** can spur further innovation and allow other researchers and industries to build upon the project's findings, enhancing the scalability and applicability of the coatings.

With multiple universities, research institutes, and companies involved in the **NanoBloc** research and development, **Open Science** facilitates better collaboration and sharing of knowledge and data among partners.

4. **Open Science** practices implemented in the **NanoBloc** project

In the **NanoBloc** project, the principles of **Open Science** are integral to our methodology, enhancing our ability to achieve our objectives, and are also part of our Communication, Dissemination, and Exploitation Plan. Given the clear market focus of our project, with strong industrial involvement, a robust strategy is in place, such as safeguarding intellectual property and ensuring confidentiality where necessary, to ensure that the commercial potential of our findings is not compromised by our **Open Science practices**.

4.1 Establishing the knowledge sharing foundations within the consortium

As a foundational pillar for **Open Science**, we believe that we first need to lay the groundwork for effective cooperation, knowledge sharing, and learning, among across our **NanoBloc** consortium consisting of leading universities and institutes and a relevant industry value chain. As such a central pillar of our project methodology is a powerful cocreation approach to drive this internal cooperation, knowledge sharing, and learning ensure. This cocreation approach is fundamental for our market focussed iterative development process as we advance our innovative developments from Technology Readiness Level (TRL) 3 to TRL 5.

4.2 Early and Open Sharing of Research

NanoBloc consortium members are planning to publish several research articles in open access journals to ensure that our findings are freely available to the global scientific community.

We also make use of preprint repositories, where it is present, to share research findings before formal peer review, ensuring that new knowledge is disseminated quickly and widely to satisfy open access requirements and accelerate the pace of scientific discovery.

In relation to licensing, Creative Commons Attribution (CC BY) or equivalent licenses are used for journal articles.

Participation in open peer-review processes is also being encouraged to enhance the transparency and rigour of our publications, which involves for example sharing reviewer comments and author responses publicly.

4.3 Open Access to Research Data

Open access to research data and other related research outputs is being promoted following the principle 'as open as possible, as closed as necessary' and operated in parallel with a robust strategy for ensuring commercial exploitation, protection of personal data or confidentiality/security are not jeopardised. We will follow this principle to balance openness with the need to protect personal data, intellectual property, and sensitive information. This ensures that while most data are openly shared, any restrictions are justified and minimal.

We have developed a Data Management Plan (DMP) for the project, which outlines the strategies for managing and sharing **NanoBloc's research** data according to the FAIR principles to ensure that our data is easily findable, accessible, interoperable, and reusable by other researchers. It includes:

Definition of the types of data/research outputs:

As part of the **NanoBloc** research, we are acquiring key data in relation to process parameters (for process monitoring purposes), and for implementing Artificial Intelligence and Machine Learning techniques towards model predictive control. While we may not be able to disclose sensitive process data, we can show ordered data on the results of testing e.g. experimental images, text, numerical, etc. In addition, we are also gathering valuable data from the experiments in relation to understanding the virucidal and biocidal mechanisms of the new coatings, as well as the toxicology assessments and characterisation of the physico-chemical features, mechanical performance and chemical resistance and durability of the coating.

Interoperability of data/research outputs:

We are using open, international and public available standards, e.g. the standards developed by the European Union and international standardization organizations like CEN and ISO, such as ISO 10303 (for CAD, CAE/Simulations, PLM and sensor data (IoT) integrations, in addition to data storage for AI/ML applications) that: increase interoperability of information technology, addressed by data exchange & sharing solutions; enable common enterprise-wide views of information, addressed by data integration solutions; address obsolescence of information technology by data archiving solutions; promote freedom from vendor lock-in, addressed by open data solution. The participation of UNE (representing CEN and CENELEC) in our consortium is a significant asset. Moreover, other proposals approved in the topic (and other relevant Horizon Europe topics) are being engaged with to establish common definitions on data sets and guarantee their interoperability.

Reusability of data/research outputs:

Where possible, we aim to make the data produced in the project usable by third parties including after the end of the project. We will provide the documentation needed to validate data analysis and facilitate data re-use (e.g. readme files with information on methodology, codebooks, data cleaning, analyses, variable definitions, units of measurement, etc.). The provenance of the data is thoroughly documented using the appropriate standards, and all relevant data quality assurance processes are described.

Data Collection and research output management:

Methods and standards for data collection. Use of lab books and effective (and digitised where possible) documentation procedures and effective packaging of research results.

Data Storage:

Where possible, data is being made freely available in the public domain to permit the widest re-use possible. The aim will be for data to be licensed using standard reuse licenses (e.g. Creative Commons, Open Data Commons). Secure storage solutions to ensure data integrity and confidentiality. Data is safely stored in trusted repositories for long term preservation and curation, and provisions are made for data recovery as well as secure storage and transfer of sensitive data.

Data Sharing:

Plans for making data available via repositories. In the case of the **NanoBloc** project we have set up a Zenodo account where we deposit our research outputs, including datasets, reports, and publications. This ensures that our data is accessible and citable.

Data Preservation:

Mandatory technical standards are being adhered to in order to ensure that scientific information, publications, data and other outputs from our project, as well as the metadata about them, is available for re-use in the long term. This involves the use of persistent and unique identifiers, of certified repositories that are compliant to the standards of the **European Open Science Cloud** and in compliance with the FAIR principles for the management of research data produced by our project. Moreover, Zenodo ensures that only our data is accessible and citable but is also preserved for the long term.

Regulatory and Ethical aspects:

Compliance with GDPR (General Data Protection Regulation) for any personal data gathered during the project.

4.4 Commitment to Citizen Science

NanoBloc consortium members are planning to publish several research articles in open access journals to ensure that our findings are freely available to the global scientific community.

We also make use of preprint repositories, where it is present, to share research findings before formal peer review, ensuring that new knowledge is disseminated quickly and widely to satisfy open access requirements and accelerate the pace of scientific discovery.

In relation to licensing, Creative Commons Attribution (CC BY) or equivalent licenses are used for journal articles.

Participation in open peer-review processes is also being encouraged to enhance the transparency and rigour of our publications, which involves for example sharing reviewer comments and author responses publicly.

5. Conclusion

5. Conclusion

Open Science is a critical component of the **NanoBloc** project, underpinning our commitment to transparency, collaboration, and impact. By embracing **Open Science practices**, we enhance the reproducibility, accessibility, and societal impact of our research.

As we move into the second phase of the project, we will continue to prioritize open access to our data and findings, fostering a culture of openness that benefits the scientific community and society at large.

We will maintain and implement our Data Management Plan and continue to deposit our data in the Zenodo Open repositories, as well as document and share our experimental methodologies and protocols to facilitate reproducibility and further research. We will make additional publications in Open Access journals. We will also organise webinars, workshops, and public lectures to disseminate our findings to a broader audience. We will also explore the opportunities to engage with policymakers to highlight the importance of **Open Science** and its role in public health and innovation.

This Project has Received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement No. **101057597**