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NanoTech Startup

NanoTech Startup Project

WP2.A2 Literature Review Report

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1. Summary

This report examines the nanotechnology ecosystems of the Czech Republic, Italy, Spain, Portugal, Germany and EU-wide with a focus on market structures, application areas, research infrastructure, funding opportunities, and the practical framework conditions for technology-based start-ups. Overall, nanotechnology is regarded in all countries as a key enabling technology rather than a standalone industry, generating significant value across sectors such as healthcare, energy, electronics, environmental technologies, and advanced manufacturing.

Key Findings

1. Nanotechnology Is Evolving from Research to Industrial Value Creation

Over the past two decades, nanotechnology has evolved from a predominantly academic discipline into a strategically important field of innovation across Europe. This development is particularly evident in the Czech Republic, which has established itself as one of the most dynamic nanotechnology hubs in Central and Eastern Europe. Its success is based on strong collaboration between universities, research institutes, and industry, as well as a strong emphasis on applied research and technology transfer.

Germany possesses the most industrialised nanotechnology ecosystem among the countries reviewed. Nanotechnology is deeply embedded in key sectors such as engineering, chemicals, machinery, medical technology, and electronics. Major research organisations, including Fraunhofer, Helmholtz, Leibniz, and Max Planck institutes, form the backbone of the national innovation system.

Spain has positioned itself as a European leader in graphene, nanomaterials, and nanomedicine. More than 450 companies operate in the sector, with a strong export orientation and growing international competitiveness.

Portugal follows a highly research-driven model. The International Iberian Nanotechnology Laboratory (INL) in Braga serves as a key international centre of excellence and plays a central role in connecting scientific research with industrial innovation.

Italy leverages nanotechnology to strengthen and modernise its traditional industrial sectors, particularly advanced materials, healthcare, energy, and manufacturing. The number of nanotechnology-related companies and research initiatives has increased steadily in recent years.

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2. Common Technological Priorities Across Europe

Despite national differences, the countries examined focus on several common technological domains:

- Nanomaterials and functional materials (graphene, nanofibers, nanocomposites, advanced coatings)
- Nanomedicine and life sciences (drug delivery systems, diagnostics, biosensors, regenerative medicine)
- Nanoelectronics and nanophotonics
- Energy and environmental technologies (batteries, hydrogen, photovoltaics, water treatment)
- Advanced manufacturing and industrial applications

The Czech Republic stands out internationally for its expertise in nanofiber technologies. Nanomembranes developed and manufactured in the country are used in air and water filtration, medical devices, cosmetics, and specialized protective systems.

Spain has established a leading position in graphene production and applies nanotechnology extensively in healthcare and energy-related innovations.

3. Research Infrastructure Is a Critical Success Factor

A defining feature of all examined countries is the central role of public research institutions. Nanotechnology innovations are typically generated within universities, research centers, and publicly funded laboratories before being commercialised through spin-offs and technology-based start-ups.

Each country has invested significantly in research infrastructure:

- Czech Republic: CEITEC, CATRIN, CXI, and other specialized centres
- Italy: National Research Council (CNR), Italian Institute of Technology (IIT), and leading technical universities
- Spain: ICN2, IMDEA Nanociencia, and the NanoSpain network
- Portugal: INL, CeNTI, and several university-based research institutions
- Germany: Fraunhofer, Helmholtz, Leibniz, and Max Planck organisations

These facilities can provide access to clean rooms, pilot production lines, advanced characterisation equipment, and testing laboratories, significantly reducing barriers for emerging technology companies.

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4. Start-ups as Drivers of Commercialisation

The report highlights the crucial role of start-ups in transforming scientific discoveries into marketable products and services. Most nanotechnology start-ups originate from universities or public research institutions and focus on highly specialised markets.

Successful business models are commonly based on:

- Proprietary materials and technologies
- Patent-protected processes
- Business-to-business (B2B) industrial solutions
- Medical and healthcare applications
- High-performance products for environmental and energy sectors

5. Funding Landscape: Strong Public Support but Limited Private Capital

Across all countries, government agencies, innovation programs, and European Union funding mechanisms represent the primary sources of financing, particularly during the early stages of technology development.

Key funding instruments include:

- National research and innovation programs
- Technology transfer and incubation schemes
- Innovation vouchers
- R&D tax incentives
- European funding programs such as Horizon Europe, Eurostars, and the EIC Accelerator

The EIC Accelerator is particularly important for nanotechnology companies, as it provides a combination of grants and equity financing for high-risk deep-tech ventures.

At the same time, many countries face a shortage of private venture capital for early-stage deep-tech companies. This funding gap is particularly evident in Italy and the Czech Republic, where significant challenges remain in financing the transition from laboratory research to commercial-scale production.

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6. Key Challenges and Areas for Improvement

Despite the positive outlook, several structural challenges continue to limit the growth potential of nanotechnology ventures:

- Scaling laboratory innovations to industrial production
- High capital requirements and long development cycles
- Complex regulatory and certification procedures
- Uncertainty regarding market acceptance of new materials and technologies
- Limited availability of specialised deep-tech investors

Regulatory compliance, safety assessments, and certification requirements for nanomaterials remain particularly demanding for young companies and can significantly slow commercialisation efforts.

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2. Literature Review for the Czech Republic

Partner organisation	Asociace nanotechnologického průmyslu ČR
Country	Czech Republic

1. NanoTechnology Industry Landscape

1.1 Overview of the NanoTechnology Industry in the Czech Republic

The Czech Republic has established itself as one of the most dynamic NanoTechnology hubs in Central and Eastern Europe. Building on a strong tradition in materials science, chemistry, physics, and engineering, the country has leveraged its research excellence and industrial base to develop a competitive NanoTechnology ecosystem. Over the past two decades, NanoTechnology has evolved from a primarily academic research domain into a strategically important sector with growing commercial relevance. The Czech nano-sector is characterized by close interaction between universities, public research institutes, and industry, with a particular emphasis on applied research and technology transfer.

The national NanoTechnology landscape benefits from a highly skilled workforce, relatively strong public funding for research, and an export-oriented economy. Czech NanoTechnology companies are well integrated into European research networks and global value chains, often targeting niche, high-value applications rather than mass markets. This positioning allows Czech firms to compete internationally despite the country's moderate overall market size.

1.1.1 Key Sub-fields Relevant to the Country

Several NanoTechnology sub-fields are particularly prominent in the Czech Republic. **Nanomaterials** represent the strongest and most mature domain, encompassing nanofibers, nanoparticles, nanocomposites, surface coatings, and advanced functional materials. The Czech Republic is internationally recognized for its expertise in nanofiber production, especially using electrospinning technologies, which originated from Czech academic research and led to globally competitive industrial applications.

Nanoelectronics and nanophotonics form another important sub-field, closely linked to the country's strengths in physics, microelectronics, and semiconductor research. Activities include nanoscale sensors,

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optoelectronic components, and advanced lithography-related research, often embedded within broader micro – and nano-systems engineering.

NanoTechnology for medicine and life sciences is a rapidly growing area, focusing on drug delivery systems, antimicrobial materials, diagnostics, and tissue engineering. This sub-field benefits from interdisciplinary collaboration between materials scientists, chemists, biologists, and medical researchers, often centered around university hospitals and biomedical research centers.

1.1.2 Market Size and Economic Importance

While the Czech NanoTechnology market is relatively small in absolute terms compared to global leaders, its economic importance is significant relative to the country's size. The sector consists of several dozen specialized companies, many of which are small and medium-sized enterprises (SMEs) with strong export orientation. NanoTechnology contributes indirectly to key Czech industries such as automotive manufacturing, healthcare, energy, and advanced manufacturing by enhancing product performance, sustainability, and competitiveness.

From an economic perspective, NanoTechnology plays a catalytic role rather than functioning as a standalone industry. Its impact is most visible through productivity gains, innovation spillovers, and the creation of high-value-added products. Public investment in NanoTechnology-related research infrastructure has also generated long-term benefits by attracting international projects, skilled researchers, and private R&D investment.

1.2 Applications in the Different Industries

NanoTechnology in the Czech Republic is highly application-driven, with a strong focus on translating research outputs into practical industrial solutions. The diversity of applications reflects the interdisciplinary nature of the field and its ability to address challenges across multiple sectors.

The Czech Republic is one of the world's largest industrial producers of nanofiber membranes. Companies such as NanoMedical, Nafigate Park, Pardam, Spur, and nanoSPACE Technology supply not only finished products incorporating nanomembranes, but also various types of nanofiber membranes to foreign companies, for example in the fields of filtration and cosmetics.

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The Czech Republic also exports fiber-spinning machines, including so-called laboratory units for research centers and universities. Nanomembranes are used for the filtration of air, water, and food-processing liquids. An original Czech solution is the use of nanomembranes in bedding for allergy sufferers, where they capture allergens and dust mites. Another Czech company uses nanofilters in the design of filtration and ventilation units for protective shelters and bunkers.

In the Czech Republic, nanomaterials are applied in drug carriers and catalysts, cosmetics, advanced wound dressings, tissue engineering and energy devices, antibacterial clothing with fibers enriched with nanosilver, self-cleaning coatings, specialized products for the maintenance of various household and industrial surfaces, as well as in devices for purifying tap water using carbon nanotubes.

Nanotechnology in cosmetics, particularly nanofiber delivery systems, represents an advanced approach to skincare by enhancing the effectiveness of active ingredients and minimizing the need for additives. Nanopharma's nanoBeauty masks show how nanofiber technologies developed for medical research can be successfully applied to high-performance cosmetic products, with activation occurring only upon contact with water and skin, allowing up to approximately 92% of active ingredients to penetrate the skin without preservatives.

Nanomedical focuses on chitosan-based nanofiber masks made from natural, biodegradable chitosan nanofibers with anti-inflammatory and skin-soothing properties. nanoSPACE applies nanofiber technology across various sectors and offers a wide range of nanotechnology-based cosmetic products, including nanoBeauty masks in multiple variants tailored to different skincare needs, emphasizing gentle formulations suitable for sensitive skin.

Contipro is a Czech biotechnology company specializing in nanocosmetics and nanoplaster technologies based on advanced research in hyaluronic acid. In cosmetics, Contipro uses nanotechnology to enhance skin hydration, regeneration, and anti-aging effects by improving the delivery of active ingredients. The company also develops innovative nanopatches that enable targeted, efficient, and minimally invasive delivery of substances into the skin, bridging cosmetic and pharmaceutical applications.

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1.2.1 Key Industrial Application Areas

Healthcare and Life Sciences represent one of the most important application domains. Czech NanoTechnology is widely used in wound care, antimicrobial textiles, medical devices, and drug delivery systems. Nanofiber-based materials are particularly prominent in filtration, wound dressings, and protective medical equipment, where they offer high surface area, breathability, and effective barrier properties. Research is also ongoing in nanocarriers for targeted drug delivery and advanced diagnostic tools.

In the **Energy sector**, NanoTechnology contributes to improved energy efficiency, energy storage, and renewable energy systems. Applications include nanostructured materials for batteries and supercapacitors, catalysts for hydrogen production, and advanced coatings that enhance the durability and performance of energy infrastructure. Although large-scale commercialization is still limited, these technologies are strategically important for long-term energy transition goals.

Electronics and Sensors benefit from nanoscale materials and structures that enable miniaturization, improved sensitivity, and lower power consumption. Czech research institutions and companies are active in developing nanosensors for environmental monitoring, industrial process control, and medical diagnostics, often integrating NanoTechnology with microelectronics and data systems.

Advanced Materials and Manufacturing is a core application area, closely aligned with the Czech industrial base. Nanocomposites, surface treatments, and functional coatings are used to enhance mechanical strength, wear resistance, corrosion protection, and thermal properties. These solutions are particularly relevant for the automotive, aerospace, and machinery sectors.

In **Environment and Sustainability**, NanoTechnology supports water and air purification, waste treatment, and pollution monitoring. Nanofiber filters and photocatalytic materials are widely applied in filtration systems, contributing to improved environmental performance and compliance with increasingly strict regulations.

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1.2.2 Role of Startups

Startups play a crucial role in the Czech NanoTechnology value chain, often acting as the primary vehicles for commercialization. Many NanoTech Startups originate as **spin-offs from universities and public research institutes**, translating laboratory-scale innovations into market-ready products. These companies typically focus on niche applications where high performance and specialized functionality justify higher costs.

Czech NanoTech Startups often collaborate closely with large industrial enterprises, supplying advanced materials, components, or pilot-scale solutions that are later integrated into mass production. This collaborative model reduces market entry risks and allows Startups to leverage the manufacturing and distribution capabilities of established firms. At the same time, Startups benefit from public support schemes, incubators, and innovation centers that provide access to infrastructure, funding, and business expertise.

1.3 Characteristics and Importance of the NanoTech Sector

The NanoTechnology sector in the Czech Republic is characterized by high innovation intensity, strong research foundations, and strategic relevance for national competitiveness.

1.3.1 Innovation Characteristics

NanoTechnology in the Czech Republic is **highly R&D-intensive**, with innovation driven primarily by scientific advances and experimental development. The sector is inherently interdisciplinary, combining materials science, chemistry, physics, biology, and engineering. This interdisciplinarity fosters creative problem-solving but also requires effective coordination across disciplines and institutions.

Innovation cycles in NanoTechnology tend to be long, as technologies must pass through extensive testing, validation, and certification before commercialization. Nevertheless, Czech researchers and companies have demonstrated strong capabilities in moving from fundamental research to applied solutions, particularly in materials-based innovations.

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1.3.2 Research Infrastructure

The Czech Republic possesses a well-developed **research infrastructure** supporting NanoTechnology. Major universities, including technical and natural science institutions, host specialized laboratories and research centers dedicated to nanomaterials, nanoelectronics, and nanobiotechnology. Public research institutes complement university research by focusing on applied and industrially relevant projects.

The country has invested significantly in shared facilities such as clean rooms, pilot lines, advanced microscopy centers, and testing laboratories. These facilities are often accessible to both academic and industrial users, facilitating collaboration and lowering entry barriers for Startups and SMEs. Technology centers and regional innovation hubs further support prototyping, scaling, and validation activities. A list of NanoTechnology research centers and universities offering accredited programs focused on NanoTechnology is provided below.

1.3.3 NanoTechnology Research Centers in the Czech Republic

CEITEC, Brno

https://www.ceitec.cz

https://www.ceitec.eu/advanced-nano-and-microtechnologies/rp1

Nanoelectronic and nanophotonic application, analysis of nanostructures, nanomagnetism and spintronics

https://www.ceitec.eu/advanced-materials/rp4

Low-dimensional nanomaterials, nanocomposites, bioelectronics ...

https://biomaterials.ceitec.cz

Nanostructured polymer-composite biomaterials that induce connective tissue growth

CATRIN, Olomouc

https://www.catrin.com

https://www.catrin.com/research-groups/

Magnetic nanostructures, carbon nanostructures, molecular magnets, nanomaterials in biomedicine, environmental NanoTechnologies, nanomaterials boosts for hydrogen production,nanoelectronics and

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spinotronics ...

CNT, Ostrava

https://ceet.vsb.cz/cnt/en/cnt/

Characterization of nanomaterials and their composites, the application of NanoTechnologies and advanced materials and their environmental safety, nanophysics, magneto-optics, plasmonics and spintronics, and molecular modelling and simulation ...

CXI, Liberec

https://www.cxi.tul.cz/#aboutus

Advanced (waste)water treatment technologies, membrane bioreactors, application of nanomaterials in various treatment processes and technologies, nano-based filters, functionalized nanomaterials, preparation of nanoparticles, nanomaterials in tissue engineering and catalysis, nanomaterials and porous structures for regenerative medicine, drug delivery and cosmetics, electrospinning, development of nanofiber matrices and nanomaterials.

CENMAT, Pardubice

https://fcht.upce.cz/en/fcht/center-of-materials-and-NanoTechnologies-cemnat

Renewable energy resources, 1D nanotubes and nanoparticles for solar cells and baterries, chemically active surfaces zeolites, silica, alumina as membranes or nanofibers, metamaterials, 3D photonic crystals ...

NTC, Plzeň

https://www.ntc.zcu.cz/en/

Advanced and quantum materials in the fields of ecological energy sources and smart transportation, superconductivity, quantum sensors and detectors, 2D nanomaterials ...

Nanorobots Research Center, Praha

https://nanorobots.cz/frontpage/

Research on self-propelled autonomous nanomachines, nanomedicine, wearable nanoelectronics

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FZU – Institute of Physics, Praha

https://www.fzu.cz/en/research

Magnetic nanomaterials, semiconductor nanostructures, spinotronics, dynamics of nanosystems, 2D nanomaterials, quantum technologies, antibacterial and self-cleaning coatings ...

1.3.4 Universities in the Czech Republic with Accredited NanoTechnology Programs

VSCHT, Praha

https://www.vscht.cz

http://nano.vscht.cz/ .... they even have a special Bc. study program focused on NanoTechnology in chemical engineering

CVUT, Praha

https://www.fbmi.cvut.cz/en

TUL, Liberec

https://www.tul.cz/en/home-page/

University of West Bohemia, Plzen

https://www.tul.cz/en/home-page/

University of South Bohemia, Ceske Budejovice

https://www.prf.jcu.cz/en/

focused a lot on biotechnologies

UJEP, Usti nad Labem

https://www.physics.ujep.cz/en/

UNIVERSITY OF PARDUBICE, Pardubice

https://fcht.upce.cz/en

UPOL, Olomouc

https://www.upol.cz/en/

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UTB, Zlín

https://www.utb.cz/en/vyhledavac-oboru/NanoTechnology-and-advanced-materials-phd/

VSB-TUO, Ostrava

https://www.vsb.cz/en

MASARYK UNIVERSITY, Brno

https://www.sci.muni.cz/en

1.3.5 Strategic Relevance

NanoTechnology aligns closely with **national innovation and industrial strategies**, particularly in areas such as advanced manufacturing, healthcare technologies, and sustainability. It is seen as a key enabling technology that strengthens the competitiveness of traditional industries while fostering the emergence of new high-tech sectors. Participation in European research programs further enhances the strategic position of Czech NanoTechnology by integrating it into broader innovation ecosystems.

1.4 Challenges and Barriers

Despite its strengths, the Czech NanoTechnology sector faces several challenges that affect its long-term growth and global competitiveness.

1.4.1 Technological and Scientific Challenges

One of the main technological challenges is **scaling up NanoTechnology solutions from laboratory to industrial production**. Many nanomaterials exhibit excellent performance at small scales, but maintaining quality, uniformity, and reliability in large-scale manufacturing remains difficult. Reproducibility and long-term stability are critical issues, particularly for applications in healthcare and electronics.

1.4.2 Economic and Market Challenges

NanoTechnology development often requires **high upfront investment** in specialized equipment and skilled personnel. Long development cycles and uncertain market demand can deter private investors,

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especially in early-stage ventures. Market acceptance is another challenge, as customers may be cautious about adopting new materials or technologies without proven cost-benefit advantages.

1.4.3 Regulatory Considerations

Regulatory and standardization issues present additional barriers. Concerns about **health, safety, and environmental impacts** of nanomaterials require thorough risk assessment and compliance with evolving regulations. The lack of harmonized international standards can complicate market entry and increase certification costs, particularly for SMEs.

Overall, NanoTechnology in the Czech Republic represents a strategically important, innovation-driven sector with strong research foundations and growing industrial impact. Addressing technological, economic, and regulatory challenges will be essential to fully realize its potential and ensure sustainable long-term development.

2. Funding and Financial Support Opportunities

Access to appropriate funding is one of the key success factors for Startups, especially in their early stages of development. In the Czech Republic, Startups can benefit from a relatively diverse funding ecosystem that combines public support, private investment, and hybrid financial instruments at regional, national, and international levels. This chapter provides an overview of the funding landscape available to Startups in the Czech Republic, with a focus on early-stage companies, and discusses both opportunities and challenges related to accessing financial support.

2.1 Overview of the Funding Landscape

The funding landscape for Startups in the Czech Republic has developed significantly over the past decade, driven by increased governmental support for innovation, the growth of venture capital activity, and stronger integration into European and global markets. While the ecosystem is still smaller compared to Western European countries, it offers a solid foundation for early-stage entrepreneurs.

Startup financing typically follows several **development stages**. In the **pre-seed stage**, founders often rely on personal savings, support from family and friends, or small grants and innovation vouchers. This phase focuses on idea validation, market research, and early product development. The **seed stage** usually

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involves higher financial needs, such as developing a minimum viable product (MVP), hiring key team members, and entering the market. Funding at this stage may come from angel investors, seed venture capital funds, or public Startup programs.

The **early-stage (Series A)** phase targets business growth, customer acquisition, and revenue generation. At this point, Startups often seek venture capital funding or strategic investors. Finally, the **scale-up stage** focuses on rapid expansion, internationalization, and process optimization, often supported by larger venture capital funds, corporate investors, or international financial institutions.

Overall, Czech Startups benefit from a **mixed funding model**, where public funding plays a particularly important role in reducing early-stage risk and attracting private investors.

2.2 Regional / Local Level

Regional and local funding instruments are often the first external financial resources available to Startups. These programs aim to support entrepreneurship, innovation, and job creation within specific regions and cities.

2.2.1 Public Funding Programs

At the regional and municipal level, public funding is typically provided through **local government grants, job centers, and innovation-focused initiatives**. Many regions in the Czech Republic offer **Startup grants** designed to encourage self-employment and new business creation, especially for unemployed individuals or recent graduates.

Labour Offices (Job Centers) provide financial support for starting a business, usually in the form of one-time grants or monthly contributions during the first months of operation. These programs are particularly suitable for micro-Startups and sole proprietors, although eligibility criteria can be restrictive.

Another important tool is **innovation vouchers**, which are widely used across Czech regions. Innovation vouchers support cooperation between Startups or SMEs and research institutions such as universities or research centers. The funding typically covers services like prototype development, feasibility studies, testing, or consulting. This instrument is especially valuable for technology-oriented Startups with limited R&D resources.

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Cities such as Prague, Brno, and Ostrava also run **local entrepreneurship programs**, often combined with incubators or innovation hubs, providing small grants, mentoring, and access to shared infrastructure.

2.2.2 Private and Hybrid Instruments

At the regional level, **local banks** play a significant role in providing debt-based financing, such as business loans, overdrafts, and leasing. However, traditional bank financing is often difficult for early-stage Startups due to the lack of collateral and operating history.

To address this issue, some regions offer **guarantee schemes or subsidized loans**, often in cooperation with public institutions. These hybrid instruments reduce the risk for banks and improve Startups' access to credit. Regional incubators and accelerators may also provide small seed investments combined with mentoring and networking support.

2.3 National Level

National-level funding represents a crucial pillar of the Czech Startup ecosystem, particularly in areas related to innovation, research, and technological development.

2.3.1 Public Funding Programs

The Czech government offers a range of **national public funding programs** aimed at supporting Startups, innovation, and R&D activities. These programs are typically administered by ministries or specialized agencies and often co-financed by the European Union.

National **R&D grants** support applied research, experimental development, and commercialization of innovations. These grants are especially relevant for Startups in sectors such as IT, engineering, biotechnology, and clean technologies.

In addition, the state provides **Startup and innovation support programs**, including business acceleration schemes, mentoring, and internationalization support. Some programs focus specifically on young innovative companies, offering financial contributions combined with expert guidance.

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Another important instrument is **tax incentives**, particularly R&D tax deductions. Startups conducting eligible research and development activities can deduct related costs from their tax base, which significantly reduces their overall tax burden. Although these incentives do not provide immediate cash, they improve long-term financial sustainability.

2.3.2 National Grant Programs & Providers for NanoTechnology Startups (Czech Republic)

1) Ministry of Industry and Trade (MPO – Ministerstvo průmyslu a obchodu)

The Ministry of Industry and Trade is one of the central government bodies responsible for supporting business development, innovation, competitiveness, and technology adoption across the Czech Republic. It designs and oversees major national grant programs funded from the state budget and EU funds. Programmes can include support for innovative Startups, digitalization, internationalization, and R&D activities.

Examples:

- **Operational Programme Enterprise and Innovation for Competitiveness (OP PIK)** – offers grants and financial instruments for SMEs, innovation projects, and export support (co-funded by EU and national sources)
- **National calls** targeting digital transformation, energy efficiency, and innovation adoption

2) CzechInvest – Investment and Business Development Agency

CzechInvest is a national government agency focused on economic development, investment attraction, and Startup support. Its mandate includes helping Czech Startups scale, access foreign markets, and connect with investors.

Relevant support programmes include:

- **Technology Incubation Programme** – a major initiative providing pre-seed and early-stage support to technology Startups in sectors like AI, advanced materials, ecology, mobility, and life sciences. This programme combines financial and non-financial support with investor networking.

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- Programs linked to **ESA BIC Czech Republic** (space tech incubation) or **CERN Venture Connect** for deep tech and hardware Startups.

CzechInvest also operates the **Enterprise Europe Network (EEN)** in the Czech Republic, offering support in accessing EU business opportunities, innovation funding guidance, and international partner search.

Structure and Eligibility:

- Startups can receive direct financial support up to ~CZK 4–5 million (pre-seed / early stage).
- Includes consulting and business support worth additional value.
- Typically runs over 18–24 months.
- Focus areas include advanced materials and technologies that are highly relevant for NanoTechnology ventures.

Relevance for NanoTech Startups:

NanoTechnology often involves advanced materials, surface engineering, and high-tech product development, which are among the core fields targeted by this programme. Early-stage NanoTech Startups can use the funding to develop prototypes, refine technologies, and prepare for market entry.

3) Technology Agency of the Czech Republic (TA ČR – Technologická agentura ČR)

The **Technology Agency of the Czech Republic** is a key national institution dedicated to financing applied research, experimental development, and innovation. It manages competitive calls for funding projects that generate new products, technologies, or services and enhance company competitiveness.

Funds and programs include:

- **TREND Programme** – supports applied research and development that strengthens competitiveness and promotes innovative products.
- Other thematic calls focused on collaborative R&D or partnerships between industry and research institutions.

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TA ČR acts as a national contact point for certain international programmes like **Eureka/Eurostars**, which combine Czech public funding with international cooperation.

Examples of programmes typically available:

- **Projects supporting applied research** leading to commercialization – ideal for Startups working on materials research or NanoTech applications
- **Collaborative grant** calls with universities or research institutes
  Why it matters: TA ČR grants help bridge the gap between scientific research and marketable technology — which is critical for deep tech areas like NanoTechnology

Relevance for NanoTech Startups:

These grants are ideal for NanoTechnology Startups that are closely tied to R&D, particularly those collaborating with academic partners or technology institutes to validate technologies or develop prototypes.

4) Czech Science Foundation (GA ČR – Grantová agentura ČR)

Although primarily focused on fundamental research, the **Czech Science Foundation** provides competitive funding that can be valuable for Startup-related research or spin-off projects emerging from academic environments. It funds research projects through calls for proposals across scientific fields.

Funding Scope: Over **400+ projects funded annually**, with total budgets in the billions of CZK

5) National Plan for Recovery (Národní plán obnovy – NPO)

The **National Plan for Recovery** is a major funding framework at the national level that channels EU recovery funds into innovation, export support, and internationalization initiatives for Startups and SMEs. For example, there are specialized NPO calls supporting Startup internationalisation, mentoring services, and business expansion activities.

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6) Support via RIS3 and Operational Programmes

National strategic frameworks like **RIS3 (Research, Innovation, and Smart Specialisation Strategy)** and its associated **national and operational programmes** support Startups through public competitions for grants focused on innovation, digital industries, and high-tech sectors. These are often coordinated by government ministries such as the Ministry of Industry and Trade, but disbursed through specific calls.

7) **Národní rozvojová investiční (NRI)-PO Fond 2025+**

PO Fond 2025+ is a state-backed investment fund in the Czech Republic designed to support the growth and capital-market entry of small and medium-sized companies (up to 500 employees) by helping them prepare for and execute Initial Public Offerings (IPOs) on the Prague Stock Exchange, especially on the Start Market.

The fund is managed by **Národní rozvojová investiční (NRI)**, a subsidiary of the National Development Bank, and was created in cooperation with the Ministry of Industry and Trade and the Prague Stock Exchange. Its overall allocation through **2030 is around CZK 300–360 million**, and it can invest up to **30% of the newly issued shares** in a given IPO, leaving the majority of capital to private investors. The main goals of IPO Fond 2025+ are to make it easier for ambitious Czech firms to attract capital, encourage more domestic companies to list publicly, and strengthen the Czech capital market by mobilizing both public and private investment.

Here are **specific current (early 2026) national funding opportunities** that a **NanoTechnology Startup in the Czech Republic** could realistically target

1) CzechInvest – ***Technology Incubation (Technologická inkubace)***
Provider: CzechInvest (national government agency)
Programme Status: New call opened **24 Nov 2025–9 Jan 2026** for Incubation PLUS.
Funding Available: Up to **CZK 5 million per Startup** (≈ EUR 200 k) for **18–24 months** of support.
Focus Areas: Advanced materials (e.g., NanoTechnology), AI, ecology & circular economy, medtech & biotech, quality of life technologies.

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Relevance for NanoTech Startups*:*

Since NanoTechnology often involves advanced materials and product development, this incubator grant is highly applicable for early-stage prototype work or pilot product market entry.

2) TA ČR – ***Public Call (Druhá veřejná soutěž)***

Provider: Technology Agency of the Czech Republic (TA ČR)

Programme Status: Public competition ongoing, **results expected by 28 Feb 2026**.

Funding Available: Approx. **CZK 460 million total allocation** (individual projects up to **CZK 12 million**, with up to **85 % intensity**).

Eligibility: Businesses and research organizations working on **applied research and experimental development** in priority technology areas defined by the call.

Relevance for NanoTech Startups:

Ideal for R&D projects involving **nanomaterials, nanoscale processes, or experimental NanoTechnology development**. This call can cover prototyping, testing, and pre-market validation phases.

Tip: Align your application with priority research goals (e.g., materials science, sustainability, applied physics) to boost success chances.

3) TA ČR – ***Eurostars/EU Partnership on Innovative SMEs***

Provider: Technology Agency of the Czech Republic (national contact point)

Programme Status: Ongoing *Eurostars 3 Call 10* (2026).

Funding Available: Co-funded by EU & national budgets — typical grants for SMEs and Startups with breakthrough tech.

Eligibility: Innovative SMEs with international partners across Europe; must involve R&D and strong commercialization potential.

Relevance for NanoTech Startups*:*

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Excellent for NanoTech Startups working on international R&D consortia **— e.g., nanophotonics, nanoelectronics, advanced coatings, or life-science nano solutions.**

4) GA ČR – ***Standard Projects & Junior Star Grants***

Provider: Grantová agentura České republiky (Czech Science Foundation)

Status & Funding:

- **Standard Projects:** CZK 3 billion for basic research (2026 round).
- **Junior Star:** Individual research funding up to **CZK 25 million** for early-career scientists (5year projects).

Deadline Info: Projects with 2026 launch are funded on a competitive schedule; application deadlines were earlier in 2025.

Relevance for NanoTech Startups:

If your Startup originates from university research, these grants can support fundamental nanoscience research that strengthens your technology base — especially if tied to experimental breakthroughs or early prototypes.

5) **Národní rozvojová investiční (NRI)-PO Fond 2025**

Provider: Národní rozvojová investiční

Status & Funding: The fund has been allocated approximately CZK 360 million through 2030 to invest in eligible companies. A call for applications for Czech firms with up to 500 employees was issued in November 2025, and the programme is actively accepting registrations to support companies' capital-raising and IPO preparations.

Relevance for NanoTech Startups:

IPO Fond 2025+ is particularly relevant for nanotechnology startups with strong R&D backgrounds that are transitioning from innovation to commercial scale. By co-investing in IPOs, the fund helps reduce entry barriers to public capital markets, supports long-term growth financing, and increases credibility with private investors. For NanoTech companies operating in capital-intensive fields such as advanced

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materials, medical technologies, or nanocosmetics, the fund provides an opportunity to secure growth capital while gaining visibility and trust through a public listing.

2.3.3 Private and Hybrid Instruments

On the private side, the national ecosystem includes a growing number of **venture capital (VC) funds**, **angel investor networks**, and **corporate venture capital (CVC)** initiatives. Angel investors typically invest smaller amounts at early stages and often contribute valuable experience and industry contacts.

Venture capital funds focus on Startups with high growth potential and scalable business models. While competition for VC funding is strong, successful Startups benefit from both capital and strategic support. Corporate venture capital, operated by large Czech or international companies, targets Startups whose innovations align with corporate strategy and offers opportunities for long-term partnerships.

Hybrid instruments, such as **co-investment funds**, combine public and private capital to stimulate investment into early-stage Startups and reduce risk for private investors.

2.4 International Level

International funding opportunities are particularly important for Czech Startups aiming to scale beyond the domestic market. These programs provide access to larger financial resources, international networks, and global markets.

2.4.1 Public Funding Programs

At the international level, **European Union funding programs** represent the most significant source of public support. These programs focus on innovation, research, digitalization, sustainability, and cross-border cooperation.

EU funding often supports **collaborative projects**, involving partners from multiple countries, which allows Startups to access knowledge, technology, and foreign markets. In addition, **bilateral and multilateral funding schemes** support cooperation between Czech Startups and international partners, particularly in research and innovation.

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Although highly competitive, these programs can provide substantial financial support and significantly enhance a Startup's credibility.

Specific current (early 2026) international funding opportunities that a **NanoTechnology Startup in the Czech Republic** could realistically target are:

1) EIC Accelerator (European Innovation Council)

- Offers **blended finance (grants + equity)**: up to **€2.5 M in grants** + equity for high-impact deep tech ventures.
- Suitable for high-risk, high-reward technologies including **nanomaterials, semiconductor tech, nano-enabled medtech, advanced manufacturing**.

2) European Innovation Partnerships

- Large collaborative calls facilitating joint projects with European partners (industry + academia). Often structured with strong support from TA ČR for Czech entities.

2.4.2 Private and Hybrid Instruments

International **venture capital funds** and **cross-border accelerators** offer Startups not only funding but also access to global mentorship, investor networks, and customers. Participation in international accelerators often helps Startups refine their business models and prepare for international expansion.

Hybrid instruments, such as public-private international funds, support Startups entering foreign markets by sharing financial risk and providing strategic guidance. For ambitious Czech Startups, these instruments are key to successful globalization.

2.5 Accessibility and Challenges of Funding

Despite the wide range of funding opportunities, Startups in the Czech Republic face several challenges when accessing financial support. Common obstacles include high administrative complexity, strict eligibility criteria, and long evaluation processes, particularly for public grants. Many early-stage founders lack experience with grant applications or investor negotiations, which reduces their

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chances of success. In addition, public funding often requires co-financing, which can be difficult for Startups with limited capital. Nevertheless, with proper preparation, professional support, and a clear growth strategy, Czech Startups can effectively leverage available funding instruments to support their development and long-term competitiveness.

Here's a quick look at where each program is most relevant in a typical NanoTech development path:

Programme	Stage	Best Use Case
CzechInvest Technology Incubation	Pre-seed / Early	Prototype refinement, market preparation
TA ČR Public R&D Calls	Early / Growth	Applied R&D, product testing, certification
TA ČR Eurostars	Expansion	International R&D collaboration
GA ČR Grants	Early / Research	Basic research tied to NanoTech capabilities
EIC Accelerator	Scale-up	Global product launch + significant growth

Summary of Key Deadlines (2026 cycle)

- **Technology Incubation**: application closed early Jan 2026 (but future calls likely in 2026)
- **TA ČR Druhá veřejná soutěž**: results by **28 Feb 2026**; next call might open thereafter
- **Eurostars 3**: ongoing calls in **2026**
- **EIC Accelerator**: continuous submission windows throughout 2026 (varies by round)

Tips for NanoTech Funding Success (Practical)

1. **Align your proposal with national priorities**: NanoTech applications in energy, medtech, advanced manufacturing or sustainability are particularly competitive
2. **Partner with academic institutions** to strengthen applications for TA ČR or GA ČR calls
3. **Explore EU instruments early**, especially for scaling beyond Czech markets
4. **Track RIS3 and TA ČR newsletters** — calls are often updated mid-year

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3. Practical Tips

Establishing a NanoTechnology (NanoTech) business in the Czech Republic requires a combination of technical expertise, strategic planning, and thorough knowledge of the national entrepreneurial environment. Due to the research-intensive and capital-demanding nature of NanoTech, founders must navigate a complex system of public authorities, support institutions, and innovation-oriented organizations. The Czech Republic offers a relatively well-structured ecosystem for innovative Startups, supported by national ministries, municipal authorities, chambers of commerce, universities, and public innovation agencies.

This chapter provides practical guidance tailored to the Czech context. It covers the first administrative steps in business creation, outlines available training and support programs, explains the national framework for intellectual property protection, and highlights key networking and incubation opportunities relevant to NanoTech Startups.

3.1 First Steps in Business Creation

The early phase of business creation is decisive for the long-term success of a NanoTech Startup. Founders must choose an appropriate legal structure, ensure compliance with trade and company law, and establish relationships with relevant public institutions.

3.1.1 Administrative Procedures

In the Czech Republic, entrepreneurs may choose from several legal forms, the most common being sole proprietorship (OSVČ), limited liability company (společnost s ručením omezeným – s.r.o.), and joint-stock company (akciová společnost – a.s.). For NanoTech Startups, limited liability forms are generally preferred, as they reduce personal financial risk and are better suited for attracting investors.

A fundamental administrative step is obtaining a trade license (živnostenské oprávnění). This process is handled by the trade licensing offices of municipal authorities (živnostenské odbory městských úřadů). These offices determine whether the planned business activity falls under a free, regulated, or licensed trade, which is particularly important for NanoTech companies involved in advanced manufacturing, laboratory services, or applied research.

Trade license applications can be submitted in person, electronically, or through the Czech POINT system, which serves as a one-stop shop for public administration services. Once the trade license is issued, entrepreneurs must register with the tax authority, social security administration, and health insurance

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companies. Companies such as s.r.o. and a.s. must also be entered into the Commercial Register maintained by the relevant Regional Court.

3.1.2 Relevant Players

Several key institutions support entrepreneurs during the business creation process in the Czech Republic. The Hospodářská komora České republiky (Czech Chamber of Commerce) is the most significant business association, representing entrepreneurs across regions and sectors. The Chamber provides advisory services, legal and regulatory information, professional training, and networking opportunities. It also plays an advocacy role, representing business interests at the national and European levels. More information is available at https://www.komora.cz/

Municipal trade licensing offices remain essential partners throughout the business lifecycle, particularly when expanding business activities or modifying licenses. Public business support agencies such as CzechInvest and the Technological Agency of the Czech Republic (TA ČR) offer financial instruments, innovation vouchers, and consulting services targeted at technology-driven Startups.

Universities and research institutions contribute through technology transfer offices (TTOs), which assist in the commercialization of research results, patent licensing, and the establishment of spin-off companies.

3.2 Guide to Existing Training and Support Programs

Given the interdisciplinary nature of NanoTech, founders must continuously develop both technical and managerial competencies. The Czech Republic offers a variety of public and specialized programs designed to support entrepreneurial education and business development.

3.2.1 Job Centers and Public Coaching Programs

Public employment services and job centers increasingly support entrepreneurship through coaching and retraining programs. These initiatives often include business planning assistance, financial literacy training, and individual mentoring. Such programs are particularly beneficial for researchers and engineers transitioning from academia to entrepreneurship.

Many public coaching programs are subsidized or provided free of charge and are organized in cooperation with municipal authorities and chambers of commerce. By participating in these programs, founders gain access not only to knowledge but also to local entrepreneurial networks.

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3.2.2 Specialised Programs

In addition to general support programs, NanoTech Startups benefit from specialized initiatives focused on high-tech innovation. Czech universities offer entrepreneurship courses, accelerators, and innovation labs that combine technical mentoring with business development.

CzechInvest operates national and international Startup support schemes, including accelerator programs and soft-landing services for international expansion. These programs help NanoTech Startups access foreign markets, investors, and research partners.

3.3 Patents and Intellectual Property

Intellectual property protection is a critical success factor for NanoTech Startups, as their value is closely linked to proprietary knowledge and innovation outcomes.

3.3.1 Strategy for NanoTech Startups

NanoTech founders should develop an intellectual property strategy at an early stage. Patents are the primary tool for protecting inventions such as novel nanomaterials, production processes, and technological applications. Utility models, industrial designs, and trade secrets may complement patent protection.

Effective IP management requires careful timing of patent applications, avoidance of premature disclosure, and alignment with commercialization plans. Cooperation with patent attorneys and university TTOs is strongly recommended.

3.3.2 National IP Framework

In the Czech Republic, the Industrial Property Office (Úřad průmyslového vlastnictví, ÚPV) is responsible for granting patents, registering trademarks, and protecting industrial designs. The Office provides guidance on application procedures, costs, and legal requirements.

Patent applicants must submit a detailed description of the invention and subsequently request substantive examination. Annual maintenance fees apply to keep patents valid. Support services offered by the ÚPV, the Czech Chamber of Commerce, and public innovation agencies help Startups navigate the IP system.

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3.4 Networking Opportunities and Incubation

Networking and incubation significantly influence the growth potential of NanoTech Startups by facilitating access to expertise, infrastructure, and capital.

3.4.1 Networks and Cluster Organisations

NanoTech entrepreneurs in the Czech Republic can join sector-specific networks such as the Czech NanoTechnology Industry Association (Nanoasociace), https://nanoasociace.cz/en/. These organizations promote collaboration between companies, research institutions, and public authorities and represent the sector at national and international levels.

Important networking platform is Ynovate, a national innovation network connecting regional innovation centers, https://www.ynovate.cz/en/.

Additional networking opportunities are provided by the Enterprise Europe Network and regional innovation clusters supported by chambers of commerce and regional governments.

Participation in these networks enables NanoTech founders to access collaborative projects, policy advocacy, and visibility within the Czech and European innovation ecosystems.

3.4.2 Incubators and Accelerators

Startup incubators and accelerators provide essential support during early development stages. Czech incubators often offer office space, laboratory facilities, mentoring, and access to investors. Some incubators are specifically linked to universities and research centers, making them particularly suitable for NanoTech Startups.

•**CzechInvest – Technological Incubation Programme**: https://czechinvest.gov.cz/en/For-Startups/Technology-incubation

A nationwide incubation scheme offering mentoring, expert consulting, and access to funding for technology-based Startups.

• **ESA Business Incubation Center Czech Republic**: https://www.esa-bic.cz/

Supports technology Startups applying advanced materials, sensors, or NanoTechnologies with up to EUR 50,000 in non-equity funding.

• **InQbay – CTU Business Incubator**: https://inqbay.cvut.cz/en/

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A university-linked incubator at the Czech Technical University in Prague, supporting research spin-offs and early-stage Startups.

• **South Moravian Innovation Center (JIC)**: https://www.jic.cz/

Provides mentoring, acceleration programs, and investor access for innovative Startups, including deep-tech ventures.

Accelerator programs typically focus on rapid validation of business models, preparation for investment, and scaling strategies. Participation in such programs enhances the technological readiness and market competitiveness of NanoTech ventures.

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3. Literature Review for Italy

Partner organisation	Confcommercio Molise
Country	Italy

1. Nanotechnology Industry Landscape

1.a. Overview of the Nanotechnology Industry in Italy

1.a.i. Key sub-fields relevant to the country

Italy's nanotechnology landscape reflects a strategic alignment between its strong manufacturing heritage and emerging high-tech capabilities. The country's research and development efforts concentrate on several key sub-fields that leverage national industrial strengths while addressing global technological challenges. Primary focus areas include **nanomaterials**—particularly graphene and 2D materials, which promise revolutionary applications in electronics and energy storage—as well as **nanomedicine**, where nanoparticle-based drug delivery systems and advanced diagnostic tools represent frontier areas of investigation. Additionally, significant activity occurs in **nano-electronics and photonics**, positioning Italy within the European semiconductor and sensor ecosystem, and in **nanostructured coatings** for energy efficiency and sustainable construction—domains where Italy's established materials science expertise provides a competitive advantage. These research directions are underpinned by a robust institutional infrastructure comprising public research bodies such as the Italian National Research Council (CNR) with its network of specialized institutes, the Italian Institute of Technology (IIT) known for its interdisciplinary approach, and leading technical universities including Politecnico di Milano, Politecnico di Torino, and others that maintain world-class nanotech facilities (CNR, 2023; IIT, 2023).

1.a.ii. Market size and Economic Importance

Quantifying the precise economic footprint of Italy's nanotechnology sector presents methodological challenges, as official statistics do not isolate this cross-cutting technology from broader industrial classifications. Nevertheless, the **National Institute of Statistics (ISTAT)**, in collaboration with **Unioncamere**, provides valuable insights through periodic surveys. Their latest report identifies **1,240 Italian enterprises** engaged in nanotechnology-related activities as of late 2024, marking a notable 35%

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increase from 920 enterprises recorded in 2019. This growth trajectory suggests gradual but steady market development. However, the enterprise landscape remains dominated by micro and small firms (those with fewer than 50 employees), with relatively few pure-play nanotechnology startups that focus exclusively on nanoscale innovations (ISTAT & Unioncamere, 2025). While the commercial impact of nanotechnology in Italy remains modest compared to more established industrial sectors, the technology holds strategic importance that transcends current market size. It is formally recognized as a **Key Enabling Technology (KET)** under national and EU innovation strategies due to its cross-sectoral potential (European Commission, 2024).

1.b. Applications in the Different Industries

1.b.i. Key Industrial Application Areas

Italy's nanotechnology applications span multiple strategic sectors, reflecting both established industrial strengths and emerging opportunities in high-tech domains. The deployment of nanoscale innovations across these diverse fields demonstrates the technology's horizontal nature and its potential to enhance competitiveness across the economic spectrum:

- **Healthcare and Life Sciences**: This sector represents one of the most promising application areas, with substantial research activity in nanoparticle-based drug delivery systems that enable targeted therapeutics and reduce side effects, as well as advanced biosensors for early disease detection. Leading academic institutions including IIT, Sapienza University of Rome, and the University of Bologna maintain cutting-edge laboratory facilities dedicated to nanomedicine research. However, despite strong scientific capabilities, the translation of these innovations into commercial products remains constrained by regulatory complexity, lengthy clinical validation requirements, and limited venture capital availability for early-stage biotech ventures (Pozzoli, Tosi, & Vandelli, 2020).
- **Energy**: In alignment with European decarbonization objectives and Italy's National Energy and Climate Plan, significant research efforts concentrate on nanostructured photovoltaics, particularly next-generation perovskite solar cells that promise higher efficiency at lower cost. CNR's Institute for the Study of Nanostructured Materials (CNR-ISMN) leads work in this domain. Parallel investigations explore catalytic nanomaterials for green hydrogen production, positioning Italy within the emerging hydrogen economy value chain. These developments are critical for enhancing energy security and reducing dependence on fossil fuel imports (CNR, 2023).

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- **Electronics and Digital Transition**: Italy contributes to Europe's digital sovereignty ambitions through research on nanoscale sensors, quantum dots, and two-dimensional material components for next-generation electronic devices. These efforts often unfold through collaborative arrangements between research institutions and major semiconductor players such as STMicroelectronics, which maintains significant R&D presence in Italy. The integration of nanotechnology into sensors, Internet of Things (IoT) devices, and flexible electronics represents a strategic opportunity to strengthen Italy's position in high-value segments of the global electronics supply chain (STMicroelectronics & IIT, 2023).
- **Advanced Materials and Manufacturing**: Italy's traditional strength in chemical and materials manufacturing provides fertile ground for nanotechnology integration. Major industrial players such as **Eni** (through its Versalis chemical division) and **Mapei** (a global leader in construction chemicals) have successfully incorporated nanocomposites into polymer formulations and specialized coatings, enhancing material performance characteristics such as strength, durability, thermal resistance, and barrier properties. These applications demonstrate how nanotechnology can incrementally improve existing product lines while opening pathways to entirely new material functionalities (Eni, 2023; Mapei, 2023).
- **Environment and Sustainability**: Addressing environmental challenges through nanotechnology aligns with both EU Green Deal priorities and Italy's commitment to circular economy principles. Current development efforts include nanostructured filtration membranes for water purification that can remove contaminants at molecular scale, nano-catalysts designed to reduce industrial emissions and improve air quality, and nanomaterials for environmental remediation. Many of these projects receive funding through the Piano Nazionale di Ripresa e Resilienza (PNRR), Italy's implementation of the EU Recovery and Resilience Facility, which allocates substantial resources to green technologies and sustainable innovation (MIMIT, 2025).

1.b.ii. Role of Startups

Startups in Italy typically enter the nanotechnology value chain as academic spin-offs or specialized B2B service providers, rather than as mass-market product companies. A notable example is a graphene-based biosensor venture developed by researchers affiliated with the Italian Institute of Technology (IIT) and Politecnico di Milano, which received €2.3 million in non-dilutive funding from the European Innovation Council (EIC) Accelerator in 2023 to advance prototype validation in medical diagnostics—a project

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publicly listed in the EIC's official database (European Commission, 2025). Similarly, CNR-NANOTEC in Lecce has fostered SMEs offering nanomaterial characterization and safety testing services to European clients, leveraging PNRR-funded open-access infrastructure to support commercialization (CNR-NANOTEC, 2023). These cases illustrate a recurring model: Italian nanotech startups often emerge from public research institutions and focus on niche technological solutions or R&D-enabling services, collaborating closely with larger industrial partners (e.g., in healthcare or advanced manufacturing) rather than pursuing standalone product scaling. This pattern reflects both the strength of Italy's public research base and the limited availability of early-stage risk capital for deep-tech ventures (AIFI & Italia Startup, 2024).

1.c. Characteristics and Importance of the NanoTech Sector

1.c.i. Innovation Characteristics

Nanotechnology development in Italy exhibits distinctive innovation characteristics that shape both opportunities and challenges for startups and established companies. The field is inherently **R&D-intensive**, typically requiring sustained investment in advanced instrumentation, specialized facilities, and highly trained personnel before reaching commercial viability. Furthermore, nanotechnology is fundamentally **interdisciplinary**, demanding convergent expertise spanning physics, chemistry, materials science, biology, and multiple engineering disciplines—a requirement that necessitates collaborative team structures and complicates talent recruitment. Development timelines in nanotechnology are characteristically extended, often spanning 5 to 10 years from initial concept to market-ready product, reflecting the complexity of materials optimization, safety validation, regulatory approval processes, and industrial scale-up. Success in this sector consequently depends not only on scientific excellence but also on sustained access to specialized infrastructure such as cleanrooms and characterization equipment, proficiency in navigating evolving regulatory frameworks for nanomaterials, and the financial resilience to endure protracted development cycles (Bonaccorsi, Cinelli, & Fantoni, 2021).

1.c.ii. Research Infrastructure

Italy hosts world-class research infrastructure:

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- **CNR Institutes**: Including NANOTEC (Lecce), ISMN (Bologna), and IMM (Bologna/Catania), offering open-access cleanrooms and pilot lines (CNR, 2023).
- **IIT (Genoa)**: Operates advanced labs for graphene, nanomedicine, and sustainable nanomaterials (IIT, 2023).
- **INFN**: Provides nanofabrication facilities at LNF (Frascati) and LABEC (Florence) (INFN, 2022).
- **University Labs**: Politecnico di Milano, Politecnico di Torino, and University of Bologna maintain dedicated nanotech facilities.

Access to these resources is often available to SMEs via PNRR-funded programs or collaborative projects (MIMIT, 2025).

1.c.iii. Strategic Relevance

Nanotechnology is included in Italy's **National Recovery and Resilience Plan (PNRR)** under Mission 4 ("Education and Research") and Mission 1 ("Digitalisation"), particularly in **Important Projects of Common European Interest (IPCEIs)** on microelectronics, batteries, and hydrogen (MIMIT, 2025; European Commission, 2025). It is also central to the EU's **Key Enabling Technologies (KETs)** strategy, to which Italy actively contributes (European Commission, 2024).

1.d. Challenges and Barriers

1.d.i. Technological and Scientific Challenges

Translating nanotechnology innovations from laboratory proof-of-concept to industrial-scale production presents persistent scientific hurdles. Key obstacles include ensuring reproducibility of nanomaterial synthesis across batches, maintaining material stability under real-world operating conditions, and achieving seamless integration with existing manufacturing processes without disrupting established production lines. These technical barriers often delay commercialization timelines and increase scale-up costs, particularly for startups lacking access to pilot-scale facilities or process engineering expertise (Pozzoli et al., 2020).

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1.d.ii. Economic and Market Challenges

Italian nanotechnology ventures confront a pronounced funding gap during early development stages, characterized by high capital intensity, extended R&D timelines (typically 5–10 years), and scarce private risk capital willing to support deep-tech commercialization. This confluence creates a "valley of death" between academic validation and market-ready prototypes. The challenge is compounded by the Italian venture capital landscape's strong orientation toward software and digital services, leaving nanotechnology and advanced materials startups struggling to secure seed funding despite scientific promise (AIFI & Italia Startup, 2024).

1.d.iii. Regulatory Considerations

Nanotechnology startups must navigate a complex and evolving regulatory environment that adds significant compliance burden, particularly for resource-constrained SMEs. At the European level, nanomaterials fall under REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals), which mandates separate registration dossiers for each "nanoform" with specific safety data—increasing administrative costs and technical requirements compared to bulk materials (ECHA, 2023).

For nanomedicine applications, the pathway becomes even more demanding: products must undergo stringent clinical validation and approval processes administered by the Italian Medicines Agency (AIFA), often extending time-to-market by several years and requiring substantial investment in regulatory affairs expertise.

2. Funding and Financial Support Opportunities

2.a. Overview of the Funding Landscape

Italy’s funding landscape for nanotechnology startups reflects broader structural characteristics of the national innovation system, where **public, non-dilutive instruments** predominate over private risk capital. This configuration creates both opportunities and constraints for deep-tech ventures. While grant-based support reduces dilution and enables patient capital deployment—critical advantages for nanotechnology companies facing extended R&D timelines—the scarcity of equity investors familiar with nanoscale

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technologies can impede growth-stage financing and strategic guidance. The funding pathway typically unfolds across distinct developmental stages. During the pre-seed phase

- entrepreneurs typically access proof-of-concept grants administered by the Ministry of Universities and Research (MUR) or university technology transfer offices, which provide modest funding (typically €30,000–€100,000) to validate technical feasibility and establish initial intellectual property positions. Transitioning to the seed stage
- ventures with validated prototypes can pursue more substantial non-dilutive funding through competitive programs like the European Innovation Council (EIC) Accelerator or regional innovation vouchers, which support prototype refinement and early market validation activities. Finally, at the scale-up phase
- companies demonstrating market traction may access growth capital through instruments such as the *Fondo per la Crescita Sostenibile* (Sustainable Growth Fund) or, increasingly, the EIC's equity facility that combines grant and investment components.

A notable structural challenge within this ecosystem is that most public funding programs concentrate on Technology Readiness Levels (**TRL 4–7**)—the demonstration and pilot-scale phases—while leaving earlier-stage research translation and prototyping (TRL 1–3) comparatively underfunded. This gap poses particular difficulties for nanotechnology ventures, where fundamental materials optimization and safety characterization often require significant resources before reaching demonstrable technical milestones (MIMIT, 2025).

2.b. Regional / Local Level

2.b.i. Public Funding Programs

- **Emilia-Romagna**: This northern region, characterized by strong manufacturing capabilities and innovation infrastructure, operates several programs relevant to nanotechnology ventures. Through ART-ER (the regional innovation agency), the region administers **Nanofab-ER**, a specialized initiative that provides small and medium enterprises with subsidized access to nanofabrication pilot lines and cleanroom facilities, alongside co-funding for collaborative R&D projects with grants reaching up to €300,000. This combination of infrastructure access and

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financial support addresses a critical bottleneck for startups lacking capital-intensive equipment (ART-ER, 2023).

- **Puglia**: In southern Italy, this region has strategically leveraged European recovery funds to strengthen its nanotechnology ecosystem. Puglia provides institutional and financial support to **CNR-NANOTEC** in Lecce as a designated regional technology hub (Tecnopolo) under PNRR funding streams, creating opportunities for startups to access world-class nanofabrication facilities, technical expertise, and connections to national and European research networks. This investment aims to catalyze innovation-driven economic development in a region historically characterized by limited private R&D investment (Regione Puglia, 2024).
- **Lazio**: The region encompassing Rome has developed targeted support mechanisms for technology-based entrepreneurship. Through Lazio Innova (the regional development agency), the region offers **Smart&Start Lazio** grants ranging from €100,000 to €300,000, designed specifically for innovative startups in technology sectors. Notably, the program includes dedicated funding for intellectual property protection—a particularly valuable provision for nanotechnology ventures where patent portfolios often constitute core strategic assets. The competitive selection process emphasizes innovation content, market potential, and team capabilities (Lazio Innova, 2024).

2.b.ii. Private and Hybrid Instruments

While regional banking networks (operating under the broader Italian banking system coordinated by Banca d'Italia-The Bank of Italy) provide standard SME lending products, these debt instruments typically require collateral and cash flow profiles that emerging nanotechnology companies rarely possess. Traditional lenders generally lack the technical expertise and risk appetite necessary for deep-tech ventures characterized by long development cycles and uncertain commercialization timelines. Significantly, no Italian region currently operates a dedicated venture capital fund focused specifically on nanotechnology or advanced materials, representing a structural gap in the financing ecosystem. Nanotechnology startups seeking regional equity investment must therefore compete within generalist innovation funds or seek capital from broader European investors (AIFI & Italia Startup, 2024).

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2.c. National Level

2.c.i. Public Funding Programs

- ***Fondo per la Crescita Sostenibile* (FCS, Sustainable Growth Fund)**: Administered by the Ministry of Enterprises and Made in Italy, this flagship instrument provides both grants and subsidized loans for industrial R&D projects in Key Enabling Technologies, explicitly including nanotechnology. The fund prioritizes projects demonstrating industrial relevance, partnership between companies and research centers, and potential for commercialization. Typical awards range from €500,000 to several million euros depending on project scope and partnership structure, making it accessible to both ambitious startups and established SMEs pursuing nanoscale innovations (MIMIT, 2025).
- **PNRR Valorizzazione (PNRR Research Valorization)**: Part of Italy's broader PNRR investment in research infrastructure and innovation, this program specifically targets the commercialization gap between academic research and market entry. Administered by the Ministry of Universities and Research, it funds proof-of-concept validation activities, spin-off company formation, and early-stage IP development emerging from university laboratories. For nanotechnology ventures originating in academic settings, this represents an important bridge from laboratory prototypes to investable startup companies, providing resources during the critical technical de-risking phase (MUR, 2023).
- **Invitalia Loan Guarantee Schemes**: Beyond its direct grant programs, Invitalia administers state-backed loan guarantee mechanisms that can cover up to 80% of bank lending to innovative startups. These guarantees partially address the collateral challenge faced by asset-light nanotechnology companies seeking debt financing for equipment purchases, working capital, or scaling operations. By reducing lender risk, the guarantee scheme enables startups to access traditional banking channels that would otherwise remain closed to pre-revenue or early-revenue ventures (Invitalia, 2025).

2.c.ii. Private and Hybrid Instruments

- **Italian Innovation Fund (managed by CDP, Cassa Depositi e Prestiti)**: This public-private hybrid vehicle represents Italy's most significant institutional commitment to venture capital investment in deep technology. Capitalized by Italy's national promotional institution (CDP) alongside European Investment Fund resources, the fund operates through a co-investment model,

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deploying capital alongside private venture capital firms in technology-intensive startups. This structure aims to catalyze private investment while leveraging public risk-bearing capacity. For nanotechnology companies reaching Series A or B fundraising stages, the Italian Innovation Fund can provide crucial growth capital, though accessing these resources typically requires first securing a private VC lead investor (CDP, 2024).

- **Angel Networks**: Italian Angels for Growth (IAG) includes members with materials expertise, though few nanotech deals are public (IAG, 2025).

2.d. International Level

2.d.i. Public Funding Programs

Italian nanotechnology startups access three principal EU-level public funding instruments. The European Innovation Council (EIC) Accelerator provides the most substantial support for breakthrough deep-tech ventures, combining non-dilutive grants of up to €2.5 million with optional equity investment for companies demonstrating high innovation potential and market readiness (European Commission, 2025). Horizon Europe, the EU's €95.5 billion research framework programme (2021–2027), funds collaborative R&D consortia in strategic nanotechnology domains including nanomedicine, advanced materials, and nano-electronics—typically requiring partnerships between research institutions, SMEs, and industrial players (CORDIS, 2025).

For smaller-scale international collaboration, the Eurostars programme (operated under the Eureka network) supports SME-led R&D projects involving at least two European partners, offering a more accessible entry point for startups seeking cross-border validation and co-development opportunities (Eureka, 2024). While highly competitive, these instruments represent critical sources of patient, non-dilutive capital for Italian nanotech ventures navigating extended development timelines.

2.d.ii. Private and Hybrid Instruments

The international venture capital landscape for Italian nanotechnology remains sparse: no major global VC funds maintain dedicated investment theses focused exclusively on Italian nanotech or advanced materials ventures. Consequently, startups typically access international capital only after achieving significant technical de-risking or revenue traction.

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Cross-border accelerators affiliated with the European Institute of Innovation and Technology (EIT)—notably EIT Health for nanomedicine applications and EIT Manufacturing for advanced materials integration—occasionally support nanotechnology ventures through thematic programmes, providing mentorship, pilot-project opportunities, and connections to corporate partners rather than direct equity investment. These intermediaries serve as valuable bridges to European markets but do not resolve the fundamental scarcity of early-stage risk capital specialized in deep-tech commercialization pathways..

2.e. Accessibility and Challenges of Funding

Despite the availability of multiple funding instruments across regional, national, and European levels, Italian nanotechnology startups encounter persistent structural barriers that constrain equitable access to capital and impede venture maturation. Three interrelated challenges stand out. First, administrative complexity significantly burdens resource-constrained early-stage ventures: application procedures for national and EU grant programmes frequently demand extensive documentation, multi-layered eligibility verifications, and prolonged evaluation cycles—often exceeding six months from submission to disbursement. This bureaucratic friction disproportionately affects deep-tech founders lacking dedicated administrative support, diverting scarce human capital from R&D toward compliance activities. Second, a pronounced early-stage capital gap persists for innovations at Technology Readiness Levels (TRL) 1–3, where fundamental materials research, safety characterization, and proof-of-concept validation occur. Most public instruments—including PNRR *Valorizzazione and the Fondo per la Crescita Sostenibile*—target TRL 4–7 demonstration phases, leaving a critical "valley of death" between laboratory discovery and prototype validation that few private investors are willing to bridge. Third, geographic disparity compounds these challenges: startups emerging in Southern Italy and island regions face markedly weaker innovation ecosystems, with limited access to experienced mentors, sector-specialized incubators, and active angel or venture capital networks compared to their counterparts in the industrial North (e.g., Lombardy, Emilia-Romagna, Piedmont). This spatial imbalance risks reinforcing regional development divides even as PNRR investments aim to strengthen research infrastructure across the national territory (ISTAT & Unioncamere, 2025). Collectively, these barriers underscore the need for streamlined application pathways, dedicated pre-seed instruments for deep-tech validation, and targeted capacity-building initiatives in under-resourced regions to ensure Italy's nanotechnology potential is fully and equitably realized.

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3. Practical Tips

3.a. First Steps in Business Creation

3.a.i. Administrative Procedures

Establishing a nanotechnology startup in Italy follows standard procedures for innovative enterprises, with some sector-specific considerations. For young entrepreneurs (under 35 years), the most accessible legal structure is the **S.r.l.s.** (Società a responsabilità limitata semplificata), which requires minimal share capital (just €1) and reduced notary costs. The entire registration process can be completed online through the **Comunica Star** platform, managed by Unioncamere, which centralizes business registration, tax identification number assignment, and mandatory communications with public authorities. Total costs typically range from €200 to €300, and the process takes 5 to 7 business days from submission to completion. Importantly, no sector-specific operating license is required for nanotechnology activities per se; however, companies handling regulated nanomaterials—particularly those classified as hazardous substances under REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) or subject to workplace safety regulations—must comply with notification and registration obligations administered by the European Chemicals Agency (ECHA) and Italian authorities (Unioncamere, 2025; ECHA, 2023).

3.a.ii. Relevant Players

- **Chambers of Commerce**: Provide free legal guidance via *Sportelli Unici* (Unioncamere, 2025).
- **Invitalia**: Italy's national agency for inward investment and enterprise development provides comprehensive startup support including business plan coaching, feasibility studies, and state-backed loan guarantees through programs like Smart&Start Italia. Their services are particularly relevant for technology-intensive ventures that require patient capital and technical validation assistance (Invitalia, 2025).
- **TTOs**: Assist with spin-off creation (IIT, 2023; CNR, 2023).
- **INAIL**: Provides free nanomaterial safety assessments (INAIL, 2024).

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3.b. Guide to Existing Training and Support Programs

3.b.i. Job Centers and Public Coaching Programs

Garanzia Giovani (Youth Guarantee), Italy's implementation of the EU-wide youth employment initiative, provides entrepreneurship training and coaching services for young people aged 18 to 30 who are not in employment, education, or training (NEETs). While the program offers valuable foundational support on business basics, financial literacy, and startup methodologies, its curriculum is intentionally generalist and does not address the specialized technical, regulatory, or funding challenges specific to deep-tech sectors like nanotechnology (ANPAL, 2024).

3.b.ii. Specialised Programs

- **PoliHub (Milan)**: Based at Politecnico di Milano, PoliHub runs a Deep Tech Founders Program specifically designed for science-based ventures. The program combines business training with access to university laboratories and prototyping facilities, mentorship from industry experts, and connections to investors familiar with long development cycles. This infrastructure access is particularly valuable for nanotechnology startups requiring specialized equipment during their early validation phase (PoliHub, 2024).
- **I3P (Turin)**: Advanced materials incubation (I3P, 2024).
- **CNR-NANOTEC**: Open-access training on nanomaterial safety (CNR-NANOTEC, 2023).
- **NanoInnovation Conference**: This annual gathering represents Italy's premier networking forum for the nanotechnology community, bringing together researchers, entrepreneurs, investors, and corporate innovation managers. The conference features dedicated startup pitch sessions, technology showcases, and structured networking opportunities—providing visibility for early-stage ventures and facilitating connections that can lead to partnerships, pilot projects, or investment discussions (NanoInnovation, 2025).

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3.c. Patents and Intellectual Property

3.c.i. Strategy for NanoTech Startups

For nanotechnology startups, intellectual property strategy requires careful balancing of patent protection, trade secrets, and publication considerations. Entrepreneurs should prioritize early provisional patent filings to establish priority dates while continuing development, conduct thorough patent landscape analyses to identify freedom-to-operate and avoid infringement risks, and strategically determine which innovations merit patent protection versus trade secret status. Utility patents covering novel materials, synthesis methods, or device architectures represent the most common protection mechanism in nanotechnology, though careful claim drafting is essential given the rapid pace of technological evolution and potential for design-arounds (EPO, 2025).

3.c.ii. National IP Framework

Italian patent applications are filed through the **UIBM** (Italian Patent and Trademark Office), with application fees ranging from €400 to €600 depending on complexity. UIBM offers free preliminary patent searches and maintains specialized advisory services for startups. For ventures targeting international markets, direct filing with the European Patent Office (EPO) enables multi-country protection through a single application, though at higher cost. Many nanotechnology startups adopt a staged approach: securing Italian or provisional priority, then extending to European or PCT (Patent Cooperation Treaty) applications once commercial traction validates the investment in broader geographic protection (UIBM, 2025; EPO, 2025).

3.d. Networking Opportunities and Incubation

3.d.i. Networks and Cluster Organisations

- **NMP-Italy**: This national coordination platform (Nanomaterials and Nanotechnologies Italian Platform) connects Italian nanotechnology stakeholders across academia, industry, and government, facilitating information exchange, collaborative projects, and policy dialogue. NMP-Italy organizes working groups, disseminates funding opportunities, and serves as Italy's

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representative in European nanotech networks, making it a valuable resource for startups seeking to understand ecosystem dynamics and identify partnership opportunities (NMP-Italy, 2025).

- **KETs Italy**: Coordinated by the Ministry of Universities and Research, this initiative promotes Key Enabling Technologies (including nanotechnology) through policy coordination, industry-research matchmaking events, and strategic roadmapping exercises. KETs Italy helps startups navigate national innovation policies, connect with relevant industrial clusters, and access coordinated funding instruments designed to strengthen Italy's position in strategic technology domains (MUR, 2023).
- **ERGA (Emilia-Romagna)**: Operating within one of Italy's most industrialized regions, this cluster (coordinated by ART-ER, the regional innovation agency) brings together companies, research centers, and service providers in the advanced materials value chain, including several entities working with nanomaterials. ERGA facilitates collaborative R&D projects, technology scouting, and connections between startups and established manufacturers seeking innovation partners (ART-ER, 2023).

3.d.ii. Incubators and Accelerators

- **PoliHub**, **I3P**, and **BioNanotech Centre (Catania)** each provide differentiated support combining laboratory access, business mentorship, investor introductions, and sector-specific technical expertise. While none operates as an exclusively nanotechnology-focused incubator, these leading hubs have developed substantial experience supporting deep-tech ventures and maintain networks of mentors and advisors knowledgeable about materials science commercialization challenges. Entrepreneurs should evaluate program fit based on specific technical requirements, geographic proximity to relevant industrial ecosystems, and the quality of sector-specific mentorship available (PoliHub, 2024; I3P, 2024; University of Catania, 2023).

While the absence of a dedicated nanotechnology incubator represents a gap in Italy's support infrastructure, the existing landscape of university-affiliated and technology-focused incubators has demonstrated capacity to support advanced materials ventures, and entrepreneurs can access sector-specific technical support through complementary networks such as CNR-NANOTEC and industry clusters.

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4. Literature Review for Spain

Partner organisation	Almeira Consultores, sl
Country	Spain

1. Nanotechnology Industry Landscape

Spain is one of the key players in the European nanotechnology ecosystem. It ranks among the top ten EU countries in terms of innovation in this field. This landscape manifests itself:

- Regional concentration - The main centers are Catalonia where more than 100 companies are located, the Basque Country and Madrid.
- The dominance of SMEs and Startups - in the sector over 60% of SMEs and dynamic startups originating from universities (spin-offs).
- Specializing in graphene and nanomaterials - the country is a world leader in the production of high-quality graphene (e.g. Graphenea).
- A well-developed research network - The foundation is centres of excellence such as ICN2 or the international INL laboratory shared with Portugal.

1.1 Overview of the Nanotechnology Industry in Spain

The country's nanotechnology sector has undergone a transformation from an academic phase to an industrial ecosystem over the past decade. According to data for 2025, this market is showing steady growth, especially in niches such as DNA nanotechnology or nanomaterials for energy. Spain can boast of success in using EU funds for the construction of infrastructure. This made it possible to attract private investment capital.

The nanotechnology industry in Spain is not evenly distributed, but concentrated in regions, the main ones:

- Catalonia (Barcelona). The largest nanotechnology hub in the country. There are over 107 companies operating here with an annual turnover of more than 430 million euros. ICN2 (Institut Català de Nanociència i Nanotecnologia), which is a global benchmark in nanosystems research.

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- Basque Country (San Sebastián, Bilbao). The main interest is in industrial and material applications. The biggest player is Graphenea, a global producer of graphene, supplying companies such as Intel and Nokia.

- Madrid. The main areas of activity are nanobiotechnology and microelectronics. One of the most well-known in this area is IMDEA Nanociencia which is an institute that combines basic research with market needs in the health and energy sectors.

Nanotechnology in Spain is focused on the main areas of application and specialization which include: graphene and carbon materials, nanomedicine and biotechnology, and energy and environment. Spain is a key exporter of these technologies. Graphene is mainly handled by two companies: Graphenano - focuses on industrial-scale production for construction and batteries, and Graphenea - supplies high-purity graphene for electronics. One of the largest recipients of nano systems is the healthcare sector. In Spain, targeted drug delivery systems and innovative biosensors are being developed. NANBIOSIS offers advanced services in the design of biomaterials and nanomaterials for clinical purposes. With a strong focus on the energy transition, nanotechnology research is focusing on more efficient photovoltaic cells, state-of-the-art energy storage systems and nanocatalysts for the production of green hydrogen.

The focal point of the industry's integration is NanoSpain, a Spanish nanotechnology network founded in 2004 to coordinate activities in the field of nanoscience and nanotechnology. It brings together more than 370 research groups and 4500 scientists, facilitating the transfer of technology from laboratories to industry. This network organizes annual conferences, which are the main meeting place for business and science.

1.1.1 Key Sub-fields Relevant to the Country

Spain is projected to increase its share of the nanotechnology market through projects related to the EU's technological sovereignty. The Spanish DNA Nanotechnology market is also expected to increase its value significantly. The only inhibiting factor is the need for greater involvement of private capital in the commercialization phase. Spain's nanotechnology industry is based on four pillars that are crucial to the country's technological sovereignty and its economic stability. The first pillar is nanomaterials and graphene. Spain has gained the status of Europe's "graphene hub". It is a sub-field of greatest export importance. The production of graphene and advanced nanofibers powers the automotive and aerospace industries. The importance of graphene is determined by its properties and the possibility of using it in the

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production of lightweight components for electric cars, durable anti-corrosion coatings and additives for concrete that increase its durability. The most profitable segment is nanomedicine and nanobiotechnology, strongly linked to the Spanish pharmaceutical sector. The result of work in this subfield is intelligent systems for the delivery of oncological drugs (nanocapsules), biosensors for rapid diagnostics (Point-of-Care) and nano-vaccines. Nanoelectronicsand nanophotonics are also very important which is key in the context of the EU Chips Act and the Spanish PERTE Chip strategic plan. It attracts the largest public-private investments. This subfield has been used primarily in the production of sensors for precision agriculture, the development of quantum computers and efficient next-generation photovoltaic cells. Nanotechnologies also support the energy sector and environmental protection by supporting the "Green Deal" strategy, through the use of nanocatalysts for the production of green hydrogen, supercapacitors and nanotechnological membranes for water desalination.

1.1.2 Market Size and Economic Importance

The size of the market and the economic importance of nanotechnology in Spain reflect the country's status as one of the European leaders in the field of Deep Tech. The sector is not only a scientific domain, but has become an important pillar of GDP. The Spanish nanotechnology market is showing a strong growth trend, driven by the digitization of industry and the energy transition. The value of the nanomedicine market in Spain is estimated at about USD 2.15 billion. There are more than 450 companies in the country that operate in the field of nanotechnology, which together employ over 10,000 highly qualified specialists (R&D and engineering staff)

Nanotechnology supports key industries such as the automotive and construction sectors. More than 53% of Spanish nanotechnology companies are exporters. Products such as graphene from San Sebastián go to global electronics giants, which reduces the trade deficit in the high-tech sector. Spain is the 5th region in Europe in terms of the dynamics of the technology ecosystem in the southern part of the continent, which makes it attractive for venture capital funds from the US and Asia.

Market structure by segments:

- Nanomaterials (approx. 40%) - Production of nano powders, anti-corrosion coatings and graphene.
- Nanomedicine (approx. 30%) - Oncological diagnostics and advanced drug delivery systems.

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- Nanoelectronics and Optoelectronics (approx. 20%) - Sensors for agriculture (Smart Farming) and Industry 4.0.

1.2 Applications in the different Industries

With a unique combination of strong public support (programs such as PERTE), world-class research infrastructure, and a dynamic startup ecosystem, Spain has dominated specific market niches such as graphene production and advanced nanomedicine. Today, Spanish solutions realistically respond to global challenges, including the energy transition and the fight against cancer, and the optimization of resources in agriculture.

1.2.1 Key Industrial Application Areas

Nanotechnology in Spain, precisely its commercial applications, permeates key sectors of the economy, making Spanish products more competitive in global markets.

Spain, as the second largest car manufacturer in Europe, is using nanotechnology to transform towards electric mobility. The basic application in this field is:

- Replacing heavy steel components with polymers reinforced with carbon nanotubes, which reduces vehicle weight and increases the range of electric cars.
- Self-healing varnishes and water-repellent coatings for windows
- The use of graphene in the battery anodes shortens the charging time and extends the life of the cells.

The medical and pharmaceutical industry uses nanotechnology to create:

- Nanocapsules that release the drug directly into cancer cells, which minimizes the side effects of chemotherapy.
- Nanostructured coatings on orthopedic and dental implants that accelerate osseointegration (fusion with bone) and prevent infections.

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- Portable lab-on-a-chip devices, allowing for the immediate detection of disease biomarkers from a single drop of blood.

Construction companies implement nano e.g. solutions as an addition to silica or graphene nanoparticles to increase the mechanical strength of concrete, production of thermal insulation coatings.

In the face of climate change and droughts, nanotechnology in the agricultural sector and the food industry is becoming the key to the survival of Spanish agriculture. The technology is used to produce nano-fertilisers and nano-pesticides to ensure that plant protection products are released in a controlled manner, which reduces soil and groundwater contamination. Soil nanosensors monitor moisture and nutrient levels in real time, optimizing water consumption. In the food sector, foil packaging with nanosilver with antibacterial properties is used, which significantly extends the freshness of exported fruit and vegetables.

Applications in renewable energy are of great importance, including perovskite cells based on nanostructures, which achieve higher efficiency at lower production costs than traditional silicon.

1.2.2 Role of Startups

The role of startups in the Spanish nanotechnology ecosystem is fundamental. They are a bridge between discoveries at universities and the real commercial market. Spanish startups are a major driver of innovation, attracting record levels of venture capital. Most of the key nanotechnology companies in Spain were born as spin-offs from prestigious research institutes. Scientists from centers such as ICN2 or IMDEA set up companies to commercialize specific patents. Startups originating from the Catalan ecosystem account for more than 40% of all biotech companies in the region. Startups are a major magnet for foreign capital. Spanish hubs are seen as places where operating costs are lower than in Silicon Valley or Munich, while maintaining the same engineering quality. In 2025, Spanish nanotech startups saw a 20 percent increase in investment from VC funds from the US and Asia.

Despite their successes, Spanish startups face two main barriers, which are the difficulty of moving from the prototype phase to mass production (scaling) and what usually blocks most innovations, i.e. bureaucracy - the process of certifying nanotechnology products is long and expensive.

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1.3 Characteristics and Importance of the NanoTech Sector

The nanotechnology sector is the cornerstone of the modern knowledge-based economy. Its uniqueness results from its interdisciplinarity. Nanotechnology is not a separate industry, but a set of tools and methods for manipulating matter at the atomic and molecular levels.

The importance of this sector is manifested in its high transformation potential. Nanotechnology is revolutionizing traditional sectors such as textiles, construction and automotive, enabling advances in medicine (nanomedicines), energy (more efficient photovoltaic cells) and environmental protection.

1.3.1 Innovation Characteristics

Innovations in the nanotechnology sector are characterised by a high degree of investment risk, a long incubation cycle and the need for close cooperation between science and business. Spain's innovation system in nanotechnology relies heavily on strong public research units. Innovation is often science-push, where scientific discoveries seek market applications, which differs from the American model, which is more market-driven.

1.3.2 Research Infrastructure

The Spanish research infrastructure in the field of nanotechnology is based on the unique ICTS (Infraestructuras Científicas y Técnicas Singulares) model. These are strategic, large-scale facilities that are open to external users (both from the public and private sectors).

The basic components of this infrastructure:

- The Micronanofabs network consists of, among m.in, CNM-CSIC (Centro Nacional de Microelectrónica) in Barcelona and ISOM-UPM (Instituto de Sistemas Optoelectrónicos y Microtecnología) in Madrid.

- Centers of Excellence (Severo Ochoa & María de Maeztu) are prestigious accreditations awarded to the best research units. The most important here are: ICN2 (Catalan Institute of Nanoscience and Nanotechnology) and nanoGUNE (Basque Country), a center focused on nano physics and technology transfer to the Basque industry.

- Synchrotron Radiation (ALBA) offering advanced research lines for imaging the structure of matter at the atomic scale.

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1.3.3 Strategic Relevance

The strategic importance of nanotechnology in Spain can be boiled down to three key issues, which are Technological Sovereignty (PERTE), the modernisation of industry and leadership in nanomedicine.

1.4 Challenges and Barriers

The development of the nanotechnology sector in Spain faces a number of obstacles which divide them into four main categories:

- Valle de la Muerte and a port in TRL

The biggest challenge remains the transition from the laboratory to the commercial phase (the so-called gap between TRL 4 and TRL 7 technology readiness levels). The TRL (Technology Readiness Level) is a scale from 1 to 9 used to assess the maturity of a given technology. It was developed by NASA and is now a standard in EU projects (Horizon Europe) and in industry. Spain is wonderfully developed in scientific context, but there are no mechanisms to support the financing of large-scale prototyping. As a result, projects fail or are sold to foreign investors before the implementation stage.

- Regulatory and Certification

The properties of nanomaterials are neglected, so the process of placing them on the market is complicated and expensive. There is a lack of standardized standards and the cost of certification is an insurmountable financial barrier for many Spanish startups.

- Venture capital

The Spanish financial market prefers sectors with a faster rate of return such as tourism, real estate, etc. Innovation in nanotechnology requires capital with a long-term investment.

- Competences and social awareness

Despite the high quality of education, there is a shortage of staff combining knowledge of nanotechnology with business management skills. An additional problem is the lack of public knowledge about the safety of nanomaterials.

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1.4.1 Technological and Scientific Challenges

Nanotechnology faces barriers due to the nature of matter at the nanoscale, as it is extremely difficult to move from milligram production in the laboratory to tonne production in the factory while maintaining the same physicochemical properties. An additional challenge is the control of the shape, size and purity of nanoparticles in mass production remains a challenge. Another problem is the lack of cheap and fast analytical methods that would allow you to monitor nano processes directly on the production line.

1.4.2 Economic and Market Challenges

Bringing nano-products to the market is associated with high financial risks. The costs of laboratory equipment require huge financial outlays. Another problem for most investors is the long time from discovery to commercialization. Additionally, many companies are apprehensive about implementing nano solutions due to the potentially higher cost of the final product, which the customer is not always willing to accept. The dominance of Asian and American markets is also becoming a problem, which forces smaller entities to look for very narrow market niches.

1.4.3 Regulatory considerations

Most of the regulations result directly from EU regulations.

REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals). This is a basic piece of legislation that addresses specific requirements for nanomaterials. This requires the registration of nanoforms of substances, providing data on their toxicity and behaviour in the environment.

CLP (Classification, Labelling and Packaging) is about classification and labeling. If a substance in nano form exhibits different hazards than its bulk form, this must be reflected on the label.

Nanotechnology regulations in Spain are not based on a single, dedicated "Nanotechnology Law". Instead, Spain, as an EU Member State, follows a horizontal approach in which nanomaterials are subject to existing chemicals legislation, product safety and environmental protection, subject to specific technical amendments.

Key regulatory pillars in place in the Spanish market:

1. The EU framework (foundation)

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Most of the regulations in Spain are directly derived from EU regulations that aim to ensure safety while promoting innovation.

REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals). This is the most important piece of legislation. Specific requirements for nanomaterials have been in place since 2020. Companies in Spain must register nanoforms of substances, providing data on their toxicity and behaviour in the environment.

CLP (Classification, Labelling and Packaging). Refers to classification and labeling. If a substance in nano form exhibits different hazards than its bulk form, this must be reflected on the label.

There are industries where the presence of nanomaterials must be clearly marked. One of them is the cosmetics industry. According to Regulation 1223/2009, ingredients in nano form must be listed in the list of ingredients. The Spanish Agency for Medicines and Health Products (AEMPS) supervises this market. In the food industry, nanomaterials are treated as 'novel foods'. Any food product containing synthetic nanomaterials must be authorised by EFSA and labelled accordingly. Another example is biocidal products, where the use of e.g. nanosilver in antibacterial coatings requires a separate risk assessment.

2. Funding and Financial Support Opportunities

Nanotechnology funding in Spain is based on a multi-level structure that combines EU funds, national government programmes and strong regional initiatives. From 2021 to 2027, this system is driven by the Spanish Strategy for Science, Technology and Innovation (EECTI).

2.1 Overview of the Funding Landscape

Funding for nanotechnology startups in Portugal is structured across pre-seed, seed, early-stage, and scale-up phases. At the early stages, public funding is the main driver, reflecting the research-intensive and high-risk nature of nanotechnology. National agencies and EU programmes provide grants, vouchers, and co-promotion schemes that allow startups to develop prototypes, validate technologies, and collaborate with research institutions. As companies mature, they increasingly rely on hybrid instruments and private capital, including venture capital, business angels, and co-investment funds supported by the Portuguese state.

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Due to the limited size of the domestic market, many nanotechnology startups are internationally oriented from an early stage, and EU funding instruments play a central role in enabling cross-border collaboration and access to larger markets.

2.2 Regional / Local level

2.2.1 Public Funding Programs

In this context, we can talk about direct non-repayable subsidies or subsidies financed from regional budgets. An example is the regional development agency SPRI, which offers subsidies for companies for R+D projects in strategic areas. The Elkartek program funds basic research in centers such as nanoGUNE. ACCIÓ finances cooperation projects between companies and technology centres. The Regional Innovation Agency supports research consortia in the field of nanomaterials for the agri-food and marine sectors. Special grants are also offered to hire PhDs in technology companies, which is important for nanotechnology start-ups in need of highly qualified staff. These are only some of the examples that can be cited in this regard. However, it can be seen that nanotechnology is already supported at the regional level.

2.2.2 Private and Hybrid Instruments

Increasingly, we are dealing with financing coming from commercial investors who see the potential in the development of nanotechnology. Examples include companies such as BeAble Capital, a leader in science and materials investments, Asabys Partners and Ysios Capital are actively investing in start-ups originating from universities that commercialize nanotechnology patents.

Equity crowdfunding is a common phenomenon. Platforms like Capital Cell allow smaller investors to fund Spanish nano innovations, especially those with a medical profile.

Mechanisms combining public and private capital are in place to minimize the risk for commercial investors. We can mention here the Catalan ICF (Institut Català de Finances) or the Basque Seed Capital Bizkaia. These are commercially managed but publicly capitalized funds that co-invest with private VC funds in technology companies. Another example is the support of local entities, such as Elkarga in the Basque Country, which provide guarantees to nano-start-ups that do not have hard collateral, making it easier for them to obtain preferential bank loans for the purchase of research equipment.

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2.3 National Level

2.3.1 Public Funding Programs

They rely on direct grants and grants awarded by government agencies to support early-stage science and innovation.

- Agencia Estatal de Investigación (AEI):

- Proyectos de Generación de Conocimiento, which is the main program that finances basic research in nanotechnology, chemistry and condensed matter physics.

- Strategic Lines (Líneas Estratégicas) are targeted competitions for research of high societal importance, e.g. nanosensors for environmental monitoring.

- CDTI (Centro para el Desarrollo Tecnológico y la Innovación) grants:

- The NEOTEC program consists of a non-refundable subsidy for small technology companies (start-ups).

- Misiones Ciencia e Innovación supports large consortium projects solving national challenges (e.g. PERTE Chip – microelectronics, PERTE Salud – nanomedicine).

- Scholarship Programs such as Juan de la Cierva or Ramón y Cajal, funding full-time positions for outstanding nanotechnology researchers

2.3.2 Private and Hybrid Instruments

They include capital from investors looking for high returns. Spanish funds are actively funding rounds A and B for nanotech spin-offs. Large corporations such as Repsol Deep Tech, Iberdrola are investing directly in nano, which can revolutionize their supply chains.

Hybrid instruments combine the security of public funds with the efficiency of private management. Fondo Next-Tech is a fund of funds managed by an ICO that mobilizes private capital by co-investing in VC funds supporting Spanish scale-ups in the nanotechnology and AI sector. Another example is a program in which CDTI becomes a co-shareholder in technology companies alongside a private investor. If a VC fund wants to invest in a nanotech start-up, CDTI can contribute an equivalent amount, sharing the risk. The Seal of Excellence is a special national funding mechanism for projects that have undergone a rigorous

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assessment in Brussels but have not received EU funding due to a lack of budget. The Spanish government is rescuing these projects by financing them from national funds.

2.4 International Level

2.4.1 Public Funding Programs

Nanotechnology startups benefit strongly from EU research and innovation funding, including:

- Horizon Europe - priority is given to advanced materials and nanotechnology to support the green transition
- EIC Pathfinder (TRL 1-4) - Programme for Visionary Projects. Consortia often reach for grants for research on nanorobotics or new quantum computers.
- EIC Transition (TRL 4-6) - is a financial bridge for the validation of nano technologies previously developed under ERC or Pathfinder grants to prepare them for commercialization.
- Eurostars (EUREKA) is a programme that supports innovative SMEs working with partners from other countries.

These programs are particularly important for nanotechnology due to their high funding ceilings and international networks.

2.4.2 Private and Hybrid Instruments

They focus on scientific excellence and high-risk technologies:

- The InvestEU and European Tech Champions Initiative (ETCI) relies on investing in large Spanish VC funds, which then fund growth rounds for nanotech companies so that they don't have to look for capital in the US.
- International Venture Capital are global funds (e.g. from Germany or France) co-invested with Spanish leaders in spin-offs dealing with nanomedicines or semiconductors.

2.5 Accessibility and Challenges of Funding

Access to funds is uneven and depends on the profile of the entity. For Universities and Research Centers, accessibility is high. For SMEs and start-ups, accessibility can be described as moderate to low. In Spain,

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the CDTI network of contact points works very efficiently, offering free advice and checking of applications, which significantly increases the chances of success.

The main challenges are the so-called "Valley of Death". Spain is doing great in financing basic research (TRL 1-3), but companies have a huge problem with obtaining funds to scale production (TRL 6-8). Bureaucracy, mainly the complex application process and delays in the disbursement of the allocated funds, are also a barrier. The problem in the development of nanotechnology is investors' concerns about the return on investment and the very fact of lack of knowledge on the subject.

3. Practical Tips

3.1 First Steps in Business Creation

3.1.1 Administrative Procedures

Setting up a company in Spain is a structured process that can be accelerated through the PAE (Puntos de Atención al Emprendedor) system, using the electronic document DUE (Documento Único Electrónico). Companies operating in nanotechnology must additionally register with the REI (Registro de Establecimientos Industriales). If the activity involves nanomedicine, authorizations from the AEMPS (Spanish Medicines Agency) are necessary. Spain has a special startup law that offers tax breaks and facilities for digital nomads and investors.

3.1.2 Relevant Players

In Spain, the key players are divided into central agencies and specialized technology transfer units:

- CDTI (Centro para el Desarrollo Tecnológico y la Innovación) is a public entity promoting innovation and technological development of Spanish companies. It is the most important institution for nano companies, offering financing, advice and support in the internationalization of https://www.cdti.es

- ICEX (España Exportación e Inversiones) is a national agency supporting the attraction of foreign investments and the expansion of Spanish companies to external markets https://www.icex.es

- Cámara de Comercio de España is a network of chambers of commerce supporting the digitalisation and competitiveness of SMEs https://www.camara.es

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- Spanish universities and research centers have OTRI (Oficinas de Transferencia de Resultados de Investigación) offices that manage intellectual property (IP) and facilitate the creation of spin-offs.

- CSIC (Consejo Superior de Investigaciones Científicas) - a research institution with a powerful technology transfer department (VATTT) https://www.csic.es

- ICN2 (Instituto Catalán de Nanociencia y Nanotecnología) is a leader in nano technology transfer, supporting the creation of deep technology startups https://icn2.cat/en/innovation

- RedOTRI - a national network of technology transfer offices connecting all Spanish universities https://www.redotriuniversidades.es

- IMDEA Nanociencia is an Institute in Madrid dedicated exclusively to nionacia, with its own units to support innovation and incubation https://nanociencia.imdea.org

3.2 Guide to existing Training and Support Programmes

Spain offers an extensive system of entrepreneurship training, business mentoring and support for startups. This is especially important for founders of companies from academia who need support in the field of business competencies.

3.2.1 Job Centres and Public Coaching Programmes

The Servicio Público de Empleo Estatal and its regional ones play a role in promoting self-employment and entrepreneurship. They offer business formation advice, financial support, and mentorship programs.

These initiatives are crucial for early-stage nanotech startups. They help researchers combine expertise with hard management skills and regulatory awareness.

3.2.2 Specialised Programmes

Specialized bridging initiatives between science and industry can be seen, for example, in the activities of Spanish universities, which offer support at the earliest stage. An example is Proof-of-Concept - grants for the transition from laboratory tests to prototypes. Universities offer Academic Incubators based on legal advice on the creation of university spin-offs. Assistance in patent protection of nanotechnological inventions is provided by IP Management.

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For projects with a high degree of complexity, programs such as:

- The Collider based on team building, connecting scientists with experienced managers
- Bizkaia BIC programs provide access to certified clean-rooms and testing equipment, eliminating the barrier of high entry costs.
- Regulatory Mentoring consisting in support in certification processes and toxicological studies

3.3 Patents and Intellectual Property

3.3.1 Strategy for NanoTech Startups

For Spanish nanotechnology startups, IP is a key component of the company's valuation. A protection strategy is essential to secure a technological advantage in the competitive EU market, attract capital (VCs and business angels) and enable commercialization through licensing agreements with large industrial partners.

The most important elements of an IP strategy in Spain are:

- Patent protection is carried out through the registration of key inventions in the OEPM, extending it to the European (EPO) and international (PCT) level.
- Protecting Know-how
- Property Management in Spin-offs byprecisely-defining IP rights in agreements with universities

3.3.2 National IP Framework

The main authority responsible for patents in Spain is the Spanish Patent and Trademark Office. This office manages the registration of inventions and industrial designs at the national level. The institution offers specialized consulting services for startups and scientists. Small companies and research units can count on very large discounts in official fees. Spain also provides subsidies to cover the costs of patent protection abroad. This system is fully integrated with European and international procedures. This makes it easier for Spanish companies to protect their technologies around the world. The office also helps to check whether a given idea is unique before submitting an application. Such support significantly reduces the financial risk for young entrepreneurs.

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3.4 Networking Opportunities and Incubation

3.4.1 Networks and Cluster Organisations

Spain's nanotechnology ecosystem is based on strong research networks and clusters that connect the world of science with industry. The highlight is the International Laboratory of Iberian Nanotechnology INL, which is a joint project of the governments of Spain and Portugal. This center provides companies with modern clean rooms and advanced production lines for nanofabrication. It is also worth mentioning NANOMED Spain, a national platform that brings together hundreds of institutions working on the use of nanotechnology in medicine and diagnostics.

The Spanish Association of the Nanotechnology Industry also plays an important role, helping companies establish business contacts and promote their solutions in foreign markets. Regional structures such as the Basque nanoBasque network, which supports local businesses in digitization and the implementation of modern materials, are very strong. In the field of energy and sustainability, the BatteryPlat platform focuses on new methods of energy storage using nanomaterials.

All these organizations help startups find partners for joint research projects and facilitate access to private investors. Thanks to cooperation within clusters, small companies can use expensive research equipment that they would not be able to afford on their own. These networks regularly hold conferences and brokerage meetings, which speeds up the process of commercializing new discoveries.

3.4.2 Incubators and Accelerators

Spain focuses on regional specialization, which means that depending on the location, startups can count on slightly different tools tailored to the local industry.

University and Scientific Incubators - Most Spanish universities have their own structures supporting the so-called spin-offs, i.e. companies founded by scientists. The most important of them are:

- AMU Emprende - operates at the Autonomous University of Madrid and specializes in projects in the field of advanced materials and physics.
- UAB Emprèn - a center at the Autonomous University of Barcelona, which strongly promotes nanobiotechnology.

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- Parc Científic de Barcelona - one of the most important places in Europe for companies from the Life Sciences and nano-medicine sectors.
- IMDEA Nanociencia Incubator - A specialist unit in Madrid focused exclusively on supporting nanotechnology projects, offering access to world-class experts.

Technology Parks and Infrastructure

For nano companies, access to laboratories is paramount. Spanish technology parks offer not only offices, but above all production halls and equipment focused on specific sub-branches.

- Parque Tecnológico de Álava - Aerospace & Automotive
- Parque Científico y Tecnológico de Bizkaia - bio-nanotechnology
- Málaga TechPark - microelectronics and new materials for the digital sector
- Zaragoza Logistics Center - nanotechnology in supply chains and packaging.

Accelerators for Deep Technologies

Once a project leaves the research phase, it goes to accelerators that prepare it for contact with investors:

- The Collider - a program that connects scientists with entrepreneurs helping to avoid common mistakes made by researchers when entering the market.
- Ship2B Ventures – focused on technologies with a positive social impact, including nanomedicine.
- EIT Health Spain helps nano startups find business partners across the European Union.

Spain has created a well-functioning support chain. A scientist starts in a university incubator (e.g. PCB), develops a product in a technology park with access to laboratories (e.g. Bizkaia's BIC), and then scales the business with programs such as The Collider. This approach gives complex nanotechnology projects a real chance of becoming profitable companies with an international reach.

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5. Literature Review for Portugal

Partner organisation	Future Balloons Unipessoal, Lda.
Country	Portugal

1. Nanotechnology Industry Landscape

Portugal's nanotechnology ecosystem is small compared to major global players, but it has developed substantial research capabilities and strategic applications in high-value sectors. The landscape is heavily research-driven, with strong public research institutions playing a central role and increasing efforts to connect research with industry, innovation and start-up creation.

1.1 Overview of the Nanotechnology Industry in Portugal

Over the past two decades, **Portugal** has progressively built a dynamic and research-driven nanotechnology ecosystem, largely anchored in its public research system and higher education institutions. The development of nanotechnology in the country has been driven primarily by sustained public investment in scientific research, strong participation in European research programmes, and the strategic positioning of nanotechnology as an enabling technology across multiple industrial sectors.

Although **Portugal** is not among the world's largest producers of nanotechnology-based commercial products, it plays a relevant role within the European Research Area, particularly in knowledge generation, applied research, and early-stage technological development. Portuguese research groups are internationally recognised in fields such as advanced and functional nanomaterials, nanomedicine, nanoelectronics, photonics, and nanotechnology applications for energy, environment, and sustainability. Scientific output in these areas is high relative to the country's size, with Portuguese institutions frequently involved in international consortia, joint laboratories, and EU-funded collaborative projects.

A defining characteristic of the Portuguese nanotechnology landscape is its strong concentration around universities, public research organisations, and specialised technology centres. Institutions such as the ***International Iberian Nanotechnology Laboratory (INL)***, alongside major ***Universities in Lisbon, Porto, Aveiro, Minho, and Nova de Lisboa***, serve as central hubs for research, training, and technology transfer. These organisations provide access to advanced infrastructure, including clean rooms, micro- and nano-

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fabrication facilities, characterisation laboratories, and pilot-scale equipment, which are essential for nanotechnology research and early industrial validation.

The core of nanotechnology activity in **Portugal** focuses on research, collaboration and technology transfer rather than large-scale production or manufacturing of nano-products. A central pillar of this ecosystem is the ***International Iberian Nanotechnology Laboratory (INL)***, an intergovernmental research organisation located in Braga, established by the governments of Portugal and Spain to conduct world-class nanoscale research in areas such as materials science, nanomedicine, nanoelectronics, and sustainable technologies.

INL's mandate is to promote excellence in scientific research and innovation with societal and industrial impact. It hosts multidisciplinary scientists and advanced facilities, and participates actively in European research and thematic initiatives, including the **European Microelectronics Agenda** — highlighting Portugal's strategic involvement in nanotechnology at the continental level.

Besides ***INL***, Portugal's nanotech research is supported through:

- ***Public Universities and Research Institutes*** integrating nanoscience into doctoral and master's programmes (e.g., **PhD in Nanotechnologies and Nanosciences at NOVA FCT**).
- Centres for advanced materials and nanotechnology, such as the ***Centre for Nanotechnology and Technical, Functional and Intelligent Materials (CeNTI)***.
- Regional and cross-border initiatives like ***nanoGateway*** (https://nanogateway.eu/en/) and ***Nanotech@NortePT*** (https://centi.pt/en/project/nanotech-at-nortept), which aim to transfer nanotechnology knowledge to industry and enhance local competitiveness.

Portugal participates extensively in **European and International Research Programmes**, including *Horizon Europe, Interreg, and Structural Fund co-financed projects* that promote cooperation and technology development.

In recent years, this strong research base has led to the emergence of a growing number of technology-based startups and university spin-offs operating in nanotechnology-related fields. These companies typically focus on *niche markets*, high-value applications, and early-stage product development, often targeting international markets from an early stage. However, despite strong scientific capabilities and

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increasing entrepreneurial activity, the sector continues to face challenges in industrial scale-up, access to late-stage financing, and integration into large-scale manufacturing value chains.

Overall, the nanotechnology industry in Portugal can be characterised as scientifically robust, highly internationalised, and innovation-oriented, with significant potential for growth. Its future development will depend on strengthening links between research and industry, improving scale-up and commercialisation pathways, and attracting greater private investment to complement existing public support mechanisms.

1.1.1 Key Sub-fields Relevant to the Country

Key nanotechnology sub-fields in Portugal include:

- **Nanomaterials and Advanced Materials:** Functional nanomaterials, graphene and carbon-based nanostructures, nanoparticles, nanocomposites, and coatings.
- **Nanomedicine and Biotechnology:** Drug delivery systems, diagnostics, biosensors, regenerative medicine, and medical devices.
- **Nanoelectronics and Photonics:** Micro- and nanofabrication, sensors, MEMS/NEMS, optoelectronic devices.
- **Energy and Environment:** Nanomaterials for batteries, hydrogen technologies, photovoltaics, water treatment, and environmental remediation.

1.1.2 Market Size and Economic Importance

The Portuguese nanotechnology market is relatively small in absolute terms but strategically important due to its strong integration with higher-value manufacturing, healthcare, and clean technologies. Nanotechnology contributes indirectly to GDP (Gross Domestic Product) through advanced materials, pharmaceuticals, electronics, and renewable energy industries. Most economic impact currently comes from R&D activities, pilot-scale production, and technology licensing rather than mass manufacturing.

Market Size and Structure

Portugal does not yet have a consolidated, standalone nanotechnology market with large-scale domestic producers. Instead, nanotechnology activity is embedded within broader industrial value chains, where nano-enabled materials, components, and processes enhance product performance, efficiency, and

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sustainability. As a result, the economic contribution of nanotechnology is often indirect and distributed across sectors rather than concentrated in a single industry classification.

Most nanotechnology-related economic activity in Portugal is concentrated in:

- Research and development services
- Pilot-scale production and prototyping
- High-value, low-volume manufacturing
- Technology licensing and knowledge transfer

Most firms active in nanotechnology are small and medium-sized enterprises (SMEs), startups, and university spin-offs, often operating at early stages of commercialisation. Large-scale manufacturing and mass-market production of nano-enabled products are still limited and frequently located outside Portugal.

Contribution to the Economy

From an economic perspective, nanotechnology contributes to Portugal's economy primarily by:

- **Increasing the technological intensity of traditional industries**, such as textiles, footwear, construction, and automotive components, through advanced materials and nano-coatings.
- **Supporting the development of high-tech sectors**, particularly in medical devices, diagnostics, sensors, and clean energy technologies.
- **Attracting European and international research funding**, which represents a significant inflow of financial resources and highly skilled employment.
- **Generating high-skilled jobs**, especially for researchers, engineers, and specialists in materials science, biotechnology, and electronics.

While direct turnover figures attributable solely to nanotechnology remain modest, the sector plays a **multiplier role**, enhancing competitiveness, export potential, and innovation capacity in downstream industries.

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Role within the European Context

Within the European Union, Portugal positions itself as a **knowledge and research contributor** rather than a volume producer. Portuguese institutions and companies are active participants in EU-funded projects and collaborative innovation networks, which amplifies the economic impact of domestic nanotechnology capabilities beyond national borders.

The presence of international research infrastructures such as the ***International Iberian Nanotechnology Laboratory (INL)*** further reinforces Portugal's role as a **regional hub for nanotechnology research and early-stage innovation**, generating spillover effects for local suppliers, service providers, and startups.

Growth Potential and Outlook

Looking ahead, the economic importance of nanotechnology in Portugal is expected to grow, driven by:

- Increasing demand for **advanced and sustainable materials**
- The expansion of **nanomedicine and health technologies**
- The energy transition, including **batteries, hydrogen, and renewable energy systems**
- Continued access to **EU research and innovation funding**

However, realising this potential will depend on improving **industrial scale-up capabilities**, strengthening **industry–research linkages**, and increasing **private investment**, particularly at later stages of commercialisation.

In summary, although Portugal's nanotechnology market remains limited in size, its **economic importance is strategic rather than volumetric**, acting as a critical enabling technology that supports innovation, competitiveness, and value creation across multiple sectors of the Portuguese economy.

1.2 Applications in the different Industries

Nanotechnology in Portugal is applied across a wide range of industrial sectors, primarily as an **enabling technology** that enhances product performance, efficiency, and sustainability. Applications are largely driven by research excellence, sectoral specialisation, and alignment with national and European

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innovation priorities. Rather than mass-market production, Portuguese nanotechnology applications typically focus on **high-value, knowledge-intensive niches** with strong export potential.

1.2.1 Key Industrial Application Areas

Healthcare and Life Sciences

Healthcare and life sciences represent one of the most important application areas for nanotechnology in Portugal. Research and innovation activities focus on:

- Nanoparticles and nanocarriers for targeted drug delivery
- Nano-enabled diagnostic tools and biosensors
- Nanostructured biomaterials for tissue engineering and regenerative medicine
- Antimicrobial and biocompatible coatings for medical devices

These applications benefit from close collaboration between nanotechnology research groups, biomedical institutes, hospitals, and clinical research centres. Portuguese nanomedicine projects are often embedded in European research consortia and target global healthcare markets, although regulatory requirements and long development cycles slow commercialisation.

Energy and Sustainability

Nanotechnology plays a strategic role in Portugal's energy transition and decarbonisation goals. Key applications include:

- Nanomaterials for lithium-ion and next-generation batteries
- Nano-enabled hydrogen production, storage, and fuel cells
- Nanostructured materials for photovoltaic cells
- Catalysts and coatings that improve energy efficiency and durability

These applications support national priorities in renewable energy, green hydrogen, and energy storage, and are frequently developed in collaboration with EU-funded energy research initiatives.

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Projects addressing nano-based sensing for environmental monitoring and water quality, such as collaborative work between universities and industry (e.g., *NanoCatRed* (https://inl.int/projects/nanocatred/) for catalytic reduction of pollutants), highlight applied environmental research.

Electronics, Photonics, and Sensors

Portugal has a strong focus on nanoelectronics and photonics applications, particularly in sensing technologies. Key applications include:

- Chemical, biological, and environmental nano sensors
- MEMS and NEMS devices
- Optical and photonic components for data transmission and diagnostics
- Flexible and printed electronics for IoT applications

These technologies are applied in healthcare diagnostics, environmental monitoring, industrial process control, smart cities, and mobility solutions. Production is typically small-scale and highly specialised, targeting high-performance applications rather than mass semiconductor manufacturing.

Portugal's participation in EU microelectronics initiatives, supported by ANI and INL, illustrates the role of nanotechnology in sensors, microdevices, and hybrid nano-electronics, feeding into broader digital transformation agendas.

Advanced Materials and Manufacturing

Advanced materials are the **most commercially mature application area** of nanotechnology in Portugal. Applications include:

- Nanocomposites for lightweight and high-strength materials
- Smart and functional coatings (anti-corrosion, self-cleaning, antimicrobial)
- Nano-enabled textiles and functional fabrics
- Additive manufacturing using nanomaterial-enhanced inputs

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This application area is particularly important for upgrading traditional Portuguese industries such as *textiles, footwear, construction, and automotive components*, improving competitiveness through performance differentiation and sustainability.

Nanomaterials and functional coatings are being developed by centres such as ***CeNTI*** to enhance product performance (e.g., strength, durability, antimicrobial properties) and support industry competitiveness across multiple manufacturing sectors.

Environment and Sustainability

Nanotechnology contributes to environmental protection and sustainability through:

- Nanostructured membranes for water treatment and desalination
- Nano-enabled air and water quality monitoring systems
- Environmental remediation materials
- Sustainable and safe-by-design nanomaterials

These applications align with EU Green Deal objectives and increasing regulatory and societal demand for environmentally responsible technologies. Applications include nanotechnology solutions for water treatment, air quality monitoring, and sustainable materials — often emerging from cross-sector academic–industry collaboration.

In general, Portugal's nanotech applications are **technology-enabling rather than high-volume manufacturing**, focusing on high-value, research-intensive niches.

Portugal's nanotechnology landscape is **broad but strategically focused**, with particular strength in **nanomaterials, nanomedicine, sensors, and energy-related applications**. These sub-fields reflect a model based on **research excellence, EU integration, and niche high-value applications**, rather than large-scale industrial production. Academic programmes (e.g., *master's degree in Biomaterials and Nanomedicine* at ***NOVA FCT***) illustrate the growing focus on applications that could lead to clinical and industrial spin-offs.

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1.2.2 Role of Startups

Startups play a **central role in translating nanotechnology research into marketable solutions** in Portugal. Most nanotechnology startups are **spin-offs from universities or public research organisations**, leveraging publicly funded research, intellectual property, and specialised infrastructure.

Position in the Value Chain

Portuguese nanotechnology startups typically operate in:

- Early-stage R&D and proof-of-concept development
- Prototyping and pilot-scale validation
- Niche product development and specialised services
- Licensing of technologies to larger industrial players

Rather than competing in large-scale manufacturing, startups often focus on **technology development, customisation, and high-value applications**, positioning themselves as innovation partners within broader value chains.

Collaboration with Large Enterprises

Collaboration is a defining feature of the startup ecosystem:

- Startups frequently partner with large national and international companies to test and validate nano-enabled solutions.
- Industrial co-promotion projects and joint R&D initiatives are common, supported by public funding.
- In regulated sectors such as healthcare and energy, startups often rely on strategic partnerships for clinical validation, certification, and market access.

International Orientation

Due to the limited size of the domestic market, nanotechnology startups in Portugal are typically **international from an early stage**, targeting European and global markets. Participation in EU research

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projects, international accelerators, and cross-border partnerships is essential for scaling and commercialisation.

Nanotechnology applications in Portugal are diverse and strategically focused, with the strongest activity in **healthcare, energy, electronics, advanced materials, and sustainability**. Startups play a critical role as **innovation drivers and technology translators**, operating at the intersection of research excellence and industrial application, while collaborating closely with larger enterprises and international partners.

Portuguese nanotechnology startups are typically university spin-offs or deep-tech ventures emerging from publicly funded research projects. They often operate in early-stage technology development, proof-of-concept validation, and niche applications. Collaboration with large enterprises, hospitals, and international partners is common, while direct competition in mass markets is less frequent.

1.3 Characteristics and Importance of the NanoTech Sector

Research-Centred and Internationally Integrated

Portugal's nanotechnology infrastructure is anchored in public research and international collaboration. ***INL*** exemplifies this, drawing researchers globally and contributing to Europe's nanotechnology agenda.

Portuguese institutions actively participate in EU research programmes, generating scientific output that informs both regional innovation and European strategic priorities. Research and training programmes further cultivate a skilled nanotechnology workforce, supporting interdisciplinary expertise spanning nanoelectronics, nanobiotechnology and materials science.

Integration with Industry and Policy Agendas

Nanotechnology research aligns with broader national and EU policy priorities, including:

- **Green transition and sustainability goals**
- **Digital transformation and microelectronics competitiveness**
- **Advanced health technologies**

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Examples such as Portugal's participation in the **Chips Joint Undertaking** (**https://european-union.europa.eu/institutions-law-budget/institutions-and-bodies/search-all-eu-institutions-and-bodies/chips-joint-undertaking_en)** reflect efforts to integrate nanotechnology research into strategic industrial ecosystems.

Economic and Strategic Importance

While Portugal's direct economic output from nanotechnology remains modest, the sector:

- Enhances technological capabilities in key industries
- Attracts international research investment
- Facilitates knowledge transfer and startup creation

Nanotechnology thus plays an **enabling role** in the economy, amplifying Portugal's contributions to high-value innovation and addressing societal challenges through technology.

1.3.1 Innovation Characteristics

The nanotechnology sector in Portugal is highly R&D-intensive, interdisciplinary, and science-driven. Innovation often occurs at the intersection of physics, chemistry, biology, engineering, and medicine. Development cycles are long, and regulatory requirements are significant, particularly in healthcare applications.

1.3.2 Research Infrastructure

Portugal has a strong public research infrastructure supporting nanotechnology, including:

- Universities such as ***Universidade de Lisboa, Universidade do Porto, Universidade de Aveiro, Universidade Nova de Lisboa and Universidade do Minho***.
- Research institutes and laboratories such as ***INL – International Iberian Nanotechnology Laboratory*** (https://inl.int/), ***ITQB NOVA*** (https://www.itqb.unl.pt/), ***INESC Microsystems*** and ***Nanotechnologies*** (https://inesc.pt/), and ***CENIMAT*** (https://www.cenimat.fct.unl.pt/).
- Access to clean rooms, microfabrication facilities, pilot lines, and advanced characterisation laboratories.

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1.3.3 Strategic Relevance

Nanotechnology aligns with Portugal's national strategies for innovation, digital transition, health, and climate neutrality. It is embedded in priority areas such as advanced manufacturing, sustainable energy, and biotechnology.

1.4 Challenges and Barriers

Despite strong research capabilities, several challenges constrain Portugal's nanotechnology ecosystem:

Limited Industrial Scale-Up

Portugal does not yet host major nanotechnology manufacturing at scale. Most nanotechnology activity focuses on early-stage R&D, requiring significant investment and long timelines for industrial translation.

Funding and Commercialisation Gaps

Although public and EU funds support research projects, there is often a gap in financing for scale-up and commercialisation of nanotech innovations — particularly in deep tech that requires sustained private investment beyond initial research grants.

Regulatory Complexity

Especially in nanomedicine and environmental applications, nanotechnology must navigate complex regulatory frameworks that can slow market entry and raise costs.

Ecosystem Maturity

The ecosystem, while scientifically strong, is still maturing in terms of industry integration and startup scale. Portugal's nanotechnology startups often need international collaboration and market access strategies due to the limited domestic market size.

Skills and Workforce Development

While doctoral programmes in nanoscience are present, ensuring sufficient workforce supply for industrial needs across multiple nanotech sub-fields remains a structural challenge.

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To summarise, Portugal's nanotechnology landscape is defined by **research excellence, international cooperation, and strategic applications** in high-value sectors. Anchored by institutions such as the ***INL*** and supported by EU projects and regional programmes, the ecosystem is strong in knowledge creation and technology transfer. However, **industrial scale-up, regulatory complexity, and sustained commercialisation financing** represent ongoing challenges for translating scientific capabilities into large-scale economic impact.

1.4.1 Technological and Scientific Challenges

Key challenges include scaling technologies from laboratory to industrial production, ensuring reproducibility, and integrating nano-enabled solutions into existing industrial processes.

1.4.2 Economic and Market Challenges

Nanotechnology startups face high capital requirements, limited access to late-stage funding, long time-to-market, and conservative industrial customers.

1.4.3 Regulatory considerations

Regulatory complexity is significant, especially in nanomedicine and environmental applications. Compliance with EU safety, health, and environmental standards increases development costs and timelines.

2. Funding and Financial Support Opportunities

2.1 Overview of the Funding Landscape

Funding for nanotechnology startups in Portugal is structured across pre-seed, seed, early-stage, and scale-up phases. At the early stages, **public funding is the main driver**, reflecting the research-intensive and high-risk nature of nanotechnology. National agencies and EU programmes provide grants, vouchers, and co-promotion schemes that allow startups to develop prototypes, validate technologies, and collaborate with research institutions. As companies mature, they increasingly rely on **hybrid instruments and private capital**, including venture capital, business angels, and co-investment funds supported by the Portuguese state.

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Due to the limited size of the domestic market, many nanotechnology startups are **internationally oriented from an early stage**, and EU funding instruments play a central role in enabling cross-border collaboration and access to larger markets.

2.2 Regional / Local level

2.2.1 Public Funding Programs

At the regional level, funding is largely provided through the *Regional Operational Programmes* under Portugal 2030, co-financed by EU Structural and Investment Funds. These programs support:

- **Applied research and innovation projects**
- **Pilot production and testing**
- **Industry–research collaboration**

Innovation Vouchers and R&D Co-promotion Projects are widely used by nanotechnology startups to finance feasibility studies, prototype development, and collaboration with universities or technology centres. In addition, municipal and inter-municipal grants support entrepreneurship, incubation, and early product development, often linked to local innovation strategies and science parks.

2.2.2 Private and Hybrid Instruments

At the local and regional level, startups can access:

- **Banking instruments with public guarantees** offered by local banks in cooperation with development agencies
- **Regional seed funds and co-investment vehicles**, often supported by ***Portugal Ventures*** (https://www.portugalventures.pt/) or regional development bodies

These hybrid instruments reduce risk for private investors and improve access to capital for early-stage technology companies.

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2.3 National Level

2.3.1 Public Funding Programs

At national level, Portugal has a strong framework for R&D and innovation support:

- **FCT - Fundação para a Ciência e a Tecnologia** - https://www.fct.pt/en/ finances research projects, PhD grants, post-doctoral fellowships, and scientific infrastructures that generate nanotechnology spin-offs.
- **ANI - Agência Nacional de Inovação** - https://ani.pt/en/ manages innovation funding programs that support industry-driven R&D and co-promotion projects.
- **Startup Portugal initiatives**, such as:
  - **Startup Voucher** for early entrepreneurs
  - **Vale Incubação** – for incubation and acceleration services - https://www.iapmei.pt/PRODUTOS-E-SERVICOS/Incentivos-Financiamento/Sistemas-de-Incentivos/Arquivo/Incentivos-Portugal-2020/Vale-Incubacao.aspx
- **SIFIDE** - https://out.ani.pt/ani_public/Homepage.aspx – a tax incentive scheme allowing companies to deduct R&D expenses from corporate tax, reducing financial risk for innovation investment.

2.3.2 Private and Hybrid Instruments

Portugal's venture capital ecosystem has expanded, supported by **Banco Português de Fomento** through national co-investment funds. These funds provide:

- Seed and early-stage capital
- Matching investments with private Venture Capitalists (VCs) and angels

In addition:

- **Business angel networks** provide mentoring and seed funding.
- **Corporate venture capital initiatives** connect startups with large industrial players, especially in energy, health, and manufacturing.

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2.4 International Level

2.4.1 Public Funding Programs

Nanotechnology startups benefit strongly from **EU research and innovation funding**, including:

- **Horizon Europe** – collaborative R&D and innovation projects
- **EIC Pathfinder, Transition, and Accelerator** – deep-tech funding from early research to market deployment
- **Eurostars and Eureka** – for international SME collaborations

These programs are particularly important for nanotechnology due to their high funding ceilings and international networks.

2.4.2 Private and Hybrid Instruments

At the international level, startups may access:

- **European and global venture capital funds** specialising in deep tech
- **Cross-border accelerators** that provide funding, mentoring, and market access
- **EU-backed investment platforms** that combine grants, equity, and loans

2.5 Accessibility and Challenges of Funding

Despite the wide range of funding instruments, nanotechnology startups face several challenges:

- **Complex application procedures** and long evaluation times
- **High co-financing requirements** for many public programs
- **Limited late-stage private investment** for industrial scale-up
- **Long development cycles**, especially in regulated sectors like healthcare

As a result, many promising nanotechnology innovations struggle to move from the pilot stage to full commercial deployment. In summary, Portugal offers a **strong public and EU-backed funding ecosystem for nanotechnology startups**, especially in the early stages. However, scaling remains difficult due to limited private capital and structural barriers, making international partnerships and EU programs essential for long-term growth.

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3. Practical Tips

3.1 First Steps in Business Creation

3.1.1 Administrative Procedures

Company creation in Portugal is straightforward through the ***"Empresa na Hora"*** system. Common legal forms include Lda. and SA. Additional licensing may apply for laboratory and medical activities.

3.1.2 Relevant Players

- **IAPMEI** promotes competitiveness and business growth, ensure support for the design, implementation and evaluation of policies aimed at industrial activity, with a view to strengthening innovation, entrepreneurship and business investment in companies operating in areas under the supervision of the Ministry of Economy and Territorial Cohesion, namely small and medium-sized companies, except the tourism sector and the monitoring powers in this area assigned to the Directorate-General for Economic Activities. *Website:* https://www.iapmei.pt/SOBRE-O-IAPMEI/English-version.aspx
- **AICEP - Portuguese Trade & Investment Agency** is the public body that promotes the attraction of productive inward investment and the internationalisation of the Portuguese economy, fostering export growth and the international expansion of Portuguese companies. **AICEP** has offices in Portugal and an external network in around 50 countries. *Website:* https://portugalglobal.pt/en/
- **Chambers of Commerce** (the Portuguese Chamber of Commerce and Industry is a private business association, supporting the Portuguese companies since 1834, promoting both national and international development of its members. *Website:* https://www.ccip.pt/en/
- **University Technology Transfer Offices** (Portugal's universities have Technology Transfer Offices (TTOs) like **U. Porto Innovation**, **UACOOPERA (Aveiro)**, and **UCP's Knowledge Transfer Units**, managed under networks like ANI's, to commercialise research, manage IP, foster spin-offs, and link academia with industry, forming a crucial part of Portugal's growing innovation ecosystem. These TTOs support researchers in patenting, licensing, creating startups, and securing funding, driving regional development. **Websites:**

* Agência Nacional de Inovação - https://ani.pt/en/knowledge-transfer-network-tto/

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* Universidade do Porto, Inovação - https://upin.up.pt/en/content/technology-transfer
* Centro de Neurociências e Biologia Celular - https://cnc.uc.pt/en/technology-transfer https://www.utad.pt/en/research/research-and-innovation
* Universidade Católica Portuguesa - https://www.ucp.pt/innovation
* UACOOPERA, Universidade de Aveiro - https://www.ua.pt/en/uacoopera

The Technology Transfer Offices (TTOs) are the structures responsible for technology transfer and valorisation activities, playing a central role in enhancing the knowledge produced in the different research centres and laboratories of national Higher Education Institutions (HEIs). These structures represent important competence centres serving researchers, students, and faculty, supporting the development of new business models and the establishment of local and international partnerships for the commercialisation of the results of research activities funded by public funds.

3.2 Guide to existing Training and Support Programmes

Portugal offers a broad ecosystem of entrepreneurship training, business coaching, and startup support, which is highly relevant for nanotechnology founders who often come from academic or research backgrounds and require business, regulatory, and market-oriented skills.

3.2.1 Job Centres and Public Coaching Programmes

The **IEFP (Instituto do Emprego e Formação Profissional)** plays a central role in entrepreneurship and business training across Portugal. Through national and regional centres, IEFP provides:

- Entrepreneurship training and mentoring programs
- Business planning and financial literacy courses
- Support for unemployed and young entrepreneurs transitioning into self-employment

These programs are often complemented by public business coaching initiatives promoted by regional development agencies, municipalities, and inter-municipal communities. They typically offer:

- One-to-one business mentoring
- Market analysis and commercialisation guidance

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- Support in accessing public funding and preparing grant applications

Such programmes are especially useful for early-stage nanotechnology startups, where founders must combine scientific expertise with strong business planning and regulatory awareness.

3.2.2 Specialised Programmes

University-Based Entrepreneurship Programs

Portuguese universities increasingly integrate entrepreneurship into science and engineering education. Many institutions host:

- Technology transfer offices (TTOs)
- Startup bootcamps and innovation challenges
- Proof-of-concept and pre-incubation programmes

These initiatives help transform research results into viable business concepts, supporting patenting, licensing, and spin-off creation.

Deep-Tech and Science-Based Accelerators

Portugal has developed a growing number of deep-tech accelerators and science-based entrepreneurship programmes. These focus on startups with strong technological foundations, including nanotechnology, advanced materials, and life sciences. They provide:

- Technical and regulatory mentoring
- Access to laboratories, pilot lines, and testing facilities
- Investor readiness and internationalisation support

Such programs are essential for nanotech ventures, where commercialisation cycles are long and capital requirements are high.

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3.3 Patents and Intellectual Property

3.3.1 Strategy for NanoTech Startups

For nanotechnology startups, intellectual property **(IP)** is a core strategic asset. Due to high R&D costs and long development timelines, IP protection is essential to:

- Secure competitive advantage
- Attract investors and partners
- Enable licensing and technology transfer agreements

Typical IP strategies include:

- Filing patents for core technologies and processes
- Protecting know-how through trade secrets
- Structuring licensing agreements with research institutions and industrial partners

Startups must align IP strategy with business goals, market focus, and funding requirements.

3.3.2 National IP Framework

In Portugal, patents, trademarks, and industrial designs are managed by the **Portuguese Institute of Industrial Property (INPI)**. INPI provides:

- National patent and trademark registration
- Advisory services for startups and researchers
- Fee reductions and support schemes for SMEs and academic institutions

INPI works closely with European and international systems, allowing Portuguese startups to extend protection through the European Patent Office (EPO) and WIPO mechanisms.

3.4 Networking Opportunities and Incubation

3.4.1 Networks and Cluster Organisations

Portugal's nanotechnology and deep-tech ecosystem is supported by a set of national and international research and innovation networks that connect startups, universities, technology centres, and industry.

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- **INL** – International Iberian Nanotechnology Laboratory Network (Braga). Intergovernmental research hub linking Portugal and Spain. Provides access to clean rooms, micro/nano-fabrication, testing facilities, and industrial collaboration programs. https://inl.int/
- **i3N** – Institute of Nanostructures, Nanomodelling and Nanofabrication National research network integrating NOVA FCT, University of Aveiro, University of Minho, and University of Porto. https://www.i3n.org/index.php/associate-laboratory
- **CeNTI** – Centre for Nanotechnology and Smart Materials. Industry-oriented research centre focused on nanomaterials, coatings, smart textiles, and functional surfaces. https://centi.pt/en/home
- **PRODUTECH Cluster** (Advanced Manufacturing). National cluster connecting technology providers and manufacturing companies using nano-enabled processes. https://www.produtech.org/?set_language=en&cl=en
- **Health Cluster Portugal.** Network supporting nanomedicine, diagnostics, and medical devices. https://www.healthclusterportugal.pt/pt/
- **EnergyIN** – Energy & Hydrogen Innovation Network. Supports nano-enabled energy storage, hydrogen, and sustainability technologies. https://www.energyinnovation.network/

3.4.2 Incubators and Accelerators

UNIVERSITY INCUBATORS

- UPTEC – University of Porto Science and Technology Park https://uptec.up.pt/
- IPN Incubadora (Coimbra) https://www.ipn.pt/
- ULisboa Tec Labs (University of Lisbon) https://teclabs.pt/
- NOVA FCT Entrepreneurship & TTO Programmes https://www.fct.unl.pt/en/node/47756

These incubators support academic spin-offs with business mentoring, lab access, and technology transfer.

SCIENCE AND TECHNOLOGY PARKS

- Taguspark (Oeiras/Lisbon) https://taguspark.com/
- Lispolis (Lisbon) https://www.lispolis.pt/?lang=en

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- Braga Parque de Ciência e Tecnologia https://www.avepark.pt/sobre/?lang=en
- Coimbra iParque https://coimbraiparque.pt/oparque#apresentacao

They provide laboratories, offices, pilot facilities, and links to investors and industry.

SPECIALISED DEEP-TECH ACCELERATORS

- STARTUP.NANO (INL) – nanotechnology & advanced materials
- Beta-i (Lisbon) – corporate & deep-tech acceleration https://beta-i.com/
- EIT Manufacturing & EIT Health (Portugal nodes) https://www.eitmanufacturing.eu/
- TechStars Lisbon (Deep-Tech & Sustainability tracks)
- BGI – Building Global Innovators (Biotech & Health)
- Fábrica de Unicórnios (Lisbon) – scale-up and internationalisation

Portugal offers a complete support pipeline for nanotechnology startups, from research networks **(INL, i3N, CeNTI)** to incubation **(UPTEC, IPN, Taguspark)** and specialised deep-tech acceleration **(STARTUP.NANO, EIT, TechStars)**, enabling the transition from lab research to global markets.

Examples:

INL (INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY) – PROGRAMMES & INITIATIVES

- **STARTUP.NANO**

  Pre-acceleration program for nanotechnology and advanced materials startups. Supports proof-of-concept, business model validation, investor readiness, and international exposure (e.g., Boston roadshows). https://www.inl.int/projects/startup-nano/
- **INL Innovation & Entrepreneurship Office**

  Provides technology transfer, IP support, industry partnerships, and spin-off creation services.
- **INL Tech@Lab** / Industry Collaboration Programs - enables startups and companies to access INL clean rooms, micro/nanofabrication, characterisation labs, and pilot testing.

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UNIVERSITY-BASED INCUBATORS (WITH NANO/DEEP-TECH FOCUS)

- **UPTEC – Science and Technology Park of the University of Porto**
  Hosts deep-tech, materials, health, and engineering spin-offs. https://uptec.up.pt/
- **IPN Incubadora (Instituto Pedro Nunes – Coimbra)**
  Strong in advanced materials, health tech, and engineering startups. https://www.ipn.pt/
- **Taguspark (Lisbon/Oeiras) -** Technology Park with labs, scale-up facilities, and international companies. https://taguspark.pt/solucoes/incubadora/
- **ULisboa Tec Labs (University of Lisbon) -** Supports science-based startups and research spin-offs. https://teclabs.pt/
- **Startup Lisboa / Hub Criativo do Beato (hardware & deep-tech lines)**
  https://www.beato.unicornfactorylisboa.com/sobre

SCIENCE & TECHNOLOGY PARKS

- Taguspark (Lisbon/Oeiras)
- Lispolis (Lisbon) https://www.lispolis.pt/
- UPTEC (Porto) https://uptec.up.pt/pt-pt/
- Braga Parque de Ciência e Tecnologia https://www.avepark.pt/
- Coimbra iParque https://coimbraiparque.pt/oparque#apresentacao

These parks provide access to labs, offices, pilot spaces, investor links, and internationalisation support.

SPECIALISED DEEP-TECH & SCIENCE-BASED ACCELERATORS

- Fábrica de Unicórnios (Lisbon) – deep-tech & international scale-up programs
  https://unicornfactorylisboa.com/
- EIT Manufacturing / EIT Health accelerators (Portugal nodes) https://www.eitmanufacturing.eu/
- Beta-i (Lisbon) – corporate & tech acceleration https://beta-i.com/
- BGI – Building Global Innovators (health & biotech focus) https://www.bgi.pt/
- TechStars Lisbon (Deep-Tech & Sustainability tracks) https://www.techstars.com/
- Science4Tech (NOVA / ULisboa ecosystem) https://teclabs.pt/

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NATIONAL & REGIONAL NETWORKS / CLUSTERS

- INL Network (Portugal–Spain) – nanotech, sensors, materials, health https://inl.int/research-groups/
- i3N – Institute of Nanostructures, Nanomodelling and Nanofabrication https://www.i3n.org/
- CeNTI – Centre for Nanotechnology and Smart Materials https://centi.pt/
- PRODUTECH (Advanced Manufacturing Cluster) https://www.produtech.org/
- Health Cluster Portugal https://www.healthclusterportugal.pt/pt/

Portugal's nanotech startups are supported by INL-led programs **(STARTUP.NANO)**, university incubators **(UPTEC, IPN, Tec Labs)**, science parks **(Taguspark, Braga Tech Park)**, and deep-tech accelerators **(Beta-i, EIT, TechStars)** — forming a complete pipeline from lab to market.

In conclusion, Portugal offers a well-structured support ecosystem for nanotechnology startups, combining training, IP protection, networking, and incubation. While scientific excellence is strong, these support mechanisms are essential for translating research into sustainable, high-growth companies.

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6. Literature Review for Germany

Partner organisation	Nanoinitiative Bayern GmbH
Country	Germany

1. Nanotechnology Industry Landscape

1.1 Overview of the Nanotechnology Industry in Germany

Nanotechnology is not considered a standalone industry, but rather an enabling technology that contributes to innovation across numerous sectors, including healthcare, chemicals, automotive, electronics, energy, environmental technologies, and advanced manufacturing. The German nanotechnology landscape consists of large industrial corporations, specialised small and medium-sized enterprises (SMEs), research organisations, universities, and technology-oriented start-ups. Public investment in scientific research and technology transfer has helped establish a strong innovation environment, allowing scientific discoveries to move from laboratories into commercial products and industrial processes. Research organisations such as the Fraunhofer Society, Helmholtz Association, Leibniz Association, and Max Planck Society play a central role in developing new nanomaterials, manufacturing technologies, and applications. These institutions work closely with industrial partners to accelerate commercialisation and strengthen Germany's international competitiveness.

Nonetheless, the number of newly founded nanotechnology companies has declined in recent years. High capital requirements, long development cycles, increasing regulatory complexity, and challenging financing conditions have made company creation more difficult.

1.1.1 Key Sub-Fields Relevant to Germany

Pharmaceutical Research and Drug Development

Nanotechnology has become increasingly relevant in pharmaceutical research and advanced drug delivery systems. Nanoparticles, nanocarriers, and targeted delivery mechanisms enable improved treatment effectiveness and reduced side effects. German research institutions and biotechnology companies are actively developing nanomedicine solutions for e.g. cancer treatment, diagnostics, and regenerative medicine.

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Resource-Efficient Materials

Nanotechnology contributes significantly to the development of lightweight materials, high-performance composites, functional coatings, and durable surfaces. These innovations help reduce material consumption and increase resource efficiency across manufacturing industries.

Production Equipment and Components

Nanotechnology is closely linked to Germany's strengths in mechanical engineering and industrial equipment manufacturing. Specialised machinery, precision instruments, measurement systems, sensors, and production technologies are required for the fabrication and characterisation of nanomaterials and nanostructures.

Climate, Environment, and Sustainability

Nanotechnology supports numerous environmental and sustainability applications. Examples include water purification systems, air filtration technologies, energy-efficient materials, catalysts for industrial processes, and advanced battery technologies. Nanomaterials contribute to reducing emissions, improving energy efficiency, and supporting the transition toward a more sustainable and circular economy.

1.1.2 Market Size and Economic Importance

Because nanotechnology functions as a cross-cutting enabling technology, its economic impact is difficult to measure through traditional industry statistics. Rather than forming a distinct market, nanotechnology creates value within a wide range of industrial sectors. Thousands of German companies utilise nanotechnology-based products, materials and / or manufacturing processes as part of their business activities.

The economic importance of nanotechnology extends beyond direct revenues. It enhances the competitiveness of key industries by enabling innovation and supporting the development of high-value products. Nanotechnology contributes significantly to export-oriented sectors such as automotive engineering, chemicals, medical technology, electronics, and machinery manufacturing.

1.2 Applications in the Different Industries

Nanotechnology has evolved into a foundational technology with applications across a wide range of industrial sectors. By enabling the manipulation of materials and structures at the nanometer scale, it

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creates opportunities to improve performance, functionality, durability, and efficiency. In Germany, nanotechnology applications are particularly important in industries that depend on advanced materials, precision engineering and / or high-value manufacturing.

1.2.1 Key Industrial Application Areas

Healthcare and Life Sciences

Healthcare represents one of the most dynamic application fields for nanotechnology. Nanoparticles are used in drug delivery systems, diagnostic tools, medical imaging, biosensors, and regenerative medicine. Nanostructured materials can improve the effectiveness of pharmaceuticals and enable more targeted therapies. German universities, research institutes, and biotechnology companies are actively developing nanomedical solutions for oncology, infectious diseases, and personalised medicine.

Energy

The energy sector benefits from nanotechnology through improved batteries, fuel cells, solar cells, and energy storage systems. Nanomaterials can enhance conductivity, increase efficiency, and extend product lifetimes. Germany's transition toward renewable energy and sustainable energy systems has created strong demand for innovations in battery technologies, hydrogen applications, and energy-efficient materials.

Electronics and Semiconductor Technologies

Nanotechnology is fundamental to modern electronics. The continuous miniaturisation of electronic components relies on nanoscale manufacturing techniques and materials. Applications include semiconductors, sensors, microchips, displays, photonics, and quantum technologies.

Advanced Materials and Manufacturing

Advanced materials represent one of the largest application areas for nanotechnology in Germany. Nanostructured coatings improve material properties such as corrosion resistance, wear protection, and surface functionality. Lightweight composites and functional materials contribute to increased efficiency in automotive, aerospace, and industrial manufacturing. Nanotechnology also enables new production methods and supports the development of smart materials with adaptive properties.

Environment and Sustainability

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Environmental applications include water treatment, air purification, waste management, environmental monitoring, and pollution control. Nanomaterials can improve filtration efficiency, enable more effective catalysts, and support resource-efficient industrial processes. These technologies contribute to sustainability goals while creating new business opportunities for innovative companies.

1.2.2 Role of Startups

Startups play an important role in the nanotechnology value chain despite representing only a small proportion of the overall sector. They often act as innovation drivers by commercialising scientific discoveries and exploring niche applications that may not initially attract the attention of larger corporations.

A significant share of nanotechnology startups originate as university spin-offs or research-based ventures. Researchers frequently establish companies to commercialise technologies developed within universities or public research institutes.

Startups typically focus on highly specialised technologies, such as novel materials, sensors, diagnostic systems, advanced coatings, or manufacturing processes. Rather than competing directly with large corporations, they often position themselves as technology suppliers, development partners, or providers of specialized solutions within larger industrial value chains.

However, the number of new nanotechnology start-ups in Germany has declined in recent years. Several factors contribute to this trend, including high development costs, lengthy certification and approval procedures, increasing regulatory requirements, and limited availability of growth-stage financing. Deep Tech ventures often require substantial investments before reaching commercial viability, making entrepreneurship more challenging than in many digital sectors.

1.3 Characteristics and Importance of the NanoTech Sector

1.3.1 Innovation Characteristics

One of the defining characteristics of nanotechnology is its exceptionally high research and development intensity. Scientific progress often requires sophisticated equipment, advanced experimental methods, and long-term investments. Product development cycles can be considerably longer than in many other technology sectors due to the need for extensive testing, validation, and regulatory approval.

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Another important characteristic is its interdisciplinary nature. Nanotechnology combines expertise from physics, chemistry, materials science, biology, medicine, engineering, and information technology. Successful innovation therefore depends on close collaboration between specialists from multiple disciplines.

Knowledge transfer between academia and industry is particularly important. Scientific discoveries frequently serve as the basis for commercial innovation, making universities and research institutes key contributors to technological advancement.

1.3.2 Research Infrastructure

Universities across Germany conduct internationally recognised research in nanoscience, materials engineering, nanomedicine, nanoelectronics, and related disciplines. Institutions such as the Technical University of Munich (TUM), Karlsruhe Institute of Technology (KIT), RWTH Aachen University, TU Dresden, and many others contribute significantly to scientific progress.

Public research organisations form another essential pillar of the innovation ecosystem. The Fraunhofer Society focuses on applied research and technology transfer, while the Helmholtz Association operates large-scale research facilities. The Max Planck Society contributes fundamental scientific discoveries, and the Leibniz Association supports interdisciplinary and application-oriented research.

Entrepreneurs and companies can benefit from access to advanced laboratories, characterisation facilities, clean rooms, pilot production lines, testing environments, and demonstration platforms.

1.3.3 Strategic Relevance

Nanotechnology is strategically important for Germany's future economic and industrial development. It contributes directly to several national priorities, including digitalisation, climate protection, sustainable resource management, healthcare innovation, and industrial competitiveness.

The technology supports the transformation of traditional industries by enabling more efficient manufacturing processes. Nanotechnology also strengthens Germany's position in global high-technology markets where innovation and technological leadership are critical competitive advantages.

Furthermore, nanotechnology contributes to addressing major societal challenges. Advanced materials support renewable energy systems and energy storage technologies. Nanomedicine enables improved

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healthcare solutions. Environmental applications contribute to cleaner production processes and more efficient resource utilisation.

1.4 Challenges and Barriers

Despite its considerable scientific and economic potential, the nanotechnology sector faces a variety of challenges that can slow innovation, commercialisation, and market adoption. Many of these barriers arise from the highly interdisciplinary nature of the field and the complexity of transferring scientific discoveries into industrial products. In Germany, where nanotechnology is closely linked to advanced manufacturing, healthcare, electronics, and environmental technologies, companies must overcome technological, economic, and regulatory hurdles before achieving large-scale commercial success.

Particularly for start-ups and small technology companies, the path from laboratory research to market-ready products is often lengthy, resource-intensive, and associated with significant risks. While Germany provides an excellent research infrastructure and public support for innovation, overcoming these barriers remains one of the central challenges for maintaining international competitiveness in nanotechnology.

1.4.1 Technological and Scientific Challenges

One of the most significant technological challenges in nanotechnology is the transition from laboratory-scale research to industrial-scale production.

Manufacturing techniques that are technically feasible in research laboratories may prove too expensive, too slow, or insufficiently reliable for industrial production. Companies therefore face the challenge of developing production methods that combine technical precision with economic efficiency.

Reliability and reproducibility represent additional obstacles. Nanomaterials often exhibit unique properties because of their extremely small dimensions, but these properties can be sensitive to slight variations in manufacturing conditions. Ensuring consistent quality across large production volumes is essential, particularly in sectors such as healthcare, electronics, and aerospace where product performance and safety are critical.

Characterisation and measurement also present ongoing challenges. Specialised equipment is required to analyse structures and properties at the nanoscale. The complexity of these analyses can increase

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development costs and create difficulties when comparing results across different laboratories and organizations.

Furthermore, nanotechnology innovation frequently requires interdisciplinary collaboration between experts from physics, chemistry, biology, materials science, engineering, and medicine. While such collaboration enables ground breaking innovations, it can also increase project complexity and extend development timelines.

1.4.2 Economic and Market Challenges

Nanotechnology innovations often require substantial financial investments before commercial revenues can be generated. Research and development activities are typically expensive.

Long development cycles are particularly challenging for start-ups and young companies. In sectors such as medical technology, pharmaceuticals, advanced materials, and electronics, it may take several years, or even more than a decade, for new technologies to progress from initial research to commercial deployment. During this period, companies must secure sufficient financing while managing technological and market uncertainties.

Access to private investment can be difficult because many nanotechnology ventures operate within the broader Deep Tech sector. Investors often perceive these projects as high-risk due to long commercialisation timelines and uncertain market outcomes. While Germany offers public funding programmes and innovation grants, securing follow-up financing for growth and industrial scaling remains a challenge for many companies.

Market acceptance can also create barriers. Customers and industrial users may be hesitant to adopt new technologies without extensive evidence of performance, reliability, and cost-effectiveness. In some sectors, nanotechnology-based solutions compete with well-established conventional technologies that already benefit from mature supply chains and proven market acceptance.

Another challenge concerns the declining number of start-ups in Germany. High entry barriers, increasing regulatory requirements, and competition for highly qualified talent have contributed to lower rates of company formation compared to previous decades.

1.4.3 Regulatory Considerations

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Regulatory issues play a particularly important role in nanotechnology because many applications involve novel materials whose long-term effects may not yet be fully understood. Policymakers, regulators, researchers, and industry stakeholders therefore place significant emphasis on safety assessment and responsible innovation.

Health and environmental considerations are among the most important regulatory concerns. Certain nanomaterials may interact differently with biological systems than larger-scale materials of the same chemical composition. Understanding potential risks related to human exposure, occupational safety, environmental release, and waste management requires extensive scientific investigation.

The European Union has established regulatory frameworks that address nanomaterials within existing legislation, including chemicals regulation, medical devices, pharmaceuticals, cosmetics, food products, and environmental protection. Companies developing nanotechnology-based products must therefore navigate complex regulatory requirements that may vary depending on the intended application.

Regulatory approval procedures can be particularly demanding in healthcare and life-science applications. Products such as nanomedicines, diagnostic systems, and medical devices often require extensive preclinical testing, clinical validation, and regulatory review before entering the market. These processes can significantly increase both development costs and commercialisation timelines.

At the same time, effective regulation is essential for building public trust and ensuring the responsible development of nanotechnology. A balanced regulatory framework that protects health and the environment while supporting innovation will remain a critical factor for the future growth and competitiveness of Germany's nanotechnology sector.

2. Funding and Financial Support Opportunities

2.1 Overview of the Funding Landscape

Nanotechnology funding and financial support for start-ups and companies dealing with it is a robust, global, multi-billion-dollar area focused on enhancing material properties at the 1-100 nanometre scale, with significant investments in healthcare, energy, mobility, and electronics.

Early stage funding in R&D support on nanotechnology mainly comes from various government programs and initiatives. Financial support for innovative R&D projects can be obtained from local, national, as well as European authorities, and here mainly from the funding and tender opportunities in the Horizon Europe

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program of the European commission. Other international R&D funding programs for early stage innovations in nanotechnology include the IRAsme and CORNET funding programs supported by the EU.

Venture capital funding for nanotechnology in Europe is rapidly advancing, with specialized firms like imec.xpand, Capital-E, and i&i Biotech Fund leading investments in early-stage startups. Significant growth is driven by deep-tech initiatives focusing on AI, healthcare, and advanced materials.

Key players and funding sources in the European nanotech scene include imec.xpand, capital-e.com, i&i Bio, xista Ventures, and other private venture capital focusing mainly on sustainable and biomedical applications.

2.2 Regional / Local Level

2.2.1. Public Funding Programs

In the Franconia region of Bavaria there are comprehensive funding offers and structures for research, development and application in the field of nanotechnology. Funding focuses on networking business and science, especially in the Nuremberg/Erlangen/Würrzburg metropolitan region.

Main funding institutions and networks include:

Cluster Nanotechnology (Nanoinitiative Bayern GmbH) based in Würzburg. This initiative coordinates the nanotechnology cluster in Bavaria, promotes the exchange of information and offers network management.

Nanonetz Bayern e.V.: It connects actors, promotes young talents and supports the exchange of knowledge in Bavaria.

Bayern Innovativ is supported by the Bavarian State Ministry for Economic Affairs. Key objectives are regional development, energy projects, networks and technology transfer.

Research projects and priorities in Franconia

FORNanoSat: Since June 2025, this initiative has been promoting the industrial production of nanosatellites in which five research institutions (including in Franconia) are involved.

FAU Erlangen-Nuremberg: The Interdisciplinary Center for Nanostructured Films (IZNF) and the Department of Materials Science are central contact points.

NanoSkin: A collaborative research project on surface functionalization in the nano range.

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NanoTeach: This project promotes nanotechnology teaching content in schools in order to secure the next generation of skilled workers.

Funding instruments in Bavaria

The Bavarian Technology Funding Program plus (BayTP+) supplies funds for applied research projects.

Within the program Digital Bonus Bavaria small companies (SMEs) can receive grants for digital solutions, which often go hand in hand with nanotechnology applications (e.g. process optimization).

In addition, Innovation vouchers will support research and development projects in small companies and craft businesses.

2.2.2. Private and Hybrid Instruments

Investment grants for companies in Bavaria can be obtained from the Bavarian Regional Fund (BRF) and in some economical weak regions also from the European ERDF funding program with key targets on innovation, SME support, climate & environment. For digitization projects support can also be obtained from „Digital Bonus Bavaria“, and start-ups may be eligible for grants from „Start-up country Bavaria“.

Key players and VC companies in Bavaria include:

- Bayern Kapital: It manages specialized funds (approx. EUR 700 million) and invests in young technology companies, including nanotechnology.
- High-Tech Gründerfonds (HTGF) is a major seed investor (with participation from KfW and industrial partners such as Siemens/Bosch) that invests in nanotechnology and materials science startups.
- UnternehmerTUM: The TU Munich Entrepreneur Center is closely linked to the start-up scene and supports DeepTech startups, which raised around 18% of the total German VC volume in 2021.
- BayBG Bavarian investment company offers equity capital for SMEs and startups.
- Corporate VC: Companies like Siemens Energy Ventures are involved in the Bavarian region.

2.3 National Level

2.3.1 Public Funding Programs

Financial support for innovations in nanotechnology in Germany is mainly supplied by the Federal Ministry of Research, Technology and Space and from the Federal Ministry for Economic Affairs and Energy as well as the program of the Federal Ministry of Finance on tax deduction of R&D expenses.

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Funds in nanotechnology in Germany is a central component of the federal government's research and innovation policy, especially as part of the High-Tech Strategy 2025. Current priorities and programs include:

- Materials research and innovation: Funding measures such as “Material innovations for a good and safe life (MaterialVital)” focus on biohybrid and living material systems.
- Promoting young talent: The NanoMatFutur competition supports young scientists in developing innovative nanomaterials.
- Future clusters (Clusters4Future): Projects like nanodiag BW receive significant funding (e.g. 45 million euros) for the application of nanotechnology in personalized medicine.
- Nanotechnology & Sustainability: The Federal Environment Agency (UBA) supports projects that investigate the sustainable use of nanotechnology.
- Safety research: The “NanoCare4.0” initiative focuses on the application safety of new material innovations.

Digital cutting-edge technologies in and for Germany: In addition to other technology programs and international cooperation projects, funds can also be obtained for the use of digital technologies in the construction industry, the process and manufacturing industries, and in mobility and transport, as well as the use of quantum computing and artificial intelligence in development, production, and administration.

The “Applied Energy Research Program” in Germany includes funding for innovative energy systems, efficient heating and cooling, climate-neutral energy supply, acceleration of heat transmission, as well as the efficient use of materials in keeping it in the economic cycle as long as possible.

National hydrogen strategy for funds on projects for the production of renewable hydrogen and the development of innovative production technologies, projects for the production of hydrogen derivatives, integrated projects for the implementation of a hydrogen value chain for electrical energy generation from renewable sources as well as for accompanying research ideas.

An overview on federal funding programs in Germany can be found in the federal funding database: Specific announcements for research and innovation in the nanotechnology sector can be searched for using the federal funding database. Many BMBF measures are handled through the database of Projektträger Jülich (PtJ).

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Most interesting for companies in Germany for financial and efficient R&D support is the deduction of project costs from tax payment in the yearly tax return. Deductible are 25% of personnel costs as well as 15% of costs for contract work up to a total of 1 mio € for R&D investments beyond usual R&D work. Funds can be obtained retrospectively by the tax return.

2.3.2 Private and Hybrid Instruments

Important venture capital providers & investors in Germany include:

- eCAPITAL Entrepreneurial Partners invests in deep tech, including process engineering/new materials.
- MIG Capital is focused on Deep Tech and Life Sciences; it has made notable investments in industry giants.
- The High-Tech Gründerfonds is a key player in early-stage financing, often involved in spin-offs in the areas of nanomaterials and biotechnology.
- b.value AG invests in DeepTech startups with a focus on advanced materials and biotechnology.
- AM Ventures is a leading VC in the field of additive manufacturing (3D printing), often with a reference to nanomaterials.
- Bayern Kapital is very active in financing startups in the nanotechnology sector in Bavaria.
- Vsquared Ventures is a deep tech investor with a focus on industrial applications.
- TRUMPF Venture is the corporate VC of the mechanical engineering company Trumpf, active in photonics and industrial measurement technology.

2.4 International Level

2.4.1 Public Funding Programs

International public funding in nanotechnology is a multi-billion-dollar, highly strategic area, with global R&D investment exceeding $4 billion annually. The USA leads with over $1.5 billion in annual federal funding through the National Nanotechnology Initiative (NNI), followed by substantial investments from China, South Korea, and the European Union for advanced materials and biomedical research.

Public funding for nanotechnology in Europe is driven by the European Commission's Framework Programme Horizon Europe and national initiatives, focusing on advanced materials, nanomedicine,

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energy storage, and industrial applications. Major investments support collaborative R&D to maintain a leading role in global nanosciences, with significant funding also dedicated to safety and regulation.

The EU promotes cooperative research between partners from European countries through initiatives like M-ERA-NET which provided over €42 million in public funding for joint projects. Key focus of the current call is on materials research and innovation to support the European Green Deal and Sustainable Development.

R&D funding with focus on small and medium-sized enterprises in their innovation efforts is also supplied by IraSME which is a network of different European countries/regions dedicated to “innovation without borders”. Focus is on supporting international projects on a national / regional level through well-established public funding programmes with as little extra bureaucracy as possible.

Funding on an international worldwide level is supplied by CORNET (COllective Research NETworking) which is a network of ministries and funding agencies that combine their existing funding schemes to increase the competitiveness of small and medium-sized enterprises (SMEs). In this way, CORNET supports new funding organisations worldwide to introduce pilot actions and schemes for pre-competitive Collective Research.

2.4.2 Private and Hybrid Instruments

International funding for nanotechnology ventures is driven by large-scale public initiatives, specialised venture capital, and cross-border collaborative grants aimed at advancing materials, energy supply and storage, healthcare, and electronics.

Key International Funding Sources & Programs include the National Nanotechnology Initiative NNI in the US, a major public funding source with over $2.2 billion requested for 2025 to support research and development.

Specialised funds like the Racah Nanotech Fund in Israel provide early-stage capital for university-linked IP, bridging the gap between research and commercialization.

Organizations like the International Institute for Nanotechnology (IIN) facilitate collaborations that have helped startups secure over $2.7 billion in venture capital.

Top areas for investments with regard to energy is the energy storage and solar cell technology, with regard to healthcare & Life Sciences are drug delivery methods, diagnostics, and novel therapeutics., and with

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regard to materials and manufacturing are mainly carbon nano materials like graphene and carbon nanotubes, as well as advanced manufacturing tools.

2.5 Accessibility and Challenges of Funding

Public funding, including grants and loans from local, national, or EU entities, is accessible for operational and innovative purposes, with specific, time-sensitive, and tiered access pathways. Accessibility often depends on the key requirements and subjects of the various calls. It mostly involves intense competition for limited capital, since demand for funding often exceeds supply, making it difficult to secure the necessary capital.

For individuals or organisations seeking public funding, the understanding of specific criteria and meeting all requirements of the tiered application processes is essential. Despite availability, access is often limited to some organisations or special required combinations of partners due to high, competitive demand, or potential biases where funding disproportionately reaches overrepresented or well-established groups

Funding for startups is accessible through a diverse, stage-dependent ecosystem ranging from early-stage grants, angel investors, and accelerators to later-stage venture capital and government loans. The economic uncertainty from global financial fluctuations, market volatility, and reduced investor involvement for risk creation is challenging for investors in a high-scrutiny environment often complicated by poor financial planning and lack of regulatory hurdles.

3. Practical Tips

3.1 First Steps in Business Creation

3.1.1 Administrative Procedures

The first step in creating a business is selecting an appropriate legal form. Common structures include the Gesellschaft bürgerlichen Rechts (GbR), the Unternehmergesellschaft (UG), the Gesellschaft mit beschränkter Haftung (GmbH), and, in later growth stages, the Aktiengesellschaft (AG).

The GbR (Civil Law Partnership) is the simplest form of partnership and can be established by at least two founders without a minimum capital requirement. It is often chosen during the very early stages of a venture, for example when researchers or entrepreneurs collaborate on a business idea before formally incorporating a company. While the GbR offers low administrative effort and flexibility, its partners are

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personally and jointly liable for all obligations of the business. For this reason, many technology-based start-ups eventually transition to a UG or GmbH once commercial activities increase, external financing is sought, or liability risks become more significant.

The UG (Unternehmergesellschaft), often referred to as a “mini-GmbH”, provides limited liability while requiring only a very small initial capital contribution. It is frequently used by founders who wish to benefit from limited liability but do not yet have sufficient capital to establish a GmbH.

The GmbH (Gesellschaft mit beschränkter Haftung) is the most common legal form for technology start-ups in Germany. It offers limited liability, a professional corporate structure, and strong credibility with investors, customers, and business partners. As a result, many deep-tech and nanotechnology companies choose the GmbH once they begin commercial operations or seek external investment.

For companies planning significant growth, raising substantial investment capital, or preparing for public markets, the AG (Aktiengesellschaft) may become relevant. However, due to its higher administrative complexity and regulatory requirements, it is rarely selected during the initial start-up phase.

Once the legal form has been chosen, the company must be registered with a notary and entered into the German Commercial Register (Handelsregister). In addition, businesses must register with the local trade office (Gewerbeamt), unless they qualify as a purely freelance activity. Following registration, the company receives a tax number from the responsible tax authority and may also require VAT registration.

For nanotechnology companies, licensing and approval requirements depend largely on the specific business model and application area. Companies developing medical devices, pharmaceuticals, diagnostic technologies, chemicals, or environmental technologies may be subject to additional regulatory obligations under German and European legislation. Early consultation with regulatory experts is therefore highly recommended.

Founders should also establish appropriate accounting systems, arrange business insurance coverage, and ensure compliance with employment, tax, and data protection regulations. While these requirements apply to all businesses, technology-based start-ups often face additional obligations related to laboratory operations, occupational safety, handling of hazardous substances, and research activities.

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3.1.2 Relevant Players

A variety of institutions support entrepreneurs throughout the company creation process.

The Chambers of Industry and Commerce (IHKs) provide information on legal requirements, business planning, taxation, internationalization, and company registration. They often organize seminars, networking events, and training programmes for new entrepreneurs.

Insurance providers play an important role in helping founders manage operational risks. Depending on the company's activities, relevant policies may include professional liability insurance, product liability insurance, property insurance, cyber insurance, and employer-related coverage.

For university-based founders, Technology Transfer Offices (TTOs) are particularly important. These offices assist researchers in commercializing scientific results, evaluating intellectual property, negotiating licensing agreements, and establishing spin-off companies. Many German universities and research organizations operate dedicated entrepreneurship and technology transfer units.

Public business support agencies at the federal, state, and regional levels provide additional assistance. Organizations such as development banks, innovation agencies, and economic development corporations offer information on funding opportunities, grants, networking initiatives, and international market access.

Research organizations including the Fraunhofer Society, Helmholtz Association, Leibniz Association, and Max Planck Society also support technology commercialization through specialized spin-off programmes and industrial cooperation projects.

3.2 Guide to Existing Training and Support Programs

Germany offers a broad range of entrepreneurship support programmes aimed at helping founders acquire business skills, validate business models, secure financing, and build sustainable companies. For nanotechnology entrepreneurs, these programmes can be particularly valuable because scientific expertise alone is often insufficient for successful commercialisation. Business development, market analysis, regulatory planning, intellectual property management, and fundraising capabilities are equally important.

Support programmes exist at national, regional, university, and sector-specific levels. Many programmes are accessible not only to established companies but also to researchers and students who are still in the early stages of developing a business idea.

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3.2.1 Job Centers and Public Coaching Programs

Several public institutions provide coaching and entrepreneurship support for prospective founders.

The Federal Employment Agency (Bundesagentur für Arbeit) supports unemployed individuals who wish to start their own businesses. Under certain conditions, entrepreneurs may receive financial assistance and coaching support during the transition from employment to self-employment.

Business coaching programmes are available through federal and state-level initiatives. These programmes often subsidise consulting services related to business planning, market analysis, financial management, internationalization, and organizational development. Such support can be particularly useful for first-time founders with strong technical expertise but limited business experience.

Many regional economic development agencies offer entrepreneurship workshops, mentoring programmes, and networking events. These initiatives help founders understand the practical aspects of company creation and connect them with relevant stakeholders within the innovation ecosystem.

The Chambers of Industry and Commerce (IHKs) regularly organise seminars covering topics such as taxation, legal requirements, financing, accounting, marketing, and business management. These programmes provide valuable practical knowledge for entrepreneurs across all sectors.

3.2.2 Specialised Programs

In addition to general entrepreneurship support, Germany offers numerous programmes specifically designed for technology-oriented and research-based ventures.

Universities play a particularly important role. Entrepreneurship centres at institutions such as the Technical University of Munich (TUM), Karlsruhe Institute of Technology (KIT), RWTH Aachen University, and TU Dresden provide training, mentoring, incubation services, and access to industry networks. Many of these programmes specifically target deep-tech and science-based innovations.

The federal EXIST Programme is one of Germany's most important initiatives for academic entrepreneurship. It supports students, graduates, and researchers who wish to transform research results into innovative start-ups. Funding can cover living expenses, material costs, coaching, and business development activities during the start-up preparation phase.

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Research organisations such as Fraunhofer, Max-Planck and Helmholtz operate dedicated programmes that support technology transfer and spin-off creation. These initiatives help researchers evaluate market potential, develop commercialization strategies, and establish companies based on scientific discoveries.

While Germany has relatively few programmes focused exclusively on nanotechnology, many deep-tech accelerators and innovation centres regularly support nanotechnology ventures. These programmes typically address advanced materials, biotechnology, medical technology, semiconductors, sensors, photonics, and sustainability technologies.

Specialised training may also be available through industry associations, cluster organisations, and innovation networks. Such programmes often focus on technology transfer, regulatory requirements, intellectual property management, and industrial collaboration within nanotechnology-related sectors.

3.3 Patents and Intellectual Property

Intellectual property (IP) is one of the most valuable assets for many nanotechnology companies. Since nanotechnology innovations are often based on novel materials, manufacturing processes, devices, or scientific discoveries, effective management of intellectual property can play a crucial role in establishing competitive advantages and attracting investment.

For start-ups, intellectual property should not be viewed solely as a legal issue but as a strategic business consideration. Decisions regarding patents, trade secrets, publications, and licensing arrangements can significantly influence future growth opportunities and market positioning.

3.3.1 Strategy for NanoTech Startups

There is no universally correct intellectual property strategy for nanotechnology start-ups. The optimal approach depends on the specific technology, business model, market environment, competitive situation, and commercialisation strategy.

In some cases, filing patent applications may be the most appropriate option. Patents can provide exclusive rights to commercially valuable inventions and increase attractiveness for investors, partners, and potential acquirers. Strong patent portfolios are often particularly important in sectors such as advanced materials, medical technology, biotechnology, and electronics.

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In other situations, companies may choose to publish their innovations without seeking patent protection. Public disclosure can prevent competitors from obtaining patents on the same invention while avoiding the costs associated with patent applications and maintenance.

Alternatively, some companies may decide to keep certain information confidential as trade secrets. This approach can be advantageous when inventions are difficult to reverse-engineer or when long-term confidentiality is achievable.

The key point is that founders should consciously develop an intellectual property strategy that aligns with their specific business objectives. Intellectual property decisions should ideally be considered at an early stage, particularly before discussing inventions with external partners or publicly presenting research results.

Professional advice from patent attorneys, technology transfer offices, and innovation consultants can help entrepreneurs evaluate different options and develop an appropriate strategy.

3.3.2 National IP Framework

Germany provides a well-established intellectual property system that offers protection for patents, trademarks, utility models, designs, and copyrights.

The central authority responsible for patents and trademarks is the German Patent and Trade Mark Office (DPMA). Companies can apply for national patents directly through the DPMA. For broader protection across Europe, entrepreneurs may also consider applications through the European Patent Office (EPO).

Patent application costs vary depending on the complexity of the invention, legal support requirements, and the geographical scope of protection. In practice, the preparation and prosecution of high-quality patent applications often involve significant professional expenses in addition to official filing fees.

The patent process typically includes application preparation, filing, examination, and potential grant. Because nanotechnology inventions often involve highly specialised scientific concepts, close cooperation with experienced patent attorneys is generally advisable.

3.4 Networking Opportunities and Incubation

The German networks play a crucial role in connecting researchers, entrepreneurs, start-ups, established companies, investors, and policymakers. For young entrepreneurs and emerging nanotechnology

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companies, participation in these networks provides valuable access to expertise, collaboration opportunities, funding information, market insights, and potential business partners.

3.4.1 Networks and Cluster Organisations

One of the directly nanotechnology-oriented organisations is the Cluster Nanotechnology, based in Bavaria. The cluster serves as a central platform for companies, research institutes, universities, and public institutions involved in nanotechnology and advanced materials. Through conferences, workshops, matchmaking events, and technology transfer activities, the cluster promotes innovation and facilitates cooperation between science and industry.

Another key initiative is Nano in Germany, a national platform that increases the visibility of German nanotechnology activities both domestically and internationally. The initiative provides information about technological developments, industrial applications, and networking opportunities while helping stakeholders establish partnerships across different sectors.

The NINa Innovation Platform (North European Initiative Nanotechnology e.V.) has been an important driver for knowledge exchange within the German nanotechnology community. NINa supports the transfer of research results into commercial applications and fosters interdisciplinary collaboration among scientists, engineers, entrepreneurs, and industrial partners. Through its extensive network, the organisation contributes to strengthening Germany's position as a leading location for nanotechnology innovation.

A particularly valuable resource for technology-oriented start-ups is the Fraunhofer Network Nanotechnology (FNT). The network brings together numerous Fraunhofer Institutes with expertise in nanomaterials, nanoelectronics, nanomedicine, surface technologies, and advanced manufacturing. Entrepreneurs benefit from access to cutting-edge research infrastructure, contract research opportunities, technology licensing, and collaborative development projects. The Fraunhofer Network serves as an important bridge between scientific discoveries and industrial implementation.

Beyond these organisations, Germany hosts several regional innovation clusters and technology networks that incorporate nanotechnology as part of broader fields such as advanced materials, photonics, microelectronics, biotechnology, and medical technology. Examples include initiatives within the Innovation Alliance Baden-Württemberg, Silicon Saxony, and various state-level cluster programmes.

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3.4.2 Incubators and Accelerators

Germany offers a support infrastructure for technology-based start-ups, including numerous incubators, accelerators, entrepreneurship centres, and innovation hubs. While only a limited number of programmes focus exclusively on nanotechnology, many support deep-tech ventures whose technologies are based on nanoscience, advanced materials, microelectronics, biotechnology, or medical technology.

One of the most influential actors is the Fraunhofer-Gesellschaft, which supports the commercialisation of scientific innovations through spin-off programmes, technology transfer activities, and industry collaborations. Researchers and entrepreneurs working with nanotechnology-based solutions can benefit from access to laboratories, pilot production facilities, technical expertise, and business development support. The Helmholtz Enterprise Programme provides funding and mentoring for researchers seeking to transform scientific discoveries into market-ready products and services. Several successful deep-tech start-ups in materials science, energy technologies, and nanotechnology-related fields have emerged from Helmholtz research centres.

The High-Tech Gründerfonds (HTGF) is Germany's leading seed investor for technology start-ups. Although HTGF is not an accelerator in the traditional sense, it provides early-stage financing, mentoring, and access to an extensive network of industrial partners and investors. Numerous companies operating in nanotechnology, advanced materials, diagnostics, and semiconductor technologies have received support from HTGF.

University-based incubators also play an important role. Institutions such as the Technical University of Munich (TUM), Karlsruhe Institute of Technology (KIT), RWTH Aachen University, and Dresden University of Technology operate entrepreneurship centres that support science-based start-ups through coaching, infrastructure, networking, and access to investors. These universities maintain strong links to nanotechnology research and frequently generate spin-offs in related fields.

In addition, Germany hosts several accelerator programmes focused on deep-tech innovation. Programmes such as UnternehmerTUM in Munich, SpinLab in Leipzig, and CyberLab in Karlsruhe support founders through structured mentoring, business training, investor access, and connections to industrial customers. While not exclusively dedicated to nanotechnology, they regularly work with start-ups developing advanced materials, sensors, microelectronics, photonics, and other technologies closely related to nanoscience.

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Furthermore, regional technology parks and innovation centres provide laboratory space, cleanroom facilities, prototyping infrastructure, and specialised business support. Examples include technology parks in Berlin, Dresden, Munich, Aachen, and Karlsruhe, which host numerous deep-tech and nanotechnology ventures.

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7. Literature Review for the EU

Partner organisation	bit cz training, s.r.o.
Country	Czech Republic

1. Nanotechnology Industry Landscape

The nanotechnology industry in the European Union is best understood as a cross-cutting enabling ecosystem rather than a single, clearly bounded sector. Across the EU, nanotechnology is embedded in advanced materials, micro and nanoelectronics, biotechnology, clean energy, medical technologies, environmental applications, photonics, and high-value manufacturing. This broad position within the European innovation system reflects the EU's longstanding treatment of nanotechnology as one of the key enabling technologies that support industrial innovation, resilience, and green and digital transition objectives.

At the EU level, the sector is characterised by a strong science base, dense public research networks, and extensive collaboration between universities, research organisations, technology centres, startups, SMEs, and industrial groups. Nanotechnology-related work is visible in both frontier research and market-oriented innovation. The EU does not function as a single homogeneous market for nanotechnology companies; instead, it offers a shared regulatory and funding framework that connects national ecosystems and enables cross-border research, testing, commercialization, and scale-up.

A major strength of the EU nano ecosystem is its diversity. Northern and Western European countries often lead in industrial scale-up, venture capital access, and manufacturing integration, while Central, Southern, and Eastern Europe contribute specialised research capabilities, cost-competitive engineering capacity, and emerging innovation hubs. This combination creates an environment in which nanotechnology startups can develop technologies in one country, test them with partners in another, and target customers across the Single Market.

From a strategic perspective, the relevance of nanotechnology in the EU has grown further as the Union has intensified efforts around strategic autonomy, advanced materials, semiconductor resilience, energy transition, defence-relevant innovation, and health preparedness. The European Commission's ongoing preparation of an Advanced Materials Act for 2026 shows that advanced materials and related nano-

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enabled technologies are no longer treated only as laboratory topics; they are now being positioned as part of Europe's industrial competitiveness agenda.

1.1 Overview of the Nanotechnology Industry in the European Union

The EU nanotechnology landscape has matured over the last two decades through sustained public investment in research infrastructure, collaborative programmes, mobility schemes, and industrial partnerships. Instead of concentrating only on a few isolated excellence centres, the Union has built a distributed ecosystem of universities, applied research institutes, pilot lines, cluster organisations, and startup support instruments. This model enables knowledge generation and technology transfer across borders and reduces dependence on a single national market.

In practical terms, the EU's nanotechnology industry includes early-stage academic spin-offs, SME technology developers, specialised testing and prototyping providers, and established industrial companies that integrate nanoscale solutions into larger products and processes. Nanotechnology is especially important in sectors where performance improvements at the material or device level create strong downstream benefits, such as filtration, coatings, medical diagnostics, batteries, semiconductors, packaging, catalysis, and lightweight materials.

1.1.1 Key Sub-Fields Relevant to the European Union

Several nanotechnology sub-fields are particularly relevant across the EU. Nanomaterials and advanced materials remain the strongest and most commercially visible field, including nanoparticles, nanofibres, nanotubes, nanocomposites, smart coatings, functional surfaces, and lightweight high-performance materials. These are used in manufacturing, construction, mobility, healthcare, packaging, and sustainability-oriented applications.

Nanoelectronics and micro-nano systems are another central field, particularly in sensors, semiconductor components, photonics, flexible electronics, and quantum-related technologies. This area is strategically important because it connects nanotechnology to digital sovereignty, industrial automation, and the wider European semiconductor agenda.

Nanomedicine and nano-biotechnology also play a major role. Research and startup activity across the EU focuses on targeted drug delivery, biosensors, imaging, regenerative medicine, antimicrobial materials,

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and advanced medical devices. These applications are highly promising, but they also face some of the most demanding regulatory and validation pathways.

Energy and environmental nanotechnologies form a fourth major cluster. They include materials for batteries, hydrogen, catalysis, photovoltaics, air and water purification, environmental remediation, and safe and sustainable-by-design materials. In the EU context, these applications are closely tied to Green Deal priorities and industrial decarbonisation.

1.1.2 Market Size and Economic Importance

It is difficult to measure the EU nanotechnology market as a separate statistical category because nanotechnology is dispersed across many industries and value chains. Its economic importance is therefore broader than any single market figure would suggest. Rather than acting as a self-contained sector, nanotechnology functions as a multiplier of productivity and innovation. It improves the performance, durability, sustainability, and value-added characteristics of products in sectors that are economically significant for Europe, including automotive, energy, chemicals, pharmaceuticals, electronics, industrial equipment, and health technologies.

The economic weight of nanotechnology in the EU is also visible through its role in attracting research funding, supporting intellectual property generation, creating spin-offs from universities and research organisations, and strengthening high-skilled employment. Many nanotechnology ventures target specialised B2B niches rather than mass consumer markets, which means their turnover can be modest in the early years while their strategic significance remains high.

1.2 Applications in the Different Industries

Nanotechnology applications in the EU are broad and increasingly market-oriented. The strongest application logic is not “nanotechnology for its own sake” but nano-enabled performance gains inside industrial, health, digital, and sustainability value chains. The same nanomaterial or nanoscale process may therefore serve different sectors depending on its functional properties.

Healthcare and life sciences are among the most dynamic application fields. Nano-enabled drug delivery systems, lab-on-chip devices, biosensors, antimicrobial coatings, advanced wound care, and tissue engineering platforms continue to attract strong research and startup attention. In this area, the EU

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benefits from excellent research institutions and collaborative clinical networks, though commercialisation is often slower because of testing, certification, and reimbursement requirements.

In energy and climate-related sectors, nanotechnology supports better batteries, more efficient catalysts, advanced membranes, hydrogen-related materials, improved photovoltaic performance, and longer-lasting components for renewable-energy systems. These applications are strategically attractive because they contribute directly to the EU's decarbonisation agenda, energy security, and industrial competitiveness.

In electronics, photonics, and smart systems, nano-enabled materials and fabrication techniques are used for sensors, MEMS/NEMS, optical components, miniaturised devices, flexible electronics, and semiconductor-related processes. This area is especially relevant as Europe seeks stronger positions in high-value digital manufacturing and resilient supply chains.

Advanced materials and manufacturing represent perhaps the broadest industrial use case. Nanotechnology enhances corrosion resistance, mechanical strength, thermal properties, barrier performance, antimicrobial behaviour, and surface functionality in industrial products. These benefits are relevant to the automotive, aerospace, industrial equipment, consumer goods, packaging, and construction materials sectors.

Environmental and sustainability applications are also expanding. Nanostructured filters, membranes, photocatalytic materials, and sensing systems are increasingly explored for water treatment, air quality monitoring, industrial emissions control, and circular-economy solutions. This is a field where research, regulation, and market demand are evolving together.

1.2.1 Key Industrial Application Areas

At the EU level, the most important industrial application areas can be grouped into five categories. First, healthcare and life sciences, where nanotechnology supports diagnostics, drug delivery, biomaterials, and medical devices. Second, energy and climate technologies, including batteries, hydrogen, photovoltaics, and resource efficiency. Third, electronics, photonics, and smart sensing, where miniaturisation and performance are central. Fourth, advanced manufacturing and functional materials, where nano-enabled improvements drive competitiveness in traditional industries. Fifth, environment and sustainability, where nanotechnology contributes to filtration, remediation, monitoring, and circular product design.

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1.2.2 Role of Startups

Startups play a particularly important role in the EU nanotechnology value chain because they often serve as the main bridge between research excellence and market applications. A large share of nano-focused startups emerge as university or research spin-offs. Their role is usually not to build immediate mass-manufacturing capacity but to validate new materials, devices, coatings, sensing systems, or platform technologies, and then integrate them into broader industrial ecosystems.

Many EU nanotechnology startups operate in a B2B model, selling specialised solutions, pilot services, IP, or components to industrial customers. Others pursue licensing, joint development agreements, or strategic partnerships with larger firms. This reflects the deep-tech nature of the field: high R&D intensity, complex testing requirements, and long product development cycles make collaboration essential.

Startups also benefit from the EU's cross-border framework. Because domestic markets for specialised nano solutions are often small, many founders internationalise early. They may build a consortium through Horizon Europe, seek mentorship through EIT or accelerator schemes, protect IP at the European level, and seek manufacturing or validation partners across several Member States. This EU dimension is a structural advantage, especially for small firms in emerging ecosystems.

1.3 Characteristics and Importance of the NanoTech Sector

The EU nanotechnology sector is highly research-driven, interdisciplinary, infrastructure-dependent, and strategically significant. Unlike many digital startups that can enter the market quickly with limited physical assets, nanotechnology ventures often require access to expensive laboratories, clean rooms, pilot lines, advanced microscopy, testing facilities, and specialised regulatory expertise. This makes the surrounding innovation ecosystem as important as the startup itself.

At the same time, nanotechnology is strategically valuable because it supports other priority sectors. It is not only a source of standalone innovations but also a foundation technology that strengthens advanced manufacturing, health innovation, digital industries, sustainable materials, and energy systems. In policy terms, this gives nanotechnology a high multiplier value.

1.3.1 Innovation Characteristics

Innovation in nanotechnology is typically science-based, interdisciplinary, and long-cycle. Breakthroughs often emerge at the interface of materials science, chemistry, biology, physics, engineering, and data-

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driven design. Technologies frequently require years of optimisation, reproducibility testing, safety assessment, and pilot validation before market entry. As a result, nanotechnology innovation needs patient capital, specialised mentoring, and realistic expectations about time to market.

Another common innovation feature is dependence on intellectual property. Many nanotechnology startups are built around proprietary know-how, patent families, process innovations, or exclusive access to specific research outputs. Freedom-to-operate analysis and careful publication strategy are therefore critical from the earliest stages.

1.3.2 Research Infrastructure

One of the EU's strongest advantages is its research infrastructure. Across the Union, startups and research teams can access universities, public research institutes, technology centres, pilot lines, testing infrastructures, nanofabrication facilities, and clean-room environments. These are often connected through European research programmes, cluster projects, or open-access models that reduce entry barriers for SMEs.

The quality of infrastructure varies by region, but the overall EU picture is strong. Large research organisations, technical universities, and specialised centres provide access not only to equipment but also to interdisciplinary expertise, validation partners, and training pipelines. For deep-tech founders, this infrastructure often determines whether an idea can move beyond the laboratory.

1.3.3 Strategic Relevance

Nanotechnology is strategically relevant to the EU because it directly contributes to competitiveness, sustainability, resilience, and technological sovereignty. It supports advanced materials, semiconductors, medical innovation, circularity, clean industry, and the development of critical technologies. The Commission's move toward an Advanced Materials Act confirms that advanced materials and related nanoscale technologies are now seen as core industrial assets rather than peripheral scientific topics.

1.4 Challenges and Barriers

Despite its strengths, the EU nanotechnology sector faces several structural challenges. The first is fragmentation. The Union offers rich capabilities, but they are spread across many countries, institutions, and funding schemes, making the ecosystem difficult to navigate for startups. The second challenge is

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scale-up. Europe is strong in science and prototyping, but moving from demonstration to industrial production remains difficult in many nano-related fields.

A third challenge concerns financing. While public R&D support is substantial, private capital for later-stage industrialisation is still uneven and often concentrated geographically. This affects especially hardware-intensive and materials-based startups that need larger and more patient investments than software ventures.

A fourth challenge is regulatory complexity. In areas involving chemicals, medical devices, environmental exposure, or product safety, nanotechnology startups face demanding compliance requirements. These are necessary and legitimate, but they increase cost, timelines, and the need for specialised expertise.

1.4.1 Technological and Scientific Challenges

Typical technological challenges include reproducibility, stability, reliability, and scale-up from laboratory conditions to industrial production. Many nanomaterials behave well in controlled experiments, but it becomes harder to manufacture consistently at a commercial scale. Integration into existing industrial processes can also be difficult, especially where certification, contamination control, or process redesign is required.

1.4.2 Economic and Market Challenges

Economic barriers include high upfront capital needs, long development cycles, uncertain demand at early stages, and conservative industrial procurement behaviour. Many customers want validated performance data and regulatory certainty before adopting nano-enabled products. For startups, this can create a long pre-revenue period.

1.4.3 Regulatory Considerations

Regulatory considerations are particularly important in the EU context. Nano-enabled substances and products may need to comply with REACH, sector-specific product rules, medical-device rules, workplace safety requirements, environmental assessments, and evolving standards for safe, sustainable-by-design materials. For founders, regulatory planning is not a final step but an early strategic task.

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2. Funding and Financial Support Opportunities

The European Union offers one of the world's most developed public funding environments for research and innovation, and this is especially relevant for nanotechnology startups. Because nanotechnology is a deep-tech field with long development cycles, substantial testing needs, and high infrastructure costs, founders often rely on a blended financing path that combines grants, project funding, vouchers, public-backed equity, accelerator support, and private investment.

At the EU level, funding can be understood across stages. Pre-seed financing often includes research grants, proof-of-concept support, university-linked commercialisation funds, and startup vouchers. Seed and early-stage development are supported by collaborative R&D programmes, EIC instruments, incubators, and national or regional schemes aligned with EU priorities. At later stages, startups may combine EU support with private venture capital, strategic corporate partnerships, export support, or scale-up instruments.

An important advantage of the EU ecosystem is that funding is not limited to one source. Founders can stack or sequence instruments, for example, moving from a university proof-of-concept grant to a Horizon consortium, then to an EIC application, and later to private investment. The challenge is that this landscape is complex and requires strong proposal-writing and project-management capacity.

2.1 Overview of the Funding Landscape

The EU funding landscape for nanotechnology startups is broad but layered. Some instruments support research consortia, others target single SMEs, and others focus on access to infrastructure, IP support, market validation, or internationalisation. In general, the most important distinction is between non-dilutive public support and private or hybrid finance.

Non-dilutive public support remains extremely important in nanotechnology because it reduces the burden of early technical risk. Research and innovation grants help startups validate technologies that private investors may consider too early or too capital-intensive. At the same time, these grants often require building consortia, developing administrative capacity, and aligning with policy priorities such as sustainability, digitalisation, health, or advanced materials.

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Private and hybrid funding becomes more important as startups move toward industrial validation, certification, market entry, and scaling. This includes angels, deep-tech venture capital, corporate venture capital, strategic partnerships, and co-investment structures linked to EU-backed or national development institutions.

2.2 Regional / Local Level

At the regional and local levels, funding opportunities vary by Member State and region, but many are linked to broader EU cohesion or innovation policy frameworks. Regional innovation vouchers, smart specialisation strategies, technology-transfer grants, and local incubator programmes can be particularly useful for nano startups because they often support feasibility studies, testing, prototype development, and collaboration with nearby universities or technology centres.

Regional actors are also important as access points into wider EU programmes. Science parks, development agencies, chambers of commerce, cluster organisations, and local innovation centres often help startups identify relevant calls and build cross-border partnerships.

2.2.1 Public Funding Programs

Typical regional public instruments include innovation vouchers, startup grants, feasibility support, proof-of-concept schemes, and collaborative R&D calls linked to regional smart specialisation priorities. For nanotechnology ventures, these are especially valuable because they can finance small but critical steps such as materials testing, patent landscaping, prototyping, or access to clean-room infrastructure before the company is ready for larger EU applications.

2.2.2 Private and Hybrid Instruments

At the local and regional levels, hybrid finance can include publicly supported seed funds, regional co-investment vehicles, guarantee schemes, and incubators that combine mentoring with small-ticket investments. Availability differs widely across Europe, but in strong innovation regions, such instruments can reduce the funding gap between academic development and investor readiness.

2.3 National Level

National-level support remains a core pillar for nanotechnology founders in the EU. Even when the final perspective is European, most startups are legally established in a single Member State and therefore

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depend on national agencies, ministries, innovation funds, tax incentives, and public procurement frameworks.

Many Member States offer R&D grants, innovation agency programmes, tax deductions for research expenditure, and specialised support for university spin-offs and deep-tech firms. For nanotechnology, these national measures are often the most practical first step because they are easier to access than large EU consortium projects and can help prepare companies for international funding later.

2.3.1 Public Funding Programs

At the national level, the most relevant public instruments typically include startup and innovation grants, applied research calls, proof-of-concept schemes, technology transfer support, export-readiness measures, and R&D tax incentives. Depending on the country, they may be delivered through innovation agencies, ministries of economy or research, national science foundations, or public development banks.

2.3.2 Private and Hybrid Instruments

National ecosystems also shape access to private and hybrid instruments. These may include angel networks, deep-tech venture funds, public-private co-investment vehicles, corporate venture programmes, and development-bank-backed financing. For nano startups, countries with stronger deep-tech investment cultures generally offer better conditions for the transition from prototype to industrial validation.

2.4 International Level

At the international level, the EU itself provides the most important shared framework for nanotechnology funding. For many startups, this is where Europe's added value is most visible. EU programmes not only finance projects; they also connect partners, provide credibility, and open access to research infrastructures, markets, and cross-border customers.

The most important EU-level funding framework remains Horizon Europe, which continues through 2027 with a large overall budget and strong relevance for advanced materials, manufacturing, health, digital technologies, and sustainability. For nanotechnology startups, Horizon Europe is valuable both for collaborative projects and for pathways built towards commercialization.

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The European Innovation Council is particularly important for deep-tech ventures. The EIC Accelerator is designed for startups and SMEs with high-risk, high-impact innovations and remains one of the most visible EU instruments for moving from development to scale-up. In parallel, other EIC tools and EU partnerships support earlier-stage research translation and thematic innovation communities.

2.4.1 Public Funding Programs

The most important international public programmes for nanotechnology startups in Europe include Horizon Europe, the EIC instruments, Eurostars, Eureka-linked collaboration schemes, and thematic partnerships related to advanced materials, manufacturing, health, and digital technologies. Current 2026 Horizon Europe industry calls show direct relevance for advanced materials, circular materials, access to technology infrastructures, and market-oriented valorisation.

These programmes are particularly valuable because they enable cross-border consortia, shared validation, and international credibility. They also help startups work with large research organisations and industrial partners beyond their home country.

2.4.2 Private and Hybrid Instruments

At the EU and international levels, startups can also access deep-tech venture capital, corporate partnerships, cross-border accelerators, EIT-backed business-creation services, and public-private instruments that combine grants, equity, and market support. Such instruments are especially useful once a company has a validated prototype and a clear path to certification, pilot deployment, or industrial integration.

2.5 Accessibility and Challenges of Funding

Although the funding landscape is rich, access is not easy. Founders often face complex calls, heavy documentation, strict eligibility rules, co-financing requirements, and long evaluation periods. For small teams, grant applications can consume substantial time. Success also depends on the ability to describe technological novelty in business terms, demonstrate market relevance, manage partnerships, and present credible scale-up planning.

For nanotechnology startups, the most common funding challenge is the gap between technically promising results and investor-ready business maturity. Public funding can help close this gap, but only if

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founders sequence instruments carefully and build the necessary commercialization capabilities in parallel with technical development.

A practical EU-level funding pathway for a nano startup often looks like this: begin with university or regional proof-of-concept support, move to national applied R&D or innovation funding, participate in collaborative EU projects for validation and partnerships, protect IP at the European level, and then target EIC, venture investors, or strategic industrial partnerships for scale-up.

3. Practical Tips

Founding a nanotechnology startup in the European Union requires more than technical expertise. Because the field combines science, regulation, infrastructure, funding complexity, and international collaboration, founders need an early business strategy with a European outlook, even if the company starts in a single local ecosystem. Practical preparation should therefore cover legal setup, support actors, training, IP, regulatory planning, and network building from the beginning.

3.1 First Steps in Business Creation

The first practical step is to choose the most suitable national legal form and establish the company in a Member State whose ecosystem matches the technology's needs. Since company law remains largely national, there is no single EU-wide startup registration system in force for all firms. Founders should therefore select the jurisdiction based on access to research partners, tax environment, grant eligibility, talent availability, and investor familiarity with deep tech.

For nano startups, this initial setup should be accompanied by three early strategic actions. First, define the application field precisely. Investors and public evaluators respond better to a startup that solves a concrete problem in health, energy, manufacturing, electronics, or the environment than to one that presents nanotechnology as a generic capability. Second, map the technology readiness level and the validation path, including testing, pilot needs, and likely regulatory milestones. Third, clarify ownership of knowledge, especially when the technology originates from a university, public laboratory, or collaborative project.

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3.1.1 Administrative Procedures

Administrative procedures differ across Member States, but several common tasks apply across the EU: selecting the legal form, registering the company, obtaining a tax number, opening business banking arrangements, clarifying employment and social insurance obligations, and checking whether the planned activity triggers any sector-specific licensing, laboratory, product-safety, or chemical-handling requirements.

For nanotechnology companies, additional practical checks are often necessary. If the company works with engineered nanomaterials, chemicals, laboratory services, medical applications, or industrial pilot production, founders should verify from the outset whether REACH, workplace-safety rules, waste handling, product testing, or sector-specific certifications may apply. These issues should not be postponed until commercialization, because they can influence material choices, documentation standards, and cost planning.

3.1.2 Relevant Players

At the EU level, several categories of actors are especially relevant. Chambers of commerce and business support agencies help with company creation and general compliance. Universities and technology transfer offices are critical when the startup is based on research results, patents, or spin-off agreements. Regional innovation agencies and clusters can help identify early funding and industrial contacts.

The Enterprise Europe Network is one of the most practical EU-wide support mechanisms for SMEs with international ambitions. It helps companies navigate Single Market opportunities, regulations, and partnering. For startups aiming to expand beyond their domestic market, it can be a useful first point of contact.

National Contact Points for Horizon Europe and related programmes are also important, especially for startups planning EU applications. They can provide orientation on calls, consortium logic, and proposal fit. In addition, European Digital Innovation Hubs, EIT communities, and specialised cluster organisations can help connect technical teams with customers, investors, and cross-border infrastructure.

3.2 Guide to Existing Training and Support Programs

Because many nanotechnology founders come from scientific rather than business backgrounds, structured entrepreneurship support is highly valuable. The best support programmes do not only explain

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how to register a company; they build capabilities in business modelling, regulatory planning, IP strategy, customer discovery, fundraising, and internationalisation.

Across the EU, training and support exist at several levels. Public entrepreneurship programmes, employment services, university accelerators, incubators, deep-tech bootcamps, and EIT-linked initiatives all contribute to the support pipeline. The most useful programmes for nanotechnology are those that combine business support with access to laboratories, testing, industrial mentors, and sector-specific knowledge.

3.2.1 Job Centres and Public Coaching Programs

General entrepreneurship support from public employment services, municipal programmes, or national startup agencies can be a helpful entry point, particularly for founders transitioning from academia or unemployment into entrepreneurship. These programmes often provide business planning, mentoring, and financial literacy support. On their own, they are rarely sufficient for a nanotechnology startup, but they can help founders formalise the business concept and prepare for more specialised support.

3.2.2 Specialised Programs

At the EU level, specialised support is especially important. EIT communities, manufacturing and health innovation programmes, science parks, and university-based incubators often provide exactly the combination deep-tech founders need: technical mentors, investor-readiness coaching, access to pilots and demonstrators, and links to industrial customers. Startup founders should actively seek programmes that understand long development cycles and the difference between digital startups and materials- or device-based companies.

3.3 Patents and Intellectual Property

Intellectual property is central in nanotechnology because competitive advantage often depends on novel compositions, processes, coatings, device architectures, or application methods. A nano startup without a clear IP strategy risks losing control over its core value proposition, especially when it works in collaborative research or publishes scientific results early.

Founders should therefore build an IP plan from the start. This does not always mean patenting everything immediately, but it does mean clarifying ownership, timing, territorial scope, confidentiality rules, and the

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relationship between patents, trade secrets, and publications. When the startup emerges from a university or public lab, the spin-off agreement and licensing terms must be reviewed carefully.

3.3.1 Strategy for NanoTech Startups

A practical IP strategy for nano startups usually includes four elements. First, identify what is genuinely protectable: materials, formulations, processes, uses, device designs, or integrated systems. Second, conduct a freedom-to-operate and prior-art review before committing major resources. Third, align patent timing with funding and publication plans to ensure scientific dissemination does not compromise novelty. Fourth, decide early which parts of the know-how should remain confidential trade secrets rather than public patents.

3.3.2 National IP Framework

Although patent and trademark filings can start at the national level, EU-level and European-level tools are crucial for growth-oriented startups. The European Patent Office is highly relevant to companies seeking broader patent protection, while the EUIPO is relevant to trademarks and designs. In addition, the European IP Helpdesk provides free first-line support for SMEs and EU project participants on IP management, protection, and exploitation in cross-border contexts.

For practical reasons, startups should not treat IP as a purely legal afterthought. It should be integrated into investor discussions, partnership agreements, grant applications, and commercialization planning.

3.4 Networking Opportunities and Incubation

Networking is exceptionally important in nanotechnology because founders rarely succeed in isolation. They need researchers, testing facilities, supply-chain partners, industrial users, regulatory advisors, and investors. In the EU context, the best networking is usually not generic startup networking but specialised ecosystem participation where materials, health, manufacturing, or advanced-technology stakeholders meet.

Relevant networking structures include cluster organisations, sector platforms, technology centres, European partnerships, EIT communities, industry events, and matchmaking through the Enterprise Europe Network. Participation in these structures helps founders understand where real demand exists and which partnerships are worth pursuing.

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3.4.1 Networks and Cluster Organisations

Cluster organisations and research networks are especially valuable because they connect firms to laboratories, industrial users, and policy-relevant initiatives. For nano startups, the right network can open access to pilot lines, testing, demonstrators, and first customers. Founders should map both national and cross-border cluster options rather than staying only within their local region.

3.4.2 Incubators and Accelerators

Incubators and accelerators can be very helpful, but founders should choose carefully. Generic startup programmes may be too focused on fast-scaling digital business models. Nanotechnology ventures usually benefit more from university-linked incubators, deep-tech accelerators, or manufacturing and health innovation platforms that understand prototyping, regulation, long validation cycles, and capital intensity.

In practical terms, founders should prioritise support environments that offer at least some of the following: access to laboratories or testing infrastructure, links to industrial partners, regulatory or IP mentoring, grant support, and exposure to investors familiar with deep tech. The right incubator can dramatically shorten the path from research output to structured company development.

Overall, the most effective practical strategy for a nanotechnology startup in the EU is to act locally but plan internationally: establish the company in a supportive home ecosystem, protect and structure the IP early, use national and regional support to validate the technology, and then leverage EU networks, funding, and partnerships to scale.

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8. Glossary

Term	Definition
2D Materials	Atomically thin materials (one or few atomic layers thick) with exceptional electronic, mechanical, and thermal properties. Graphene is the prototypical example; others include transition metal dichalcogenides (e.g., MoS_2). Critical for next-generation sensors, flexible electronics, and energy applications.
Accelerator	A time-limited program (typically 3–6 months) that helps startups refine their business model, connect with investors, and prepare for scale-up. Often culminates in a "demo day."
Advanced Materials	Materials with improved or novel functional properties (e.g. strength, reactivity, lightness, conductivity, biocompatibility), often enhanced through nanoscale structures or processing.
AEI (Agencia Estatal de Investigación)	The National Research Agency that finances basic research in the field of nanotechnology, chemistry and physics.
AEMPS (Agencia Española de Medicamentos y Productos Sanitarios)	The Spanish Agency for Medicines and Health Products, which supervises the market for nanomedicine and cosmetic products containing nanomaterials.
AG (Aktiengesellschaft)	German public limited company whose shares can be publicly traded. Typically used by larger companies and corporations.
Angel investor / Business Angel	A private individual investing early-stage capital in startups, usually in exchange for equity and often strategic support.
ANI – National Innovation Agency (Agência Nacional de Inovação)	A public body that manages innovation funding programmes and R&D projects with industry.
Applied Research	Research aimed at solving practical problems or creating marketable products and services.
ART-ER (Agenzia Regionale per la Ricerca e l'Innovazione dell'Emilia-Romagna)	Emilia-Romagna's regional innovation agency. Manages regional R&D funding, technology transfer, and specialized programs such as Nanofab-ER, which provides SMEs with subsidized access to nanofabrication facilities and cleanrooms. Serves as a model for regional innovation support in Italy's industrial north.
Biomaterials	Materials compatible with biological systems are used in regenerative medicine and medical devices.
Business Incubator	An organisation that supports early-stage startups with office/lab space, mentorship, training, and access to networks –often affiliated with universities or public agencies.

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CDP (Cassa Depositi e Prestiti)	Italy's national promotional institution and development bank, wholly owned by the Ministry of Economy and Finance. Channels public resources into strategic sectors through direct investment (e.g., Italian Innovation Fund) and co-investment with private venture capital. Central actor in bridging Italy's early-stage funding gap for deep-tech ventures.
CDTI (Centro para el Desarrollo Tecnológico y la Innovación)	A public institution promoting innovation and technological development, offering grants (e.g. NEOTEC), consulting and support in the internationalization of companies.
CeNTI – Centre for Nanotechnology and Smart Materials	Portuguese technology centre focused on nanomaterials, coatings, and functional textiles.
Clean room	A controlled environment with very low particle contamination, essential for nano- and microfabrication.
CLP (Classification, Labelling and Packaging)	A regulation on the classification, labelling and packaging of substances, requiring consideration of the specific risks arising from the nano form.
CNR (Consiglio Nazionale delle Ricerche / National Research Council)	Italy's largest public research organization, operating >100 institutes nationwide. Key nanotech units include CNR-NANOTEC (Lecce), CNR-ISMN (Bologna), and CNR-IMM (Bologna/Catania). Provides open-access cleanrooms, pilot lines, and technical expertise to startups via PNRR-funded valorization programs.
Commercialisation	The process of bringing a technology from the laboratory to the market.
Comunica Star	Official online platform (managed by Unioncamere) for company registration, tax identification, and mandatory business communications with public authorities. Enables complete startup registration in 5–7 business days at €200–300 total cost. Mandatory channel for all new business formations in Italy.
CSIC (Consejo Superior de Investigaciones Científicas)	The largest research institution in Spain with an extensive technology transfer department.
Deep Tech	Technologies based on scientific breakthroughs, characterised by a high degree of risk, a long development cycle and high capital intensity.
DPMA (German Patent and Trade Mark Office / Deutsches Patent- und Markenamt)	Germany's central authority for patents, trademarks, designs, and utility models.
Drug Delivery	Use of nanoparticles to transport medicines directly to target cells.
DUE (Documento Único Electrónico)	An electronic document that enables quick and structured establishment of a company in the PAE system.

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EIC Accelerator (European Innovation Council Accelerator)	Flagship EU funding instrument for breakthrough deep-tech startups. Provides non-dilutive grants up to €2.5 million plus optional equity investment for companies at Technology Readiness Levels (TRL) 6–9. Highly competitive; Italian nanotech ventures have secured awards (e.g., €2.3M for a graphene biosensor spin-off in 2023).
EIC Pathfinder	EU programme funding visionary research projects at a very early stage of development (TRL 1-4).
EIC Transition	A financial bridge dedicated to the validation of nano technologies developed in earlier research phases (TRL 4-6).
EIT (European Institute of Innovation and Technology)	An EU body that fosters innovation through Knowledge and Innovation Communities (KICs) such as EIT Health, EIT Manufacturing, and EIT RawMaterials.
Enabling Technology	A technology that improves products and processes across multiple industries.
Enterprise Europe Network	The EU-supported network helps SMEs with internationalisation, Single Market rules, partnering, and innovation support.
Entrepreneurship Support Organisation (ESO)	Public or private entities (e.g., chambers of commerce, innovation agencies) that provide coaching, training, or funding to new entrepreneurs.
EPO (European Patent Office)	International organization responsible for granting European patents under the European Patent Convention.
EU Funding Programmes	Collective term for financial instruments managed by the European Union, including Horizon Europe, EIC, ERDF, and Eureka/Eurostars.
European IP Helpdesk	A free first-line service that supports SMEs and EU project participants with IP management and protection.
EXIST	German federal funding programme supporting academic entrepreneurship and university spin-offs.
FCS (Fondo per la Crescita Sostenibile / Sustainable Growth Fund)	Flagship national R&D funding instrument administered by the Ministry of Enterprises and Made in Italy (MIMIT). Provides grants and subsidized loans (€500,000–several million) for industrial research projects in Key Enabling Technologies, including nanotechnology. Prioritizes company-research center partnerships with clear commercialization pathways.
FCT – Fundação para a Ciência e a Tecnologia	Portugal's main public research funding body.
FNT (Fraunhofer-Netzwerk Nanotechnologie)	Network of Fraunhofer Institutes coordinating nanotechnology research, development, and technology transfer activities.

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Fraunhofer (Fraunhofer-Gesellschaft)	Germany's largest organisation for applied research and technology transfer.
Functional Coatings	Coatings with special properties: antimicrobial, anti-corrosion, self-cleaning.
Garanzia Giovani (Youth Guarantee)	Italy's national implementation of the EU Youth Guarantee initiative. Offers entrepreneurship training, coaching, and vouchers to NEETs (Not in Employment, Education or Training) aged 15–29. Provides foundational business skills but lacks deep-tech specialization; best suited as a first-step resource for young founders.
GbR (Gesellschaft bürgerlichen Rechts)	Civil law partnership and one of the simplest legal forms for business activities in Germany.
GmbH (Gesellschaft mit beschränkter Haftung)	German limited liability company and the most common legal form for technology start-ups.
Graphene	Single-layer carbon atoms arranged in a hexagonal lattice. Exhibits extraordinary electrical conductivity, mechanical strength, and thermal properties. Considered a strategic material for next-generation electronics, energy storage, and composite materials.
Green Transition	Shift towards a sustainable, low-carbon economy.
Helmholtz (Helmholtz Association of German Research Centres)	German research organisation, operating major research infrastructures.
Horizon Europe	The EU's main funding programme supporting research and innovation, with a particular focus on nanomaterials and the green transition.
HTGF (High-Tech Gründerfonds)	Germany's leading seed-stage investor for technology and deep-tech start-ups.
Hybrid Instruments	Funding mechanisms that combine public and private investment (grants + equity).
ICEX (España Exportación e Inversiones)	National Agency supporting the attraction of foreign investments and the expansion of Spanish companies to external markets.
ICTS (Infraestructuras Científicas y Técnicas Singulares)	A unique model of large-scale strategic research infrastructure, open to public and private users.
IHK (Industrie- und Handelskammer / Chamber of Industry and Commerce)	German regional chamber supporting businesses with advisory services, training, networking, and legal information.
IIT (Istituto Italiano di Tecnologia / Italian Institute of Technology)	Genoa-based national research institution with interdisciplinary focus on robotics, nanotechnology, and life sciences. Operates advanced labs for graphene synthesis, nanomedicine, and

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	sustainable nanomaterials. Strong track record in academic spin-off creation; maintains technology transfer offices supporting company formation.
INAIL (Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro)	National Institute for Insurance against Accidents at Work. Beyond its insurance mandate, INAIL provides free nanomaterial safety assessments and publishes workplace safety guidelines for handling engineered nanomaterials – critical support for early-stage nanotech ventures lacking EHS expertise.
Incubator (nanotech)	A specialized support facility for early-stage nanotechnology ventures, providing access to shared infrastructure such as cleanrooms, nanofabrication tools, and characterization equipment that would otherwise be prohibitively expensive for startups. Nanotech incubators typically offer additional services critical to the sector – including EHS (environmental, health, and safety) guidance for nanomaterial handling, regulatory support for REACH compliance, and connections to research laboratories for technology validation.
INL (International Iberian Nanotechnology Laboratory)	International Laboratory of Iberian Nanotechnology in Braga, a joint project of the governments of Spain and Portugal, offering access to clean rooms and nanofabrication.
INPI – Instituto Nacional da Propriedade Industrial	Portuguese authority responsible for patents and trademarks.
Invitalia	Italy's national agency for investment attraction and enterprise development. Offers startup coaching, feasibility studies, and state-backed loan guarantees (covering up to 80% of bank lending). Manages Smart&Start Italia, a grant program for innovative startups, and serves as first point of contact for foreign investors entering the Italian market.
IP (Intellectual Property)	Legal rights over inventions (patents), designs, software, or brands that allow creators to control and monetize their innovations.
IPCEI (Important Project of Common European Interest)	Large-scale, cross-border industrial initiatives approved by the EU to strengthen strategic sectors (e.g., microelectronics, batteries, hydrogen)—often involving nanomaterials.
KETs (Key Enabling Technologies)	A group of advanced technologies (micro/nano-electronics, photonics, nanotechnology, advanced materials, biotechnology, and AI) identified by the EU as essential for industrial competitiveness and sustainability.
Leibniz Association	Network of independent German research institutes conducting both fundamental and applied research.
Max Planck Society	German organisation for fundamental scientific research.

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MEMS / NEMS	Micro/Nano Electro-Mechanical Systems are used in sensors and electronic devices.
Micro- and Nanofabrication	Manufacturing processes at micro and nano scales.
MIMIT (Ministero delle Imprese e del Made in Italy / Ministry of Enterprises and Made in Italy)	Government ministry responsible for industrial policy, SME support, intellectual property (via UIBM), and management of national innovation funds (e.g., FCS). Key counterpart for nanotech ventures seeking public R&D funding or regulatory guidance on industrial applications.
MUR (Ministero dell'Università e della Ricerca / Ministry of Universities and Research)	Government ministry overseeing higher education and public research. Administers the PNRR Valorizzazione program that funds proof-of-concept validation and spin-off creation from university labs. Coordinates the KETs Italy initiative promoting strategic technologies including nanotechnology.
Nano in Germany	National platform promoting German nanotechnology activities and international visibility.
Nanomaterials	Materials with at least one external dimension, or internal/surface structure, in the size range 1-100 nanometres. Exhibit novel physical, chemical, or biological properties compared to bulk counterparts. Includes nanoparticles, nanotubes, nanowires, and nanostructured surfaces.
Nanomedicine	Application of nanoscale materials and devices to diagnose, treat, and prevent disease. Includes nanoparticle-based drug delivery systems (enabling targeted therapeutics), nanoscale biosensors for early disease detection, and imaging contrast agents. Faces extended development timelines due to regulatory requirements (AIFA/EU clinical validation).
NanoSpain	A Spanish nanotechnology network that coordinates the activities of more than 370 research groups and facilitates the transfer of technology to industry.
Nanostructured Coatings	Thin surface layers engineered at the nanoscale to impart specific functionalities—e.g., self-cleaning, anti-corrosion, thermal insulation, or antimicrobial properties. Applied in construction (Mapei), energy efficiency, and industrial manufacturing.
Nanotechnology	The understanding, control, and application of matter at the nanoscale to create materials, devices, and systems with novel properties.
NEET	"Not in Education, Employment, or Training"—a demographic category often targeted by youth entrepreneurship programs.
NINa (North European Initiative Nanotechnology e.V.)	German innovation network promoting collaboration and technology transfer in nanotechnology.

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OEPM (Oficina Española de Patentes y Marcas)	The Spanish Patent and Trademark Office that manages the registration of inventions and industrial designs.
OTRI (Oficina de Transferencia de Resultados de Investigación)	Research Transfer Offices at universities, responsible for managing intellectual property and supporting spin-offs.
PERTE (Proyectos Estratégicos para la Recuperación y Transformación Económica)	Strategic national projects aimed at modernizing industry, including the microelectronics (Chip) and health sectors.
Pilot line	A pre-industrial production environment is used to validate manufacturing processes before full commercial scale-up.
Pilot-Scale Production	Small-scale production to test industrial feasibility.
PNRR (Piano Nazionale di Ripresa e Resilienza)	Italy's National Recovery and Resilience Plan, implementing the EU Recovery and Resilience Facility. Allocates €191.5 billion (€68.9bn grants) across six missions; nanotechnology features prominently in Mission 1 (Digitalisation) and Mission 4 (Education and Research), particularly through Tecnopoli infrastructure investments and research valorization schemes.
Proof of Concept (PoC)	A demonstration that a technology or idea can work in practice; often funded by universities or public grants to bridge the gap between research and commercialization.
Public Procurement of Innovation (PPI)	When public authorities act as early adopters of innovative solutions, creating market opportunities for startups.
R&D (Research and Development)	Activities related to scientific research, technological innovation, and product development.
REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals)	EU regulation (EC 1907/2006) governing chemical substances, including specific provisions for nanomaterials ("nanoforms"). Requires separate registration dossiers demonstrating safety data for each nanoform, posing compliance challenges for SMEs.
Regulatory Framework	A set of laws and standards governing commercialisation.
S.r.l.s. (Società a responsabilità limitata semplificata)	implified limited liability company form available to entrepreneurs under 35 years. Requires minimum share capital of €1, reduced notary costs, and online registration via Comunica Star. Most accessible legal structure for young nanotech founders; limits liability while minimizing setup barriers.
Scale-up	The transition from laboratory or pilot activity to commercial production and market deployment.
Smart&Start Italia	National grant program managed by Invitalia for innovative startups. Provides non-dilutive funding (typically €100,000-€500,000) to cover early operational costs, prototyping, and IP protection. Particularly relevant for nanotech ventures lacking

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	revenue but demonstrating technological novelty and market potential.
SME (Small and Medium-sized Enterprise)	A business with fewer than 250 employees and annual turnover below €50 million; eligible for most EU and national support schemes.
Spin-off	A company created to commercialise results originating from a university, research institute, or larger organisation.
Sportello Unico per le Imprese (Single Enterprise Desk)	One-stop service desks operated by local Chambers of Commerce (Unioncamere network). Provides free legal and administrative guidance on business creation, permits, public incentive programs, and connections to regional innovation agencies. First point of contact for entrepreneurs navigating Italy's administrative landscape.
Startup	A newly established company designed to develop and validate a scalable business model, often in technology-intensive sectors.
Technology Readiness Level (TLR)	Standardized 9-point scale (NASA/ESA origin) assessing maturity of technologies from basic research (TRL 1) to commercial deployment (TRL 9). Critical for navigating EU/national funding instruments, which often target specific TRL ranges.
Technology Transfer	The process of moving knowledge, discoveries, or technologies from research institutions to the market, often via licensing or spin-offs.
Tecnopolo (pl. Tecnopoli)	PNRR-funded regional technology hubs designed to strengthen research-business collaboration through shared infrastructure. Examples include CNR-NANOTEC in Lecce (nanotech focus), Rome's healthtech hub, and Turin's advanced manufacturing center. Offer startups open-access to pilot lines, cleanrooms, and technical expertise.
The Collider	A specialized accelerator program that connects scientists with experienced entrepreneurs to build effective business teams.
TRL (Technology Readiness Level)	Standardized 9-point scale (NASA/ESA origin) assessing maturity of technologies from basic research (TRL 1) to commercial deployment (TRL 9). Critical for navigating EU/national funding instruments, which often target specific TRL ranges (e.g., PNRR Valorizzazione focuses on TRL 3–5).
TTO (Technology Transfer Office)	University or research institute office responsible for commercialisation of research results, patenting, and support for spin-offs.
TU (Technical University)	Designation used by several German universities specializing in engineering and applied sciences.

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UG (Unternehmergesellschaft, haftungsbeschränkt)	Simplified form of a limited liability company in Germany requiring very little initial capital; often called a "mini-GmbH.
UIBM (Ufficio Italiano Brevetti e Marchi)	Italian Patent and Trademark Office, part of MIMIT. Manages national IP filings (€400–600 application fees) and offers free preliminary patent searches and startup advisory services. First step for nanotech ventures seeking Italian patent protection before extending to EPO or PCT filings.
Unioncamere	National association of Italian Chambers of Commerce. Operates the Comunica Star platform, maintains the national business registry (Registro Imprese), and coordinates Sportelli Unici across 105 provincial chambers. Provides free foundational support to all new enterprises regardless of sector or size.
VAT (Value Added Tax)	Consumption tax applied to goods and services in Germany and throughout the European Union.
Venture capital (VC)	Professional equity investment in companies with strong growth potential, often at seed, early, or growth stage.
Vocational Education and Training (VET)	Education and training that equips learners with practical skills and knowledge for specific occupations or entrepreneurship

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