

PATENT LANDSCAPE ANALYSIS IN THE FIELD OF ADVANCED MATERIALS

Independent Expert Report



Patent landscape analysis in the field of advanced materials

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Patent landscape analysis in the field of advanced materials

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List of abbreviations

AI	Artificial intelligence
AM	Advanced materials
CN	China (two-letter country code)
CNIPA	China National Intellectual Property Administration
CPC	Cooperative Patent Classification
DG	Directorate-General (European Commission)
DG GROW	Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
DG RTD	Directorate-General for Research and Innovation
DIANA	Defence Innovation Accelerator for the North Atlantic (NATO)
DOCDB	EPO master documentation database (source of DOCDB simple patent families)
EC	European Commission
EEA	European Economic Area
EIT	European Institute of Innovation and Technology
EP	European patent (publication code for filings at the EPO)
EPO	European Patent Office
EU	European Union
EU-27	European Union of 27 Member States
EUIPO	European Union Intellectual Property Office
EUR-Lex	Online database of European Union law
FRAND	Fair, reasonable and non-discriminatory (licensing terms)
HE	Horizon Europe
IAM-I	Innovative Advanced Materials Initiative
ICT	Information and communication technologies
IP	Intellectual property
IP5	The five largest patent offices (CNIPA, EPO, JPO, KIPO, USPTO)
IPC	International Patent Classification
IPR	Intellectual property rights
JPO	Japan Patent Office
JRC	Joint Research Centre (European Commission)

KTH	KTH Royal Institute of Technology, Sweden
MPEG LA	Moving Picture Experts Group Licensing Administrator
MTA	Material Transfer Agreement
NACE	Statistical classification of economic activities in the European Community
NATO	North Atlantic Treaty Organization
NDA	Non-disclosure agreement
PATSTAT	EPO Worldwide Patent Statistical Database
PCT	Patent Cooperation Treaty
PRO	Public research organisation
R&D	Research and development
R&I	Research and innovation
REA	European Research Executive Agency
RI&TI	Research and technology infrastructure
RQ	Research question
SEP	Standard-essential patent
SIPO	State Intellectual Property Office of China (predecessor of CNIPA)
SME	Small and medium-sized enterprise
SSRN	Social Science Research Network
TFEU	Treaty on the Functioning of the European Union
TRL	Technology readiness level
TTBER	Technology Transfer Block Exemption Regulation
TTO	Technology Transfer Office
US	United States of America
USPTO	United States Patent and Trademark Office
WIPO	World Intellectual Property Organization
WO	WIPO publication code for international (PCT) applications

Abstract

This study analyses the patent landscape in the field of advanced materials to understand how intellectual assets are protected, managed, and commercialised across the EU, and how the EU's position compares to that of the United States and China. The study draws on a large-scale patent analysis covering 2010–2024, built on 5,481 CPC codes mapped to five sectors: mobility, construction, energy, electronics, and medical devices. This is complemented by surveys of universities, public research organisations, and companies, alongside stakeholder interviews and a validation workshop. The findings reveal a clear contrast between quantity and quality of patents. In volume terms, European companies and PROs file fewer patents than actors in both the United States and China, and their share of global filings has not kept pace with the rapid expansion seen elsewhere, particularly in China. On quality, however, Europe holds a strong position. European portfolios show strong international orientation, high triadic-family shares, and solid citation performance, with particular strengths in energy, medical, and electronics materials aligned with EU policy priorities. This position is constrained by persistent obstacles to turning protected inventions into market outcomes. These include long development timelines, high costs, limited staff and IP expertise, and a critical investment gap around TRL 4–5. The study also finds that near-universal industry–academia collaboration rarely produces jointly owned results, owing to ownership disputes and misaligned incentives. To address these gaps, the report sets out inputs into policy options. These include clearer patenting guidance, support for scale-up below TRL 7, stronger valorisation frameworks, and a facilitating EU role in collaborative licensing mechanisms such as patent pools and clearinghouses.

Résumé

Cette étude analyse le paysage des brevets dans le domaine des matériaux avancés afin de comprendre comment les actifs intellectuels sont protégés, gérés et commercialisés à travers l'UE, et comment la position de l'UE se compare à celle des États-Unis et de la Chine. Elle s'appuie sur une analyse de brevets à grande échelle couvrant la période 2010-2024, fondée sur 5 481 codes CPC rattachés à cinq secteurs : la mobilité, la construction, l'énergie, l'électronique et les dispositifs médicaux. Cette analyse est complétée par des enquêtes auprès d'universités, d'organismes publics de recherche et d'entreprises, ainsi que par des entretiens avec les parties prenantes et un atelier de validation. Les résultats révèlent un contraste clair entre la quantité et la qualité des brevets. En volume, l'Europe dépose moins de brevets que les États-Unis et la Chine, et sa part dans les dépôts mondiaux n'a pas suivi le rythme de l'expansion rapide observée ailleurs, en particulier en Chine. Sur le plan de la qualité, en revanche, l'Europe occupe une position solide. Les portefeuilles européens présentent une forte orientation internationale, une part élevée de familles triadiques et de bons résultats en matière de citations, avec des points forts particuliers dans les matériaux liés à l'énergie, au médical et à l'électronique, en cohérence avec les priorités politiques de l'UE. Cette position est limitée par des obstacles persistants à la transformation des inventions protégées en débouchés commerciaux. Ceux-ci comprennent des délais de développement longs, des coûts élevés, un manque de personnel et d'expertise en matière de propriété intellectuelle, ainsi qu'un déficit critique d'investissement autour des TRL 4-5. L'étude constate également que la collaboration quasi généralisée entre l'industrie et le monde académique débouche rarement sur une propriété conjointe des résultats, en raison de différends relatifs à la propriété et d'incitations mal harmonisées. Pour combler ces lacunes, le rapport propose des éléments pour l'élaboration d'options politiques. Ceux-ci comprennent des orientations plus claires en matière de dépôt de brevets, un soutien à la montée en échelle en dessous du TRL 7, des cadres de valorisation renforcés et un rôle facilitateur de l'UE dans les mécanismes de licences collaboratives tels que les communautés de brevets et les centres de compensation.

Executive summary

Advanced materials are one of the key enablers of Europe's industrial competitiveness, supporting innovation and value creation across strategic sectors such as energy, mobility, electronics, construction and health. Their importance has been further underscored by recent EU policy initiatives seeking to reinforce technological sovereignty, accelerate the green transition and enhance the valorisation of publicly funded research. Given this context, the study analyses patenting and exploitation patterns in advanced materials, with particular attention to the role of EU industry, universities and public research organisations (PROs), and to Europe's position relative to the United States (US) and China.

The analysis indicates that Europe's position is characterised by selective but comparatively high-quality patenting. **Although European actors generate fewer advanced materials patents than their counterparts in the US and China, their patent portfolios display a strong international orientation, a high prevalence of triadic patent families, and a robust citation performance.** This pattern points to a strategic emphasis on inventions with global commercial relevance rather than volume-driven patenting. By contrast, the rapid expansion of advanced materials patenting in China is largely driven by domestic filings with limited international coverage, reflecting differences in incentive structures rather than necessarily weaker technological capabilities. The US, in turn, combines high patenting volumes with extensive international diffusion, supported by well-developed university–industry linkages and mature innovation financing ecosystems.

At a sectoral level medical devices, electronics and energy sectors stand out. **Medical devices** stand out as a particular strength in inward patenting to the EU, marked by a strong tendency of European firms to file first in Europe, a comparatively higher share of foreign-origin priority filings, and solid performance in triadic families and citations. By contrast, **electronics** dominate among start-ups, scale-ups, universities and public research organisations, combining high patenting intensity with strong internationalisation. Electronics also represent the largest share of European companies' global patent portfolios, reflecting Europe's integration into competitive international value chains. At the same time, the highest shares of highly cited patents among European firms are observed in **energy** and medical devices, pointing to specific strengths in frontier inventions aligned with decarbonisation and health priorities.

Priority-filing patterns further clarify Europe's position in the global innovation landscape. Although only a limited share of global advanced materials patents is first filed in Europe, **European firms continue to prioritise the EU (i.e. patents first filed in an EU Member State or via the European Patent Office) as their initial filing jurisdiction**, suggesting a strong domestic patenting base. Sectoral differences nonetheless suggest that Europe acts as an attractive innovation hub in selected domains. Medical devices and construction attract relatively high levels of foreign-origin priority filings in Europe, while outward filing by European firms in these sectors remains more limited. Where European companies do seek protection abroad, filings are concentrated primarily in the US rather than China, particularly in energy and electronics.

Patenting behaviour should be considered within a broader framework of intellectual asset management and exploitation strategies. **Across both academic and industrial actors, patents remain the most commercially significant form of IP, but they are rarely deployed in isolation.** Universities and public research organisations (PROs) make extensive use of non-disclosure agreements, trade secrets and internal know-how to manage early-stage results and structure collaborations. This approach is particularly relevant given the long development cycles typical of advanced materials. Firms similarly combine patenting with secrecy-based protection, notably for processes and formulations that are difficult to reverse-engineer or where disclosure could undermine competitive advantage. Hybrid approaches, integrating contractual instruments, structured background and foreground IP arrangements, and data-licensing mechanisms, are widely applied to manage complex collaborative innovation environments.

Patent exploitation patterns differ significantly across actor groups. Universities and public research organisations (PROs) rely primarily on licensing, spin-off creation and collaborative research and development, reflecting their public missions and limited capacity for downstream market deployment. Firms, by contrast, tend to exploit patents mainly through internal use, complemented by licensing and collaboration where this is strategically justified. **Nevertheless, despite high levels of industry–academia collaboration, joint patenting remains relatively limited.** Many collaborative projects remain concentrated at low to mid technology-readiness levels, while IP negotiations are frequently lengthy and administratively burdensome. A persistent funding gap at TRL 5–7 further constrains the translation of patented inventions into market-ready technologies.

The study identifies a consistent set of challenges across stakeholder groups. Financial constraints remain a central barrier, notably the costs associated with filing, maintaining and internationalising patents, which disproportionately affect universities, public research organisations (PROs) and smaller firms. Limited internal resources and access to specialised expertise further constrain the management of complex IP portfolios and the advancement of commercialisation activities. In academia, institutional incentive structures continue to favour publication over patenting, while lengthy patenting processes may conflict with career progression considerations. Firms also point to concerns regarding examination quality, enforceability and increasingly dense patent landscapes in certain advanced materials domains, which can reduce the effective value of patent protection. Industry–academia collaboration is further impeded by misaligned incentives, ownership uncertainties and administrative complexity.

The report also assesses the potential role of collaborative licensing mechanisms, including patent pools and clearinghouses, in supporting knowledge valorisation. **Such mechanisms can reduce transaction costs, facilitate access to complementary technologies and help address patent fragmentation.** While they are well established in sectors such as information and communication technologies and life sciences, their uptake in advanced materials remains limited. This reflects low awareness, governance complexity and resource constraints. Stakeholders nonetheless express interest, while noting that the fragmented and heterogeneous nature of advanced materials often favours smaller-scale, project-based arrangements over large, standards-oriented pools.

Overall, the findings indicate that **Europe’s challenge in advanced materials lies less in technological capability than in the effective translation of high-quality inventions into scalable commercial outcomes.** Addressing funding gaps at mid technology-readiness levels, strengthening institutional intellectual assets management capacity, simplifying collaboration frameworks and supporting targeted experimentation with collaborative licensing models could significantly enhance knowledge valorisation.

1. Patenting and exploitation trends

RQ1. What are the patenting and exploitation trends in the area of advanced materials by industry, universities and PROs in the EU? How does it compare to the US and China? Dual-use aspect will be addressed here too.

RQ2. How are industry, universities and PROs active in patent protection and exploitation in the field of advanced materials positioned in terms of growth or revenue? Do they perform better than actors not active in the field? How does it compare to the US and China?

RQ3. Is the protection of IP used as an instrument to access financing and if not, how could this be remedied?

Between 2010 and 2024, patenting activity in advanced materials (AM) expanded worldwide, but at markedly different rates across major innovation regions. While Europe has maintained a strong and diversified base of patenting organisations, its overall growth in AM patent families has remained relatively stable compared with the sharp upward trajectories observed in the US and, especially, in China. This pattern mirrors a broader trend seen across advanced technologies, where Europe's scientific excellence and industrial R&D capacity have not always translated into proportional increases in patenting or market deployment¹.

This pattern is also consistent with the Joint Research Centre's (JRC) Economic Complexity analysis², which shows that the EU's innovation system combines strong existing technological capabilities with more limited expansion into fast-growing and disruptive technology domains. The JRC finds that technological diversification typically follows pathways closely related to existing industrial and scientific strengths, which helps explain why Europe's scientific excellence and industrial R&D capacity have not always translated into proportional increases in patent volumes or rapid market deployment, despite a strong underlying innovation base.

According to the European Commission's Industrial R&D&I Investments and Market Analysis in Advanced Materials (2024)³, the number of company-owned AM patents in the EU remained stable over 2010–2019 despite rising R&D investment. In contrast, the US and China achieved significant patent growth, driven respectively by robust innovation-financing ecosystems and state-backed programmes targeting strategic materials such as energy storage, electronics, and composites. The US benefits from well-integrated university–industry patenting networks and venture capital channels that accelerate technology transfer, while China's expansion reflects coordinated policy support and industrial scaling capacity.

In addition, JRC⁴ shows that advanced materials patenting in Europe and the US experienced rapid growth prior to the financial crisis of 2008–2009, followed by a plateau in annual filings, while China continued to expand rapidly. The JRC analysis highlights that these divergent trajectories are not explained by R&D intensity alone, but by differences in capability accumulation, policy coordination, and positioning within the global technological space.

1 Industrial R&D&I investments and market analysis in advanced materials – Summary report, Publications Office of the European Union, 2024, <https://data.europa.eu/doi/10.2777/371763>

2 Albora, G., Benoit, F., Caldarola, B., Di Girolamo, V., Diodato, D., Napolitano, L., & Sciarra, C. (2025). Path to innovation: An economic complexity analysis of technological perspectives in the EU – Advanced Materials. Joint Research Centre, European Commission. Publications Office of the European Union. <https://data.europa.eu/doi/10.2760/6124424>

3 Industrial R&D&I investments and market analysis in advanced materials – Summary report, Publications Office of the European Union, 2024, <https://data.europa.eu/doi/10.2777/371763>

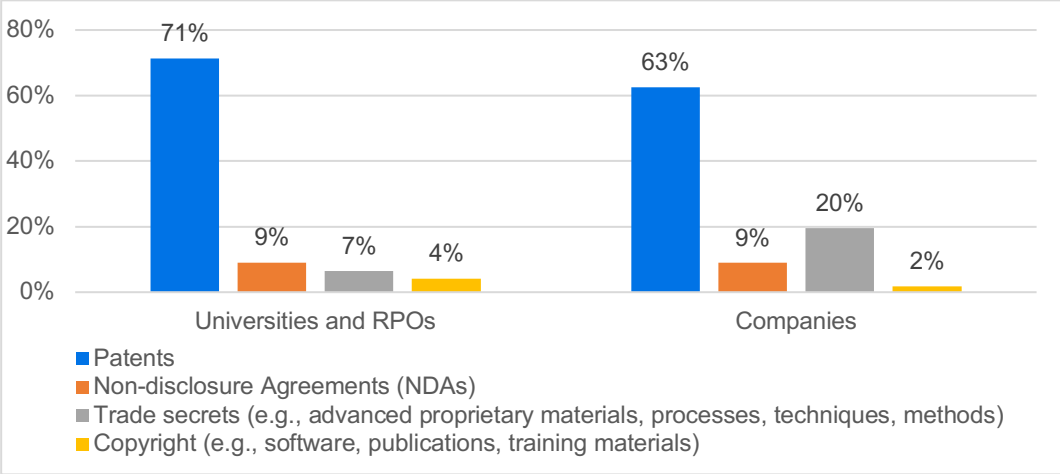
4 Albora, G., Benoit, F., Caldarola, B., Di Girolamo, V., Diodato, D., Napolitano, L., & Sciarra, C. (2025). Path to innovation: An economic complexity analysis of technological perspectives in the EU – Advanced Materials. Joint Research Centre, European Commission. Publications Office of the European Union. <https://data.europa.eu/doi/10.2760/6124424>

Against this global backdrop, **patenting remains one of the key instruments of intellectual property (IP) protection and management within Europe’s advanced materials innovation ecosystem, yet there is some clear evidence that it’s not the only one** (also see sections below and Figure 7).

Figure 1 shows that patents hold the highest commercial value for both universities and public research organisations (PROs) and companies in the field of advanced materials. Among universities and PROs, 71% identified patenting as their main intellectual assets management mechanism, far ahead of non-disclosure agreements (9%) and trade secrets (7%).

Similarly, a majority of companies (63%) also regard patents as their primary IP asset, although their portfolio is more diversified. Around a fifth (20%) rely mainly on trade secrets, and smaller shares use non-disclosure agreements (9%), and trademarks (4%)⁵ as their principal means of safeguarding innovation. This suggests that to date, for both stakeholder groups, patents are viewed as the most commercially valuable form of intellectual assets management. Nevertheless, as shown in Figure 7, both stakeholder groups actively use non-disclosure agreements and trade secrets in addition to patents.

Figure 1. Question: "Of the options you selected above, which one is the primary (i.e. with highest commercial value) IP management strategy your organisation uses?"



Source: University and PROs survey (n=122) and Company survey (n=56).

For universities and PROs, patenting has become increasingly structured and strategic, although institutional maturity and resources vary widely. Several respondents described a clear evolution over the past decade – from ad hoc, researcher-led patenting to more centralised and professionalised systems. One institute representative noted that their first patent was filed only five years ago, and the establishment of a Technology Transfer Office (TTO) marked a decisive turning point, enabling the education of researchers, internal IP policies, and formal agreements with partners. Others confirmed similar transitions, with newly founded universities or research institutes progressively embedding intellectual assets management into their organisational strategies. This institutionalisation of intellectual assets management reflects a broader trend in the European research landscape towards embedding knowledge valorisation as a core mission of publicly funded research⁶.

Despite progress, the interviews also highlight divergent levels of strategic alignment and internationalisation. Some institutions follow well-defined international patenting strategies, filing first in Europe and then extending their coverage through the Patent Cooperation Treaty (PCT)

5 Not visible in the figure due to presentation decision.

6 European Commission. (2023). Guiding principles for knowledge valorisation. Publications Office of the European Union.

or the unitary patent system to secure broader protection. Others are only beginning to formalise IP ownership rules or develop clear procedures for sharing rights with researchers and partners. Larger research institutes often apply a case-by-case approach, coordinated through innovation offices that provide tailored support for grant applications, translational research, and early identification of patentable results.

1.1. The diversity of AM patents filed in Europe

The distribution of patents across sectors and jurisdictions provides insight into the scope and international orientation of innovation in advanced materials (AM). In this analysis, EU patents refer to all patents first filed in any of the EU27 Member States or at the European Patent Office (EPO). Triadic patent families⁷ serve as a proxy for the global competitiveness and technological value of inventions. A higher share of triadic families indicates that applicants consider the technology strategically important in multiple major markets⁸.

1.1.1. Patents filed by companies

Table 1 shows that patent filings related to innovation in advanced materials span across all major sectors in every leading jurisdiction. Patents with an EU priority jurisdiction are particularly concentrated in electronics (20,545 patents) and construction (11,779), followed by energy and mobility. In terms of internationalisation, EU priority filed patents display the highest triadic share (24.1%), almost double that of the US (13.7%) and far above China (0.6%). Filing the same invention simultaneously in Europe, the US and Japan typically reflects a strategic decision to incur substantially higher costs and administrative complexity, which is generally justified when applicants seek protection across multiple leading markets. The higher triadic share of European patents therefore indicates a stronger orientation towards international markets and global IP protection strategies. At the same time, the comparatively low share of triadic patents among Chinese filings should not be interpreted as evidence of lower technological relevance, but rather as reflecting different incentive structures and patenting strategies, including a stronger focus on domestic market protection within China's innovation system, as highlighted by the JRC's Economic Complexity analysis⁹ (also, refer to Annex 3 for more details on Chinese patenting in AM).

Looking at the selected sectors separately, medical devices (34.8%) and energy (27.6%) show the most internationalised portfolios among EU-priority filings. By contrast, mobility (19.2%) and construction (24.1%) remain more domestically concentrated but still perform far above Chinese levels, where less than 1% of patents in any sector form triadic families. The Chinese patent landscape, although expansive (with over 190,000 patents across these AM sectors), remains primarily national in scope, indicating rapid internal diffusion but limited cross-border protection. Overall, the data reveal a qualitative rather than quantitative advantage for Europe: fewer EU priority filings by companies, but stronger indicators of technological internationalisation and, by extension, commercial potential.

7 Triadic families are considered those filed at the European Patent Office (EPO), the United States Patent and Trademark Office (USPTO) and the Japan Patent Office (JPO).

8 For the detailed methodology of patent analysis refer to Annex 2; for the delineation of technologies and sectors please refer to Annex 1.

9 Albora, G., Benoit, F., Caldarola, B., Di Girolamo, V., Diodato, D., Napolitano, L., & Sciarra, C. (2025). Path to innovation: An economic complexity analysis of technological perspectives in the EU – Advanced Materials. Joint Research Centre, European Commission. Publications Office of the European Union. <https://data.europa.eu/doi/10.2760/6124424>

Table 1. Number of AM patents in selected AM sectors and share of triadic families per priority jurisdiction.
Company data (2010-2024)¹⁰

	EU		US		China	
AM sector	No of patents	Share of triadic patents	No of patents	Share of triadic patents	No of patents	Share of triadic patents
Construction	11,779	24.1%	9,932	18.4%	53,771	0.7%
Electronics	20,545	25.7%	28,704	13.5%	146,096	0.7%
Energy	4,429	27.6%	4,235	16.6%	25,357	0.9%
Medical devices (NACE 3250)	2,676	34.8%	3,620	19.4%	9,366	1.1%
Mobility	2,880	19.2%	1,807	19.3%	3,945	0.9%
Total of unique patents ¹¹	28,865	24.1%	35,257	13.7%	194,216	0.6%

Source: PATSTAT data.

While large firms dominate advanced materials patenting in absolute terms, start-ups and scale-ups also play a distinct and increasingly visible role. Although their patent portfolios are much smaller, these younger firms are active across all major AM sectors, with particularly strong engagement in electronics.

Despite their smaller scale, start-ups and scale-ups exhibit a high degree of internationalisation in their patenting behaviour. Across all sectors, around one quarter of their patents form triadic families, a level comparable to that observed for established European companies. The highest triadic shares are observed in energy and medical devices, where global markets, regulatory requirements and investor expectations tend to encourage early international protection. Electronics also displays consistently high triadic shares, in line with its globally integrated value chains. Overall, the evidence indicates that Europe's emerging advanced materials firms, while limited in patenting volume, pursue internationally oriented IP strategies, positioning themselves early for participation in global markets and value chains.

¹⁰ A full AM patents dataset is used, and each patent family is attributed to an ownership type (Company, PROs) based on the institutional sector of its applicants (full methodology can be found in Annex 2.).

¹¹ "Unique patents" refers to the deduplicated count of distinct patents. Because a single patent may be assigned to more than one AM sector, sector-level figures cannot be summed to the total; each patent is counted once in the "Total of unique patents" row.

Table 2. Number of AM patents in selected AM sectors and share of triadic families in EU priority jurisdiction by startups and scaleups. Dealroom data (2010-2024)¹²

	All Start-ups/scale-ups filing in EU priority Jurisdiction		European Start-ups/scale-ups filing in any priority jurisdiction	
AM sector	No of patents	Share of triadic patents	No of patents	Share of triadic patents
Construction	377	24.6%	420	21.2%
Electronics	1341	26.2%	987	26.3%
Energy	219	30.5%	126	28.6%
Medical devices (NACE 3250)	261	28%	341	30.5%
Mobility	27	11%	34	20.6%
Total of unique patents	1654	24.5%	1443	25.1%

Source: PATSTAT and Dealroom data.

1.1.1.1. *Priority filing patterns: inflows to and outflows from Europe*

Table 3 presents the distribution of company patents in advanced materials by the jurisdiction of their priority filing. Between 2010 and 2024, companies worldwide filed over 107,000 patents related to advanced materials. Only about 4.7% of these patents have their priority jurisdiction in Europe, illustrating that the global innovation base in this field remains heavily concentrated outside the EU.

Within this total, approximately 26% of patents with EU priority jurisdiction were filed by non-European companies. Among European companies, the majority of patents (82.6%) were first filed in Europe, confirming a generally home-oriented filing strategy. However, around 17% of European company patents were first filed outside the EU. Methodological factors can partly explain this, as patent ownership is attributed to the country of the company's headquarters, which may differ from the location of the subsidiary or R&D centre that actually filed the patent. It may also reflect joint international projects, where filings occur in the jurisdiction of a consortium partner, or strategic choices to prioritise protection in larger or faster-growing markets such as the US or China.

¹² The analysis focuses on companies in the internal company database that are from Dealroom database and have been assigned advanced materials patents. Dealroom is a widely used source for startup and scale-up data, enabling consistent identification of innovative firms. For sectoral classification, only patent families belonging to priority advanced materials sectors were retained. Sector assignment is based on CPC and NACE classifications, and patents were included in the analysis only if they fall within the predefined priority sectors.

Table 3. Company patent distribution based on the origin of the patent (2010-2024) ¹³

AM sector companies belong to	All company patents (all jurisdictions)	Global Company patents with priority jurisdiction in Europe (% of all patents)	European company patents with priority jurisdiction in Europe (% of total European company patents)	European company patents with priority jurisdiction outside Europe (% of total European company patents)
Electronics	76,169	2,440 (3.2%)	1,716 (78.2%)	478 (21.8%)
Construction	16,346	711 (4.3%)	436 (88.6%)	56 (11.4%)
Energy	23,258	613 (2.6%)	420 (71.4%)	168 (28.6%)
Medical devices (NACE 3250)	2,992	572 (19.1%)	435 (86.6%)	71 (14.0%)
Mobility	11,168	1,247 (11.2%)	1,094 (87.1%)	162 (12.9%)
Total of unique patents	107,773	5,079 (4.7%)	3,721 (82.6%)	786 (17.4%)

Source: TECHNOTE data and PATSTAT.

When comparing the share of global company patents with an EU priority jurisdiction and the share of European company patents first filed outside the EU, a notable inverse pattern emerges. **Sectors that attract a higher proportion of foreign-origin patents filed in Europe tend to have lower outward filing shares among European companies, and vice versa.**

This relationship can be interpreted as an indicator of the relative strength and attractiveness of the EU innovation base within each sector:

- In sectors such as medical devices and construction, a higher foreign presence in EU-priority filings coincides with lower internationalisation of European companies. This suggests that the EU may be seen by companies as a strong and self-sustaining innovation hub, attracting non-European firms to seek protection in its market while domestic firms focus on consolidating their position locally.
- Conversely, in sectors such as energy and electronics, where fewer foreign-origin patents are first filed in Europe, European companies show greater outward orientation, seeking first protection abroad. This pattern implies a weaker domestic patenting base or stronger global dependency, as firms prioritise external markets or partnerships beyond Europe.
- The mobility sector falls between these two poles, reflecting both international integration and a balanced dual orientation of European and non-European actors.

Further analysis suggests that when European companies choose to prioritise protection outside Europe, they overwhelmingly target the US rather than China (see the table below). Across all AM sectors, 37% of patents first filed outside Europe go to the US, compared to only 6% to China. In terms of sectors, the strongest US orientation appears in energy (53% of outward filings) and electronics (45%), reflecting the global competitiveness and rapid innovation cycles in these fields. Medical devices also show a pronounced focus on the US (41%).

¹³ Sector was assigned based on the company sector, not patent sector.

Table 4. European company patent distribution based on the destination of the priority patent filings (2010-2024)¹⁴

AM sector companies belong to	European company patents with priority jurisdiction outside Europe	European company patents with priority jurisdiction in the US (% of total patents priority filed abroad)	European company patents with priority jurisdiction in China (% of total patents priority filed abroad)
Electronics	478	215 (45%)	41(9%)
Construction	56	9 (16%)	3 (5%)
Energy	168	89 (53%)	23 (13%)
Medical devices (NACE 3250)	71	29 (41%)	-
Mobility	162	35 (22%)	2 (1%)
Total of unique patents	786	290 (37%)	46 (6%)

Source: TECHNOTE data and PATSTAT.

1.1.2. Patents filed by universities

A similar pattern emerges for universities (Table 5). Although universities file substantially fewer patents than companies, those with priority filings in the EU display a relatively high degree of internationalisation, with 12.3% of patents being triadic. This proportion exceeds that of patents with US priority (1.4%) and Chinese priority (0.07%). The energy sector (22.8%) stands out for its high share of triadic patents, underscoring the global significance of European academic research in materials for energy conversion and storage.

The very low triadic ratios for Chinese and US university patents potentially suggest that academic patenting outside Europe remains predominantly local or experimental in scope. In contrast, European institutions pursue protection for a selective subset of high-impact inventions, often through technology transfer offices or international collaborations.

Please note that the analysis of academic patents was conducted only on university patents due to methodical limitations. The complementary qualitative analysis and interview information covers both, universities and private research organisations (PROs).

¹⁴ Sector was assigned based on the company sector, not patent sector.

Table 5. Number of AM patents in selected AM sectors and share of triadic families. University data (2010-2024)¹⁵

	EU ¹⁶		US		China	
AM sector	No of patents	Share of triadic patents	No of patents	Share of triadic patents	No of patents	Share of triadic patents
Construction	373	11.3%	455	1.3%	6,126	0%
Electronics	1,972	13.2%	3,236	1.4%	48,908	0.1%
Energy	276	22.8%	457	1.8%	7,984	0.1%
Medical devices (NACE 3250)	645	13.5%	961	1.7%	6,575	01%
Mobility	36	5.6%	39	0%	412	0%
Total of unique patents	2,594	12.3%	4,053	1.4%	58,290	0.07%

Source: PATSTAT data.

1.2. Chinese patenting in advanced materials

Chinese patenting in advanced materials has expanded rapidly, particularly from around 2015 onward. CNIPA (formerly SIPO) now records roughly five to six times as many AM-related patents as the USPTO and the EPO respectively. However, the share of these filings that form triadic families remains far lower, confirming that the surge is driven overwhelmingly by domestic, single-jurisdiction filings rather than by internationally protected inventions.

This pattern is not specific to advanced materials. A broader analysis of all patent families in PATSTAT shows Chinese filing activity rising faster than in the US or Europe since the early 2000s, a trend already well documented in the literature. Within advanced materials, however, the acceleration is more pronounced: between 2012 and 2016, CNIPA filings in the field grew almost seven-fold ($\times 6.7$), against near-flat growth at the EPO, USPTO and under WIPO (each close to $\times 1.2$), and well above China's all-field growth over the same period ($\times 1.9$). This indicates that advanced materials became an area of heightened strategic importance for China over the past decade.

The orientation of these filings has also shifted. Before 2015, Chinese AM patents were more often filed in more than one jurisdiction; since then they have become overwhelmingly domestic. The proportion of CNIPA families in the field containing only a Chinese member rose from about 2% in 2000–2004 to over 90% in 2022–2023. In other words, the vast majority of recent Chinese AM patent activity is confined to China.

These trends point to a dual dynamic: a growing global presence of Chinese patenting alongside an even faster expansion of purely domestic activity. This reinforces the interpretation that the comparatively low triadic share of Chinese filings reflects a domestic-market focus rather than lower technological relevance (see Annex 3 for the full analysis).

¹⁵ A full AM patents dataset is used, and each patent family is attributed to an ownership type (Company, University) based on the institutional sector of its applicants (full methodology can be found in Annex 2.).

¹⁶ Here and elsewhere in our analysis EU patents refer to all patents filed in any of EU27 jurisdictions + EPO patents.

1.3. Patent quality

The aim of this section is to understand how influential and far-reaching the inventions in the field of advanced materials (AM) are. Quality is measured through a few indicators. The first is how often a patent is later cited by other patents, known as forward citations, which signals its technological influence. The second is the number of jurisdictions in which a patent is protected, referred to as breadth, which indicates its international reach. The third is whether a patent ranks among the top 10% most cited, which identifies the highest-impact inventions. The analysis begins by comparing Europe with its main competitors, the US and China. This comparison is based on where each patent was first filed, so it groups patents according to whether they were first filed in Europe, in the US or in China. It considers the patents of companies as well as those of universities, first overall and then sector by sector. It then focuses on companies alone, comparing European firms with their non-European counterparts. This comparison looks first at worldwide patent portfolios and then at the patents that were first filed in Europe.

Patent quality indicators, such as forward citations and family size, suggest that European patents in advanced materials (AM) have a solid influence and international reach, even though the overall volume of filings is smaller than in the US or China. At the same time, important limitations to these indicators should be acknowledged. Forward citations are influenced by differences in patenting practices, language and the accessibility of patent documents, and may underrepresent the impact of patents filed primarily in non-English languages, notably Chinese-language filings. These patterns are consistent with a stronger emphasis in Europe on selective, knowledge-intensive innovation and international protection strategies, rather than large-scale patenting.

Across major patent offices, EU priority-filed company patents record an average of 4.3 forward citations, compared with 12.4 for US priority-filed and 1.8 for China priority-filed patents (see Table 6). **The difference reflects the stronger global diffusion of US inventions, while the European figure still denotes a substantial technological influence relative to its portfolio size.** University and PRO patents in the EU average 2.5 citations, signalling valuable but more incremental outputs typical of publicly funded research. By contrast, Chinese filings receive comparatively fewer forward citations, which is partly influenced by linguistic and accessibility barriers, but nonetheless points to more limited observable international reuse of these inventions within the global patent system.

Table 6. Forward citations of AM patent families in selected sectors, by priority jurisdiction

Priority jurisdiction	Company patents			University Patents		
	Average citations forward citations)	(Median forward citations)	No of unique patents	Average citations forward citations)	(Median forward citations)	No of unique patents
EU	4.3 (1)		28,865	2.5 (1)		2,594
US	12.4 (4)		35,257	6.8 (3)		4,053
China	1.8 (1)		194,216	2.3 (1)		58,290
Other	5.3 (2)		117,376	3.7 (1)		15,020
Multiple (EU included) ¹⁷	9 (4)		47,054	11 (5)		3,419
WO (PCT)	1.9 (0)		11,173	2.6 (0)		1,766

Source: PATSTAT data.

Within EU-priority filings, company patents in energy (5.2 citations) and medical devices (5.0) show the highest impact, suggesting that these sectors generate innovations of broad relevance across materials and manufacturing domains (see Table 7). Construction and electronics also perform above the average, reflecting the importance of AM in sustainable building and smart components. University patents tend to display lower citation counts overall, although their strongest performance is observed in electronics and energy, where academic advances often underpin industrial applications.

Table 7. Forward citations of AM patent families in selected AM sectors in the EU priority jurisdiction

AM sector	Company patents			University Patents		
	Average citations forward citations)	(Median forward citations)	No of unique patents	Average citations forward citations)	(Median forward citations)	No of unique patents
Construction	4.4 (2)		11,779	2 (0)		373
Electronics	4.6 (2)		20,545	2.7 (1)		1,972
Energy	5.2 (2)		4,429	3.7 (1)		276
Medical devices (NACE 3250)	5 (2)		2,676	2.4 (1)		645
Mobility	4.3 (1)		2,882	1.3 (0)		36

Source: PATSTAT.

The breadth indicator, which reflects the average number of jurisdictions per patent family, reveals that EU company patents typically protect their inventions in 2 to 3 jurisdictions¹⁸ (see Table 8). In comparison, university patents average approximately 1 to 2 jurisdictions¹⁹. This shows that firms pursue broader international protection aligned with commercial exploitation, whereas universities usually file in a limited set of markets, often to support collaborative or

¹⁷ Cases with more than one priority jurisdiction on the same filing date (one of the filings in in the EU-country). Since no single priority authority can be assigned, these families are grouped separately to ensure consistency.

¹⁸ Mostly US, China and Japan.

¹⁹ Mostly US or China.

licensing opportunities. This narrower reach is consistent with their public-research mission and resource constraints.

Table 8. Breadth of impact in the EU priority jurisdiction per AM sector (2010-2024)

AM sector	Company patents		University Patents	
	Average breadth (median)	No of unique patents	Average breadth (median)	No unique patents
Construction	2.7 (2)	11,779	1.3 (1)	373
Electronics	2.7 (2)	20,545	1.5 (1)	1,972
Energy	2.9 (2)	4,429	2 (1)	276
Medical devices (NACE 3250)	3.4 (3)	2,676	1.6 (1)	645
Mobility	2.4 (2)	2,882	1 (1)	36

Source: PATSTAT data.

The share of highly cited patents (those in the top 10% of forward citations) provides another perspective on patent quality. Between 2010 and 2024, 13.9% of EU priority filed company patents fall into this top category, compared with 29% of the US priority filings and 4.1% of China priority filings. For universities, the EU share reaches 7%, below the 23% observed in the US but well above China’s 5.6% (see Table 9). This pattern confirms that European research and industry together produce a modest but influential share of frontier inventions.

Table 9. Share of highly cited patents in selected sectors, 2010-2024

Priority jurisdiction	Companies	Universities	Overall (including other applicant types)
EU	13.9%	7%	12.2%
US	29.0%	23.1%	26.3%
China	4.1%	5.6%	3.7%
Other	16.5%	6.2%	14.3%
Multiple (Including EU)	31.3%	35.2%	30.1%
WO (PCT)	5.1%	8.8%	5%

Source: PATSTAT.

At the sectoral level, energy-related patents (18.2%) lead in the EU, followed by medical devices (16.5%) and electronics (15%). These fields closely correspond to Europe’s strategic priorities for decarbonization, digitalisation, and health technologies. Construction and mobility also exhibit notable proportions of highly cited patents (approximately 15%), indicating a growing technological sophistication in sustainable materials and lightweight engineering.

Table 10. Share of highly cited patents per selected sector in the EU priority Jurisdiction (2010-2024)

AM sector	Companies	Universities	Overall (including other applicant types)
Construction	14.9%	5.9%	13.3%
Electronics	15%	7.9%	13.2%
Energy	18.2%	12%	16.5%
Medical devices (NACE 3250)	16.5%	6.7%	12.8%
Mobility	14.7%	2.8%	13.7%

Source: PATSTAT.

Based on the patent quality analysis, we see that the European patent portfolio is smaller in scale but strong in quality. The sectoral distribution suggests that Europe's comparative advantages lie in energy efficiency, medical materials and advanced electronics, consistent with broader policy aims to enhance sustainability and technological sovereignty.

1.3.1. Patent quality of European Companies relative to foreign competitors²⁰

The differentiated analysis of patent quality by applicant origin provides additional insight into how European companies position their advanced materials (AM) innovations relative to foreign competitors. As shown in Table 11, clear differences emerge depending on both company origin and the jurisdiction in which patents are first filed. Patents filed by European companies outside the EU exhibit the highest average number of forward citations (7.8) and the largest share of highly cited patents (13.9%), while EU-priority filings by European companies show lower average citation counts (4.4) and a smaller share of highly cited patents (7.9%). This pattern suggests that outward-oriented filings tend to concentrate on inventions with broader technological relevance or stronger international visibility, whereas EU-priority filings encompass a wider range of innovation outputs.

Foreign companies also show a consistent pattern across filing locations. Patents filed by foreign companies in the EU have slightly higher average citation counts (5.2) than those filed by European companies in the EU, and a higher share of highly cited patents (9.8%). This indicates that foreign firms tend to prioritise EU filings for inventions with stronger technological impact or market relevance, reinforcing the view of the EU as an attractive jurisdiction for protecting high-quality advanced materials innovations. At the same time, the similarity between foreign companies' citation performance inside and outside the EU suggests that their patenting strategies are less sensitive to filing location and more closely aligned with global portfolio management.

²⁰ The analysis covers 228,046 patent families in priority sectors, assigned to companies in the internal company database. For the analysis of patents filed in the EU, only EU priority regions are considered for this category. For patents filed outside the EU, all priority regions are taken into account, including filings under the WIPO (PCT) route and patent families with multiple priority filings. Highly cited patents are defined as patent families whose number of forward citations is at or above the 90th percentile (0.9 quantile) of the forward citation distribution, calculated over the full set of 228,046 patent families included in the analysis.

Table 11. Patent quality indicators compared across EU and foreign companies (in priority sectors)

	No of unique patents	Average forward citations (Median forward citations)	Share of highly cited patents
Patents filed by the EU companies in the EU	15 419	4.4 (1)	7.9%
Patents filed by the EU companies outside the EU	11 251	7.8 (3)	13.9%
Patents filed by the foreign companies in the EU	4011	5.2 (2)	9.8%
Patents filed by the foreign companies outside the EU	199 244	5.6 (2)	9.9 %

Source: TECHNOTE data and PATSTAT.

Sectoral analysis at the global level (see Table 12) shows that differences in average citation impact between EU and foreign companies are generally modest. Across most advanced materials sectors, citation averages are closely aligned, with EU companies performing particularly strongly in electronics (6.5 citations), energy (6.6) and medical devices (6.1). These figures are comparable to those observed for foreign companies in the same sectors, supporting the interpretation that European firms are able to generate patents with technological influence similar to that of their global competitors when international portfolios are taken into account.

Table 12. Forward citations of AM patent families in selected AM sectors globally

	EU Company patents		Foreign company Patents	
AM sector	Average citations	No of unique patents	Average citations	No of unique patents
Construction	5.2	10 868	5.6	64 886
Electronics	6.5	18 461	5.9	163 388
Energy	6.6	3 742	6.2	31 143
Medical devices (NACE 3250)	6.1	3 002	6.8	14 485
Mobility	5.5	2 121	5.6	5 941
Total:	5.8	26 670	5.7	203 255

Source: TECHNOTE data and PATSTAT.

Focusing specifically on patents filed in the EU priority jurisdiction (see Table 13) reveals a more selective pattern. Foreign companies' patents receive higher average citation counts across most sectors, notably in medical devices (6.4 citations compared with 4.8 for EU companies) and energy (6.0 compared with 5.4). EU companies remain competitive in electronics and mobility, but overall their EU-priority filings display lower average citation levels, consistent with broader and more extensive use of the EU patent system.

Table 13. Forward citations of AM patent families in selected AM sectors in the EU priority jurisdiction

AM sector	EU Company patents		Foreign company Patents	
	Average forward citations (Median forward citations)	No of unique patents	Average forward citations (Median forward citations)	No of unique patents
Construction	4.5 (1)	6 238	5.3 (2)	1 497
Electronics	4.8 (2)	10 899	5.4 (2)	2 980
Energy	5.4 (2)	2 208	6 (3)	548
Medical devices (NACE 3250)	4.8 (2)	1 511	6.4 (3)	378
Mobility	5.4 (2)	1 353	5.5 (2)	313
Total	4.4 (1)	15 419	5.2 (2)	4011

Source: TECHNOTE data and PATSTAT.

The analysis of highly cited patents further supports this interpretation (refer to Table 14). At the global level, the share of highly cited patents is broadly similar for EU and foreign companies across all sectors (10.4% and 9.9%, respectively), with EU companies showing particularly strong performance in energy (13.6%) and electronics (11.2%). Within the EU priority jurisdiction, however, foreign companies consistently display higher shares of highly cited patents across most sectors, reaching 13.7% in medical devices and 12.0% in energy, compared with 8.8% and 10.8% for EU companies. This indicates that foreign firms tend to reserve EU-priority filings for a more limited set of high-impact inventions, whereas European companies deploy EU patent protection more broadly across their innovation portfolios.

Table 14. Share of highly cited patents per selected sector globally (2010-2024)

AM sector	EU Company patents, %	Foreign company patents, %
Construction	10.4%	11.2%
Electronics	11.2%	10.3%
Energy	13.6%	12.7%
Medical devices (NACE 3250)	13%	14%
Mobility	10.7%	10.8%
Total:	10.4%	9.9 %

Source: TECHNOTE data and PATSTAT.

A closer look at highly cited patents within the EU priority jurisdiction (see Table 15) confirms this selective filing behaviour. Across all sectors, foreign companies exhibit a higher share of highly cited patents in the EU than European companies (9.7% compared with 7.9% overall). The gap is particularly pronounced in medical devices, where 13.7% of foreign companies' EU-priority patents are highly cited, compared with 8.8% for EU companies, and in energy (12.0% versus 10.8%). Differences are more moderate in electronics (10.1% versus 8.5%) and construction (10.8% versus 8.7%), while mobility shows near parity between EU and foreign firms. These patterns reinforce the interpretation that foreign companies tend to use the European patent system more selectively, concentrating on higher-impact inventions, whereas European companies deploy EU-priority filings more broadly across their innovation portfolios.

Table 15. Share of highly cited patents per selected sector in the EU priority Jurisdiction (2010-2024)

AM sector	EU Company patents, %	Foreign company patents, %
Construction	8.7 %	10.8%
Electronics	8.5%	10.1%
Energy	10.8%	12%
Medical devices (NACE 3250)	8.8%	13.7%
Mobility	10.3%	10.2%
Total:	7.9%	9.7%

Source: TECHNOTE data and PATSTAT.

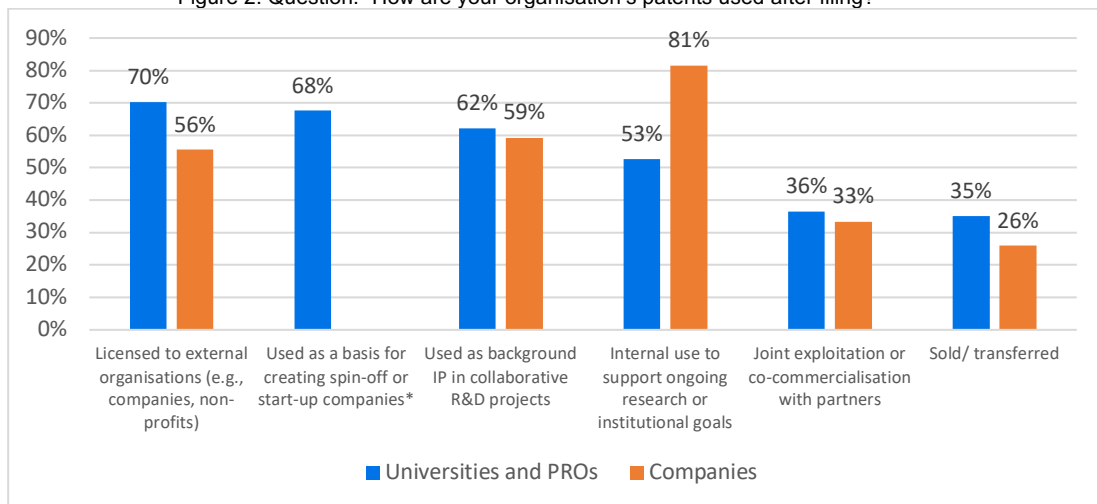
1.4. Patent exploitation trends

The commercialisation of AM patents takes multiple forms, ranging from internal use within firms to licensing agreements, spin-offs, joint ventures, and open-innovation collaborations. Each model reflects the strategic intent, organisational capacity, and sectoral context of the patent holder. Our analysis suggests that **academic and private actors occupy complementary roles in the AM innovation ecosystem: universities and PROs utilise patents to disseminate knowledge and promote entrepreneurship. At the same time, companies primarily leverage them to enhance internal capabilities and safeguard their market position.**

Survey results show that universities and PROs use patents through a mix of collaborative and entrepreneurial routes (see Figure 2). The most common pathways are licensing to external organisations (70%) and spin-off creation (68%), confirming that industry engagement and entrepreneurship are central to the exploitation of IP in advanced materials. Around 62% use patents as background IP in collaborative R&D projects, and 53% for internal research or institutional goals, showing their role in enabling partnerships and sustaining innovation. Less frequent are joint exploitation (36%) and patent sales or transfers (35%), indicating that most institutions prefer to retain ownership and pursue cooperation-based commercialisation rather than outright divestment.

In contrast, companies rely more heavily on internal use (81%) as the main mode of exploiting patents, with substantial engagement in licensing to external organisations (56%) and notable involvement in collaborative R&D, where patents are used as background IP (59%), meaning that existing patents contributed to partnerships as pre-existing intellectual assets. Around one third of companies report joint exploitation or co-commercialisation with partners (33%), while just over a quarter indicate selling or transferring patents (26%). This pattern suggests that, for industry, patents primarily serve as strategic assets for protecting proprietary technologies and maintaining competitive advantage, while also playing an increasingly important role in licensing and collaborative innovation activities.

Figure 2. Question: “How are your organisation’s patents used after filing?”²¹



Source: University and PROs survey (n=74) and Company survey (n=27).

Interviews confirm this picture. Multiple interviewees from universities and PROs reported that both licensing and spin-offs are used, depending on the technology’s maturity and market readiness. Licensing is preferred for near-market or incremental innovations, where established companies can absorb scale-up costs. Spin-offs are typically used for early-stage or high-risk technologies that require sustained development. As an interviewee explained, forming a spin-off enabled his team to raise venture capital while maintaining control over the technology.

Survey evidence further indicates that universities active in advanced materials most frequently license their patents to private-sector partners, particularly small and medium-sized enterprises (SMEs) (see Table 16). Nearly all respondents reported engaging SMEs at least occasionally, and around one in ten do so regularly. Large corporations, start-ups, or individual inventors are also common recipients, indicating that patent licensing in this field is strongly market-oriented. These findings suggest that while collaborative research frameworks are widespread in advanced materials, **formal patent licensing remains concentrated in industry-facing channels, where firms, particularly SMEs, act as key intermediaries for transferring academic inventions toward commercial application.**

²¹ “Used as a basis for creating spin-off or start-up companies” was not given as an option in the company survey, as this patent use was deemed irrelevant to companies during the survey design phase of this project.

Table 16. Question: "How often do the following organisation types typically license your organisation's patents?" (Count)

	Never	Sometimes	Often
Universities or research institutions	31	20	1
SMEs	5	41	6
Large corporations	10	35	7
Individual inventors or start-ups	11	33	8
Public-private partnerships	29	22	1
Private or public research consortia	33	17	2

Source: University and PROs survey (n=52).

Interviews and open-ended survey responses show that universities and PROs pursue patent commercialisation for strategic and institutional reasons that extend beyond revenue generation. Respondents cited the importance of patents in attracting external financing, supporting spin-offs, and securing industry partnerships. Patents were also seen as tools to enhance institutional reputation, demonstrate research impact to funders, and advance the public mission of knowledge valorisation, consistent with the European Commission's Guiding Principles for Knowledge Valorisation (2023).

Interview narratives added nuance: For universities and PROs, spin-offs were described not merely as financial vehicles but as mechanisms for researcher engagement and talent retention, offering alternative career paths and reducing brain drain. In addition, one participant highlighted that national frameworks can have a significant influence on the success of patent exploitation. As an illustration, an interviewee noted that Spain's revenue-sharing rules can influence patent exploitation outcomes. In this system, a substantial share of licensing or spin-off income is typically retained by the institution, which may affect the incentives for researchers to remain actively engaged in commercialisation activities. This was contrasted with Sweden's KTH model, which grants individual researchers extensive ownership and control over their inventions.

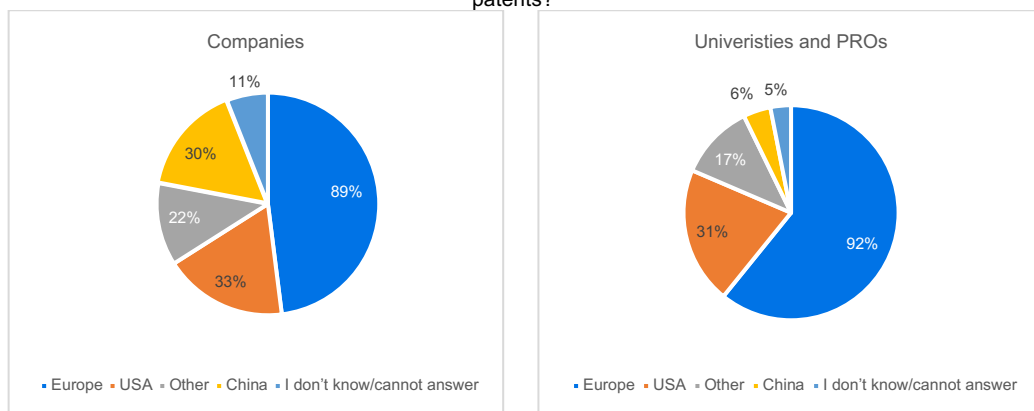
When triangulated with responses from the interviewed companies, a complementary picture emerges. Firms emphasised market-driven motives: notably ensuring competitive positioning, attracting investors, and supporting exit strategies or acquisition value. Some use licensing to facilitate patent uptake, while others primarily patent to deter imitation. Internal decision-making depends on factors such as the complexity of manufacturing, the defensibility of rights, and legal enforceability in target markets.

1.5. Patenting and exploitation experience in the US and China compared to the EU

The survey shows that 31% of university and PRO respondents have filed patents in the US, and 6% also filed in China. By contrast, patenting activity is overwhelmingly concentrated in Europe, with 92% of universities and PROs reporting patent filings in European jurisdictions. Companies have patented in these countries at a higher rate: 33% of company respondents reported patent filings in the US, while 30% indicated filings in China. At the same time, European patenting remains dominant among companies as well, reported by 89% of respondents. They were also asked to compare the experiences.

In addition, survey results indicate that universities and research-performing organisations (PROs) active in advanced materials primarily commercialise and license their patents within European markets. Still, a significant share also targets the US, reflecting transatlantic partnerships and the appeal of a larger, more innovation-driven economy (see Figure 3).

Figure 3. Question: "In which geographic markets does your organisation primarily commercialise or license patents?"



Source: University and PROs survey (n=64) and Company survey (n=27).

1.5.1. Comparative analysis of EU and US

Overall, **respondents view Europe as more favourable for patent filing costs and procedural quality, while the US is seen as stronger in market reach, enforcement, and simplicity of translation.** As shown in Table 17, companies are markedly more likely than universities and PROs to view Europe as favourable in terms of patent filing costs (69% of companies versus 46% of universities/PROs) and examination rigour (54% versus 42%), while universities and PROs express more mixed views and higher levels of uncertainty across these dimensions.

By contrast, companies tend to associate the US more strongly with advantages related to patent maintenance costs and translation costs (54% in both cases), whereas universities and PROs are more likely to emphasise the US market coverage and strategic market value (58%), reflecting its perceived importance as a commercial destination.

The main divergence lies in perceptions of system complexity and enforceability: companies are more inclined than universities and PROs to view Europe favourably in terms of intellectual assets management complexity across laws, language and procedural requirements (54% versus 25%), as well as IP rights enforcement (46% versus 25%). By contrast, universities express higher uncertainty and limited confidence in enforcement outcomes, in particular the practical ability to defend patent rights in case of infringement, as reflected in the high share of "don't know" responses (71% "don't know"). This uncertainty may partly reflect the institutional separation of roles within universities, as technology transfer offices (target respondents of the survey) are typically closely involved in patent filing and portfolio management, while the decision to enforce and litigation are less frequent and often handled by external legal advisers or central university administration.

These findings suggest that firms approach patent systems through a business lens, valuing cost predictability and market impact, whereas universities assess them based on administrative experience and potential for collaboration. However, results should be interpreted with caution, given the small sample size (7 companies, 24 universities/PROs), which limits statistical generalisation and may reflect individual institutional experience rather than systemic consensus.

Table 17. Question: "For each factor below, please select the region you consider to be more favourable (Europe or the United States)."

	Companies			Universities and PROs		
	Europe	US	Don't know	Europe	US	Don't know
Patent filing cost	69%	15%	15%	46%	25%	29%
Patent maintenance (renewal) cost and patent term	23%	54%	23%	42%	25%	33%
Length of the patent application process	46%	38%	15%	50%	13%	38%
Patent quality examination rigour	54%	0%	46%	42%	21%	38%
IP rights enforcement	46%	8%	46%	25%	4%	71%
Patent scope and rights granted (effectiveness, speed, and cost)	46%	23%	31%	38%	21%	42%
Translation costs	23%	54%	23%	17%	25%	58%
IP management complexity across laws, language and procedural requirements	54%	23%	23%	25%	25%	50%
Ease of commercialisation	23%	23%	54%	25%	29%	46%
Market coverage/size (strategic market value)	46%	15%	38%	13%	58%	29%

Source: University and PROs survey (n=24) and Company survey (n=13).

Qualitative explanations further justify these differences. Survey respondents described the US system as commercially attractive due to its large unified market, predictable enforcement, and greater industrial demand, noting that "target customers are based in the US" or that "domestic markets are limited." Others highlighted procedural advantages such as single-language operation, lower translation costs, and the flexibility of continuation applications, which allow incremental claim adjustments. Still, several respondents regarded Europe as more consistent administratively, given the EPO's transparency and structured search process. At the same time, the US was seen as costlier but more commercially rewarding once patents were granted. A minority considered both systems broadly equivalent, differing mainly in scope and administrative complexity.

Interview evidence adds nuance to these perceptions. University representatives viewed the US as strategically essential but procedurally demanding, describing the patent process as lengthy and variable, with examiner discretion and the absence of an early search report complicating the refinement of claims. Smaller research institutions found US filings slower and more resource-intensive, whereas organisations with international legal networks reported smoother experiences. Beyond patenting, some pointed to regulatory barriers that slow commercialisation. For example some materials in the medical devices sector fall outside the US Food and Drug Administration's standard approval pathways, illustrating how innovation in advanced materials can outpace US regulatory adaptation.

Company interviews echoed the dual character of the US environment. The country is regarded as a high-value yet high-barrier jurisdiction, consistently featured in global portfolios due to its market visibility and influence on investor confidence. Firms acknowledged stricter standards for inventiveness and occasional bias toward domestic applicants, yet still viewed the US patent system as commercially decisive, despite high enforcement and maintenance costs.

1.5.2. Comparative analysis of EU and China

Survey results indicate that **Europe remains the preferred patent environment for both research-performing and industrial actors**. Stakeholders favour Europe for its enforcement reliability, procedural clarity, and integration with commercialisation channels; they also appreciate the quality of examination and institutional familiarity. **By contrast, China is recognised for its lower maintenance costs and faster application timelines**, yet respondents consistently rated it lower on IP quality, enforcement reliability, and ease of commercialisation (see Table 18).

These findings suggest that while China offers procedural and cost advantages, they are often outweighed by perceived weaknesses in predictability and post-grant value. The relatively high share of “don’t know” responses among universities further indicates limited direct experience, suggesting that foreign academic and corporate actors do not yet operate on an equal footing in China’s IP environment. However, these patterns should be interpreted cautiously, given the small sample size (combined n=23), which makes results indicative rather than generalisable.

Table 18. Question: "For each factor below, please select the region you consider to be more favourable (Europe or China)."

	Companies			Universities and PROs		
	Europe	China	Don't know	Europe	China	Don't know
Patent filing cost	38%	50%	13%	57%	29%	14%
Patent maintenance (renewal) cost and patent term	13%	63%	25%	50%	43%	7%
Length of the patent application process	25%	63%	13%	36%	29%	36%
Patent quality examination rigour	50%	13%	38%	64%	7%	29%
IP rights enforcement	75%	13%	13%	79%	0%	21%
Patent scope and rights granted (effectiveness, speed, and cost)	50%	13%	38%	79%	7%	14%
Translation costs	75%	0%	25%	57%	29%	14%
IP management complexity across laws, language and procedural requirements	75%	0%	25%	57%	14%	29%
Ease of commercialisation	63%	0%	38%	57%	7%	36%
Market coverage/size (strategic market value)	50%	25%	25%	43%	7%	50%

Source: University and PROs survey (n=14) and Company survey (n=8).

Open-ended company responses reinforce this view. Firms described the Chinese patent system as cheaper and faster to file and grant, highlighting lower maintenance costs, simpler evaluation procedures, and the strategic value of China’s large domestic market. Several praised the efficiency and clarity of examination feedback; however, these comments primarily focused on administrative convenience, rather than enforcement or post-grant commercial outcomes.

University and PRO interviewees painted a more cautious picture. They described greater procedural and linguistic burdens in China compared with Europe or the US, citing translation costs and multiple rounds of correspondence during examination. One respondent reported that

a single application required six exchanges over five years, versus a one-year process in Australia. While the filing process itself was considered straightforward, translation requirements and procedural length added cost and complexity.

When it comes to commercialisation, **both academic and industrial actors approach China strategically but warily**. Several respondents expressed reservations about the predictability of IP enforcement and the practical challenges associated with defending patent rights, which shape more cautious engagement strategies. Only a few institutions reported filing or licensing patents in China, primarily due to industrial partner requirements or recognition of the market's growing importance.

At the same time, interview evidence suggests that the Chinese market is becoming an increasingly important component of global patent portfolios, reflecting its expanding industrial base and growing innovation capacity. Companies described China as a complex but unavoidable market—one where patents are used primarily for strategic positioning and defensive protection rather than for immediate commercial exploitation. Despite perceived protectionist tendencies and uneven enforcement, firms continue to file there to safeguard future market opportunities and signal global competitiveness.

In summary, global advanced materials patenting has expanded strongly since 2010, but Europe's growth has remained comparatively flat relative to the rapid acceleration observed in the US and particularly in China. Within this context, European actors appear to pursue a more selective, internationally oriented patenting approach: despite lower volumes and a small share of global priority filings, EU priority patents display higher triadic shares and solid quality indicators, suggesting stronger cross-market relevance and commercial intent. Survey and interview evidence also indicates that patents remain the most commercially valued IP instrument for both universities and PROs and companies, although firms report a more diversified mix including trade secrets and non-disclosure agreements. Overall, the evidence points to a qualitative rather than quantitative European advantage, with strengths concentrated in sectors aligned with strategic priorities (notably energy, medical devices and electronics), alongside continued constraints in converting R&D capacity into higher patenting scale and faster deployment.

1.6. Dual-use patents

Dual-use items, defined as goods, software, and technologies that can be used for both civilian and military purposes, are central to the EU's export control regime under Regulation (EU) 2021/821. Recent European Commission work on dual-use R&I stresses linking and enhancing synergies between civil and defence research and innovation. Two accompanying expert reports advocate a “dual-use by design” approach and showcase practical cases across sectors^{22,23}. Dual-use is relevant in advanced materials, among others, where lightweight composites, nanomaterials, high-performance alloys, and protective coatings have both high commercial value and strategic military potential. These materials enhance protection, energy efficiency, and resilience in applications spanning energy, aerospace, and defence.

Recent evidence from parallel research on advanced materials research and technology infrastructures (RI&TIs) indicates a growing orientation towards defence and dual-use applications, particularly over the past three years²⁴. This includes a sharp increase in demand for testing and validation capacities for defence-related technologies, reflected, for example, in the expansion of NATO DIANA-affiliated test centres and in stakeholder reports that more than

22 European Commission: Directorate-General for Research and Innovation, Making the most of EU research and innovation investments – Rethinking dual use, Publications Office of the European Union, 2025, <https://data.europa.eu/doi/10.2777/6637451>

23 European Commission: Directorate-General for Research and Innovation, Unlocking the potential of dual-use research and innovation, Publications Office of the European Union, 2025, <https://data.europa.eu/doi/10.2777/5771805>

24 A forthcoming study developed by Technopolis Group, commissioned by DG RTD.

40% of surveyed advanced materials R&TIs are already engaged in dual-use or defence-related development activities.

Against this background of increasing dual-use orientation at the level of research infrastructures and technology development, this study examines whether similar dynamics are observable in patenting activity in advanced materials.

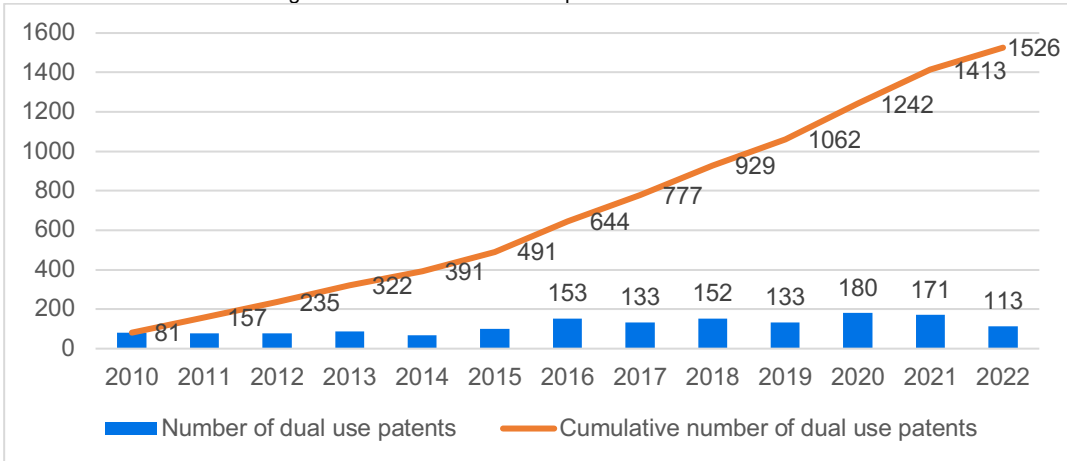
One way to assess whether advanced materials patents have dual-use potential is to examine **whether the patents identified using the already defined set of 5,481 CPC codes also include patent codes explicitly related to military and defence technologies.** For this task, we draw on work by the JRC. The JRC has developed a consolidated list of patent codes relevant for identifying military and defence technologies.²⁵ This typology includes codes from across technological domains, ranging from traditional defence systems to materials, chemical processes, and aerospace adaptations. Examples include A62D 101/02 (chemical warfare substances), B21K 21/04 and related subclasses (ammunition cartridges and projectiles), B64D 1/06 (bomb release mechanisms), E04H 9/04–12 (protective shelters and bunkers), broad weapons-related classes (F41–F42), and more specialised codes such as G01S 19/18 (satellite positioning with military applications). Applying this mapping to the AM patent dataset enables the identification of patents whose technological features could, in principle, support dual-use functions.

Figure 4 illustrates a steady and continuous increase in the cumulative number of advanced materials patent families identified as potentially dual-use between 2010 and 2022, reaching more than 1,500 patents by the end of the period. At the same time, the annual number of identified dual-use patents remains relatively low and broadly stable, indicating a gradual accumulation of disclosed dual-use-relevant inventions rather than a sharp expansion in patenting activity. Overall, the pattern suggests that while dual-use-related patenting in advanced materials is persistent over time, it represents a small and slowly growing segment of the overall advanced materials patent landscape.

Trends in the most recent years should be interpreted with caution, as patent filing, examination, and publication involve inherent time lags. As a result, patent-based indicators are structurally ill-suited to capturing very recent shifts in technological orientation, particularly those observed since 2022–2023.

25 Caviggioli F., De Marco A., Scellato G. (2018). Assessing the innovation capability of EU companies in developing dual use technologies, EUR 29481 EN, Publications Office of the European Union, Luxembourg, doi:10.2760/032120.

Figure 4. Evolution of dual use patent families over time



Source: PATSTAT data.

Across all jurisdictions (Table 19), the share of patents potentially falling under dual-use categories is very small, averaging below 1% of total filings between 2010 and 2024. EU-priority filed patents (patents filed by any actors choosing the EU as their priority jurisdiction) account for 0.4% of possible dual-use cases, a proportion broadly consistent with that of other advanced economies. The US shows a slightly higher share (0.7% overall), reflecting its stronger integration between civilian and defence-related research. In comparison, China remains lower (0.2%), suggesting a more precise separation between its civilian AM patenting activity and military-focused technologies. For universities and research-performing organisations, dual-use relevance is negligible across all regions (0–0.2%).

Table 19. Share of possible dual-use patents in selected sectors by priority jurisdiction, 2010-2024

Priority jurisdiction	Companies	Universities	Overall
EU	0.4%	0%	0.4%
US	0.6%	0.2%	0.7%
China	0.2%	0.2%	0.2%
Other	0.1%	0.2%	0.2%
Multiple (EU included)	0.3%	0.1%	0.3%
WO (PCT)	0.2%	0.1%	0.2%

Source: PATSTAT. Total number of patents analysed: 1,614.

In the EU priority filed subset, the limited number of potentially dual-use patents (145 patents identified) is concentrated in mobility (0.8%) and construction (0.7%). These findings are consistent with the technological profiles of these sectors, where lightweight composites, high-strength alloys, and additive manufacturing techniques may have both civil aviation or infrastructure and defence or aerospace relevance.

Table 20. Share of possible dual-use patents per selected sector in the EU (2010-2024)

AM sector	Companies
Construction	0.7%
Electronics	0.3%
Energy	0.2%
Medical devices (NACE 3250)	0.1%
Mobility	0.8%

Source: PATSTAT. Total number of patents analysed: 145²⁶.

The analysis therefore indicates that the share of advanced materials patents that can be explicitly identified as potentially dual-use through defence-related patent classifications is limited and largely confined to a few industrial subdomains where materials performance and safety standards intersect with aerospace or transport technologies. The absence of significant dual-use activity among universities suggests that public research in advanced materials remains firmly anchored in civilian objectives.

This finding does not imply that dual-use or defence-related innovation in advanced materials is limited in absolute terms. Rather, it reflects the conservative nature of patent-based identification methods, which capture only disclosed and codified technological signals.

Nevertheless, the limitations of this approach must be clearly acknowledged. First, a part of military innovation occurs in classified or secret settings and is therefore not captured in the public patent system. As a result, patent-based analysis may systematically underrepresent the true scale of defence-related technological development. In addition, patent protection requires public disclosure of technical information, which can conflict with national security considerations or strategic interests, particularly in defence-related and dual-use contexts²⁷. Legal mechanisms such as secrecy orders, delayed publication, or restricted disclosure exist within patent systems to prevent sensitive inventions from entering the public domain²⁸. Beyond formal legal constraints, firms active in dual-use domains may also strategically rely on secrecy or trade secrets instead of patents when the risks associated with disclosure outweigh the benefits of formal IP protection²⁹.

Second, some militarily relevant inventions may be classified under general civilian codes and go undetected, while others may fall under broad categories that include technologies with little practical military value. Third, there is a conceptual limitation: potential dual-use is not equivalent to actual dual-use. A material may have military applications, but unless there is evidence of uptake, adaptation, or deployment in that context, its relevance remains hypothetical.

Against this background, the patent-based findings should be interpreted as a conservative, lower-bound estimate of dual-use innovation activity. Increased engagement in dual-use research, testing, and capability development may therefore coincide with stable or even subdued levels of observable patenting.

The patent-based findings align with stakeholder feedback at the level of disclosed research and commercialisation activity. Interviewees from universities and PROs generally reported limited engagement with dual-use technologies in their advanced materials research.

26 1,614 is the total global AM sample used for dual-use screening, of which 145 are EU-priority cases.

27 de Rassenfosse, G., Jensen, P. H., & Webster, E. (2023). Patent disclosure, secrecy and the strategic use of intellectual property. *Research Policy*, 52(7), 104829.

28 European Parliament (2014). Trade secrets and patent disclosure: Balancing innovation, transparency and security. Directorate-General for Internal Policies, Policy Department A: Economic and Scientific Policy. IPOL-JURI_NT(2014)493055_EN.

29 Acosta, M., Coronado, D., & Martínez, M. Á. (2018). Trade secrets versus patents: Protecting innovation in a global context. *Journal of Intellectual Capital*, 19(3), 537–556.

Most stated that dual-use is not an explicit focus of their organisations' strategies or intellectual property management. They emphasised that their institutions either prohibit or avoid defence-related work. While they acknowledged that some materials, such as those used in drones, robotics, or permanent magnets, could have dual-use potential, these applications were described as incidental rather than intentional, and none reported dedicated valorisation strategies for them.

A few interviewees recognised the emerging relevance of dual-use awareness in Europe's research landscape. An interviewee mentioned growing engagement with Spain's Defence Secretariat as national funding for dual-use and security-related projects increases, though he noted that ethical reservations among researchers persist. Another interviewee highlighted the importance of early awareness, observing from her U.S. experience that biomaterials research can unexpectedly lead to energy or defence applications. Overall, while most institutions have procedural checks (e.g., declarations in project proposals) to flag potential dual-use, active exploitation, or policy guidance remains rare. The prevailing approach is reactive and compliance-oriented, not strategic.

Survey evidence supports these qualitative findings. When survey respondents were asked whether challenges arising from dual-use applications of their technology hamper their organisation's ability to bring technologies to the market, the responses show that dual-use considerations are largely not seen as a significant barrier to commercialising patented technologies. A large majority of respondents (62% combining "not a challenge" and "not applicable") indicated that dual-use issues do not affect their ability to bring technologies to market, and only a very small share (8%) viewed them as a moderate challenge, with none identifying them as a major obstacle. This complements the themes emerging from the interviews and suggests that **most organisations either do not work on technologies with clear dual-use potential or have limited interaction with defence or security markets.**

Overall, the analysis above suggests that European advanced materials innovation remains predominantly civilian in terms of disclosed patenting and commercialisation activity, while dual-use potential is concentrated in a narrow range of industrial technologies. At the same time, growing engagement with dual-use and defence-related research and testing infrastructures indicates that patent-based evidence alone does not fully capture recent shifts in technological orientation. Importantly, this analysis does not assess the extent to which advanced materials innovations are ultimately adopted, adapted, or deployed in defence applications, which may follow different pathways and timelines than those observable through patenting or commercialisation data.

1.7. Economic benefits of patenting and access to funding

Existing empirical studies on intellectual property and firm performance show that IPR-intensive firms tend, on average, to exhibit higher revenue per employee, stronger export orientation and better employment growth than firms without formal IP protection (for example, see the EPO–EUIPO study³⁰). While these results do not establish a causal link between patenting and economic success, they indicate that IP-active firms are more likely to operate in knowledge-intensive, higher-value segments of the economy.

More recent evidence further shows that patents play an important signalling role in financial markets, particularly for young and innovative firms facing information asymmetries. Analysis of European start-ups indicates that firms holding patents are significantly more likely to attract venture capital funding and to achieve successful exit outcomes, suggesting that formal IP

30 European Patent Office & European Union Intellectual Property Office. (2021). Firm-level analysis of IPR usage and business performance. European Patent Office. <https://link.epo.org/web/publications/studies/en-ipr-performance-study.pdf>

protection is widely interpreted by investors as an indicator of technological maturity and growth potential³¹. Our qualitative evidence from the interviews with universities and companies working in the field of advanced materials is consistent with this pattern. Interviewees report that patents are frequently used as signals of technological quality to facilitate access to funding and partnerships when negotiating with investors, applying for public funding, or preparing spin-offs.

Interview evidence highlights the central role of patents in shaping investment and valuation strategies among advanced materials companies. Across cases, intellectual property is viewed not only as a mechanism of protection but also as a financial and signalling asset that directly supports capital acquisition and strategic growth.

For publicly listed and venture-backed firms, **patents underpin credibility with investors, serving as tangible proof of technological capability**. One company described its “licensing technology” as central to attracting investors and raising capital, with the patent portfolio forming the foundation of a licensing-based business model. Others saw patents as tools for leveraging R&D into transactional value, facilitating mergers, acquisitions, joint ventures, or future exits. Early-stage enterprises emphasised the symbolic value of patent quantity, noting that “the more you have, the better it looks,” even when patent quality or commercial viability may differ.

Universities and PROs conveyed a more variable relationship between patents and investment. In their view, IP plays a supportive but uneven role in attracting funding across technology fields and organisational contexts. This reflects important differences between public and private funding logics. While private investors typically assess patents as appropriable assets linked to scalability, licensing potential or exit opportunities, public funding bodies tend to place greater emphasis on patents as indicators of technological readiness, project credibility and institutional commitment, particularly in early-stage valorisation and proof-of-concept schemes^{32,33}.

Interviewees agreed that patents are essential for signalling technological maturity when applying for public funding. Several cited examples of using patents to strengthen applications for proof-of-concept and valorisation grants, national “Transition” programmes, or EU schemes such as Horizon Europe and the EIT. In these cases, patents act primarily as gateways to public funding, demonstrating readiness for investment rather than serving as commercial assets in their own right.

However, interviewees also noted persistent gaps in funding continuity at mid-technology readiness levels (TRL 5–7), where promising technologies often stall due to insufficient support. They suggested that longer-term, larger-scale EU grants could help sustain patent-based valorisation during this critical phase. This concern is consistent with broader EU evidence showing that scale-up financing remains a structural bottleneck in advanced materials innovation, particularly for SMEs and spin-offs facing high pilot, validation and other pre-commercial development costs, including those related to intellectual property management³⁴.

There are also differences noted by the sector. For example, in the biomedical sector, the relationship between patents and investment was described as particularly complex. One university representative explained that many medical device patents are speculative, covering conceptual designs without demonstrated feasibility. Large corporations often file such patents to occupy technological space, which can block smaller innovators from obtaining protection even when their inventions are more practical. This practice distorts perceived patent value and creates barriers to investment by obscuring which IP represents genuine innovation. As one

31 European Patent Office & European Union Intellectual Property Office. (2023). Patents, trade marks and startup finance: Funding and exit performance of European startups. EPO/EUIPO.

32 Industrial R&D&I investments and market analysis in advanced materials – Summary report, Publications Office of the European Union, 2024, <https://data.europa.eu/doi/10.2777/371763>.

33 European Patent Office & European Union Intellectual Property Office. (2023). Patents, trade marks and startup finance: Funding and exit performance of European startups. EPO/EUIPO.

34 Industrial R&D&I investments and market analysis in advanced materials – Summary report, Publications Office of the European Union, 2024.

interviewee observed, “the medical device patent landscape is dominated by large companies,” leaving start-ups facing prohibitive costs and risks, especially around clinical trials. While patents remain an expected prerequisite for funding, their quality and credibility matter far more than sheer volume.

In summary, the evidence suggests that patents generate economic value in advanced materials less through a direct, universal productivity effect and more through their role as strategic assets that support investment, partnering and scaling. The literature indicates that IP-active firms tend to perform better on indicators such as revenue per employee and exports, while more recent studies highlight patents’ signalling function in reducing information asymmetries for investors, particularly for start-ups. Interview evidence aligns with this, showing that firms use patent portfolios to underpin valuation narratives, licensing-based business models and exit strategies, whereas universities and PROs describe patents as more context-dependent signals that strengthen credibility in public funding and proof-of-concept schemes. At the same time, respondents emphasised a persistent funding discontinuity at mid TRLs (around TRL 5–7), where patent-backed technologies often stall due to high validation and scale-up costs. Sectoral nuances also matter: in medical devices, interviewees noted that dense and strategically filed patent landscapes can distort perceived IP value, raising barriers for start-ups and reinforcing that patent quality and credibility, not volume alone, shape access to finance.

In summary, between 2010 and 2024, patenting in advanced materials expanded worldwide, although the number of patent families first filed in Europe remained broadly stable while filings first made in the US and China rose quickly. Grouping patents by where they were first filed, their priority jurisdiction, Europe accounts for fewer patents than these two jurisdictions, yet its filings show a higher share of triadic families, which points to protection sought across several major markets. Patents remain the most valued IP instrument for both universities and companies, and European filings record higher forward citations and shares of highly cited inventions in energy, medical devices and electronics.

European companies file most of their patents in Europe, while around 17% file first in another jurisdiction, most often the US. Universities and PROs commercialise their patents mainly through licensing and spin-offs, whereas companies rely primarily on internal use alongside licensing. Survey respondents consider Europe favourable for filing costs and examination quality, and the US favourable for market reach and enforcement, while China is recognised for lower costs and faster timelines. Patents with dual-use potential remain below 1% of filings and concentrate in mobility and construction. Across both universities and companies, patents also serve as signals of technological maturity that support access to funding.

2. Challenges, needs, and alternative intellectual assets management strategies

RQ4. What are the challenges and needs of EU actors for patent protection and exploitation in advanced materials?

Survey and interview evidence indicate that both universities and PROs, as well as companies, encounter a range of obstacles in patenting and commercialisation. Across both types of organisations, financial limitations, restricted internal resources, process complexity, and institutional or regulatory factors are reported to constrain the ability to protect and exploit intellectual property in the form of patents (Figure 5 & Figure 6).

Financial limitations constitute a significant barrier to patenting and commercialisation. Universities and PROs report that the costs of filing, maintaining, and internationalising IP portfolios are high, and that institutions often lack the flexibility to support long-term development or international patent phases. This can constrain the timing and scope of licensing opportunities. Companies also identify cost as a major challenge. Interview respondents note that patent fees and legal support, especially from IP lawyers, are expensive. In relation to this, the major consideration is how broad protection should be: global filing is costly, yet limiting patents to Europe can feel risky. These costs are compounded by pressure to generate revenue quickly. The challenge is particularly acute for smaller companies, while larger firms have more financial resources to file widely and more capacity to defend against potential infringement.

Advanced materials face distinctive cost barriers that shape both R&D and IP strategy. Funding bodies and industry respondents highlight that validating new materials requires expensive characterisation and specialised equipment, while scale-up from laboratory to industrial production is complex, time-consuming and capital-intensive. This is compounded by the need for multidisciplinary expertise, from atomic-scale design to end-use devices, making advanced materials development riskier than digital innovations and increasing the importance of effective protection strategies such as patents. The literature on materials innovation reinforces these points, noting that scalability and manufacturing challenges, such as complex synthesis, quality control issues and limited production infrastructure, raise costs and slow commercialisation, especially for emerging materials³⁵.

Limited internal resources further impede sustained commercialisation efforts. Universities and PROs often operate with insufficient staff and expertise, requiring personnel to manage multiple projects simultaneously. Budgetary limitations frequently constrain the recruitment of additional specialists. Companies report relying on a combination of in-house IP experts and external consultants, particularly for complex or international cases. Across both sectors, limitations in personnel and expertise restrict the ability to maintain patent portfolios, navigate regulatory frameworks, and advance technologies towards commercialisation. Notably, drafting materials-related patents is particularly slow and resource-intensive, as it requires extensive experimental data and precise material characterisation.

Institutional and cultural factors also strongly shape how universities and PROs approach IP and commercialisation. Patenting is often secondary to publishing, as researchers are primarily evaluated on publication metrics. Limited institutional incentives for patenting are closely intertwined with administrative delays discussed later in this section. Lengthy patenting timelines, which in some cases extend to four or five years, can prevent early-career researchers and senior academics from publishing results or presenting at conferences while awaiting patent clearance. This further exacerbates the tensions between academic career incentives and commercialisation objectives.

Evidence from interviews with EC officials confirms that European academia lacks a robust patenting culture, with limited incentives and weak technology transfer mechanisms that leave many inventions unprotected or underutilised. The absence of systematic IP training further reduces awareness of protection and commercialisation strategies. Strengthening IP training for universities and PROs is therefore a critical need in the EU, as it would support more coherent IP strategies, help avoid loss of novelty, improve claim quality, and ensure stronger documentation – while also fostering more effective collaboration with industry.

Company interviewees, while generally confident in navigating the patenting landscape, express **concerns regarding the quality of patent examination, the effectiveness of enforcement, and inconsistencies across jurisdictions.** Patents are often viewed more as deterrents than enforceable instruments, with limited practical impact. Some of these concerns are specific to advanced materials and related technology domains. In biopolymers, for instance, low inventive-

35 Arshad, M. U. (2024). Exploring the latest advances in materials science: Development of new materials with unique properties. *Social Science Review Archives*, 2(1), 41-56.

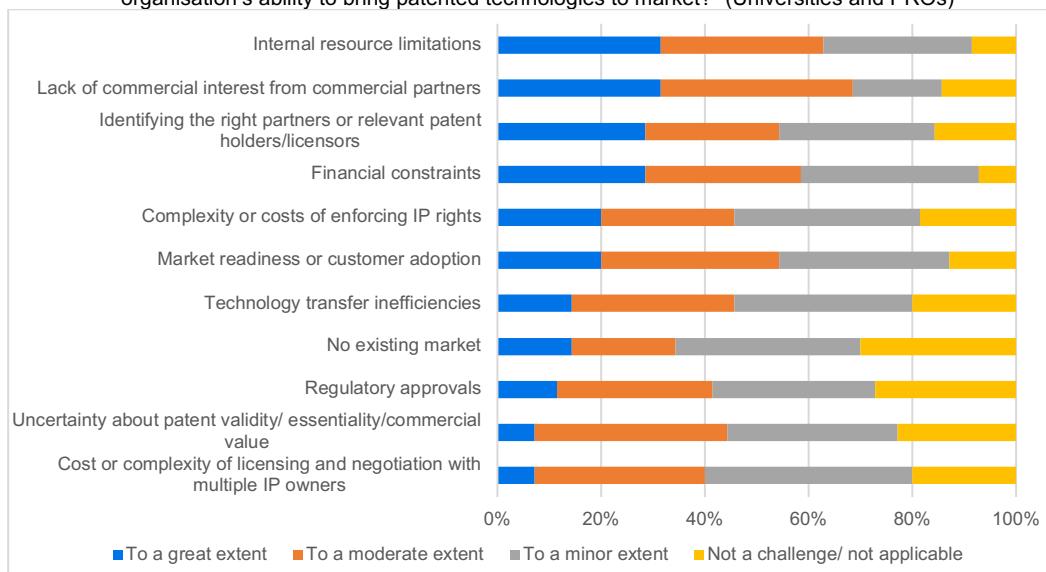
step thresholds have led to dense patent clustering, creating overlapping rights that can restrict further innovation. Firms active in cross-cutting areas such as additive manufacturing and 3D printing, as well as aerospace and advanced composites report similar challenges.

Administrative and regulatory complexity further affects patenting and commercialisation, particularly during the patent examination and post-filing phases. Cross-jurisdictional variation creates uncertainty around timelines, costs, and outcomes: first examination responses may arrive within six months in some countries, while in others they can take three years or more, depending not only on the jurisdiction but also on examiner workload and expertise. In technologically specialised fields, such as advanced materials, limited examiner familiarity can lead to repeated office actions and multi-year delays, particularly in the US and China (see section Patenting and exploitation experience in the US and China compared to the EU in the Patenting and exploitation trends chapter for more details). Additional burdens, such as mandatory translations in non-English jurisdictions and jurisdiction-specific compliance, increase costs and reliance on local legal representatives.

Collaboration between companies and universities and PROs is often constrained by intellectual assets management, particularly for early-stage technologies at TRL 4–5. Transitioning from lab-scale validation to industrial application requires substantial investment, which is often difficult to secure, leaving many promising patents underexploited. Even with patents in place, universities and PROs may struggle to find industrial partners willing to assume the financial and technical risks of early-stage innovations. Investor and industry preferences for mature, low-risk technologies can further disadvantage university-led projects, which are typically driven by scientists with limited business or regulatory experience. From the industry perspective, challenges also arise around ownership, differing IP valuation, and expectations on contributions and control. Universities and PROs may be perceived as overestimating their input or seeking full ownership, complicating partnerships and slowing technology commercialisation.

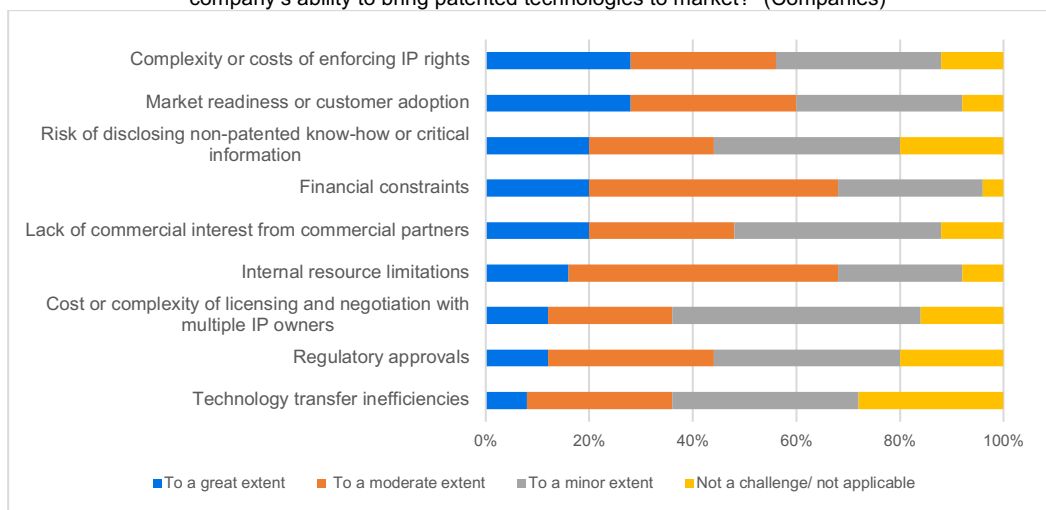
In summary, interview and survey evidence shows that universities and PROs and companies face interconnected financial, organisational, and regulatory barriers to patenting and commercialising advanced materials. High patenting costs, limited expertise, slow examinations, and jurisdictional complexity create uncertainty and delay. Sector-specific challenges, such as capital-intensive validation, scale-up difficulties, and multidisciplinary demands, amplify risk. Weak patent culture and IP training, as well as lack of academic incentives to pursue IPs further hinder exploitation. Addressing these issues requires strengthening financial support, IP capabilities, regulatory coherence, and university-industry collaboration.

Figure 5. Question: "Please indicate the extent to which each of the following challenges hampers your organisation's ability to bring patented technologies to market?" (Universities and PROs)



Source: University and PROs survey (n=70).

Figure 6. Question: "Please indicate the extent to which each of the following challenges hampers your company's ability to bring patented technologies to market?" (Companies)



Source: Company survey (n=25).

RQ5. Do actors use other means of protection of their results in advanced materials, e.g. Trade secrets?

RQ6. What other strategies are used to protect and valorise R&I results?

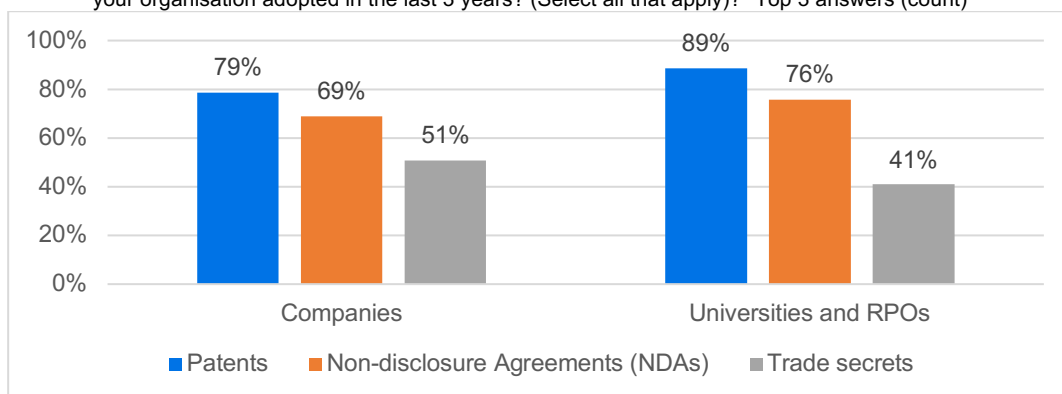
RQ7. Do actors adopt different IP management strategies (not patenting, selective patenting, IP sharing, open access)? What are the reasons?

2.1. Key IP instruments across academia and industry

Survey evidence indicates that universities and PROs and companies active in advanced materials employ a range of IP instruments to protect and valorise innovations.

Participants were first asked to select all IP strategies they have used in the past three years (Figure 7). For both types of organisations, the three most common approaches are patents, NDAs and trade secrets. Patents are the most widely used, cited by 89% of universities/PROs and 79% of companies. NDAs and trade secrets are the next most common strategies, reflecting a preference for formal IP protection alongside contractual confidentiality and secrecy measures to safeguard innovations and collaborative development

Figure 7. Question: "In the advanced materials sector, which of the following IP management strategies has your organisation adopted in the last 3 years? (Select all that apply)?" Top 3 answers (count)³⁶



Source: University and PROs survey (n=132) and Company survey (n=61).

When asked which IP type they **consider primary to their intellectual assets management strategy** (single choice question), **patents dominate in both sectors: 71% of universities and PROs and 63% of companies identified patents as central to their strategies** (Figure 1; discussed in more detail in Section 1. Patenting and exploitation trends). Other IP types are far less prominent: only 9% of universities and PROs cited NDAs as primary, while among companies, trade secrets were the only other instrument regarded as central, mentioned by one-fifth of respondents. These findings indicate that actors combine patenting with secrecy-based instruments, using patents for protection and commercialisation while confidentiality tools support knowledge sharing and collaboration. Consistent with the findings discussed in Section 1, Figure 1 captures the IP instrument respondents consider most central to their strategy, whereas Figure 7 reflects the broader set of IP instruments used in practice over the past three years.

Interviewed funding bodies stress that patenting decisions in advanced materials are highly context dependent. Patents are generally considered appropriate for materials, devices, or components that can be physically reproduced or reverse-engineered, whereas process-based or formulation-specific innovations may be better protected through trade or process secrets. Timing is particularly important in advanced materials, as long development cycles and delayed market readiness can reduce the immediate value of patent protection, while in other cases rapid application may be necessary to secure early advantage. Funding bodies also note that advanced materials often constitute sub-components within larger systems, meaning that value can be captured through downstream products or processes even in the absence of patents, and that alternative protection strategies are therefore common and justified.

³⁶ Trademarks are not shown for universities as the share of respondent that selected it is much small than top options (15%).

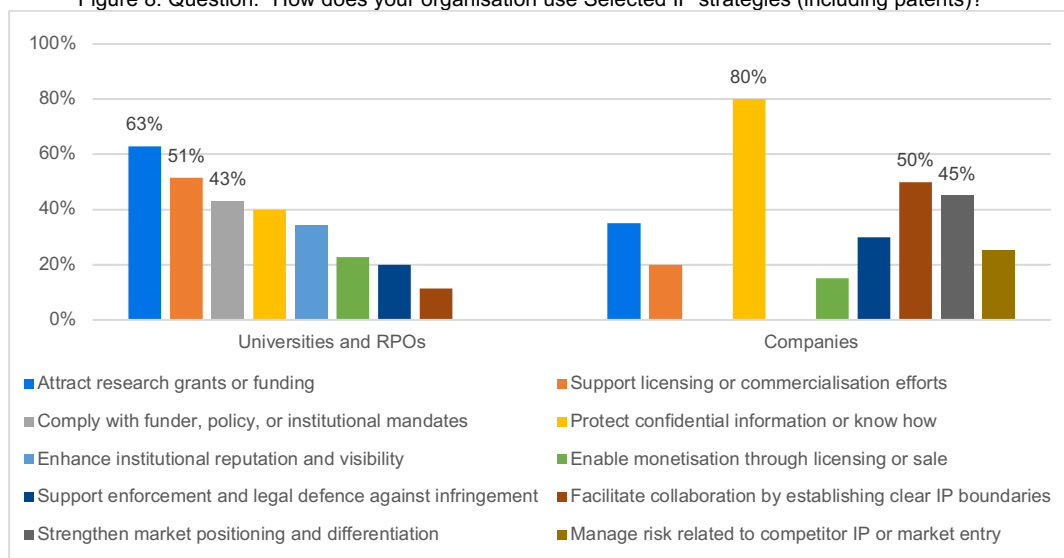
Interviews with academia and industry representatives support these findings, showing that both sectors rely on a mix of formal IP rights and contractual mechanisms to structure collaboration, govern information flows, and prevent premature disclosure, often based on case-by-case assessments of technological maturity and commercial pathways.

2.2. Motivations for non-patent strategies

Survey data indicate that among universities and PROs that did not report patents as their primary IP strategy, the main objectives driving the use of IP measures are to **attract research funding (63%), support licensing or commercialisation efforts (43%), and comply with funder or policy requirements (51%)** (Figure 8). Interviews confirm and expand upon these findings, showing that universities and PROs frequently use trade secrets, internal know-how, and NDAs to protect sensitive information, particularly in collaborative projects or in fields where early disclosure could compromise commercialisation. Researchers explain that trade secrets allow faster market entry without the delays associated with patent applications. NDAs are also commonly used to manage information sharing with partners and collaborators. These mechanisms help universities and PROs balance the pressure to publish with the need to safeguard innovations for potential commercialisation. They also form an important part of institutions' valorisation strategies, as safeguarded results can more easily be licensed or developed into spin-offs.

For companies that do not prioritise patents, survey data indicate that the primary motivations are **protecting confidential information and know-how (80%), facilitating collaboration by establishing clear IP boundaries (55%), and strengthening market positioning (45%)** (Figure 8). Interviews illustrate that companies rely on trade secrets to safeguard core formulations, mechanical details, and processes that, if patented, could otherwise be reverse-engineered. In many advanced materials fields, the process by which the material is produced is more commercially sensitive than the material/technology itself. Therefore, secrecy is a particularly effective and crucial protection mechanism.

Figure 8. Question: "How does your organisation use Selected IP strategies (including patents)?"**



Source: University and PROs survey (n=35) and Company survey (n=20).

*This question was offered to those respondents who did not consider patents as their primary IP strategy.

2.3. Hybrid protection approaches

Survey and interview evidence shows that actors combine contractual tools (NDAs, collaboration agreements, data-licensing arrangements), organisational measures (role-based access controls, internal IP inventories), and reputational strategies (trusted partnerships, track record in collaboration) **to safeguard sensitive information while maintaining openness where required.**

Universities and PROs rely on Technology Transfer Offices (TTOs) to coordinate patentability assessment, align publication with IP protection, and manage know-how and data as intellectual assets. Universities and PROs typically patent inventions with strong commercial potential or when protection is required for collaboration with industry. At the same time, fundamental research is disseminated through publications, as academic recognition and funding incentives prioritise openness. Some institutions prioritise filing patents before publication to secure intellectual property and protect commercial potential, while others focus on open-access dissemination to maximise societal impact and the broader use of their research.

Interviewees further emphasise that obligations in EU-funded projects, particularly open-access requirements and Data Management Plans, necessitate early protection steps before publication or data release. These practices support not only protection but also valorisation, as early safeguarding enables smoother licensing negotiations and clearer IP ownership. Universities and PROs also use NDAs, data-sharing agreements, and background/foreground IP inventories to structure collaboration and protect sensitive results.

Companies also adopt a hybrid approach, utilising trademarks, copyrights, and operational security measures (e.g., access controls and internal IP inventories). They apply a selective strategy, patenting core technologies that support market position, licensing opportunities, or investor confidence, while keeping more sensitive elements, like manufacturing processes or proprietary formulations, a secret. Patents may be avoided when enforcement is costly or disclosure risks could diminish competitive advantage. Non-patent assets, including proprietary datasets or specialised expertise, are monetised through licensing, co-development, and data-sharing agreements.

Ultimately, the survey and interview evidence show that both universities/PROs and companies in advanced materials rely on a combination of patents, trade secrets and NDAs, with patents forming the core IP instrument across sectors. However, IP strategies are highly context dependent: while patents are central for commercially promising, reproducible technologies, secrecy-based and contractual tools are widely used to protect process innovations, manage collaboration, and avoid premature disclosure. Actors frequently adopt hybrid protection approaches, combining formal IP rights with organisational controls and contractual arrangements to balance openness, funding requirements and commercial interests.

In summary, universities, PROs, and companies in advanced materials face interconnected financial, organisational, and regulatory barriers to patenting and commercialisation. Perceived high costs, limited expertise, slow examinations, and jurisdictional complexity create uncertainty and delay, while sector-specific challenges, including capital-intensive validation, scale-up difficulties, and multidisciplinary demands, amplify risk. Despite these obstacles, patents remain the dominant IP instrument across both sectors, complemented by trade secrets and NDAs, which are widely used to protect process innovations, manage collaboration, and avoid premature disclosure. Evidence from surveys and interviews indicates that IP strategies are highly context dependent: actors adopt hybrid approaches, combining formal IP rights with organisational controls and contractual arrangements to balance openness, funding requirements, and commercial interests. However, weak patent culture, limited IP training, and misaligned academic incentives continue to hinder exploitation. Addressing these issues will require strengthening financial support, IP capabilities, regulatory coherence, and university-industry collaboration, alongside targeted training to improve awareness of protection and commercialisation strategies across the European advanced materials ecosystem.

3. Collaboration between industry and academia

RQ8. How can collaboration between industry and academia foster valorisation of results? What are the barriers/challenges for industry-academia co-creation?

Survey evidence shows that universities and public research organisations report very high levels of engagement with industry and investors. The absolute majority of respondents (89.6% of the 107 institutions) indicate that they collaborate with industry and investors, based on the question “Does your institution collaborate with industry and investors to support the valorisation or uptake of patented research results?”. A further 8% report no current collaboration but express interest in doing so, suggesting an overall strong orientation toward external engagement.

Companies were also asked about their collaboration patterns with academia. **The results indicate that academic partnerships are well embedded in firms’ innovation activities:** 70% of companies report engaging in multiple joint projects per year. This supports the view that interaction is frequent rather than occasional (see table below).

Table 21. Question: "In the past three years, how frequent have your collaborations with academia been?"

	Count of answers	percentage share
Very frequent (multiple projects per year)	31	70%
Occasional (1-2 projects per year)	12	27%
Rare (less than once per year)	1	2%
I don't know/cannot answer	0	-

Source: Company survey (n=44).

Although the survey questions posed to companies and to universities and PROs were not formulated identically, the combined results still offer a coherent picture of how collaboration typically unfolds in the advanced materials field. Both surveys show that **collaborative research is the central mode of engagement**. Companies most frequently report involvement in joint research projects and public programmes, while universities and PROs identify collaborative R&D with industry as their most common cooperation channel (see Table 22 and Table 23). This suggests that research-driven partnerships remain the main entry point for cross-sector collaboration.

Table 22. Question: "How does your company currently engage with academic institutions in the advanced materials field?"

	Count of answers	Percentage share
Joint research projects and public research programmes	39	78%
Sponsored contract research	26	52%
Joint ventures and strategic partnerships	9	18%
Licensing and technology transfer	7	14%
Our organisation does not engage with academic institutions	1	2%
I don't know/cannot answer	1	2%

Source: Company survey (n=50).

At the same time, **universities and PROs report engaging across a broader range of valorisation mechanisms than companies indicate using in their direct interactions with academia. These include licensing, participation in innovation consortia and spin-off creation** (see table below). It is important to note that the university survey captures all forms of collaboration with industry and external partners, not only those involving the companies responding to this survey. By contrast, the company survey reflects the much narrower set of activities that firms themselves undertake with academic institutions. **Companies report relatively limited involvement in licensing or strategic partnerships with universities, which suggests that their engagement tends to be concentrated in upstream, exploratory stages of innovation rather than in later commercialisation pathways.** The limited use of staff mobility also reinforces the finding that collaboration remains primarily research-centred rather than integrated across organisational boundaries.

Table 23. Question: "What types of collaboration with industry does your institution most frequently engage in for valorising research? (select all that apply)"

	Count of answers	Percentage share
Collaborative R&D projects with industry	91	96%
Participation in innovation consortia (e.g. Horizon Europe)	80	84%
Creation of spin-offs or start-ups	60	63%
Licensing agreements	55	58%
Staff mobility (e.g. secondments, industrial PhDs)	30	32%
Other	4	4%

Source: University and PROs survey (n=95).

Despite frequent collaboration, the survey results show that **joint patenting remains relatively uncommon**. When asked how often collaborations result in co-owned patent applications or granted patents, most companies report that this happens rarely or never (see Table 24). Open comments indicate several reasons for this pattern. Respondents note that many joint projects remain at low technology readiness levels, making research outputs too early-stage for patenting. Others explain that collaborative work may generate only a single patent over several years, illustrating long development cycles and limited immediate commercial potential. Some companies expressed a clear preference to avoid joint ownership due to the administrative complexity and shared responsibilities it entails, instead favouring the acquisition of rights from universities. These insights reinforce the broader finding that frequent collaboration does not automatically translate into shared IP outcomes.

Table 24. Question: "When your organisation collaborates with academic institutions in the field of advanced materials, how often do these collaborations result in joint (co-owned) patent applications or granted patents?"

	Count of answers	Percentage share
Rarely (in a small minority of collaborations)	23	52%
Sometimes (in about half of collaborations)	9	20%
Never	8	18%
Often (in a majority of collaborations)	4	9%

Source: Company survey (n=44).

Turning to the challenges of working together, the survey questions again differ but point to a shared set of structural constraints (see Table 25 and Table 26). **Both stakeholder groups identify intellectual property management as a core difficulty. Universities and PROs frequently cite ownership disputes and negotiation complexity, and companies similarly report challenges with rights allocation.** This convergence suggests that IP governance may be a significant friction point during the transition from research to commercial application.

Both surveys also indicate a **misalignment of objectives and expectations**. Universities and PROs highlight limited industry interest in early-stage or high-risk research as their most prevalent challenge. Companies, in turn, identify misalignment between academic and commercial priorities and limited academic engagement in commercialisation. These differences reflect the distinct incentive structures of the two groups: universities operate largely at low TRLs and are steered by publication and research impact, while companies prioritise shorter time horizons and market viability.

Bureaucratic complexity appears as a relatively important aspect across both surveys. Universities report delays and complex agreements, and companies concur, noting that lengthy administrative processes can hinder or discourage collaboration. In a field such as advanced materials, where timely proof-of-concept and validation are crucial, bureaucratic delays can be particularly detrimental.

Financial constraints are also featured among the challenges. Universities and PROs emphasise the shortage of funding for technology maturation and proof-of-concept work, while companies, although to a lesser extent, highlight funding for joint research or for commercialisation steps as one of their challenges.

Table 25. Question: "What are the main challenges your institution faces when collaborating with industry or other external actors to support the valorisation or uptake of patented research results? (Select all that apply)"

	Count of answers	Percentage share
Limited industry interest in early-stage or high-risk research	68	72%
Intellectual property management issues (e.g., IP ownership disputes)	47	49%
Financial constraints (e.g. lack of funding for technology maturation or proof-of-concept stages)	47	49%
Bureaucratic delays or complex agreements	41	43%
Lack of clear incentives for industry-academia partnerships	35	37%
Difficulty identifying or accessing appropriate partners	27	28%
Lack of internal support (e.g. insufficient TTO capacity or legal expertise)	15	16%
Other	5	5%

Source: University and PRO survey (n=95).

Table 26. Question: "What are the main challenges your company encounters when collaborating with academic institutions for the commercialisation of your innovations? (select all that apply)"

	Count of answers	Percentage share
Misalignment between academic and commercial objectives	29	67%
Intellectual property management challenges (e.g., IP ownership or rights disputes)	26	60%
Limited academic interest or engagement in commercial applications	18	42%
Financial constraints (e.g., insufficient funding for joint research or commercialisation)	16	37%
Bureaucratic delays or complex agreements	15	35%
Lack of clear incentives for industry-academia partnerships	12	28%
Communication barriers or cultural differences between academia and industry	6	14%
Implementation challenges (e.g., adapting internal processes to adopt academic innovations or new materials)	2	5%

Source: Company survey (n=43).

Despite the challenges identified, companies also highlighted a range of clear benefits associated with collaborating with academic institutions in the context of patent commercialisation³⁷. Survey responses underscore **access to cutting-edge scientific expertise, specialised testing capabilities and exposure to novel research directions**. Companies particularly value the diversity and long-term nature of academic projects and the role of universities in training future scientists and engineers. Collaboration is also seen as a source of high-quality ideas or inventions that may enhance companies' wider patent portfolios. Although negotiating agreements can be complex, some firms note that academic partners are open to finding mutually acceptable arrangements. **Overall, companies view academia as an important source of scientific depth and exploratory capacity, even if commercial pathways tend to be led by industry.**

Companies also identified several factors that would enhance collaboration effectiveness. **Respondents emphasised the need for closer alignment between research topics and industrial priorities, including through student projects or doctoral work co-defined with industry.** Some called for a stronger focus on product development rather than publication metrics, and for clearer, faster and more standardised IP agreements to reduce transaction costs. Additional suggestions included dedicated patent management support on the academic side and EU-level assistance, such as IP advice for SMEs or structured industry placements for academic staff.

Universities and PROs identified a wide set of conditions that would strengthen their ability to collaborate effectively with industry and other external partners on the valorisation and uptake of patented research results³⁸. **A dominant theme is the need for significantly stronger funding at early TRLs, including support for proof-of-concept, prototyping, pilot facilities and pre-industrial demonstration.** Researchers emphasise that without such resources, patented inventions remain too risky or insufficiently validated to attract industrial uptake. Many

37 Open ended survey question: "What are the main benefits of collaborating with academic institutions for patent commercialisation in the advanced materials sector?"

38 Open-ended question: What factors would enhance the opportunities for and effectiveness of collaboration with industry to support valorisation, licensing or broader uptake of patented research results?

respondents therefore call for prematuration programmes, public–private co-investment schemes and stable support for deep-tech spin-offs.

Interview insights illustrate how institutions seek to integrate collaboration into their patenting strategies. Several interviewees described the advantages of co-developing patents with industrial partners in advanced materials, where scale-up and market access are challenging. Some noted that linking patent applications to proof-of-concept funding or spin-off creation can strengthen commercial prospects. Others described delaying patent filings until technical validation is achieved, which they regard as a more strategic approach to intellectual assets management in this field. These observations reflect institutional efforts to align research outputs with realistic commercial pathways, although they remain individual viewpoints and cannot be generalised across the sector.

Finally, universities and PROs also emphasise the role of broader ecosystem conditions, including access to industrial clusters, stronger regional collaboration networks, improved matchmaking platforms and more visible communication channels with potential partners. Some interviewees, particularly those based in smaller countries or regions with less developed industrial ecosystems, noted that demonstration facilities and stronger risk-reduction mechanisms are essential. In these contexts, the pathway to licensing is typically longer and requires more extensive validation before potential industrial partners are willing to engage.

In summary, collaboration between industry and academia clearly supports valorisation by providing access to complementary expertise, enabling early technological exploration, shaping patenting strategies and creating pathways through spin-offs, licensing and collaborative R&D. However, structural barriers, including TRL gaps, intellectual assets management complexity, differing incentives, administrative burdens and insufficient funding for technology maturation significantly constrain the effectiveness of these mechanisms.

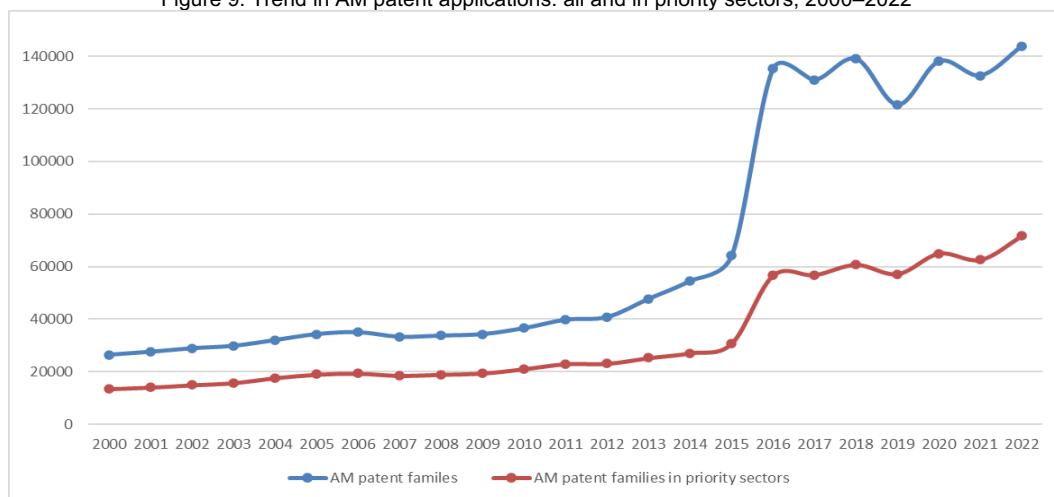
4. Collaborative mechanisms

RQ9. Do patent pools and clearinghouses represent feasible and adequate means to foster valorisation of patents in advanced materials?

Over the past three decades, patent applications worldwide have increased from about 1 million in 1995 to around 2 million in 2010, and reached approximately 3.55 million in 2023³⁹. As shown in the graph below, a similar upward trend is observed for patent applications in the field of advanced materials.

39 World Intellectual Property Organization. (2024). *Patents highlights*. In *World intellectual property indicators 2024: Highlights*. <https://www.wipo.int/web-publications/world-intellectual-property-indicators-2024-highlights/en/patents-highlights.html>

Figure 9. Trend in AM patent applications: all and in priority sectors, 2000–2022



Source: PATSTAT.

In some instances, this growth can lead to the emergence of a patent thicket. This refers to a network of overlapping patents held by multiple companies, which increases the costs of downstream activities, such as cumulative innovation and new product development, that build upon multiple existing innovations⁴⁰. In addition, when access to these technologies increasingly relies on licensing, downstream innovators may be required to identify and negotiate multiple licenses with different patent holders, raising search and transaction costs and potentially making coordination more difficult⁴¹.

Collaborative mechanisms such as **patent pools and patent clearinghouses** have **increasingly gained relevance** as tools to facilitate access to technology, reduce transaction costs, and foster innovation by enabling more efficient sharing and commercialisation of intellectual property⁴².

Patent pools can be defined as agreements between two or more patent owners to license one or more of their patents to one another or to third parties⁴³. Patent pools are often associated with complex technologies that require complementary patents to provide efficient technical solutions⁴⁴. The role of patent pools is to:

- Create accessible bundles of complementary intellectual property rights that can be licensed collectively rather than individually.

This approach helps to overcome the “tragedy of the anti-commons,” where fragmented ownership of related patents can impede innovation due to complex and costly licensing negotiations. By streamlining access and reducing transaction costs, patent pools facilitate the diffusion of technology, while preserving incentives for innovation through fair compensation and recognition of patent holders’ rights. These cooperative arrangements enable the holders of multiple patents, each essential for developing a specific product or process, to license or

40 Shapiro, Carl, Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard-Setting (March 2001). Available at SSRN: <https://ssrn.com/abstract=273550> or <http://dx.doi.org/10.2139/ssrn.273550>

41 Aoki, R. and Schiff, A. (2008), Promoting access to intellectual property: patent pools, copyright collectives, and clearinghouses. *R&D Management*, 38: 189-204. <https://doi.org/10.1111/j.1467-9310.2008.00502.x>

42 Armillotta, M. (2010). *Technology Pooling Licensing Agreements: Promoting Patent Access Through Collaborative IP Mechanisms* (1st ed.). Nomos Verlagsgesellschaft mbH. <http://www.jstor.org/stable/j.ctv941sht>

43 WIPO (2014). Patent pools and antitrust – A comparative analysis.

https://www.wipo.int/documents/743993/747687/patent_pools_report.pdf/8690993c-639b-d12d-eb8f-fff1125cf13f?version=1.2&t=1671199878003

44 Ibid.

transfer their rights collectively at a single price⁴⁵. Patent pools are usually managed either by an independent organisation acting on behalf of all members or by one or more members who administer the pool for the collective group⁴⁶.

Clearinghouses are another form of collaborative licensing mechanism that can help promote efficient access to licensable IP. The term "clearing house" originates from the banking sector, where it refers to the system through which cheques and bills are exchanged among member banks, so that only net balances are settled in cash. Over time, the concept has evolved and broadened in scope. Today, it is commonly used to describe any mechanism that facilitates the matching of providers and users of goods, services, or information⁴⁷. In the context of technology and innovation, clearinghouses:

- Act as intermediaries between patent holders and third parties, facilitating negotiations and transactions in line with their specific mandates.

Initially conceived as simple intermediaries that provide access to data on relevant technologies, these entities have evolved to promote greater collaboration and knowledge exchange among patent holders within targeted technological sectors⁴⁸. In addition, clearinghouses can take an active role by packaging and licensing IP on behalf of owners, negotiating licensing terms, developing standard agreements, and managing the collection and distribution of royalties⁴⁹.

Two main functional types of IP clearinghouses can be distinguished:

1. Informational clearinghouses, which collect and provide access to data on existing intellectual property,
2. Licensing clearinghouses, which not only share information but also sell licenses and may manage royalty collection⁵⁰.

Another dimension of classification concerns ownership and governance, which shape incentives and pricing strategies⁵¹. These factors determine who controls access to technologies and how revenues or cost savings are shared.

Well-documented examples of patent pools or clearinghouses are still limited in the advanced materials field, reflecting its technological diversity, fragmented application domains, and limited reliance on standards. Consequently, illustrative examples are more easily found in other innovation-intensive sectors, such as life sciences and ICT, which offer useful insights into the functioning of these collaborative mechanisms.

Illustrative examples from life sciences and ICT

In the life sciences, patent pools and clearinghouses have mainly emerged in response to concerns about fragmented ownership of essential patents for research, diagnostics, and access to medicines. A widely cited example is the Medicines Patent Pool⁵², established in 2010 to aggregate patents for key antiretroviral medicines and license them to generic manufacturers for use in low- and middle-income countries. The pool has reduced transaction costs, enabled the development of fixed-dose combinations, and improved access to

45 Rodriguez V. (2010). Patent pools: intellectual property rights and competition. doi: 10.2174/1874613601004020062.

46 Aoki, R. and Schiff, A. (2008), Promoting access to intellectual property: patent pools, copyright collectives, and clearinghouses. *R&D Management*, 38: 189-204. <https://doi.org/10.1111/j.1467-9310.2008.00502.x>

47 A.F. Krattiger, 2004. "Financing the bioindustry and facilitating biotechnology transfer," *IP Strategy Today*, volume 8, pp. 1–45.

48 Amillotta, M. (2010). *Technology Pooling Licensing Agreements: Promoting Patent Access Through Collaborative IP Mechanisms* (1st ed.). Nomos Verlagsgesellschaft mbH. <http://www.jstor.org/stable/j.ctv941sht>

49 Ibid.

50 Aoki, R. and Schiff, A. (2008), Promoting access to intellectual property: patent pools, copyright collectives, and clearinghouses. *R&D Management*, 38: 189-204. <https://doi.org/10.1111/j.1467-9310.2008.00502.x>

51 Ibid.

52 <https://medicinespatentpool.org/>

treatment while preserving incentives for patent holders through voluntary participation and defined licensing terms. Other initiatives, such as WIPO Re:Search⁵³, illustrate a clearinghouse-type model that facilitates access to patents and know-how for neglected diseases by matching patent holders and researchers, without necessarily bundling rights into a single license.

In the ICT field, patent pools have long been used to manage the patents associated with technical standards, where multiple complementary patents are required for interoperability. Pools administered by specialised licensing entities such as MPEG LA⁵⁴, Via Licensing⁵⁵ and Sisvel⁵⁶ bundle standard-essential patents for technologies including digital video compression, audio codecs and wireless communications, offering one-stop licenses. These arrangements have reduced royalty stacking, lowered transaction costs and facilitated downstream market entry. Taken together, these standard-based patent pooling practices illustrate how collaborative licensing mechanisms have functioned as durable institutions in cumulative and patent intensive sectors, providing a useful reference point when assessing their potential relevance for other complex technology fields.

4.1. Limitations and potential barriers

Lack of awareness

The literature indicates that **knowledge and practical experience with patent pools and clearinghouses remain limited**, which constitutes a key barrier to their wider adoption⁵⁷. Many potential stakeholders are not fully aware of how collaborative licensing mechanisms function, their governance requirements, or their potential benefits for reducing transaction costs and facilitating technology diffusion.

This **lack of familiarity was also reflected in the interviews, where several participants highlighted their limited knowledge of such collaborative mechanisms**. At the same time, when these models were presented and briefly described, interviewees expressed clear interest and recognition of their potential value, particularly as tools to:

- Facilitate access to technologies
- Support collaboration among diverse actors
- Improve the efficiency of intellectual assets management.

This suggests a need for increased awareness of collaborative models and attention to the practical challenges associated with their implementation.

Balancing efficiency gains and competitive risks in collaborative licensing

Companies often require multiple IP licenses to produce a single product, and negotiating each license entails fixed transaction costs related to search, contracting, and enforcement. These costs limit the level of royalties, since excessive fees make production unprofitable and discourage market entry. By lowering transaction costs and simplifying access to complementary technologies, clearinghouses or patent pools can facilitate licensing, foster collaboration among patent holders, and stimulate innovation.

⁵³ <https://bvgh.org/wipo-research/>

⁵⁴ <https://www.iam-media.com/organisation/mpeg-la>

⁵⁵ <https://via-la.com/>

⁵⁶ <https://www.sisvel.com/>

⁵⁷ Van Zimmeren, E., Vanneste, S., Matthijs, G., Vanhaverbeke, W., & Van Overwalle, G. (2011). Patent pools and clearinghouses in the life sciences. *Trends in Biotechnology*, 29(11), 569-576. doi:10.1016/j.tibtech.2011.06.002.

At the same time, by reducing the individual bargaining frictions that hinder royalty-setting, **competitive discipline might be weakened**.⁵⁸ This can make it easier for IP owners to coordinate on higher royalties or prices, ultimately diminishing the expected welfare gains from improved efficiency.

Governance complexity and risks of concentration

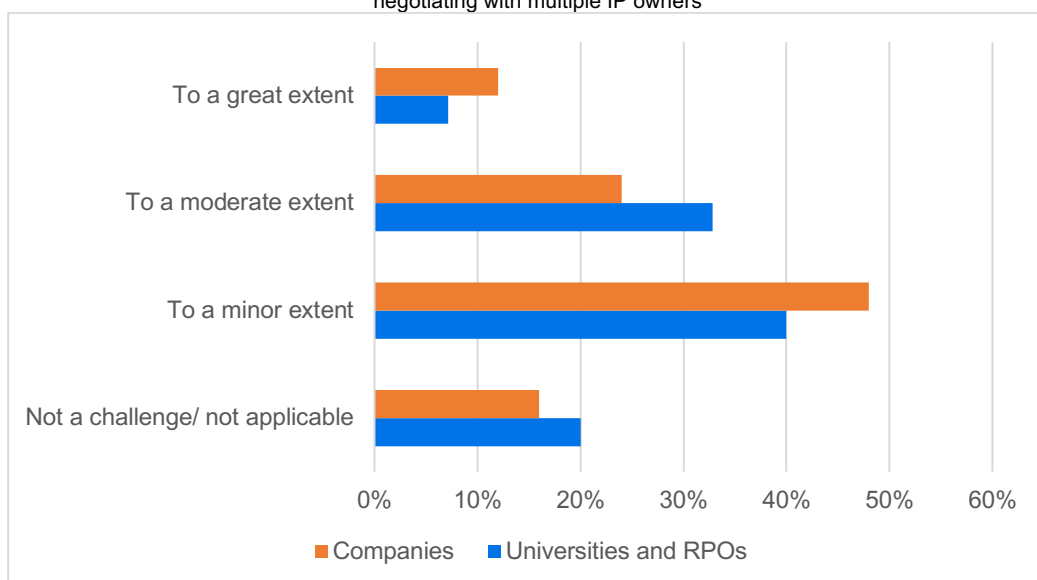
One limitation of patent pools is that their establishment often requires lengthy and costly negotiations to identify essential patents, to agree on valuation methods, and to design fair royalty-sharing mechanisms.⁵⁹ These processes can be resource-intensive, particularly for SMEs or research organisations with limited legal and administrative capacity. One company, for example, noted that it had considered setting up a patent pool to address challenges in coordinating intellectual property rights in the field of advanced polymers. However, they highlighted one major challenge: such **pools require the alignment of all parties, and any deviation forces renegotiation across all agreements**. Launching new polymers would have required building a tailored, resource-intensive legal framework, ultimately making a patent pool unfeasible for them.

As shown in the graph below, the survey conducted for this study confirms this challenge: around 40% of respondents from universities and public research organisations reported that **the cost or complexity of licensing and negotiating with multiple IP owners constitutes a moderate or major obstacle to effective technology transfer**. A slightly lower share (36%) of company respondents reported the same level of difficulty.

58 Aoki, Reiko & Schiff, Aaron. (2010). Intellectual Property Clearinghouses: The Effects of Reduced Transaction Costs in Licensing. *Information Economics and Policy*. 22. 218-227. 10.1016/j.infoecopol.2010.01.001

59 Elahi, Shirin & Müller, Marcus & Carmichael, Guy & Karachalios, Konstantinos & Rutz, Berthold. (2007). Scenarios for the future. How might IP regimes evolve by 2025?

Figure 10. Question: “Please indicate the extent to which each of the following challenges hampers your organisation’s ability to bring patented technologies to market?” Challenge: cost or complexity of licensing and negotiating with multiple IP owners



Source: University and PROs survey (n=70) and Company survey (n=25).

Given these challenges, the implications for participation and market dynamics can be significant:

- Patent holders with smaller portfolios may find it **difficult to participate or influence collaboration terms**.
- If not properly regulated, patent pools risk being **dominated by a few large players** who could coordinate market behaviour or exclude competitors.

Such outcomes could transform a mechanism originally designed to foster innovation and efficiency into one that instead reinforces market concentration and restricts competition. Under certain conditions, patent pools may create opportunities for anti-competitive behaviour and entail the **risk of collusion or coordinated conduct that could limit technological diversity or exclude competitors from the market**. A patent pool may hence be regarded as a potential enabler of innovation diffusion and a possible vehicle for market foreclosure, if not properly structured⁶⁰.

Overall assessment

Patent pools and clearinghouses **offer a feasible way to foster patent valorisation**. They can reduce transaction costs, ease access to complementary technologies, and enhance intellectual assets management and technology transfer, helping to address patent fragmentation and support cumulative innovation.

Their **practical uptake remains however limited** due to low awareness, governance complexity, and resource constraints, especially for SMEs and research organisations. Without adequate supervision, they may also **reinforce market concentration** or facilitate coordination among dominant patent holders.

RQ10. What should be the role of the EU in establishing or supporting such collaborative licensing mechanisms?

60 WIPO (2014). Patent pools and antitrust – A comparative analysis.

The Communication “Advanced Materials for Industrial Leadership” highlights the EU’s fragmented patent landscape and the need to accelerate the valorisation of R&D results⁶¹. By integrating collaborative licensing models such as patent pools for complementary technologies or clearinghouses providing transparent, standardised access, the EU could directly **support the commercialisation of advanced materials** developed within its research ecosystem, while remaining fully aligned with competition law and the principles of open innovation. While these considerations apply across patent fields, the Communication identifies patent fragmentation and weak valorisation as important challenges for the uptake of advanced materials.

The EU’s Knowledge Valorisation policy framework provides the strategic mandate to promote intermediaries that facilitate technology transfer and IP uptake. The Commission’s Recommendation (EU) 2023/499 on the Code of Practice on the Management of Intellectual Assets⁶², and the Council Conclusions on knowledge valorisation⁶³, explicitly call for strengthening licensing capacities, standardised agreements, and digital platforms that connect IP supply and demand. Similarly, Commission’s Recommendation (EU) 2024/774 on a Code of Practice on industry-academia co-creation for knowledge valorisation emphasises the role of intermediaries and digital platforms in facilitating co-creation and better matching innovation supply and demand in industry-academia collaboration⁶⁴. These instruments form **the policy environment within which a European clearinghouse for patents on advanced materials could develop**.

The regulatory environment provides a foundation for collaborative licensing mechanisms such as patent pools and clearinghouses. The key legal instrument is the **Technology Transfer Block Exemption Regulation (TTBER, Regulation (EU) No 316/2014)**⁶⁵, which offers a safe harbour under Article 101(3) TFEU for technology transfer agreements, including joint licensing arrangements, provided that the patents are complementary, the pool is open and transparent, and no hardcore restrictions (e.g. price-fixing or output limits) are imposed. The accompanying 2014 Technology Transfer Guidelines (notably section 4.4)⁶⁶ clarify the conditions under which patent pools are considered pro-competitive, emphasising openness to all interested licensees, independent administration, and licensing on fair, reasonable and non-discriminatory (**FRAND**) terms.

These principles effectively **legitimise patent pools and clearinghouses in the EU when structured appropriately**, providing legal certainty to participants. It is important to note that there is an ongoing review of the TTBER and Guidelines, launched by the European Commission in 2024 and due to conclude before the regulation’s expiry in 2026⁶⁷.

4.2. Standard-essential patents

A standard essential patent (SEP) is a patent that covers an invention indispensable for implementing a specific technology standard. Such standards are vital to ensure the safety, interoperability, and compatibility of products and services offered by different companies⁶⁸. Technology standards are often highly complex, involving numerous SEPs linked to a single

61 <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52024DC0098>

62 Commission Recommendation (EU) 2023/499 of 1 March 2023 on a Code of Practice on the management of intellectual assets for knowledge valorisation in the European Research Area

63 <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022H2415&qid=1670573108748>

64 <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32024H0774&qid=1709626992959>

65 Commission Regulation (EU) No 316/2014 of 21 March 2014 on the application of Article 101(3) of the Treaty on the Functioning of the European Union to categories of technology transfer agreements Text with EEA relevance

66 Communication from the Commission — Guidelines on the application of Article 101 of the Treaty on the Functioning of the European Union to technology transfer agreements

67 https://competition-policy.ec.europa.eu/public-consultations/2023-technology-transfer_en

68 <https://www.wipo.int/en/web/patents/topics/sep>

standard. Some products may rely on only certain elements of a standard to perform specific functions, while others may incorporate multiple standards simultaneously. This is especially true in the **information and communication technologies (ICT) sector**, where interoperability is critical.

In some cases, and in compliance with antitrust laws, **SEP holders with patents relevant to a given standard may form a patent pool**.⁶⁹ The licensing of such SEPs is, however, prone to market failures such as externalities (both positive and negative), information problems, market power, and free riding.

In 2023, the Commission published its **proposal for a regulation to facilitate SEP licensing** by enhancing transparency, reducing information asymmetries between SEP holders and implementers, and supporting the conclusion of fair, reasonable, and non-discriminatory (FRAND) licence agreements. The Commission proposed establishing a competence centre within the EU Intellectual Property Office (EUIPO), responsible for managing a SEP registry and database. SEP holders would be required to register their patents with the EUIPO, which would conduct essentiality checks and define FRAND-related criteria. However, in early 2025, the Commission announced that it was withdrawing the proposed SEP regulation since “neither the Parliament nor the Council adopted a clear signal of support for the SEP Proposal,” adding, that, if “circumstances change,” the Commission will revisit its policy stance⁷⁰.

Although SEPs have so far played **a limited role in the advanced materials domain**, their relevance is expected to grow as standardisation advances in areas such as batteries, sustainable polymers, and advanced composites. These standards can help ensure interoperability, safety, and reliability across industrial applications.

Overall assessment

The existing EU policy and regulatory framework provides the basis for collaborative licensing mechanisms such as patent pools and clearinghouses. While the TTBER establishes the conditions under which such arrangements can comply with competition law, the Code of Practice on the Management of Intellectual Assets provides guidance on good practices in IP licensing. A recent study confirms that the TTBER regime continues to provide an important safe harbour for technology licensing, while identifying limitations in its application to innovation-driven markets and agreements involving fragmented and complementary patent rights⁷¹. The ongoing review of the TTBER will therefore be important for sectors such as advanced materials.

Interviews with EU officials indicate that the **practical scope for these mechanisms in the advanced materials domain remains limited**. Officials noted that “patent pools and clearing houses are important because they help move research into industry” but also stressed that “the fragmented field makes collective licensing less straightforward”. **Smaller, project-based consortia were therefore considered more realistic collaborative licensing models** for supporting the valorisation of R&D results and technology transfer.

In summary, **patent pools and clearinghouses can foster patent valorisation in advanced materials** by reducing transaction costs, facilitating access to complementary technologies, and addressing patent fragmentation. However, their practical uptake in this field remains limited. Evidence from the interviews conducted for this study suggests that this is partly due to **low awareness and limited experience with such mechanisms among potential stakeholders**. Existing EU rules on technology transfer, together with recent initiatives to strengthen knowledge valorisation, allow such mechanisms to operate provided they are carefully structured. In the short term, smaller, project-based collaborative licensing

⁶⁹ Ibid.

⁷⁰ <https://www.euronews.com/next/2025/07/31/eu-commission-confirms-ditching-of-ai-liability-and-patents-proposals>

⁷¹ European Commission (2024). Support study for the evaluation of the Technology Transfer Block Exemption Regulation. Publications Office of the European Union (2adab2d0-2cda-4d48-8aa5-8381ac058eb9_en).

models may offer a more feasible pathway than large-scale pools, particularly in a fragmented and innovation-driven sector such as advanced materials.

5. Conclusions and inputs into policy options

Overall conclusions

The analysis shows that Europe maintains a selective yet high-quality patenting position in advanced materials. European organisations file fewer patents than their counterparts in the United States (US) and China, but their portfolios display stronger international orientation, higher triadic shares and solid citation performance. This reflects a focus on quality rather than patenting volume. The US benefits from strong university–industry linkages and investment ecosystems that support international patenting and technology transfer. China’s rapid expansion in advanced materials patenting is driven largely by domestic filings, with very limited international protection and low triadic shares, reflecting different incentive structures rather than necessarily lower technological relevance.

A consistent pattern emerges across sectors. **Europe shows its strongest global positioning in energy materials, medical materials and electronics, where the share of triadic families and high citation rates tends to exceed those of the US and China.** These sectors are closely aligned with EU policy priorities on decarbonisation, digitalisation and health technologies. By contrast, electronics and construction account for the largest patent volumes globally, driven predominantly by China, which dominates numerically but focuses on domestic protection.

Beyond these sectoral strengths, Europe’s position is also shaped by distinctive patterns of priority filing behaviour. **Only 4.7% of global advanced materials company patents have their priority filing in the EU, suggesting that global innovation is concentrated outside Europe.** Yet among European companies, a large majority (82.6%) file first in Europe, demonstrating a strong home-oriented base. This pattern varies by sector and reveals important insights into the EU’s relative attractiveness. **Sectors such as medical devices and construction attract a comparatively high share of foreign-origin priority filings in Europe and show relatively low outward orientation among European firms. This suggests that in these fields, the EU functions as a strong and self-sustaining innovation hub where non-European actors actively seek protection.**

When European companies file priority patents outside Europe, they overwhelmingly target the US, which accounts for 37% of all outward priority filings, compared with only 6% directed to China. This strong US orientation is most pronounced in the energy and electronics sectors. These outward patterns reinforce the view that the US remains the primary strategic market for European advanced materials innovators.

Alongside patenting, alternative intellectual assets management strategies play a central role in the advanced materials field. **Universities and PROs use NDAs, trade secrets and internal know-how extensively to manage early-stage results, structure collaborations and avoid premature disclosure.** These strategies help reconcile the need to publish with opportunities for licensing and spin-off creation. **Companies often combine patents with secrecy-based protection, particularly for processes and formulations that are difficult to reverse-engineer or where disclosure could compromise their competitive advantage.** Hybrid measures, such as contractual agreements, background IP inventories used to identify, document and contractually allocate pre-existing IP in collaborative projects, and data-licensing mechanisms, are widely used to navigate the complexity of materials development and collaborative projects.

Patent exploitation patterns differ across actors. Universities and PROs rely mainly on licensing, spin-offs and collaborative R&D. At the same time, companies focus on internal use. **Joint patenting remains uncommon despite high levels of cooperation because many projects remain at early TRL stages and because, among other factors, IP negotiations are often lengthy and administratively demanding.** Funding gaps at TRL 5–7 further slow the transition from patents to market-ready technologies.

Despite these constraints, collaboration between industry and academia is extensive, providing access to complementary expertise, facilities, and talent. Yet the commercial impact of collaboration is mainly constrained by misaligned incentives and diverging expectations around IP ownership. Across stakeholders, there is a consistent call for clearer IP frameworks, improved technology maturation support, and more predictable cooperation mechanisms.

As patenting grows, collaborative licensing mechanisms such as patent pools and clearinghouses have gained attention as tools to reduce transaction costs, improve transparency and facilitate access to complementary technologies. Patent pools can streamline licensing for complex technologies by bundling essential patents and offering them under a single, collective set of terms. Clearinghouses can provide information services, standardised agreements and royalty management. However, their uptake remains low due to limited awareness, governance complexity and resource constraints, especially among smaller actors. Stakeholders express interest in these mechanisms but note that fragmented materials fields and the need for bespoke legal frameworks limit their practical feasibility. Without appropriate safeguards, these models may also risk concentration or anti-competitive outcomes.

First inputs to elaborations for policy options

Below, we also provide our preliminary elaborations on the potential policy options to improve knowledge valorisation in the area of advanced materials through patent protection and exploitation, as well as industry-academia collaboration. In particular, we focus on:

- Strategic actions for supporting the valorisation of results in the area of advanced materials through patent protection and exploitation.
- Strategic actions for the development and/or support of collaborative licensing mechanisms at the EU level, such as patent pools and clearinghouses.

Strategic actions for supporting the valorisation of results in the area of advanced materials through patent protection and exploitation

Maximising the valorisation of advanced materials research in Europe requires strengthening the effectiveness, accessibility, and strategic use of patent protection. While Europe demonstrates strong patent quality and high international orientation, several systemic barriers limit the ability of organisations to convert protected inventions into market-ready applications. These include funding gaps at mid-TRL levels, fragmented intellectual assets management across institutions, limited capacity for international filings, and misaligned industry–academia incentives. Against this background, EU action can play a central role in supporting more effective, coordinated and strategically oriented IP exploitation across the AM innovation ecosystem.

A key area for EU intervention concerns the reinforcement of institutional and organisational capacity for patent management within universities, PROs, and SMEs. The analysis shows that public research organisations may lack specialised staff, international filing budgets, or structured IP procedures, which restrict their ability to pursue high-value protection or engage in successful commercial negotiations. Strengthening IP literacy and internal competencies is therefore essential. EU-level initiatives could include targeted training, advisory services, and

practical guidance on materials-specific patent drafting, claim quality, international filing strategies, and management of background and foreground IP in collaborative projects.

At the same time, addressing the funding gap at TRL 5–7 represents a strategic priority. Stakeholders consistently report that patent exploitation is limited not by a lack of invention but by insufficient resources for prototyping, piloting and industrial validation. Without this support, patents remain too early-stage for licensing or investment. The EU could strengthen valorisation by expanding proof-of-concept and maturation schemes, promoting joint industry–academia scale-up programmes, and integrating IP-linked milestones into innovation funding instruments. Such measures would enable protected inventions to reach the level of technical validation required for licensing, spin-off creation and industrial uptake.

A further opportunity lies in simplifying and standardising IP collaboration frameworks. Both universities and companies identify IP negotiations, ownership uncertainty, and administrative delays as key obstacles to valorisation. The EU could therefore promote model agreements for AM collaborations, licensing, joint ownership and data sharing, in line with ongoing Commission initiatives such as the Lab to Unicorn actions under the Startup and Scaleup Strategy, along with clear guidance on best practices for early IP alignment in research partnerships. Standardised contractual tools and interoperable procedures would reduce the transaction costs that currently hinder exploitation and would make cross-border cooperation more predictable. This approach would reflect the European Commission’s emphasis on improving the quality of IP governance across the research and innovation system.

In parallel, the EU can support the strategic use of hybrid IP protection mechanisms, which are essential in advanced materials where competitive advantage often lies in processes, formulations and tacit knowledge. Initiatives could include guidance on managing trade secrets, structuring know-how protection, and integrating these tools with patents in a coherent valorisation framework. In practice, this could involve the development of EU-level guidance and training modules for universities, PROs and SMEs on combining patents with trade secret protection, building on existing best practices such as the EU Trade Secrets Directive implementation guidelines and WIPO guidance on trade secret management. Practical tools could include model intellectual assets management protocols for collaborative R&D projects, templates for documenting background and foreground know-how, and advisory services to help organisations determine when inventions should be patented, protected as trade secrets, or managed through hybrid approaches. Strengthening institutional capacity to manage both patented and non-patented assets would reduce the risk of premature disclosure and enhance the attractiveness of European technologies to investors and industrial partners.

Finally, industry–academia collaboration must be better aligned with valorisation objectives. Although engagement is frequent, its translation into jointly exploited IP remains limited due to differing incentives and fragmented institutional practices. EU action could include incentives for co-development of patents, support for AM-specific innovation clusters, enhanced mobility schemes for researchers, and structured matchmaking platforms. These measures would help integrate the expertise, facilities and market access needed to turn protected AM inventions into deployable technologies.

Strategic actions for the development and/or support of collaborative licensing mechanisms at the EU level, such as patent pools and clearinghouses

In the fields of advanced materials, where technological developments span multiple domains and intellectual property is often fragmented among a wide range of actors, collaborative licensing mechanisms such as patent pools and clearinghouses could help overcome barriers to technology valorisation. These mechanisms can reduce transaction costs, ease access to

complementary technologies, and promote more efficient management and diffusion of intellectual property⁷². However, their practical adoption remains limited, mainly due to:

- Low awareness
- Governance complexity
- Resource constraints, particularly among SMEs and research organisations

A central area for EU action, therefore, concerns the **strengthening of awareness and technical capacity on collaborative licensing models** such as patent pools and clearing houses. Interviewees confirmed that interest is high, but familiarity is low.

Addressing this knowledge gap is a prerequisite for broader participation. EU-level initiatives could include **information campaigns, targeted training and advisory services, and the dissemination of practical guidance on legal, organisational, and financial aspects** of setting up or joining such mechanisms. These actions could build on the Council Conclusions on knowledge valorisation⁷³ and the Code of Practice on the Management of Intellectual Assets⁷⁴, which call for strengthening licensing capacities, standardised agreements, and intermediaries connecting IP supply and demand.

In parallel, the EU could provide clearer guidance on the operation of patent pools and clearinghouses within the boundaries of competition law, in line with the Technology Transfer Block Exemption Regulation (TTBER) and the accompanying Technology Transfer Guidelines⁷⁵.

The ongoing review of these instruments offers an opportunity to clarify how collaborative licensing arrangements can be implemented in compliance with competition rules, ensuring openness, transparency, and fair, reasonable and non-discriminatory (FRAND) licensing practices⁷⁶. **Developing model governance structures and standardised contractual templates would help reduce the legal uncertainty and administrative burden** that currently deter participation, especially for smaller entities.

Experience from other technology fields suggests that collaborative licensing mechanisms can be effective when deployed in well-defined, patent intensive sectors. In the life sciences, initiatives such as the Medicines Patent Pool and WIPO Re:Search demonstrate how patent pools and clearinghouse-type platforms can facilitate access to essential technologies and know-how while preserving voluntary participation and incentives for right holders. In the environmental and clean technology field, WIPO GREEN⁷⁷ provides a marketplace-style platform that connects technology providers, users and investors, illustrating how lighter clearinghouse models focused on matchmaking and visibility can support technology diffusion even without full patent bundling. In the ICT sector, standard-based patent pools administered by specialised licensing entities (e.g. MPEG LA, Via Licensing and Sisvel), provide well-established examples of collaborative licensing mechanisms that support interoperability and efficient market entry in cumulative technologies. These examples illustrate different institutional configurations through which access to patented technologies can be facilitated, ranging from bundled licensing to lighter, platform-based approaches. In this context, the European Union

72 Armillotta, M. (2010). Technology Pooling Licensing Agreements: Promoting Patent Access Through Collaborative IP Mechanisms (1st ed.). Nomos Verlagsgesellschaft mbH. <http://www.jstor.org/stable/j.ctv941sht>

73 <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022H2415&qid=1670573108748>

74 Commission Recommendation (EU) 2023/499 of 1 March 2023 on a Code of Practice on the management of intellectual assets for knowledge valorisation in the European Research Area

75 Commission Regulation (EU) No 316/2014 of 21 March 2014 on the application of Article 101(3) of the Treaty on the Functioning of the European Union to categories of technology transfer agreements Text with EEA relevance

76 Communication from the Commission — Guidelines on the application of Article 101 of the Treaty on the Functioning of the European Union to technology transfer agreements

77 <https://www3.wipo.int/wipogreen/en/>

Intellectual Property Office, in its Strategic Plan 2030, indicates that it will explore the feasibility of an online platform to facilitate the licensing or transfer of IP rights, particularly with a view to supporting SMEs⁷⁸. In advanced materials, this approach may be relevant in light of the sector's technological heterogeneity and fragmented patent ownership.

Building on these illustrative examples, targeted pilot initiatives could be promoted to test collaborative licensing frameworks in selected advanced materials areas, such as batteries, sustainable polymers, and advanced composites where commercialisation typically involves the integration of multiple interdependent technologies across different value chains. **EU support could focus on helping actors identify existing patents, technologies and potential partners, for example through shared databases and matchmaking tools.** The aim would be to reduce information gaps and search costs, particularly for SMEs and research organisations. In practice, such support could **prioritise smaller, project-based consortia focused on a clearly defined advanced material use case requiring access to complementary patents and know-how, where coordination costs are lower and technological complementarities clearer.** Early coordination between research organisations, industry and standardisation bodies could also be encouraged, particularly in areas where standard-essential patents may begin to emerge. Taken together, such an approach would position the EU primarily as **facilitator of collaborative licensing models, rather than regulator**, lowering participation risks for SMEs and research organisations while allowing these mechanisms to develop where they are economically and technologically justified.

In conclusion:

- By combining awareness-raising, legal clarity, and practical experimentation, the EU can play a catalytic role in enabling the development of patent pools and clearinghouses that strengthen knowledge diffusion, improve access to critical technologies, and
- Enhance awareness-raising, legal clarity, and practical experimentation to support the development of patent pools and clearinghouses to accelerate the valorisation of advanced materials research across Europe.

⁷⁸ https://euipo.europa.eu/tunnel-web/secure/webdav/guest/document_library/contentPdfs/about_euipo/strategic_plan/strategic-plan-2030_en.pdf

Annex 1. Technology delineation

This section outlines the approach used to analyse innovation in advanced materials covering both their technological scope and potential dual-use applications. It defines the technological boundaries using a set of 5,481 CPC codes and maps them to five EU priority areas: Mobility, Construction, Energy, Electronics, and Medical Devices. This is refined through NACE (Statistical Classification of Economic Activities in the European Community) sector mapping to ensure consistency with related studies.

Technology delineation

The starting point for delineating the scope of the analysis is the list of **5,481 Cooperative Patent Classification (CPC) codes for advanced materials** identified in the context of the study on Industrial R&D&I investments and market analysis in advanced materials.⁷⁹ This list encompasses the full secondary matrix described in the Materials 2030 Manifesto, detailing material specifications and associated innovation needs.⁸⁰

Building on this foundation, the analysis also incorporates five strategic priority areas for advanced materials: **Mobility, Construction, Energy, Electronics, and Medical Devices**. These priority areas serve as the framework for the analysis and help the delineation of relevant patent activity within each domain.

To ensure consistency with two other ongoing studies on advanced materials—the study on the production and use of advanced materials and the study on the uptake of advanced materials—a concordance table was developed in collaboration with the consortia working on those projects. While the three studies have different focal points, the concordance table serves as a common reference for mapping technologies to the five priority areas. In addition to this, a mapping between materials and priority areas has also been carried out to ensure alignment across studies. This process included a further reclassification of materials based on two frameworks: one suggested by the client (general materials classification) and another used in the parallel study on the production and use of advanced materials.

The mapping of advanced materials technologies to these priority areas mainly draws on data regarding the **NACE sectors of patent applicants**. This second approach has been identified as particularly valuable, as it relies on a bottom-up, data-driven methodology that provides a more granular and empirically grounded view of technological activity across sectors. The relevant list of NACE sectors was initially developed in the context of the Industrial R&D&I investments and market analysis study. For the current study, the list has been revised to reflect the narrower scope of the "Medical Devices" category compared to the broader "Healthcare and Medicine" category. It was agreed to retain one of the previously selected codes from the healthcare and medicine category, namely **C3250 – Manufacture of medical and dental instruments and supplies**, and to add **C2660 – Manufacture of irradiation, electromedical and electrotherapeutic equipment** in order to more accurately capture relevant patent activity in this domain. The table below lists all relevant NACE classes for each of the priority areas identified.

79 European Commission, Directorate-General for Research and Innovation, Van de Velde, E., Braitto, N., Van Roy, V., Stančiauskas, V., et al., Industrial R&D&I investments and market analysis in advanced materials : summary report , Publications Office of the European Union, 2024, <https://data.europa.eu/doi/10.2777/371763>

80 <https://research-and-innovation.ec.europa.eu/system/files/2022-02/advanced-materials-2030-manifesto.pdf>

Table 27. EU priority areas in Advanced Materials and mapping of NACE classes

Priority areas	NACE class
Mobility	C2910 - Manufacture of motor vehicles
	C2920 - Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers
	C2931 - Manufacture of electrical and electronic equipment for motor vehicles
	C2932 - Manufacture of other parts and accessories for motor vehicles
	C3011 - Building of ships and floating structures
	C3012 - Building of pleasure and sporting boats
	C3020 - Manufacture of railway locomotives and rolling stock
	C3030 - Manufacture of air and spacecraft and related machinery
	C3040 - Manufacture of military fighting vehicles
	C3091 - Manufacture of motorcycles
	C3092 - Manufacture of bicycles and invalid carriages
	C3099 - Manufacture of other transport equipment nec
	H4910 - Passenger rail transport, interurban
	H4920 - Freight rail transport
	H4931 - Urban and suburban passenger land transport
	H4932 - Taxi operation
	H4939 - Other passenger land transport nec
	H4941 - Freight transport by road
	H4942 - Removal services
	H4950 - Transport via pipeline
	H5010 - Sea and coastal passenger water transport
	H5020 - Sea and coastal freight water transport
	H5030 - Inland passenger water transport
	H5040 - Inland freight water transport
	H5110 - Passenger air transport
	H5121 - Freight air transport
	H5122 - Space transport
Construction	F4110 - Development of building projects
	F4120 - Construction of residential and non-residential buildings
	F4211 - Construction of roads and motorways
	F4212 - Construction of railways and underground railways
	F4213 - Construction of bridges and tunnels
	F4221 - Construction of utility projects for fluids
	F4222 - Construction of utility projects for electricity and telecommunications
	F4291 - Construction of water projects
	F4299 - Construction of other civil engineering projects nec
	F4311 - Demolition
	F4312 - Site preparation
	F4313 - Test drilling and boring
	F4321 - Electrical installation
	F4322 - Plumbing, heat and air-conditioning installation
	F4329 - Other construction installation
	F4331 - Plastering
	F4332 - Joinery installation
	F4333 - Floor and wall covering
	F4334 - Painting and glazing
	F4339 - Other building completion and finishing
	F4391 - Roofing activities
	F4399 - Other specialised construction activities nec
	M7111 - Architectural activities
	C2344 - Manufacture of other technical ceramic products
	C2351 - Manufacture of cement

Energy	C2362 - Manufacture of plaster products for construction purposes
	C2314 - Manufacture of glass fibres
Energy	D3511 - Production of electricity
	D3512 - Transmission of electricity
	D3513 - Distribution of electricity
	D3521 - Manufacture of gas
	D3522 - Distribution of gaseous fuels through mains
	D3530 - Steam and air conditioning supply
	C2711 - Manufacture of electric motors, generators and transformers
	C2712 - Manufacture of electricity distribution and control apparatus
	C2720 - Manufacture of batteries and accumulators
	C2731 - Manufacture of fibre optic cables
	C2732 - Manufacture of other electronic and electric wires and cables
	C2733 - Manufacture of wiring devices
	C2740 - Manufacture of electric lighting equipment
	C2751 - Manufacture of electric domestic appliances
	C2752 - Manufacture of non-electric domestic appliances
	C2790 - Manufacture of other electrical equipment
Electronics	C2611 - Manufacture of electronic components
	C2612 - Manufacture of loaded electronic boards
	C2620 - Manufacture of computers and peripheral equipment
	C2630 - Manufacture of communication equipment
	C2640 - Manufacture of consumer electronics
	C2651 - Manufacture of instruments and appliances for measuring, testing and navigation
	C2652 - Manufacture of watches and clocks
	C2660 - Manufacture of irradiation, electromedical and electrotherapeutic equipment
	C2670 - Manufacture of optical instruments and photographic equipment
	C2680 - Manufacture of magnetic and optical media
	C2711 - Manufacture of electric motors, generators and transformers
	C2712 - Manufacture of electricity distribution and control apparatus
	C2720 - Manufacture of batteries and accumulators
	C2731 - Manufacture of fibre optic cables
	C2732 - Manufacture of other electronic and electric wires and cables
	C2733 - Manufacture of wiring devices
	C2740 - Manufacture of electric lighting equipment
	C2751 - Manufacture of electric domestic appliances
	C2752 - Manufacture of non-electric domestic appliances
	C2790 - Manufacture of other electrical equipment
	C2811 - Manufacture of engines and turbines, except aircraft, vehicle and cycle engines
	C2812 - Manufacture of fluid power equipment
	C2813 - Manufacture of other pumps and compressors
	C2814 - Manufacture of other taps and valves
	C2815 - Manufacture of bearings, gears, gearing and driving elements
	C2821 - Manufacture of ovens, furnaces and furnace burners
	C2822 - Manufacture of lifting and handling equipment
	C2823 - Manufacture of office machinery and equipment
	C2824 - Manufacture of power-driven hand tools
	C2825 - Manufacture of non-domestic cooling and ventilation equipment
	C2829 - Manufacture of other general-purpose machinery nec
	C2830 - Manufacture of agricultural and forestry machinery
	C2841 - Manufacture of metal forming machinery
	C2849 - Manufacture of other machine tools
	C2891 - Manufacture of machinery for metallurgy

	C2892 - Manufacture of machinery for mining, quarrying and construction
	C2893 - Manufacture of machinery for food, beverage and tobacco processing
	C2894 - Manufacture of machinery for textile, apparel and leather production
	C2895 - Manufacture of machinery for paper and paperboard production
	C2896 - Manufacture of plastics and rubber machinery
	C2899 - Manufacture of other special-purpose machinery nec
Medical devices	C3250 - Manufacture of medical and dental instruments and supplies
	C2660 - Manufacture of irradiation, electromedical and electrotherapeutic equipment

Source: compiled by the consortium based on study on Industrial R&D&I investments and market analysis in advanced materials.

Annex 2. Patent analysis methodology

Description of the dataset

To enable a comprehensive analysis of the advanced materials patenting landscape, two complementary patent datasets were used.

The first dataset consists of advanced manufacturing patent families (docdb_family_id) extracted from the PATSTAT database and is used for patent-level analysis. This dataset forms the basis for examining technological activity, sectoral distribution, citation patterns and priority jurisdictions.

The second dataset is a company-level dataset, linking patent families to applicant firms. This dataset is used to analyse patenting activity by EU and non-EU companies, enabling comparisons of geographic patterns and ownership structures in advanced manufacturing innovation.

PATSTAT data

The analysis based on PATSTAT Global includes all advanced materials (AM) patent families with a priority filing year from 2010 onwards. Using CPC code mapping, approximately 1.3 million unique DOCDB patent families were initially identified.

To restrict the analysis to patents relevant to the defined priority sectors, an additional IPC–NACE concordance mapping was applied, as described in more detail in the sector classification methodology section below. Patent families were mapped to NACE codes, and only those assigned to NACE divisions belonging to the priority sectors (as defined in Table 1 in the Technology Delineation chapter) were retained. Following this sectoral filtering, a total of 633,209 patent families were selected for the subsequent analysis.

Patents mapped to internal company database

Our internal company database contains approximately 23.5 million companies. Of these, 15.7 million companies originate from the Orbis database, 3.2 million companies from Dealroom, and the remainder from Technote data.

Applicant information from PATSTAT was mapped to the internal company database using a matching algorithm. When a match between a PATSTAT applicant and a company in the internal database was identified, the corresponding patent families were assigned to that company.

Using this approach, 435,422 advanced manufacturing patent families were assigned to companies in the internal database. Among these, 228,046 patent families were associated with at least one of the defined priority sectors and were retained for the analysis.

Sector classification (IPC–NACE concordance)

Patents were assigned to priority sectors using the IPC–NACE concordance table provided by KU Leuven, based on the established mappings developed by:

- Van Looy, Vereyen & Schmoch (2015), Eurostat
- Schmoch et al. (2003), DG Research
- Schmoch (2008)

The concordance links IPC technology classes to NACE Rev. 2 industrial sectors, enabling consistent assignment of patents to economic domains. The IPC-NACE concordance table covers manufacturing sectors; therefore, not all NACE divisions in the priority sectors are fully covered, but each sector has most of its NACE codes mapped (see Annex 1 for delineation). If

a patent contained multiple IPC codes mapping to different sectors, it was assigned to all relevant sectors.

Ownership type assignment

Each patent family is attributed to an ownership type (Company, University) based on the institutional sector of its applicants. Applicant information was harmonised at the person level using PATSTAT person identifiers (psn_id) and sectoral classifications. For every patent family, all applicants were considered, regardless of their country of residence.

A dominant-type rule was applied to assign a single ownership category per family, following the hierarchy: Company > University > Public Research Organisation > Individual. Thus, a family with at least one company applicant is classified as Company-owned; if no company is present but at least one university is present, it is classified as University-owned, and so on.

This approach ensures consistent, non-overlapping attribution of patents to ownership types while capturing the overall institutional structure of innovation in advanced materials. The ownership type is analysed jointly with the priority jurisdiction (country of first filing) to describe patterns of technological activity by geography and institutional sector.

Priority jurisdiction classification

Each patent family was assigned to a priority jurisdiction based on the authority (country or regional office) of its earliest application(s) recorded in PATSTAT. When multiple authorities shared the same earliest filing date, all were retained and grouped into broader priority regions to ensure comparability.

Priority regions were defined as follows:

- EU includes applications filed with the European Patent Office (EP) or in European countries (AT, BE, BG, HR, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, RO, SK, SI, ES, SE). Note: this grouping covers both EPO filings and European national filings and therefore is not limited strictly to the EU-27 member states.
- US corresponds to applications first filed with the United States Patent and Trademark Office (USPTO).
- China corresponds to applications filed with the China National Intellectual Property Administration (CNIPA).
- WO (PCT) designates international applications filed under the Patent Cooperation Treaty.
- All other authorities were grouped under Other.

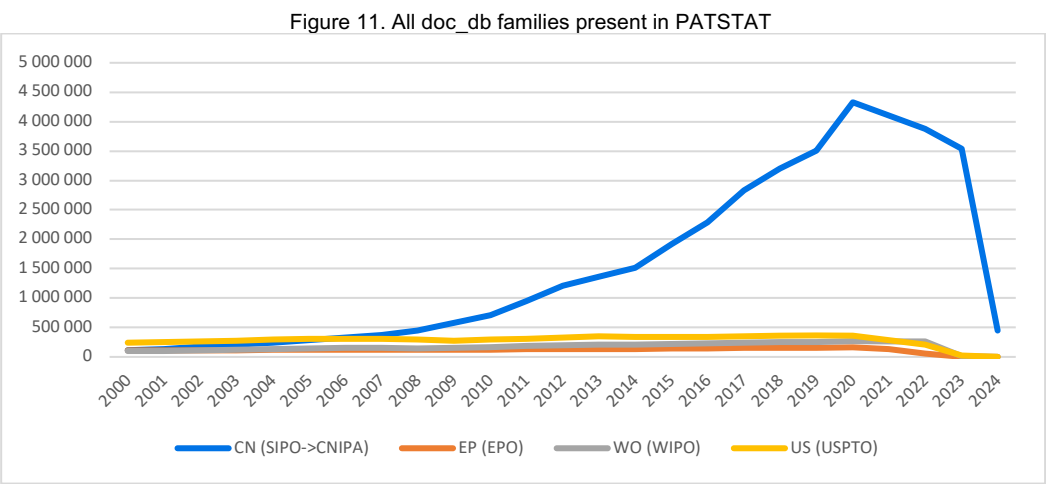
For the statistical tables, only patent families with a single priority region among the EU, the US, or China were retained to ensure clear regional attribution. This approach reflects the geographic origin of inventive activity as indicated by the first filing jurisdiction.

Annex 3: Trends in patenting activity in China

As became clear from Figure 9 in the final report, a remarkable upsurge of patent activity from 2015 onward can be observed within the field of Advanced Materials. As table 1 (page 10) indicates, the amount of patent activity situated in China is particularly pronounced. In terms of total patent activity within the field of AM, CNIPA (formerly known as SIPO) patent counts are currently 5 to 6 times higher than the numbers observed within the USPTO and EPO patent system respectively. At the same time, in terms of triadic patent families, the numbers (and hence the proportion) are much lower for CNIPA patents than for USPTO and EPO.

The question arises whether these dynamics are specific to patent activity within the field of advanced materials or whether they reflect a more general trend. As such we considered all patent families (DOC DB), across all fields and jurisdictions in a separate analysis.

In the next figure one can observe the trends for all DOC DB families present in PATSTAT (Edition Autumn 2024) by jurisdiction (CNIPA, EPO, WO, USPTO).



Source: Patstat.

Here it becomes clear that patent activity within China is rising significantly more than in the US and Europe, and that this trend is starting already from the early 2000s. As such, this trend is not new and has been signaled and documented previously (see amongst others, the references in the following table).

Table 28. Relevant literature (examples)

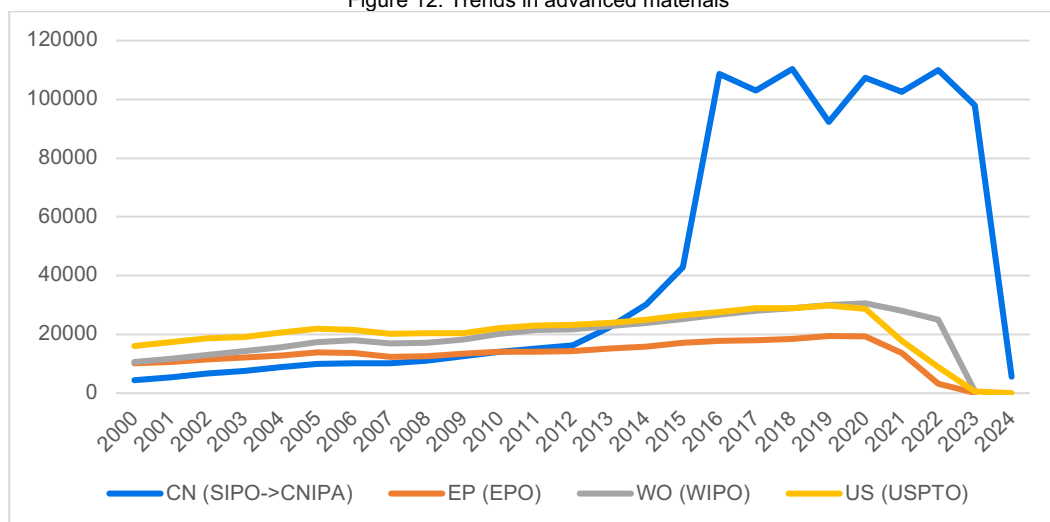
Author	Journal	Publication year	Title
Hu & Jefferson	Journal of Development Economics	2009	A great wall of patents: What is behind China's recent patent explosion?
Haiyang Zhang	International Journal of Business and Management	2010	What is Behind the Recent Surge in Patenting in China?
AGZ. Hu, P. Zhang, L.J. Zhao	Journal of Development Economics	2017	China as number one? Evidence from China's most recent patenting surge
Ling Feng & Xiang Yu	European Review	2022	The Fourth Amendment of Chinese Patent Law and Discussion on its Practical Effects
L. Zhang, F. Qi, Y. Huang, B. Van Looy, L. Chen, O. Saritas	Science and Public Policy	2023	Chinese public university patents during 2006–20: a comprehensive investigation and comparative study

Source: Compiled by the study team.

At the same time, it stands out that the growth patterns within the field of Advanced Materials are even more pronounced, especially in the time period around 2015 (before/after). While the overall growth trend is of a more continuous nature, one observes a more abrupt shift from 2015 onwards. Patent activity in the field of Advanced Materials within the CNIPA jurisdiction multiplied by 6.71 in a five-year timeframe (2012-2016) whereas the growth activity for EPO, and WIPO equals 1.23, and 1.19 for USPTO. The overall trends for the same period equal to 1.88 for CNIPA, 1.08 for EPO, 1.18 for WIPO, and 1.04 for USPTO.

These trends clearly signal that for China Advanced Materials have become a increasingly prominent area of strategic importance during the last decade.

Figure 12. Trends in advanced materials



Source: Patstat.

Within the field of Advanced Materials, a second observation becomes striking. While in the period before 2015 the orientation of patents filed for in China was predominantly geared towards filing in more than one jurisdiction, this is no longer the case in more recent periods. Within the table below one finds the number of filings (doc_db family counts) within CNIPA in the field of Advanced Materials as well as the number of filings with only one Chinese member in these families. The resulting proportion is evolving from 2% (time period 2000-2004) towards over 90% during recent years (2022-2023). Stated otherwise, the vast majority of patent activity observed in these data is situated only in China.

Table 29. Illustration of parents filed in China

publn_auth	earliest_filing_year	CNIPAdocdb_solo_family_cnt	CNIPAdocdb_family_cnt	%
CN	2000	103	4407	2%
CN	2001	135	5355	3%
CN	2002	155	6677	2%
CN	2003	184	7455	2%
CN	2004	202	8870	2%
CN	2005	256	9974	3%
CN	2006	389	10065	4%
CN	2007	456	10111	5%
CN	2008	538	11030	5%
CN	2009	647	12511	5%
CN	2010	839	14020	6%
CN	2011	1033	15126	7%
CN	2012	1766	16200	11%
CN	2013	7567	22381	34%
CN	2014	13902	30130	46%
CN	2015	24343	42885	57%
CN	2016	88187	108759	81%
CN	2017	81511	102962	79%
CN	2018	88162	110330	80%
CN	2019	68549	92210	74%
CN	2020	84236	107288	79%
CN	2021	83303	102643	81%
CN	2022	102489	110019	93%
CN	2023	97572	98072	99%
CN	2024	5612	5619	100%
		752136	1065099	71%

Source: Patstat.

Hence, on the one hand, we are observing an increasing 'global' presence of China in terms of patent activity (see also WIPO⁸¹, IP5 reports⁸²); at the same time, within China the increase of 'domestic' patent activity is even more pronounced. In recent years, each day more than 10.000 patents are filed at CNIPA on a daily base (compared to 450 in Europe). As such, the notion of patent thickets seems no longer appropriate for describing the current IP landscape in China; instead, patent forests (or even 'jungles?') might become a more relevant term in this respect.

81 WIPO report: IP Facts and Figures

82 CNIPA IP5 Statistics Reports: <https://english.cnipa.gov.cn/col/col2967/index.html>

Annex 4. Survey and interview programme

Survey programme

University and PRO survey

The survey of universities and PROs was based on a list compiled from Horizon Europe (HE) projects relevant to the field of advanced materials. The HE projects sample was filtered using a predefined set of technology-related keywords associated with advanced materials technology domains. The filtering relied on a structured classification of technology domains and subdomains (see Table 30), operationalised through corresponding keywords. This approach ensured that the selected projects included technologies of interest. In addition, the company sample was manually filtered based on business activities to remove organisations not directly involved in technological development and in terms of thematic relevance.

Table 30. Technology classification (Levels 1 and 2) used for keyword-based filtering

Domain (Technology Level 1)	Subdomain (Technology Level 2)
Lightweight materials	Additive manufacturing
	Alloys and treatments
	Layered products
	Mortars, concrete or artificial stone or mixtures
Design for circularity	Adhesives and adhesive processes
Sustainable additives and catalysts	Compounds of rare earth metals
	Specific properties of additives
	Paper treatments (impregnating, coating)
	Climate change mitigation in production or processing related to chemical industry
Renewable energy & efficiency	Insulators or insulating bodies
	Glass composition and surface treatment
	Compounds of alkali metals (lithium, sodium, etc.)
	Compounds of metals - thorium
	Shaped ceramic products
	Magnetic materials
	Non-metallic elements and compounds
	Nanotechnology - electromagnetic energy
	Nanotechnology - containing nucleic acid
Advanced surfaces	Metallic material coating and surface treatment
	Layered products
	Materials for prostheses or for coating prostheses
	Nanostructures
	Optical elements
	Materials specially adapted for outerwear
	Specific uses or analysis of nanostructures
	Nanotechnology - containing nucleic acid

Alternative active ingredients	Chemical treatment or coating of shaped articles made of macromolecular substances
	Medical, dental, or toiletry preparations
	Compounds of metals - radium
Renewables & recyclable materials	Wrappers or flexible covers; packaging materials of special type or form
	Climate change mitigation in wastewater treatment and waste management
	Macromolecular compounds - specific compositions
	Macromolecular compounds from carbon-to-carbon unsaturated bonds

Source: produced by the study team.

The study team has identified a total of 3,519 projects, involving 1,055 unique participants that are universities or PROs from the EU-27. The Excel files containing detailed project information and participant details were shared with the client, who subsequently contacted the project coordinators of the identified organisations.

The survey link was shared with the client, who then disseminated it to the coordinators of the HE projects. Although this approach does not allow the use of personalised links (meaning respondents cannot save progress or resume later), dissemination by DG RTD was considered the most effective strategy, as communication directly from the Commission carries greater credibility and ensures higher engagement rates.

The survey has been finalised with a total of 132 responses (Table 31), with 24 respondents agreeing to follow-up interviews and providing contact information.

Table 31. Count of university and PRO survey responses across the EU-27

Country	Total Count of responses
Spain	35
Italy	22
Germany	16
Belgium	8
France	8
Netherlands	7
Austria	6
Finland	4
Slovenia	4
Sweden	4
Czechia	3
Portugal	3
Greece	2
Hungary	2
Ireland	2
Poland	2
Denmark	1
Lithuania	1
Cyprus	1
Romania	1
Total	132

Source: produced by the study team.

An Excel file has been prepared containing detailed responses to all survey questions. These responses have been anonymised; all information that could identify respondents – including names, organisations, organisation URLs, session IDs, and the names of colleagues recommended as interviewees – has been removed.

Company survey

To maximise coverage and engagement, the company survey outreach combined direct email campaigns to identified companies with dissemination through a relevant association.

At the inception of the company survey, the study team relied on email campaigns sent to a total of 811 companies, for which relevant contacts were identified using Milda.ai, with up to three contact persons per company. These contacts were identified drawing on both Horizon Europe participation data and Technote.ai company records.

As a first step, the survey targeted firms that had participated in HE projects related to advanced materials, resulting in an initial dataset of 3,666 companies. Using PPMI's internal tool, Milda.ai⁸³, the study team identified relevant contacts for 314 companies, with up to three contacts per company in some cases. However, early response rates indicated that relying solely on HE projects participants was insufficient to generate the desired level of engagement.

⁸³ <https://milda.ai/>

To broaden the outreach, the team expanded the survey using Technote.ai⁸⁴ data to identify additional companies. Milda.ai was again used to find relevant contacts, resulting in a further 497 companies with at least one contact (up to three in some cases). These companies were approached in the same manner as the initial group.

To avoid overburdening respondents, the survey was launched in batches. When multiple contacts exist within a company, the invitation was first sent to one representative. If no response was received within a week, the invitation was sent to another contact. Each campaign included an initial invitation and one reminder, sent one to two days before the survey deadline. This approach ensured multiple opportunities for a company-level response without repeatedly contacting individual respondents.

In parallel, the study team engaged with relevant associations and networks to further improve response rates. An agreement was reached with the Innovative Advanced Materials Initiative (IAM-I)⁸⁵ to disseminate the survey among its members. The support of IAM-I proved particularly effective in securing a substantial number of survey responses, as well as interview participants.

The survey has been finalised with a total of 61 responses (Table 32), with 15 respondents agreeing to follow-up interviews and providing contact information.

Table 32. Count of company survey responses across the EU-27

Country	Total Count of responses
Spain	17
Germany	7
Italy	7
France	6
Portugal	6
Netherlands	5
Austria	4
Belgium	2
Sweden	2
Canada	1
Denmark	1
Finland	1
Lithuania	1
Other	1
Total	61

Source: produced by the study team.

An Excel file has been prepared containing detailed responses to all survey questions. These responses have been anonymised; all information that could identify respondents – including names, organisations, organisation URLs, session IDs, and the names of colleagues recommended as interviewees – has been removed. The file has been provided to the Commission as a separate annex to ensure transparency and compliance with data protection requirements.

⁸⁴ <https://technote.ai/>

⁸⁵ <https://www.iam-i.eu/>

Interview programme

Interviews complemented the survey by exploring selected themes in greater depth. The programme was intended to cover company representatives, universities and research-performing organisations (PROs), and relevant EU institutions. The interview programme has been finalised, reaching a total of 31 interviewees (Table 33): 16 from universities and PROs, 8 from companies, 5 from European Commission agencies, and 2 from financial institutions (funding bodies). While interviews with funding bodies were not originally planned, they were included following the recommendation of an EC agency, as they could offer valuable insights into companies' investment strategies and advise on measures to support their commercialisation and IP protection.

Table 33. Interview programme overview

No	Type of stakeholder	Country	No	Type of stakeholder	Country
1	EC/agency - DG GROW D3	n/a	16	University/PRO	Czech Republic
2	EC/agency - JRC B6	n/a	17	University/PRO	Czech Republic
3	EC/agency - JRC B6	n/a	18	University/PRO	Slovenia
4	EC/agency - REA C3.002	n/a	19	University/PRO	Spain
5	EC/agency - RTD A3	n/a	20	University/PRO	Cyprus
6	Company	Netherlands	21	University/PRO	Austria
7	Company	Italy	22	University/PRO	Spain
8	Company	Italy	23	University/PRO	Spain
9	Company	Austria	24	University/PRO	Italy
10	Company	Austria	25	University/PRO	Portugal
11	Company	Austria	26	University/PRO	Spain
12	Company	Spain	27	University/PRO	Spain
13	Company	Spain	28	University/PRO	Italy
14	Funding body	Austria	29	University/PRO	Spain
15	Funding body	Denmark	30	University/PRO	Belgium
			31	University/PRO	Finland

Source: produced by the study team.

Annex 5. Survey questionnaires

Survey for university and research performing organisation representatives – questionnaire

Introduction

This survey is being conducted as part of the **Patent landscape analysis in the field of advanced materials study**, carried out by PPMI (part of the Verian Group), IDEA Consult, and INCENTiM-KU Leuven for the European Commission's Directorate-General for Research and Innovation. Please see the [letter of recommendation](#) provided by the European Commission, which gives further information about the study.

The aim of this study is to understand intellectual property management trends and explore the key factors influencing the management and commercialisation of intellectual property (IP) in the field of advanced materials. This includes looking at challenges in patent protection, exploring alternative ways of protecting innovations (such as trade secrets), investigating cases where stakeholders choose not to protect innovations, and understanding the role of patents and other IP protection strategies in helping universities and public research organisations engage in commercialisation of their R&I efforts through founding spin-offs or establishing partnerships with industry.

Your feedback will provide valuable insights to help shape future EU policies aimed at improving how patents are used and commercialised in Europe, particularly in the advanced materials sector. The results will help identify ways to support industry-academia collaboration and explore collaborative intellectual assets management and licensing strategies like patent pools and clearinghouses.

In the period 2010–2019, the EU's share of advanced materials patents in the world visibly declined. This occurred despite an upward trend in R&D in most innovation markets between 2016–2021.

Your input in this survey is crucial. It can help improve our understanding of this trend and inform updated policy measures that could positively impact the situation.

This survey will take approximately **15 minutes to complete**.

All collected personal and other data will be treated confidentially, reported in aggregated form only, used exclusively for the purposes of this study, and handled in line with the [Data Protection Notice](#).

Fields marked with * are mandatory.

In case of any technical issues or other questions, please contact IPprotection_AM@ppmi.it.

Thank you very much for your valuable feedback and support.

Q1. Please confirm that you have read and accepted the terms of the Data Protection Notice on personal data protection on how PPMI ensures the confidentiality of your responses on behalf of the European Commission. *

- ☐ I understand my data rights, and wish to continue
- ☐ I wish to leave

↳ If “I wish to leave” is selected, the respondent is disqualified and exits the survey.

General questions

Q2. This survey covers the following topics: IP management, commercialisation of IP, and collaboration with businesses. Are you comfortable answering questions related to these topics? *

- ☐ Yes
- ☐ No
- ☐ I don't know / cannot answer

↳ If "No" or "I don't know / cannot answer" is selected, the respondent is disqualified after the next question.

Q3. Can you suggest a colleague who would be best equipped to reflect on these topics (i.e. IP management, commercialisation of IP, and collaboration with businesses)? *

↳ Shown only if "No" or "I don't know / cannot answer" was selected above.

Colleague's name: _____

Colleague's email address: _____

Q4. Please indicate the location of the organisation you are representing in this survey.

*

- ☐ Austria
- ☐ Belgium
- ☐ Bulgaria
- ☐ Croatia
- ☐ Republic of Cyprus
- ☐ Czechia
- ☐ Denmark
- ☐ Estonia
- ☐ Finland
- ☐ France
- ☐ Germany
- ☐ Greece
- ☐ Hungary
- ☐ Ireland
- ☐ Italy
- ☐ Latvia
- ☐ Lithuania
- ☐ Luxembourg
- ☐ Malta
- ☐ Netherlands
- ☐ Poland
- ☐ Portugal
- ☐ Romania
- ☐ Slovakia
- ☐ Slovenia
- ☐ Spain
- ☐ Sweden

Q5. In the advanced materials sector, which of the following IP management strategies has your organisation adopted in the last 3 years? (Select all that apply) *

- ☐ Patents
- ☐ Trade secrets (e.g. advanced proprietary materials, processes, techniques, methods)
- ☐ Copyright (e.g. software, publications, training materials)
- ☐ Non-disclosure Agreements (NDAs)
- ☐ Material Transfer Agreements (MTAs) / Data Use Agreements
- ☐ Defensive publication
- ☐ Creative Commons licensing
- ☐ Trademarks
- ☐ No protection / deliberate public disclosure
- ☐ Open-source or open-data licensing
- ☐ Other (please specify): _____
- ☐ None of the above

↳ If "None of the above" is selected, the respondent skips to the "Collaboration with industry and investors" section.

Q6. Of the options you selected above, which one is the primary (i.e. with highest commercial value) IP management strategy your organisation uses? *

- ☐ Patents
- ☐ Trade secrets (e.g. advanced proprietary materials, processes, techniques, methods)
- ☐ Copyright (e.g. software, publications, training materials)
- ☐ Non-disclosure Agreements (NDAs)
- ☐ Material Transfer Agreements (MTAs) / Data Use Agreements
- ☐ Defensive publication
- ☐ Creative Commons licensing
- ☐ Trademarks
- ☐ No protection / deliberate public disclosure
- ☐ Open-source or open-data licensing
- ☐ Other (please specify): _____

Patent filing process abroad

↳ This section is shown only to respondents whose primary IP management strategy is "Patents".

Q7. To the best of your knowledge, does your organisation file Advanced Materials patents in the US? If so, are you able to compare your experience and the relative advantages and disadvantages of filing in the US versus the EU? *

- ☐ Yes
- ☐ Yes, but I cannot compare
- ☐ No
- ☐ I don't know / cannot answer

Q8. Can you suggest a colleague who would be able to comment on it in an interview?

↳ Shown only if "Yes, but I cannot compare" was selected above.

Colleague's name: _____

Colleague's email address: _____

Q9. To the best of your knowledge, does your organisation file Advanced Materials patents in China? If so, are you able to compare your experience and the relative advantages and disadvantages of filing in China versus the EU? *

- ☐ Yes
- ☐ Yes, but I cannot compare
- ☐ No
- ☐ I don't know / cannot answer

Q10. Can you suggest a colleague who would be able to comment on it in an interview?

↳ Shown only if "Yes, but I cannot compare" was selected above.

Colleague's name: _____

Colleague's email address: _____

Q11. For each factor below, please select the region you consider to be more favourable (Europe or United States). If you are unsure or have no experience with a particular aspect, select "I don't know". *

↳ Shown only if the respondent files Advanced Materials patents in the US.

	Europe	USA	I don't know
Patent filing cost	☐	☐	☐
Patent maintenance (renewal) cost and patent term	☐	☐	☐
Length of the patent application process	☐	☐	☐
Patent quality examination rigour	☐	☐	☐
IP rights enforcement	☐	☐	☐
Patent scope and rights granted (effectiveness, speed, and cost)	☐	☐	☐
Translation costs	☐	☐	☐
IP management complexity across laws, language and procedural requirements	☐	☐	☐
Ease of commercialisation	☐	☐	☐
Market coverage / size (strategic market value)	☐	☐	☐

Q12. In the question above, you mentioned that patenting in the US is more favourable in some aspects. Please comment on the advantages of the US system compared to the EU.

↳ Shown only if at least one factor above was rated more favourable in the USA.

Open-ended response

Q13. For each factor below, please select the region you consider to be more favourable (Europe or China). If you are unsure or have no experience with a particular aspect, select “I don’t know”. *

↳ Shown only if the respondent files Advanced Materials patents in China.

	Europe	China	I don’t know
Patent filing cost	☐	☐	☐
Patent maintenance (renewal) cost and patent term	☐	☐	☐
Length of the patent application process	☐	☐	☐
Patent quality examination rigour	☐	☐	☐
IP rights enforcement	☐	☐	☐
Patent scope and rights granted (effectiveness, speed, and cost)	☐	☐	☐
Translation costs	☐	☐	☐
IP management complexity across laws, language and procedural requirements	☐	☐	☐
Ease of commercialisation	☐	☐	☐
Market coverage / size (strategic market value)	☐	☐	☐

Q14. In the question above, you mentioned that patenting in China is more favourable in some aspects. Please comment on the advantages of the Chinese system compared to the EU.

↳ Shown only if at least one factor above was rated more favourable in China.

Open-ended response

Patent use, commercialisation strategies and barriers to patent utilisation

↳ This section is shown only to respondents whose primary IP management strategy is “Patents”.

In this section, we would like to understand how your institution uses advanced materials patents after filing — whether through licensing, research collaboration, spin-off creation, or other forms of knowledge and technology transfer. We will also explore your motivations for patenting, the typical timeframes for external uptake or valorisation of patented research results, and any challenges your institution faces in supporting this process.

Q15. How are your organisation’s patents used after filing? (Select all that apply) *

- ☐ Internal use to support ongoing research or institutional goals
- ☐ Licensed to external organisations (e.g. companies, non-profits)
- ☐ Sold / transferred
- ☐ Joint exploitation or co-commercialisation with partners
- ☐ Used as a basis for creating spin-off or start-up companies
- ☐ Used as background IP in collaborative R&D projects
- ☐ Disclosed for public benefit (e.g. open licensing, defensive publication)
- ☐ Not currently used / dormant

- ☐ Other (please specify): _____
- ☐ I don't know / cannot answer

Q16. What are the main reasons your organisation's patents are not currently used or commercialised? (Select all that apply) *

↳ Shown only if "Not currently used / dormant" was selected above.

- ☐ The invention lacks clear market application or industry interest
- ☐ Insufficient internal resources to pursue commercialisation
- ☐ Regulatory or legal barriers
- ☐ Patent protection not strong enough to justify commercialisation
- ☐ Technology is still under development or not ready for market
- ☐ Preference for open / public dissemination over commercialisation
- ☐ Relevant expertise or commercial partners are lacking
- ☐ Patent serves as a defensive publication or research tool only
- ☐ The cost of maintaining or promoting the patent is too high
- ☐ Other (please specify): _____

Q17. How often do the following organisation types typically license your organisation's patents? (Rate each on the scale below) *

↳ Shown only if "Licensed to external organisations" was selected above.

	Never	Sometimes	Often
Universities or research institutions	☐	☐	☐
SMEs	☐	☐	☐
Large corporations	☐	☐	☐
Individual inventors or start-ups	☐	☐	☐
Public-private partnerships	☐	☐	☐
Private or public research consortia	☐	☐	☐

Q18. In which geographic markets does your organisation primarily commercialise or license patents? (Select all that apply) *

↳ Shown only if patents are licensed, sold/transferred, jointly exploited, or used as background IP.

- ☐ Europe
- ☐ USA
- ☐ China
- ☐ Other (please specify): _____
- ☐ I don't know / cannot answer

Q19. What are the main reasons why your organisation commercialises or licenses patents in the foreign countries / markets selected above?

Please consider aspects such as market size, regulatory environment, enforcement mechanisms, costs, or any other relevant factor.

↳ Shown only if "USA" or "China" was selected above.

Open-ended response

Q20. What strategic considerations and success factors motivate your organisation to engage in patent commercialisation and licensing, beyond financial return and invention protection (e.g. attracting external financing, ensuring market positioning, risk management, or other)?

Please describe any internal or external conditions that contribute to effective commercialisation in your experience.

Open-ended response

Q21. Please indicate the extent to which each of the following challenges hampers your organisation's ability to bring patented technologies to market. *

	Not a challenge / Not applicable	To a minor extent	To a moderate extent	To a great extent
Regulatory approvals	☐	☐	☐	☐
Lack of commercial interest from commercial partners	☐	☐	☐	☐
No existing market	☐	☐	☐	☐
Financial constraints	☐	☐	☐	☐
Internal resource limitations	☐	☐	☐	☐
Technology transfer inefficiencies	☐	☐	☐	☐
Market readiness or customer adoption	☐	☐	☐	☐
Identifying the right partners or relevant patent holders / licensors	☐	☐	☐	☐
Cost or complexity of licensing and negotiation with multiple IP owners	☐	☐	☐	☐
Risk of disclosing non-patented know-how or critical information	☐	☐	☐	☐
Inadequate IP protection	☐	☐	☐	☐
Complexity or costs of enforcing IP rights	☐	☐	☐	☐
Risk of infringement disputes due to fragmented patent ownership (patent thickets)	☐	☐	☐	☐
Uncertainty about patent validity / essentiality / commercial value	☐	☐	☐	☐
Challenges arising from dual-use applications of our technology	☐	☐	☐	☐

Alternative IP protection and open dissemination strategies

↳ This section is shown only to respondents whose primary IP management strategy is NOT "Patents".

At the beginning of the survey, you chose that your organisation primarily uses *[primary IP strategy selected earlier]*. In this section we will explore it.

Q22. How does your organisation use [primary IP strategy]? (Select all that apply) *

- ☐ Attract research grants or funding
- ☐ Comply with funder, policy, or institutional mandates
- ☐ Protect creative works or software (e.g. simulation tools, design files, material processing software, technical documentation)
- ☐ Protect confidential information or know-how (e.g. proprietary formulations, manufacturing processes, testing protocols)
- ☐ Support licensing or commercialisation efforts
- ☐ Support enforcement and legal defence against infringement
- ☐ Facilitate collaboration by establishing clear IP boundaries (e.g. joint R&D with other research organisations, universities, businesses, or customers in advanced materials)
- ☐ Enhance institutional reputation and visibility
- ☐ Enable monetisation through licensing or sale
- ☐ Other (please specify): _____

Q23. In which geographic markets does your organisation currently commercialise or license the [primary IP strategy]? (Select all that apply) *

- ☐ Europe
- ☐ USA
- ☐ China
- ☐ Other (please specify): _____
- ☐ We do not currently commercialise or license these IPs

Q24. What are the main reasons why your organisation commercialises or licenses via [primary IP strategy] in the foreign markets chosen above?

Please consider aspects such as market size, regulatory environment, enforcement mechanisms, costs, or any other relevant factor.

↳ Shown only if “USA” or “China” was selected above.

Open-ended response

Q25. Has your organisation considered filing patents for your innovations in the advanced materials sector, but decided to use alternative IP protection methods ([primary IP strategy]) instead? *

- ☐ Yes, we considered patenting but decided against it
- ☐ No, we did not consider patenting
- ☐ Not sure / Do not know

Q26. What were the main reasons for not pursuing patenting? (Select all that apply) *

↳ Shown only if “Yes, we considered patenting but decided against it” was selected above.

- ☐ High cost of patenting
- ☐ Innovation too early-stage for patenting
- ☐ Alternative methods provide stronger or faster protection of inventions
- ☐ To avoid public disclosure of sensitive information
- ☐ Patent already filed by other parties (e.g. co-investors or competitors)
- ☐ Too many patents exist in the field already
- ☐ Enforcement of patents is not feasible or effective in our target markets
- ☐ Simpler or less burdensome process than patenting

- ☐ We prefer not to patent for other reasons (please specify):
-

Q27. If some of the challenges or reasons you selected above were addressed or improved externally, how likely would your organisation be to pursue patenting in the future? *

↳ Shown only if relevant reasons (e.g. high cost, too many patents, patent already filed, or simpler process) were selected above.

	To no extent	To a small extent	To a great extent
High cost of patenting	☐	☐	☐
Too many patents exist in the field already	☐	☐	☐
Patent already filed by co-investors or competitors	☐	☐	☐
Simpler or less burdensome process than patenting	☐	☐	☐

Collaboration with industry and investors for research valorisation

This section focuses on your institution's collaboration with industry and other external actors for the purpose of patent valorisation, technology transfer, and the broader uptake of research results in the sector of advanced materials. We aim to understand the extent and effectiveness of these partnerships, as well as the challenges your institution may encounter in facilitating the commercial or societal application of patented innovations.

Q28. Does your institution collaborate with industry and investors to support the valorisation or uptake of patented research results in the sector of advanced materials? *

- ☐ Yes, frequently
- ☐ Yes, occasionally
- ☐ No, but we are interested in doing so
- ☐ No, we are not interested in such collaboration

Q29. What types of collaboration with industry does your institution most frequently engage in for valorising research? (Select all that apply) *

↳ Shown only if "Yes, frequently" or "Yes, occasionally" was selected above.

- ☐ Collaborative R&D projects with industry
- ☐ Licensing agreements
- ☐ Participation in innovation consortia (e.g. Horizon Europe)
- ☐ Creation of spin-offs or start-ups
- ☐ Staff mobility (e.g. secondments, industrial PhDs)
- ☐ Other (please specify): _____

Q30. What are the main challenges your institution faces when collaborating with industry or other external actors to support the valorisation or uptake of patented research results? (Select all that apply) *

↳ Shown only if "Yes, frequently" or "Yes, occasionally" was selected above.

- ☐ Intellectual property management issues (e.g. IP ownership disputes)
- ☐ Lack of clear incentives for industry-academia partnerships

- ☐ Limited industry interest in early-stage or high-risk research
- ☐ Bureaucratic delays or complex agreements
- ☐ Lack of internal support (e.g. insufficient TTO capacity or legal expertise)
- ☐ Difficulty identifying or accessing appropriate partners
- ☐ Financial constraints (e.g. lack of funding for technology maturation or proof-of-concept stages)
- ☐ Other (please specify): _____

Q31. What factors would enhance the opportunities for and effectiveness of your institution's collaboration with industry or other external partners to support the valorisation, licensing, or broader uptake of patented research results?

Please provide as much detail as possible.

Open-ended response

Final questions

Q32. Are there any additional comments that you would like to add?

Open-ended response

Q33. Would you be willing to participate in a follow-up interview? *

- ☐ Yes
- ☐ No

Q34. To schedule an interview, please share your name, surname, and email address with us. *

↳ Shown only if "Yes" was selected above.

Your name: _____

Your email address: _____

Thank you

Thank you for taking our survey. Your response is very important to us.

Survey for company representatives – questionnaire

Introduction

This survey is being conducted as part of the **Patent landscape analysis in the field of advanced materials study**, carried out by PPMI (part of the Verian Group), IDEA Consult, and INCENTiM-KU Leuven for the European Commission's Directorate-General for Research and Innovation. Please see the [letter of recommendation](#) provided by the European Commission for information about the study.

Advanced materials play a critical role in driving innovation and addressing Europe's strategic goals, particularly in areas like sustainability, digitalisation, and clean energy. At the same time, effective intellectual property (IP) management is key to unlocking the potential of these

materials, supporting economic growth, fostering collaboration, and ensuring Europe's global competitiveness.

We have identified you as a company that is active in the advanced materials sector. The questions in this survey will include the following:

- Your company's main and secondary intellectual property (IP) protection strategies in the field of advanced materials;
- Your experience with patent filing processes, including comparisons between Europe, the United States, and China;
- How your company uses and commercialises patents, including licensing, strategic motivations, and any barriers faced;
- Your company's use of alternative IP management strategies such as trade secrets, open access, defensive publication, etc;
- Your company's collaboration with academic institutions to support patent commercialisation and innovation uptake.

In the period 2010–2019, the EU's share of advanced materials patents in the world visibly declined. This occurred despite an upward trend in R&D in most innovation markets between 2016–2021.

Your input in this survey is crucial. It can help improve our understanding of this trend and inform updated policy measures that could ultimately improve market uptake of advanced materials. This is expected to contribute to a more favourable innovation landscape benefiting European businesses.

This survey will take approximately **15 minutes to complete**.

All collected personal and other data will be treated confidentially, reported in aggregated form only, used exclusively for the purposes of this study, and handled in line with the [Data Protection Notice](#).

Fields marked with * are mandatory.

In case of any technical issues or other questions, please contact IPprotection_AM@ppmi.it.

Thank you very much for your valuable feedback and support.

Q1. Please confirm that you have read and accepted the terms of the Data Protection Notice on personal data protection on how PPMI ensures the confidentiality of your responses on behalf of the European Commission. *

- ☐ I understand my data rights, and wish to continue
- ☐ I wish to leave

↳ If "I wish to leave" is selected, the respondent is disqualified and exits the survey.

General questions

Q2. This survey covers the following topics: IP management, commercialisation of IP, and collaboration with academia. Are you comfortable answering questions related to these topics? *

- ☐ Yes
- ☐ No
- ☐ I don't know / cannot answer

↳ If "No" or "I don't know / cannot answer" is selected, the respondent is disqualified after the next question.

Q3. Can you suggest a colleague who would be best equipped to reflect on these topics (i.e. IP management, commercialisation of IP, and collaboration with academia)?

↳ Shown only if “No” or “I don’t know / cannot answer” was selected above.

Colleague’s name: _____

Colleague’s email address: _____

Q4. In the advanced materials sector, which of the following IP management strategies has your company adopted in the last 3 years? (Select all that apply) *

- ☐ Patents
- ☐ Trademarks
- ☐ Copyright
- ☐ Utility models
- ☐ Industrial designs
- ☐ Confidentiality or non-disclosure Agreements (NDAs) with your employees
- ☐ Trade secrets (e.g. advanced proprietary materials, processes, techniques, methods)
- ☐ Other (please specify): _____
- ☐ None of the above

↳ If “None of the above” is selected, the respondent skips to the “Industry-academia collaboration” section.

Q5. Of the options you selected above, which one is the primary (i.e. with highest commercial value) IP management strategy your company uses? *

- ☐ Patents
- ☐ Trademarks
- ☐ Copyright
- ☐ Utility models
- ☐ Industrial designs
- ☐ Confidentiality or non-disclosure Agreements (NDAs) with your employees
- ☐ Trade secrets (e.g. advanced proprietary materials, processes, techniques, methods)
- ☐ Other (please specify): _____

Patent filing process

↳ This section is shown only to respondents whose primary IP management strategy is “Patents”.

In this section, we ask you to share your company’s experience with patent filing in Europe and abroad. The questions are designed to capture both practical aspects (such as costs, duration, and enforcement) and your overall impressions of filing in different jurisdictions. Please answer based on your own knowledge; if you cannot provide an answer, you will have the option to indicate this or suggest a colleague who may be better placed to respond.

Q6. Do you have experience filing patents in the US? If so, are you able to compare your experience and the relative advantages and disadvantages of filing in the US versus the EU? *

- ☐ Yes
- ☐ Yes, but I cannot compare
- ☐ No
- ☐ I don’t know / cannot answer

Q7. Can you suggest a colleague who would be able to comment on it in an interview?

↳ Shown only if “Yes, but I cannot compare” was selected above.

Colleague's name: _____

Colleague's email address: _____

Q8. Do you have experience filing patents in China? If so, are you able to compare your experience and the relative advantages and disadvantages of filing in China versus the EU? *

- ☐ Yes
- ☐ Yes, but I cannot compare
- ☐ No
- ☐ I don't know / cannot answer

Q9. Can you suggest a colleague who would be able to comment on it in an interview?

↳ Shown only if “Yes, but I cannot compare” was selected above.

Colleague's name: _____

Colleague's email address: _____

↳ If the respondent has no comparable experience filing in either the US or China, the survey skips to “Patent use, commercialisation strategies and barriers”.

Q10. For each factor below, please select the region you consider to be more favourable (Europe or United States). If you are unsure or have no experience with a particular aspect, select “I don't know”. *

↳ Shown only if the respondent has experience filing patents in the US.

	Europe	USA	I don't know
Patent filing cost	☐	☐	☐
Patent maintenance (renewal) cost and patent term	☐	☐	☐
Length of the patent application process	☐	☐	☐
Patent quality examination rigour	☐	☐	☐
IP rights enforcement	☐	☐	☐
Patent scope and rights granted (effectiveness, speed, and cost)	☐	☐	☐
Translation costs	☐	☐	☐
IP management complexity across laws, language and procedural requirements	☐	☐	☐
Ease of commercialisation	☐	☐	☐
Market coverage / size (strategic market value)	☐	☐	☐

Q11. In the question above, you mentioned that the USA is more favourable in some aspects. Please comment on the advantages of the US system compared to the EU.

↳ Shown only if at least one factor above was rated more favourable in the USA.

Open-ended response

Q12. For each factor below, please select the region you consider to be more favourable (Europe or China). If you are unsure or have no experience with a particular aspect, select “I don’t know”. *

↳ Shown only if the respondent has experience filing patents in China.

	Europe	China	I don’t know
Patent filing cost	☐	☐	☐
Patent maintenance (renewal) cost and patent term	☐	☐	☐
Length of the patent application process	☐	☐	☐
Patent quality examination rigour	☐	☐	☐
IP rights enforcement	☐	☐	☐
Patent scope and rights granted (effectiveness, speed, and cost)	☐	☐	☐
Translation costs	☐	☐	☐
IP management complexity across laws, language and procedural requirements	☐	☐	☐
Ease of commercialisation	☐	☐	☐
Market coverage / size (strategic market value)	☐	☐	☐

Q13. In the question above, you mentioned that China is more favourable in some aspects. Please comment on the advantages of the Chinese system compared to the EU.

↳ Shown only if at least one factor above was rated more favourable in China.

Open-ended response

Patent use, commercialisation strategies and barriers to patent utilisation

↳ This section is shown only to respondents whose primary IP management strategy is “Patents”.

We would like to understand how your company uses patents post-filing, including internal exploitation, licensing, and commercialisation challenges within the advanced materials sector. We understand that some of this information may be sensitive, but we would greatly appreciate any insights you can provide, and we assure you the information you provide will only be used in aggregated form and will be safely stored in compliance with strict data protection standards.

Q14. How are your company’s patents used after filing? (Select all that apply) *

- ☐ Internal use for own competitive advantage
- ☐ Licensed to third parties
- ☐ Sold / transferred
- ☐ Joint exploitation with another organisation
- ☐ Collaborative R&D projects
- ☐ Other (please specify): _____
- ☐ I don’t know / cannot answer

Q15. In which geographic markets does your company primarily commercialise or license patents? (Select all that apply) *

- ☐ Europe
- ☐ USA
- ☐ China
- ☐ Other (please specify): _____
- ☐ I don't know / cannot answer

Q16. What are the main reasons why your company commercialises or licenses in the foreign markets listed above?

Please consider aspects such as market size, regulatory environment, enforcement mechanisms, costs, or any other relevant factor.

↳ Shown only if "USA", "China" or "Other" was selected above.

Open-ended response

Q17. What strategic considerations and success factors motivate your company to engage in patent commercialisation and licensing, beyond financial return and invention protection (e.g. attracting external financing, ensuring market positioning, risk management, or other)?

Please describe any internal or external conditions that contribute to effective commercialisation in your experience.

Open-ended response

Q18. Please indicate the extent to which each of the following challenges hampers your company's ability to bring patented technologies to market. *

	Not a challenge / Not applicable	To a minor extent	To a moderate extent	To a great extent
Regulatory approvals	☐	☐	☐	☐
Lack of commercial interest from commercial partners	☐	☐	☐	☐
No existing market	☐	☐	☐	☐
Financial constraints	☐	☐	☐	☐
Internal resource limitations	☐	☐	☐	☐
Technology transfer inefficiencies	☐	☐	☐	☐
Market readiness or customer adoption	☐	☐	☐	☐
Identifying the right partners or relevant patent holders / licensors	☐	☐	☐	☐
Cost or complexity of licensing and negotiation with multiple IP owners	☐	☐	☐	☐
Risk of disclosing non-patented know-how or critical information	☐	☐	☐	☐
Inadequate IP protection	☐	☐	☐	☐
Complexity or costs of enforcing IP rights	☐	☐	☐	☐
Risk of infringement disputes due to fragmented patent ownership (patent thickets)	☐	☐	☐	☐
Uncertainty about patent validity / essentiality / commercial value	☐	☐	☐	☐
Challenges arising from dual-use applications of our technology	☐	☐	☐	☐

Alternative IP management strategies

↳ This section is shown only to respondents whose primary IP management strategy is NOT "Patents".

At the beginning of the survey, you chose that your company primarily uses [primary IP strategy selected earlier]. In this section, we will explore it.

Q19. How does your company use [primary IP strategy]? (Select all that apply) *

- ☐ Attract investment or funding
- ☐ Protect brand identity or product names (e.g. names of advanced material products, product lines, or proprietary certification marks)
- ☐ Protect creative works or software (e.g. simulation tools, design files, material processing software, technical documentation)
- ☐ Protect confidential business information or know-how (e.g. proprietary formulations, manufacturing processes, testing protocols)

- ☐ Protect functional or technical innovations (e.g. new material compositions, processing methods, application-specific technologies)
- ☐ Protect product appearance or design — e.g. distinctive shapes, textures, or surface patterns of advanced material products (shown for industrial designs only)
- ☐ Support licensing or commercialisation efforts
- ☐ Support enforcement and legal defence against infringement
- ☐ Facilitate collaboration by establishing clear IP boundaries (e.g. joint R&D with universities, suppliers, or customers in the advanced materials field)
- ☐ Strengthen market positioning and differentiation
- ☐ Enable monetisation through licensing or sale
- ☐ Manage risk related to competitor IP or market entry
- ☐ To complement the patents we already have
- ☐ Other (please specify): _____

Q20. In which geographic markets does your company currently commercialise or license [primary IP strategy]? (Select all that apply) *

- ☐ Europe
- ☐ USA
- ☐ China
- ☐ Other (please specify): _____
- ☐ We do not currently commercialise or license these IPs

Q21. What are the main reasons why your company commercialises or licenses [primary IP strategy] in the foreign markets chosen above?

Please consider aspects such as market size, regulatory environment, enforcement mechanisms, costs, or any other relevant factor.

↳ Shown only if “USA”, “China” or “Other” was selected above.

Open-ended response

Q22. Has your company considered filing patents for your innovations in the advanced materials sector, but decided to use alternative IP protection methods instead? *

- ☐ Yes, we considered patenting but decided against it
- ☐ No, we did not consider patenting
- ☐ Not sure / Do not know

Q23. What were the main reasons for not pursuing patenting? (Select all that apply) *

↳ Shown only if “Yes, we considered patenting but decided against it” was selected above.

- ☐ High cost of patenting
- ☐ Innovation too early-stage for patenting
- ☐ Alternative methods provide stronger or faster protection of inventions
- ☐ To avoid public disclosure of sensitive information
- ☐ Patent already filed by other parties (e.g. co-investors or competitors)
- ☐ Too many patents exist in the field already
- ☐ Enforcement of patents is not feasible or effective in our target markets
- ☐ Simpler or less burdensome process than patenting
- ☐ We prefer not to patent for other reasons (please specify): _____

Q24. If some of the challenges or reasons you selected above were addressed or improved externally, how likely would your company be to pursue patenting in the future? *

↳ Shown only if relevant reasons (e.g. high cost, patent already filed, too many patents, or simpler process) were selected above.

	To no extent	To a small extent	To a great extent
High cost of patenting	☐	☐	☐
Patent already filed by other parties (e.g. co-investors or competitors)	☐	☐	☐
Too many patents exist in the field already	☐	☐	☐
Simpler or less burdensome process than patenting	☐	☐	☐

Industry-academia collaboration

This section focuses on collaboration between your company and academic institutions for the purpose of patent commercialisation in the advanced materials sector. We aim to understand whether such partnerships are pursued, how effective they are in practice, and what challenges or barriers you may encounter.

Q25. How does your company currently engage with academic institutions in the advanced materials field? (Select all that apply) *

- ☐ Sponsored contract research
- ☐ Licensing and technology transfer
- ☐ Joint ventures and strategic partnerships
- ☐ Joint research projects and public research programmes
- ☐ Our organisation does not engage with academic institutions
- ☐ I don't know / cannot answer

↳ If "I don't know / cannot answer" is selected, the respondent skips to the "Final questions" section.

Q26. Why does your organisation currently choose not to collaborate with academic institutions in the field of advanced materials? (Select all that apply) *

↳ Shown only if "Our organisation does not engage with academic institutions" was selected above.

- ☐ Lack of relevant academic expertise in our specific technology area
- ☐ Misalignment between academic research focus and our commercial priorities
- ☐ Concerns over intellectual property ownership or management
- ☐ Collaboration process is too slow or bureaucratic
- ☐ Previous negative experiences with academic partnerships
- ☐ Lack of clear commercial benefits or return on investment
- ☐ Sufficient in-house R&D capabilities; there is no need for external academic input
- ☐ Confidentiality or competitive concerns
- ☐ Lack of funding or resources to support collaboration
- ☐ Unawareness of collaboration opportunities or relevant contacts
- ☐ Other (please specify): _____

Q27. In the past three years, how frequent have your collaborations with academia been?

*

↳ Shown only if the respondent engages with academic institutions (any option other than “does not engage” or “I don’t know”).

- Very frequent (multiple projects per year)
- Occasional (1–2 projects per year)
- Rare (less than once per year)
- I don’t know / cannot answer

Q28. When your organisation collaborates with academic institutions in the field of advanced materials, how often do these collaborations result in joint (co-owned) patent applications or granted patents? *

If you wish, use the comment section below to provide more details.

↳ Shown only if collaborations are “Very frequent” or “Occasional”.

- Often (in a majority of collaborations)
- Sometimes (in about half of collaborations)
- Rarely (in a small minority of collaborations)
- Never

Open-ended response

Q29. What are the main benefits of collaborating with academic institutions for patent commercialisation in the advanced materials sector?

↳ Shown only if collaborations are “Very frequent” or “Occasional”.

Open-ended response

Q30. What are the main challenges your company encounters when collaborating with academic institutions for commercialisation of your innovations? (Select all that apply) *

↳ Shown unless the respondent selected “I don’t know / cannot answer” for how they engage with academia.

- ☐ Misalignment between academic and commercial objectives
- ☐ Intellectual property management challenges (e.g. IP ownership or rights disputes)
- ☐ Lack of clear incentives for industry-academia partnerships
- ☐ Limited academic interest or engagement in commercial applications
- ☐ Bureaucratic delays or complex agreements
- ☐ Financial constraints (e.g. insufficient funding for joint research or commercialisation)
- ☐ Implementation challenges (e.g. adapting internal processes to adopt academic innovations or new materials)
- ☐ Communication barriers or cultural differences between academia and industry
- ☐ Other (please specify): _____

Q31. What factors would enhance the effectiveness of industry-academia collaboration for commercialisation of your innovations?

Please provide as much detail as possible.

Open-ended response

Final questions

Q32. Are there any additional comments that you would like to add?

Open-ended response

Q33. Would you be willing to participate in a follow-up interview? *

- ☐ Yes
- ☐ No

Q34. To schedule an interview, please share your name, surname, and email address with us. *

↳ Shown only if "Yes" was selected above.

Your name: _____

Your email address: _____

Thank you

Thank you for taking our survey. Your response is very important to us.

Annex 6. Validation workshop

Purpose and scope

As part of the validation step of the study, a validation workshop was held on 3 June 2026. Its purpose was to test whether the study's findings resonate with the lived experience of practitioners working in advanced materials, and to surface issues that the analysis may not have captured.

The patent landscape analysis had yielded a comprehensive set of quantitative and qualitative findings on Europe's competitive position, patenting and exploitation behaviours, intellectual assets management strategies, academia–industry collaboration, and the role of collaborative licensing mechanisms. Among the key insights were that Europe produces fewer but higher-quality patents than the US or China; that most organisations struggle to translate patents into commercial outcomes; and that, while collaboration between companies and universities is common, it rarely leads to shared ownership of results. The workshop brought European valorisation practitioners together to explore what these developments mean in practice and to test the findings against their real-world experience.

The discussion was organised around three themes drawn from the study:

- The status quo in advanced materials — prevailing IP and commercialisation practices, and persistent challenges;
- Collaboration between companies and universities;
- European advanced materials sector competitiveness in the context of rising Chinese activity.

Each theme was introduced with a short summary of what the data shows, followed by targeted questions for the group.

Workshop organisation and agenda

The session formed part of a joint event covering two studies: the present study on the *Patent landscape analysis in the field of advanced materials*, and the *Support study for a proposal establishing a framework of measures for strengthening Europe's advanced materials ecosystem (the Advanced Materials Act)*. The session for the present study was the first of the two, held before the coffee break. The event was delivered online. The full agenda is set out below; this annex concerns the first session (09:00–10:35), highlighted in the table.

Table 34. Validation workshop agenda

Time	Session
09:00–09:10	Welcome and introduction
09:10–09:20	Presentation of key findings of the patent landscape analysis in the field of advanced materials
09:20–10:20	Moderated stakeholder discussion The status quo in advanced materials — prevailing IP and commercialisation practices and persistent challenges Collaboration between companies and universities European AM sector competitiveness in the context of rising Chinese activity
10:20–10:35	Open reflections and wrap-up
10:35–10:45	Coffee break
10:45–10:55	Introduction to the support study for a proposal establishing a framework of measures for strengthening Europe’s advanced materials ecosystem (Advanced Materials Act)
10:55–11:05	Presentation of key findings (support study — Advanced Materials Act)
11:05–12:20	Moderated stakeholder discussion Priority areas and actions Fast-track lab-to-market transition Digitalisation and AI Skills development Market uptake
12:20–12:30	Conclusion and next steps

Note: shaded rows indicate the session covered by this annex.

Session format and participants

The session ran for approximately 85 minutes and brought together 40 attendees, including participants from industry and academia, alongside members of the study team and representatives of the European Commission. It was structured in three parts:

- **Presentation of key findings (10 minutes):** the study team presented the main results from the *Patent landscape in advanced materials study*.
- **Moderated discussion (60 minutes):** attendees were split into two groups of 17 and 22, each with one facilitator. The facilitator introduced each theme with a summary of the data and then opened the floor. Discussion and collaboration were supported by a shared Miro board⁸⁶, which presented the topics and questions and gave participants space to contribute electronically through digital sticky notes. Participants were invited to share their experiences, push back on the findings, and raise issues that the study may not have captured. Facilitators paced the discussion according to where the liveliest debate emerged. In addition, the order of the questions differed between the two groups, allowing each group to begin with and prioritise different topics, thereby ensuring balanced coverage of all three themes overall.
- The Miro board was used to facilitate engagement and to make it easier to capture participants’ ideas, with attendees encouraged to elaborate on the points they had noted and to engage with one another’s contributions. In addition, each facilitator was supported

⁸⁶ <https://miro.com/what-is-miro/>

by a member of the study team acting as a note-taker, ensuring that no input or connection between points raised on sticky notes, in the chat, or verbally was missed.

Wrap-up (15 minutes): the facilitators summarised the key points raised, and participants were invited to flag any gaps or misrepresentations in the study's findings before the session closed.

Themes and questions discussed

Each theme was introduced with a short summary of the relevant findings, followed by targeted questions to guide the discussion.

Theme 1 — The status quo in advanced materials – prevailing IP and commercialisation practices and persistent challenges

[The data suggest Europe files fewer patents overall than the US or China, but European patents are more likely to be protected in multiple countries simultaneously – which typically signals higher commercial value.] Does that match what you see in your field? Where do you think Europe is strongest – and where is it falling behind?

[Filing a patent is only the first step. Both survey respondents and interviewees pointed to a persistent gap between having a protected invention and commercialising it. Cost, limited staff time, and long development timelines were the most cited obstacles.] Does this ring true for your organisation? What is the biggest obstacle between a protected invention and something that reaches the market or gets used?

Theme 2 — Collaboration between companies and universities

[Despite near-universal collaboration, 70% of companies say joint projects rarely or never yield jointly owned results – citing ownership disputes and mismatched timelines and incentives.] Why is this? And what makes the difference between a collaboration that breaks down over rights and one that works unexpectedly well? Looking beyond individual projects, what practical or policy changes would most help to resolve these ownership and incentive mismatches?

[Early-stage university innovations (TRL 4–5) often stall before attracting industry investment, despite demonstrated technical feasibility.] How do you currently manage this transition – and what tools, funding models, or policy changes would best support it?

Theme 3 — European competitiveness and rising Chinese activity

[Chinese filings in advanced materials are now 5–6 times higher than in Europe or the US, and the vast majority are filed and retained within China.] Have you felt the impact of this in your work – for example, when checking whether you can use a technology, when competing for contracts, or when looking for partners?

[European and Chinese researchers still collaborate extensively – many participants may have ongoing or past partnerships with Chinese institutions.] Has the way you approach collaboration or knowledge-sharing with Chinese partners changed in recent years – and if so, what drove that change?

Discussion outcomes and validation

The discussion session generated insights across all three themes, drawing on the experience of participants from across the advanced materials community. Overall, the discussion served to validate the study's findings: participants broadly recognised and agreed with the results

presented, and no significant points of contention were raised. Rather than challenging the analysis, the discussion confirmed the main conclusions, added practical and sector-specific context, and surfaced a number of suggestions for how the issues identified might be addressed in future. The key points raised under each theme are summarised below.

Theme 1 — The status quo in advanced materials (intellectual assets management and commercialisation)

In the first theme discussion, **participants generally recognised and agreed with the findings of the study**. In particular, the discussion confirmed that Europe files fewer patents but with stronger commercial relevance and broader international coverage; wider country coverage was seen to secure market access and support a "local for local" strategy. At the same time, Europe was described as more risk-averse and selective than the US: in the European context, patenting tends to occur where there is a clear and secure route to commercialisation, and once a patent is filed European actors tend to ensure that it is also commercialised. It was nonetheless cautioned that wider international filing should not automatically be understood as evidence of stronger commercial exploitation, and that this relationship warrants further analysis.

On the obstacles between a protected invention and market use, the findings were strongly confirmed. Long development timelines make the value of low-TRL IP difficult to assess, long payback periods turn IP maintenance into a persistent cost, and the principal investment gap was located around TRL 4–5, where scaling raises both cost and perceived risk and companies are therefore reluctant to invest. Cost, staff time, and patenting know-how were the most frequently cited practical constraints, with SMEs and university research groups in highly regulated fields such as medical devices (where regulatory complexity and market-entry costs are high) seen as particularly exposed.

Suggestions raised included clearer patenting guidelines and faster, more responsive IP assessment; support for SMEs in developing a know-how strategy; and a time-limited "scale-up" protection and investment framework for the phase below TRL 7.

Theme 2 — Collaboration between companies and universities

In the second theme discussion, participants confirmed the study's finding that, despite near-universal collaboration, joint projects rarely result in jointly owned outcomes. Collaboration was noted to take place predominantly at low TRL levels, where the future commercial value of the IP remains uncertain, making partners reluctant either to retain IP or to agree exploitation rights in advance. From the industry perspective, early-stage IP was often considered to be overvalued by academic partners, particularly where demands for exploitation rights exceeded the current market value of the invention; companies were seen to engage most seriously when results were close to commercial application. Participants also observed that patenting has become more cost-driven than in the past, with companies increasingly weighing maintenance costs against uncertain future returns.

The discussion further highlighted the practical difficulty of joint ownership arrangements, noting that differences between national legal frameworks complicate the licensing of jointly owned patents and that rights are, in practice, frequently divided by technical area and agreed between partners at the outset.

Suggestions raised included the development of a protocol, set of recommendations or good-practice pathway for collaborative European projects, clarifying expectations around IP ownership, exploitation rights and decision-making before disputes arise — seen as particularly valuable for smaller research groups and companies with limited capacity to negotiate complex arrangements. Participants also pointed to the continuous tracking of IP with clearly assigned responsibility; stakeholder dialogues and shared European-level roadmaps (with semiconductors and chemical engineering noted as areas where alignment is already emerging); blended public–private funding instruments to bridge the TRL 5–8 gap; and stronger

EU support for university research groups, given that technology transfer offices cannot drive commercialisation alone.

Theme 3 — European competitiveness amid rising Chinese activity

In the third theme discussion, participants confirmed that rising Chinese patenting activity represents a major strategic challenge for the European advanced materials sector. The high volume of filings, together with the granting of numerous technology variants, was seen as creating a competitive environment in which European actors have limited means to respond. Participants further noted that European companies can no longer rely solely on local production for local markets and may increasingly require a presence in Asian markets to remain competitive, while recognising that operating in those markets is more complex given the scale and nature of Chinese patenting practices.

On collaboration, some participants suggested that knowledge-sharing with Chinese partners may have been reduced in some cases, associated principally with export-control restrictions and broader legal constraints. It was also noted, by individual participants, that legal and regulatory considerations could encourage more cautious knowledge-sharing practices with Chinese partners.

It was suggested that aspects relating to Chinese data and IP rules, and the evolving EU framework on sensitive technologies and data, could be worth exploring further in future analysis.

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This study examines how patents in advanced materials are protected, managed, and commercialised across Europe, and how the EU compares to the United States and China. Combining a large-scale analysis of patents filed between 2010 and 2024 with surveys, interviews, and a stakeholder workshop, it finds that Europe files fewer patents than its competitors but produces higher-quality ones, with broader international reach and strong positions in energy, medical, and electronics materials. Europe's challenge lies not in generating inventions but in commercialising them. The report sets out options to strengthen patenting guidance, support scale-up, and foster collaborative licensing across the EU.

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