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Trends in validation of a granted European patent by technology field

Analysis report created by:
Tim Hewson, Rachael Ker, Marcell Komlosi,
Madeleine Fowler, Amelia Thomson and Rebecca Allen.

Introduction

One of the pleasures of being a European Patent Attorney is notifying the Applicant that the European Patent Office intends to grant a patent. That notification is always followed by the Attorney asking their client an important question – "where would you like us to validate your new patent?"

Depending on the importance of the case, the budget available, the location of competitors, and customers, and the nature of the industry in which the Patent Proprietor operates, the countries selected for validation will vary.

Abel + Imray has a dedicated validation team able to handle your validations and they will always start the process by sending applicants a table showing predicted costs for validation in each available state. The purpose of this report is to go further and give an overview of the factors influencing the geographical scope of validation in various technology areas. It does this by looking at historical data that indicates where patents are "usually" validated.

As you will see, as well as general trends with larger countries tending to attract more validations, there are important differences between technology sectors. This report necessarily gives generalised analyses for each sector and is no substitute for the in-depth knowledge clients will have of their own industrial niche. However we hope that the data included will both help to reassure clients as to what is "normal" in their sector as well as spurring Patent Proprietors to think about the geographical location of customers, competitors and importers, so that they are able to achieve cost-effective and commercially-useful validations strategies. This report is timely because we are on the cusp of the new UPC validation system. It will be interesting to repeat this exercise in a couple of year's time and see what impact the UPC has had on the geographical coverage of patents.

As always, you should contact one of our attorneys if you have any questions, want to discuss any of these issues or require advice specific to your patents.

What is national validation?

A European patent application is examined and eventually granted centrally by the European Patent Office (EPO). After it has been granted, a European patent needs to be validated in each of the countries in which the owner requires protection. Following validation, each national patent is an individual property right which must be maintained and enforced in each country separately.

Although it may seem like a good idea to validate in all countries available under the European Patent Convention (EPC), each validation has associated costs which will quickly add up. There must be a balance between the cost for the initial validation and subsequent maintenance of the patent, and the protection granted by the patent. This balance will be very different for each client, for example, a validation in a particular country may be crucial for client A yet could be of little value to client B. An important factor in this balance is the field of technology in which the patent is concerned. This booklet analyses trends in validation of patents in different fields of technology, giving clients a high-level overview to assist in making informed decisions in where to validate a granted European patent.

It should also be noted that the Unitary Patent package of the European Union (EU), when it eventually enters into force in 2023 will introduce the possibility of validating centrally in participating EU member states.This is likely to result in some cost savings at the expense of a loss of flexibility and the need to litigate centrally in the new Unified Courts. The option of individual validations in accordance with the current system will remain. Further information on the Unitary Patent may be found at abelimray.com/upc

Factors in validation

Size of country and economy

Everything else being equal (which of course it is not), validating in countries with larger populations and economies will be of greater value than in smaller countries. The adjacent table gives population and economic data for each European Patent Convention (EPC) member state. It does not include the EPC extension and validation states, which are only available if the European patent application was previously extended/validated in that state. You should remember that with a life-span of up to 20 years, the relative strength of economies may change. It is expe cted that countries to the East of Europe with currently less-developed economies will show higher growth in the coming decades than many countries in Western Europe.

Location of customers, competitors and importers

A patent grants a monopoly over certain acts. Those acts include use of the invention, making the invention and importing the invention. This means that there may be opportunities to enforce a patent at various points in the supply chain. The Netherlands in particular is of interest in that regard, although it has a relatively small population and economy, a patent in the Netherlands is often considered to be of greater value than the small size of the Dutch market would suggest because many of Europe's imports pass through the Port of Rotterdam. This combined with a well-regarded enforcement regime, means that having a patent in the Netherlands may be of significance to the European market as a whole.

Nature of industry

Many industries are not evenly distributed across Europe. From nuclear technology to medical devices to aviation, industries are clustered in certain locations. The barriers to entry to setting up in a new location will also vary with industry.

GDP, population and GDP per capita for all EPC states

	State	GDP (£, billions)[1]	Population (millions)[2]	GDP per capita (€)
AL	Albania	15.93	2.88	5 530
AT	Austria	415.06	8.96	46 350
BE	Belgium	521.22	11.54	45 170
BG	Bulgaria	69.88	7.00	9 980
CH	Switzerland	695.82	8.59	80 990
CY	Cyprus	24.13	1.18	20 460
CZ	Czech Republic	245.15	10.69	22 930
DE	Germany	3708.61	83.52	44 410
DK	Denmark	346.52	5.77	60 040
EE	Estonia	32.38	1.33	24 420
ES	Spain	1240.82	46.74	26 550
FI	Finland	258.89	5.53	46 800
FR	France	2572.96	65.13	39 510
GB	United Kingdom	2773.23	67.53	41 070
GR	Greece	188.25	10.47	17 970
HR	Croatia	58.91	4.13	14 260
HU	Hungary	158.58	9.69	16 370
IE	Ireland	438.93	4.88	89 900
IS	Iceland	22.27	0.34	65 700
IT	Italy	1828.11	60.55	30 190
LI	Liechtenstein[3]	5.59	0.04	147 210
LT	Lithuania	57.03	2.76	20 670
LU	Luxembourg	75.49	0.62	122 600
LV	Latvia	33.84	1.91	17 750
MC	Monaco	5.93	0.04	156 140
ME	Montenegro	5.10	0.63	8 120
MK	North Macedonia	12.08	2.08	5 800
MT	Malta	15.12	0.44	34 320
NL	Netherlands	881.76	17.10	51 570
NO	Norway	419.49	5.38	77 990
PL	Poland	590.79	37.89	15 590
PT	Portugal	217.55	10.23	21 270
RO	Romania	247.15	19.36	12 760
RS	Serbia	54.87	8.77	6 250
SE	Sweden	553.03	10.04	55 110
SI	Slovenia	53.75	2.08	25 860
SK	Slovakia	100.00	5.46	18 330
SM	San Marino[4]	1.48	0.03	43 760

Cost of validation in each country

Validation in each state usually involves appointing a local representative and, for some countries, preparing and filing a translation for either part of or the entire granted patent. Each of these steps has an associated cost which can vary greatly across different countries. This section delves a little deeper into the associated costs in each country.

As a result of longstanding efforts to reduce the cost of the post-grant translation regime, the **London Agreement** came into force in 2008. Countries which ratified the optional Agreement have removed, entirely or largely, the requirement for translations of European patents. In some London Agreement countries, validation does not impose any translation requirements. In other signatory countries, the local patent office require a translation of the claims only into a national language. Finally, many countries which are non-signatories of the London Agreement retain the traditional rule, requiring that the whole patent specification be translated into a national language.

The associated costs of validating a European patent for which the specification is in English have been estimated for a typical-length specification and are grouped in the adjacent table.

When considering which countries to validate in, it is worth considering the long-term expenses, because a separate renewal fee is payable in each state to keep the patent in force. Renewal fees are payable annually and are collected by each national patent office, though there are renewal fee payment services available which simplify the process. The renewal fees differ depending on the country, however significant divergence only arises towards the end of the lifetime of the patent. Towards the end of a patent's life, the burden of renewal fees may be eased by abandoning the patent in countries of lower importance. A proprietor may decide to validate a patent fairly widely on the understanding that the selection of countries be reconsidered every few years so that less valuable countries can be dropped when renewal costs become significant.

Estimated costs of validation

Requirements	Typical validation cost (GB£)	Countries (see table on page 4 for countries and their codes)
No translation required	250 – 1000	BE, FR, DE, IE, LU, MT, MC, *MA*, CH/LI, GB
Translation of the claims only	1000 – 2000	AL, HR, DK, FI, HU, IS, LV, LT, NL, MK, NO, SI, SE
Full translation	2500 – 5000	AT, BA, BG, *KH*, CY, CZ, EE, *GE*, GR, IT, ME, PL, PT, *MD,* RO, SM, RS, SK, ES, *TN*, TR

(The states shown in italics are 'Extension' or 'Validation' states which are only available if the European patent application was previously extended/validated in that state.)

Validation and extension states

The EPO may form an agreement with extension states, which are states that are not yet party to the European Patent Convention (EPC). The extension system provides the applicant with a cost effective and simplified way to obtain patent protection in extension states. Once the extension fee is paid and the patent is granted, the applicant can then choose to validate the patent in extension states, which will be subject to national law and treated in the same way as a national patent.

There is currently only one extension state, Bosnia and Herzegovina. Montenegro was until recently also an extension state. However, on 1st October 2022 became a contracting state of the EPC. European Patent applications filed after this date will include the designation of Montenegro[5].

There are also agreements (confusingly referred to as "validation agreements") which allow European patent applicants to obtain patent protection in non-European countries, and function in a similar way to extension states. The current list of states with which the EPO has a validation agreement includes Morocco, Republic of Moldova, Tunisia, and Cambodia.

Fees for coverage of states with which the EPO has a validation or extension agreement are due **before** grant of a European patent. Validation in these countries is only an option post-grant if these fees are paid. It is therefore very important to discuss this with your attorney during the patent application process if you are considering obtaining patent protection in any of the states in which the EPO has an extension or validation agreement.

Protection in Hong Kong from a granted European Patent

It is possible to extend European patents designating the UK to the Hong Kong Special Administrative Region (SAR). The Hong Kong patent rules draw a distinction between "standard" patents, which can last up to 20 years from filing and "short-term" patents, which can last up to 8 years, neither of which require search and substantive examination[6].

A granted European patent can form the basis of a standard patent, while a short-term patent can be based off a search report from the EPO.

There is a two stage formal registration process for standard patents. Firstly, within 6 months of the publication of the European patent application that designates the UK, a "request to record" must be filed along with a copy of the patent application and payment of the prescribed fees. Secondly, the granted European patent must be separately registered in the Hong Kong SAR within 6 months of the grant of the European patent.

There is no time limit for filing a short-term patent application. However, if the applicant wishes to claim priority from an application in another country then the application must be filed within 12 months of the date of filing of the initial application.

The data in this booklet

Fields of Technology

Patents are classified using International Patent Classification (IPC) codes. There are over 70,000 entries in the IPC system[7]. The World Intellectual Property Organization (WIPO) has defined 35 technology fields using the IPC codes.

The EPO published the number of European patents granted in each technology field in 2019[8]. The data was sorted in descending order and the top 15 entries are shown in the table on page 9. This booklet investigates the top 15 fields of technology, with the exception of 'Measurement', 'Mechanical elements' and 'Other special machines', as these fields were considered too broad to align with specific industrial sectors.

First renewal fee paid as opposed to validation

The EPO Statistics & Trends Centre[9] provides useful data on the general trends of the total number of applications filed, the top applicants, the top technology fields and the geographic origin of applications. The EPO also provides data on where granted European patents are validated, see General trends in Validation section.

The EPO data showing the number of patents validated in each country is not always a good representation of where patentees would like patent protection because, as discussed above, some countries require no deliberate action for validation. Therefore, when looking at the number of validations, it appears that virtually every granted European patent is validated in those countries. In order to give a better indication as to where patents are validated, we used the number of patents for which the first renewal fee was paid at the national office, giving an indication as to the number of validations for which the applicant actually intended on keeping the patent alive.

The latest date the first renewal fee for a European patent granted in 2019 could be paid at a National office was 30 June 2021[10]. In July 2021, the status of each patent granted in 2019 with at least one of the IPC codes associated with the chosen technology field was retrieved by an IP professional search service provider and processed into a dataset used in this report.

Extrapolated Data

When looking at the general validation trend across all granted patents (next section), the data for countries that require no deliberate action for validation was extrapolated. The number of patents for which the first renewal fee was paid in countries that require deliberate action for validation (using the data from the IP professional search service provider) was compared to the number of validations recorded for those countries in the EPO data. This comparison was used to extrapolate the number of validated patents for countries which require no deliberate action for validation.

In Figure 1, the extrapolated values are used for countries marked with an asterisk (*). These countries include Germany, France and the United Kingdom.

European patents granted in 2019 in different fields of technology

	Field of Technology	European Patents granted in 2019
1	Digital communication	11855
2	Medical technology	9840
3	Electrical machinery, apparatus, energy	9638
4	Computer technology	8517
5	Transport	8449
6	Measurement	6757
7	Engines, pumps, turbines	5942
8	Mechanical elements	4985
9	Other special machines	4456
10	Telecommunications	4362
11	Pharmaceuticals	4144
12	Civil engineering	4104
13	Audio-visual technology	3604
14	Organic fine chemistry	3369
15	Biotechnology	3320

General trends in validation

Without examining differences in areas of technology, it can be noted that overall, Germany, the United Kingdom and France are the most popular countries in which to validate a European patent. These three countries alone account for about half of the total validations in 2019, across all fields of technology. Austria, Italy, and Spain rank next in popularity, with Ireland, Switzerland, the Netherlands and Belgium rounding out the top ten.

These trends partly reflect the relative cost and complexity of validation procedures in the different European Patent Convention (EPC) member countries. Over half of the top ten are countries have minimal requirements for validation; these are marked with an asterisk* on Figure 1. This means that a European patent will automatically take effect in these countries as soon as it is granted without requiring filing of a local language translation. Thus, in these countries, the next major decision after grant is whether or not to maintain the patent by paying national renewal fees.

The trends also reflect the size of these countries' economies and overall share of the European market. Validating a patent in just the top three countries of Germany, the UK and France will account for just over 45% of the EU's GDP. Adding the next largest markets, Italy and Spain, takes this share to over 60%, and including the Netherlands as well gives protection nearly 70% of the EU's GDP[11].

Figure 1
Validations in member states of patents granted in 2019 EPO data with extrapolated data for missing countries)
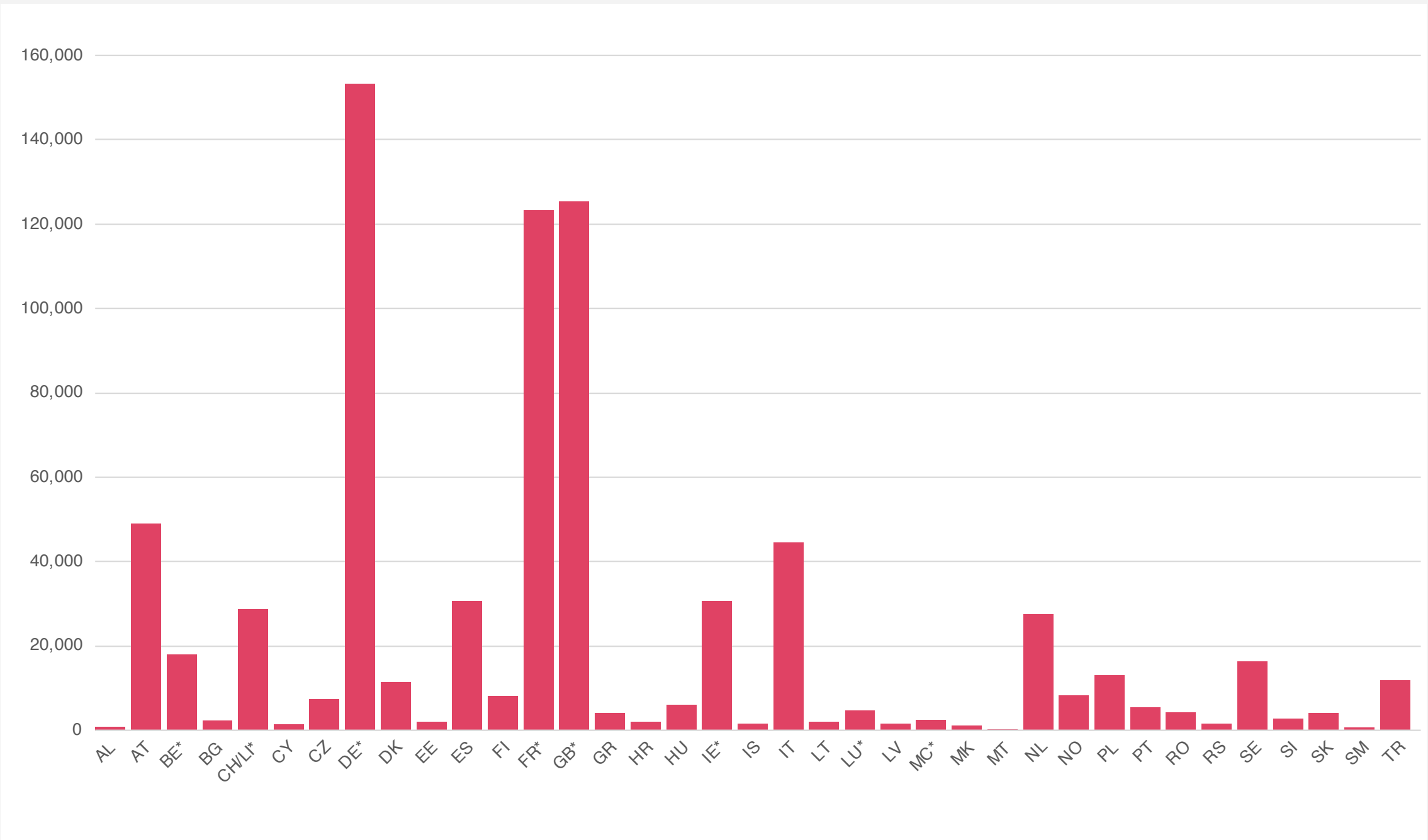
Fields of technology

Summing the validations of patents in each selected field of technology in all member states, Figures 2 and 3 show each field of technology's share of granted European patents and validations respectively.

Pharmaceuticals, Civil Engineering, Organic Fine Chemistry and Biotechnology all have a higher share of validations than granted patents, suggesting that patents in these fields are validated in more countries than patents in the other fields. This could be due to the applicants in these fields generally having a higher budget for Intellectual Property. It may also be an indication of the high value of patents in these fields and, as a result, what would be considered a 'satisfactory' level of protection in Europe.

On the other end of the spectrum is Digital Communication which has a much smaller share of validations than it does of granted European patents, suggesting that applicants are much less likely to validate in as many countries as for other fields. This suggests a lower standard of what would be considered a 'satisfactory' level of protection, applicants perhaps choosing a balance of covering the most GDP in Europe with the least number of validations.

Figure 2
Share of the Total European Patents Granted for each Technology Field
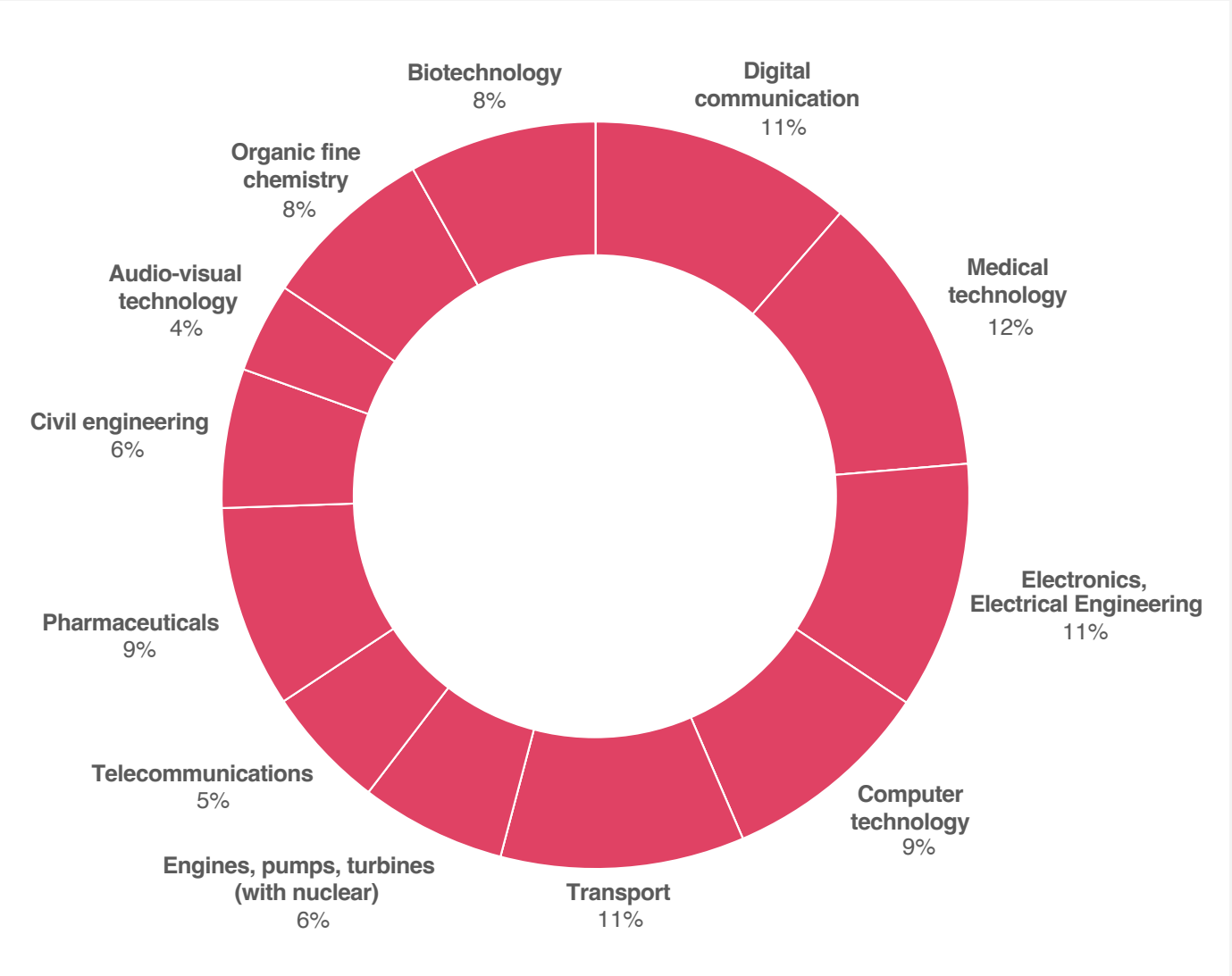
Figure 3
Share of the Total Validations for each Technology Field
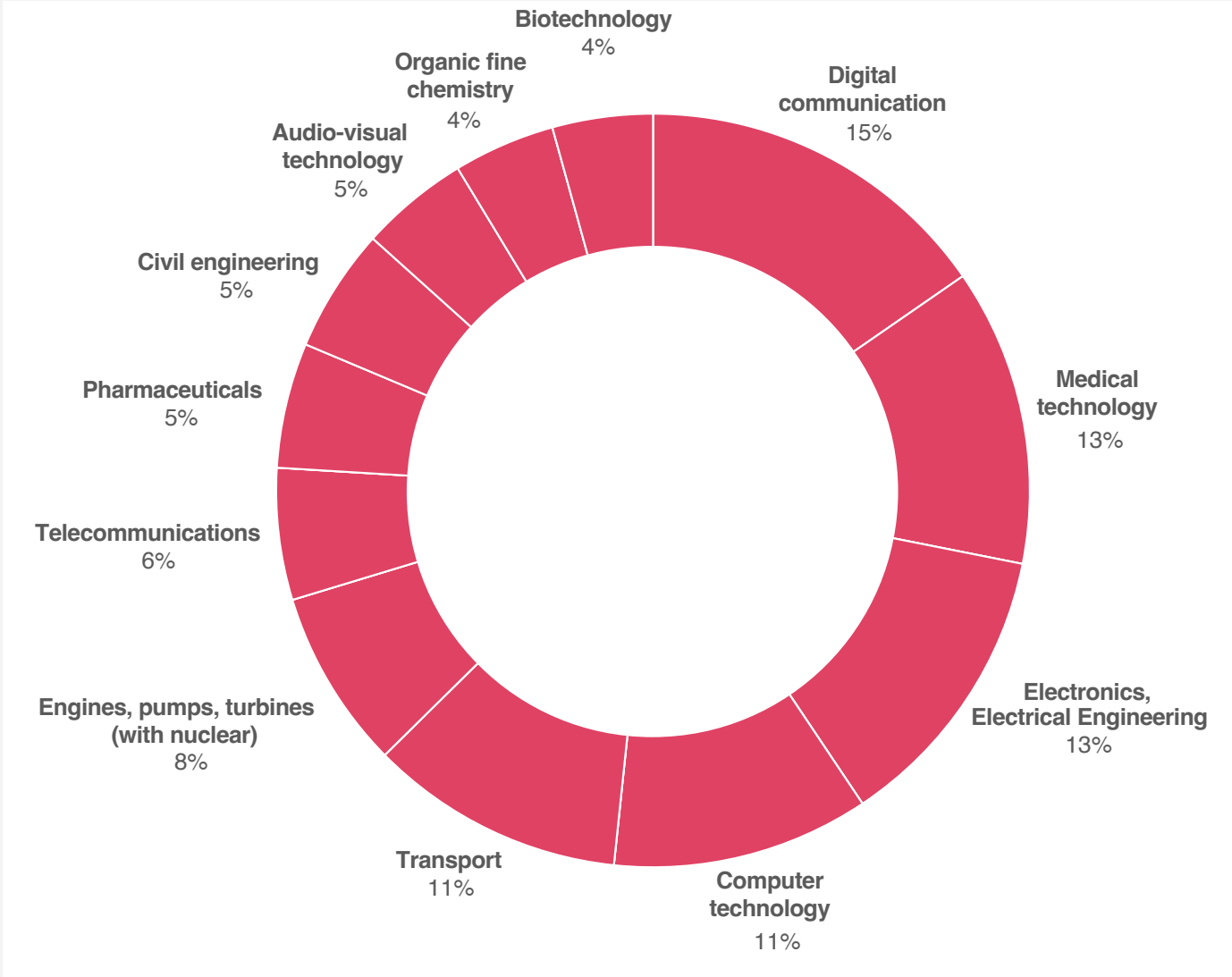
Digital communication and telecommunication

Digital communication is a technology field straddling telecommunications and computers[12], so both Digital Communication and Telecommunication are considered together in this section. The European telecommunications sector is very large, with Europe's largest telecommunication company Deutsche Telekom having a market value of 94.4 billion euros in 2022[13].

The sector includes inventions relating to the transmission of digital information such as telegraphic, telephonic and pictorial communication – in other words, inventions for transmitting words, audio, and video as signals for telephones, TV, radio and the internet[14]. Companies in the sector include telephone operators (both fixed and mobile), internet service providers and cable and satellite companies.

The sector can be divided into three sub-sectors:

(i)   Telecommunications equipment – transmission systems e.g. local networks
(ii)   Telecommunications services – foreign and domestic
(iii) Wireless communication – mobile devices, and cloud based technology.

Trends in European patent validations show Germany in the top spot, followed closely by the UK and then France. This correlates well with the locations of the largest European telecomm companies with Vodafone in the UK and Orange in France having the second and third highest revenue in European telecommunications in 2022. The Spanish company Telefonica is the fourth largest telecommunications operator in Europe with a market value in 2022 of 28.9 billion euros, and was the second largest operator in 2019[15]. However, whilst Spain is a popular country for patent validations in the telecommunications sector, it has a lower share of patent validations than the Netherlands, Italy, Ireland and Iceland.

Figure 4
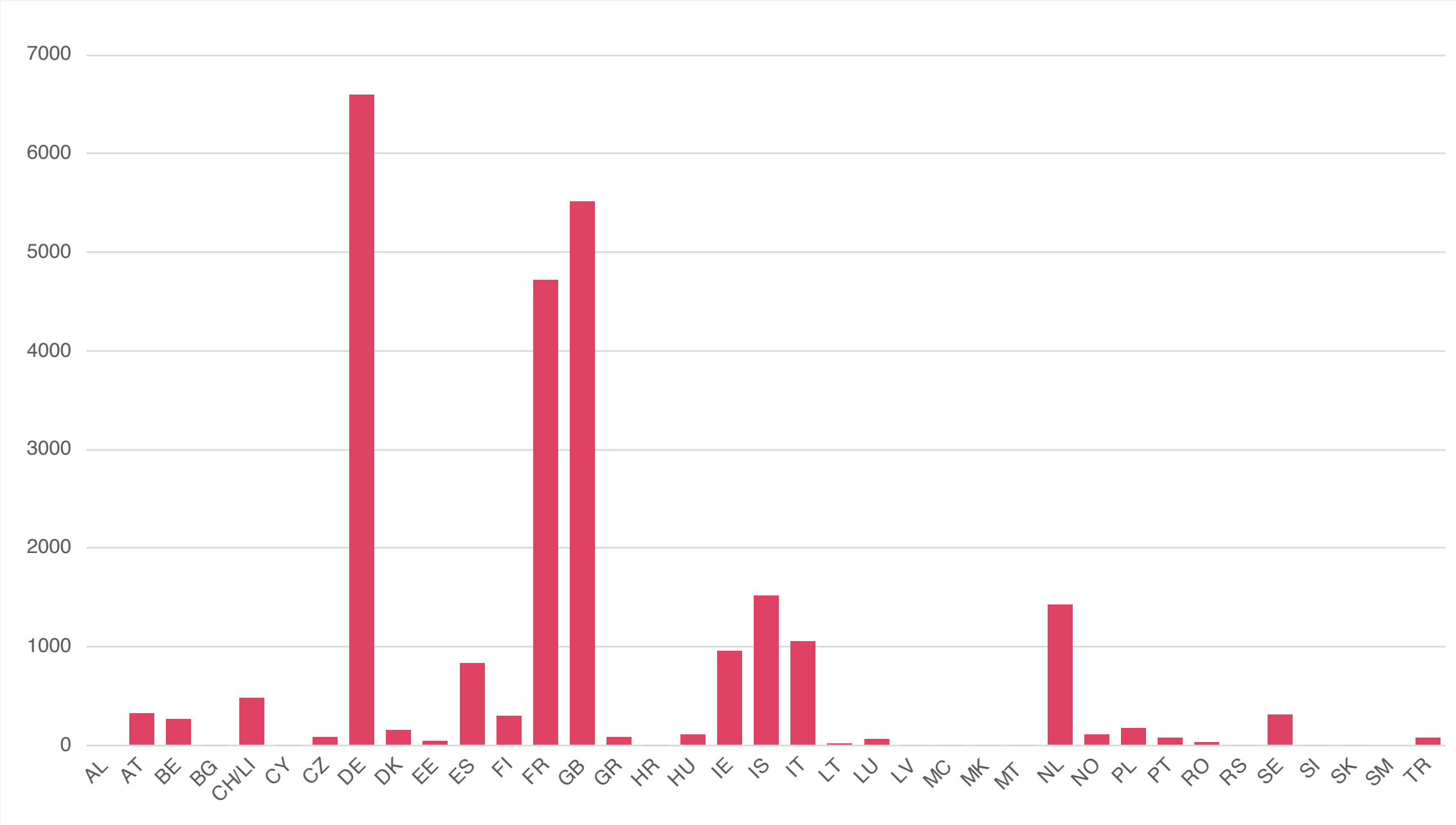Total number of validations of digital communications patents granted in 2019 in each member state
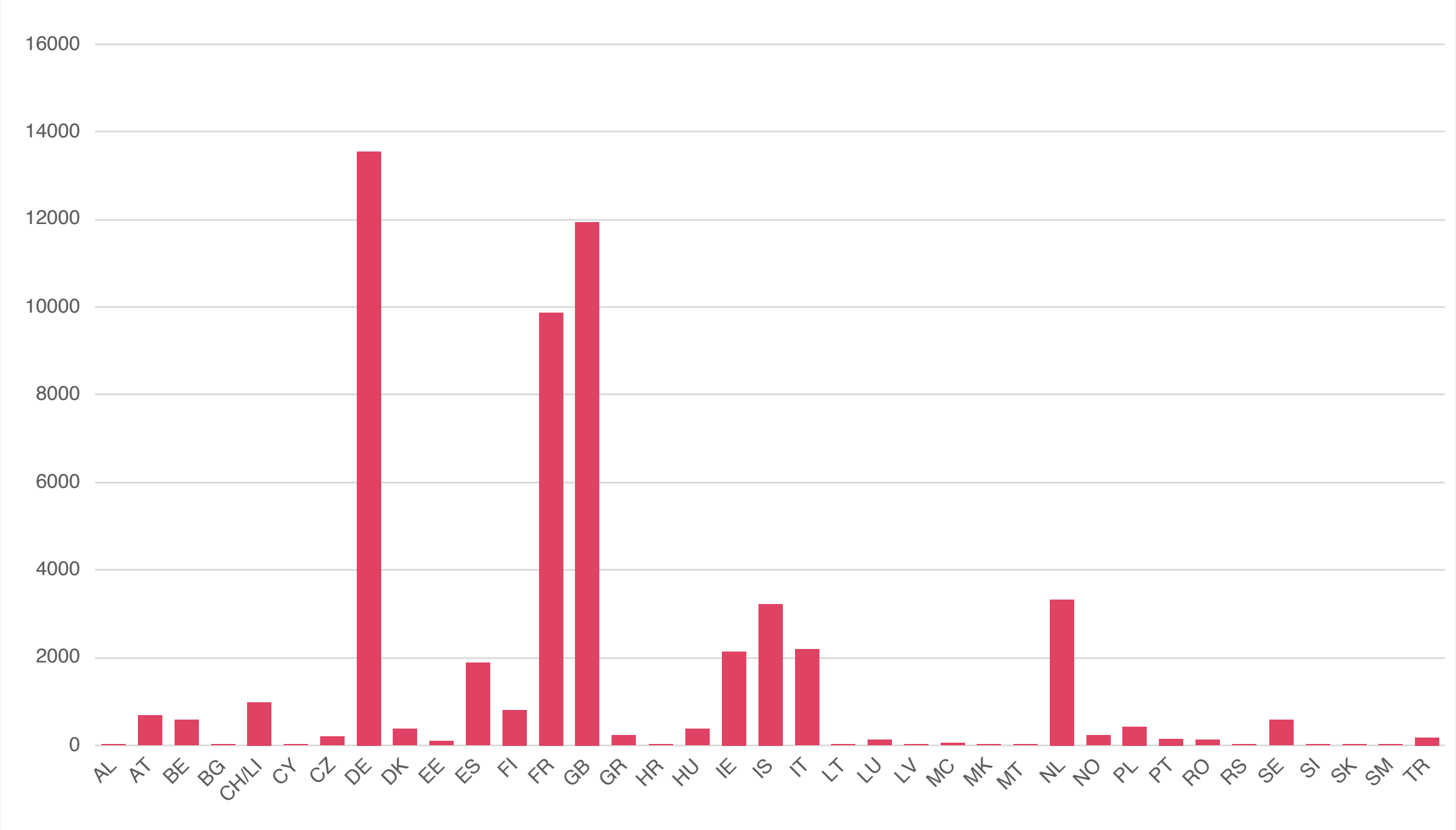
Another important factor to consider when deciding where to validate a telecommunications patent is which countries are the biggest users of telecommunications networks and services. The Netherlands has a very strong broadband sector as it has one of the highest proportions of internet users in the world; 96.3% of individuals in the Netherlands had internet access in 2019[16]. Iceland has some of the world's biggest cryptocurrency mining centres and is an ideal location for data centres thanks to its cold climate and cheap electricity, which comes mainly from hydroelectric and geothermal sources[17]. In 2016, data centres already accounted for around 1% of Iceland's GDP and the sector has been growing ever since[18].

If you are considering validating a patent in the telecommunications sector, it is worth considering:
(i)   the locations of the largest telecommunication companies, and
(ii)   the use of telecommunications networks in that country.

Computer technology

The Computer Technology sector can be split into two main sub-sections:

(i)   Computer hardware, and
(ii) Software and services.

The field of computer technology includes inventions from both computer hardware and software and services sub-sections: relating to digital and analogue computers, optical computing devices, data processing, data recognition, speech analysis and information storage.

The top European countries for validation in this sector are Germany, followed closely by the UK and then France. A second tier of countries with significantly fewer validations than the top three being the Netherlands, Iceland, Italy, Ireland and Spain.

The German technology market is very large and generates annual sales revenues of more than 230 billion Euros. Germany's position in the sector lies generally in software and services, rather than in hardware. Germany imports 83 billion euros worth of the hardware it uses (which corresponds to around 90% of the market), whereas it only imports 24 billion euros worth of software and services (or 17 percent of the market). Many US technology companies manage their European activity from Ireland. This explains the fact that 17% of the software and services imports of Germany came from Ireland[19].

When considering where to validate a patent in the computer technology sector it is important to consider where the invention will be manufactured and where it will be sold as well as the locations of competitor companies and their main markets.

Figure 6
Total number of validations of computer technology patents granted in 2019 in each member state
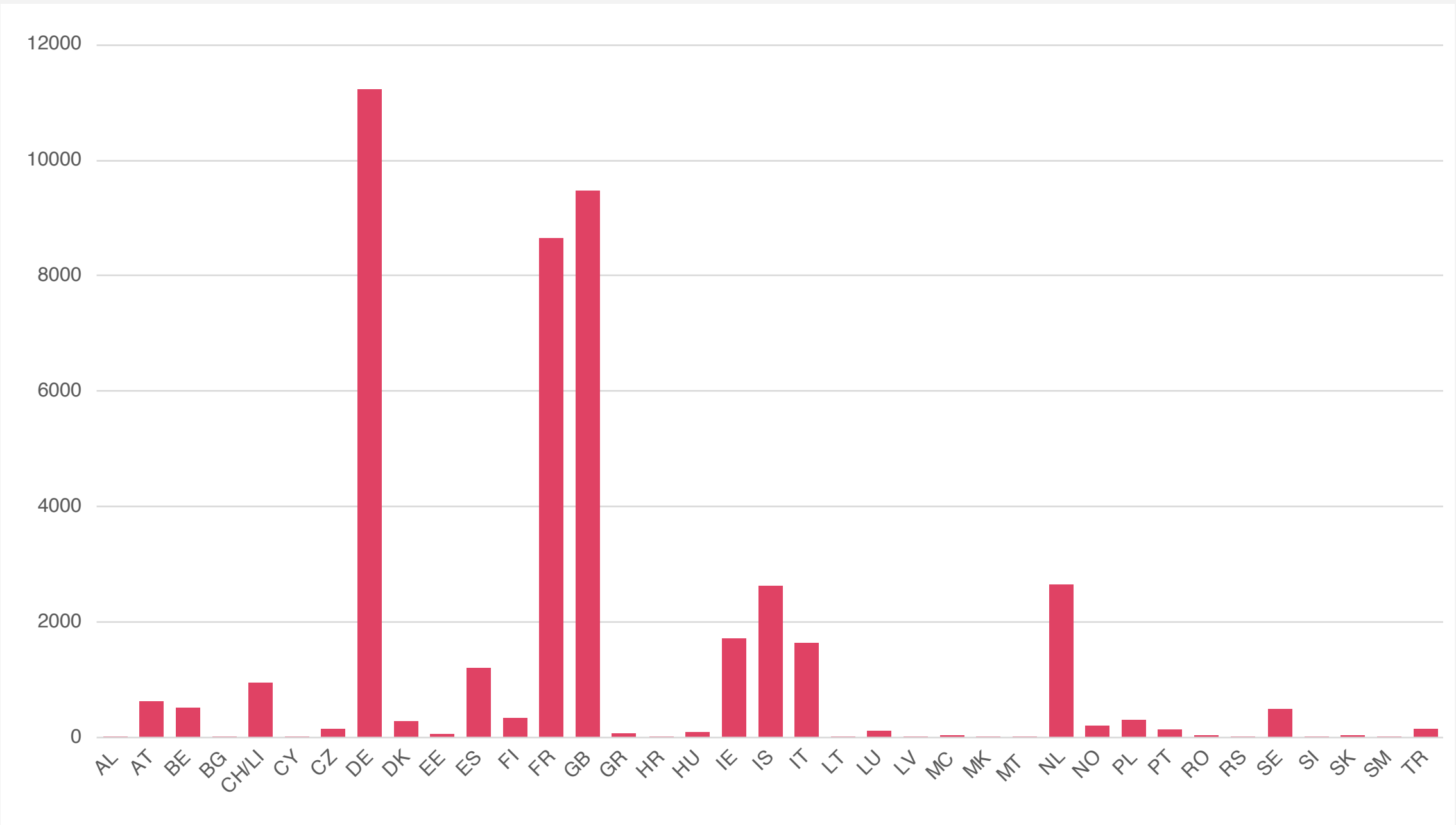
# Electronic and electrical engineering

The electronics sector is innovative, fast-moving, and increasingly competitive. It includes not just consumer products (such as televisions and other household appliances), but also industrial equipment, some medical devices (such as medical imaging equipment), and semiconductor production. The semiconductor industry is the most profitable area of the electronics sector. On a global scale, electronics production is dominated by the US, China, and Hong Kong[20].

Again, the top three choices for European patent validation remain Germany, the UK, and France. However, Germany represents a far greater proportion of validations for electronics than it does for other fields such as pharma or civil engineering. This may be due to Germany's status as the largest electronics market in Europe, both in production and sales, and its considerable investment in electronics R&D[21]. The next tier of countries includes Italy and Austria. Although it is more expensive to validate in these countries, they are ranked among the top EU countries for electrical equipment and electronics output[22], and Austria in particular has a strong track record for research and investment in this sector[23].

For patentees deciding on an electronics validation strategy, one factor to consider will be the specific area of technology concerned and where manufacturing and sales are likely to take place. Consumer electronics are likely to be sold in many countries, so a larger number of validations may be required. Validation strategies for medical electronics, may also take into account countries' healthcare spending, for example.

Total number of validations of electronics patents granted in 2019 in each member state
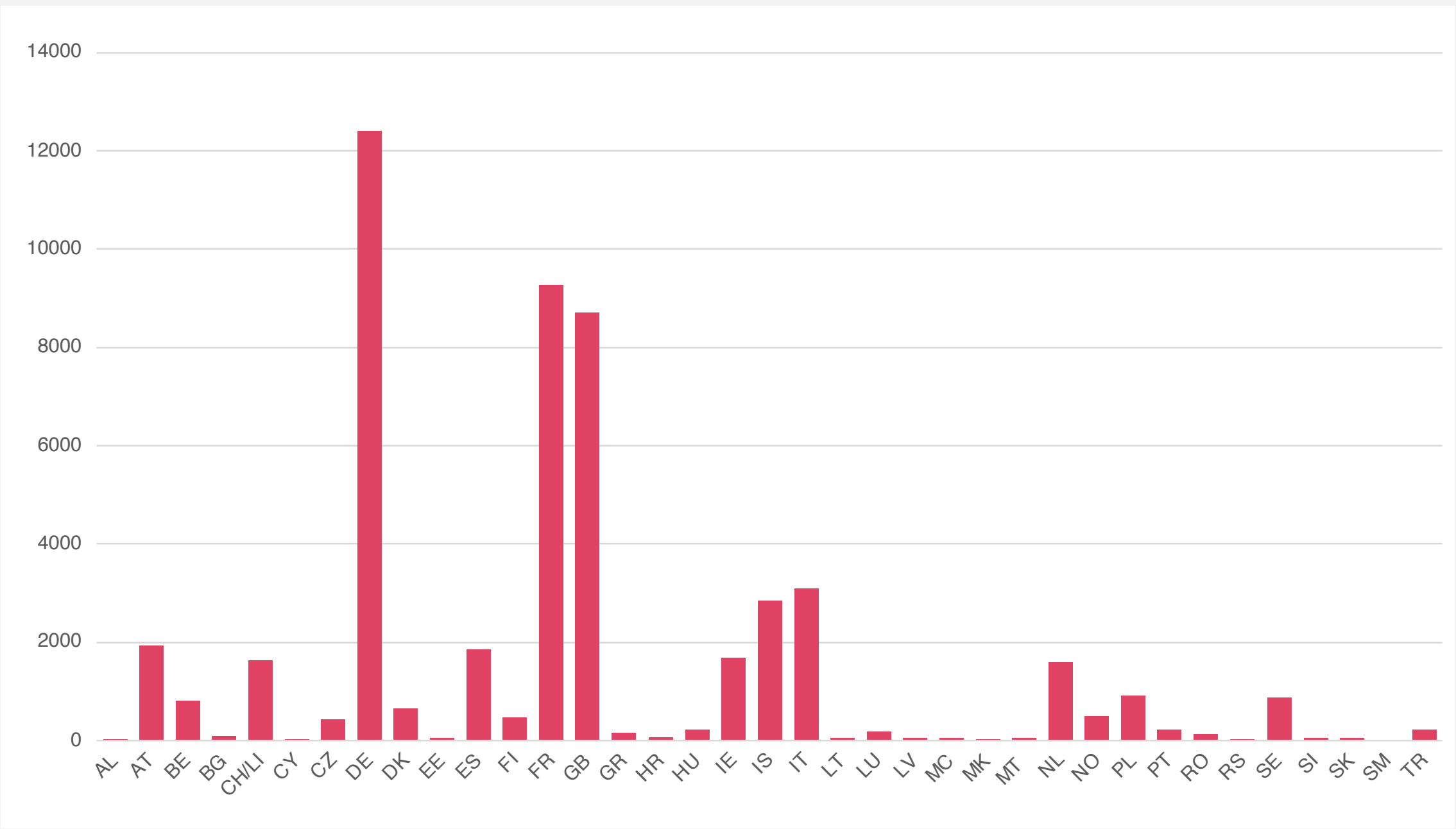
Audio-visual technology

As its name suggests, audio-visual technology concerns electronic media having both a sound and visual component. The industry of audio-visual technology is highly interlinked with film, broadcasting, video and multimedia markets. This area of technology includes products and processes related to the following categories based on patent classifications:

(i)   **Displays**, arrangements or circuits for control of indicating devices using static means to present variable information;
(ii) **Information storage** based on relative movement between record carrier and transducer;
(iii) **Pictorial communication**, e.g. television;
(iv) **Loudspeakers**, **microphones**, such as acoustic electromechanical transducers and deaf-aid sets;
(v)   **Stereophonic** systems; and
(vi) **Secret communication**, including the jamming of communication.

Taking a look at European validations in the audio-visual technology, the majority of patents are registered nationally in a small subset of countries, in particular the UK, Germany and France. The lack of translation requirements beyond the claim translations needed for grant might be the reason for this trend in addition to their valuable market potentials. Other attractive jurisdictions include the Netherlands and Italy, however, the magnitude of validations is less striking than what we might observe in the chemical or healthcare sector. Apart from considering economic factors such as market size, validation fees and renewal fees, a European patent holder might regard the different approaches of national courts during infringement proceedings as a selection criteria for validation. Strategically, it might be beneficial to validate in a country, where the national courts have a reputation as being more pro-patentee and where effective and timely enforcement is available.

Figure 8
Total number of validations of audio-visual patents granted in 2019 in each member state
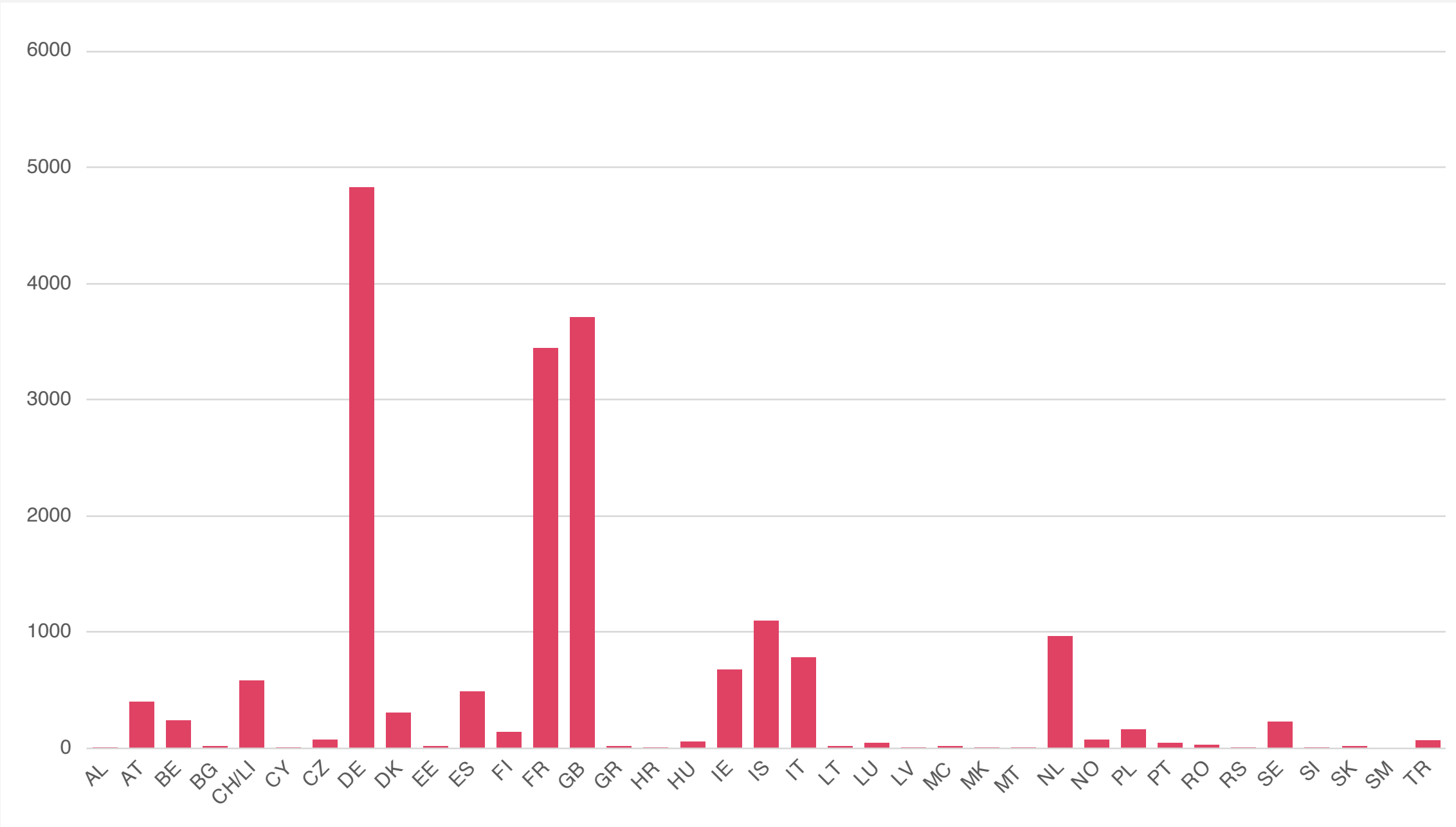
Transport

Patents granted in the field of transport have most validations in Germany, France and the UK, these countries making up over half of the total validations in the field. They are followed by Italy, Iceland and Austria.

Transport is a very diverse field so, in order to better understand trends in validation, the field was sub-divided into Rail, Automotive, Bicycles, Ships and Waterborne Vessels, and Aircraft sectors.

The aircraft sub-sector has the largest share of validations with 35% of the total validations, followed by the automotive sub-sector with 22%. Ships or Waterborne vessels and Rail sub-sectors are a close third and fourth with 18% and 17% respectively. The bicycle sub-sector has the lowest share of validations with 8%, perhaps due to the low unit cost in comparison to the units produced in the other sub-sectors of transport.

The below table lists the 6 countries with the most validations in each sub-sector. Each sub-sector is discussed in turn below.

States with the most validations in different sub-sectors of transport

#	Rail	Automotive	Bicycles	Ships and Water- borne vessels	Aircraft
1	Germany	Germany	Germany	UK	France
2	France	France	France	France	Germany
3	UK	UK	UK	Germany	UK
4	Austria	Italy	Italy	Italy	Italy
5	Switzerland/ Lichtenstein	Iceland	Iceland	Netherlands	Iceland
6	Italy	Austria	Spain	Norway	Spain

Figure 9
Total number of validations of transport patents granted in 2019 in each member state
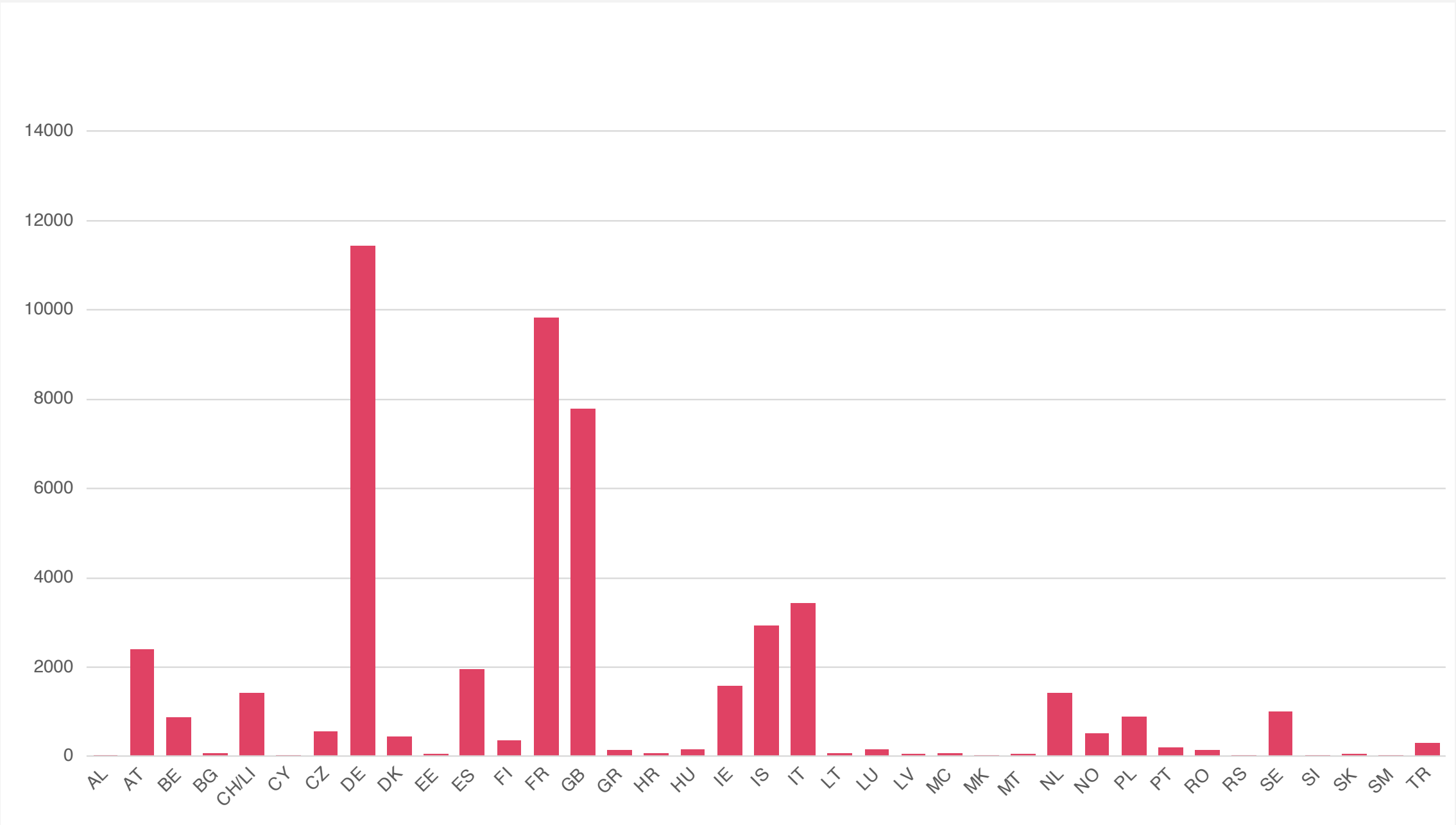
Rail

The key suppliers to the Rail industry in Europe in 2019 were Bombardier (acquired by Alstom in 2021), Alstom (France), Stadler (Switzerland) and Siemens (Germany)[24], so it is unsurprising that Germany, France and Switzerland take top positions.

A patent grants a monopoly over certain acts, including the use of the invention. The interconnected nature of Europe's railway network means rolling stock may travel through several countries in the course of its journeys. In 2021 there were more than 270 distinct rail links for passenger trains crossing borders in Europe[25]. Therefore, care should be taken to ensure patent protection is secured for countries rolling stock may be used in. Of course, this consideration is also relevant to other forms of international transportation, including ships and aircraft.

Automotive and Bikes

Although the Bicycles sector consists of technology relating to push bikes, the Automotive and Bicycles sectors follow a similar trend. Italy follows the usual top 3; Germany, France and the UK. Italy is recognised as a leader in design, not limited to fashion design but in industrial design as well[26]. Italy may be an important country to consider, especially for technology relating to luxury transport goods such as sports cars and high-end bicycles – for example, Italian brands Ferrari and Cinelli for cars and bicycles respectively.

Ships or Waterborne Vessels

Although Germany holds first place for validations in nearly all fields, in Ships and Waterborne Vessels, it is surpassed by the UK and France.

From 2002 to 2020, the European shipbuilding industry was dominated by Germany, France and Poland, with Croatia, The Netherlands, Italy and Spain also making significant contributions[27]. In 2013, Italian shipping company Fincantieri acquired Vard Group, making it the largest shipbuilding company in Europe. Its European shipyards are located in Italy, Norway and Romania[28]. In 2020, Norway had the highest gross weight of seaborne freight handled in all ports per capita in Europe at 41.4 tonnes per capita followed by the Netherlands at 32 tonnes per capita[29]. The Netherlands is of course home of the Port of Rotterdam, the largest port in Europe.

Aircraft

France takes top position with the most validations in the Aircraft sub-sector. France has a strong aeronautical industry with companies such as Airbus, Safran Group and Zodiac Aerospace[30] (which was acquired by Safran in 2018). The top 5 European countries with the highest aerospace exports in 2020 were France, Germany, UK, Spain and Italy[31].

Figure 10
Validations for sub-sectors of Transport

Rail 17%
Aircraft 35%
Automotive 22%
Ships or Waterborne vessels 18%
Bikes 8%
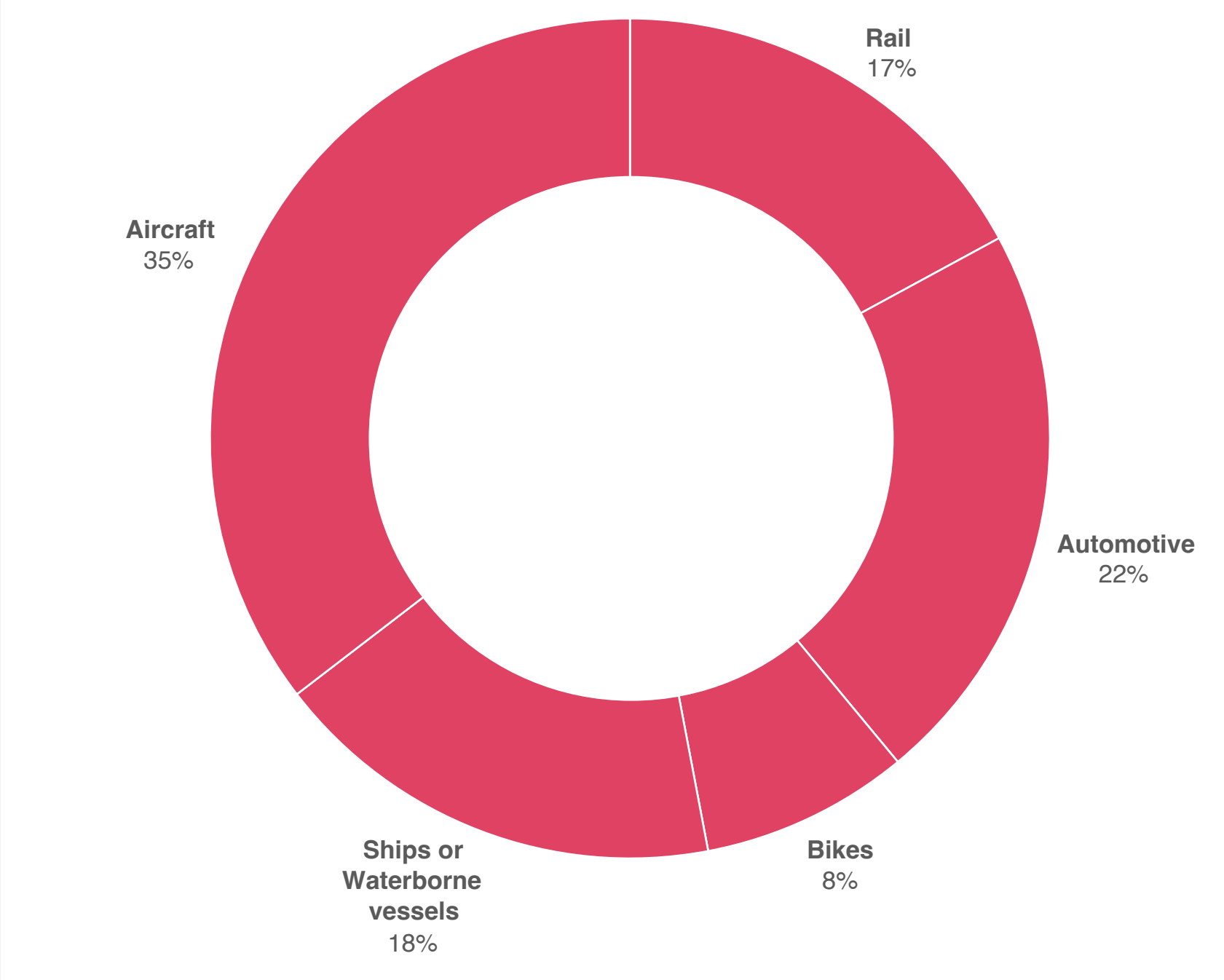
Engines, pumps and turbines

The field of 'Engines, Pumps and Turbines' covers technology relating to the energy production industry, including technology relating to nuclear engineering.

Firstly looking at validations of patents across the whole field, the four countries with the most validations are Germany, France, the UK and Italy. The order of the top four countries follows the same order as those countries ranked by their overall energy supply[32]. In 2019, Germany and France were ranked among the top 5 countries in the world for their spending on Research and Development in Energy technologies, while Denmark and Italy were noted as places of research growth within the energy industry[33].

Now looking at validations of patents covering technology that relates to nuclear engineering specifically, Belgium, Switzerland, the Netherlands and Finland have a higher share of validations for nuclear engineering than for the overall field. These countries appear in the top 15 nuclear-generating countries in the world with 39.1%, 34.5%[34], 32.9% and 33.9% of their energy generated by nuclear, respectively[35]. This is another example of how, for a given field, there will be variations in validation trends across different sub-sectors of that field.

Figure 11
Total number of validations of engines, pumps and turbines patents granted in 2019 in each member state
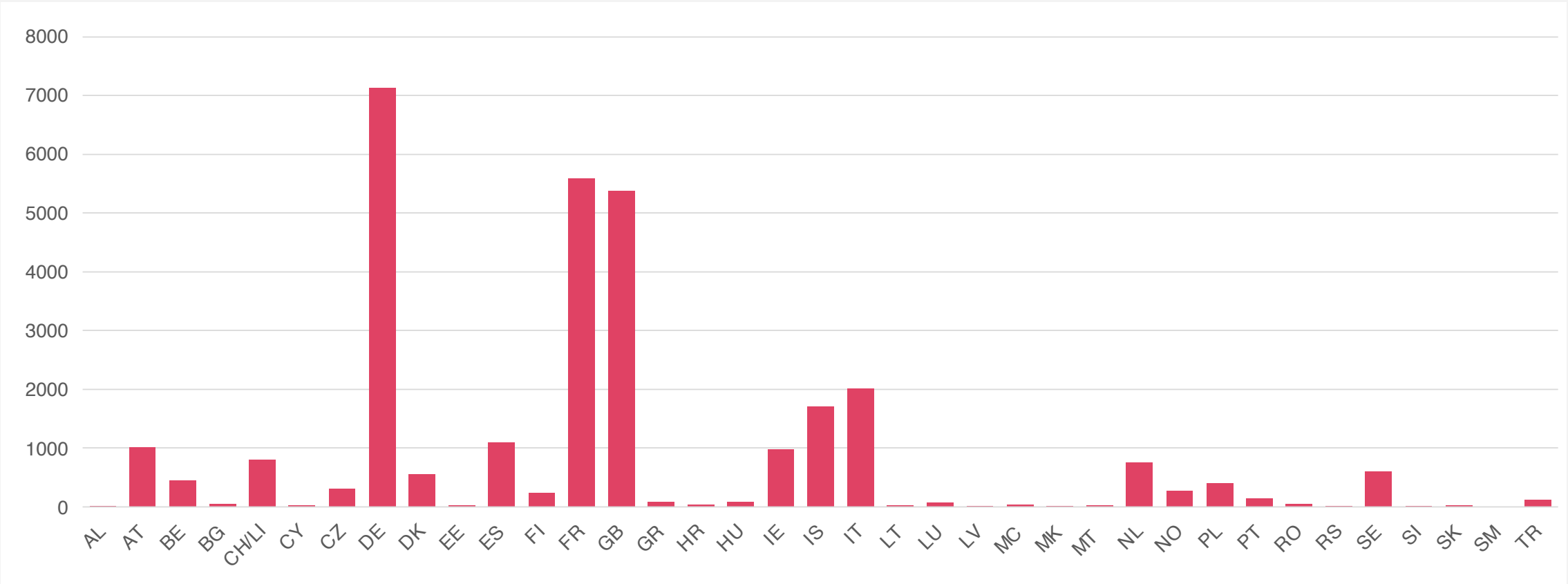
Figure 12
Validations for Nuclear Engineering
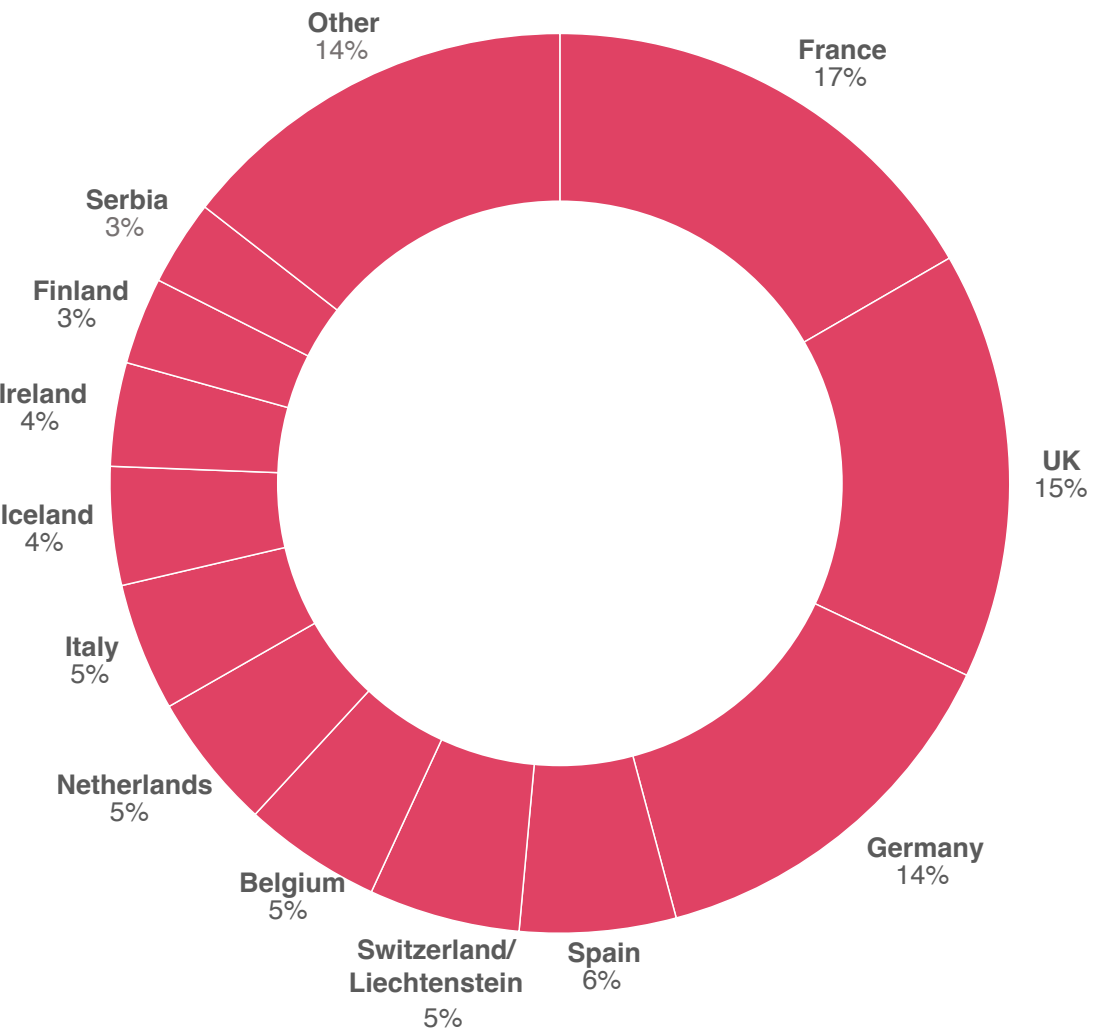
Civil engineering

This field includes inventions relating to the construction of roads, railways and bridges, in addition to hydraulic engineering, water supply, building construction, and mining. The civil engineering market in Europe was estimated to be worth 2004.2 billion dollars in 2018 and the construction sector accounted for 42.7% of that revenue[36].

Germany had 13.7% of the civil engineering market share in 2018, which correlates to the trends in patent validation which show Germany as the most validated country followed by the UK and France. Although patent validations in the Civil Engineering sector are dominated by these top three countries, the rest of the field is significantly more varied than in other sectors (such as telecommunications) with Italy, Austria, Netherlands, Switzerland, Spain, Iceland, Norway, Poland, Belgium and Ireland all having a relatively large number of validations.

Out of the top ten construction companies in Europe, three – Vinci, Bouygues and Eiffage - are based in France. ACS and Acciona are based in Spain, Royal Bam Group and Volkerwessels in the Netherlands and Balfour Beatty and Strabag in the UK and Austria respectively[37].

Europe has a significant mining and quarrying industry and is self-sufficient in producing some industrial minerals . In 2018, Denmark had the largest share of EU value added in the quarrying and mining sector, followed by Poland, the Netherlands and Germany[39].

If you are considering validating a patent in the civil engineering sector then it is important to consider the countries where your invention is most likely to be manufactured and/or used. Countries that have a high proportion of competitor companies or a large market share in the sector are also important to consider. For countries where validation of a patent is not essential, consider the relative costs of validating in that jurisdiction and weigh this against the potential benefits of gaining protection in that country.

Figure 13
Total number of validations of civil engineering patents granted in 2019 in each member state
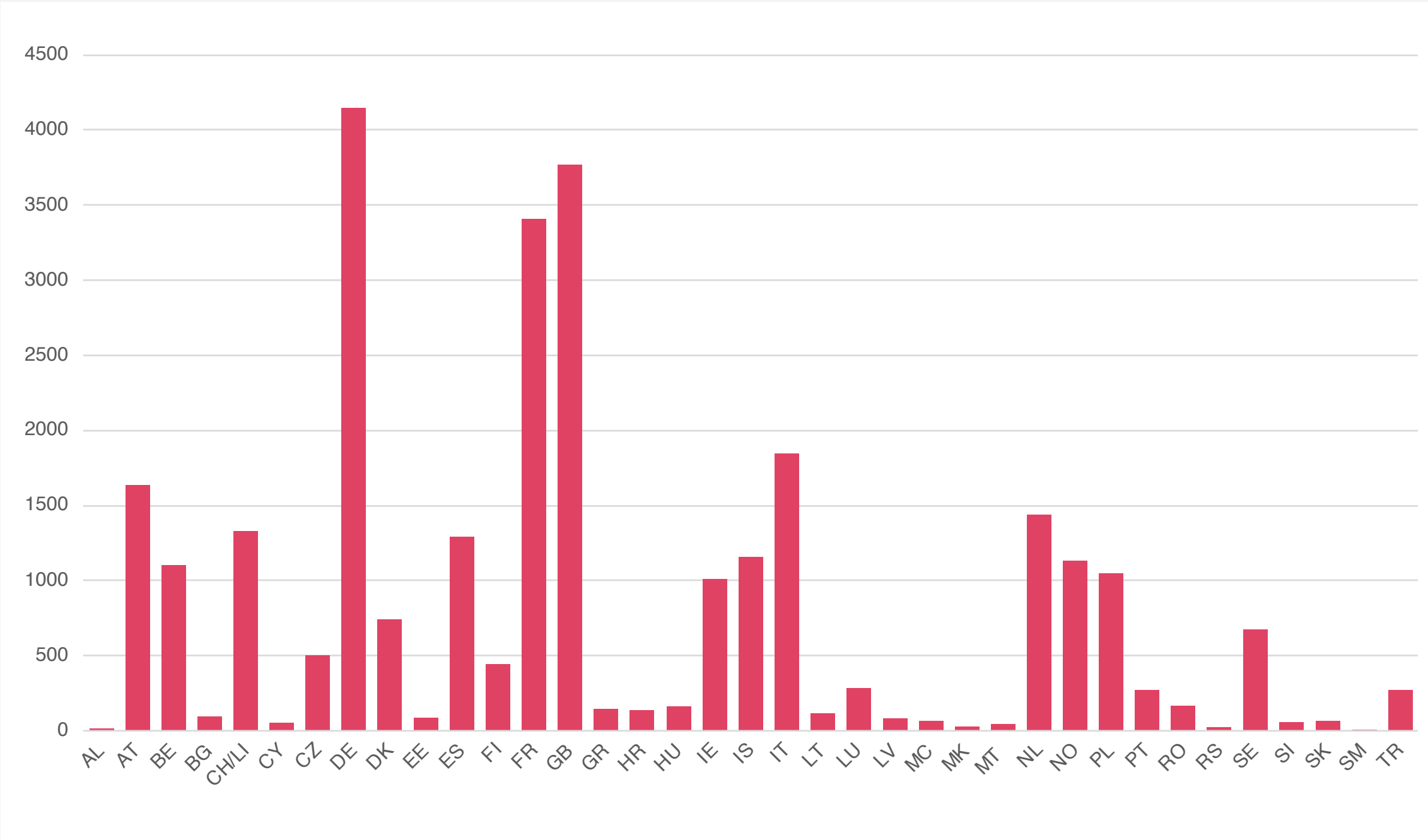
Organic fine chemistry

The European chemical industry is a distinctly advanced sector. Despite the rapid rise of chemical manufacture in China, the value of EU's exports still exceeds the cost of its imports, sustaining its high demand for production of its chemicals[40].

The EU's production of fine chemicals can be divided into three distinct categories: base chemicals, specialty chemicals and consumer chemicals. Base chemicals (or commodity chemicals) include substances which can be produced in bulk quantities by manufacturers, such as petrochemicals and their derivatives, polymers and common inorganics. As they are usually developed in a standardised form, the quality of the products does not vary significantly. In contrast, specialty chemicals cover unique substances which are developed for their performance and function. A non-exhaustive list of specialty chemicals may include dyes, pigments, pesticides, herbicides, antibiotics, essential oils and adhesives. Lastly, consumer chemicals are sold directly to the general consumer and may be found lying on the shelves of households worldwide. This category comprises personal hygiene products (such as soaps, shampoo and toothpaste), household cleaning products, cosmetics and fragrances.

As the chemical industry covers such a wide variety of essential products, it is no wonder that it is regarded as a catalyst for economic growth globally. Therefore, a strategic and well-planned patent portfolio for business owners is essential from an early stage to stay competitive within the industry.

Looking at European patent validations, the general trend of registering for a national patent seems to correlate with countries having the largest chemical sales revenue. This includes Germany, France and the UK having the largest proportion of overall validations, followed by Italy, Spain, the Netherlands and Belgium. Also, the attractiveness of validating in Switzerland may be attributed to the chemical industry's position as the country's leading exporter with contribution from major players such as Roche and Syngenta, which are among the top 10 companies validating in this sector[41].

When deciding on where to validate your patent related to organic fine chemistry, you may wish to consider the following:

(i)   countries where you expect the majority of your sales to come from;
(ii) countries where the manufacture of your product might take place;
(iii) countries where your competitors run their business; and
(iv) any other strategic geographical positions, such import/export hotspots.

Figure 14
Total number of validations of organic fine chemistry patents granted in 2019 in each member state
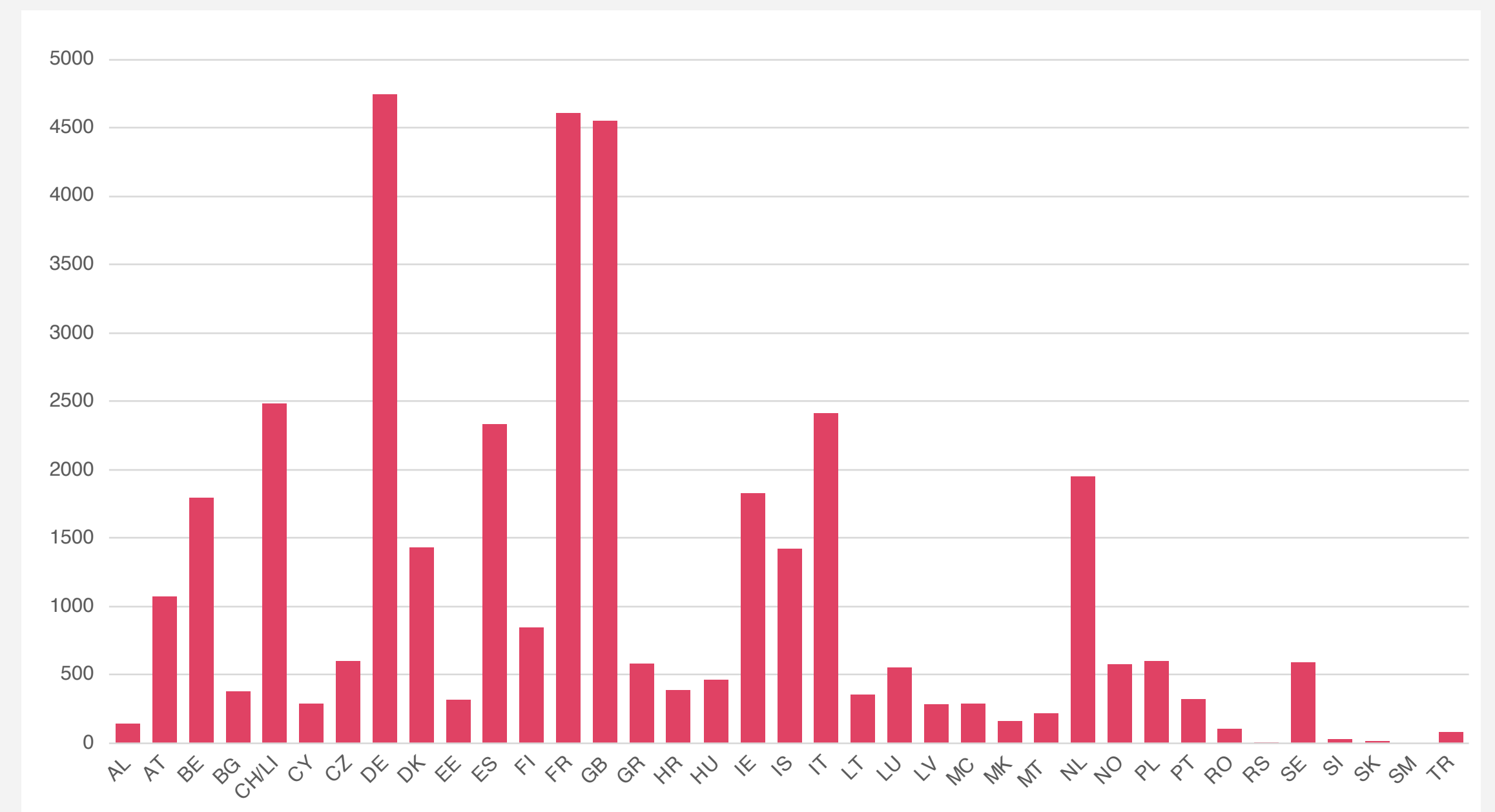
Biotechnology

The field of biotechnology harnesses living organisms, usually to manufacture commercial products but also to solve industrial or environmental problems. The sector can be divided broadly into two sub-sectors, depending on the application of the products or processes [42]:

1. Industrial and agricultural biotechnology
This includes many common industrial products from enzymes to biofuels and some plastics, and generally uses microbes like bacteria or yeast (which are also increasingly used to combat pollution by breaking down environmental contaminants). Agricultural biotechnology generally uses genetic techniques to produce, for example, disease-resistant crops.

2. Medical biotechnology
Some of the best-known products in this part of the sector are 'biologics', i.e. large, complex therapeutic molecules created from living organisms (such as antibody drugs). Medical biotechnology also includes therapeutics based on DNA or RNA, as well as cell-based therapies.

Increasingly, medical biotechnology has begun to overlap with the pharmaceutical sector. Many larger pharmaceutical companies are also active in biotechnology research and development, and often market biologics alongside more 'traditional' small-molecule pharmaceuticals. The cost and time-scale of development are also similar for both types of product, and may even be larger for some newer therapeutics (such as cell-based therapies) that may have their own specific safety and efficacy issues to overcome.

This overlap between sectors is reflected by the overall similarity in countries chosen for validation across both the pharmaceutical and biotechnology fields. Switzerland has jumped to fourth place for biotechnology, which is consistent with the ever-increasing number of biotechnology companies in the country and its strong investment in the sector [43]. Denmark also joins the top ten countries for biotechnology validations, in keeping with the consistently high ranking of its biotech sector both in Europe and globally [44].

Validation strategies for biotechnology patents will depend on whether the technology sits within the medical or industrial sector. For medical biotechnology, many of the key questions will be the same as for pharmaceutical patents, especially when it comes to technology-specific regulatory or manufacturing issues. Across the biotech market as a whole, validation in countries where competing products enter Europe may also offer patentees greater control – especially since a large value share of the global biotech sector is accounted for by two non-European countries; the US and China [45].

Figure 15
Total number of validations of biotechnology patents granted in 2019 in each member state
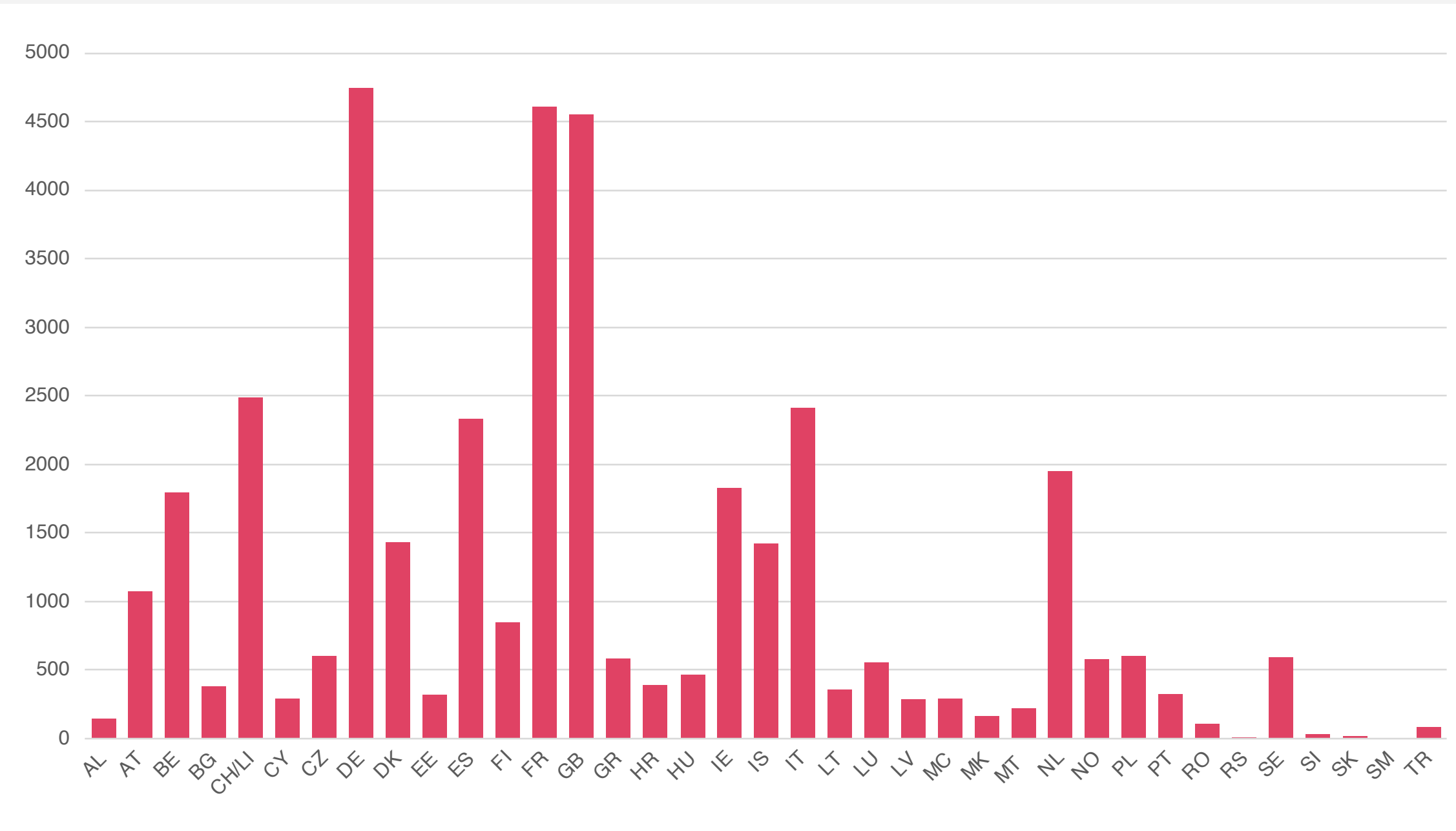
Medical technology

Medical technology (MedTech) is a sector with one of the highest numbers of applications within the European patent system. In 2020, more than 14,200 patent applicants were filed at the European Patent Office (EPO) in the area of MedTech, surpassing other healthcare sectors, such as pharmaceuticals and biotechnology[46]. This may be as a result of the shorter time of product innovation or improvement, shorter time of clinical trials and lower cost of obtaining market authorisation in the MedTech field relative to the expenditure and time-scale of pharmaceutical drug development.

MedTech inventions can be grouped in the following sub-classes:

(i)   Medical devices, such as simple bandages or wound care products; syringes; anaesthesia machines and pacemakers;

(ii) In vitro diagnostics (IVD-s), including non-invasive tests used on biological samples. For example, ABO blood-typing, blood glucose monitoring, PCR tests, pregnancy tests and clinical chemistry analysers;

(iii) Digital health, comprising information and communication technologies (ICT-s) specially adapted for handling or processing of medical or healthcare data[47].

When deciding on where to validate your patent concerning a safeguarded product or process in the MedTech field, it is worth taking into account the business and trading activities as well as the consumers of the European countries. It is no surprise that Germany, the UK and France are leading in the total number of validations, however, Italy and Spain have a significant share of the European medical device and IVD-s market[48,49]. Interestingly, Switzerland, Ireland and the Netherlands have a considerable trade surplus relative to other European countries[50]. On top of that, the number of medical technology employees per capita is highest in Ireland and Switzerland, further indicating great market opportunities for patent validation[51].

Figure 16
Total number of validations of medical technology patents granted in 2019 in each member state
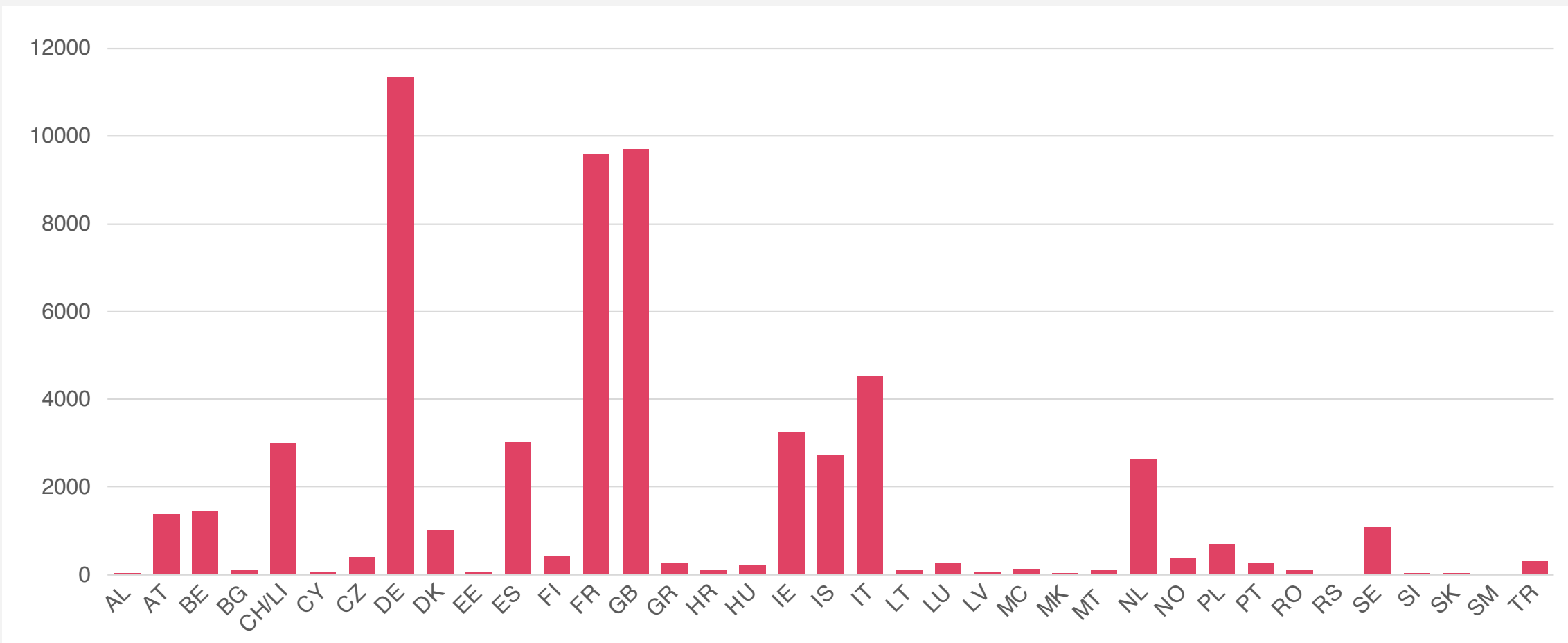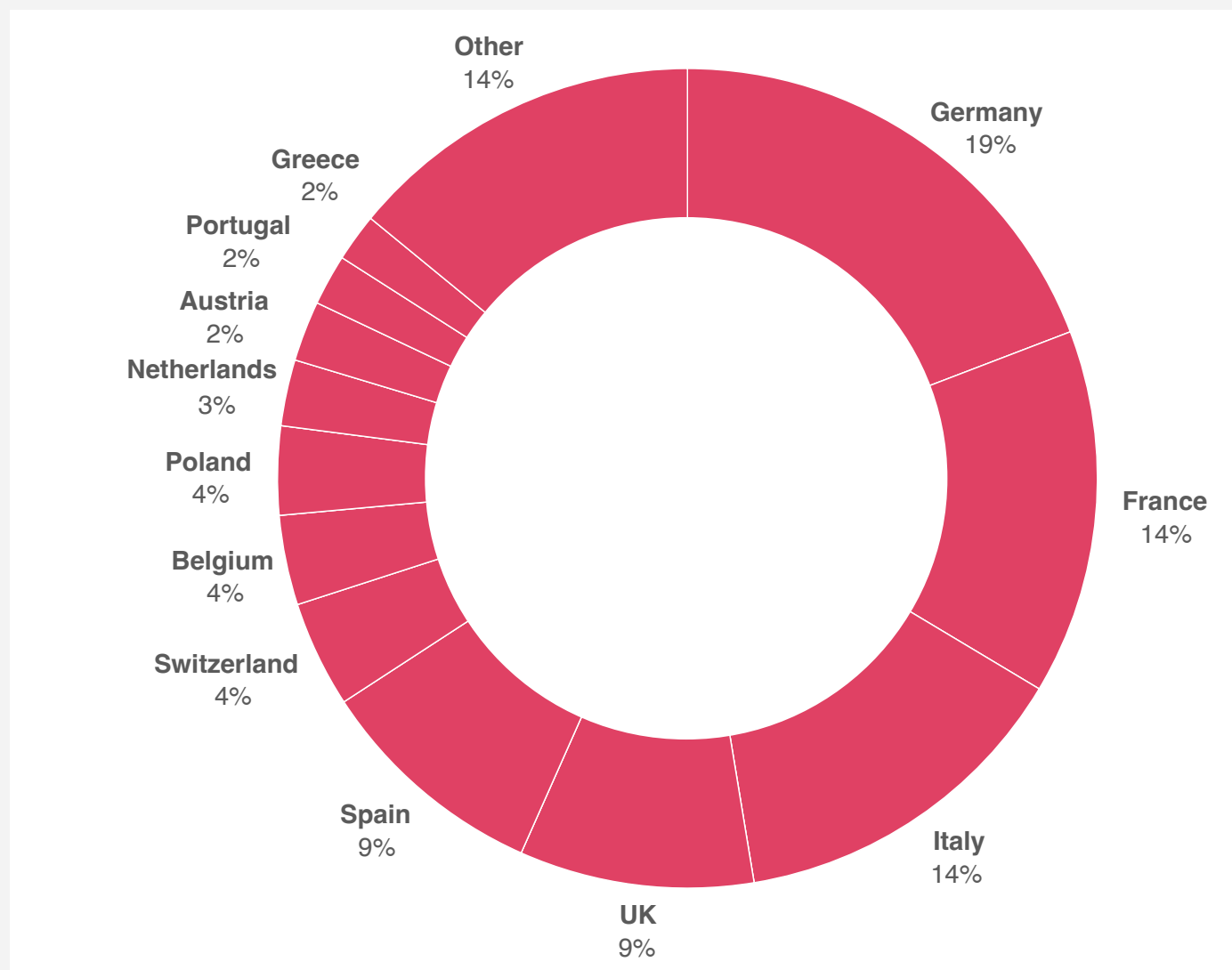

Figure 17
IVD market shares of each member state
Source: MedTech Europe, 2020

Pharmaceuticals

The pharmaceutical industry is one of the best-performing high-tech sectors in Europe. In 2019, the European pharmaceutical market was worth around €213 billion, and accounted for 23% of pharmaceutical sales worldwide[52]. Balanced against this – and against the high value of a key pharmaceutical patent – are the challenges of bringing new drugs to market, which can take over a decade and cost millions in research and development. These challenges highlight the need for carefully considered validation strategies for pharma patents.

In the pharma field, Germany, France, and the UK are once again the top three countries for validations, followed by Italy and Spain. However, smaller countries make up a greater proportion of pharmaceutical validations than they do for validations overall. This may reflect the strategy of larger pharmaceutical companies to validate key patents in as many jurisdictions as possible – which often includes all EPC member states.
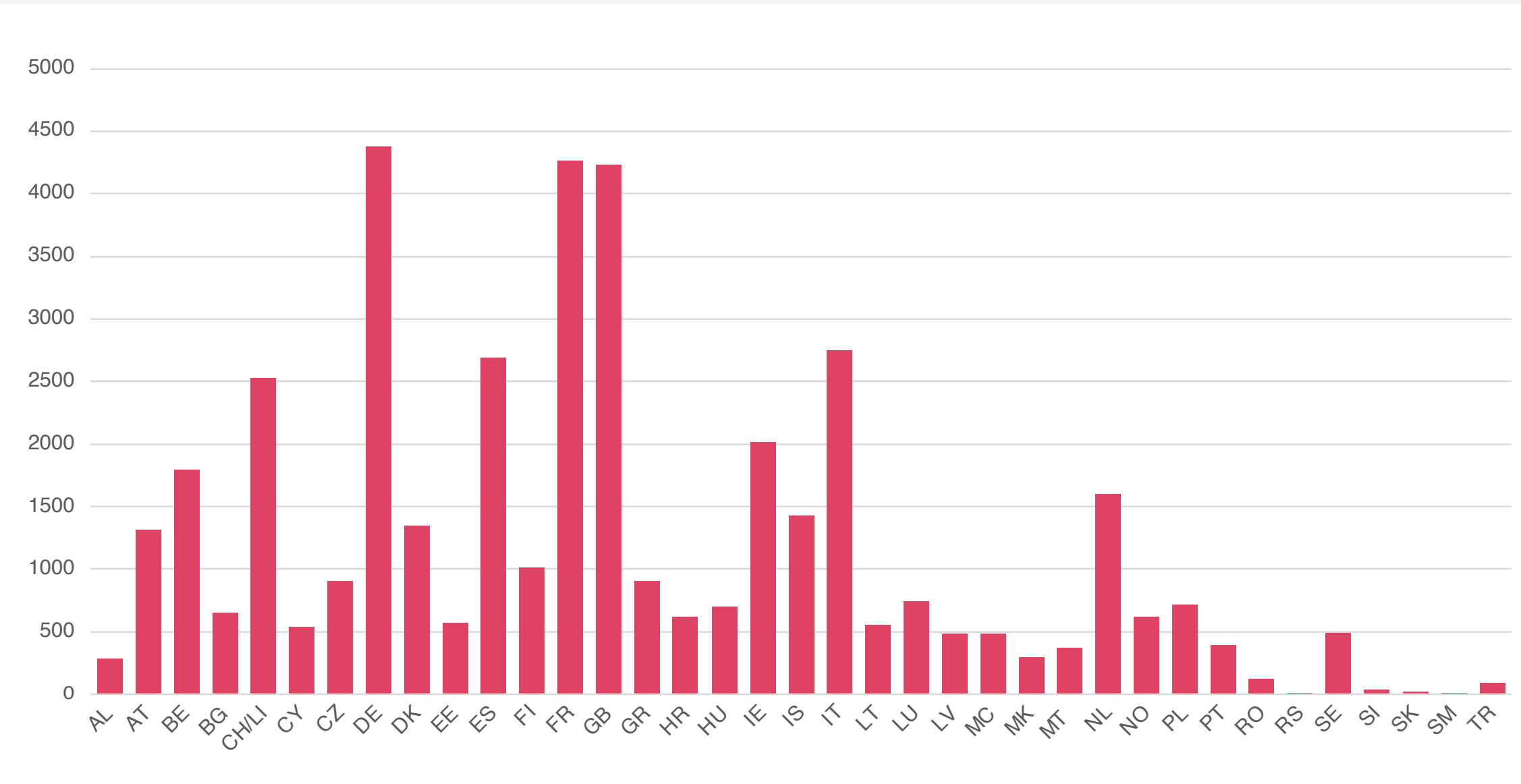
Most countries in the top ten for pharmaceutical validations also have strong local pharmaceutical industries, and many are also among the top European spenders on healthcare – meaning that they are potentially valuable markets to protect. For example, EFPIA data estimated Italy's pharmaceutical production as the third highest in the EU for 2018.

Of the ten applicants with the highest numbers of Pharmaceutical European Patent applications, three (Novartis, Roche and Nestlé) are at least partially based in Switzerland[52] and two (Bayer and Boehringer Ingelheim) are based in Germany. These two countries alone export 26% of the world's packaged medicines[54]. Ireland, despite its small population, has a strong presence in pharmaceutical manufacturing and a high level of investment in pharma research and development[55].

Some of the key areas to consider for a pharmaceutical validation strategy are:

(i)   where you are likely to manufacture;
(ii) where any clinical trials are likely to take place;
(iii) where the largest markets are likely to be, which could depend on a number of factors such as population size, demographics, overall healthcare expenditure, disease status; and,
(iv) Last but not least – where any competitors might be likely to launch their products. For a particularly valuable pharmaceutical patent, e.g. for a clinical lead compound, it is also worth considering major markets outside the EPC states such as the US or Japan.

Figure 18
Total number of validations of pharmaceutical patents granted in 2019 in each member state

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Abel & Imray LLP
+44 (0)20 7242 9984
ai@abelimray.com