



SMEs and Open Strategic Autonomy

Final Report



Written by: CSIL, IDEA Consult, PPMi, LSE – Trade Policy Hub
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Abbreviations

A&D	Aerospace and Defence
AI	Artificial Intelligence
API	Active Pharmaceutical Ingredients
ASEAN	Association of Southeast Asian Nations
ATC	Agreement on Textiles and Clothing
B2B	Business-To-Business
B2G	Business-To-Government
BMWK	German Federal Ministry for Economic Affairs and Climate Action
BRDE	Brazilian Company of Innovation and Research
CAD	Computer-Aided Design
CAP	Common Agricultural Policy
CAPEX	Capital Expenditure
CCS	Carbon Capture and Storage
CCT	Carbon Capture Technology
CCUS	Carbon Capture Utilisation and Storage
CIR	Crédit Impôt Recherche
CIRFS	European Man-Made Fibres Association
CRM	Critical Raw Material
DG GROW	Directorate General for Internal Market, Industry, Entrepreneurship and SMEs
DG HERA	Directorate General for Health Emergency Preparedness and Response
DHS	(US) Department of Homeland Security
DOD	(US) Department of Defence
EC	European Commission
ECA	European Court of Auditors
EDF	European Defence Fund
EIB	European Investment Bank
EIC	European Innovation Council
EIF	European Investment Fund
EMA	European Medicine Agency
ERDF	European Regional Development Fund
ERMA	European Raw Materials Alliance
ESA	European Space Agency
ETS	Emission Trading System
EU	European Union
EUR	Euro
EV	Electric Vehicles

F2F	Farm To Fork
FDF	Finished Dosage Forms
FDI	Foreign Direct Investment
FTA	Free Trade Agreements
GDP	Gross Domestic Product
GPA	Government Procurement Agreement
GTA	Global Trade Alert
GVC	Global Value Chain
ICT	Information and Communication Technology
IMF	International Monetary Fund
IoT	Internet of Things
IP	Intellectual Property
IPCEI	Important Projects of Common European Interest
IPCEI-CIS	Important Projects of Common European Interest - Cloud Infrastructure and Services
IPI	International Procurement Instrument
IPR	Intellectual Property Rights
IRA	Inflation Reduction Act
IT	Information Technologies
JRC	Joint Research Centre
JU	Joint Undertaking
KET	Key Enabling Technology
LIB	Lithium-Ion Batteries
MFA	Multi-Fibre Arrangement
MMF	Man-Made Fibres
MNC	Multinational Companies
MRA	Mutual Recognition Agreement
MS	Member State
NACE	Statistical classification of economic activities in the European Union
NIPO	New Industrial Policy Observatory
NRRP	National Resilience and Recovery Plan
OCT	Observatory of Critical Technologies
OECD	Organisation for Economic Cooperation and Development
OEM	Original Equipment Manufacturers
OPEX	Operational Expenditure
OSA	Open Strategic Autonomy
PAIH	Polish Investment and Trade Agency
PCT	Patent Cooperation Treaty
PGM	Platinum Group Metals
PPE	Personal Protective Equipment

PPP	Public-Private Partnership
PV	Photovoltaic
QiuS	Quantifying Industrial Strategies
R&D	Research and Development
REE	Rare Earth Elements
S3	Smart Specialisation Strategy
SAARC	South Asian Association for Regional Cooperation
SBIR	Small Business Innovation Research
SME	Small and Medium-sized Enterprise
STEM	Science, Technology, Engineering and Mathematics
STTR	Small Business Technology Transfer
UAE	United Arab Emirates
UK	United Kingdom
USA	United States of America
USD	United States Dollar
VET	Vocational Education and Training
WTO	World Trade Organisation

Abstract

Open Strategic Autonomy (OSA) is a political concept that refers to the European Union's ability to act independently in strategically important areas while seeking multilateral cooperation when possible. Initially mentioned in European Council conclusions in December 2013, OSA gained prominence after the COVID-19 pandemic, and it is now shaping the design of future industrial policies. The success of the OSA paradigm is strictly interrelated with SMEs active participation in strategic sectors. This study aims to analyse to what extent and through which means SMEs are involved in such strategic industries, and to provide recommendations for policy actions aimed at maximising the benefits of SMEs participation in OSA while limiting risks. It builds on the outcomes of extensive desk research and stakeholders' engagement. Results show that SMEs presence in strategic sectors is pervasive, although their contribution in terms of value added is limited. They oversee different stages along the value chains analysed, and they play a crucial role in R&D activities and in developing critical innovations and solutions even in industries dominated by large firms. In recent years, all major economies have implemented policies aimed at achieving strategic autonomy goals. Yet, limited emphasis has been put on supporting SMEs. The study concludes with the presentation of an Action Plan centred on two key points. First, recommended measures strike a balance between enhancing EU economic interests and resilience, and improving EU SMEs participation in an open international trading system. Second, the proposed actions comply with the need for the EU to lead in high-value technologies and productions. The Action Plan builds on five policy pillars and a foundational pillar that addresses general framework conditions to enable SME growth.

Résumé

L'Autonomie Stratégique Ouverte (Open Strategic Autonomy, OSA) est un concept politique faisant référence à la capacité de l'Union Européenne à agir de manière indépendante dans des domaines d'importance stratégique tout en recherchant la coopération multilatérale lorsque cela est possible. Initialement mentionnée dans les conclusions du Conseil européen en décembre 2013, l'OSA a gagné en visibilité après la pandémie de Covid-19 et façonne désormais la conception des futures politiques industrielles. Le succès de l'OSA en tant que nouveau paradigme est étroitement lié à la participation active des PME dans les secteurs stratégiques. Cette étude vise à analyser dans quelle mesure, et par quels moyens, les PME sont impliquées dans ces industries stratégiques, et à fournir des recommandations pour des actions politiques visant à maximiser les avantages de la participation des PME à l'OSA tout en limitant les risques. L'étude s'appuie sur les résultats de recherches documentaires approfondies et sur les contributions de parties prenantes. Les résultats montrent que la présence des PME dans les secteurs stratégiques est généralisée, bien que leur contribution en termes de valeur ajoutée reste limitée. Les PME sont d'une importance capitale dans différentes étapes des chaînes de valeur analysées, et elles jouent un rôle crucial dans les activités de R&D et dans le développement d'innovations et de solutions critiques même dans des industries dominées par de grandes entreprises. Au cours des dernières années, toutes les principales économies ont mis en œuvre des politiques visant à atteindre des objectifs d'autonomie stratégique. Cependant, peu d'efforts ont été mis sur les PME en particulier. L'étude se conclut sur la présentation d'un Plan d'Action centré sur deux points clés. Premièrement, les mesures recommandées établissent un équilibre entre le renforcement des intérêts économiques et de la résilience de l'UE et l'amélioration de la participation des PME de l'UE à un système commercial international ouvert. Deuxièmement, les actions proposées répondent à la nécessité de l'UE d'être leader en matière de technologies et productions à haute valeur ajoutée. Le Plan d'Action repose sur cinq piliers politiques et un pilier central qui aborde les conditions générales du cadre permettant la croissance des PME.

Executive summary

Open Strategic Autonomy (OSA) refers to the European Unions (EU)'s capacity to act autonomously in strategically important areas while seeking multilateral cooperation where appropriate. First appearing in the European Council conclusions in December 2013, the concept gained significant attention after the COVID-19 pandemic. The pandemic highlighted both the advantages of the Single Market's integration into global value chains and the need to understand and address Europe's strategic dependencies. This realisation has led to a shift in trade and industrial policy, aiming to boost the EU's production capabilities and diversify supply sources, thereby reducing external vulnerabilities and promoting sustainable strategic autonomy in key industrial sectors.

Various studies have analysed different industrial ecosystems, identifying critical products and technologies where the EU faces significant challenges. These include dependency on imported inputs, lack of domestic production, and low innovation autonomy and digital sovereignty. Key areas of concern include semiconductors and microelectronics, telecommunication and digital infrastructure and technologies, renewable energy technologies, pharmaceutical ingredients, drones and robotics for both civil and military applications, technical textiles, fertilisers and high-protein crops, and new technologies for clean and sustainable mobility.

The implications of this new paradigm on Small-Medium Enterprises (SMEs), which are vital to local economies in the EU by contributing to job creation, innovation, and overall economic growth, **have not yet been comprehensively analysed.** This study addresses this gap, building on an extensive documentary and literature review, analysis of the (limited) available statistics on SMEs in the strategic value chains, along with a rich interview programme conducted between January and May 2024. This programme involved more than one hundred stakeholders, including policymakers, business associations, independent experts, research organisations, and companies.

SMEs' involvement is crucial for the success of the OSA paradigm. While OSA initiatives often focus on large companies with the capacity to compete globally, the participation of SMEs helps build resilient and diversified supply chains. SMEs possess critical expertise and have strong local ties, adding significant value in sectors where localisation is essential. The study shows that SMEs are prevalent in nearly all value chains analysed, often exceeding 70% in terms of the number of active companies. However, their value-added contribution is (still) generally limited due to capital-intensive production processes. European SMEs are notably active in Research and Development (R&D) and innovation, developing critical solutions even in industries dominated by large non-EU competitors. In their capacity as producers, they mainly operate in niche markets, producing high value-added, tailor-made solutions in the central phase of the value chain. In the lower value chain segments, SMEs are present as users, distributors, installers, and service providers. Their presence in the supply of input phase is more limited, although they play a significant role in recovery and recycling activities, particularly in dismantling and recycling wind turbines, solar panels, and batteries. By integrating SMEs into OSA-aligned supply chains, larger companies can benefit from their agility, flexibility, and local knowledge, adapting effectively to changing market conditions and regulatory environments. This ensures that investments are economically viable and sustainable in the longer term.

The OSA paradigm presents significant opportunities for SMEs involved in the value chain of strategic products and technologies. These opportunities include increased investment and support for research and innovation, expanded market reach through access to global trade networks, and the potential to attract substantial inward Foreign Direct Investments (FDI). This can benefit SMEs by strengthening their linkages with multinational companies, finding new clients, and increasing their participation in global value chains.

However, there are notable risks for SMEs as well. They require significant financial and human resources to keep pace with rapid innovation dynamics and may struggle to find investors for scaling up. Strategies focused on reshoring or regionalising supply chains might complicate existing relationships and contracts with large companies outside the EU. Furthermore, SMEs downstream in the value chain may face pressures to innovate and modernise their operations to stay competitive and align with the changing landscape shaped by OSA initiatives. The impact of OSA on SMEs extends beyond specific value chains and industrial ecosystems. A significant build-up of production capabilities can lead to competition for an already scarce workforce, exacerbating skill shortages across various sectors.

In the recent years, all major economies worldwide have implemented policies aimed at achieving strategic autonomy goals. These policies include subsidies, export/import regulations, FDI strategies, procurement policies, and localisation initiatives. Despite the difficulty of obtaining reliable and comparable data across countries, it appears that the financial volume of policy measures implemented in the EU is relatively small compared to those provided in non-EU countries. In specific technology areas where some data is available, such as electric vehicles, wind turbines, and railway rolling stock, studies indicate that industrial subsidies in China are at least three to four times, and in some cases up to nine times higher, than those in major EU and other OECD countries. These subsidies include direct government support to dominant Chinese manufacturers of green technology products, and indirect policies such as subsidised inputs, preferential access to critical raw materials, forced technology transfers, strategic public procurement, and preferential treatment in administrative procedures.

A notable common aspect of OSA policies globally is the limited explicit emphasis on supporting SMEs. In the EU, there are initiatives specifically targeted at SMEs or that include mechanisms favouring SMEs over larger companies. These initiatives primarily focus on fostering fundamental research or more applied experimentation and innovation in areas where the EU exhibits economic and innovation dependency. In general, SMEs operate "under the radar," being involved in niche markets and specialised solutions, and therefore may not reap the benefits of government support. Additionally, SMEs face several challenges in accessing and participating in government support programmes. The main strengths and weaknesses of EU policies with a bearing on OSA and with specific reference to SMEs, are summarised in the table below.

Table. Strengths and weaknesses of EU policies affecting OSA and SMEs

EU policy area	Strengths	Weaknesses
Support to R&D and innovation	<ul style="list-style-type: none"> • Several support programmes available at both EU and national level • Availability of several technology-specific support • Many measures specifically targeted at or favouring SMEs over larger companies • High innovation capacity of SMEs 	<ul style="list-style-type: none"> • High-funding needs, especially for breakthrough technologies • Lack of dedicated support for some strategic products and technology • Fragmented support system • Underperformance of scaling-up
Support to production and diversification	<ul style="list-style-type: none"> • Important Projects of Common European Interest (IPCEIs) provide a good framework to support production expansion that is also attentive to SMEs 	<ul style="list-style-type: none"> • Some challenges in the application and implementation phases limit SME participation in the IPCEIs • Diversification policies into segments facing direct competition from extra-EU countries can be only marginally effective

	<ul style="list-style-type: none"> • FDI measures promoted by Member States can create opportunities for local SMEs • SMEs have highly specialised capabilities, making them valuable partners, suppliers and subcontractors of large enterprises • Both supply-side and demand-side policies are used to support emergence and development of new industries and markets 	<ul style="list-style-type: none"> • FDI spillovers to SMEs do not occur automatically. Appropriate mechanisms must be put in place to facilitate them • Skill shortages can limit production expansion and diversification
Support to rebalance global trade	<ul style="list-style-type: none"> • Trade openness is key for EU SMEs, and EU policies denote higher preference for openness than extra-EU countries • Public procurement can have a role to stimulate domestic production and, in very selected domains (e.g. defence), to protect domestic production 	<ul style="list-style-type: none"> • Overly trade-restrictive or protectionist policies can negatively impact on EU SMEs • SMEs still face high obstacles in participating in international trade • Need to ensure a level playing field for EU SMEs on the internal market • SME participation in public procurement remains limited

Source: Authors.

To harness the benefits and mitigate the risks associated with the OSA paradigm for SMEs, it is crucial to implement adequate policy measures that engage SMEs more extensively. To this end, the study provides an Action Plan for a more SME-centric OSA.

The Action Plan builds on two strategic considerations:

- **Trade openness is crucial for SMEs.** There is a need to balance trade openness and EU economic interests and resilience. It is essential for the EU to stand for its economic interests and enhance domestic production in the context of an open and globalised economy. This principle is encapsulated in the concept of OSA and is particularly important for SMEs. Trade openness offers substantial advantages to EU SMEs, primarily by facilitating access to a broader range of markets and diversifying sources of raw materials and inputs, which are often less accessible or more costly in the EU. Given the nature of global value chains, a shift towards stringent protectionism could be very disruptive. Given Europe's relatively high labour and operating costs (e.g. for energy), significant reshoring to the EU is likely to result in price increases that could threaten economic stability. The Action Plan, therefore, envisions the EU supporting SMEs engagement in an open international trading system while strategically promoting and protecting sectors when economically justified or where security concerns are paramount.
- **SMEs play a key role in R&D and innovation, and this is a strength the EU should leverage.** Encouraging innovation is vital for keeping European industries at the forefront of technological advancements and maintaining a competitive edge. The EU's extensive range of initiatives supporting R&D and innovation already underscores its commitment to fostering research and innovation as essential drivers of international competitiveness. Indeed, competing in the mass production of low-value goods in the EU is challenging, given the fierce international competition. Instead, it is crucial for the EU to lead in high-value technologies and products. It is equally essential that businesses can transition from niche to larger markets to compete globally.

The Action Plan builds on five policy pillars and a foundational pillar that addresses the general framework conditions necessary for all SMEs. Each pillar consists of action lines for which

ecosystem-specific recommendations are provided. The general structure of the Action Plan and lines of action are briefly illustrated below.

- **Pillar I: Strengthening and focusing R&D and innovation.** The EU and Member States' initiatives demonstrate a strong commitment to fostering SMEs innovation. Despite these extensive measures, the EU faces some limitations in its support for R&D and innovation. Given the central role that SMEs play in R&D and innovation across various ecosystems, these limitations should be addressed through the following lines of action:
 - Establish dedicated R&D support schemes for specific technologies;
 - Rationalise funding opportunities for SMEs to overcome resource fragmentation and harmonise application procedures;
 - Foster IPR protection by simplifying patenting process and training SMEs on alternative means of protection;
 - Promote collaborations and strategic alliances between large firms, research institutions and SMEs.
- **Pillar II: Fostering scaling-up.** EU SMEs face persistent difficulties in fostering scale-ups and entrepreneurial ventures that enable them to transition from innovation and niche markets to significant growth stages of production. This struggle to scale up emphasises the necessity for adequate support for successive, increasingly larger funding rounds as firms expand. The following lines of action should be followed to address this issue in a holistic manner.
 - Increase sector-specific public funding and private investor engagement to support SMEs scale-up;
 - Address regulatory obstacles and improve information to help SMEs expand their product applications into new markets;
 - Stimulate demand to develop strategic markets where SMEs can have an important role;
 - Promote the use of digital technologies in SMEs.
- **Pillar III: Bolstering domestic production and promoting diversification.** Pillar III focuses on strengthening the EU's domestic production capacities and encouraging diversification into high-value-added sectors. Increasing production capacity is essential for building resilience against global supply chain disruptions, which have become more frequent due to geopolitical tensions, pandemics, and other unforeseen events. For SMEs, this diversification translates into reduced dependency on external sources for critical components and materials, as well as potential business opportunities. Diversifying production towards more strategic technologies and high-value market segments presents significant costs but also offers substantial advantages. SMEs that diversify successfully can gain a competitive advantage by supplying products and services for growing markets. Although domestic subsidies to boost production are already common, both in the EU and worldwide, major EU competitors, such as the USA and China, are making significantly larger investments. Given this landscape, there is a pressing need to enhance investment within the EU to ensure competitiveness and economic resilience. The recommended lines of action are as follows:
 - Support SMEs investment in emerging markets;
 - Expand IPCEIs use, facilitate SME involvement, and speed up implementation;

- Ensure interlinkages between giga factories/FDI and EU SMEs in a systemic and coordinated manner between EU and Member States;
 - Support SME production diversification to enable participation in changing value chains;
 - Implement regulatory changes to reduce unnecessary burdens that hinder production expansion in SMEs.
- **Pillar IV: Enhancing EU SMEs' global reach.** Internationalisation is a key growth strategy for EU SMEs. The literature documents several advantages of global trade, including low-cost production facilities and knowledge and learning accumulation that allow SMEs to improve their performance and develop new products. Integration into global value chains (GVCs) leads to increased competitiveness, and FDI flows are a significant vehicle for participating in GVCs. Participation in GVCs results in access to new markets, networking, and collaboration with other companies in the same global industry. It also increases bargaining power with suppliers and clients. Despite these advantages, SMEs still encounter significant challenges in such internationalisation, primarily due to difficulties in accessing finance, information and skills. A recent report by the European Court of Auditors (ECA) underscores the need for enhanced awareness, improved coherence, better coordination, and increased sustainability in SME internationalisation efforts. These general recommendations are crucial in leveraging opportunities presented by OSA. The Action Plan further identifies the following specific lines of action:
 - Support for SME internationalisation programmes focused on ambitious projects and innovative SMEs;
 - Tackle non-tariff measures that limit SME access to third-country markets;
 - Ensure adequate market surveillance to maintain a level playing field for SMEs in the internal market.
- **Pillar V: Reinforcing market intelligence and monitoring.** Despite considerable recent research aimed at pinpointing strategic vulnerabilities within ecosystems based on import dependency, EU production, and diversification of supply sources, there remains a significant gap in our understanding. This relates to the details of the structure, localisation, and scale of production of certain sectors within the EU. This is especially the case for the involvement of SMEs. This lack of detailed knowledge hinders the ability to formulate adequate policy responses. A stark illustration of this was in the COVID-19 pandemic when there was insufficient knowledge and data on firms, predominantly SMEs, producing technical textiles that could switch to the manufacture of personal protective equipment. The following specific lines of action are recommended:
 - Monitor technology / market needs to help SMEs decide where to position themselves;
 - Monitor EU production capacities, market structure, and data sharing;
 - Promote best practices sharing to showcase potential market opportunities for SMEs.
- **Foundational pillar: Continue improving the framework conditions.** This last pillar is dedicated to the continued improvement of framework conditions critical for the support and development of SMEs. The issues concerned are well-known – such as lack of information, skill shortages, difficult access to public funding, and administrative burden – but addressing them is vital if the impact of specific policy measures aimed at supporting SMEs is to be maximised. This continued improvement helps ensure that

SMEs can effectively participate in and benefit from OSA-related initiatives. Specific areas for improvement are:

- Increase awareness and monitoring of SME-friendly public procurement;
- Improve information on public support available for SMEs, as well as existing venture capital /investor funds;
- Enhance coordination at the EU level to ensure availability of critical materials and goods for SMEs in all ecosystems;
- Improve communication between high level EU institutions and SMEs, through the involvement of existing intermediary organisations;
- Reinforce activities for skill development and retention in SMEs.

1 Introduction

1.1 Open Strategic Autonomy and potential impact on Small-Medium Enterprises

1.1.1 Emergence and development of the Open Strategic Autonomy concept

Open Strategic Autonomy (OSA) is a political concept referring to the capacity of the European Union (EU) to act autonomously in strategically important areas, while aiming for multilateral cooperation wherever possible and appropriate.

This concept has become a focal point within the EU over the last ten years. It was first included in the European Council conclusions in December 2013 as an objective to enhance European defence, technological and industrial capabilities.¹ It was defined as the EU's “*capacity to act autonomously when and where necessary with partners wherever possible*”. Subsequently, it gained significance within the global strategy for the EU's Foreign and Security Policy of 2016, serving to safeguard European principles, values, and interests.²

After the COVID-19 pandemic, its scope has expanded to include industrial affairs, businesses and SMEs, digital, trade and international economics.³ In fact, while the COVID-19 crisis demonstrated the advantages of the Single Market's integration into global value chains in terms of mitigating shocks during periods of crisis,⁴ it also showed the need to acquire a more comprehensive understanding of Europe's current and prospective strategic dependencies. This realisation provides the basis for a shift in trade and industrial policy that promotes the EU as a geographical region open to stable, rules-based international trade⁵, fosters domestic capacity where needed and is less reliant on foreign actors. As highlighted by the European Commission, this need is particularly salient in critical sectors such as health-related products, battery technology, hydrogen production, semiconductor manufacturing, cloud and edge technologies and the acquisition of essential raw materials.⁶ These initiatives aim to boost the EU's capabilities, thereby reducing external vulnerabilities and promoting sustainable and strategic autonomy in key industrial sectors.

The Commission's 2021 Trade Policy Review refers to Open Strategic Autonomy as “*the EU's ability to make its own choices and shape the world around it through leadership and*

¹ European Council, Conclusions (EUCO 217/13), 19/20 December 2013. Available at: <https://data.consilium.europa.eu/doc/document/ST-217-2013-IN1/en/pdf>.

² European External Action Service. (2016). Shared Vision, Common Action: A Stronger Europe A Global Strategy for the European Union's Foreign and Security Policy [online]. Available at: https://www.eeas.europa.eu/eeas/global-strategy-european-unions-foreign-and-security-policy_en.

³ European Commission. (2021). Commission sets course for an open, sustainable and assertive EU trade policy [online]. European Commission - European Commission [online]. Available at: https://ec.europa.eu/commission/presscorner/detail/en/ip_21_644.

⁴ OECD. (2020). Shocks, risks and global value chains: insights from the OECD METRO model [online]. Available at: <https://www.oecd.org/trade/topics/metro-trade-model/>. and European Commission. (2021). Trade Policy Review - An Open, Sustainable and Assertive Trade Policy [online]. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021DC0066>.

⁵ Access to international trade and international supply chains have proven most effective in promoting the productivity of European firms (Shu and Steinwender, 2019), their innovation (Akcigit and Melitz, 2021; European Commission, 2022b), and resilience (Baldwin and Freeman, 2021).

⁶ European Commission. (2021). Strategic dependencies and capacities. COMMISSION STAFF WORKING DOCUMENT. Accompanying the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Updating the 2020 New Industrial Strategy: Building a stronger Single Market for Europe's recovery [online]. SWD(2021) 352 final. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021SC0352>.

engagement, reflecting its strategic interests and values.⁷ OSA was seen not just as a policy choice but also as a mindset for decision-makers. **It encompasses: “resilience and competitiveness”, “sustainability and fairness”, and “assertiveness and rules-based cooperation”.** In the Commission’s 2021 document on ‘Strategic Dependencies and Capacities’,⁸ OSA was more expansively defined as *“the ability to shape the new system of global economic governance and develop mutually beneficial bilateral relations, while protecting the EU from unfair and abusive practices, including to diversify and solidify global supply chains to enhance resilience to future crises”*. This shift was also the subject of the 2021 issues paper ‘Strategic Autonomy, Strategic Choices’ by the Analysis and Research Team of the Council, the Joint Research Centre (JRC) scenarios report on Open Strategic Autonomy 2040 and the second Commission strategic foresight report.⁹ Moreover, the EU Strategic Autonomy Monitor published a briefing on ‘EU strategic autonomy 2013-2023 - From concept to capacity’ in 2022.¹⁰

Several geopolitical trends are driving the EU’s pursuit of strategic autonomy. These include heightened military tensions, escalating competition for natural resources, and the emergence of important new players like India on the global stage.¹¹ Tensions and strategic rivalries between China and both Europe and the United States of America (USA) are on the rise. Despite forecasts indicating a decelerating growth in China, the Chinese and US economies are expected to remain roughly similarly sized, perpetuating their great power competition and strategic rivalries.¹² Within this context, the EU has a unique opportunity to strengthen its economic and geopolitical space and independence. By positioning itself as a stable, secure, and competitive environment for business, investments, research and innovation and production, the EU can remain a pivotal player on the global stage.

Synergies between the internal and external dimensions of EU policies are a cornerstone in achieving OSA. This is highlighted by the fact that strengthening the resilience and sustainability of the EU economy, and its supply chains is central to achieving OSA. Indeed, resilience is mentioned in the Strategic Foresight Report as a unifying goal of all EU policies.¹³ The same report also makes the link between resilience and autonomy: *“geopolitical resilience relates to Europe bolstering its ‘Open Strategic Autonomy’ and ‘global leadership role’*.”¹⁴ More recently, the report ResilientEU 2030, in defining the priorities of the Spanish Presidency of the Council, highlighted nine lines of action pertaining to OSA (Figure 1).¹⁵ These dedicated actions recognise that the pursuit of the pillars of the OSA should not take place in a vacuum with respect to existing policies, but that a comprehensive, systemic approach is needed, which *“combines different solutions, leveraging the synergies between them, assessing their potential impacts and calibrating their trade-offs”*.

⁷ European Commission. (2021). Trade Policy Review - An Open, Sustainable and Assertive Trade Policy. (Cit.)

⁸ European Commission (2021). Strategic dependencies and capacities. (cit.).

⁹ JRC. (2021). Shaping and securing the EU’s Open Strategic Autonomy by 2040 and beyond [online]. Available at: <https://publications.jrc.ec.europa.eu/repository/handle/JRC125994>.

¹⁰ European Parliament (2022). EU strategic autonomy 2013-2023: From concept to capacity. Briefing. Available at: [https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI\(2022\)733589](https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2022)733589).

¹¹ Spain’s National Office of Foresight and Strategy. (2023). Resilient EU2030 [online]. Resilient EU2030: a roadmap for strengthening the EU’s resilience and competitiveness [online]. Available at: <https://spanish-presidency.consilium.europa.eu/en/news/the-spanish-presidency-presents-resilient-eu2030-roadmap-to-boost-european-union-open-strategic-autonomy/>.

¹² Bruegel. (2024). 2024 will be about Western economic normalisation, China’s deceleration and India’s catch-up [online]. Authored by García-Herrero, A [online]. Available at: <https://www.bruegel.org/comment/2024-will-be-about-western-economic-normalisation-chinas-deceleration-and-indias-catch>.

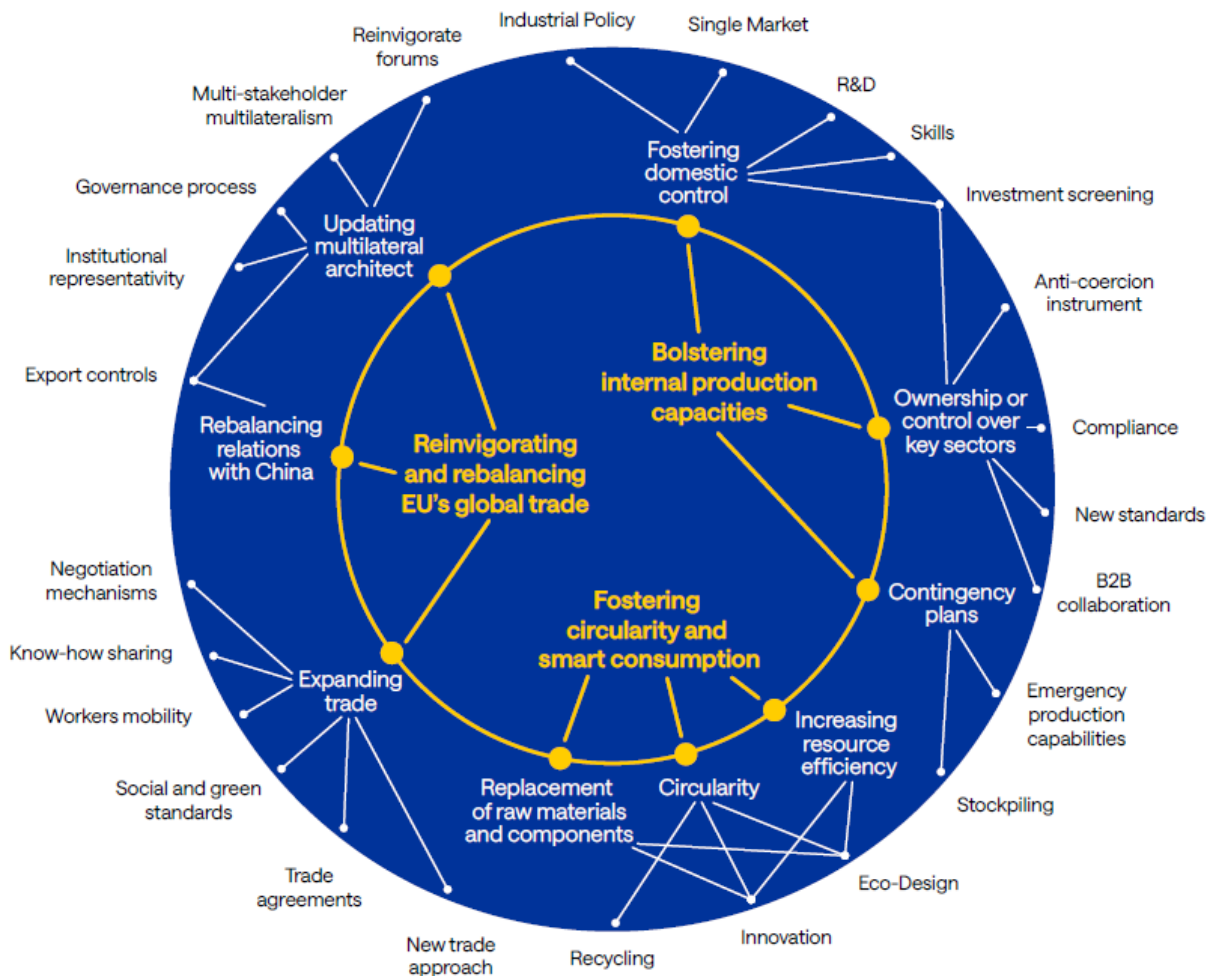
¹³ European Commission. (2022). 2022 Strategic Foresight Report Twinning the green and digital transitions in the new geopolitical context. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL [online]. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0289>.

¹⁴ European Parliament. (2022). Future Shocks 2022: Addressing risks and building capabilities for Europe in a contested world [online]. Available at: [https://www.europarl.europa.eu/thinktank/en/document/EPRS_STU\(2022\)729374](https://www.europarl.europa.eu/thinktank/en/document/EPRS_STU(2022)729374).

¹⁵ Spain’s National Office of Foresight and Strategy (2023). Resilient EU2030. (cit.).

Importantly for the current study, the Spanish Presidency of the Council’s report highlights that governments have a regulatory and facilitating role to play by introducing policy measures in a market-oriented manner. These measures should consider factors such as cost-effectiveness, technological development, fair competition, and previously agreed economic, social, and environmental goals. These measures, as well as the thoughts and methodology underpinning them, represent important steps to make the concept of OSA more concrete and geared towards policy action.

Figure 1. OSA pillars and lines of actions for the EU



Source: Spain’s National Office of Foresight and Strategy, 2023.

From a concrete perspective, the range of policy measures promoting OSA is broad and diverse. These include global trade initiatives such as export quotas, export-related non-tariff measures, anti-dumping actions, and import monitoring. Internationally, OSA can be supported by policies that incentivise and manage Foreign Direct Investments (FDI), as well as strategic procurement measures. Domestically, strategic dependencies can be addressed through measures to boost internal production such as subsidies, R&D grants, state aid, tax exemptions, and localisation incentives. Additionally, initiatives aimed at enhancing innovation capabilities and promoting emerging alternative markets also contribute to this objective.

Box 1: Global Perspectives: The Open Strategic Autonomy paradigm beyond the EU

The EU is not alone in the desire to become more independent, resilient and gain strategic autonomy. It could be argued that a similar paradigm shift is taking place in various corners of the globe. Beyond the EU, notable shifts in policy reflect a similar emphasis on enhancing national self-sufficiency and reducing reliance on external sources. In the United States of America (**USA**), initiatives such as “America First” and the application of “Buy American” during the Trump administration reflected an aim of reducing US economic interdependence. The Inflation Reduction Act deploys significant incentives to promote renewable energy and improve energy efficiency in the United States of America.¹⁶ This underscores a renewed focus on bolstering domestic industries and securing supply chains. The resurgence of the chip industry in Silicon Valley symbolises America's reinvigorated commitment to reclaiming technological leadership and reducing dependence on foreign semiconductor production.

China also has demonstrated a growing trend towards self-sufficiency and autonomy, evident in its strategic economic policies. Under the banner of initiatives like "Made in China 2025" (launched in 2015) and the "Dual Circulation Strategy" (2020) the Chinese Government has articulated a clear vision of strengthening domestic capabilities across key industries, reducing dependence on foreign technologies, and enhancing national resilience. This drive extends beyond economic sectoral policies to encompass technological advancements, where China aims to achieve self-sufficiency in critical areas such as semiconductor manufacturing, artificial intelligence, and advanced manufacturing processes. Concurrently, Beijing has pursued policies to bolster indigenous innovation, foster domestic research and development, and cultivate homegrown champions capable of competing on the global stage.

Meanwhile, **India** pursued the Production Linked Incentive (PLI) and its 'Make in India' strategy (launched in 2014) with the aim of transforming its economy into a manufacturing powerhouse. The promotion of the 'Make in India' approach is connected to broader global dynamics, as companies worldwide seek alternative production sites in Asia to mitigate risks associated with overreliance on China. For example, the US 'friendshoring' policy aims to strengthen economic ties with trusted partners, thereby encouraging companies to explore India as a manufacturing destination.¹⁷

Source: Authors.

1.1.2 The relationship between OSA and SMEs

SMEs play a pivotal role in driving the EU's economy. These enterprises form the backbone of innovation, employment, and economic growth across various sectors. They contribute significantly to job creation, accounting for 64.4% of employment within the non-financial business economy of the EU.¹⁸ Their agility and flexibility enable them to adapt swiftly to changing economic conditions, thus bolstering resilience within the EU economy. Additionally, SMEs are often at the forefront of technological advancements and are vital for sustaining Europe's competitive edge globally.¹⁹ The EU has increasingly acknowledged and emphasised the significant role that SMEs play in its economic and societal fabric. In particular,

¹⁶ U.S. Department of the Treasury. (2022). H.R.5376 - Inflation Reduction Act of 2022 [online]. PUBLIC LAW 117–169. Available at: <https://www.congress.gov/117/plaws/publ169/PLAW-117publ169.pdf>.

¹⁷ <https://www.cfr.org/blog/modis-state-visit-us-litmus-test-values-based-us-trade-policy>.

¹⁸ European Commission and JRC. (2023). Annual Report on European SMEs 2022/2023 [online]. Available at: <https://publications.jrc.ec.europa.eu/repository/handle/JRC134336>.

¹⁹ Singh, R.K., Garg, S.K. and Deshmukh, S.G. (2008). Strategy development by SMEs for competitiveness: a review. Benchmarking: An International Journal, 15(5), pp.525–547.

there is an increased focus on the impact of economic and policy developments on smaller businesses and what policies are conducive to their competitiveness.²⁰

It was the European Industrial Strategy of 2020 that made the link between the Open Strategic Autonomy and the role of SMEs in the European economy. A key feature of the strategy was to reduce supply dependencies and accelerate green and digital transitions.²¹ Regarding SMEs, the strategy acknowledged the need to pay attention to SMEs, highlighting the role of industrial alliances as a platform that is “*broad and open in principle, and will pay particular attention to inclusiveness for start-ups and SMEs*”.²²

But why should SMEs be involved in the unfolding of the OSA paradigm? What implications does OSA have for SMEs?

The implications for SME involved in the OSA paradigm are manifold. OSA is a multifaceted concept that entails risks and opportunities for SMEs active in the EU. Incorporating the value chain perspective of critical industries promises a better understanding of how OSA can impact SMEs, which in turn depends on their exact role in the value chain, such as upstream technological development, direct manufacturing or supplying larger companies. Potential opportunities and risks for SMEs identified by prior literature are briefly presented in Table 1.

Table 1. Potential opportunities and risks of OSA for SMEs

SMEs' positioning the value chain	Potential opportunities of OSA for SMEs	Potential risks of OSA for SMEs
SMEs contributing to technological development upstream in the value chain	Increased investment and support for research and innovation within critical industries can create a conducive environment to develop cutting-edge technologies and solutions. ²³ This can enhance their competitiveness and position them as key players in global markets.	SMEs in this position typically face pressure to constantly innovate and keep pace with rapidly evolving technological standards. This requires significant financial and human resources. Also, SMEs active in R&D often face profitability problems, due to difficulties in finding investors to scale-up.
SMEs that are direct manufacturers within the value chain	OSA can impact SMEs' access to inputs, technology and markets. The dual objective of strengthening the EU's resilience and autonomy in key strategic sectors while remaining open to global trade and investment presents SMEs with the opportunity to expand their market reach through enhanced access to global trade networks and diversified supply chains. ²⁴	Policy efforts to strengthen OSA could mainly benefit well-known multinational companies, rather than smaller businesses. ²⁵ In fact, subsidies and other state aid measures often flow towards "national champions" rather than smaller companies that are less known. ²⁶

²⁰ Key strategic documents emphasising the centrality of SMEs in EU policy making are the Small Business Act (<https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0394:FIN:en:PDF>), and the European SME Strategy (<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0103>).

²¹ European Commission. (2021). European industrial strategy [online]. Available at: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/european-industrial-strategy_en.

²² *Idem*.

²³ Mahardhani, A.J. (2023). The Role of Public Policy in Fostering Technological Innovation and Sustainability. *Journal of Contemporary Administration and Management (ADMAN)*, 1(2), pp.47–53.

²⁴ United Nations Conference on Trade and Development. (2024). Promoting International Investment by Small and Medium-sized Enterprises. Available at: https://unctad.org/system/files/official-document/diae2023d7_en.pdf.

²⁵ Narula, R. and Verbeke, A. (2015). Making internalization theory good for practice: The essence of Alan Rugman's contributions to international business. *Journal of World Business*, 50(4), pp.612–622.

²⁶ Friederiszick, H.W., Roller, L.-H. and Verouden, V. (2008). European State Aid Control: An Economic Framework [online]. In: Buccrossi, P. eds. *Handbook of Antitrust Economics*. Pp. 625-770. Available at: <https://ec.europa.eu/dgs/competition/economist/esac.pdf>

SMEs' positioning the value chain	Potential opportunities of OSA for SMEs	Potential risks of OSA for SMEs
<p>SMEs functioning as suppliers to larger companies within the value chain</p>	<p>OSA may attract substantial inward Foreign Direct Investments (FDI), encourage EU firms to invest within Europe rather than abroad, or drive already existing larger companies to reduce dependence on non-EU suppliers. This then creates new opportunities for local SMEs.</p> <p>SMEs with adequate absorptive capacity can benefit from establishing or strengthening their linkages with multinational companies by finding new clients and increasing their participation in global value chains. Large firms can thus act as “anchor firms” for SMEs as suppliers by providing them with stable and sizable contracts, which can offer a steady revenue stream and boost their credibility.</p> <p>SMEs can benefit in other ways, such as joint research and development projects, collaborate on innovation initiatives, and access resources such as technology, expertise, and global networks.</p>	<p>SMEs may face increased pressure to comply with stringent quality standards, regulatory requirements putting undue administrative burdens on SMEs, and delivery schedules imposed by larger customers. Failure to meet these expectations could result in loss of contracts or reduced orders, impacting the SME's revenue and long-term viability. Regarding SMEs supplying to or partnering with multinational companies (MNCs) based outside the EU, OSA initiatives may impose stricter compliance requirements, or even impose outright barriers, possibly in retaliation to trade measures taken at the EU-level.</p> <p>Strategies focused on reshoring or regionalising supply chains may lead MNCs to reconsider their sourcing decisions and prioritise suppliers within their home countries. This could indeed benefit SMEs, but also hurt them and disrupt existing supply chain relationships and contracts with large companies based outside of the EU.</p>
<p>SMEs operating as users downstream the value chain</p>	<p>SMEs can benefit from the increased availability of cutting-edge technologies to streamline processes, improve efficiency, and develop innovative products and services.</p> <p>The adoption of strategic technologies provides SMEs with tools for more efficient operations and customer insight, while facilitating collaboration and networking within different ecosystems. Unlike large enterprises, SMEs leverage their agility by exploiting these new technologies to quickly adapt to market demands, explore niche areas and participate in the green transition by producing green technologies.</p> <p>Moreover, as SMEs embrace these advancements, they gain the internal capabilities that eventually enable them to become less dependent on foreign technologies.</p>	<p>As OSA drives advancements in technologies related to the digitalisation and environmental sustainability, SMEs may find themselves needing to adopt new technologies or adapt their operations to meet evolving standards and regulations.²⁷ This could entail investments in upgrading digital infrastructure, implementing sustainable practices, or complying with stricter environmental regulations. Consequently, SMEs downstream in the value chain may face pressures to innovate and modernise their operations to remain competitive and align with the changing landscape shaped by OSA initiatives.</p>

Source: Authors.

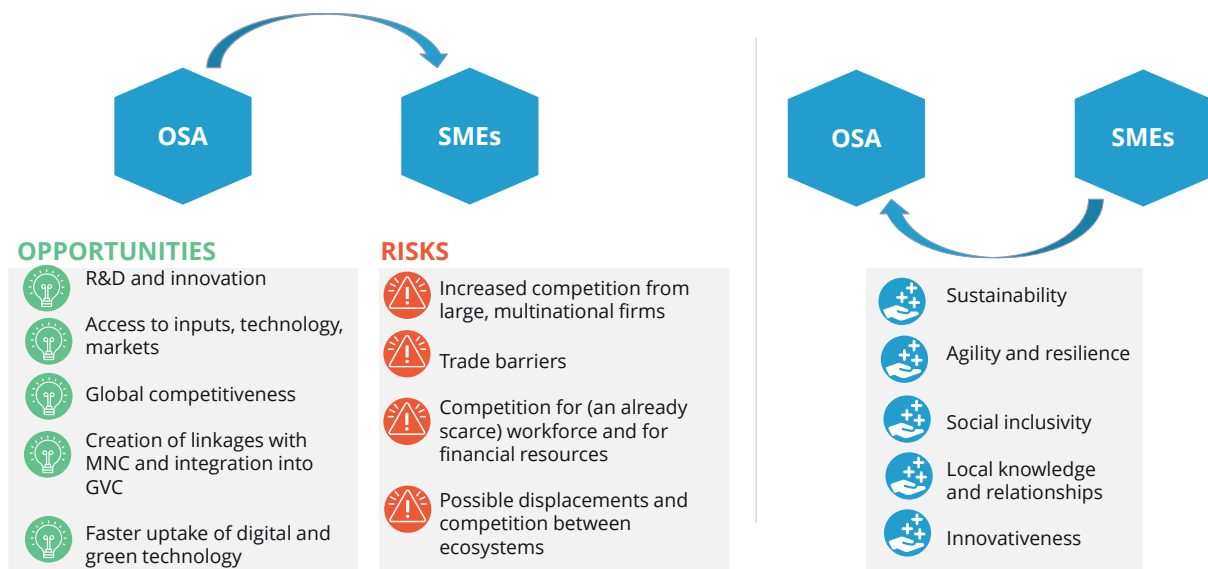
The impact of OSA on SMEs extends beyond specific value chains and industrial ecosystems. It also affects broader challenges, such as skill shortages across the EU or integrated capital markets. A significant build-up of production capabilities can lead to competition for an already scarce workforce, exacerbating skill shortages across various sectors. For instance, increased demand for advanced manufacturing technologies under OSA

²⁷ European Parliament. (2021). Europe's Digital Decade and Autonomy [online]. Available at: [https://www.europarl.europa.eu/thinktank/en/document/IPOL_STU\(2021\)695465](https://www.europarl.europa.eu/thinktank/en/document/IPOL_STU(2021)695465).

can lead to a scarcity of skilled workers in fields such as engineering, robotics, computer science and Artificial Intelligence. Similarly, when large corporations or government entities allocate significant resources to specific projects or industries deemed important for OSA, it may reduce the available funding that could otherwise be directed towards SMEs.

Moreover, there are cross-cutting effects of state aid, including the concentration of public support funds on selected projects, which may have ramifications on firms, especially SMEs, in other ecosystems. For instance, on the positive side, the development of battery farms may positively affect the availability and affordability of battery technologies, enhancing the competitiveness of SMEs in electric vehicle manufacturing and the energy management sector. On the negative side, battery farm projects may increase competition for land, driving up prices and making it more difficult for SMEs in the agriculture or construction sector to access affordable land for farming or construction purposes.

Figure 2. The dual relationship between OSA and SMEs



Source: Authors.

The relationship between OSA and SMEs is inherently bidirectional. While OSA can have positive and negative impacts on SMEs, it is also essential to recognise that **SMEs play a pivotal role in ensuring the sustainability of investments in line with OSA over the long term.** SME involvement is crucial for various reasons. First, SMEs are often vital for local economies, contributing to job creation, innovation, and overall economic growth.²⁸ By integrating SMEs into their investments in OSA-aligned supply chains, larger companies can benefit from their agility, flexibility, and local knowledge and thus adapt effectively to changing market conditions and regulatory environments.²⁹ The involvement of local SMEs also fosters the embeddedness of investments in local ecosystems.³⁰ SMEs often have strong ties to local communities and markets. Their deep understanding of local preferences, regulations, and networks can add significant value to the value chain, especially in sectors where localisation is important. This embeddedness ensures that investments are economically viable and socially and environmentally sustainable, as local SMEs are more attuned to their communities' needs and concerns than their larger counterparts. SME participation in value chains can also

²⁸ Mason, C., & Brown, R. (2014). Entrepreneurial ecosystems and growth-oriented entrepreneurship. Final Report to OECD, Paris: OECD Publishing.

²⁹ Morgan, T., & Anokhin, S. (2019). Sustainable economic development and the role of SMEs: Evidence from a panel of emerging economies. *Journal of Small Business Management*, 57(3), 906-923.

³⁰ Dacin, M. T., Dacin, P. A., & Matear, M. (2011). Social entrepreneurship: Why we don't need a new theory and how we move forward from here. *Academy of Management Perspectives*, 25(3), 37-57.

lead to job creation and economic growth, particularly in regions where SMEs are prevalent.³¹ Moreover, the participation of SMEs can help build resilient and diversified supply chains, as many smaller businesses possess critical expertise and capabilities in niche areas important to the success of value chains, thereby reducing dependency on imports and enhancing the overall stability of the investment ecosystem.³² Therefore, fostering strong partnerships between OSA initiatives and SMEs across the EU is essential for achieving sustainable and inclusive economic growth that benefits larger industries and local communities.

1.2 Study objectives and methodology of analysis

This study comes at a decisive time given the ongoing discussion about how strategic autonomy should address the challenges posed by unexpected supply chain disruptions, such as those posed by the COVID-19 pandemic and Russia's war of aggression against Ukraine. The discussion involves how to reshape the European industrial strategy and related internal and external policies. The implications of this new paradigm on SMEs have not yet been thoroughly analysed. This study aims to fill this gap by focusing on the following specific objectives:

- Analysing the potential economic impact (both opportunities and risks) of more effective OSA for SMEs;
- Mapping existing policies in the EU and in the EU Member States promoting OSA, that affect SMEs.
- Identifying policy solutions at the EU and Member State levels on how to strengthen OSA while maximising the benefits to SMEs. These recommendations may include suggestions for the introduction of new policies as well as the recalibration of existing ones.

In terms of geographical coverage, the study covers all EU Member States and the EU level. It also includes relevant information from key economies outside of the EU27 where these are appropriate and useful for comparisons.

Methodological tools employed in the analysis include desk research of relevant existing literature, reports and policy documents related to OSA and SMEs in the selected ecosystems. These are complemented by consultation with relevant stakeholders, including independent experts, policy makers, industry associations and other actors, both at the national and EU level (see details on the interview programme in Annex I). Emerging conclusions and recommendations have been discussed with the SME Envoy Network.³³

The study touches upon all industrial ecosystems to some extent. However, the analysis is concentrated on a selected number of ecosystems where the most critical strategic dependencies have been identified by previous studies and which have been regarded as strategic priorities by the European Commission. This selection is presented and justified in the subsequent section.

³¹ Pache, A. C., & Santos, F. (2013). Inside the hybrid organization: Selective coupling as a response to competing institutional logics. *Academy of Management Journal*, 56(4), 972-1001.

³² Oxelheim, L., & Wihlborg, C. (2017). The challenges of Europe's four freedoms: In search of a new governance architecture for the European Union. *Journal of European Integration*, 39(8), 917-938.

³³ Presentations of this study were delivered at the SME Envoy Network meetings on March 14, 2024 (Brussels) and June 12, 2024 (Berlin), as well as during the online meeting with the SME Envoys' Sherpas on May 8, 2024.

2 Selected ecosystems and areas of strategic dependency

In recent years, there has been a notable increase in the attention and efforts to analyse strategic vulnerabilities and dependencies within the EU. Various studies have extensively reviewed different industrial ecosystems, shedding light on the most critical products and technologies where the EU is facing the greatest challenges in the face of evolving global dynamics (see an overview in the following Table 2).

Table 2. Ecosystem Selection and Strategic Dependencies: Literature Review

Study	Description	Method	Identified vulnerable ecosystems and products/technologies
Spain's National Office of Foresight and Strategy (2023). Resilient EU2030 ³⁴	This provides insights into the strategic landscape and outlines key priorities for resilience-building within the EU. Specifically, the study provides nine lines of action to tackle the EU vulnerabilities aligned with the European principles of competitiveness and cohesion. These lines of action were identified in close consultation with representatives from all EU Member States.	<ul style="list-style-type: none"> • Geo-political analysis • Time, spatial trend analysis of products-based dependencies. 	The following wide groups of vulnerabilities are identified: <ul style="list-style-type: none"> • Key enabling technologies. • Digital Services (e.g., cloud and computing) • Raw materials and semi-processed goods
European Commission (2023). An enhanced methodology to monitor the EU's strategic dependencies and vulnerabilities ³⁵	This study develops a data-driven methodology to detect EU strategic dependencies using highly disaggregated product-level trade data. It identifies 204 products in sensitive industrial ecosystems where the EU experiences an important level of foreign dependency. The study suggests how to address the EU's OSA agenda.	<p>Based on the BACI database³⁶, the study refines three indicators (previously developed by a 2021 European Commission study³⁷) to operationalise the OSA concept.</p> <p>The first indicator captures products with a low level of import diversification. The second indicator identifies how important foreign sources are for the EU. The third indicator explores to what degree extra-EU imports can be substituted by EU production. The study enhances the above three indicators by controlling for product re-exports; and introducing a temporal</p>	<p>ECOSYSTEMS (products)</p> <ul style="list-style-type: none"> • DIGITAL (laptops, mobile phones, monitors, or projectors) • HEALTH (some medicines, specific medical instruments, and COVID-19 related goods such as protective garments) • AGRI-FOOD (fertilisers, as well as critical inputs in farming and fishing with examples such as soya beans or fishing rods) • AEROSPACE AND DEFENCE (navigational instruments for aeronautical and space navigation) • ENERGY INTENSIVE INDUSTRIES (raw

³⁴ Spain's National Office of Foresight and Strategy. (2023). *Resilient EU2030* [online]. (cit.).

³⁵ European Commission. (2023). *An enhanced methodology to monitor the EU's strategic dependencies and vulnerabilities* [online]. Available at: https://single-market-economy.ec.europa.eu/publications/enhanced-methodology-monitor-eus-strategic-dependencies-and-vulnerabilities_en

³⁶ BACI provides yearly data on bilateral trade flows for 200 countries at the product level (5000 products). Products are identified using the Harmonized System (HS), which is the standard nomenclature for international trade, used by most customs. The BACI database relies on raw data from the UN statistical Division (COMTRADE dataset).

³⁷ European Commission (2021). *Strategic dependencies and capacities*. (cit.).

Study	Description	Method	Identified vulnerable ecosystems and products/technologies
		perspective, from 2018 to 2022 by integrating information from BACI and the Trade-Figaro database by Eurostat.	materials) • RENEWABLES (raw materials, photovoltaic cells or LED lamps)
JRC (2024). Assessing Open Strategic Autonomy: A two-dimensional index to quantify EU-27 autonomy in industrial ecosystems and strategic technologies ³⁸	The study offers a comprehensive framework for evaluating the EU's autonomy across various industrial ecosystems and strategic technologies. It argues that the presence or absence of OSA depends on several aspects: <ul style="list-style-type: none"> • Domestic capacities, e.g., for the EU as a whole or at the MS level. • Provisional autonomy, defined by the relationship between own capacity and external dependency. • Current focus of external dependencies on specific partners, determining how easily they could eventually be substituted by others. • Manifest and latent risks, complexities, and tensions in relations with specific external partners. 	The study proposes a two-dimensional "OSA index" ³⁹ to operationalise the aforementioned aspects both at the industrial ecosystems level and for specific technologies. The considered dimensions are: (i) the economic domain (the market); (ii) the innovation domain. Like the EC (2023) ⁴⁰ report, this study is also based on trade data from Prodcum, and the UN Comtrade (BACI), while the EPO Patstat database provided the indicators for innovation.	ECOSYSTEMS: <ul style="list-style-type: none"> • Digital • Electronics • Health • Agri-food • Aerospace and Defence • Energy Intensive Industries • Mobility • Renewables • Construction • Textile TECHNOLOGIES: <ul style="list-style-type: none"> • Big data /AI • Biotechnology • Nanotechnologies • Internet of things • Advanced materials

Source: Authors.

Annex II presents the rationale that guided the selection of specific ecosystems. As it is shown, **the analysis encompasses nine of the 14 industrial ecosystems** identified by the European Commission's Communication titled "A New Industrial Strategy for Europe",⁴¹ which previous research has identified as prone to potential vulnerabilities. Nevertheless, certain key enabling technologies examined within these ecosystems are also relevant for those excluded from in-depth analysis.

The analysis concentrates on specific strategic value chains within each ecosystem, selected according to three main criteria. First, chosen value chains are linked to critical products or technologies where there are dependencies. These take different forms but are

³⁸ JRC. (2024). Assessing Open Strategic Autonomy. JRC Publications Repository [online], Authored by Kroll, H., 2024. Available at: <https://publications.jrc.ec.europa.eu/repository/handle/JRC136359>.

³⁹ The OSA concept is operationalised considering the « Provisional Autonomy», i.e. the ecosystem own capacity as compared to external reliance, and the « Strategic Autonomy (Sovereignty) », i.e., which additionally requires a consideration of the concentration of external reliance as well as the risk associated with the partners on which external reliance is concentrated.

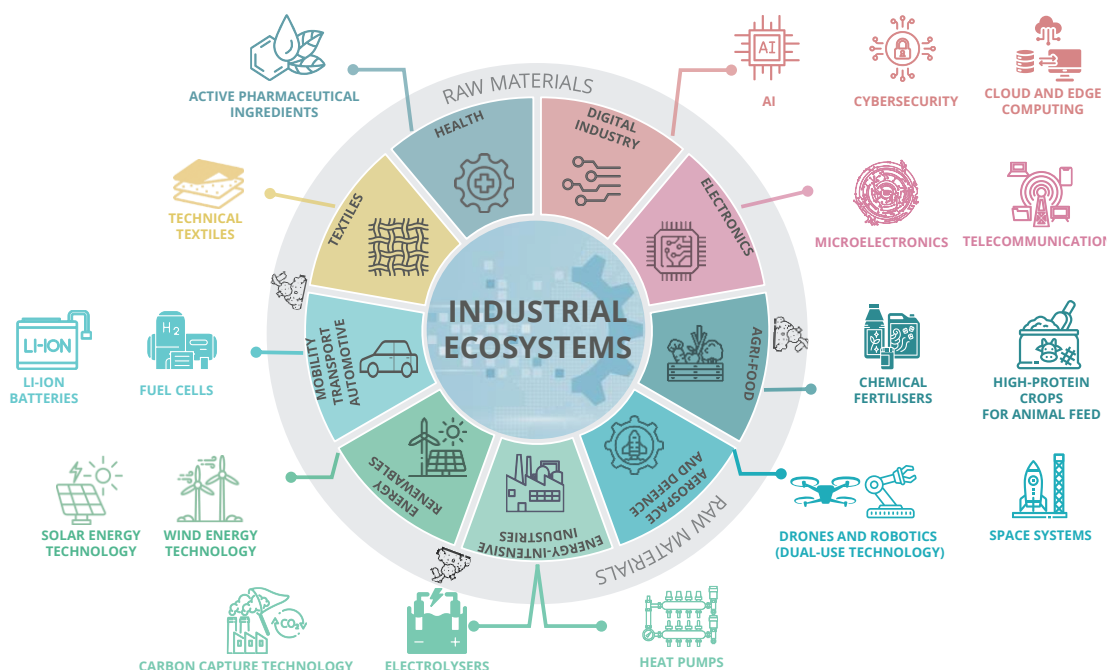
⁴⁰ European Commission. (2023). An enhanced methodology to monitor the EU's strategic dependencies and vulnerabilities [online]. (cit.).

⁴¹ European Commission. (2020). A New Industrial Strategy for Europe. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS. [online]. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0102>.

mainly related to dependency on importing some critical inputs and intermediate components for production from non-EU countries. In other cases, strategic vulnerabilities stem from the lack of domestic production and the need to import specific final goods. Additionally, dependency may be related to innovation capacity and the fact that innovation in specific domains lags behind non-EU countries. Second, the concept of OSA is of utmost relevance for the products and technologies selected (based on extant literature and discussions with key stakeholders). Finally, in all the value chains considered, SMEs play a significant role or have the potential to do so, whether through direct manufacturing or indirect involvement in the value chains. Annex II offers a thorough discussion of how the selection has been made, and Figure 3 presents an overview of the products and technologies under study. Moreover, the charts included in Annex III depict the extent of value added within each chosen ecosystem covered by the selection.

Even if, for the purpose of the analysis, specific products and technologies have been associated with specific ecosystems, it should be kept in mind that **it can be challenging to split the analysis into distinct categories due to the strong interdependencies that exist among the ecosystems**. Ecosystems are interconnected networks of industries, technologies, and stakeholders that rely on each other for inputs, outputs, and innovation. As a result, attempting to isolate one ecosystem from another can overlook the intricate relationships and dependencies that exist within and across industries. For example, advancements in key enabling technologies (KETs), such as nanotechnology, biotechnology, and advanced manufacturing, have broad applications across multiple industries, blurring the boundaries between traditional ecosystems. Dual-use technologies, which have both civilian and military applications (e.g. robotics and drones, or cybersecurity), and multi-application products serving multiple purposes or that can be adapted for use across different sectors (e.g. textiles used in the construction, automotive, or agri-food industries or semi-conductors used in the automotive industry, renewable energy and other economic sectors), also contribute to interdependencies. As another example, raw materials serve as the building blocks for various industries, providing essential inputs for manufacturing processes, product development, and technological advancements. Therefore, their availability and accessibility are key factors that influence the competitiveness and resilience of industries across different ecosystems.

Figure 3. Overview of the ecosystems and products/technologies analysed



Source: Authors.

3 The role of SMEs in the areas of strategic dependency

This section offers an overview of the significance and the positioning of SMEs in the areas of strategic dependencies analysed. It also tackles the relevant dynamics that characterise SMEs development and their geographic distribution. A clear understanding of how pervasive SMEs in the strategic value chains are, their role, and which are the dynamics they are faced with is the essential precondition to propose and design SME-friendly OSA policies. It is equally vital to map the relevance of the strategic value chains and SMEs across EU MSs, to implement OSA policies aimed at European territorial cohesion.

3.1 Current landscape: significance and positioning of SMEs in the value chains

SMEs are highly prevalent across nearly all the value chains analysed, with many industries having SME participation exceeding 70% in terms of the number of companies active.⁴² The absolute number of SMEs varies significantly across industries. For instance, in the robotics and drones industries, SMEs comprise nearly 95% of all firms, but the sector itself is relatively small, with only around 320-350 businesses.⁴³ Similarly, in battery production, 92% of firms are classified as SMEs, but the industry as a whole encompasses approximately 600 companies.⁴⁴ In contrast, the technical textile industry boasts around 18,500 firms, the majority of which are SMEs.⁴⁵ In the semiconductor sector, SMEs are part of the overall ecosystem, as chip designers and Original Equipment Manufacturers (OEMs). Whilst the semiconductor industry is highly consolidated, there are more than 2,000 companies active in the Silicon Europe Alliance.⁴⁶ According to Crunchbase's EU Electronics Companies figures, there are just 10,000 companies within the sector, most of which are SMEs, including start-ups.⁴⁷ The number of SMEs also varies depending on the specific definition of industries. In the EU, there are approximately 120 production sites for mineral fertilisers, primarily comprising large enterprises. However, when considering a broader perspective of the fertiliser industry, which includes organic fertilisers or plant biostimulants, the number of companies is a multiple of 120 and includes a significant number of SMEs.

SMEs occupy different roles along the segments of the value chains, and their significance varies considerably (Figure 4). However, interviewed stakeholders agree that **in all the value chains SMEs are active in R&D activities and develop critical innovation**. In the pharmaceutical sector, SMEs conduct most of the research regarding innovative production processes for already existing APIs. The European technical textile industry is at the forefront of innovation thanks to SMEs that can count on the collaboration of research institutes for the development of new fibres and materials. The innovativeness of SMEs and small scale injects agility and flexibility into the market. It is the focus on innovation that enables SMEs to figure out alternatives to the main products in a value chain. SMEs are pioneers in innovation in the telecommunication sector, as well as in robotics and drones, allowing them to be responsive to new requirements and market changes. The more novel types of electrolyzers are

⁴² Eurostat. (2023). sbs_sc_ovw. Available at: https://ec.europa.eu/eurostat/databrowser/product/page/SBS_SC_OVW

⁴³ *Idem*.

⁴⁴ *Idem*.

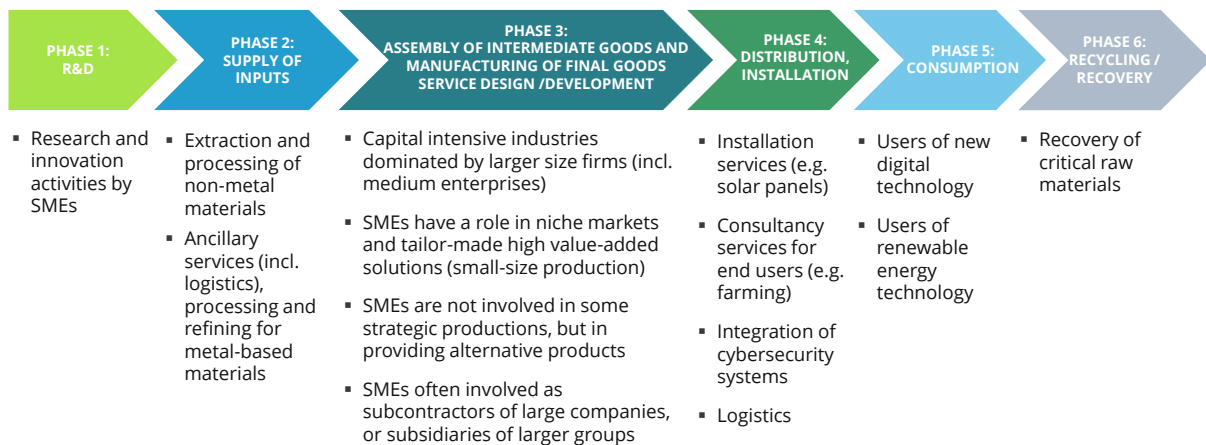
⁴⁵ *Idem*.

⁴⁶ Silicon Europe. (2022). Position Paper on the European Chips Act [online]. Available at: <https://www.silicon-europe.eu/nc/news/news/news-detail/archive/2022/november/article/silicon-europe-position-paper-on-the-european-chips-act/16/>

⁴⁷ Crunchbase (2024). European Union (EU) Electronics Companies (Top 10K). Available at: <https://www.crunchbase.com/hub/european-union-electronics-companies>.

developed mainly by smaller companies. R&D activities on fuel cells are often delegated to SMEs, or large companies create joint ventures, or decide to establish R&D start-ups to offset the loss of profits that R&D activities entail due to the lack of mass commercialisation of fuel cell products. When strong collaborative links between industry and research are established, SME innovation can flourish. In the robotics and drones industry, there is fruitful collaboration among large companies, SMEs, research institutions, and government agencies. This enables SMEs to leverage the strengths of these parties and independently access resources and markets that might otherwise be beyond their reach.

Figure 4. Positioning of SMEs within the value-chains investigated



Source: Authors.

SMEs are important for developing innovative solutions even in industries that today are largely dominated by big extra-EU competitors. In the digital ecosystem, the first-mover advantage and massive infrastructure development since the mid-2000s have enabled US companies – namely Amazon AWS, Microsoft Azure, and Google Cloud Platform, the so-called hyper-scalers – to gain a dominant market position. The relative absence of EU companies limits their contribution to industry standard-setting and marginalises them, putting them at risk of being unable to actively participate in the digital transition. However, innovation produced by SMEs has the potential to gain market shares. In cloud computing, for instance, SMEs provide innovative open-source multi-platform cloud solutions that contrast with the dominance of US hyper-scalers and help promote open-source software, aligning with the Commission’s goal of digital sovereignty. This is paramount to overcome the lock-in effects that over-reliance on non-EU proprietary software creates.

Innovation is not limited to manufacturing; it also extends to the development of new services. In the mobility industry, a French SME, Hype Taxi, has partnered with major automobile manufacturers to offer taxi services for hydrogen-powered taxi fleets, which in turn are serving as a pilot test for the use of fuel cell electric vehicles in transportation. In the agri-food industry, SMEs are vital to support farmers in using fertilisers and alternatives to imported soy more efficiently, while carbon capture and storage projects often involve specialised advisory firms in addition to manufacturing companies.

SMEs exhibit a relatively lower presence in the supply of inputs, such as chemicals and critical raw materials (particularly metal materials, such as platinum-group metals, lithium, aluminium, etc.), primarily due to the dominance of larger companies in this capital-intensive sector. SMEs are somewhat more involved in the extraction of non-metallic minerals that are

primarily used in industrial applications and processes (e.g. borates and feldspar), which are less capital-intensive.⁴⁸

SMEs operating in the central phase of the value chain are mostly involved in niche markets and the production of tailor-made high value-added solutions. In the heat pump industry, for instance, SMEs tend to specialise in designing and implementing customised solutions or complex installations rather than more generic solutions that can be provided more efficiently by large companies. For instance, SMEs are typically not directly involved in producing LIB cells, but they do support large battery cell manufacturers by implementing small-scale pilot test lines for quality assurance or by supplying specialised machinery to the gigafactories. When it comes to carbon capture and storage, the EU is home to a sizeable share of start-ups, with many becoming large companies relatively soon. The potential involvement of SMEs is greater for relatively small-scale projects, compared to large-scale projects which require massive storage capacity concentrated in one geographical area. In a similar vein, large enterprises are more active in the production of electrolyzers using a relatively mature technology (alkaline and Proton Exchange Membrane), which leads to more price competition and the emergence of capital-intensive and large-scale production sites, whereas smaller companies tend to specialise in less mature technologies. In the space industry, small companies provide specialised materials, components, and services to larger companies and government agencies. Their smaller size and flexibility allow them to acquire in-depth knowledge of the clients' needs and to offer ad-hoc personalised solutions. In some ecosystems such as agri-food, SMEs that are hampered in the manufacture of mineral fertilisers because of the capital-intensive nature of their production, have switched their productive capacity to alternative goods – organic-based fertilisers – to benefit from the proximity to raw materials and end-users (small farmers). They have also engaged in developing alternative technologies, such as biostimulants and are successful in this niche market.

The above mentioned agility of SMEs is often facilitated by unconventional organisational and governance structures (such as cooperatives, see the Box below). In contrast to public-owned enterprises these facilitate swift decision-making and foster a culture of collaboration and innovation.⁴⁹

Box 2: The role of cooperative firms in agrifood and renewable energy value chains

Cooperative firms, often referred to as cooperatives, are business organisations owned and operated by a group of individuals for their mutual benefit. These individuals, known as members, pool their resources and share in the decision-making and profits of the cooperative. Cooperatives exist in various countries around the world and are present in a wide range of sectors, including agriculture (crop production, livestock farming, viticulture, agri-food processing) and, to a growing extent, the renewable energy sector (production and distribution of clean energy from sources such as wind, solar, and hydroelectric power).

Some countries have a strong tradition of cooperative ownership and operation. EU Member States known for their significant cooperative sectors include Spain, Italy and France. Cooperatives are also prevalent in the USA and India.

Cooperative companies in the EU face some specific challenges that can affect their operations and growth. There is a huge variety of national laws on cooperatives in the EU that can be an impediment to cross-border-oriented cooperatives and producer

⁴⁸ According to stakeholders interviewed, SMEs represent approximately 80% of the number of companies active in the extraction and processing phases of non-metal materials.

⁴⁹ Discover the Benefits of Cooperative Ownership for Startups. FasterCapital. Available at: <https://fastercapital.com/content/Discover-the-Benefits-of-Cooperative-Ownership-for-Startups.html>.

organisations because of the added legal uncertainty and absence or inconsistent application of EU legislation. There is also legal uncertainty in the application of competition law and its application. Some countries, such as the USA, have more exemptions for cooperatives in competition law in order to rebalance the market power of large firms.

Source: Authors based on European Parliament (2019).⁵⁰

The lower segments of the value chains analysed are dominated by SMEs in their capacity as users, distributors and installers of the technologies and products, or for providing other services. These activities are typically less subject to economies of scale and cannot be easily outsourced to firms located outside of the EU. SMEs in the energy renewables value chain are responsible for installing solar panels. In the agri-food sector SMEs offer consultancy services to end-users, especially those implementing organic farming techniques that make less use of imported fertilisers and high-protein crops for animal food. In the cybersecurity value chain, SMEs are very active in integrating cybersecurity software within existing systems. Finally, SMEs are also active consumers of strategic technologies such as digital tools and renewable energy solutions. In the digital ecosystem, the role of SMEs as users of key enabling technologies such as AI, cloud computing and cybersecurity is very important. The objectives set out by the European Commission for the digital transition cannot be achieved without SMEs becoming mature users of these technologies. Moreover, their role as users is essential in supplying the domestic market for these technologies and prompting their development. Along the same line of reasoning, autonomy in the energy realm may only be achieved if an increasing number of SMEs become users of renewable energy.

The very last mile of the value chain entails activities related to recovery and recycling. In this respect, it is worth mentioning the **upsurge of all the activities concerned with the recovery and recycling of raw materials from waste. SMEs typically play an important role in these activities.** SMEs in the EU, in particular, have a strong potential to be frontrunners in the dismantling and recycling of wind turbines, solar panels and batteries. See more on this in Box 3.

Box 3: Recovery of raw materials from other products: examples from batteries, fuel cells and solar panels

Rare earth magnets are essential components in battery and fuel cell electric vehicles. The 2023 Regulation on batteries and waste batteries represents a significant step towards promoting sustainable practices in the battery industry. This regulation introduces mandatory recycling quotas aimed at enhancing the circularity of battery materials and reducing reliance on primary raw materials, particularly critical raw materials, such as cobalt, lithium and nickel.⁵¹ In 2018, a CEPS study estimated that EUR 400 to 550 million in **cobalt, nickel, aluminium, and lithium** could be recovered from electric vehicle batteries by 2030. This could reach EUR 1.9-2.6 billion by 2040.⁵² **Platinum group metals** (PGMs) – i.e. platinum, palladium, and rhodium – are highly recyclable and, once recycled, secondary PGMs have exactly the same properties as primary PGMs. The largest source of secondary supply today is catalytic converters. Organisations like the International Platinum Group Metals Association play a significant role in overseeing and facilitating the recovery process of these precious metals

⁵⁰ Cooperatives: Characteristics, activities, status, challenges. Think Tank | European Parliament [online]. Available at: [https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI\(2019\)635541](https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2019)635541).

⁵¹ REGULATION (EU) 2023/1542 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 12 July 2023 concerning batteries and waste batteries, amending Directive 2008/98/EC and Regulation (EU) 2019/1020 and repealing Directive 2006/66/EC.

⁵² CEPS. (2018). Prospects for electric vehicle batteries in a circular economy. Available at: https://circulareconomy.europa.eu/platform/sites/default/files/circular_economy_impacts_batteries_for_evs.pdf.

from spent fuel cells. Most PGMs are recoverable throughout the product lifecycle, from production scrap through to end-of-life materials.⁵³

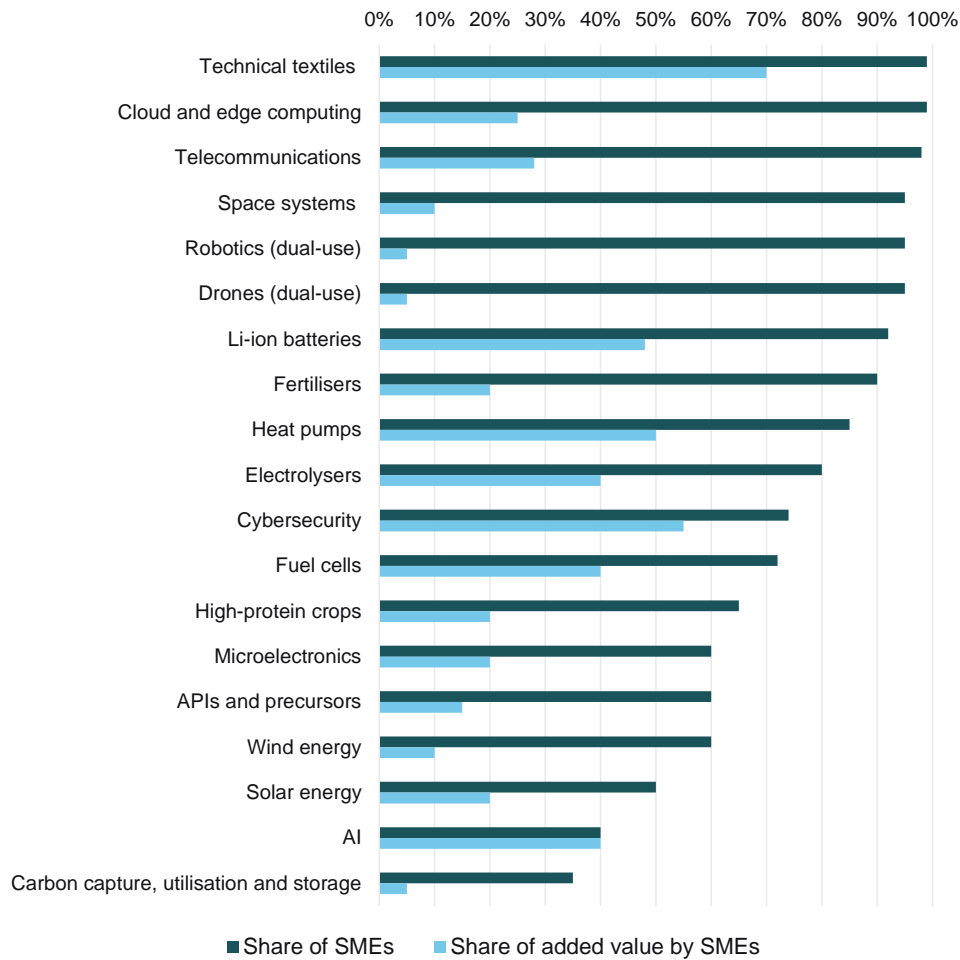
In a similar spirit, solar panels contain valuable materials such as silver, copper, and crystalline silicon, as well as aluminium and glass, that can be extracted once the life span of 25 to years has passed. By 2050, the global recoverable value from solar panels globally could cumulatively exceed USD 15 billion. In addition, the environmental impact of *not* recycling used solar panels and instead dumping them on waste sites, is damaging to the environment. Despite the technical difficulties, start-ups in various parts of the world are entering this growth market with solutions.

Source: Authors.

Notwithstanding the pervasive presence of SMEs, they generally contribute to less than half of the value added (Figure 5). The discrepancy is strictly related to the fact that SMEs are usually not involved in core value added manufacturing activities, as discussed above. They dominate in niche markets and ancillary services which are essential for the smooth functioning of the market but do not generate high value added. Many of the production processes identified are largely capital-intensive and are therefore more easily overseen by large firms with high capital endowments. The same manufacturing processes are also characterised by economies of scale, which lower the production cost and increase value added. Battery cell manufacturing, for example, is an area in which SMEs struggle to compete due to the difficulties they face in scaling up production. This is because the quality of the materials used needs to be consistently good in large quantities to ensure that cells are uniform or do not present cracks. SMEs can struggle to operate such large scale and resource-intensive processes. A similar situation exists in the manufacture of mineral fertilisers. The extraction, processing, and production phases are subject to economies of scale and involve heavy machinery, limiting – if not preventing – the involvement of SMEs. The manufacturing of large-volume generic APIs, like paracetamol, also requires a similarly vast infrastructure that precludes SMEs from participating in the process. The complexity inherent in the production process of some APIs – such as ibuprofen – also prevents SMEs from engaging fruitfully. Even in a strongly SME-dominated ecosystem, such as textiles, medium-size firms are more present in the upstream, capital-intensive segments of the value chain.

⁵³ Matthey, J. A guide to PGMs Understanding the fundamentals of platinum group metals [online]. Available at: https://matthey.com/documents/161599/404086/7843_JMP_PGM_Guide_3_v2.pdf/82c84aa8-5c32-2dbc-f47d-c1752a500989?t=1707173188044.

Figure 5. Proportion of SMEs in the manufacturing segments of strategic value chains



Note: Figures refer to value chain segments that lead to the production of the critical technologies/products, i.e. the manufacturing of intermediate and final products. The downstream activities using the strategic product/technologies are not considered. Figures reported in the chart are our educated guesses based on a triangulation of data sources: Eurostat statistics of SMEs in the NACE sectors attributed to each technology/product (see Annex III), analysis of company level data extracted from the Orbis database, existing market research reports and interviews with stakeholders. A margin of error in the range between 5-15% should be assumed.

Source: Authors.

Notably, the relatively low share of value added SMEs produce does not signal a lack of competitiveness or relevance within the value chains. SMEs occupy different positions in the value chains analysed and they are involved in many support activities that do not necessarily rely on economies of scale to be efficient, but are crucial for the correct functioning of the industry. This is evident in niche and innovative productions and in the provision of ancillary services to large manufacturers, as previously discussed.

3.2 Evolving dynamics: industry consolidation and emerging new markets

The landscape depicted in the previous section is undergoing some dynamic changes with implications for SMEs. These changes are due to the inherent characteristics of the strategic value chains rather than the outcomes of initiatives in the OSA domain. In fact, the policies in place are relatively new, and their effects on SMEs are yet to be seen (for a detailed overview

of OSA-oriented policies, see Section 4). Additionally, the lack of impact on SMEs can be attributed to the fact that many initiatives do not specifically target or prioritise SMEs, resulting in only indirect effects on them.

First, in recent years, a process of industry consolidation of European firms has begun and this continues to unfold across various sectors. In the textile industry, the merger or acquisition of SMEs by larger corporations has been considered a means of enhancing international competitiveness, leveraging economies of scale and creating synergies. This trend has primarily affected capital-intensive entities upstream in the value chain, such as man-made fibre producers, weavers, and spinners, whilst SMEs involved in manufacturing finished products in technical textiles are also impacted, albeit to a lesser extent.

Consolidation processes in industries reshape the dynamics between SMEs and large companies within GVCs. As larger corporations merge or acquire smaller firms, the relationship between SMEs and market giants evolves. In some cases, consolidation leads to increased vertical integration, where large companies exert greater control over the entire value chain, potentially sidelining SMEs or relegating them to subcontracting roles. In the pharmaceutical industry, innovative SMEs have frequently been offered the opportunity to join large groups through complete acquisition or exclusive licensing agreements. Feedback from interviews points out that, in some respect, large pharmaceutical companies have taken advantage of these dynamics to acquire innovations that would have been more costly to develop internally.

Indeed, while large companies can greatly benefit from the innovative solutions developed by SMEs, **they can also create opportunities for these smaller entities to become strategic partners or suppliers**, gaining from the resultant economies of scale, access to new markets, and shared resources. An example is offered by Symbio FCell, a start-up founded in 2010 specialising in fuel cell systems. Initially acquired by Michelin in 2018, Symbio later became the partner of a joint venture with Forvia in 2019, and subsequently a key innovation partner for Stellantis in developing hydrogen commercial vehicles. By 2023, Stellantis had joined as an equal stakeholder, culminating in the launch of Europe's largest fuel cell production side. Symbio today employ more than 750 people.⁵⁴

Industry consolidation is not limited to European companies. In certain sectors, foreign companies are increasingly acquiring European SMEs or setting up shop in local markets via Foreign Direct Investment (FDI), signifying a notable shift in ownership dynamics across the European business landscape. This brings both opportunities and risks for EU SMEs. Literature highlights the positive effects that foreign ownership can bring to European SMEs. For example, it has been assessed that foreign ownership, especially in the form of venture capital or private equity, has a significant albeit partial role in improving the availability of external funding for independent high-tech SMEs located in the EU.⁵⁵ Foreign venture capitalists or private equity investors may also spur the innovation performance of SMEs thanks to their worldwide marketing linkages and managerial and financial resources.⁵⁶ Indeed, as Europe lags in innovation in several value chains, acquisitions may stimulate innovation by transferring skills and capacities to the acquired SMEs, leading to positive

⁵⁴ See: <https://www.symbio.one/en/who-we-are/our-history>.

Stellantis. (2023). Symbio inaugurates its first gigafactory SymphonHy, Europe's largest integrated site producing hydrogen fuel cells, supporting the deployment of sustainable and efficient mobility. Available at: <https://www.stellantis.com/en/news/press-releases/2023/december/symbio-inaugurates-its-first-gigafactory-symphonhy-europe-s-largest-integrated-site-producing-hydrogen-fuel-cells-supporting-the-deployment-of-sustainable-and-efficient-mobility>.

⁵⁵ Louri, H., Loufir, R., & Papanastassiou, M. (2002). Foreign investment and ownership structure: an empirical analysis. *Empirica*, 29, 31-45.

Corsi, C., & Prencipe, A. (2017). Improving the external financing in independent high-tech SMEs: Does the foreign ownership matter?. *Journal of Small Business and Enterprise Development*, 24(4), 689-715.

⁵⁶ Corsi, C., & Prencipe, A. (2018). Foreign ownership and innovation in independent SMEs. A cross-European analysis. *Journal of Small Business & Entrepreneurship*, 30(5), 397-430.

spillovers across various ecosystems.⁵⁷ A case in point is the collaboration between the South Korean KSOE (Korean Shipbuilding & Offshore Engineering), a member of the Hyundai Group, and the Estonian SME Elcogen. KSOE is investing EUR 45 million in Elcogen to further deepen the collaboration on emission-free power generation systems as well as green hydrogen production. KSOE's decision was motivated by the cutting-edge technology Elcogen offers, which is at the most advanced stages globally.⁵⁸ The investment would then help Elcogen gain access to new markets beyond the EU and acquire expertise from global leaders in the hydrogen technology industry.

On a more negative note, foreign acquisitions can put Europe's strategic autonomy at risk. In the telecommunication value chain, foreign companies are acquiring many SMEs operating in 4G and 5G networks so the European lead in technology and IP is shifting to other regions. In the battery ecosystem, countries like Poland and Hungary, which have a strong tradition of FDI-friendly government,⁵⁹ welcomed Asian players from Korea (Samsung SDI, LG Chem), China (Semcorp) and Japan (Toray). As a result of massive investment in Europe, these Asian companies captured important shares in the battery component market in Europe.⁶⁰ The recent entrance of Chinese electric vehicle giant BYD in Hungary, potentially creating opportunities for local supply chains,⁶¹ and bringing around EUR 100 billion in investment spillovers, might also lead to the EU market being flooded with cheap vehicles, entering direct competition with European ones.⁶² This example underscores the importance for EU and national policymakers to carefully evaluate the potential costs and benefits of FDI policies, ensuring they maximize positive spillovers on SMEs while safeguarding European strategic interests. As noted by the OECD, FDI-SME spillovers do not materialise automatically, and a broad mix of policies can be implemented to increase their magnitude.⁶³

Some value chains seem more dynamic than others, especially concerning the emergence of start-ups. In this respect, the space industry, along with the New Space Economy, has been very active in recent years. Indeed, technological advancements, reduction in technology costs and increased accessibility to space has fuelled the progressive involvement of small companies in the industry. SMEs and mid-caps are in particular, frequently engaged in R&D activities. This can lead to spin-offs from space technology in other sectors, cross-fertilisation between ecosystems and technological advancement across various industries. Mid-caps are particularly active in robotics and drones and many start-ups appear in the semiconductor and telecommunication value chains (for a definition of mid-caps, see Box 5 below). Start-ups are also relevant and vital in the development of carbon capture and storage technology. Indeed, many new companies are emerging in this sector, raising substantial funding to set up carbon capture and storage solutions and explore innovative ways to utilise the captured CO₂. Wind energy represents another industry with considerable start-up activities in the EU. A heat map of start-up activities reveals that the United Kingdom, as well as the North-Western part of the EU represent the most active hotspots globally.⁶⁴ The share of European SMEs and mid-caps operating in AI relative to the total number of AI firms

⁵⁷ OECD (2023), Policy Toolkit for Strengthening FDI and SME Linkages, OECD Publishing, Paris, <https://doi.org/10.1787/688bde9a-en>.

⁵⁸ Elcogen. (2023). HD Hyundai makes a Strategic Investment in Elcogen. Available at: <https://elcogen.com/hd-hyundai-makes-a-strategic-investment-in-elcogen/>

⁵⁹ Schito, M. (2022). The effects of state aid policy trade-offs on FDI openness in Central and Eastern European Countries. *International Review of Public Policy*, 4(4: 2).

⁶⁰ Sachwald, F. (2013). *Going multinational: the Korean experience of direct investment*. Routledge.

⁶¹ China Chamber of Commerce to the EU (2024). BYD Signs Agreement for Production Facility in Hungary. Available at: http://en.ccceu.eu/2024-02/04/c_4047.htm

⁶² Bloomberg. (2023). Hungary Sees EV Investment Surge as BYD Poised to Set Up Factory. Available at: <https://www.bloomberg.com/news/articles/2023-11-06/hungary-sees-ev-investment-surge-as-byd-poised-to-set-up-factory>.

⁶³ OECD (2023), Policy Toolkit for Strengthening FDI and SME Linkages, OECD Publishing, Paris, <https://doi.org/10.1787/688bde9a-en>.

⁶⁴ <https://www.startup-insights.com/innovators-guide/wind-energy-trends/>

in the European market is higher than other countries – only behind Korea – with around 33% of these registered as patenting companies, which suggests a vibrant sector in terms of R&D potential.⁶⁵

Box 4. Definition of mid-caps adopted in this study

Mid-caps refer to companies with a market capitalisation and size that falls between that of large-capitalised and small-capitalised companies. While there is no universally agreed-upon definition for mid-caps, in this study we follow the definition provided in the “Study to map, measure and portray the EU mid-cap landscape” (European Commission, 2022)⁶⁶, according to which mid-caps are defined as enterprises with more than 250 but fewer than 1,500 employees.

Mid-cap companies are often characterised by a balance between growth potential and stability, offering investors opportunities for growth similar to small-cap companies, but with a somewhat lower level of risk compared to smaller, less established firms.

Source: Authors.

As highlighted in the previous section, alongside ongoing industry shifts, **some new emerging markets offer fertile ground for both new company creation and the differentiation of products and services among SMEs**. A prime example lies in the opportunity for SMEs to assume a pivotal role in the recycling and recovery of raw materials, with a notable focus on sectors like batteries, fuel cells, wind turbines and solar panels. SMEs can also provide alternative solutions, such as offering multi-cloud platform services based on open-source software. Similarly, SMEs can empower farmers in the agriculture sector by offering organisational solutions that leverage technology and data, enabling them to optimize resource management and enhance productivity and sustainability. SMEs can carve out a niche in these emerging markets and thereby contribute significantly to advancing sustainable practices and the circular economy.

On a different note, the European production capacity in certain sectors is disappearing. The energy crisis that started in mid-2022 brought about several production cutbacks and insolvencies, particularly in energy-intensive manufacturing processes. As a result, the EU has seen the disappearance of, for example, elastane producers and a significant reduction in acrylic fibre manufacturers, with only one remaining in the EU, in Lavradio, Portugal. Other longer period factors affected some value chains in the health and in the microelectronics ecosystems as discussed in the Box below.

Box 5. Recent disappearance of some production in the EU: implications for European SMEs

The recent disappearance of some production segments within the EU is posing significant challenges for SMEs across various industries. In the textile ecosystem, dependencies on raw materials and chemicals have led to the vanishing of certain fibre productions like **elastane and acrylic fibres** within the EU. Additionally, high-energy costs have impacted energy-intensive industries like **man-made fibres and non-woven products**, further contributing to the sector’s challenges. Similarly, the pharmaceutical sector faces risks to OSA with the shift of API production towards competitors from China and India, impacting SMEs, which struggle

⁶⁵ As per data in RDI Technote data. See: <https://rdimonitoring.technote.ai/>.

⁶⁶ European Commission. (2022). Study to map, measure and portray the EU mid-cap landscape: final report [online]. Authored by: Austrian Institute of Technology (AIT), Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (European Commission), Integral Research (United Kingdom), The Economic and Social Research Institute (ESRI Ireland), Dachs, B., Siedschlag, I., Yan, W., Yoveska, M., Boeira, F. and Ivory, S., Publications Office of the European Union. Available at: <https://data.europa.eu/doi/10.2873/546623>

to compete due to high production costs and regulatory burdens. An extreme case is **paracetamol**, for which no production plant currently exists in the EU. Moreover, in the semiconductor sector, SMEs are vulnerable in **chip design** and as Original Equipment Manufacturers (OEMs), due to lack of investment and global supply chain fragility. When it comes to the production of solar panels, the EU has lost the capability to produce specialised tools needed for the manufacturing of **ingots and wafers**, as well as the relevant research and innovation capabilities to reverse this disappearance.

On the one hand, these disappearing production segments impacted SMEs' competitiveness and raised concerns about the EU's strategic autonomy and resilience. SMEs are particularly vulnerable to market consolidation, where larger entities absorb smaller ones, potentially marginalising them and reducing market diversity and innovation. This consolidation can lead to a loss of specialised skills and local knowledge crucial for SMEs. On the other hand, this process underscores the greater importance of SMEs in small-scale, innovative productions, and reflects a shift towards specialisations in high-value-added sectors. Rather than competing on cost with mass production markets outside the EU, this approach can better capitalise on the EU's inherent strengths in innovation and quality.

Source: Authors.

3.3 Mapping the geographic presence of SMEs in strategic value chains across Member States

Official statistics are notably scarce regarding the number of SMEs operating within the supply chains of strategically dependent products and technologies analysed in this study and their geographical distribution. Even when specific industry statistical codes are linked to value chain analyses (as detailed in Annex III), comprehensive data classifying SMEs by sector (using the NACE classification) and geographic location across Member States are largely absent or incomplete. This lack of data hinders a systematic analysis of the distribution of SMEs in these industries and across EU Member States, particularly regarding their number, employment, or production.

The interviews and detailed desk research discussed in Annex V reveal varying patterns in the geographical distribution of SMEs across strategic industries. A few industries are predominantly concentrated in larger Member States such as France, Germany, Italy, and Spain, which also host a significant number of SMEs. This includes the production of APIs and defence and space-related technologies, such as dual-use robotics, drones, space systems, and technical textiles. Conversely, smaller or Central and Eastern European Member States like Belgium, Portugal, Croatia, Ireland (for cloud and edge computing), the Netherlands (for microelectronics), and Greece, Cyprus, Finland, Romania, Czechia (for many renewable energy technology) show prominent involvement in other technologies. Production valleys for heat pumps are notably found in Czechia, Slovakia, and Poland. Meanwhile, the production of organic fertilisers, telecommunications technology, and high-protein crops for animal feed is more evenly distributed across the EU, reflecting a similar spread of SMEs.

The geographical distribution of SMEs is influenced by a combination of economic, social, and institutional factors, which vary in importance based on the strategic value chain or technology under consideration and are discussed below.

Cluster effects and proximity to large companies are two of the main drivers of location, significantly influencing the development of a comprehensive network of supplier SMEs within various ecosystems. Major corporations like ASML, ASM International, NXP, and BE Semiconductors Industries have been crucial in fostering industrial clusters for microelectronics in the Netherlands. Similarly, major legacy operators based in several key European countries have historically dominated the telecom sector. These include Orange in

France, Deutsche Telekom in Germany, ZTE Italia in Italy, and Movistar/Telefónica in Spain. Furthermore, Nokia in Finland and Ericsson in Sweden are pivotal European telecom infrastructure and network equipment providers, substantially fostering industrial clusters within their respective domains.

The proximity to major corporations largely influences the localisation of SMEs in the aerospace and defence sectors. Currently, notable clusters exist within specific regions in France, Germany, Italy, Sweden, Spain, and Poland. This proximity facilitates lower procurement costs, minimises supply chain risks, and enhances collaboration. Although several specialised SMEs and mid-caps are emerging across all EU supply chain tiers, a significant concentration of SMEs remains near the largest industrial groups in the major Member States. Similarly, agglomeration effects continue to shape the concentration of API production in Germany, France, and Italy – countries with long-established industrial traditions in the chemical and pharmaceutical sectors.⁶⁷ However, production is also expanding to other EU Member States, particularly those with lower labour costs. In the textile ecosystem, regions with a consolidated historical specialisation show a large concentration of SMEs. Innovation and manufacturing capacities in technical textiles are predominantly concentrated in Germany and Italy, followed by France, the Netherlands, Finland, Belgium, and Austria.⁶⁸ Although no specific geographic pattern is evident in the cybersecurity domain, SMEs tend to cluster around larger companies, especially in countries with a strong sector tradition. For instance, France hosts several major cybersecurity firms, including Capgemini, Atos, Orange Cyberdefense, and Airbus.

Similar to the proximity to large corporations, **being close to research organisations and technical universities with relevant expertise also influences the strategic positioning of SMEs.** This proximity facilitates access to technology, innovation, collaboration opportunities, and knowledge spillovers. Robotics production, including drones for civilian use, is more dispersed across the EU27 than military robotics, with notable activity in countries such as the Netherlands, Denmark, Slovenia, Austria, Belgium, Greece, and Portugal. The localisation of SMEs in this market segment is driven by proximity to leading research institutions, for example, Radboud University and Wageningen UR in the Netherlands, and the Danish Technological Institute and Universal Robots in Denmark. Similarly, the presence of dedicated research centres in the Netherlands boosts the local production of fuel cells.⁶⁹ The proximity of SMEs to businesses and research organisations also supports the production of organic fertilisers and high-protein crops for animal feed in the leading manufacturing countries for these technologies.⁷⁰

New regions of specialisation are also emerging, fostered by cluster policies and the Smart Specialisation Strategies.⁷¹ To mention only a few, Ireland's *Offshore Wind Industrial Strategy (Powering Prosperity)* supports the Irish supply chain and manufacturing capacity in

⁶⁷ The first chemical APIs to be discovered were salicylic and acetylsalicylic acid, developed by a French and German chemist respectively. Italy is particularly noteworthy, with 11 out of its 20 regions hosting pharmaceutical clusters that operate upstream in the value chain. South Germany is recognised as one of the world's foremost hubs for the development and production of biopharmaceuticals. Manufacturing sites in France are distributed throughout the country.

⁶⁸ Italy specialises in the manufacturing of yarns, fabrics, textile-wearing apparel and accessories, leather clothes and accessories, and articles of fur and footwear. Germany specialises in capital-intensive subsectors such as textiles, technical and industrial textiles and man-made fibres. Belgium and Austria are known for their specialisation in man-made fibres.

⁶⁹ This is in addition to the SMEs operating in fuel cell production in other larger countries. Indeed, the production of fuel cells is mainly concentrated in Germany and, to a lesser extent, in Italy, Spain, and France.

⁷⁰ Leading producers are Germany, Poland, Spain, Belgium, Finland, Lithuania, Italy, France and the Netherlands.

⁷¹ The European Smart Specialisation Strategy has been a cornerstone of the EU Cohesion Policy programming period 2014-2020. It was designed as a policy framework to boost economic growth and job creation by enabling each region in the EU to identify and develop its own competitive advantages. Within the smart specialisation framework, local authorities together with academia, business spheres and the civil society worked for the implementation of long-term growth strategies supported by EU funds.

the offshore wind energy sector.⁷² Croatia aims to strengthen the competitiveness of its defence industry, increasing its specialisation, e.g. in dual-use technology and technical textile for military applications.⁷³ Similarly, according to interviews, Austria pursues the goal of decarbonising its industry by capitalising on the country's long expertise in the field of renewable energy. There is the potential for significantly increasing semiconductor production capacity in Sweden, while Denmark has set out its vision to develop the next generations of robots. The goal is to create an international hub to develop, test and produce robotics, including drones and autonomous solutions for various environments (water, land, and air) and different tasks.⁷⁴

Access to a skilled labour force is another crucial factor driving the localisation of SMEs, especially in knowledge-intensive segments of the value chains. This complements the strategic advantage gained from proximity to research organisations, as businesses often establish themselves in areas where they can readily attract and retain talent with the necessary expertise. SMEs engaged in developing and manufacturing of carbon capture and storage technology are primarily concentrated in the North Sea area, encompassing Belgium (Flanders), Denmark, France, the Netherlands, and Germany, regions with a long-standing tradition in renewable energy technologies. Similarly, heat pump valleys in Czechia, Poland, and Slovakia provide access to qualified personnel, enhancing operational efficiency and fostering innovation. Additionally, fuel cell startups are flourishing within the so-called 'hydrogen valleys', designated areas that focus on developing and showcasing flagship hydrogen technology projects.⁷⁵

Proximity and access to natural resources are the main factors driving the location of companies in the raw materials extraction and processing industry, production of organic fertilisers, and renewable energy from wind and sun. The European Commission's Raw Materials Scoreboard⁷⁶ shows the location of mining of metal and selected industrial minerals in the EU. Some sites, such as those for magnesium extraction in Norway and France, were closed in 2001, mainly because of competition from cheap imports from China; in contrast, other sites located in Romania are still operational.⁷⁷ When it comes to producing organic fertilisers, access to arable land, water, and organic waste drives the geographic distribution of SMEs in the sector. As mentioned, production is currently quite dispersed in the EU, with leading producers in Germany, Poland, Spain, Belgium, Finland, Lithuania, Italy, and the Netherlands. In the renewable energy sector, climate conditions dictate the business localisation, with Spain leading in solar panel production and North (Sweden) and Baltic Sea bordering countries (Poland, Finland, Latvia, and Lithuania) focusing on wind energy technology, leveraging their coastal locations for logistical advantages in offshore wind energy installations.

Proximity to end users is a crucial driver of localisation for industries that significantly benefit from the ability to respond swiftly to changes in demand, offer personalised products and reduce transportation costs and lead times to the final market. One

⁷² Irish Dept. of Enterprise, Trade, and Employment (2024). Powering Prosperity – Ireland's Offshore Wind Industrial Strategy. Available at <https://enterprise.gov.ie/en/publications/powering-prosperity.html#:~:text=Powering%20Prosperity%20%E2%80%93%20Ireland's%20Offshore%20Wind%20Industrial%20Strategy%2C%20the%20first%20strategy.and%20maximises%20the%20economic%20benefits.>

⁷³ See The Smart Specialisation Strategy of Croatia, available at: https://mzo.gov.hr/UserDocImages/dokumenti/EUfondovi/OPKK_2014-2020/Pregled-javnih/Analiticki%20izvjestaj%204.%20komponente.pdf. Also see the Croatian defence industry report available at: https://hkkoi.hr/dokumenti/katalog_klaster_2023.pdf.

⁷⁴ Details are provided in the Annex V, Ecosystem analysis.

⁷⁵ See: <https://h2v.eu/>.

⁷⁶ JRC (2021). RMIS - Raw materials scoreboard 2021 [online]. RMIS - Raw Materials Information System [online]. Available at: <https://rmis.jrc.ec.europa.eu/scoreboard2021#/>.

⁷⁷ Onstad, E. (2022). Exclusive: Europe aims to revive magnesium output by 2025 to cut China reliance. Reuters [online], 20 May 2022. Available at: <https://www.reuters.com/markets/commodities/exclusive-europe-aims-revive-magnesium-output-by-2025-cut-china-reliance-2022-05-20/>.

example is electrolyser manufacturers, who strategically situate their facilities near target markets to cater to the specific needs of each project while reducing the substantial transportation costs associated with the bulky electrolyser plants.⁷⁸ Similarly, the telecommunications sector flourishes in regions with a high demand for telecom products and services, often correlated with population density. Moreover, the competitive advantage in producing high-protein crops for animal feed is significantly enhanced by proximity to consumers.

The availability of dedicated infrastructure is another crucial factor that influences where SMEs choose to operate. In the telecommunications and digital sectors, reliable access to telecommunications networks, internet connectivity, and power supply provides the essential technological backbone for businesses integrating cloud computing and deploying advanced mobile networks, such as 4G, 5G, and the upcoming 6G networks. Furthermore, access to logistical infrastructure like ports and airports, along with cheap electricity, not only facilitates the movement of goods and services to markets but also provides a competitive advantage by reducing production costs. This dynamic is clearly demonstrated in countries like Sweden, where such factors support the production of lithium-ion batteries.

Finally, **the policy environment, regulatory or fiscal regimes and specific support measures significantly impact the geographic distribution of SMEs.** For instance, the concentration of SMEs producing lithium-ion batteries in countries like France, Germany, Italy, Hungary, Poland, Spain, and the Netherlands is driven by substantial direct government incentives and favourable regulatory regimes, including FDI-related policies. Historical involvement in space and defence-related sectors, supported by financial incentives and favourable regulatory conditions, has facilitated the establishment of major global players in the assembly and manufacturing of defence and space technology in Italy, France, and Germany. Interviews indicate that many data-driven companies choose Ireland due to its favourable fiscal regime. Additionally, heat pump production sites are often situated in rural areas within respective countries, close enough to end-users to manage logistics but distant enough to benefit from lower land costs and comply with noise-related regulations. However, **these strategic localisation decisions can face challenges, including opposition from local stakeholders**, particularly in projects involving wind energy and the establishment of electric automotive plants, reflecting broader concerns around environmental and community impacts (Box 6).

Box 6: Tesla's EV gigafactory in Germany has catalysed the country's latest climate justice debate

In March 2024, German environmental organisations intensified their resistance against the proposed expansion of Tesla's gigafactory in Grünheide, in the Berlin-Brandenburg Land. In the environmentalists' opinion, the factory's expansion plans will affect a conservation area. On top of that, the production increase would be against the reduction of the amount of cars environmental organisations expect in Germany in the near future in favour of an increase in the use of public transport. In the week of March 15th, the factory was reconnected to the electricity grid after a power outage caused by an arson attack on a nearby pylon in the first week of March. The attack was claimed by far-left activists. Notwithstanding statements from both Tesla Stoppen and residents of Grünheide condemned the sabotage of the pylon, the

⁷⁸ For this reason, the industry is quite dispersed across EU Member States and countries like Denmark and the Netherlands are relatively well-positioned as producers of electrolysers. For a similar reason, the Basilicata region in Italy was chosen as one of the sites to build a hydrogen valley in Italy for the production of electrolysers for green hydrogen. See for details Affari Italiani. (2023). Regione Basilicata punta alla produzione di energia green con l'idrogeno verde. Available at: <https://www.affaritaliani.it/economia/regione-basilicata-punta-alla-produzione-di-energia-green-con-l-idrogeno-verde-886350.html>.

incident has garnered significant media attention in Germany and has sparked discussions regarding the role of electric vehicles in combating climate change.

Source: Authors based on international media.⁷⁹

For more detailed information on the current geographical presence, countries and regions that have declared the aim of increasing their specialisation in particular technologies (based on a review of the Smart Specialisation Strategies), and drivers of localisation by technology, please refer to Table 15 in Annex IV.

⁷⁹ Krantz, P. (2024). Tesla EV factory drives latest climate justice struggle in Germany. Climate Home News [online], 15 March 2024. Available at: <https://www.climatechangenews.com/2024/03/15/tesla-ev-gigafactory-drives-germany-latest-climate-justice-struggle/>.

4 Overview of policy measures affecting OSA and SMEs

4.1 Comparative analysis of policy approaches

This section provides a general overview of the main policy measures adopted by the EU and other countries worldwide that have a bearing on OSA. It draws on three primary data sources:

- The Policy Inventory developed for this study, based on desk research and information provided by stakeholders (see Box 7 below and Annex VII). This inventory highlights examples of policy measures implemented by the EU, Member States, and selected countries to promote OSA, directly or indirectly, with either an explicit or implicit orientation towards SMEs.
- The IMF New Industrial Policy Observatory (NIPO) database (see Box 8), containing industrial and trade policy measures implemented or announced by countries worldwide in 2023, including those motivated by OSA reasons. However, this database does not specifically focus on SME-relevant policies.
- The OECD Quantifying Industrial Strategies (QuiS) database (Box 9), which includes industrial policy measures implemented by six countries from 2019 to 2021, some of which are specifically focused on SMEs. While these are relevant to supporting competitiveness, they do not necessarily relate to OSA.

Box 7: The newly constructed Policy Inventory on SMEs and OSA

The Policy Inventory included in Annex VII provides a list of policy measures impacting SMEs within the framework of OSA. Incorporating around 170 measures from both EU and non-EU countries, it presents a diverse array of strategies designed to enhance SME competitiveness and resilience across the industrial ecosystems considered in this study. The database does not aim to be exhaustive, but rather to illustrate the different types of policies. For each measure there are details of its objectives, strategic dependency sectors/products, and expected impact on SMEs. Moreover, policy measures can be searched by ecosystem, the product/technology where there is strategic dependency, the country (or countries) where it was implemented, and the type of instrument, (i.e. domestic subsidy, specific investment projects, sectoral strategy or regulatory measure, among others. Coverage is mostly of the policies introduced after 2020, but the database also includes policy initiatives implemented as early as 2005.

Source: Authors.

Box 8: The New Industrial Policy Observatory (NIPO)

The New Industrial Policy Observatory (NIPO) dataset monitors emerging patterns of industrial policy intervention. It is compiled by the International Monetary Fund (IMF), which defines industrial policies as "*any targeted government intervention aimed at developing or supporting specific domestic firms, industries, or economic activities to achieve national economic or noneconomic objectives.*"⁸⁰ The term "new" industrial policies is introduced to emphasise that these encompass measures with evolving objectives and targets.

⁸⁰ International Monetary Fund (IMF). 2024. How to Cover Industrial Policies in IMF Surveillance Broad Considerations

The NIPO database relies on information collected by the Global Trade Alert⁸¹ team and aims to identify **new industrial policy measures implemented by governments worldwide**.

The NIPO includes measures at various levels of intervention, ranging from broad plans and strategies to policies, regulations, and firm-specific interventions. It records state measures implemented or announced on or **after January 1st, 2023**, and is updated monthly. Each entry in the NIPO database refers to a distinct state intervention. The monitoring covers **75 jurisdictions** (countries and supra-national institutions, such as the EU), representing 94% of global GDP, selected because they have been consistently tracked through the longstanding Global GTA commercial policy monitoring initiative.⁸² Each measure is associated with predefined set of motives and products/sectors covered. Motives include: national security, geopolitical concerns, security of supply (for non-food products), strategic competitiveness, or climate change mitigation. Product categories cover: low-carbon technology, dual-use products, critical minerals, advanced technology products, semiconductors, medical products, and IT or digital services.

Source: Authors.

Box 9: The OECD database of industrial strategies (QuIS)

The OECD 'Quantifying Industrial Strategies' (QuIS) project aims to assess industrial policy expenditures across countries by collecting publicly available data from various decentralized sources. The QuIS database currently encompasses nine countries: **Canada, Denmark, France, Ireland, Israel, Italy, the Netherlands, Sweden, and the United Kingdom**, along with data from the EU aggregate level. It monitors approximately 1,050 policy instruments annually, totalling **3,152 observations** spanning the period from **2019 to 2021**. Data collected for each country undergo additional checks and validation by the respective countries, before being made publicly available on the [OECD website](#).

Industrial policy expenditures included in the database are defined as “*direct support extended by the public sector to businesses, aimed at promoting investment (including digitalisation and cleaner production), improving competitiveness, or supporting economic development*”. The covered industrial policy instruments are a subset of those outlined in the taxonomy by Criscuolo et al. (2022).⁸³ These instruments encompass tax expenditures benefits, grants, government venture capital, loans, and guarantees. Support for the private sector facilitated through public agencies (such as innovation agencies or development banks) or local authorities is within the scope, provided the intermediary offers direct support to firms. Policy instruments targeting agriculture are excluded from the scope due because of the substantial portion of agricultural support in the form of market price support, which is not reflected in budgetary spending numbers and would distort comparisons.

Source: Authors.

All major economies worldwide have introduced policies in pursuit of strategic autonomy objectives. The policy mix encompasses the following options:

⁸¹ The Global Trade Alert (GTA) initiative documents credible announcements of meaningful and unilateral changes by governments that affect the relative treatment of foreign versus domestic commercial interests. The dataset begins in November 2008, the month of the first G20 Summit. The GTA database tracks changes in over 60 types of policy intervention undertaken by governments, including corporate subsidies, many of which have been associated with industrial policies over the years, and contains information on over 61,000 distinct interventions.

⁸² Simon Evenett, Adam Jakubik, Fernando Martín, Michele Ruta (IMF) (2024). The Return of Industrial Policy in Data. IMF Working Paper

⁸³ Criscuolo, C. et al. (2022), “An industrial policy framework for OECD countries: Old debates, new perspectives”, OECD Science, Technology and Industry Policy Papers, No. 127, OECD Publishing, Paris, <https://doi.org/10.1787/0002217c-en>.

- Subsidies: capital injections and equity stakes, financial grants, import incentives, in-kind grants, interest payment subsidies, price stabilisation, production subsidies, state loans, and tax or social insurance relief, and other state aid;
- Export policy: export bans, export licensing requirements, export quotas, export tariff quotas, export taxes, local supply requirements for exports, and export-related non-tariff measures;
- Import policy: anti-dumping, anti-subsidy, import bans, import monitoring, import licensing requirements, import quotas, import tariffs, import tariff quotas, internal taxation of imports, import-related non-tariff measures and safeguards;
- FDI policy: entry and ownership rules, financial incentives, other treatment of FDI and operations;
- Procurement policy: strategic procurement, preferences in procurement and other changes to public procurement law or practice;
- Localisation policy: localisation incentives or requirements.

The IMF NIPO database indicates more than 300 examples of policies (either already in place or announced in 2023) that were motivated by OSA-related objectives, such as strategic competitiveness, national security, geopolitical concerns⁸⁴ and resilience/security of supply.⁸⁵

The EU (including Member States) demonstrates a strong emphasis on strategic competitiveness and enhancing resilience and security of supply, with nearly 80% of all OSA-related policy actions connected to these motives. Examples include:

- Actions to secure the supply of critical raw materials: such as the EU proposal for the European Critical Raw Materials Act,⁸⁶ or the Italian EUR 500 million loan guarantee to fund the purchase of raw materials;
- New strategies: such as the European Green Deal industrial plan, the European Chips Act, or the French national strategies for batteries;
- Programmes or subsidised investment targeted at specific firms to expand production plants: such as the European Projects of Common European Interest (see more on this below), or national initiatives such as the German EUR 600 million state aid support for ThyssenKrupp Steel Europe for decarbonising steel production and production of green hydrogen. Or the German plan to provide support to the Taiwan Semiconductor Manufacturing Company to build a semiconductor plant in Germany;
- Subsidies or incentives for innovation: several EU Member States have received funding from the EU Innovation Fund for large-scale innovation projects in strategic sectors; another example is the European Tech Champions Initiative.
- Trade liberalising actions: such as reduced import duties on industrial or agricultural products that are not sufficiently produced in the EU are necessary for the evolution of the battery and electrical vehicle industry.⁸⁷

⁸⁴ For instance, sanctions against Russia related to the war of aggression in Ukraine are considered based on a geopolitical concern.

⁸⁵ It relates to non-food products only.

⁸⁶ https://single-market-economy.ec.europa.eu/publications/european-critical-raw-materials-act_en.

⁸⁷ EUR-Lex, Official Journal of the EU. "Council Regulation (EU) 2022/2583 of 19 December 2022 amending Regulation (EU) 2021/2278 suspending the Common Customs Tariff duties referred to in Article 56(2), point (c), of Regulation (EU) No 952/2013 on certain agricultural and industrial products". 30/12/2022. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2022.340.01.0001.01.ENG&toc=OJ%3AL%3A2022%3A340%3ATOC EUR-Lex. Official Journal of the EU.

Table 3. Overview of the number of OSA-related policy measures introduced in the EU and beyond during 2023, by motive

Country	Number of policy actions Motive: Strategic competitiveness	Number of policy actions Motive: Resilience/security of supply	Number of policy actions Motive: Geopolitical concerns	Number of policy actions Motive: National security	Size of subsidy for policies referring to at least one of the four motives (USD million)	Trade covered for policies referring to at least one of the four motives (USD million)
EU + MS	174	109	53	25	335,651	998,140
EU	13	17	38	9	46,710	250,482
Germany	47	24	5	2	150,068	279,370
Spain	14	11			13,619	28,220
France	23	8		1	20,513	42,873
Netherlands	8	8	2	4	11,025	43,437
Austria	7	7		1	12,480	25,751
Czechia	2	5			8,732	29,161
Greece	4	5		1	8,986	25,002
Italy	34	4			16,570	165,809
Portugal	5	4			1,785	2,307
Belgium	5	3		1	4,018	50
Finland	2	3			8,766	27,661
Hungary	4	2			5,641	2,054
Poland	3	2	7	5	8,773	25,963
Slovakia	1	2			8,779	24,984
Ireland	1	1			8,732	24,984
Slovenia		1			129	0
Croatia	1	1			0	13
Denmark		1	1	1	327	20
Extra-EU countries						
USA	56	44	37	57	231,868	1,456,099
Japan	34	44	10	1	4,041	136,001
India	52	28			9,652	348,031
Turkey	25	24			5,120	86,454
Rep. of Korea	60	19	2	2	73,091	953,810
Brazil	98	16			253,681	190,697
Argentina	24	15			432	4,600
UK	14	14	6	3	10,944	49,239
Russia	13	8	12	6	199	107,002
China	31	4		12	41,857	1,242,436
Switzerland		2	26		0	2,542
Canada	45	1	17	12	22,087	27,491

Note: The same policy measure may have been classified under one or more OSA motives.

Source: Authors' elaboration of the IMF NIPO database.

Table 4. Overview of the number OSA-related policy measures introduced in the EU and beyond during 2023, by typology

Country	Domestic subsidies	Export barriers	Export incentives	FDI measures	Import barriers	Localisation content measures	Public procurement measures	Others
EU + MS	100	19	2	8	18	0	7	18
EU	7	17	0	3	18	0	4	11
Germany	23	1	0	2	0	0	0	1
Spain	11	0	0	0	0	0	0	0
France	8	0	0	0	0	0	1	0
Netherlands	10	1	0	1	0	0	0	0
Austria	6	0	1	1	0	0	0	0
Czechia	5	0	0	0	0	0	0	0
Greece	6	0	0	0	0	0	0	0
Italy	3	0	1	0	0	0	0	0
Portugal	4	0	0	0	0	0	0	0
Belgium	3	0	0	0	0	0	1	0
Finland	3	0	0	0	0	0	0	0
Hungary	2	0	0	0	0	0	0	0
Poland	2	0	0	1	0	0	0	6
Slovakia	2	0	0	0	0	0	0	0
Ireland	1	0	0	0	0	0	0	0
Slovenia	1	0	0	0	0	0	0	0
Croatia	1	0	0	0	0	0	0	0
Denmark	2	0	0	0	0	0	1	0
Extra-EU countries								
USA	49	19	0	0	1	6	7	19
Japan	37	7	5	1	0	0	0	4
India	9	17	0	0	1	1	0	0
Turkey	16	0	0	0	8	0	0	0
Rep. Korea	7	2	3	0	9	0	0	1
Brazil	4	0	0	0	12	0	0	0
Argentina	0	1	0	0	14	0	0	0
UK	9	6	0	0	3	0	1	2
Russia	7	4	0	9	2	0	2	1
China	3	6	0	3	3	0	0	1
South Africa	6	0	0	0	0	0	0	0
Switzerland	0	13	0	1	6	0	0	6
Canada	2	2	0	0	2	0	11	13

Source: Authors' elaboration of the IMF NIPO database.

The EU's policy measures favouring OSA appear to be relatively less focused on geopolitical concerns and national security goals than strategic competitiveness and resilience (see Table 3). The category of geopolitical concerns includes several export and import restriction measures taken after February 24, 2022, primarily in response to Russia's military aggression against Ukraine. Among the few examples of measures motivated by national security concerns are the European Commission's decision, followed by some

Member States (Belgium, France, Denmark), to suspend the use of TikTok on corporate devices to strengthen cybersecurity,⁸⁸ and the EU's update of the list of dual-use goods. Export of the latter is controlled in line with international obligations to prevent the proliferation of weapons of mass destruction.⁸⁹

In contrast, **while maintaining a high level of support to bolster production and thus strategic competitiveness in sectors such as robotics, energy storage, and automotive, China also exhibits a notable focus on national security.** The relatively higher number of measures in national security reflects China's ongoing efforts to strengthen its domestic capabilities in critical areas and its focus on safeguarding its strategic interests. Examples of such policies include a ban on US arms manufacturers from exporting to or importing from China, and the announcement of export control measures for a list of drone-related items. Similarly, the **USA places significant emphasis on national security**, with the highest number of measures motivated by this objective. This reflects the focus of US intervention justified by national security. Several policy actions also refer to strategic competitiveness and resilience/security of supply. Emerging economies like Brazil and India also have numerous policies to boost competitiveness, usually as part of their broader economic development strategies.

Regarding the measure used, the IMF database shows that **the EU, along with its Member States, demonstrates an emphasis on subsidy-related measures that reflects a preference for financial support measures.** These account for about 40% of all the subsidy measures introduced by the major world economies (Table 4). In contrast, non-EU countries like the USA and China display a more diverse array of policy tools including domestic subsidies and a stronger emphasis on protecting domestic markets through public procurement preferences, localisation measures, and export barriers. Emerging economies like India and Brazil show a higher reliance on import barriers, which is typical for nations aiming to reduce dependency on foreign goods and boost local production capabilities. Brazil appears to place emphasis on shielding its market from external competition.

Comparing the financial volume of policy measures across countries presents significant challenges. **Despite the large number of EU and Member States measures and their strong focus on subsidies, the financial volume appears to be relatively small compared to what is provided in non-EU countries.** Some measures have only recently been announced, and there is a lack of associated financial data. Many measures are general and do not have direct budget allocations, complicating any quantitative financial analysis. Another major obstacle is the diversity of the policies considered. Some measures listed, such as non-tariff trade barriers, do not typically provide any quantitative measurement that would enable their financial impact to be assessed, even if they may have significant economic implications. Others, such as tax credit schemes granted over multiple years, are difficult to compare directly with investment subsidies.

Taking these limitations into account, some observations can still be made. According to the IMF database, the EU27 seem to lead with a substantial allocation of over USD 330 million in subsidies. This exceeds the amounts allocated by the USA and China. However, in specific technology areas, such as electric vehicles, wind turbines, and railway rolling stock, studies indicate that industrial subsidies in China are at least three to four times, and in some cases, up to nine times higher than those in major EU and other OECD countries. These include direct government subsidies to the dominant Chinese manufacturers of green technology products, estimated at around EUR 221 billion. Additionally, Chinese companies benefit from subsidised

⁸⁸ https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1161.

⁸⁹ https://policy.trade.ec.europa.eu/news/2023-update-eu-control-list-dual-use-items-2023-09-15_en.

inputs, preferential access to critical raw materials, forced technology transfers, strategic public procurement, and preferential treatment in administrative procedures. As previously mentioned, these are not easily quantified economically.⁹⁰

To some extent, this kind of “invisible” support is reflected in the last column of Table 3, which shows the value of trade affected by trade-related measures. This shows the total value of imports affected by domestic subsidies and measures aimed at boosting exports. China and the USA stand out with the highest trade value affected by such measures, totalling over USD 1.4 billion in the case of the Chinese market and USD 1.2 billion in the US.

The OSA policies implemented worldwide share a lack of emphasis on SMEs. A text-based analysis was made of the IMF database by searching policy titles for information related to SMEs and small businesses. Out of over 2,500 trade and industrial policy measures included in the database, only 34 entries explicitly refer to SMEs, fourteen of which are in the EU. When narrowing the search to policy measures associated with OSA goals, the number of SME-focused policies shrinks to 13 out of 1,100 policies, eight of which are in the EU, and all are related to enhancing strategic competitiveness. These include measures supported by the European Investment Bank (EIB) or the European Innovation Fund (EIF), and fully national support schemes for SMEs and midcaps. Other countries with dedicated SME policy measures include the UK and a few others, such as Brazil, which supports innovative projects for SMEs in the telecommunications, IoT, and cybersecurity sectors. The Republic of Korea also has a five-year plan to support nuclear plant SMEs. At a sub-national level Henan Province in China has introduced a fund for national SMEs. No similar measures have been found in the USA. While the analysis has some methodological limitations due to its focus on the titles of policy measures, it is striking to observe such a limited reference to OSA policies for SMEs. This discrepancy underscores a potential gap where the needs and contributions of SMEs may not be sufficiently addressed or prioritised in OSA focused economic policies.

4.2 Main EU policies

After the above general comparative overview of political approaches across different countries worldwide, this section provides more insights into the main EU policies adopted to support OSA and SMEs specifically. Some references and comparisons with extra-EU policies are also made when these are considered of interest as potential models for the EU. The full list of policies identified and reviewed is in Annex VII.

The discussion is structured by distinguishing between the following:

- Measures providing support to R&D and innovation;
- Measures to support production expansion and diversification;
- Measures to rebalance the EU's position in the global trade.

4.2.1 Support to R&D and innovation

The policy inventory reveals a significant number of initiatives aimed at fostering fundamental research or more applied experimentation and innovation in areas where the EU exhibits economic and innovation dependency. Many of these policies are either

⁹⁰ Kiel Institute for the World Economy. (2024). Foul Play? On the Scale and Scope of Industrial Subsidies in China. Kiel Policy Brief 173. Available at: <https://www.ifw-kiel.de/publications/foul-play-on-the-scale-and-scope-of-industrial-subsidies-in-china-32738/>.

specifically targeted at SMEs or include mechanisms that favour SMEs over larger companies.

The Horizon Europe programme provides funding opportunities for all the strategic products and technologies analysed in this study. The European Innovation Council (EIC)'s Accelerator, as part of Horizon Europe,⁹¹ is a pivotal funding programme aimed at bolstering the growth and innovation capabilities of start-ups and SMEs.⁹² This initiative provides financial support and offers resources and expertise, helping SMEs navigate the complexities of the innovation landscape, access relevant networks and partnerships, and overcome potential challenges along the way.⁹³ According to a recent evaluation study,⁹⁴ because of its European dimension, the sizeable funding (EUR 10.1 billion) and the focus on disruptive innovation and breakthrough technologies, the EIC stands out as the only programme having sufficient breadth and scale to make a difference, generating significant benefits that similar national programmes cannot deliver.

This initiative is similar to some USA established schemes, like the Small Business Innovation Research (SBIR) Program and Small Business Technology Transfer (STTR) Program. Established by Congress, the SBIR (1982) and STTR (1992) programs fund R&D by SMEs and cooperative projects between small businesses and US research institutions, respectively. These programs have inspired the European SME instrument,⁹⁵ a precursor to the EIC instrument. Furthermore, the recent US Inflation Reduction Act (2022) has increased the refundable R&D tax credit for SMEs from USD 250,000 to USD 500,000, which can be applied against payroll taxes and other business expenses.⁹⁶

The EU also funds R&D and innovation for SMEs through various sector or technology specific programmes, such as the Sustainable Textiles European Partnership, which focuses on fostering research and innovation within the textile sector, including technical textiles.⁹⁷ The Clean Hydrogen Partnership also mobilises investments in R&D and innovation for European electrolyzers and fuel cell manufacturers and stimulates collaboration with private entities and academia.⁹⁸ Under Horizon 2020 the EU supported research projects identifying alternative sources of protein (such as insects, algae or microbes) and has listed innovation in the sustainability of food systems as one of the key priorities for current Horizon Europe funding. The European Digital Programme complements Horizon Europe by supporting digitalisation in AI, cybersecurity, data infrastructure, and digital skills development. It offers favourable funding conditions for SMEs, with a co-funding rate of up to 75%.⁹⁹ The Chips for Europe initiative, whose first pillar is focused on SMEs, establishes a fund worth EUR 3.3 billion to facilitate access to financing, particularly for start-ups and small mid-caps, to enhance technological capacity and innovation.¹⁰⁰ In 2024, the European Commission launched the AI innovation

⁹¹ European Innovation Council and SMEs Executive Agency (EISMEA). Official website: https://eisma.ec.europa.eu/programmes/european-innovation-council_en

⁹² Applicants from EU Member States and countries associated to the Horizon Europe programme: Single start-up or SME (including spin-outs); Small mid-caps (fewer than 499 employees) in need of rapid scale up of the TRL 9 activity. Mid-caps can apply for investment only. Natural persons or legal entities willing to set up an SMEs or a mid-cap.

⁹³ EIC Accelerator, see: https://eic.ec.europa.eu/eic-funding-opportunities/eic-accelerator_en.

⁹⁴ European Commission, DG RTD (2022). Evaluation study on the European Innovation Council (EIC) – Pilot. Authored by CSIL. Available at: <https://op.europa.eu/en/publication-detail/-/publication/e862f900-f68b-11ec-b976-01aa75ed71a1/language-en>.

⁹⁵ SME instrument: SME instrument | Programme | H2020. CORDIS | European Commission [online]. Available at: https://cordis.europa.eu/programme/id/H2020_EIC-SMEInst-2018-2020.

⁹⁶ The White House. (2022). FACT SHEET: How the Inflation Reduction Act Will Help Small Businesses. The White House. Available at: <https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/12/fact-sheet-how-the-inflation-reduction-act-will-help-small-businesses/>.

⁹⁷ https://environment.ec.europa.eu/strategy/textiles-strategy_en.

⁹⁸ <https://ec.europa.eu/docsroom/documents/50014>

⁹⁹ EIB. (2022). *European Cybersecurity Investment Platform*. Available at: <https://www.eib.org/attachments/lucalli/20220206-european-cybersecurity-investment-platform-en.pdf>.

¹⁰⁰ Chips Act: Council gives its final approval. (2023). European Council [online]. Available at: <https://www.consilium.europa.eu/en/press/press-releases/2023/07/25/chips-act-council-gives-its-final-approval/>.

package to support AI startups and SMEs, providing access to AI-dedicated supercomputers and financial support for incubation and scale-up activities.¹⁰¹

Sector-specific support is also evident in the Aerospace and Defence ecosystem through the European Defence Fund (EDF), which finances cross-border cooperation on R&D activities and has introduced calls specifically targeting SMEs and mid-caps. In 2023, the EDF received a record number of proposals since the establishment of the Fund in 2021, with an overall 76% increase in 2022.¹⁰² Additional calls to empower SMEs in the ecosystem (e.g. business accelerator and matchmaking) are expected in 2025.¹⁰³ Another instrument in this domain is the Cassini initiative, which supports entrepreneurs and SMEs in the space industry for the period 2021-2027¹⁰⁴, offering EUR 1 billion to facilitate access to finance for start-ups and SMEs and providing platforms for business development and networking with large companies and potential investors.

The Innovation Fund, financed by the European Emission Trading System (ETS), supports projects that significantly reduce emissions. This has established a strong track record in financing battery innovation, with SMEs receiving a significant portion of the funding.¹⁰⁵ According to the Fund's dashboard, of the eight projects undertaken since 2021 related to batteries (worth a total of EUR 354 million), 5 participants out of the 14 are SMEs, receiving around EUR 194 million, or 55% of the total funding.¹⁰⁶ On December 6th 2023, the European Commission also announced a dedicated instrument for the battery value chain under the Innovation Fund, possibly amounting to EUR 3 billion over three years. However, it is unclear how SMEs will be involved.¹⁰⁷

While the European Commission leads in supporting R&D and innovation investment across the EU, **the European Investment Bank (EIB) significantly enhances these efforts** through targeted financing programs like the InnovFin programme. This initiative offers loans, guarantees, and equity investment to help innovative companies and startups bridge the gap from research to market deployment. For instance, in the cleantech sector, the EIB-EIF Co-Investment Programme supports SMEs and mid-caps involved in activities aligned with the EIB group's Climate Action & Environmental Sustainability objectives.¹⁰⁸ Additionally, the HERA Invest fund, created by DG HERA in collaboration with the EIB, targets SMEs in the API

¹⁰¹ European Commission. (2024). Commission launches AI innovation package. Available at: https://ec.europa.eu/commission/presscorner/detail/en/ip_24_383.

¹⁰² European Commission. (2023). Record high number of proposals received in the 2023 round of the European Defence Fund. Available at: https://defence-industry-space.ec.europa.eu/record-high-number-proposals-received-2023-round-european-defence-fund-2023-11-24_en.

¹⁰³ EUDIS EU DEFENCE INNOVATION SCHEME - For European Defence Innovators. (2024). Available at: https://defence-industry-space.ec.europa.eu/document/download/96df9642-bb76-4cf6-bb0a-381ff8b570d1_en?filename=EU%20Defence%20Innovation%20Schemehttps://defence-industry-space.ec.europa.eu/document/download/96df9642-bb76-4cf6-bb0a-381ff8b570d1_en?filename=EU%20Defence%20Innovation%20Scheme%20Factsheet%202024.pdf%20Factsheet%202024.pdf

¹⁰⁴ For details see CASSINI Initiative. Available at https://defence-industry-space.ec.europa.eu/eu-space/entrepreneurship_en

¹⁰⁵ European Commission. What is the Innovation Fund? - European Commission [online]. Available at: https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund/what-innovation-fund_en.

¹⁰⁶ Innovation Fund Project Portfolio - Innovation Fund - Portfolio of signed projects. Qlik Sense. Available at: https://dashboard.tech.ec.europa.eu/qs_digit_dashboard_mt/public/sense/app/6e4815c8-1f4c-4664-b9ca-8454f77d758d/sheet/bac47ac8-b5c7-4cd1-87ad-9f8d6d238eae/state/analysis.

¹⁰⁷ See: The Commission announces €3 billion to boost the EU's battery manufacturing industry. (2023). BATT4EU. Available at: <https://bepassociation.eu/the-commission-announced-e3-billion-to-boost-the-eus-battery-manufacturing-industry/>.

European Commission. (2024). *COM(2024) 28 final – Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of Regions on boosting start-ups and innovation in trustworthy artificial intelligence*

In particular, the Commission aims to finance AI-related activities in the following ways: i) AI factories will be financed through the EuroHPC JU (the European Joint Undertaking to advance High-Performance Computing) ; the Commission and Member States will invest a total of EUR 2.1 billion in acquiring new or upgrading existing EuroHPC supercomputers with AI capability; ii) financial support will be provided for start-up incubation and scale-up activities amounting to EUR 100 million via InvestEU.

¹⁰⁸ <https://www.eib.org/en/projects/pipelines/all/20220444>.

value chain to promote R&D and strengthen strategic autonomy, focusing on medical countermeasures for health threats like antimicrobial resistance.¹⁰⁹

Member States have introduced several other measures to foster the involvement of SMEs in R&D and innovation activities. The National Resilience and Recovery Plans (NRRPs), include substantial investments in digitalisation, renewable energy and sustainable transport, reflecting each State's economic strengths. For instance, Germany is focusing on hydrogen technologies, including electrolyzers, while Ireland and Poland are investing in wind energy generation. Many countries have set aside part of the funding to foster solar energy production. Italy, for instance, dedicates EUR 400 million to help reach the national target of 2 GW annual PV manufacturing capacity by December 2025.¹¹⁰ Other national measures to support R&D include, for example, Ireland's Disruptive Technology Innovation Fund, managed by Enterprise Ireland, which has allocated EUR 61 million between 2019 and 2021 to foster collaboration between research and industry in the ICT and health sectors.¹¹¹ The Netherlands offers the SME Innovation Stimulus for Regional and Top Sectors, providing grants and support services for R&D cooperation projects in fields such as AI, energy, and life sciences.¹¹² Between 2019 and 2021, it has allocated EUR 50 million to SMEs.¹¹³ France's Crédit Impôt Recherche (CIR) offers a tax credit to encourage R&D activities, allowing businesses to claim a percentage of eligible R&D expenses, reducing the cost of innovation for small businesses.¹¹⁴

Emerging countries like Brazil are also advancing in supporting R&D focused on SMEs to enhance international competitiveness through innovation. The Brazilian Company of Innovation and Research (BRDE) has allocated BRL 1.14 billion to telecommunications, Internet of Things (IoT) projects, and cybersecurity. These projects, benefiting from low-interest loans with flexible terms, aim to advance high-tech areas such as 5G and cybersecurity. Specifically, the BRDE has disbursed substantial funds to hundreds of SMEs across the Brazilian states.¹¹⁵

In contrast, China's approach to R&D and innovation policies predominantly favours larger enterprises. For example, the Chinese automotive chipmaker Senasic secured over USD 70 million in funding from a consortium led by the China State-owned Enterprise Mixed Ownership Reform Fund. This investment, announced on July 14, 2023, supports Senasic's R&D in sensor technologies and market expansion efforts.¹¹⁶ Another example is China's increase in R&D tax incentives for its semiconductor industry from 100% to 120%.¹¹⁷

¹⁰⁹ https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3775.

¹¹⁰ <https://esmc.solar/wp-content/uploads/2023/06/SOLAR-MANUFACTURING-IN-THE-NATIONAL-RECOVERY-AND-RESILIENCE-PLANS.pdf>.

¹¹¹ Source: Authors' elaboration of the OECD QuIS database. Gov.ie (2024) Funding of €6.8 million announced for sustainable disruptive technology. Press release: [https://www.gov.ie/en/press-release/e1e1f-funding-of-68-million-announced-for-sustainable-disruptive-technology/#:~:text=The%20Disruptive%20Technologies%20Innovation%20Fund%20\(DTIF\)%20is%20a%20%E2%82%AC500,administrative%20support%20from%20Enterprise%20Ireland](https://www.gov.ie/en/press-release/e1e1f-funding-of-68-million-announced-for-sustainable-disruptive-technology/#:~:text=The%20Disruptive%20Technologies%20Innovation%20Fund%20(DTIF)%20is%20a%20%E2%82%AC500,administrative%20support%20from%20Enterprise%20Ireland)

¹¹² <https://business.gov.nl/subsidy/sme-innovation-stimulus-regional-top-sectors-mit/>.

¹¹³ Source: Authors' elaboration of the OECD QuIS database. Netherlands Enterprise Agency, RVO. SME Innovation Stimulus for Regional and Top Sectors (MIT) | Business.gov.nl [online]. Business.gov.nl [online]. Available at: <https://business.gov.nl/subsidy/sme-innovation-stimulus-regional-top-sectors-mit/>.

¹¹⁴ <https://entreprendre.service-public.fr/vosdroits/F23533>.

¹¹⁵ Finep. Conselho Diretor do FNDCT aprova R\$ 4,9 bilhões em crédito para inovação. Press release, 26/07/2023. Available at: <https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/noticias/2023/07/conselho-diretor-do-fndct-aprova-r-4-9-bilhoes-em-credito-para-inovacao>

¹¹⁶ Butts, D. (2023). Chinese automotive chip manufacturers plan to invest billions in Hong Kong amid city's push to reindustrialise. South China Morning Post. Available at: https://www.scmp.com/tech/policy/article/3243961/chinese-automotive-chip-manufacturers-plan-invest-billions-hong-kong-amid-citys-push-reindustrialise?campaign=3243961&module=perpetual_scroll_0&pgtype=article.

¹¹⁷ GT staff reporters. (2023). China offers more tax benefits for high-tech innovation by semiconductor, mother-machine makers. Global Times. Available at: <https://www.globaltimes.cn/page/202309/1298462.shtml>.

To sum up, the EU and Member States' initiatives covered here present important strengths. The availability and variety of support programmes at different levels demonstrate a robust commitment to fostering SME innovation. Such commitment is reinforced by the fact that many measures specifically target and favour SMEs over larger firms. Moreover, in many cases, the support provided is tailored to the specific technology needs. Overall, the measures available seem to prompt SMEs with high innovation capacity.

Despite these strengths, there are still some shortcomings in EU support for R&D and innovation. According to stakeholders interviewed, these are mostly associated with the following aspects:

- **High funding needs, especially for breakthrough technologies.** A recent study of the current state of EU innovation policies¹¹⁸ highlights the need for the EU to invest substantially more in breakthrough technologies to avoid what is described as the "middle technology trap." This is where the EU's R&D efforts are concentrated in mid-tech industries with limited potential for sustained growth and global competitiveness. Investment in R&D is currently insufficient compared to others like the USA, particularly in high-tech sectors. The EU invests significantly in traditional sectors like automotive but still lags in digital and emerging technologies. Investment in high-reward, but also high-risk projects poses particular challenges for SMEs, which lack the resources and financial cushion necessary to navigate the uncertainty and high costs these projects entail.
- **Fragmented support systems.** As noted earlier, a large number of programmes are provided by the European Commission, the EIB, and Member States. The result is a fragmentation where programs tend to operate "in silos". For instance, interviews emphasised that programmes like the European Defence Fund (EDF) and Cassini operate independently without synergies, despite their potential overlap in sectors like defence and space. This compartmentalisation could hinder effective cross-sector collaboration.
- **Lack of dedicated support for some strategic products and technology.** While several sector or technology-specific support programmes exist, certain sectors lack dedicated support instruments. The aforementioned report¹¹⁹ argues that specialised funding programmes are necessary to support research in specific cutting-edge technologies, such as AI, biotechnology, and next-generation materials, which demand intensive capital and research commitments. To some extent, the need for dedicated programmes stems from the currently fragmented nature of EU funding, which often narrowly resources across too many small projects without sufficient impact. According to interviews, dedicated support programmes would benefit other sectors, such as technical textile. Today, Horizon Europe provides general funding for the textile industry but does not specifically cater to technical textiles. The European Defence Fund, however, supports R&D for the defence industry, which may indirectly benefit innovations in technical textiles for defence applications. However, this support is not specifically tailored to meet the distinct needs of the technical textiles sector. Stakeholder interviews highlight a critical gap in the absence of dedicated funds for technical textiles. SMEs in the sector also struggle to access opportunities and funding due to intense competition from companies from other sectors.

¹¹⁸ European Policy Analysis Group. (2024). EU innovation policy. How to escape the middle technology trap. Authored by Fuest C., D. Grow, P.L. Mengel, G. Presidente and J. Tirole. Available at: [EU Innovation Policy: How to Escape the Middle Technology Trap | Publication | Econpol Europe](#).

¹¹⁹ *Idem*,

- **Underperformance in scaling up.** Despite several programmes that support the development and commercialisation of innovation, Europe continues to struggle to develop scale-ups – or entrepreneurial ventures in transitioning to significant growth phases of production. As of mid-2021, Europe boasted 92 unicorns (start-ups valued over USD 1 billion) with a total value of EUR 253.3 billion, compared to the USA's 394 unicorns worth USD 1.2 trillion.¹²⁰ In addition, from 2016 onward, the USA witnessed 71 initial public offerings over USD 1 billion, while Europe saw only 21.¹²¹ Europe's struggle with scaling-up entrepreneurial ventures highlights the need for sufficient funding to support multiple, progressively larger funding rounds as firms grow.¹²² Several stakeholders have stressed that the current funding landscape fails to bridge this equity gap.

4.2.2 Support to production expansion and diversification

Important Projects of Common European Interest (IPCEIs) are key EU instruments designed to boost production capacity in critical strategic sectors through substantial investment and promotion of collaboration and innovation. Introduced in 2014,¹²³ IPCEIs are cross-border European initiatives that address market failures and advance innovation in essential sectors, technologies and infrastructure. Characterised by their significant size, scope, and risk, these projects also aim to benefit the EU more broadly.¹²⁴ The projects approved thus far are in microelectronics, batteries, telecommunications, hydrogen, and cloud computing providing an overview of the IPCEIs approved (Table 5). Investment of this kind is too large for a single Member State to handle efficiently alone.

The 2021 Communication on State Aid rules for IPCEIs has revised the provisions governing IPCEIs,¹²⁵ and ensures that projects that address significant strategic dependencies receive favourable assessments. This Communication also addresses the need, raised by several stakeholders participating in the public consultation on the IPCEI framework,¹²⁶ for broader participation to prevent dominance by larger Member States and larger companies (“national champions”), which could potentially distort the market and increase economic disparities within the EU. The Communication mandates that projects involve at least four Member States and requires transparency, allowing all Member States to learn about and potentially join these initiatives. While initial IPCEIs involved only a few larger Member States, later initiatives, like the first IPCEI on Hydrogen, have expanded to include 15 participating Member States.

The 2021 Communication also made significant progress toward increasing the involvement of SMEs in IPCEIs. This allowed for public aid, even if co-financing from the SMEs is limited, thus facilitating their participation and promoting collaboration between large enterprises and SMEs.¹²⁷ For instance, the first IPCEI on batteries grants SMEs access to larger firms’ operational facilities to enhance their development processes and exchange

¹²⁰ Pitchbook data mentioned by Quas. A., Mason C., Companò R., Testa G., Gavigan J.P. (2022). The scale-up finance gaps in the EU: Causes, consequences, and policy solutions. *European Management Journal*, Vol. 40, Issue 5, pp: 645-652. Doi: <https://doi.org/10.1016/j.emj.2022.08.003>

¹²¹ EIF. (2021). Scale-up financing and IPOs: Evidence from three surveys. EIF Working Paper, 2021/69. Available at: https://www.eif.org/news_centre/publications/EIF_Working_Paper_2021_69.htm.

¹²² Pitchbook data mentioned by Quas. A., Mason C., Companò R., Testa G., Gavigan J.P. (2022). (cit.).

¹²³ COMMUNICATION FROM THE COMMISSION. Criteria for the analysis of the compatibility with the internal market of State aid to promote the execution of important projects of common European interest. (2014/C 188/02)

¹²⁴ IPCEIs are not limited to the EU but involve EEA countries as well.

¹²⁵ European Commission. (2021). COMMUNICATION FROM THE COMMISSION C(2021) 8481 final. Criteria for the analysis of the compatibility with the internal market of State aid to promote the execution of important projects of common European interest. Available at:

https://eur-lex.europa.eu/resource.html?uri=cellar:c6681395-4ded-11ec-91ac-01aa75ed71a1.0004.02/DOC_1&format=PDF.

¹²⁶ Poitiers, N. and Weil, P. (2022). Opaque and ill-defined: the problems with Europe’s IPCEI subsidy framework. Bruegel. Available at: <https://www.bruegel.org/blog-post/opaque-and-ill-defined-problems-europes-ipcei-subsidy-framework>.

¹²⁷ The IPCEIs rules dictate that the project must involve important co-financing by the beneficiary.

know-how.¹²⁸ While the large scale of IPCEI investments generally necessitates significant contributions from larger companies with extensive production capabilities, SMEs can still play a crucial role by providing niche solutions and specialised services essential for the development of IPCEI technologies.

Table 5. Key characteristics of approved IPCEIs

	1 st IPCEI on Microelectronics (2018)	1 st IPCEI on Batteries (2019)	2 nd IPCEI on Batteries-EuBatIn (2021)	1 st Hydrogen IPCEI - Hy2Tech (2022)	2 nd Hydrogen IPCEI - Hy2Use (2022)	2 nd IPCEI on Microelectronics and Communication Technologies (2023)	IPCEI on Next Generation Cloud Infrastructure and Services (2023)	3 rd Hydrogen IPCEI - Hy2Infra (2024)
Participating companies	29	17	42	35	29	85 (56)	109 (19)	32
SMEs	2	3	12	5	7	22 (11)	40 (3)	10
State aid approved (EUR billion)	1.9	3.2	2.9	5.4	5.2	8.1	1.2	6.9
Expected private investments (EUR billion)	6.5	5	9	8.8	7	13.7	1.4	5.4
Participating Member States	FR, DE, IT, UK, AT	BE, FR, DE, IT, PL, SE, FI	AT, DE, HR, FI, FR, DE, EL, IT, PL, SK, ES, SE	AT, BE, CZ, DK, EE, FI, FR, DE, EL, IT, NL, PL, PT, SK, ES	AT, BE, DK, FI, FR, EL, IT, NL, PL, PT, SK, ES, SE, NO	AT, CZ, FI, FR, DE, EL, IE, IT, MT, NL, PL, RO, SK, ES	FR, NL, DE, PL, HU, ES, IT	FR, DE, IT, NL, PL, PT, SK

Note: with respect to “Participating companies” and “SMEs”, figures refer to the total number of participants; for the 2nd IPCEI on microelectronics and for the IPCEI on Next Generation Cloud Infrastructure the number of direct participants to the IPCEI is reported in parentheses. With respect to the 2nd IPCEI on Microelectronics, the European Commission report the existence of an additional 600 indirect partners with a marginal role, which are not counted here. The size of companies involved in the initiatives was retrieved through research in the Orbis database.

Source: Authors’ elaboration based on European Commission information (https://competition-policy.ec.europa.eu/state-aid/ipcei/approved-ipceis_en).

The involvement of SMEs in IPCEIs has steadily increased.¹²⁹ The first IPCEI on microelectronics (2018) envisaged the involvement of only 2 SMEs among 29 participants. The second IPCEI on microelectronics and communication technologies (2023) involved 22 SMEs among which 11 qualified as direct participants and an additional 600 indirect partners with a more marginal role.¹³⁰ Feedback from SMEs and business associations emphasises that the benefits of IPCEIs extend beyond financial support. The programme is crucial for smaller firms that cannot self-finance, but it also enhances SME visibility, opening up new market opportunities. IPCEIs foster new collaboration and innovation within the broader industrial ecosystem. Even indirect participants, like SMEs subcontracting to larger firms, experience positive spillovers, especially in technological collaboration that helps bridge their innovation gaps. This aligns with the economic literature that provides substantial evidence of positive spillovers for SMEs involved in subcontracting to large companies. SMEs that built close

¹²⁸ European Commission. (2019). *C(2019) 8823 final – Important Project of Common European Interest (IPCEI) on Batteries*. Available at: https://ec.europa.eu/competition/state_aid/cases/202230/SA_54794_50781182-0000-C266-8373-C59CF8C4E8CE_311_1.pdf.

¹²⁹ SMEs can participate to IPCEIs in different capacities, assuming the role of direct, indirect or associated participants. For indirect and associated partners the Member States proposing the IPCEI do not ask for approval of aid under the IPCEI communication because they may concern projects that are benefitting from aid based on other legal bases (e.g. General Block Exemption Regulation).

¹³⁰ https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3087

partnerships with other companies within the same value-chain displayed significantly higher growth rates.¹³¹ Technological collaboration between SMEs and large firms plays an essential role in closing the innovation gap of the smaller companies.¹³²

Box 10: Involvement of SMEs in IPCEIs: some examples

The IPCEI on Next Generation Cloud Infrastructure and Services involves 35 SMEs indirectly and 5 start-up partners. The collaboration between the Spanish Open Nebula (a direct SME partner working on an open-source platform for enterprises) and the Luxembourgish Data Vaccinator (an indirect start-up partner operating in the health ecosystem) aims to support the development of innovative capabilities for secure data anonymisation in cloud-edge environments. Open Nebula and Data Vaccinator will jointly work on the certification and delivery of a Proof of Concept on a cloud-edge meta-orchestrator platform.¹³³

Elcogen is an Estonian SME working on solid oxide fuel cells for stationary systems and is participating in the first IPCEIs on hydrogen. In this context, Ecogen will provide validation and integration of cells, stacks and modules for the IPCEI partners' system prototypes and design advanced pilot lines to enable industrialisation and mass production. Thanks to the collaborative opportunities provided by the IPCEI and the experience acquired, Elcogen hopes to build upon on the results of these projects to set up a gigafactory in Estonia to enable them scale up production.¹³⁴

Source: Authors based on interviews.

However, the information gathered from interviews points to several remaining obstacles to SMEs participation in IPCEIs:

- **Complex application processes:** The application process is deemed too complex and costly, which deters smaller SMEs from applying. Data shows that about 81% of SMEs in IPCEIs employ more than 10 people, with nearly 54% having between 20 and 150 employees.¹³⁵
- **Slow evaluation time:** The lengthy approval process, such as the two-year evaluation period for the second IPCEI on batteries, results in a loss of competitive advantage as other countries like China and the USA move ahead with their subsidies.
- **Inconsistent fund distribution:** Once the European Commission approves an IPCEI, national authorities are given responsibility for managing the funding. This can lead to different Member States receiving funding at different times, which can then hinder effective coordination across Member States.

A distinctive feature of IPCEIs is their focus on innovative projects and the first industrial deployments positive spillover effects. This approach contrasts with the US Inflation Reduction Act (IRA), which is more geared towards mass production and commercial activities, using tax credits as a primary incentive tool.¹³⁶ Manufacturers of battery components, wind and solar equipment, and electric vehicles have announced tens of billions of dollars in

¹³⁴ See: Elcogen AS (EE05). (2023). IPCEI Hydrogen. Available at: <https://ipcei-hydrogen.eu/page/view/f2177c0c-392a-4f92-ac5e-f59bed7cee51/elcogen-as-ee05>.

¹³⁵ Source: Authors' elaboration based on Orbis database. These estimates have to be taken with some caution due to missing information in Orbis about a number of SMEs participating in the IPCEIs.

¹³⁶ Federal Register. (2023). *Section 45X Advanced Manufacturing Production Credit*. Available at: <https://www.federalregister.gov/documents/2023/12/15/2023-27498/section-45x-advanced-manufacturing-production-credit>.

new investments, creating significant local opportunities for SMEs.¹³⁷ Another important difference is that European support does not discriminate against foreign producers in the same way as the USA does. Several IRA subsidies are subject to local content requirements and are potentially trade-distortive. This is the case for most spending on clean-tech manufacturing support or clean-fuel and emissions-reduction subsidies as well as subsidies for green-energy production and investment. Consequently, some European leaders have raised concerns that the IRA may violate WTO provisions on national treatment.¹³⁸

Policies supporting the establishment or expansion of production facilities are easier to find at Member State level. For instance, Germany is funding a Wolfspeed and ZF Friedrichshafen semiconductor plant in Saarland, and is planning to support the new Taiwan Semiconductor Manufacturing Company semiconductor plant.¹³⁹ Germany has also granted ArcelorMittal with EUR 55 million for a green steel plant.¹⁴⁰ France has provided a direct grant to STMicroelectronics and GlobalFoundries for a microchip plant,¹⁴¹ and Hungary has invested EUR 89.6 million in Samsung SDI's electric vehicle battery plant.¹⁴²

Investments in large-scale production facilities are expected to bolster local industrial ecosystems through agglomeration and spillover effects favouring local SMEs.¹⁴³ Historically, policies supporting the relocation or expansion of large enterprises into specific areas have been crucial in attracting large companies to less developed regions. Relevant policy measures can enhance links between large enterprises and SMEs (or FDI-SME) and thus knowledge and technology spillovers. These include programmes that foster strategic partnerships, value chain linkages, labour mobility between larger companies and local SMEs, strengthened intellectual property regimes for SMEs, and SME-sensitive application of supply chain legislation.¹⁴⁴ Such policies also strengthen the sustainability of value chains. In Italy, for example, "framework agreements" ("accordi quadro") have historically played a pivotal role in incentivising the establishment of large companies in the Southern regions. These are legal agreements between the government, regional stakeholders, business associations and the large company concerned. Such framework agreements establish general conditions and specific provisions (often in the form of financial incentives) to attract direct investment by the large company in a specific region. Apulia, particularly the industrial hub centred around Bari,

¹³⁷ <https://www.wri.org/insights/inflation-reduction-act-anniversary-manufacturing-resurgence>, <https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/12/fact-sheet-how-the-inflation-reduction-act-will-help-small-businesses/>.

¹³⁸ France24. (2022). <https://www.france24.com/en/france/20221129-on-us-state-visit-macron-to-draw-the-line-on-american-protectionism>. Available at: <https://www.france24.com/en/france/20221129-on-us-state-visit-macron-to-draw-the-line-on-american-protectionism>.

¹³⁹ Federal Ministry for Economic Affairs and Climate Action. Press Release, "Ansiedlung von Wolfspeed im Saarland ist wichtiger Schritt zur Stärkung des Mikroelektronik-Standorts Deutschland" ["Settlement of Wolfspeed in Saarland is an important step towards strengthening Germany as a microelectronics location"] of 1 February 2023. Available at: <https://www.bmwk.de/Redaktion/DE/Pressemitteilungen/2023/02/20230201-ansiedlung-von-wolfspeed-im-saarland-ist-wichtiger-schritt.h>.

¹⁴⁰ SA.63733 Germany: Aid to ArcelorMittal Hamburg for a decarbonisation project. Available at: https://ec.europa.eu/competition/elojade/isef/case_details.cfm?proc_code=3_SA_63733 European Commission. Press Release, "State aid: Commission approves €55 million German measure to support ArcelorMittal's green steel demonstration plant" of 17 February 2023. Available at: https://ec.europa.eu/commission/presscorner/detail/en/IP_23_847 European Commission's Decision.

¹⁴¹ European Commission Press Release, 28 April 2023, "State aid: Commission approves French measure to support STMicroelectronics and GlobalFoundries to set up new microchips plant": https://ec.europa.eu/commission/presscorner/detail/en/ip_23_2447

¹⁴² SA.48556 (2018/N - 2019/C) Regional investment aid to Samsung SDI - LIP. Available at: https://ec.europa.eu/competition/elojade/isef/case_details.cfm?proc_code=3_SA_48556 European Commission, Press Release 28/02/2023.

¹⁴³ Crescenzi, R., & Harman, O. (2023). *Harnessing Global Value Chains for regional development: How to upgrade through regional policy, FDI and trade* (1st ed.). Routledge. <https://doi.org/10.4324/9781003356141>.

¹⁴⁴ OECD. (2023). *Future-Proofing SME and Entrepreneurship Policies*, Key Issues Paper, 27-28 June 2023, OECD SME & Entrepreneurship Ministerial Meeting. Available at: <https://www.oecd.org/cfe/smes/key-issues-paper-oecd-sme-and-entrepreneurship-ministerial-meeting-2023.pdf>.

OECD. (2023). *Policy Toolkit for Strengthening FDI and SME linkages*. <https://doi.org/10.1787/688bde9a-en>. Available at: https://www.oecd-ilibrary.org/industry-and-services/policy-toolkit-for-strengthening-fdi-and-sme-linkages_688bde9a-en.

has thrived thanks to past framework agreements, with multinational giants like Fiat, Bosch, and Getrag serving as key catalysts for regional development. Their presence has been instrumental in shaping the landscape of the industrial district.¹⁴⁵ Similar practices are found in Germany ("Rahmenverträge") and France ("contrats cadre").

Collaborative clusters also promote productive capacity and spillover benefits for SMEs. As an example, in the batteries value chain, the BATT4EU public-private partnership established in 2021 includes 225 members, around of which are 15% are SMEs. Such partnerships or clusters benefit SMEs through collaboration with larger firms thus acquiring knowledge and sharing business plans. Another form of collaboration occurs in the **hydrogen valleys**, which showcase flagship projects in hydrogen technologies. The fact that hydrogen is applicable to a wide range of technologies can also facilitate collaboration across ecosystems. For instance, the value chain coverage in the Zero-Emission Valley in France involves electricity from solar photovoltaic power, hydrogen production through electrolysis, a hydrogen refuelling infrastructure for hydrogen-powered vehicles, as well as fuel cell fleets for various uses (e.g. trucking, light commercial transport).¹⁴⁶

Favouring diversification is another way for the EU to reduce its external dependency and increase the production of strategic products and technologies. These measures are particularly important for SMEs, since diversification can be very costly. An illustrative example can be found in the automotive sector. Producing batteries requires substantial investment in R&D, specialised equipment and skills, and rigorous quality control measures, all of which can pose financial challenges for smaller enterprises. A sudden transition to new technologies may not only prove difficult to undertake for SMEs, resource-wise, but it may also alter their operational processes, requiring profound behavioural changes. A shift towards electrification might lead to sub-optimal economies of scope for firms operating in the automotive industry, whereby the green transition would generate a situation in which a company might need capital to keep two businesses afloat: the legacy technology part (i.e. components for internal combustion engines), which are needed to generate the profits necessary for the company to generate the new expertise, and the new business the company is striving for (i.e. components for battery systems). This predicament is particularly risky for SMEs, as they are likely to be in the volume business and produce as much as possible.

A case of a diversification strategy being pursued with limited effects can be observed in the technical textiles sector. During the COVID-19 pandemic, national authorities provided public funding to SMEs in this industry to help them adapt their manufacturing processes and product offerings to produce personal protective equipment (PPE) such as face masks and medical gowns. For instance, in 2020, the German federal government launched a EUR 130 billion stimulus package to enhance healthcare system resilience and pandemic preparedness, which included EUR 1 billion to build up strategic PPE reserves.¹⁴⁷ In Italy, the 'Cura Italia' plan initially allocated EUR 50 million to assist companies in transitioning to mask production, funds that were quickly depleted.¹⁴⁸ However, the EU failed to fully capitalise on this opportunity. While the EU attempted to accelerate production between 2020 and 2021, all major countries

¹⁴⁵ Clo, S., Florio M., Pellegrin J. And Sirtori E. (2018). How do research intensive systems emerge in less developed areas? The case of mechatronics in the Italian southern region Apulia International Journal of Technological Learning, Innovation and Development, Inderscience Enterprises Ltd, vol. 10(1), pages 1-36. Available at: <https://ideas.repec.org/a/ids/ijtlid/v10y2018i1p1-36.html>.

¹⁴⁶ See: Hydrogen valleys - ZEV - Zero Emission Valley. Clean Hydrogen Partnership -MISSION INNOVATION. Available at: <https://h2v.eu/hydrogen-valleys/zev-zero-emission-valley-0>.

¹⁴⁷ European Observatory on Health Systems and Policies (November 2020). COVID-19 Health System Response Monitor (HSRM). Country: Germany. Policy response: "2.1. Physical infrastructure. Physical infrastructure». Available at: <https://eurohealthobservatory.who.int/monitors/hcrm/hcrm-countries/hcrm/germany/ensuring-sufficient-physical-infrastructure-and-workforce-capacity/physical-infrastructure/>

¹⁴⁸ Gagliardi, A. (2020). Si riparte con mascherine per tutti, prime aperture dal 27/4. Il Sole 24 ORE, 24 April 2020. Available at: <https://stream24.ilsole24ore.com/embed/ADjmSQM>.

worldwide made significant investments in non-woven fabric production, leading to a price decrease due to oversupply. During interviews, stakeholders reported that the production capacity for non-woven fabrics, especially meltblown, increased more than tenfold, while demand drastically decreased. This dynamic rendered European production non-competitive. In the EU, the significant capital investment required to convert production resulted in uncompetitive product prices compared to Chinese counterparts. Consequently, EU consumption needs during the pandemic continued to rely heavily on imports.¹⁴⁹ **This example suggests that a policy fostering diversification into segments facing direct competition from extra-EU countries can be only marginally effective.** Diversification into higher-value productions, where EU SMEs can excel, could instead create more opportunities.

At the EU level, the **Transition Pathways** introduced by the European Commission can be considered a **soft policy tool for co-creation with the industry to engage companies and push them to diversify in the direction of new and clean technologies**.¹⁵⁰ The recently established Transition Pathways platform is meant to get stakeholders –especially SMEs – to start taking steps by widening their production scope. For instance, the Transition Pathway for the digital ecosystem provides resources and guidance for SMEs in the digital sector to transition towards renewable energy sources for their data centres and operations. In agri-foods, it could assist small-scale farmers to transition towards organic farming practices or agroecological methods to reduce reliance on chemical inputs and promote biodiversity.

Box 11: Skill shortages in European SMEs

To boost production in strategic sectors, having a skilled labour force is crucial. However, according to a recent survey, nearly two-thirds (63%) of SMEs expressed difficulties in finding suitable talent.¹⁵¹ The Commission has pinpointed 42 vocational shortages¹⁵² and critical gaps that must be addressed to support the OSA goals. In the textile ecosystem, challenges stem from an aging workforce and difficulty in attracting younger skilled workers, necessitating comprehensive upskilling and reskilling initiatives. The *microelectronics* ecosystem faces shortages in semiconductor design and production skills, highlighting the need for enhanced training programmes and competence centres to foster innovation and self-reliance in chip manufacturing. The *digital economy* ecosystem reveals a significant deficit in AI and cybersecurity expertise, with a particular emphasis on retaining high-level talent within the EU. As for *li-ion batteries*, the rapid scale-up of production capacities calls for specialised training in safety standards and production technologies to meet the workforce demands of new gigafactories. In the *heat pumps* industry, there is a pronounced shortage of technicians skilled in the installation and maintenance of advanced systems, requiring targeted technical education and certification programmes. Similarly, the *wind and solar energy sectors* both suffer from a lack of skilled personnel to support ambitious renewable energy installation targets, necessitating strategic partnerships and training initiatives to bolster skillsets in manufacturing, installation, and maintenance of renewable energy technologies.

Skills shortages are not only an EU problem, but a global challenge. The USA, for example, is grappling with a significant workforce shortage in technology sectors. A recent study by the Semiconductor Industry Association and Oxford Economics highlights an impending shortage in the semiconductor sector. The USA are projected to face a shortage of 67,000 technicians, computer scientists and engineers in the semiconductor sector alone by 2030, with a larger

¹⁴⁹ European Commission (2021). Data on the EU Textile Ecosystem and its Competitiveness. Authored by CSIL and Blumine. Available at: <https://op.europa.eu/en/publication-detail/-/publication/574c0bfe-6142-11ec-9c6c-01aa75ed71a1>.

¹⁵⁰ For an overview of transition pathways, refer to [EU Transition Pathways \(europa.eu\)](https://ec.europa.eu/eurostat/tgm/table.do?cat=1&code=sdg_8_10_11_12_13_14_15_16_17_18_19_20_21_22_23_24_25_26_27_28_29_30_31_32_33_34_35_36_37_38_39_40_41_42_43_44_45_46_47_48_49_50_51_52_53_54_55_56_57_58_59_60_61_62_63_64_65_66_67_68_69_70_71_72_73_74_75_76_77_78_79_80_81_82_83_84_85_86_87_88_89_90_91_92_93_94_95_96_97_98_99_100_101_102_103_104_105_106_107_108_109_110_111_112_113_114_115_116_117_118_119_120_121_122_123_124_125_126_127_128_129_130_131_132_133_134_135_136_137_138_139_140_141_142_143_144_145_146_147_148_149_150_151_152_153_154_155_156_157_158_159_160_161_162_163_164_165_166_167_168_169_170_171_172_173_174_175_176_177_178_179_180_181_182_183_184_185_186_187_188_189_190_191_192_193_194_195_196_197_198_199_200_201_202_203_204_205_206_207_208_209_210_211_212_213_214_215_216_217_218_219_220_221_222_223_224_225_226_227_228_229_230_231_232_233_234_235_236_237_238_239_240_241_242_243_244_245_246_247_248_249_250_251_252_253_254_255_256_257_258_259_260_261_262_263_264_265_266_267_268_269_270_271_272_273_274_275_276_277_278_279_280_281_282_283_284_285_286_287_288_289_290_291_292_293_294_295_296_297_298_299_300_301_302_303_304_305_306_307_308_309_310_311_312_313_314_315_316_317_318_319_320_321_322_323_324_325_326_327_328_329_330_331_332_333_334_335_336_337_338_339_340_341_342_343_344_345_346_347_348_349_350_351_352_353_354_355_356_357_358_359_360_361_362_363_364_365_366_367_368_369_370_371_372_373_374_375_376_377_378_379_380_381_382_383_384_385_386_387_388_389_390_391_392_393_394_395_396_397_398_399_400_401_402_403_404_405_406_407_408_409_410_411_412_413_414_415_416_417_418_419_420_421_422_423_424_425_426_427_428_429_430_431_432_433_434_435_436_437_438_439_440_441_442_443_444_445_446_447_448_449_450_451_452_453_454_455_456_457_458_459_460_461_462_463_464_465_466_467_468_469_470_471_472_473_474_475_476_477_478_479_480_481_482_483_484_485_486_487_488_489_490_491_492_493_494_495_496_497_498_499_500_501_502_503_504_505_506_507_508_509_510_511_512_513_514_515_516_517_518_519_520_521_522_523_524_525_526_527_528_529_530_531_532_533_534_535_536_537_538_539_540_541_542_543_544_545_546_547_548_549_550_551_552_553_554_555_556_557_558_559_560_561_562_563_564_565_566_567_568_569_570_571_572_573_574_575_576_577_578_579_580_581_582_583_584_585_586_587_588_589_590_591_592_593_594_595_596_597_598_599_600_601_602_603_604_605_606_607_608_609_610_611_612_613_614_615_616_617_618_619_620_621_622_623_624_625_626_627_628_629_630_631_632_633_634_635_636_637_638_639_640_641_642_643_644_645_646_647_648_649_650_651_652_653_654_655_656_657_658_659_660_661_662_663_664_665_666_667_668_669_670_671_672_673_674_675_676_677_678_679_680_681_682_683_684_685_686_687_688_689_690_691_692_693_694_695_696_697_698_699_700_701_702_703_704_705_706_707_708_709_710_711_712_713_714_715_716_717_718_719_720_721_722_723_724_725_726_727_728_729_730_731_732_733_734_735_736_737_738_739_740_741_742_743_744_745_746_747_748_749_750_751_752_753_754_755_756_757_758_759_760_761_762_763_764_765_766_767_768_769_770_771_772_773_774_775_776_777_778_779_780_781_782_783_784_785_786_787_788_789_790_791_792_793_794_795_796_797_798_799_800_801_802_803_804_805_806_807_808_809_810_811_812_813_814_815_816_817_818_819_820_821_822_823_824_825_826_827_828_829_830_831_832_833_834_835_836_837_838_839_840_841_842_843_844_845_846_847_848_849_850_851_852_853_854_855_856_857_858_859_860_861_862_863_864_865_866_867_868_869_870_871_872_873_874_875_876_877_878_879_880_881_882_883_884_885_886_887_888_889_890_891_892_893_894_895_896_897_898_899_900_901_902_903_904_905_906_907_908_909_910_911_912_913_914_915_916_917_918_919_920_921_922_923_924_925_926_927_928_929_930_931_932_933_934_935_936_937_938_939_940_941_942_943_944_945_946_947_948_949_950_951_952_953_954_955_956_957_958_959_960_961_962_963_964_965_966_967_968_969_970_971_972_973_974_975_976_977_978_979_980_981_982_983_984_985_986_987_988_989_990_991_992_993_994_995_996_997_998_999_1000)

¹⁵¹ European Year of Skills: Survey highlights skills shortages in small and medium-sized enterprises (SMEs). Available at: <https://ec.europa.eu/social/main.jsp?langId=en&catId=89&furtherNews=yes&newsId=10661>.

¹⁵² European Commission. Commission actions tackle labour and skills shortages in EU. Available at: https://ec.europa.eu/commission/presscorner/detail/en/ip_24_1507.

gap of 1.4 million such workers projected in various sectors.¹⁵³ Moreover, sectors such as lithium batteries are experiencing serious recruitment problems, requiring a concerted effort to improve training and education to meet the growing demand for these essential components in the transition to electric vehicles.¹⁵⁴ In response to this scenario, the CHIPS Act emerges as an important legislative measure aimed at fortifying the US semiconductor industry, emphasising workforce development through partnerships between industry, educational institutions, and training providers.¹⁵⁵ Similarly, the semiconductor industry in China is also facing significant challenges, with the China Center for Information Industry Development and the China Semiconductor Industry Association estimating a workforce shortage of 200,000.¹⁵⁶

Source: Authors based on interviews.

The use of alternative products is strategically used in some ecosystems to reduce import dependence. In the agri-food ecosystem, the Integrated Nutrient Management Action Plan is promoting policy initiatives to use organic and inorganic fertilisers more efficiently,¹⁵⁷ with the ultimate goal of drastically reducing the need for imported fertiliser. Examples include enhanced fertilisation practices, such as using cover crops, choosing the appropriate type of fertiliser for the specific circumstances, and precision farming, allowing optimised application of limited amounts of fertilisers.¹⁵⁸ Since these initiatives typically involve SMEs, they can create positive business opportunities for them.¹⁵⁹

Alongside measures to boost production capacities and stimulate production diversification, there are EU and Member State initiatives aimed at stimulating demand, particularly in emerging markets with significant SME involvement. For example, the Common Agricultural Policy (CAP) supports the development of high-protein crops like soybeans, peas, and lentils, which small farmers primarily cultivate.¹⁶⁰ At the Member State level, France launched the “Protein Plan” to support the production of protein crops for both the human and animal feed.¹⁶¹ Support to high-protein crops has also been granted through the Cluster 1 – “Resiliency and agri-food industry capacities 2030” – of the France 2030 plan.¹⁶² EU regulations have also been relaxed to encourage the consumption of non-conventional

¹⁵³ Ravi, S. (2023). America Faces Significant Shortage of Tech Workers in Semiconductor Industry and Throughout U.S. Economy. SIA - Semiconductor Industry Association, 25 July 2023. Available at: <https://www.semiconductors.org/america-faces-significant-shortage-of-tech-workers-in-semiconductor-industry-and-throughout-u-s-economy/>.

¹⁵⁴ Grzelewski, J. (2024). A new report identifies ‘significant’ skills gaps in the US battery industry [online]. Tech Brew [online]. Available at: <https://www.emergingtechbrew.com/stories/2024/03/01/US-battery-industry-workforce-center-for-automotive-research-UAW>.

¹⁵⁵ McKinsey. The CHIPS and Science Act: What is it and what is in it? [online]. Available at: <https://www.mckinsey.com/industries/public-sector/our-insights/the-chips-and-science-act-heres-whats-in-it>.

¹⁵⁶ Ackerman, K. (2023). The Labor Shortage is the Biggest Problem for the Semiconductor Industry [online]. Sourceability [online]. Available at: <https://sourceability.com/post/the-labor-shortage-is-the-biggest-problem-for-the-semiconductor-industry>.

¹⁵⁷ https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12899-Nutrients-action-plan-for-better-management_en

¹⁵⁸ European Economic and Social Committee. (2023). Addressing the fertiliser Crisis in Europe: Actions for availability, affordability, and sustainability. Available at: <https://www.eesc.europa.eu/en/news-media/news/addressing-fertiliser-crisis-europe-actions-availability-affordability-and-sustainability>.

¹⁵⁹ For example, Forigo is an Italian-based SME that, among other activity, provides support to farmers on how to use cover crops, which reduce the need for fertilisers. Agrotti, M. Cover Crops: what they are, how to produce them and what kind of benefits they provide. FORIGO. Available at: <https://www.forigo.it/en/news/cover-crops-what-they-are-production-and-benefits>.

¹⁶⁰ At least 19 Member States intend to make use of the possibilities to provide ‘coupled support’ for protein crops in their CAP Strategic Plans for 2023-2027. European Commission. (2022). Safeguarding food security and reinforcing the resilience of food systems. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0133>.

¹⁶¹ [Lancement de la stratégie nationale en faveur du développement des protéines végétales | Ministère de l'Agriculture et de la Souveraineté alimentaire](#)

¹⁶² [Appel à projets : « Résilience et Capacités Agroalimentaires 2030 » | Bpifrance](#)

protein sources.¹⁶³ The Fertiliser Regulation (EC) No 2019/1009 has introduced a definition of plant bio stimulants, reflecting the market interest and promoting their use as a complement to traditional fertilisers.¹⁶⁴ Backed up by the France 2030 investment plan, the French government invested EUR 21 million in 2023 to foster biocontrol to reduce the consumption of chemical fertilisers.¹⁶⁵ Though still small, the carbon capture technology market is rapidly growing and offers significant opportunities for SMEs. A mix of national and European funding helps promote industrial carbon management solutions across nearly 20 Member States. France's CCUS strategy includes government support for installing carbon capture storage systems at nearly 50 potential sites and seeks partnerships within Europe to secure markets for these industrial solutions.¹⁶⁶

This section has highlighted several strengths related to European and national policies aimed at bolstering internal production:

- **The IPCEI framework is pivotal for fostering innovation and launching large-scale production in the EU with active SME involvement.** It also underscores the EU's effort to maintain fair competition in the market and avoid trade distortions, in line with global trade rules
- **Member States' FDI and production expansion policies can generate positive spillovers for local SMEs.** They favour the establishment of fruitful links between foreign multinationals – and more in general large enterprises – and SMEs, which generate knowledge and technology spillovers, and strengthen the sustainability of value chains.
- **The EU has a robust network of cluster organisations and intermediaries that promote innovation and collaboration.** Such initiatives can be leveraged to provide SMEs with substantial growth opportunities within dynamic and highly strategic sectors.
- **The synergetic benefits of supply- and demand-side policies are leveraged to support the emergence and development of new industries and markets.**

Nevertheless, **the analysis identifies specific limitations** that need to be accounted for:

- **IPCEIs present important challenges** in the application and implementation phase that limit SMEs participation. Specifically, the stakeholders interviewed complained about the complex application procedure, the lengthiness of the evaluation process and the inconsistency in the timely distribution of funding.
- **Production diversification is costly, requires reskilling/upskilling, and can take a long time, and SMEs need support throughout this process.** Diversification policies into segments facing direct competition from extra-EU countries can only be marginally effective. For this reason, it is important to target high-value productions to create promising opportunities for competitiveness.
- **FDI positive spillovers to SMEs do not necessarily occur automatically.** Appropriate mechanisms should be put in place to facilitate the creation of effective collaborations between foreign multinationals and SMEs, such as the mentioned “framework agreements”.

¹⁶³ As one example, the Commission authorised using insect processed proteins in fishmeal in 2017 and in poultry and pig feed in 2021. This is also in line with repeated calls of the European Parliament to diversify sources of animal feed ([https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI\(2023\)739328](https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2023)739328)).

¹⁶⁴ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R1009>

¹⁶⁵ [France 2030 : un plan d'investissement pour la France | economie.gouv.fr](https://www.economie.gouv.fr/fr/france-2030-un-plan-dinvestissement-pour-la-france)

¹⁶⁶ <https://www.conseil-national-industrie.gouv.fr/actualites/consultation-sur-la-strategie-nationale-ccus>, <https://www.grtgaz.com/medias/communiqués-de-presse/lancement-goco2>

- Albeit being a general problem, **skill shortage is particularly hitting SMEs** and limit their potential to expand production and diversify.

4.2.3 Support to rebalance global trade

Trade openness offers substantial advantages to EU SMEs, primarily by facilitating access to a broader range of markets and diversifying sources of raw materials and inputs, which are often less accessible or more costly domestically.¹⁶⁷ Given the intricate global interconnections of value chains, a shift towards stringent protectionism could severely disrupt these networks. Moreover, the European production landscape is characterised by relatively high labour and operational costs (e.g. for energy). Business associations interviewed share the opinion that if the EU were to pivot towards protectionist measures, such as significant tariffs on imports or stringent import quotas, the cost structure of goods produced within the EU could become prohibitively high, leading to both a loss in international competitiveness on the global market, and to higher prices in the EU market. They argue that while some level of protection may be necessary to safeguard critical industries and maintain economic sovereignty, a balanced approach is essential to take into account the needs of SMEs.

Trade data and recent studies reveal a notable disparity in trade openness between the US and EU economies. While historically their levels were comparable, the USA has experienced a modest increase over the years, reaching 28% of GDP in 2022. Conversely, the EU has seen a remarkable surge in trade openness, reaching 51% of GDP in the same year.¹⁶⁸ This figure reflects both significant export values and a substantial volume of imports. This surge can be partly attributed to the aftermath of Brexit, where intra-EU trade previously involving the UK has shifted to external trade. The EU has also actively pursued the expansion of its trade network, fostering preferential trade relationships with over 75 countries worldwide. Furthermore, the EU extends unilateral preferential access to the Single Market for 65 developing nations, including 47 Less Developed Countries. In contrast, the USA have comparatively fewer Free Trade Agreements (FTAs) in place. The EU's trade policy also extensively relies on so-called "mini deals" – as opposed to the larger and harder to ratify multilateral and FTAs – although it is not yet clear what effect these "mini-deals" will have.¹⁶⁹

The EU's preference for trade openness is further evidenced by its general reluctance to impose import bans or export restrictions on third countries, with the exception of the recent sanctions against Russia, as discussed in Section 4.1. Typically, the EU has focused on only prohibiting imports of goods that fail to meet specific EU quality and safety standards, thereby ensuring consumer protection within the EU market. The EU Solar Energy Strategy includes measures focused on green public procurement, such as the Big Public Buyers initiative, and the application of the Eco-design Directive and Energy Labelling Regulation to solar PV systems. For example, it bans the entry of solar panels into the EU Single Market manufactured using child or forced labour.

The European public procurement market is also relatively open compared to its global competitors. The EU seeks to ensure that measures supporting domestic producers, such as the World Trade Organization's non-discrimination rules, do not result in unjustified discrimination or breach legal obligations. In contrast, some countries outside the EU require that products purchased through public procurement be domestically produced, thereby limiting opportunities for European businesses (see examples in the Box below). In the

¹⁶⁷ For instance, see Henig D. and Zilli R. (2022). The New Globalisation: SMEs and International Trade – The Supply Chain is as Important as Direct Exports. European Centre for International Economy article. Available at: <https://ecipe.org/publications/smes-international-trade-supply-chain-important-direct-exports/>.

¹⁶⁸ WTO data, discussed and analysed by Cernat L. (2024). On the importance of trade openness. European Centre for International Political Economy. Available at: [On the importance of trade openness | \(ecipe.org\)](https://ecipe.org/publications/on-the-importance-of-trade-openness/).

¹⁶⁹ Cernat, L (2023), "The art of the mini-deals: The Invisible Part of EU Trade Policy", European Centre for International Political Economy, October. Available at: <https://ecipe.org/publications/mini-deals-invisible-part-of-eu-trade-policy/>.

aerospace and defence sector, for instance, 60% of the European launch contracts were issued following open market rules over the period 2017-2019. Only the remaining 40% gave preference to the EU based companies.¹⁷⁰ In comparison, the share of restricted/captive markets is 73% of the launch contracts in Japan, 77% in the USA, 79% in Russia, 87% in India and more than 99% in China.¹⁷¹

Another example pertains to the renewable energy sector, where local content requirements are widespread across the globe, especially in the offshore wind industry.¹⁷² The UK provides ample support for its offshore wind industry, encapsulated in its Offshore Wind Sector Deal. The Sector Deal sets a target to achieve 60% lifetime UK content in domestic offshore wind projects by 2030. Even though the scheme has been adjusted after a complaint from the EU, it appears that the UK country is pursuing a form of buy-national policy.¹⁷³ Similarly, countries such as Canada, China, India and the USA have various regimes of local content rules to support their local renewable energy industry. Problematic practices often attributed to China include stringent certification processes, opaque approval systems, clauses that safeguard national interests, and demands for unusually low prices that foreign manufacturers cannot feasibly meet.

The US IRA's protectionist elements, mostly in the form of local-content requirements, such as 'Made in America' requirement for cars and batteries, have come under severe criticism as representing a frontal attack on the World Trade Organization's (WTO) and the WTO's Government Procurement Agreement (GPA) in particular.¹⁷⁴ In the case of China (and other major economies such as India), its procurement practices cannot be legally challenged by the EU since it is not a member of the GPA. Despite China's expressed interest in joining the GPA, progress has been slow, hindered by resistance from powerful Chinese state-owned enterprises and concerns over exposing procurement procedures to international scrutiny.

Box 12: Domestic public procurement: examples for extra-EU countries

- **USA:** Two US Laws require that certain products purchased by the Department of Defence (DOD) and some Department of Homeland Security (DHS) agencies be manufactured and wholly produced within the USA. The Berry Amendment requires certain items purchased by DOD to be 100% domestic in origin. The items covered by the law have varied over the years; currently, the Berry Amendment applies to DOD purchases of textiles, clothing, footwear, food, hand or measuring tools, stainless steel flatware, and dinnerware. DOD purchases of these items must be entirely grown, reprocessed, reused, or produced in the USA. DOD can buy from non-US sources when: i) products are unavailable from American manufacturers at the satisfactory quality and sufficient quantity at US market prices; ii) items are used in support of combat operations or contingency operations; iii) products are intended for resale at retail stores such as military commissaries or post exchanges; and iv) purchases are part of a contract whose value is at or below USD 250,000.¹⁷⁵

¹⁷⁰ PwC (2020). 'Main trends & challenges in the space sector'. Available at: <https://www.pwc.fr/en/industrie/secteurspatial/pwc-space-team-public-reports-and-articles/main-trends-and-challenges-in-the-spacesector.html>.

¹⁷¹ JRC. (2023). Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study [online]. JRC Publications Repository [online]. Available at: <https://publications.jrc.ec.europa.eu/repository/handle/JRC132889>.

¹⁷² <https://durham-repository.worktribe.com/output/1185140/wto-law-on-subsidies-and-local-content-rules-in-the-renewable-energy-sector>

¹⁷³ https://policy.trade.ec.europa.eu/news/eu-and-uk-agree-way-forward-wto-dispute-concerning-uks-green-energy-subsidy-scheme-2022-07-01_en and <https://www.gov.uk/government/publications/offshore-wind-sector-deal/offshore-wind-sector-deal>.

¹⁷⁴ European Parliament. (2023). EU's response to the US Inflation Reduction Act (IRA). Briefing paper IP/A/ECON/2023-09, ISBN 978-92-848-0755-0 | doi:10.2861/0467 | QA-04-23-599-EN-N. Available at: [https://www.europarl.europa.eu/RegData/etudes/IDAN/2023/740087/IPOL_IDA\(2023\)740087_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/IDAN/2023/740087/IPOL_IDA(2023)740087_EN.pdf).

¹⁷⁵ Congressional Research Service. Buying American: The Berry and Kissell Amendments (Updated January 20, 2023),

- **India:** Since 2017, the Government of India has issued a number of public procurement-related measures to increase the domestic production of products and services encompassing chemicals and petrochemicals, the power distribution sector, and defence technologies.¹⁷⁶ In 2023, the Defence Acquisition Council approved contracts worth a total of over USD 30 billion to enhance the operational preparedness of the armed forces, with more than 95% of the allocated budget to be sourced from domestic industries¹⁷⁷.
- **China:** China's "Buy Chinese" policy requires procurement of domestic goods - except in rare circumstances – as one means of promoting indigenous innovation and Chinese-owned technologies and brands. The fragmented legal and institutional framework in China exacerbates local protectionism, with government entities at lower levels having significant discretion in setting procurement rules.

Source: Authors based on the IMF NIPO database and the different sources mentioned in the footnotes.

Since 2012, the EU has attempted to counteract this non-reciprocity in public procurement through proposals for an International Procurement Instrument (IPI) to ensure fairness and openness in procurement markets.¹⁷⁸ However no substantial progress has been achieved, and no measures have been successfully negotiated under the IPI, making it even more challenging to enforce fair procurement practices with China and other countries.

¹⁷⁹

Meanwhile, the European Commission is taking other actions to balance its preference for trade openness with measures justified by the need to safeguard EU security, public order, and economic interests. The FDI screening regulation adopted in March 2019 established an EU-wide framework in which the European Commission and the Member States can coordinate their actions on foreign investments. After only one year of enforcement, the Commission has screened 400 foreign investments, mostly in the sector of manufacturing, ICT and retail, and from countries as diverse as the USA, the UK, China, Canada and the United Arab Emirates (UAE). On export controls over 30,000 applications for export licences for military and dual-use exports – including drones, robotics, space systems and telecommunication – to non-EU countries worth EUR 38.4 billion, which resulted in 603 denials.¹⁸⁰

The EU has started selectively applying local content requirements in public procurement. In 2023, the Commission approved the decision adopted by the Member States to restrict or exclude the Chinese Huawei and ZTE from 5G networks' procurement of services and equipment. The Commission's communication was part of the European cybersecurity policy, and in the application of the 5G cybersecurity toolbox. It identified Huawei and ZTE as suppliers that represent materially higher risks than other suppliers for the security of 5G networks, which serve as critical infrastructure for various essential services for the EU internal

¹⁷⁶ According to the IMP NIPO database, taken all together, the trade value of these products is about USD 20 billion. However, this value is underestimated as it is missing from several entries.

¹⁷⁷ Ministry of Defence of India – Year and Review 2023. Available at <https://pib.gov.in/PressReleaseFramePage.aspx?PRID=1989502>.

¹⁷⁸ <https://eur-lex.europa.eu/EN/legal-content/summary/the-eu-s-international-procurement-instrument-ipi.html>.

¹⁷⁹ European Parliament. (2016). Why China's public procurement is an EU issue. European Parliamentary Research Service. Available at: [https://www.europarl.europa.eu/RegData/etudes/ATAG/2016/593571/EPRS_ATA\(2016\)593571_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/ATAG/2016/593571/EPRS_ATA(2016)593571_EN.pdf).

¹⁸⁰ European Commission. (2021). Trade and security: Commission highlights work to defend EU interests and values. Press release. Available at: https://ec.europa.eu/commission/presscorner/api/files/document/print/en/ip_21_6226/IP_21_6226_EN.pdf. European Commission. (2022). Second Annual Report on the screening of foreign direct investments into the Union. Available at: [https://ec.europa.eu/transparency/documents-register/detail?ref=COM\(2022\)433&lang=en](https://ec.europa.eu/transparency/documents-register/detail?ref=COM(2022)433&lang=en).

Regulation (EU) 2021/821 of the European Parliament and of the Council of 20 May 2021 setting up a Union regime for the control of exports, brokering, technical assistance, transit and transfer of dual-use items (recast). Available at: <https://eur-lex.europa.eu/eli/reg/2021/821>.

market's operation.¹⁸¹ The Commission also intends to apply this decision in all relevant EU funding programmes and instruments.¹⁸² The EU mandates that 40% of key climate infrastructure, including electrolysers, should be sourced from European manufacturers. The legal basis lies in EU procurement regulations, particularly Directive 2014/24/EU on public procurement, which allows EU Member States to impose environmental considerations in public procurement procedures. According to some stakeholders interviewed, given the already strong position of EU firms in the electrolysers sector, the 40% target could be raised further.¹⁸³ Some Member States are adopting a similar approach. For instance, Poland is setting a target of 50% of local components in wind farm projects in the Baltic Sea.¹⁸⁴

The European Commission is currently assessing potential retaliatory measures against China in response to discriminatory and distortive procurement practices that severely limit opportunities for European companies. This applies to the medical devices sector, where countries like Germany, the Netherlands, Ireland, France, Belgium, and Italy are leading global exporters and are keen to enter the Chinese market. Should the ongoing investigation of distortive practices confirm their existence, the Commission may implement retaliatory measures against China. This could result in Chinese companies being barred from participating in the EU's public procurement market, worth over EUR 2 trillion.¹⁸⁵

Public procurement can serve not only to promote and protect EU production but also to foster and support SME participation. The 2014 Directive introduced SME-friendly provisions;¹⁸⁶ however, principles of equal treatment, genuine competition, and non-discrimination prevent public sector buyers from favouring SMEs over large enterprises. For example, clauses like those in the European Space Agency (ESA)'s procurement policy, which prevent major system integrators from submitting proposals in areas where SMEs have recognised expertise,¹⁸⁷ would not be feasible under EU procurement rules. Instead of enacting measures that give preferential treatment to SMEs, such as earmarking procurement shares or providing price advantages, the EU has implemented other measures to "level the playing field." One such measure is dividing contracts into smaller lots, which stakeholders find increases the likelihood of SMEs winning contracts. Nonetheless, a recent study indicates that this practice mainly increases the chances for SMEs to win smaller-value lots (EUR 25,000 or less).¹⁸⁸ The study suggests that a higher quality procurement process characterised by transparency, competition, administrative efficiency, and a low risk of corruption (linked to avoiding non-open, opaque procedures) is associated with greater SME participation and a higher likelihood of SMEs winning contracts.¹⁸⁹

¹⁸¹ European Commission (15, June 2023). Communication from the Commission: Implementation of the 5G cybersecurity Toolbox C(2023) 4049 final. Available at: <https://digital-strategy.ec.europa.eu/en/library/communication-commission-implementation-5g-cybersecurity-toolbox>.

¹⁸² European Commission (15, June 2023). Commission announces next steps on cybersecurity of 5G networks in complement to latest progress report by Member States. Press Release. Available at https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3309.

¹⁸³ <https://www.hydrogeninsight.com/electrolysers/europe-on-track-to-deliver-21gw-green-hydrogen-electrolyser-factory-capacity-by-2025/2-1-1476501>.

¹⁸⁴ [The local content indicator in Polish wind farm projects in the Baltic Sea can reach as much as 50 percent - Baltic Wind](https://www.euronews.com/my-europe/2024/04/24/eu-launches-new-probe-into-chinas-public-procurement-of-medical-devices).

¹⁸⁵ <https://www.euronews.com/my-europe/2024/04/24/eu-launches-new-probe-into-chinas-public-procurement-of-medical-devices>.

¹⁸⁶ DIRECTIVE 2014/24/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on public procurement and repealing Directive 2004/18/EC. OJ L 94, 28.3.2014.

¹⁸⁷ https://www.esa.int/About_Us/Business_with_ESA/Small_and_Medium_Sized_Enterprises/Procurement_policy_on_fair_access_for_SMEs_-_the_C1-C4_Clauses.

¹⁸⁸ Hoekman, B. and Onur Tas, B. K. (2020). Procurement policy and SME participation in public purchasing. *Small Business Economics*, 58: 383-402. <https://doi.org/10.1007/s11187-020-00414-z>

¹⁸⁹ *Ibid.*

On the public procurement quality score, see <https://digiwhist.eu/publications/quality-of-government/>.

Overall, **the previous overview revealed a number of strengths:**

- The EU is undertaking initiatives on several fronts to more assertively enforce its rights and defend its values, including introducing new legislative proposals and tools to address international trade and market distortions. These efforts highlight the EU's proactive stance in ensuring fair trade practices and defending its economic interests. However, **EU behaviour denotes a clear preference for trade openness, which is considered a key factor for SME genuine development.**
- **Recently, the EU has implemented several regulatory measures to promote SMEs participation in public procurement.** The latter are focused on ensuring a level playing field for SMEs competing with larger firms rather than on granting preferential access to tenders.

The stakeholders interviewed highlighted **several weaknesses as well:**

- **SMEs, which strongly rely on open trade, may face challenges if overly restrictive policies are implemented.** Stakeholders have warned about the need to find a balance between measures favouring domestic production and maintaining trade openness.
- Despite the EU diplomatic efforts, **SMEs still face significantly higher obstacles than larger enterprises in participating in international trade.** The widespread presence of non-tariff measures is one of the main reasons for this. A survey conducted in 2015 by the International Trade Centre and the European Commission, involving 8,100 companies across all European Member States, revealed that a third of European exporters encounter burdensome non-tariff measures, both within their own countries and in destination markets.¹⁹⁰ As noted by stakeholders interviewed, while tariffs in most OECD countries are generally low today, SMEs do still continue to face the burden of non-tariff measures and regulatory barriers to trade. These represent a fixed cost, which needs to be paid regardless of the volume; with low trade volumes (e.g., for SMEs), they are a higher cost ad valorem
- **While openness is key, there is a need to ensure a level playing field for EU SMEs.** SMEs within the EU often encounter significant competitive challenges stemming from competing with extra-EU companies that operate under less stringent regulatory frameworks and benefit from lower costs. This disparity can place EU SMEs at an unfair competitive disadvantage.
- **The effect of recent regulatory changes in the public procurement framework appears to be marginal. SME participation in these procedures remains significantly limited,** facing disproportionate barriers compared to large enterprises.¹⁹¹ Studies indicate that local content provisions would not significantly help SMEs, nor would they be consistent with a non-discriminatory approach. Improving the general quality of public procurement practices is deemed more important to ensure that SMEs can compete more effectively.¹⁹²

¹⁹⁰ International Trade Centre and the European Commission. (2016). Navigating non-tariff measures. Insights from a business survey in the European Union. No. MAR-16-66.E. Available at: <https://intracen.org/resources/publications/navigating-non-tariff-measuresinsights-from-a-business-survey-in-the>.

¹⁹¹ European Commission. (2021). SME needs analysis in public procurement. Authored by t33 for unit GROW C.2 – Public Procurement. doi: 10.2873/86199.

¹⁹² Hoekman, B. and Onur Tas, B. K. (2020). *Cit.*

5 Action Plan for a SME-friendly OSA

5.1 Overall strategic direction

This section introduces an Action Plan aimed at providing an SME-centric perspective within the OSA paradigm. The overview of policy measures targeting strategic technologies and products has highlighted opportunities to improve market conditions and enable SMEs to maximise their engagement in OSA. Specific actions should be implemented considering what is legally feasible for the EU and can be realistically achieved in light of international competition. This Action Plan focuses on leveraging the real strengths of Europe, which lie in the capabilities of its SMEs. Notably, it is meant to make sure that the OSA paradigm is put in place retaining such capabilities and promoting a competitive environment for SMEs.

Because of their small size, SMEs are more exposed to barriers constraining their development potential vis-à-vis larger enterprises. Factors explaining the difficulty of SMEs to grow and compete, largely explored by past studies,¹⁹³ can be related to typical market failures (i.e., when the interactions among the economic agents fail to deliver socially efficient outcomes) or to wider systemic failures (i.e., when problems are rooted in the system and institutions which drive the interactive behaviours). Traditional obstacles faced by SMEs include limited access to resources, understood in both financial, information and human capital terms; organisational constraints, such as lack of time, quality and forward-looking ownership and management, and inertia to behavioural change; less ability to shape the external environment, but higher dependence on it with less bargaining power (see Annex VI for a detailed discussion of the needs of SMEs in specific ecosystems).

These challenges require a holistic approach. Interviewed stakeholders call for action to impact the general market conditions. Stand-alone and isolated initiatives either in the funding or in the regulatory realms, would not serve the purpose because the difficulties faced by SMEs result from the interaction of different layers of complexity. A mix of policies would best tackle the threats and make SMEs genuinely part of OSA.

For this reason, the Action Plan touches upon a large number of different areas where effort is needed. Some areas are relevant to all ecosystems, while others are more specific. Prioritisation is difficult because it may imply favouring one ecosystem over the others. Other criteria for selecting a starting point are possible, and they can be considered by policy makers, taking into account the whole economic and political European landscape, as discussed in Section 6.

The Action Plan has been developed by considering the need to balance trade openness and EU economic interests and resilience. It is essential for the EU to stand for its economic interests and enhance domestic production in the context of an open and globalised economy. This principle is encapsulated in the concept of OSA and is particularly important for SMEs. Boosting internal production capacity is crucial to enhancing the EU's resilience against disruptions or emergencies. However, in today's globalised world, where certain raw materials are found only in specific countries, the EU cannot fully internalise certain value chains. Additionally, given Europe's relatively high labour and operational costs (e.g. for energy),

¹⁹³ European Parliament. (2016). Barriers to SME growth in Europe. Briefing. Available at: [https://www.europarl.europa.eu/RegData/etudes/BRIE/2016/583788/EPRS_BRI\(2016\)583788_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2016/583788/EPRS_BRI(2016)583788_EN.pdf).
S. Leitner, R. Stehrer. (2015). What determines SMEs' Funding Obstacles to Bank Loans and Trade Credits? The Vienna Institute for International Economic Studies, Working Paper 114, 2015.
European Commission. (2015). Survey on Access to Finance of Enterprises. Analytical Report, 2015.

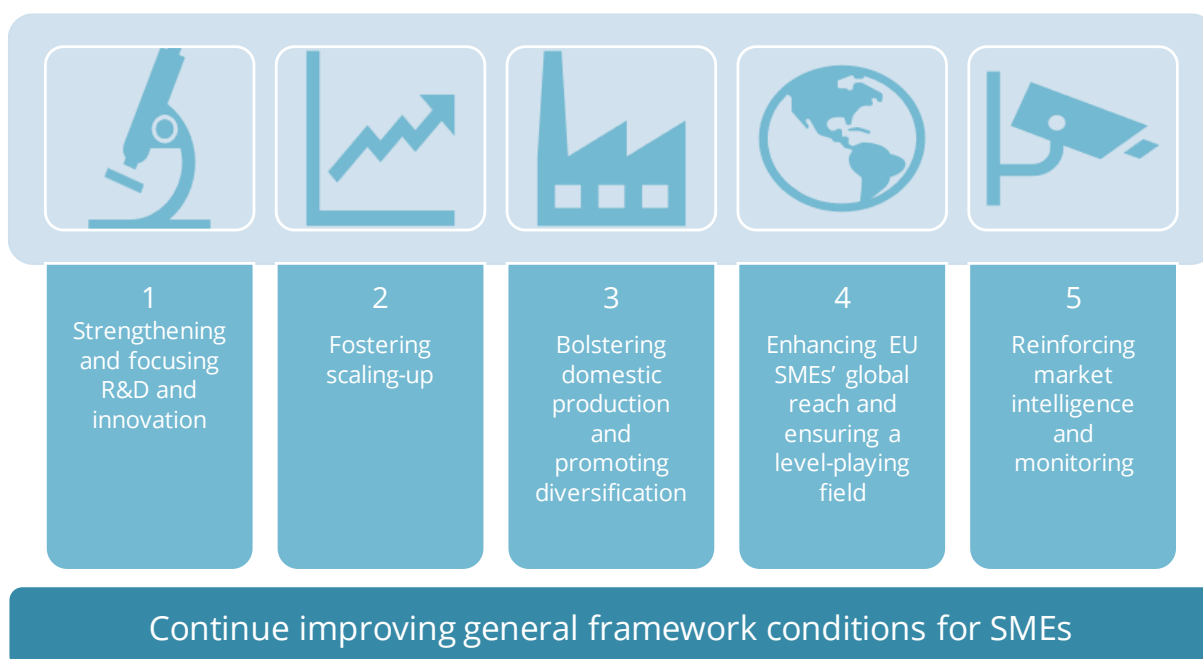
significant reshoring to the EU is likely to result in price increases that could threaten economic stability. **The Action Plan, therefore, envisions the EU supporting SMEs engagement in an open international trading system** while strategically promoting and protecting sectors when economically justified or where security concerns are paramount.

The Action Plan builds on another strategic consideration: innovation is crucial for SMEs given their significant role in R&D and innovation. The EU's extensive range of initiatives supporting R&D and innovation underscores its commitment to fostering research and innovation as essential drivers of international competitiveness. Protective measures like tariffs could stifle innovation by shielding domestic industries from competition. Conversely, market openness can stimulate innovation. Encouraging innovation is vital for keeping European industries at the forefront of technological advancements and maintaining a competitive edge. Competing in the mass production of low-value goods in the EU is more challenging. Consequently, **it is crucial for the EU to lead in high-value technologies and products and that businesses can transition from niche to larger markets in order to compete globally.**

The Action Plan builds on five pillars addressing different policy areas, and an additional foundational pillar focusing on enhancing the general framework conditions for SMEs which is critical across all SME-related policies:

- Pillar I: Strengthening and focusing R&D and innovation;
- Pillar II: Fostering scaling-up;
- Pillar III: Bolstering domestic production and promoting diversification;
- Pillar IV: Enhancing EU SMEs' global reach and ensuring a level-playing field;
- Pillar V: Reinforcing market intelligence and monitoring;
- Foundational pillar: Continue improving general framework conditions for SMEs.

Figure 6. Action Plan to maximise OSA opportunities for SMEs



Source: Authors.

These policy actions involve both the EU and Member State authorities. On the one hand, the rationale for EU-wide action stems from the interconnected nature of today's globalised economy, where challenges often transcend national borders. By harmonising regulations and policies across Member States, the EU can create a more conducive environment for businesses, including SMEs, to operate seamlessly across borders, promoting fair competition and reducing regulatory burdens. Furthermore, EU-wide measures leverage the collective resources and expertise of Member States, enabling more efficient and effective responses to common challenges. This coordinated action enhances consistency and coherence in policy implementation, giving businesses greater certainty and predictability. On the other hand, some policies are best designed and introduced at the national level when they need to be tailored to specific local needs, preferences, or conditions. This includes areas like education and taxation, which fall within the scope of national regulatory sovereignty and can only be implemented at that level.

The delineation between national and EU-level policies is sometimes blurred, necessitating collaboration and coordination between Member State and EU authorities.

Indeed, such a coordinated approach is essential to effectively address the specific needs and challenges faced by SMEs in the context of OSA. By aligning policies and initiatives at both levels, policy makers can create an enabling environment that empowers SMEs to thrive, innovate, and contribute meaningfully to Europe's strategic autonomy objectives. For example, certain national taxation policies can distort competition within the EU. This is evident in Ireland, Luxembourg, and the Netherlands, where highly favourable tax systems attract significant foreign direct investment from multinational corporations seeking lower corporate tax rates and favourable tax structures. While these policies may stimulate economic growth and investment in these countries, and indirectly benefit local SMEs through spillover effects, they can also create disparities in tax burdens across the EU and undermine fair competition within the single market, as indicated by Eurostat data.¹⁹⁴ Therefore, ensuring coordination between national and EU-level policy frameworks is crucial to promote fair economic growth and preserve the single market's integrity.

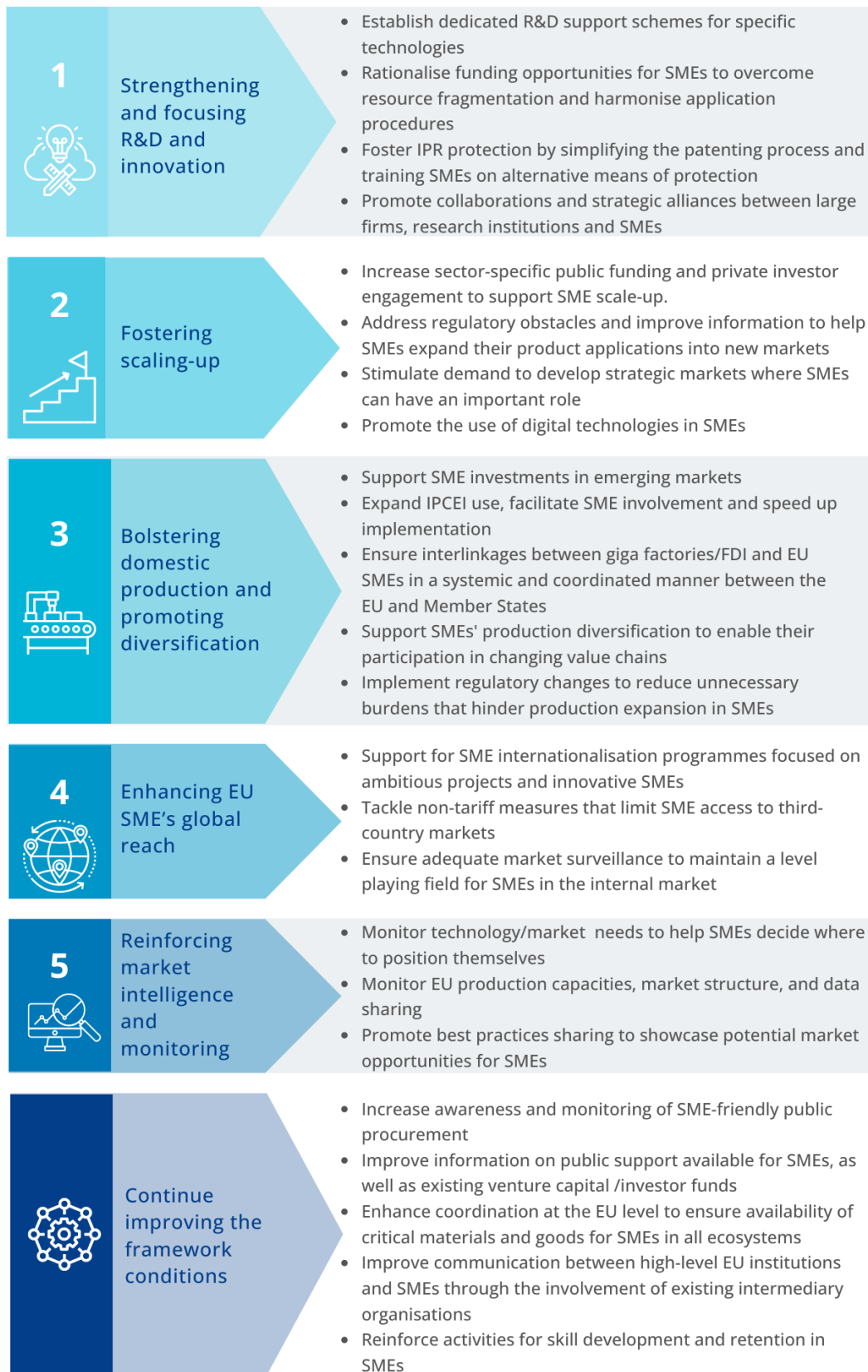
5.2 From the Action Plan to ecosystem-specific recommendations

Each pillar of the Action Plan includes a set of action lines, illustrated in the figure below.

In what follow, the content of each line of action is explained. For each of them, specific recommendations are formulated based on discussions with stakeholders and the identification of current needs for policy intervention. These recommendations may also draw upon experiences and good practices observed in countries outside the EU. Some recommendations pertain to all ecosystems, while others are more ecosystem-specific. For each recommendation, it is specified whether it is addressed to the EU, to Member State authorities, or to both.

¹⁹⁴ Eurostat. Foreign direct investment - stocks. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Foreign_direct_investment_-_stocks.

Figure 7. The Action Plan and its lines of action in detail



Source: Authors.

5.2.1 Pillar I: Strengthening and focusing R&D and innovation

The EU and Member States’ initiatives demonstrate a strong commitment to fostering SMEs innovation. Despite these extensive measures, the EU faces some limitations in its support for R&D and innovation. Given the central role that SMEs play in R&D and innovation across various ecosystems, these limitations should be addressed through the following lines of action:

- i. Establish dedicated R&D support schemes for specific technologies;
- ii. Rationalise funding opportunities for SMEs to overcome resource fragmentation and harmonise application procedures;
- iii. Foster IPR protection by simplifying patenting process and training to SMEs on alternative means of protection;
- iv. Promote collaborations and strategic alliances between large firms, research institutions and SMEs.

Table 6. Policy recommendations under the Action Plan Pillar I

Pillar I: Strengthening and focusing R&D and innovation	
Action points	Who should act
<p>i. Establish dedicated R&D support schemes for specific technologies. Enhancing R&D support for specific technologies is crucial amidst the array of available schemes. While SMEs developing specific technologies are supported through dedicated funding programmes (e.g. HERA Invest support SMEs developing new molecules to tackle antimicrobial resistance), others can only resort to more general funding sources, such as Horizon Europe, and lack targeted funding. Ensuring dedicated R&D support for specific technologies, tailored to the distinct needs of sectors, would consolidate resources and improve access to funding for SMEs.</p> <ul style="list-style-type: none"> ➤ Technical textiles. Investment in new materials and product innovation is crucial for the technical textile sector. However, access to public funding supporting R&D is limited for this specific sector. SMEs can either access general Horizon Europe calls or the European Defence Fund for textile innovations applicable to the defence sector. In both programs, textile firms find themselves directly competing with firms from other sectors. Having a dedicated funding programme for technical textiles innovation could be more visible to SMEs and increase the probability of securing support. ➤ Carbon Capture Technology. The market for Carbon Capture Technology is still immature and uncertainties about the viability of a profitable business model prevail. Dedicated R&D support – e.g. via tax credits, grants, low-interest loans or direct subsidies – would help kickstarting the market. ➤ Cybersecurity. A dedicated support scheme for SMEs developing cybersecurity solutions would help them facing the disadvantages implied by the Cyber Resilience Act. The European Cybersecurity Organisations proposed a fund of at least EUR 1 billion in order to promote investments in European cybersecurity start-ups and SMEs, as well as keeping competences and strategic solutions within Europe. 	<p>EU (European Commission and European Investment Bank) and Member States</p>

<ul style="list-style-type: none"> ➤ Robotics (dual-use). It would be advisable to set up more ambitious public European/national funding programs to strengthen cutting-edge research in dual-use robotics, by either expanding the existing capped-threshold funding instruments for SMEs (e.g., European Innovation Council) or by introducing new dedicated funding instruments. While steps forward have been taken recently with dedicated public funds specific to the sector for joint industrial research (e.g., European Defence Fund), a funding gap still exists in the dual-use applications. ➤ Telecommunication. Dedicated EU funding opportunities for SMEs should be considered. More specifically, funding could be directed towards building over ten mobile 4G or 5G networks in Europe that are fully built and/or supplied by European SMEs, such as in rural areas or on university campuses. This initiative could support R&D related to 5G applications. 	
<p>ii. Rationalise funding opportunities for SMEs to overcome resource fragmentation and harmonise application procedures. Streamlining funding opportunities and standardising application procedures is imperative to overcome the current fragmentation in R&D support. The support landscape is often characterised by isolated programmes operating independently, hindering effective collaboration across sectors. The numerous different schemes also results in complex application processes, which is particularly challenging for SMEs to navigate. Standardisation of the processes or the creation of a one-stop-shop on funding opportunities for SMEs would address this point. The need for rationalisation and harmonisation is relevant for all the ecosystems analysed, but it specifically hits the following technologies:</p> <ul style="list-style-type: none"> ➤ Technical textiles. Existing funding opportunities for textile SMEs should be better communicated to increase awareness among these businesses. The forthcoming Transition Pathway Platform established by the Commission could serve as an important one-stop-shop service for all SMEs in the textile ecosystem. However, it is crucial to ensure that adequate focus is placed on the technical textile sectors. ➤ Li-ion batteries, Cloud and edge computing, Microelectronics. Public funding is fragmented, making it difficult and burdensome for SMEs to identify the best financing solutions among the available national and European measures. The creation of a one-stop-shop service that provides information about funding opportunities at all levels would enable them to make more informed and focused decisions. ➤ Electrolysers. SMEs are often overlooked in large EU funding programmes. However, their participation to research programmes like Horizon Europe Clean Hydrogen Partnership would be crucial and more efforts to support them should be made. ➤ Space systems and dual-use technologies. Public funding supports need to made more open and integrated. Synergies between EU public funding programmes in Space, Defence (e.g. the EDF), Horizon Europe and other relevant programmes are needed to promote cross-fertilisation between the space and non-space sectors. 	<p>Mainly the European Commission to consolidate and coordinate information from both the EU and Member State levels</p>
<p>iii. Foster IPR protection by simplifying patenting process and training to SMEs on alternative means of protection. Increased use of IPR (intellectual property rights) protection is crucial, given the limited</p>	<p>The European Commission is in a better position</p>

<p>diffusion of intellectual property protection in some sectors. SMEs often opt to keep knowledge in-house rather than pursuing patent protection due to financial constraints. This can place SMEs at a disadvantage, especially vis-à-vis non-EU competitors. The European Commission has made an effort to enhance IPR protection (e.g., the Trade Secret Directive¹⁹⁵), but awareness among smaller companies remains low. Simplifying the patenting process for SMEs, particularly in non-patenting industries, and providing education on alternative means of protection such as utility models, would help address this problem across ecosystems.</p> <ul style="list-style-type: none"> ➤ All ecosystems. Dedicated patenting procedures tailored for SMEs would reduce the administrative burden, particularly in dealings with the European Patent Office. Additionally, communication actions and training activities should be implemented to raise awareness about the opportunities provided by legislation on IPR protection and how it can be effectively enforced. ➤ Technical textiles, Agri-food. SMEs operating in these industries would benefit from receiving tailored information and resources to effectively utilise IPR instruments. Awareness-raising campaigns about the benefits of intellectual property, as well as intelligence on international and national IP laws, are crucial. Additionally, SMEs would benefit from information about alternatives to more established protection instruments, such as the implementation of utility models. ➤ Space systems. While governments and public agencies have traditionally dominated the space sector, the technical and financial contributions from the private sector are becoming increasingly important. To further develop these activities and maintain a competitive edge, it is essential to support SMEs in protecting their IP rights. Specifically, SMEs need guidance on how to safeguard their IPR when involved in pan-European, cross-country projects. 	<p>to negotiate with the European Patent Office and to provide guidance for SMEs involved in pan-European projects.</p> <p>Other training and communication actions are more suitable at Member State level, through already existing intermediary organisations.</p>
<p>iv. Promote collaborations and strategic alliances between large firms, research institutions and SMEs. Research institutions and larger companies can offer SMEs access to laboratories, testing facilities and skilled researchers, thereby providing invaluable infrastructure and expertise that would be costly for SMEs to develop independently. Similar benefits arise from SME participation in cluster initiatives. While project-specific collaborations and longer-term strategic alliances are well-established in sectors such as robotics, drones, and telecommunications (5G PPP), more needs to be done in other industries.</p> <ul style="list-style-type: none"> ➤ Electrolysers. The establishment of the Electrolysers Partnership, as part of the European Clean Hydrogen Alliance, aims to unite electrolyser manufacturers and suppliers of components and materials within the alliance's existing framework. This initiative will enable SMEs to connect with other firms within the value chain and learn about potential supply sources. Additionally, it will be important to encourage financial institutions, including the European Investment Bank (EIB), to join and participate in this partnership 	<p>The European Commission and intermediary organisations at EU level for collaboration across Member States;</p> <p>National authorities and national/regional intermediary organisations for actions within specific Member States.</p>

¹⁹⁵ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016L0943>.

- **APIs.** Collaboration with universities and research institutes should be fostered to support SMEs that are involved in API manufacturing but lack the capacity to establish large research departments. This partnership can bridge the gap in their innovative capabilities, helping them stay at the forefront of innovation and maintain their competitive edge in the market.
- **Microelectronics.** Collaboration between SMEs, research institutions and production facilities is notably lacking in the semiconductor industry, yet it would be highly beneficial for SMEs. Local authorities typically facilitate connections between companies, especially across different countries, and strengthening their role could enhance these critical linkages. The EU could facilitate and coordinate the process.
- **Robotics (dual-use).** SMEs should be supported in the development, testing, and promotion of robotic technology through engagement with competence centres and mentoring. This support will help complete the chain from 'idea to market' for their products. Aerospace and defence technology requires extensive, rigorous testing and validation to meet stringent standards. Competence centres, with their state-of-the-art testing infrastructure and facilities, are well-equipped to cater to the specific needs of the sector.
- **Heat-pumps.** To maintain a leading role in cutting-edge research and development related to heat pumps, it is essential to continue fostering collaboration among industry stakeholders, research institutions, and government bodies.
- **Solar energy technology.** EU SMEs are heavily involved in the development of innovative solutions, such as building-integrated PV, agri-photovoltaics, road-integrated PV, floating PV, and vehicle-integrated PV. While SMEs often keep their knowledge tacit and in-house, these innovations present promising opportunities that should be valorised on a larger scale. Intermediaries, such as university technology transfer offices, SME-supporting government agencies, and specialised cluster organisations, are crucial in helping facilitate the transition of tacit knowledge into formalised intellectual property, ensuring it is protected and can be effectively utilised.

5.2.2 Pillar II: Fostering scaling-up

EU SMEs face persistent difficulties in fostering scale-ups and entrepreneurial ventures that enable them to transition from innovation and niche markets to significant growth stages of production. This struggle to scale up emphasises the necessity for adequate support for successive, increasingly larger funding rounds as firms expand. The following lines of action should be followed to address this issue in a holistic

manner.

- i. Increase sector-specific public funding and private investor engagement to support SMEs scale-up;
- ii. Address regulatory obstacles and improve information to help SMEs expand their product applications into new markets;
- iii. Stimulate demand to develop strategic markets where SMEs can have an important role;
- iv. Promote the use of digital technologies in SMEs.

Table 7. Policy recommendations under the Action Plan Pillar II

Pillar II: Fostering scaling-up	
Action points	Who should act
<p>i. Increase sector-specific public funding and private investor engagement to support SME scale-up. SMEs often occupy niche markets, developing and commercialising innovative and specialised solutions. It is important to support their growth and leverage their niches to expand their market opportunities. Many stakeholders point to a lack of comprehensive strategies to aid SMEs in expanding their business activities and thus improve their growth potential. There is a particular absence of initiatives that engage private investors in supporting SMEs, and especially in some strategic sectors. Mobilising private funds would provide the continuing financial support that is crucial for industries that face prolonged transitions from R&D to market phases. Introducing simplified financial tools for investors to inject risk capital into SMEs would benefit all the ecosystems analysed. However, addressing these challenges would be particularly important for the following technologies and products.</p> <ul style="list-style-type: none"> ➤ Cybersecurity. SMEs involved in cybersecurity suffer from a financial gap that constrains their growth possibilities. One solution would be to increase the involvement of venture capitalists in the cybersecurity domain. The promotion of cybersecurity projects may also be realised by embedding them more deeply into the Cassini initiative. ➤ AI. SMEs scaling-up in the AI industry would be incentivised through stronger involvement of private investors in the sector. The latter can be achieved by: i) promoting risk-taking among investors by engaging financial institutions such as the EIB and the EIF to provide de-risking promote risk taking; ii) promote private sector investment by setting up a European AI Venture Capital scheme to support SMEs developing critical AI applications in their growth phase; iii) facilitating joint investments by SMEs with similar or complementary needs for AI solutions. This could take the form of mere match- 	<p>EU (European Commission, European Investment Bank and European Investment Fund) and Member States</p>

<p>making (e.g. by providing a kind of directory that allows the identification of SME partners with aligned interests) or active financing (e.g. by guaranteeing private sector financing for SME alliances via the EIB) or offering dedicated calls for such alliances.</p> <ul style="list-style-type: none"> ➤ APIs. The transition from the R&D to the market phase takes significant long time in the pharmaceutical industry. The API authorisation process is burdensome and costly. These factors prevent many pharmaceutical SMEs from growing. Scale-up of the activities would be fostered by measures to promote the long-term involvement of European private investors in the market. ➤ Electrolysers. Co-investment schemes, public-private partnerships, tax breaks for equity investors, loan guarantees, etc., are necessary to realise the ambitious targets for the electrolyser industry. For this specific value chain, the EIB could potentially step-up efforts to underwrite loans for electrolyser manufacturers. ➤ Robotics (dual-use). Funding opportunities should be diversified by ensuring better access to venture/private capital to SMEs with specialised funds. The EU equity facility for the space sector Cassini is an example that can be replicated in dual-use robotics technology. ➤ Solar energy technology. SMEs and start-ups should be supported to reach their minimum production scale. To this end, financial support may be granted via general or dedicated EU programmes or via the SME-specific instruments used in the Member States. ➤ Space systems. The European market is still characterised by a funding gap that prevent SMEs from scaling-up. Hence, the private equity market should be further supported to secure funding for SMEs in the new space economy in the direction sketched by the Cassini Initiative. ➤ Wind energy technology. Scaling-up of SMEs in the wind industry would be facilitated by combining EU and Member States funding schemes. Cascade funding schemes are instrumental in this respect and should be increased. 	
<p>ii. Address regulatory obstacles and improve information to help SMEs expand their product applications into new markets. In some sectors the expansion of market applications for products and technologies would provide SMEs with new opportunities for growth. Expansion is often hindered by structural and regulatory obstacles. In some instances, the barriers are due to overly stringent and outdated regulations that require modernisation. In other cases, information about additional market opportunities is missing.</p> <ul style="list-style-type: none"> ➤ High Protein crops. The production of animal feed and biofuel is typically interconnected, with biofuel commonly being a byproduct of animal feed production. Current regulations prevent producers of high-protein crops from also producing biofuels. Without a viable biofuel market, the sustainability of growing and processing these crops is at risk. Therefore, amending sector-specific regulations could allow farmers to produce both high-protein crops and biofuels, expanding their agricultural opportunities. ➤ Fuel cells. Highly innovative SMEs could exploit the flexibility offered by fuel cell technologies to explore alternative uses, such as in construction and space exploration. National and local governments would help in these efforts by providing the necessary market 	<p>The European Commission with respect to regulatory changes;</p> <p>National authorities and national/regional intermediary organisations for information dissemination within specific Member States</p>

<p>intelligence and facilitating the networking of companies operating in different sectors.</p> <ul style="list-style-type: none"> ➤ Telecommunication. To support European SME's role in the 5G rollout, the policy focus should be put especially on RAN (Radio Access Network) virtualisation, open-source telecommunications services and building a dynamic wireless system. These are market niches where with ample business opportunities for SMEs. All actions aimed at involving SMEs and nurturing start-ups in these fields are useful. 	
<p>iii. Stimulate demand to develop strategic markets where SMEs can have an important role. The market for certain cutting-edge technologies remains quite small. Supporting R&D and scaling-up in such technologies will not automatically ensure the economic success without an active market. Measures aimed at boosting demand are therefore essential.</p> <ul style="list-style-type: none"> ➤ Carbon Capture Technology. The Carbon Capture Technology (CCT) market remains limited. Encouraging broader adoption of this technology by firms is crucial to sustain market growth and expand business opportunities for SMEs. This can be achieved by raising price levels within the ETS system, motivating firms to reduce or eliminate CO₂ emissions. In addition, tax credits and direct support for firms adopting CCT solutions would further incentivise uptake. ➤ Fertilisers. The demand for bio-based fertilisers could be supported by further promoting the use of sustainable farming practices and by supporting the implementation of organic farming, which already engages many SMEs. ➤ Cloud and edge computing and Fuel cells. In order to further stimulate the development of alternative cloud and edge computing solutions or fuel cells technology by SMEs, it would be important to envisage measures – such as tax deductions or vouchers – aimed at stimulating demand for such solutions by other firms. 	<p>The European Commission is responsible for setting ETS prices and would be in a better position to carry on massive information campaign to stimulate demand;</p> <p>Member States for fiscal measures.</p>
<p>iv. Promote the use of digital technologies in SMEs. European SMEs continue to lag behind in adopting digital solutions. This reluctance to adopt could threaten their global competitiveness and their capacity to collaborate efficiently with larger EU companies. Furthermore, if SMEs do not engage actively in using and developing digital solutions, the EU's reliance on foreign digital service providers might increase, putting the EU's digital sovereignty at stake.¹⁹⁶</p> <ul style="list-style-type: none"> ➤ Cybersecurity, Cloud and edge computing, AI. To encourage the adoption of digital solutions by SMEs, it is necessary to support their investment in digitisation, especially for internal data collection. Tax deductions for innovative technologies and for the hiring of specialised profiles would prompt the uptake. 	<p>Member States</p>

¹⁹⁶ European Parliament. (2020). "Digital sovereignty for Europe". EPRS Ideas Paper. [https://www.europarl.europa.eu/RegData/etudes/BRIE/2020/651992/EPRS_BRI\(2020\)651992_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2020/651992/EPRS_BRI(2020)651992_EN.pdf)

5.2.3 Pillar III: Bolstering domestic production and promoting diversification

Pillar III focuses on strengthening the EU's domestic production capacities and encouraging diversification specifically into high-value-added sectors. Increasing production capacity is essential for building resilience against global supply chain disruptions, which have become more frequent due to geopolitical tensions, pandemics, and other unforeseen events. For SMEs, this diversification translates into reduced dependency on external sources for critical components and materials, but also potential business opportunities. Diversifying production towards more strategic technologies and high-value market segments presents significant costs, but also offers substantial advantages. SMEs that diversify successfully can gain competitive advantage by supplying products and services for growing markets. Although domestic subsidies to boost production are already commonly, both in the EU and worldwide, major EU competitors, such as the USA and China, are making significantly larger investments. Given this landscape, there is a pressing need to enhance investment within the EU to ensure competitiveness and economic resilience. The recommended lines of action are as follows:

- i. Support SMEs investments in emerging markets;
- ii. Expand IPCEIs use, facilitate SME involvement, and speed up implementation;
- iii. Ensure interlinkages between giga factories/FDI and EU SMEs in a systemic and coordinated manner between EU and Member States;
- iv. Support SME production diversification to enable their participation in changing value chains;
- v. Implement regulatory changes to reduce unnecessary burdens that hinder production expansion in SMEs.

Table 8. Policy recommendations under the Action Plan Pillar III

Pillar III: Bolstering domestic production and promoting diversification	
Action points	Who should act
<p>i. Support SME investments in emerging markets. There are emerging markets that could help the EU achieve its goals of autonomy and resilience, where SMEs can play a significant role. These markets are in particular those relating to sustainability and the circular economy with strong local connections, such as recycling raw materials from old batteries, wind turbines, or solar panels. In addition to demand-side interventions to stimulate these markets (covered by Pillar II), supply-side interventions are needed. Public investment in such sectors would enable SMEs to capture market segments overlooked by larger firms, thus promoting both competitiveness and sustainability.</p> <ul style="list-style-type: none"> ➤ Batteries, fuel cells, wind and solar energy technology. Decommissioning, repowering, and recycling are gradually gaining importance due to the end-of-life phases of the products considered. These activities may constitute an interesting business opportunity for SMEs, and they should be supported with dedicated funding. ➤ Fertilisers. The use of bio-based fertilisers, as alternative to chemicals, should be promoted by investing in infrastructure for the collection, treatment, and processing of biowaste. Equally, the production of compost and digestate may be incentivised by 	European Commission and Member States

<p>promoting the separate collection of bio waste and supporting composting facilities.</p> <ul style="list-style-type: none"> ➤ Could and edge computing. SMEs in this value chain are already providing alternative solutions to those offered by hyperscalers, like multi-cloud platform services based on open-source software. Additional support would allow to expand their market. 	
<p>ii. Expand IPCEI use, facilitate SME involvement and speed up implementation. IPCEIs are important instruments for enhancing EU production capacity. Some critical strategic sectors – i.e. batteries, hydrogen, microelectronics and cloud computing – have already benefitted from them. The use of IPCEIs could be further expanded within these value chains and others. More generally IPCEIs could be a powerful instrument for industries developing breakthrough technologies, where cross-country collaboration is essential due to the high risks and costs associated with the projects, or where disruptive innovations need to be taken to the market (e.g. carbon capture technologies, API, solar panels). But application for – and implementation of – IPCEI projects are still challenging for SMEs and needs to be addressed.</p> <ul style="list-style-type: none"> ➤ All ecosystems. SME involvement would be facilitated by simplifying the application process and expediting the lengthy evaluation and approval phase by the Commission. ➤ All ecosystems. Following the approval from the European Commission, there is a lack of coordination among Member States in fund allocation. Each country is responsible for distributing funds to national participants, but they do so at different speeds. Improving coordination in fund distribution among Member States would encourage the participation of SMEs in IPCEIs and foster collaboration with firms from other EU countries. ➤ APIs, carbon capture technology, solar panel technology. The innovation needed to further develop these ecosystems and reduce strategic dependencies would require substantial funding and coordinated cross-country involvement. Setting up IPCEIs in these areas would facilitate achieving these goals. 	<p>European Commission; Member States for the proposal of new IPCEIs</p>
<p>iii. Ensure interlinkages between giga factories/FDI and EU SMEs in a systemic and coordinated manner between the EU and Member States. Evidence from IPCEI implementation and scientific literature emphasises the economic benefits of embedding large production facilities within local ecosystems that include, in particular, SMEs. Experts note that SME engagement in the supply chains of large companies often occurs naturally thanks to the capacities, specialisation, and flexibility of EU SMEs. However, explicit measures should be put in place to facilitate their involvement in relevant value chains. This is particularly important in the case of FDI, which may lack the strong local connections of home-grown large enterprises.</p> <ul style="list-style-type: none"> ➤ All ecosystems. Legal agreements between the company involved in the FDI, national and regional authorities, EU authorities, business associations, and other stakeholders should be envisaged. The EU should be involved as an interested party in these agreements, considering the strategic dimension of the investments for the EU. ➤ All ecosystems. When approving an FDI operation, the EU would need to ensure that the operation does not harm other EU Member States and that the location is chosen considering not only local specialisations but also the need to minimise economic disparities 	<p>European Commission and Member States</p>

<p>across EU regions and achieve convergence. Whenever possible, the EU may promote the involvement of less developed or smaller Member States that have adequate capacities in place, thereby fostering balanced economic growth across the EU. As an example of this, with reference to carbon capture storage sites, it is important to supplement the already existing large-scale facilities closed to the North Sea with smaller, modular sites dispersed across Europe. Smaller sites have the added advantage of allowing more SMEs to be active.</p> <ul style="list-style-type: none"> ➤ Li-ion batteries. Policymakers should incentivise larger battery manufacturers to purchase equipment from and enter commercial agreements with local suppliers. This strategy could significantly enhance cluster policies in the battery and automotive ecosystems, especially important during local supply chain crises. Local authorities and collaboration clusters should act as liaison points between supranational and regional levels, facilitating large manufacturers to engage with local SME. ➤ Telecommunication. The telecommunication industry has undergone a wave of foreign acquisitions, raising concerns about digital sovereignty and competitiveness. It is advisable to closely monitor the market, assess the benefits for the local ecosystems and the involvement of local SMEs, to understand trends and implement effective actions. ➤ AI. Simplifying the process for non-EU start-ups to set up shop within the EU would stimulate greenfield foreign investment on the continent as opposed to brownfield mergers and acquisitions deals, which only redirect the value-added elsewhere. 	
<p>iv. Support SMEs production diversification to enable their participation in changing value chains. Certain industries are undergoing significant transformations, posing challenges for SMEs involved in production of end products or within the value chain. SMEs in these sectors could benefit from support in the form of advice on production diversification opportunities and potential financial assistance to implement such strategies.</p> <ul style="list-style-type: none"> ➤ Li-ion batteries. Specific public funding for diversification projects is needed, especially targeting mid-caps that will play a key role as enablers of the transition to electric vehicles, connecting OEMs with tier-2 suppliers. The European Investment Bank (EIB) has financed several projects in mobility and may prove an important source of funding to be further expanded to support companies and local communities seeking to pursue the green transition in mobility. Additional support may be granted in the form of advisory services for SMEs. European and national legislators may share with SMEs best practices about how automotive SMEs can expand into new areas by diversifying production. SMEs in automotive could be inspired by other markets strategies to re-purpose their machinery and operational processes with minimal changes and leverage their know-how in manufacturing of particular components with potential for application in other fields. ➤ Technical textile. Traditional production lines face stiff competition from outside the EU and struggle with low profitability. SMEs producing technical textiles for medical applications could be incentivised to shift their production towards reusable products. This would expand their production scope and help reduce the EU's dependency on some extra-EU products. 	<p>EU (European Commission, European Investment Bank) and Member States for funding;</p> <p>National authorities and national/regional intermediary organisations for information dissemination within specific Member States</p>

<ul style="list-style-type: none"> ➤ High-protein crops. SMEs and start-ups, especially those diversifying their production towards alternative protein-rich sources of animal feed, would benefit from additional dedicated funding support. ➤ Telecommunication. A joint effort across all industry players should be exerted to develop a new generation of services and deployments for markets underserved by legacy operators. It focuses on advocating for cost-effective next generations software-defined networks (mobile core and RAN) to do this. With respect to spectrum availability, SMEs should be enabled to build neutral host networks in areas where mobile network operators do not see any business case, allowing mobile virtual network operators (MVNOs) to obtain access to all 4G/5G networks in Europe and enacting regulatory framework in support of local spectrum licenses. ➤ Construction sector applying solar panel technology and heat pumps. The application of new technology that can find application in buildings (e.g. heat pumps and solar panel technology integrated solutions – such as building-integrated PV, agri-photovoltaics, road-integrated PV, floating PV, and vehicle-integrated PV) should be fostered, particularly among SMEs operating in the construction ecosystem. This will allow them to exploit new, promising market opportunities. Additionally, enhancing skills for installers is necessary to support these advancements. 	
<p>v. Implement regulatory changes to reduce unnecessary burdens that hinder production expansion in SMEs. To foster growth and competitiveness among SMEs and start-ups across various industries, it is crucial to implement regulatory changes that reduce unnecessary burdens hindering production expansion in particular strategic industries. By streamlining administrative processes and providing targeted support, these businesses can more easily navigate the complex regulatory landscape, and expand their operations.</p> <ul style="list-style-type: none"> ➤ APIs. When a pharmaceutical company considers switching from a foreign to a European API supplier, it faces a complex administrative process. This includes certifying any changes in suppliers or production methods with the relevant authority, involving extensive paperwork. This bureaucratic burden can deter companies from changing suppliers. To encourage such shifts, implementing fast-track procedures for companies opting for European suppliers could especially benefit SMEs. ➤ Li-ion batteries. The burden of compliance with standards is particularly high for SMEs. To this respect, they would benefit from public assistance in all the activities related to ensuring that their products comply with the new Battery Regulation, such as calculation of the carbon footprint and labelling requirements. ➤ Carbon Capture Technology. It would be important to establish a regulatory framework to support the development of CO₂ transport and storage infrastructure as the CCS market would probably entail the export of CO₂ from EU producers with few facilities towards EU member states with excess storage facilities. Smaller businesses typically operate with limited resources and tighter budgets, making them more vulnerable to uncertainties and changes in the regulatory landscape. ➤ Heat-pumps. It would be advisable to streamline the permitting process for various heat pump installations and technologies. Pre- 	<p>European Commission</p>

approved guidelines for heat pump facility locations, as well as support for the repurposing of existing facilities, would facilitate greater involvement of SMEs.

- **Wind energy technology.** Operating in the wind energy industry confronts SMEs with considerable regulatory burden related to access to power grid or getting permits on time. By streamlining the necessary procedures governments would support increased SMEs involvement.
- **Cybersecurity.** Greater diffusion of new cybersecurity technologies would benefit from eliminating any significant regulatory hurdles for software distribution across the Member States, or export restrictions.
- **Cybersecurity, Fuel cells, Electrolysers.** SMEs in the cybersecurity domain are issuing cybersecurity certifications that are applicable across the EU, and ease recognition of compliance with EU quality standards. Similar actions could be prompted within the fuel cells and the electrolysers industries.
- **Fertilisers.** Private investment to support the production of organic based fertilisers could be incentivised by easing some regulatory barriers, such as the clarification on the use of animal by-products, and the elaboration of standards across the EU.

5.2.4 Pillar IV: Enhancing EU SMEs' global reach

Internationalisation is a key growth strategy for EU SMEs. The literature documents several advantages of global trade, including low-cost production facilities and knowledge and learning accumulation that allow SMEs to improve their performance and develop new products. Integration into global value chains (GVCs) leads to increased competitiveness, and FDI flows are a significant vehicle for participating in GVCs. Participation in GVCs result in access to new markets, networking, and collaboration with other companies in the same global industry. It also increases bargaining power with suppliers and clients.¹⁹⁷ Despite these advantages SMEs still encounter significant challenges in such internationalisation, primarily due to difficulties in accessing finance, information and skills.¹⁹⁸ A recent report by the European Court of Auditors (ECA) underscores the need for enhanced awareness, improved coherence, better coordination, and increased sustainability in SME internationalisation efforts.¹⁹⁹ These general recommendations are crucial in leveraging opportunities presented by OSA. The Action Plan further identifies the following specific lines of action:

- i. Support for SME internationalisation programmes focused on ambitious projects and innovative SMEs;
- ii. Tackle non-tariff measures that limit SME access to third-country markets;
- iii. Ensure adequate market surveillance to maintain a level playing field for SMEs on the internal market.

Table 9. Policy recommendations under the Action Plan Pillar IV

Pillar IV: Enhancing EU SMEs' global reach	
Action points	Who should act
<p>i. Support for SME internationalisation programmes focused on ambitious projects and innovative SMEs. The recent ex-post evaluation of Cohesion Policy support to SME competitiveness in the 2014-2020 period has provided evidence that more ambitious projects are associated with higher and more durable effects. This is observed, in</p>	European Commission and Member States

¹⁹⁷ Crescenzi, R., & Harman, O. (2022). Climbing up global value chains: leveraging FDI for economic development. LSE Report for Hinrich foundation. Available at: <https://www.lse.ac.uk/business/consulting/assets/documents/Climbing-up-global-value-chains.pdf>.

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Crespi, G., Criscuolo, C., & Haskel, J. (2008). Productivity, exporting, and the learning-by-exporting hypothesis: Direct evidence from UK firms. *Canadian Journal of Economics/Revue Canadienne d'économique*, 41(2), 619-638. <https://doi.org/10.1111/j.1540-5982.2008.00479.x>

Lloyd-Reason, L., & Mughan, T. (2002). Strategies for internationalisation within SMEs: the key role of the owner-manager. *Journal of small business and enterprise development*, 9(2), 120-129.

¹⁹⁸ Magni, D., Chierici, R., Fait, M. and Lefebvre, K. (2021), "A network model approach to enhance knowledge sharing for internationalization readiness of SMEs", *International Marketing Review*, Vol. 39 No. 3, pp. 626-652. <https://doi.org/10.1108/IMR-03-2021-0110>.

Ghuri, P., Lutz, C., & Tesfom, G. (2003). Using networks to solve export-marketing problems of small-and medium-sized firms from developing countries. *European Journal of Marketing*, 37(5/6), 728-752.

Bugamelli, M., & Infante, L. (2003, November). Sunk Costs of Exports: A Role for Industrial Districts?. In *Local Economies and Internationalisation in Italy Conference* (p. 343).

Paul, J., Parthasarathy, S., & Gupta, P. (2017). Exporting challenges of SMEs: A review and future research agenda. *Journal of World Business*, 52(3), 327-342. <https://doi.org/10.1016/j.jwb.2017.01.003>.

¹⁹⁹ European Court of Auditors (2022). SME internationalisation instruments. A large number of support actions but not fully coherent and coordinated. Special report 07/2022. Available at: <https://op.europa.eu/webpub/eca/special-reports/sme-internationalisation-instruments-07-2022/en/>.

<p>particular, in the case of instruments supporting SME internationalisation, where support to large-scale internationalisation strategies were more effective than vouchers for the acquisition of business services or for participation into fairs.²⁰⁰</p> <ul style="list-style-type: none"> ➤ All ecosystems. Measures supporting SME internationalisation should stimulate and reward more ambitious projects. These should be larger-scale internationalisation strategies that are part of a comprehensive development plan, possibly associated with activities to develop and commercialise innovation. This approach is vital for OSA, as it encourages SMEs to engage in higher-impact internationalisation efforts that contribute directly to strengthening the EU's strategic independence and economic resilience, while strengthening SME competitiveness. ➤ Fuel cells and electrolyzers. Stakeholders interviewed have suggested that SMEs producing fuel cells and electrolyzers can be incentivised to release certifications of product quality. Customers would be encouraged to use certified products over cheaper imports, thereby helping to rebalance global trade. A similar approach is already in use in the cybersecurity realm and could be expanded to other technologies. 	
<p>ii. Tackle non-tariff measures that limit SME access to third-country markets. The bilateral trade agenda should be revived to reduce non-tariff barriers that are limiting SMEs' access to certain countries, e.g. in the EU near neighbours (Morocco, Turkey, Tunisia).</p> <ul style="list-style-type: none"> ➤ All ecosystems. The use of existing instruments such as the Global Trade Alert should be fostered to better inform EU trade dialogue. At the same time, it would be advisable to build new SMEs-friendly databases through which SMEs can easily signal non-tariff measures they are confronted with. ➤ All ecosystems. The International Regulatory Co-operation set up by the OECD represents a good practice.²⁰¹ It is aimed at helping creating options that reduce unnecessary diversity of domestic regulation among trading partners, while maintaining national policy objective. This experience could be further expanded to third-countries with whom Europe has strong trade ties. 	European Commission
<p>iii. Ensure adequate market surveillance to maintain a level playing field for SMEs on the internal market. In many sectors, EU SMEs face challenges due to competition from non-EU companies that supply low-quality products to the European market. This need is perceived as particularly strong in the textile industry.</p> <ul style="list-style-type: none"> ➤ Technical textile. SMEs in the technical textile industry are more vulnerable to predatory trade practices compared to larger players. However, it is challenging for them to file lawsuits against unfair trade practices. Improving market surveillance activities for textile products would help address this issue. The European Commission should support Member States' customs authorities in enhancing customs controls to ensure that imported textile products comply 	European Commission has an important role to play to help Member States address the challenge they face

²⁰⁰ European Commission, DG REGIO, Ex post evaluation of Cohesion Policy programmes 2014-2020 financed by the ERDF. Work Package 6: SME support. Contract number: 2021CE16BAT064. The evaluation has been led by CSIL. The Final Report is due by mid-2024.

²⁰¹ <https://www.oecd.org/gov/regulatory-policy/irc.htm>; <https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0475>.

	<p>with EU legislation. This would safeguard the advantage of European products in terms of quality and help protect SMEs' IPRs.</p> <p>➤ Digital technology, especially cloud computing. It is vital to provide a solution to unfair software licencing practices, exemplified by cases involving Microsoft and Broadcom. These practices pose significant barriers for EU SMEs, potentially limiting their ability to compete effectively in the cloud market. One way to tackle these unfair practices is through antitrust, which can however be lengthy and costly for SMEs. An alternative solution would be the extension of the Digital Markets Act (DMA) to software (e.g. VMware), which could be regarded as 'gatekeeper' in order to provider fairer business practices in the sector.</p>	
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5.2.5 Pillar V: Reinforcing market intelligence and monitoring

Despite considerable recent research aimed at pinpointing strategic vulnerabilities within ecosystems based on import dependency, EU production, and diversification of supply sources, there remains a significant gap in our understanding. This relates to the detail on the structure, localisation, and scale of production of certain sectors within the EU. This is especially the case for the involvement of SMEs. This lack of detailed knowledge hinders the ability to formulate adequate policy responses. A stark illustration of this was in the COVID-19 pandemic, when there was insufficient knowledge and data on firms, predominantly SMEs, producing technical textiles that could switch to the manufacture of personal protective equipment.

The following specific lines of actions are recommended:

- i. Monitor technology / market needs to help SMEs decide where to position themselves;
- ii. Monitor EU production capacities, market structure, and data sharing;
- iii. Promote best practices sharing to showcase potential market opportunities for SMEs.

Table 10. Policy recommendations under the Action Plan Pillar IV

Pillar V: Reinforcing market intelligence and monitoring	
Action points	Who should act
<p>i. Monitor technology/market needs to help SMEs decide where to position themselves. Stakeholders interviewed highlighted that SMEs often lack awareness of market opportunities in strategic sectors within the OSA domain. To ensure SMEs play an active role in achieving OSA goals, it is important to inform them about the business opportunities available in various ecosystems.</p> <p>➤ Cloud and edge computing. Multi-cloud platforms, edge computing, and cross-sectoral software applications offer important opportunities for SMEs compared to infrastructure investments, which are very costly and dominated by larger firms. Some successful ongoing projects suggest that there may be available market space in these areas, especially for SMEs at the technological forefront. Policymakers should engage with stakeholders to co-create solutions aimed at identifying market gaps and opportunities for European cloud service providers and SMEs involved in cloud and edge computing technology.</p>	<p>European and national business/sector associations</p>

<ul style="list-style-type: none"> ➤ APIs. The space for SMEs to bolster API production is limited. Implementing advisory or training initiatives to highlight market gaps and areas where SME contributions could be essential would enable them to position themselves where the chances of success are the highest. ➤ Carbon Capture Technology. A mapping of companies active in the industry is needed. This would make it easier to set the right policies and foster closer collaboration within the ecosystem, particularly for SMEs, whose role is currently not very visible and may be understated. ➤ Microelectronics. To allow SMEs better positioning in the market, it would be advisable to identify specific application areas for companies to focus on. Additionally, it is important to highlight the territorial dimension of the mapping, investigating what is being produced in each Member State and how SMEs can serve the entire European market. ➤ Robotics (dual-use). Organising matchmaking initiatives for investors, A&D SMEs, business associations, and policymakers would facilitate SMEs' access to relevant information and the market's needs. These initiatives could take the form of workshops or targeted networking events. They can help make SMEs and investors aware of the unique features and opportunities within the dual-use sector while simultaneously enabling SMEs to better understand investor expectations and government and agency technology requirements. 	
<p>ii. Monitor EU production capacities, market structure, and data sharing. This study has uncovered a notable scarcity of data on SMEs operating within strategic value chains. The available Eurostat statistics – which cover the number of firms, employment, turnover, and value added data – are significantly lacking in detail when broken down by Member States and industry classification codes. This deficiency is often attributed to confidentiality concerns, but such gaps pose serious problems when analysing the economic impact and potential of SMEs. This in turn hinders effective policy formulation and strategic planning.</p> <ul style="list-style-type: none"> ➤ All ecosystems. It would be important to establish a European-level database that compiles information on the number of firms active in each strategic technology, their size and their industry classification code (NACE). In addition, existing relevant databases used by national competent authorities should be made accessible to other Member States and the European Commission. This would enable policymakers to closely monitor all value chains and identify any production capacity gaps, enhancing strategic decision-making and the ability to support EU SMEs. ➤ All ecosystems. Some regulatory changes as well as state aid granting decisions aimed at reaching OSA goals may affect the functioning of the market to the possible detriment of SMEs. It would be vital to explicitly acknowledge these potential market distortions already in the Impact Assessment phase for new regulatory initiatives. In a similar vein, state aid evaluations should take into consideration how the decision would impact the availability of funding for other sectors and for other companies, especially SMEs. ➤ Solar energy technology, and potentially others. The EU-US Trade and Technology Council has led to cooperation through the operationalisation of a joint early warning mechanism for disruptions in semiconductor supply chains and through the exchange of 	<p>European Commission (Eurostat) and Member States</p>

<p>information and market intelligence to address the impact of non-market economic policies.²⁰² Stakeholders interviewed in the solar energy industry have highlighted the need to expand the Council's activities to cover other critical raw materials and components. This recommendation potentially applies to other ecosystems and industries as well.</p>	
<p>iii. Promote best practices sharing to showcase potential market opportunities for SMEs. SMEs involvement in value chains can be improved by exchanging best practice in demonstrate the market feasibility and potential opportunities of certain technological innovations.</p> <ul style="list-style-type: none"> ➤ Heat-pumps. Providing best-practice examples of successful installations would be instrumental in raising awareness and showcasing the potential benefits to both manufacturers and installers. ➤ Solar energy technology. The Big Buyers Working Together²⁰³ project and Community of Practice for sustainable solar panels²⁰⁴ are promising and should be further expanded to disseminate information and co-training to SMEs and let them deal with the complexities and technicalities of Green Public Procurement. ➤ Cybersecurity. Embedding cybersecurity projects into the Cassini initiative would promote the dissemination of best practices from the space sector to other cybersecurity domains, opening up business opportunities for SMEs. ➤ AI. Increasing the visibility of successful AI investments that can be considered best practices would highlight the market opportunities within the sector and boost SME engagement. This can be achieved by leveraging existing tools like AI on Demand.²⁰⁵ 	<p>European and national business associations</p>

5.2.6 Foundational pillar: Continue improving the framework conditions

This last pillar is dedicated to the continued improvement of framework conditions critical for the support and development of SMEs. The issues concerned are well-known – such as lack of information, skill shortages, difficult access to public funding, administrative burden – but addressing them is vital if the impact of specific policy measures aimed at supporting SMEs is to be maximised. This continued improvement helps ensure that SMEs can effectively participate in and benefit from OSA-related initiatives. Specific areas for improvement are:

- i. Increase awareness and monitoring of SME-friendly public procurement;
- ii. Improve information on public support available for SMEs, as well as existing venture capital /investor funds;
- iii. Enhance coordination at the EU level to ensure availability of critical materials and goods for SMEs in all ecosystems;
- iv. Improve communication between high level EU institutions and SMEs, through the involvement of existing intermediary organisations

²⁰² https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/stronger-europe-world/eu-us-trade-and-technology-council_en.

²⁰³ <https://public-buyers-community.ec.europa.eu/about/big-buyers-working-together>.

²⁰⁴ <https://public-buyers-community.ec.europa.eu/communities/community-public-buyers-sustainable-solar-pv>.

²⁰⁵ <https://aiod.eu/>.

v. Reinforce activities for skill development and retention in SMEs.

Table 11. Policy recommendations under the Action Plan's Foundational Pillar

Foundational Pillar: Continue improving the framework conditions	
Action points	Who should act
<p>i. Increase awareness and monitoring of SME-friendly public procurement. The Public Procurement Directive²⁰⁶ envisages several provisions targeting SMEs. However, feedback from interviews suggests that these instruments are still underutilised by national contracting authorities.</p> <p>➤ All ecosystems. Conducting close monitoring of public procurement procedures to understand why procurement authorities are not leveraging SME provisions would be beneficial. Setting up dedicated databases for SMEs to collect the documentation needed for procurement procedures would significantly improve the application procedure for SMEs.</p>	European Commission, Member States and national authorities
<p>ii. Improve information on public support available for SMEs, as well as existing venture capital /investor funds. SMEs find it difficult to navigate the large and diverse landscape of European public support instruments. Nor are SMEs in certain technology sectors always aware of the private or public-private funds available in the EU that offer equity and venture capital for growing companies.</p> <p>➤ All ecosystems. Any effort to improve information on both public and private funding opportunities would help close the financing gap that SMEs experience across a range of technologies.</p>	EU (European commission, EIB) and Member States
<p>iii. Enhance coordination at the EU level to ensure availability of critical materials and goods for SMEs in all ecosystems. SMEs in some sectors (like aerospace and defence) can more easily access critical raw materials due to their higher willingness to pay, driven by relatively higher profitability compared to firms in other sectors. Enhanced coordination at the EU level is necessary to ensure that all ecosystems have access to these critical materials.</p> <p>➤ All ecosystems. Establishing a European central purchasing point would help provide a level playing field, ensuring equitable access to raw materials and critical inputs for all SMEs.</p> <p>➤ All ecosystems. Critical materials availability could also be achieved by creating an international strategy for CRMs leveraging instruments such as investment and export credits to diversify the global supply chains.</p> <p>➤ All ecosystems. Experts consulted have proposed the establishment of a Green Tech Partnership wherein a group of countries would collaborate in extraction, refining, manufacturing, and innovation activities through coordinated specialisation. Specific instruments for the Green Tech Partnership could include trade and investment agreements, technology transfer, financing, and carbon pricing. It would also be important to tackle the supply</p>	European Commission

²⁰⁶ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0024>.

<p>of strategic durable, non-perishable materials and components, e.g. through stockpiling actions.</p>	
<p>iv. Improve communication between high level EU institutions and SMEs, through the involvement of existing intermediary organisations. Stakeholders highlight that the OSA paradigm remains relatively unknown among SMEs. This hinders their effective involvement.</p> <ul style="list-style-type: none"> ➤ All ecosystems. Chambers of commerce, cluster organisations, business associations and national contact points could play a key role in improving communication on the European Commission’s OSA strategy. This would ensure that SMEs understand and can contribute effectively to the overall goals of OSA. 	<p>European Commission, national/business associations</p>
<p>v. Reinforce activities for skill development and retention in SMEs. All EU Member States are experiencing increased labour and skills shortages. While several activities have already been launched at the EU and Member State level to promote upskilling, reskilling, and skill retention in the EU, the current skilled workforce is not enough to satisfy the likely increasing demand for certain skills, also due to an ageing population.</p> <ul style="list-style-type: none"> ➤ All ecosystems. The EU needs to provide competitive incentives to attract and retain specialists in Europe. Salary alone is insufficient, given the stronger financial capabilities of US companies. Complementary measures, already adopted by some Member States but that could be reinforced, include tax exemptions. ➤ All ecosystems. A significant hurdle impeding skills attraction is the existence of 27 different regulatory processes, making the choice difficult for non-EU talent to understand. Member State governments should rethink their visa programmes to attract foreign talents. For instance, simplified immigration and integration procedures for foreign talent would make the choice much easier. Better coordination at EU level would also be advisable. 	<p>Mainly Member States, European Commission for more coordination</p>

6 Concluding remarks

This report has demonstrated the critical role SMEs play across all ecosystems and value chains affected by strategic dependency and vulnerability, which are specifically targeted by OSA initiatives. The role of SMEs ranges from manufacturing to innovation activities, from providing ancillary services to larger EU or foreign companies based in the EU, to actively participating in the development of emerging markets such as carbon capture technology, cybersecurity, critical raw material recovery, edge computing, or very specialised solutions that compete with more consolidated ones (e.g. multi-cloud platforms and biofertilisers). Achieving the OSA goals across various ecosystems is untenable unless SMEs are empowered to fully participate in the value chains, contribute to increased production, and develop their potential for innovation and scaling up.

The challenge is great and ambitious, as highlighted by Mr Mario Draghi, the former president of the European Central Bank. Tasked by the European Commission with producing a high-level report on the EU's competitiveness, Mr Draghi states in January 2024 that the EU needs to invest an "*enormous amount of money in a relatively short time*" to deal with the deep challenges it is facing.²⁰⁷ In April, he added that "*a radical change is needed*", which "*requires us to act as the European Union in a way we have never seen, possibly always*".²⁰⁸

Against this evolving and challenging landscape, this study has contributed to shedding light on how EU competitiveness can be restored or relaunched in critical areas characterised by strong dependency and vulnerability. **The proposed Action Plan for a SME-friendly OSA emphasises a strategy that does not leave SMEs behind** but actively involves them in the implementation of key initiatives and decision-making frameworks. The Action Plan is based on the cornerstones of free trade and openness, principles that are vital for the competitiveness of EU, as also highlighted in Enrico Letta's 2024 report on the future of the EU internal market,²⁰⁹ and of its SMEs particularly. Moreover, the Action Plan outlines strategies for expanding domestic production capacity, reaffirm the EU's position as a global leader in research and innovation, and ensure that openness is balanced by mechanisms that provide a level playing field for EU SMEs.

The EU should set a clear strategic direction in enforcing OSA goals. Strengthening and restoring the industrial and technological competitiveness of the EU extends beyond national policies and requires a concerted effort at the European level, involving both public and private actors. This is crucial not only because the challenge is significant, but also because specific Member States may have their own preferences or economic interests regarding certain ecosystems, particularly those where they have greater capabilities and specialisation. Assessing whether enhancing autonomy in one specific industry outweighs the importance of autonomy in another, under budgetary constraints, may involve contrasting different objectives such as technological sovereignty, national security, food security, climate change, and public health. However, ranking these objectives is impossible, as they all play a critical role in shaping societal well-being and national resilience. Because of this, and because ecosystems are strongly interconnected – with many strategic sectors relying on the same critical materials – it is important that the EU ensures coordination and alignment in policy actions and fosters synergies to maximise the impact of these policies. Specialisations and capabilities of specific

²⁰⁷ <https://www.politico.eu/article/eu-must-find-enormous-amount-of-money-to-face-global-challenges-draghi-says/>: <https://www.eunews.it/en/2024/04/16/draghis-report-holds-the-key-to-europes-future-competitiveness-radical-change-needed/>.

²⁰⁸ <https://www.eunews.it/en/2024/04/16/draghis-report-holds-the-key-to-europes-future-competitiveness-radical-change-needed/>.

²⁰⁹ Letta, E. (2024). Much more than a Market. Speed, security, solidarity. Available at: <https://www.consilium.europa.eu/media/ny3j24sm/much-more-than-a-market-report-by-enrico-letta.pdf>.

Member States should be leveraged, while also ensuring that opportunities are distributed across all EU Member States whenever feasible.

Strategic direction may also imply the necessity of setting priorities. In navigating the extensive list of policy recommendations and considering the high investment needs and that some initiatives can be achieved only in the longer-terms (e.g. those for more enabling framework conditions for SMEs), it may be necessary to strategically prioritise investments. Different approaches are possible. One option may be to concentrate most efforts on nascent markets, where the EU can still build a solid competitive position and where SMEs play a significant role. These markets include, for example, carbon capture technology, cybersecurity solutions, organic fertilisers, and the recovery and recycling of raw materials, but also some specialised technology for solar energy production and cloud computing. In other industries where the EU already faces strong competition from countries outside the EU, the strategy could focus on niche productions and high-value specialisations to reinforce a competitive advantage built on differentiation. Another option may be to target industries/ value chains that not only enhance the EU's strategic autonomy but also potentially impact on a broad spectrum of SMEs. Value chains with a larger SME participation, or recommendations that impact on SMEs across many ecosystems may deserve special attention to ensure broad-based benefits and bolster economic resilience. Setting strategic priorities may also relate to the choice of the policy instruments to use. The policy overview presented a wide range of policies supporting SMEs and OSA. Among these, public procurement seems to play a marginal role in that it has been regulated in a way to avoid market distortions and it has not directly targeted SMEs. However, the international experience shows that public procurement may be a key policy tool for OSA objectives. It may be worth considering whether a different approach to public procurement could better achieve strategic OSA goals and enhance SME involvement.

Policy predictability and consistency over time, as well as speed are crucial to address these challenges and implement the Action Plan. As highlighted by several stakeholders interviewed, predictability in policy ensures that investors and manufacturers have the confidence to commit resources. Since upfront investments can be high, it is essential to combine policies that support both the supply side of the industry and the demand-side to boost consumption. This dual approach helps ensure sufficient and predictable demand, making investors more willing to incur the costs and risks associated with substantial investments. At the same time, whatever prioritisation approach is chosen among the various sectors, the most pressing priority is the urgency with which these actions are implemented. The EU must swiftly mobilise resources and coordinate efforts promptly to maximise the effectiveness of the OSA initiatives and not lose further ground against international competitors. In these crucial times for the EU, immediate action is essential to secure a competitive advantage in the fast-paced global economy.

Annexes

Annex I: Interview programme

An in-depth interview programme was carried out with the relevant stakeholders, including EU policymakers, Member State representatives, business associations, SMEs, and experts. In total, 103 interviews were completed.

The Table below provides a breakdown of interviews carried out by type of stakeholder.

Table 12. Breakdown of interviews by type of stakeholder

Type of stakeholder	Number of interviews carried out	Mode
Business association	47	Oral
EC official	27	Oral
National policy makers	16	Written
Company	8	Oral/Written
Independent expert	4	Oral
Research organisation	1	Oral
Total	103	

Source: Authors.

Annex II: Selection of industrial ecosystems and strategic products and technologies for in-depth analysis

Table 13. Selection of industrial ecosystems

Industrial ecosystem	Selected or not	Rationale for selection or non-selection
 AGRI-FOOD		<p>While food security, as such, is not at risk in the EU, the European Economic and Social Committee noted that Member States and the EU, should adopt toolboxes to deal with unexpected crises and disruptions to food supply chains.²¹⁰ In fact, there are critical dependencies in certain products, such as high-protein crops for animal feed and fertilisers. In line with the Farm to Fork (F2F) strategy²¹¹, the EU should aim to make food systems more sustainable by promoting environmentally friendly practices. But the EU lacks innovation sovereignty in the agri-food sector, with intellectual property mostly held by non-European companies.²¹²</p>
 DIGITAL		<p>The Digital Decade programme is integral to Europe's digital transformation. However, to compete on the global stage, the EU must be able to develop essential technologies facilitating efficiency and cost reduction. The European digital ecosystem is particularly vulnerable when it comes to AI, big data, digital security, and IoT, with heavy reliance on Asian countries and the US for technology imports.²¹³ SMEs are also lagging in the use of digital technology compared with larger companies. The EU's reliance on non-EU digital platforms such as Google, Facebook, Amazon, and Microsoft highlights the significant role played by these multinational tech giants in shaping the digital landscape within the EU. At the same time, these platform economies facilitate B2B e-commerce for SMEs.</p>
 ELECTRONICS		<p>The electronics ecosystem is highly economically vulnerable, due to import and innovation dependency, for instance in the areas of micro- and nanoelectronics.²¹⁴ Chip shortages that occurred during COVID-19 revealed Europe's dependence in semiconductors. These digital key technologies underpin all digital systems and are therefore strategic for several sectors.</p>
 ENERGY-INTENSIVE INDUSTRIES		<p>Energy-intensive industries are central to the EU's green and digital transition and remain essential suppliers of, for example, steel for wind turbines, aluminium for electric cars or chemicals for semiconductors. In general, there are no current shortages in the supply chains of energy-intensive industries, but the analysis of trade flows data (European Commission, 2023)²¹⁵ has identified several products (including raw/processed materials and chemicals) where the EU suffers from potential strategic dependencies due to high reliance on imports.</p> <p>The EU is exposed to a significant increase in potential innovation sovereignty issues in energy-intensive industries, due to external corporate control of the innovation process.²¹⁶ Furthermore, the high cost of energy, especially compared to other regions of the world, jeopardises the competitiveness of these industries. At the same time, a rapid increase in the deployment of green technologies within these industries can hugely increase demand for the materials and components required for their</p>

²¹⁰ European Economic and Social Committee (2021). Strategic autonomy and food security and sustainability. PI_EESC : EESC-2021-02555-AS. Available at: <https://op.europa.eu/en/publication-detail/-/publication/edfb7e1f-2dc2-11ec-bd8e-01aa75ed71a1/language-en>.

²¹¹ European Commission. (2020). Farm to Fork Strategy [online]. Available at: https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en.

²¹² JRC. (2024). Assessing Open Strategic Autonomy. (cit.)

²¹³ Idem.

²¹⁴ Idem.

²¹⁵ European Commission. (2021). Trade Policy Review - An Open, Sustainable and Assertive Trade Policy.(cit.).

²¹⁶ JRC. (2024). Assessing Open Strategic Autonomy. (cit.)

Industrial ecosystem	Selected or not	Rationale for selection or non-selection
		production, with the risk of bottlenecks. In this study, we will focus on technologies that have the potential to reduce the environmental impact of these industries for these reasons.
 <p>ENERGY-RENEWABLES</p>		Looking at recent empirical work assessing strategic autonomy, dependencies and vulnerabilities of the EU renewable energy production ecosystems, a mixed pattern emerges . On the aggregate level the JRC (2024) ²¹⁷ finds that renewable energy is one of the few identified industrial ecosystems that shows both economic and innovation autonomy. On the other hand, the European Commission indicates that renewable energy products are among the ones with the highest aggregate risk of Single Point of Failure. ²¹⁸ This suggests that substantial differences may exist between the various sub-sectors or technologies with the renewable energy value chain.
 <p>HEALTH</p>		Health is a pivotal grand societal challenge within the EU and a focal point of the EU's mission-oriented innovation policies. Health-related issues, such as diseases, healthcare accessibility, and public health crises, have a profound effect on individuals and society as a whole. The health ecosystem displays a notably lower level of economic dependency than other ecosystems. ²¹⁹ The main challenge is in the lack of innovation autonomy . This dependency is largely due to low investment in pharmaceutical R&D in Europe compared to other traditional partners like the USA and Japan (0.1% of GDP compared to 0.35% and 0.25% respectively). At the same time, Europe is facing serious problems related to medicines shortages , which raises concerns in healthcare accessibility.
 <p>MOBILITY-TRANSPORT-AUTOMOTIVE</p>		The mobility ecosystem is pivotal for the “Fit for 55” strategy for ensuring that EU policies are in line with its climate neutrality goals . Road transportation contributes significantly to greenhouse gas emissions, prompting a push for new low-carbon technologies such as batteries and hydrogen-powered fuel cells, as well as smart mobility solutions such as mobility-as-a-service. However, this transition entails a stronger demand for raw and processed materials for which the EU currently lacks production capacity. Significant investment is therefore required for technology and capacity creation, as well as strategic partnerships for material procurement.
 <p>TEXTILE</p>		The textile ecosystem is dominated by SMEs . The EU exhibits notable innovation autonomy in the textile ecosystem (high level of patenting and innovation), but lacks economic sovereignty, due to high import dependency of semi-finished (man-made fabrics, yarns, fabric) and finished products (apparel and footwear). ²²⁰ Import dependency is due to the high level of globalisation of the value chains of the ecosystem, as well as past offshoring and relocation strategies of lower value-added manufacturing activities. ²²¹ The debate on reshoring the manufacturing segments of the textile value chain is gaining momentum, especially after the disruption experienced due to the COVID-19 pandemic. Strengthening autonomous production in certain capital-intensive and highly innovative segments could serve as a significant driver of competitiveness for EU SMEs.
		Security and defence are strategic domains in the context of increasing power competition and intensification of threats. The concept of strategic autonomy was initially used in the context of reinforcing of Europe's defence industry. ²²² The aerospace and defence sectors maintain a level of dependency on external inputs, although less pronounced compared to other

²¹⁷ *Idem*.






²¹⁸ European Commission. (2023). An enhanced methodology to monitor the EU's strategic dependencies and vulnerabilities. (*cit.*)

²¹⁹ JRC. (2024). Assessing Open Strategic Autonomy. (*cit.*)

²²⁰ *Idem*.

²²¹ European Commission (2021). Data on the EU Textile Ecosystem and its Competitiveness. Authored by CSIL and Blumine. Available at: <https://op.europa.eu/en/publication-detail/-/publication/574c0bfe-6142-11ec-9c6c-01aa75ed71a1>.

²²² European Council, Conclusions (EUCO 217/13), 19/20 December 2013. (*cit.*)



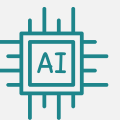
Industrial ecosystem	Selected or not	Rationale for selection or non-selection
AEROSPACE AND DEFENCE		ecosystems. ²²³ Nevertheless, maintaining political sovereignty in this field is deemed essential to ensure defence capabilities, national security, as well as for geopolitical positioning. Fostering innovation in this sector is strategically significant due to the dual-use nature of many technologies.
 CONSTRUCTION	⊗	The EU displays a relatively high level of autonomy in the construction ecosystem. ²²⁴ Nor has this ecosystem been identified as critical by other studies. While access to some raw materials, like hydrogen and metals, can be critical for the construction industry, these are already covered under other ecosystems.
 CULTURAL AND CREATIVE INDUSTRIES	⊗	Pure service-based ecosystems, such as tourism, cultural and creative industries, retail, and proximity, social economy and civil security, that involve no (or only marginal) material production, are not considered areas of vulnerabilities, and for this reason they have been excluded from any previous analysis of OSA by the European Commission. The application of new digital technologies (e.g., AI-based software) or technologies boosting the green transition can find use in these ecosystems too, but they are analysed under the ecosystems that are more directly involved in their development.
 PROXIMITY, SOCIAL ECONOMY AND CIVIL SECURITY	⊗	
 RETAIL	⊗	
 TOURISM	⊗	

Source: Authors.

²²³ JRC. (2024). Assessing Open Strategic Autonomy. (cit.)

²²⁴ *Idem*.

Table 14. Selection of areas of strategic dependency

Selected areas of strategic dependency		Reason for selection: Why is it relevant from an OSA perspective?	Reason for selection: Why is it relevant for SMEs?
Agrifood			
	Mineral fertilisers	Fertilisers play a significant role in ensuring food security. Their production and cost are heavily reliant on natural gas and other chemicals, leading to high import dependency within the EU. ²²⁵ Since Russia's invasion of Ukraine, a major global producer of mineral fertilisers and energy, the sector has experienced significant disruptions in the supply chain and notable cost increases .	The fertiliser industry is dominated by large companies, but SMEs play a central role in strategies aimed at reducing dependence, particularly in the production of alternative sources of fertilisers such as organic fertilisers, biostimulants, as well as services to enhance the efficient use of mineral fertilisers.
	High-protein crops for animal feed	The European Green Deal and Farm to Fork Strategies aim to promote sustainable agriculture, reduce greenhouse gas emissions, and enhance food security within the EU. Cultivating high-protein crops aligns with these objectives by supporting the development of sustainable agricultural practices and reducing the environmental impact of livestock farming. The EU is largely self-sufficient in the production of low-protein crops, but currently relies heavily on imported high-protein crops, such as soybeans, to meet the protein needs of its livestock industry. ²²⁶ This dependency poses risks to food security, vulnerability to supply chain disruptions and price fluctuations in global markets.	SMEs are active in producing, developing and processing alternative sources , such as rapeseed or sunflower seeds.
Digital			
	AI	Despite multiple application in AI (e.g. in the Health, Cultural and Creative Industries, Agri-food, Mobility, Aerospace & defence, etc.), it is within the digital ecosystem and with machine learning applications, that the main market growth will come from. ²²⁷ The software segment (as opposed to hardware and services) is expected to hold the largest share of this market growth, since software lies at the heart of AI applications. ²²⁸ In the EU, AI displays one of the main import dependencies for the digital ecosystem and low innovation autonomy vis-a-vis extra-EU countries. ²²⁹	SMEs are mostly potential users of AI, because of the significant costs in developing foundational models. However, only 7.4% of them currently use AI, due to insufficient level of digital skills, ²³⁰ as well as a shortage of ICT

²²⁵ European Commission (2022) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Ensuring availability and affordability of fertilisers (COM(2022) 590 final). European Commission, Brussels

²²⁶ European Parliament (2023). European protein strategy. EPRS Briefing. Available at: [https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/751426/EPRS_BRI\(2023\)751426_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/751426/EPRS_BRI(2023)751426_EN.pdf).




²²⁷ Artificial Intelligence - Europe. Statista [online]. Available at: <https://www.statista.com/outlook/tmo/artificial-intelligence/europe> [accessed 10 April 2024].

²²⁸ Artificial Intelligence (AI) Market Size, Share, forecast 2032 [online]. Spherical Insights [online]. Available at: <https://www.sphericalinsights.com/reports/artificial-intelligence-ai-market>.

²²⁹ European Commission. (2024). Monitoring the twin transition of industrial ecosystems: digital industrial ecosystem: analytical report [online]. Publications Office of the European Union. Available at: <https://data.europa.eu/doi/10.2826/166054>.

JRC. (2024). Assessing Open Strategic Autonomy. (cit.).

²³⁰ See: https://ec.europa.eu/eurostat/databrowser/view/isoc_eb_ai/default/table?lang=en.

Selected areas of strategic dependency		Reason for selection: Why is it relevant from an OSA perspective?	Reason for selection: Why is it relevant for SMEs?
	Cybersecurity	<p>Cybersecurity will be the cornerstone of a more trustworthy digital ecosystem.²³¹ Although cybersecurity is a ubiquitous technology with a wide range of applications (e.g. smart ecosystems, financial services, defence, energy, transportation, government, health, space, etc.), relative competence centres are most often found in the digital infrastructure area.</p> <p>While the EU keeps pace with the USA in terms of scientific research, it displays significant dependences when it comes to the development of cybersecurity products and technologies, likely due to the presence of fewer European big players.²³² The EU also lags significantly behind in investment directed to innovating start-ups and scale-ups in this domain.</p>	<p>specialists. This may have important consequences on SMEs' productivity and competitiveness on the global stage.</p> <p>The large majority of cybersecurity companies in the EU are SMEs (74%), testifying to the vibrant liveliness of European entrepreneurship in this field.²³³ However, these companies are often just the last mile of the value chain, focusing on system integrators that put together products from third parties.</p>
	Cloud and edge computing	<p>Cloud and edge computing are pivotal enablers of the EU's digital transformation. It is predicted that, by 2025, 85% of organisations will embrace a cloud-first principle.²³⁴ The application of cloud and edge computing is also widespread in other ecosystems (e.g. autonomous vehicles, smart farming). Cloud and edge computing are also key enabler or other critical technologies, such as AI cloud-native software. However, Europe is facing important dependencies in this area, with the main cloud platform operators being extra-EU players (e.g. Microsoft Azure, Oracle, AWS).²³⁵</p>	<p>SMEs may not have much of a market in infrastructure for cloud computing, but they provide multi-cloud solutions to enhance inter-operability. SMEs can also take advantage of the nascent stage of edge computing in order to provide geographically localised services.</p>
Electronics			
	Microelectronics (including silicon wafers, IP design/CAD tools, manufacturing equipment, chip design,	<p>Microelectronics are considered a strategic technology for several reasons. They enable the creation of electronic devices and systems and are therefore integral to a wide range of applications and emerging technologies, including telecommunications, computing, consumer electronics, automotive systems and autonomous vehicles, AI, IoT, augmented reality, medical devices, and more. Microelectronics also play a crucial role in national security due to their use in defence systems, communication networks, intelligence gathering, and encryption technologies.</p> <p>In global chip fabrication, the European share of capacity is below 10%.²³⁶ The global economy</p>	<p>The vast majority of almost 10,000 companies in the semiconductor sector in Europe are SMEs, including start-ups.²³⁸ SMEs are part of the different stages of the supply chain, as well as downstream as users.</p> <p>The Chips Act recognises their centrality and SMEs have been given special</p>

²³¹ European Commission. EU strategic dependencies and capacities: second stage of in-depth reviews. Commission SWD(2022) 41 final. 2022.

²³² *Idem.*


²³³ *Idem.*

²³⁴ *Idem.*

²³⁵ *Idem.*

²³⁶ Chips Act – the EU's plan to overcome semiconductor shortage. (2023). European Parliament [online]. Available at: <https://www.europarl.europa.eu/topics/en/article/20230210STO74502/chips-act-the-eu-s-plan-to-overcome-semiconductor-shortage>.

²³⁸ Position Paper on the European Chips Act. (2022). Silicon Europe Alliance. Available at: https://www.silicon-europe.eu/fileadmin/user_upload/silicon-europe/Dokumente/2022-11-15_SiliconEurope_ChipsActStatement.pdf.

Selected areas of strategic dependency	Reason for selection: Why is it relevant from an OSA perspective?	Reason for selection: Why is it relevant for SMEs?
and semiconductor manufacturing)	<p>relies on Taiwan for 92% of the production of 7- and 5-nm chips. The global supply chain of semiconductors comprises more than 50 choke points, i.e., steps where one region holds more than 65% of the global market share. This represents a high risk of disruptions due to natural disasters, accidents, infrastructure failures, cyberattacks and geopolitical tensions.</p> <p>The EU has acknowledged that the fragility of the semiconductor supply chain puts potentially every sector of the EU economy at risk of disruption, threatening in particular the EU's ability to reap the benefits of the digital transition and to ensure its digital sovereignty.²³⁷ One example is how the war in Ukraine affected the supply of semiconductor-grade neon (a key gas used in chip lithography). Around half of the global supply of neon was provided by two Ukrainian firms, which had to shut down production in Mariupol and Odessa.</p>	<p>attention on two points:</p> <p>(1) Easier access to finance and investment opportunities for SMEs are needed.</p> <p>(2) Competence centres will provide services to semiconductor start-ups and SMEs to improve design capabilities and developing skills.</p>
 Telecommunications	<p>Telecommunications technologies, encompassing hardware, software, and services related to mobile and fixed networks, are strategic for several reasons. They serve as the backbone for global connectivity, enabling seamless communication and data exchange across vast distances. They form the infrastructure that supports various devices and services, including smartphones, tablets, computers, and IoT devices. Telecommunications technologies are pivotal for the deployment and operation of 5G and next-generation wireless networks. These networks promise significantly faster data speeds, lower latency, and increased capacity compared to previous generations, unlocking new possibilities for applications like augmented reality, virtual reality, autonomous vehicles, and smart cities. They are fundamental to the growth and expansion of the IoT ecosystem. Moreover, robust telecommunications infrastructure is essential for national security and public safety, as it enables surveillance and monitoring systems, and facilitate disaster response and recovery efforts.</p> <p>The EU is the 5th region in the world with 3.5% of the global telecommunication electronics production and behind China, other Asian countries and the USA.²³⁹ In 2017, the telecom market as a whole was the largest of electronic markets.²⁴⁰ In terms of overall telecommunication value chain, the EU had an 18% of share in telecommunications services, 4% share in telecommunication electronic equipment, 4% share in electronic boards and 5% share in semiconductors (for telecommunication).²⁴¹ Production of communications equipment in Europe has more than halved since 2010, and the same is true of infrastructure equipment.²⁴² The USA have succeeded in more or less maintaining their production. Nokia (Finland) and</p>	<p>The majority (97.2%) of firms in the telecoms and post sector together are small firms employing less than 50 employees, 1.9% are medium-sized firms and only 0.9% are large firms with more than 250 employees.²⁴³</p> <p>SMEs will also have a critical role in developing, piloting and deploying 5G technologies, both to help with disruptive technologies and to address the needs of various vertical sectors. European SMEs have a great added value in providing innovative concepts and solutions that are having an important impact on the 5G value chain.</p>

²³⁷ The EU chips act: Securing Europe's supply of semiconductors. (2022). European Parliamentary Research Service [Online]. Available at: <https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/733596/EPRS-Briefing-733596-EU-chips-act-V2-FINAL.pdf>.

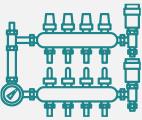


²³⁹ Study on the Electronics Ecosystem. (2020). Decision SARL [online]. Available at: https://www.ipcei-me.eu/wp-content/uploads/2020/11/Study-on-the-Electronic-Ecosystem_Decision_Feb2020.pdf.

²⁴⁰ *Idem*.

²⁴¹ *Idem*.

²⁴² *Idem*.




²⁴³ Telecommunication: Comprehensive sectoral analysis of emerging competences and economic activities in the European Union. (2008). European Commission. DG EMPL project VC/2007/0866.

Selected areas of strategic dependency	Reason for selection: Why is it relevant from an OSA perspective?	Reason for selection: Why is it relevant for SMEs?
	Ericsson (Sweden) are the only two major Europe-based telecom infrastructure and network equipment suppliers at the top of the international rankings, all the other top companies are non-EU ones. Europe has a few legacy telecoms operators, such as Orange, BT, Deutsche Telekom, etc. with differentiating size and activity spread.	
Energy-intensive industries		
 <p>Heat pumps</p>	Heat pumps are an important part of the solutions for making buildings and industries more energy efficient and hence for contributing to attaining climate neutrality. Heat pumps allow using ambient or geothermal energy and waste heat, which increases the flexibility of the industry's energy system. Heat pumps are one of the 5 key strategic technologies identified in the Net Zero Industry Act. The EU heat pump sector is highly innovative and well established . However, the increased demand requires increased manufacturing capabilities. In 2020 the EU became for the first time a net importer , mainly from China. ²⁴⁴ Although few specific material vulnerabilities are reported, sensitivities remain in the area of volatility in metals prices and potential disruptions in critical components such as semiconductors and permanent magnets. The EU is a technology leader especially for large buildings, district heating and cooling networks and industrial applications. Bottlenecks related to both access to some critical raw materials and the lack of trained installers for industrial heat pumps.	The EU has ample production capacities where SMEs play an important role in various roles. ²⁴⁵ The production has an oligopolistic structure in the large scale segment without dominating the SME producers.
 <p>Carbon capture technology</p>	Carbon Capture Utilisation and Storage (CCUS) is a relatively new technology and industry. It is one of the eight strategic technologies identified in the Net Zero Industry Act and is an important technology for reaching climate neutrality by 2050. In 2022 CCUS saw unprecedented growth . Investments doubled between 2021 and 2022. The EU together with the USA and Japan filed the most high-value inventions. ²⁴⁶ CCUS is perceived as a promising technology helping to reach carbon neutrality by 2050, yet concerns about leakages, safety and public acceptance remain at the forefront. The sector uses indirectly a few materials that are on the EU Critical Raw Materials list .	SMEs may facilitate the CCUS in the production, e.g. small-scale test beds , innovative solutions, but also indirectly upstream for construction and maintenance, monitoring of the injection wells. In case biomass is used as a material for bioenergy , SMEs are important for supplying the feedstock (forest management, agriculture).
 <p>Electrolysers</p>	Electrolysers are devices that use electrical energy to split water (H ₂ O) into its constituent elements, hydrogen (H ₂) and oxygen (O ₂), through a process called electrolysis. They enable the production of hydrogen without greenhouse gas emissions when powered by renewable electricity. The Green Deal Industrial Plan classifies water electrolysis as one of the strategic decarbonisation technologies for achieving climate neutrality by 2050. In terms of production capacity half is	SMEs and small mid-caps are present in the innovation segment , with the European Innovation Council Fund providing support for scaling-up. They are also active in the production of

²⁴⁴ JRC (2023). The Heat Pump Wave: Opportunities and Challenges. JRC Science for Policy Report. ISSN 1831-9424. Available at: https://build-up.ec.europa.eu/system/files/2023-07/JRC134045_01.pdf.

²⁴⁵ EHPA (2023). Heat Pumps in the Net Zero Industry Act. Position paper. Available at: <https://www.ehpa.org/wp-content/uploads/2023/07/20230612-EHPA-position-NZIA.pdf>.

²⁴⁶ https://setis.ec.europa.eu/carbon-capture-utilisation-and-storage-european-union-0_en.

Selected areas of strategic dependency		Reason for selection: Why is it relevant from an OSA perspective?	Reason for selection: Why is it relevant for SMEs?
		situated in China while Europe and the USA hold a similar share of the global market. It is expected that capacities will double between 2022-2023. ²⁴⁷ The EU is still leading in terms of high value inventions, together with Japan. ²⁴⁸ European companies have a strong presence as international patent holders and there are a substantial numbers of European manufacturers . However, the EU depends heavily in imports for the necessary critical raw materials included in this technology. ²⁴⁹ This technology is closely linked to the production of fuel cells within the mobility ecosystem (see below), since fuel cells are based on hydrogen.	segments within the value chain and the more novel and niche technologies.
Energy-renewables			
	Solar energy technology	The European Green Deal generates a massive demand for solar energy generation with a tenfold increase needed by 2050. Solar photovoltaic (PV) technologies have become the world's fastest-growing energy technology. Specific PV technologies are also critical for EU's space and defence interests, for instance to guarantee satellite power supply. EU companies are global leaders in several downstream segments of the solar PV value chain. However, the EU faces important strategic dependencies in the upstream manufacturing segments, as China holds 96% of global solar wafer production. ²⁵⁰	SMEs operate especially in the installation and maintenance phases. Few small production companies survived the import pressure from China. There is potential for SMEs to become active in the recycling of panels and they are active in innovation activities.
	Wind energy technology	Current EU manufacturing capabilities easily cover the current demand for major wind energy components. However, in order to fulfil the 2030 climate targets, bottlenecks in supply may occur as more components will need to be purchased from outside the EU. More specifically, potential supply risks may occur in the supply of rare earths which are used in the permanent magnets of turbine generators and wind turbine towers. The EU holds a prominent position in the assembly of wind turbines. ²⁵¹	SMEs facilitate production, installation, maintenance, act as innovative small enterprises for valorising new products and services bringing R&D and production. SMEs operate in symbiosis with the large companies that dominate the market.
Health			
	Active Pharmaceutical Ingredients (APIs) and precursors	Europe's reliance on imports from Asia for a significant portion of APIs and precursors, the essential components of pharmaceutical products, is steadily increasing. Due to intense competition from Asia, European production capacity for approximately 20% of APIs has been depleted . ²⁵² The concept of OSA in this area is linked to the need of enhancing the EU's pharmaceutical production capacity.	While SMEs play a role in producing certain APIs, they often encounter challenges in accessing business opportunities or collaborating with larger companies. Given the specific market dynamics, it is worth exploring how OSA could potentially create new

²⁴⁷ <https://www.iea.org/reports/global-hydrogen-review-2023/executive-summary>



²⁴⁸ <https://hydrogen-central.com/irena-innovation-trends-electrolysers-hydrogen-production/>

²⁴⁹ https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/water-electrolysis-and-hydrogen-growing-deployment-prospects-europe-and-beyond-2023-11-24_en

²⁵⁰ <https://pv-magazine-usa.com/2024/03/04/thin-prospects-for-ingot-wafer-and-solar-cell-manufacturing/>

²⁵¹ <https://windeurope.org/intelligence-platform/product/the-state-of-the-european-wind-energy-supply-chain/>

²⁵² Spain's National Office of Foresight and Strategy. (2023). *Resilient EU2030* [online]. (cit.).

Selected areas of strategic dependency	Reason for selection: Why is it relevant from an OSA perspective?	Reason for selection: Why is it relevant for SMEs?
Mobility-transport-automotive		opportunities for SMEs.
 <p>Li-ion batteries</p>	<p>Lithium-ion batteries (li-ion) are strategically important for a more sustainable and decarbonised Europe, especially for transport, which contributes to 76% of the total CO₂ emissions.²⁵³ LIBs are used in sectors such as mobility, energy storage and portable devices. Their demand is forecast to increase annually by 30% between 2022 and 2030. The biggest increase in demand will come from mobility, with over 80% of the applications, thanks to the push for electric vehicles (EVs).²⁵⁴ LIBs are particularly apt for EV applications thanks to their high energy density, low recharge time and weight.²⁵⁵ Some of the major battery manufacturers are also automotive original manufacturers like Tesla and BYD or have strong partnerships with automotive makers (LG, Samsung, Panasonic).²⁵⁶</p> <p>Although Asia is currently the global hub of EV battery making, European manufacturers should be able to compete on price, because the biggest costs in battery making are (raw) materials, the capital-intensive manufacturing process and the cost of energy. In these three areas, there is hardly any competitive disadvantage compared to Asian manufacturers.²⁵⁷</p>	<p>While the production is dominated by a few large companies, SMEs are involved in their supply chain. In particular, SMEs can provide Original Equipment Manufacturers (OEMs) with tailor-made solutions for niche applications, which will be key for the future competitiveness of suppliers currently linked to legacy technologies such as ice combustion engines. In downstream segments, SMEs in the aftermarket are the first point of contact dealing with the end-of-life cycle logistics for batteries.</p>
 <p>Fuel cells</p>	<p>Fuel cells are used in three main areas: transport (75%), stationary power generation (24%) and portable applications (<1%).²⁵⁸ Fuel cells are also necessary for the green transition in mobility because the supply of raw materials for LIBs will not be enough to meet the increasing demand. Hence, they represent an alternative to EVs and help reduce the burden on the battery value chain.²⁵⁹ Nevertheless, the mobility market for fuel cells is still at an early stage, with only Japanese Toyota and Korean Hyundai providing commercial-ready fuel cell electrical vehicles. The biggest hurdle in the EU is the lack of standardisation for this technology and high</p>	<p>The European hydrogen and fuel cell sector harbours significant potential for local SMEs to create additional business, thanks to several ongoing projects under the Important Projects of Common European Interest (IPCEIs) for the hydrogen value chain. However, much of this potential will depend on the market demand for this new technology,</p>

²⁵³ CO₂ emissions from cars: facts and figures (infographics). (2019). Topics | European Parliament [online]. Available at: <https://www.europarl.europa.eu/topics/en/article/20190313STO31218/co2-emissions-from-cars-facts-and-figures-infographics>.

²⁵⁴ Battery 2030: Resilient, sustainable, and circular. (2023). McKinsey [online]. Available at: <https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/battery-2030-resilient-sustainable-and-circular>.

²⁵⁵ Lithium-ion batteries - statistics & facts. Statista [online]. Available at: <https://www.statista.com/topics/2049/lithium-ion-battery-industry/>.

²⁵⁶ Top 15 Lithium Ion Battery Manufacturer in 2024. (2022). MANLY Battery [online]. Available at: <https://manlybattery.com/top-10-lithium-ion-battery-manufacturers/>.

²⁵⁷ JRC. (2022). Clean Energy Technology Observatory: Batteries for Energy Storage in the European Union – 2022 Status Report on Technology Development, Trends, Value Chains and Markets [online]. JRC Publications Repository [online]. Available at: <https://publications.jrc.ec.europa.eu/repository/handle/JRC130724>.

²⁵⁸ JRC. (2023). Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study [online]. JRC Publications Repository [online]. Available at: <https://publications.jrc.ec.europa.eu/repository/handle/JRC132889> [accessed 9 April 2024].

²⁵⁹ Spain's National Office of Foresight and Strategy. (2023). *Resilient EU2030* [online]. (*cit.*).

Selected areas of strategic dependency	Reason for selection: Why is it relevant from an OSA perspective?	Reason for selection: Why is it relevant for SMEs?
	<p>dependence on raw materials needed for fuel cells (only 3% of which produced by the EU).²⁶⁰</p>	<p>which has not yet reached a stage of widespread commercialisation. Indeed, SMEs are mostly involved in R&D operations, as a de-risking strategy for larger companies.</p>
<p>Textile</p>  <p>Technical textiles</p>	<p>The technical textiles industry is a top value-added growth industry, where Europe has a strong market position and prominent know-how potential.²⁶¹ Differently from other labour-intensive segments of the ecosystems (e.g. clothing), characterised by high import dependency, technical textiles is a capital intensive segment where the EU can still maintain competitiveness at the global level. This makes it relevant for analysis from an OSA perspective.</p> <p>Technical textiles, including non-wovens and articles made of non-wovens, are considered a critical product for the EU. Non-wovens revealed their strategic value during the pandemic, withstanding the sanitary emergency and being used to produce several key hygienic products and filters, including face masks.</p> <p>Technical textiles have other end-use industries. For instance, in the automotive sector, non-wovens are used in over 42 parts of a car, ranging from loudspeaker covers, mats, and window frames, to oil and fuel filters.²⁶² Advanced fabrics can be used for protection and defence applications too, ranging from public services clothing, technical luggage, fabrics for parachutes, etc.</p>	<p>The sector is almost entirely dominated by SMEs.²⁶³</p>
<p>Aerospace and defence (A&D)</p>  <p>Drones (dual-use technology)</p>	<p>The European Drone Strategy 2.0, adopted by the European Commission, sets out a vision for the further development of the European drone market. European Drone Strategy 2.0 emphasises the identification and exploitation of critical technology building blocks, such as artificial intelligence, robotics, semi-conductors, EU space services and mobile telecommunications, to help reduce strategic dependencies.²⁶⁴ The civil applications of drones gained ground, and dominate the market regarding the number of units, with over a million units sold by 2015 in various fields of applications such as agriculture, provision of data for science, logistics and commerce.</p>	<p>SMEs and start-ups represent an important part of the aerospace and defence ecosystem since they perform many niche, complex and innovative tasks in the manufacturing supply chain. As regards the drones market, SMEs are strongly represented downstream in</p>



²⁶⁰ JRC. (2023). Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study [online]. JRC Publications Repository [online]. Available at: <https://publications.jrc.ec.europa.eu/repository/handle/JRC132889> [accessed 9 April 2024].

²⁶¹ European Commission. (2020). Advanced technologies for industry: sectoral watch: technological trends in the textiles industry [online]. EU:s publikationsbyrå. Available at: <https://data.europa.eu/doi/10.2826/69367>.

²⁶² European Commission (2021). Data on the EU Textile Ecosystem and its Competitiveness. (cit.)

²⁶³ European Commission (2021). Data on the EU Textile Ecosystem and its Competitiveness. (cit.)

²⁶⁴ European Commission. (2022). A Drone Strategy 2.0 for a Smart and Sustainable Unmanned Aircraft Eco-System in Europe. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS [online]. COM/2022/652 final. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0652>

Selected areas of strategic dependency		Reason for selection: Why is it relevant from an OSA perspective?	Reason for selection: Why is it relevant for SMEs?
		However, the market size in terms of value is still dominated by military applications, followed by commercial and hobby applications. ²⁶⁵ Cross-fertilisation is possible as civilian drones and civil aeronautics may benefit from developments in the field of defence and vice versa.	the supply chain of drones and especially in the manufacture of small drones. ²⁶⁶
	Robotics (dual-use technology)	<p>In January 2024, the European Commission announced that in early 2025 it will publish an EU-wide strategy paper to ensure coordination across the continent in the uptake of robotics powered by artificial intelligence (AI). Indeed, software-related challenges of robotics include the ability to perform more and more intelligent tasks by using complex software architectures.²⁶⁷</p> <p>The strategy will address all aspects of development and robotics across the 27 Member States of the EU to ensure that Europe stays an important player in the field. It will be linked to other relevant commission plans, such as the AI in workplace initiative and the AI Act. Robotics and artificial intelligence are considered to be possible game changers regarding the fundamental role of people and demography for a state to enable and scale up domestic production, wealth, and military power.²⁶⁸ Indeed, the development of robotics is expected to have a huge impact on the A&D sector. Several countries, including the United States and China, are driving forces in exploring the potential of robotics in the defence sector and space exploration.</p>	The market for robots is categorised into two major segments, namely industrial robots (accounting for 80% of the EU current market) and service robots (20% of the market, with almost half in logistics). Service robotics is expected to displace industrial robotics in terms of sales and market value over the next two decades. ²⁶⁹ Exoskeletons (or wearable robotics) are also of increasing importance, gaining market share in the future for both civil healthcare and defence applications. SMEs are involved in the use of robotic technology. Moreover, a new wave of robotics startups has emerged. ²⁷⁰
	Space systems	On 10 March 2023, the High Representative and the Commission presented for the first time a Joint Communication on an EU Space Strategy for Security and Defence that will allow the EU to protect its space assets, defend its interests, deter hostile activities in space and strengthen its strategic posture and autonomy. ²⁷¹ Indeed, space has always been used by nations to demonstrate their sovereignty, power and technological progress. From 3 space-launching countries (the USSR, US and France) and 3 additional countries owning satellites (Canada, United	The space industry and specifically launch activities and satellite manufacturing for the institutional domestic market segment (including both civil and military applications) can be considered at least partly a captive

²⁶⁵ European Commission. (2020). Critical Raw Materials for Strategic Technologies and Sectors in the EU A Foresight Study. Available at https://rmis.jrc.ec.europa.eu/uploads/CRMs_for_Strategic_Technologies_and_Sectors_in_the_EU_2020.pdf

²⁶⁶ JRC. (2023). Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study [online]. (cit.). and Kunertova, D. (2019). Military Drones in Europe: The European Defense Market and the Spread of Military UAV Technology : Research Report. Center for War Studies.

²⁶⁷ Henry-Fellows, R. (2024). European Commission to publish AI-powered robotics strategy [online]. Available at: <https://www.roboticsandautomationmagazine.co.uk/news/legislation-regulation/european-commission-to-publish-ai-powered-robotics-strategy.html>.

²⁶⁸ Dear, K. (2022). Beyond the 'Geo' in Geopolitics: The Digital Transformation of Power. The RUSI Journal, 166(6–7), pp.20–31.

JRC. (2023). Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study [online]. (cit.).

²⁶⁹ Authors' elaboration based on interview with business association representative; Robotics – Europe by Statista Statista Market Insights, and on Mordorintelligence data. See <https://www.mordorintelligence.com/industry-reports/europe-service-robots-market-industry>

²⁷⁰ European Robotics: Creating new markets for SMEs. Robohub [online]. Available at: <https://robohub.org/sparc-european-robotics-creating-new-markets-for-smes/>.

²⁷¹ European External Action Service. (2023). EU Space Strategy for Security and Defence. Available at: https://www.eeas.europa.eu/eeas/eu-space-strategy-security-and-defence-0_en.

Selected areas of strategic dependency	Reason for selection: Why is it relevant from an OSA perspective?	Reason for selection: Why is it relevant for SMEs?
	<p>Kingdom and Italy) in 1966, more than 65 countries are today involved in space. However, only a few of these states, (mainly the US, China, Russia, Western Europe, Japan and India) have the industrial and technical capacity to manufacture their own satellites and launchers and operate the on-ground tracking, telemetry and control systems to monitor and guide their spacecraft.</p> <p>The competitors of the EU in this field are at the same time the main suppliers of critical and strategic (raw) materials for space systems.</p>	<p>market.²⁷² About 400-500 SMEs contribute to the European space supply chain.²⁷³ Only a few are 'pure' space players, while the majority is composed of aerospace businesses, often microenterprises. Their workforce may represent as much as 4,000 to 6,000 of the total. The majority of SMEs in the space supply chain are located in France, Germany and Italy, in close proximity to the large players.²⁷⁴</p>

Source: Authors based on mentioned sources and interviews.

²⁷² JRC. (2023). Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study [online]. (cit.).

²⁷³ Lionnet, P. (2021). The current structures of the European space manufacturing sector [online]. ASD Eurospace [online]. Available at: <https://eurospace.org/analysis-current-structures-of-the-european-space-manufacturing-industry/>.

²⁷⁴ *Ibid.*

Annex III: The extent of ecosystem coverage in the analysis

The following charts provide an indication of the extent to which each ecosystem is covered by the analysis of strategic products/technologies, relative to the entire sectoral composition of the ecosystem, in terms of value added. The degree of coverage is assessed by considering the economic activities (according to the NACE classification) that are more directly associated with the sample of products/technologies analysed within each ecosystem.

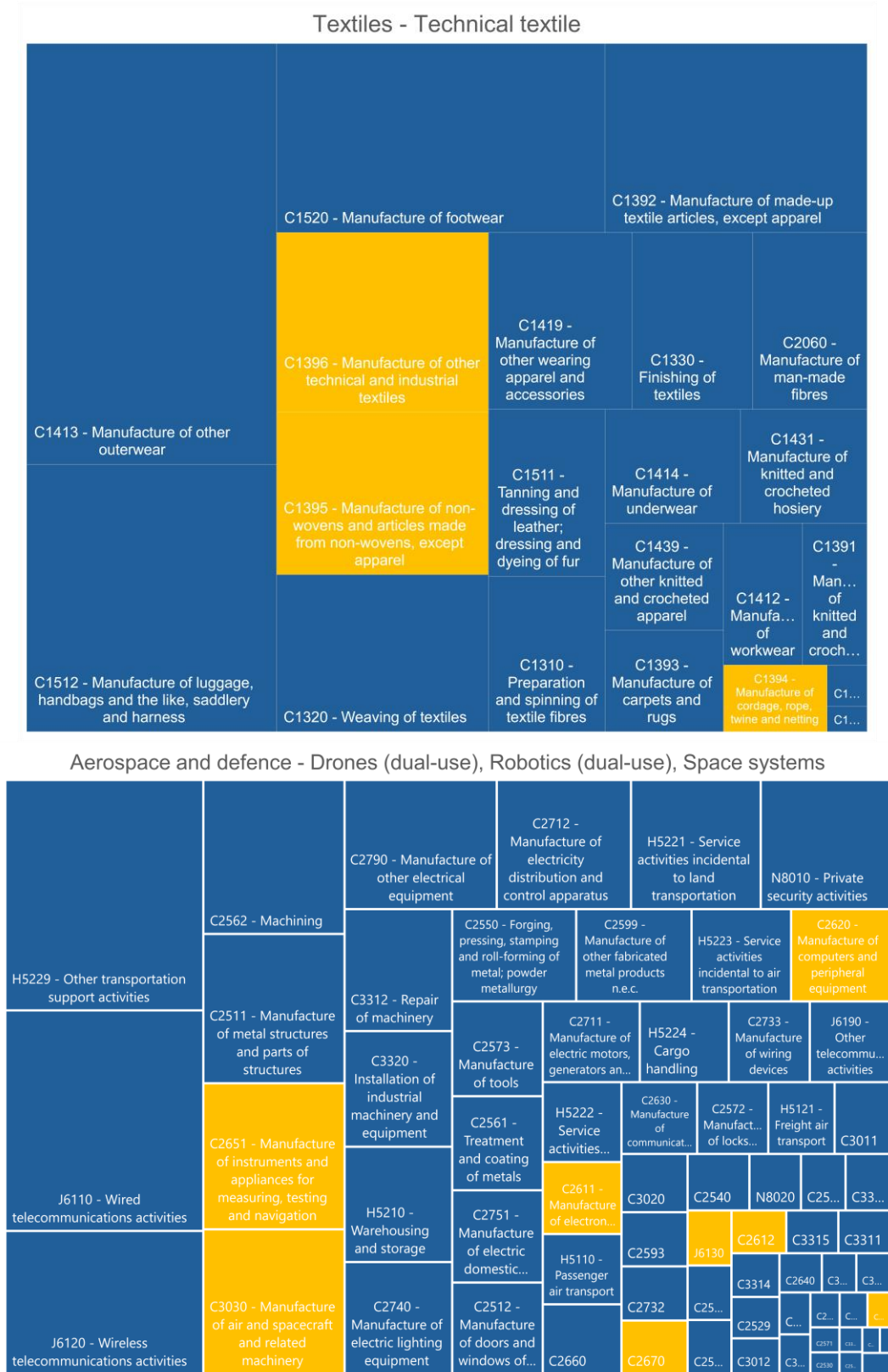
Please note that these charts should be viewed as indicative only, and the following cautionary notes are in order:

- The list of NACE codes associated with each ecosystem has been compiled from the Annual Single Market Report 2022.²⁷⁵ In some instances, this list has been slightly adjusted to ensure that relevant NACE codes pertaining to the selected strategic products and technologies were included.²⁷⁶
- Some NACE codes are defined in very general terms and may be relevant for more products/technologies and ecosystems. For instance, C26.1.2 - Manufacture of loaded electronic boards covers the production of microcontrollers for embedded systems (within the Digital ecosystem), but is also highly relevant for drones and robotics under Aerospace and Defence.
- NACE codes may not capture many emerging technologies well. For instance, NACE J6202 (Computer consultancy activities) includes cybersecurity but hardly covers activities related to AI or IoT.
- A relatively low coverage of the ecosystem does not necessarily indicate a negative aspect. The sectors targeted by the analysis may be those with the highest growth or innovation potential.
- The production activities of companies can be complex and diversified, often not fitting neatly into the NACE classification system. Companies themselves may not always accurately report their primary economic activity code. Because of these limitations, the NACE classification system must be taken with a grain of salt.
- We opted to represent the coverage in terms of value-added, but other variables could also be utilised. However, these variables are still taken into account when analysing the value chains within each ecosystem.

²⁷⁵ <https://ec.europa.eu/docsroom/documents/48877> .

²⁷⁶ The NACE codes that have been added are listed below the charts.

Figure 8. NACE sectors related to the strategic products/technologies analysed by ecosystem

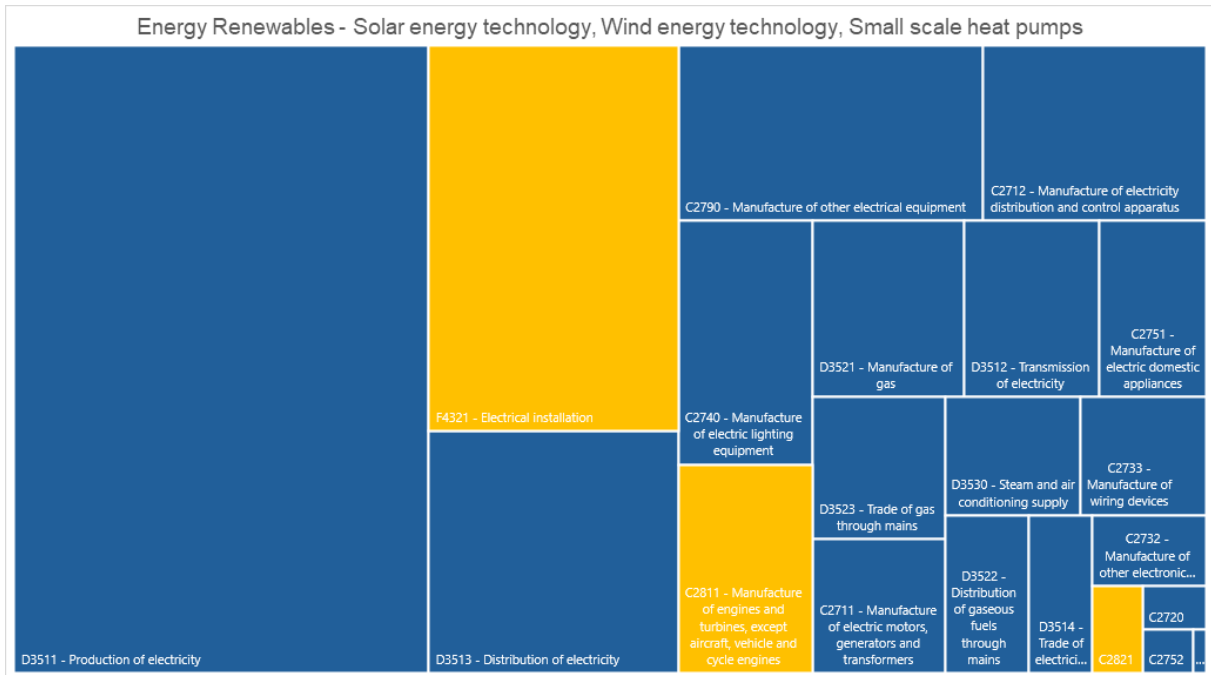


Electronics - Microelectronics, Telecommunications

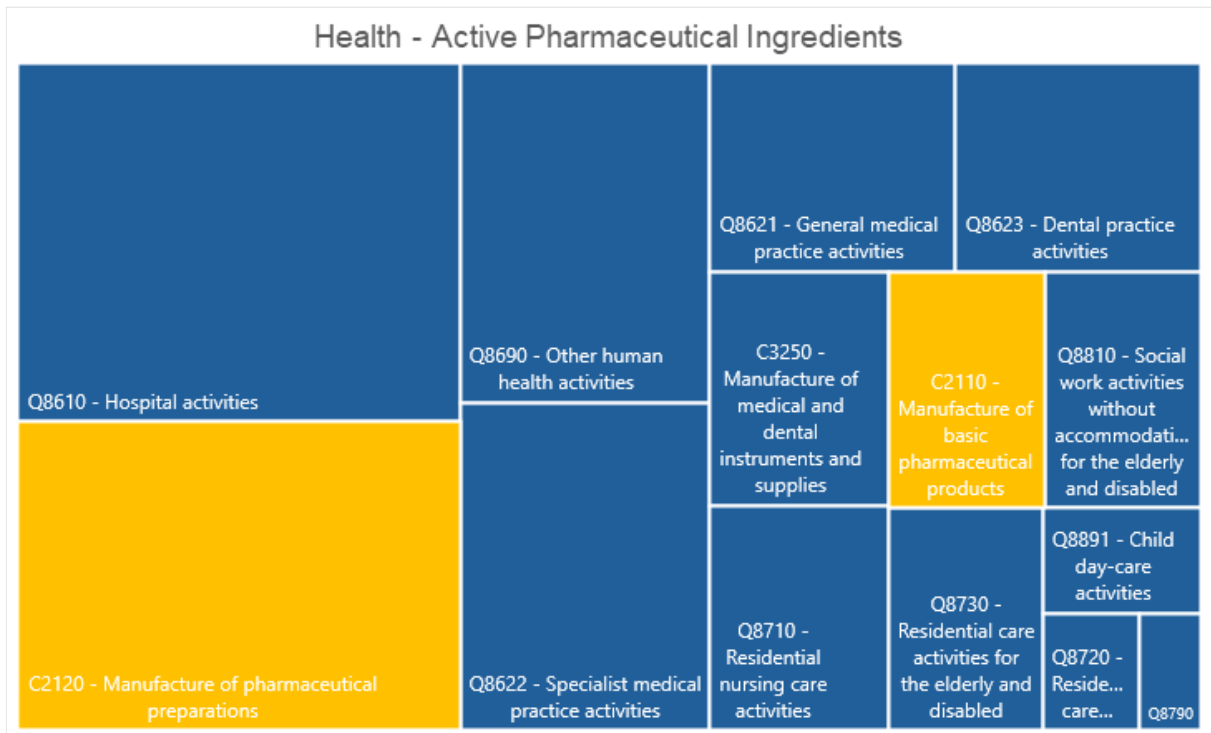
J6110 - Wired telecommunications activities	C2790 - Manufacture of other electrical equipment	C2712 - Manufacture of electricity distribution and control apparatus		C2740 - Manufacture of electric lighting equipment		C2811 - Manufacture of engines and turbines, except aircraft, vehicle and cycle engines		
		C2822 - Manufacture of lifting and handling equipment	C2825 - Manufacture of non-domestic cooling and ventilation equipment		C2751 - Manufacture of electric domestic appliances		C2711 - Manufacture of electric motors, generators and transformers	
	C2651 - Manufacture of instruments and appliances for measuring, testing and navigation	C2620 - Manufacture of computers and peripheral equipment	C2892 - Manufacture of machinery for mining, quarrying and...	J6190 - Other telecommunications activities		C2841 - Manufacture of metal forming machinery	C2611 - Manufacture of electronic components	
		C2830 - Manufacture of agricultural and forestry machinery	C2813 - Manufacture of other pumps and compressors	C2660 - Manufacture of irradiation, electromedic...	C2630 - Manufacture of communicat...		C2893 - Manufacture of machinery for food,...	
J6120 - Wireless telecommunications activities	C2824 - Manufacture of power-driven hand tools	C2814 - Manufacture of other taps and valves	C2812 - Manufa... of fluid power equipm...	C2670 - Manufact... of optical...		J6130 - Satellite...	C2612 - Manufa...	
		C2815 - Manufacture of bearings, gears, gearing and driving elements	C2733 - Manufacture of wiring devices	C2896 - Manufact... of plastics...	C2894 - Manufac... Manuf...		C2821 - Manuf...	
			C2732 - Manufa... of other electron...	C2895 - ...	C28...	C2...		
				C2849 - Manufac...	C2640 - C...	C...	C2...	C...

Digital - AI, Cybersecurity, Cloud and edge computing

J6201 - Computer programming activities	J6110 - Wired telecommunications activities		J5829 - Other software publishing					
	J6120 - Wireless telecommunications activities	J6209 - Other information technology and computer service activities		J6311 - Data processing, hosting and related activities		C2620 - Manufact... of computers and peripheral equipment		
		J5813 - Publishing of newspapers	C2611 - Manufacture of electronic components	C2630 - Manufact... of communi... equipment	J5821 - Publishing of computer games		J5811 - Book publishing	
		J6190 - Other telecommunications activities	C2660 - Manufacture of irradiation, electromedi...	J5814 - Publishing of journals and...	J6130	C2612	J6399	
J6202 - Computer consultancy activities	C2651 - Manufacture of instruments and appliances for measuring, testing and navigation	J6203 - Computer facilities management...	J6312 - Web portals	C2670	C2640	S9...	J5... S95...	



Note: Even though the three technologies reported in the graph are formally part of the Electronics ecosystem (C2821, C2811 and F4321) they are investigated in the context of the Energy Renewables given their relevance for the achievement of the ecosystem's goals.



Agri-food - High-protein crops for animal feed and Chemical fertilisers

A1 - Crop and animal production, hunting and related service activities	C1071 - Manufacture of bread; manufacture of fresh pastry goods and cakes	C1013 - Production of meat and poultry meat products		C1011 - Processing and preserving of meat		C1105 - Manufacture of beer					
		C1107 - Manufacture of soft drinks; production of mineral waters and other bottled waters		C1102 - Manufacture of wine from grape		C1039 - Other processing and...		C1091 - Manufact... of prepared feeds for...			
	C1051 - Operation of dairies and cheese making	C1200 - Manufacture of tobacco products		C1083 - Processi... of tea and coffee		C1012 - Processi... and...		C1041 - Manuf... of oils...		C1061 - Manu... of gra...	
		C1082 - Manufacture of cocoa, chocolate and sugar...		C2015 - Manufa... of fertiliser...		C1020 - Processi... and...		C10...		A3 - Fish... C1...	
	A2 - Forestry and logging	C1101 - Distilling, rectifyin...		C1085 - Manufa...		C10...		C1...		C1...	
		C1092		C10...		C1...		C1...		C1... C...	

Note: Although Mineral fertilisers (C2015) formally belong to the Energy Intensive ecosystem, they are analysed within the Agri-food ecosystem given their relevance for food production.
 Source: Authors.

Annex IV: Spatial distribution of SMEs and drivers of localisation

Table 15. Location of production of strategic products/technologies

Product/Technology	Countries (regions/area)	Smart Specialisation Strategies identifying the product/technology as strategic priority	Drivers of localisation
Robotics and Drones (dual-use technology)	<ul style="list-style-type: none"> Aerospace & Defence use: France (south-western, e.g., Bordeaux and Toulouse; Provence-Alpes-Cote-d'Azur; Paris region); Germany (north-western, e.g. Bremen, and the southern-most federal states, such as Bavaria and Baden-Württemberg); Italy (A&D clusters in Lazio, Lombardy, Campania, Piedmont, Tuscany, Liguria); Poland (Wielkopolska, Lower Silesian; BielskoBiala area); Spain (Central-southern around the axis Madrid-Seville-Cadiz); Sweden (Mälars region, the Linköping area and in Gothenburg, including Trollhättan) Civilian use: The production for civilian use is more dispersed across EU27 (especially robotics): Netherlands, Denmark, Slovenia, Austria, Belgium, Greece, Portugal 	<p>France (Aquitaine, Bretagne, Haute Normandie, Limousin, Pays de la Loire, Provence-Alpes-Côte d'Azur, Alsace, Auvergne, Basse Normandie, Bourgogne, Franche-Comté, Ile-de-France, Languedoc-Roussillon, Lorraine, Midi-Pyrénées, Nord-Pas-de-Calais, Picardie), Italy (Campania, Autonomous Province of Trento, Lombardia, Lazio, Veneto, Emilia-Romagna, Liguria, Marche, Toscana), Germany (Bavaria, Bremen, Lower Saxony, North Rhine-Westphalia, Thuringia), Spain (Cantabria, Castilla y León, Cataluña, Comunidad de Madrid, Principado de Asturias, Comunidad Foral de Navarra), Poland (Dolnośląskie, Mazowieckie Podlaskie, Świętokrzyskie), Sweden (Norrbottens län), Finland (Helsinki-Uusimaa, Kanta-Häme, Ostrobothnia, Lapland, Kymenlaakso, Pohjois-Savo), Austria, Bulgaria, Estonia, Greece, Croatia, The Netherlands (East Netherlands), Romania (South Muntenia, Centre, North-East), Portugal (Madeira, Norte)</p>	<ul style="list-style-type: none"> Proximity to large, and global industrial players Government, public support for defence industry (Civilian use). Strong presence of automation industry, including technology institutes and research centres.
Space systems	Belgium (Wallonia). For France, Germany, Italy, and Spain see the A&D use in the row above	<p>France (Aquitaine, Bretagne, Guadeloupe, Guyane, Haute Normandie, Provence-Alpes-Côte d'Azur, Basse Normandie, Bourgogne, Ile-de-France, La Reunion, Languedoc-Roussillon, Midi-Pyrénées, Nord-Pas-de-Calais, Picardie), Italy (Campania, Abruzzo, Puglia, Basilicata, Lombardia, Sardinia, Lazio, Veneto, Emilia-Romagna, Liguria, Marche, Toscana), Germany (Berlin/Brandenburg, Bremen, North Rhine-Westphalia, Saarland), Spain (Andalucia, Castilla y León, Cataluña, Comunidad de Madrid, Principado de Asturias), Poland (Dolnośląskie, Podkarpackie, Pomorskie, Lubuskie), Sweden (Norrbottens län), Finland (Helsinki-Uusimaa, Kanta-Häme, Ostrobothnia, Lapland, Kymenlaakso, Pohjois-Savo), Bulgaria, The Netherlands (South Netherlands), Romania (Centre, North-East), Portugal (Lisbon, Centro), Greece, Czechia</p>	<ul style="list-style-type: none"> Proximity to large, and global industrial players Manufacturing tradition in spacefaring and established industrial clusters

Product/Technology	Countries (regions/area)	Smart Specialisation Strategies identifying the product/technology as strategic priority	Drivers of localisation
Fertilisers	<ul style="list-style-type: none"> Mineral fertilisers. Production sites are geographically dispersed across the EU27. Main producers are: France, Germany, Poland, Spain, Belgium, Finland, Lithuania, Italy, the Netherlands Organic fertilisers: France, Germany, Spain, Italy, Belgium 	France (La Reunion, Midi-Pyrénées, Picardie, Basse Normandie, Centre, Haute Normandie), Poland , Germany	<ul style="list-style-type: none"> Proximity to raw materials (production inputs) especially for mineral fertilisers Proximity to end users, especially for organic fertilisers (the bulkiness of organic fertilisers which make them hard to transport over long distances) Proximity to universities and other research institutes to carry out related research, especially for the production of organic fertilisers.
High-protein crops for animal feed	Czechia, France, Germany, Lithuania, Poland (as top rapeseed producers in 2021)	France (Bourgogne, Bretagne, Haute Normandie, La Réunion, Pays de la Loire, Picardie, Basse Normandie, Corse, Languedoc-Roussillon, Midi-Pyrénées, Guadeloupe, Guyane, Limousin, Poitou-Charentes, Provence-Alpes-Côte d'Azur), Germany (Saxony-Anhalt, Saxony), Spain (Castilla y León, Región de Murcia, Comunidad Foral de Navarra), Italy (Lombardy, Veneto), Poland (Mazowieckie, Zachodniopomorskie, Dolnośląskie, Łódzkie, Małopolskie, Warmińsko-Mazurskie), Austria , Denmark , Portugal (Alentejo, Norte), Ireland , Romania (South Muntenia, West), Czechia , Latvia , Lithuania , Greece (Western Macedonia)	<ul style="list-style-type: none"> Climate suitability The availability of arable land Demand for the products The presence of companies to process the crops, and bring the end product to market Policy support
AI Cybersecurity Cloud and edge computing	The share of SMEs adopting one or all these technologies is mainly concentrated in Northern and Western Europe (including France, Italy and Spain) and/or in the proximity of urban areas.	Austria , Germany (Breme, Lower Saxony Saarland, Bavaria, North Rhine-Westphalia, Baden-Württemberg, Hessen, Mecklenburg-Western Pomerania, Thuringia), Italy (Lombardy, Liguria, Abruzzo, Calabria, Autonomous Province of Bolzano, Sardinia, Tuscany, Friuli Venezia Giulia, Umbria), Finland (Central Finland, Ostrobothnia, Helsinki-Uusimaa, Kymenlaakso, Limousin, Northern Ostrobothnia, Kymenlaakso), France (Ile-de-France, Rhône-Alpes, Auvergne, Bretagne, Nord-Pas-de-Calais, Rhône-Alpes, Languedoc-Roussillon, Midi-Pyrénées), Belgium , Portugal (Madeira, Centro), Spain (Principado de Asturias, La Rioja, Andalucía, Extremadura, Podkarpackie, Pomorskie), Ireland , Croatia , Estonia , Poland (Łódzkie, Mazowieckie, Lubuskie, Pomorskie, Łódzkie, Zachodniopomorskie), Romania (North-East, North-West), Lithuania , Bulgaria , Luxembourg	<ul style="list-style-type: none"> Access to reliable infrastructure and services Access to skilled labour Presence of larger players

Product/Technology	Countries (regions/area)	Smart Specialisation Strategies identifying the product/technology as strategic priority	Drivers of localisation
Microelectronics	France (Minalogic in Grenoble); Germany (Silicon Saxony in Dresden); Belgium (DSP Valley in Leuven), Netherlands (High Tech NL in Eindhoven)	Austria, France (Basse Normandie, Bourgogne, Bretagne, Midi-Pyrénées, Provence-Alpes-Côte d'Azur, Rhône-Alpes, La Réunion, Limousin), Germany (Bavaria, Hessen), Italy (Abruzzo, Apulia, Lazio), Greece (Western Greece), Belgium, The Netherlands	<ul style="list-style-type: none"> • Proximity to large, and global industrial players
Telecommunications	France, Italy, Germany, Spain, Finland, Sweden.	Austria, France (Alsace, Aquitaine, Bourgogne, Bretagne, Franche-Comté, Guadeloupe, Guyane, Ile-de-France, Lorraine, Midi-Pyrénées, Nord-Pas-de-Calais, Pays de la Loire, Picardie), Germany (Bavaria, Hessen, Baden-Württemberg, Berlin / Brandenburg, Bremen, Hamburg, Lower Saxony, North Rhine-Westphalia, Rheinland-Pfalz, Saarland, Schleswig-Holstein, Thuringia), Italy (Abruzzo, Apulia, Basilicata, Campania, Molise, Sardinia, Valle d'Aosta, Autonomous Province of Trento), Spain (Andalucía, Canarias, Cantabria, Castilla y León, Comunidad de Madrid), Greece (Western Greece, North Aegean, Thessaly), Belgium, Bulgaria, Finland (Central Finland), The Netherlands, Poland (Dolnośląskie, Kujawsko-Pomorskie, Małopolskie, Podkarpackie, Zachodniopomorskie Lubuskie, Świętokrzyski), Ireland, Portugal (Centro, Madeira, Norte) Estonia, Lithuania, Sweden (Gävleborgs län, Östergötlands län, Västra Götalands län), Finland (Northern Ostrobothnia, Päijät-Häme), Slovakia, Romania (South-West Oltenia / Sud-Vest Oltenia, North-East / Nord-Est), Czechia	<ul style="list-style-type: none"> • Proximity to large, and global industrial players • Access to reliable infrastructure and services • Public investments • Favorable regulations that promote competition, innovation
Heat pumps	The manufacturing sites are dispersed across the EU27. Leading producers are Sweden, France and Germany. Italy, Poland, Spain, Finland, and Baltic countries play a minor role.	Czechia, France (Alsace, Centre, Basse Normandie, Bourgogne, Ile-de-France, Limousin, Midi-Pyrénées, Nord-Pas-de-Calais, Picardie, Provence-Alpes-Côte d'Azur, Rhône-Alpes), Spain (Comunidad de Madrid), Germany (North Rhine-Westphalia, Saxony, Hamburg, Mecklenburg-Western Pomerania, Thuringia), Denmark, Sweden (Skåne län), Estonia, Romania, Finland (Kymenlaakso), Greece (Western Macedonia), Poland (Wielkopolskie)	<p>Production sites are often located in rural areas in the respective countries, but not too far from end-users. The following reasons drive such a localisation choice:</p> <ul style="list-style-type: none"> • Bulkiness and inefficiency in long-distance transportation, favour local manufacturing. • Proximity and customisation to the end-markets (historical practises, regional conditions such as climate and space constraints)

Product/Technology	Countries (regions/area)	Smart Specialisation Strategies identifying the product/technology as strategic priority	Drivers of localisation
			<ul style="list-style-type: none"> • Local regulation concerning noise regulations, recyclability, safety, and refrigerants • Production costs, for example related to land prices, tend to be lower outside of major urban areas • The presence of multinational firms active in the value chain • Technically skilled labour
Carbon capture technology	Belgium (Flanders), Denmark, France, Netherlands, Germany, Norway	France (Midi-Pyrénées, Rhône-Alpes), Germany (Hessen)	<ul style="list-style-type: none"> • Access to technology to capture and store CO2 (market-ready projects are concentrated in the North Sea area).. This is mainly because the sites to store carbon are located there.
Electrolysers	The manufacturing sites are dispersed across the EU27, with a concentration in the largest EU countries (Germany, France, Spain), but Denmark and the Netherlands are relatively well positioned.	Electrolysers were not mentioned in any S3 strategy	<ul style="list-style-type: none"> • Proximity to deployment sites (end market) • Proximity to abundant and affordable renewable energy
Solar energy technology	The manufacturing sites are dispersed across the EU27, with a concentration in Germany, Italy, France, Spain, Netherlands. Manufacturers are also localised in the Baltic countries, Sweden, Poland.	Portugal (Alentejo, Algarve), Germany (Berlin / Brandenburg, Hessen, North Rhine-Westphalia), Spain (Cataluña, Extremadura, Comunidad Foral de Navarra, Castilla-La Mancha), Cyprus, Greece, Poland (Kujawsko-Pomorskie, Podkarpackie), France (Alsace Languedoc-Roussillon, Guyane, La Réunion, Mayotte, Nord-Pas-de-Calais, Pays de la Loire, Picardie, Provence-Alpes-Côte d'Azur, Midi-Pyrénées), Lithuania, Poland (Podkarpackie), Romania (South-East, Centre), Czechia. Italy (Umbria), Sweden (Värmlands län, Västra Götalands län)	<ul style="list-style-type: none"> • Proximity to research centres and (technical) universities • Proximity to large companies • Policy environment and support measures • Local climate conditions • The availability of a high-skilled labour force
Wind energy technology	The manufactures value chain covers virtually all EU MS. The major EU MS with wind power manufacturing capacity are Germany, Denmark, and Spain, and France. For the offshore wind segment the Netherlands joins the rank of top MS. Important, but minor roles are played by EU MS bordering the North Sea (e.g.,	Portugal (Algarve, Norte), France (Aquitane, Basse Normandie, Bourgogne, Bretagne, Haute Normandie, La Réunion, Mayotte, Nord-Pas-de-Calais, Pays de la Loire, Picardie, Provence-Alpes-Côte d'Azur, Rhône-Alpes, Languedoc-Roussillon, Midi-Pyrénées), Spain (Aragon, Cataluña, Comunidad Foral de Navarra, Corse, Región de Murcia, Comunidad Foral de Navarra), Germany (Berlin / Brandenburg, Bremen, Lower Saxony, Mecklenburg-Western Pomerania, Rheinland-Pfalz,	<ul style="list-style-type: none"> • Proximity to the end users (installed capacity) • Proximity to port facilities (for offshore installations as well as for trade) • Local climate conditions • Support schemes • Acceptance by landholders • Consistency and predictability of the support for wind energy development

Product/Technology	Countries (regions/area)	Smart Specialisation Strategies identifying the product/technology as strategic priority	Drivers of localisation
	Sweden) and the Baltic Sea (Poland, Finland, Latvia, Lithuania).	Saxony, Saxony-Anhalt, Schleswig-Holstein), Cyprus, Greece, Poland (Podkarpackie, Pomorskie, Świętokrzyskie), Finland (Satakunta), Romania (South-East), Sweden (Västra Götalands län), Czechia	
APIs and precursors	The APIs' production takes place in almost all European countries, although to very different extents. The most important countries where R&D and innovation activity are performed are: Italy, Germany, and France. Spain, Ireland and Netherlands are minor producers.	Active Pharmaceutical Ingredients (APIs) were not mentioned in any S3 strategy	<ul style="list-style-type: none"> • Manufacturing tradition and established industrial clusters • Proximity to large, and global industrial players • Regulatory changes (e.g. the creation of the EU Single market) • Access to cheap labour cost (for SMEs in manufacturing countries)
Li-ion batteries	France (Lille, Bretagne, Bordeaux), Germany (Brandenburg, Lower Saxony, Baden-Württemberg), Hungary (Western Transdanubia), Italy (Piedmont, Naples), Poland (Wroclaw), Spain (Castilla-La Mancha), Sweden (Skellefteå)	Czechia, Finland (Ostrobothnia), France (13 regions), Germany (Lower Saxony, North Rhine-Westphalia, Saxony), Italy (Basilicata), Poland, Spain (Aragón).	<ul style="list-style-type: none"> • Proximity to large, and global industrial players • FDI-friendly governments, including the presence of Extra-EU companies (e.g. the presence of Asian Holding in Poland and Hungary) • Government /public support policies • Proximity to raw materials, including cheap electricity (Sweden) • Proximity to export /import infrastructure (ports)
Fuel cells	SMEs are mostly concentrated in Germany (mostly in the West: Dortmund, Aachen, Münster) and to a lesser extent Italy (Lombardia, Trentino-Alto Adige), Sweden (Gothenburg) and the Netherlands (Rijssen). Spain (Castilla-La Mancha) and France (Paris, Auvergne-Rhône-Alpes) follow. The presence in Eastern European countries is much sparser (e.g. Estonia).	Italy (Basilicata), Spain (Castilla-La Mancha), Czechia, Poland (Pomorskie)	<ul style="list-style-type: none"> • Proximity to potential markets (end users) • Access to technology (and skilled labour) • Presence of R&D centres
Technical textiles	Innovation and the manufacturing are concentrated in a few Member States (primarily Germany, and Italy, followed by France Finland and Austria). Other minor manufacturing countries are: Spain, Netherlands, Belgium, Portugal, Poland, Criatia and Czechia	Spain (Castilla-La Mancha), France (Centre, Languedoc-Roussillon, Midi-Pyrénées), Romania (Centre, North-East), Czechia, Italy (Lombardy, Tuscany), Poland	<ul style="list-style-type: none"> • Historical specialisation and established industrial clusters. • Proximity to large, and global industrial players • Access to cheap labour cost (e.g. Eastern EU countries)

Source: Authors based on desk research and stakeholder interviews.

Annex V: Ecosystems analysis

The detailed ecosystems analyses are provided in a stand-alone document accompanying the study's Final Report. The Annex presents a comprehensive and detailed analysis of each ecosystem and technology discussed in the Final Report. It is based on desk research and 103 interviews with different stakeholders, including EU policymakers, Member State representatives, business associations, SMEs, research organisations, and experts.

Annex VI: Ecosystems Highlights

This Annex comprises stand-alone presentations summarising the main findings for each technology in the ecosystems covered by the study. The documents concisely report the following information:

- the definition of the technology;
- the structure of the technology value chain;
- the role of SMEs in the value chain in terms of their share over the total number of firms, number of employed persons, share of SMEs added value over total;
- the EU strengths and vulnerabilities;
- the list of policy measures introduced to enhance OSA at EU and Member State level. Examples of Extra-EU policies also provided;
- policy recommendations to maximise SME opportunities and reduce risks in OSA.

Annex VII: Policy inventory

The stand-alone Policy Inventory document developed in the context of this study highlights examples of policy measures implemented by the EU, Member States, and selected extra-EU countries to promote OSA, directly or indirectly, with either an explicit or implicit orientation towards SMEs.

The Policy Inventory is based on desk research and information provided by stakeholders, including the SME Envoys. The inventory is a searchable repository in Excel containing, for each policy, the following information:

- the name of the policy, a short description, and its goal;
- the date of launch/entry into force;
- the duration (start and end date);
- the allocated funding (if available);
- the type of policy instruments (subsidy, regulation, specific project, training program, etc.);
- if the policy specifically targets SMEs (Yes, directly; No, only indirect influence; Unclear);
- if targeted to SMEs, the expected outcome on SMEs is briefly reported;
- if it can be considered a good practice, and why;
- the technology/ecosystem the policy refers to;
- the geographic areas where it was implemented (EU vs Extra EU);
- the country where it was implemented. It could be EU-wide, single MS, or extra-EU countries.

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