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# PATENT LANDSCAPE REPORT

Shale Oil and Gas

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Patent analytics provides an overview of the landscape of research activities in a given technology area, including top filers, collaboration links and origin.

The Canadian Intellectual Property Office (CIPO) has reviewed patenting activity in the shale oil and gas sub-sector of the oil and gas sector.

Summary..... 1

Key facts..... 1

I. Introduction..... 2

II. Methodology ..... 4

III. The global picture..... 5

IV. Canadian activity worldwide ..... 16

V. Filing activity at CIPO ..... 21

IV. Conclusion ..... 26

Annex A – Definitions ..... I

Annex B – Methodology ..... II

Annex C – Limitations.....IV

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## SUMMARY

This analysis covers technologies used as part of the extraction and refining processes in the shale oil and gas sub-sector of the oil and gas sector. The patent analysis examines inventions filed between 2000 and 2012.

Patenting activity for this industry sub-sector has experienced rapid growth over the period:

- the top five applicants account for 12% of the total patenting activity worldwide related to shale oil and gas
- China and the United States account for 66% of all filings
- Sinopec, the top filer worldwide in the shale oil and gas industry sub-sector, is an active filer in many technological areas within the industry
- Halliburton and Schlumberger are active in technologies related to “drilling” and “well formation”
- the Japanese companies Idemitsu, JX Nippon and Cosmo Oil Co. are all active in the area of “desulfurization”

## KEY FACTS

There are approximately 4,000 published patent families related to shale oil and gas worldwide. Patenting activity in this industry sub-sector has increased 188% between 2000 and 2012.

The top 5 applicants represent 12% of total patenting activity worldwide.

Top applicants appear to be involved in some level of collaboration, primarily with partners in their own country.

The top 3 worldwide applicants are:

- Sinopec (China)
- JX Nippon Oil and Energy Corp. (Japan)
- Exxon Mobil Corp. (US)

The top 3 Canadian applicants are:

- Trican Well Services Ltd.
- Envirollea Inc.
- GASFRAC Energy Services Inc.

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## I. INTRODUCTION

The objective of this report is to shine a light on the recent patenting activity in the shale oil and gas sub-sector in hopes of providing insight for those working in this interesting and important area.

Shale oil and gas will be an important part of the worldwide energy story in the coming decades. Innovation will also play a key role in maximizing what is extracted from these non-conventional oil and gas sources, while at the same time minimizing the costs and environmental impact of the processes.

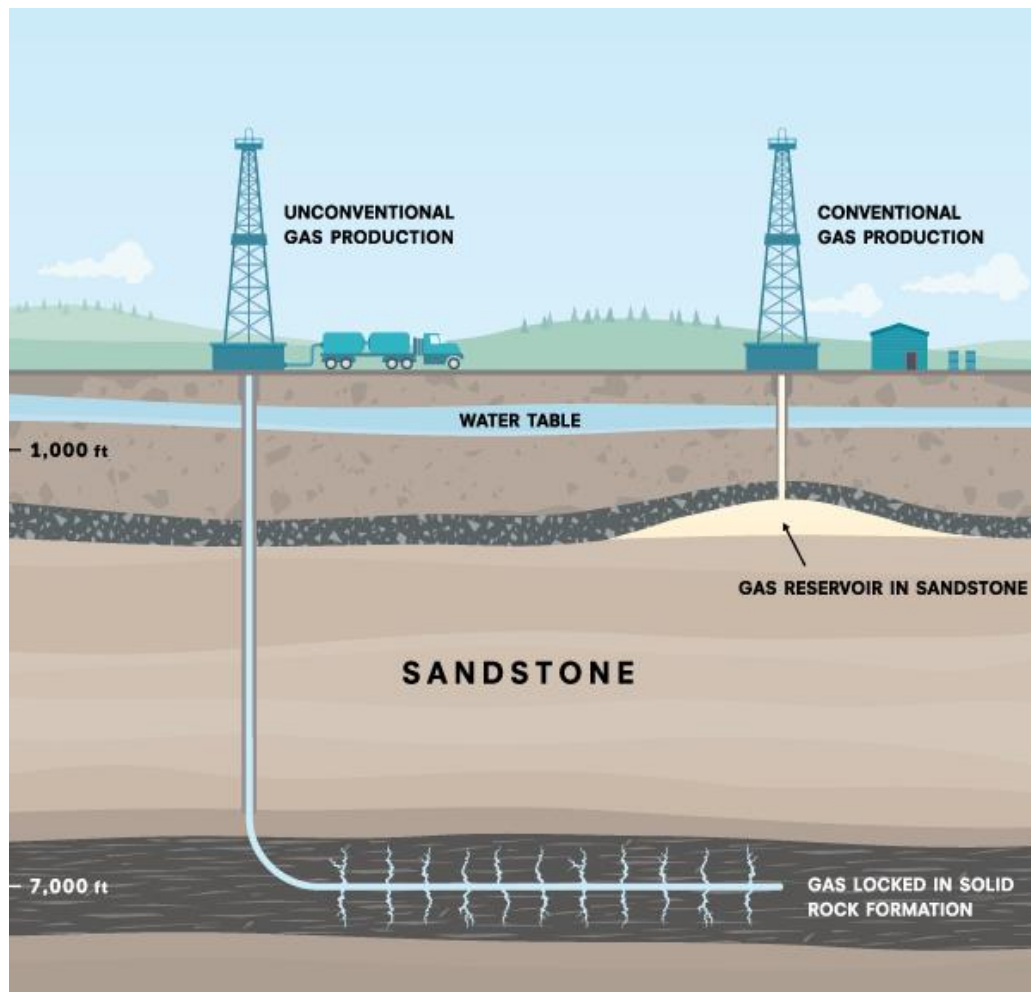
This sub-sector is of growing interest as the amount of patenting activity has increased by 188% since 2000. The data shows that there are approximately 4,000 published patent families related to the shale oil and gas sub-sector worldwide, of which 100 are from Canadian applicants. The analysis found that the top five applicants represent only 12% of total patenting activity for this sub-sector. In terms of innovation, this means that the industry may be quite competitive despite the presence of a handful of very large companies.

Based on the list of top applicants, it is clear that Chinese, American and Japanese companies are major producers of patent filings worldwide. The leading Canadian patent filers include Trican Well Service Limited, Envirollea Incorporated and GASFRAC Energy Services Incorporated. These top Canadian filers are all headquartered in Calgary, Alberta. When examining patenting activity at CIPO, the overall findings are very similar to those of the worldwide analysis, but on a smaller scale, as most of the major players are patenting in Canada.

Using patent landscape maps, we can see where patenting activity overlaps, indicating potential collaboration or intense innovation competition. We can also see that some top filers are active in areas distinct from those of other leading filers.

### Image 1: Two Oil Wells Drilling

Image 1 describes two methods for extracting shale gas



The North American Industry Classification System (NAICS) classifies this industry sub-sector under the parent grouping "Mining, Quarrying, and Oil and Gas Extraction" (NAICS 21). The sub-grouping is Non-Conventional Oil Extraction. This industry includes companies involved in the production of crude oil from surface shale, tar sands or from reservoirs in which the hydrocarbons are semisolids and conventional production methods are not possible. Companies in this industry sub-sector use advanced drilling techniques to extract oil and gas from shale formations. These techniques involve drilling deep below the surface, turning their drill bits to create horizontal wells, and then blasting water, sand and chemicals at a high pressure into the wells, which opens up fissures in shale formations and allows oil and gas to be pumped to the surface.

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## II. METHODOLOGY

The search database used to obtain the dataset for this report is Thomson Innovation, by Clarivate Analytics, a provider of content-enabled workflow solutions.

Unless otherwise stated, all analysis presented in this report is undertaken on patent families. A patent family is one or more published patents with a shared priority. Analysis by patent family more accurately reflects the number of inventions present. This is because there is generally one invention per patent family, whereas analysis by raw number of patent publications inevitably involves double counting because one patent family may contain dozens of patent publications if the applicant files for the same invention in more than one country. Analysis by patent family gives more accurate results regarding the level of innovation taking place.

The search strategy used to generate the dataset for this analysis was based on a combination of predetermined International Patent Classification (IPC) codes, as well as specific keywords. Details regarding the IPC codes and keywords can be found in Annex B.

The Canadian subset of the data consists of a patent family where at least one application has an applicant with a Canadian address. The applicant data was cleansed to remove duplicate entries which relate to the same applicant, but where a different naming convention was used, due to spelling errors, international variations, etc.

Due to the size of the dataset, the emphasis was put on cleansing records relating to the top applicants. Some inconsistencies may still occur in the naming of applicants with smaller patent portfolios. For the reasons stated above, figures and tables presented in this report should be regarded as illustrative. More details regarding limitations in the data are provided in Annex C.

### III. THE GLOBAL PICTURE

The global data set contains 12,421 published patents, translating into approximately 4,000 patent families. This analysis focuses on patent applications with a priority year from 2000 to 2012.

The top applicant in this data set is China Petroleum & Chemical Corporation (Sinopec Ltd.), a Chinese oil and gas company based in Beijing, China. Sinopec is the world's third largest company by revenue behind Royal Dutch Shell (second). Integrated oil companies account for seven of the world's top 10 ranked companies by revenue<sup>1</sup>. Exxon Mobil Corporation, BP plc and China National Petroleum Corporation are the fourth, fifth and sixth largest companies worldwide.

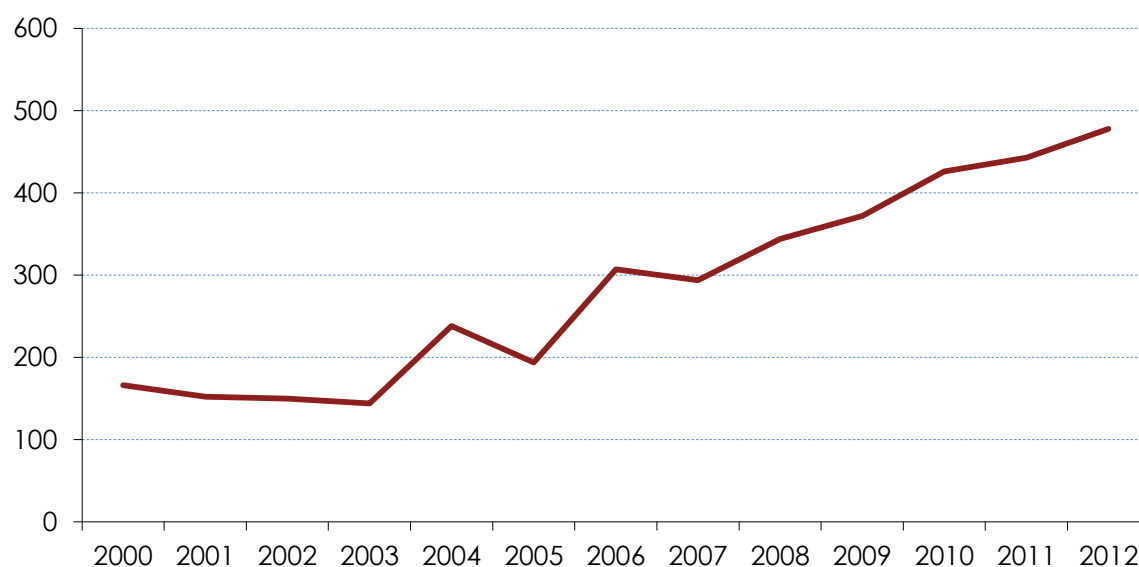
Table 1 provides an overview of the patent landscape for the shale oil and gas industry sub-sector. This data set was restricted to patents that were extracted based on methodology described in Section II above, and Annex B.

**Table 1: Summary of the shale oil and gas patent data set**

Number of patent families	3,986
Priority year range	2000 to 2012
Applicants	3,627
Priority countries	41

Figure 1 shows the number of patent families in the data set by priority year since 2000. In the early stages of the decade, filings were relatively flat until 2003. From 2004 to 2007, filings tended to fluctuate. However, growth exceeded declines, and from 2008 onwards, filings experienced continued growth. Overall, priority filings for shale oil and gas patent families experienced a 188% increase in the number of filings between 2000 and 2012.

**Figure 1: Shale oil and gas patent family filings by priority year**



<sup>1</sup> [bloomberg.com/visual-data/best-and-worst/top-20-by-revenue-worldwide-companies](http://bloomberg.com/visual-data/best-and-worst/top-20-by-revenue-worldwide-companies)



Figure 2 shows the priority country distribution for the shale oil and gas patent family data set. The top three applicants are from China. There was a 2,020% increase in overall filings in China between 2000 and 2012. The United States is another major country where inventors are filing first, with slightly fewer filings than China. Combined, China and the United States account for 66% of all filings. If Japan is included, these three countries represent 83% of all priority applications. Only 2% of filings claim priority in Canada. PCT and European patent applications filed through WIPO and the European Patent Office (EPO) are identified by the country codes WO and EP, respectively.

**Figure 2: Shale oil and gas filings by priority country distribution**

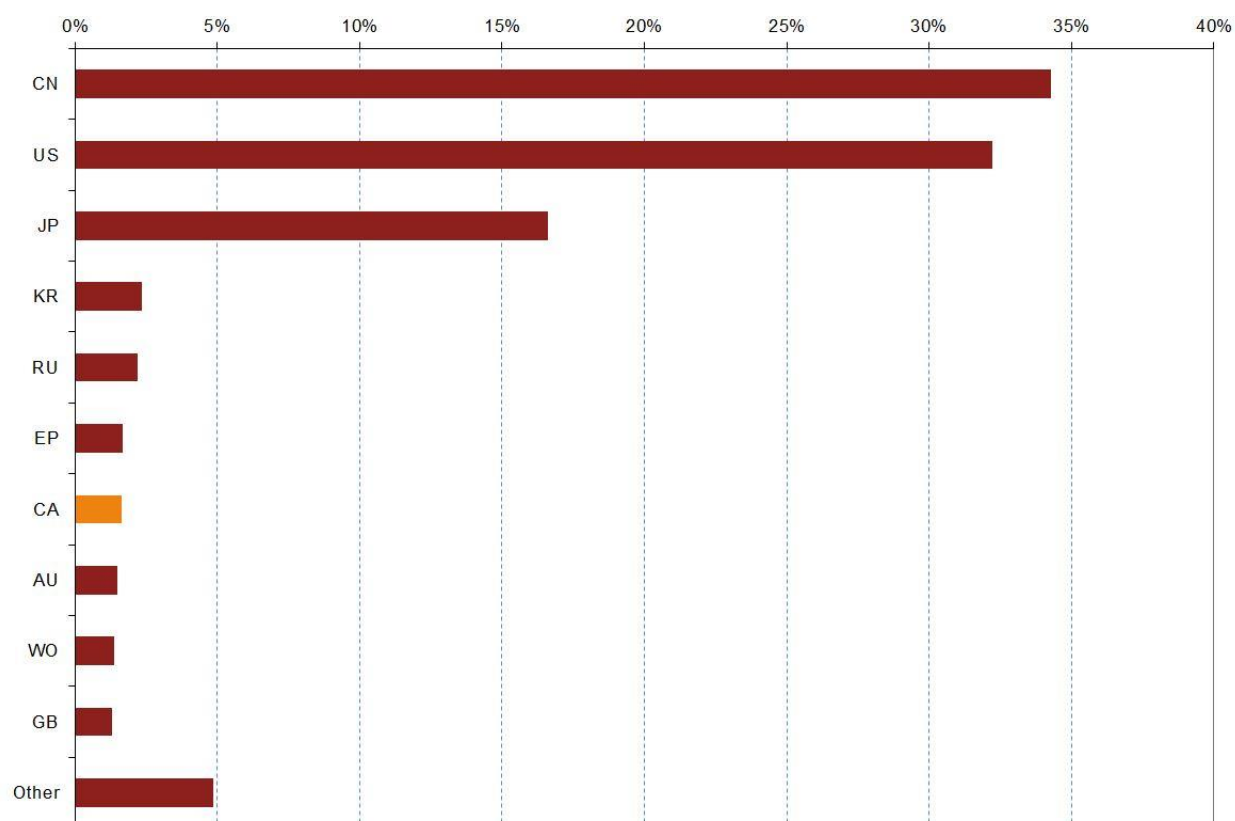


Figure 3 shows the top applicants within the shale oil and gas industry sub-sector. The top spot is occupied by the China Petroleum and Chemical Corporation (Sinopec Ltd.), with 371 patent families. Other major players with 100 or more patent families include JX Nippon Oil and Energy Corporation (209), Exxon Mobil Corporation (141), Halliburton Energy Services Incorporated (140), and Schlumberger Limited (100). This data clearly shows that Chinese, American and Japanese companies are major producers of patent filings worldwide.

**Figure 3: Top applicants**

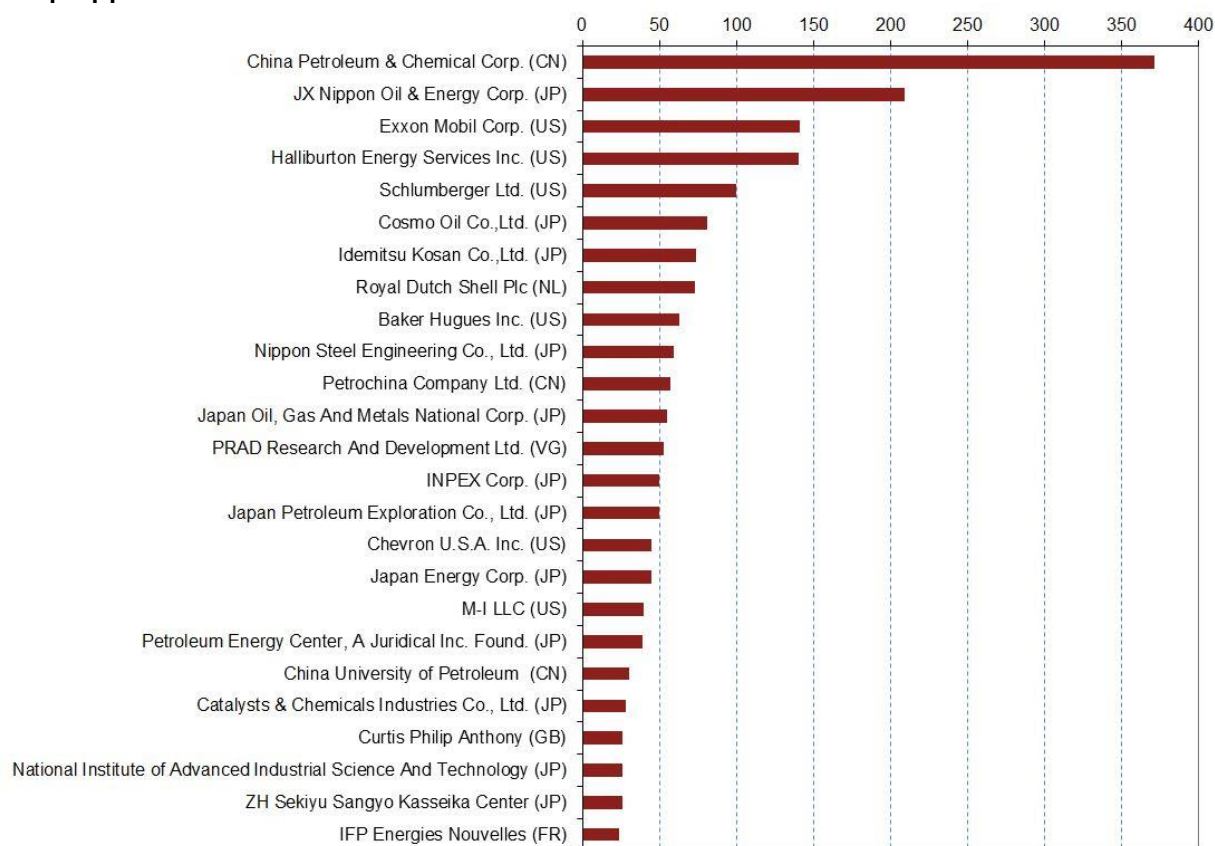


Figure 4 depicts the top applicant filing activities since 2000. Given the size of the large multinational corporations that rank among the top applicants, it is not surprising that most of these companies have been involved in the field of shale oil and gas over the past decade. It is also no surprise to see new entrants in this field as demand increases for new and cheaper ways to extract and refine shale oil and gas.

**Figure 4: Top applicant activity between 2000 and 2012**

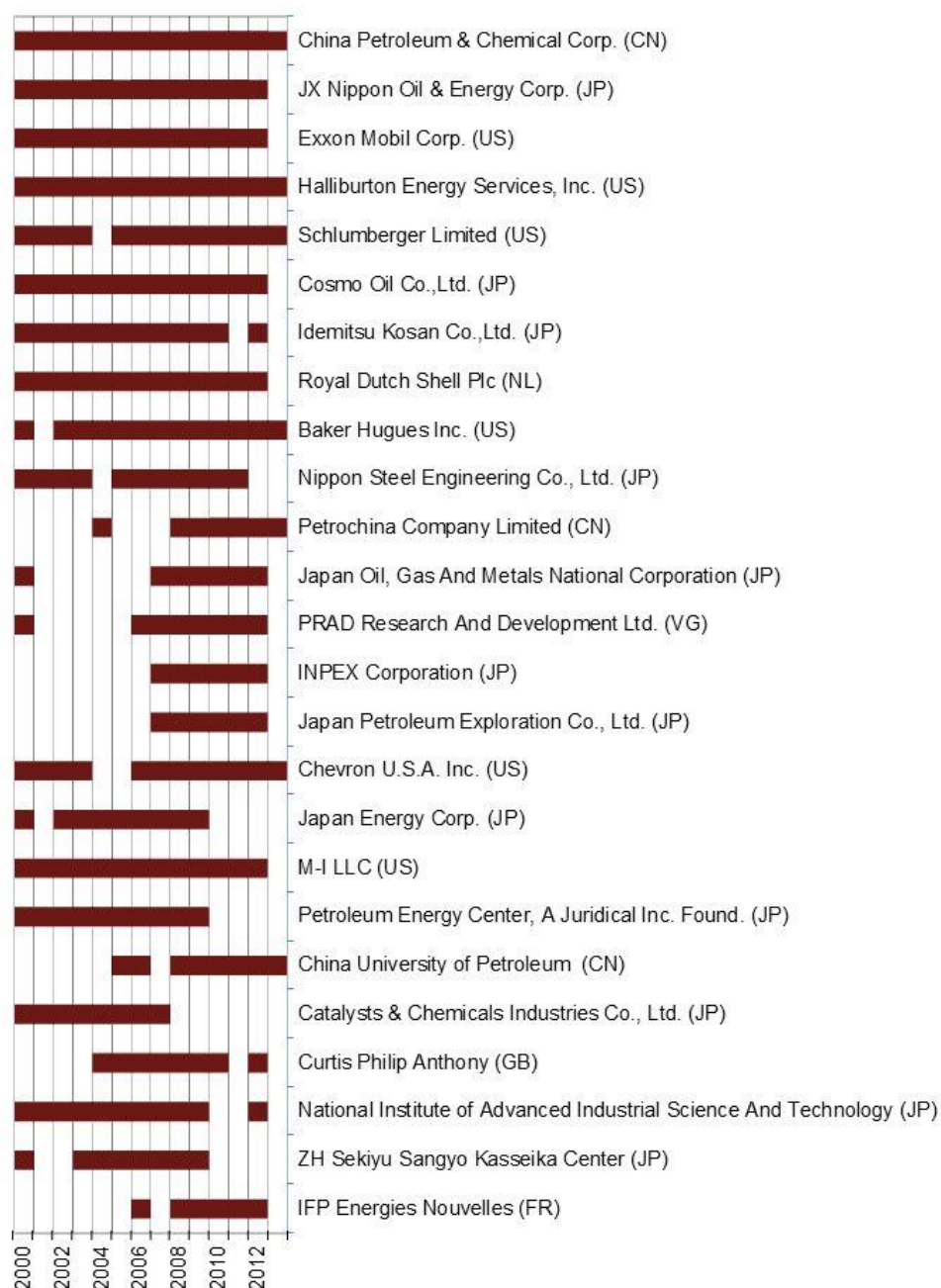
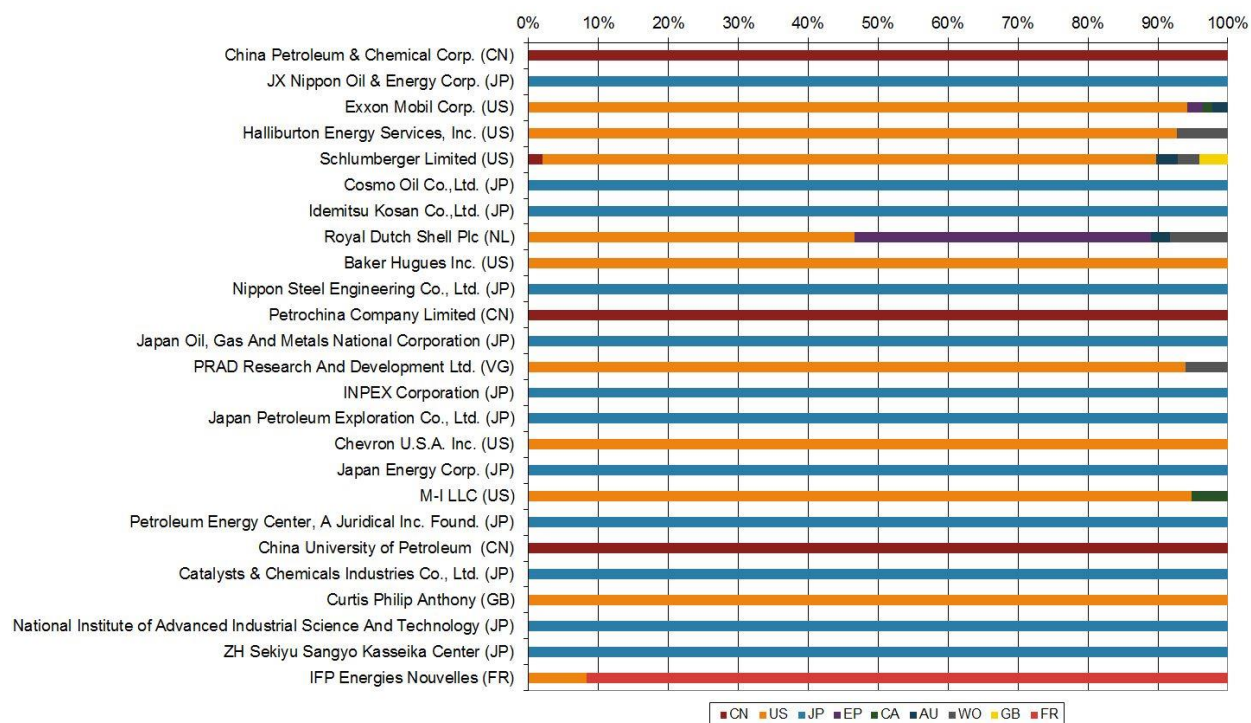


Figure 5 shows the priority country shares for the top applicants. This shows a strong bias for companies to file in their own countries first. This is true for the three Chinese companies, the 12 Japanese companies and the one French company. Royal Dutch Shell tends to split its priority filings between the United States Patent and Trademark Office (USPTO) and the EPO. Of the six American companies in the top 25, two have all of their priorities in the USA, while the other four have 90% in the USA and 10% in other countries, including Canada in two cases. This may reflect strategic filing on the part of these firms, who recognize the importance of filing for certain types of technologies in the same countries where their competitors are filing first. With respect to patent portfolio size (number of patent families per applicant), the data shows that 95% of applicants have five or fewer patent families, and 73% have only one. This suggests that there are not very many well-established applicants in the dataset. Alternatively, we can say that the research and development part of the industry is quite competitive, with lots of small firms competing at the innovation frontier.

**Figure 5: Priority country shares for top applicants**

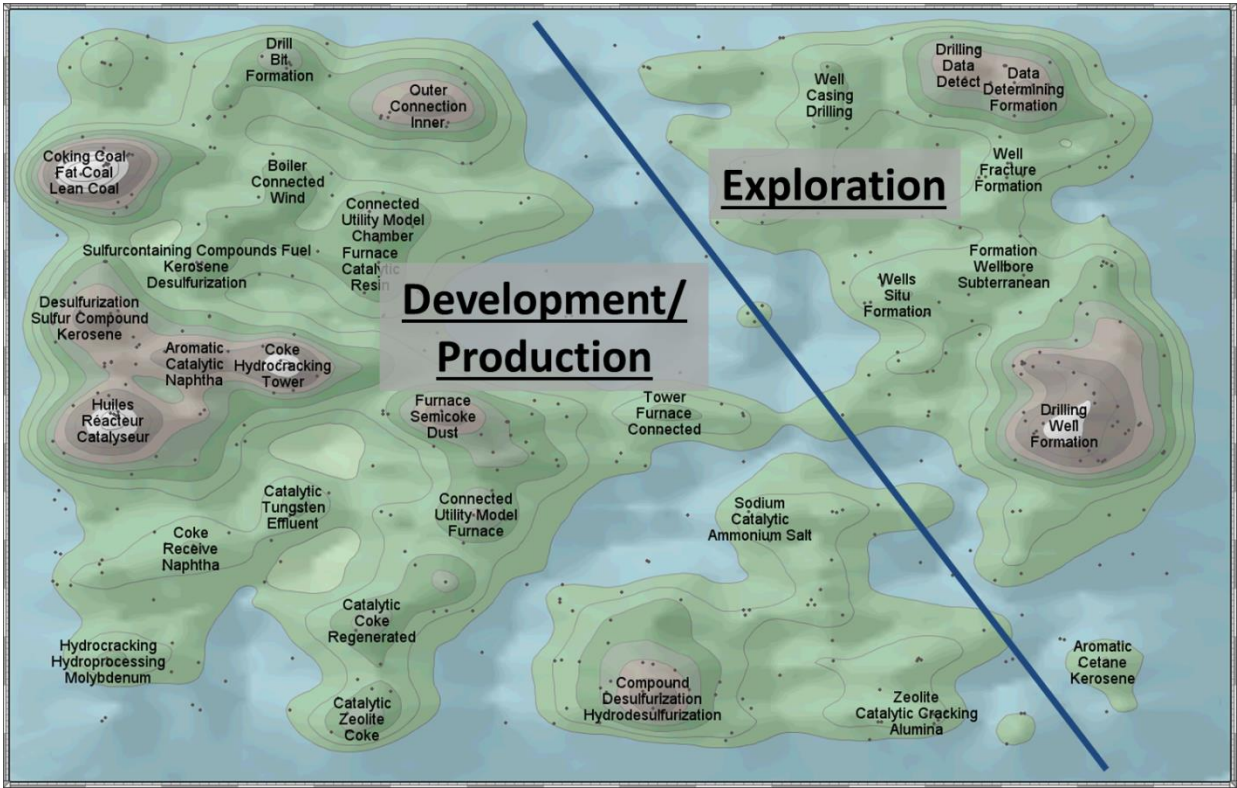


The Figure 6 map shows that the highest concentration of patents in this dataset relates to patents comprising keywords such as “coking coal, fat coal, lean coal,” “coke hydrocracking tower,” “huiles réacteur catalyseur,” and “drilling well formulation.” The water separating the islands highlights technological areas of patenting activity that are very different from each other. A clear distinction can be made between islands involving patents related to the development and production of shale oil and gas and patents tied to exploration.

**Figure 6: Patent landscape map of shale oil and gas between 2000 and 2012**  
**To read this map**

A patent landscape map provides a visual representation of the shale oil and gas patent family data set. Thomson Innovation’s ThemeScope mapping tool was used for this purpose. ThemeScope utilizes algorithms that use keywords from patent documentation to cluster patent families based on shared language. Patents are represented on the map by dots, with patents located closer together sharing more phraseology than those located further apart. The patents are organized in common themes and grouped as contours on a map to show areas of high and low patenting activity. The snow-capped peaks represent the highest concentration of patents and each peak is labelled with key terms that tie the common themes together.

The English translation of the wording is provided in a table below the map.



French	English
Huiles	Oils
Réacteur	Reactor
Catalyseur	Catalyst

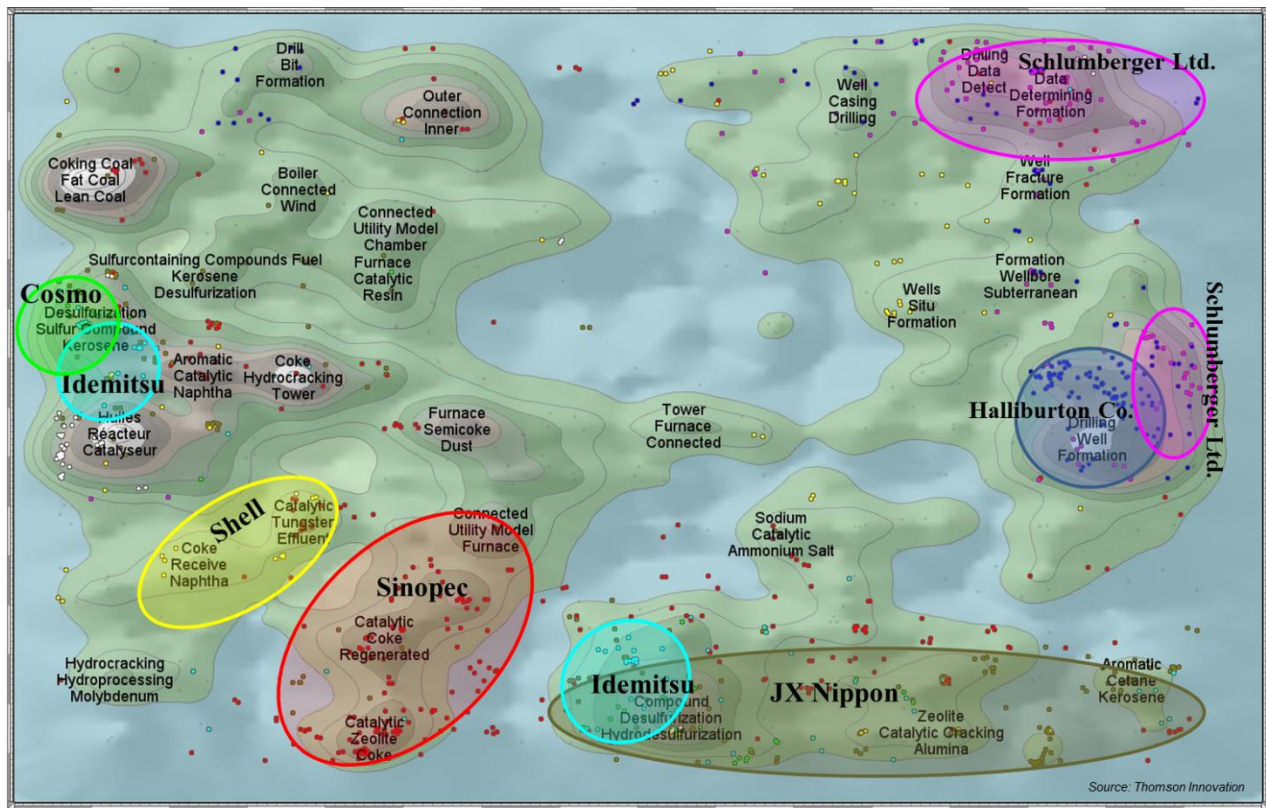


The patent landscape map in Figure 7 highlights the top seven applicants in the data set and shows the different areas of the shale oil and gas sub-sector in which they operate. For example, Sinopec is very active in the areas of “catalytic zeolite coke” and active in a number of other areas, as indicated by the red dots in the lower right hand quadrant and center left hand quadrant of the map. Areas where firms overlap can be indicative of intense competition or collaboration.

When we compare to the previous landscape map, we see that the American firms Schlumberger Ltd and Halliburton are patenting more actively in exploration technologies, whereas the Chinese, Japanese and Dutch firms are patenting more actively in development and production technologies.

**Figure 7: Patent landscape map highlighting regions of research for top applicants**  
**To read this map**

The English translation of the wording is provided in a table below the map.



French	English
Huiles	Oils
Réacteur	Reactor
Catalyseur	Catalyst

Figure 8 is a collaboration map showing collaborations involving the Chinese company Sinopec. Each dot on the collaboration map represents a patent family, and two applicants are linked together if they are named as joint applicants on a patent application. Sinopec collaborates primarily with other Chinese companies. Due to data limitations, some of the collaborations may include divisions of parent companies as well as subsidiaries.

**Figure 8: Collaboration map depicting Sinopec collaborations**

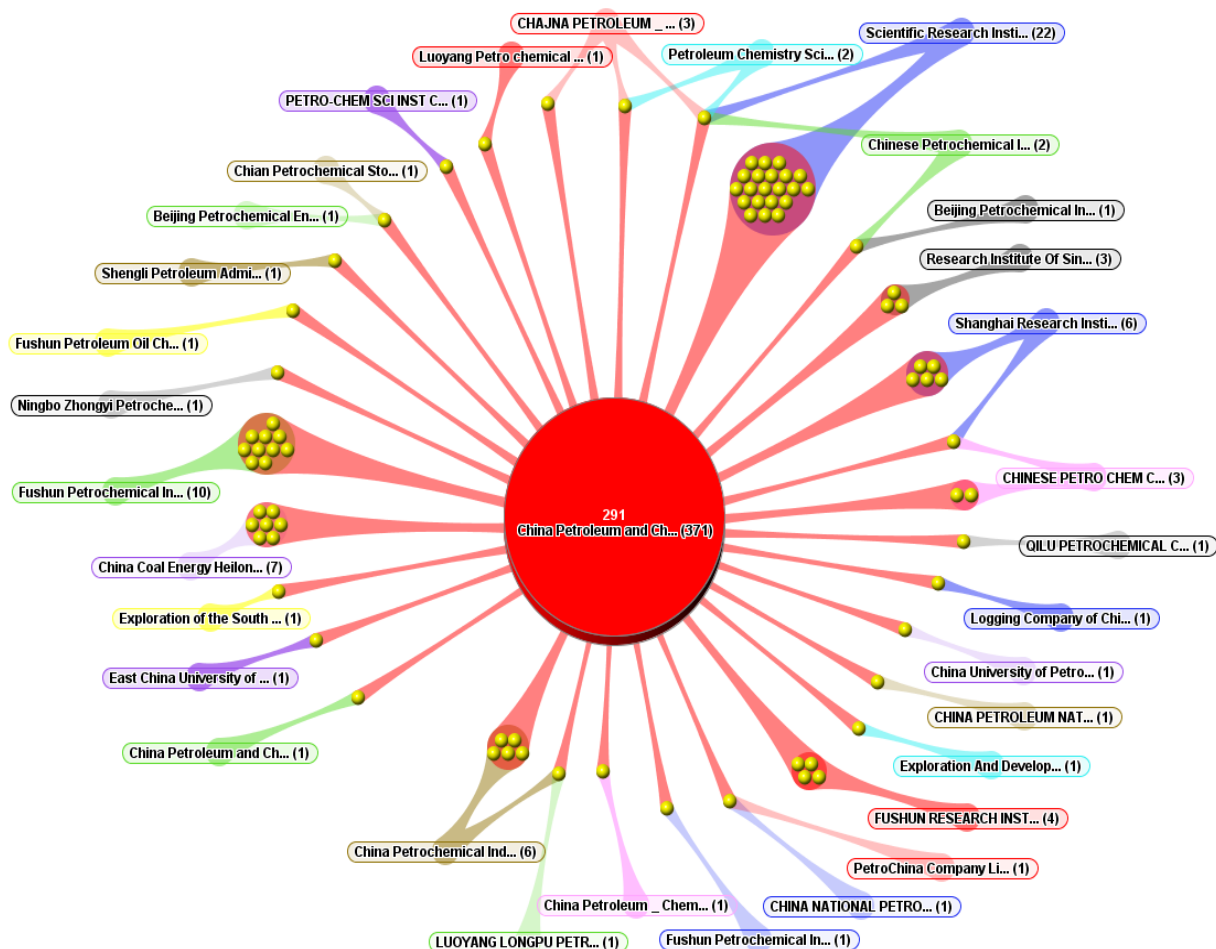


Figure 9 is a collaboration map showing collaborations involving JX Nippon Oil and Energy Corporation. JX Nippon is actively collaborating with many other Japanese companies, who are themselves collaborating with others. It is a much more complex collaboration web than that of Sinopec. This may be reflective of different approaches to R&D by the companies or perhaps of the innovation policies of the countries.

**Figure 9: Collaboration map depicting collaborations with JX Nippon**

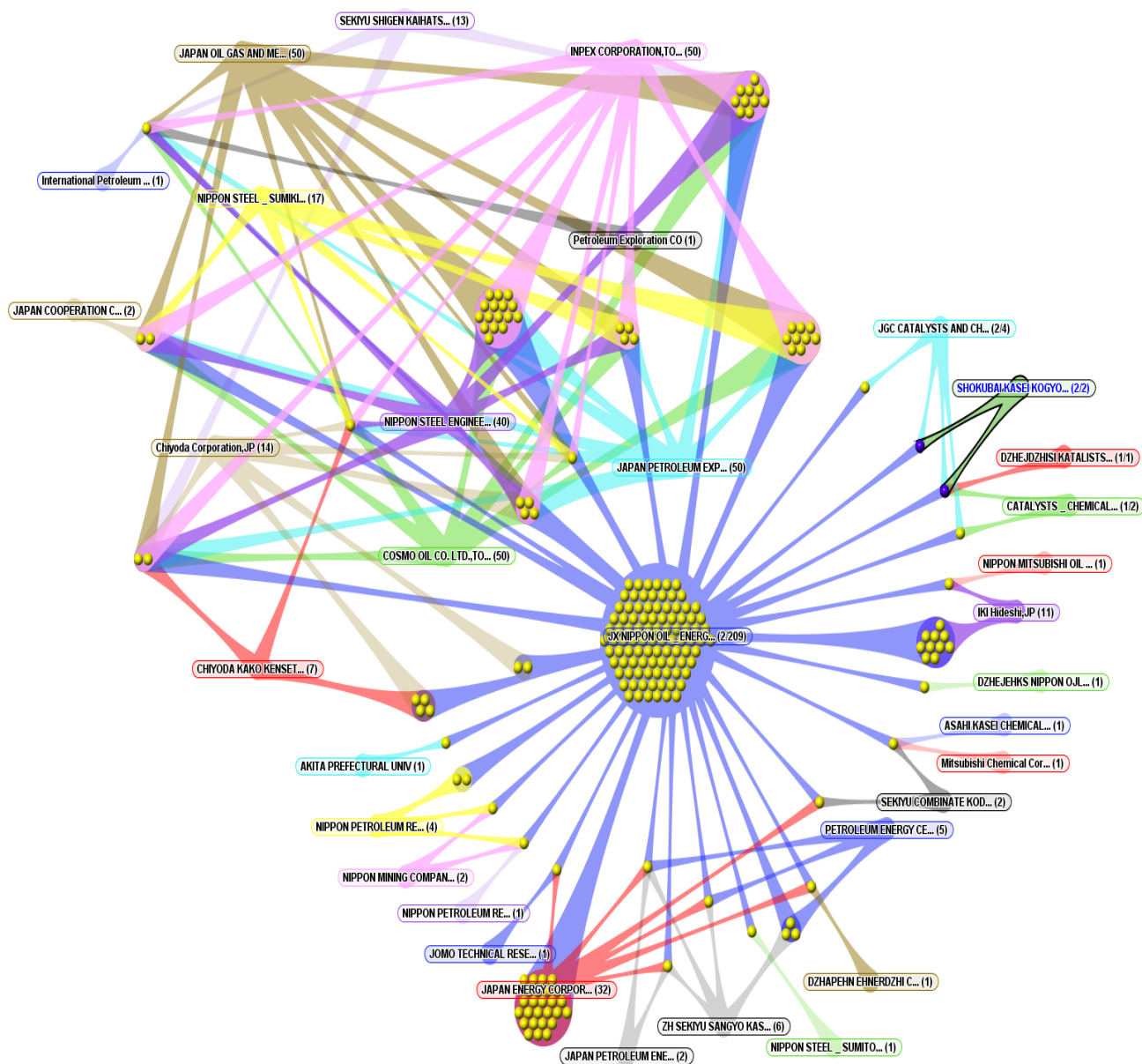




Figure 10 is a collaboration map showing collaborations involving Schlumberger Limited. It is the most extensive collaborator of the top American companies. This may be due to the company's structure with respect to subsidiaries and their patenting and R&D strategy. PRAD Research and Development is based in the British Virgin Islands, but most of its work appears to be for American companies.

**Figure 10: Collaboration map depicting Schlumberger Limited collaborations**

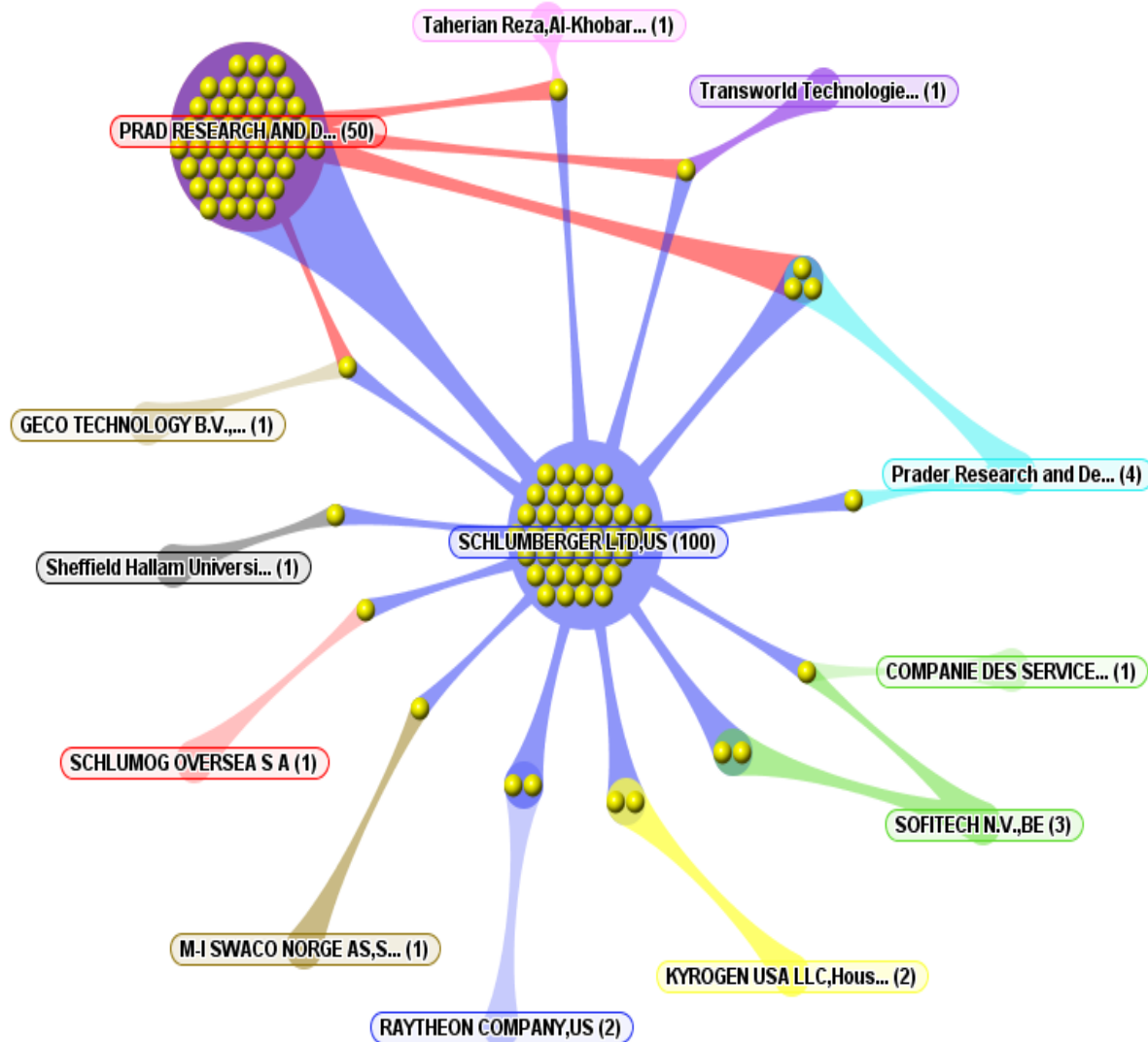
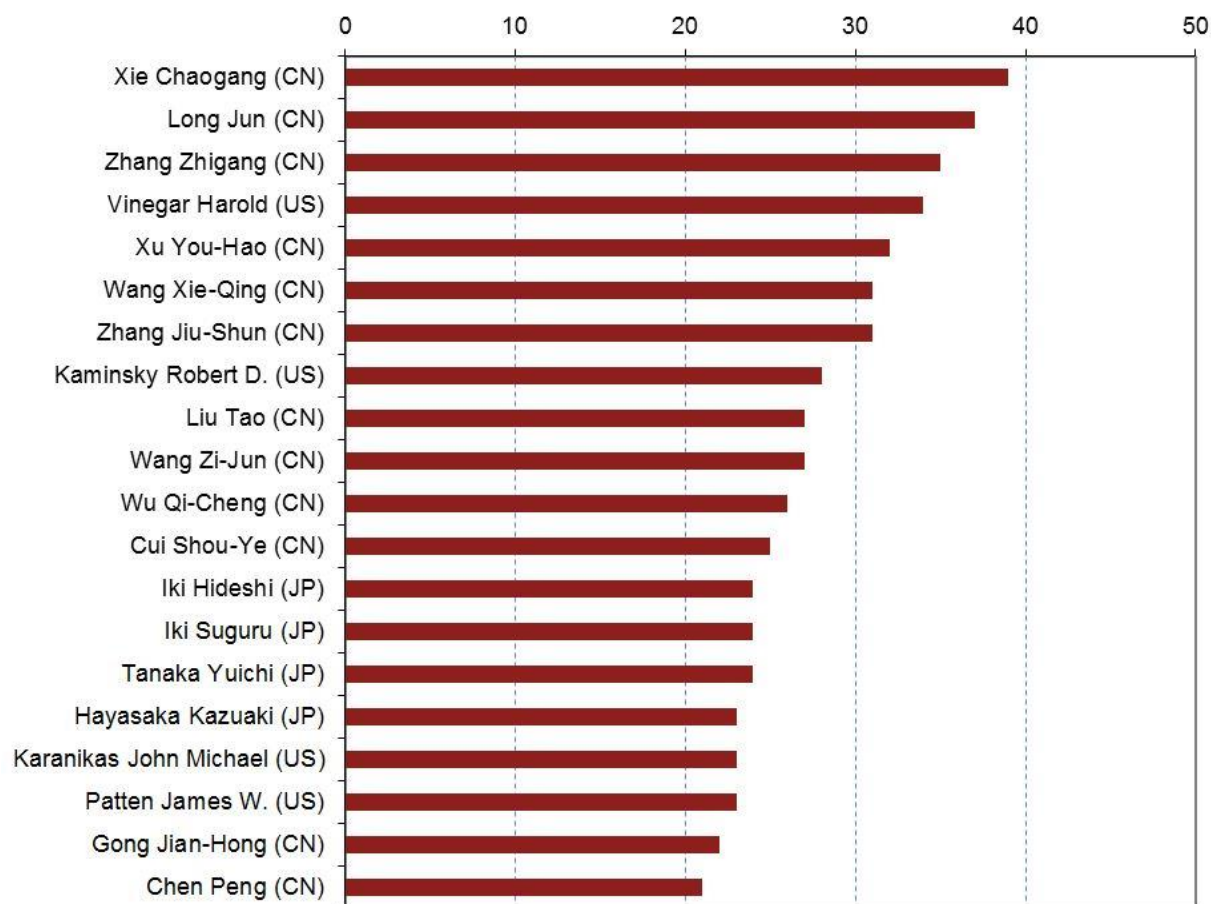


Figure 11 shows the top 20 inventors within the shale oil and gas industry sub-sector. As expected, most of the top inventors work for the top 10 patent filing applicants and are from China, Japan or the USA.

**Figure 11: Top 20 inventors worldwide**



#### IV. CANADIAN ACTIVITY WORLDWIDE

Understanding the contribution of Canadian companies to the patenting activity community is important. The following section takes a more in-depth look at the Canadian applicants. Table 2 below provides a summary of the Canadian corporate applicants within the shale oil and gas subset.

Similar to Figure 1, Figure 12 depicts an upward trend in patent filings. The high degree of variation from year to year is due to the low level of filings. However, filings are trending upwards overall.

**Table 2: Summary of Canadian subset within the shale oil and gas patent dataset**

Number of Canadian patent families	100
Priority year range	2000 to 2012
Applicants	171
Priority countries	8

**Figure 12: Shale oil and gas patent family filings by Canadian applicants by priority year**

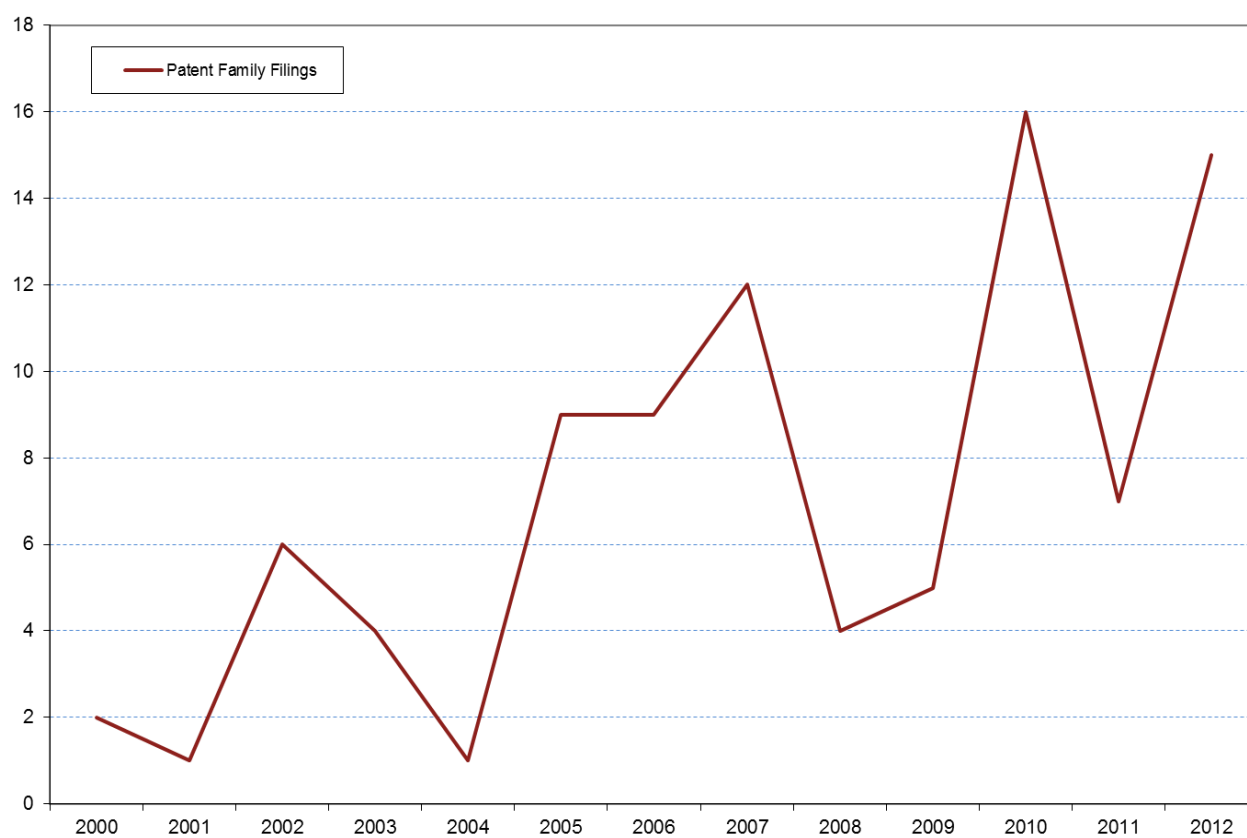


Figure 13 shows the top Canadian applicants within the shale oil and gas industry sub-sector. The top spot is occupied by the Trican Well Service Limited, with seven patent families. Other major players with five or more patent families include Envirollea Incorporated (6), GASFRAC Energy Services Incorporated (6), and Flo-Dynamics Systems Incorporated (5). Note that these four companies are headquartered in Calgary, Alberta.

**Figure 13: Top Canadian applicants**

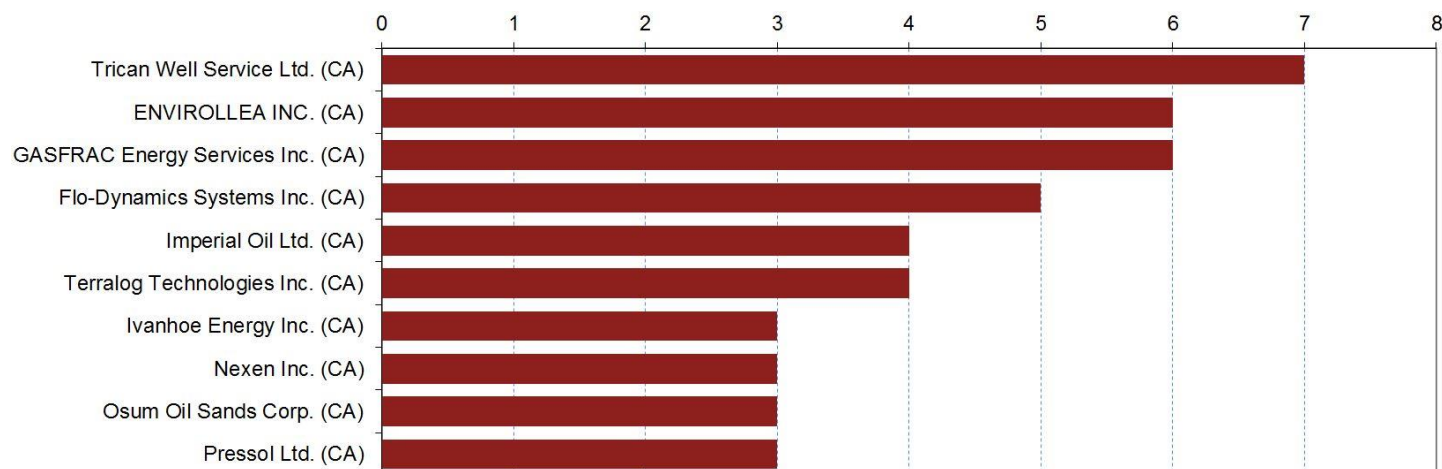


Figure 14 depicts the filing activities of the top Canadian applicants between 2000 and 2012. Patenting activity among the top five Canadian applicants begins in 2005. Overall, the patenting activity is sporadic.

**Figure 14: Top Canadian applicant activity between 2000 and 2012**

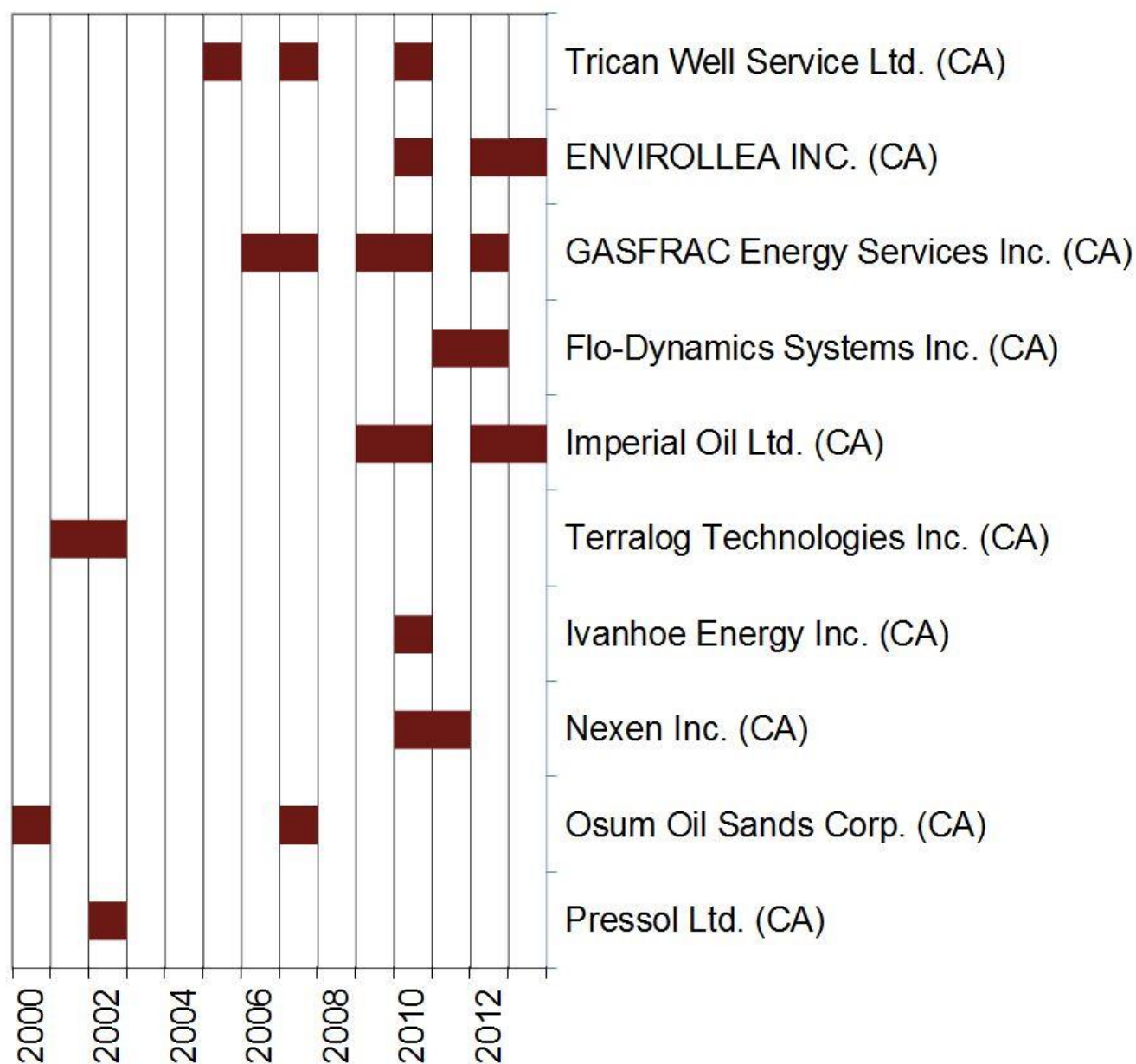
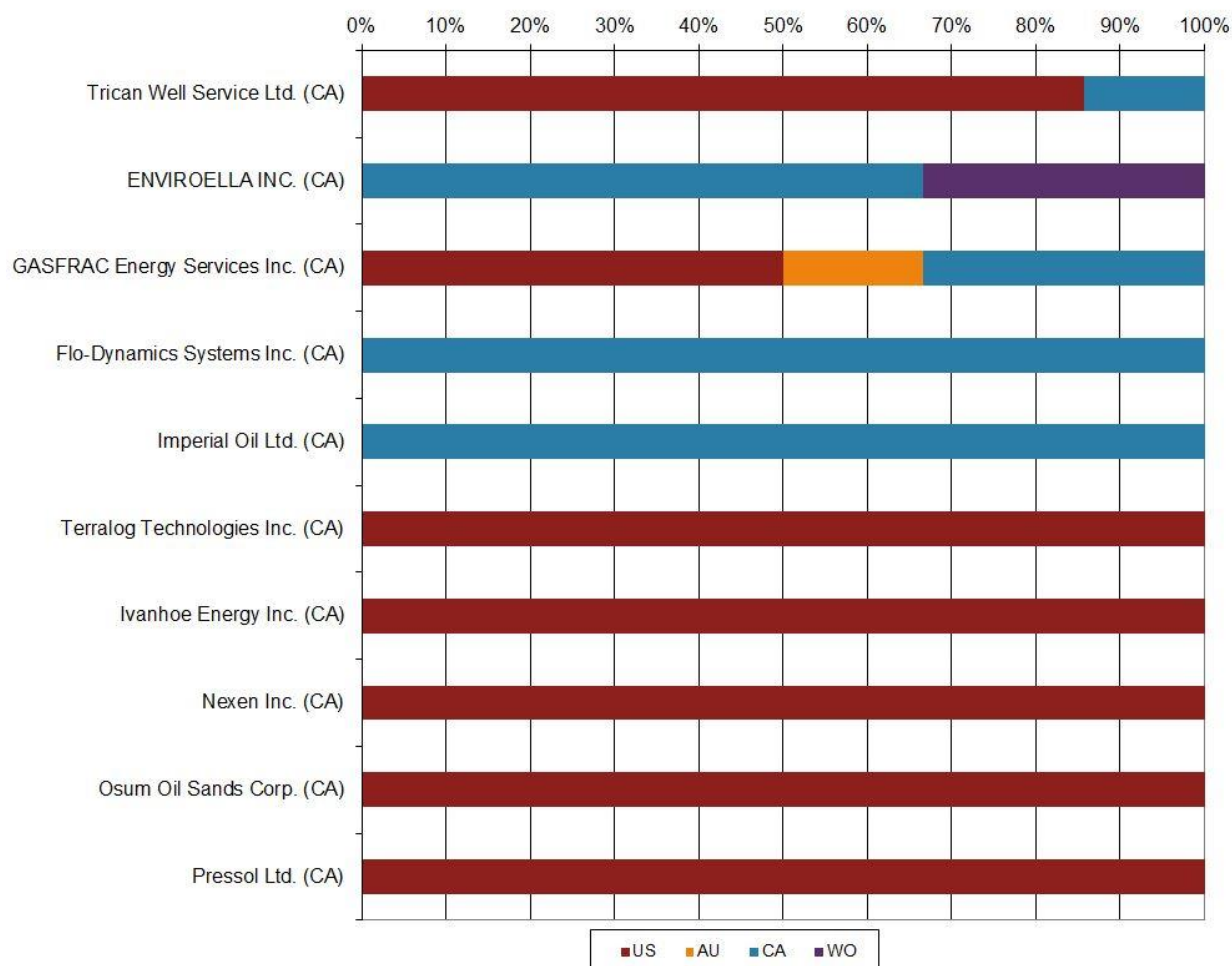


Figure 15 shows the priority country split for the top Canadian applicants. As expected, the top applicants in the Canadian subset mostly claim priority in the USA, with about 55% of all priority filings going there first. Flo-Dynamics Systems Inc. and Imperial Oil Resources Limited file all of their patents in Canada first. Approximately 35% of all Canadian filings have a Canadian priority.

**Figure 15: Priority country shares for top Canadian applicants**



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Table 3 indicates the total number of patent families by priority year for the top inventors associated with the leading Canadian patent applicants.

**Table 3: Top inventors at Canadian companies**

Inventor Name	Number of Patent Families
WHEELER Lucie B. (CA)	6
ZHANG KEWEI (CA)	6
ELLIOTT David J. (CA)	5
BILAK ROMAN (CA)	4
BRUNO MICHAEL S. (EU)	4
DUSSEAUULT Maurice B. (CA)	4
MESHER Shaun T. (CA)	4
KALOTA Steven A. (EU)	3
LIVINGSTONE James I. (CA)	3
LOREE Dwight N. (CA)	3
MONKMAN Jack (CA)	3
PAGE Pat (CA)	3
PAVEL STEPHEN K. (EU)	3
SILVERMAN Michael A. (EU)	3
ADEYINKA Olusola B. (CA)	2

## V. FILING ACTIVITY AT CIPO

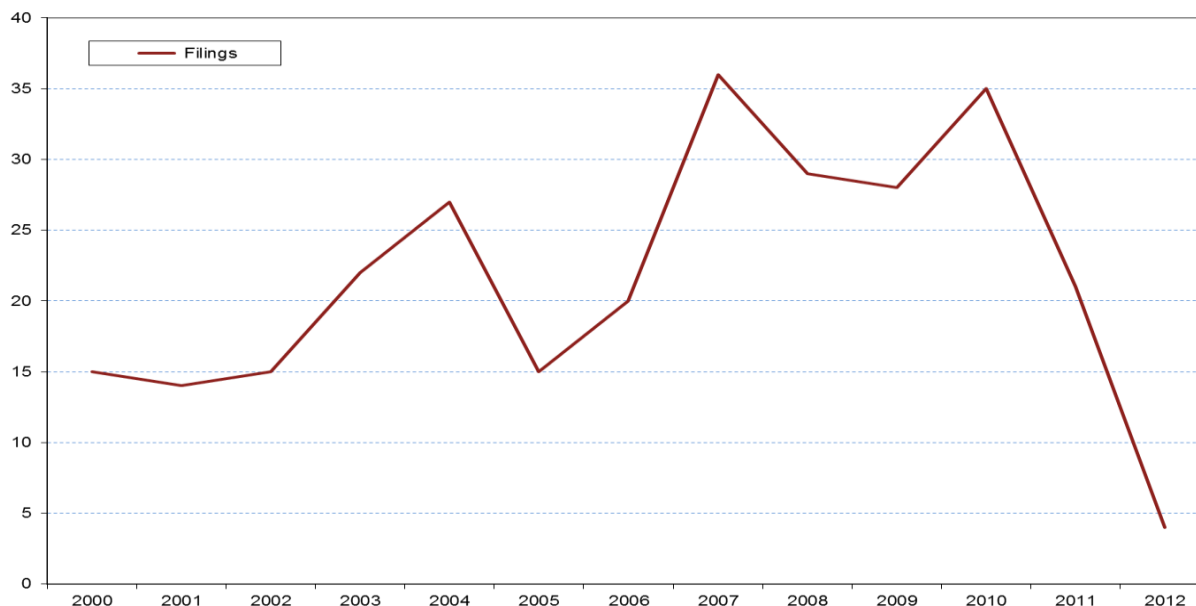
The following section focuses on shale oil and gas patents filed with CIPO. In total, 284 patents were included in the analysis. To generate the dataset for this analysis, a query similar to the one used in Thomson Innovation was employed; however, in this case it was done in CIPO's patents database and included bilingual terms.

**Table 4: Summary of shale oil and gas patents filed with CIPO**

Number of patents	284
Priority year range	2000 to 2012
Applicants	158
Priority countries	12

The trend in shale oil and gas patent applications filed with CIPO, shown in Figure 16, is similar to those seen previously. That is, it shows one of significant growth, but on a much smaller scale. Overall, the number of patents in the Canadian dataset by priority year has been increasing since 2000. The high degree of variation from year to year is likely due to the small sample size. With respect to how filings are made in Canada, 74% of patents are filed through the Patent Cooperation Treaty (PCT). This is in line with the ratio of PCT found in total filings with CIPO. We also found that 75% of applications in Canada were filed first in the USA, 5% in China, and a further 5% in Japan.

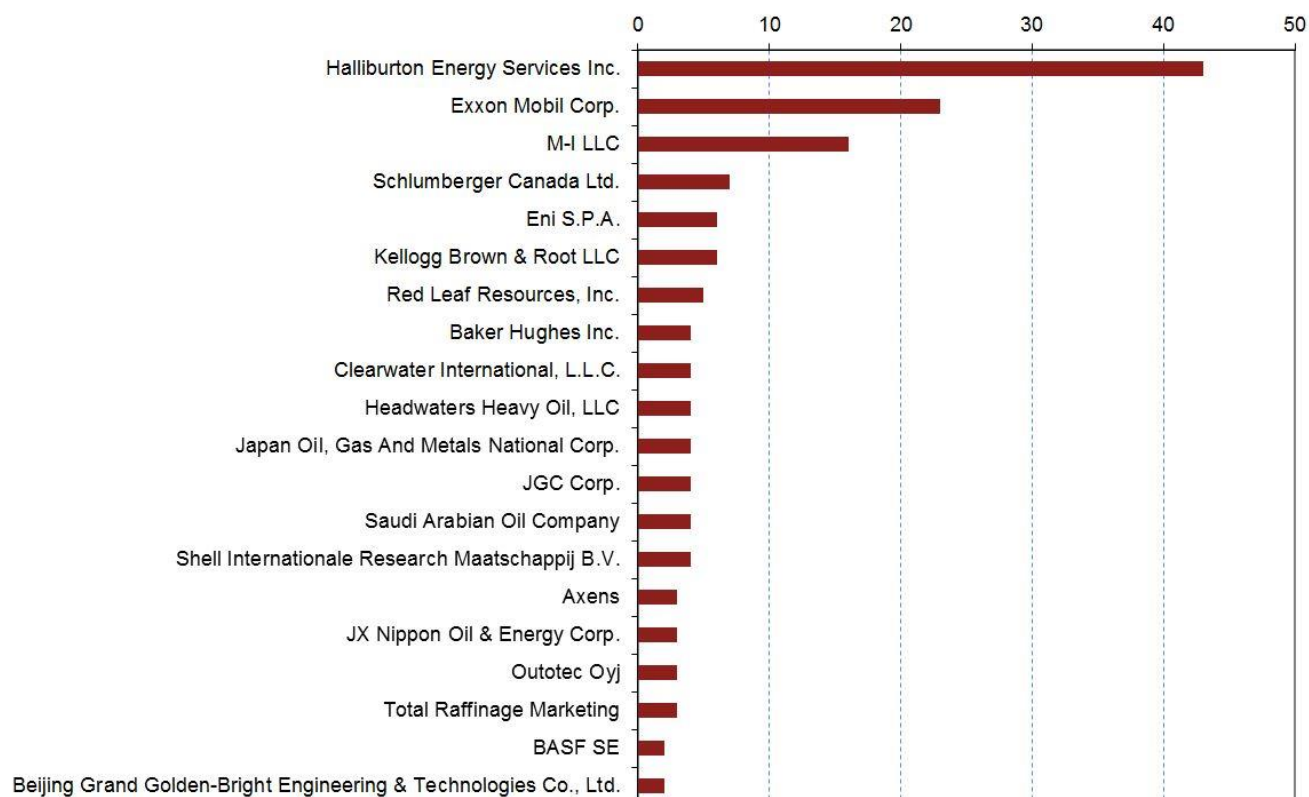
**Figure 16: Shale oil and gas patent filings at CIPO by priority year**





The top applicant for filings related to shale oil and gas is Halliburton Energy Service Inc. Exxon Mobile Corp. is second, with approximately half the number of filings of the top applicant. Of note is that Chinese and Japanese companies are not major filers in Canada, while American companies are.

**Figure 17: Top applicants at CIPO**



As depicted in Figure 18, the top three applicants have been actively filing with CIPO since 2000, whereas others are either more selective in the patents they file with CIPO or simply not actively patenting. From the information collected in the worldwide analysis, we know some of these companies are actively patenting, and are simply not filing in Canada.

**Figure 18: Top applicant activity at CIPO between 2000 and 2012**

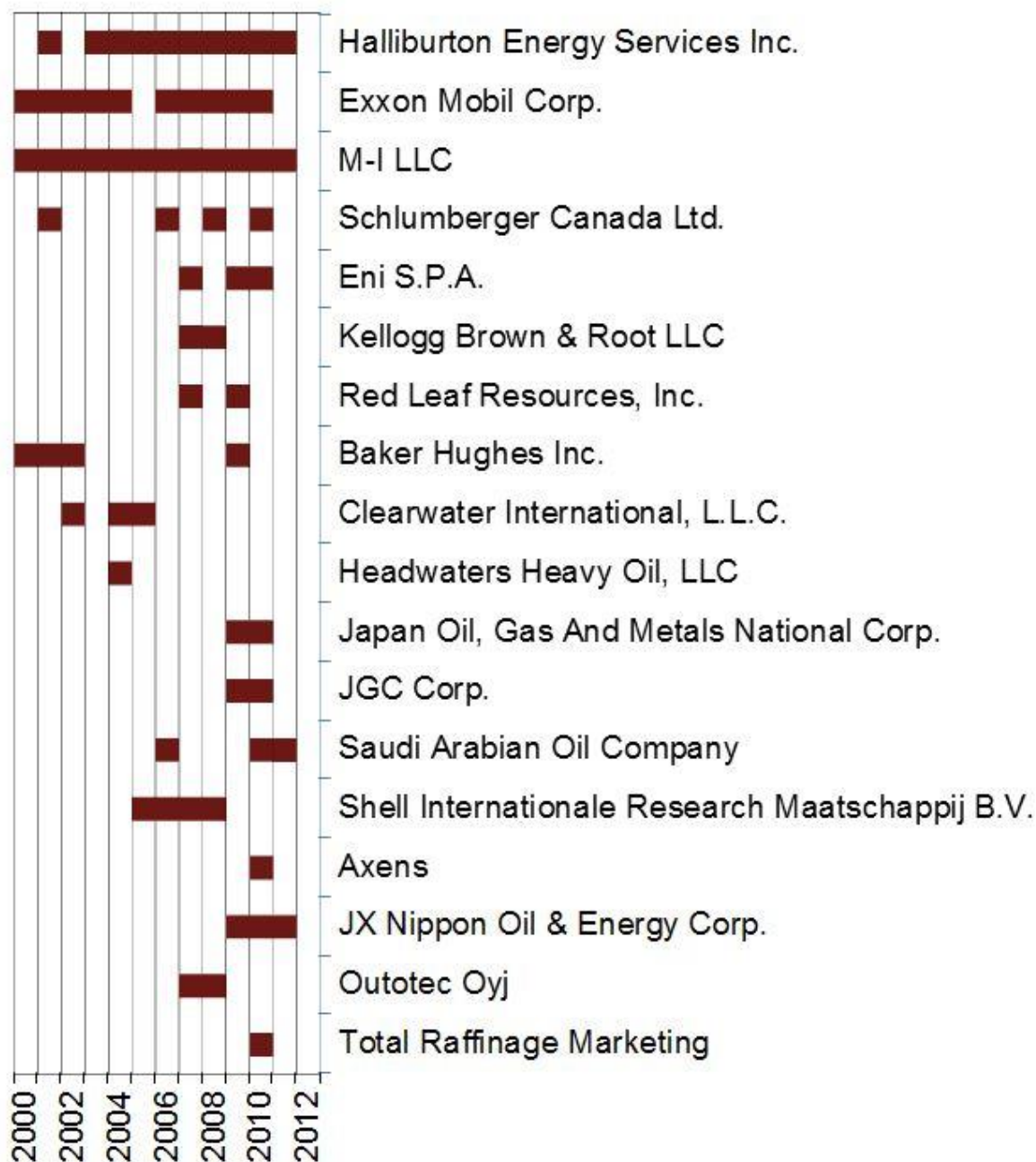
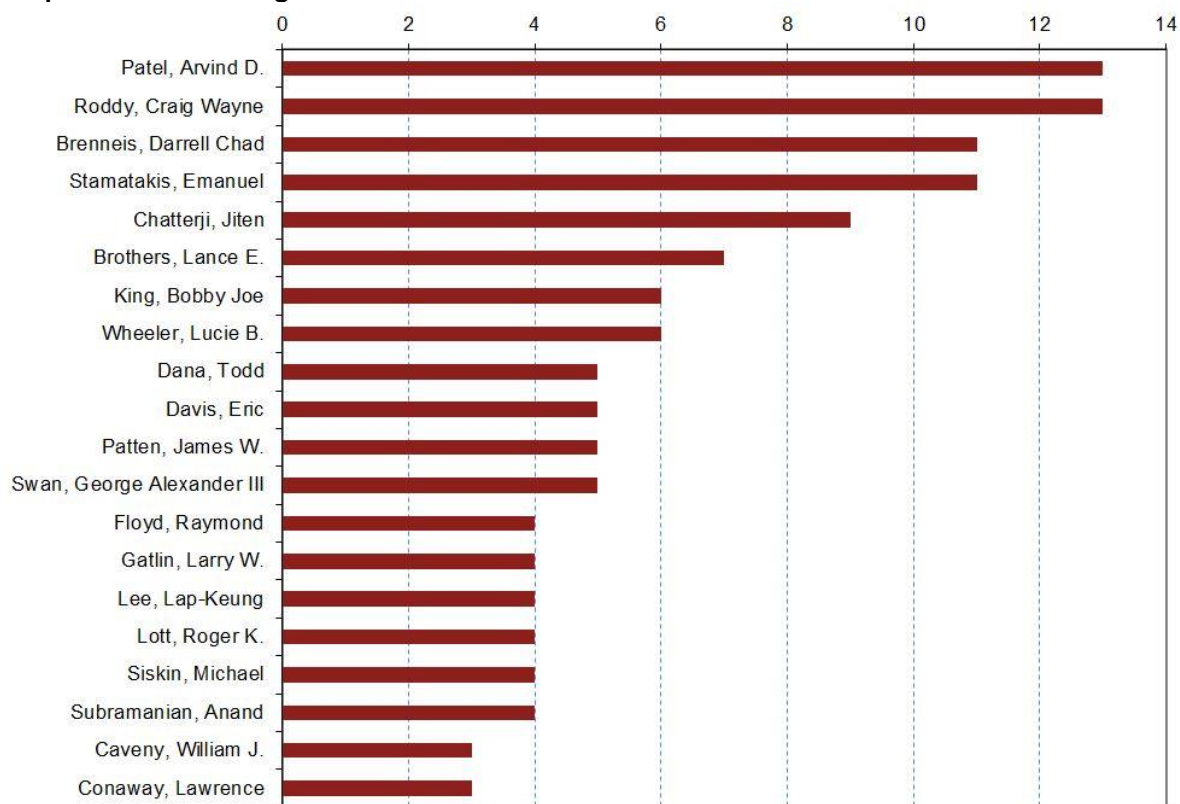


Figure 19 indicates the total number of patents by priority year for the top inventors associated with the top applicants at CIPO.

**Figure 19: Top 20 inventors filing at CIPO**



This patent landscape map is helpful in identifying technological areas where patenting activity is prominent in Canada. It is possible that because most of the world's oil sands reserves are found predominantly in Canada and Venezuela, certain inventions are only worth patenting in these countries since there is not much use for these patents elsewhere. This may also explain why firms filing in the exploration area are more likely to file in Canada than those filing in the development and production areas.

**Figure 20: Patent landscape map highlighting the technological areas where patenting activity is prominent in Canada**  
**To read this map**

The English translation of wording is provided in a table below the map.



L'une Précédente	One Preceding
L'étape	The Step
Précédente Augmenter	Preceding Augmenter
Matière	Material
D'inhibition	Inhibiting

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## IV. CONCLUSION

This report focuses on the shale oil and gas sub-sector of the oil and gas sector. This sub-sector is of growing interest, as the amount of patenting activity has increased significantly since 2000. There are approximately 4,000 published patent families related to the shale oil and gas sub-sector worldwide, of which 100 originate from Canadian applicants. The analysis found that the top five applicants represent only 12% of total patenting activity for this sub-sector. This means that in terms of innovation, the sub-sector may be quite competitive despite the presence of a handful of very large companies.

The clear leader is the China Petroleum and Chemical Corporation (Sinopec Ltd.), with 371 patent families. Other major players with 100 or more patent families include JX Nippon Oil and Energy Corporation (209), Exxon Mobil Corporation (141), Halliburton Energy Services Incorporated (140) and Schlumberger Limited (100). Based on the list of top applicants, it is clear that Chinese, American and Japanese companies are major producers of patent filings in shale oil and gas. In fact, 83% of all priority filings are filed in these three countries, primarily by domestic firms.

The leading Canadian patent filers include Trican Well Service Limited with seven patent families, and Envirollea Incorporated and GASFRAC Energy Services Incorporated, with six patent families each. These top Canadian filers are all headquartered in Calgary, Alberta. When examining patenting activity at CIPO, the overall findings are very similar to those of the worldwide analysis, but on a smaller scale, as most of the major players are patenting in Canada.

Based on the landscape maps, it's obvious that two of the top applicants, Schlumberger and Halliburton, are very active in patenting in the "drilling" and "well formation" technological area. There is also some overlap between Idemitsu and Cosmo Oil Co. patents across the landscape map. At the same time, it appears as though the other top filers are active in areas that are distinct from these four companies. For example, the large distance between technology areas is an indication that there is not much overlap between Schlumberger and Shell's patents and those of the other leading applicants, other than Halliburton. Although Sinopec is active in many technological areas on the landscape maps presented, the company is especially active in the area of "catalytic zeolite coke."

Shale oil and gas will be an important part of the worldwide energy story for the coming decades. Innovation will play a key role in maximizing what is extracted from these non-traditional oil and gas sources while minimizing the costs and environmental impact of the processes. This report shines a light on the recent patenting activity in the industry in hopes of providing insight for those working in this interesting and important sector.

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## ANNEX A – DEFINITIONS

**Application date:** The date on which an application was filed for a patent. This enables an accurate temporal reflection of the technical content of a patent application.

**Patent:** A patent is a right, granted by government, to exclude others from making, using, or selling your invention.

**Patent family:** One or more published patents with a shared priority patent. Generally there is one invention per patent family.

**Priority date:** A patent can claim priority from an earlier application. This usually happens for two reasons: a) when an application is filed in one country, international convention dictates that the applicant then has 12 months to file a corresponding application abroad. Thus the patent application would then have a priority date, which indicates the earliest date attributed to the invention; b) an earlier application may contain part of a subsequent invention so a subsequent application, made within 12 months of filing, may claim priority from the earlier application. However, in the new application, this date is only valid for the part of the invention which appears in the earlier application. Care should therefore be taken when analysing the priority date of an invention.

**Publication date:** The date on which the patent application was published. A patent is normally first published ("A" publication) 18 months after the priority date or the application date, whichever is earlier. Depending on the jurisdiction, a patent is then given a "B" or "C" publication code when the patent is granted. Any further publications (e.g. following correction) are given a numbered publication code in most jurisdictions (for example: "A1", "A2", "B1", "B2").

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## ANNEX B – METHODOLOGY

### Search strategy

The search strategy used to generate the dataset for this analysis was based on a combination of predetermined IPC codes, as well as specific keywords. For the purpose of this report, the Canadian dataset consists of a patent family where at least one application has an applicant with a Canadian address.

The applicant data was cleansed to remove duplicate entries which relate to the same applicant but where a different naming convention was used due to spelling errors, international variations, etc. Due to the size of the dataset, the emphasis was put on cleansing records relating to the top applicants. Some inconsistencies may still occur in the naming of applicants with smaller patent portfolios.

### IPC codes

Table 5, which was developed by the World Intellectual Property Organization (WIPO), identifies two categories linked to the shale oil and gas sub-sector. This concordance is used to define the focus of this analysis. The three IPCs related to shale oil and gas, identified in bold in Table 5, are examined in Table 6.

**Table 5: Technology to IPC concordance table for the shale oil and gas sub-sector<sup>2</sup>**

Category	IPC description	IPC classification (2014.01)
Basic materials chemistry	Covers typical mass chemicals such as herbicides, fertilisers, paints, petroleum, gas, detergents, etc.	A01N; A01P; C05*; C06*; C09B; C09C; C09F; C09G; C09H; <b>C09K</b> ; C09D; C09J; <b>C10B</b> ; C10C; C10F; C10G; C10H; C10J; C10K; C10L; C10M; C10N; C11B; C11C; C11D; C99Z.
Civil engineering	Covers construction of roads and buildings as well as elements of buildings such as locks, plumbing installations or strong rooms for valuables. A special part also refers to mining.	E02*; E01B; E01C; E01D; E01F-001; E01F-003; E01F-005; E01F-007; E01F-009; E01F-01*; E01H; E03*; E04*; E05*; E06*; <b>E21*</b> ; E99.

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<sup>2</sup> [wipo.int/ipstats/en/statistics/technology\\_concordance.html](http://wipo.int/ipstats/en/statistics/technology_concordance.html)



**Table 6: Description of IPC fields spanning shale oil and gas extraction and refining processes<sup>3</sup>**

Shale oil and gas IPC	IPC description
C09K 8*	Materials for applications not otherwise provided for; Applications of materials not otherwise provided for; Compositions for drilling of boreholes or wells; Compositions for treating boreholes or wells, e.g. for completion or for remedial operations.
E21B*	Earth or rock drilling; obtaining oil, gas, water, soluble or meltable materials or a slurry of minerals from wells.
C10B*	Destructive distillation of carbonaceous materials for production of gas, coke, tar, or similar materials (underground gasification of minerals).

To ensure that only relevant patent information is extracted from the Thomson Innovation patent search database, a combination of keywords and IPC codes were used with the database. The following query was used in Thomson Innovation to extract the relevant patents for examining this industry sub-sector:

IC=(C10B\* OR C10G\* OR E21B\* OR C09K008\*) AND CTB=("Shale" OR "KEROGEN OIL" OR "LIGHT OIL" OR "CANNEL OIL" OR "OGHEAD COAL" OR "ALUM SHALE" OR "STELLARITE" OR "ALBERTITE" OR "KEROSENE SHALE" OR "BITUMINITE" OR "GAS COAL" OR "ALGAL COAL" OR "WOLLONGITE" OR "SCHISTES BITUMINEUX" OR "TORBANITE" OR "KUKERSITE" OR "TIGHT GAS" OR "TIGHT OIL" OR "BAKKEN") AND AD>=(20000101) AND AD<=(20140821) NOT TI=("COAL MINING" OR "BIOFUEL" OR "COAL TAR");

<sup>3</sup> [wipo.int/ipstats/en/statistics/technology\\_concordance.html](http://wipo.int/ipstats/en/statistics/technology_concordance.html)



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## ANNEX C – LIMITATIONS

The following limitations should be kept in mind when interpreting the analysis results:

- Classification codes are applied either automatically or manually, so discrepancies across different IP offices may arise. Multiple classification codes can be applied to a single record, which can dilute the specific technical area of innovation. For a given patent family, the primary IPC applied may differ from one patent family member to another.
- Even though the applicant data field is cleansed, it is a manual process and therefore requires some interventions. Mergers and acquisitions were not examined as part of this data cleansing process.
- Records identified as “individuals” may not necessarily be private inventors. Not all companies adopt similar filing strategies, resulting in some choosing to identify their employees as applicants instead of the company name.
- Inventor fields are not cleansed and normalized; consequently, inventor rankings and relations may not be accurate.