

Patent landscape report

1 INTRODUCTION

Patents can provide important information about the current situation of a specific technology. With a patent landscape report, the patent situation of a technology within a given region is provided and analyzed.

In this report, the focus is on different technologies (renewable energy systems, energy storage systems) that are important for the sector integration. It includes several types of renewable energies and energy storage methods, alongside a few evolving technologies that might be of importance in the near future. A simple patent landscape analysis is conducted. The report starts with background information about both, the technological field, and patents in general. In the next section, information on why this patent landscape report has been done will be provided. The methodology part contains search strategy, data processing, analysis and methods used. Identified issues and limitations are also part of the methodology. After that, the main part of the report starts with the patent analysis of different technologies and a comparison of them. In the end, a conclusion will be drawn based on the findings of the previous sections.

2 BACKGROUND

a. TECHNOLOGICAL FIELD

There are many different types of renewable energy technologies. Some are already advanced and well-integrated, while others are still in the development and commercialization stage. All renewable energies rely on electricity or power generation through utilizing abundant natural systems. Advances are made to integrate more renewable energies in order to replace fossil-based energies progressively. Patent families of renewable energy systems covered in this report are related to solar photovoltaic and solar thermal energy, geothermal energy, and wind energy.

Furthermore, energy storage methods are central subjects of this report. Due to the mostly variable nature of renewable energy systems, there is a growing need for reliable and scalable energy storage systems. Storing the produced energy for when it is needed supports the transition towards green energy system. Patent families of energy storage systems covered in this report are related to aquifer thermal energy storage, Power-to-X and hydrogen, heat and seasonal storage, battery electric storage and evolving liquid air / cryogenic energy storage.

Renewable energy generation and storage of energy are important factors to enable further sector integration. Sector integration enables a more sustainable and efficient use, production, and consumption of energy. Different sectors need to develop a shared model and synergies for enabling sector integration. Generally, the technologies for sector integration already exist, however, the realization lacks among other things common operating models and support by governments and regulations. (Mäki et al.) Since these mentioned energy systems and energy storage systems are part of the sector integration, they have been chosen for patent analysis.

b. PATENTS

Patents are used to protect an invention, which is new, useful, and inventive. Getting an invention patented gives the inventor the exclusive commercial right. Other manufacturers can purchase a

license or manufacture this invention only with agreed terms by the inventor. Patenting an invention or idea protects it from being stolen and copied by others, therefore giving the inventor an advantage in the market. (Australian Government IP Australia.)

Patents are high priced when seeking a grant, especially if applying for multiple jurisdictions. However, patents indicated high interest in a specific topic since inventors and companies want to protect it. Patents contain a lot of information that usually cannot be found anywhere else publicly. Generally, it takes around 18 months for a patent application to be published after their filing or priority date. However, there are exceptions, and it varies depending on the patenting authority and jurisdiction. Some patent applications may never be published. (Trippe 2015.)

Patents can be collected in patent families. In this report, the focus is on simple families. Simple families can be described as a collection of patent documents related to a single invention with identical technical content. (European Patent Office.)

Additionally, patents can be classified according to the IPC classification codes. IPC stands for International Patent Classification. The scheme has different layers describing and classifying an invention. The classification codes and descriptions can be found through the link in the references. (Digital Science & Research Solutions 2022.) The IPC classifies patents according to their technical field and therefore delivers more information for companies and competitors in a specific field. This information is useful to follow developments and invention progress in the technical field. It is also important information for companies, because they can identify how competitive and patentable their own invention is, who potential competitors are and what the best decision is for their own invention according to market and patent activity. (Arsad et al. 2024.)

3 REASON FOR CONDUCTING PATENT RESEARCH

The patent research and patent landscape conducting are part of the work package 2 goals of the GENESIS project. The GENESIS project focuses on green energy systems and new sector integration value chain and develops a sustainable future for the energy sector with the help of a new, international level, energy technology research environment. The project is co funded by European Union and coordinated by Regional Council of Kymenlaakso. The overall goal of the project is to create new business, investments, and jobs in the Kymenlaakso region. Work package 2 consists of different sub-goals, which improve the understanding of sector integration opportunities and a patent analysis. With the help of patent research and analysis, trends in business and technology can be identified. The results can be helpful for the project goals related to sector integration.

Patent analysis has many advantages, which are important for the goals of work package 2. The benefits include the identification of market trends, technological advancements, and inventors in the competitive market. It also supports the discovery of future research fields and topics of interest. (Wali et al. 2024.) Investment opportunities and potential collaborations or partnerships can furthermore be recognized by knowing the top applicants in a field of technology. Updating and monitoring patent activity of a technological advancement can open new opportunities for improvements and innovation is an evolving field of interest. (Arsad et al. 2024.)

4 METHODOLOGY

a. SEARCH STRATEGY, DATA PROCESSING, ANALYSIS AND METHODS USED

The patent landscape analysis was conducted using data sourced from the free patent landscape tool “The Lens” by Cambia (The Lens). The Lens comprises a database with over 249 million documents and 142,5 million patent families from around 105 countries (Abu Sayem et al. 2023). With the help of tutorials, the different possibilities and functions of the tool were learned. The patent search was based on search terms related to the different technologies in question. The search terms had to be included in either the title, abstract or claims of the patent application documents in order to increase the relevancy of the patents related to the search terms. With advanced filter options the results were further refined. Filters applied were following: (1) document types: patent application, granted patents and limited patents; (2) legal status: active, granted, and pending patents, with a few exceptions were also discontinued patents were included; (3) simple families; (4) European jurisdiction.

For better comparison, trends in patent applications of European jurisdiction are compared to applications worldwide. In a few cases, classification codes are applied to further eliminate non-relevant patent results. The focus of this patent analyses was on the trend lines of patent applications over a time period, and the companies or applicants with the most patent application for European jurisdiction.

All figures have been created using the Lens patenting tool and the analysis was enabled by the Lens.

b. IDENTIFIED ISSUES AND LIMITATIONS

The first potential issue already lies in the patent application lifecycle. Depending on the jurisdiction, the patent documents are published at different lifecycle stages of the patent application. Some documents might never be publicly available since some jurisdictions only publish granted patents. If that patent will not be granted, it will not be published at all. (Trippe 2015.)

Further limitations come from the limited possibilities of using the free analysis tool. Despite refining and filtering the results, there is still a possibility that non-relevant patents are displayed in the results. Other possible inaccuracies could occur by typos in the patents, or use of similar words, which are not used in the search terms. However, the inaccuracy might not impact the trend line significantly. Furthermore, there is no relevancy ranking available, which could display the potential of a specific patent or patent application. A keyword-based search also incorporates the risk of including irrelevant document or exclude relevant documents with a too narrow keyword search. The results might lack some quality due to that limitation. In addition, the patent database determines the results and can thus patent analysis results can differ when using another database.

Additionally, companies might not patent all their innovations and developments related to a technology. The market value of an innovation or patent can also be misleading or inaccurate due to the strategic importance of patents for some companies. Results related to patent analysis therefore might not be the most accurate. (Karvonen et al. 2016.)

It can be difficult to differentiate components of larger technological systems, because they can belong to a wider range of different technologies (Shubbak 2019).

5 ANALYSIS

Solar photovoltaic and solar thermal energy systems

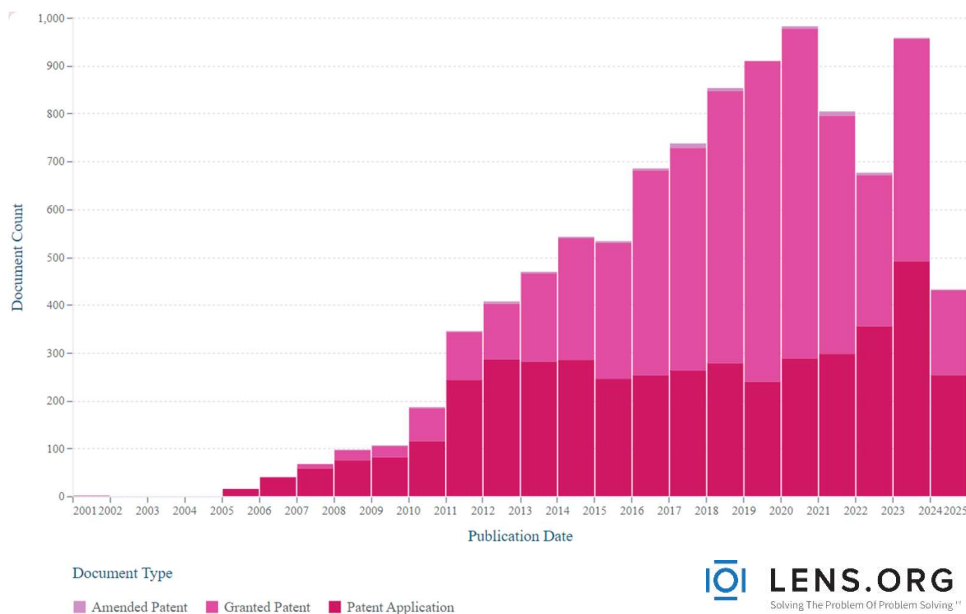


Figure 1: Solar photovoltaic and solar thermal energy systems patent document trendline for European jurisdiction

The patent analysis for solar photovoltaic and solar thermal energy systems shows a starting trend since 2005 for the European jurisdiction. Only a small number of patents have been recorded before 2005. The trend shows a growing number in patent applications, with a few exceptional declines in 2021 and 2022, which could be explained by aspects like the pandemic and economic uncertainty. Overall, the trend emphasizes the importance and far development of this technology, since there is a large and growing number of patent applications and granted patents.

LG Electronic INC and LG Chemical LTD based in South Korea were the applicants with the most applications for the European jurisdiction, followed by Huawei Digital Power Tech from in China. The market and patent documents therefore seem to be partially dominated by Asian companies.

Table 1 highlights the distribution of patent records according to their IPC classification codes. Most covered topics are related to semiconductors (IPC code H01L31), which shows a high number of inventions and research covering that technical field of photovoltaic systems and solar thermal energy systems.

Table 1: Distribution of patents in terms of key IPC classification groups

classification code	definition of code	number of patents
H01L31/18	Processes or apparatus specially adapted for the manufacture or treatment of these devices or of parts thereof	710
H02J3/38	Arrangements for parallely feeding a single network by two or more generators, converters or transformers	703
H01L31/0224	Electrodes	571
H01L31/042	PV models or arrays of single PV cells supporting structures for PV modules	435
H01L31/048	Encapsulation of modules	430

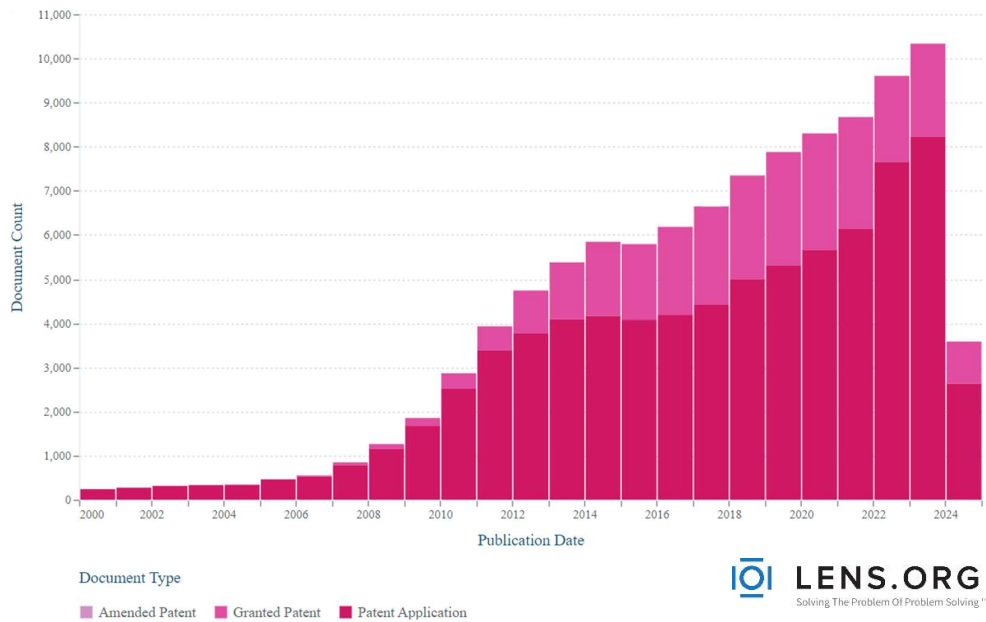


Figure 2: Solar photovoltaic and solar thermal energy systems patent document trendline worldwide documents

A similar trend shows the trend line of patent documents over time worldwide in Figure 2. The main difference to notice is that the application for patents started already in the late 1990s. However, the main growth started around the same time as in the European jurisdiction within the last 20 years. Furthermore, the total amount of patent applications is over 10 times more worldwide compared to the European jurisdiction.

Of the recorded patents for the European jurisdiction, 56% are granted patents, 44% patent applications and 0.4% amended patents. Meanwhile looking at the worldwide recorded patents, only 25% are granted patents and 75% are patent applications. This indicates a higher application activity worldwide with more innovative ideas regarding solar photovoltaic and solar thermal energy. However, it is important to note that the higher amount of applications does not mean that the quality and potential of those patents is better compared to patents for the European jurisdiction. At the same time, the high amount of granted patents in Europe show a large development in the field.

Literature implies a growing interest in solar photovoltaic combined with storage for residential applications. Nonetheless, combined storage solutions remain limited so far, but advances are being made. With the development of the technology, increased efficiency and governmental policies, the price for solar photovoltaic systems has decreased over the years. (REN21.)

Solar thermal technology has a wide range of application possibilities, which are quite far implemented and developed. Niche markets remain for solar thermal air conditioning and cooling. (REN21.)

Geothermal energy

In this patent analysis, geothermal power, heat, or energy generation have been analyzed. For both the European jurisdiction and worldwide, patent records start in 2005. The trendline in Figure 3 shows an exponentially growing trend. The comparable lower number of total patent records imply a less developed technology compared to the previously discussed solar photovoltaic and solar

thermal energy. One reason for that could be that the geothermal resources are less available worldwide and depend on geographic conditions and more complex systems. Nonetheless, 54% of recorded patent documents are granted patents, which shows innovative activity in the field.

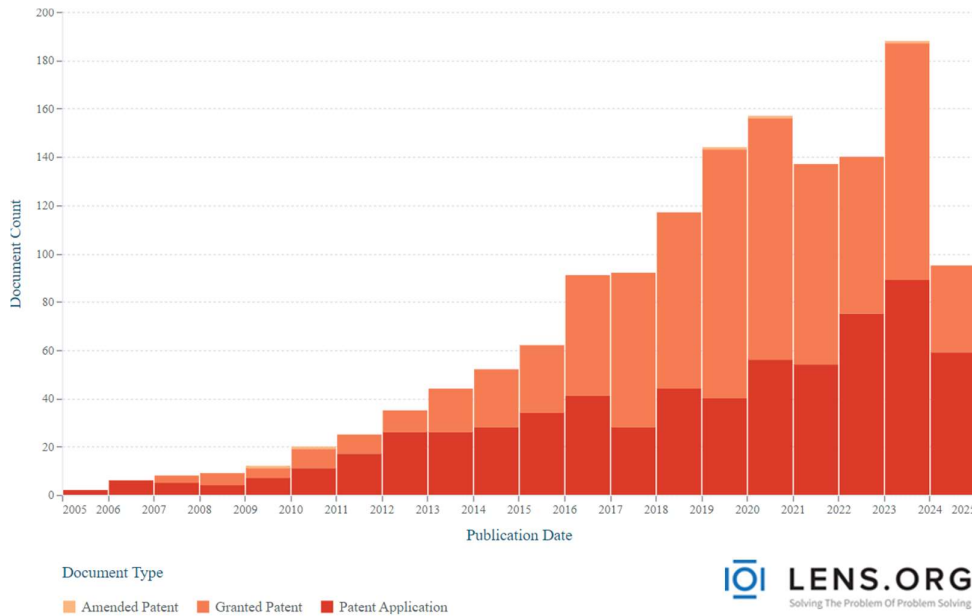


Figure 3: Geothermal energy patent document trendline for European jurisdiction

Companies with the most applications related to geothermal energy were from USA (Gen electric; Weatherford Tech Holdings LLC) and Japan (Kyocera Corp; AGC Inc).

Sector-specific challenges remain, which constrains the geothermal energy development. Those challenges are for example risk mitigation, resource risks, long project times and geothermal exploration risks. However, innovation and development in the technology continue. Research also focuses on enhanced geothermal systems, which aims on using low temperature geothermal energy and therefore make geothermal energy more geographically diverse and applicable. (REN21.)

Aquifer thermal energy storage

For this technology, only a few patent records could be found. The low amount of data however shows, an increase in patent records over the last 5 years. Due to the small amount (17) of patent records found, the trendline is difficult to evaluate. The increase in the past years could indicate a growing interest in the technology and development. Different sources indicate that aquifer thermal energy storage could be of importance in the future and a possible thermal energy storage solution. The low number of patent records could indicate an early development stage. It is also possible that aquifer thermal energy storage systems use patents and inventions of other technologies, which do not specifically mention the use for aforementioned systems. It is probably useful to observe the development within the next years to make better investment related decisions related to this technology and assess if the trend is rather growing or declining.

Power-to-X and hydrogen production

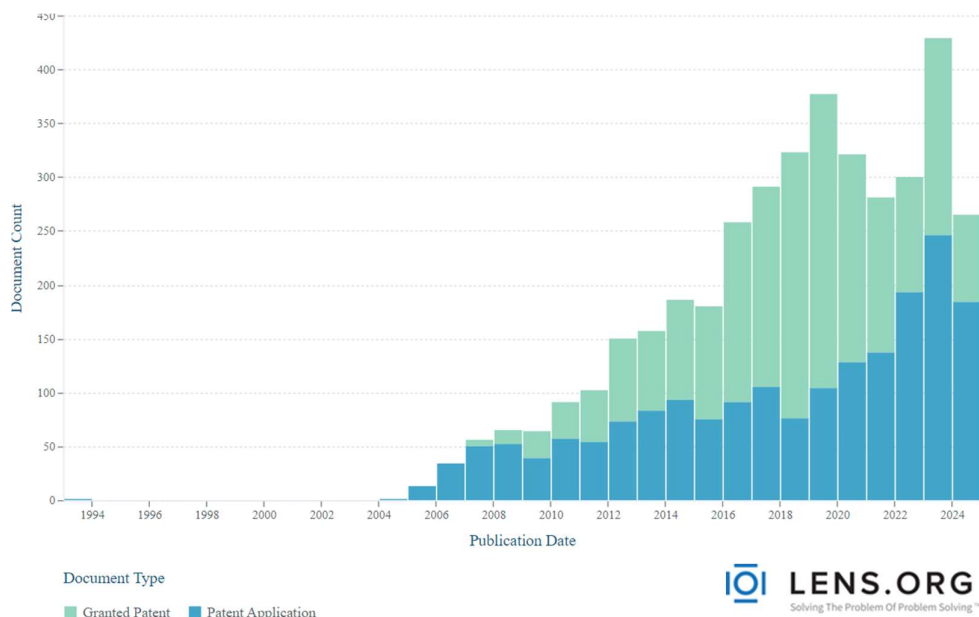


Figure 4: Power-to-X and hydrogen production patent document trendline for European jurisdiction

The trendline for European jurisdiction concerning hydrogen production and power-to-x shows a sudden increase of patent documents since 2005. A peak was reached in 2023, where so far most patent documents have been published. Despite a few years of decreased publishing activity, the trend overall is growing. Of the recorded patent documents, 52% are granted patents, while 48% are patent applications. Those aspects indicate a growing and continuing interest and development in the hydrogen sector and technology with promising innovations and developments in the field.

Table 2: Distribution of patents in terms of key IPC classification groups

classification code	definition of code	number of patents
C01B3/38	using catalysts	467
C25B1/04	by electrolysis of water	258
C01B3/48	followed by reaction of water vapor with carbon monoxide	226
H01M8/06	Combination of fuel cells with means for production of reactants or for treatment of residues regenerative fuel cells	217
H01M8/04	auxiliary arrangements, e.g., for control of pressure or for circulation of fluids	215

Table 2 shows the distribution of patents according to their IPC classification code. Technical fields with most patent documents are related to inorganic chemistry (IPC code C01), electrolytic or electrophoretic processes (IPC code C25) and processes or means for the direct conversion of chemical energy into electrical energy (IPC code H01M). Those results show the areas with most inventions regarding hydrogen technology and energy generation and conversion. A growing interest can especially be noticed in catalyst research for hydrogen production and therefore shows the importance for further research and development regarding the exploration of catalyst designs, materials, and synthesis methods.

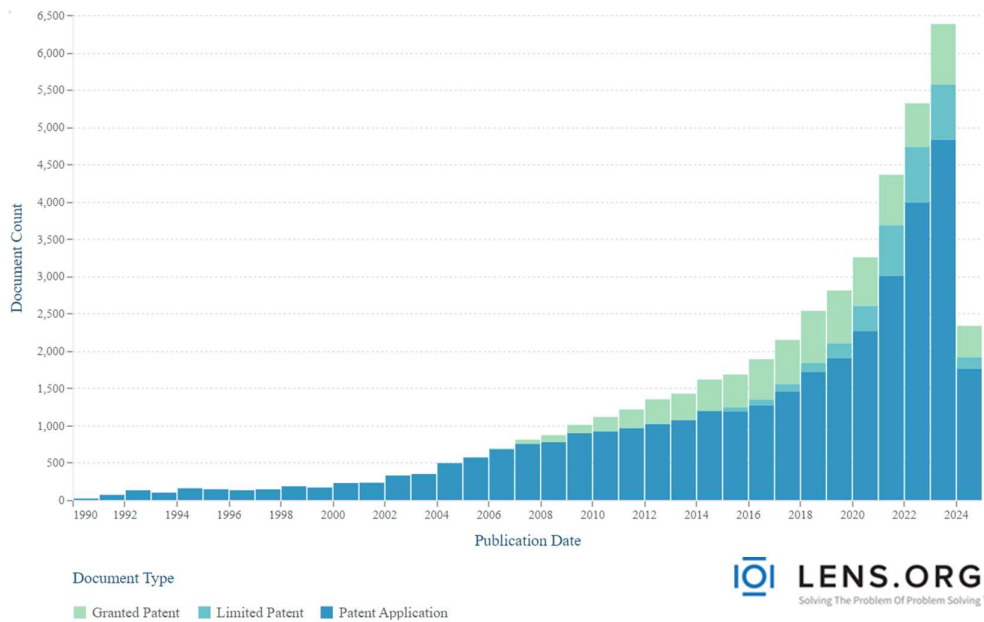


Figure 5: Power-to-X and hydrogen production patent document trendline worldwide

Figure 5 shows the trendline worldwide. Compared to the trendline for the European jurisdiction, the growth is more consistent. Nonetheless, both show a great interest and patent activity regarding hydrogen production and power-to-x. Worldwide, almost 11 times more patent documents have been published, which could indicate a rather universal technology which is not dependent on specific geographic features. 76% of the patent documents are patent applications, 17% are granted patents and 7% are limited patents. Especially the large number of patent applications in recent years shows that the research and development of innovative solutions is growing and supported.

Another aspect to notice is that for the European jurisdiction the publishing of patent documents only really starts after 2005, while in other jurisdiction it has already started in the 1990s.

The analysis of applicants with the most patent application for the European jurisdiction showed a dominance of Asian actors, however, there was also one European company (Air Liquide) based in France. According to the results, it is the applicant with the second most patent applications in Europe.

It is generally assumed, that hydrogen will play an important role in the transformation of the gas sector and the infrastructure's sustainability. One main advantage of hydrogen is the offered flexibility to the energy system. Electricity produced by renewable energies can be stored and transported, which enables access to more sectors for utilization. (Mäki et al.) The analysis shows a significant development in hydrogen technology and suggest a continuously growing trend in applications and innovation.

Energy storage methods

Seasonal energy and heat storage

The patenting activity regarding seasonal energy and heat storage in the European jurisdiction in Figure 6 is not as consistent as other previously discussed technologies. Even though the overall trend is growing, the activity fluctuates and shows several declines and inclines over time. Peak

activity has been reached in 2023. The first patent records are from 2005. 54% of the patent documents recorded for European jurisdiction are granted patents, 46% are patent applications.

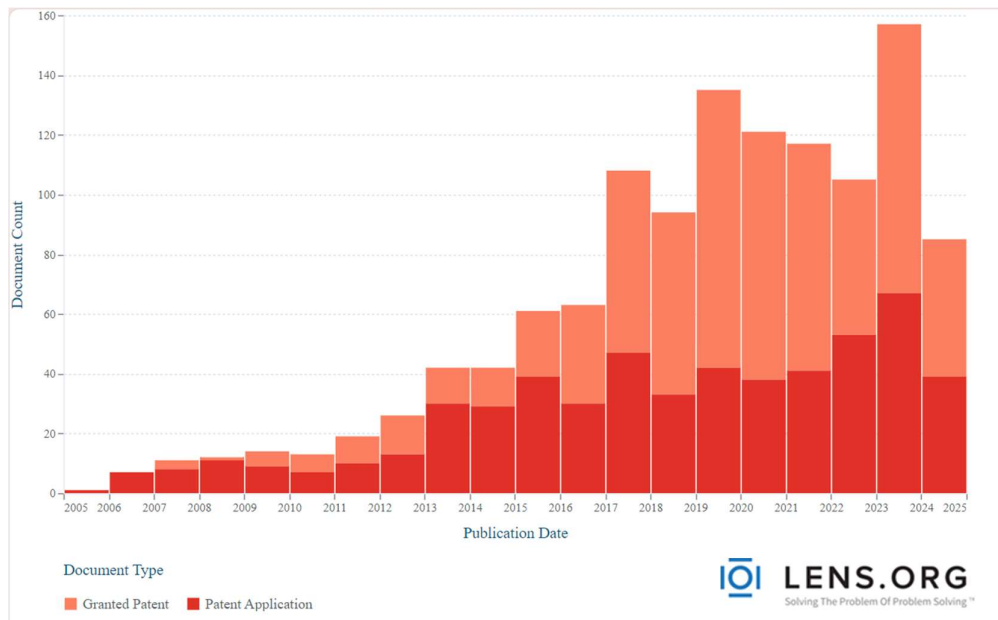


Figure 6: Seasonal energy and heat storage patent document trendline for European jurisdiction

Comparing the European trendline to the worldwide trend in Figure 7, highlights large differences. The worldwide patent trend reflects a consistent growth in patent documents with the first records from 1990. One of the only decreases in patent activity was in 2023, which could be an early indicator of an overall decreasing trend or technological constraints and challenges in the development and research. Even though worldwide 13 times more patent documents compared to European jurisdiction have been found, only 8% of them are granted patents, and 22% limited patents. The vast majority are patent applications.

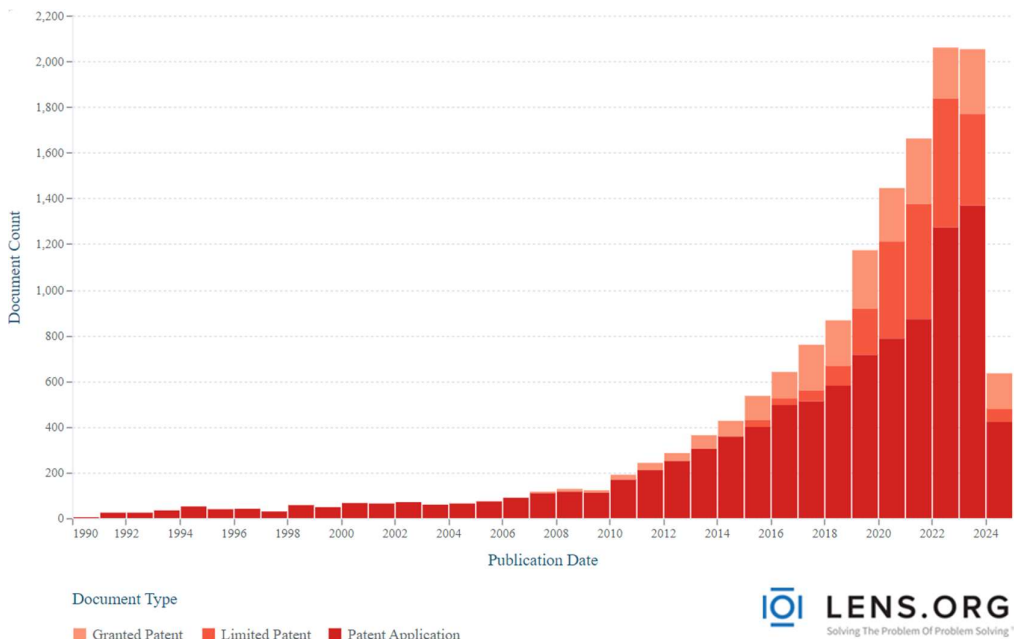


Figure 7: Seasonal energy and heat storage patent document trendline worldwide

Among the top applicants of patents in the European jurisdiction are companies from Japan (Mitsubishi Electric Corp.; Panasonic Corp.), Germany (Siemens AG) and France (Commissariat Energie Atomique). Nonetheless, due to the relatively low numbers of patent applications for each applicant, a clear leader in the field cannot be identified.

Table 3 shows the distribution of patents according to their IPC classification group. Topics of interest according to patenting activity are related to heat exchange (IPC code F28) and heating range and ventilation (IPC code F24). Concluding, especially heat exchange using different techniques and storage of heat is of high importance and interest for current research and development in the field.

Table 3: Distribution of patents in terms of key IPC classification groups

classification code	definition of code	number of patents
F28D20/00	Heat storage plants or apparatus in general, Regenerative heat-exchange apparatus not covered by groups	359
F28D20/02	using latent heat	248
C09K5/06	the change of state being from liquid to solid or vice-versa	122
F24F5/00	air-conditioning systems or apparatus not covered by group	61
F28D21/00	heat-exchange apparatus not covered by any group	27

When including “long-term” to the patent search of seasonal energy and heat storage, only a bit more than 400 patent documents could be found. Despite the low amount of patents, a rise in research has been noted since 2022. Observing the development regarding long-term heat and seasonal energy storage could indicate early developments and advancements in that field of interest. Looking at the patents according to their citation number, it is interesting to see a quite high number of citations (top 5 most cited patents with citation rate between 60 and 120). The citation of patents can be an indicator of their significance for future developments and indicate early progress for a technology (Wali et al. 2024).

Battery electric energy storage

An interesting trend can be seen at the analysis of battery electric energy storage. The trendline for the European jurisdiction in Figure 8 is almost identical to the one worldwide. The main difference between those two is the amount of patents, which is around 4 times higher worldwide. Additionally, almost the same percentage can be identified for the patent applications (67% for European jurisdiction, 66% for worldwide) and granted patents (33% for European jurisdiction, 34% worldwide with combined granted patents and limited patents). Compared to other technologies discussed in this report, the similarities are exceptional. This could indicate a predominantly high importance of batteries for the region of Europe and therefore a very similar trend with other jurisdictions.

Another interesting aspect of the trendline is the high amount of patent record in a short time. This underlines the high importance and interest of Europe and other jurisdiction in battery technology and a quick advancement and development in that field.

The top applicants are all based in Asian countries, especially in South Korea and China, which indicates worldwide market dominance regarding new inventions regarding battery electric energy storage from these areas.

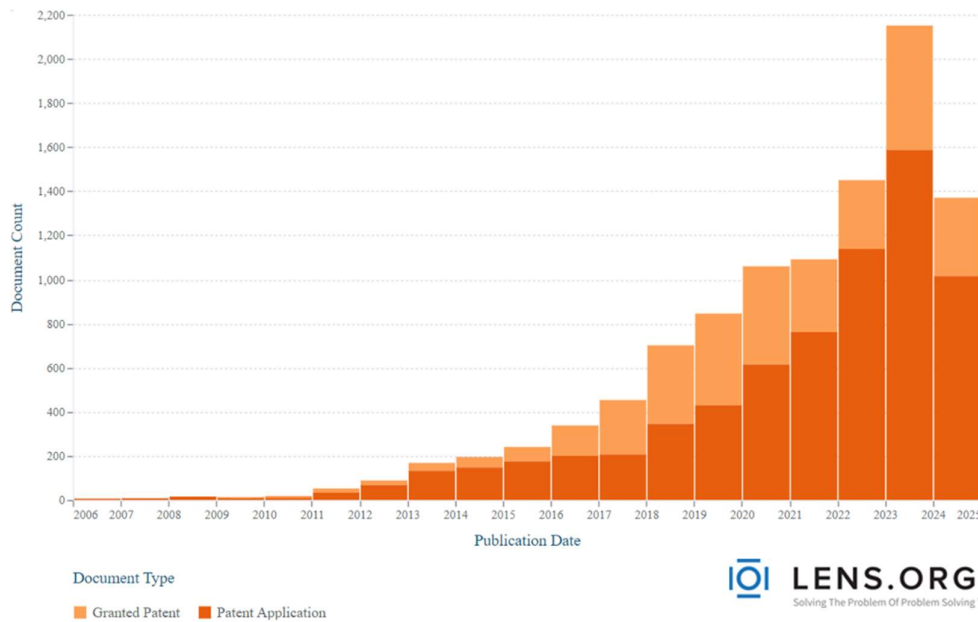


Figure 8: Battery electric energy storage patent document trendline for European jurisdiction

Looking at the distribution of patents according to their IPC classification groups in table 4, it becomes clear that especially the technological field around Lithium batteries is of high interest for inventions and improvements. Research focus lies on materials and methods regarding electrodes (IPC code H01M4), and secondary cells and manufacture thereof (IPC code H01M10). Both topics are part of the group concerning processes or means to convert chemical energy into electrical energy (IPC code H01M).

Battery energy storage systems have several advantages over other storage methods. Those advantages include scalability, quick response time and flexibility, while being a potential storage system for sustainably produced electricity. Due to several benefits of Lithium-ion batteries over other energy storage systems, Lithium-ion battery energy storage is anticipated to stay relevant as grid-scale stationary energy storage technology. (Wali et al. 2024.)

Table 4: Distribution of patents in terms of key IPC classification groups

classification code	definition of code	number of patents
H01M10/052	Li-accumulators	2.520
H01M10/0525	Rocking-chair batteries, i.e. batteries with lithium insertion or intercalation in both electrodes Lithium-ion batteries	1.709
H01M4/62	Selection of inactive substances as ingredients for active masses, e.g. binders, fillers	1.601
H01M4/36	Selection of substances as active materials, active masses, active liquids	1.561
H01M10/42	Methods or arrangements for servicing or maintenance of secondary cells or secondary half-cells takes precedence	1.441

Liquid air /cryogenic energy storage

One new energy storage solution could be the liquid air or cryogenic energy storage. Since it is an upcoming but not fully developed technology, patent research has only been conducted for worldwide patent documents. 196 patent families worldwide could be identified, of which 71% are patent applications, 19% granted patents and 10% limited patents. Currently, there is a high dominance of patent application from two actors: Highview Enterprises LTD based in the United Kingdom, and the Technical Institute of Physics and Chemistry CAS from China.

Since it is a new and evolving technology, not many conclusions can be drawn at this time, however, the technology has been mentioned in literature to have potential as a future energy storage solution. Therefore, the patent activity regarding cryogenic energy storage should be monitored.

Wind energy

Patent documents regarding wind energy are high in numbers, which shows a far developed technology. However, the trend has been fluctuating relatively much over the past years in both the European jurisdiction, but also to some extent worldwide. The growth has been either slow or declining in many years and therefore does not show a consistent growth. This can be seen and compared to in Figures 9 and 10. The growth is not consistent, which could indicate challenges regarding the technology, but also subventions and governmental policies could have an impact on that. For the European jurisdiction, the amount of granted patents has been growing mostly since 2011. 57% of all documented applications were patent applications, while 43% were granted patents.

Top applicants were mostly from local European-based countries like Denmark, Spain, and Germany, but also from the USA. The dominance of European countries for the European jurisdiction patent documents shows a high importance and support for local actors and inventions for the European market.

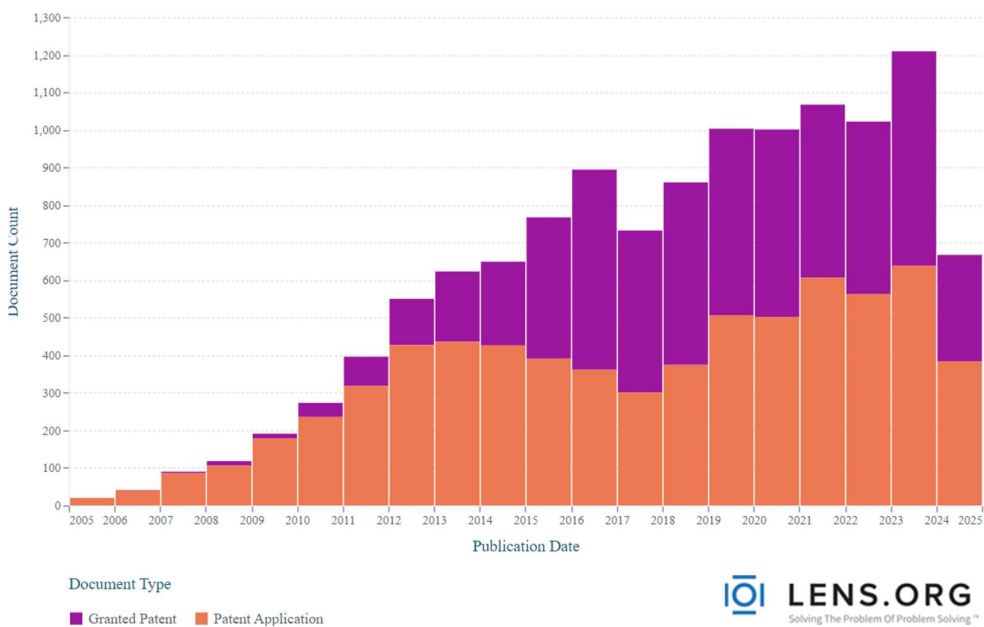


Figure 9: Wind energy patent document trendline for European jurisdiction

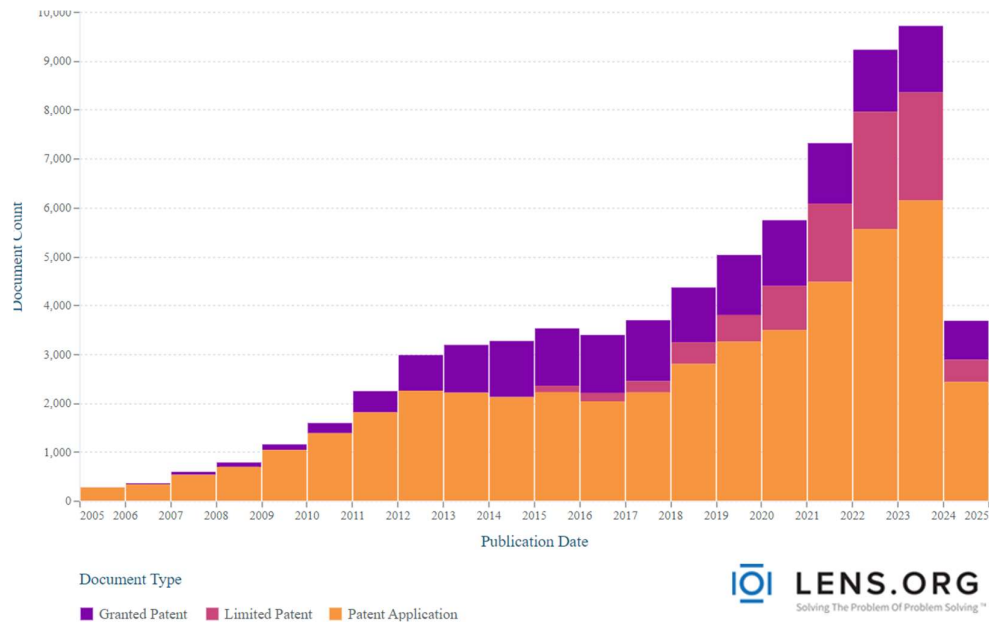


Figure 10: Wind energy patent document trendline worldwide

Worldwide 6 times more patent documents can be found. Of those, only 21% are granted patents, 12% limited patents and the vast majority of 67% are patent applications. The trendline shows less inconsistent growth compared to the European jurisdiction only, however, the graph shows very slow growth between 2011 and 2017, before a faster growth pattern starts. Peak amount of patent documents was in 2023.

Looking at the distribution of patent documents according to their IPC classification group shows, that especially the wind motors (IPC code F03D) and rotors, but also the automatic control regulation has been of most interest for inventions and development.

Table 5: Distribution of patents in terms of key IPC classification groups

classification code	definition of code	number of patents
F03D7/02	the wind motors having rotation axis substantially parallel to the air flow entering the rotor	2.966
F03D1/06	rotors	2.596
F03D7/04	automatic control regulation	1.554
F03D17/00	Monitoring or testing of wind motors, e.g. diagnostics testing during commissioning of wind motors	934
F03D1/00	Wind motors with rotation axis substantially parallel to the air flow entering the rotor controlling thereof	922

Literature indicates that wind energy is the most competitive renewable energy technology and adds large amount of energy generation capacity to the grid. Offshore wind energy is therefore very interesting. To drive costs down, the large increase in turbine scale has been in the focus for technological development. New innovative technologies are also emerging, especially focused on how to integrate energy storage to the wind energy generation. A few examples of emerging technologies are turbines which directly produce hydrogen for storage, turbines with integrated batteries or pumped storage, and wind-to-heat energy storage systems. (REN21.)

Small-scale wind energy

Small-scale wind energy has gained some interest in recent years, however there is only very little amount of patent records available, especially compared to wind energy. The low amount of patents can have many reasons. Small-scale wind energy is an evolving technology, but also the search with key words limits inventions down to patent records, which specifically contain the term “small-scale” in the title, claims or abstract of an application. Depending on the small-scale wind energy system, it can be a similar technology with similar technologies than for larger applications, but not specifically called like that. Therefore, it is assumed that many patent documents suitable for small-scale wind energy technology can be found from the wind energy technology search, and the present analysis can be prone to inaccuracies. Additionally, main focus has been on the upscaling of turbine size to drive costs down, rather than inventing new small-scale wind energy systems. The costs and return of investment of small-scale wind energy systems is one of the main challenges for a growing adoption and commercialization of them.

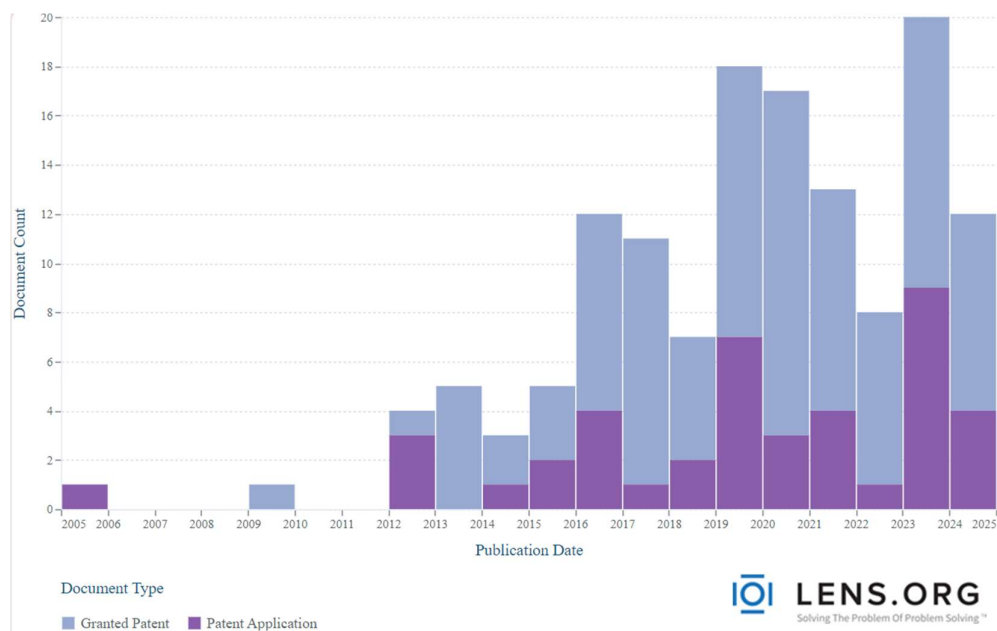


Figure 11: Small-scale wind energy patent document trendline for European jurisdiction

The graph in Figure 11 shows an interesting trend of rise and decrease in patent activity. Overall, the trend seems to be growing, but in an very inconsistent way. It however can still be seen that the topic has gained more interest since 2016. The graph furthermore reflects a high amount of granted patents with 70% of all recorded patent documents within the European jurisdiction. The top applicants were similarly to the previous discussed section mostly based in Europe, with Denmark, Germany, Switzerland, and the UK being top applicants, followed by the USA.

6 DISCUSSION AND CONCLUSION

Comparing the different renewable energy technologies discussed, most patent documents were found for wind and solar energy technologies. Those technologies are the most developed and well-established in the market.

The most significant growth could be seen for hydrogen technology, which indicates a great importance and development of this technology and a focus of innovative activity. Similarly, a large increase in patents can be seen for battery electric energy storage. Electrification, energy storage and hydrogen are identified trends of current patenting activities.

More difficult is the situation regarding seasonal energy and heat storage. While the trend is continuously growing worldwide, for the European jurisdiction the trend fluctuates a lot. The differences could indicate an overall interest for inventions, but larger technological challenges and other constraints could slow down development and progress.

Geothermal energy reflects an early-stage technology, with growing interest in the field, but also challenges. It shows a relatively low patent record count and therefore should be monitored to identify how the trend continues in the future.

For evolving technologies, the low patent count allows for little conclusions. It is therefore recommended to further monitor activity regarding aquifer thermal energy storage and cryogenic energy storage in the future, however, they do not have much relevance at current stage.

Major applicants and technology producers are concentrated on a few countries, especially China, Japan, South Korea, USA and Germany. The most important actors or countries in patenting activity however differ from the technology type. While for example for battery electric energy storage the main applicants are all from Asian countries, the wind energy patents are dominated by European applicants, both considered for the European jurisdiction.

Patenting potential of a country is dependent on several factors, such as population size, development status and economic growth. This leads to differences in patenting actors and explains why there is a few countries predominantly present in patenting activity. (Baumann et al. 2021.)

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