

WHITE PAPER

HPC SMEs in Europe: a Strategic Enabler

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An SRA 6 White Paper



EUROPEAN TECHNOLOGY
PLATFORM FOR HIGH
PERFORMANCE COMPUTING

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Executive Summary

Purpose and Scope

This white paper addresses the critical role of Small and Medium-sized Enterprises (SMEs) in Europe's High-Performance Computing (HPC) ecosystem and their contribution to European technological sovereignty. Commissioned under the Strategic Research Agenda 6 (SRA6) framework, it provides comprehensive analysis and policy guidance to ensure that European HPC and AI-focused SMEs are not only visible but central in shaping and delivering on the EU's digital, industrial, and green transition strategies.

The paper distinguishes between HPC Technology SMEs (developers of HPC hardware, software, and services) and HPC User SMEs (companies leveraging HPC for business solutions), recognizing their symbiotic relationship and collective importance to Europe's economic and technological competitiveness.

Key Messages for Policymakers, EuroHPC, and SMEs

SMEs are essential to European HPC sovereignty. The success of the EuroHPC initiative relies not only on supercomputer infrastructure (such as JUPITER or LEONARDO) but critically on the ecosystem that builds, optimizes, and utilizes them. SMEs provide niche innovation, agility, and technological autonomy over key components that large multinational corporations cannot or will not provide.

Current barriers are systemic and urgent. European HPC SMEs face significant structural challenges: limited access to funding and markets, complex procurement processes favouring large vendors, fragmented regulatory frameworks across Member States, insufficient IP protection, skills gaps, and disadvantages in administrative capacity compared to larger organizations.

Innovation potential is being underutilized. SMEs drive innovation in AI, quantum

computing, and industrial digital twins. They account for approximately 99% of European businesses and employ over 80 million people, yet their capabilities remain insufficiently integrated into strategic HPC initiatives. Without targeted support, Europe risks losing these innovative capabilities to international competition.

Policy reform is necessary and achievable.

This paper demonstrates that with adapted programme design, simplified access mechanisms, procurement reform, and targeted support for critical enablers, European SMEs can significantly strengthen Europe's technological sovereignty in HPC and AI. The recent AI Factory tenders show promising movement, but participation must go beyond token involvement to meaningful roles in technological solutions and budget allocation.

Summary of Strategic Recommendations

This white paper presents comprehensive, actionable recommendations across five strategic areas:

- 1. Simplified Programme Access:** Create dedicated SME access tracks for EuroHPC and Horizon Europe with streamlined proposal and reporting procedures, mentoring mechanisms, and recognition that SMEs cannot compete on equal administrative terms with large research organizations.
- 2. Adapted Funding Models:** Implement 100% reimbursement rates for SME-specific calls, flexible rules on minimum contributions, and explicit support for critical prototyping activities including EDA tools and tape-outs—essential stepping stones for demonstrating innovation in HPC and semiconductor technologies.
- 3. Procurement Reform:** Establish clear expectations for significant SME participation in public procurement

beyond marginal involvement. SMEs should hold central roles in technological solutions with meaningful presence in both project activities and budget allocation, particularly in AI Factories and exascale systems.

- 4. Regulatory Harmonization:** Harmonize R&I tax incentives across Member States, streamline IP protection procedures, establish clear rules for cross-border data usage and export control, and reduce legal and administrative overhead that currently disadvantages SMEs relative to international competitors.
- 5. Talent Pipeline Development:** Expand programmes like EUMaster4HPC with increased SME collaboration, simplify administrative and financial processes for SME internships, strengthen connections with National Competence Centres (NCCs), and foster learning networks that enable SMEs to build and retain specialised talent.

Vision for the Future

With the right policy framework and support mechanisms, European HPC SMEs can become global leaders in specialised technologies, contributing decisively to Europe's technological sovereignty. This requires recognition that empowering SMEs is not merely a matter of fairness but a prerequisite for Europe to achieve strategic autonomy in HPC and AI. Without a stronger role for SMEs, Europe will remain dependent on external providers; with appropriate support, European SMEs can deliver the disruptive innovation that will make Europe stronger, more competitive, and strategically autonomous in the post-exascale era.



1 Introduction

1.1 Role of SMEs in European Technological Sovereignty

Small and Medium-sized Enterprises (SMEs) in the field of High-Performance Computing (HPC) are among Europe's most agile and innovative actors in the technology landscape. From pioneering system architectures and software tools to driving industrial use cases across sectors including manufacturing, health, climate modelling, and artificial intelligence, European HPC SMEs are indispensable contributors to Europe's digital autonomy and strategic resilience.

Despite their outsized impact, these firms often operate in challenging environments—facing significant competition from multinational incumbents, barriers to funding and procurement, and regulatory fragmentation across Member States. This white paper responds to the pressing need to better understand and support HPC SMEs as Europe moves into the post-exascale era, balancing ambitions for technological sovereignty with inclusive innovation ecosystems.

1.2 Motivation for this White Paper

This white paper has been commissioned under the Strategic Research Agenda 6 (SRA6) framework. It provides targeted analysis and policy guidance to ensure that European HPC and AI-focused SMEs are not only visible but central in shaping and delivering on the EU's digital, industrial, and green transition strategies.

The motivation is both structural and strategic: structurally, because SMEs are crucial nodes in

supply chains and innovation pipelines; strategically, because their success is closely tied to Europe's ability to control its technological future in areas such as AI, quantum computing, and advanced simulation. As recognized in SRA6, empowering HPC SMEs is not merely desirable—it is essential.

1.3 Linkage to ETP4HPC SRA6 and EU Digital Strategy

This paper is a direct output of SRA6's dedicated SME working group and complements Chapter 7 of the SRA6 master document, "European HPC Technology SMEs". It aligns with the EU's Digital Decade policy programme, the European Chips Act, and EuroHPC Joint Undertaking priorities, including the deployment of sovereign exascale systems and AI Factories.

SRA6 highlights the unique position of HPC SMEs as both developers and users of advanced computing technologies, calling for concrete measures to "sharpen the tools" available to them: simplifying funding, adapting procurement practices, improving IP protection, and expanding skills development. This white paper builds on those calls and offers detailed recommendations tailored to policymakers, programme managers, and the SMEs themselves.

In this context, the white paper also reflects the broader push within the EU to reduce external dependencies, accelerate digital innovation, and ensure the competitiveness of European enterprises on the global stage. SMEs are not peripheral players—they are catalysts for transformation.

2 Typology and Role of SMEs in HPC

2.1 HPC Technology SMEs vs. HPC User SMEs

HPC Technology SMEs and HPC User SMEs represent distinct yet tightly interconnected parts of the High-Performance Computing (HPC) and Artificial Intelligence (AI) ecosystem.

HPC Technology SMEs focus on developing and providing the hardware, software, and services that enable HPC and AI capabilities. These companies may produce or integrate multi-node clusters, supercomputers, specialised components and circuitry, storage solutions, and software for data processing, data analysis, AI, and other compute-intensive applications. The users of HPC Technology SME products are businesses, research organizations, and academic institutions that leverage HPC resources to solve specific challenges and improve their operations and competitiveness.

HPC User SMEs leverage HPC capabilities to solve specific business problems and tasks (such as complex engineering simulations, data analysis, product development, and AI modeling). Essentially, HPC Technology SMEs create the tools and infrastructures, while HPC User SMEs leverage them.

The relationship between Technology SMEs and User SMEs is symbiotic. HPC User SMEs and HPC Technology SMEs collaborate to define application requirements and identify the ideal match between these requirements and the technological components needed, creating a dynamic ecosystem where both benefit from each other's advancements.

Both HPC Technology SMEs and HPC User SMEs are deeply woven into Europe's economic and social fabric. They provide two out of three jobs, support a high-quality supply chain, bring training opportunities across regions and sectors, and reinforce societal welfare. The daily challenges of European SMEs to comply with rules and regulations—which differ among EU countries—and to access information,

markets, and finance are challenges for the whole of Europe.

2.2 SMEs as Innovation Catalysts in AI, Quantum, and Industrial Digital Twins

SMEs are central to Europe's economic and social fabric, driving Europe's green and digital transitions and supporting long-term prosperity. Only a thriving community of SMEs using advanced digital technologies and data can position Europe as a world leader in shaping the digital economy. Digitalization provides great opportunities for Europe to improve the efficiency of production processes and the ability to innovate products and business models. Using advanced disruptive technologies such as Quantum Computing (QC), Artificial Intelligence (AI), Cloud, and High-Performance Computing (HPC) can dramatically boost European competitiveness.

As the drive for sustainability and competitiveness in all fields of industry, research, and civil society accelerates at unprecedented speed, it has become critical to empower both HPC Technology SMEs and User SMEs with the knowledge and tools to become major factors in bringing innovation at all levels. Their agility, innovation, local focus, and influence in supply chains make them powerful agents of change.

SMEs represent approximately 99% of businesses and more than 50% of employment worldwide, contributing up to 40% of national income (GDP) in Europe. SMEs are recognized as engines of economic growth and development, particularly in competitive and innovation-led markets. SMEs play a pivotal role in job creation, innovation, and poverty reduction, making them indispensable to the economic fabric of many nations.

SMEs are known for their business agility and focus on innovation. They are more flexible and adaptable compared to large corporations, enabling them to quickly embrace new technologies, sustainable practices, and implement

innovative solutions. This can lead to the development of new technologies, products, and services that are innovative, competitive, more environmentally friendly, and socially responsible. Moreover, SMEs are deeply rooted in local communities and ecosystems, contributing to the well-being of their local environments and societies by supporting local suppliers and producers and promoting fair and ethical labor practices.

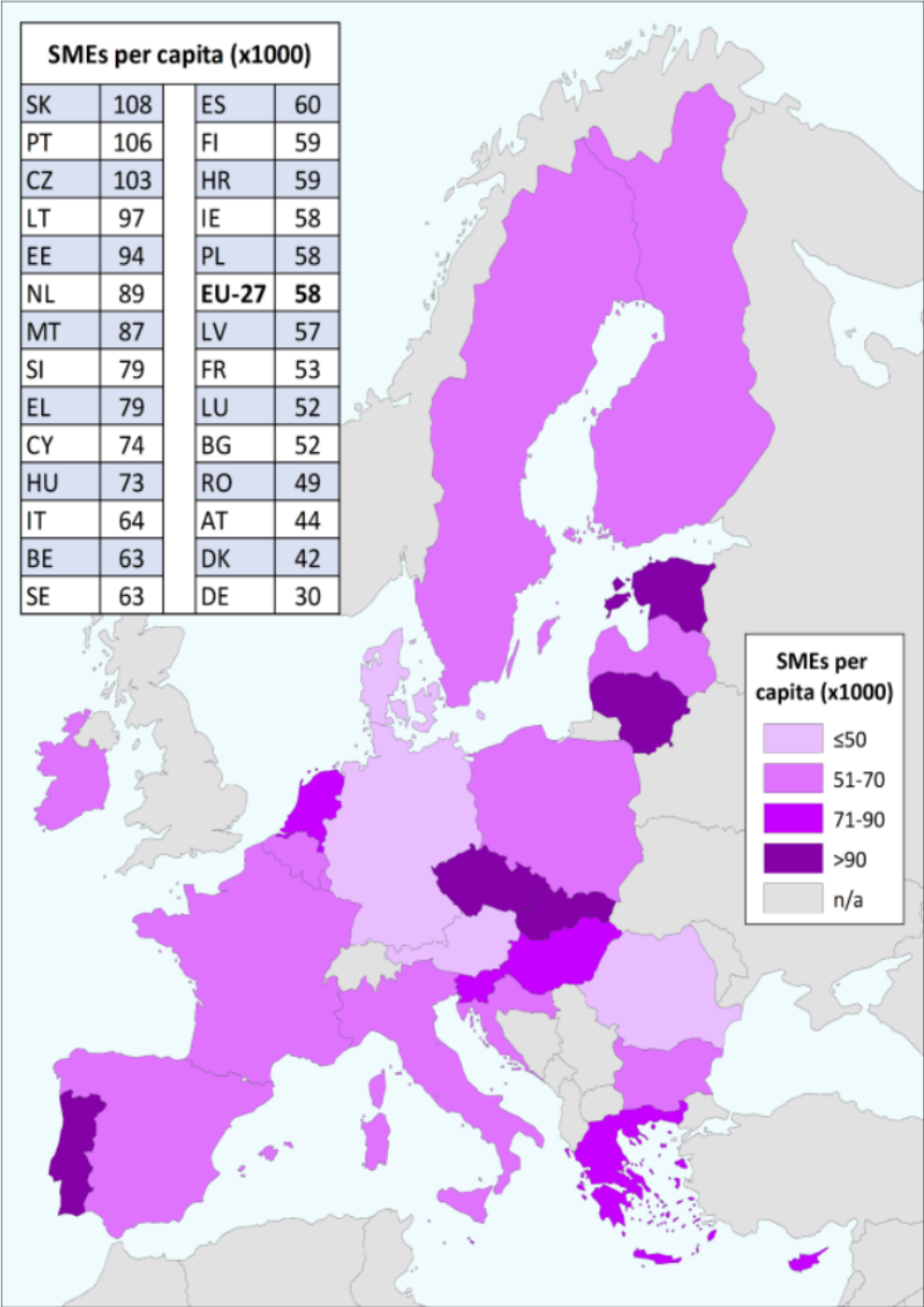
2.3 Positioning SMEs in European and Global HPC Value Chains

The 32 million European SMEs represent 99% of all businesses and are the backbone of the European business economy, representing 99.8% of all enterprises. Approximately 80 million people are currently employed in SMEs, accounting for two out of three jobs in Europe.

(<https://www.consilium.europa.eu/en/policies/support-to-small-and-medium-sized-enterprises/>)

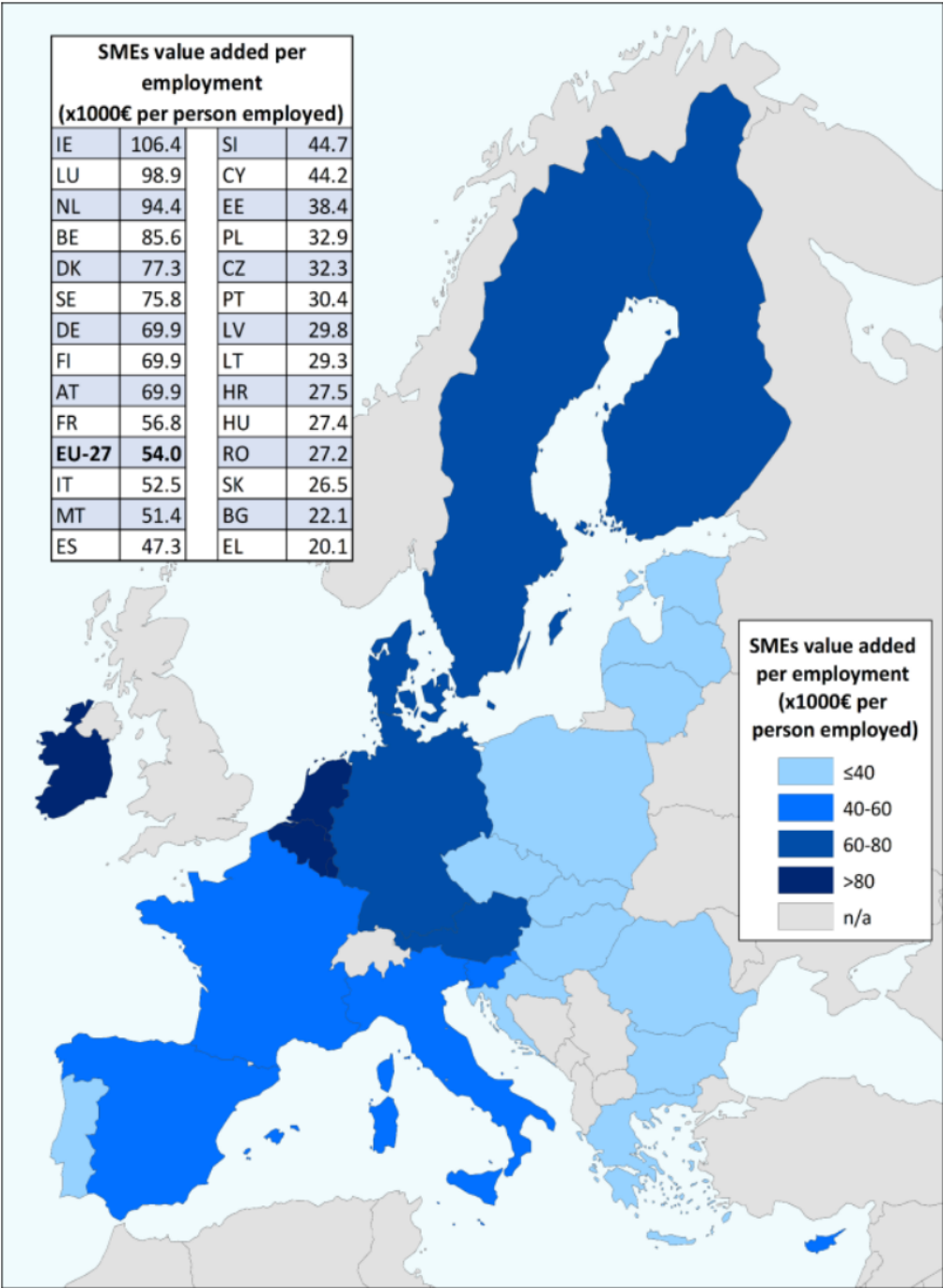
In 2024, EU SMEs experienced a minor decline in real value added of -0.2%, but employment increased by 1.1%. Projections for 2025 suggest a recovery with a 1.6% increase in real value added and a 0.9% rise in employment. Over recent years, there has been a general growth trend in both value added and employment for SMEs across most EU countries, demonstrating their resilience and importance to the European economy.

(<https://publications.jrc.ec.europa.eu/repository/handle/JRC142263>)



Source: Calculations by the JRC based on Eurostat’s Structural Business Statistics, Short-Term Business Statistics, National Accounts Database, and Population Projections.

Figure 1 - Number of SMEs per Member State on per capita basis in 2024



Source: Calculations by the JRC based on Eurostat’s Structural Business Statistics, Short-Term Business Statistics, and National Accounts Database.

Figure 2 - SMEs Value added per person employed in the NFBS of Member States in 2024

3 The Current Landscape and Emerging Opportunities

3.1 Mapping the SME Contribution to EuroHPC Systems and Projects

European SMEs are making significant contributions to EuroHPC systems and projects across multiple dimensions. SMEs provide specialised components including advanced cooling solutions, network architectures, RISC-V and FPGA-based accelerators for specific workloads (Big Data, Bioinformatics, AI), security solutions, and high-value building blocks that are often bottlenecks for HPC innovation.

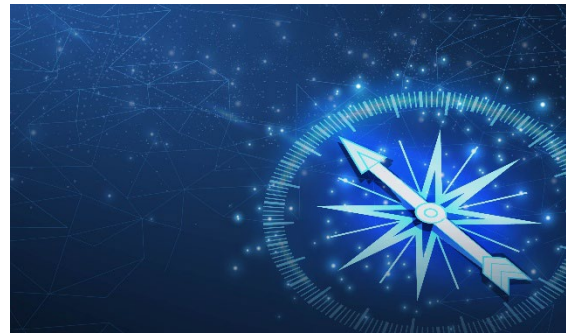
However, participation remains below potential due to structural barriers including limited visibility in procurement processes, administrative complexity, and insufficient integration into strategic planning phases of large-scale deployments.

3.2 Trends in AI, Quantum Computing, Data Sovereignty, and Foundational Models

The convergence of HPC, AI, and quantum computing presents unprecedented opportunities for European SMEs. Key trends include:

- The shift toward AI-integrated HPC systems, creating demand for specialised hardware and software solutions that SMEs can provide
- Growing emphasis on data sovereignty and European digital autonomy, creating opportunities for European technology providers

- Emergence of large language models and foundational AI models requiring specialised computational infrastructure
- Quantum computing integration with classical HPC, where SMEs can play crucial roles in hybrid system development
- Industrial digital twins requiring real-time HPC capabilities, expanding the user base for HPC technologies



3.3 Strategic Opportunities for European SMEs

European SMEs are uniquely positioned to capitalize on emerging opportunities in the HPC landscape. Their agility enables rapid response to market changes and technological innovations. Their specialization in niche technologies provides competitive advantages in specific market segments. Their European base aligns with data sovereignty requirements and strategic autonomy objectives.

To realize these opportunities, SMEs require targeted support including simplified access to funding, procurement reform, regulatory harmonization, and strengthened connections to large-scale projects and infrastructure.

4 Key Barriers to Growth and Competitiveness

4.1 Structural Challenges: Market Access, Visibility, and IP Protection

European HPC SMEs face significant structural challenges that limit their growth and competitiveness:

- **Market Access:** SMEs struggle to access strategic markets due to procurement practices favouring large established vendors. Visibility in contracting opportunities is limited, particularly in high-value deployments.
- **Intellectual Property Protection:** The patenting process is complex and costly, requiring legal expertise, IP strategy planning, and dedicated funding often missing in early-stage ventures. Monetization pathways through licensing, spinouts, or partnerships require specialised teams that most SMEs lack.
- **Regulatory Fragmentation:** Different rules and regulations across EU Member States create unnecessary complexity and cost for SMEs operating across borders.

4.2 Scaling Hurdles: Financial Risk, Infrastructure Access, and Cross-Border Complexity

Scaling represents a critical challenge for HPC SMEs:

- **Financial Risk:** Current funding models disadvantage SMEs through co-funding requirements that tie up scarce capital in long-term projects. Traditional reimbursement rates create cash flow challenges that larger organizations do not face.
- **Infrastructure Access:** Demonstrating innovation requires prohibitively expensive infrastructure including EDA tools, silicon samples, and datacentre-scale setups. Access to such resources is essential for prototyping but often financially restrictive.
- **Cross-Border Complexity:** Operating across Member States involves navigating different legal, fiscal, and administrative regimes, creating overhead that disadvantages SMEs relative to multinational competitors.



4.3 Skills Gaps and Talent Drain

SMEs often lack the financial resources to offer competitive salaries, benefits, and career advancement opportunities compared to larger firms. This limits their ability to attract top-tier talent, especially in high-demand technical fields like AI, cybersecurity, and data science. Limited brand recognition compared to well-established firms leads candidates to gravitate toward larger, well-known corporations. This becomes particularly acute in domains like HPC where niche expertise is required.

Once hired, retaining talent represents another hurdle. Combined with lack of critical mass, this can lead to burnout. However, SMEs can differentiate themselves by offering cross-functional exposure (through R&D, product strategy, and client deliveries) and high ownership roles to talented individuals, particularly those aligned with values of innovation and impact.

4.4 Procurement Disadvantages Compared to Multinationals

Public procurement in HPC and digital infrastructures has traditionally favoured large vendors, limiting SME participation in strategic markets. While recent AI Factory tenders show promising progress in incentivizing SME involvement, participation must go beyond token representation.

SMEs require meaningful roles in the technological solutions being developed, with significant presence not only in project activities but also in budget allocation. Current participation levels—sometimes as low as 1% in specific partitions—are insufficient to build genuine European technological sovereignty. Establishing clear expectations for substantial SME participation will ensure that European companies are embedded as real contributors rather than marginal partners.

5 Policy and Programme Enablers

5.1 Simplifying Access to EuroHPC and Horizon Europe R&I Programmes

SMEs often lack the administrative capacity to compete on equal terms with large industrial actors and research organizations. Current processes are overly complex, with rigid co-funding requirements and reporting obligations that absorb scarce resources.

Recommendations: Establish dedicated SME access tracks with simplified proposal and reporting procedures. Implement mentoring and brokerage mechanisms to ensure that SMEs can effectively participate in EuroHPC and Horizon Europe calls and bring disruptive innovation into European programmes.

5.2 Innovative SME-Oriented Funding Models

Traditional funding models disadvantage SMEs, as they cannot afford to tie up scarce capital in long-term co-funded projects. We strongly advocate for SME-specific instruments such as 100% reimbursement rates, dedicated "SME Innovate" calls, and more flexible rules on minimum contributions.

Funding must cover activities essential for SME survival and growth—industrial validation, prototyping, and go-to-market actions—not just academic milestones. Critically, programmes should explicitly support investments in EDA tools and tape outs. These are not final commercial products but essential prototypes: expensive, indispensable, and vital for demonstrating innovation.

Europe should ensure that SMEs can access as many of these opportunities as possible, as

they are the stepping stones for future sovereignty in HPC and semiconductor technologies.

5.3 National and EU-wide Tax, Legal, and Regulatory Reforms

European SMEs are often left behind by fragmented legal and fiscal regimes. Harmonized and simplified R&I tax incentives across Member States are needed, along with streamlined procedures for IP protection and exploitation, and clear rules on cross-border data usage and export control.

Reducing legal and administrative overhead is essential for SMEs to remain competitive and to keep innovation efforts anchored in Europe. This is particularly important when dealing with sovereign European technologies, where SMEs must be empowered to innovate and commercialize without being blocked by uneven or burdensome regulation.

5.4 Procurement Reform and SME-First Contracting

Public procurement reform must move beyond treating SME participation as a "nice-to-have" element. SMEs should hold central roles in technological solutions being developed, with meaningful presence in both project activities and budget allocation.

Establishing clear expectations for significant SME participation will ensure that European companies are embedded as real contributors to Europe's HPC and AI sovereignty, rather than marginal partners. This represents not only fairness but a prerequisite for achieving genuine technological autonomy.

6 Building the SME Talent and Innovation Pipeline

6.1 Education and Skills: From EUMaster4HPC to Vocational Tracks

Studying in top universities is one thing; gaining the capability to be immersed in enterprises and exposed to supercomputers is a key requirement to build vocations in HPC.

Programmes such as EUMaster4HPC and its follow-ups have strengthened academic curricula by providing a multicultural dimension through immersion of students in multiple countries. However, collaboration with industry and especially SMEs has been limited. The programme needs to increase the number of students, extend geographical spread (too few European countries were represented in the first implementation), and simplify administrative processes and financial support to allow SMEs to propose internships.

Without opening supercomputer markets and public funding to Technology SMEs, they are limited to proof-of-concept activities, disconnecting vocations from market demand.



6.2 Supporting SME Workforce Development and Retention

SME workforce development is primarily an internal industry issue. Deep Tech domains, however, rely on strong technical pride and brand

recognition. Opportunities to participate in highly visible and meaningful projects (at company level) with leadership roles (for individuals) are key elements to build pride and would help SMEs structure career paths and offer development opportunities.

Supporting SME participation in flagship projects not only advances technological sovereignty but also creates the conditions for talent retention and development within European SMEs.

6.3 SME Networks, Clusters, and Community Ecosystem Strengthening

Building a community able to share information is not difficult, and ETP4HPC typically provides such forums. Modern communication tools and social networks contribute to strengthening such "information networks". However, it is essential to go further and invent or promote programmes that would orchestrate business alliances.

At local (country) level, SMEs are able to collaborate through one-to-one alliances, which are opportunistic in nature. They can hardly be defined programmatically due to lack of critical mass preventing dedication of human resources and strategic priority alignment. At European level, critical mass is less of a problem.

The EuroCC network of National Competence Centers (NCCs) presents opportunities for SMEs to play key roles within the HPC ecosystem, helping User SMEs (in automotive, aerospace, energy, and other sectors) access, understand, and adapt their code for supercomputers. SMEs can provide consulting services, application porting, code optimization, and training, making HPC accessible to organizations that lack the resources of large research laboratories.

7 From Research to Market: Commercialization and IP

Bridging the gap between cutting-edge research and tangible market impact is one of the most critical challenges in technology innovation. Scientific results alone are not sufficient: they must be shaped into viable products, safeguarded by robust intellectual property strategies, and supported by collaboration models that ensure a steady pipeline of talent and industrial engagement.

7.1 Supporting Research Translation into Commercial Products

Key Challenges:

- **Defining the End Product:** Researchers often struggle to clearly articulate what the final product should be. Aligning scientific exploration with market needs requires early-stage customer engagement and business insights, skills that aren't typically part of a researcher's toolkit.
- **Demonstration Infrastructure:** Convincing stakeholders demands prototypes and performance data. However, building silicon samples or datacentre-scale setups requires prohibitively expensive infrastructure, limiting the ability to demonstrate real-world viability.
- **Translating Funding into Results:** Research funding is typically milestone-driven and academic-focused, making it difficult to allocate resources for industrial testing, marketing validation, or customer outreach.

7.2 Intellectual Property Protection and Exploitation

Key Challenges:

- **Filing and Managing Patents:** The patenting process is complex and costly, demanding legal expertise, IP strategy planning, and dedicated funding, often missing in early-stage or small ventures.

- **Tool Access for Chip/IP Development:** Developing silicon IPs requires powerful and expensive design tools (like Cadence, Synopsys, etc.), which are rarely accessible to small teams or startups. Even licensing these tools can be financially restrictive.
- **Monetization Pathways:** Exploiting IP effectively, whether through licensing, spin-outs, or partnerships, requires a dedicated team with technical and commercial acumen. Most SMEs lack the internal bandwidth or experience to pursue these avenues proactively.

7.3 SME-University-Industry Collaboration Models

Key Challenges:

- **Talent Pipeline Development:** Tailoring new university degrees to match company needs takes time, curriculum negotiation, and sustained partnership. This is particularly difficult for emerging technologies that evolve rapidly.
- **Engaging Students in Practical Work:** Creating value-driven internship programs requires structured mentorship, relevant projects, and alignment between company goals and educational outcomes. Without these, student involvement may have limited impact.
- **Resource Investment from Companies:** Supporting courses, offering guest lectures, and funding university collaborations demands time, money, and strategic focus—resources that SMEs must carefully balance against short-term commercial pressures.

Successfully navigating these challenges is essential for turning research excellence into sustainable commercial outcomes. SMEs, in particular, require targeted support mechanisms to access infrastructure, protect and monetize their IP, and engage in meaningful collaborations with academia and industry.

8 Case Studies and Good Practices

This section presents European HPC SME success stories, transformation examples from HPC/AI user SMEs, and lessons from EU and national programmes. These case studies demonstrate that HPC is a strategic enabler for SME innovation when applied judiciously.

8.1 European HPC Technology SME Success Stories

European HPC technology suppliers are developing cutting-edge solutions that strengthen the continent's tech sovereignty. Examples include SMEs specializing in advanced cooling technologies, network architectures, specialised accelerators, and security solutions for HPC environments.

These SMEs demonstrate that European companies can compete globally in specialised technology segments, provided they have access to appropriate support mechanisms including funding, procurement opportunities, and collaborative ecosystems.

8.2 HPC/AI User SME Transformation Examples

SME end-users are applying HPC and AI to become more competitive and efficient across diverse sectors including manufacturing, healthcare, climate modelling, and financial services. The lesson is that HPC is a strategic tool for any data- or compute-intensive SME problem (from agritech to finance) that may benefit from advanced computing.

A good practice is for SMEs (with help from advisors) to periodically assess their workflows for HPC/AI opportunities—even a small pilot can reveal high ROI potential.

8.3 Lessons from EU and National Programmes

Successes have often been built on learning from challenges: overcoming skill gaps,

adapting workflows, and validating business value. Continued support through programmes like FF4EuroHPC, EuroCC, and some dedicated SME-focused HPC calls will be vital to scale up these successes. There is already a continuation of these programs with [FFPlus](#), [EuroCC2](#) and EuroCC3 (planned).

By nurturing an environment where SMEs can easily experiment with HPC—with reduced risk and robust support—Europe can multiply the impact of these good practices, ensuring that advanced computing, from supercomputers to emerging quantum and AI technologies, permeates the SME sector for economic and societal benefit.

Innovation is vital to SMEs and is crucial for competing in the global economy. The EU (via projects managed by EuroHPC JU, CHIPS JU, Horizon Europe, etc) is implementing policies and programmes that support the development of innovation to increase investment in research and development, and to better convert research into improved products, solutions, services, or processes for the market. European SMEs, because of their capability to develop new and innovative products/services on their own, are ideally positioned to leverage these policies and programmes. Moreover, the increasing need for multi-disciplinary cooperation required to develop innovative products/solutions and the blurring lines between technological sectors make collaboration across companies and among companies and public research actors increasingly important. Organizations like ETP4HPC, which is a private member of EuroHPC JU, represent the ideal venue for enabling efficient and open partnerships and collaboration for innovation, and for gathering, prioritizing and presenting the proposals of the SMEs for new projects and programmes.

Horizon Europe has a centralized funding mechanism and support is available through National Contact Points (NCPs) who offer local, personalized assistance. EuroHPC JU adopts the mechanism of co-funding, where the funding

provided by EuroHPC is complemented by funding provided by National Programs via the National Funding Agencies (NFA). This mechanism may result in different implementations across the Member States, according to the local legislation. Unfortunately, the different implementations create disparities and misalignment among the participants of the consortium within the same project. The timely release of the funding provided by the EU and the NFA is critical for SMEs, because the EU funding is augmenting/complementing the funding that the SME are already investing by leveraging their own resources, and represents a key factor for ensuring that good ideas are developed, tested and validated on a realistic timeframe.

The potential synergies between the EuroHPC JU programs and national HPC programs are fostered through the National Competence Centres (NCCs), which are envisioned as a centralized coordination platform to bridge national initiatives with the broader EU HPC ecosystem. This coordination avoids duplication, promotes knowledge exchange, and maximizes the impact of European investments by ensuring that national efforts align with and complement EU goals.



From our research and participation in evaluation of HPC-related experiments, several **common lessons** have emerged about how SMEs can successfully harness HPC, and what practices or policies best support them, namely: -

- **Focus on Business Value:** The most successful SME experiments started with a clearly defined business case or industrial problem with clearly defined objectives and target benefits. HPC is used as a tool, and key enabler, not the end goal. In each

case, having **measurable objectives** (e.g. 30% cost reduction, 2x increase in users, improved accuracy) helped justify the effort and align projects to real-world impact (ff4eurohpc.euhpc-portal.eu). SMEs and their partners should jointly define what success looks like (faster time-to-market, new revenue stream, etc.) before diving into technical work. This ensures HPC usage delivers **tangible ROI** rather than being an academic exercise.

- **Right-Sized Projects & Planning:** Experience shows that picking the *right scope* is critical. **Overly ambitious projects** can overwhelm an SME, while too trivial experiments won't justify the investment. Good practice is to **plan the work carefully from the start**, selecting a project that is neither too small nor too large, and ensuring all needed software/tools are available (or can be developed) (ff4eurohpc.eu). Fortissimo experts note that the "best experiments" had a proper workplan and considered how to go from a proof-of-concept to deployment early on. In short, treat an HPC experiment like a strategic project: with milestones, risk assessment, and a path to production use if successful.
- **Partnerships and Ecosystem:** A recurring theme is that **SMEs rarely succeed alone in HPC projects**. All cases involved a partnership – whether with HPC centres (providing expertise and infrastructure), independent software vendors (providing or adapting tools), or academic experts. This **ecosystem approach** is a good practice: each party (SME, HPC provider, ISV, domain expert) plays a role in the value chain (ff4eurohpc.eu). For example, Koenigsegg's car simulation involved an ISV for the CFD software, a university for aerodynamic know-how, and a supercomputing centre (ff4eurohpc.eu). Such collaborations help SMEs overcome their skill gaps and leverage state-of-the-art resources. **Lesson for policymakers:** continue to facilitate matchmaking between SMEs and HPC/AI expertise (e.g. through competence centres, innovation hubs). The European network of **NCCs (National Competence Centres)** under

EuroCC is a positive model, as it provides a front door for SMEs to find help.

- **HPC Accessibility and Support:** A major lesson is that **simplifying access to HPC** is essential for SME uptake. Expert support and user-friendly platforms have been decisive – the SMEs could not afford to spend weeks resolving technical HPC issues (hpc-portal.eu). Good practice is to use cloud-like HPC services (web portals, containers, on-demand resource allocation) so that SMEs can focus on their application, not on IT minutiae. Initiatives like **FF4EuroHPC** have shown the effectiveness of providing SMEs with funded experiment opportunities and hands-on help, effectively de-risking the initial adoption. From a policy perspective, reducing bureaucracy for SMEs (e.g. simpler proposal processes, faster access to resources) and offering 100% funding for small experiments can greatly **lower the entry barrier** – this echoes the recommendations in ETP4HPC’s agenda to streamline SME participation.
- **Scalability and Sustainability:** Many SMEs start with a pilot on HPC – but scaling that to everyday operations is the real test. A lesson is to **design for scalability from day one**. In the above cases, teams considered how the solution would run for many users or large data volumes (e.g. containerization in the healthcare case, workflow managers, or cloud integration). Moreover, sustainability (both business and environmental) should be kept in mind: the composites case showed HPC can cut waste and energy by optimizing processes (ff4eurohpc.eu), and generally HPC can help design greener solutions (like more efficient turbines or reduced prototype testing). Good practices include evaluating the **cost of scaling on HPC** (so there are no surprises when usage grows) and ensuring knowledge transfer so the SME team can continue using the HPC solution after the project. Some experiments faced challenges going from prototype to production – addressing issues like long-term access to HPC resources or

software licensing early helps avoid “pilot purgatory”.

- **Embrace AI and New Workflows:** The landscape of HPC use in SMEs is broadening. Initially, most SME projects were classic simulations in engineering (hirs.de), but now **AI, data analytics, and digital twins** are equally prominent. SMEs should be open to combining HPC with AI/ML techniques – this can unlock novel use cases (e.g. automated image analysis, predictive maintenance, real-time decision support). Examples such as AI vision on HPC saving money in farming and many FF4EuroHPC cases illustrate that HPC+AI solutions can deliver value in **non-traditional HPC sectors** (hirs.de). The lesson is that HPC is a strategic tool for **any data- or compute-intensive SME problem** (from agritech to finance) that may benefit from advanced computing. Thus, a good practice is for SMEs (with help from advisers) to periodically assess their workflows for HPC/AI opportunities – even a small pilot can reveal if there’s high ROI potential.

8.4 Technological autonomy

SMEs are essential for reducing dependence on American or Asian technologies, particularly in critical software and hardware layers.

Large corporations and traditional manufacturers are often slow to pivot toward radical innovations. SMEs, by nature, are more agile, especially for **testing new architectures**, react quickly to the specific needs of a research centre or an industrial application.

In conclusion, these case studies and lessons demonstrate that **HPC is a strategic enabler for SME innovation** when applied judiciously. European HPC technology suppliers (like Quanscient¹) are developing cutting-edge solutions that strengthen the continent’s tech sovereignty, while SME end-users are applying HPC and AI to become more competitive and efficient. Crucially, successes have often been built on learning from challenges: e.g. overcoming skill gaps, adapting workflows, and validating

¹ <https://quanscient.com/>

business value. Continued support through programs like FF4EuroHPC, EuroCC, and dedicated **SME-focused HPC calls** will be vital to scale up these successes. By nurturing an environment where SMEs can easily experiment with HPC – with less risk and robust support –

Europe can multiply the impact of these good practices, ensuring that advanced computing, from supercomputers to emerging quantum and AI technologies, **permeates the SME sector for economic and societal benefit.**



9 Strategic Recommendations and Policy Actions

9.1 Actions for the European Commission and EuroHPC JU

Promotion of Technological Upgrading

SMEs and the European HPC industry promote technological competitiveness by developing innovative ecosystems, products, and solutions by integrating technology infrastructures, specialised R&D support, and collaborative platforms for HPC and AI. The ETP4HPC Strategic Research Agenda (SRA) is continuously updated and envisions the long-term development of HPC in Europe, providing recommendations and support for its implementation.

It is recommended to use the SRA as a compass for determining the innovation trends of the market and the future requirements of users.

Promotion of Skills Development

Developing skills to design and use advanced computing resources such as high-performance computing (HPC), artificial intelligence (AI), machine learning (ML), and quantum computing is becoming an increasingly important requirement for scientists and engineers. While it is generally not scientists' job to design, build, and maintain these compute systems, scientists need to know how to develop or fine-tune applications to get the most out of these systems.

SMEs promote (by providing teachers, tutors, training curricula, and hosting internships) and exploit (by hiring trained specialists) two major European-wide initiatives:

- **European Master For High Performance Computing (EUMaster4HPC)** is an HPC European consortium leading educational activities, funded by the EuroHPC Joint Undertaking to design and implement the first pan-European High Performance Computing (HPC) Master programme. A particular focus on mobility of students and teachers will enable students to rapidly gain

experience through internships and exposure to European supercomputing centres.

- **The European National Competence Centres (NCCs)** are key hubs for HPC, AI, and related technologies, serving as primary points of contact within their respective countries. Their mission encompasses creating a comprehensive map of HPC/AI competencies and institutions, acting as gateways to connect industry, academia, and public administration with suitable providers, and driving the industrial adoption of HPC/AI technologies.

Attracting Foreign Direct Investment

Achieving more resilient, sustainable, and profitable growth for SMEs in a global context characterized by greater competition and unstable import/export frameworks requires high productivity and relentless innovation, as well as proper funding. Foreign direct investment (FDI) in SMEs is beneficial for the whole European ecosystem because SMEs usually rely on local suppliers and partners, employ local people, retain talent, nurture a dynamic and competitive private sector, and accelerate the technological catch-up of their countries.

To attract FDI, SMEs must focus on:

- Demonstrating a clear and compelling value proposition
- Articulating how the SME's objectives can serve the investor's goals, whether market access, lower costs, or access to unique knowledge
- Facilitating investment by overcoming bureaucratic hurdles
- Demonstrating strong industry networks and actively collaborating with SMEs in neighboring countries
- Achieving and maintaining a positive reputation

Governments and national agencies also have a crucial role in creating the business and policy conditions for facilitating FDI through easing

regulatory complexities and supporting entrepreneurship and risk-taking.

Promoting the Development of Industrial Clusters

Industrial clusters are informal concentrations of interconnected companies, suppliers, and associated institutions in an industry field. As an example, Silicon Valley is a very successful and influential industrial cluster and driver of policies and programmes. In Europe, industrial clusters may become an important organizational form for promoting the organic development of a European ecosystem, spanning from start-ups and micro companies to SMEs to large enterprises.

The main benefits of industrial clusters include:

- Establishing bridges to facilitate communication and exchange among enterprises, institutions, and SMEs
- Advancing cooperation projects for the development of products, solutions, and technologies
- Encouraging the sharing of experience, promoting the outcomes of activities, and providing applicable and practical experience and models
- Gathering, prioritizing, and presenting proposals and strategies for government rules and regulations

Promoting the Development of SMEs

Promoting the development of SMEs requires a multi-faceted approach involving strategic government policy, financial incentives for SMEs, investment in infrastructure, and strong networking within and across industries (as in industrial clusters). Both governments and private entities can create a fertile environment for growth by focusing on fostering a supportive ecosystem for SMEs.

To promote the development of SMEs, the following actions could be implemented:

- Further develop and promote actions aimed to encourage entrepreneurship as well as to provide better dissemination and

knowledge of the products and solutions available from SMEs

- Secure better access for SMEs to public procurement by simplification and promoting market dialogue
- Support the connection between European SMEs and European leading companies and flagship enterprises
- Ensure that programmes leveraging European SMEs' know-how are included in the next Multiannual Financial Framework
- Support collaboration and partnerships between consolidated SMEs, large enterprises, and start-ups
- Foster learning networks for SMEs to cooperate on information sharing, mentoring new talents, and developing skilled workforce
- Provide facilitated access to global value chains (GVCs), focusing on helping local producers and service providers meet GVC requirements
- Encourage collaboration on projects where SMEs can partner for joint marketing, co-hosted events, and bundled offerings

Capital Investment and SME Support Infrastructure

A specific budget should be established to create a value exchange platform whose role would be to strengthen participation of SMEs in HPC R&D projects. Such a Project Office could be funded from an "SME Premium" being a percentage of the share of grants (SME people costs involved) or any other mechanism allowing sustainability of such an initiative.

Out of the services that such an organization would provide, we can highlight:

- Creation and dissemination of an HPC Technology SME Catalogue following SRA classification, allowing SMEs to network and be identified by larger players, facilitating matches with consortia under creation when calls are published
- Mutualized participation in events to create economies of scale and visibility at events such as ISC or SC which are hardly affordable. Hosting for this project office could be in ETP4HPC

- Administrative and legal services for project support and expertise
- Management of a programme dedicated to HPC Technology SMEs for delivery of prototype systems

9.2 Member State-Level Interventions

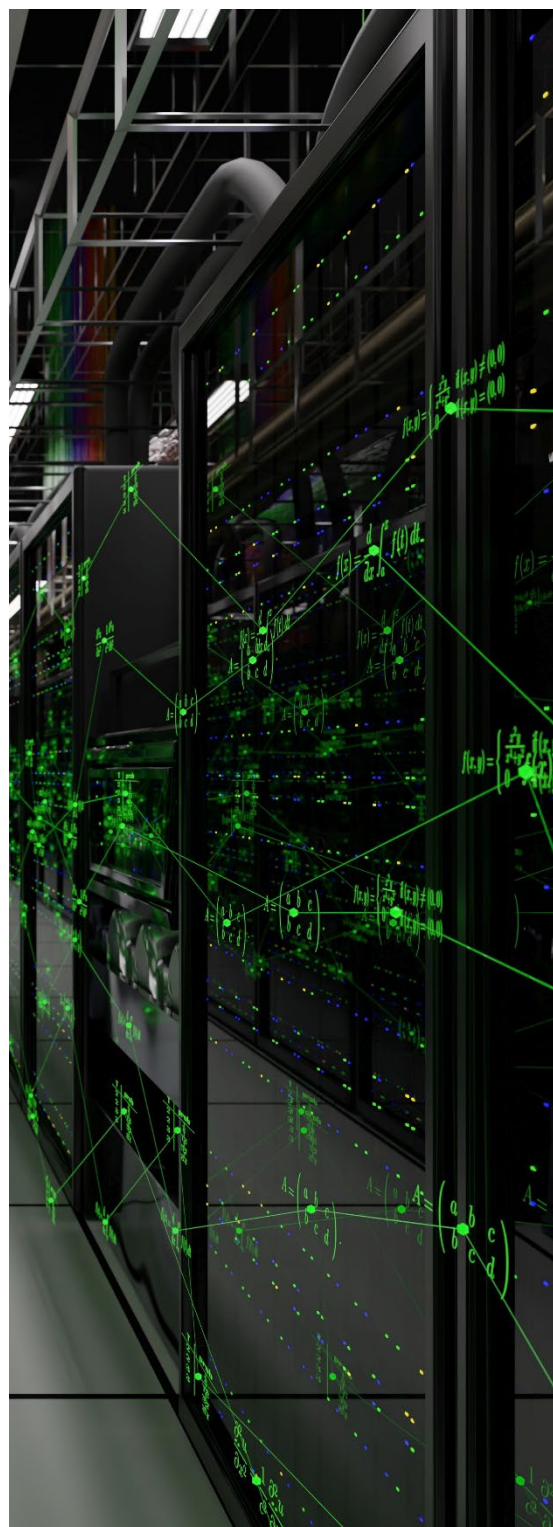
Member States play a crucial role in creating supportive environments for HPC SMEs. National-level interventions should focus on harmonizing regulations, providing targeted financial support, and ensuring that SMEs can access national and European programmes with reduced administrative burden.

Member States should also strengthen their National Competence Centres to serve as effective bridges between SMEs, research institutions, and large industrial actors, facilitating knowledge transfer and collaborative opportunities.

9.3 Recommendations for SMEs and Industry Stakeholders

SMEs themselves must actively engage with available support mechanisms, participate in industry networks and clusters, and articulate their needs clearly to policymakers. Building strong value propositions, demonstrating technical capabilities through prototypes and pilots, and forming strategic alliances with complementary SMEs can strengthen market position.

Larger industry stakeholders should recognize the strategic value of SME partnerships and actively work to integrate SMEs into supply chains and collaborative projects, viewing them not as competitors but as essential contributors to European technological sovereignty.



10 Conclusion

10.1 Vision for a Globally Competitive, Sovereign HPC SME Ecosystem

Europe stands at a critical juncture in its digital transformation. The success of initiatives like EuroHPC, the European Chips Act, and AI Factories depends fundamentally on the strength and viability of the European SME ecosystem. This white paper has demonstrated that SMEs are not merely participants but essential catalysts for innovation, sovereignty, and competitiveness in European HPC.

A globally competitive, sovereign HPC SME ecosystem requires coordinated action across multiple dimensions: simplified access to funding and programmes, adapted financial instruments, procurement reform, regulatory harmonization, strengthened talent pipelines, and robust support for commercialization and IP protection. The recommendations presented in this paper provide a comprehensive roadmap for achieving this vision.

With the right support framework, European HPC SMEs can lead in specialised technologies, contribute decisively to technological sovereignty, and compete successfully on the global stage. The choice is clear: invest in SMEs now, or risk dependence on external providers in critical technologies.

10.2 Call to Action

To policymakers: Implement the recommendations in this white paper with urgency. Simplify access, reform procurement, harmonize regulations, and create funding models that recognize SME realities. The window for establishing European leadership is limited.

To programme managers: Design calls and initiatives with SME participation at the centre, not the periphery. Meaningful SME involvement requires dedicated tracks, simplified procedures, and recognition of SME constraints.

To large industry actors: Recognize SMEs as strategic partners essential to European sovereignty. Actively integrate SMEs into supply chains and collaborative projects, sharing opportunities and expertise.

To SMEs: Engage actively with available support mechanisms, articulate your capabilities and needs clearly, form strategic alliances, and demonstrate your value through pilots and prototypes. Your innovation is essential to Europe's future.

The time for action is now. Europe's technological sovereignty and competitive future in HPC, AI, and quantum computing depend on the collective success of its SME ecosystem. Let us move forward together with clarity of purpose and urgency of action.

Appendix A: Glossary of Terms

AI: Artificial Intelligence

EDA: Electronic Design Automation

ETP4HPC: European Technology Platform for High Performance Computing

EuroHPC JU: European High Performance Computing Joint Undertaking

FDI: Foreign Direct Investment

GVC: Global Value Chain

HPC: High Performance Computing

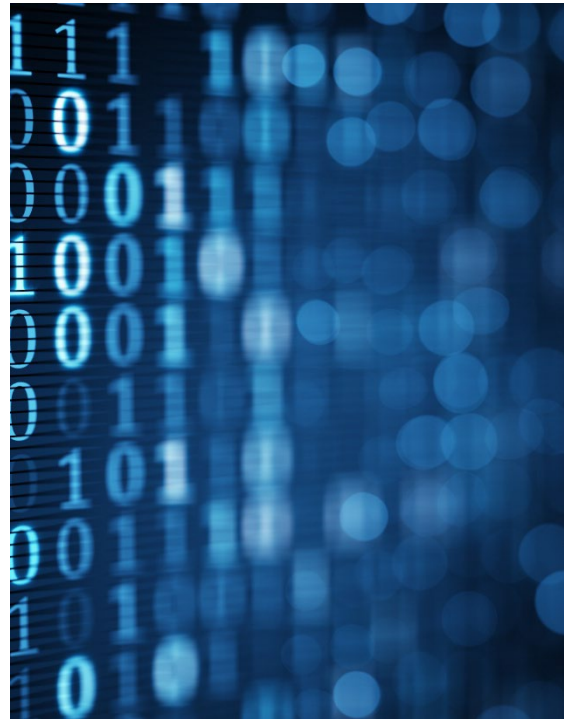
IP: Intellectual Property

NCC: National Competence Centre

R&I: Research and Innovation

SME: Small and Medium-sized Enterprise

SRA6: Strategic Research Agenda 6



Appendix B: Reference Projects and Initiatives

Key European HPC and SME Support Initiatives:

- EuroHPC Joint Undertaking (<https://www.eurohpc-ju.europa.eu/>)
- EUMaster4HPC Programme (<https://eumaster4hpc.eu/>)
- EuroCC Network of National Competence Centres (https://www.eurohpc-ju.europa.eu/research-innovation/our-projects/eurocc-2_en)
- Horizon Europe Framework Programme (https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en)
- European Chips Act (<https://digital-strategy.ec.europa.eu/en/policies/european-chips-act>)
- AI Factories Initiative (<https://digital-strategy.ec.europa.eu/en/policies/ai-factories>)
- FF4EuroHPC Programme (<https://www.ff4eurohpc.eu/>)

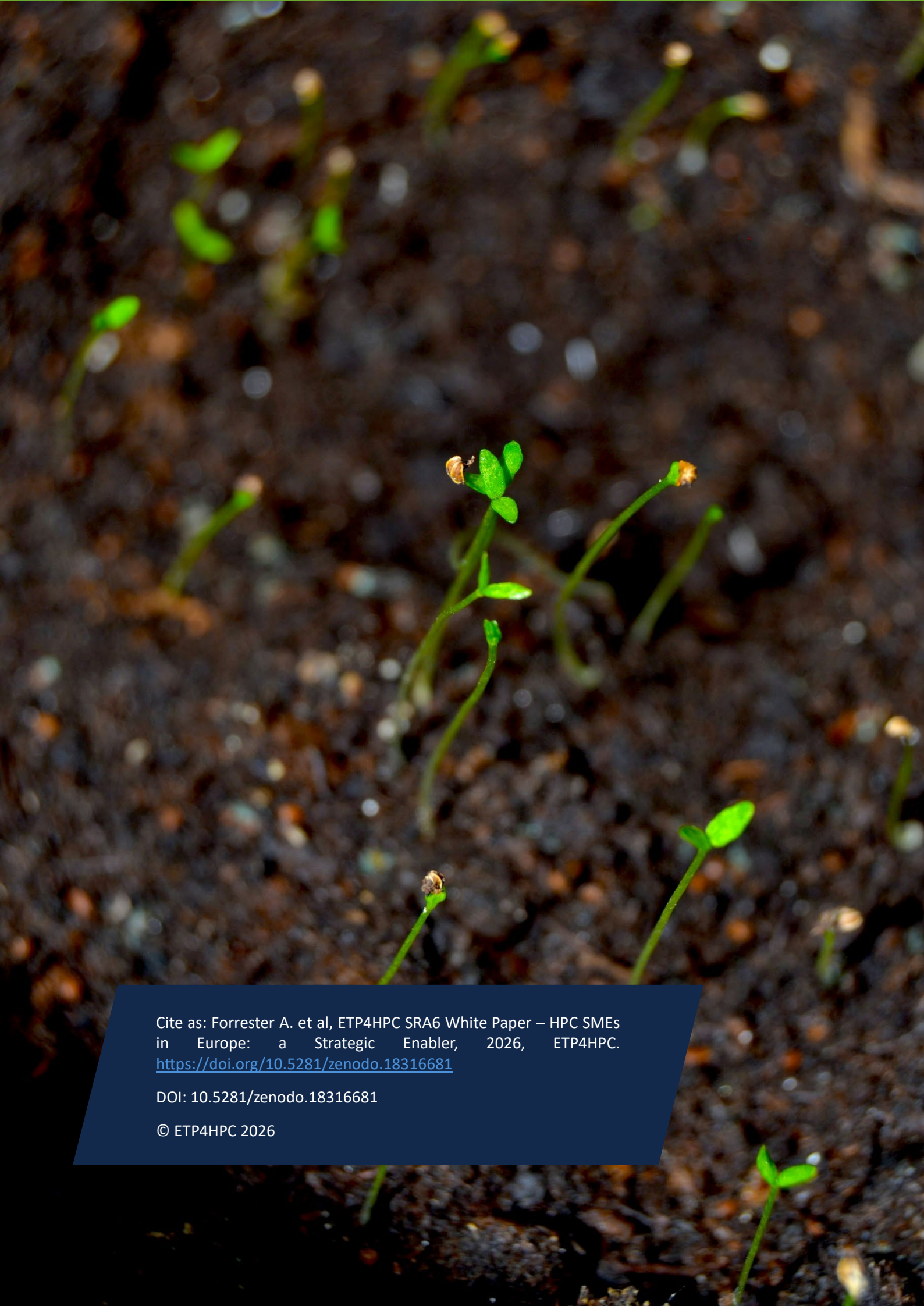
Appendix C: Contributors and Acknowledgements

This white paper was developed under the ETP4HPC Strategic Research Agenda 6 (SRA6) framework with contributions from the dedicated SME working group.

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