Relecura IP Intelligence Report

Electric Vehicle (EV) Technology

Battery and Charging Patents
Tesla Motors vs. The Rest

Relecura Inc.
www.relecura.com
contact@relecura.com

September 2014

Background

Recent News from the Electric Vehicle (EV) industry:

- Tesla has announced that it will not initiate patent lawsuits against anyone who, *"… in good faith, wants to use our technology*." [Link]
- Tesla and Panasonic are developing nickel based lithium ion battery cells, and are jointly building a large plant to manufacture these batteries. [Link]
- BMW has announced that it is willing to open up it's battery technology patents for use by other companies. [Link]
- Toyota signals a move away from EVs to fuel cell cars. [Link]
- Tesla is credited with reigniting interest in the plug-in EV among large automakers.
- The introduction of Tesla's Roadster in 2006 – a plug-in electric sports car, powered by Li-ion batteries, with a range of over 200 miles per charge and an acceleration of 0-60 miles per hour in under 4 seconds - spurred the large automakers to introduce plug-in EV models. [Link]

This report tries to address questions such as:

- Who are the major patent holders in the EV space and how does their technology IP focus compare with that of Tesla?
- How does Tesla's core IP in battery and charging technology compare with the patent assets of the other major players?
- What seems to be the current technology focus of Tesla, as well as the other companies in the EV space?

Key Findings

Top EV patent holders vs. Tesla (Tech focus in an approximate order of priority)

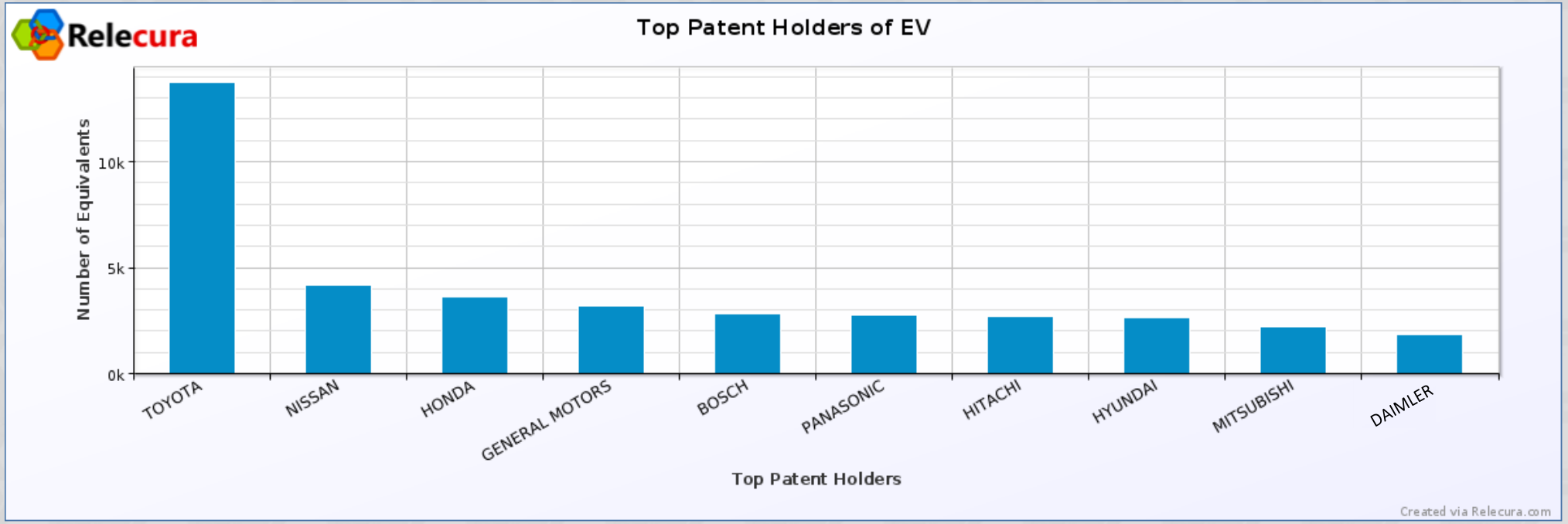
Top EV Players	Tesla
Hybrid vehicles	Plug-in electric vehicles
Fuel cells	Lithium-Ion battery packs
Power transmission components	Fast charging (Supercharging)
Battery control systems	Temperature regulation in batteries
Capacitors	Battery management
Storage systems	Safety systems related to battery charging
Charging cables and connectors	Improving battery life
On-board vehicle charging systems & methods	Reducing damage during charging and discharging

- Top EV patent holders include a mix of automakers and battery manufacturers. The list includes Toyota, Nissan, Honda, General Motors, Bosch, and Panasonic.
- The active markets for EVs are indicated by the preferred jurisdictions for patent filings by the top players. Interestingly China is #1, followed by Japan. The U.S. and Europe are #3 and #4 respectively.
- Sixty percent (60%) of Tesla's patent portfolio is related to battery packs and charging – their key focus area.
- The top Lithium battery patent holders are LG, Bosch, Toyota, Sony, Samsung, and Hitachi (Toyota is the sole automaker in this group).
- In Lithium battery technology, the top players mainly focus on the manufacture of batteries. In comparison Tesla focuses on systems that make their functioning more efficient, such as battery monitoring, temperature control , and safety systems.
- Patent filing trends of the various large automakers seem to suggest that the introduction of Tesla's Roadster in 2006 prompted the auto majors to reboot their EV related development (as indicated by a dip in filings around that time, followed by an increase).
- From their filing history, it would seem that the large automakers are hedging their bets between plug-in EVs and electric or fuel cell hybrids. The are actively filing in both EV and fuel cell related technologies.
- Tesla on the other hand is filing in technologies related to plug-in EVs alone, with an emphasis on a range of technologies related to batteries and charging.
- In spite of a smaller portfolio than the larger players, Tesla (established in 2003) has significant IP related to battery technology (Li-ion), and charging (fast charging).
- General Motors, Audi, Toyota, Ford, Samsung and Panasonic all cite Tesla patents, indicating a likely overlap in their R&D focus.

Table of Contents

Electric Vehicles (EV) - Patent Landscape

EV Technologies – Top Patent Holders

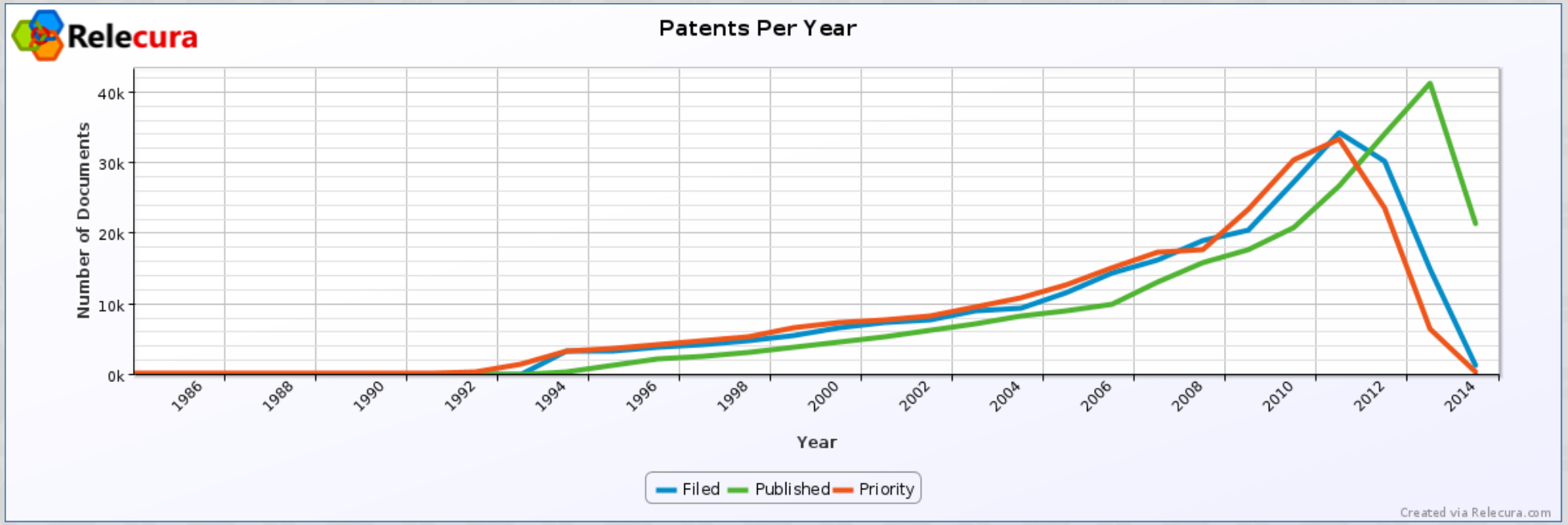


Key finding: Toyota's EV portfolio is by far the largest among the top players.

Table 1 (click link to open Tables PDF) gives a list of the various classification relating to various EV sub-technologies.

*The above results are based on 323,960 relevant patent documents for EV technologies comprising of 161,183 equivalents**.*
*** An **EQUIVALENT** refers to a set of patent filings for a single invention.*

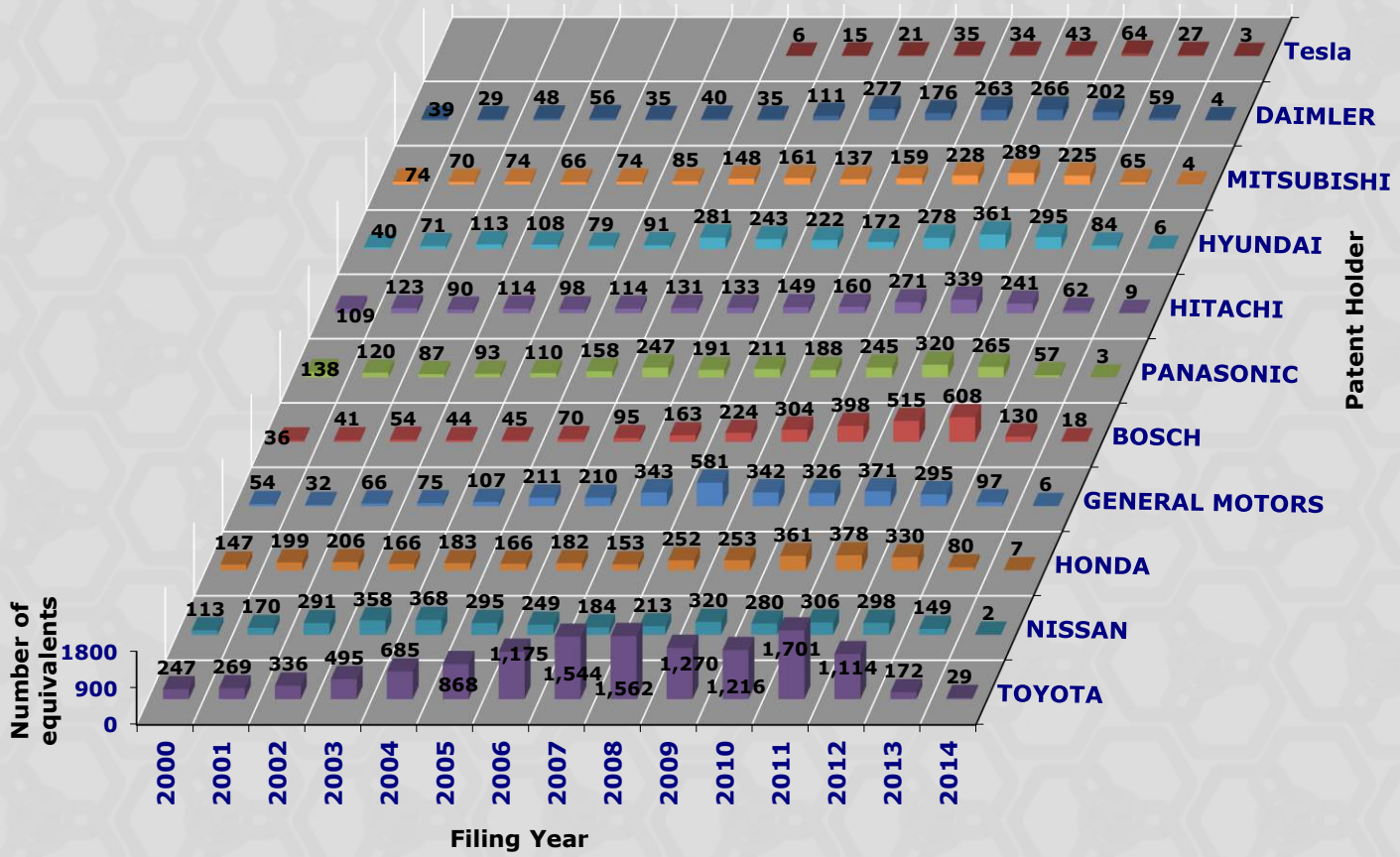
EV Technologies – Filing Trends (Overall)



Key finding: The patent filings in EV technology have continuously increased over time from the mid '90s.

The decline in filings post 2012 is most likely due to unpublished applications.

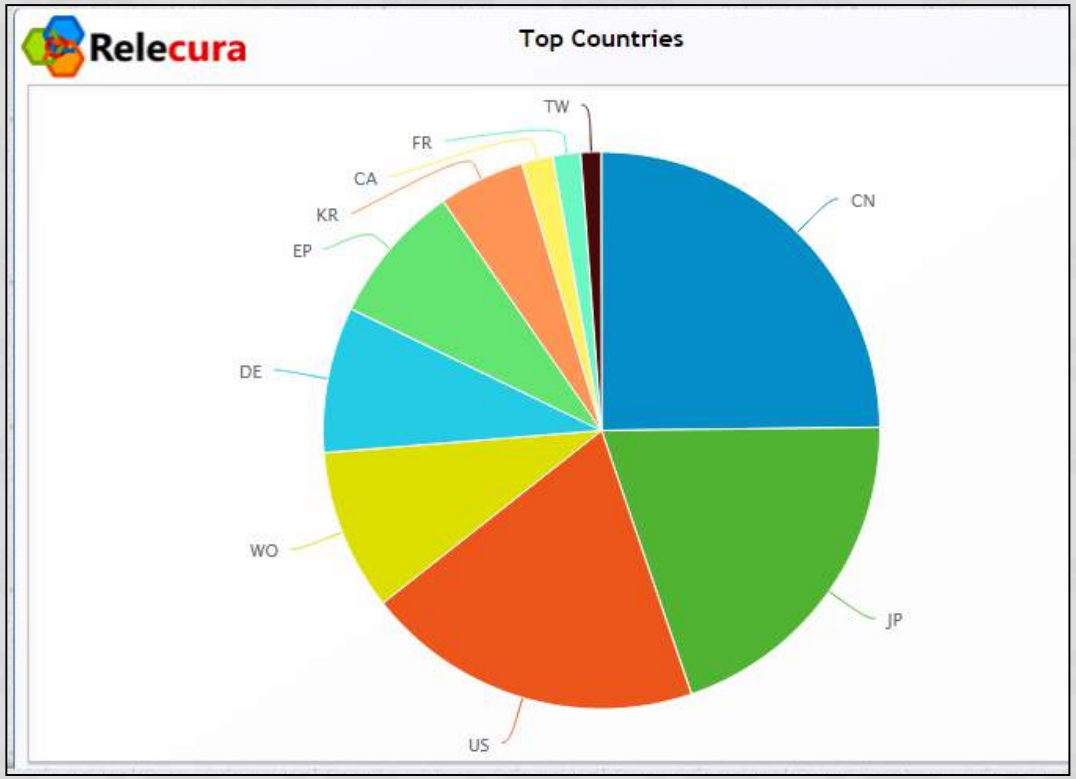
EV Technologies – Filing Trends (Top Holders)



Key Findings:

- Most of the top patent holders began filing prior to 2000.
- Tesla's earliest patent filing was in 2006.
- Daimler and Hyundai show an increase in patent filings post 2006 – perhaps indicating a greater emphasis in EV technologies.
- The same can be said to a lesser extent about the other large players – both automakers and battery manufacturers
- As an aside – Tesla introduced their first model, The Roadster, in 2006 – creating a buzz which caused the large automakers and battery manufacturers to reboot their EV-related development.

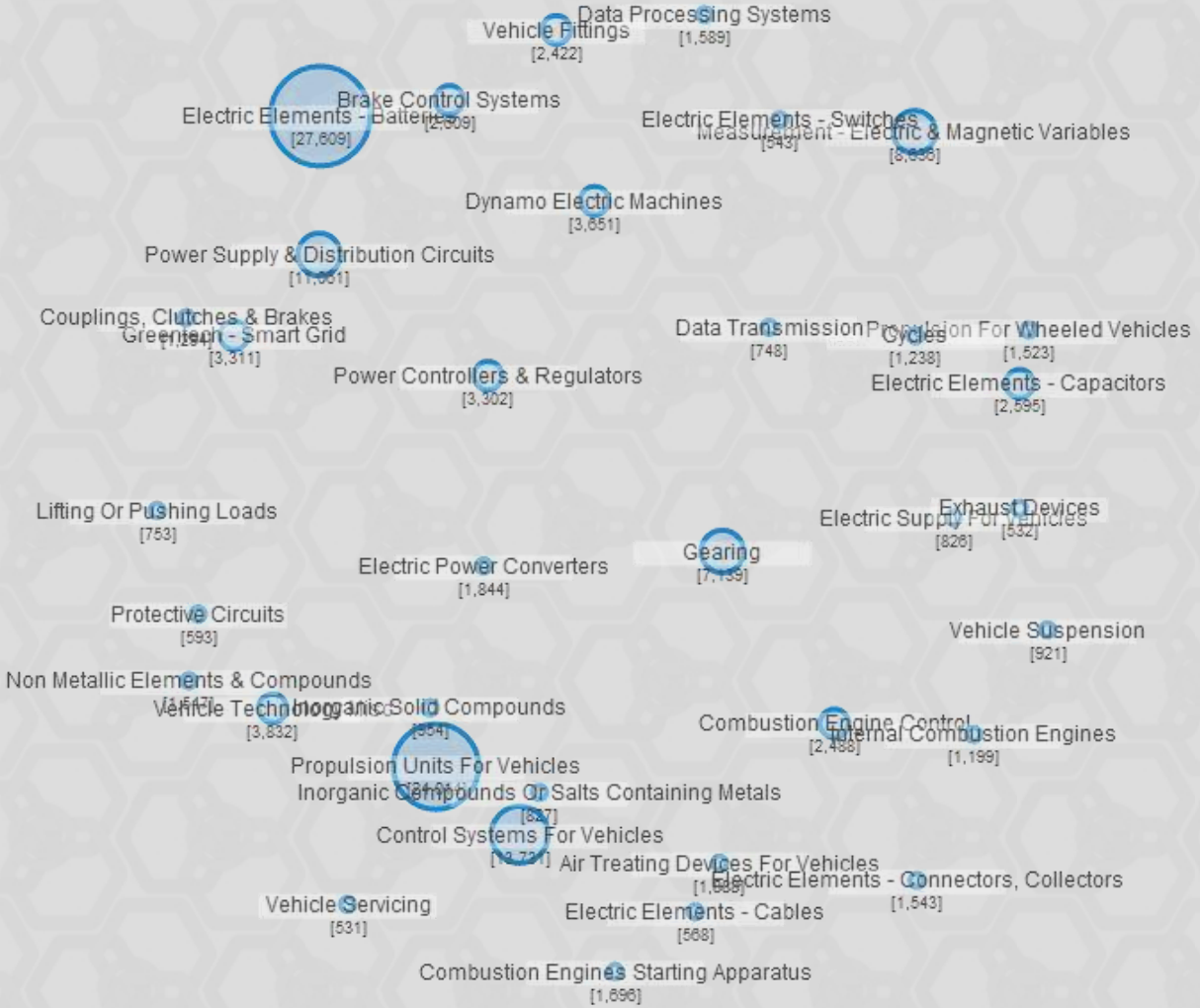
EV Technologies - Filings by Jurisdiction



Country Code	Country	Number of Applications
CN	China	59428
JP	Japan	47750
US	USA	46916
DE	Germany	20272
EP	Europe	19578
KR	Korea	11999
CA	Canada	4323
FR	France	3866
TW	Taiwan	2831

Key Finding: The large number of filings in China, Japan, U.S. clearly indicates the markets of interest for the top players.

Electric Vehicles (EV) – Technology Categories



Key Findings:

- Batteries, power supply systems, propulsion, and control units are the top segments for patents in EV technologies.
- Other technologies covered include electric elements, automotive components like gears, couplings, clutches & brakes, electric cables and materials related to batteries, safety devices, exhaust devices, vehicle fittings and servicing.

The size of the bubble represents the number of patents and the positioning of the circles represents the relatedness of the technologies.

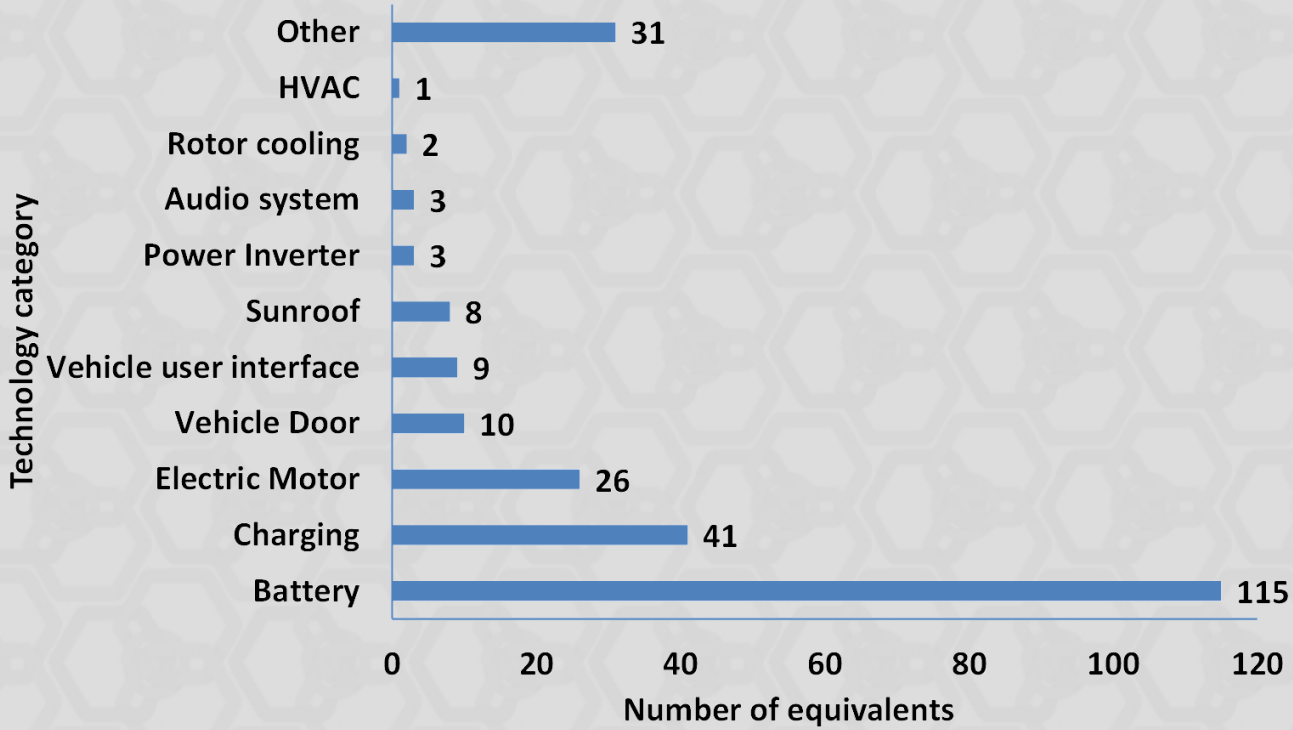
EV Technologies – Category counts (Equivalents)

Relecura Technology Category	No of Equivalents
Electric Elements - Batteries	27,609
Propulsion Units For Vehicles	24,014
Control Systems For Vehicles	13,731
Power Supply & Distribution Circuits	11,061
Measurement - Electric & Magnetic Variables	8,636
Gearing	7,139
Vehicle Technology Misc	3,832
Dynamo Electric Machines	3,651
Greentech - Smart Grid	3,311
Power Controllers & Regulators	3,302
Brake Control Systems	2,609
Electric Elements - Capacitors	2,595
Combustion Engine Control	2,488
Vehicle Fittings	2,422
Air Treating Devices For Vehicles	1,888
Electric Power Converters	1,844
Combustion Engines Starting Apparatus	1,696
Data Processing Systems	1,589

Relecura Technology Category	No of Equivalents
Non Metallic Elements & Compounds	1,547
Electric Elements - Connectors, Collectors	1,543
Propulsion For Wheeled Vehicles	1,523
Couplings, Clutches & Brakes	1,294
Cycles	1,238
Internal Combustion Engines	1,199
Inorganic Solid Compounds	954
Vehicle Suspension	921
Inorganic Compounds Or Salts Containing Metals	827
Electric Supply For Vehicles	826
Lifting Or Pushing Loads	753
Data Transmission	748
Protective Circuits	593
Electric Elements - Cables	568
Electric Elements - Switches	543
Exhaust Devices	532
Vehicle Servicing	531

Tesla Motors - Patent Portfolio Analysis

Tesla Portfolio – Technology Spread

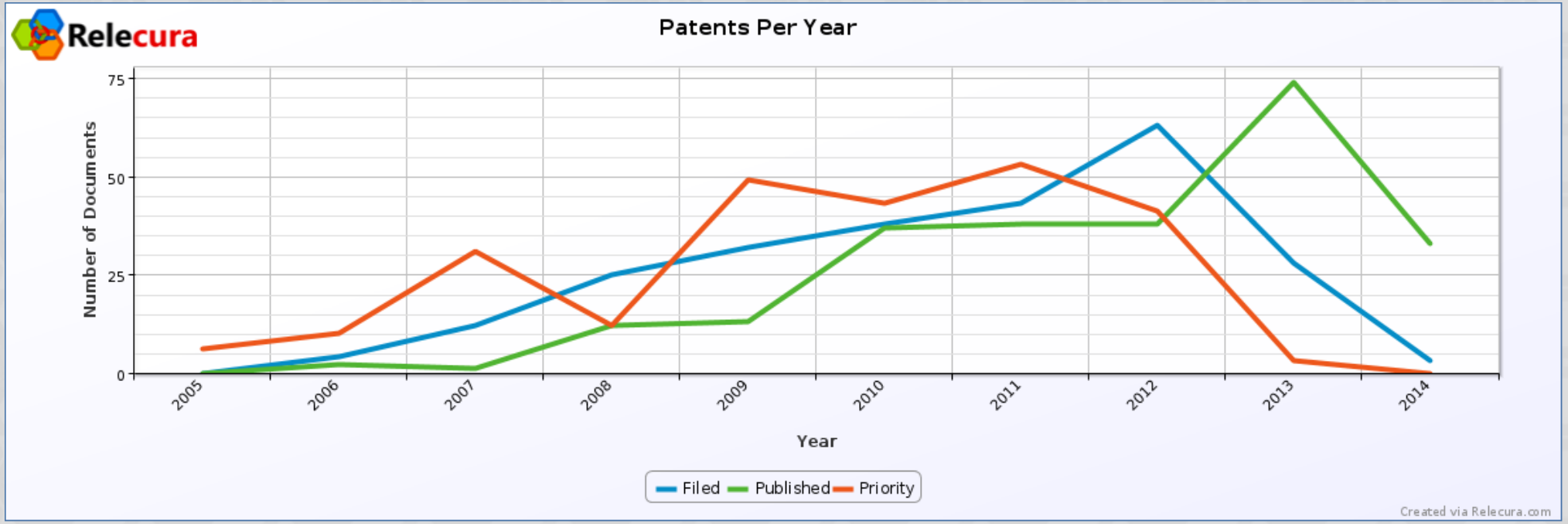


Click to view Tesla Portfolio present in Relecura

Key finding: Approximately 60% of Tesla's patent portfolio is related to battery packs and charging.

- *Tesla has a total of 655 patents resulting in 249 equivalents including 8 design patents.*
- *Tesla currently holds 311 documents (142 eq.) and has assigned 343 documents (168 eq.) to PNC Bank as security.*
- *Joint patent holdings: Tesla + Nishikawa Rubber Co. Ltd. - 7 documents (2 equivalents), Tesla + Toyota – 1 document.*

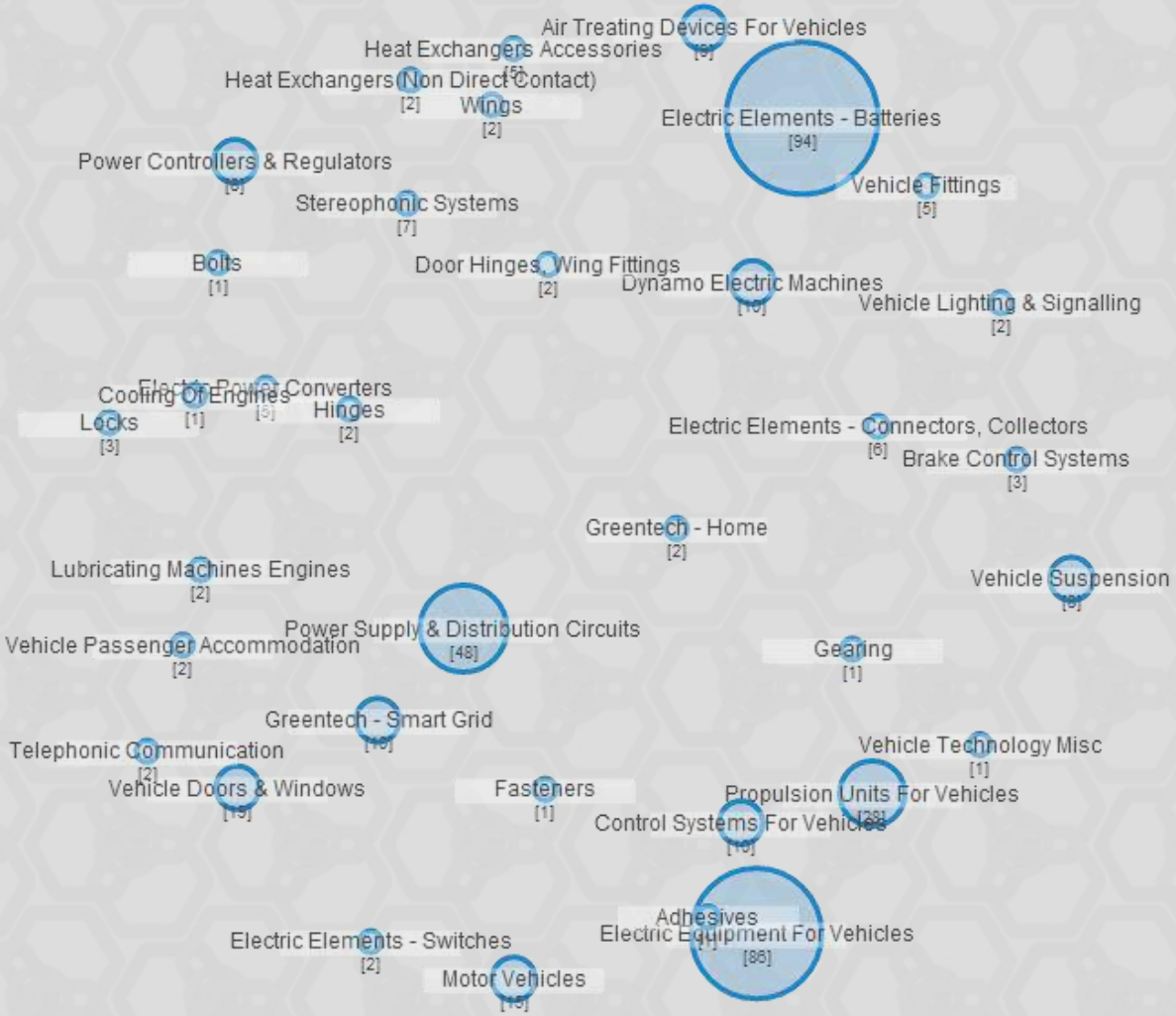
Tesla Portfolio – Filing Trends



Key finding: Tesla started filing patents in 2005 with a sharp rise filing in 2011.

The decline post 2012 is most likely due to unpublished patent applications.

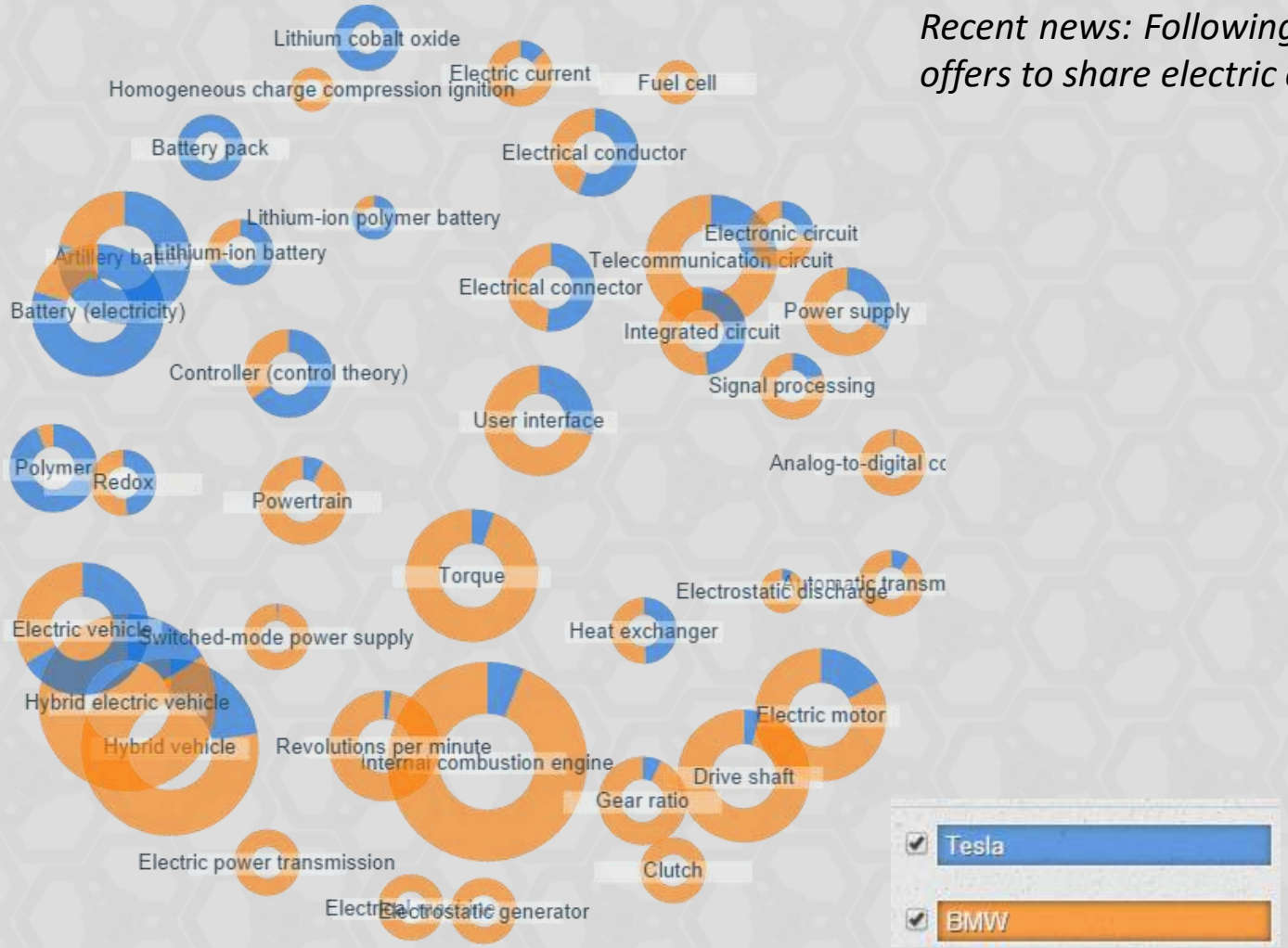
Tesla Portfolio – Technology Categories



Key Finding: Batteries, charging (power supply and distribution circuits), and electric equipment for vehicles are the IP technology focus of Tesla.

The size of the bubble represents the number of patents and the positioning of the circles represents the relatedness of the technologies.

Portfolio Comparison - Tesla vs. BMW
(Absolute Counts)



Recent news: Following in Tesla's footsteps, BMW offers to share electric car technology. [Link]

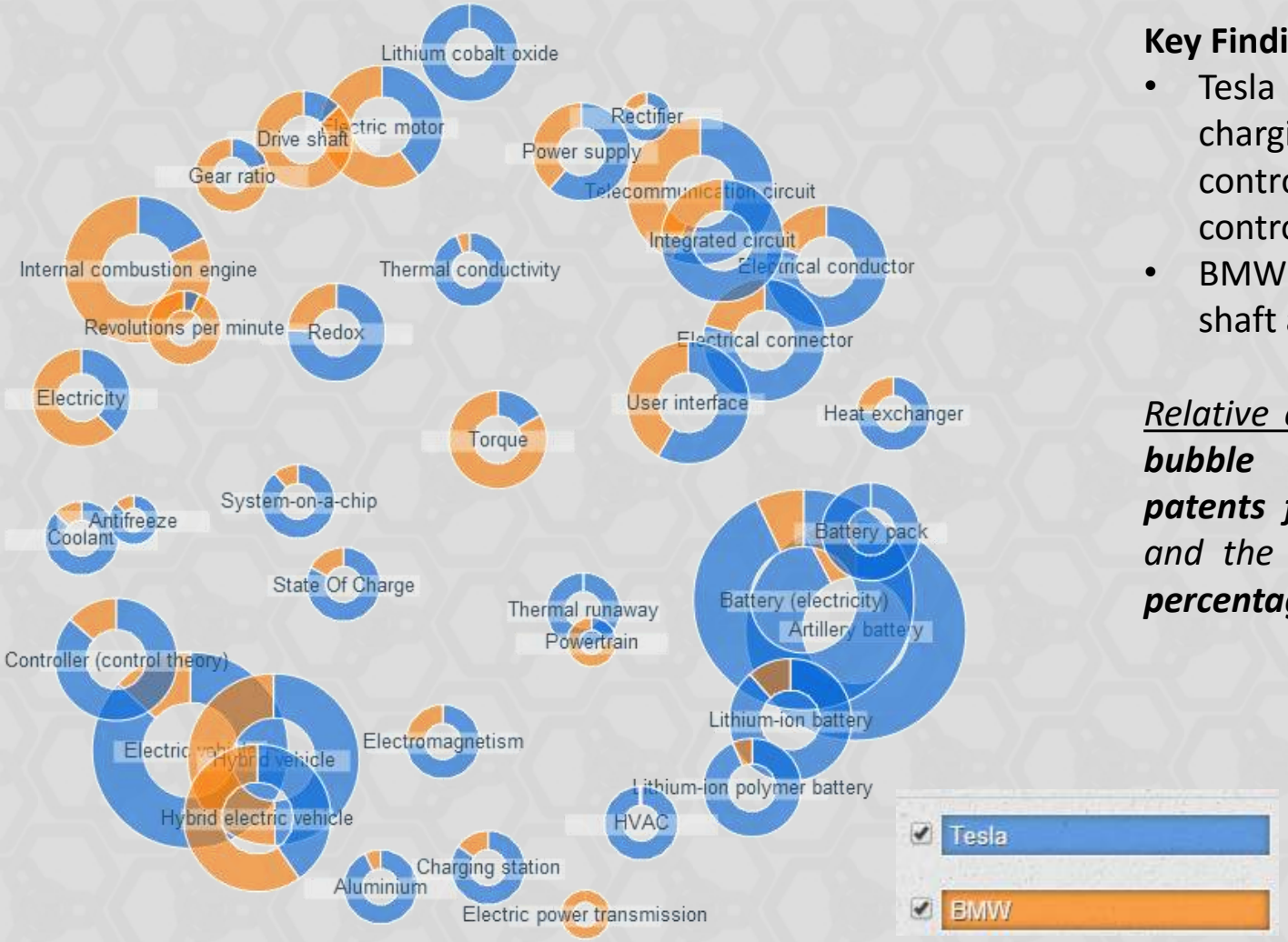
Tesla has 248 patent equivalents and BMW has 839 patent equivalents in EV technology.

Key Findings:

- Tesla has a larger number of patents addressing batteries, battery packs, Li batteries and controllers.
- BMW leads in terms of filings for hybrid vehicles, internal combustion engines, electric motors, fuel cells, and power trains.

*Absolution count comparison: The **size of each bubble** represents the **total number of patent equivalents across portfolios** and the **colored sectors** represent **relative number of equivalents in their respective portfolios.***

Portfolio Comparison - Tesla vs. BMW
(Relative Emphasis)



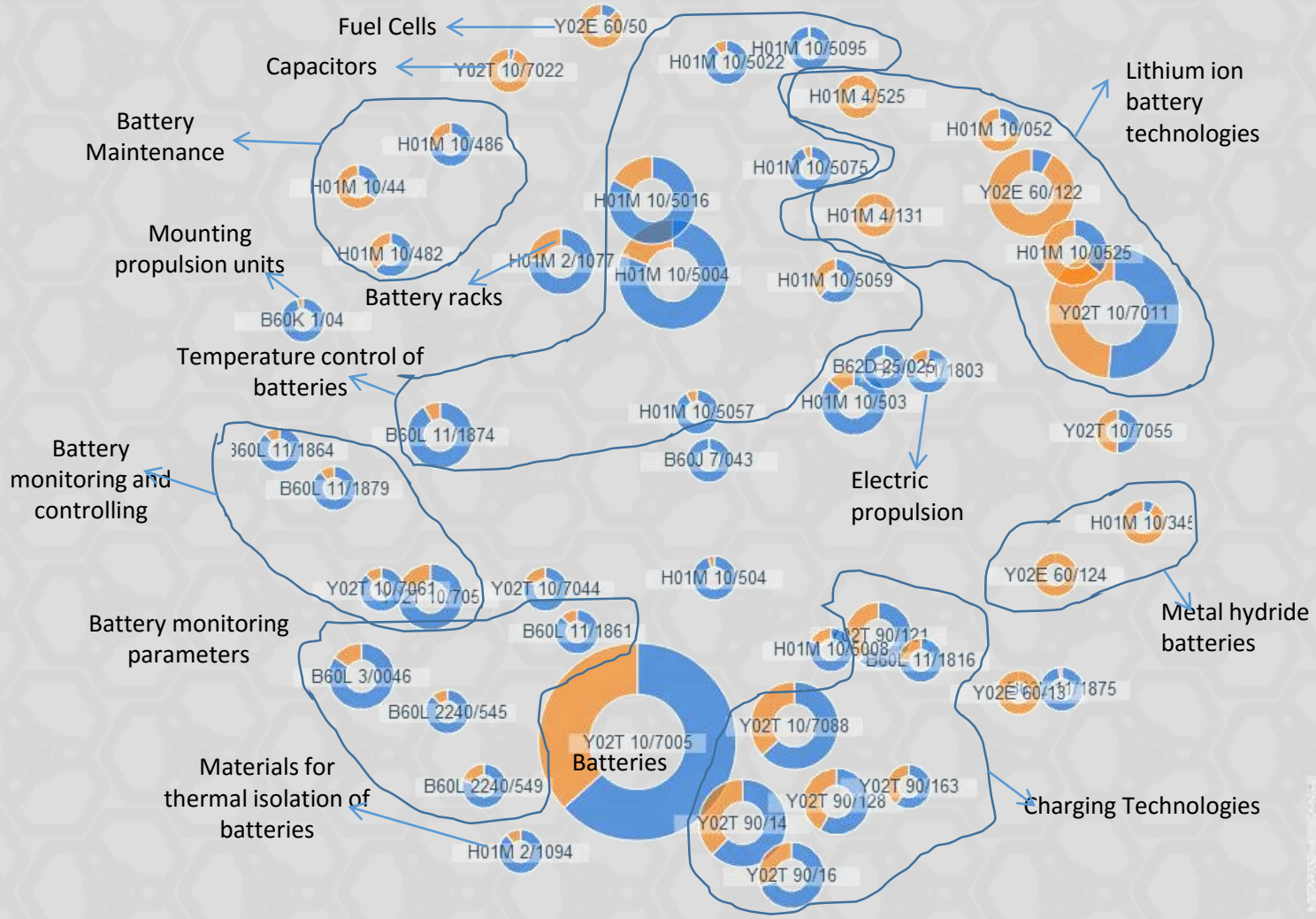
Key Findings:

- Tesla has a stronger emphasis on battery, charging methods, Lithium batteries, controlling state of charge, and thermal control mechanisms.
- BMW focuses on electric motor, gear, drive shaft and hybrid vehicles.

*Relative emphasis comparison: The **size of each bubble** represents the **percentage of total patents for each technology across portfolios**, and the **colored sectors** represent the **relative percentages in the respective portfolios**.*

The Topic Maps in the subsequent slides will solely display the relative emphasis of the compared portfolios - as shown here.

Portfolio Comparison - Tesla vs. Panasonic



Recent news: Tesla, Panasonic join forces on huge battery plant. [Link]

Key Findings:

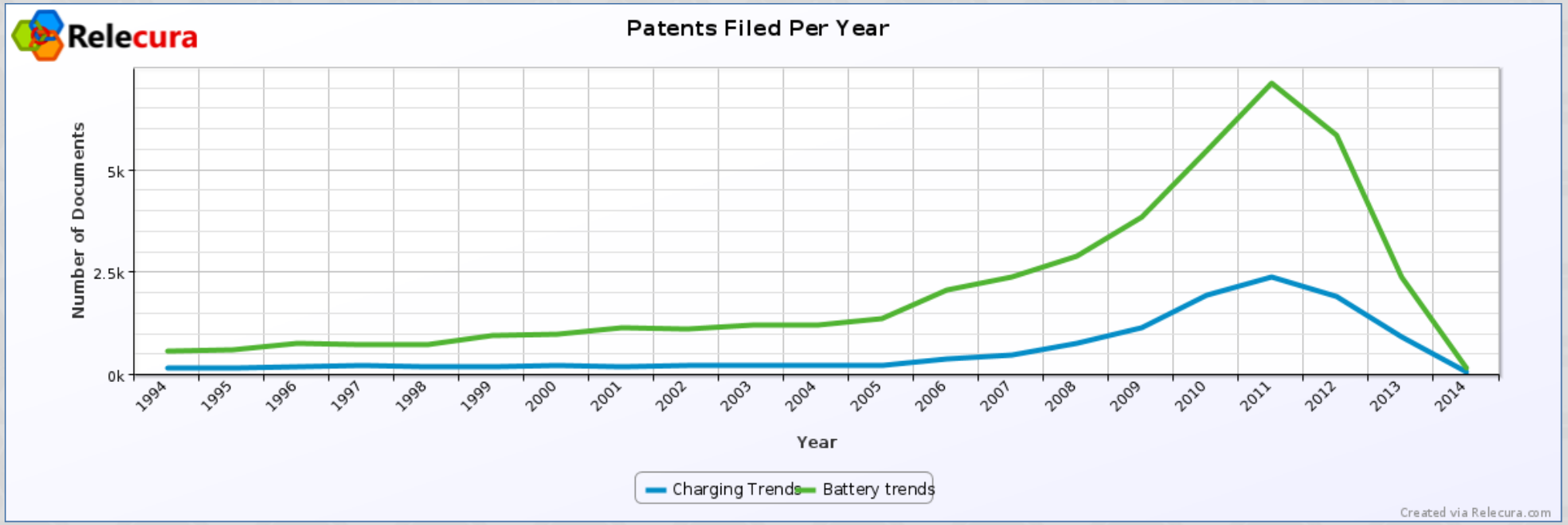
- Panasonic's concentration has been on Lithium ion batteries, metal hydride batteries, fuel cells and capacitors.
- Tesla's focus has been on charging technologies (very strong), temperature control, battery monitoring and control, battery monitoring parameters, materials for thermal isolation of batteries and battery racks.
- *Table 2 gives the descriptions of the CPC codes in the Topic Map.*

The size of each bubble represents the percentage of total patents for each CPC code across portfolios, and the colored sectors represent the relative percentages in the respective portfolios.

EV Technologies - Tesla vs. The Rest
Portfolio Counts and Ranks

Patent Holder	Electric Vehicles (overall)		Battery		Charging		Lithium Battery	
	Number of Equivalents	Ranking	Number of Equivalents	Ranking	Number of Equivalents	Ranking	Number of Equivalents	Ranking
Toyota	13,733	1	3,733	1	854	1	157	3
Nissan	4,165	2	1,020	3	236	4	34	15
Honda	3,644	3	1,208	2	248	2	16	25
General Motors	3,220	4	882	4	185	6	68	10
Bosch	2,828	5	828	5	92	17	162	2
Panasonic	2,760	6	527	11	238	3	29	18
Hitachi	2,681	7	595	9	100	12	93	6
Hyundai	2,613	8	780	6	137	8	9	38
Mitsubishi	2,218	9	583	10	206	5	20	21
Daimler	1,843	10	600	8	85	18	84	7
Tesla	249		115	40	41	37	49	11

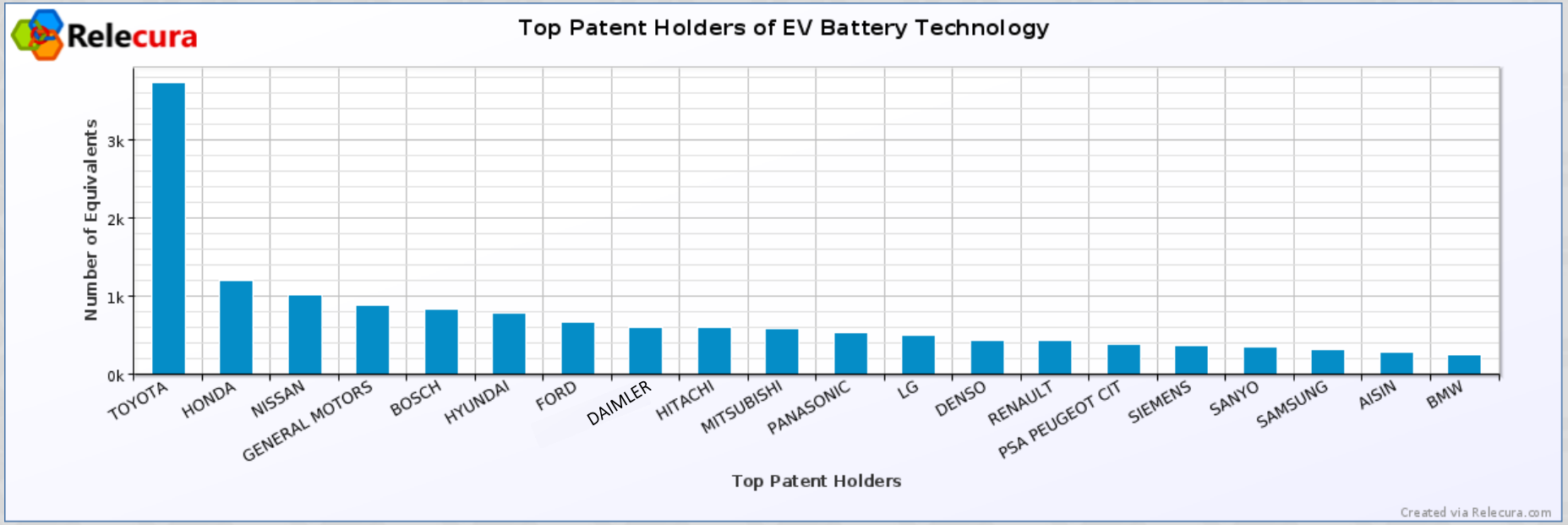
EV Battery and Charging Technologies – Filing Trends (Overall)



Key Finding: Both technologies have grown in tandem over the last 20 years, with the rate of filing in batteries leading that of charging technologies.

EV Battery Technology - Patent Portfolio Analysis

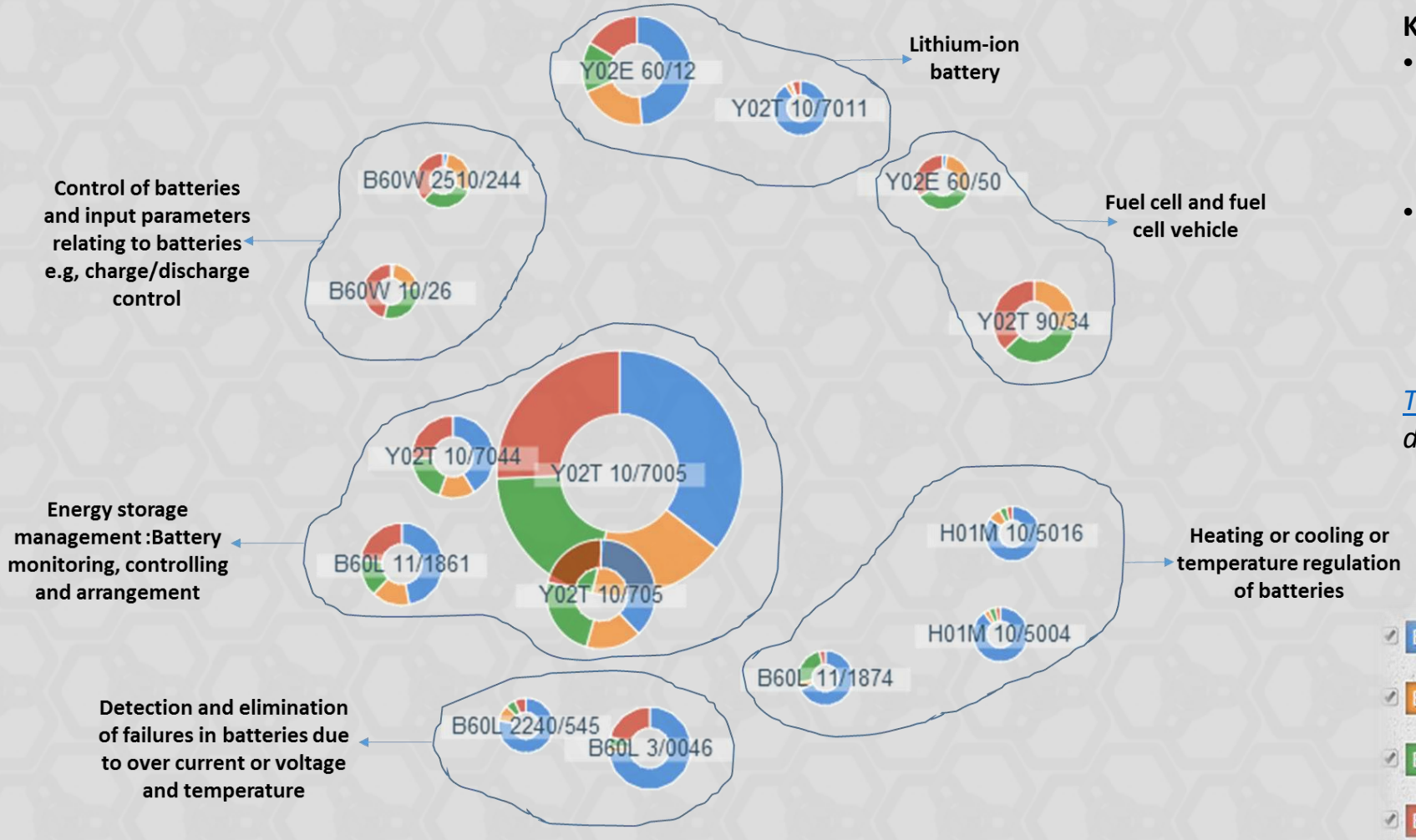
EV Battery Technology – Top Patent Holders



Smaller Patent Holders	Equivalents
Aisin Seiko	280
Chery Automobile	190
BYD Co. Ltd.	171
Johnson Controls	82
Aerovironment	63
Boston Power	9

Key Finding: The top patent holders include automobile-related companies like Toyota, Honda, Nissan, General Motors, Hyundai, and Bosch, as well as battery manufacturers like Panasonic, LG, Sanyo, and Samsung.

EV Battery Portfolio - Tesla vs. Nissan, Honda, Toyota

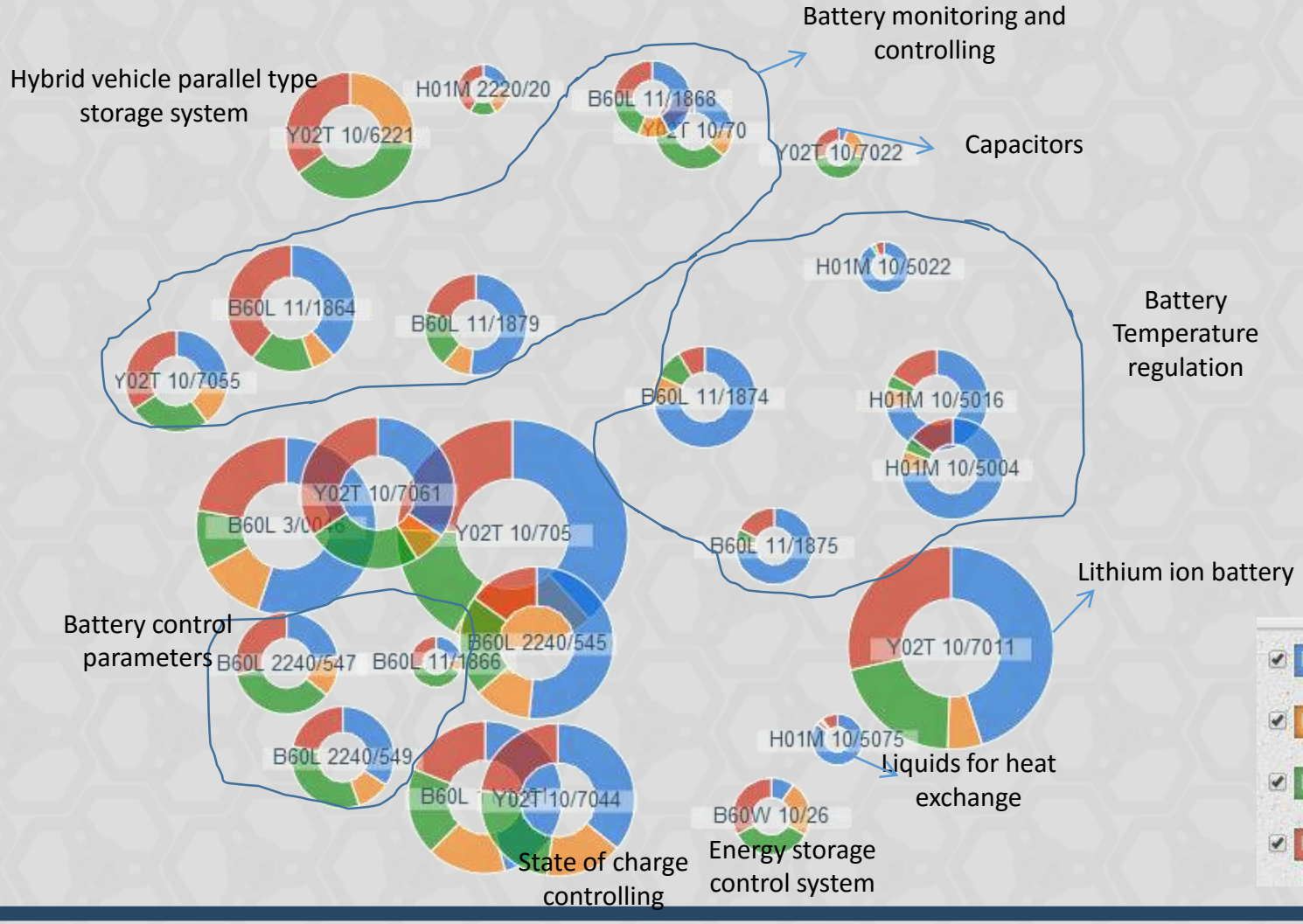


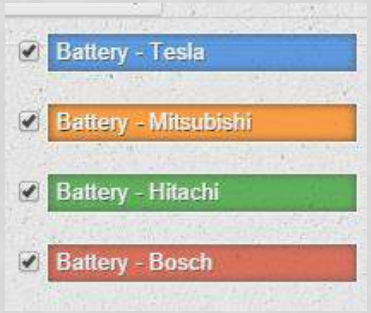
Key Findings:

- Tesla has a strong portfolio in the areas of Lithium-ion battery packs, battery temperature regulation, failure detection and elimination, and battery management.
- In comparison, the large automakers have a greater number of patents addressing fuel cells and fuel cell vehicles, battery control systems for charging/discharging.

Table 5 gives descriptions of CPC codes displayed.

EV Battery Portfolio - Tesla vs. Mitsubishi, Hitachi, Bosch



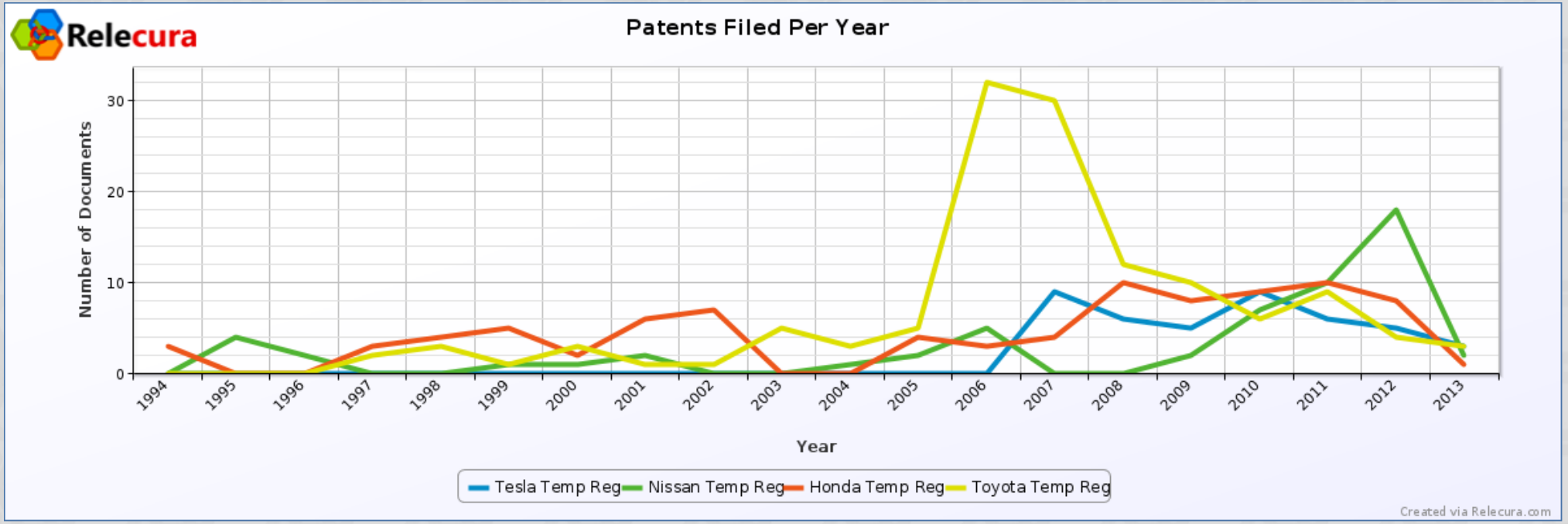


Key Findings:

- Tesla has a stronger emphasis in the areas of battery temperature regulation and Li-ion batteries.
- Tesla's focus is less in technologies related to capacitors and hybrid vehicle storage systems.
- Mitsubishi's portfolio has less of a focus on Li-ion batteries compared to Tesla and the other players shown.

Table 6 provides descriptions of the CPC codes shown in the Topic Map.

Temperature Regulation Patents *(Major Automakers)* -
Tesla vs. Nissan, Honda, Toyota

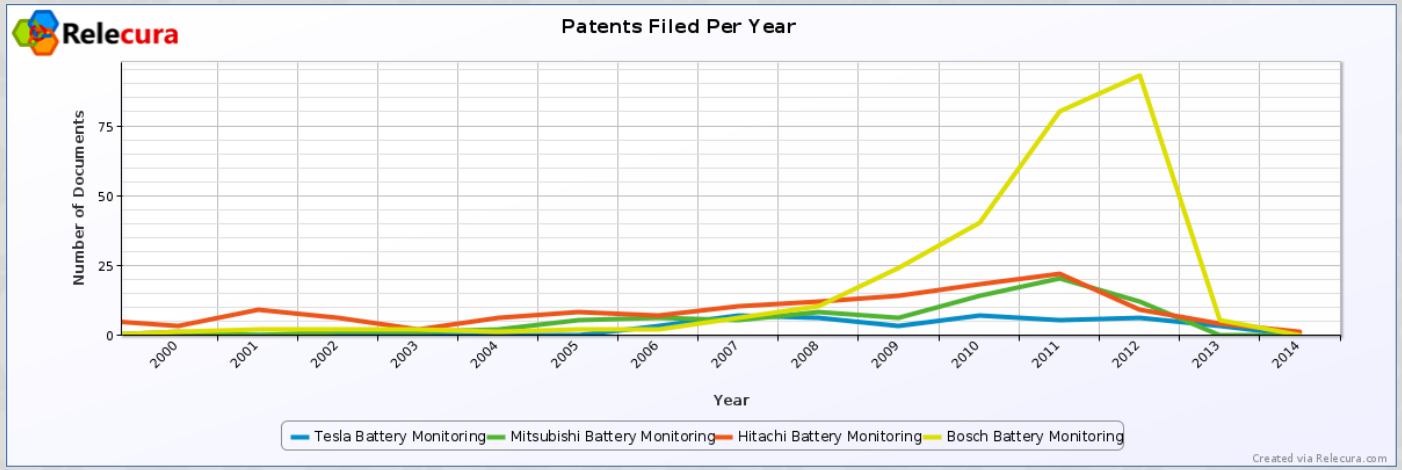


Key Findings:

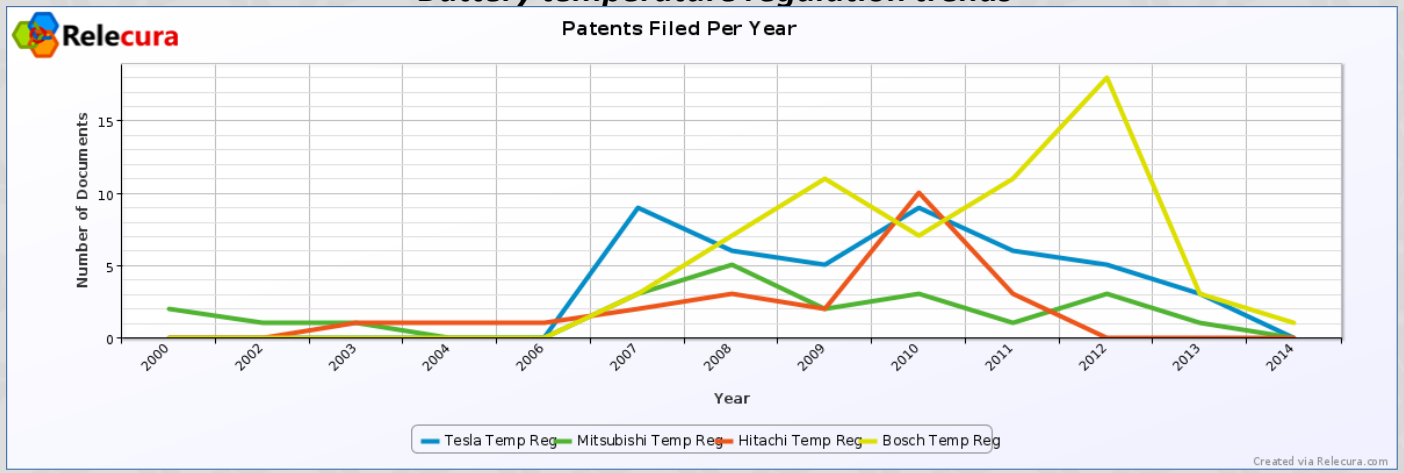
- Toyota leads the way in filing patents in this area, though it has tapered off in recent years.
- Tesla portfolio compares favorably with the other top patent holders in this area.

Temperature Regulation Patents *(Battery Manufacturers)* – Tesla vs. Mitsubishi, Hitachi, Bosch

Battery monitoring & controlling trends



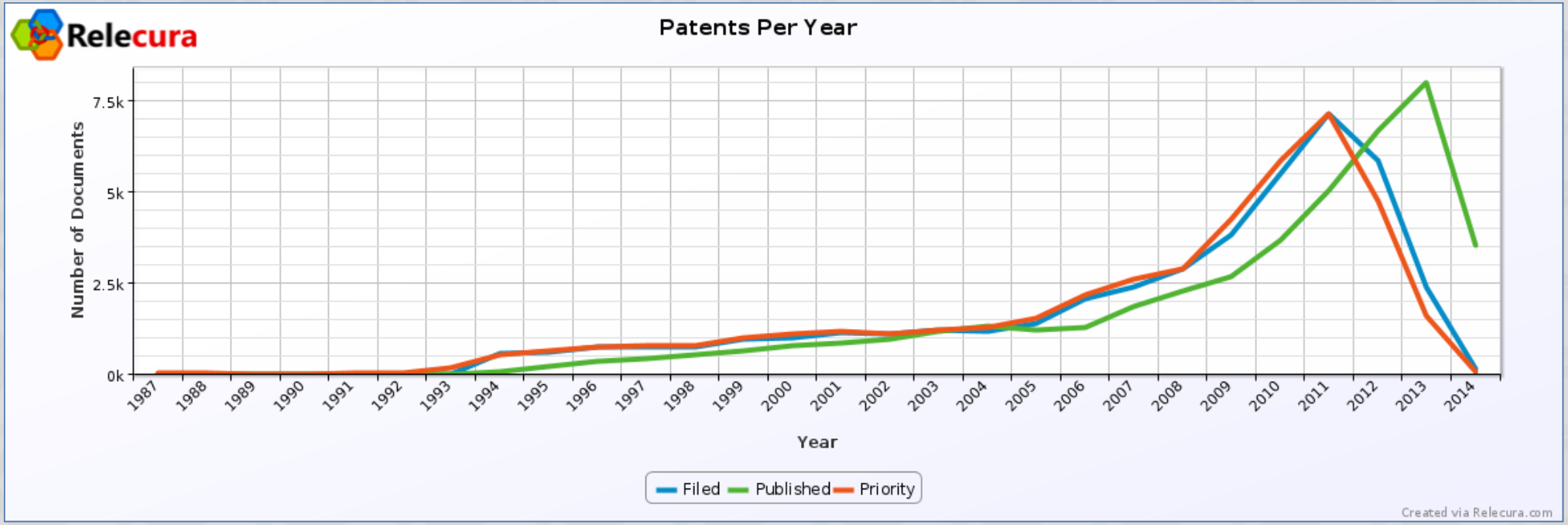
Battery temperature regulation trends



Key Findings:

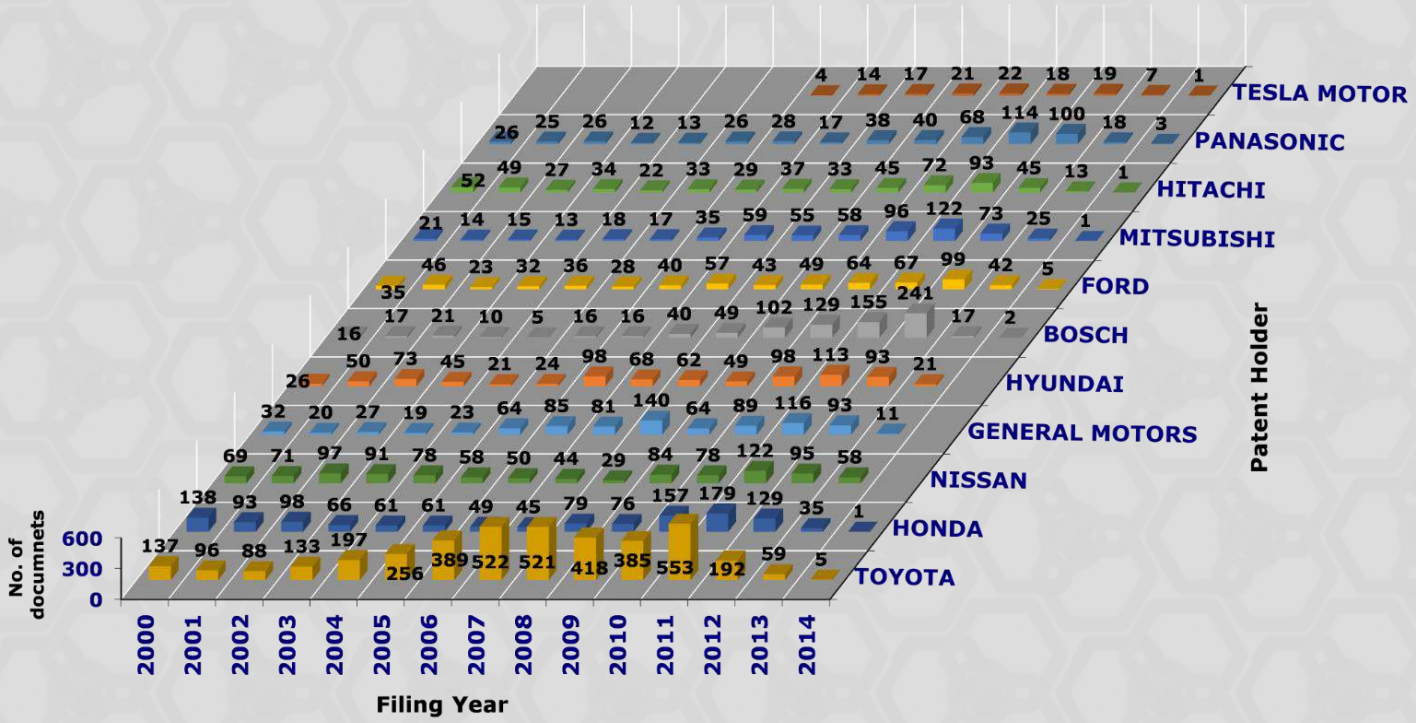
- Bosch leads in patent filings for both of these sub-technologies.
- Tesla has been actively filing patents in battery temperature regulation since 2006.

EV Battery Technology - Filing Trends



Key Finding: Patent filings in battery technology have seen a significant growth post 2006.

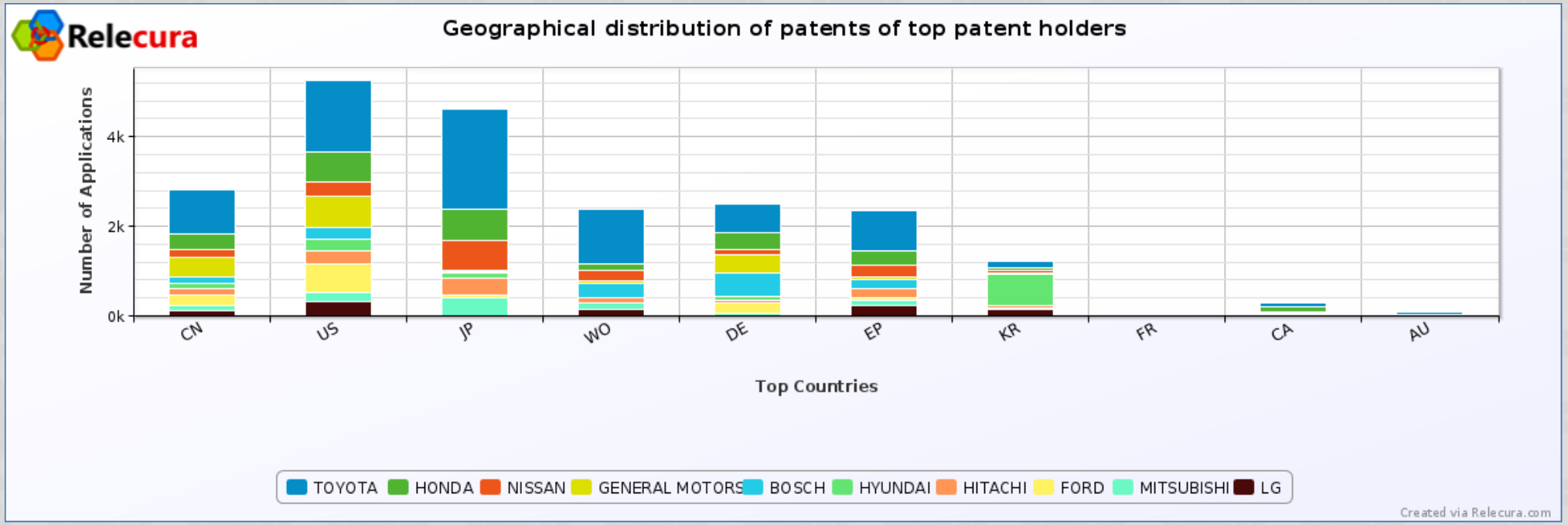
EV battery Technology – Filing Trends (Top holders)



Key Findings:

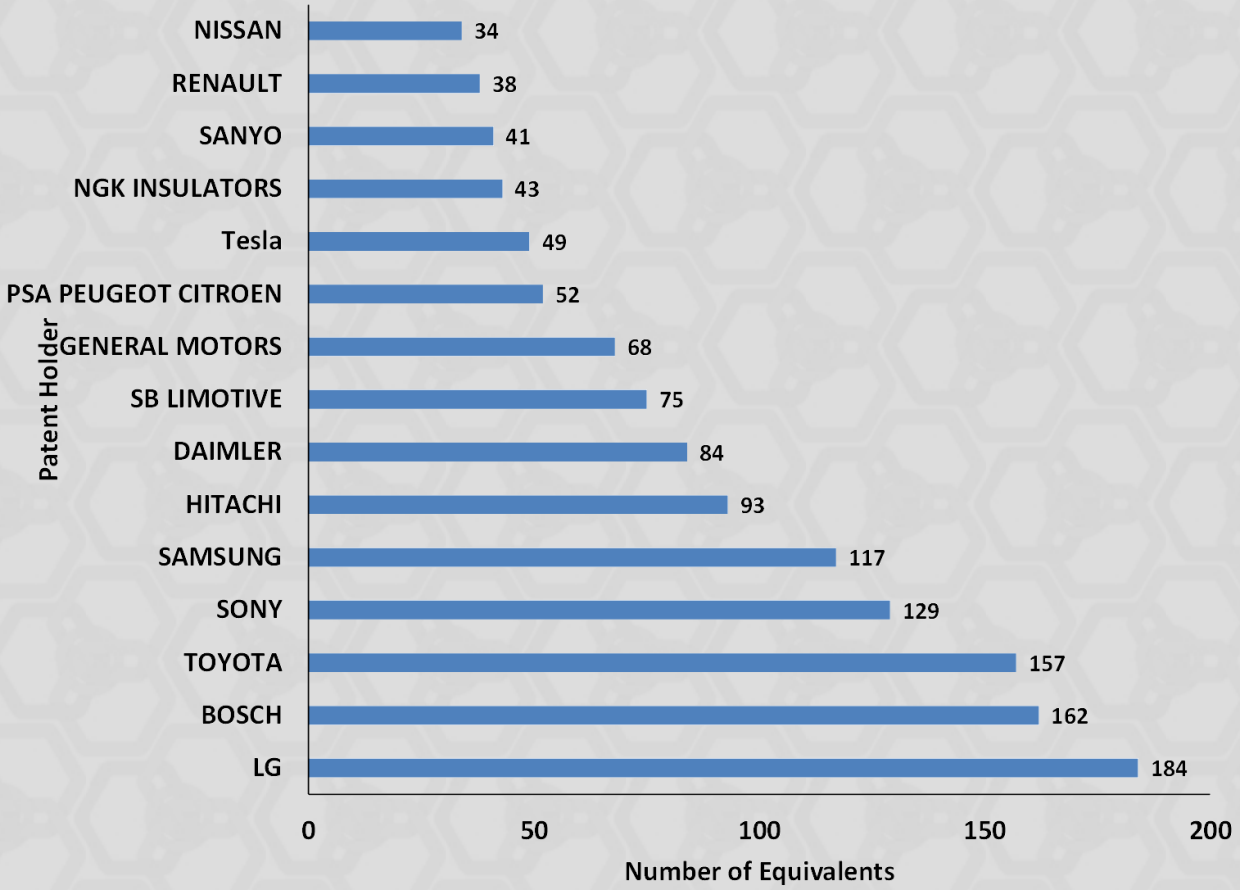
- Toyota, Honda, and Nissan have shown a steady increase in their filing activity for this area, especially since 2008.
- The patent filings of General Motors have tapered since 2008, the year in which they were the top filer for this sub-technology.
- Tesla has been filing consistently in this area, though the number of patents filed per year is lower than that of the top patent holders.

EV Battery Technology – Filing by Jurisdiction



Top patent holders	Filing jurisdictions (indicates markets of interest)
Toyota	U.S., Japan, China, Europe, Korea, PCT
Nissan, Honda	U.S., Japan, China, Germany, Europe, Canada, Australia
Hyundai	Korea, U.S., Japan
Hyundai	Korea (majority of its filings), U.S., Japan
Bosch	Germany (majority of its filings), PCT, U.S., China

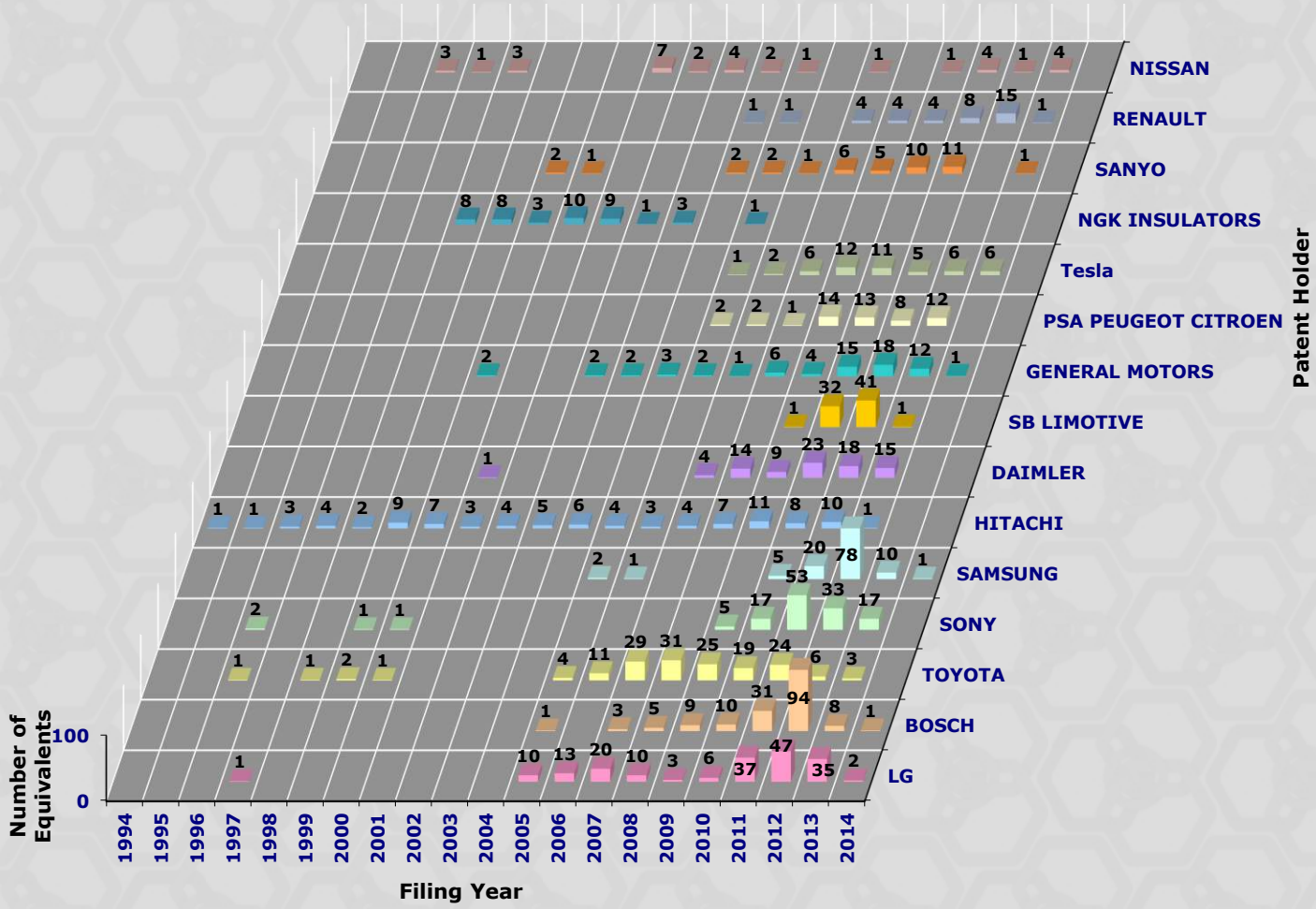
Li-ion Battery Technology – Top patent holders



Key Findings:

- Pure-play battery manufacturers like LG, Bosch, Sony, Samsung, and Hitachi, lead the major automakers in terms of patents filed in this area.
- Of the automakers, Toyota has the largest portfolio of Li-ion battery patents (overall 3rd highest, after LG and Bosch).

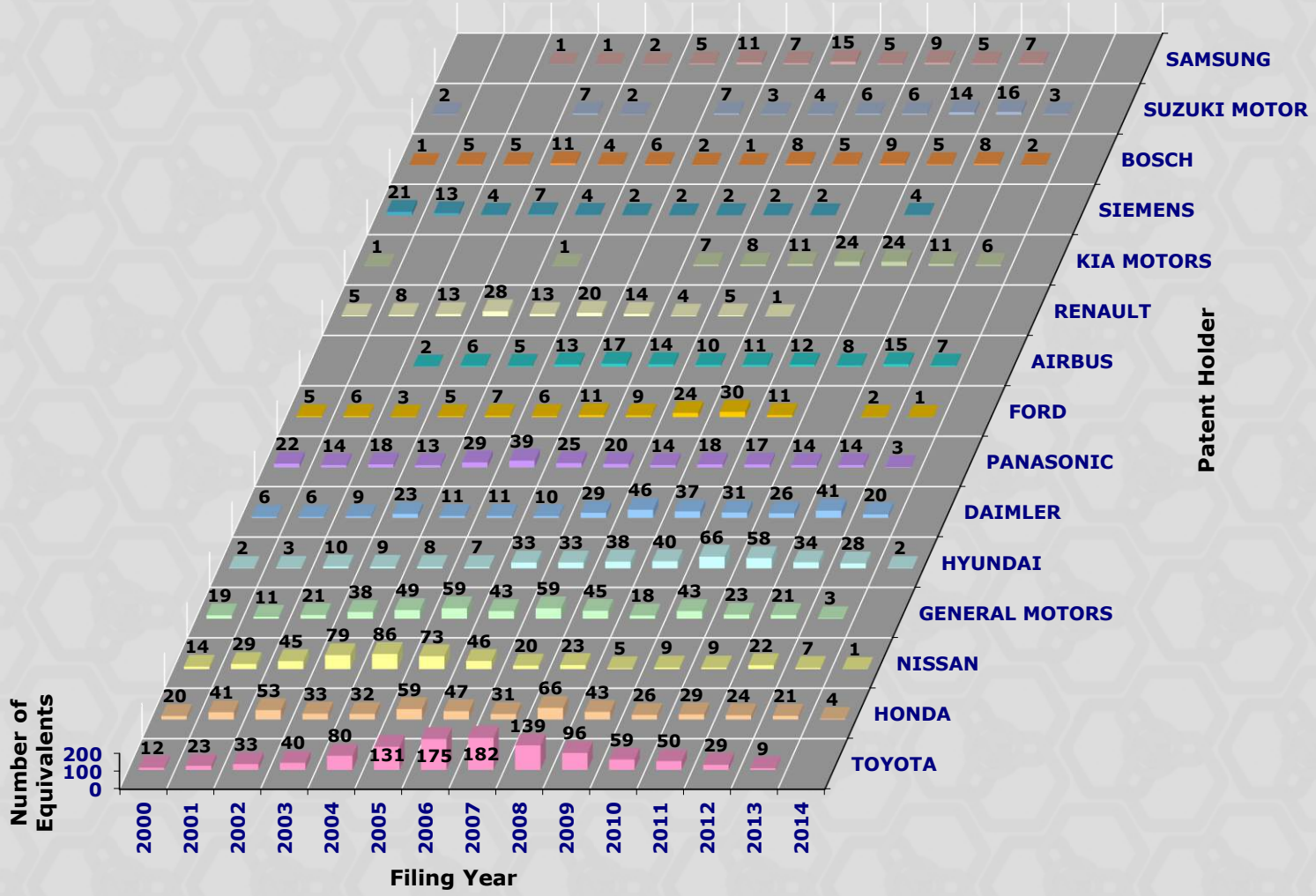
Li-ion Battery – Filing Trends (Top holders)



Key Findings:

- Most of the top players began filing patents in this area around 2005.
- Toyota (which leads in total number of Li-ion patents among the automakers), has tapered off its filings in this area. This might signal a move away from EVs to other technologies such as fuel cell cars. [see news article]

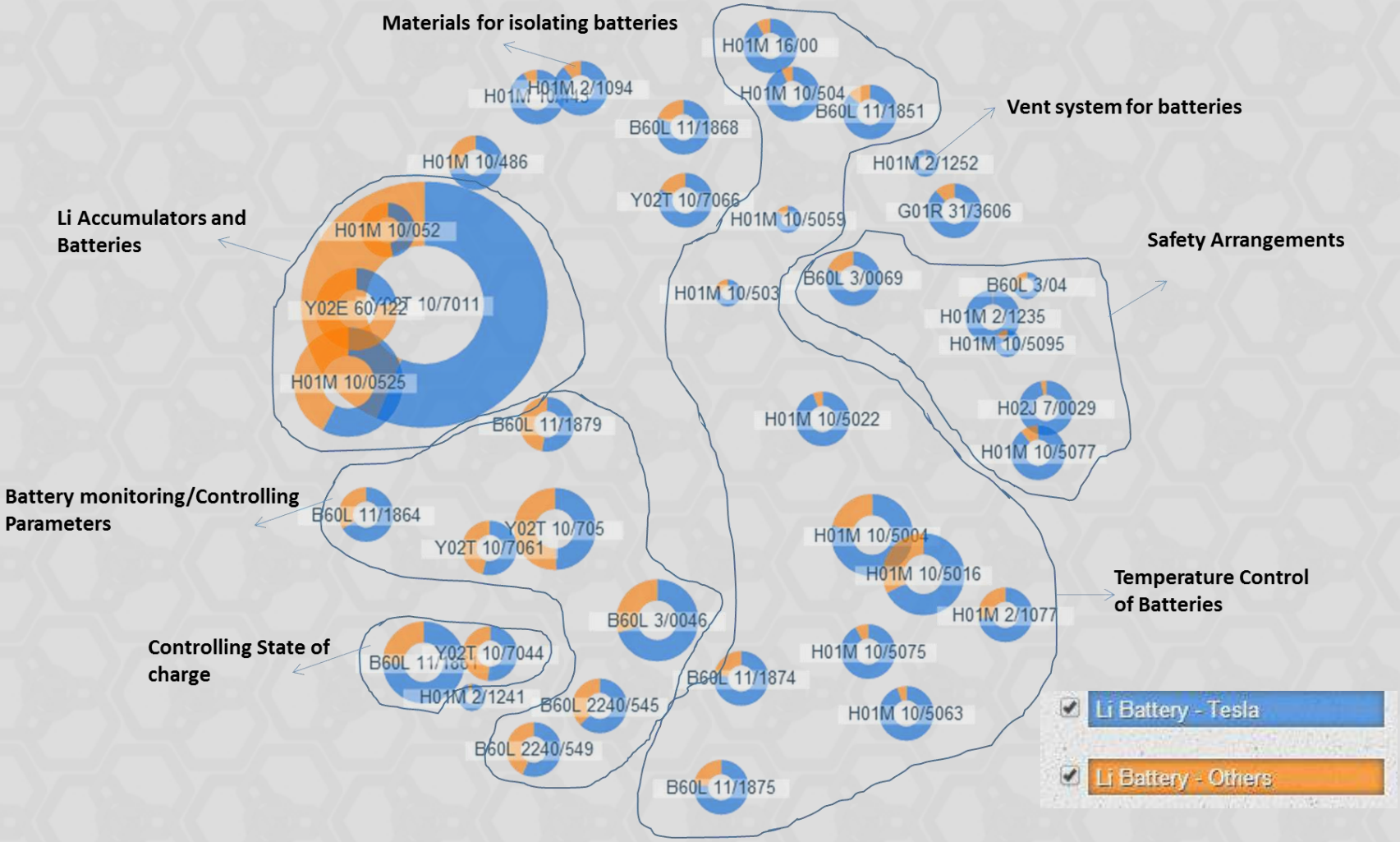
Fuel Cells – Filing Trends (Top holders)



Key Findings:

- Several of the large automakers, like Toyota, Honda, Hyundai, Ford, and Renault, have filed for patents in fuel cells.
- The number of patents filed by these automakers have however decreased in recent years.
- Toyota, Bosch, General Motors, Nissan, Daimler, Renault, and Samsung seem to be hedging their bets by filing in both Li-ion batteries and fuel cells.
- Tesla has no patent filings in this area.

Li-ion Battery Patents - Tesla vs. Others

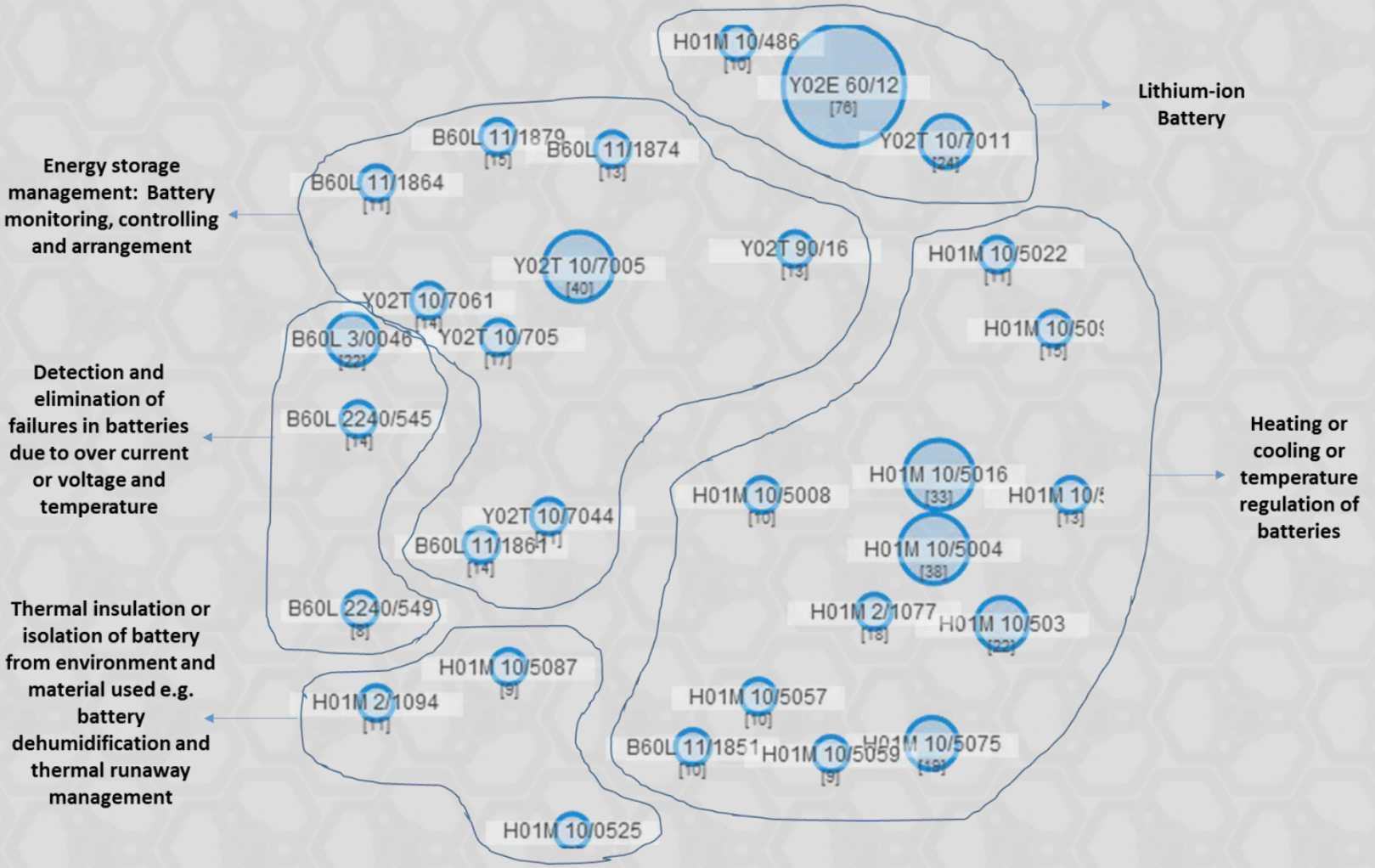


Key Findings:

- Sub-technology spread for Li-ion battery patents - Li accumulators, temperature control, vent systems, safety arrangements, battery isolation, battery monitoring and controlling parameters, state of charge controlling technologies.
- Tesla focus: temperature control, safety arrangements, vent systems, state of charge controlling in Li batteries.
- Focus of other players: Li accumulators and Li battery manufacturing.

Table 7 gives descriptions of the CPC codes displayed.

Tesla - EV Battery Portfolio



Key Finding: Tesla's EV battery portfolio covers sub-technologies like Li-ion battery packs, battery monitoring and control systems, temperature regulation i.e. heating or cooling of batteries, detection and elimination of failures related to batteries, battery protection systems like dehumidifiers and thermal runaway management.

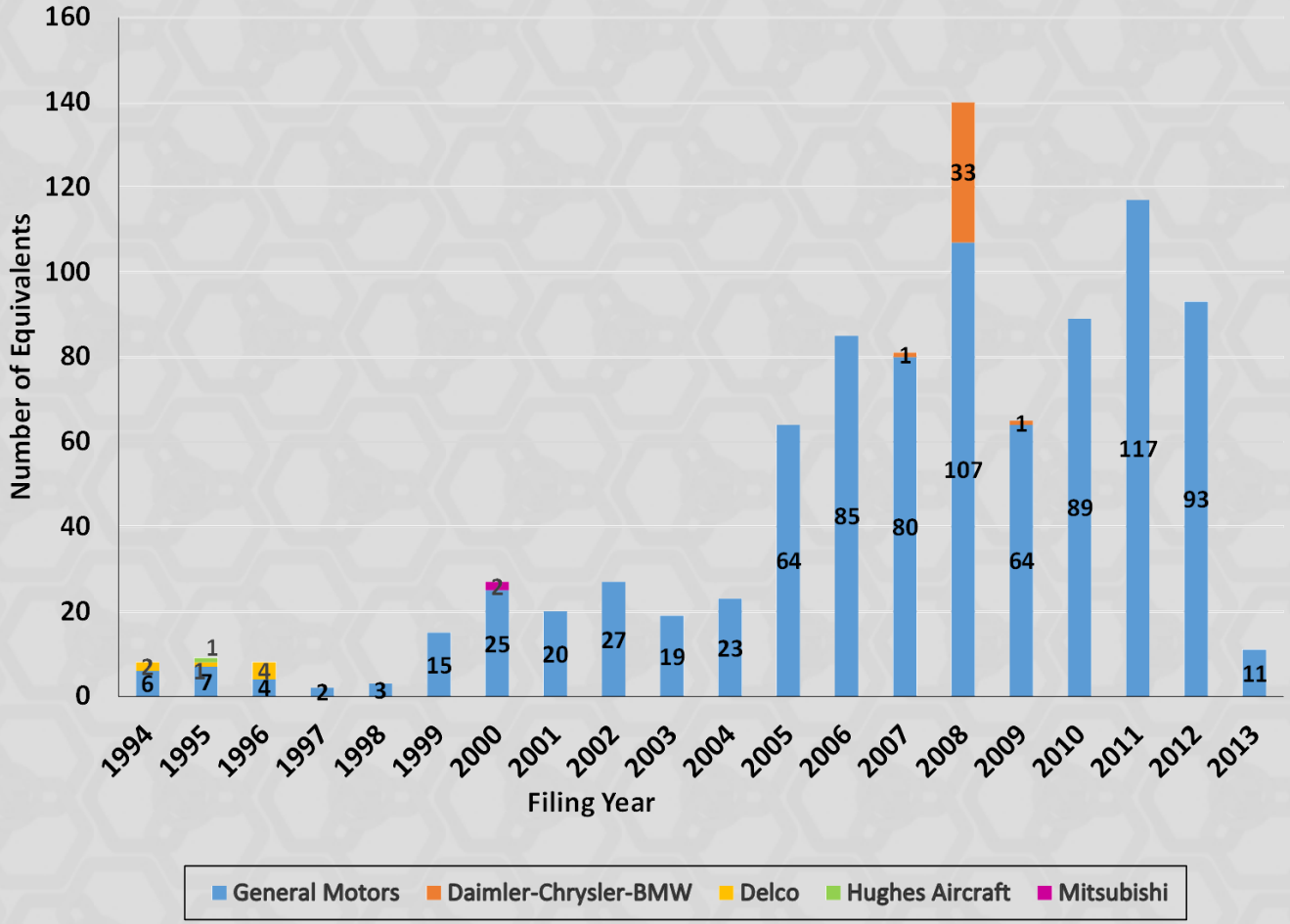
Table 3 gives descriptions of the CPC codes displayed in the Topic Map.

Tesla – Top Cited EV Battery Patents

Publication Number	Relecura Star Rating	Forward Citations Count	Forward Citation Assignee	Self Citations	Title	Filing Date
US20090021385A1	3.5	39	General Motors (5), IBM (4), Daimler (3), Honda (2), Bosch (2), Denso (2)	1	Electric Vehicle Communication Interface	2007-07-18
US7671565B2	3.0	38	Audi (5), Panasonic (5), Sinoelectric Powertrain Corp. (5), Volkswagen (3), Renault (2)	8	Battery pack and method for protecting batteries	2006-02-13
US20100188043A1	3.0	20	Cisco (3), Volkswagen (2), Toyota (2), Johnson Controls (1), Denso (1)	1	System for optimizing battery pack cut-off voltage	2009-01-29
US7923144B2	2.5	20	Audi (6), Panasonic (3), Autoliv (2), Mission Motor Company (2), Samsung (1)	1	Tunable frangible battery pack system	2007-03-31
US7667432B2	3.0	18	Sinoelectric Powertrain Corp. (4), EnerDel Inc. (3), Mission Motor Company (2), General Motors (1)	0	Method for interconnection of battery packs and battery assembly containing interconnected battery packs	2006-04-27
US20100136402A1	3.0	18	Audi (3), Lithium Energy Japan (3), Bosch (2), Samsung (2),	3	Sealed battery enclosure	2009-04-22
US7890218B2	2.5	16	Ferrari (2), General Motors (1), BMW (1), Porsche (1)	5	Centralized multi-zone cooling for increased battery efficiency	2007-07-18
US20090023056A1	2.5	14	Johnson Controls (3), LG (1), SB LiMotive (1)	1	BATTERY PACK THERMAL MANAGEMENT SYSTEM	2007-07-18
US7433794B1	2.5	14	Mission Motor Company (3), Panasonic (2), Bosch (1), Smasung (1)	2	Mitigation of propagation of thermal runaway in a multi-cell battery pack	2007-07-18
US7602145B2	2.5	13	Audi (2), Volkswagen (2), Mission Motor Company (2), Sony (1), Porsche (1)	0	Method of balancing batteries	2006-07-18

Table 4 gives additional details about the technologies addressed by each of the above patents.

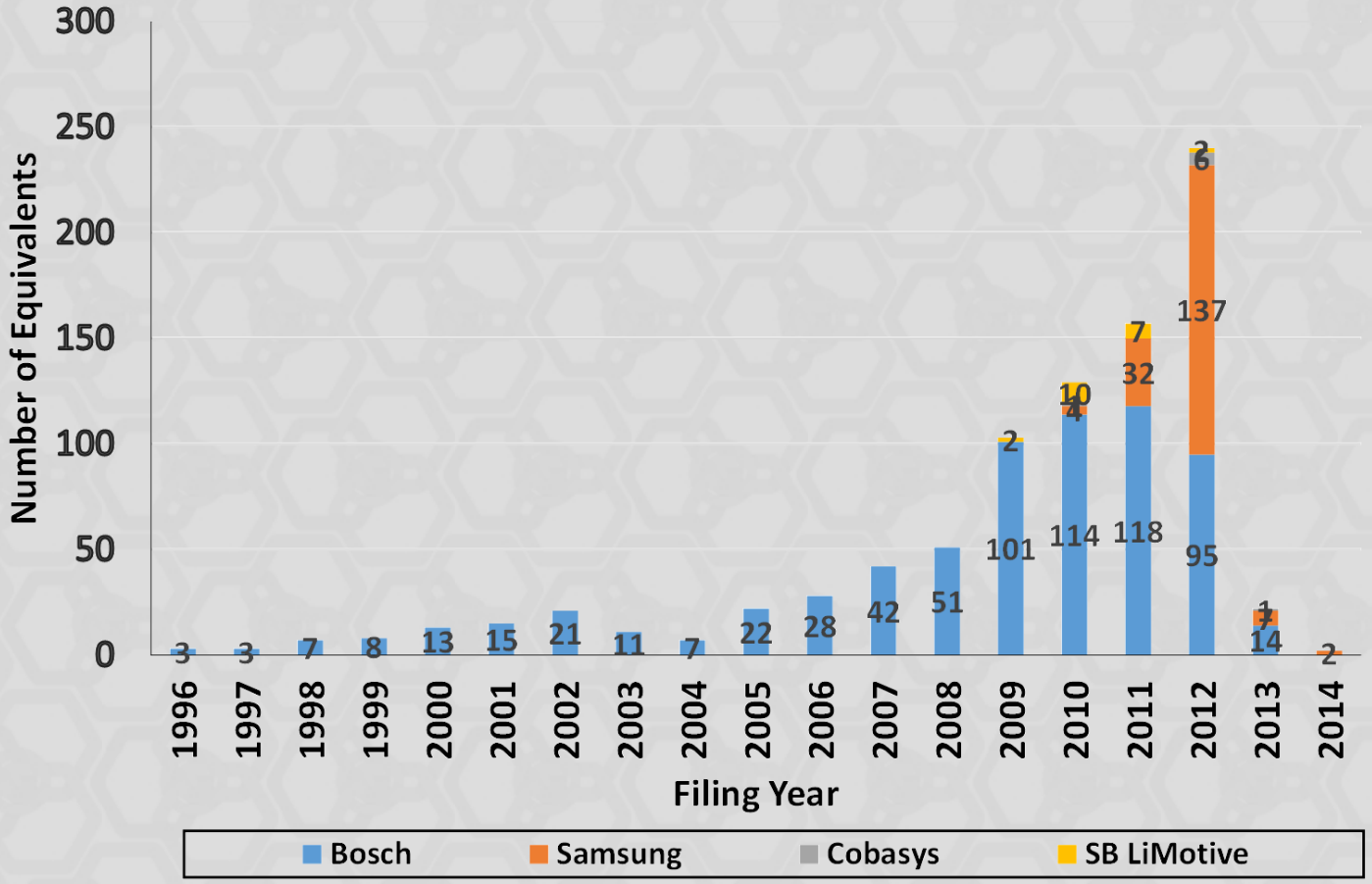
GM Battery Portfolio Growth – via Acquisition and M&A
(using Patent Assignment Records)



Key Findings:

- Most of GM's patents are a result of in-house R&D, with modest contributions from either its M&A activity or acquisitions.
- Contributions to GM's patents portfolio come from companies such as Daimler-Chrysler-BMW, Delco, Hughes Aircraft, and Mitsubishi.

Bosch Battery Portfolio Growth - via Acquisition and M&A
(using Patent Assignment Records)

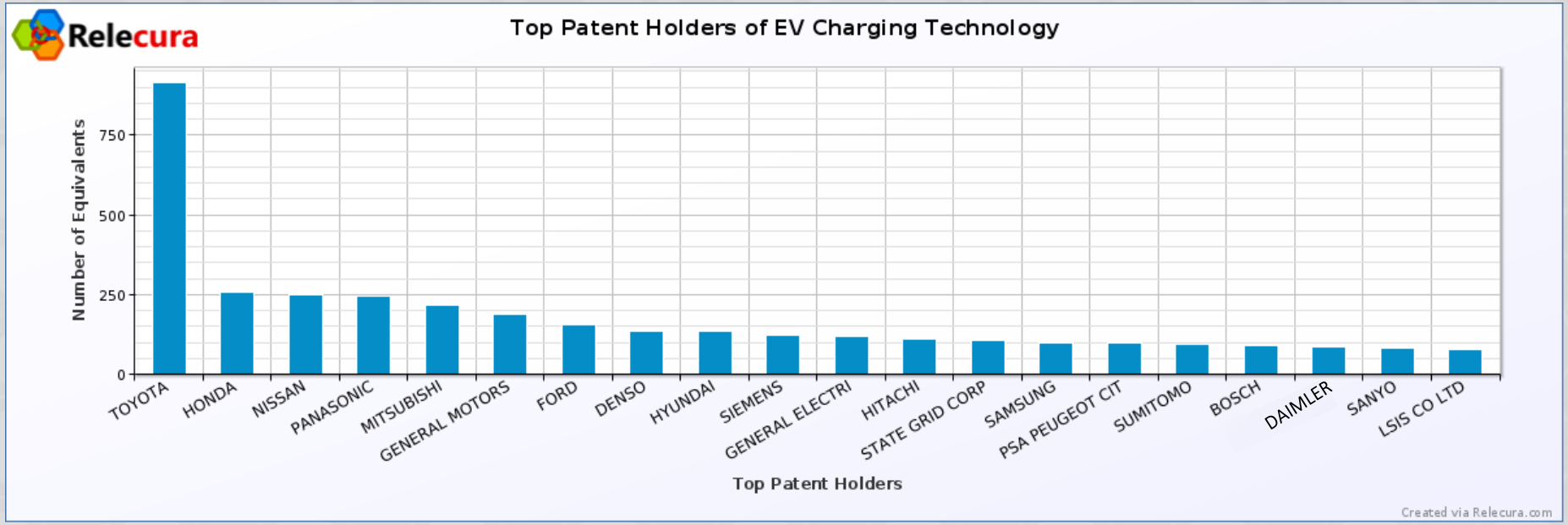


Key Findings:

- Bosch has been involved in various joint ventures (JVs) over the years to develop and manufacture Li-ion batteries for use in hybrid, plug-in hybrid vehicles and electric vehicles.
- Bosch formed a JV with Samsung in 2008 called SB LiMotive. The partnership was dissolved in 2012, as a result of which certain patent assets were assigned to Bosch from both Samsung and SB LiMotive.

EV Charging Technology - Patent Portfolio Analysis

EV Charging Technology – Top Patent Holders

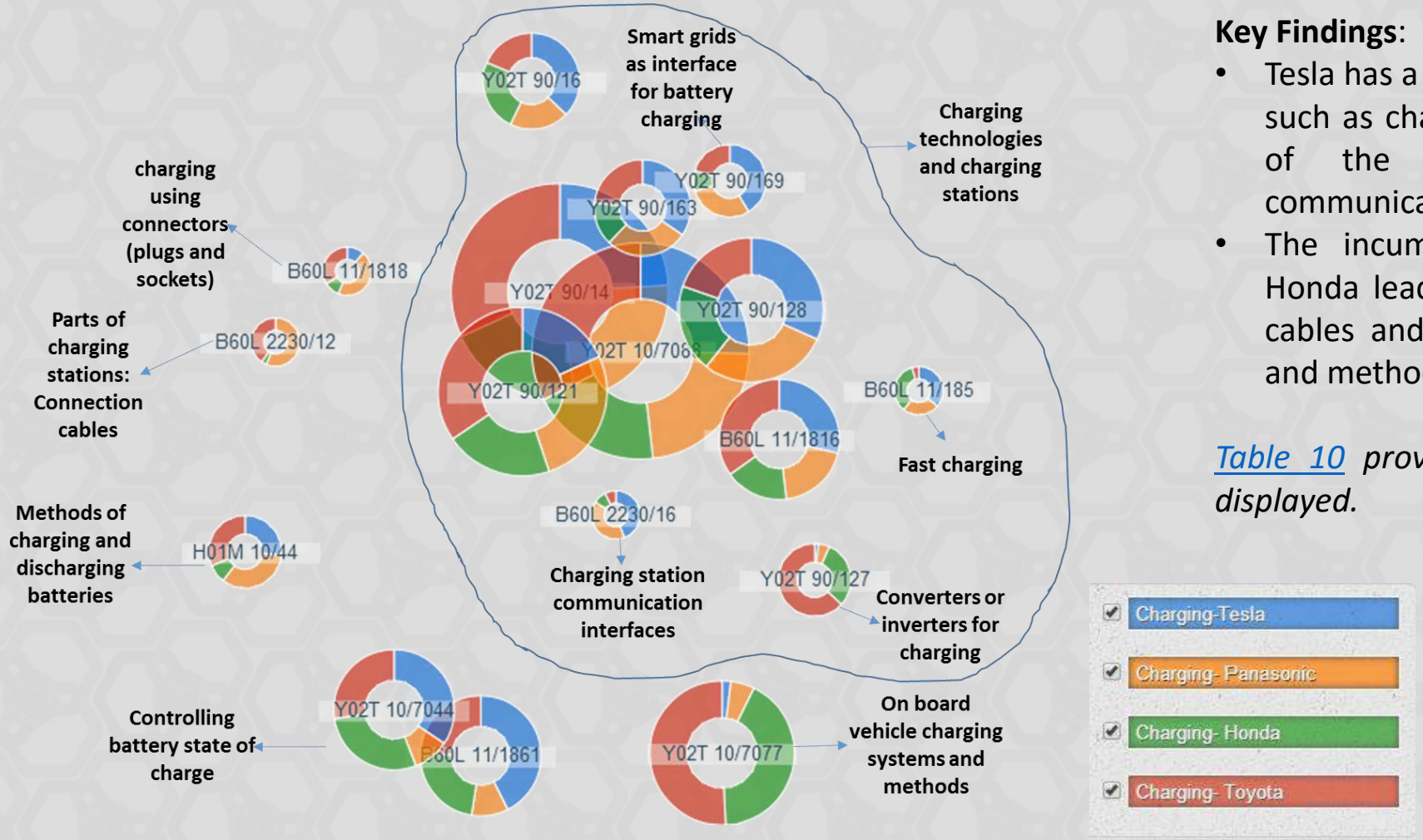


Smaller Patent Holders	Equivalents
Qualcomm	72
SAIC Motors	60
Kiekert AG	53
RWE	53
Witricity Corp	32
Chargepoint	29
IBM	28
Access Business Group Int LLC	18
Proterra Inc.	17

Key Findings: Includes both automakers and battery manufacturers.

- Large automobile manufacturers - Toyota, Honda, and Nissan
- Battery manufacturers - Panasonic, Siemens and Samsung

EV Charging - Tesla vs. Panasonic, Honda, Toyota

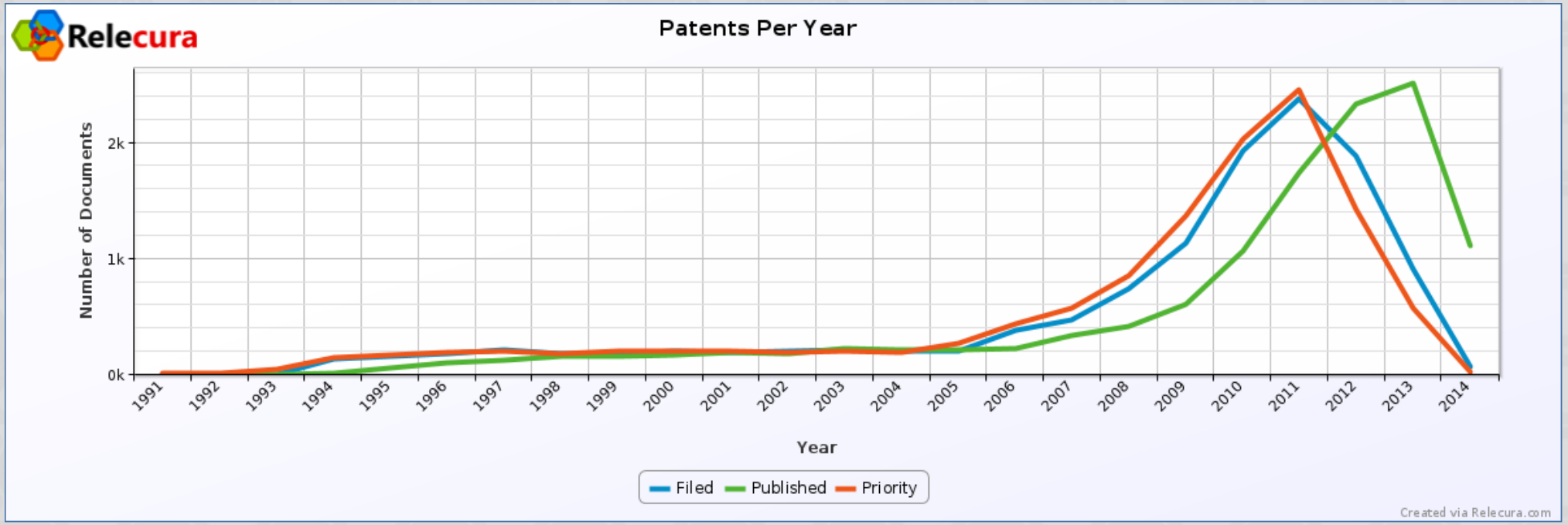


Key Findings:

- Tesla has a greater emphasis in sub-technologies such as charging methods, controlling the state of the charge, and charging station communication interfaces.
- The incumbents like Toyota, Panasonic and Honda lead in developing charging connectors, cables and on board vehicle charging systems and methods.

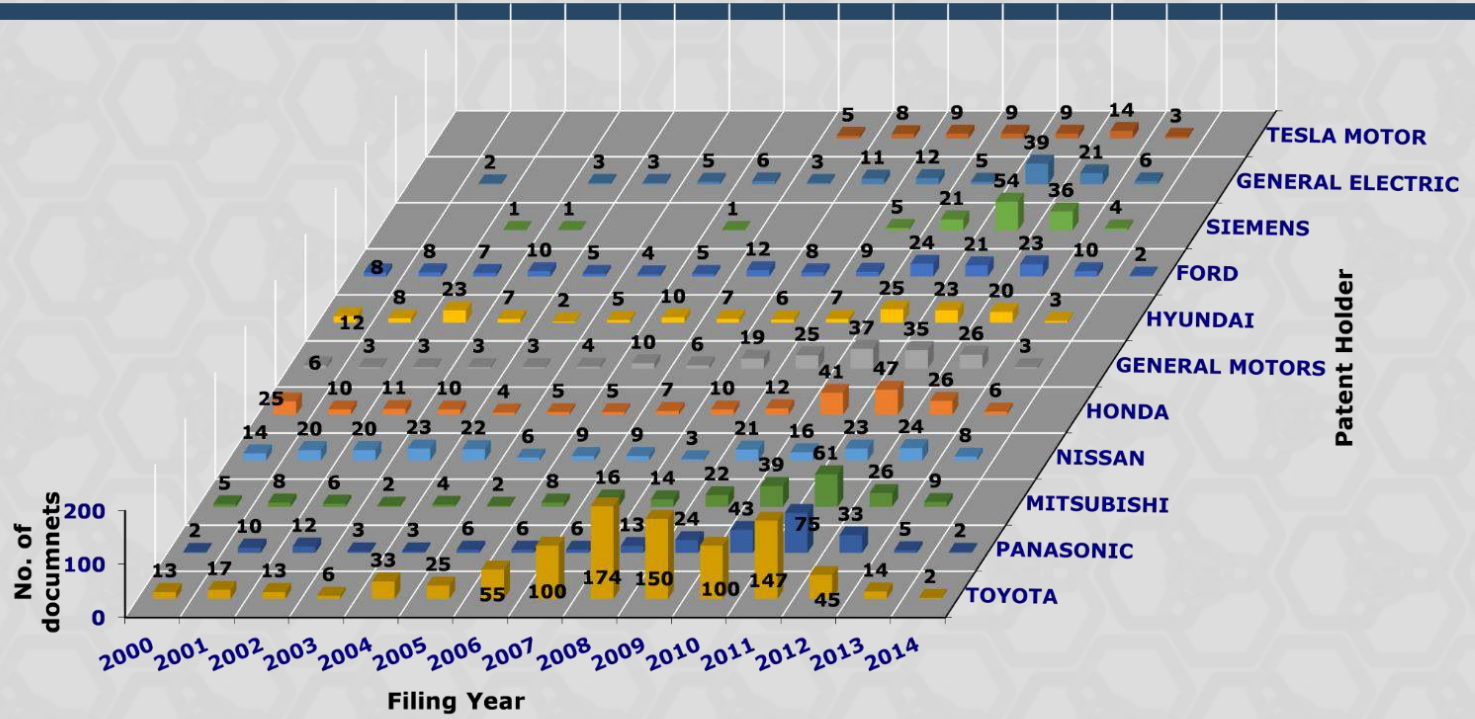
Table 10 provides descriptions of the CPC codes displayed.

EV Charging Technology - Filing Trends (Overall)



Key Finding: Patent filing activity shows a significant growth from 2007 onwards.

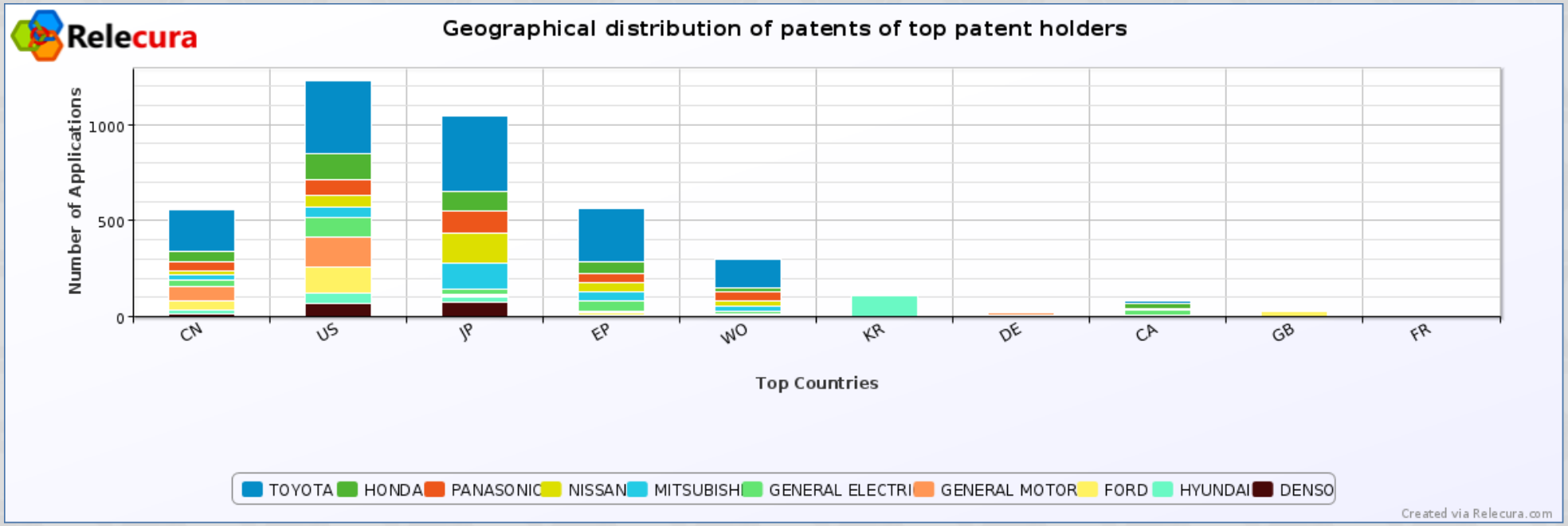
EV Charging Technology – Filing Trends (Top holders)



Key Findings:

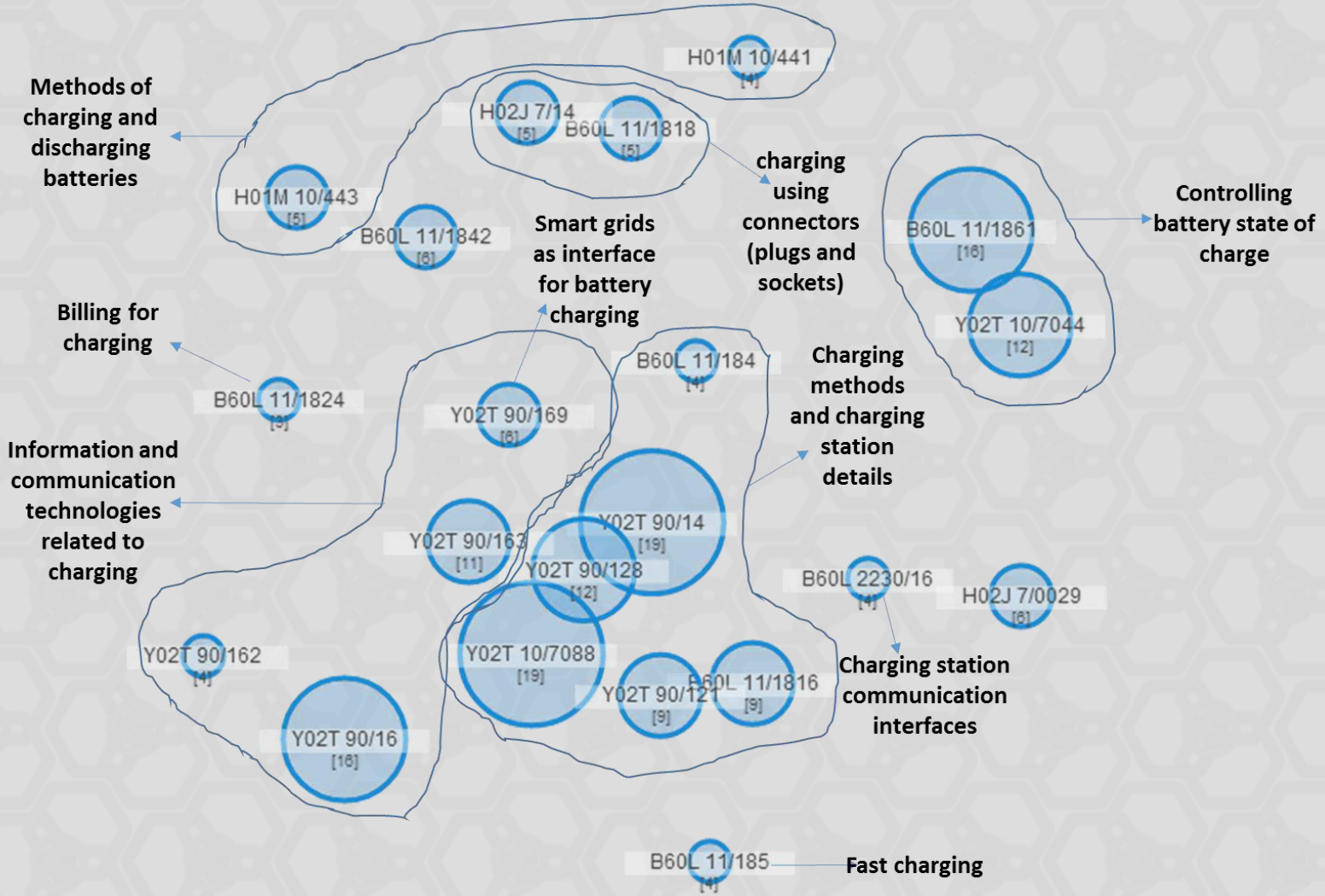
- Patent filings in EV charging technologies dipped for various large players (like Toyota, Honda, Nissan, and General Electric) in the early to middle period of the last decade. Each of these players have ramped up their filings in this area in the last 3-5 years.
- Toyota leads in patent filings in this area.

EV Charging Technology – Filings by Jurisdiction



Top patent holders	Filing jurisdictions (indicates markets of interest)
Toyota	U.S., Japan, China, Europe, PCT
Nissan, Honda, Panasonic	U.S., Japan, China, Europe, PCT (relatively fewer filings)
Ford	Great Britain, U.S., China
Hyundai	Korea, U.S., Japan, China
General Motors	U.S., China

Tesla – EV Charging Portfolio



Key Findings:

- Tesla's charging portfolio is mainly focused on methods and systems for charging the battery safely, time and cost optimization for the user with the flexibility to control the charging, improving battery life by reducing damage during charging and discharging.
- Tesla also holds patents related to charging station communication interfaces, smart grid integration, as well as fast charging.
- *Table 8 provides descriptions of the CPC codes displayed.*

Tesla - Top Cited EV Charging Patents

Publication Number	Relecura Star Rating	Forward Citation Count	Forward Citation Assignees	Self Citations	Title	Filing Date
US7782021B2	3.0	24	Ford (2), Honda (1), Toyota (1), Panasonic (1), LSIS Co. Ltd (1)	4	Battery charging based on cost and life	2007-07-18
US7629773B2	3.0	19	Toyota (3), Ford (2), Prosche (2), General Motors (1)	3	Multi-mode charging system for an electric vehicle	2009-01-29
US7683570B2	3.0	18	Toyota (2), Chargepoint Inc. (2), Bosch (1), Samsung (1), Panasonic (1)	6	Systems, methods, and apparatus for battery charging	2007-07-18
US8063757B2	2.5	17	Ford (3), Audi (2), Toyota (1), BMW (1), Denso (1), Volkswagen (1)	1	Charge state indicator for an electric vehicle	2007-07-18
US20090140700A1	3.0	17	Toyota (2), BMW (1) , Porsche (1), PSA Peugeot Citroen (1), General electric (1)	1	Multi-mode charging system for an electric vehicle	2009-01-16
US20100138092A1	2.5	16	Advanergy Inc. (6), Lightening Energy (3), Vovlo (1)	1	Battery charging time optimization system	2009-11-05
US8536825B2	2.5	5	General Motors(1), Audi (1), BlackBerry (1)	0	State of charge range	2009-12-31
US8754614B2	2.5	5	Panasonic (2), IBM (1), Mitsubishi (1)	0	Fast charging of battery using adjustable voltage control	2009-07-17

Table 9 provides additional details of the patents listed above.

Tesla's Key Technology - "Fast Charging" Patents

Publication Number	Filing Date	Title	Relecura Star Rating
US8754614B2	2009-07-17	Fast charging of battery using adjustable voltage control	2.5
US8552693B2	2009-09-30	Low temperature charging of Li-ion cells	2.5
US8638063B2	2010-10-13	AC current control of mobile battery chargers	2.5
US20110156661A1	2009-12-31	Fast charging with negative ramped current profile	2.5
US20130234648A1	2012-03-09	Low temperature fast charge	2.0
US20130307475A1	2012-05-18	Charge rate optimization	2.5
US20140121866A1	2012-10-31	Fast charge mode for extended trip	2.5

- Tesla promotes its proprietary "Fast Charging" technology for quick recharge.
- Tesla's charging stations deliver up to 120 kW, which can replenish half a charge in as little as 20 minutes. It works by delivering DC power directly to the battery by using special cables that bypass the onboard charging equipment.
- Tesla designs and builds all of the key components for the battery system, including the chargers, the electronics for monitoring the battery pack, and the battery cooling system.
- "Superchargers", which are small and light weight, are used to enable fast charging.

Tesla's webpage and FAQ for "Fast Charging"

List of Tables

Links lead to PDF with detailed tables.

Table Number	Title
1	EV technology categorization and classification codes for each category.
2	Description of CPC codes listed in Topic Map comparison of the Tesla and Panasonic patent portfolios.
3	Description of the CPC codes listed in Topic Map of Tesla's battery portfolio.
4	List of the top ten forward cited patents from Tesla's battery portfolio.
5	Description of CPC codes listed in the Topic Map comparison of the battery portfolios of Tesla with the large automakers Nissan, Honda and Toyota.
6	Description of the CPC codes listed in the Topic Map comparison of the battery portfolios of Tesla with other battery manufacturers Mitsubishi, Hitachi and Bosch.
7	Description of the CPC codes listed in Topic Map comparison of the Lithium battery portfolio of Tesla with other patent holders.
8	Description of CPC codes listed in the Topic Map of Tesla's charging portfolio.
9	List of the top ten forward cited patents from Tesla's charging portfolio.
10	Description of the CPC codes listed in the Topic Map comparison of the portfolios of Tesla, Toyota, Honda, and Panasonic addressing charging technology.

Disclaimer

This document is provided for information purposes only and the contents hereof are subject to change without notice. This document, including the information and analysis and any opinion or recommendation, is neither legal advice nor intended for investment purposes. This document is not warranted to be error-free, nor subject to any other warranties or conditions, whether expressed orally or implied in law, including implied warranties and conditions of merchantability or fitness for a particular purpose. Relecura Inc. specifically disclaims any liability with respect to this document and no contractual obligations are formed either directly or indirectly by this document.

Relecura is a web-based patent and portfolio analysis platform that uses a knowledge discovery framework to simplify IP analysis for prior-art search, technology landscaping, competitive intelligence, and IP commercialization activities. For more details visit www.relecura.com or write to info@relecura.com.


www.twitter.com/relecura


www.facebook.com/relecura


www.linkedin.com/company/relecura-inc-