

Appendix to the 2022 Patent Report

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1. Patent Analysis

1.1. Fuel Cell Patent Activity

1.1.1. Assignee Data

The data presented below shows the top 10 filers of patent applications (Figures A1.1.1 to A1.1.8) and granted patents (Figures A1.1.9 to A1.1.16) in the area of fuel cells recorded annually from 2014 to 2021 at the top 5 patent offices. In each case the bars show the absolute number of patent applications associated with a particular entity.

The top 10 filers for both the published fuel cell applications and the granted fuel cell patents predominantly comprise the same entities. Toyota is steadily in the leading position, with second place typically being taken by Hyundai.

Figure A1.1.1: Top 10 filers of fuel cell patent applications at the top 5 offices for 2014.

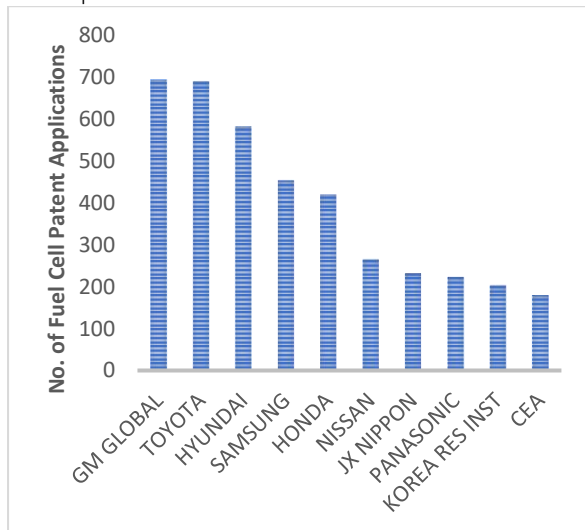


Figure A1.1.2: Top 10 filers of fuel cell patent applications at the top 5 offices for 2015.

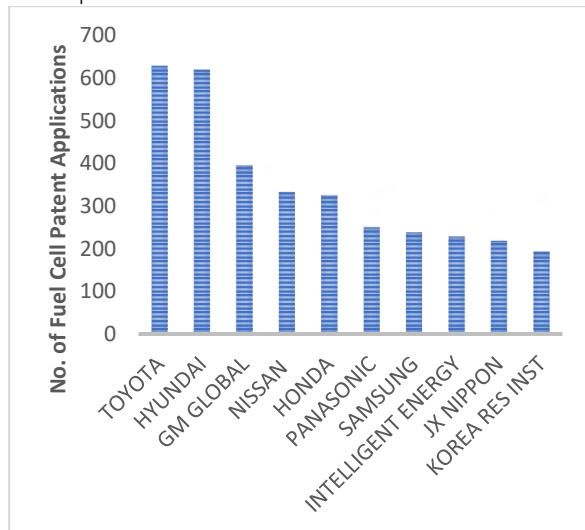


Figure A1.1.3: Top 10 filers of fuel cell patent applications at the top 5 offices for 2016.

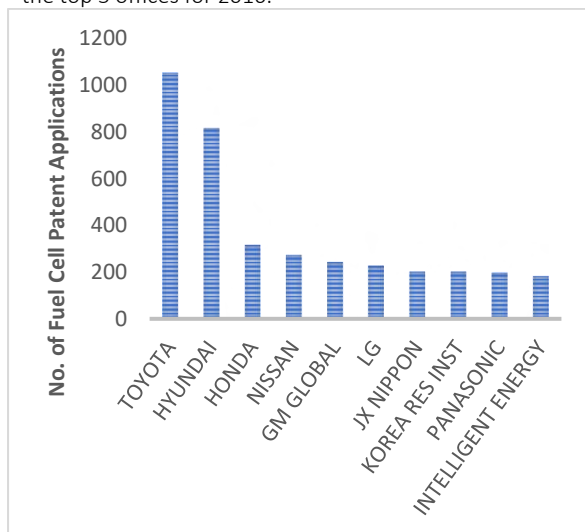


Figure A1.1.4: Top 10 filers of fuel cell patent applications at the top 5 offices for 2017.

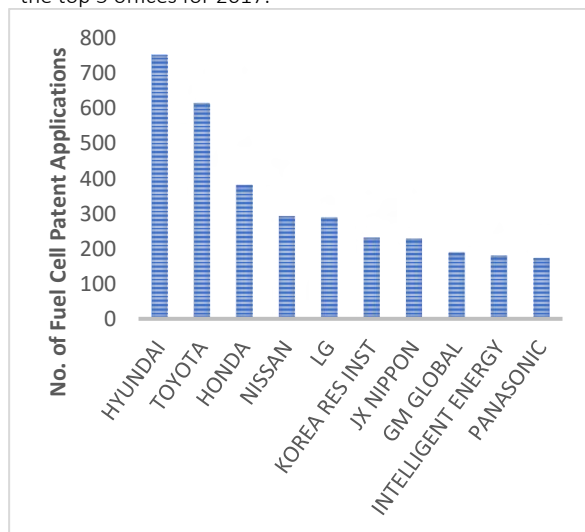


Figure A1.1.5: Top 10 filers of fuel cell patent applications at the top 5 offices for 2018.

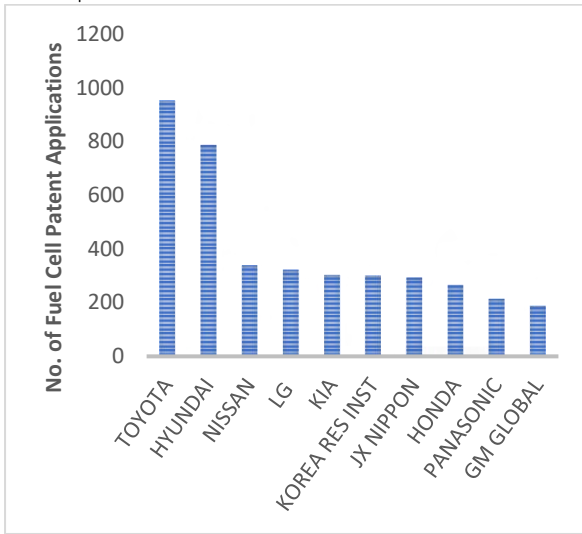


Figure A1.1.6: Top 10 filers of fuel cell patent applications at the top 5 offices for 2019.

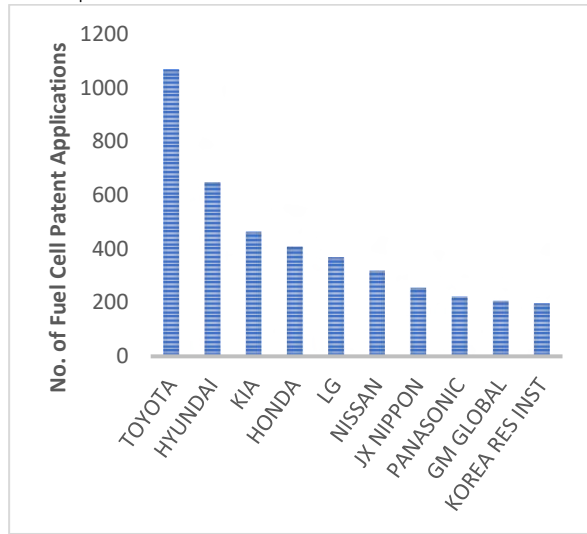


Figure A1.1.7: Top 10 filers of fuel cell patent applications at the top 5 offices for 2020.

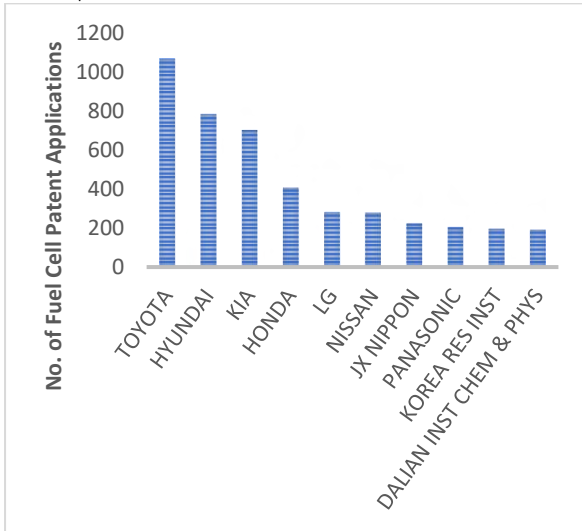


Figure A1.1.8: Top 10 filers of fuel cell patent applications at the top 5 offices for 2021.

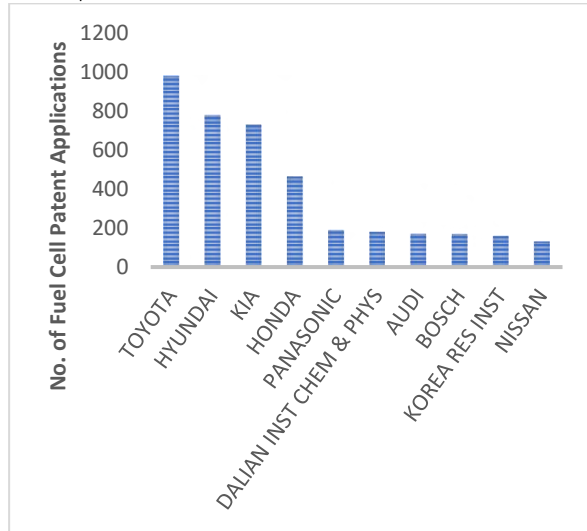


Figure A1.1.9: Top 10 filers of granted fuel cell patents at the top 5 offices for 2014.

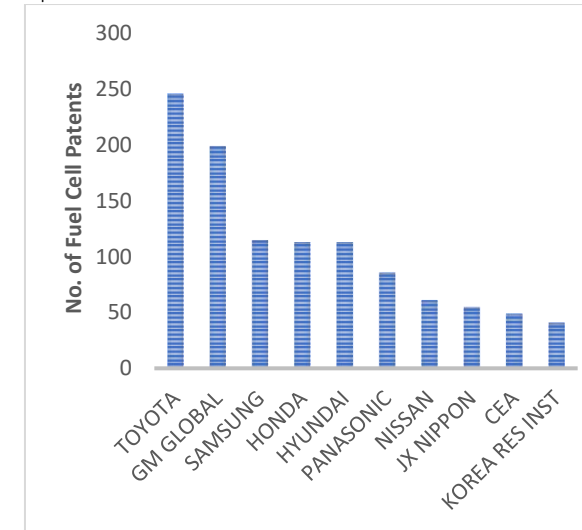


Figure A1.1.10: Top 10 filers of granted fuel cell patents at the top 5 offices for 2015.

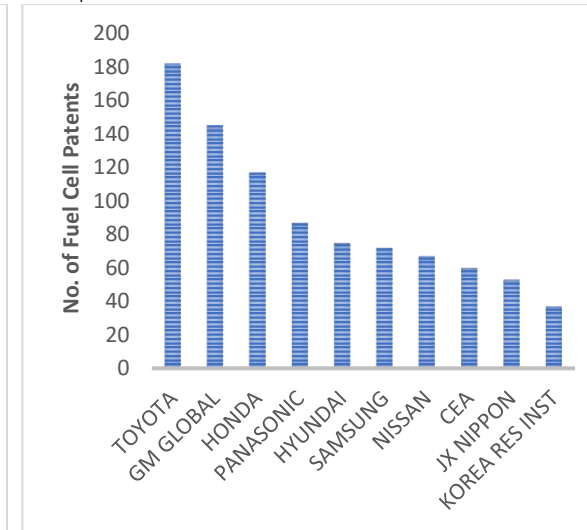


Figure A1.1.11: Top 10 filers of granted fuel cell patents at the top 5 offices for 2016.

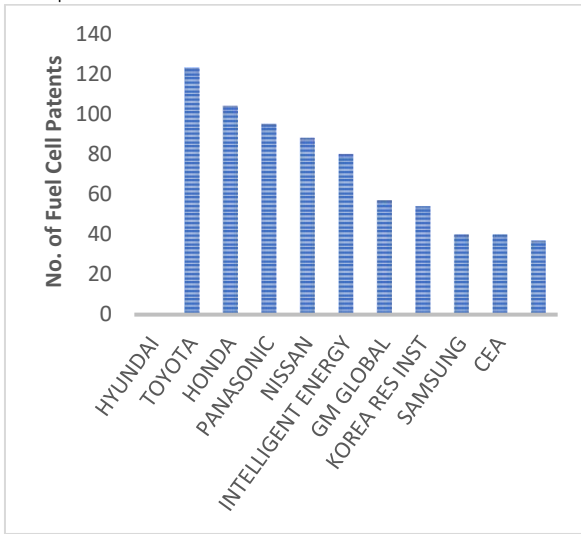


Figure A1.1.12: Top 10 filers of granted fuel cell patents at the top 5 offices for 2017.

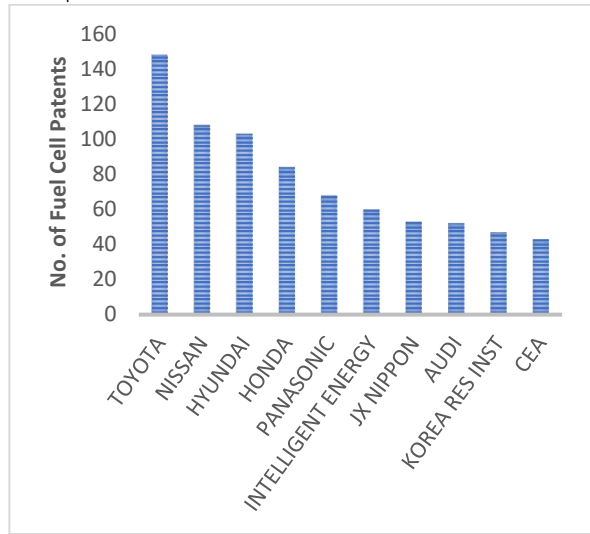


Figure A1.1.13: Top 10 filers of granted fuel cell patents at the top 5 offices for 2018.

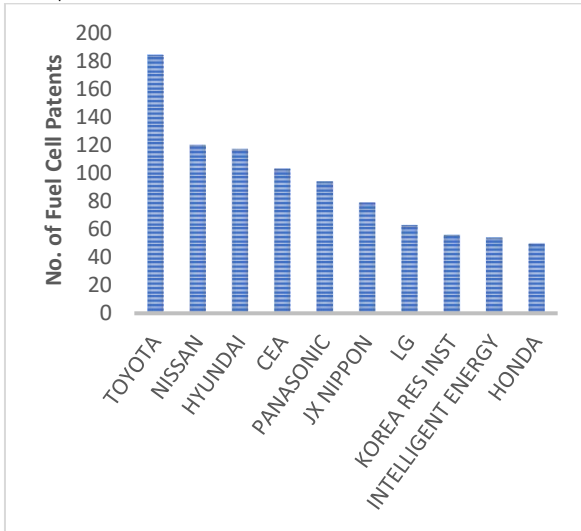


Figure A1.1.14: Top 10 filers of granted fuel cell patents at the top 5 offices for 2019.

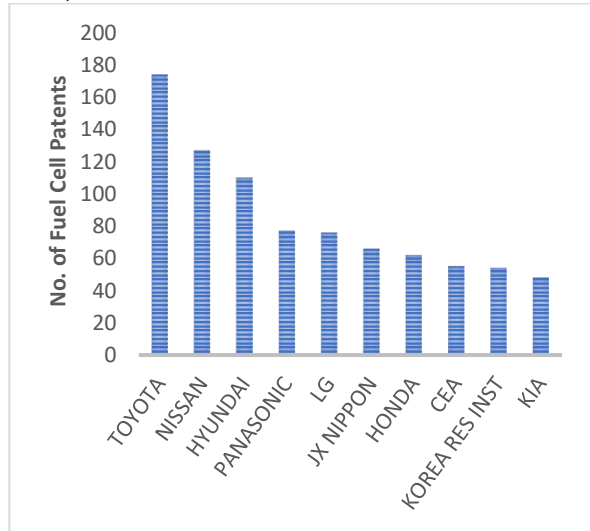


Figure A1.1.15: Top 10 filers of granted fuel cell patents at the top 5 offices for 2020.

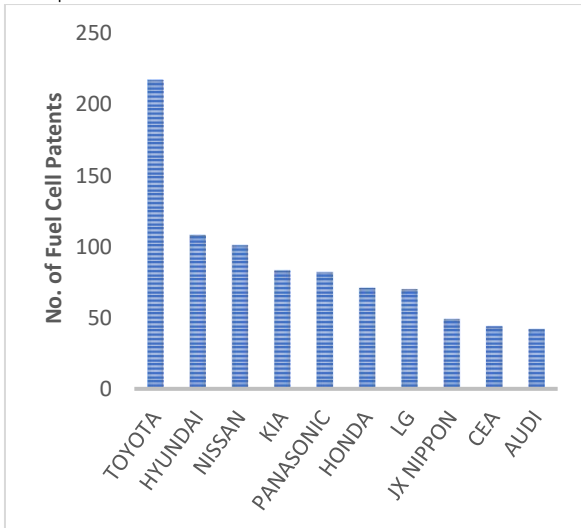
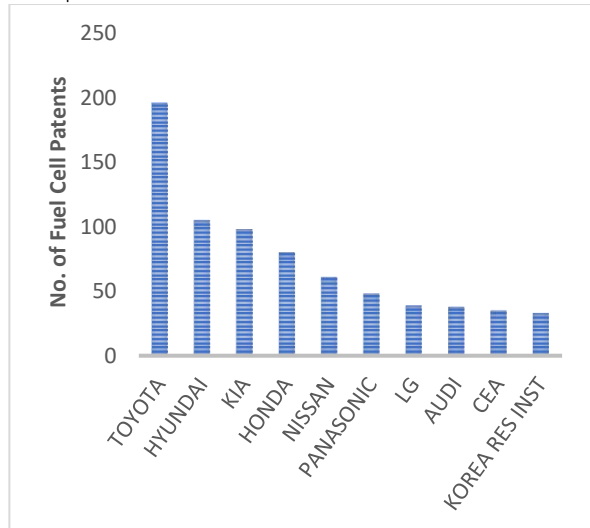


Figure A1.1.16: Top 10 filers of granted fuel cell patents at the top 5 offices for 2021.



1.1.2. Academic Patent Filers

The data presented below shows the top 10 university filers of patent applications (Figures A1.1.17 to A1.1.24) and granted patents (Figures A1.1.25 to A1.1.32) in the area of fuel cells recorded annually from 2014 to 2021 at the top 5 patent offices. In each case the bars show the absolute number of patent applications associated with a particular entity.

The top 10 academic filers are dominated by Chinese and Japanese universities. The University of Tsinghua features in the top three university filers annually from 2014 to 2021.

Figure A1.1.17: Top 10 university filers of fuel cell patent applications at the top 5 offices for 2014.

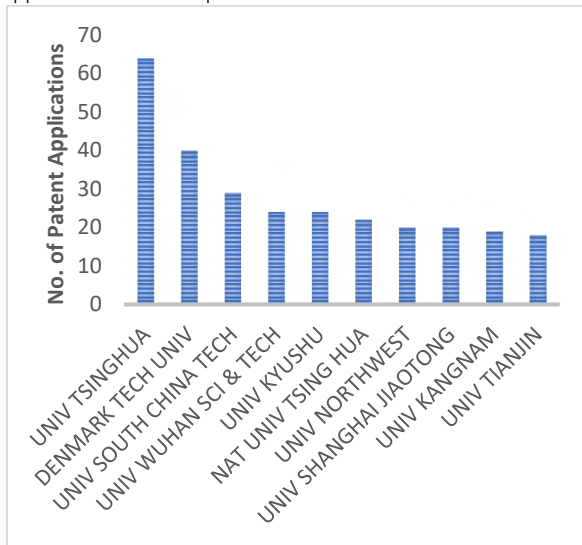


Figure A1.1.18: Top 10 university filers of fuel cell patent applications at the top 5 offices for 2015.

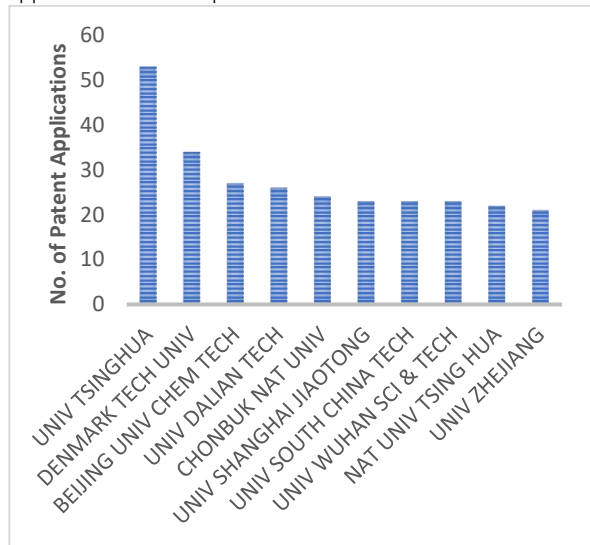


Figure A1.1.19: Top 10 university filers of fuel cell patent applications at the top 5 offices for 2016.

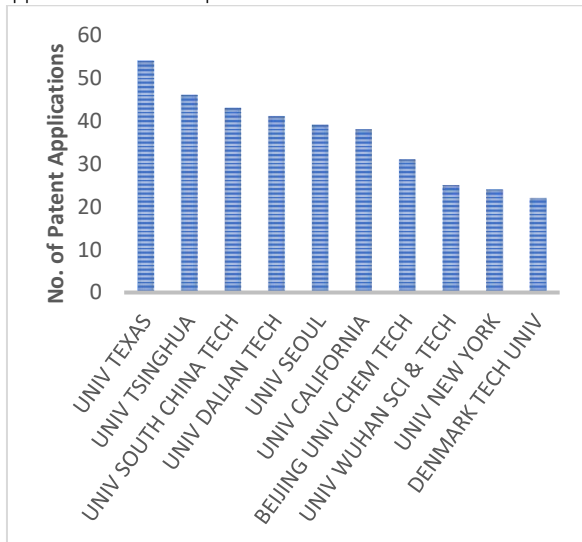


Figure A1.1.20: Top 10 university filers of fuel cell patent applications at the top 5 offices for 2017.

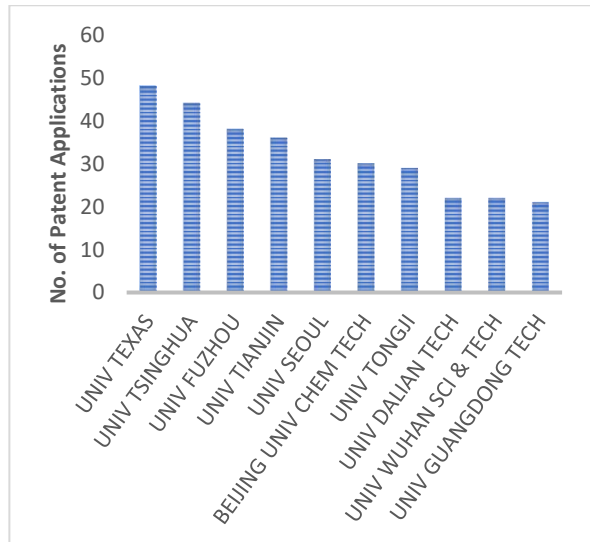


Figure A1.1.21: Top 10 university filers of fuel cell patent applications at the top 5 offices for 2018.

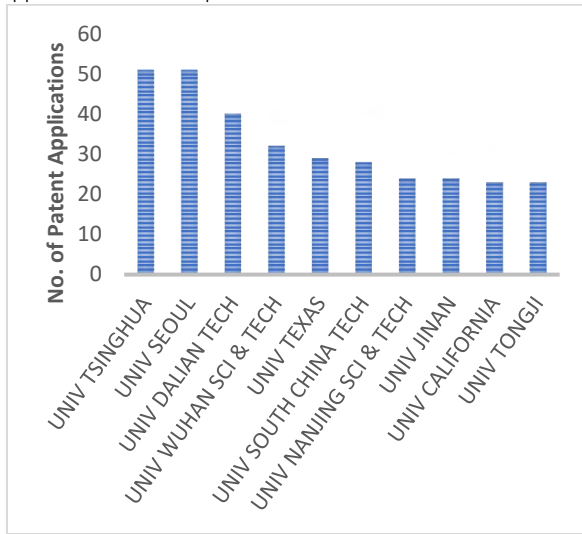


Figure A1.1.22: Top 10 university filers of fuel cell patent applications at the top 5 offices for 2019.

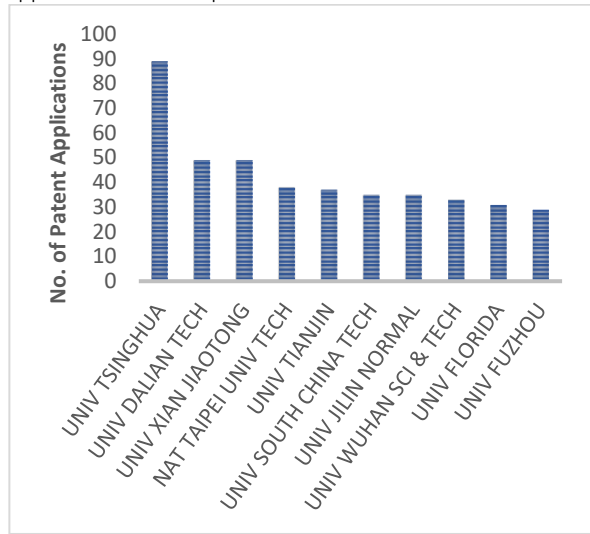


Figure A1.1.23: Top 10 university filers of fuel cell patent applications at the top 5 offices for 2020.

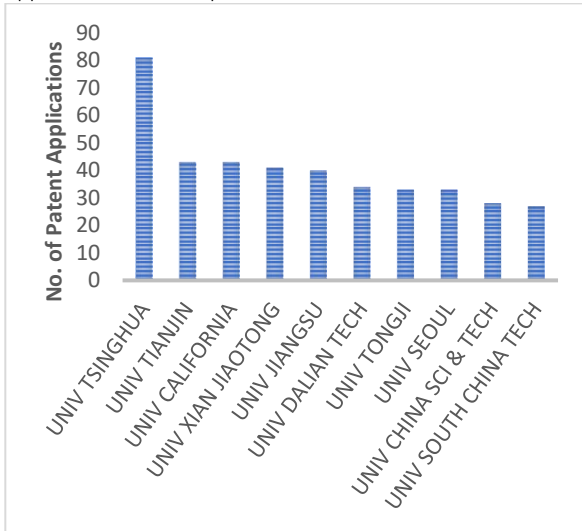


Figure A1.1.24: Top 10 university filers of fuel cell patent applications at the top 5 offices for 2021.

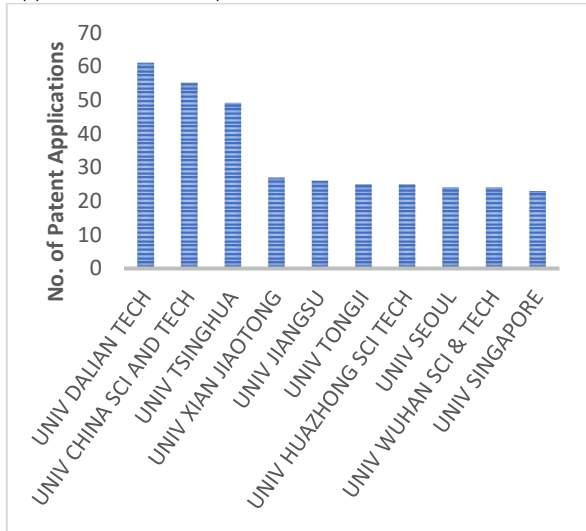


Figure A1.1.25: Top 10 university filers of granted fuel cell patents at the top 5 offices for 2014.

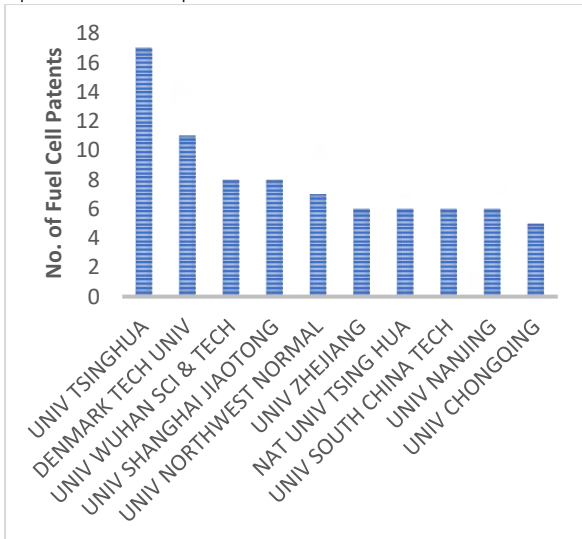


Figure A1.1.26: Top 10 university filers of granted fuel cell patents at the top 5 offices for 2015.

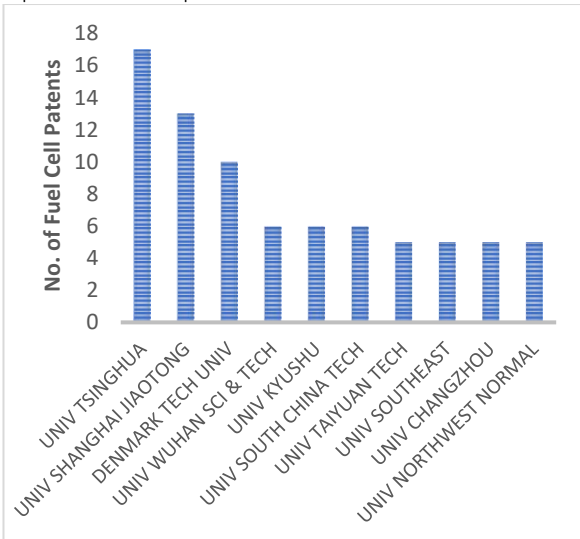


Figure A1.1.27: Top 10 university filers of granted fuel cell patents at the top 5 offices for 2016.

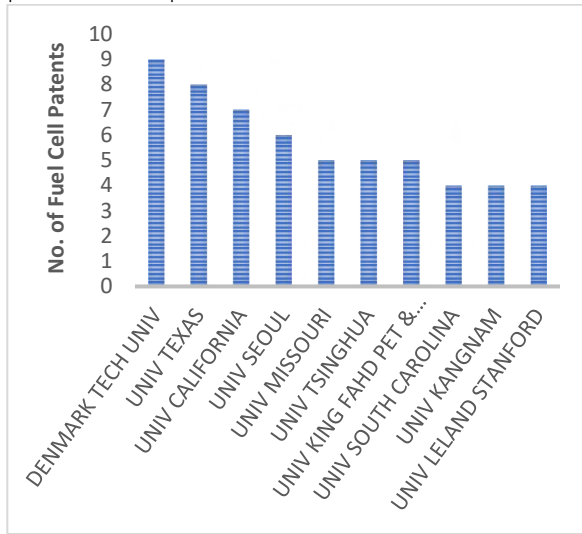


Figure A1.1.28: Top 10 university filers of granted fuel cell patents at the top 5 offices for 2017.

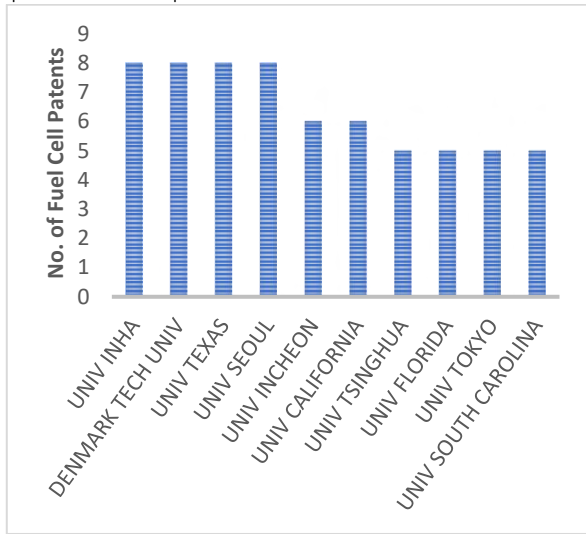


Figure A1.1.29: Top 10 university filers of granted fuel cell patents at the top 5 offices for 2018.

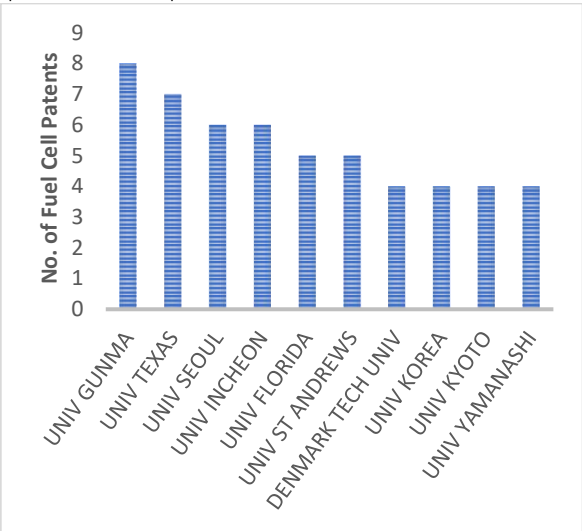


Figure A1.1.30: Top 10 university filers of granted fuel cell patents at the top 5 offices for 2019.

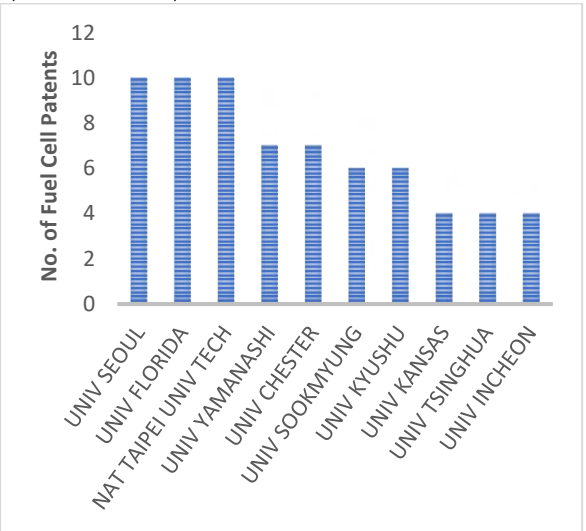


Figure A1.1.31: Top 10 university filers of granted fuel cell patents at the top 5 offices for 2020.

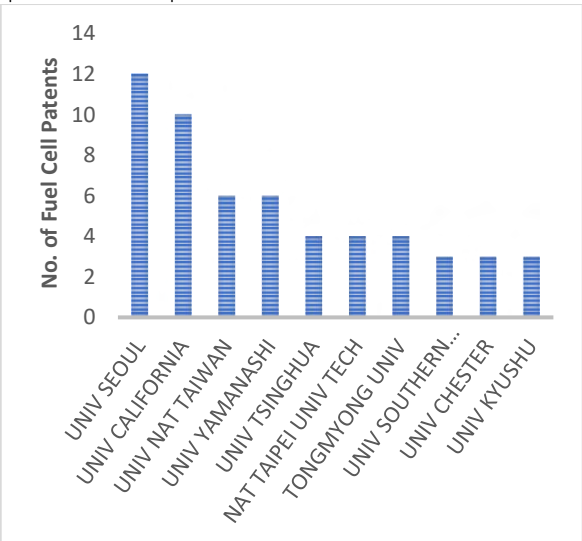
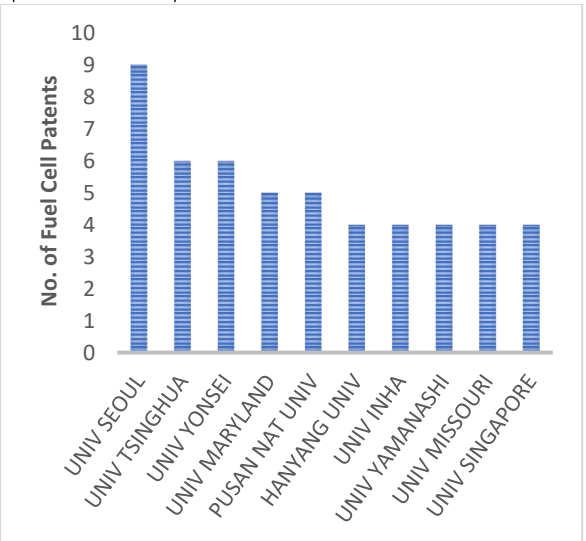


Figure A1.1.32: Top 10 university filers of granted fuel cell patents at the top 5 offices for r 2021.



1.2. Fuel Cell Chemistry

The data presented below shows the top 10 filers of patent applications for each of the individual fuel cell chemistries, for the years 2014 to 2021, for each of the top 5 patent offices. In each case the bars show the absolute number of patent applications associated with a particular entity.

1.2.1. Direct Alcohol Fuel Cells

Figures A1.2.1 to A1.2.8 show the top 10 assignees of direct alcohol fuel cell (DAFC) patent applications, e.g. direct methanol fuel cells (DMFCs), for the top 5 offices.

The top filers appear to vary over the period.

Figure A1.2.1: Top 10 filers of DAFC patent applications at the top 5 offices for 2014.

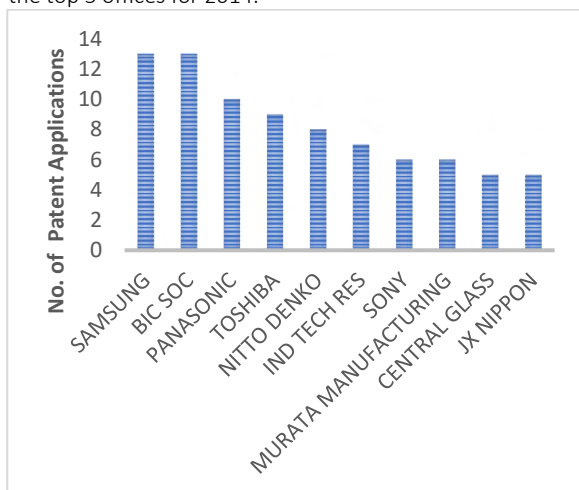


Figure A1.2.2: Top 10 filers of DAFC patent applications at the top 5 offices for 2015.

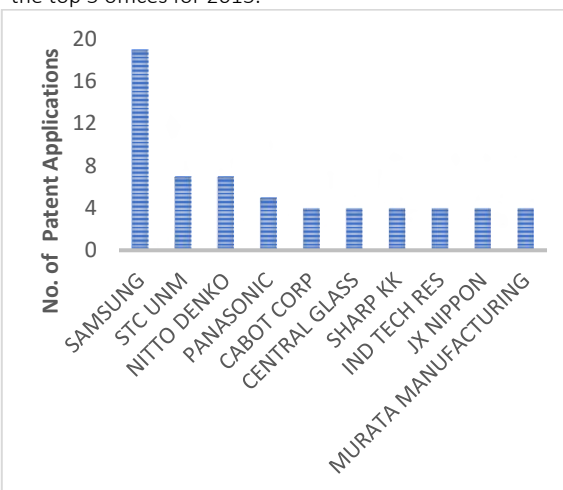


Figure A1.2.3: Top 10 filers of DAFC patent applications at the top 5 offices for 2016.

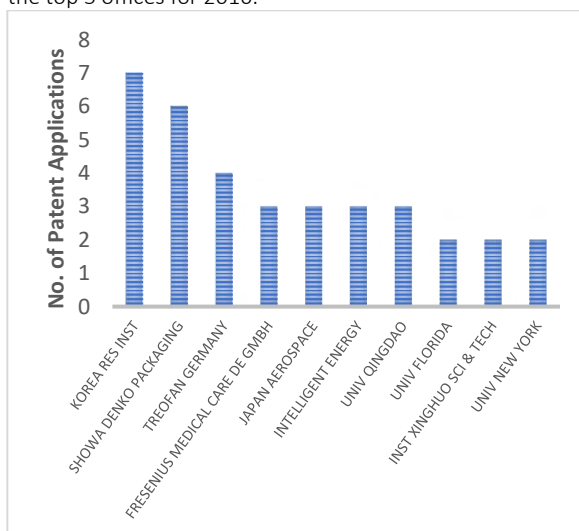


Figure A1.2.4: Top 10 filers of DAFC patent applications at the top 5 offices for 2017.

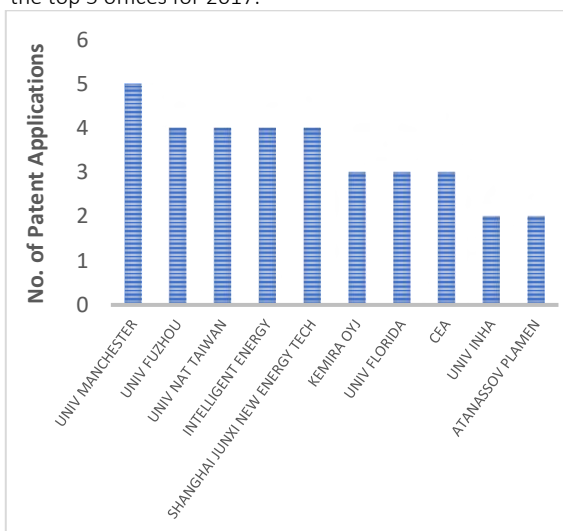


Figure A1.2.5: Top 10 filers of DAFC patent applications at the top 5 offices for 2018.

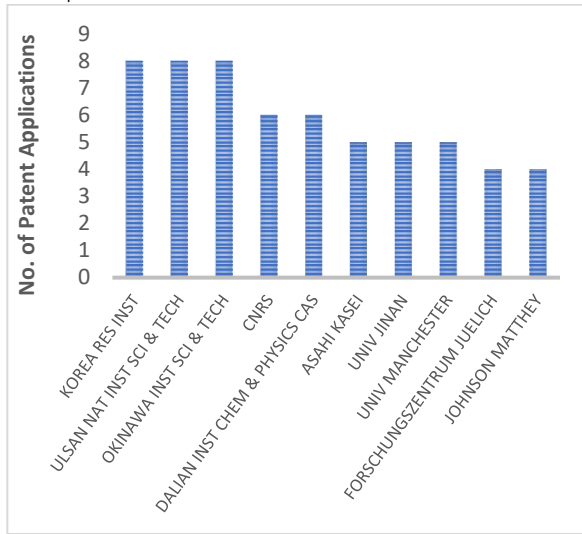


Figure A1.2.6: Top 10 filers of DAFC patent applications at the top 5 offices for 2019.

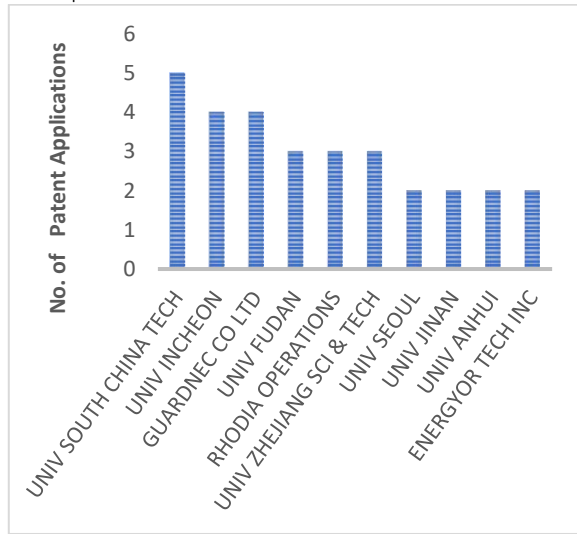


Figure A1.2.7: Top 10 filers of DAFC patent applications at the top 5 offices for 2020.

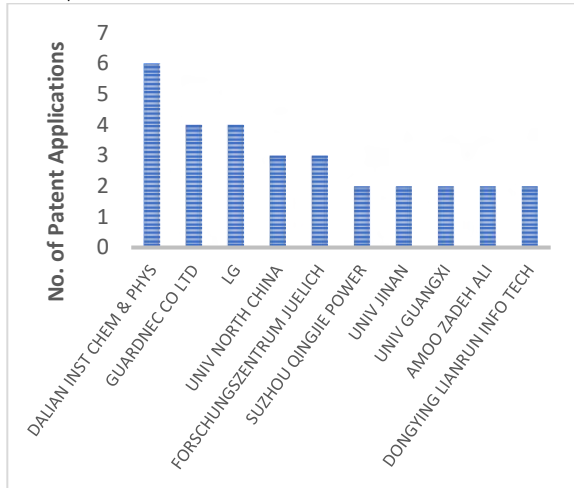
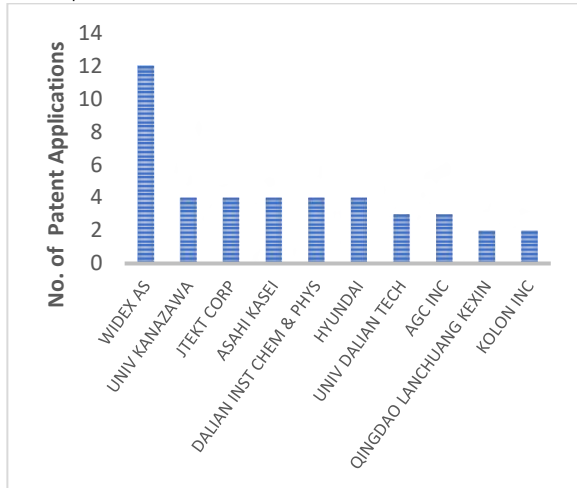


Figure A1.2.8: Top 10 filers of DAFC patent applications at the top 5 offices for 2021.



1.2.2. Molten Carbonate Fuel Cells

Figures A1.2.9 to A1.2.16 show the top 10 assignees of molten carbonate fuel cell (MCFC) patent applications, for the top 5 offices.

Exxon Mobil are the leading filer of MCFC patent applications, featuring in the top four annually from 2014 to 2021.

Figure A1.2.9: Top 10 filers of MCFC patent applications at the top 5 offices for 2014.

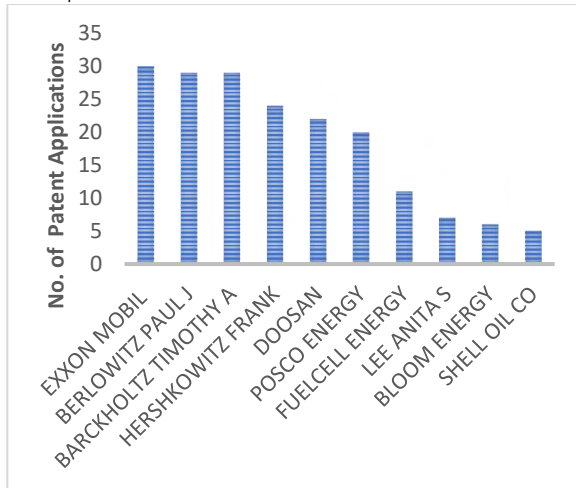


Figure A1.2.10: Top 10 filers of MCFC patent applications at the top 5 offices for 2015.

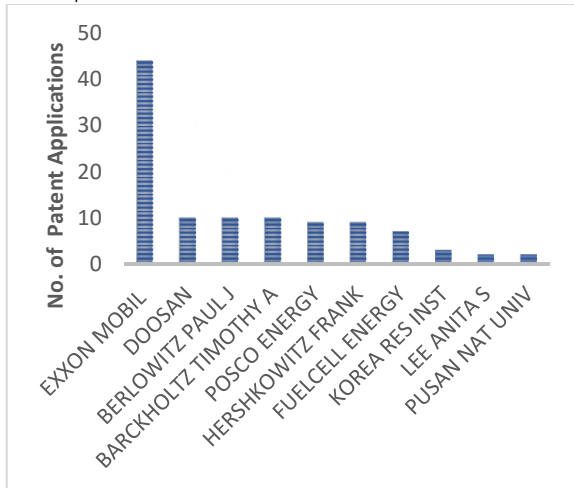


Figure A1.2.11: Top 10 filers of MCFC patent applications at the top 5 offices for 2016.

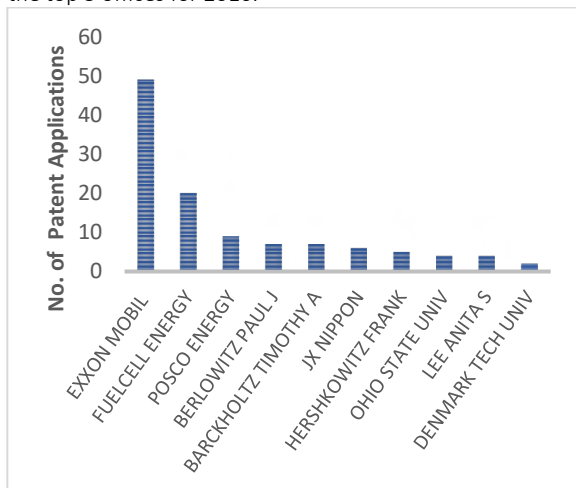


Figure A1.2.12: Top 10 filers of MCFC patent applications at the top 5 offices for 2017.

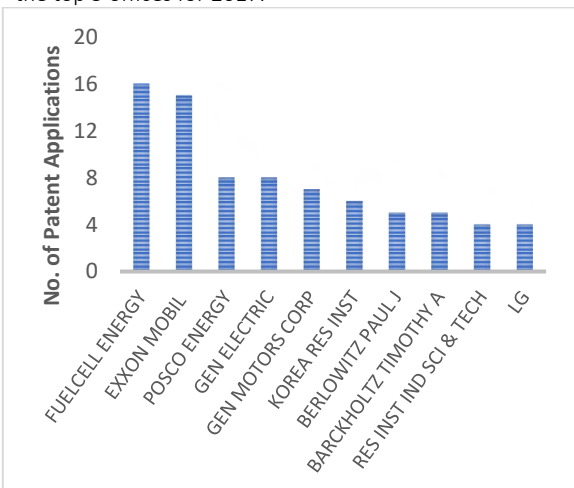


Figure A1.2.13: Top 10 filers of MCFC patent applications at the top 5 offices for 2018.

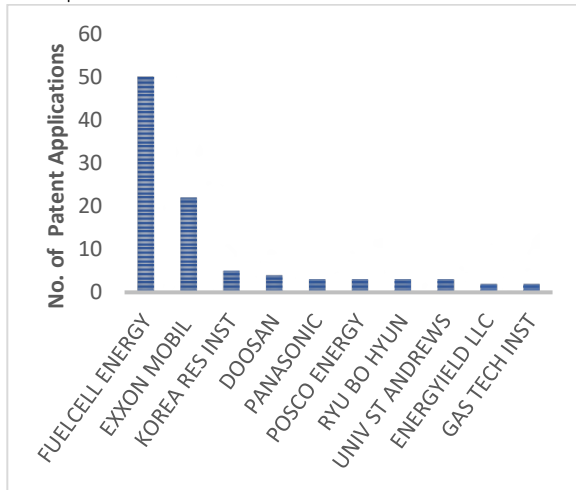


Figure A1.2.14: Top 10 filers of MCFC patent applications at the top 5 offices for 2019.

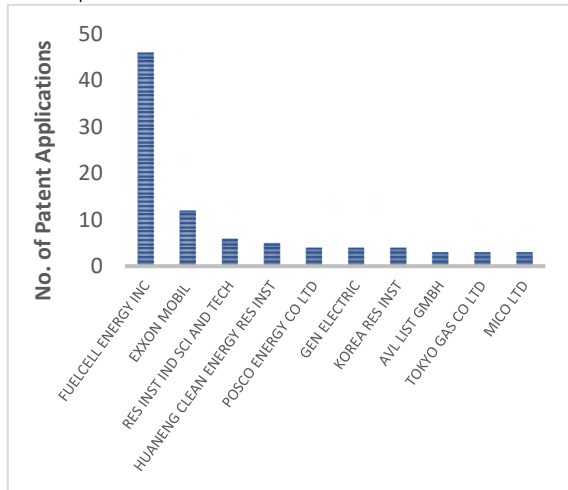


Figure A1.2.15: Top 10 filers of MCFC patent applications at the top 5 offices for 2020.

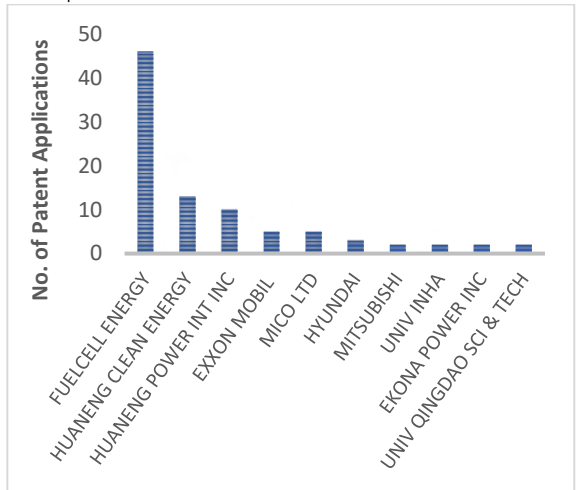
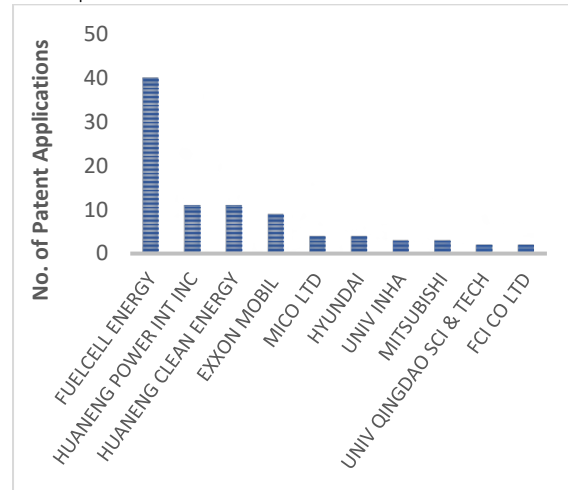


Figure A1.2.16: Top 10 filers of MCFC patent applications at the top 5 offices for 2021.



1.2.3. Alkaline Fuel Cells

Figures A1.2.17 to A1.2.24 show the top 10 assignees of alkaline fuel cell (AFC) patent applications, for the top 5 offices.

The top filers appear to vary over the period.

Figure A1.2.17: Top 10 filers of AFC patent applications at the top 5 offices for 2014.

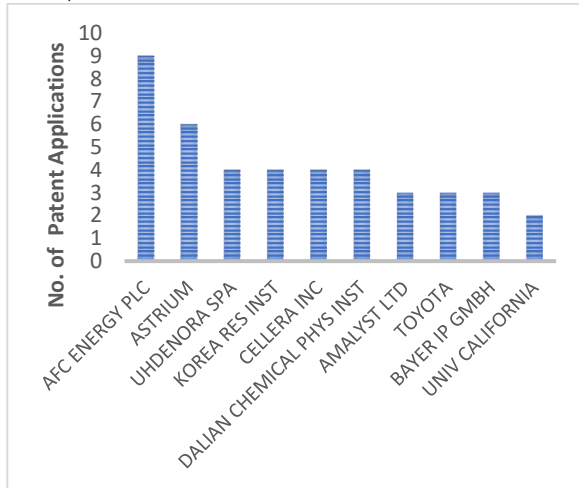


Figure A1.2.18: Top 10 filers of AFC patent applications at the top 5 offices for 2015.

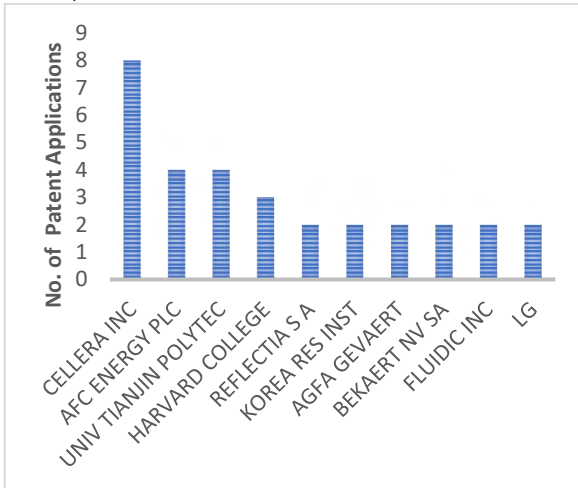


Figure A1.2.19: Top 10 filers of AFC patent applications at the top 5 offices for 2016.

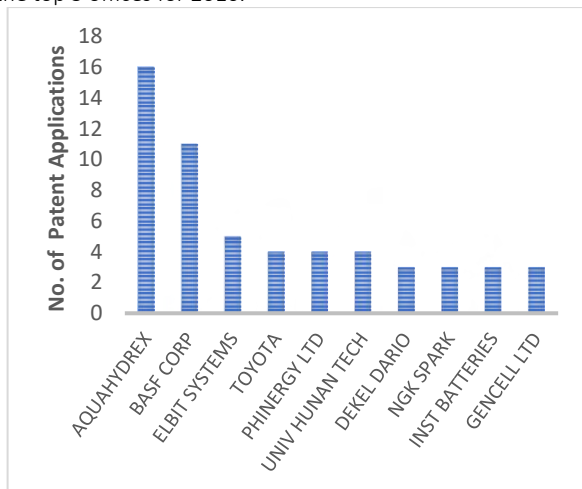


Figure A1.2.20: Top 10 filers of AFC patent applications at the top 5 offices for 2017.

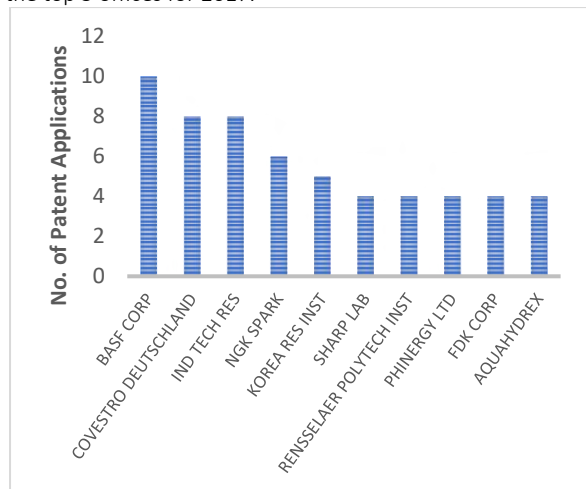


Figure A1.2.21: Top 10 filers of AFC patent applications at the top 5 offices for 2018.

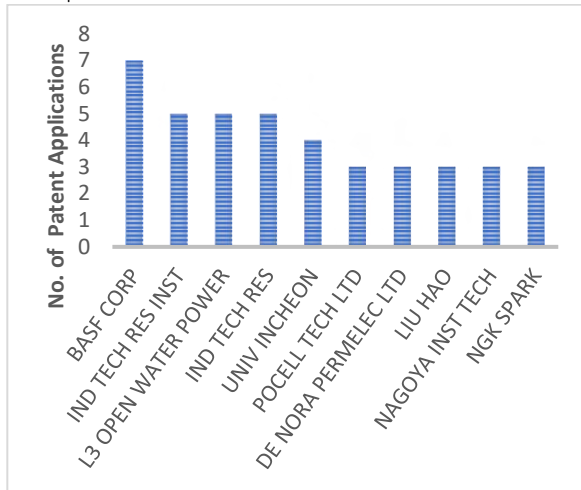


Figure A1.2.22: Top 10 filers of AFC patent applications at the top 5 offices for 2019.

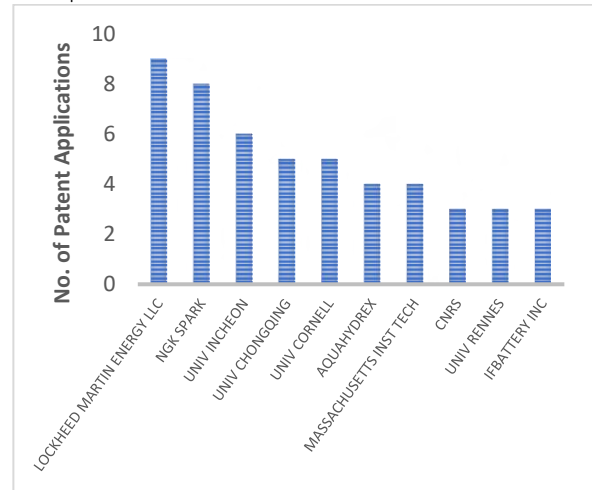


Figure A1.2.23: Top 10 filers of AFC patent applications at the top 5 offices for 2020.

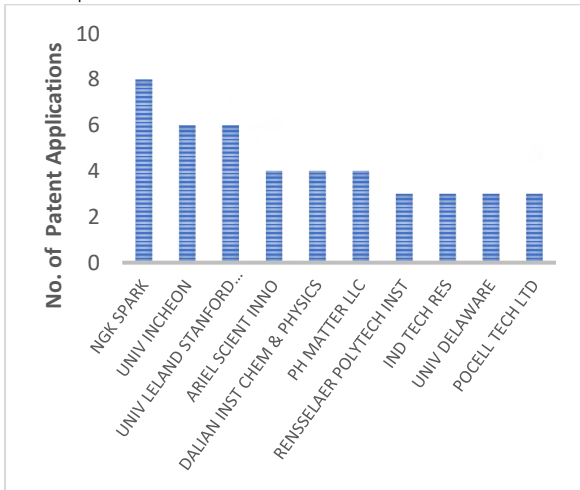
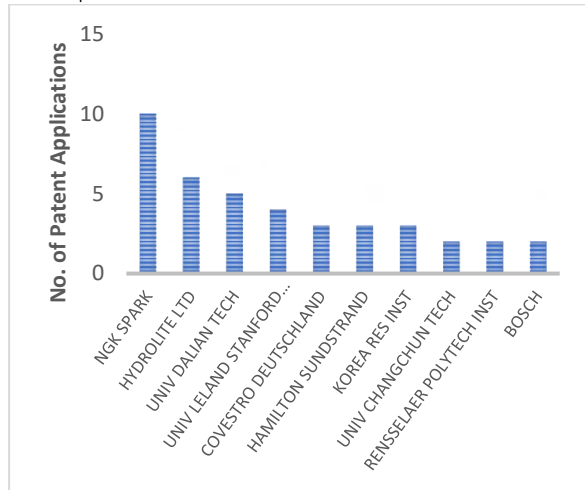


Figure A1.2.24: Top 10 filers of AFC patent applications at the top 5 offices for 2021.



1.2.4. Phosphoric Acid Fuel Cells

Figures A1.2.25 to A1.2.32 show the top 10 assignees of phosphoric acid fuel cell (PAFC) patent applications, for the top 5 offices.

Doosan are consistently the top filers of PAFC patent applications annually between 2015 and 2021.

Figure A1.2.25: Top 10 filers of PAFC patent applications at the top 5 offices for 2014.

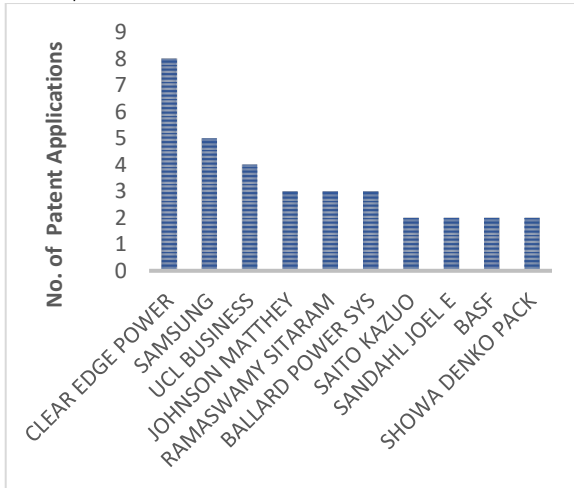


Figure A1.2.26: Top 10 filers of PAFC patent applications at the top 5 offices for 2015.

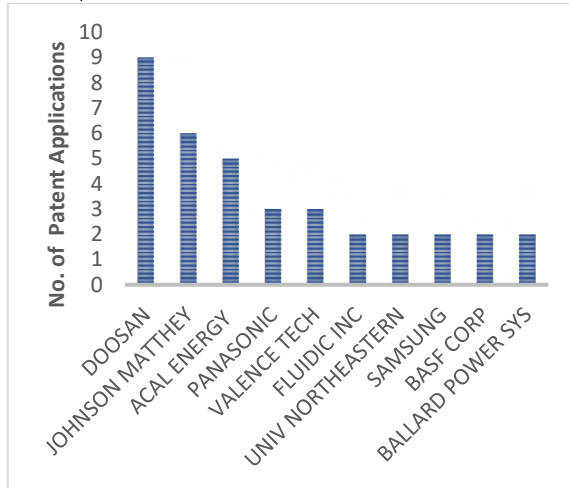


Figure A1.2.27: Top 10 filers of PAFC patent applications at the top 5 offices for 2016.

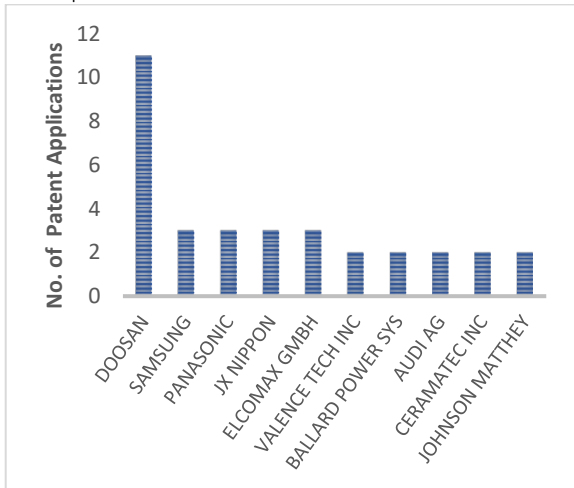


Figure A1.2.28: Top 10 filers of PAFC patent applications at the top 5 offices for 2017.

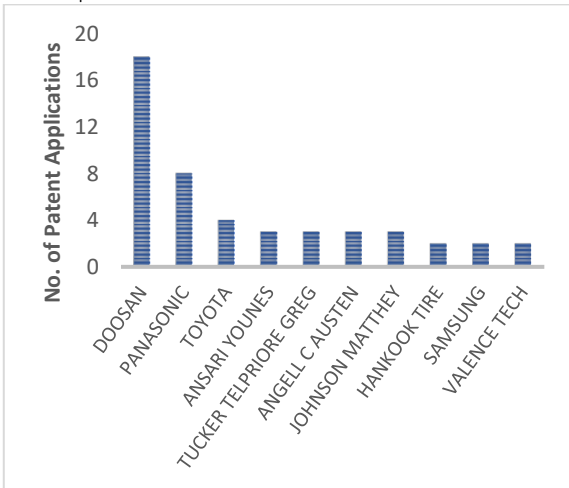


Figure A1.2.29: Top 10 filers of PAFC patent applications at the top 5 offices for 2018.

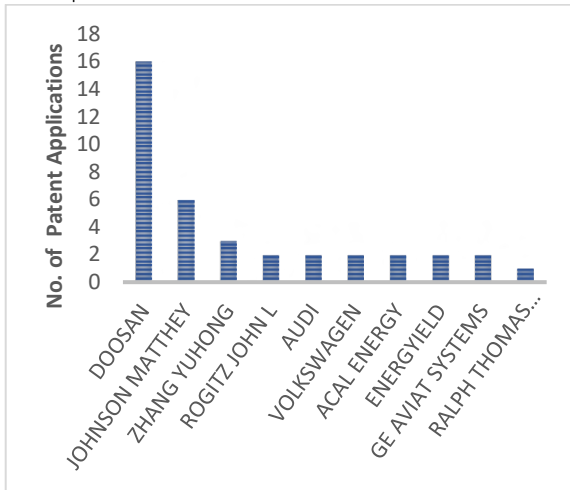


Figure A1.2.30: Top 10 filers of PAFC patent applications at the top 5 offices for 2019.

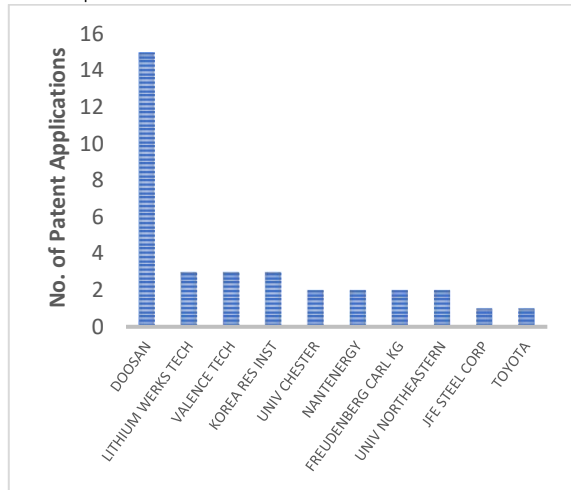


Figure A1.2.31: Top 10 filers of PAFC patent applications at the top 5 offices for 2020.

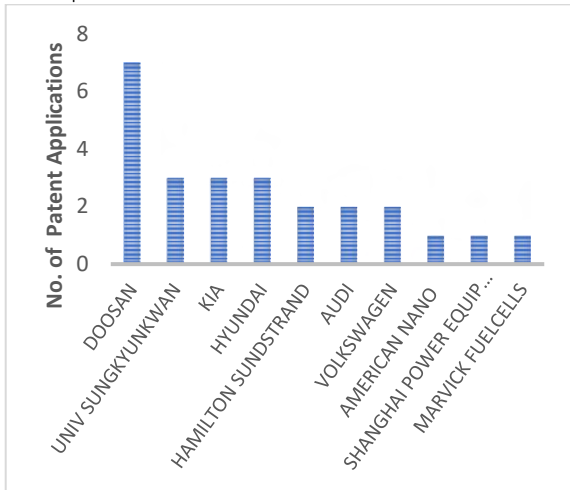
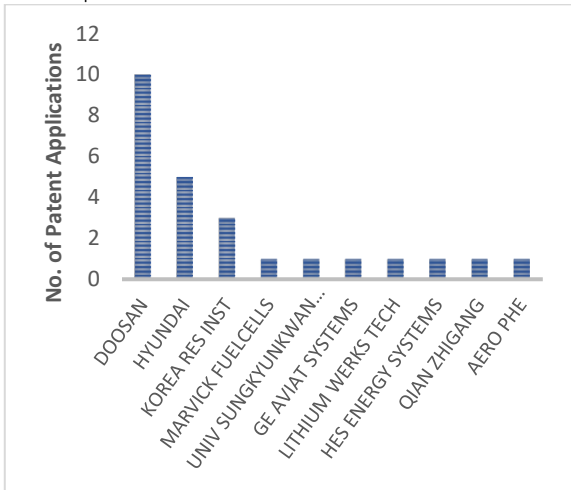


Figure A1.2.32: Top 10 filers of PAFC patent applications at the top 5 offices for 2021.



1.2.5. Proton Exchange Membrane Fuel Cells

Figures A1.2.33 to A1.2.40 show the top 10 assignees of proton exchange membrane fuel cell (PEMFC) patent applications, for the top 5 offices.

Many of the top 10 filers come from the automotive sector.

Figure A1.2.33: Top 10 filers of PEMFC patent applications at the top 5 offices for 2014.

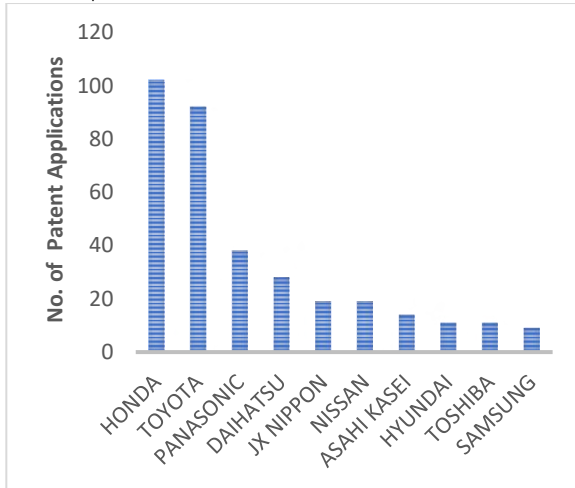


Figure A1.2.34: Top 10 filers of PEMFC patent applications at the top 5 offices for 2015.

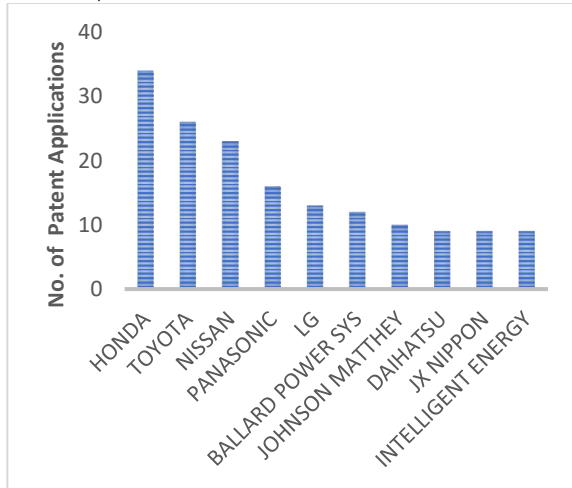


Figure A1.2.35: Top 10 filers of PEMFC patent applications at the top 5 offices for 2016.

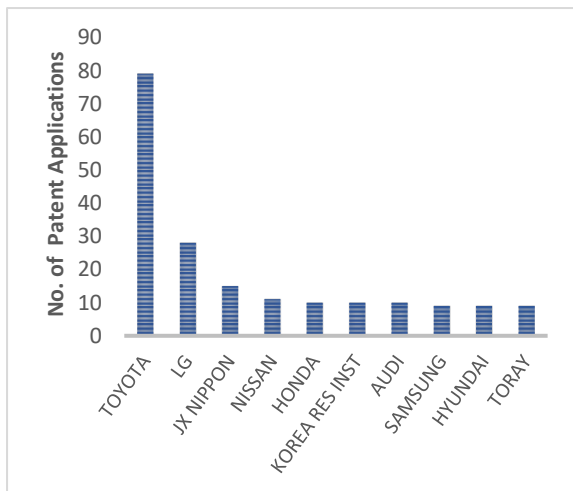


Figure A1.2.36: Top 10 filers of PEMFC patent applications at the top 5 offices for 2017.

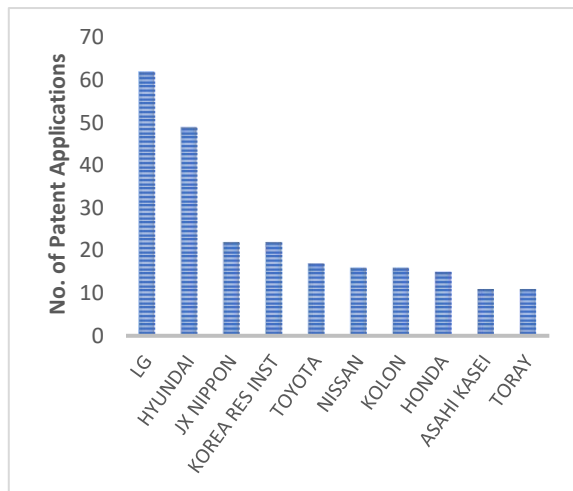


Figure A1.2.37: Top 10 filers of PEMFC patent applications at the top 5 offices for 2018.

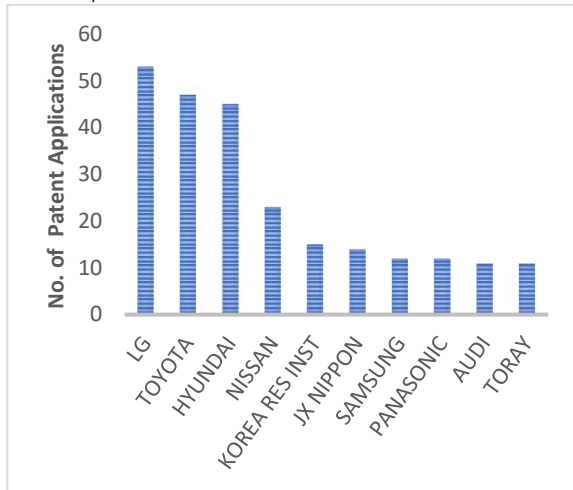


Figure A1.2.38: Top 10 filers of PEMFC patent applications at the top 5 offices for 2019.

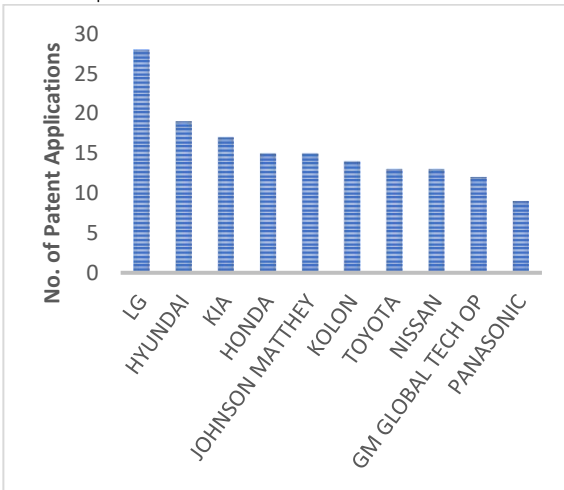


Figure A1.2.39: Top 10 filers of PEMFC patent applications at the top 5 offices for 2020.

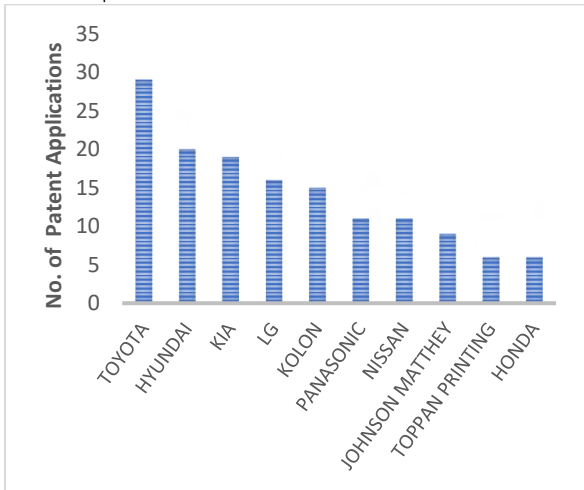
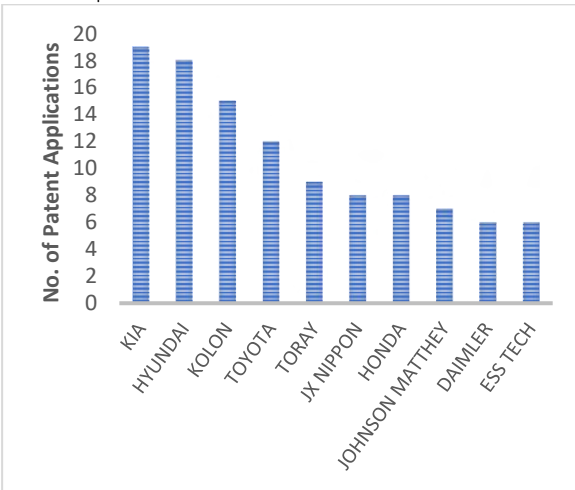


Figure A1.2.40: Top 10 filers of PEMFC patent applications at the top 5 offices for 2021.



1.2.6. Solid Oxide Fuel Cells

Figures A3.3.41 to A3.3.48 show the top 10 assignees of solid oxide fuel cell (SOFC) patent applications, for the top 5 offices.

The top filers appear to vary over the period. However, LG (China), NGK (Japan and Europe) are prominent entities.

Figure A1.2.41: Top 10 filers of SOFC patent applications at the top 5 offices for 2014.

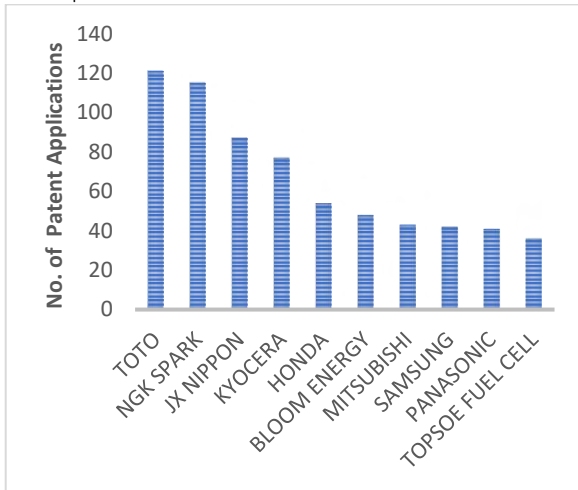


Figure A1.2.42: Top 10 filers of SOFC patent applications at the top 5 offices for 2015.

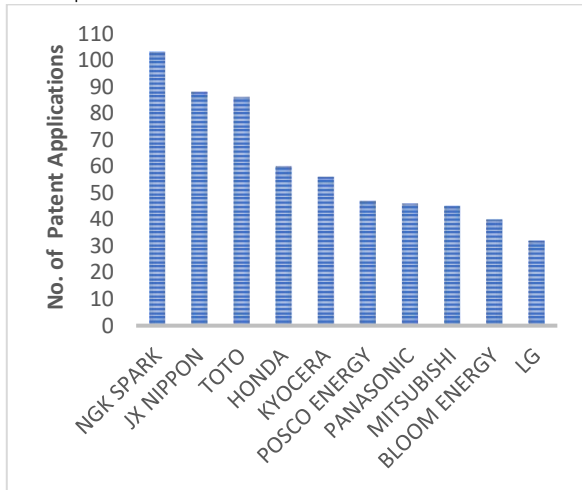


Figure A1.2.43: Top 10 filers of SOFC patent applications at the top 5 offices for 2016.

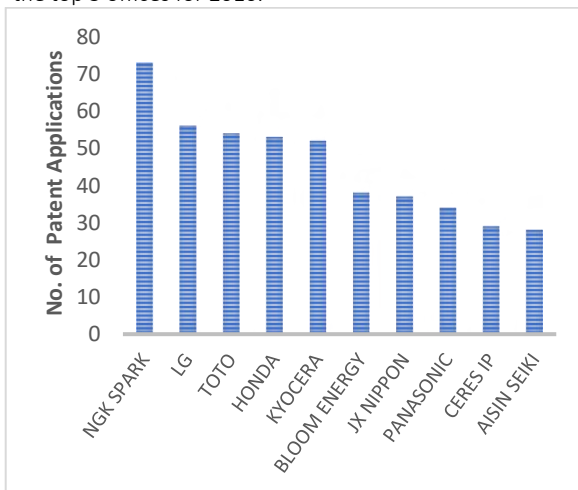


Figure A1.2.44: Top 10 filers of SOFC patent applications at the top 5 offices for 2017.

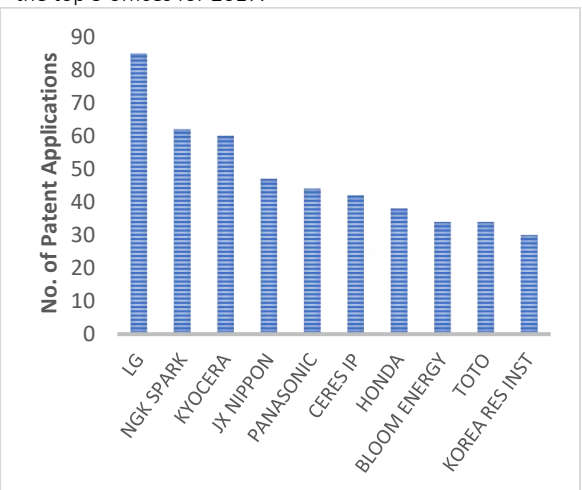


Figure A1.2.45: Top 10 filers of SOFC patent applications at the top 5 offices for 2018.

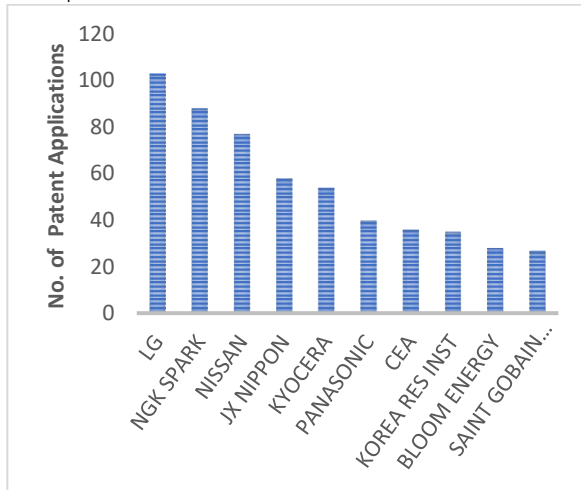


Figure A1.2.46: Top 10 filers of SOFC patent applications at the top 5 offices for 2019.

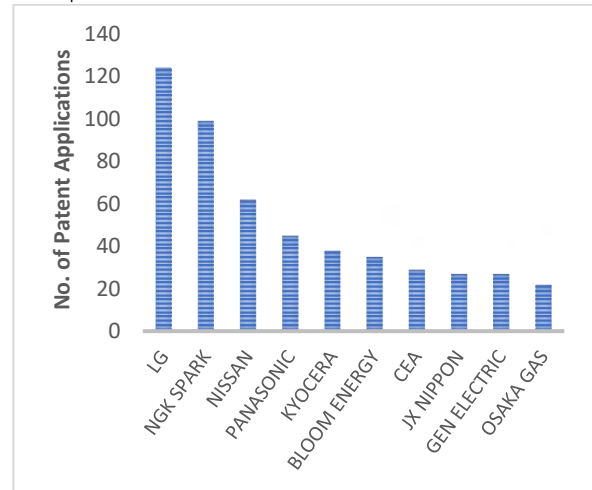


Figure A1.2.47: Top 10 filers of SOFC patent applications at the top 5 offices for 2020.

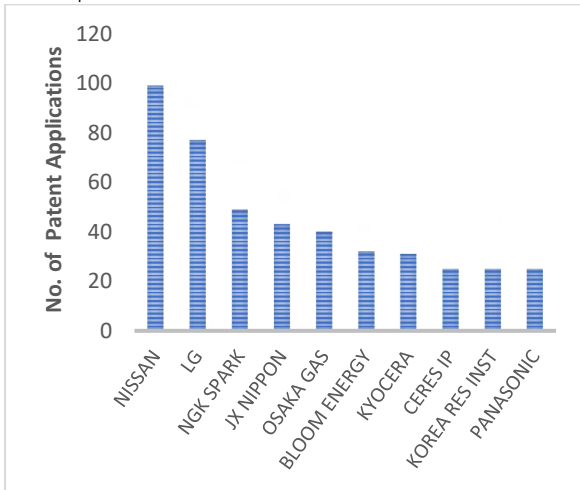
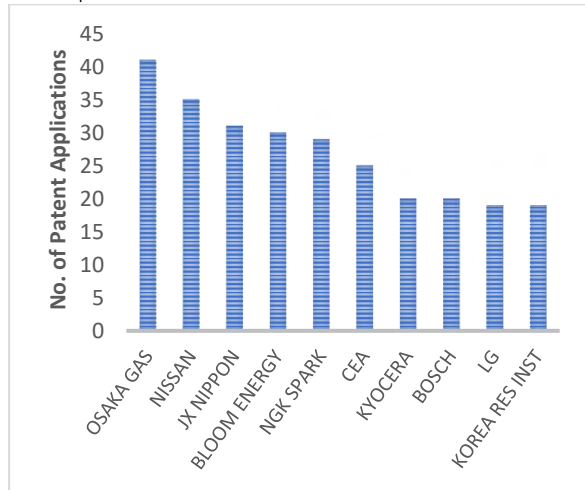


Figure A1.2.48: Top 10 filers of SOFC patent applications at the top 5 offices for 2021.



1.3. Fuel Cell Deployment

The data presented below shows the top 10 filers of patent applications for mobile, stationary and portable fuel cells, for the years 2014 to 2021, for each of the top 5 offices. In each case the bars show the absolute number of patent applications associated with a particular entity.

1.3.1. Mobile Fuel Cells

Figures A1.3.1 to A1.3.8 show the top 10 assignees of mobile fuel cell patent applications for the top 5 offices.

The top 10 assignees are unsurprisingly dominated by automotive companies.

Figure A1.3.1: Top 10 filers of mobile fuel cell patent applications at the top 5 offices for 2014.

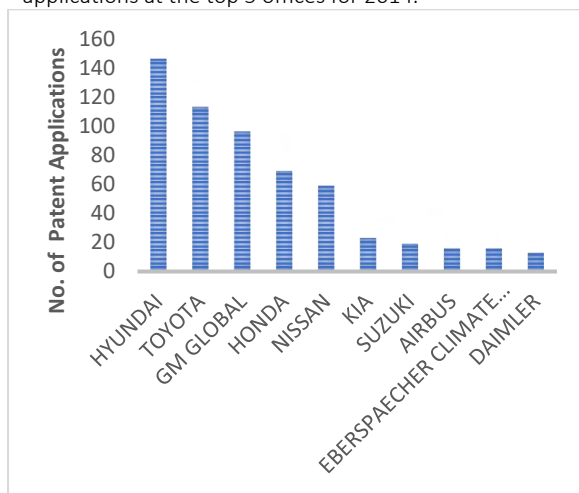


Figure A1.3.2: Top 10 filers of mobile fuel cell patent applications at the top 5 offices for 2015.

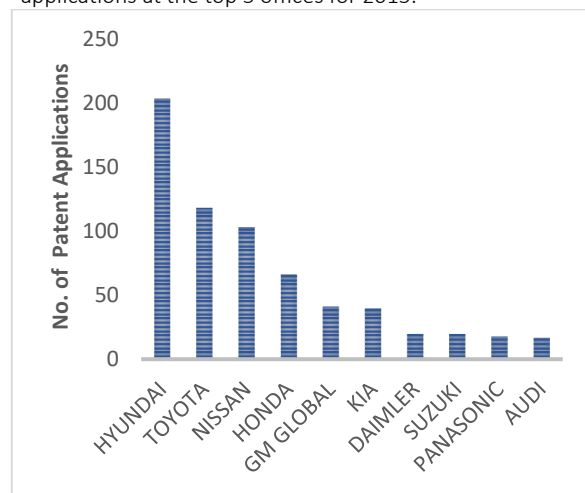


Figure A1.3.3: Top 10 filers of mobile fuel cell patent applications at the top 5 offices for 2016.

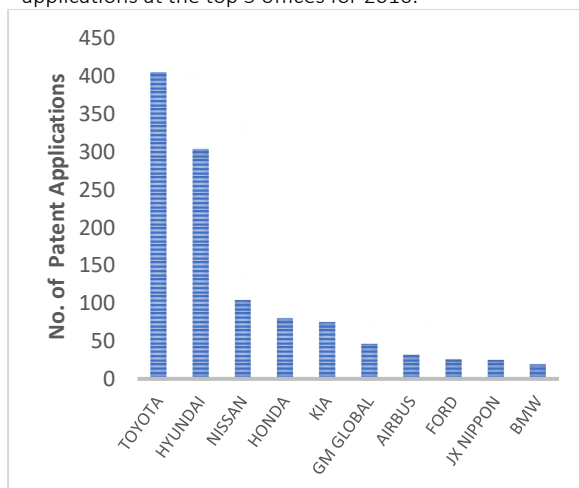


Figure A1.3.4: Top 10 filers of mobile fuel cell patent applications at the top 5 offices for 2017.

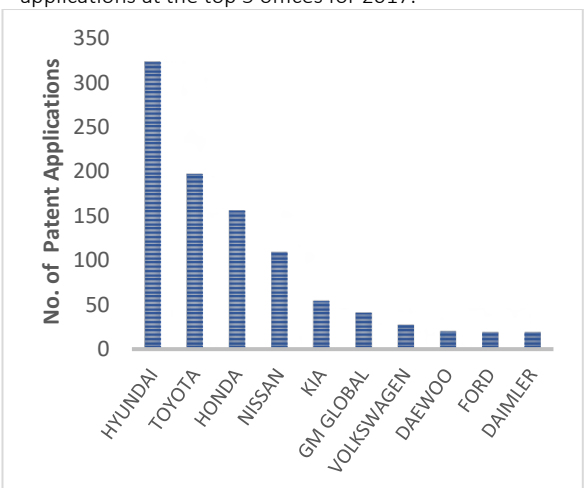


Figure A1.3.5: Top 10 filers of mobile fuel cell patent applications at the top 5 offices for 2018.

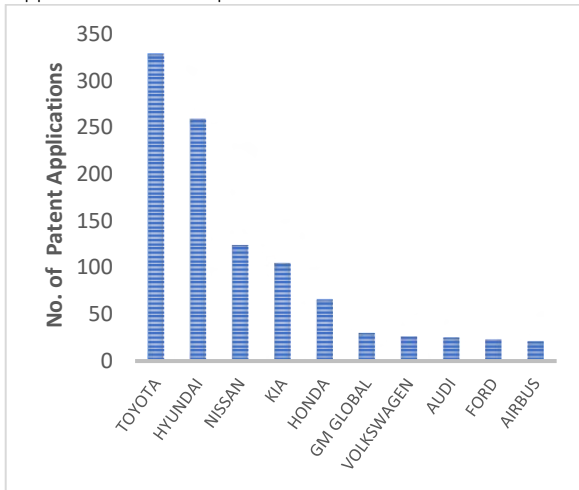


Figure A1.3.6: Top 10 filers of mobile fuel cell patent applications at the top 5 offices for 2019.

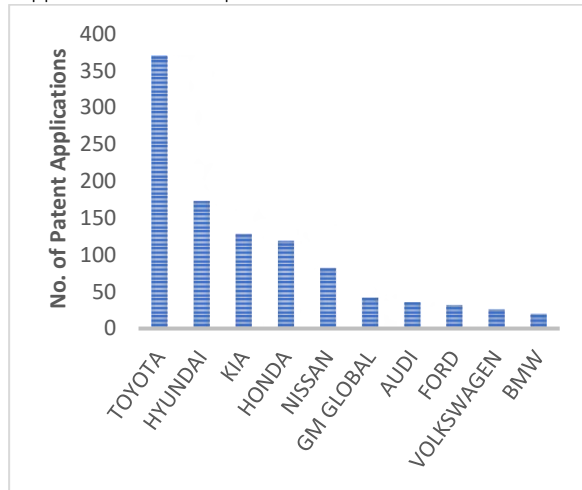


Figure A1.3.7: Top 10 filers of mobile fuel cell patent applications at the top 5 offices for 2020.

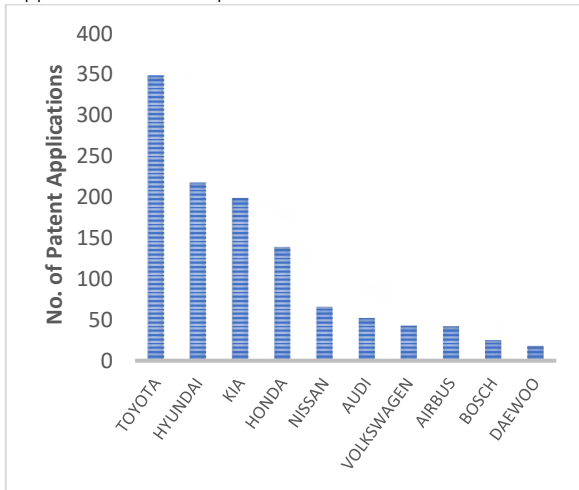
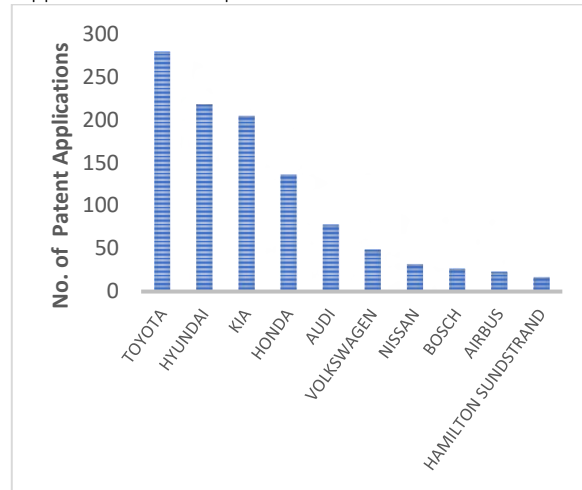


Figure A1.3.8: Top 10 filers of mobile fuel cell patent applications at the top 5 offices for 2021.



1.3.2. Stationary Fuel Cells

Figures A1.3.9 to A1.3.16 show the top 10 assignees of stationary fuel cell patent applications for the top 5 offices.

The top filers appear to vary over the period.

Figure A1.3.9: Top 10 filers of stationary fuel cell patent applications at the top 5 offices for 2014.

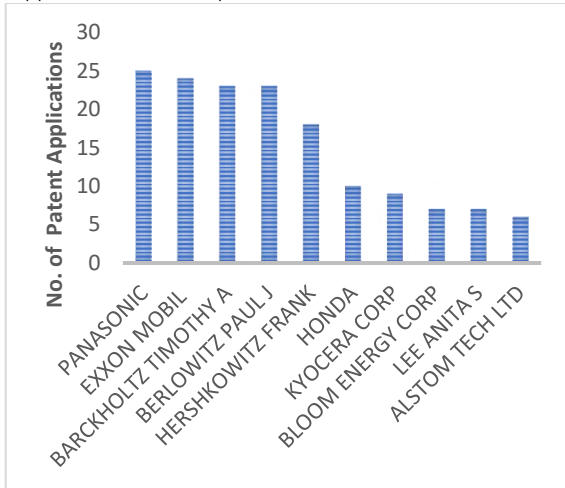


Figure A1.3.10: Top 10 filers of stationary fuel cell patent applications at the top 5 offices for 2015.

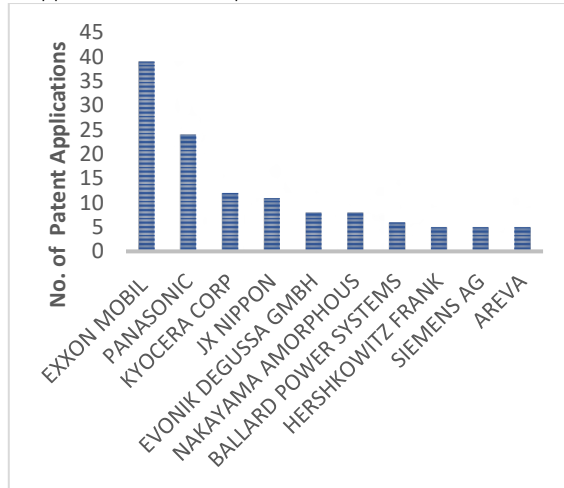


Figure A1.3.11: Top 10 filers of stationary fuel cell patent applications at the top 5 offices for 2016.

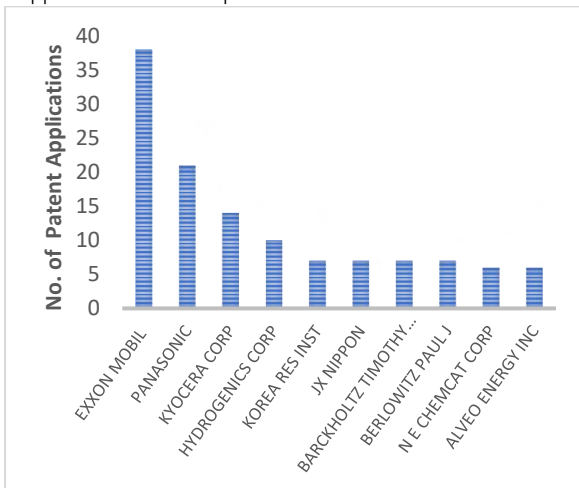


Figure A1.3.12: Top 10 filers of stationary fuel cell patent applications at the top 5 offices for 2017.

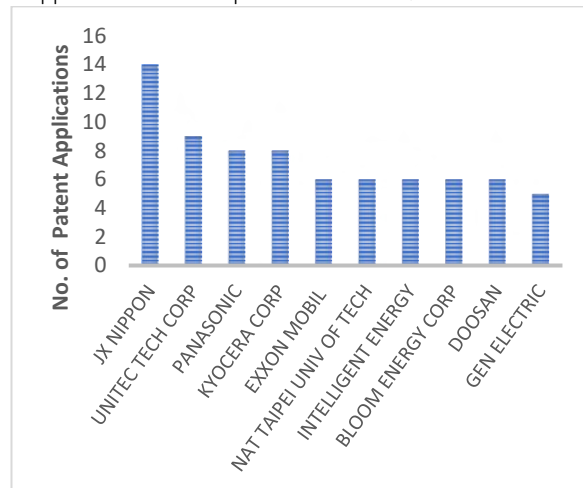


Figure A1.3.13: Top 10 filers of stationary fuel cell patent applications at the top 5 offices for 2018.

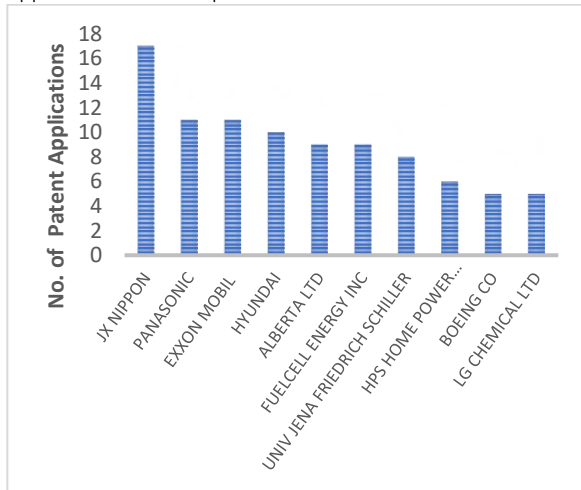


Figure A1.3.14: Top 10 filers of stationary fuel cell patent applications at the top 5 offices for 2019.

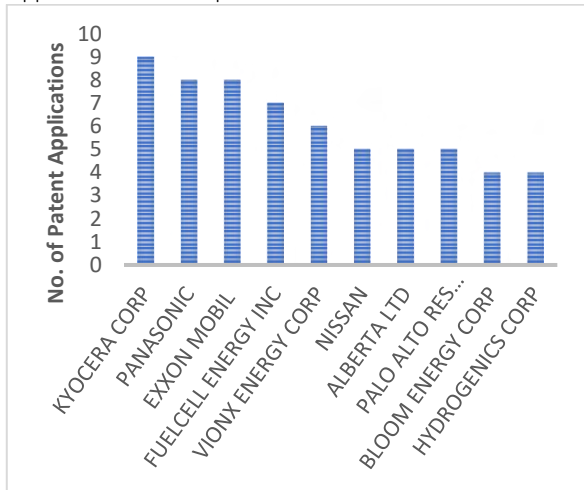


Figure A1.3.15: Top 10 filers of stationary fuel cell patent applications at the top 5 offices for 2020.

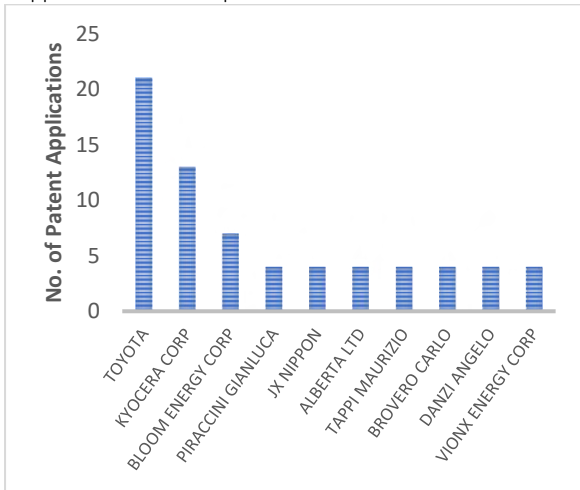
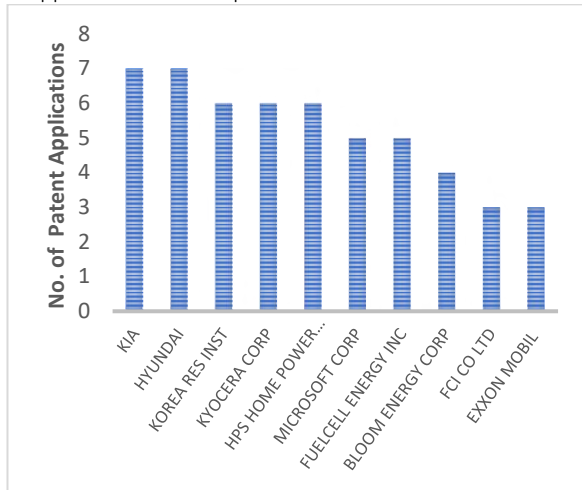


Figure A1.3.16: Top 10 filers of stationary fuel cell patent applications at the top 5 offices for 2021.



1.3.3. Portable Fuel Cells

Figures A1.3.17 to A1.3.24 show the top 10 assignees of portable fuel cell patent applications for each of the top 5 offices.

Intelligent Energy are a dominant entity in the field of portable fuel cell patent applications featuring in the top two annually between 2014 and 2019.

Figure A1.3.17: Top 10 filers of portable fuel cell patent applications at the top 5 offices for 2014.

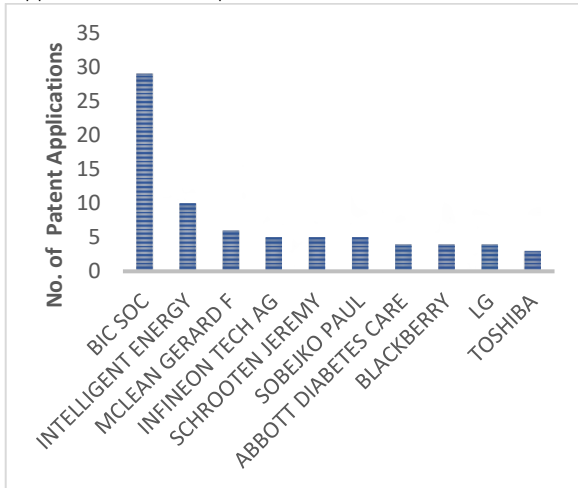


Figure A1.3.18: Top 10 filers of portable fuel cell patent applications at the top 5 offices for 2015.

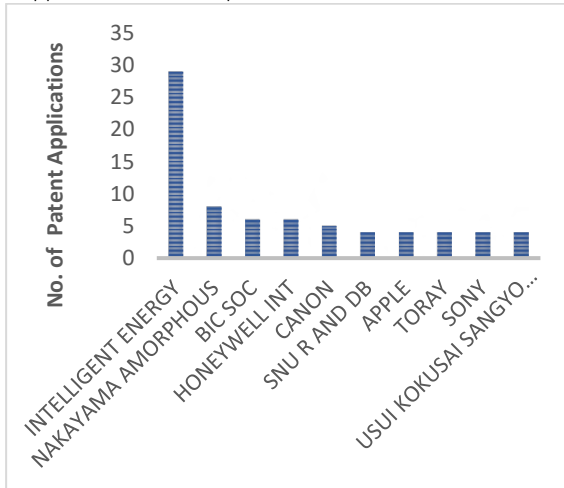


Figure A1.3.19: Top 10 filers of portable fuel cell patent applications at the top 5 offices for 2016.

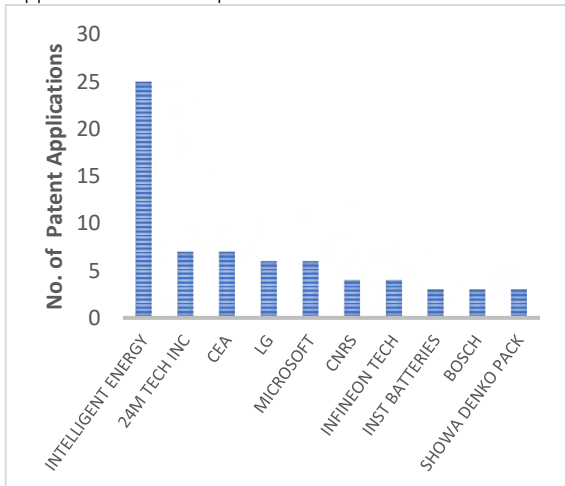


Figure A1.3.20: Top 10 filers of portable fuel cell patent applications at the top 5 offices for 2017.

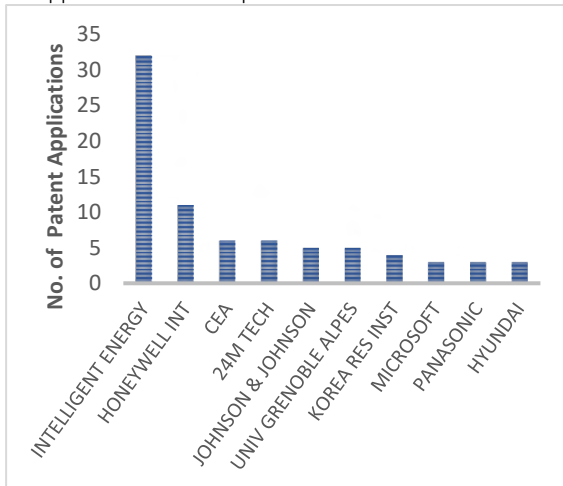


Figure A1.3.21: Top 10 filers of portable fuel cell patent applications at the top 5 offices for 2018.

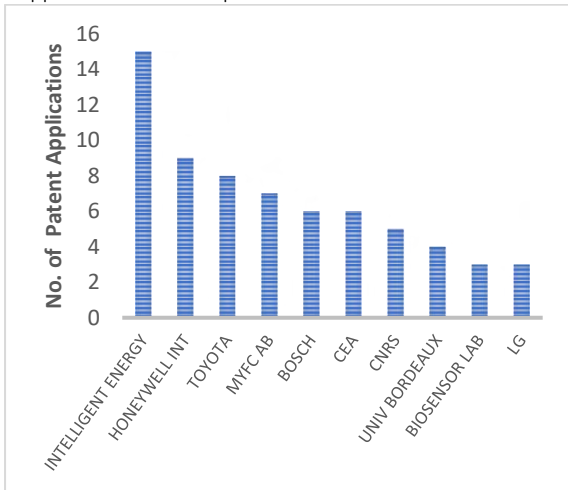


Figure A1.3.22: Top 10 filers of portable fuel cell patent applications at the top 5 offices for 2019.

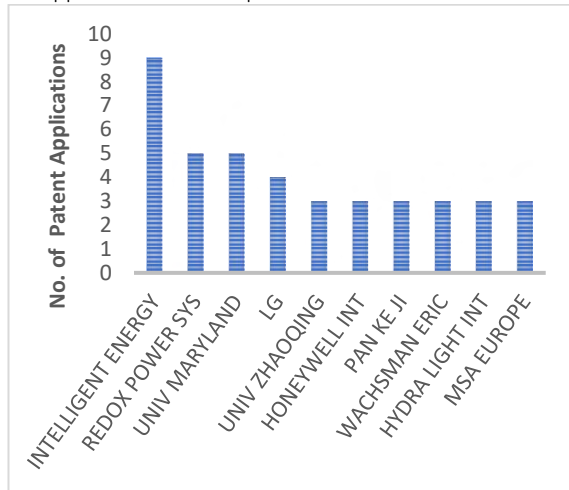


Figure A1.3.23: Top 10 filers of portable fuel cell patent applications at the top 5 offices for 2020.

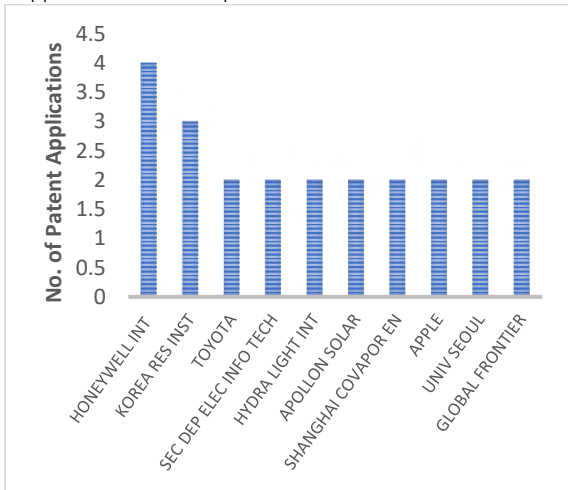
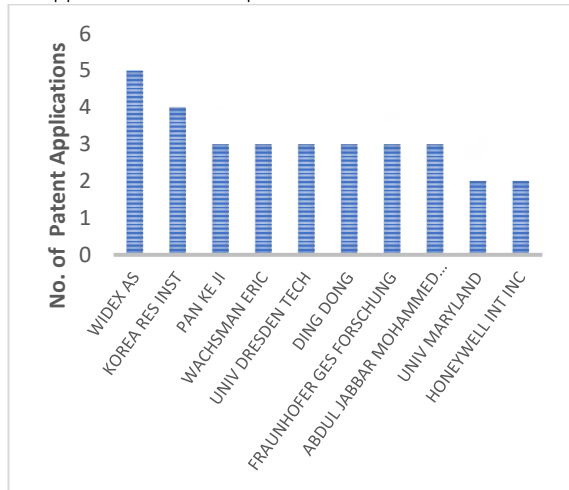


Figure A1.3.24: Top 10 filers of portable fuel cell patent applications at the top 5 offices for 2021.



1.4. Hydrogen Production, Distribution and Storage

The data presented below shows the top 10 filers of patent applications for hydrogen storage, distribution and production, for the years 2014 to 2021, for each of the top 5 offices. In each case the bars show the absolute number of patent applications associated with a particular entity.

1.4.1. Hydrogen Storage

The data presented below in Figures A1.4.1 to A1.4.8 shows the top 10 filers of hydrogen storage patent applications, for the years 2014 to 2021, for each of the top 5 offices.

The data shows that Toyota is a prominent entity.

Figure A1.4.1: Top 10 filers of hydrogen storage patent applications at the top 5 offices for 2014.

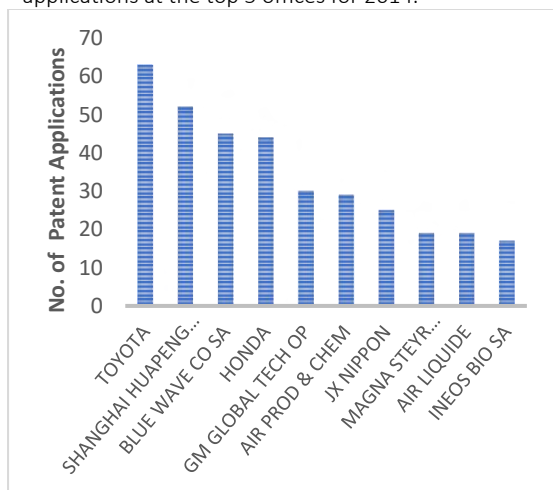


Figure A1.4.2: Top 10 filers of hydrogen storage patent applications at the top 5 offices for 2015.

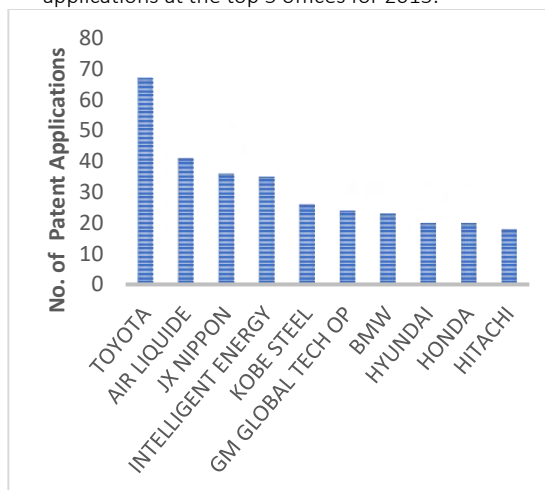


Figure A1.4.3: Top 10 filers of hydrogen storage patent applications at the top 5 offices for 2016.

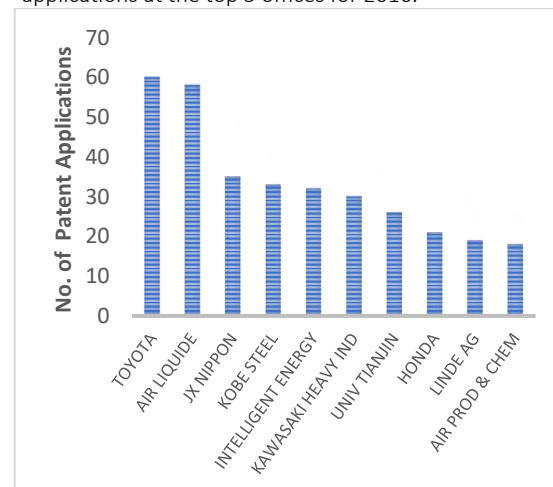


Figure A1.4.4: Top 10 filers of hydrogen storage patent applications at the top 5 offices for 2017.

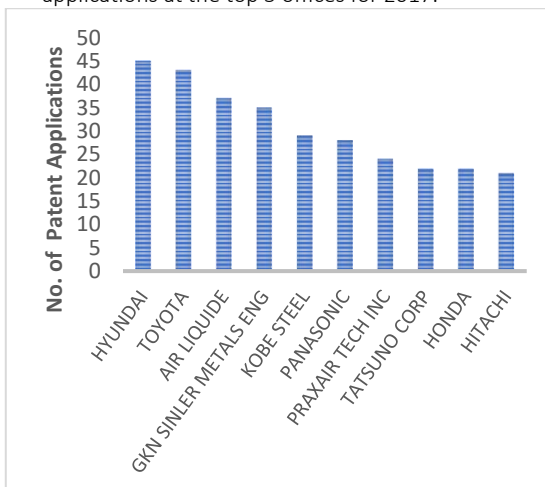


Figure A1.4.5: Top 10 filers of hydrogen storage patent applications at the top 5 offices for 2018.

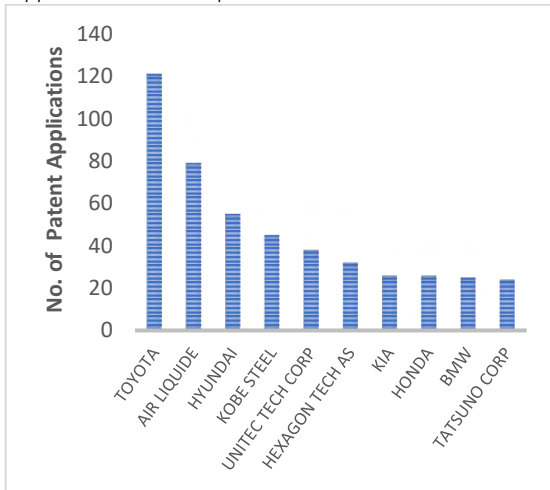


Figure A1.4.6: Top 10 filers of hydrogen storage patent applications at the top 5 offices for 2019.

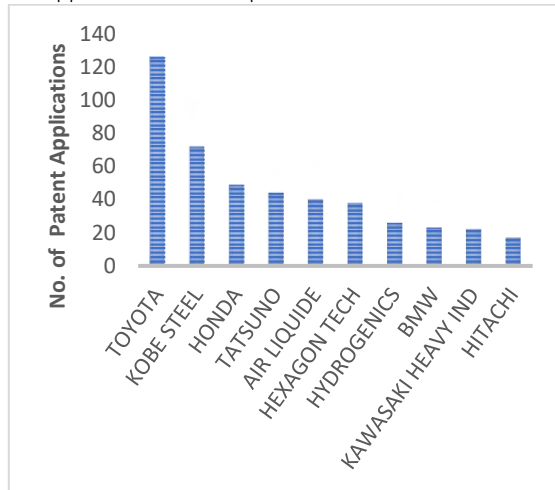


Figure A1.4.7: Top 10 filers of hydrogen storage patent applications at the top 5 offices for 2020.

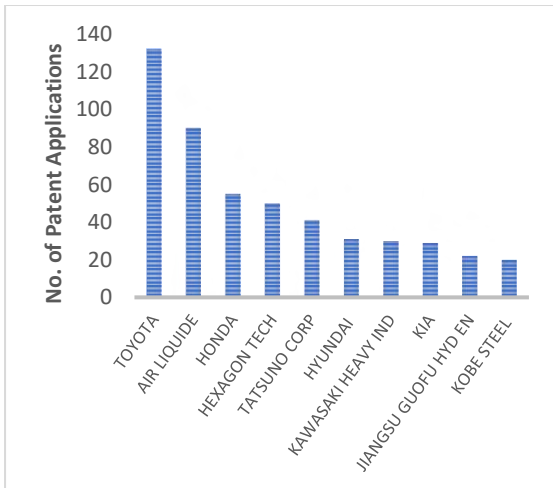
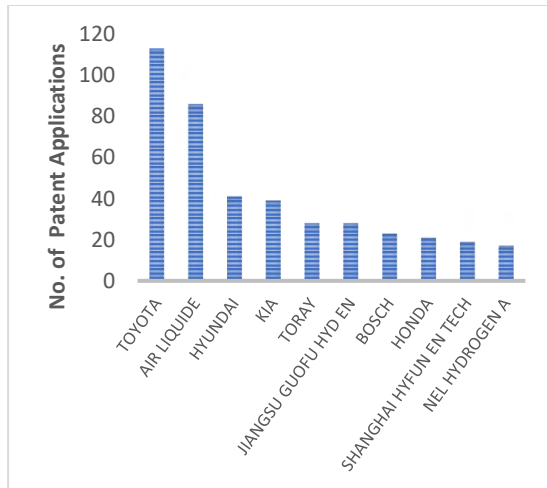


Figure A1.4.8: Top 10 filers of hydrogen storage patent applications at the top 5 offices for 2021.



1.4.2. Hydrogen Distribution

The data presented below in Figures A1.4.9 to A1.4.16 shows the top 10 filers of hydrogen distribution patent applications, for the years 2014 to 2021, for each of the top 5 offices.

Whilst the top filers appear to vary over the period, the number of patent applications filed within this sector remain relatively low.

Figure A1.4.9: Top 10 filers of hydrogen distribution patent applications at the top 5 offices for 2014.

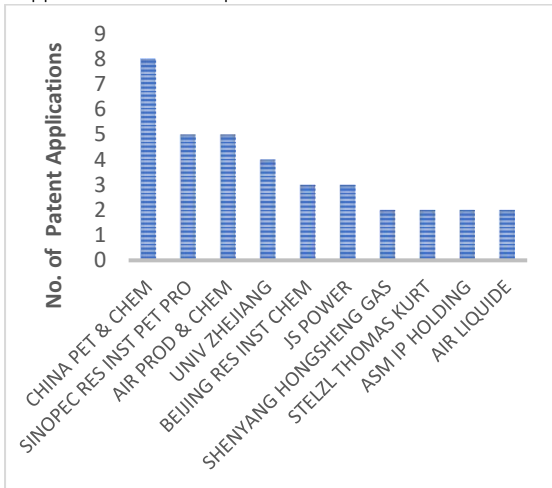


Figure A1.4.10: Top 10 filers of hydrogen distribution patent applications at the top 5 offices for 2015.

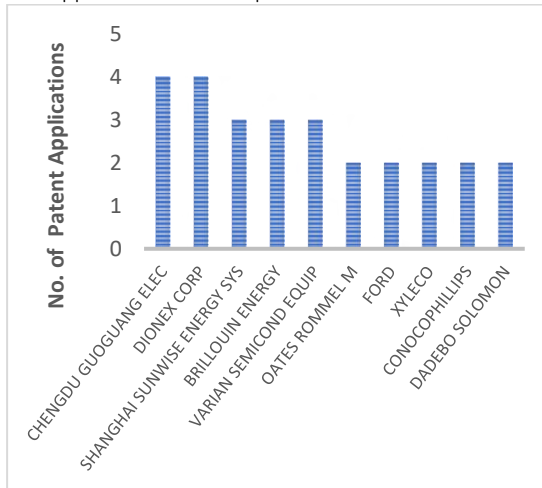


Figure A1.4.11: Top 10 filers of hydrogen distribution patent applications at the top 5 offices for 2016.

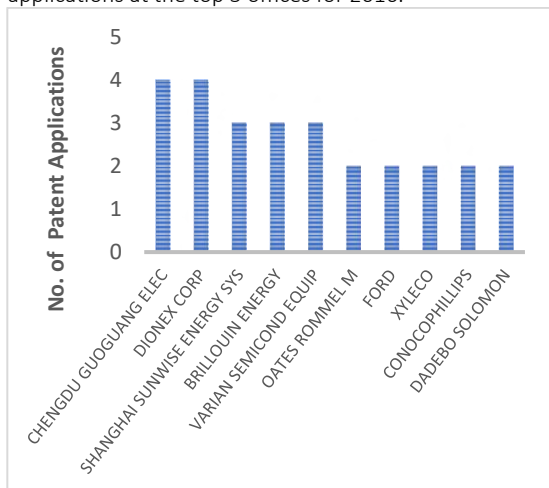


Figure A1.4.12: Top 10 filers of hydrogen distribution patent applications at the top 5 offices for 2017.

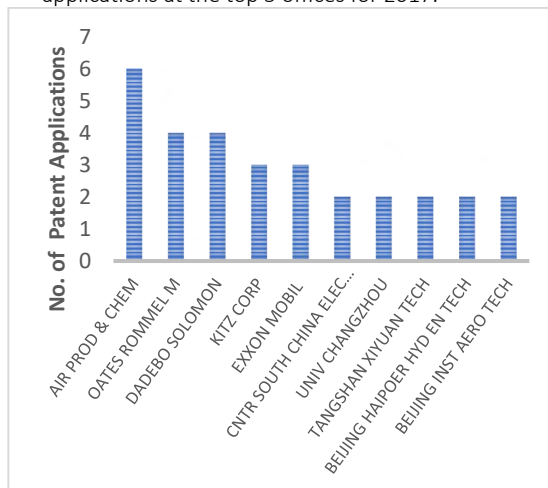


Figure A1.4.13: Top 10 filers of hydrogen distribution patent applications at the top 5 offices for 2018.

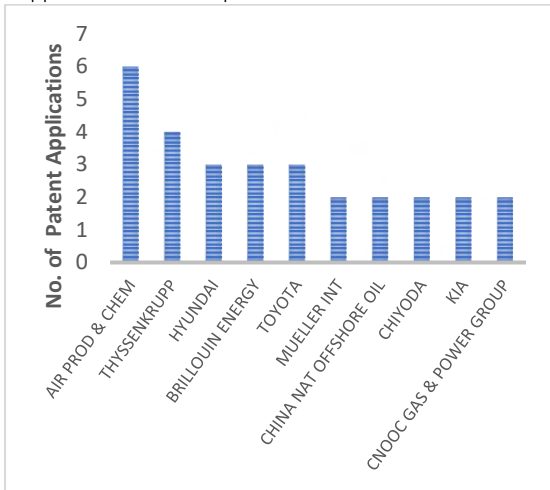


Figure A1.4.14: Top 10 filers of hydrogen distribution patent applications at the top 5 offices for 2019.

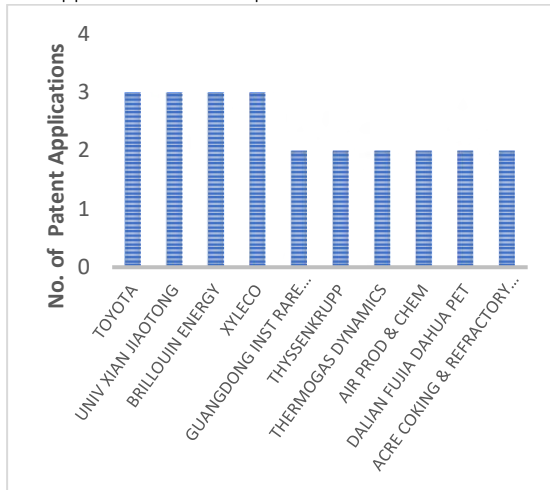


Figure A1.4.15: Top 10 filers of hydrogen distribution patent applications at the top 5 offices for 2020.

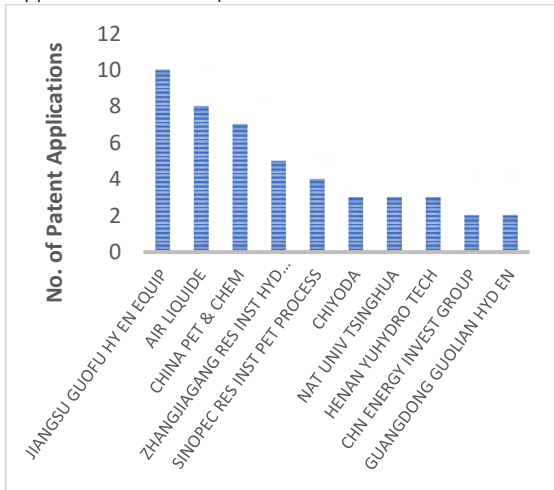
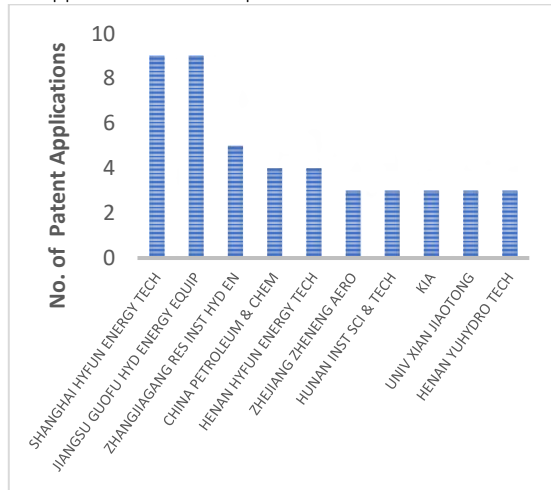


Figure A1.4.16: Top 10 filers of hydrogen distribution patent applications at the top 5 offices for 2021.



1.4.3. Hydrogen Production from Electrolysis

The data presented below shows the top 10 filers of patent applications (Figures A1.4.17 to A1.4.24) and granted patents (Figures A1.4.25 to A1.4.32) in the area of hydrogen production from electrolysis across the top 5 patent offices.

The top filers appear to vary over the period.

Figure A1.4.17: Top 10 filers of hydrogen production patent applications at the top 5 offices for 2014.

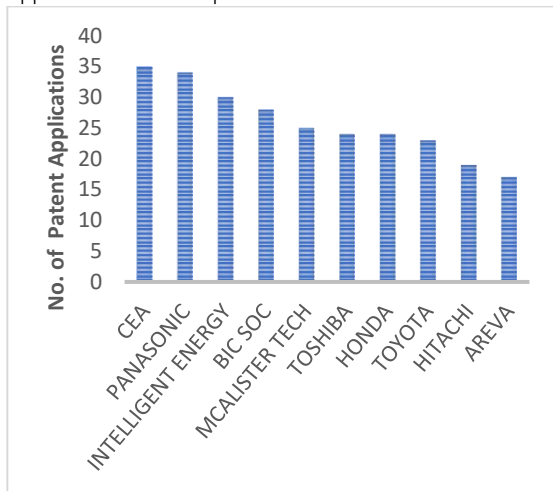


Figure A1.4.18: Top 10 filers of hydrogen production patent applications at the top 5 offices for 2015.

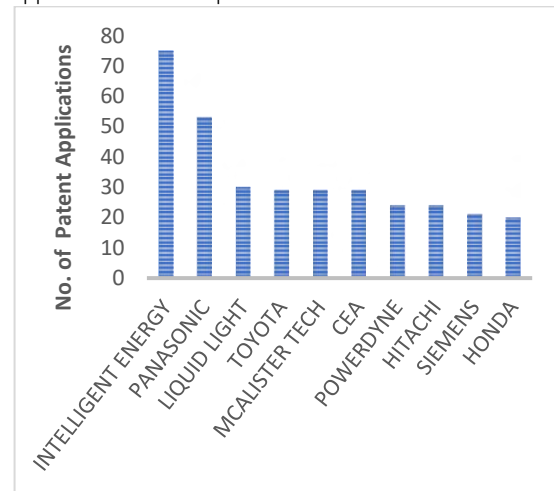


Figure A1.4.19: Top 10 filers of hydrogen production patent applications at the top 5 offices for 2016.

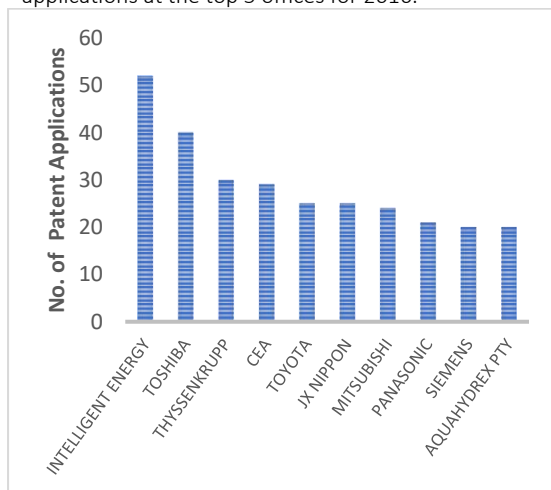


Figure A1.4.20: Top 10 filers of hydrogen production patent applications at the top 5 offices for 2017.

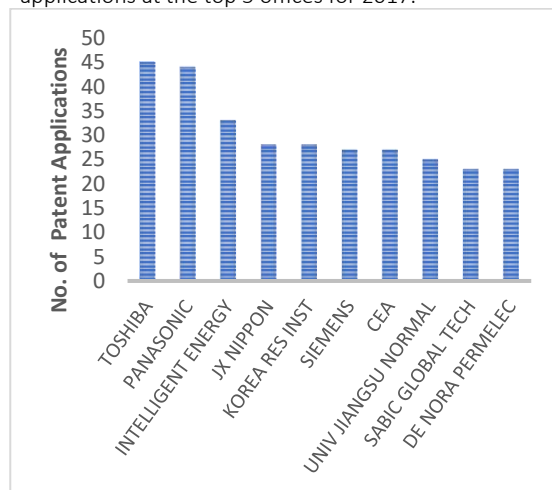


Figure A1.4.21: Top 10 filers of hydrogen production patent applications at the top 5 offices for 2018.

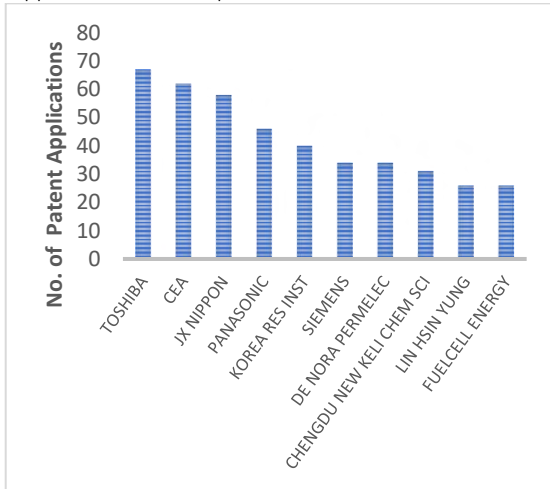


Figure A1.4.22: Top 10 filers of hydrogen production patent applications at the top 5 offices for 2019.

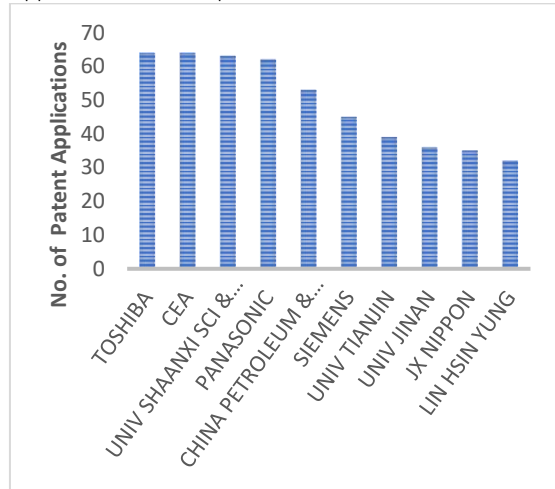


Figure A1.4.23: Top 10 filers of hydrogen production patent applications at the top 5 offices for 2020.

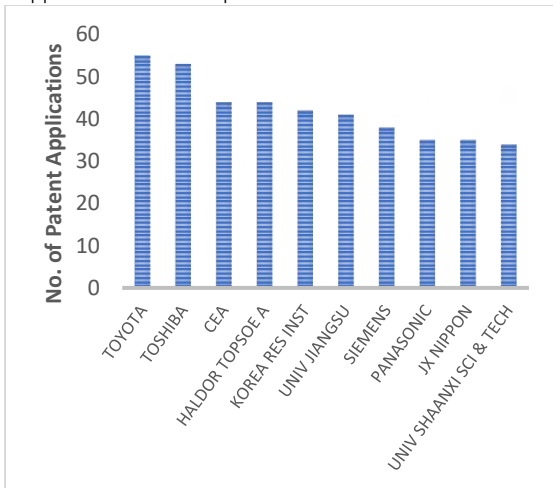


Figure A1.4.24: Top 10 filers of hydrogen production patent applications at the top 5 offices for 2021.

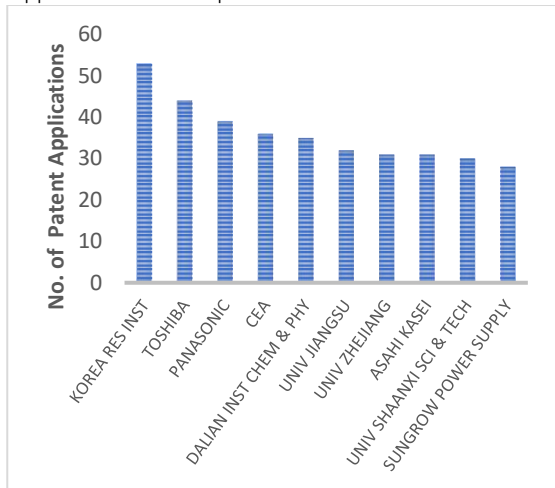


Figure A1.4.25: Top 10 filers of hydrogen production patents at the top 5 offices for 2014.

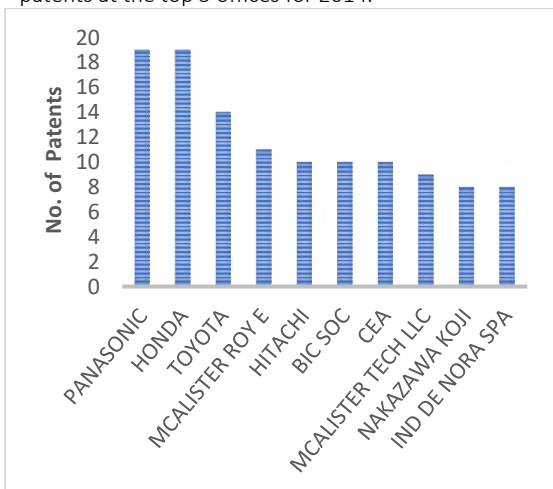


Figure A1.4.26: Top 10 filers of hydrogen production patents at the top 5 offices for 2015.

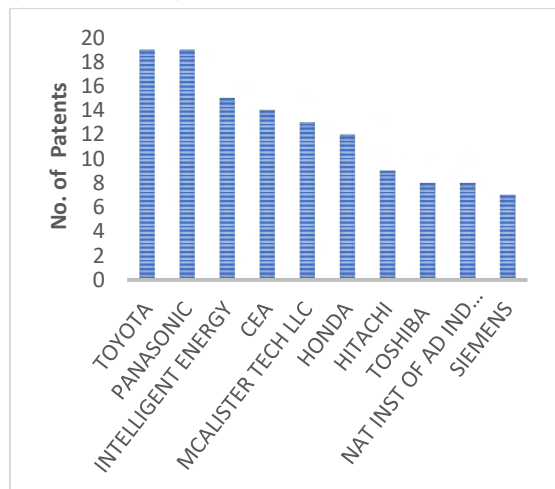


Figure A1.4.27: Top 10 filers of hydrogen production patents at the top 5 offices for 2016.

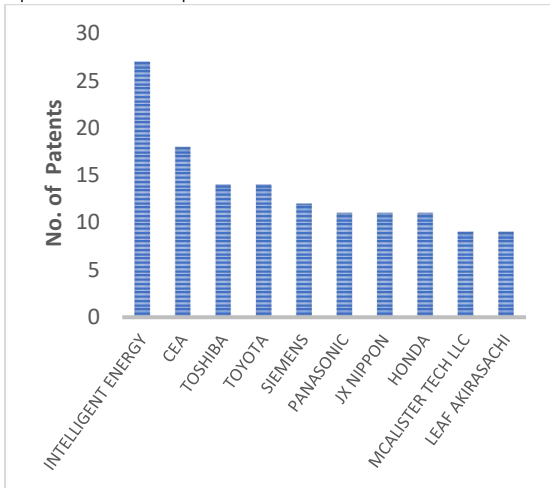


Figure A1.4.28: Top 10 filers of hydrogen production patents at the top 5 offices for 2017.

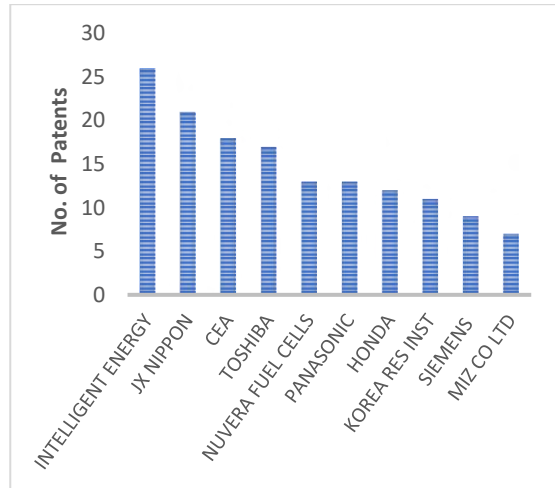


Figure A1.4.29: Top 10 filers of hydrogen production patents at the top 5 offices for 2018.

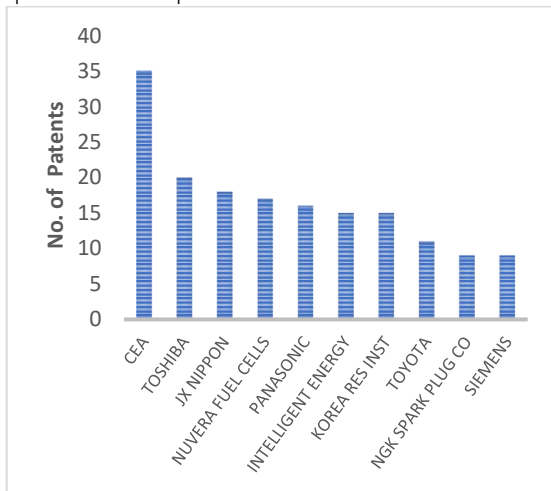


Figure A1.4.30: Top 10 filers of hydrogen production patents at the top 5 offices for 2019.

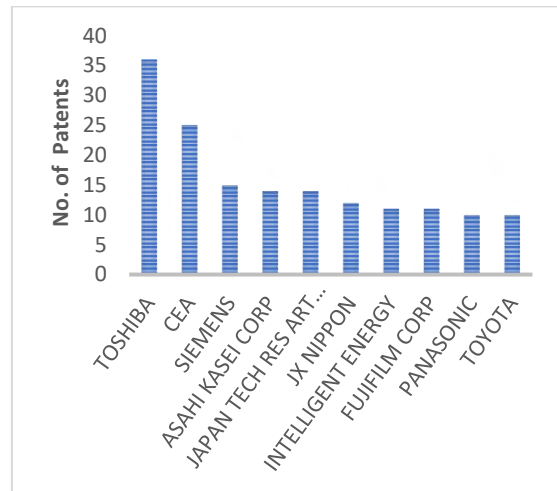


Figure A1.4.31: Top 10 filers of hydrogen production patents at the top 5 offices for 2020.

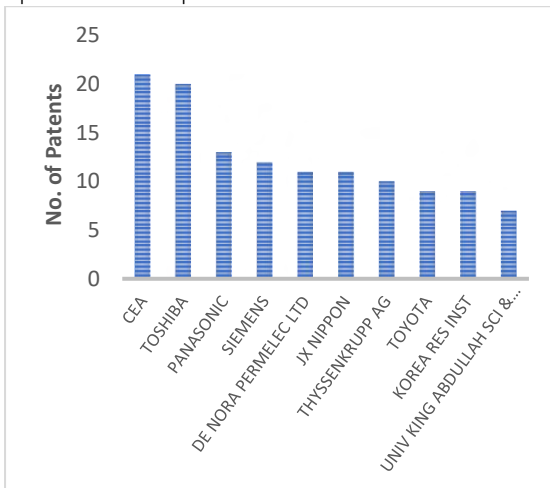
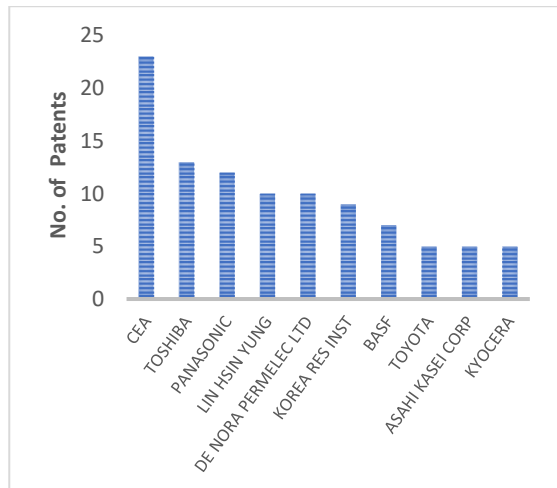


Figure A1.4.32: Top 10 filers of hydrogen production patents at the top 5 offices for 2021.



2. Comparable Technologies

The above sections describe the progress in fuel cell technologies through the patent applications. In order to have a more complete picture and to be able to see the progress against other comparable technologies, in this section we assess the patent activity within the sector of battery accumulators.

2.1. Battery Accumulators

2.1.1. Lithium Batteries

The data presented below shows the top 10 filers of patent applications (Figures A2.1.1 to A2.1.8) and granted patents (Figures A2.1.9 to A2.1.16) in the area of lithium batteries recorded annually from 2014 to 2021 at the top 5 patent offices. In each case the bars show the absolute number of patent applications associated with a particular entity.

LG, Samsung and Toyota are in the top three assignees annually (for the period 2014 to 2020) for both published lithium battery application and granted lithium battery patents.

Figure A2.1.1: Top 10 filers of lithium battery patent applications at the top 5 offices for 2014.

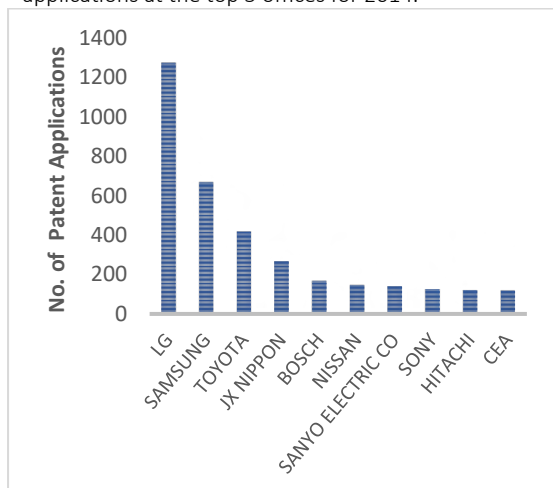


Figure A2.1.2: Top 10 filers of lithium battery patent applications at the top 5 offices for 2015.

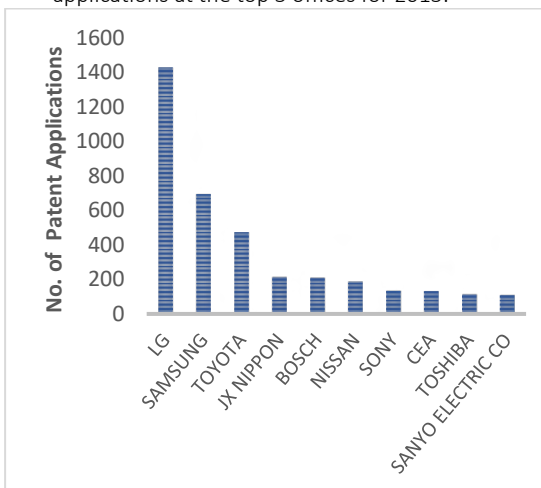


Figure A2.1.3: Top 10 filers of lithium battery patent applications at the top 5 offices for 2016.

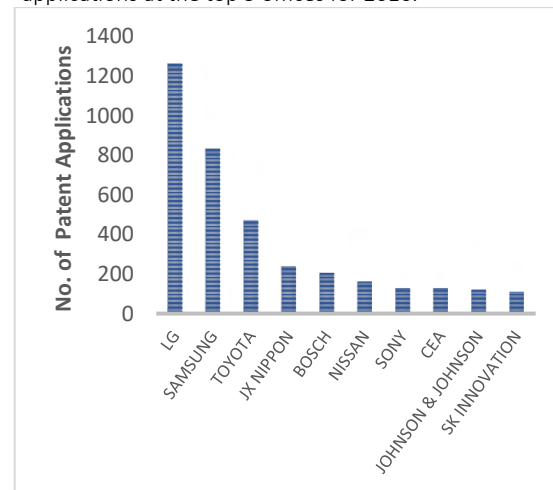


Figure A2.1.4: Top 10 filers of lithium battery patent applications at the top 5 offices for 2017.

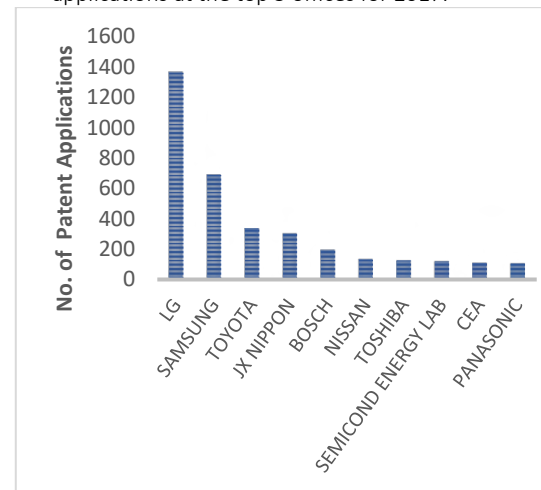


Figure A2.1.5: Top 10 filers of lithium battery patent applications at the top 5 offices for 2018.

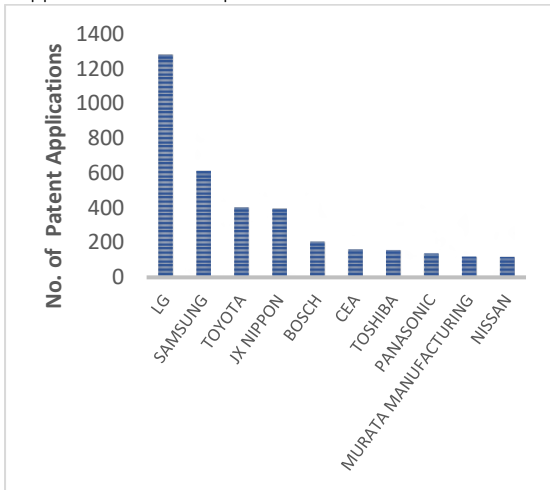


Figure A2.1.6: Top 10 filers of lithium battery patent applications at the top 5 offices for 2019.

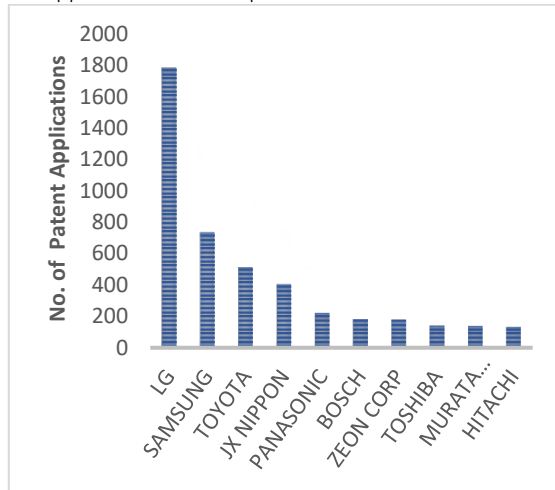


Figure A2.1.7: Top 10 filers of lithium battery patent applications at the top 5 offices for 2020.

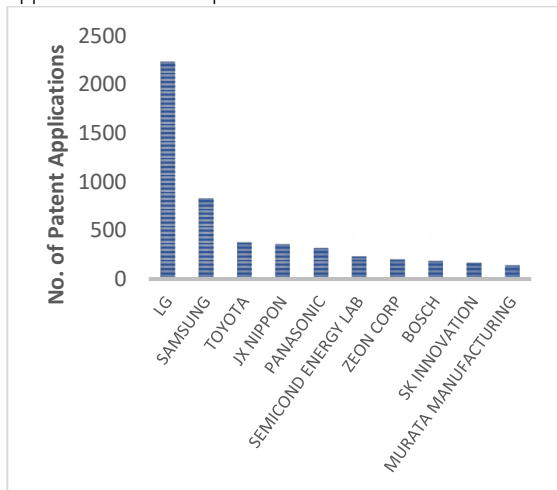


Figure A2.1.8: Top 10 filers of lithium battery patent applications at the top 5 offices for 2021.

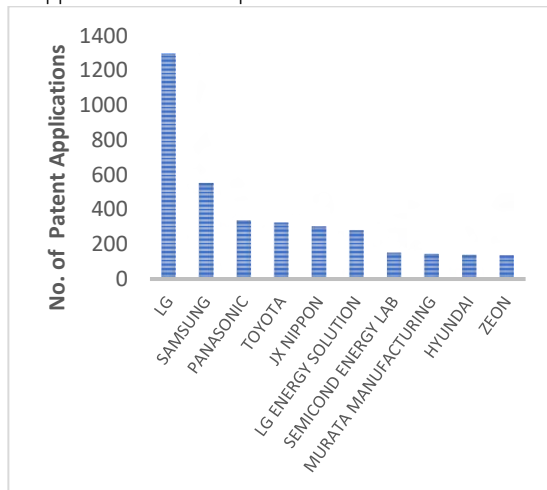


Figure A2.1.9: Top 10 filers of granted lithium battery patents at the top 5 offices for 2014.

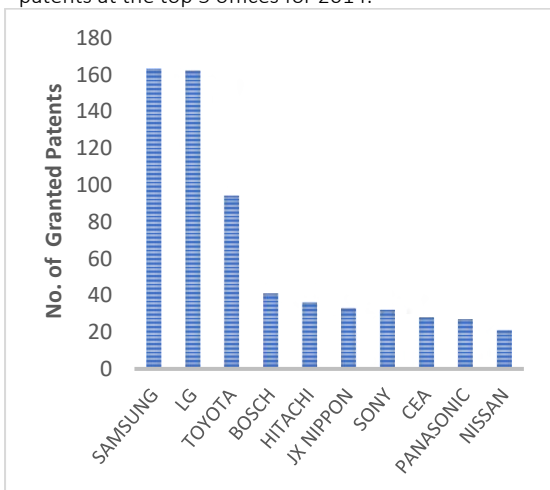


Figure A2.1.10: Top 10 filers of granted lithium battery patents at the top 5 offices for 2015.

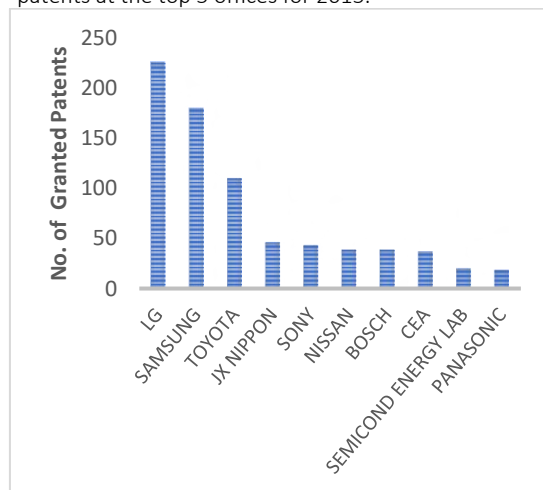


Figure A2.1.11: Top 10 filers of granted lithium battery patents at the top 5 offices for 2016.

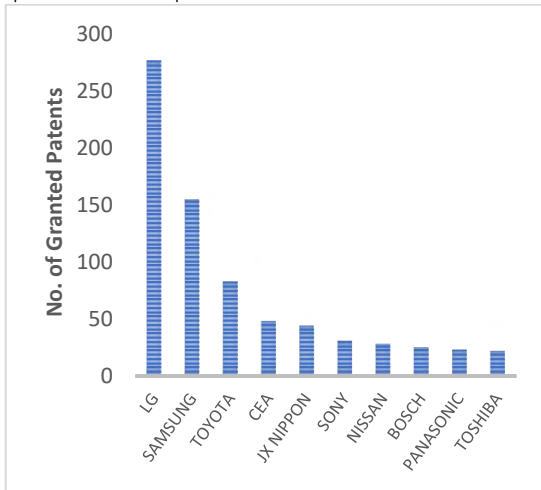


Figure A2.1.12: Top 10 filers of granted lithium battery patents at the top 5 offices for 2017.

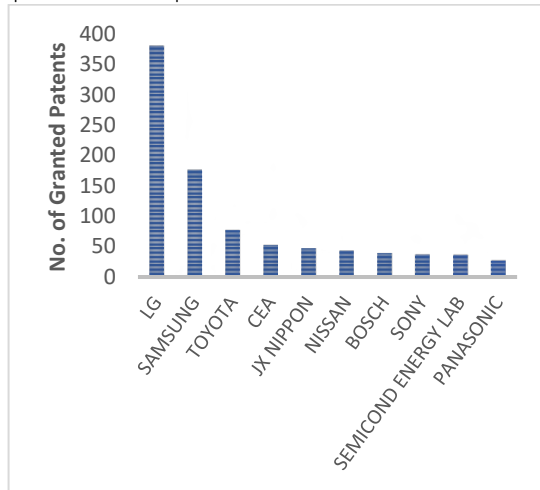


Figure A2.1.13: Top 10 filers of granted lithium battery patents at the top 5 offices for 2018.

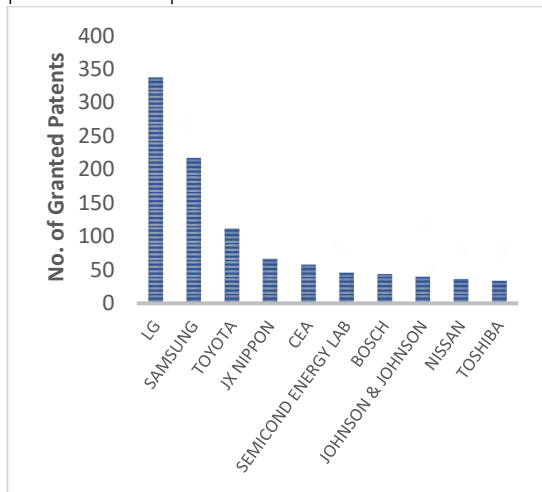


Figure A2.1.14: Top 10 filers of granted lithium battery patents at the top 5 offices for 2019.

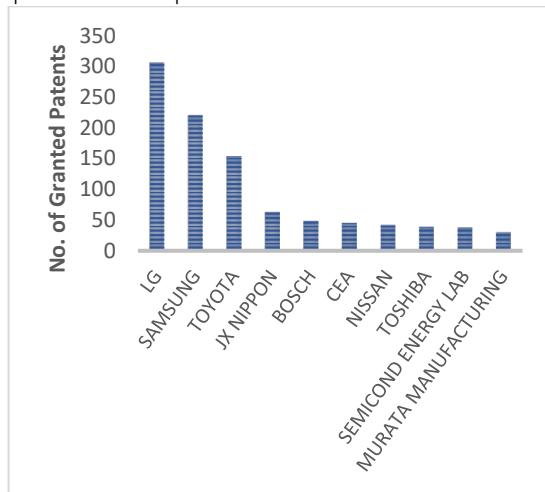


Figure A2.1.15: Top 10 filers of granted lithium battery patents at the top 5 offices for 2020.

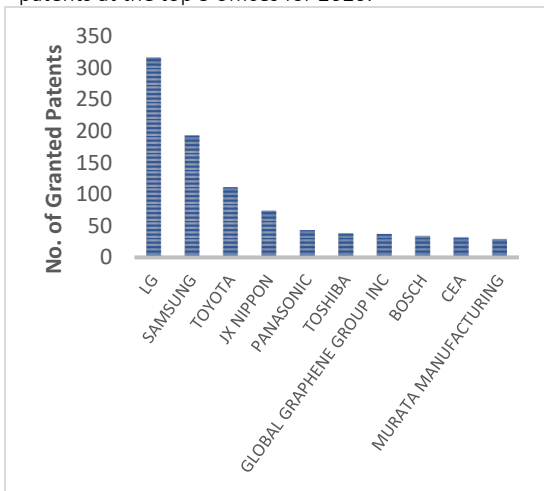
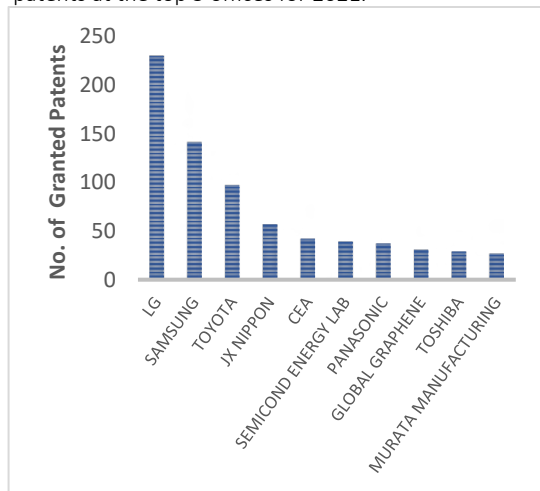


Figure A2.1.16: Top 10 filers of granted lithium battery patents at the top 5 offices for 2021.



2.1.2. Lead-Acid Batteries

The data presented below shows the top 10 filers of patent applications (Figures A2.1.17 to A2.1.24) and granted patents (Figures A2.1.25 to A2.1.32) in the area of lead-acid batteries recorded annually from 2014 to 2021 at the top 5 patent offices. In each case the bars show the absolute number of patent applications associated with a particular entity.

Whilst the top filers appear to vary over the period, the number of applications filed within the field of lead-acid batteries remains relatively low, in comparison to the number of lithium battery applications and granted patents.

Figure A2.1.17: Top 10 filers of lead-acid battery patent applications at the top 5 offices for 2014.

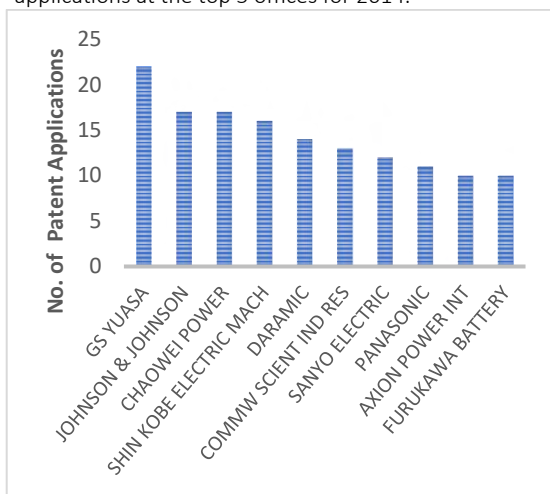


Figure A2.1.18: Top 10 filers of lead-acid battery patent applications at the top 5 offices for 2015.

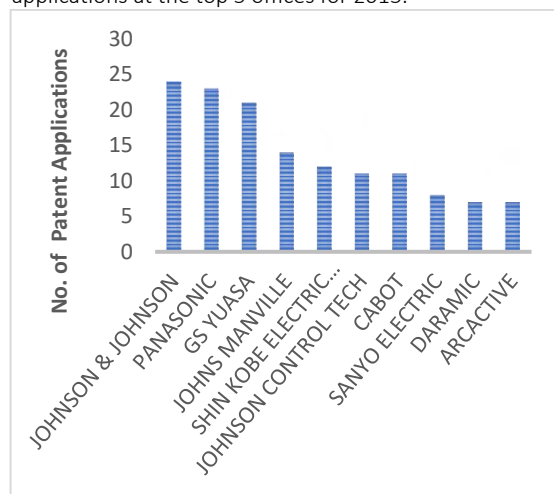


Figure A2.1.19: Top 10 filers of lead-acid battery patent applications at the top 5 offices for 2016.

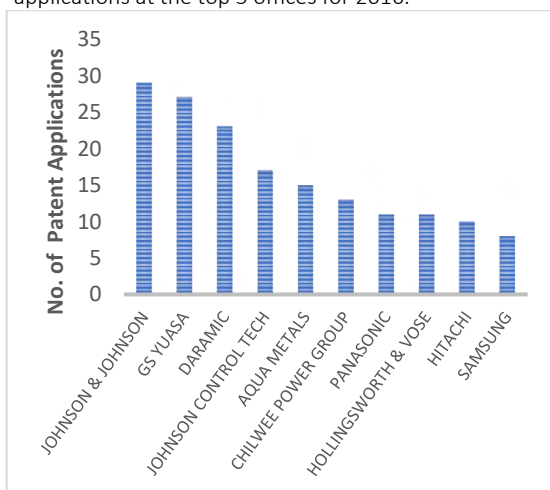


Figure A2.1.20: Top 10 filers of lead-acid battery patent applications at the top 5 offices for 2017.

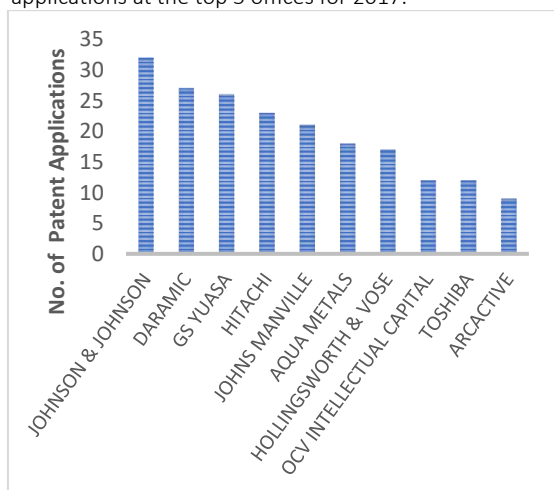


Figure A2.1.21: Top 10 filers of lead-acid battery patent applications at the top 5 offices for 2018.

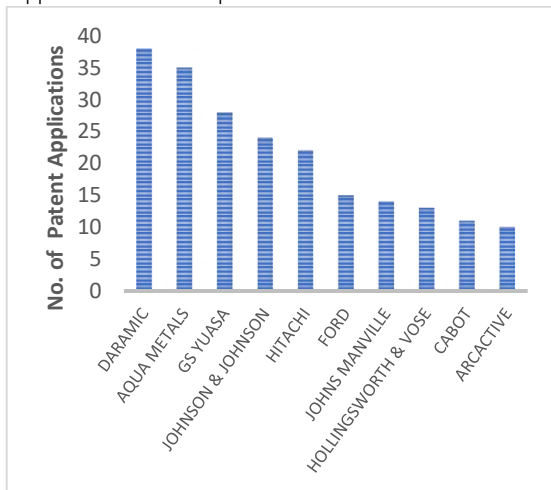


Figure A2.1.22: Top 10 filers of lead-acid battery patent applications at the top 5 offices for 2019.

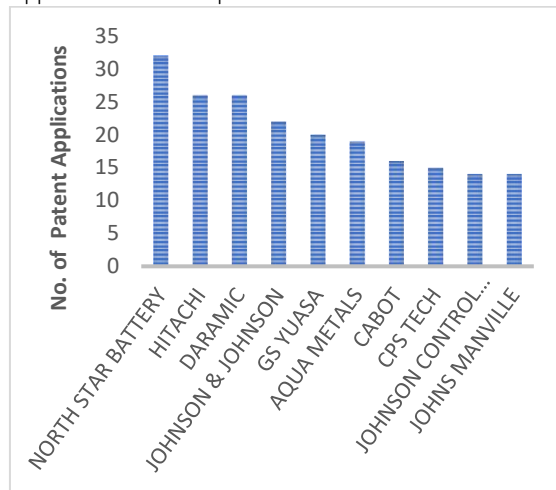


Figure A2.1.23: Top 10 filers of lead-acid battery patent applications at the top 5 offices for 2020.

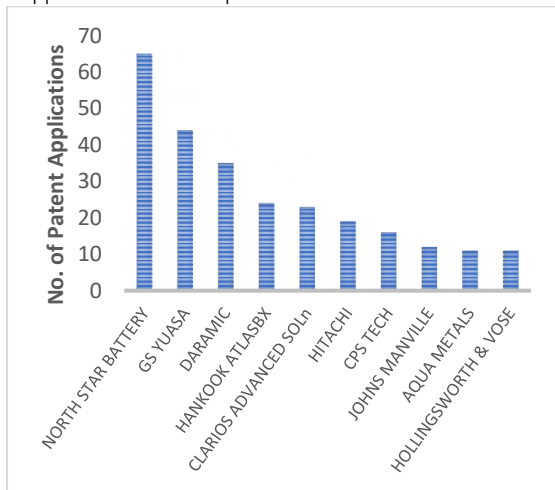


Figure A2.1.24: Top 10 filers of lead-acid battery patent applications at the top 5 offices for 2021.

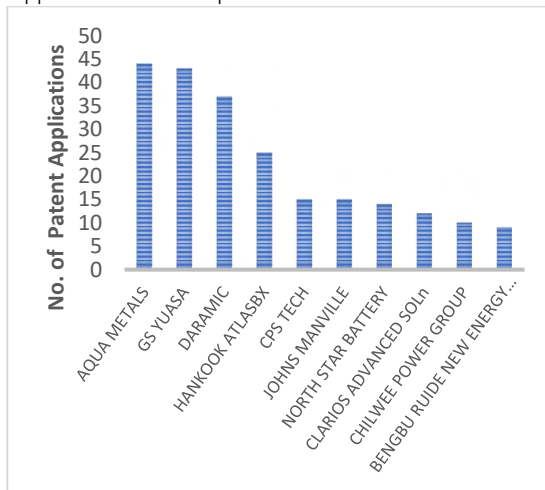


Figure A2.1.25: Top 10 filers of granted lead-acid battery patents at the top 5 offices for 2014.

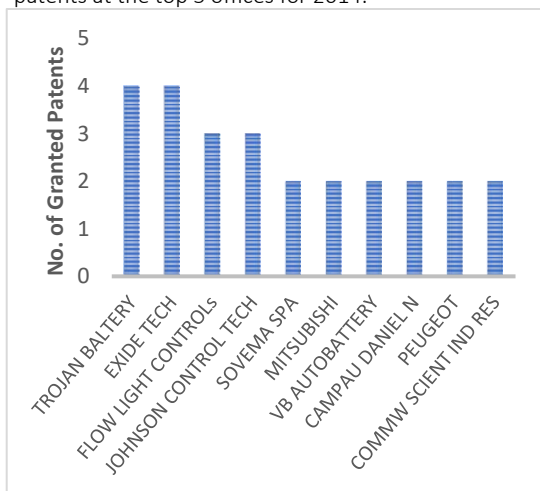


Figure A2.1.26: Top 10 filers of granted lead-acid battery patents at the top 5 offices for 2015.

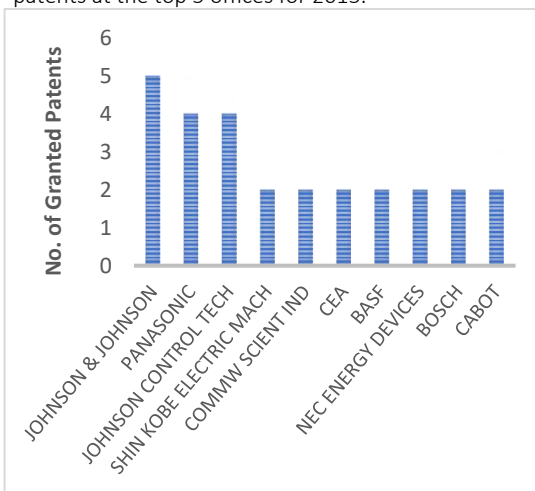


Figure A2.1.27: Top 10 filers of granted lead-acid battery patents at the top 5 offices for 2016.

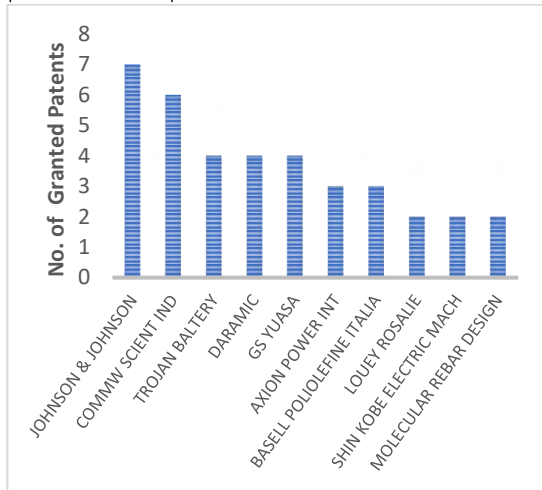


Figure A2.1.28: Top 10 filers of granted lead-acid battery patents at the top 5 offices for 2017.

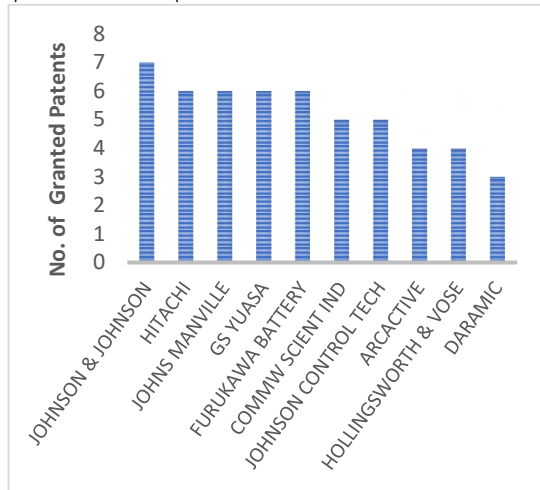


Figure A2.1.29: Top 10 filers of granted lead-acid battery patents at the top 5 offices for 2018.

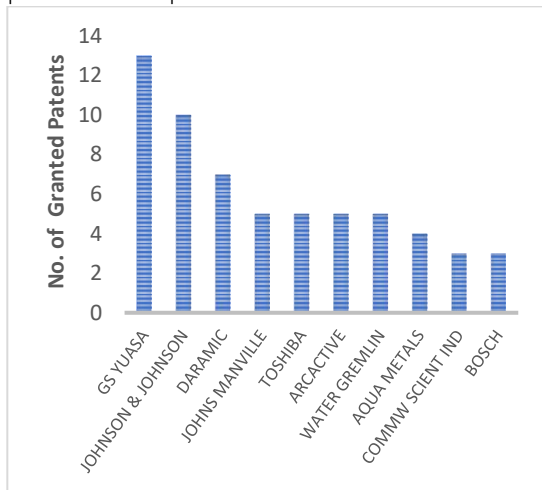


Figure A2.1.30: Top 10 filers of granted lead-acid battery patents at the top 5 offices for 2019.

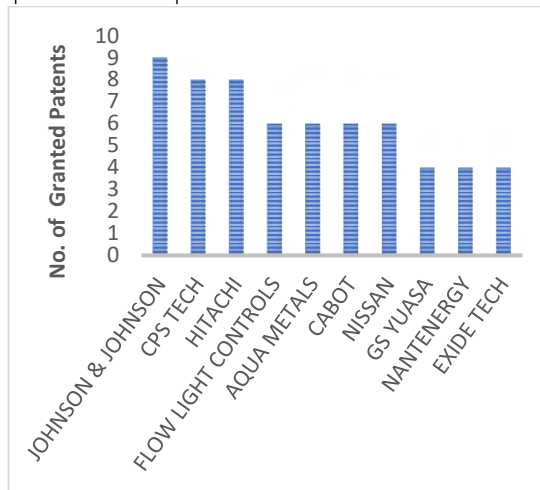


Figure A2.1.31: Top 10 filers of granted lead-acid battery patents at the top 5 offices for 2020.

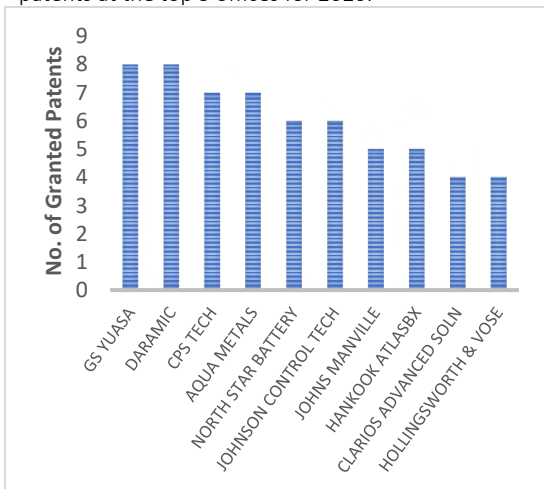


Figure A2.1.32: Top 10 filers of granted lead-acid battery patents at the top 5 offices for 2021.

