Measuring green innovation in Australia

A patent-based analysis

Prepared for the Climate & Recovery Initiative

September 2020

ClimateWorks AUSTRALIA

Founded in 2009 through a partnership with The Myer Foundation and Monash University and working within the Monash Sustainable Development Institute.

CPD CENTRE FOR POLICY DEVELOPMENT

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About the Climate & Recovery Initiative

The Climate & Recovery Initiative (CRI) is a collaborative initiative coordinated by the Centre for Policy Development and ClimateWorks Australia, with a steering group that includes Pollination Group, Australian Industry Group and the Australian Council of Trade Unions. Working together, we are seeking to identify the best ideas and opportunities for aligning Australia's economic recovery with climate and transition priorities, and to get them into the right hands.

Important background context on patents as a measure of innovation

There are several different ways to measure green innovation - each gives a slightly different perspective

- **Patents**: patents are legal rights over a scientific idea, implemented to help firms & other institutions recover R&D costs. Patents are useful for capturing early-stage and radical innovation
- **Emissions/materials intensity:** producing the same unit of output with fewer emissions is a good indicator for green technology adoption and process innovation
- **Green imports and exports**: green imports is a good measure for green technology adoption by Australian firms while exports is an indicator of the degree to which Australian firms are facilitating green technology diffusion abroad
- **Green R&D investment:** investment into green technologies may or may not translate into new low-carbon goods. Therefore, green investment is a good measure of "level of effort" towards developing green technologies. It is typically harder to get data on this.

There is extremely rich data for patents making them a popular metric for measuring innovation

- Since patents are legal instruments to protect intellectual property, information on type of idea, inventor, and geography are systematically documented across countries
- There is also a comprehensive classification of what counts as a “green patent”. In short, it is any technology that can increase energy or materials efficiency; reduce GHG emissions; and help in adaptation.
- We use aggregated data from all patent offices around the world from 2000-2016
    - The analysis stops at 2016 because for most patent offices, there is a 3-4 year administrative lag in recording and updating patent filings
    - Extending the analysis to 2020 risks showing spuriously low innovation levels when in reality, the low numbers are because of lags in recording data
    - We look at “granted patents” rather than patent filings to ensure we capture genuine innovation rather than opportunistic filing behaviour
    - Filtering by “granted patents” significantly affects the results

Patents are filed in the country where the invention is intended to be deployed

Countries that become knowledge hubs create the *right environment* for innovation. Such countries typically:

- Offer legal protection for intellectual property
- Have large markets to attract R&D investment
- Offer favourable financing for risky R&D investments
- Offer subsidies for innovation

Australia is already one of the top ten countries in the world in terms of patents received each year (EPO annual report, 2019).

But what is Australia's status as a "green" innovator?

Australia as a market for green innovation

Australia is a key destination for green patents in the G20

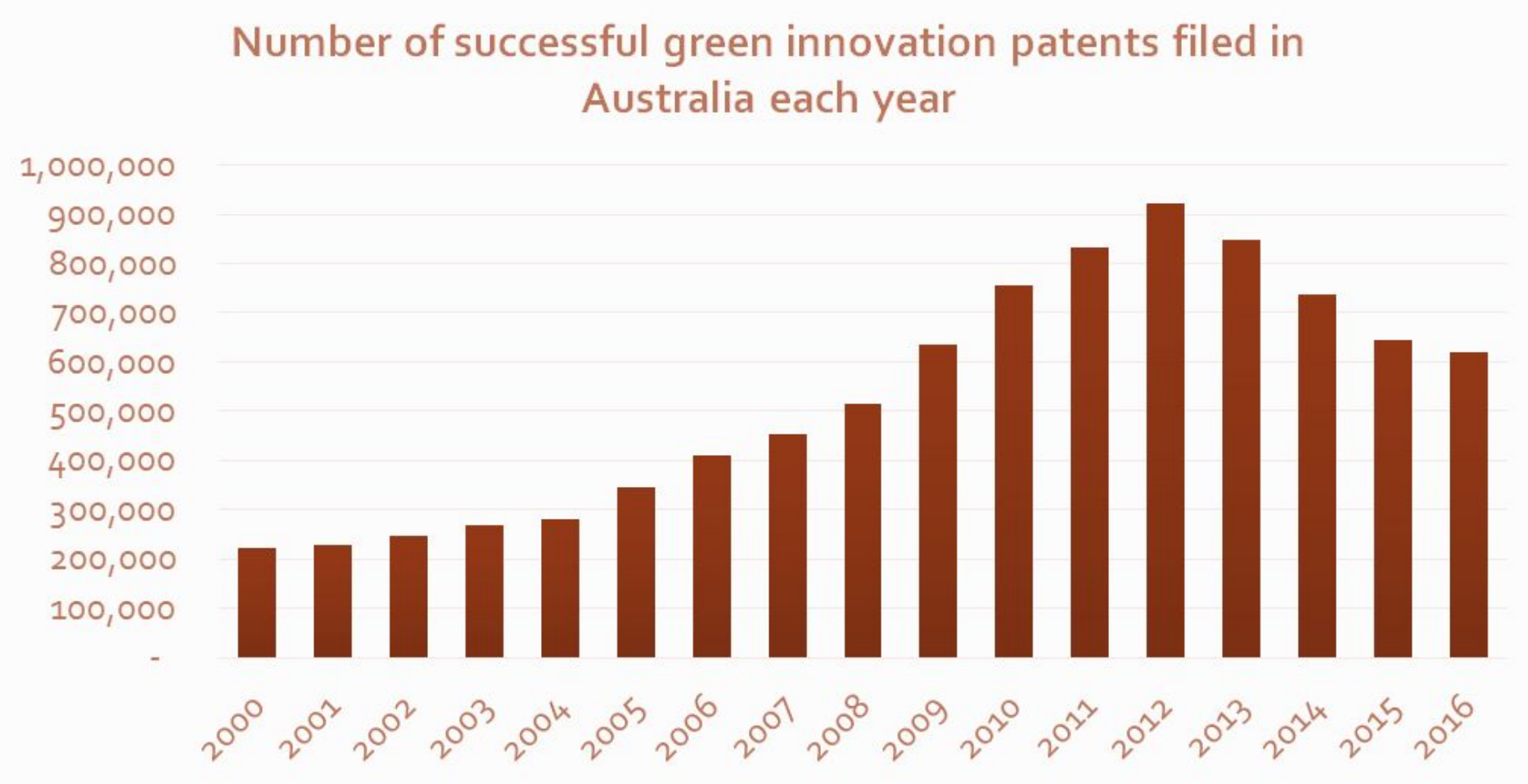
- Ranking 7 in the G20 (and 8 globally), Australia has succeeded in attracting and generating green ideas
- Australia has robust institutions for fostering scientific advancement
- With stronger incentives for explicitly green innovation, Australia may be able to go up the ranking

Number of successful green patents filed cumulatively across 2000-16

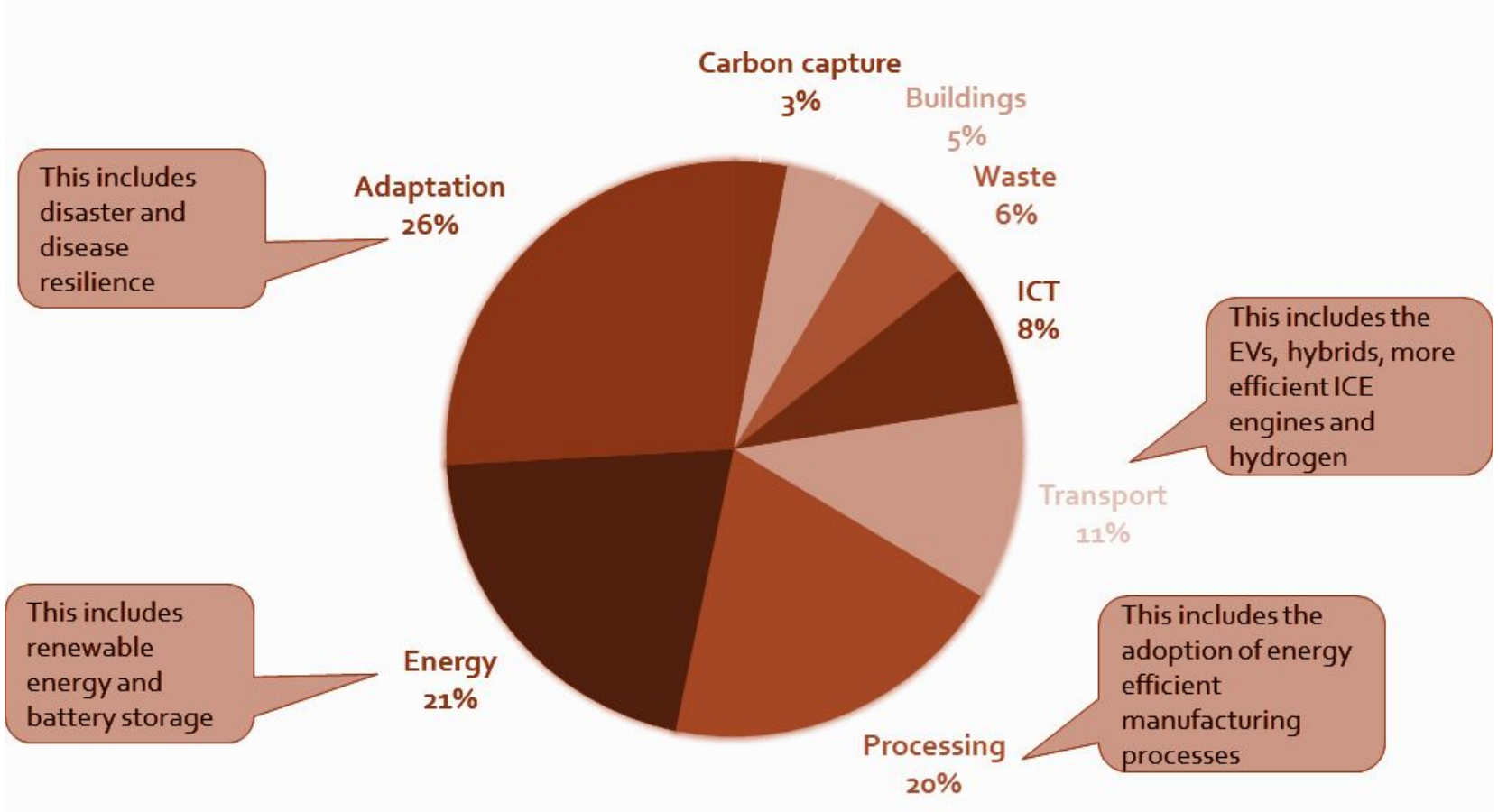
Rank	Country	Number of patents
1	China	2,999,848
2	USA	2,279,816
3	Japan	1,479,812
4	Europe	917,038
5	South Korea	823,735
6	Germany	343,869
7	Australia	267,345
8	Canada	243,290
9	Russia	206,118
10	Spain	180,045
11	France	118,586
12	Brazil	95,643
13	Mexico	80,846
14	South Africa	65,037
15	Great Britain	64,027
16	Argentina	12,021
17	Turkey	7,371
18	India	1,345
19	Indonesia	151

*No data for Saudi Arabia

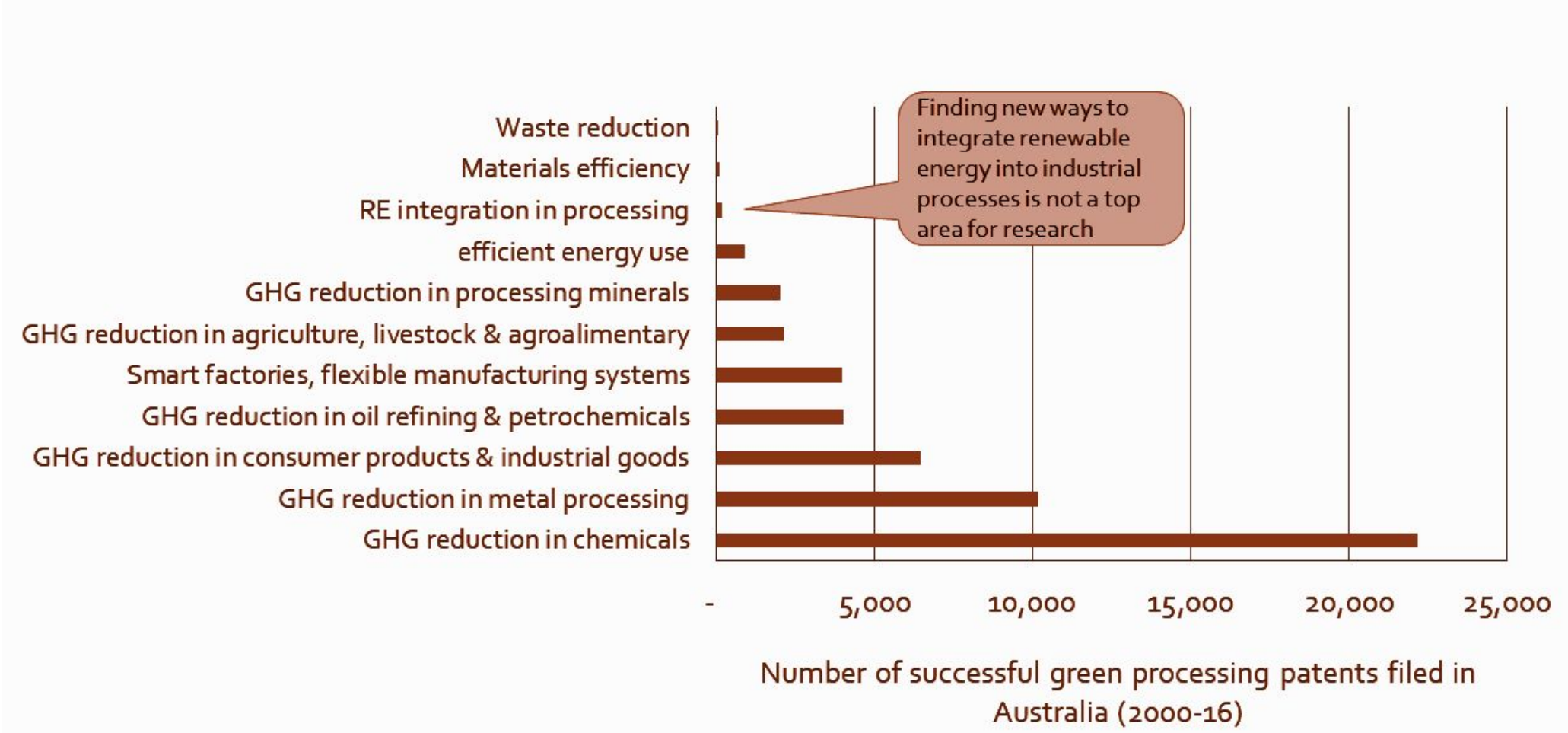
Green innovation in Australia has picked up over time with a slight decline in recent years



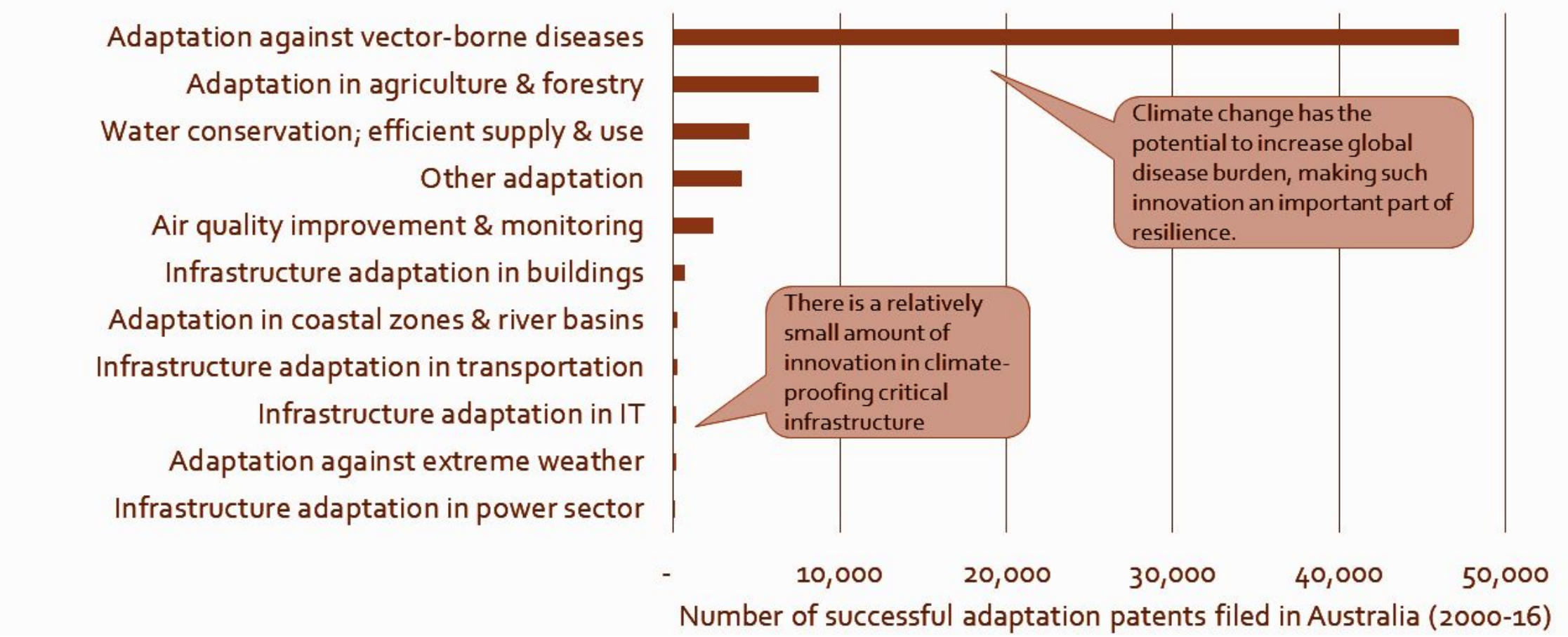
Two-thirds of green patents in Australia are related to energy, adaptation and process. CCS has seen less innovation



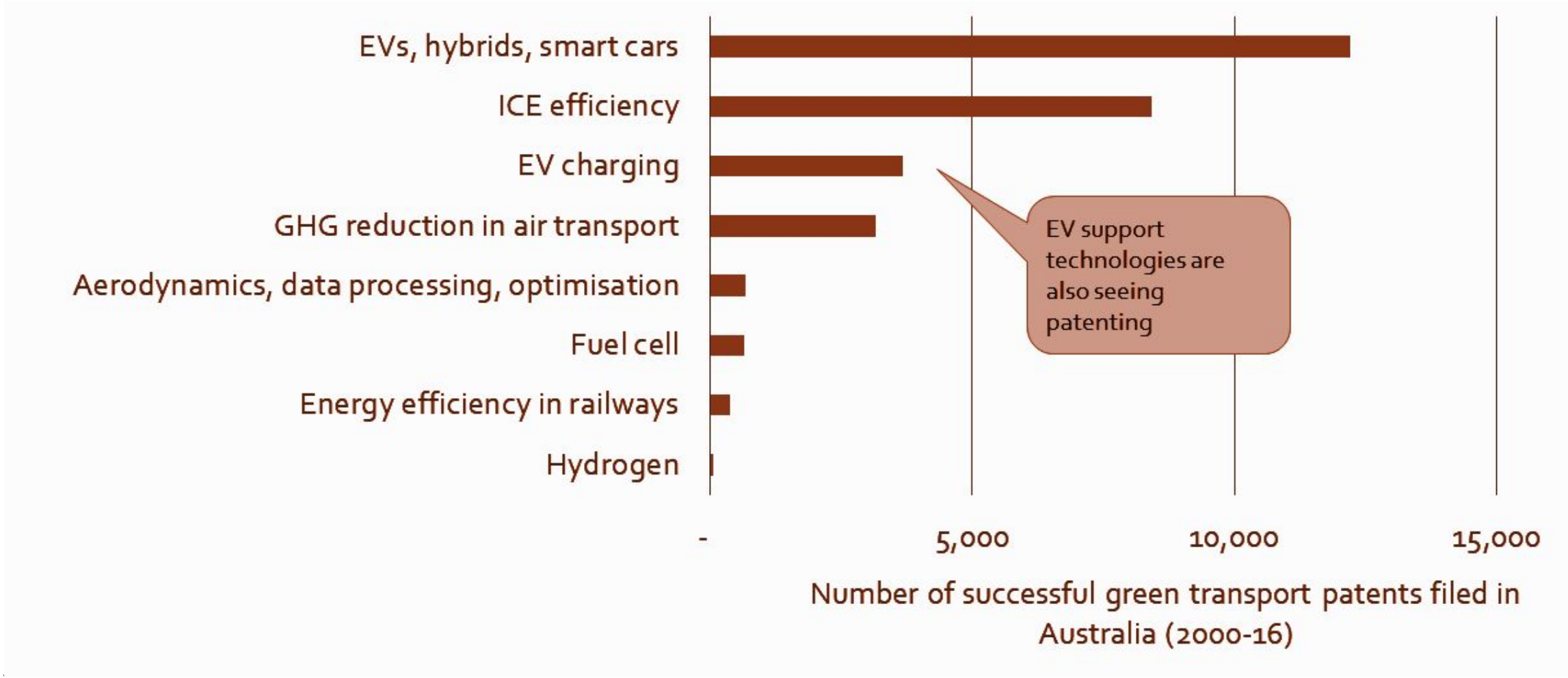
Australia has significant innovation in improving the efficiency of chemicals and metal processing



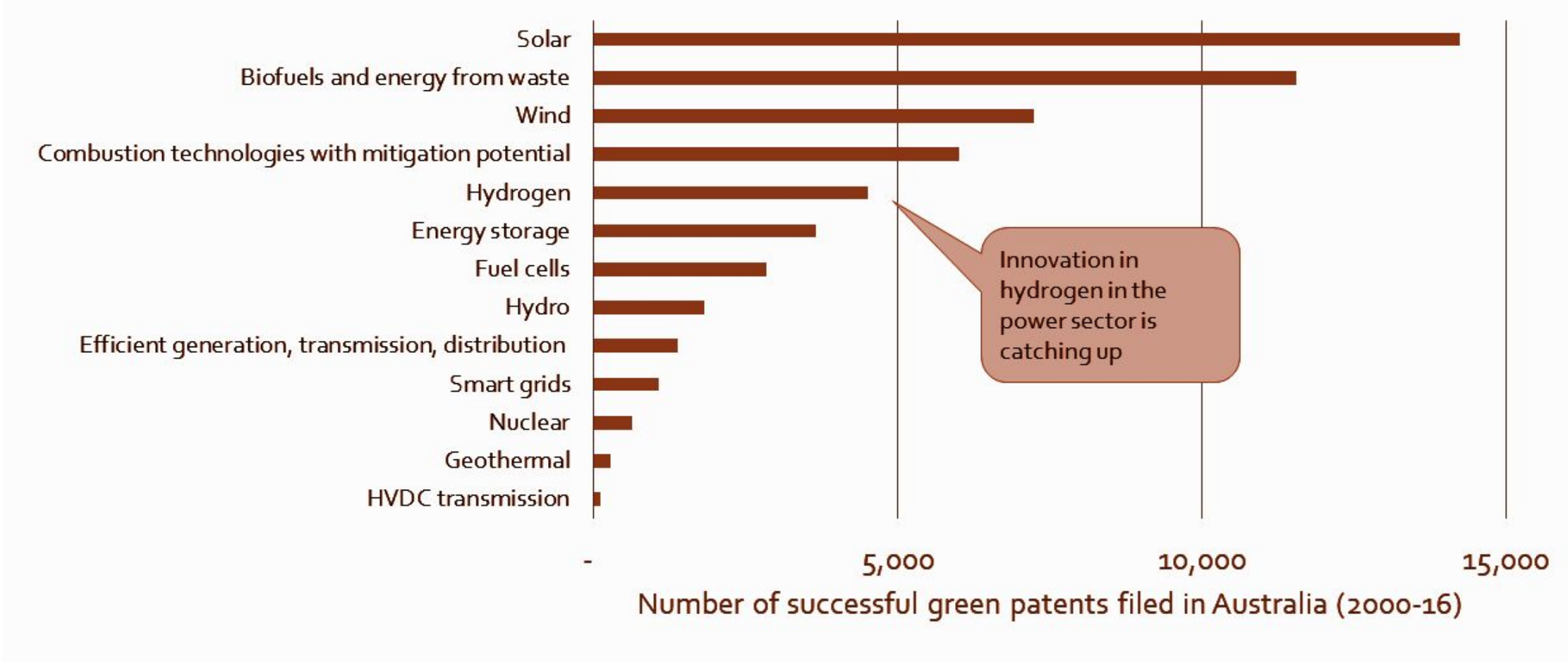
Australia has significant innovation in adaptation against vector-borne diseases but less in securing critical infrastructure



Within transport, Australia has most of its innovation in electric vehicles, smart cars & hybrids. Hydrogen less patenting



Australia has significant innovation in solar, biofuels and wind



Australia and the United States have a strong reciprocal relationship in green innovation

Top countries from whom Australia receives green innovation

Rank	Country
1	USA
2	Japan
3	Germany
4	France
5	Great Britain
6	China

Top recipients of Australian green innovation

Rank	Country
1	USA
2	Europe
3	Canada
4	South Korea
5	Russia
6	Taiwan

Key takeaways and policy implications

Summary of results

- We already knew that Australia was a top-ten country in terms of patenting activity each year. What we wanted to understand is if Australia is also well-positioned in green innovation.
- This analysis has shown that Australia is a leader in green innovation, coming in at 7 in the G20 and 8 globally. While it ranks below behemoths such as China, USA, South Korea and Japan, it is in the same league as Germany and Canada.
- Given the composition of Australia's economy, it is unsurprising that many green patents are in energy & industry.
- Australia's green innovation in industry is in technologies that aim to improve the efficiency of chemicals and metal processing.
- Australia's innovation in energy is mostly in solar, biofuels and wind. Innovation in hydrogen is catching up.
- There is evidence of innovation in fledgling technologies such as CCS but the amount of patenting is much lower compared to that in established technologies.
- There is less innovation in adaptative technologies that climate-proof critical infrastructure and finding news ways of integrating renewable energy in industrial processes.
- Australia has productive reciprocal relationships with top green innovators such as the USA.

Policy takeways

- Even though Australia does not have carbon pricing, it has attracted significant innovation in green technologies.
- This can be attributed to Australia's strong institutional context for scientific/industrial research & its robust intellectual property regime.
- However, with stronger incentives for green innovation, Australia could do even better. While it ranks highly, the gap between Australia's green patenting and that of the top 3 is significant.
- The top-most global green innovators* tend to have robust incentives & large markets for green tech innovation.
- The world's top green innovators are: China, USA, Japan, South Korea and Europe. Note: within USA, green innovation is concentrated in California which has strong green incentives & scientific clusters.
- Next steps for Australia include capitalising on existing green tech strengths by putting in place the right incentives and seeing which strategic green technologies are lagging behind so that they can receive more support.
- Incentives to foster more green innovation include: targeted subsidies for green innovation, R&D tax credits, grants, prize schemes, stronger scientific partnerships with green tech leaders, stringent energy efficiency standards, carbon pricing and stable political signals.

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