Europäisches Patentamt
European Patent Office
Office européen des brevets

New frontiers in oncology: an evolving innovation ecosystem

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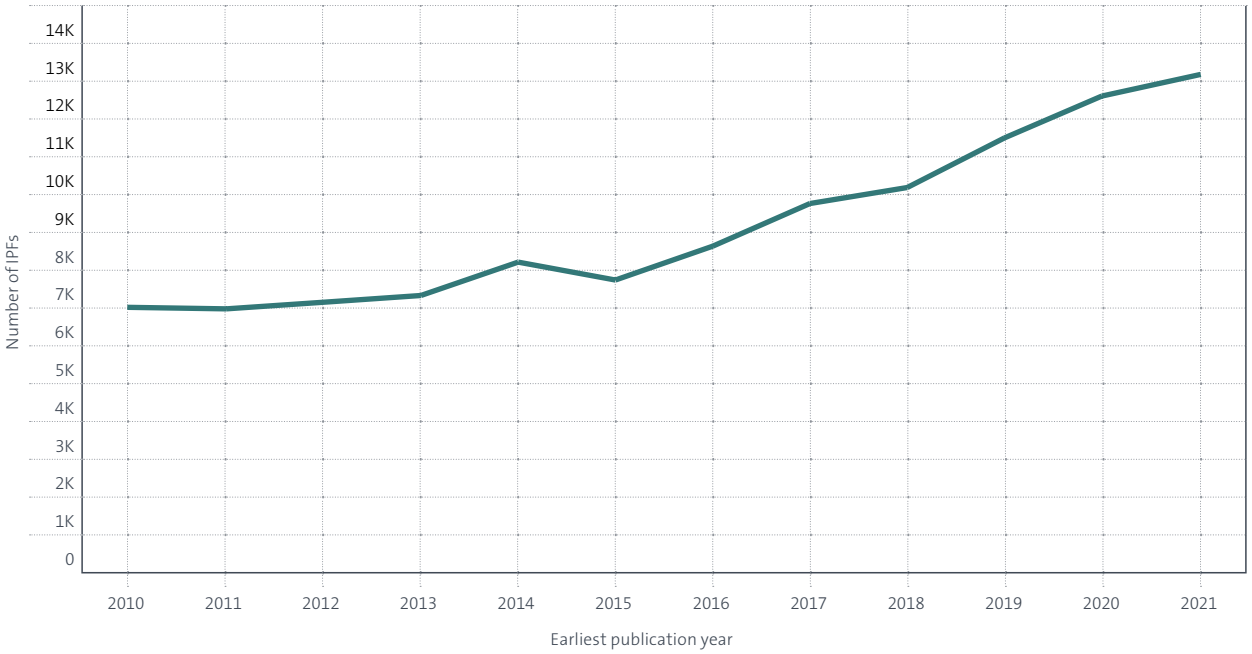
Executive summary

The health sector remains a cornerstone of European competitiveness, as highlighted in the Draghi report on The Future of European Competitiveness (Draghi 2024a, 2024b), underscoring the strategic importance of fostering innovation in this domain. The purpose of this study is to identify the most promising cancer-related technologies. It introduces a framework for categorising 28 distinctive cancer technology fields and deepening our understanding of the recent acceleration in cancer-related innovation. After identifying a set of future growth technology fields, this study evaluates Europe's contribution to them, while examining the pivotal roles played by public research institutions, including universities, public research organisations (PROs) and hospitals and startups. By doing so, it provides new perspectives on the actors and innovations driving progress in cancer-related technologies across Europe.

This study is a crucial extension of a first EPO study on patents and innovation against cancer published in February 2024 (EPO, 2024a). Our initial study comprehensively mapped cancer-related technologies and highlighted the critical role of actors beyond large pharmaceutical companies, such as universities and PROs. It raised important questions about what is driving the recent high-growth phase, how innovation dynamics are evolving at the frontier of cancer research and what strategies the different players are employing. This second study addresses these questions by focusing on the most promising fields of cancer technology and examining the contributions of diverse innovators across various regions and sectors. It provides deeper insights into the trends currently shaping the innovation landscape in the fight against cancer. Based on the lifecycle stage and innovation trajectory indicated by patent activity, it also helps policymakers, researchers and industry stakeholders to target their research and development efforts, investments and policies by equipping them with actionable insights.

Figure E1

Trend in IPFs in cancer-related technologies, 2010-2021



Source: EPO

Key findings

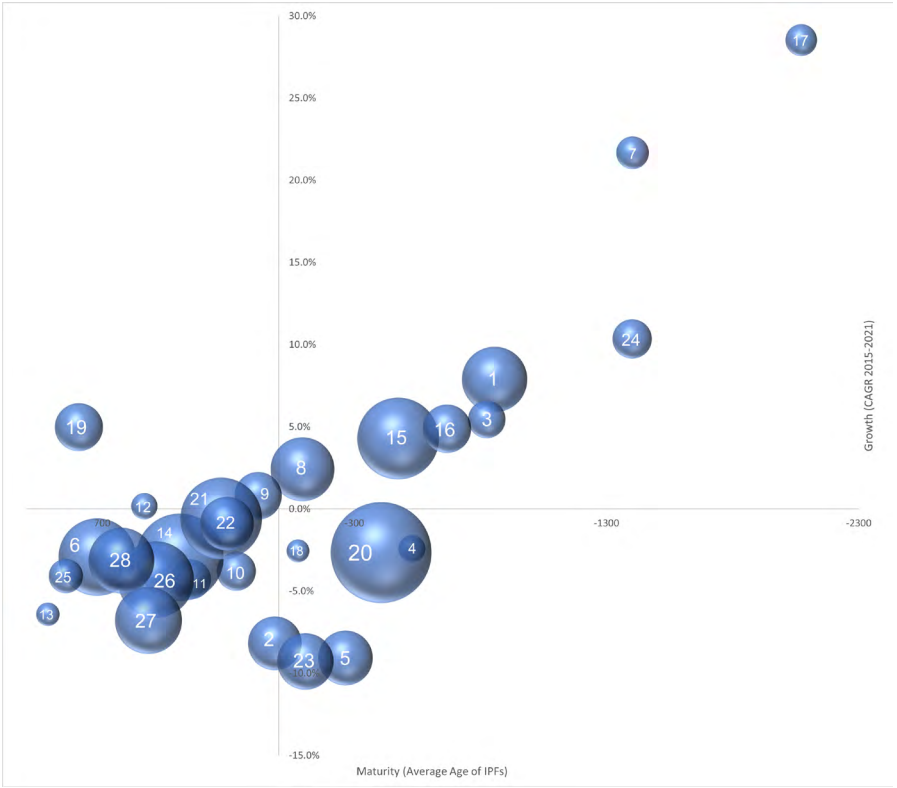
1. Patent data help identify technologies that have been driving the recent surge in cancer-related innovation

After a period of near stagnation with a compound annual growth rate (CAGR) of just 1.7% between 2010 and 2015, patenting activity in cancer-related technologies experienced a significant surge, growing at a CAGR of 9.3% between 2015 and 2021 (Figure E1). This was more than three times faster than the CAGR in all technology fields over the same time period (CAGR in IPFs in all technology areas was 3.0% between 2015 and 2021). Leveraging the expertise of EPO examiners, this study categorises cancer innovation into 28 distinctive technology fields, identifying 11 of them as growing at an even faster pace during this period of accelerated activity (Figure E2).

Among them are the relatively young technologies, as measured by the average age of all international patent families (IPFs) in the field, such as healthcare informatics, image analysis, liquid biopsies, immunotherapy with antibodies, cellular immunotherapy, immunotherapy with small molecule immunomodulators, non-coding nucleic acids and gene therapy, as well as more mature technology fields such as well-established immunotherapy approaches (e.g. cytokines and oncolytic viruses) and certain physical treatments (e.g. photodynamic therapy and tumour treating fields), but also alternative treatments and prevention (e.g. extracts from plants and animal tissue).

Figure E2

Distribution of the 28 cancer technology fields according to growth (CAGR 2015-2021, y-axis), maturity (average age of all IPFs, x-axis) and relative size (number of IPFs and size of the circle)



Cancer technology fields

1 Liquid biopsies
2 Tumour biopsies
3 Healthcare informatics
4 Bioinformatics
5 Personalised medicine
6 Hormonal therapy
7 Gene therapy
8 Non-coding nucleic acids
9 Alternative treatments and prevention (e.g. extracts from plants and animal tissue)
10 Surgery
11 Radiotherapy
12 Other physical treatment (e.g. photodynamic therapy, TTFs)
13 Mitigating side effects
14 Cancer models
15 Immunotherapy - Antibodies
16 Immunotherapy - Small molecule immunomodulators
17 Immunotherapy - Cellular
18 Immunotherapy - Vaccines
19 Immunotherapy - Other approaches (e.g. cytokines, oncolytic viruses)
20 Targeted therapy - Protein kinase inhibitors
21 Targeted therapy - Other small-molecule targeting agents (e.g. HDAC, angiogenesis, proteasome inhibitors, etc.)
22 Targeted therapy - Conjugates
23 Imaging apparatus
24 Image analysis
25 Imaging agents
26 Chemotherapy - DNA damaging agents
27 Chemotherapy - Anti-tubulin agents
28 Chemotherapy - Antimetabolites

Source: EPO

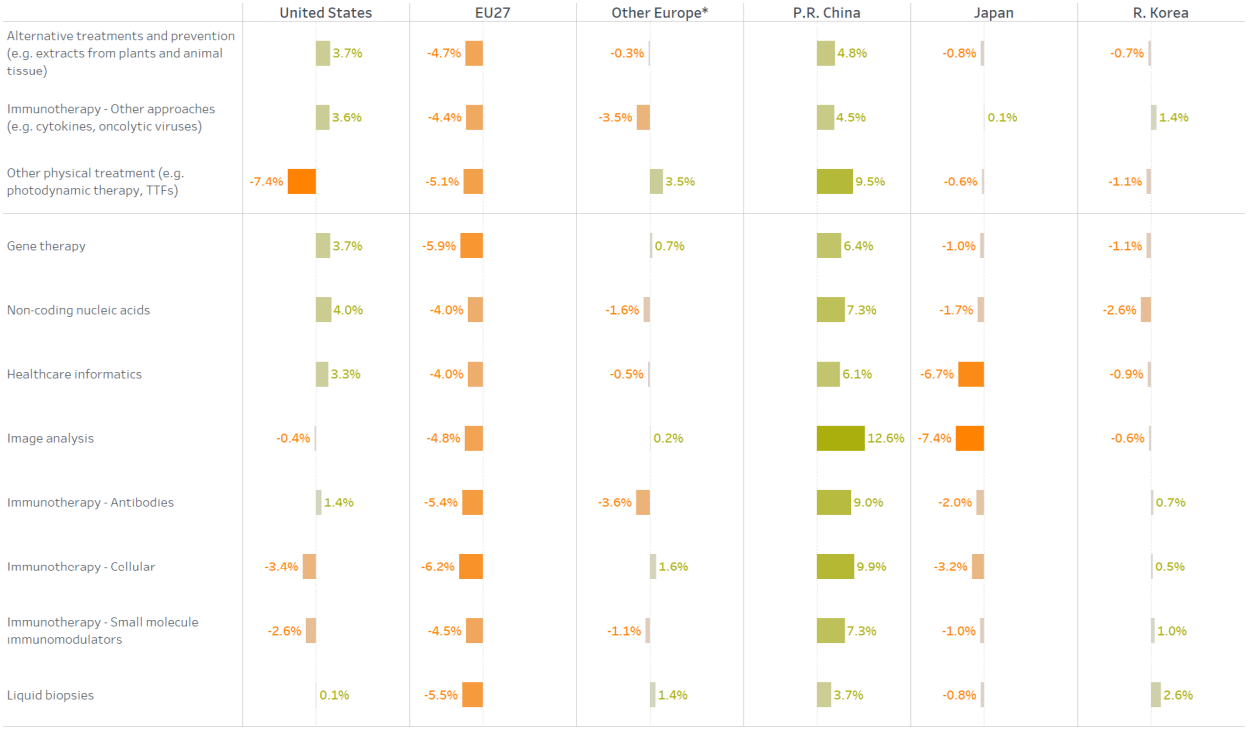
2. While US and Chinese applicants expanded their patenting activity in high-growth cancer technologies, European applicants struggle to keep pace

The recent growth period in cancer-related patenting activity after 2015 was primarily driven by US applicants, who consolidated their dominance in cancer-related innovation, accounting for 44.6% of all cancer-related IPFs between 2010 and 2021. With a share of 9% over the same period, Chinese applicants significantly increased their annual output over time, surpassing the EU27 in 2021 with over 2 000 IPFs filed that year. Europe remains a strong contributor, with EU applicants generating over 17 800 IPFs between 2010 and 2021 and an additional 7 500 IPFs from other EPO member states, collectively representing a 23.9% share over the period 2010-2021.

However, despite increasing absolute numbers of IPFs, the performance of the EU after 2015 faced headwinds. EU applicants experienced a decline in market share across all high-growth cancer technology fields from 2010-2015 to 2016-2021 (Figure E3). The largest share loss for EU applicants was in cellular immunotherapy (-6.2 percentage points), while the smallest decline was in healthcare informatics and non-coding nucleic acids (-4 percentage points). In contrast, US applicants maintained or increased their shares in most high-growth fields, while Chinese applicants achieved significant growth in shares across all cancer-related technology fields.

Figure E3

Change in shares in IPFs in high growth technology by major innovation centre (2010-2015 vs. 2016-2021, in percentage points)



*AL, CH, IS, LI, MC, ME, MK, NO, RS, SM, TR, UK

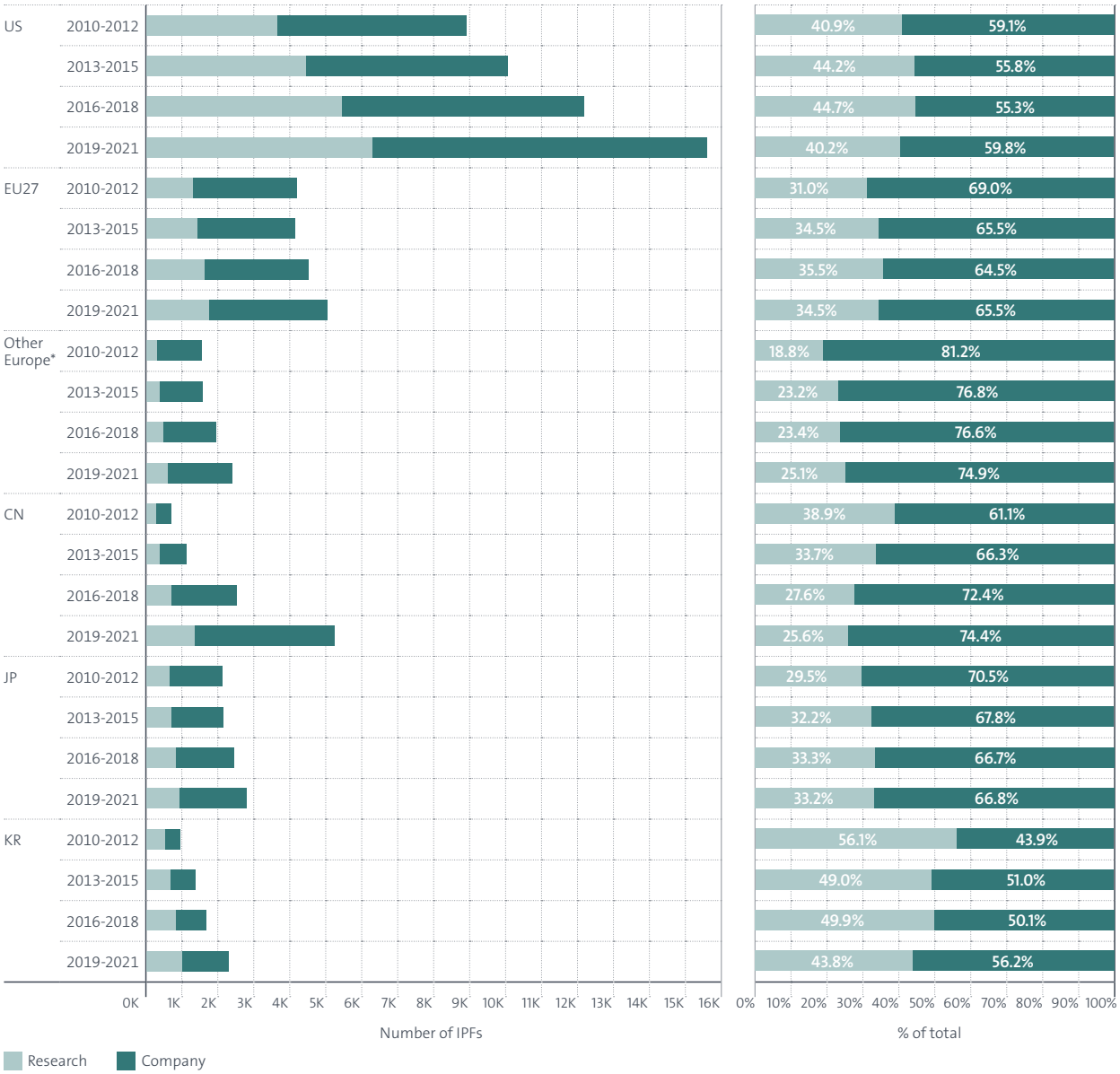
Source: EPO

3. While the research sector drove cancer-related patenting with 37.3% of all IPFs between 2010-2021, their contribution varies widely by country, technology and over time

Cancer-related innovation demonstrates a strong dependence on science-driven research originating from universities, public research organisations and hospitals. As Figure E4 shows, in the US, institutions from the research sector maintained a very high share of its country's cancer-related IPFs, peaking at 44.7% during the initial growth phase (2016-2018). However, their share declined to 40.2% in 2019-2021, indicating that US companies started to expand their cancer-related patent portfolios at a faster pace than US research institutions, especially in high-growth technology fields. Similarly, EU research institutions increased their share of the EU's total cancer-related IPFs from 31% in 2010-2012 to a peak of 35.5% in 2016-2018, before experiencing a slight decline to 34.5% in 2019-2021. Their contributions to individual technology fields generally mirrored the trends observed for EU companies, reflecting a strong alignment in innovation efforts across both the public and private sectors. Conversely, Chinese research institutions saw a sharp drop in their share in cancer-related IPFs from Chinese applicants, from 38.9% in 2010-2012 to just 25.6% in 2019-2021, as companies became the dominant drivers of the P.R. China's patenting surge in almost all cancer technology fields.

Figure E4

Contribution of research institutions to cancer-related IPFs in major innovation centres, 2010-2021



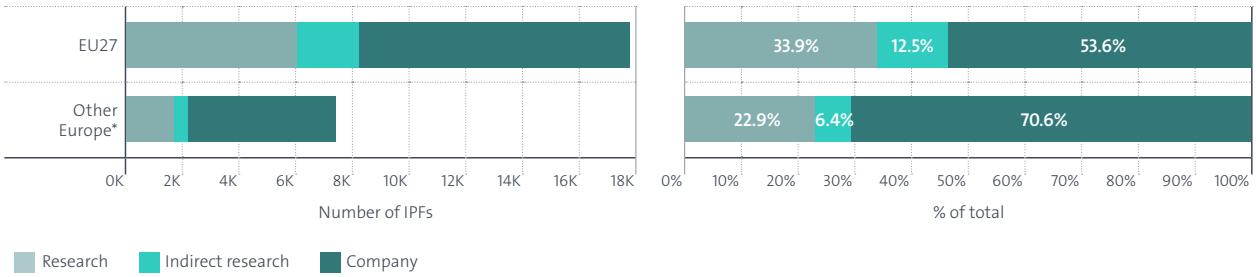
*AL, CH, IS, LI, MC, ME, MK, NO, RS, SM, TR, UK

Source: EPO

Beyond direct patenting activity, European research institutions had a significant indirect impact, with 12.5% of all EU cancer-related IPFs and 6.4% of all IPFs from other EPO member states between 2010 and 2021 originating from research institutions but filed by companies (Figure E5). Including these contributions, nearly half of all cancer-related IPFs from EU applicants and nearly 30% in other EPO member states trace their origins to research institutions.

Figure E5

Direct and indirect contribution of European research institutions to cancer-related IPFs, 2010-2021



*AL, CH, IS, LI, MC, ME, MK, NO, RS, SM, TR, UK

Source: EPO

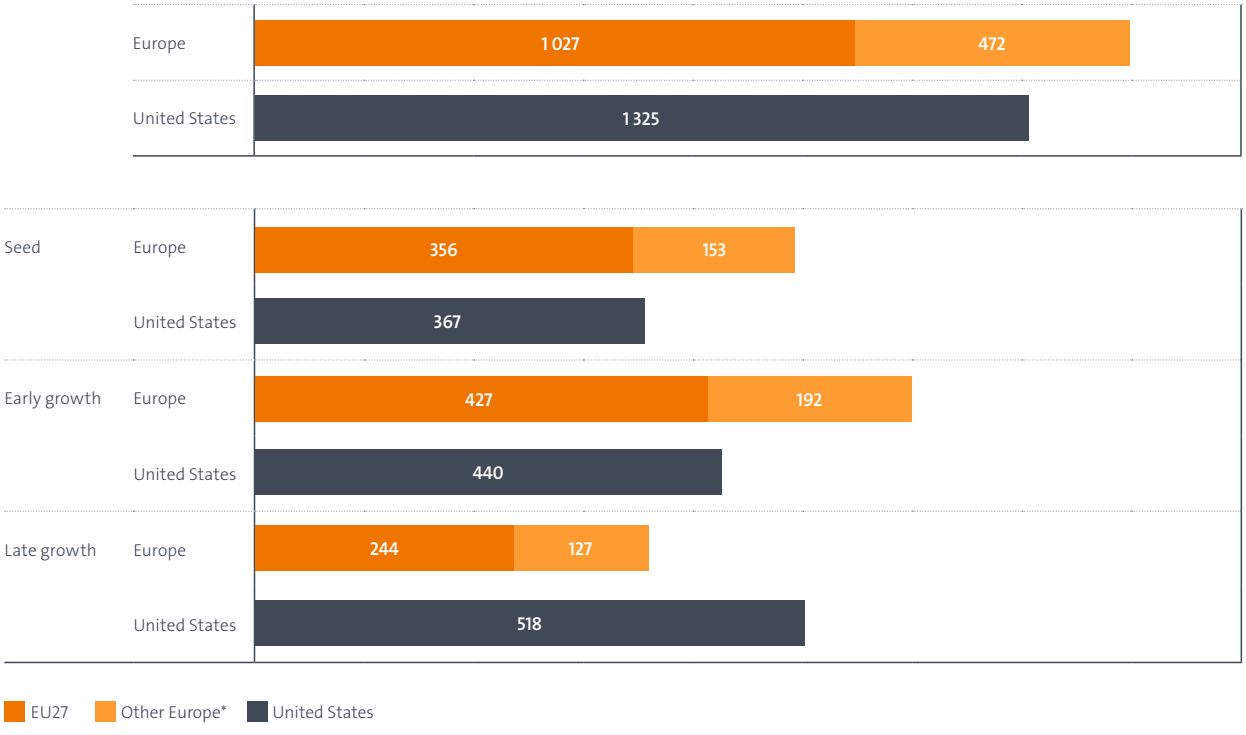
4. With nearly 1 500 entities, Europe hosts a larger number of cancer-related startups than the US, but fewer European startups successfully scale to late growth stages

There are almost 1 500 cancer-related startups, including 1 027 in the EU and an additional 472 in other EPO member states, that are applicants of cancer-related IPFs published in 2010 or after (Figure E6). In comparison, the US has 1 325 cancer-related startups. Among all EPO member states, the UK takes the top spot with 290 startups, while France leads within the EU with 246 startups, followed by Germany with 208, while Switzerland ranks fourth overall with 151.

However, when considering the growth stage of these companies, a stark difference emerges. While Europe clearly exceeds the US in the number of startups in the seed and early growth stages, the US significantly outpaces Europe in scaling startups to the late growth stage. Nearly 40% of US cancer-related startups have reached this advanced stage, compared to just 24% in the EU and slightly under 27% in other EPO member states. In the EU, the largest share of startups (41.6%) remains in the early growth stage, while another 34.7% are still in the seed stage, indicating the challenges European startups may face in scaling successfully.

Figure E6

Cancer-related startups in Europe and the US by growth stage of the company



* AL, CH, IS, LI, MC, ME, MK, NO, RS, SM, TR, UK

Source: EPO

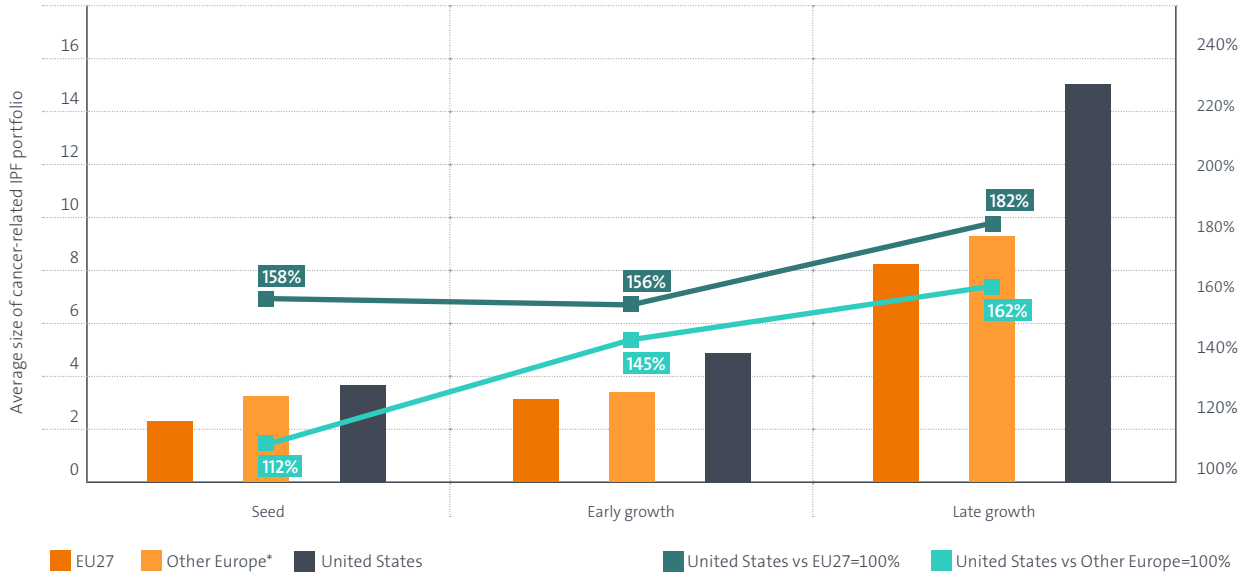
5. US startups hold significantly larger patent portfolios than their European counterparts across all growth stages

US startups have significantly larger cancer-related patent portfolios than their European counterparts, with an average of 8.55 IPFs per company compared to 4.07 in the EU and 4.95 in other EPO member states (Figure E7).

This trend holds across all growth stages: US late-growth startups hold 82% more IPFs than EU counterparts, while seed-stage and early-growth US startups exceed EU portfolios by 58% and 56%, respectively. Startups in other EPO member states outperform EU startups, but still lag behind the US. This could highlight the stronger patenting activity and strategic use of intellectual property rights (IPR) by US startups in scaling their innovations.

Figure E7

Comparison of average number cancer-related IPF portfolios of US and European startups across different growth stages, 2010-2024



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Source: EPO

The full report is available for download at:
epo.org/trends-oncology

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