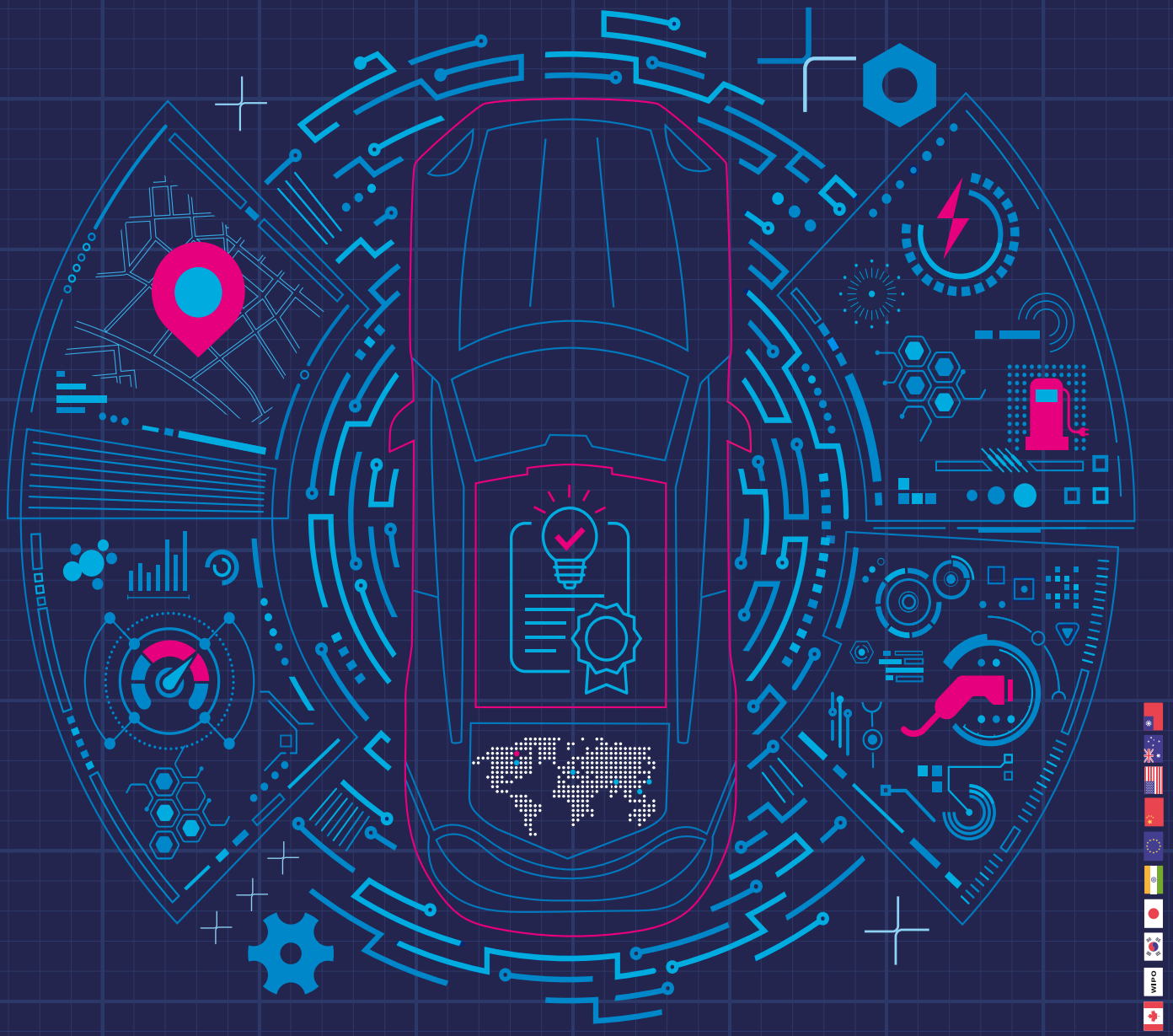
SNAPSHOT REPORT

Automotive Patents



Intellectual Property Ontario

CONTENTS

Intellectual Property Ontario

Note: The number of patent applications filed in 2021 and 2022 may increase as patent applications have an 18 month delay and therefore this data may not have been captured at the time of research.

Intellectual Property Ontario

PATENT LANDSCAPE REPORT: AUTOMOTIVE TECHNOLOGIES

What is a patent landscape report?

In simple terms, a patent landscape report provides an overview of patent rights for a specific technology in a selected country, region, or globally. For this report, the focus is upon patents within the global automotive sector. Since patent applications are publicly disclosed 18 months after filing, the content of this report is based on a search of public databases maintained by intellectual property (IP) offices around the world. Due to a correlation between patents and economic indicators, patent landscape reports can disclose patent filing trends that reveal important information, such as filing strategies, sector competitors, economic opportunities, as well as potential risks in the given sector.

What is the value?

In business terms, the patent landscape report is essentially a competitive analysis, serving to identify key players in what may be a competitive landscape. The information revealed serves to inform decision makers and may factor into the IP and business strategies of a company. A greater awareness of important markets and competitors in the sector enhances the ability to enact commercialization strategies to drive value into the company.

How can I use this information?

Innovator and policy makers — Patent landscape reports are tremendously valuable to small-to-medium size enterprises (SMEs). The reports may enable SMEs to make refinements to their IP and business strategies to ensure the company's R&D and commercialization efforts remain relevant to the industry sector. Analytics based on the report permits for informed strategic decisions, especially when it comes to investment in IP. The alignment of investment dollars to areas of high growth potential increases downstream commercialization opportunities, therein driving economic growth for the company, for Ontario, and Canada as a whole.

SCOPE & OBJECTIVE OF THIS REPORT

- This report provides a snapshot of the global patent landscape for the automotive sector, with a particular focus on **autonomous vehicles, electric vehicles, vehicle connectivity, automotive manufacturing** and **shared mobility.**

- This report is a condensed overview of a much larger study prepared for Intellectual Property Ontario (IPON) by UnitedLex—a third party data services provider that focuses on legal and IP data and research. The larger study is an important tool used by IPON's IP analysts to provide tailored patent landscape reports specific to a clients' area of specialty.

- The objective of this report is to identify opportunities for Canadian businesses in the automotive sector by analyzing the current state of patenting activities, potential technology gaps, and to provide actionable recommendations that companies can adopt in developing their IP strategy.

- Around 300,000 active patents were identified including granted, pending and utility models in the preparation of this report. All have been analyzed and segmented into the automotive subcategories noted above.

- The methodology employed in this report involved the categorization of patents into multiple technology segments and the extraction of valuable insights from the patent datasets.

EXECUTIVE SUMMARY

Expanded Dataset Total Patents
~300k

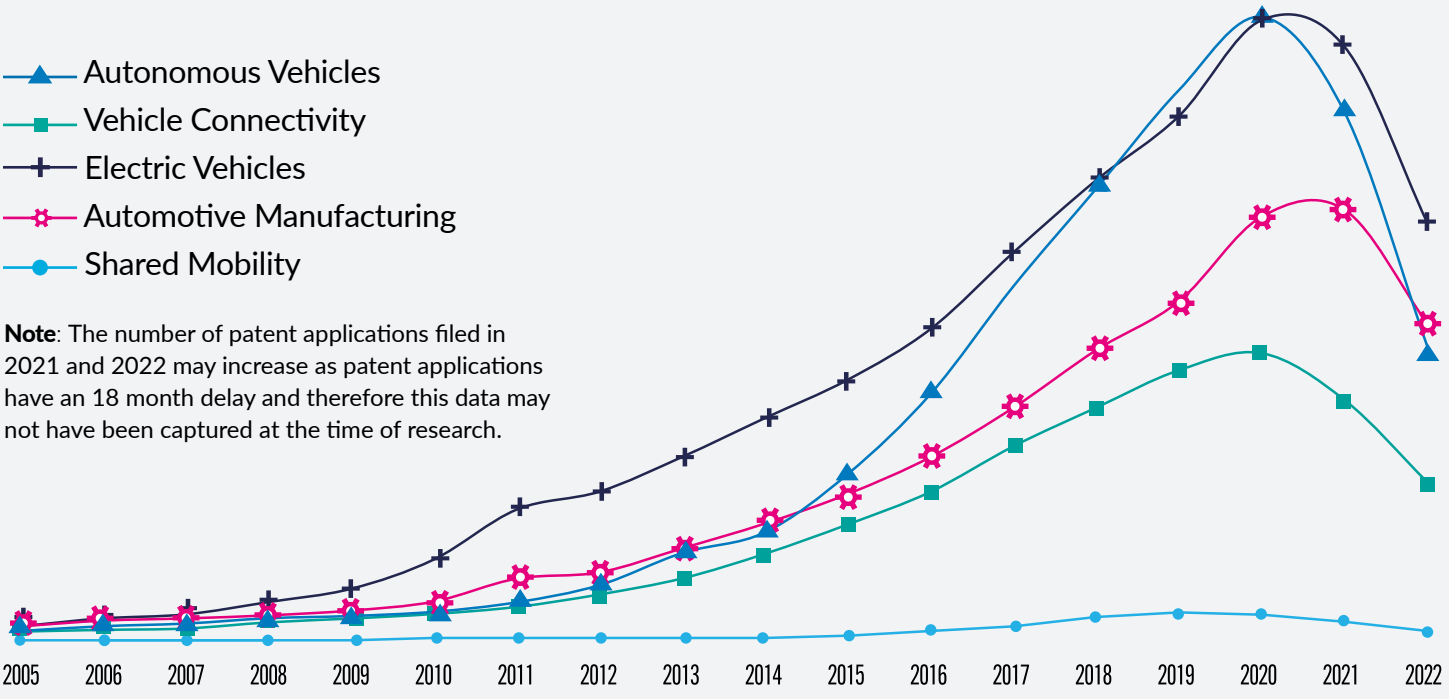
Patent Families (INPADOC)
~200k

Pending Applications
~160k

Granted Patents
~125k

- With growing investment in self-driving cars and electric transportation, the automotive industry has been active since 2010 in terms of patent filings. There has been an exponential increase in patents especially in the fields of **autonomous vehicles and electric vehicles since 2015.** This indicates that numerous players are exploring and investing in this sector.

- In Canada, patent filings are concentrated in the fields of **autonomous vehicles and electric vehicles,** indicating that Canadian companies in the automotive sector primarily focus on these specific domains.



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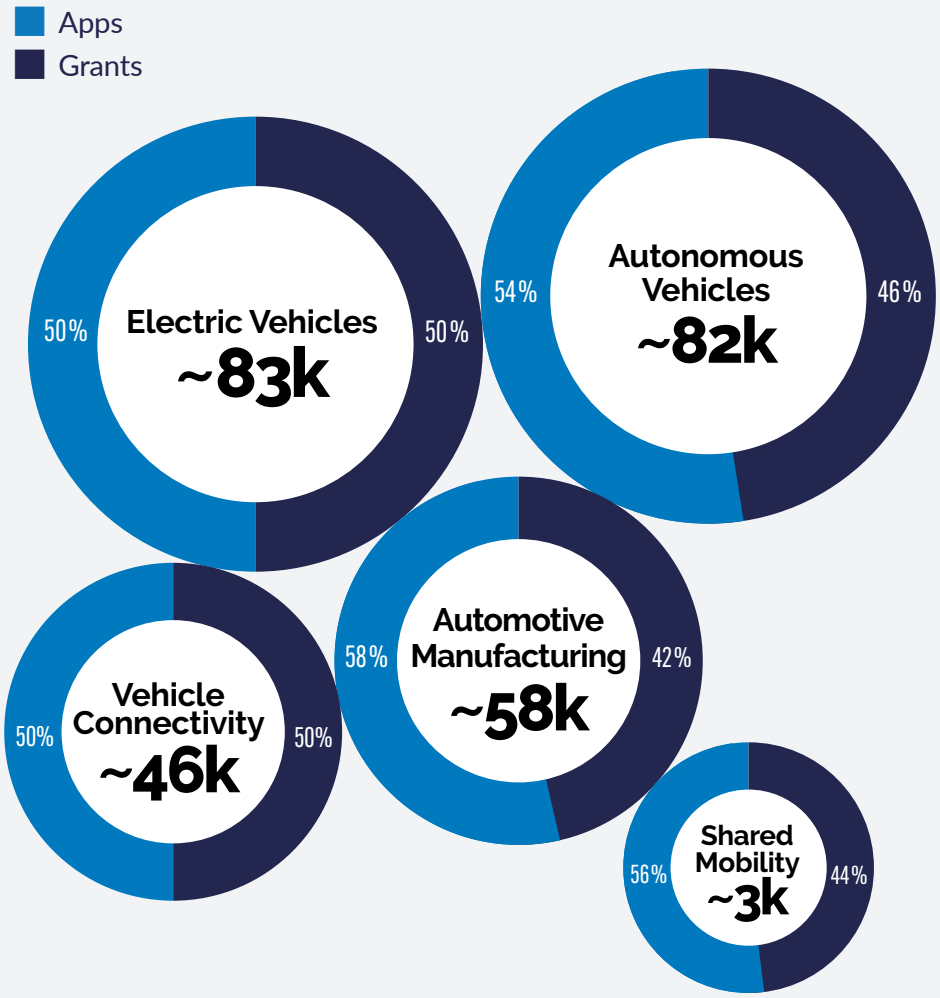
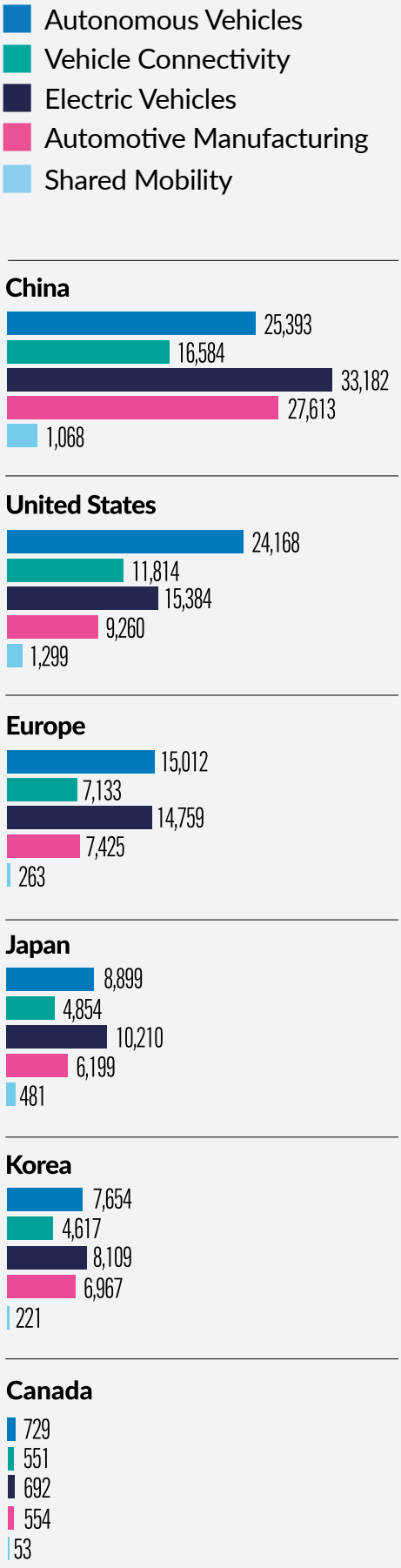
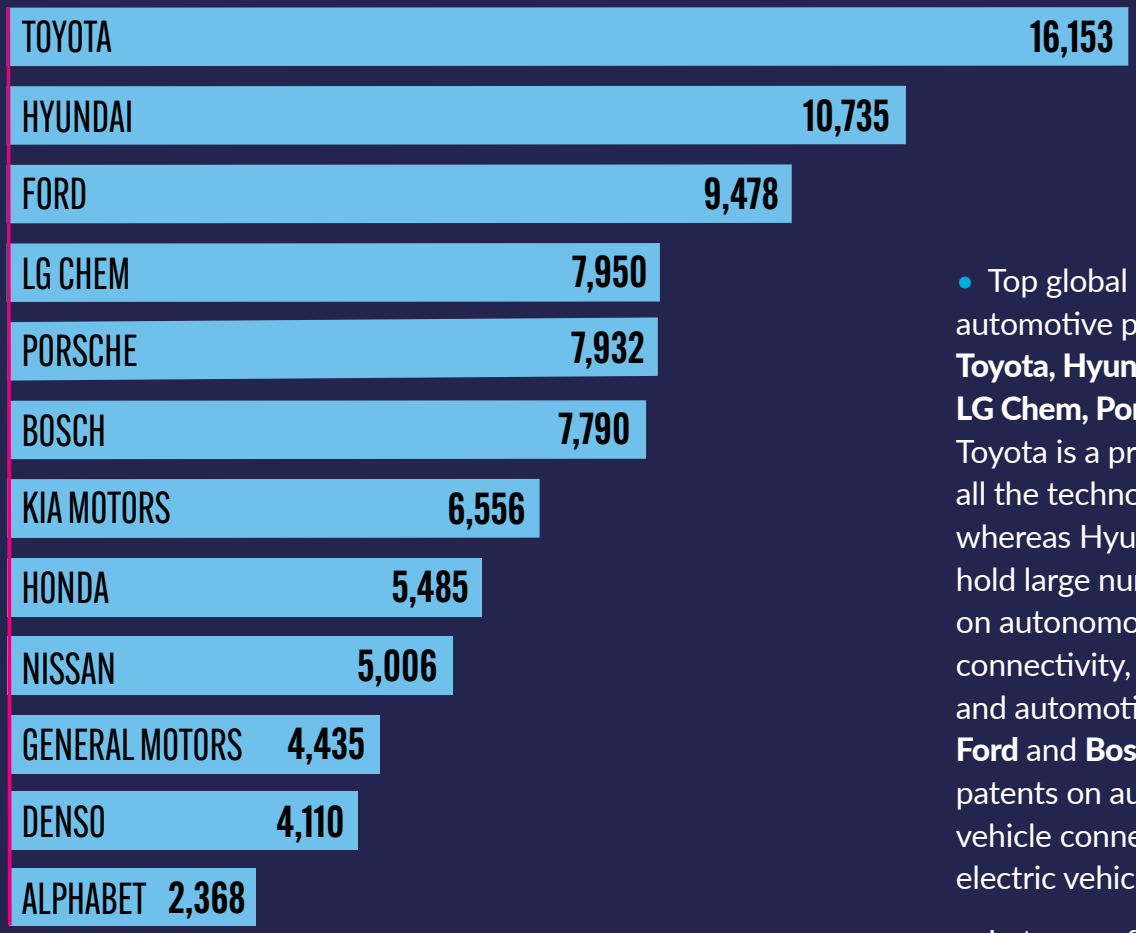




- Ontario-based assignees are mostly exploring vehicle connectivity and electric vehicle domains. However, Ontario is significantly lagging behind other developed regions, as evidenced by the fact that automotive patent filings account for only 0.3% of global filings despite being a highly developed province with significant opportunities in the automotive space.

- China is the top jurisdiction with the largest number of patents in the automotive sector followed by the US and Europe. Chinese companies such as **Baidu, Huawei, Byd Co.** and **CATL** hold numerous patents in various automotive technology segments.



- Top global players for automotive patents include **Toyota, Hyundai, Ford, LG Chem, Porsche** and **Bosch.** Toyota is a prolific player in all the technology segments whereas Hyundai and Porsche hold large numbers of patents on autonomous vehicles, vehicle connectivity, electric vehicles, and automotive manufacturing. **Ford** and **Bosch** actively filed patents on autonomous vehicles, vehicle connectivity and electric vehicles.

- In terms of granted patents, **Toyota** emerges as the top patent holder, followed by **Hyundai, LG Chem, Ford** and **Nissan.**

- Automotive component manufacturer **LG Chem** holds a significant number of patents in the field of automotive batteries.

- Approximately **30% of total patent filings are held by the top 10 players**, with a primary emphasis on the fields of autonomous vehicles and electric vehicles.

- Canadian patent filings account for ~0.9% of global filings, with **Magna International, Geotab, Blackberry,** and **Leddartech** representing the key Canadian players contributing to patent filings.

- Canada's automotive industry is primarily located in Ontario and Quebec, with Windsor, Ontario, claiming the title of Canada's automotive capital. Ontario based assignees in the automotive sector collectively hold around 1,000 patents filed, constituting a 0.3% share of the total patents. Notable players in Ontario's automotive sector include **Magna International, Geotab, Blackberry** and **University of Toronto**.

Top players in Canada's Automotive Sector

BlackBerry

CLEARPATH ROBOTICS™

GEOTAB

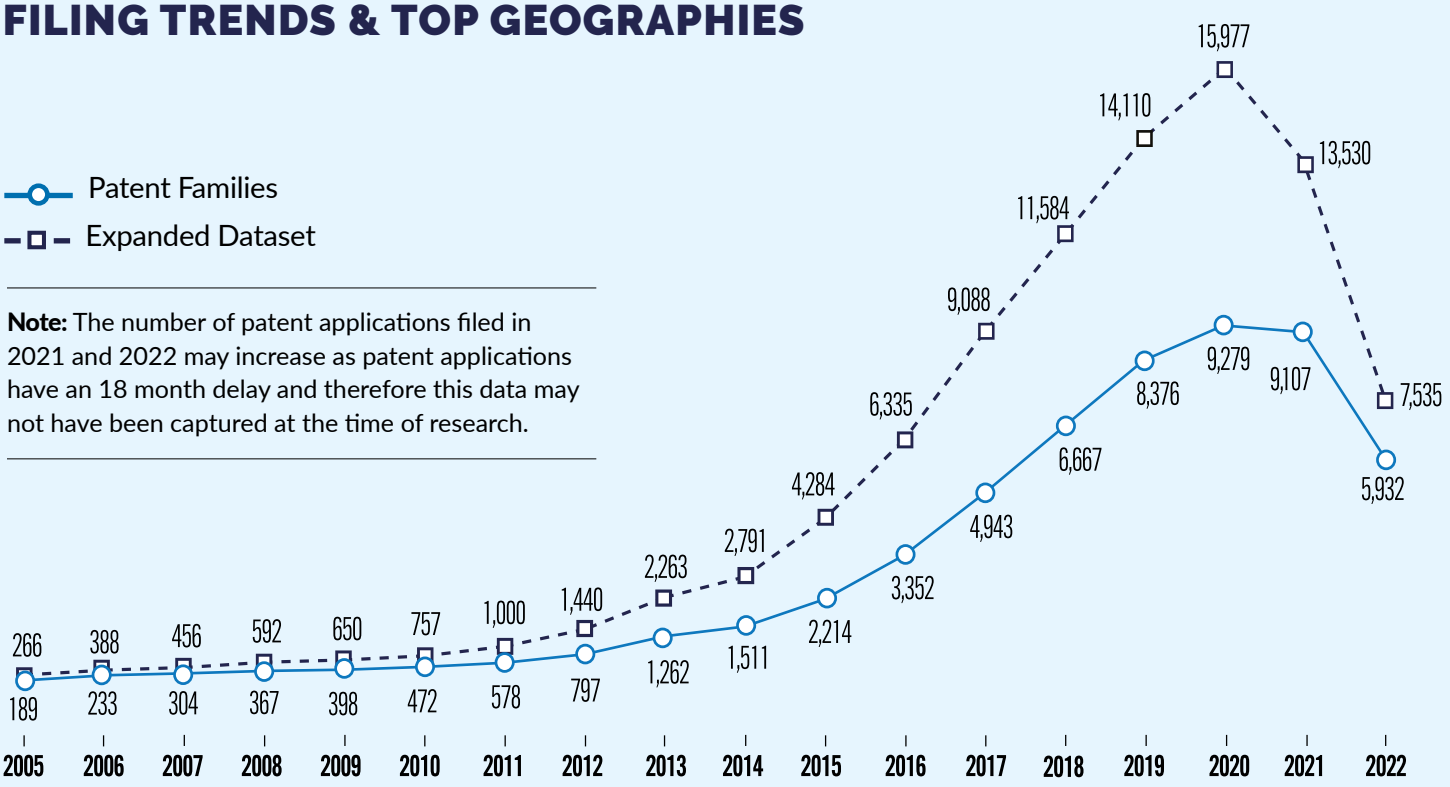
LeddarTech

MAGNA

UNIVERSITY OF TORONTO

(AV)

FILING TRENDS & TOP GEOGRAPHIES



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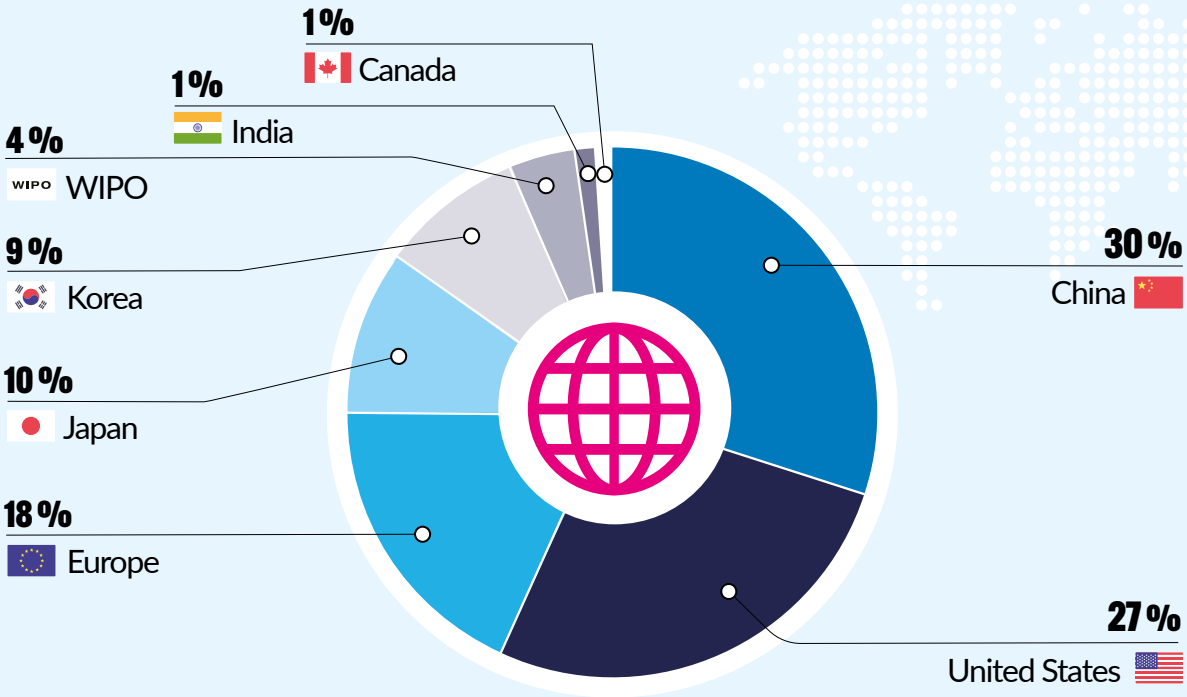


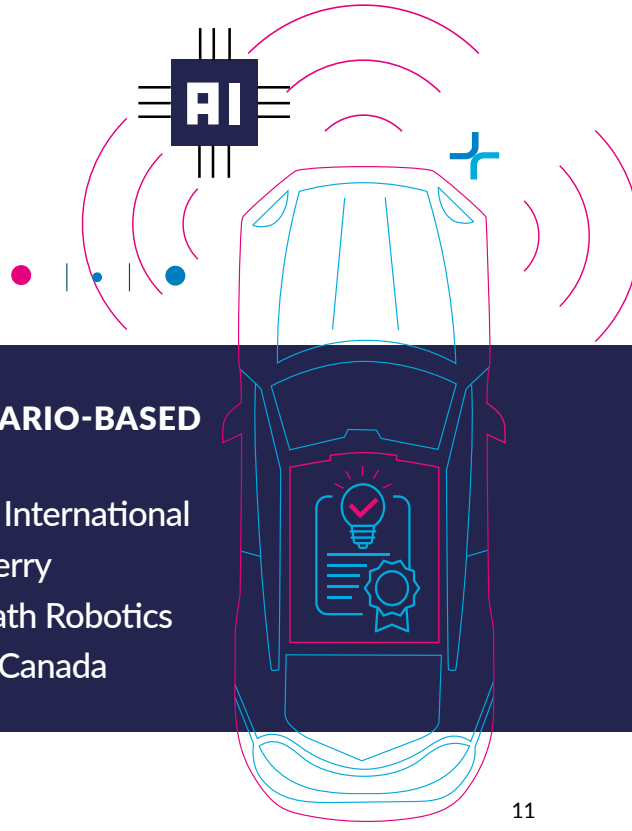
AUTONOMOUS VEHICLES (AV)

FILING TRENDS & TOP GEOGRAPHIES

- Patent filings increased from 2014 to 2020, demonstrating significant expansion of the automotive sector and stressing its importance as a critical area for ongoing technological advancements. There has been a significant increase in patent filings in numerous sub-technologies in areas of AV like collision avoidance systems, AI algorithms, and automated vehicle parking. Patent filings in the US and China are increasing at an exponential rate with a maximum number of filings in 2020.

- Among all countries, China has the most AV patents and holds approximately 30% of the total patent set. Patent filings in China have increased over the years with an exponential growth rate compared to other countries. The top patent sub-category among all countries is object or collision avoidance systems. The second sub-category with the most patents in China, Europe and Japan is vehicle parking.

- Chinese Internet giant Baidu has filed numerous patents in AV with a particular focus on object or collision avoidance systems and AI and machine learning based processing. Close to 50% of total patents filed by Baidu are in China. A significant presence of Chinese players is clearly noticed in the patenting activity of autonomous vehicles companies. Some of them include Zhejiang Geely Holding Group, CDGM Glass, Huawei, Dongfeng Motor Corp, China Faw Co., and Shanghai Automotive Industry Corporation.



TOP CANADIAN PLAYERS

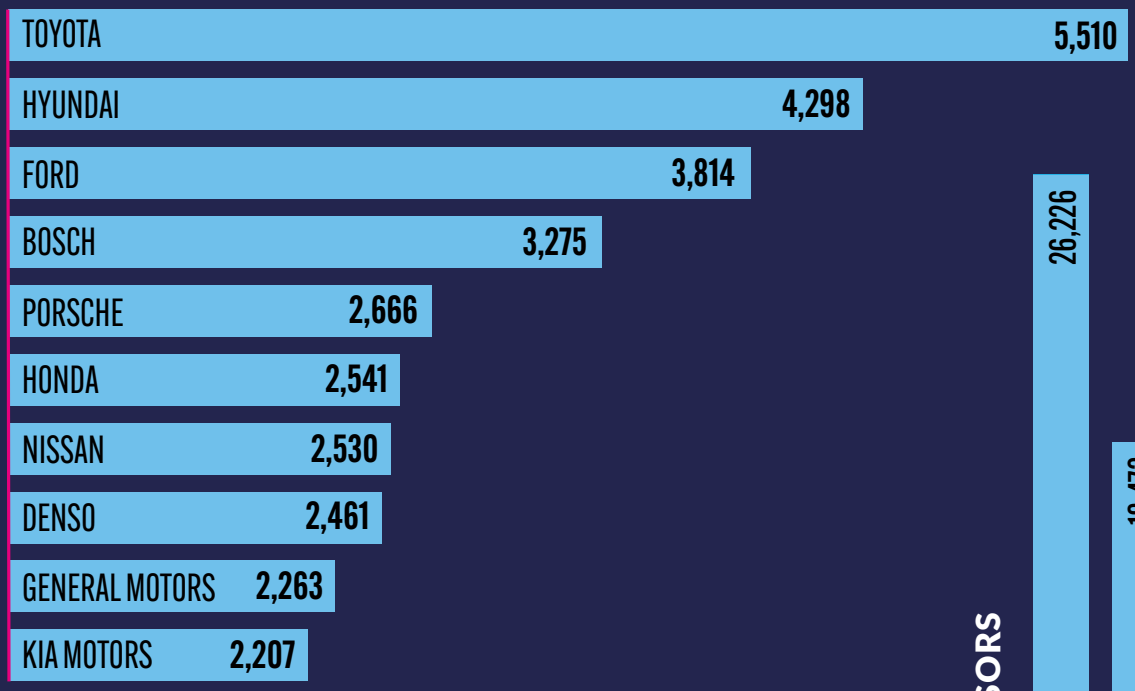
- LeddarTech
- Blackberry
- ClearPath Robotics

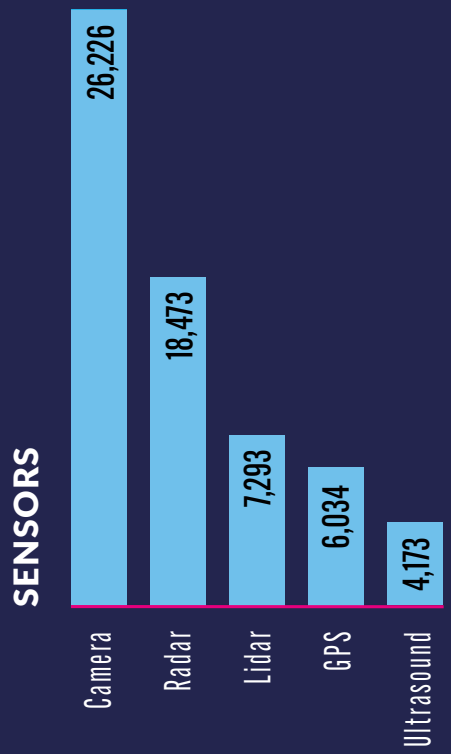
TOP ONTARIO-BASED PLAYERS

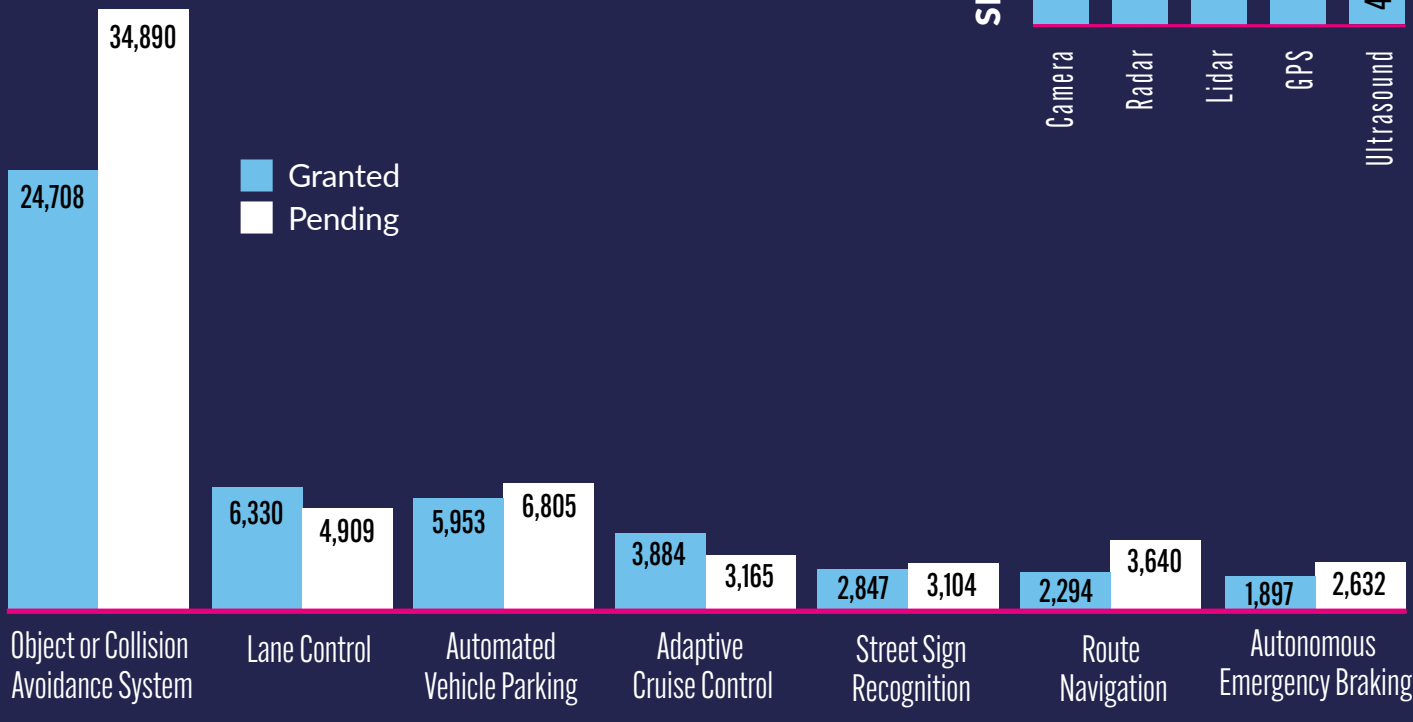
- Magna International
- Blackberry
- Clearpath Robotics
- Thales Canada

(AV)

KEY PLAYERS & TECHNOLOGY SEGMENTS







AUTONOMOUS VEHICLES (AV)

KEY PLAYERS & TECHNOLOGY SEGMENTS

- Most of the AV patents are filed in the categories of object or collision avoidance system technologies, image sensors and radar. Key players in the field of Object or Collision Avoidance systems include Toyota, Ford, Alphabet, General Motors, and Bosch. Other players who have filed a considerable number of patents in last 5 years are Baidu, Alphabet, Aptiv, Intel, BMW, Hitachi and Amazon.

- Toyota and Hyundai have been filing patents in all segments of autonomous driving indicating their intent to protect areas of various self-driving features. Ford and Porsche's patent focus are on object or collision avoidance systems and automated vehicle parking, while Honda owns more patents in the lane control and adaptive cruise control domain. Bosch focuses more on automated vehicle parking and lane control.

- Approximately 2,000 patents describe the use of AI and machine learning in object or collision avoidance systems, with top players in this subcategory being Ford, Baidu, Bosch, Aptiv, Alphabet, Amazon, Intel and General Motors. Some of the non-automotive players include Sony, State Farm Mutual Automobile Insurance, iFlight Innovation and Boeing, who also have patenting activity in the area of object or collision avoidance systems.

- Universities, primarily from China and Korea, have filed approximately 6,000 AV patent applications, which account for 6% of the total set, with object or collision avoidance being the most prominent category.

- The number of patent applications filed in Canada each year has remained relatively consistent, with an average of around 100 filings per year from 2017 to 2020. In contrast, other countries have seen an increasing trend in filing rates over the years, with China leading in terms of the highest patent filing rate. Among the top assignees, only Nissan appears to have significant filings in Canada, while other players have limited activity in the country.

WHITESPACES

- Emotional intelligence or social interaction in object detection and collision avoidance
- Cognitive computing based path or trajectory planning

IP STRATEGY CONSIDERATIONS:
AUTONOMOUS VEHICLES (AV)

1

When developing an IP strategy pertaining to autonomous vehicles, one needs to consider the influence of both US and China patent filings (as more than half of the patents are filed in these countries), in addition to other jurisdictions relevant to your business. The top five industry players have 20% of their total patents filed in China indicating this country is a key component of their IP strategy. If China is a critical market to your business strategy as well, then budgets and time estimates need to be planned for, as translation fees may increase the cost to execute this strategy.

2

There has been an exponential increase in AI and machine learning patents within the AV space in recent years. An IP strategy should consider how and where to carve out a patent position within this rapidly growing sector.

3

The top patent owners in the AV technology sub-sectors differ, so an IP strategy needs to be based on relevant players in your technology area of interest, as well as the overall patent leaders.

4

An IP strategy should consider there are less patent heavy areas with more opportunities for IP ownership and leadership, such as automated vehicle parking, emergency braking, street sign recognition, and route navigation. An IP strategy needs to consider what the end-goal of IP ownership in a less crowded patent space may be and if there is an opportunity to be an IP leader to protect future whitespace.

5

Canadian SMEs working in this space should monitor the patents of Nissan, Alphabet and Uber as they are the top filers in Canada and all of them own patents in object or collision avoidance systems. Any SME working in the area of object or collision avoidance should have an IP strategy that addresses how they will compete against these large, well known IP owners as some have a history of enforcing their patent rights.

6

Along with the global key players, an IP strategy should monitor Chinese players such as Baidu, Lyft, Zhejiang Geely Holding Group, CDGM Glass, Huawei Technologies, Dongfeng Motor and non–automotive players such as Sony, State Farm Mutual Automobile Insurance, iFlight Innovation and Boeing to determine where these companies are investing and how to gain a competitive advantage. Additionally, Alphabet, Aptiv, Intel, BMW, Hitachi and Amazon have filed significant numbers of patents in the last 5 years in the AV domain. As a result, any IP strategy needs to consider not only known automotive companies, but IP positions by non-automotive players and technology players.

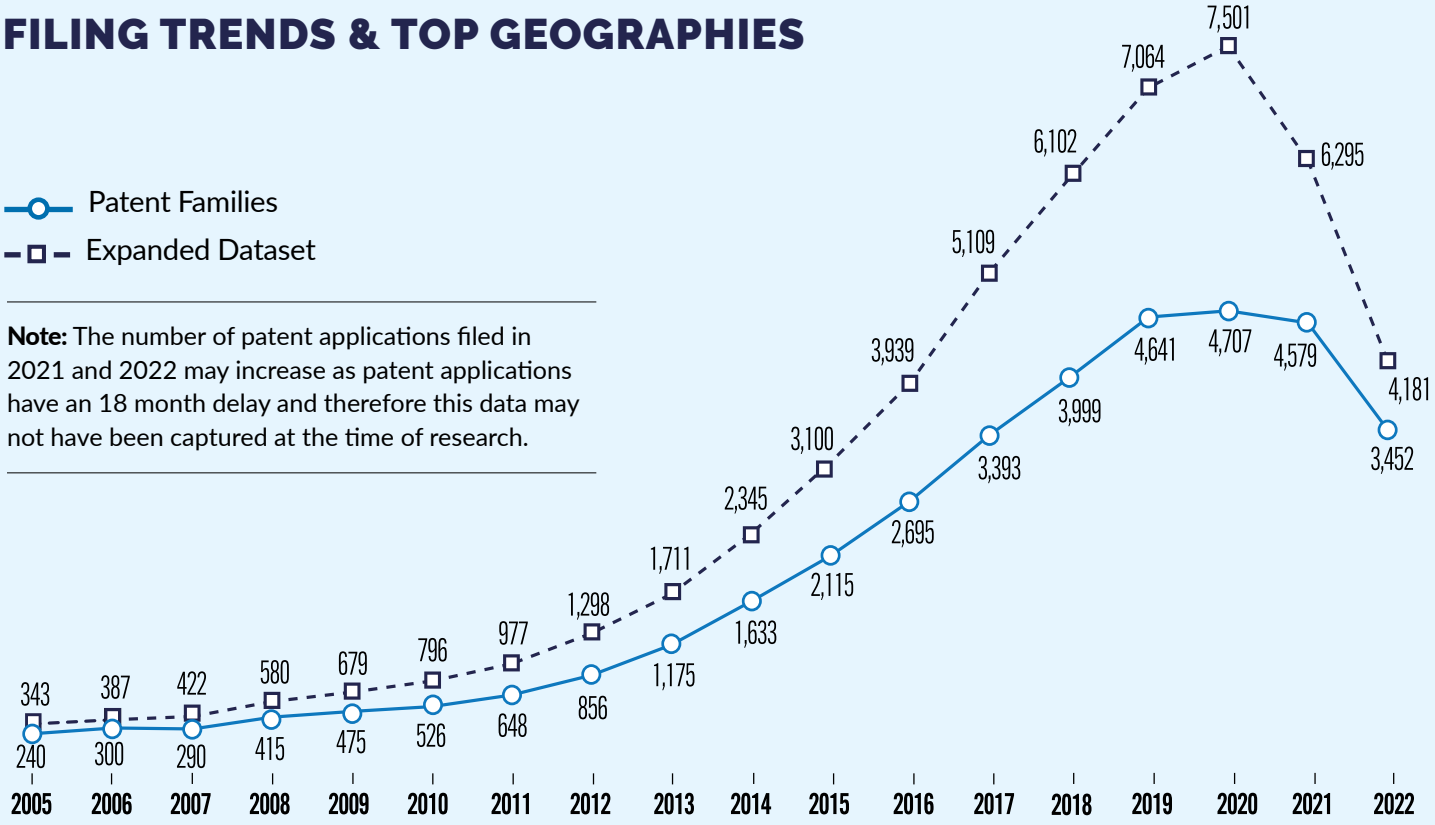
7

The category of object or collision avoidance system technologies has a high patent volume, so SMEs in this space should consider having a strategy that includes clearance searches during product development to understand the risks and other freedom to operate concerns. A clearance search needs to be completed by an IP or legal professional. IPON's funding program can help offset this cost among other IP expenses.

If you're interested in becoming a client, please visit: www.ip-ontario.ca/apply

(VC)

FILING TRENDS & TOP GEOGRAPHIES



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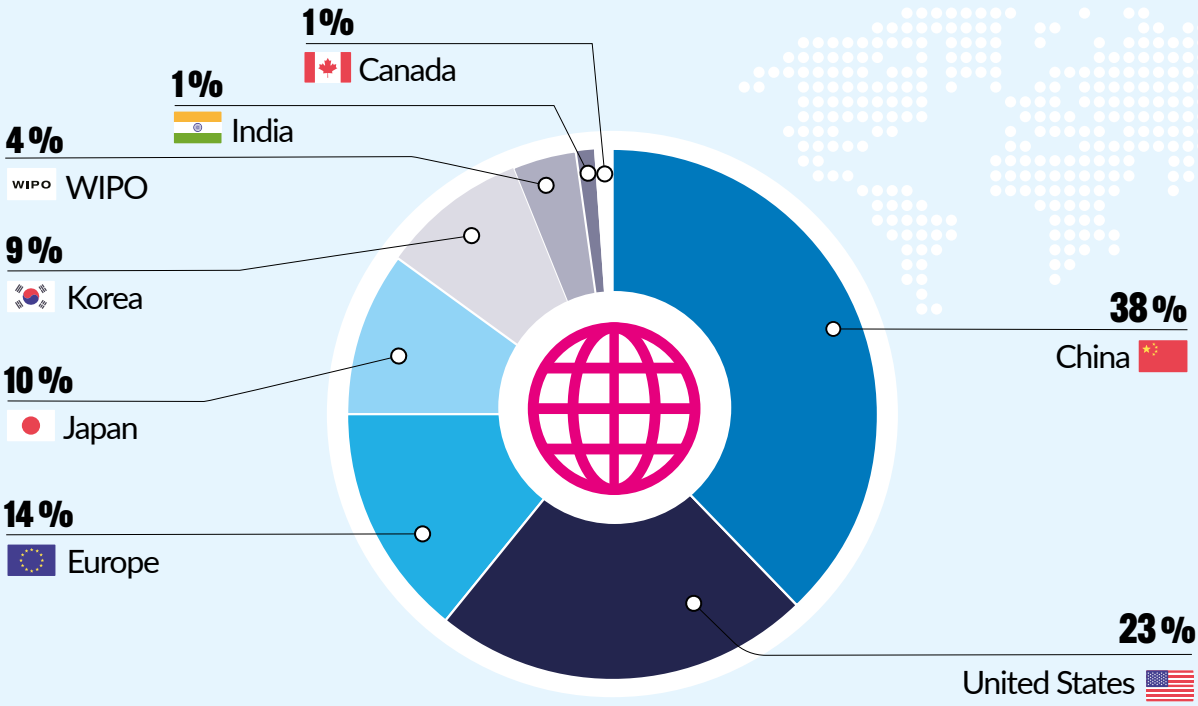


VEHICLE CONNECTIVITY (VC)

FILING TRENDS & TOP GEOGRAPHIES

- Patent filings have consistently increased since 2014, reaching their peak in 2020. Most companies have shown an upward trend in filings over the years, with the highest numbers recorded in 2019 and 2020. However, Bosch, Ford, and Denso had their maximum filings in 2017 and 2018, followed by a decreasing trend.

- China has witnessed maximum filings and growth rate in this area with China's patent set to be approximately 38% of the total global patent set. 28% of the patents from the top five players are filed in China. Vehicle-to-vehicle (V2V) communication is the category with the greatest number of patents in all regions. The second most filed technology category in China is remote vehicle diagnosis while filings in US, Europe and Japan are primarily in fleet management.

- Top Chinese players in VC are Huawei (40% of their patents are filed in China), State Grid Corporation of China, China Faw, and CDGM. Huawei focuses on V2V communication technology whereas State Grid Corporation of China filed mostly on vehicle-to-grid (V2G) and vehicle to home communication (V2H).

TOP CANADIAN PLAYERS

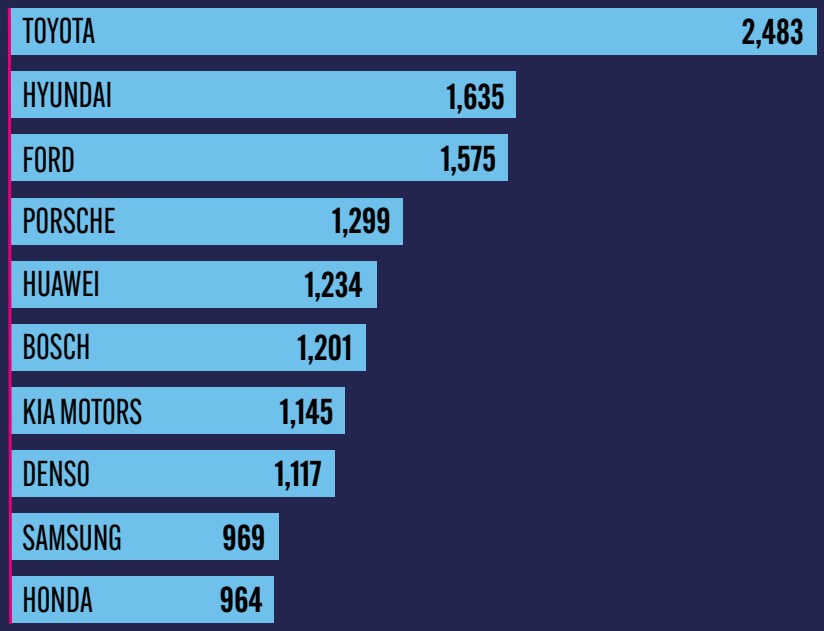
- Geotab
- Blackberry
- University of Toronto
- eLeapPower

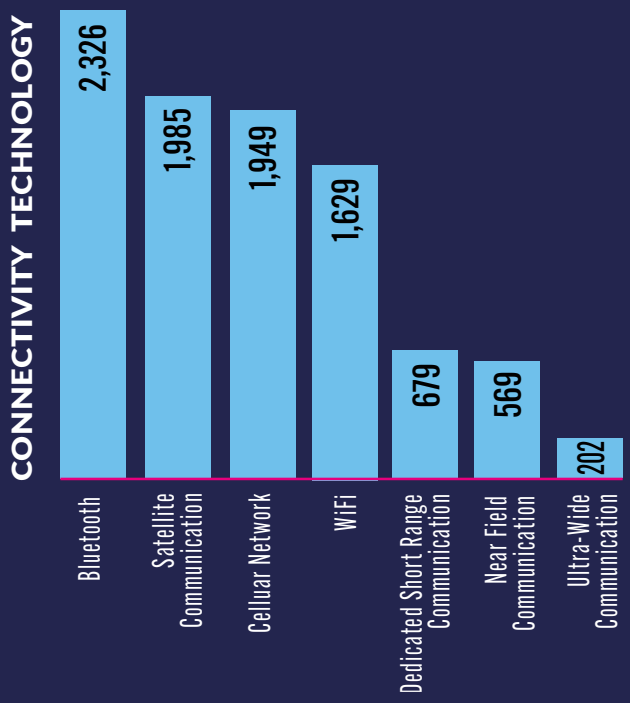
TOP ONTARIO-BASED PLAYERS

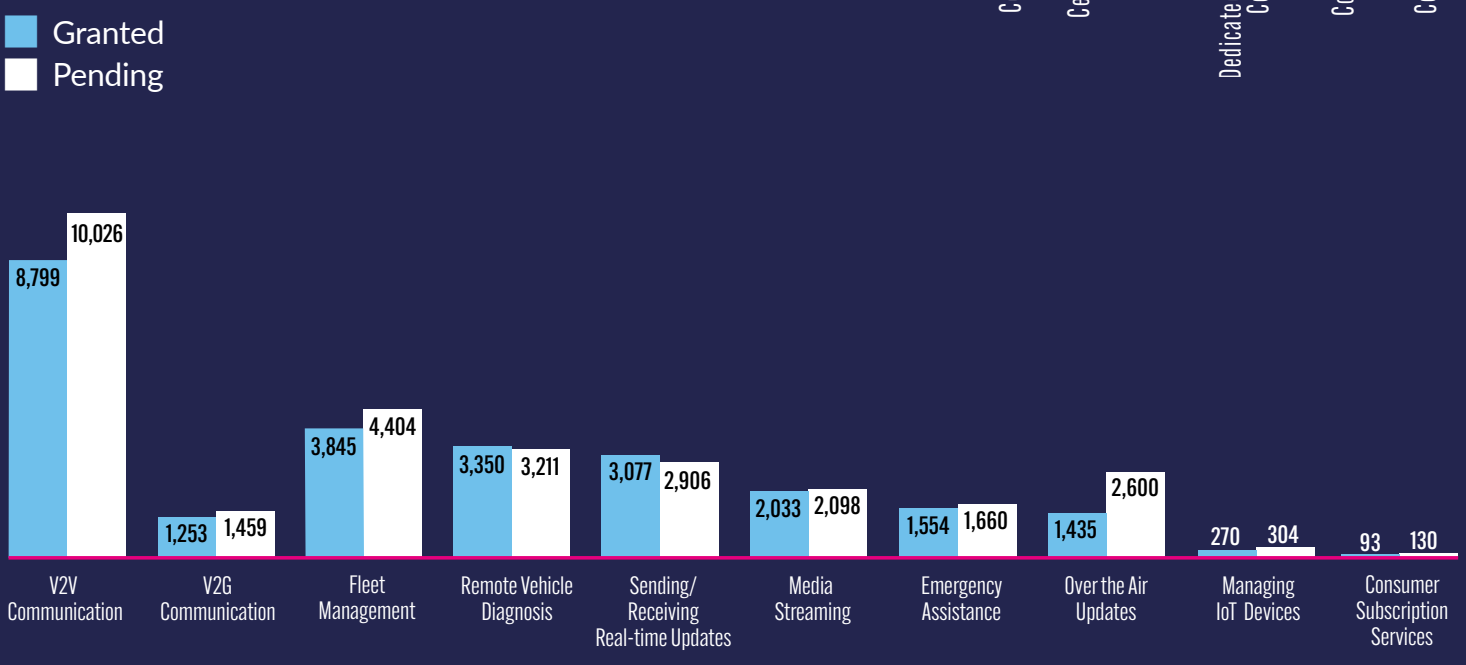
- Geotab
- Blackberry
- University of Toronto
- eLeapPower
- Clearpath Robotics

(VC)

KEY PLAYERS & TECHNOLOGY SEGMENTS







VEHICLE CONNECTIVITY (VC)

KEY PLAYERS & TECHNOLOGY SEGMENTS

- V2V communication is a crowded technology segment with more pending applications than granted ones. Bluetooth, satellite communication and cellular network 4G/5G are the most widely used connectivity technologies. Fleet management followed by remote vehicle diagnosis are the prominent application areas where most of the key players have filed patents.

- Huawei, Toyota, Qualcomm, Ford and Denso are the major players in V2V. The surge in patent filings in V2V communication can be attributed to its transformative potential in revolutionizing transportation through enhanced road safety by enabling real-time sharing of critical information among vehicles. Automobile manufacturers Toyota, Porsche, Hyundai, Ford and Kia Motors lead in patent ownership related to fleet management, whereas Ford, Bosch, Hyundai, Launch Tech and Toyota dominate the domain of remote vehicle diagnosis. The Korean company, Samsung, leads patent filings in media streaming and managing IoT devices.

- Several companies are noticeable in individual segments. Some of them are Bose Corp. in the sub-category of media streaming, Philips in managing IoT devices, Sumitomo in over the air updates, Aptiv & Cox in consumer subscription services, and WiTricity in V2G/V2Home communication. Automotive related service providers such as Samsung, WiTricity, Verizon and Amazon have portfolios with quality patents comparable to top car manufacturing companies such as Ford, Toyota, etc.

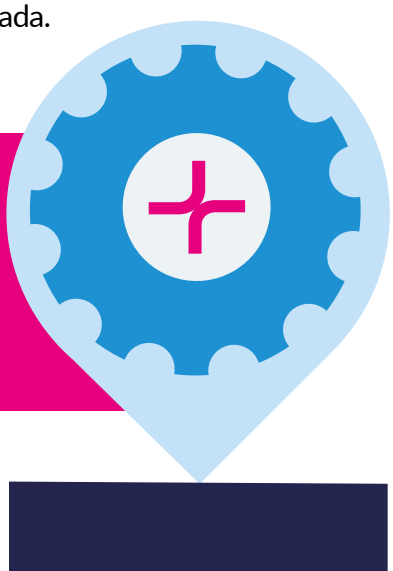
- Car manufacturing companies such as Toyota, Hyundai, Bosch, Ford, and Porsche and automotive related services providers such as Huawei, Samsung, Qualcomm, Panasonic and LG Electronics have drastically increased VC patent filings from 2015.

- Universities have filed approximately 4,000 patent applications, which account for approximately 8% of the total set, in this domain. The University of Toronto has 37 VC patent applications and Université Laval has one patent application. The University of Toronto has filed patent applications in V2G and V2H in collaboration with eLeapPower, and Université Laval has filed a patent application on sending/receiving real-time updates. Canadian/Ontario based player Geotab holds ~115 patent applications in this domain. Most of their filings are in the remote vehicle diagnosis sub-category.

- All the top assignees in Canada have filed a significantly low number of patents in this space. Qualcomm (V2V), Allstate Corp (remote vehicle diagnosis), Omnitracs (fleet management), Blackberry (media streaming), Nuro (fleet management) and United Parcel Service of America (fleet management) hold patents in Canada.

WHITESPACES

+ Consumer subscription services (seat warming, remote start, infotainment system)
+ Augmented advertising in cars



IP STRATEGY CONSIDERATIONS:
VEHICLE CONNECTIVITY (VC)

1

As a Canadian SME in the automotive sector, it could be beneficial to leverage collaboration or licensing opportunities with domestic academic institutions such as the University of Toronto or an institution that holds patents in a similar technology field. This could further research and innovation, create potential licensing opportunities, avoid patent infringement risks, and prevent competitors from entering the market.

2

The top players in the VC space hold very few patents in Canada which presents Canadian SMEs the opportunity to capture patent ownership and dominate the Canadian market. This could result in future licensing opportunities.

3

When developing an IP strategy pertaining to VC, one must consider the influence of both US and China patents filings (as more than half of the VC patents are filed in these countries), in addition to other jurisdictions relevant to the business. The top five players have 28% of their total patents filed in China indicating this country is a key component of their IP strategy. If China is a critical market to your business strategy as well, then budgets and time estimates need to be planned for, as translation fees may increase the cost to execute this strategy.

4

There are greater patent opportunities in managing IoT devices and consumer subscription services. The top patent owners in various VC technology sub-sectors may vary, so developing an IP strategy should consider not only the overall patent leaders but also relevant players in the specific technology area of interest.

5

It is important to monitor patents from Chinese players as well as from top players such as Samsung, Qualcomm, Panasonic, LG Electronics, WiTricity, Verizon and Amazon, who all have significant filings in recent years. By doing so, a SME will understand what specific technologies competitors are exploring, identify licensing opportunities and avoid patent infringement risks.

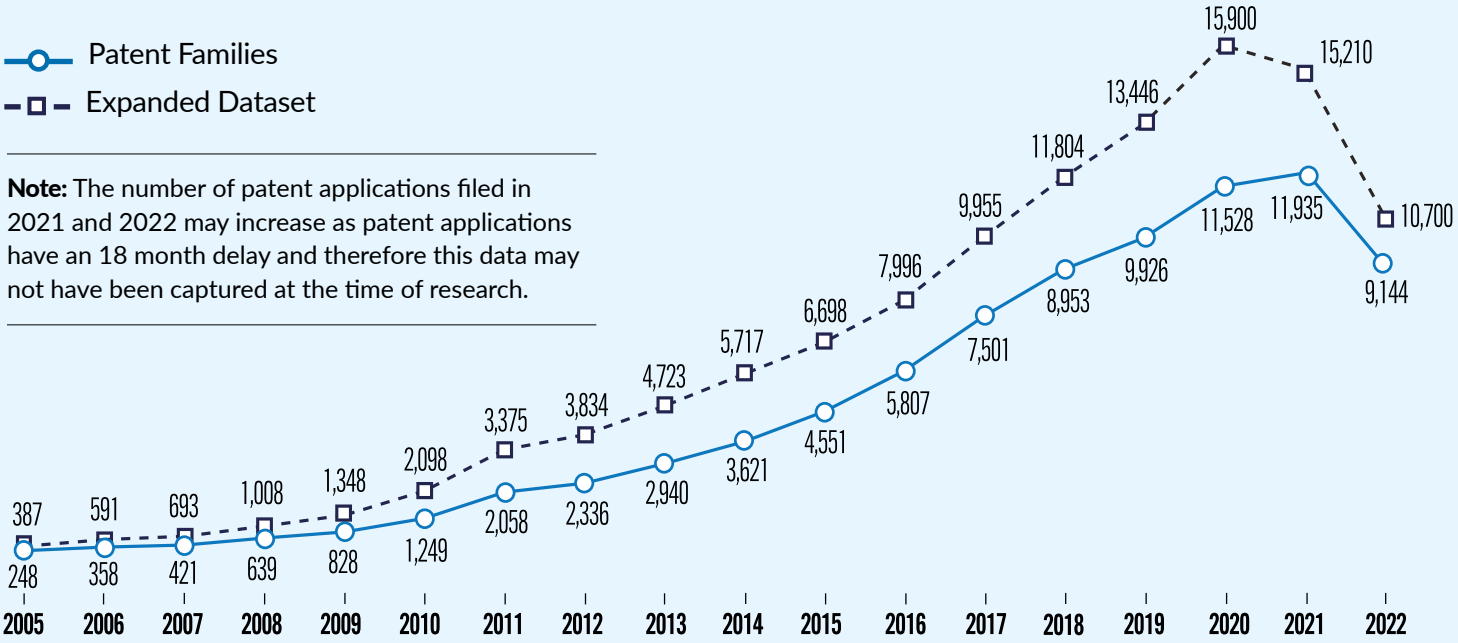
6

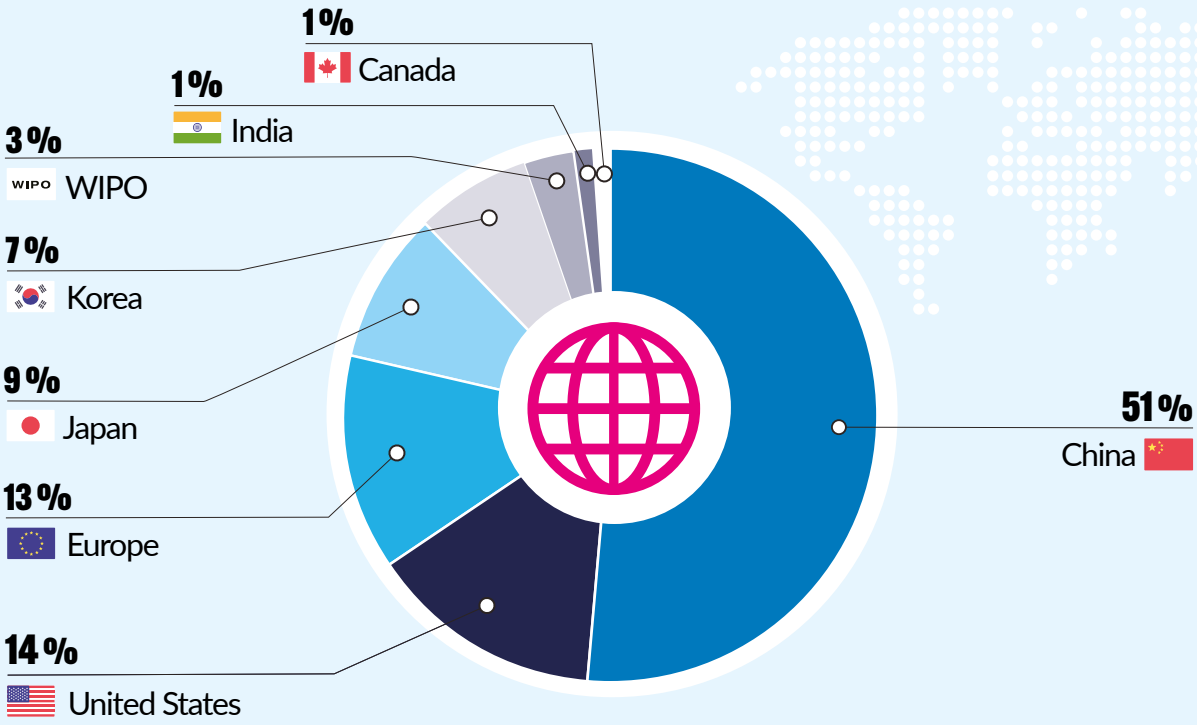
V2V communication followed by fleet management are the top technology sub-categories with a heightened level of innovation, research and development and technological advancement in recent years. Before investing development time and resources in these sectors, a clearance search may need to be conducted to learn about the infringement risks and other freedom to operate concerns as these spaces are highly crowded with patent ownership. A clearance search needs to be completed by an IP or legal professional. There are many IP resources and funding opportunities available for Ontario innovators to help offset costs such as client support available through IPON.

To apply to become an IPON client, visit www.ip-ontario.ca/apply

(EV)

FILING TRENDS & TOP GEOGRAPHIES





ELECTRIC VEHICLES (EV)

FILING TRENDS & TOP GEOGRAPHIES

- The number of patent filings in the EV space has significantly increased from 2010 onwards. Since 2010, manufacturers of automotive components and car manufacturing companies have actively filed patents in this domain. Most of the top filers have increased their patent portfolio over the years with maximum filings in 2019 and 2020, while LG Chem and Bosch have maximum filings in 2014. Overall, most of the patents filed in this category have a long-shelf life left of the 20 years that a patent is valid for, therefore indicating innovation and research are happening in this space.

- China is the top EV patent jurisdiction, followed by the US, Europe, Japan and Korea. China, among all countries, has witnessed maximum filings in this area with China's patent set to be approximately 51% of the total EV patent set. Of the total patent set of top 5 players 22% are filed in CN. Chinese players such as Byd, Baic Motor, Aulton New Energy, Zhejiang Geely Holding Group, and State Grid Corporation, hold the majority of these patents. Byd and Zhejiang Geely file patents primarily in the sub-category of battery and transmission systems, Baic on battery and battery management systems (BMS), Aulton New Energy on battery and battery swapping, and State Grid Corporation of China on wired charging and BMS.

- Battery is the top explored area in all regions. In China, the second largest explored area is transmission systems whereas in the US, Europe and Japan the focus is wireless charging.

- Since 2010, manufacturers of automotive components like LG Chem, Toshiba, Denso, and Hitachi have actively filed in this domain.

TOP CANADIAN PLAYERS

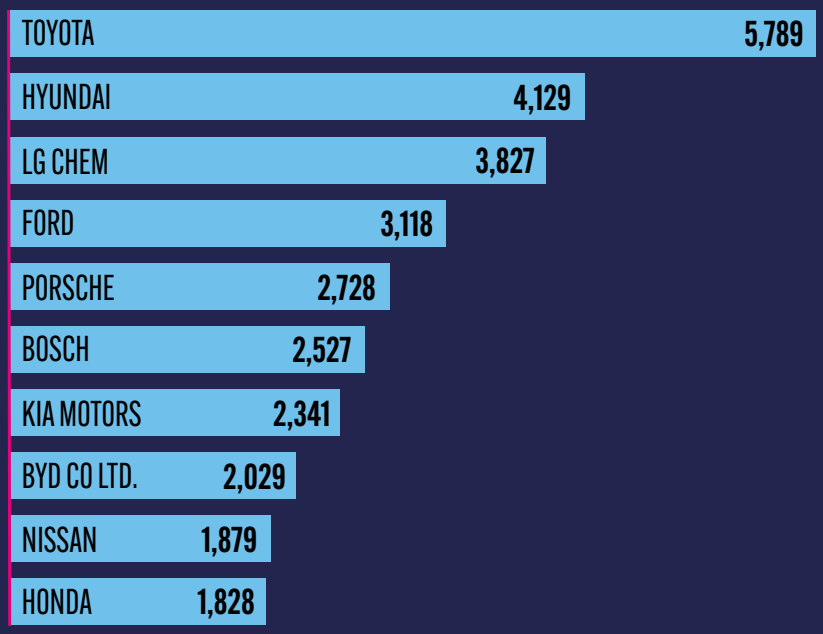
- Taiga Motors
- Magna International
- DCBEL
- Geotab

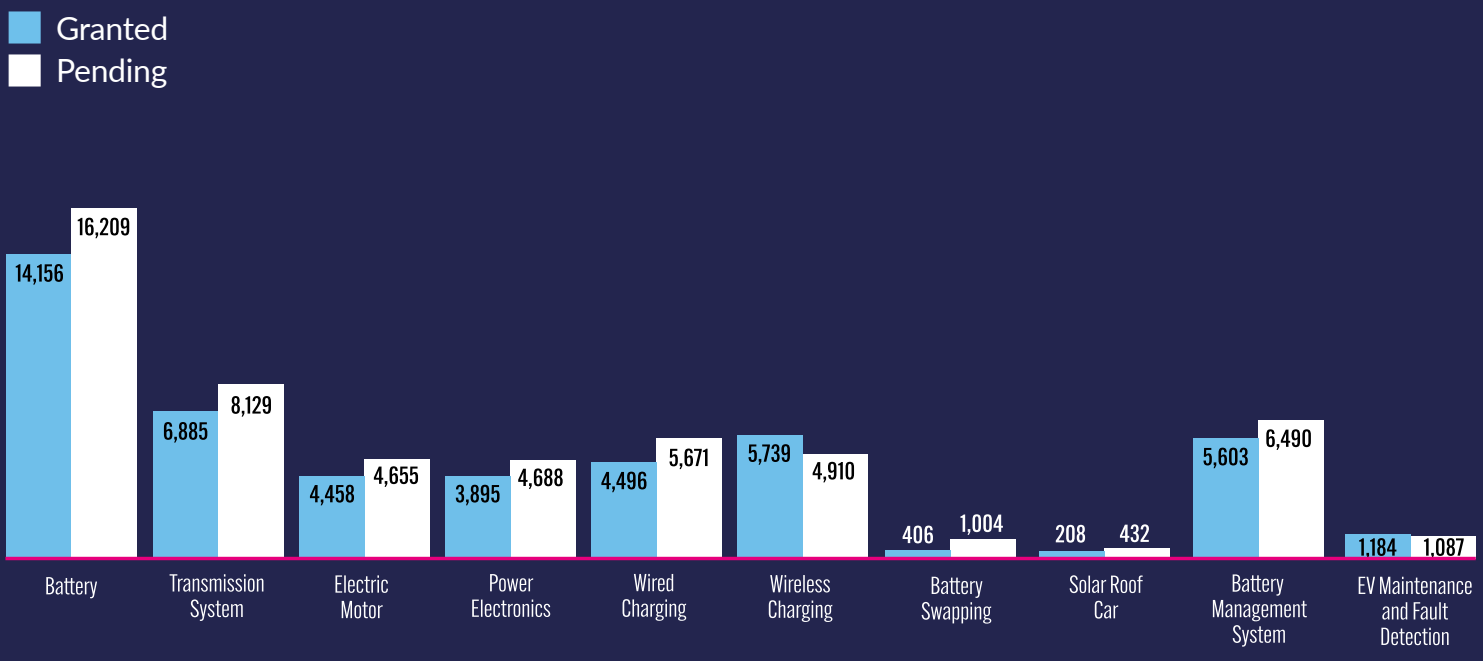
TOP ONTARIO-BASED PLAYERS

- Magna International
- Geotab
- University of Toronto
- eLeapPower

(EV)

KEY PLAYERS & TECHNOLOGY SEGMENTS





ELECTRIC VEHICLES (EV)

KEY PLAYERS & TECHNOLOGY SEGMENTS

- The top research area of interest globally is EV batteries. LG Chem, Toyota, Porsche, Ford and Bosch are the key players in this space. Out of the total patents filed by LG Chem, 90% are in EV batteries. Toyota, Porsche, Hyundai, Ford, ABB and State Grid Corp. of China are the prolific players in the field of wired charging. Automotive related service providers WiTricity, Panasonic and Ihi Corp. hold patents on wireless charging technology. Hyundai, LG Chem, Toyota, Ford and Bosch lead the filings related to BMS.

- Areas that present opportunities and have less patents filed are battery swapping and solar roof cars. Chinese players such as Alton New Energy, Nio, Bluepark New Energy, State Grid Corp. of China, and Japanese automobile manufacturer Honda, lead the battery swapping domain whereas Toyota, Hanergy, Hyundai, Kia and State Grid Corp. of China dominates the solar roof cars category.

- Universities worldwide have filed approximately 6,000 patent applications, constituting around 5% of the total EV patent set in this domain. Top categories for academic institutions are EV batteries, wireless charging and transmission systems. Many Canadian universities have filed in this space including the University of Toronto, McMaster University, Université Laval, Queen's University, University of Calgary, University of Windsor, McGill University, Université de Sherbrooke, Western University, and University of Ontario Institute of Technology. The University of Toronto (with ~41 patent applications) has mostly filed patent applications in EV batteries, power electronics and wired charging in collaboration with eLeapPower. Further, Queen's University has filed five patent applications in power electronics.

- All the top global assignees have significantly lower filings in Canada. Nissan (wireless charging), Toyota (EV batteries), Suzhou Eagle Electric (EV design patents), Proterra Operating Co. (BMS), and Byd (EV batteries) are the top 5 players who have patents in Canada.

WHITESPACES

- Vehicle-to-Vehicle Wireless Charging
- Self-Repairing Batteries for Electric Vehicles

IP STRATEGY CONSIDERATIONS: ELECTRIC VEHICLES

1

Apart from the key players identified, many Canadian universities hold patents in the EV space. Collaboration or partnership with them can be considered as a part of your IP strategy and help to further research and innovation, create potential licensing opportunities, avoid patent infringement risks, and prevent competitors from entering the market.

2

It is important to monitor and analyze patents from LG Chem as 90% of their EV patents are comprised of battery technology related to battery structure and function. By doing so, an SME will understand what specific technologies this top player is exploring, identify licensing opportunities and avoid patent infringement risks. Other players aside from the ones identified that should be monitored as part of an IP strategy are WiTricity and Mojo Mobility as both companies have quality patent portfolios in wireless charging technologies.

3

Categories within the EV space that have more opportunities and less patents filed are battery swapping and solar roof cars. As part of an IP strategy, this white space could provide Canadian companies with future licensing opportunities, the ability to ward off competitors and the chance to become a patent leader. Most of the key players holding a majority of the battery swapping and solar roof car patents are based out of China.

4

China needs to be part of your global IP strategy as more than half of the EV patents are filed in China alone. The top five players have 22% of their total patents filed in China indicating this country is a key component of their IP strategy. When developing an IP strategy pertaining to EV, one must consider if China is a critical market, and if so then budgets and time estimates relating to patenting in this country need to be planned for.

- Key players for each of the EV technology sub-categories differ, so an IP strategy needs to be based on relevant players in your technology area of interest, as well as the overall patent leaders to identify areas of opportunities and risks.

5

- EV batteries is the top category of interest among innovators in this space and is a highly crowded sub-category in terms of patents. If you are planning to invest in this sector as a business or policy maker, a clearance search may need to be conducted during product development to learn about the infringement risks and address freedom to operate concerns. A clearance search needs to be completed by an IP or legal professional. IPON's funding program can help offset this cost among other IP expenses.

6

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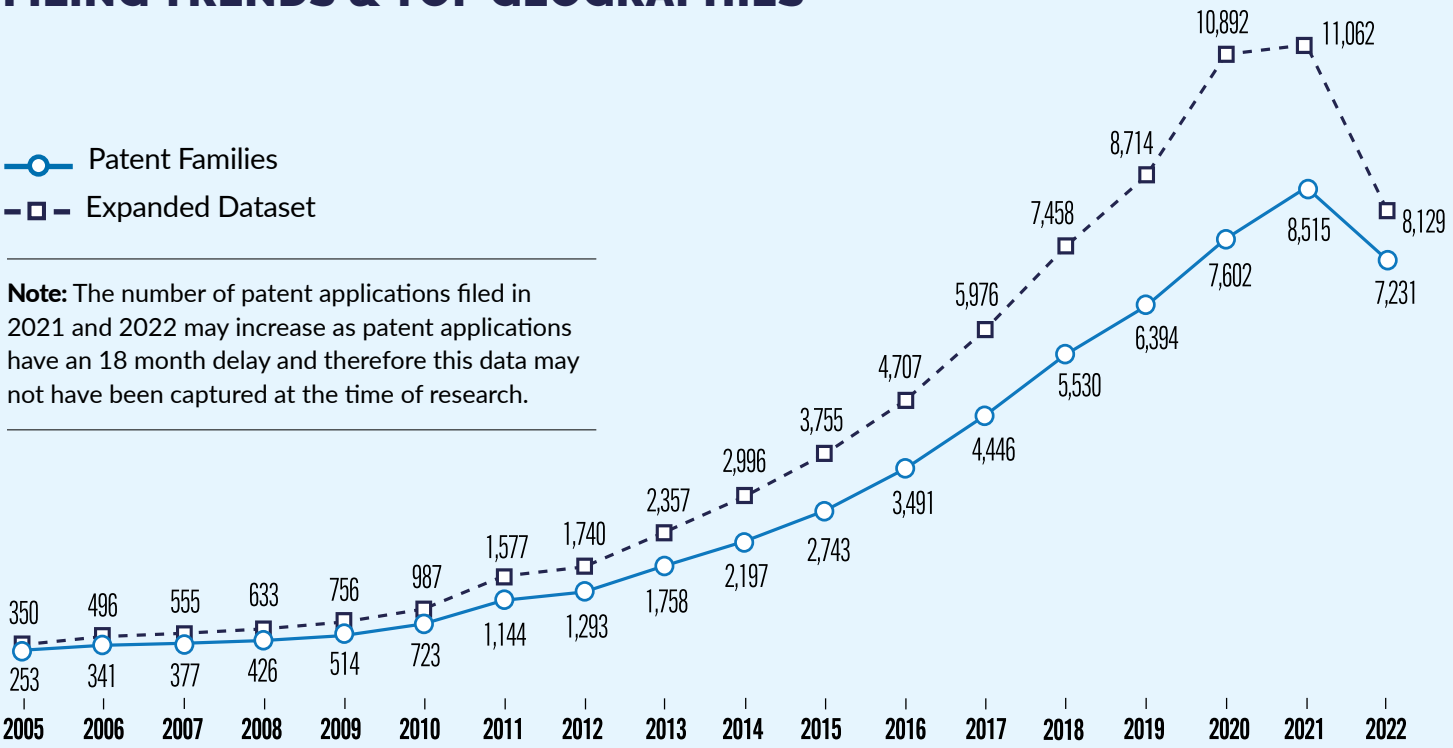
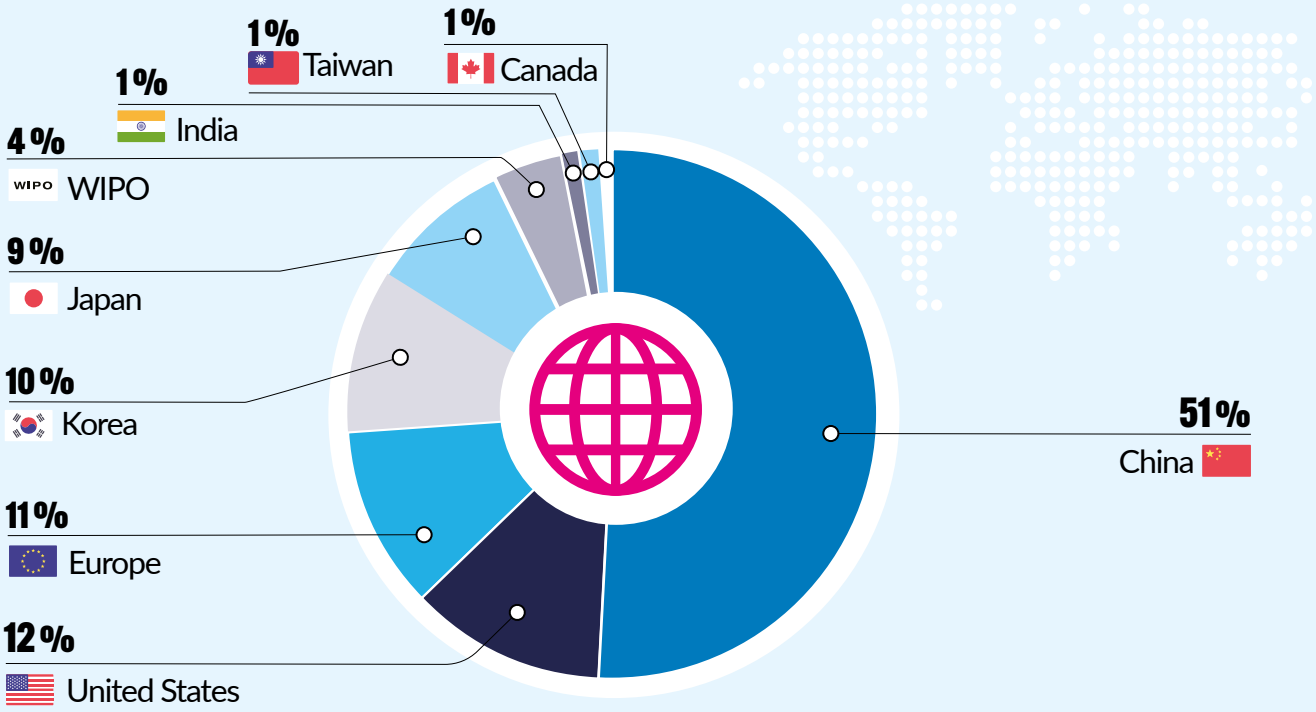
AUTOMOTIVE MANUFACTURING

FILING TRENDS & TOP GEOGRAPHIES





AUTOMOTIVE MANUFACTURING

FILING TRENDS & TOP GEOGRAPHIES

- The number of filings have significantly increased from 2010 onwards with manufacturers of automotive components and car manufacturing companies actively filing patents in this domain. Most of the companies have increased filing trends over the years with maximum filings in 2018-2020, while Hyundai Motor has maximum filings in the years 2015 and 2017. Overall, the global patent portfolio for automotive manufacturing is in its early years of the 20 years that a patent is valid for.

- Like other automotive categories, China is the top jurisdiction followed by countries such as the US, Europe, Korea and Japan. China has witnessed maximum filings in this area with China's patent set to be approximately 51% of total automotive manufacturing patent set. Of the total patent set of the top five players 21% are filed in China. LG Chem, Chinese Academy of Science, CATL, Toyota, State Grid Corp. of China and Byd Co. dominate the patenting activity of automotive manufacturing.

- In terms of technology segments, EV battery manufacturing is the leading technology in all regions. In China, the second prominent technology is components recycling whereas filings in the US and Europe are primarily focused on additive manufacturing, AI and digital twinning technologies.

- Automotive related service providers such as Panasonic, Samsung, BASF, and automotive component manufacturers such as LG Chem, CATL, Fanuc, and Continental, have actively filed in this domain since 2014. Electronics giant Apple holds patents on augmented and virtual reality and digital twinning technologies and has filed mainly in US and China.

- BASF, Toyota, Boeing, PPG Industries and CATL are the most prolific players of automotive manufacturing filings in Canada. Boeing and PPG industries file patents primarily in the subcategory of additive manufacturing.

- In the US, Strong Force Intellectual Capital, which is a venture capital entity, holds several patents in the industrial IoT subcategory.

TOP CANADIAN PLAYERS

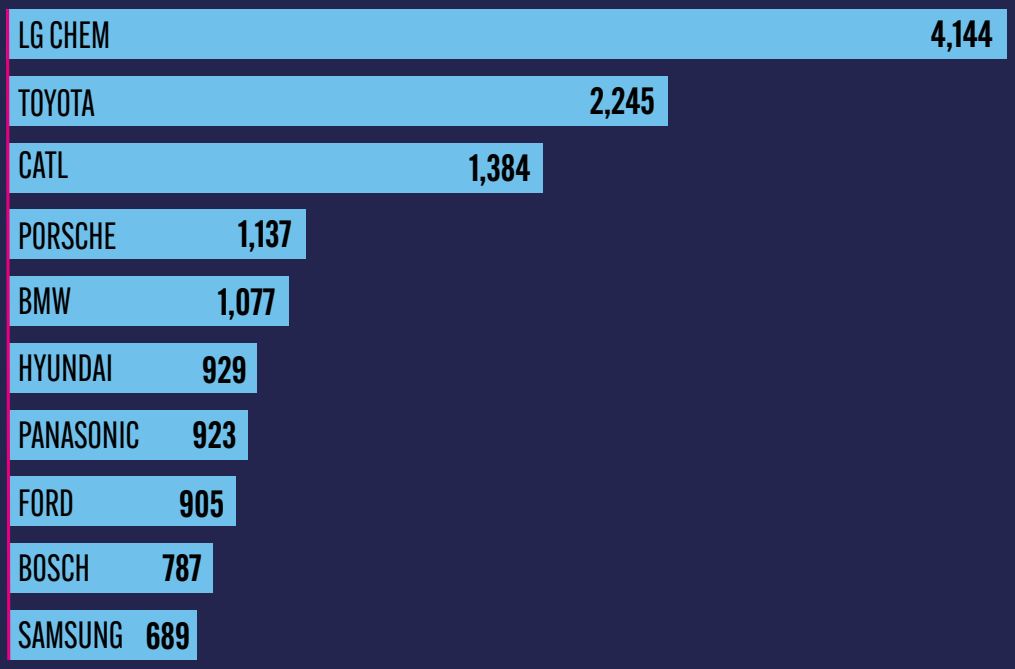
- Hydro-Québec
- Magna International
- CAE Inc.

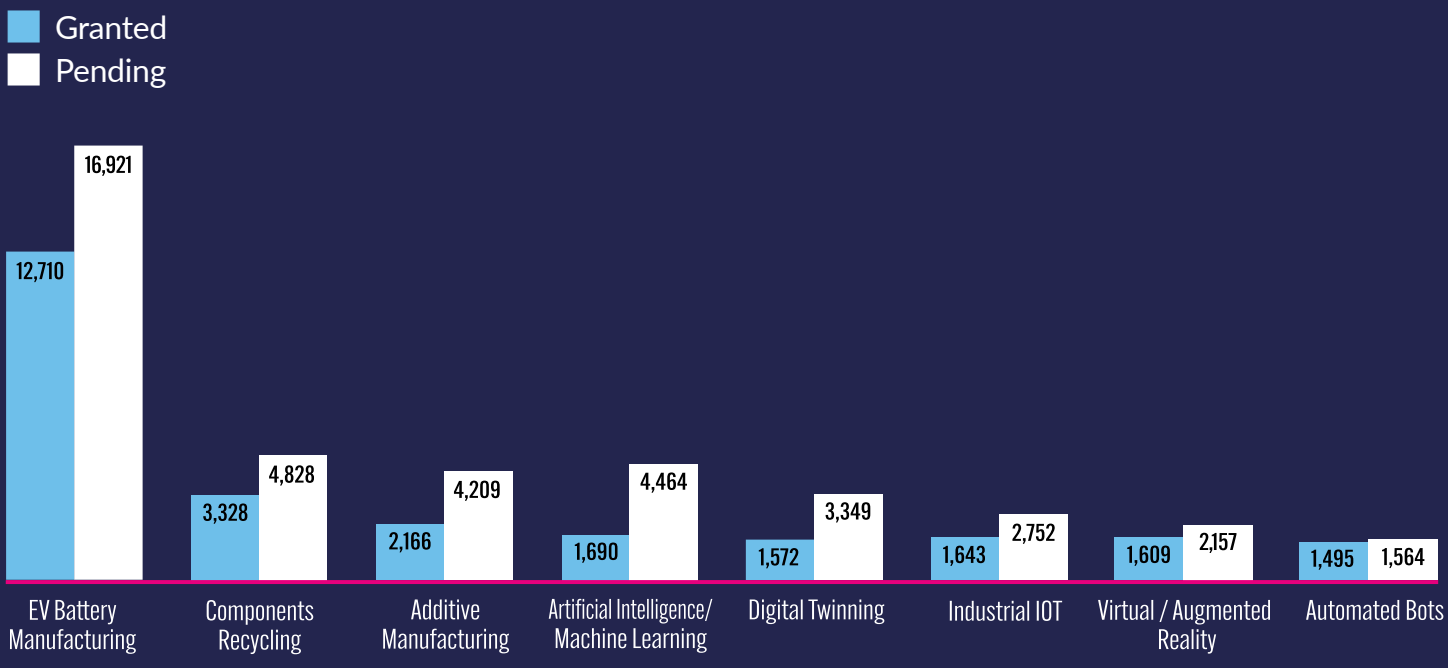
TOP ONTARIO-BASED PLAYERS

- Magna International
- Toronto-Dominion Bank

AUTOMOTIVE + MANUFACTURING

KEY PLAYERS & TECHNOLOGY SEGMENTS





AUTOMOTIVE MANUFACTURING

KEY PLAYERS & TECHNOLOGY SEGMENTS

- EV battery manufacturing is the leading technology segment with more pending applications than granted patents. LG Chem, Toyota, CATL, Samsung and Panasonic are the key players in battery manufacturing. Within the automotive manufacturing category, LG Chem only holds patents in the technology segment of battery manufacturing and the top jurisdictions LG Chem has filed in are Korea, China followed by Europe and United States. BASF, Ford, Toyota, Hyundai, and Dongfeng Motor dominate the field of components recycling.

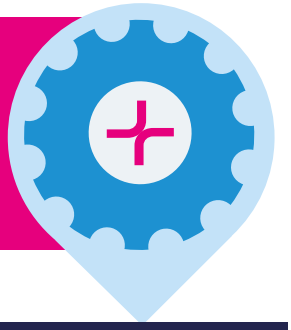
- Advanced manufacturing techniques include additive manufacturing, AI, digital twinning, industrial IoT, augmented and virtual reality, and automated bots. The patent filings in these areas have seen a drastic increase in the last five years with more pending applications reported than granted ones indicating these are the evolving technologies in the manufacturing domain and research is actively taking place. The top five players of each of these areas is outlined below.

- Globally, universities have filed approximately 8,000 patent applications, which accounts for 10% of the total automotive manufacturing patent set in this domain. Most of the universities are based in China. The University of Toronto, with nine patent applications, has collaborated with eLeapPower to file patent applications related to EV battery manufacturing and components recycling areas. Western University, also with nine patent applications, has partnered with the China Automotive Battery Research Institute to file patent applications related to EV battery manufacturing. In addition to this, McMaster University has filed three patent applications in the category of EV battery manufacturing, and Queen's University has filed five patents on EV battery manufacturing and additive manufacturing.

Additive Manufacturing	Artificial Intelligence	Digital Twinning	Industrial IOT	Augmented/ Virtual Reality	Automated Bots
Ford	Nvidia	Siemens	Strong Force IOT	Porsche	Funac Ltd.
BMW	Intel	Ford	Porsche	Hyundai	Midea Group
HP	BMW	Toyota	Hyundai	Panasonic	ABB
Porsche	Alphabet	Porsche	Jilin University	Continental	Yaskawa Electric
General Motors	Micron Technology	Bosch	China Faw	BMW	Rockwell Automation

WHITESPACES

- Manufacturing of sodium ion batteries for EVs
- Quality inspection using automated bots



IP STRATEGY CONSIDERATIONS:
AUTOMOTIVE MANUFACTURING

1. The top five players of the automotive manufacturing sector have 21% of their total patents filed in China indicating this country is a key component of their IP strategy. When developing an IP strategy pertaining to automotive manufacturing, one must consider if China is a critical market, and if so then budgets and time estimates pertaining to filing a patent in this country need to be planned for, as requirements such as translation fees may increase costs and time constraints.

2. It's important to monitor and analyze patents from LG Chem as its patents related to automotive manufacturing involve Battery Manufacturing technology which discloses the manufacturing process of batteries used in electric vehicles. By doing so, a SME will understand what specific technologies this top player is exploring, identify licensing opportunities, and avoid patent infringement risks.

3. Sub-categories with opportunities for Canadian SMEs to license or become a key player in terms of patent ownership are advanced manufacturing techniques, additive manufacturing, AI, digital twinning, industrial IoT, augmented and virtual reality, and automated bots. Each of these subcategories have a far fewer total number of patents filed than a category such as EV battery manufacturing.

4. Apart from the top automobile manufacturing companies noted, other key players that need to be monitored are Panasonic, Nvidia, Alphabet, Intel, Siemens, Chinese Academy of Science, Samsung and Continental as they have filed a large number of patents in the last five years.

- Some Canadian universities hold patents in this domain. Collaboration or partnership with them can be considered as a part of your IP strategy and help to further research and innovation, create potential licensing opportunities, avoid patent infringement risks, and prevent competitors from entering the market.

5

- Patents related to EV battery manufacturing is the most prominent sub-category within the automotive manufacturing sector. If you are an innovator or policy maker planning to invest in this sector, a clearance search may need to be conducted to learn about the infringement risks and to ensure return on investment as this area is highly crowded in terms of patents. A clearance search needs to be completed by an IP or legal professional. IPON's funding program can help offset this cost among other IP expenses.

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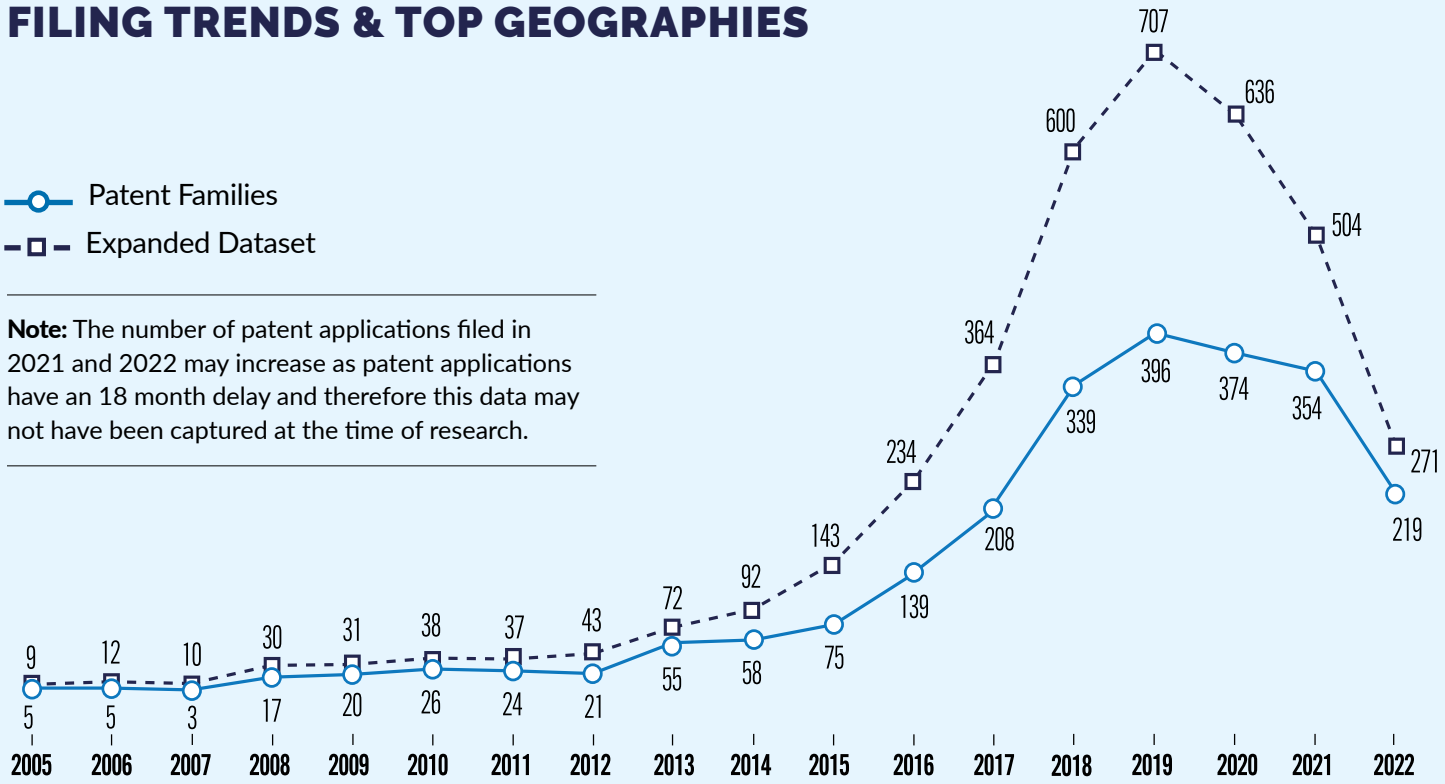
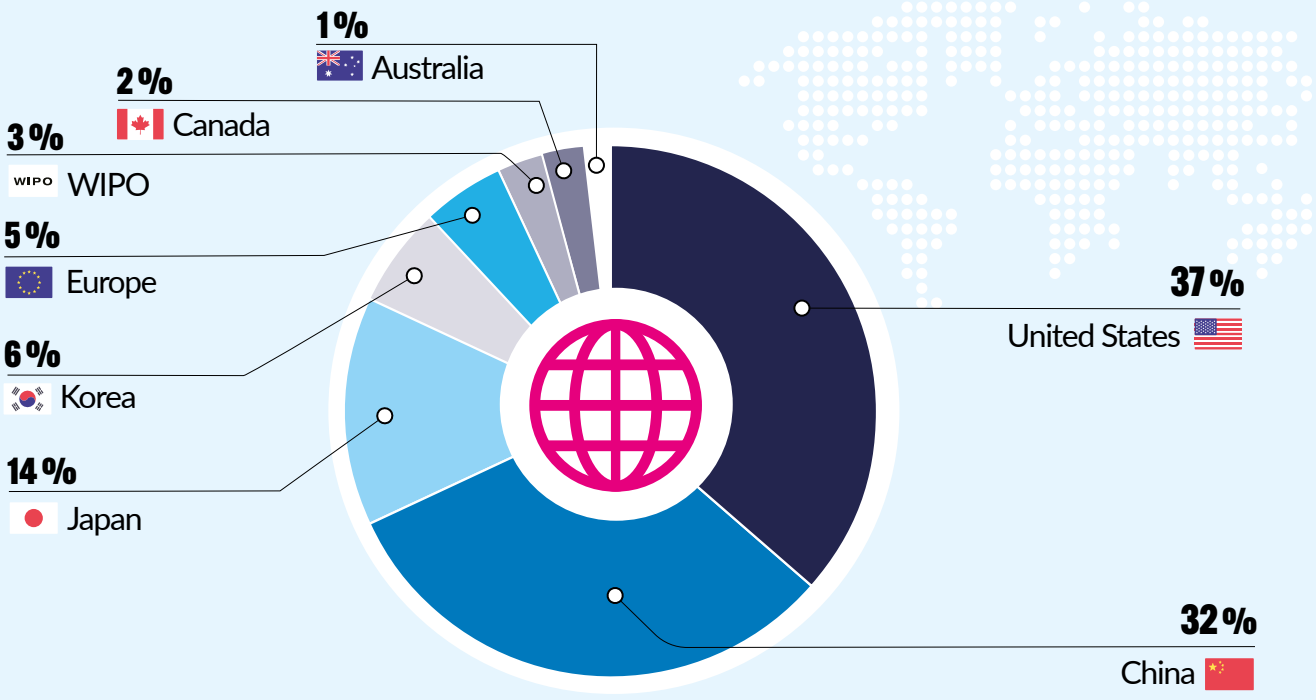
SHARED MOBILITY

FILING TRENDS & TOP GEOGRAPHIES



Note: The number of patent applications filed in 2021 and 2022 may increase as patent applications have an 18 month delay and therefore this data may not have been captured at the time of research.



SHARED MOBILITY

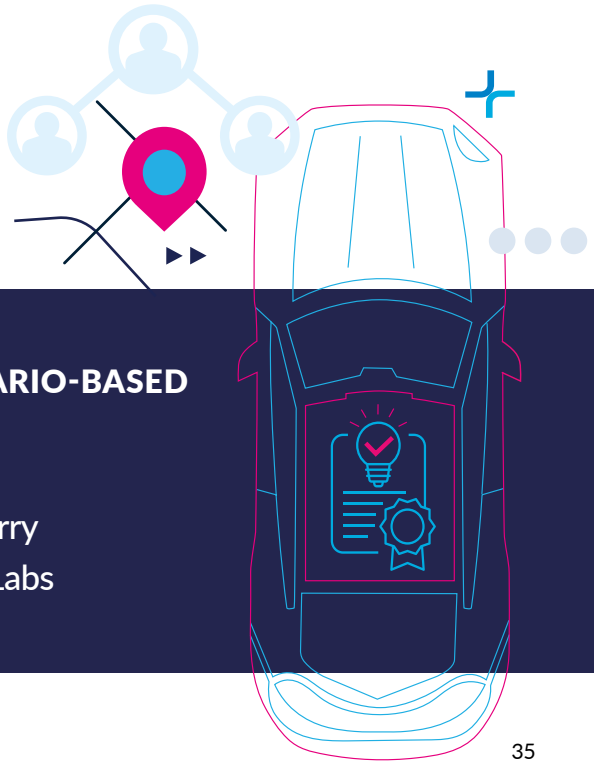
FILING TRENDS & TOP GEOGRAPHIES

- The number of patent filings in the category of shared mobility has significantly increased since 2015 onwards as the rise of internet access and smartphones has contributed to exponential growth. In comparison to other automotive categories, the number of patents filed in shared mobility is fewer. Toyota has extensively filed in the years 2018 and 2019 in the sub-category of ride sharing technology. Uber consistently filed patents in this category from 2015 to 2019. There is a small dip in patent filings in 2021 implying reduced research and development activities across the globe.

- Of the global patent set 37% were filed in the US, demonstrating its position as the leading market. China comes second at 32% followed by 14% in Japan. Among the total filings of the top five key players (Uber, Toyota, Lyft, Didi Global and Alphabet) 44% are filed in the US.

- In terms of technology segments, e-hailing patents dominate in China whereas in other countries, the focus area is ride sharing.

- A significant presence of Chinese players is clearly noticed in the patenting activity of Shared Mobility such as Didi Global, Lyft, Beijing Sankuai Online Technology Co, Nanjing Lingxing Technology Co, Huawei technologies. Other major players in E-hailing are Salesforce, Shanghai Qinggan Intelligent Technology, Alibaba Group, Alps Electric Co., Gogoro Inc. and State Farm Mutual Automobile Insurance and the top jurisdiction is China. Other prolific players in ride sharing are Here Global, Sony, Microsoft, Baidu, Denso, IBM and Renault, the top jurisdiction is the US.



TOP CANADIAN PLAYERS

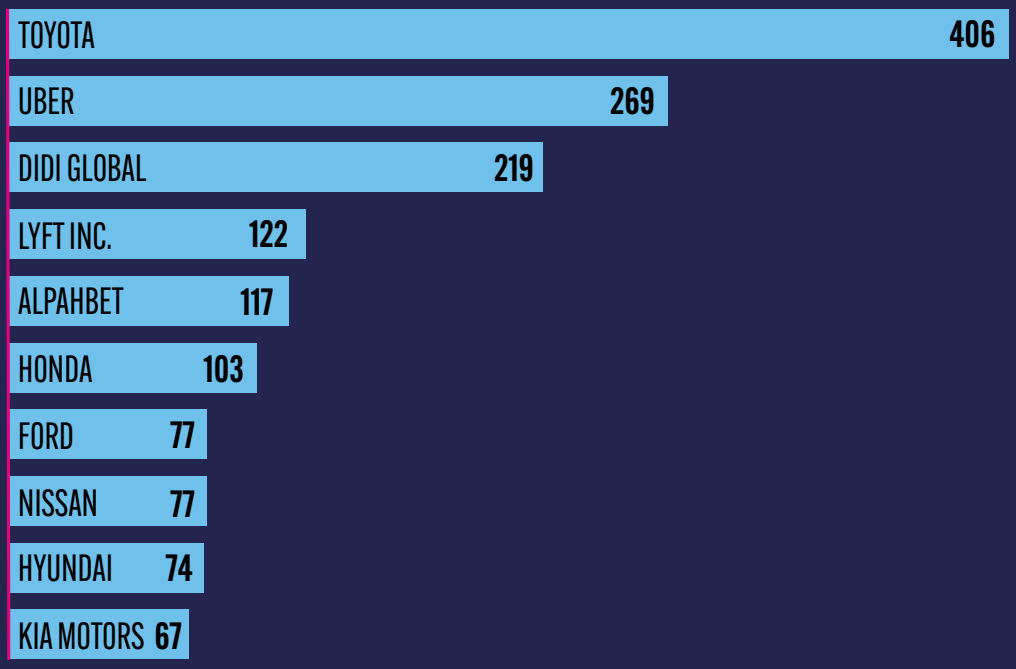
- Geotab
- Blackberry
- Transit Labs

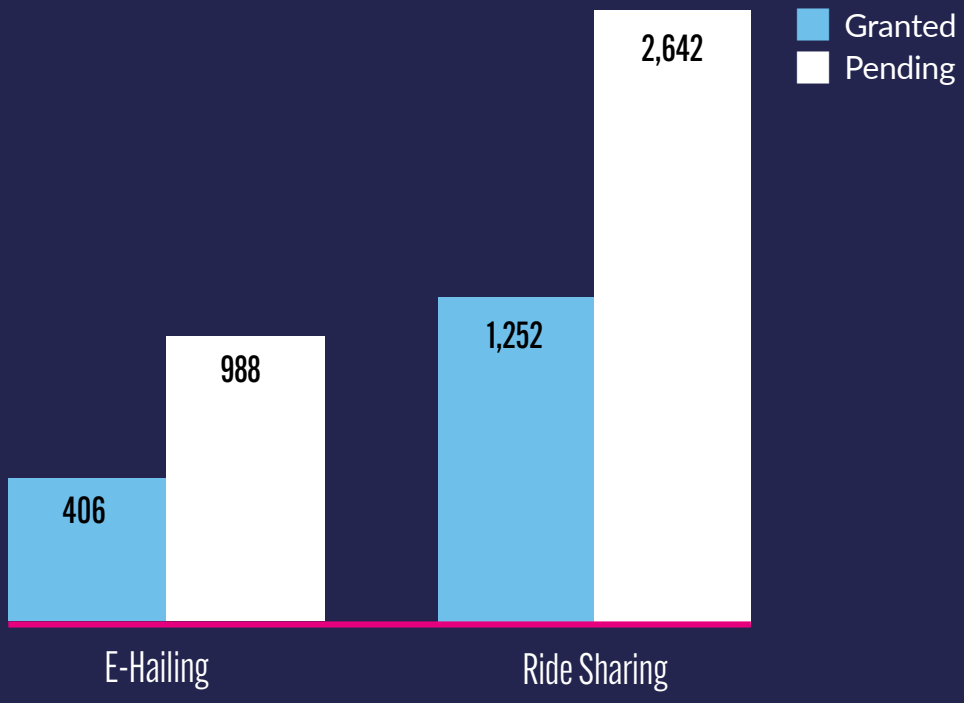
TOP ONTARIO-BASED PLAYERS

- Geotab
- Blackberry
- Transit Labs

SHARED MOBILITY

KEY PLAYERS & TECHNOLOGY SEGMENTS





SHARED MOBILITY

KEY PLAYERS & TECHNOLOGY SEGMENTS

- Toyota, Uber, Didi Global, Lyft and Alphabet lead the ride sharing technology sub-category while Toyota, Didi Global, Honda, Nissan and Ford dominate the e-hailing technology sub-category.

- Patent filings from non-automotive players such as Microsoft, Alphabet, Sony, and IBM have been gradually increasing. Companies that are automotive related service providers have drastically increased their filings from 2012 onwards. Examples of these companies include Uber, Didi Global, Lyft, Alphabet, and IBM.

- Universities worldwide have filed approximately 100 patent applications, which is less than 1% of the total set in this domain. Most of the top universities in this area are China-based and no Canadian university has filed patent applications in this domain.

- The number of patent applications filed in Canada each year appears to be quite low, typically in single digits, with the exception of 2018 when 12 patent applications were filed. Other countries have witnessed an increasing filing trend over the years. Uber technologies holds 27 patents in Canada in the ride sharing sub-category while other key players don't have any patent filings in Canada.

WHITESPACES

+ Managing shared car ownership
+ Predictive scheduling

IP STRATEGY CONSIDERATIONS:
SHARED MOBILITY

1. The US and China should be part of your global IP strategy if working on technology related to shared mobility. The top five players in shared mobility have 44% of their total patents filed in China indicating this country is a key component of their IP strategy. If China is a critical market under your global IP strategy, then budgets and time estimates need to be planned for, as requirements such as translation fees may increase the cost to execute this strategy.

2. This sector is unique in that there are a lot of smaller players and non-automotive entities, such as IBM, Uber, and Salesforce, holding a significant number of patents in this category. It is important to monitor what key players are doing and disclosing in their patents to identify white spaces, licensing opportunities, and avoid patent infringement risks.

3. The top patent owners in the shared mobility sub-sectors differ, so an IP strategy needs to be based on relevant players in your technology area of interest, as well as the overall patent leaders.

4. Ride sharing is the prominent technology sector in the shared mobility category. However, if you are planning to invest in this sector, a clearance search may need to be conducted to learn about the infringement risks as this area is highly crowded in terms of patent filings. A clearance search needs to be completed by an IP or legal professional. There are many IP resources and funding opportunities available for Ontario innovators to help offset costs including ones available to IPON clients.

For more information, visit
www.ip-ontario.ca/apply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ACTIONABLE RECOMMENDATIONS

DEVELOP A COMPREHENSIVE IP PORTFOLIO STRATEGY

This is a way for an innovator or company to manage and protect its intangible assets. Determine what types of IP protection (e.g., patents, trademarks, trade secrets) are most relevant to your business goals and technology. Prioritize the protection of novel inventions and unique product features by filing patents before commercialization and refraining from disclosing sensitive information to others.

COMPETITOR ANALYSIS

Identify and monitor the competitors and key players and keep in mind that the competitors vary from technology to technology. Each of the technology segments of the five automotive sectors pose unique threats, and have new developments and areas of investment. This information can help your organization prioritize defensive (to reduce patent infringement risks) and offensive (to maintain market leadership and prevent competitor growth) IP strategies.

COLLABORATION AND LICENSING OPPORTUNITIES

Identify potential partners, companies, or academic institutions with complementary technologies to explore collaboration or licensing opportunities. This can facilitate faster product development and market entry. Additionally, consider potential collaboration opportunities with research institutions to expand your IP portfolio.

GLOBAL PATENT STRATEGY

For all five automotive sectors, China and the US appear to be key markets; therefore, these two markets must be considered for your IP strategy. It is important to understand where opportunities are for patents or licensing, as well as freedom to operate concerns and infringement risks.

IDENTIFY WHITE SPACES

SMEs need to analyze their product or service portfolios, identify key features of the technology, and if it matches the whitespace areas identified, it is highly recommended that patent applications be filed. This can provide opportunity for your company to focus on creative advancements while avoiding significant competition.

FREEDOM TO OPERATE ANALYSIS

The regions of China, the US, Europe, Japan, and Korea stand out for their significant patent filings in the automotive sector. Further, refer to our previous slides to learn about the crowded technology segments. SMEs need to exercise additional caution if investing in these segments, as there is a substantial risk of patent infringement. It is suggested that one conduct a Freedom to Operate (FTO) assessment before launching products in any market. This assessment must be completed by an IP or legal professional. IPON's funding program can help offset this cost among other IP expenses.

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Next Steps

I'M AN IPON CLIENT

As a client you have access to the full report and can book time with one of IPON's IP analysts who will help you:

- Validate your corporate planning
- Update your IP strategy
- Determine potential markets
- See how your competitors are positioned with IP
- Learn about the emerging players
- Understand the IP risks and opportunities specific to your business

I'M AN INNOVATOR

We're glad you're interested in learning more about IP. As an innovator in Ontario's ecosystem there are several resources available to help you protect and leverage your IP:

- Apply to be an IPON client to be eligible for tailored IP services and grants
- Learn IP basics through an on-demand self-guided study program
- Reach out to your Regional Innovation Centre to discuss their IP services or mentorship opportunities
- Join IPON for future events and review existing resources such as how to conduct a patent search

I'M A POLICY MAKER

IP is the economic driving force in the 21st century economy. When Ontario companies own and retain IP, communities, cities and the province benefit.

IPON welcomes the opportunity to advise on ways to integrate IP-based decision making such as funding opportunities, strategic planning and IP due diligence frameworks.

Contact your IPON representative today at

info@ip-ontario.ca

For more information, please visit: www.ip-ontario.ca/apply

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