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Clean coal
technologies:
Where does
Australia
stand?



The Opportunity

As the world’s leading exporter of coal, Australia should be well placed to drive clean coal technology innovations. Our research shows we’re falling far behind.

By **Mike Lloyd** and **Justin Blows**

Why Australia needs clean coal

Coal is now Australia’s largest source of export earnings, worth an estimated \$43 billion in 2008/9¹ and placing Australia as the world’s leading exporter of coal².

Australia is also heavily reliant on coal for energy production, with 76% of Australian electricity expected to come from coal in 2008/9, compared to 7% for

simultaneously avoiding dangerous climate change.

A number of technologies have been proposed around the world to reduce greenhouse gas emissions associated with burning coal. This divergent range suggests clean coal technologies are still going through a major period of development. In simple terms, these technologies can be divided into three classes,

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renewable energy sources, such as hydro and wind power³.

Burning coal is a major contributor to the production of the greenhouse gas CO₂. With increasing pressure to reduce greenhouse gas emissions, future Australian coal exports and coal-fired power generation are uncertain. It is in Australia’s national interest to develop technologies that allow the continued export of coal and its use for power generation, while

each with its own advantages and disadvantages (see Table 1).

About Griffith Hack

The Griffith Hack Clean & Sustainable Technologies Group provides intellectual property services to organisations that develop technologies with a reduced environmental impact.

Griffith Hack analysed Australian clean coal patents filed in between 2003 and 2008 to determine trends in technologies and applicants.

Need to know

While clean coal technology is expected to play a pivotal role in future energy generation worldwide, data suggests Australians are filing fewer clean coal patents, with less commercial value, than foreign entities. This may erode effectiveness to commercialise clean coal innovation.

Assuming patent counts are a measure of innovation, patent data suggests Australia is weak in clean coal technology innovation compared to other technologies, such as mining technology and solar. This suggests a historical under-investment in clean coal.

Australian patent filings are fragmented across a relatively large number of individuals, companies and research organisations. This suggests there is no centre of critical mass for clean coal research, development and commercialisation, which may be contrary to the national interest.

In this report we uncover:

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Why we need clean coal technologies
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How to improve Australia’s performance

clean coal technologies are still going through a major period of technology development

Table 1: Classes of clean coal technology

<u>Class 1: coal combustion</u>	<u>Class 2: coal conversion</u>	<u>Class 3: CO₂ capture</u>
<p>These technologies improve the efficiency of the combustion process, and include:</p> <ul style="list-style-type: none"> • dewatering of brown coal • pulverisation of coal • reducing the emission of gases other than CO₂, for example, sulphur dioxide <p>Possible disadvantage</p> <ul style="list-style-type: none"> • likely to produce incremental rather than major reductions in CO₂ emissions <p>Possible advantages</p> <ul style="list-style-type: none"> • relatively low technical risk • could even be retrofits or modifications of existing plants • an improvement in combustion efficiency will reduce the amount of CO₂ produced for a given amount of energy produced 	<p>These technologies convert coal to alternative fuel types, such as:</p> <ul style="list-style-type: none"> • gasification • coal to liquids • capturing of methane from coal seams • ultra clean coal, which is the pulverisation of a 'cleaned' coal into a gas or liquid fuel substitute <p>Possible disadvantage</p> <ul style="list-style-type: none"> • can be high risk due to the technical complexities of some of these processes <p>Possible advantages</p> <ul style="list-style-type: none"> • potential for major reductions in CO₂ emissions • environmental benefits can come from the ability to separate CO₂ prior to combustion, and the improved efficiencies of alternative combustion technologies 	<p>These technologies capture and store CO₂ after combustion, and include:</p> <ul style="list-style-type: none"> • CO₂ separation from flue gases • geosequestration (concentrating and storing CO₂ underground) • mineral sequestration • alternative use of CO₂ • using oxygen instead of air in conventional coal plants, which may allow direct capture of all flue gases without CO₂ separation being necessary <p>Possible disadvantages</p> <ul style="list-style-type: none"> • many existing CO₂ capture processes can consume a significant amount of the energy produced in burning the coal • the sheer volume of flue gases produced by our larger coal power stations can present scale up and storage difficulties <p>Possible advantage</p> <ul style="list-style-type: none"> • in many cases, could 'bolt-on' to existing coal power plants

** It should be noted that each technology group includes technologies that are already technically and commercially proven, for example, coal seam methane is being commercially used today to create electricity in Queensland.*

The Method

To focus on recent trends, the analysis for this study was drawn from the Australian patent register from the last five years.

How we conducted the study

We analysed Australian patents filed between 2003 and 2008. Patents filed prior to 2003 may still be important, however, we wanted to focus on recent trends.

The date of national phase entry was used for analysis of Patent Cooperation Treaty (PCT) patents.

Griffith Hack's Information Services Group searched the Australian patent register for patents or patent applications related to clean coal technologies. From this set, we excluded provisional patent applications because these are not full patents, but combined granted patents and patent applications, both of which are referred to as 'patents' in this report.

We then subjectively classified the remaining patents into coal combustion (32 patents or patent applications), coal conversion (31 patents), and CO₂ capture (55 patents). Within each technology area, we further separated the patents into individual technology fields.

Recent PCT international patent applications may not be included in our data. However, Griffith

Hack will provide updates on clean coal patent trends as new data becomes available.

Why analyse patent data?

Analysis of patent data, such as the count of patents filed, can be used as a measure of the commercial readiness and competitiveness of Australian companies, particularly when compared with foreign enterprises.

A patent offers its holder a number of commercial advantages that greatly increases their ability to operate in the market. Generally, patents filed correlate with competitiveness.

Analysis of patent data can also be used to measure innovation. While not a perfect measure, patents filed correlate with innovative activity.

There are clear examples of the commercial use of patents in the clean and sustainable technology field. Firstly, Toyota is reported to have filed more than 2000 patents to protect its Prius hybrid engine system. It is also worth noting that more than 870 PCT worldwide patent families have been filed to protect various developments in the area of wind turbines.

Patent benefits

The benefits of patents include:

- A patent demonstrates ownership of the technology it covers, promoting investment in research, development, commercialisation, deployment and diffusion of the technology within the market.
- A patented technology is more likely to attract funding through equity, a loan or government grant.
- A patent provides clarity and legal certainty, promoting technology transfer through licensing, joint ventures and sale of the technology.
- A patent, particular when part of a patent portfolio, provides leverage when engaging other commercial parties about an alleged infringement.
- A patent provides leverage during negotiation of technology transfer and sale.
- A patent increases reputation and brand value.
- A patent provides confirmation that commercial technology is being developed, and not just research publications.
- A patent provides proof of publication.

Analysis of patent data can also:

- Identify key filers of clean coal patents in Australia and who are the leading innovators.
- Identify the areas of clean coal technology showing the greatest innovation.

The Results

We have identified key trends in clean coal patent applications, which show clean coal patent filing is increasing, but few of these patents are filed by Australians.

The patent process

The patenting process begins when an applicant or their patent attorneys files a 'patent application'. After a period of time – from a few months to five years or more – a 'patent' is granted.

Patent attorneys are often careful to distinguish between patent applications and granted patents, as only a granted patent can be enforced against third parties. The majority of the patents referred to in this study are patent applications because they are yet to be granted.

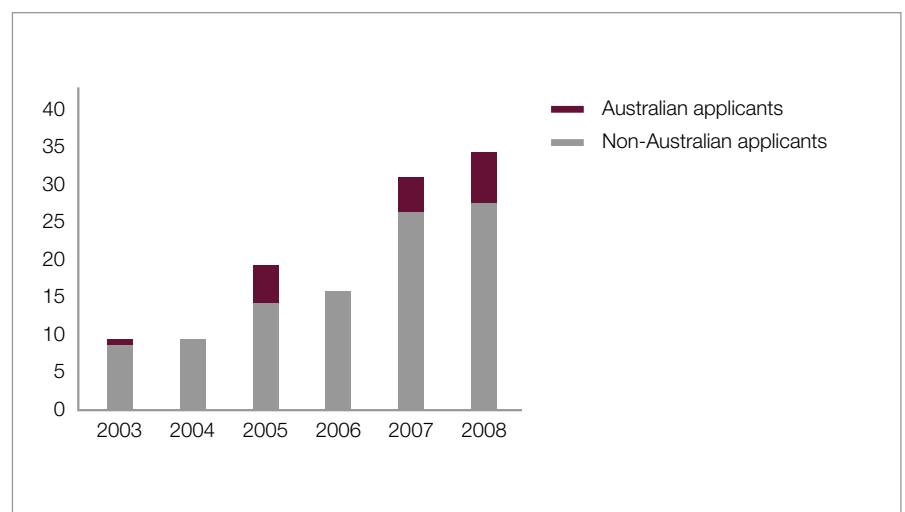
For conciseness, we refer to both patent applications and granted patents as 'patents' in this study, as the aim is to show inventive activity, and not legal protection gained by the patent applicants.

Clean coal patents

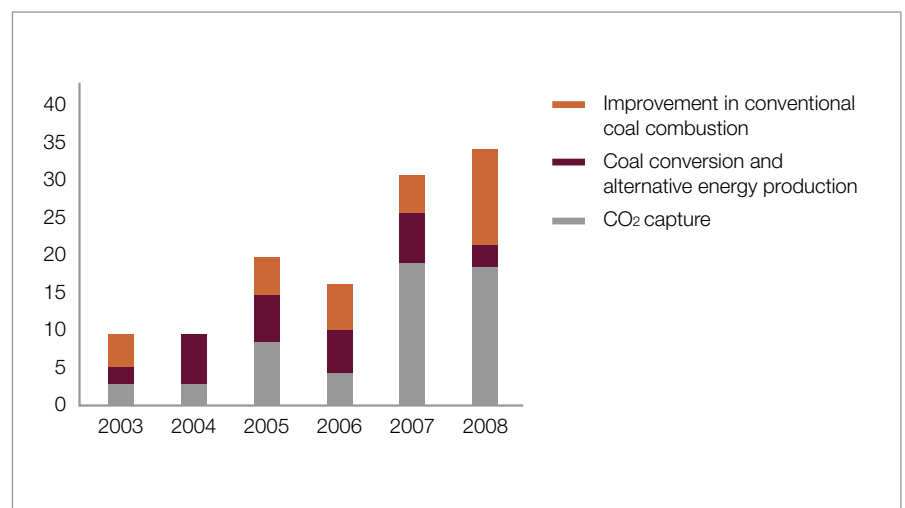
Clean coal patent applications are steadily rising in Australia. Most of the clean coal patent applications were filed by non-Australian applicants (see Graph 1).

As Graph 2 shows, these patents are mainly filed in the CO₂ capture area. There was a small decrease in the number of coal conversion patents filed in 2008.

Graph 1: Known clean coal patent applications filed in Australia



Graph 2: Known clean coal patents filed in Australia – main technology areas



The most common field for patents related to conventional coal combustion was related to pulverisation (Graph 3). Pulverised coal combustion and related technologies can lead to improvements in the thermal efficiency of coal power plants, reducing their CO₂ output for a given amount of energy produced.

Patents related to gasification dominated the area of coal conversion (Graph 4), followed by patents related to coal-to-liquid technologies.

The area of CO₂ separation has seen the most patenting activity (Graph 5 opposite page). This

The area of CO₂ separation has seen the most patenting activity

may not be surprising due to the acknowledged issues in finding an energy efficient means of separating CO₂ from other flue gases.

The source of clean coal patents

The US is the leading source of clean coal patents (Graph 6), but Australia and Japan are the next biggest sources. The US

was also notable in that it was filing patents in all three main clean coal technology classes. In contrast, Australia, as well as some other leading countries, is mostly filing patents related to CO₂ capture.

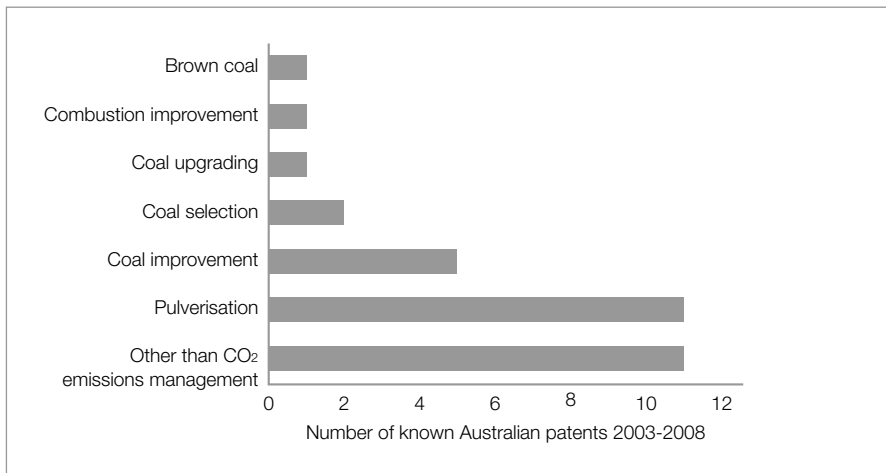
Is Australia filing enough clean coal patents?

Australian applicants filed 14% of clean coal patents over this period (Graph 7). This is the same figure as the overall rate of Australian patents filed by Australian applicants for all patent classes, and an improvement over the general rate of Australian sourced patent filings for chemical processing patents.

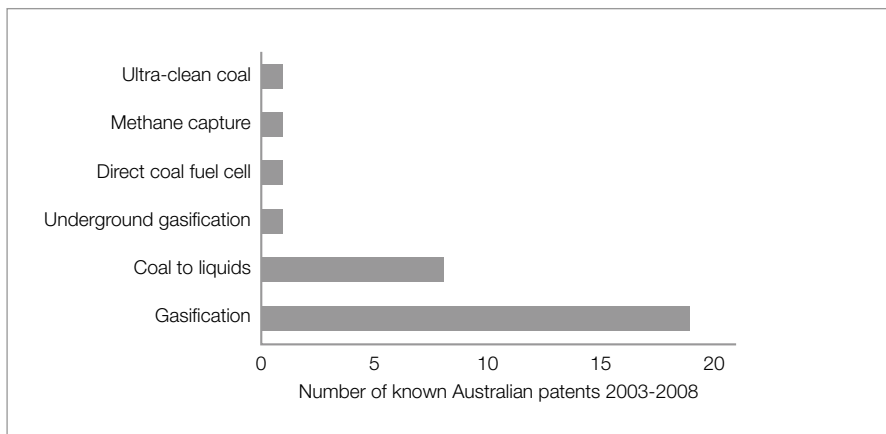
However, a better reference would be to compare this figure to technology areas of national interest, where Australia is a technology leader, such as civil engineering, mining and agriculture. Between 2003 and 2008, Australian applicants filed 39% of Australian civil engineering and mining patents, and 33% of agricultural patents, showing what Australian applicants are capable of achieving.

Graph 7 also shows the relative filing performance by Australian applicants varies between clean coal technology areas, with Australia outperforming the 14% mean value in the area of CO₂ capture, but underperforming in the other areas of clean coal technology.

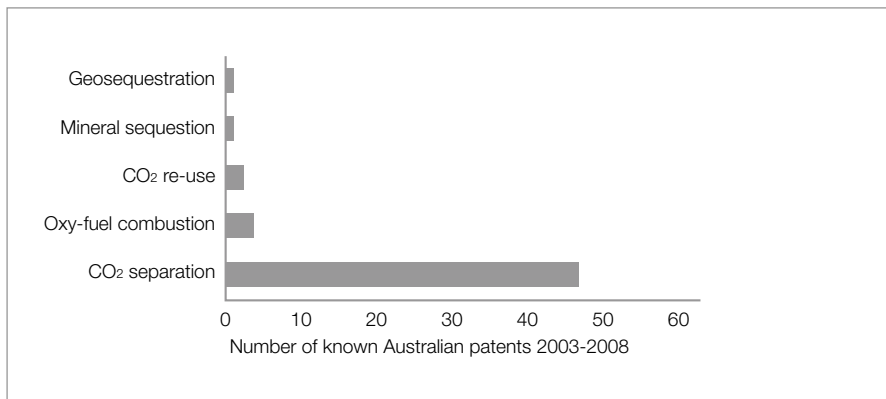
Graph 3: Types of conventional coal combustion patents filed in Australia



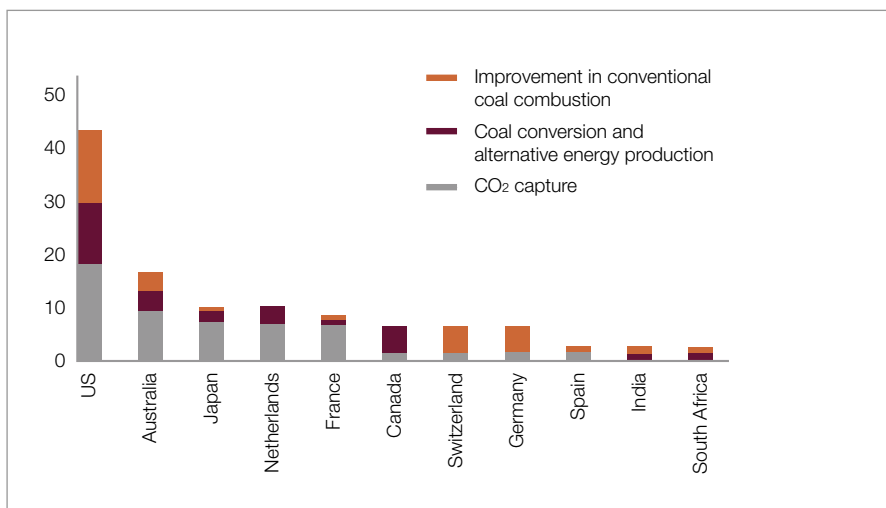
Graph 4: Types of coal conversion patents filed in Australia



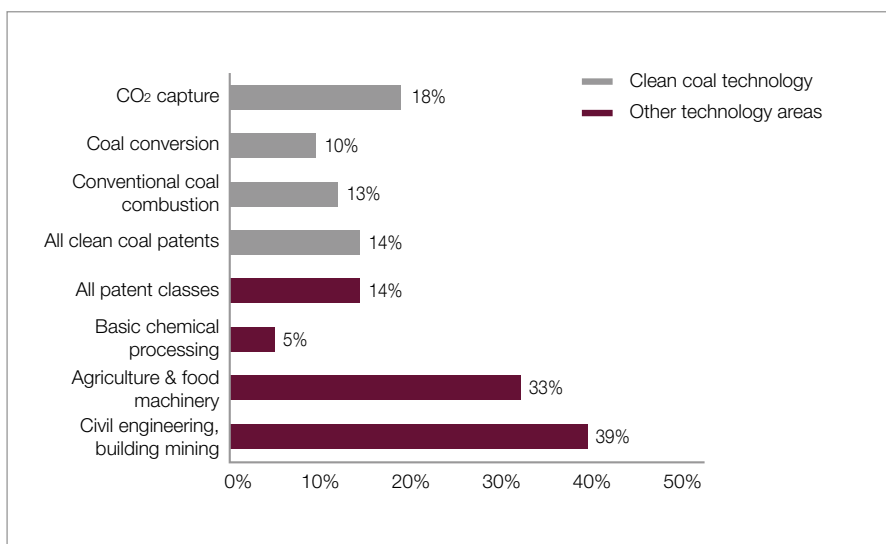
Graph 5: Types of coal combustion patents filed in Australia



Graph 6: Source of known clean coal patents filed in Australia 2003-2008 – leading countries



Graph 7: Percentage of Australian applicants, Australian patents filed 2003-2008



Contact us

We are interested in your feedback if your organisation has one or more of its patents missed from this study. We will use this feedback to adjust our query to ensure that similar patents are included in future studies.

Please contact Griffith Hack to discuss your intellectual property needs and how we can help meet these needs using our extensive databases and intellectual property expertise.

Potential errors

There are a couple of areas of potential error in this type of study:

- The query used to identify potential clean coal patents might have missed some clean coal patents because of a different title, abstract or patent technology classification being used.
- The subjective analysis might have excluded a patent as not being clean coal because on the whole it was not focused on clean coal, but it may have been possible to apply the claimed technology to the clean coal area.

References (from page 2)

- 1 See www.pm.gov.au/media/Release/2008/media_release_0484.cfm
- 2 See www.eia.doe.gov/oiaf/aeo/supplement/sup_ogc.xls
- 3 See www.abareconomics.com/publications_html/energy/energy_07/auEnergy_proj07_tables.pdf

Australian companies ranked comparatively poorly in comparison to overseas applicants

Which companies filed the most patents?

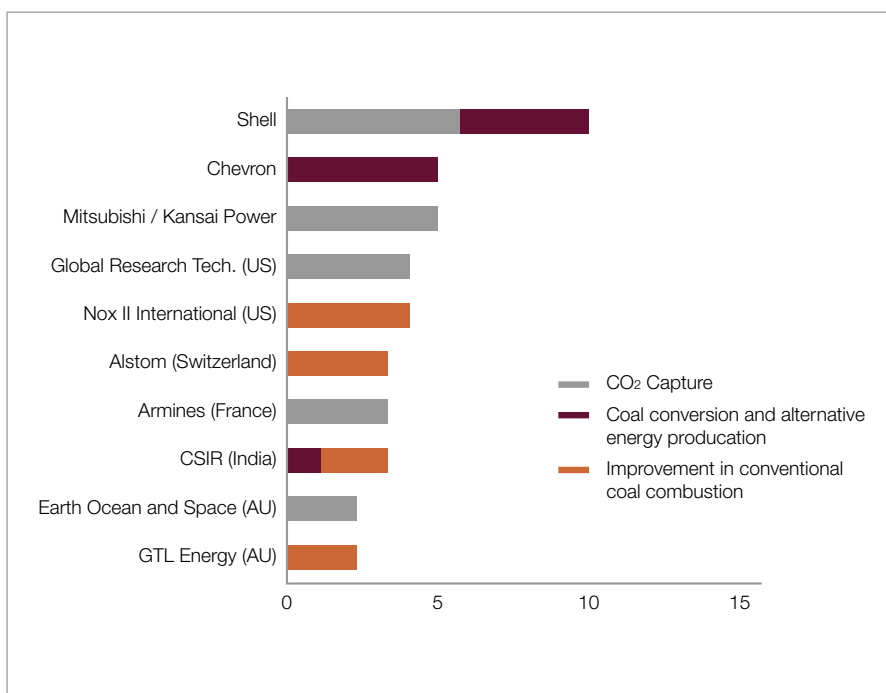
Strong benefits can be gained by having a patent portfolio instead of individual patents. The largest patent portfolios were owned by two petrochemical companies, (Graph 8). In this group of leading applicants, there was only one Australian company, namely, GTL Energy Ltd.

Although Graph 6, analysed earlier, shows Australia is second for the number of patents filed, these were filed by a number of different parties. This means Australian companies ranked poorly in comparison to overseas applicants. In practical terms, this may mean Australian companies lack the critical mass to commercialise patents or patent portfolios.

Other Australian organisations who filed Australian patents in the clean coal area are:

- CO₂ separation:
CO₂ CRC
CSIRO
Greensols Australia Pty Ltd
 - CO₂ sequestration:
Ocean Nourishment Corporation
Southern Cross University
 - Ultra clean coal:
UCC Energy Pty Ltd
 - CO₂ emissions management:
Yarraboldy Briquette Company
- There were also patents filed by five private individuals.

Graph 8: Clean coal patents filed by leading international and Australian applicants 2003-2008



Comparison to solar energy patent trends

A soon-to-be-published Griffith Hack Clean and Sustainable Technologies Group study on solar energy patents suggests about five times as many solar energy patents were filed in Australia between 2003 and 2008 as clean coal patents. And about 22% of these solar energy patents were filed by Australian applicants.

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The Lessons

Australian clean coal patents are being filed in a range of technology areas, although CO₂ separation is starting to dominate.

What we learnt

The available patent data suggests Australians are not filing sufficient patents to be commercially competitive. The poor clean coal patent filing rate contrasts with the rate for other areas of Australia's national interest, such as civil engineering, mining and agriculture.

Secondly, the patents being filed by Australian applicants tend to be focused on the area of CO₂ separation. Should another technology end up as the dominant technology in clean coal, for example, gasification combined with CO₂ capture prior to combustion, Australia may end up as a net importer of clean coal IP rights.

Additionally, the total number of Australian patents being filed in the clean coal area from all countries is relatively low compared to other clean energy technologies. This suggests the total amount of innovative activity around the world in clean coal is also relatively low.

How to improve patent filing performance

There are a few processes that can help Australian applicants in

the clean coal area improve their patent filing performance.

Australian companies and organisations that are working and researching in the clean coal area are encouraged to be fully aware of the benefits and realities of the patent system and the patent landscape, for example, existing patents filed by other organisations in their technology areas.

Sometimes Australian organisations can be reluctant to engage in the patent system because of fears about excessive costs, lack of in-house knowledge about patents and patent searching, and misguided beliefs that if they ignore patents, the patent system will not be of concern to them. Targeted education and further support can help to overcome these fears and misguided beliefs.

Current and future Australian government agencies funding clean coal research and projects, both at the state and federal level, need to ensure that funding recipients are appropriately protecting new developments, and these recipients fully understand the IP landscape to avoid the risk of patent infringements. **GH**

What may result

Australia's underperformance in patent filing could result in:

- Reduced opportunity to create an Australian industry providing technology licensing and other technology transfer services to other countries.
- Reduced likelihood of a manufacturing industry providing clean coal related plant and equipment.
- Reduced tax revenue due to clean coal technology royalties being paid to overseas IP owners.
- Increased reluctance of technology companies to invest in developing clean coal technologies as their patent position is insufficient to protect this investment.

Australian governments have recently recognised the importance of clean coal to Australia's future by providing substantial funds for research and demonstration. The Global Carbon Capture and Storage Institute recently announced by the federal government, for example, has the stated aim of accelerating "carbon projects through facilitating demonstration projects and identifying and supporting necessary research", as well as consideration to include regulatory frameworks.

It will be interesting to see how these government programs affect clean coal innovation in the future. We will follow these developments in further patent reports.

Want to know more?

Griffith Hack would be pleased to discuss the details of this study and other exciting work it is doing to promote the benefits of clean and sustainable technology IP.

To learn more about this study, please contact Mike Lloyd, Griffith Hack's IP Portfolio Management Consultant, on (03) 9243 8315 or mike.lloyd@griffithhack.com.au

To use patent data to determine technology trends in your industry, please contact George Mokdsi, Griffith Hack's Information Services Manager, on (02) 9925 5975 or george.mokdsi@griffithhack.com.au

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