GENI Global Energy Network Institute

The Economic Argument for Adopting a Zero Emissions Energy Policy in Australia

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Abstract:

Australia is ranked among the highest nations in the world in terms of per capita greenhouse gas emissions; its energy capacity is mostly made up of fossil fuels, and it is one of the largest exporters of coal and uranium. In contrast, Australia boasts vast wind and solar energy resources that could be potentially exploited. This paper examines the economic argument for Australia to make changes in its energy consumption and mineral exports and take advantage of its potential by pursuing zero emissions renewable energy policies. This paper continues to argue that, given potential problems in the export sector, catastrophic consequences of unmitigated climate change and the economic feasibility of a zero emissions policy, it is only logical for Australia to make dramatic changes to its current situation in hopes of achieving a greener economy.

1. Introduction

It is well understood, at this point in the history of our civilization, that the phenomenon of climate change is no longer a myth or a distant possibility but rather a reality.[1] Climate change and other risks of our times no longer pose a threat to individual countries or societies but rather are a threat to the world as a whole, irrespective of social class and wealth. In other words, the risk is now global, not only local.[2] Given the circumstances, it becomes obvious that a global agreement will prove paramount in addressing these issues, and, without it, we can only fail. Therefore, it is our obligation as an international community to face the upcoming challenges and do what is in our hands to mitigate the potential effects of climate change and ensure high standards of living for future generations. This course of action, as is expected, involves some countries giving up more than others; as they have enjoyed decades of wealth (externality-inducing activities) that have imposed a burden on the planet we must now care for. These countries, given their level of development, must also be the leaders in the coming decades when it calls for the promotion of alternative sources of energy to fuel our economies.

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[1] Intergovernmental Panel on Climate Change. *Climate Change 2007: Synthesis Report.* IPCC, 2007.

[2] Beck, Ulrich. *Risk Society: Towards a New Modernity.*

Australia is, and has been, one of the major per capita polluters in the world. It has the highest level of per capita emissions among OECD nations and one of the highest levels on a global scale.[3] As mentioned, some countries will be expected to shift more than others in the face of an international agreement. This is an issue worth considering for Australian policymakers when planning future energy projections for the nation. Moreover, Australia is not only a major consumer, but also a major exporter of fossil fuels (most notably coal) and other natural resources (most notably uranium, contributing to the global nuclear cycle). This raises the question: should Australia keep pursuing these export and consumption policies and keep investing in the corresponding sectors, or should it develop alternative ways of producing energy and alternative export sectors? As will be observed, the latter option will prove superior in the long term. Fortunately, Australia is also endowed with incredible renewable energy potential that could aid in a shift of the economy from fossil fuels to renewable energies. Taking this into account, and considering that climate change is expected to severely impact Australia (by extreme weather - already seen in the floods of 2010, reduced rain and snowfall, negative macroeconomic effects, wealth redistribution impacts and destruction of infrastructure), it is only logical to take action before the consequences become worse.

All the aforementioned issues will be analyzed in the upcoming pages. The main section of this paper examines the current energy situation in Australia, describes the situation regarding its exports, and goes on to provide arguments based on a cost-benefit analysis for Australia to radically change its energy consumption and export bundles, in view of global climate change and the costs of no action.

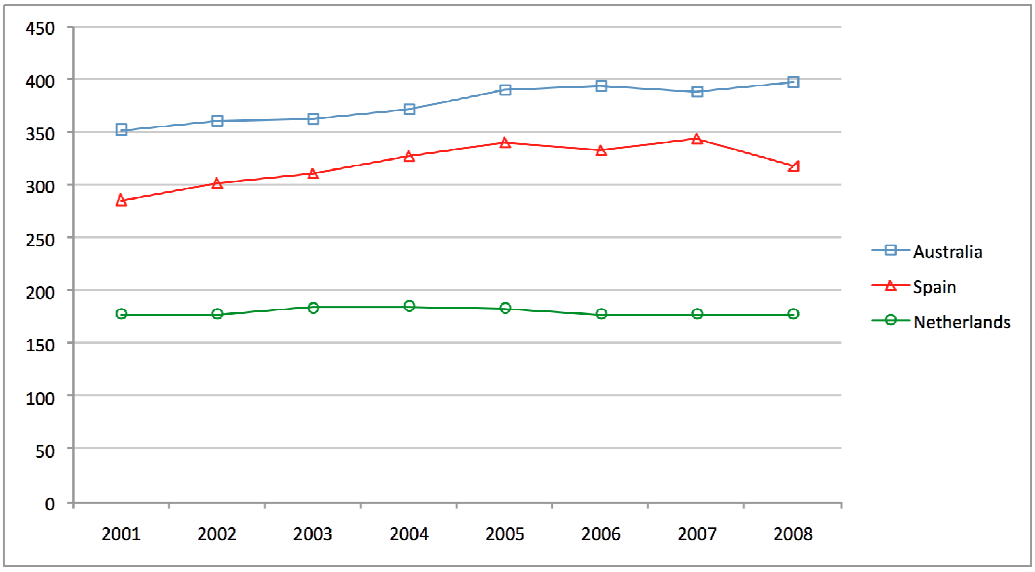
[3] Garnaut, Ross. *The Garnaut climate change review.* Cambridge University Press, 2008. Chapter 7.

2. The Economic Argument for Adopting a Zero Emissions Energy Policy in Australia

2.1. Energy and emissions in Australia: current situation.

As one of the major developed economies in the world, Australia is also one of the major polluters, especially in per capita terms. Among the most developed nations, it is certainly the most energy intensive alongside the United States. In 2006, Australia's net greenhouse gas emissions were 576 Mt CO_2-e and in per capita terms, this places them as the highest polluter among OECD countries and among the highest in the world.[4] The following figures may provide additional insight.

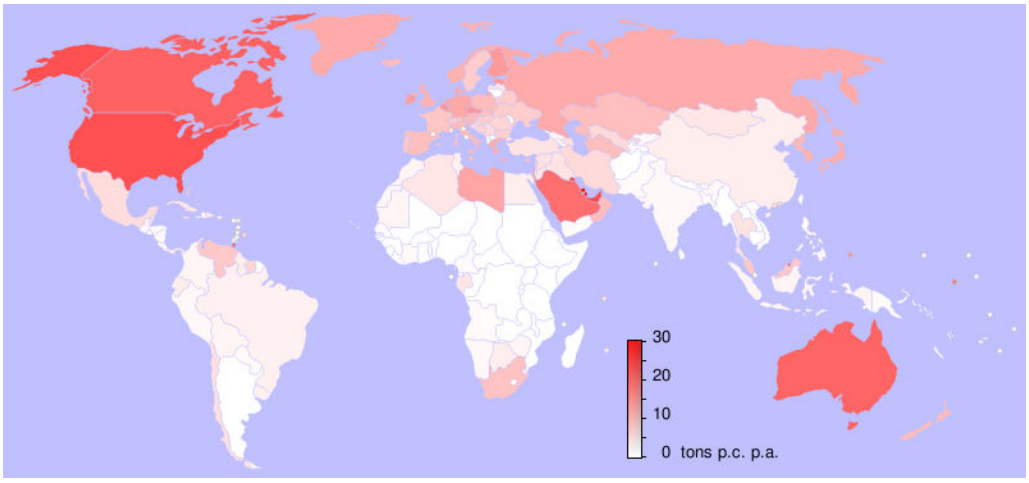
Figure 1: Per capita greenhouse gas emissions from fuel combustion: Australia, Spain, and the Netherlands.[5]



[4]Garnaut, Ross. *The Garnaut climate change review.* Cambridge University Press, 2008. Chapter 7.

[5] Data source: OECD, *CO2 emissions from fuel combustion; Environment: Key Tables from OECD*, Vol. No. 1 (2010).

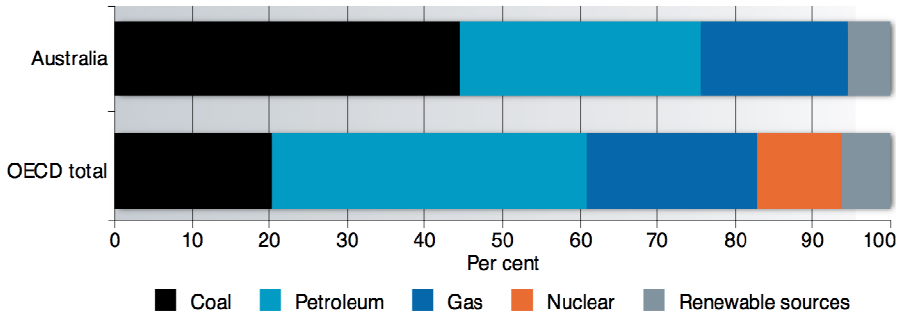
Figure 2: CO_2 emissions per capita around the world.[6]



As shown in Figure 1, Australia has higher emissions per capita from fuel combustions than both Spain and the Netherlands. This fact is relevant because both countries have similar GDP to Australia, and it gives an understanding of the "CO_2 intensity of GDP." However, it must be pointed out that Spain has a higher GDP and higher population than Australia whereas the Netherlands has both inferior GDP and less population; this can explain the difference in both countries and give us further information about how Australia's per capita emissions are so far above the OECD average. The OECD benchmark is especially relevant, because it groups the economies with most similar economic characteristics to Australia. Moreover, in world comparisons it is at the top in terms of per capita emissions and only ranks below countries such as Kuwait, Bahrain, and other petroleum exporting states. Given these countries' resource endowments, it is logical for Middle East nations to adopt these energy resources. However, their weight in the world economy is not comparable to that of Australia or the USA and is why they are not the focus of this paper. These findings observed above have a lot to do with the energy intensity and, moreover, the fuel mix of the economy. In order to fully understand the causes and reasons for Australia's extremely high emissions per capita level, it is necessary to know about their source. The following figure provides further information.

[6] Http://climatechange.thinkaboutit.eu/think4/post/swedish_voices_i_-_goeran_ekloef/

Figure 3: Fuel mix in Australia and the OECD; primary energy supply.[7]



Source: IEA (2007b).

When it comes to energy supply, Australia's share of coal is surprisingly high, more than double the OECD average. Renewable energies are also lower in terms of primary energy supply. On the other hand, nuclear power seems to be irrelevant (without taking uranium exports into account, which will be addressed in further sections of this paper). The abundance coal, an extremely dirty source of energy, in Australia explains why it still lags behind in adopting a cleaner energy consumption mix, while other developed countries have shifted to cleaner sources of energy. As expected, Australia is a major consumer and exporter of coal, simply because it is cheaper and more profitable, a statement that shall be revisited in further sections.

Given this situation, we can derive that Australia has a large margin of improvement for energy consumption and that it would be logical to adopt policies aimed at "cleaning" up the energy mix, i.e. the development of more renewable energy sources that could reduce Australia's dependence on coal and other fossil fuels.

2.2. Commodity and natural resource exports

When analyzing a country's greenhouse gas emissions, sometimes it is not sufficient only to account for what is emitted within its borders. In other words, it is also important to consider the exports that leave the country and their contribution to those global emissions leading to potential global consequences. In other words, a coal exporting country could, under some circumstances, be considered responsible for these emissions even though it is not the direct producer of CO_2. This situation should

[7] Garnaut, Ross. *The Garnaut climate change review.* Cambridge University Press, 2008. Chapter 7.

be of vital interest to Australian policymakers, as the world's largest exporter of coking coal and the second largest exporter of thermal coal.[8]

Figure 4: Reserves and production of iron ore, black coal, and gas[9]

	Unit	Reserves	Annual production	Years of production[(a)]	Reserves as share of world Per cent	Production as share of world Per cent
Iron ore	Gigatonnes	28	0.39	71	17	17
Black coal	Gigatonnes	44	0.45	98	7	6
Gas	Trillion m^3	3	0.05	63	2	2

(a) Years of production at current production levels
Sources: ABARES; Geoscience Australia

Australia's black coal reserves are strikingly not one of the most important in world terms (even though 98 years of additional production are predicted). Since domestic consumption is certainly not enough to keep up with domestic production, Australia has become one of the top coal (and other natural resources such as uranium) exporters in the world. The main export markets for Australia are industrialized nations that lack great amounts of coal of their own, especially Japan and South Korea. Even countries with vast reserves of coal, such as China and India, are importing coal from Australia. As we will analyze and with the help of the next two figures, there are a number of characteristics having to do with Australia's export practices that may pose a problem for Australia in the long run.

[8] Virginia Christie, Brad Mitchell, David Orsmond and Marileze van Zyl. "The Iron Ore, Coal and Gas Sectors." *Bulletin* (Reserve Bank of Australia), March 2011: p2.
Note: coking coal is typically used in the steel mill process, whereas thermal coal has lower carbon content and is used in the generation of electrical power.
[9] Virginia Christie, Brad Mitchell, David Orsmond and Marileze van Zyl. "The Iron Ore, Coal and Gas Sectors." *Bulletin* (Reserve Bank of Australia), March 2011: p1.

Figure 5: Australian thermal coal exports by destination[10]

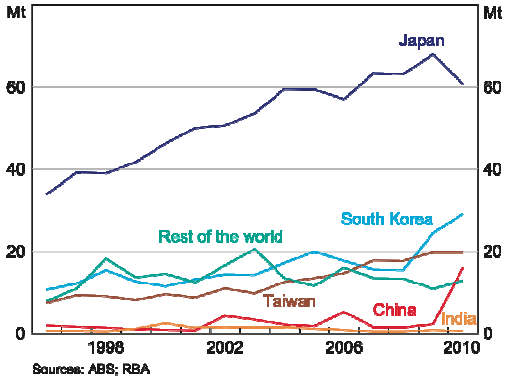


Figure 6: Australian resource exports[11]

	Average annual growth 2005–2010			Share of total (values)	
	Volumes	Prices	Values	2005	2010
Resources sector	4.9	11.0	16.6	41.4	56.7
– Iron ore	10.6	22.8	35.7	5.9	17.3
– Coking coal	4.9	9.2	14.8	8.2	10.5
– Thermal coal	5.6	7.7	13.8	3.8	4.6
– LNG	10.2	10.5	21.8	1.9	3.3

Sources: ABS; RBA

From the graphs above, we can extract two important facts that can lead to problems. In the first place, the great majority of coal exports (and other types of commodity exports) from Australia are directed at East Asia. Secondly, figure 6 indicates that the resources sector accounts for more than half of Australian total exports. The fact that Australian commodity exports are directed towards East Asia makes a great deal of sense, given the geographical proximity of both regions. In years of declining importance of Australian exports to East Asia, the minerals and fuels sectors have managed to increase their market share, from 4.6% to 9.2% in the East Asian market.[12] Moreover, Australia exports more coal to Japan than the rest of the world put together; thus leading to the issue of the Japanese monopsony (where a large buyer controls the market). Japan, as the main importer of coal from multiple countries, is able to obtain a lower price when negotiating with mineral exporting

[10] Virginia Christie, Brad Mitchell, David Orsmond and Marileze van Zyl. "The Iron Ore, Coal and Gas Sectors." *Bulletin* (Reserve Bank of Australia), March 2011: p5.
[11] Virginia Christie, Brad Mitchell, David Orsmond and Marileze van Zyl. "The Iron Ore, Coal and Gas Sectors." *Bulletin* (Reserve Bank of Australia), March 2011: p2.
[12] Lu, Peter Drysdale and Weiguo. "Australia's Export Performance in East Asia." *Pacific Economic Papers* (Australia-Japan Research Centre), September 1996: p30.

countries such as Australia or Canada, thus reducing jobs, benefits and investment in the exporting nations. Furthermore, these countries' (most notably Japan's) energy preferences can also have huge effects on Australia's terms of trade and trade volumes. For example, if East Asian nations were to apply strict environmental rules in the near future, or even in the presence of market-based policies such as cap-and-trade systems, there could be major shocks to Australian commodity exports that would translate into domestic job and investment losses.[13] This is even truer in the case of Japan, a country that in a way holds too much market power over Australian coal exports, thus increasing the potential volatility and risk due to lack of diversification. Furthermore, and in reference to the second fact about Australia's exports we have pointed out, Australia might face what is commonly known as the "Dutch Disease."

The Dutch Disease has its origins in Dutch exports of natural gas and, in this case, has been described as "the negative symbiosis between the mining and other tradable sectors that mutes both the rate and efficiency of economic growth."[14] This is an argument for alternative investments in other sectors other than mining. The Dutch Disease will cause a nation's currency to appreciate, because of an increased demand for the natural resource, and, therefore, make other exports (manufactures in this case) less competitive. This, again, provides an argument for investing heavily in other sectors such as renewable energy technologies. In this sense, expansion of one part of the economy draws resources from the rest creating serious imbalances and inflation. This phenomenon provides important insight for the mining sector and most notably the coal sector. However, the case of uranium mining should be addressed of separately.

One thing can be said with certainty about uranium mining in Australia: it is controversial. There are a number of interest groups within the country who enter the debate as to whether Australia should participate in the contemporary nuclear fuel cycle, and the issue is frequently present in political debates. This comes as no surprise if we take into account the size and potential importance of the sector in

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[13] Mercer, David. *"A Question of Balance": Natural Resources Conflict Issues in Australia.* The Federation Press, 1995. P183/p214.
[14] Mercer, David. *"A Question of Balance": Natural Resources Conflict Issues in Australia.* The Federation Press, 1995. P220.

Australia. Australia currently holds 22.7% of global uranium resources and almost as much as Russia, the USA, and Canada combined.[15] The potential profits of this industry are vast, especially considering the recent rise of Chinese and Indian nuclear programs. These mine holdings can be observed in the following map, which depicts the available uranium resources in Australia:

Figure 7: Uranium resources in Australia[16]

The nature of nuclear energy and uranium sets them apart from fossil fuels, especially when taking nuclear waste management into account. There has been debate about whether Australia, as an exporter of uranium, should host an international waste depository, and the question has certainly created controversy in Australian politics and among the public. This situation, together with the rest of the mining sectors, also poses a threat to indigenous communities, which must also be considered in the cost-benefit analysis and policy design. In reference to uranium mining, some indigenous aboriginal leaders have stated, "mining would undermine their spiritual and physical

[15] International Atomic Energy Agency. *World Distribution of Uranium Deposits (UDEPO) with Uranium Deposit Classification.* IAEA, 2009. P11.
[16] Jim Falk, Jim Green and Gavin Mudd. "Australia, uranium and nuclear power." *International Journal of Environmental Studies* 63 (December 2006). P846.

association with their land."[17] Given these complex societal implications and the complications of participating in a nuclear fuel cycle with an uncertain future (especially due to the 2011 Japan Fukushima disaster), uranium mining in Australia is a sector that should certainly be reconsidered.

To sum up and in view of the findings that have been analyzed, Australia's booming export sector may provide profits in the short term, while posing risks, economic challenges and political difficulties in a long-term perspective. Both dependence on foreign market conditions and heavy reliance on a certain export sector may lead to unexpected shifts and losses for the Australian economy. Finally, the extension of these export policies will keep adding to global greenhouse gas emissions and, therefore, to the increased effects of climate change. Without a change in energy policy and lacking an international agreement, as we will see in the next section, these effects may be catastrophic. These issues are something Australian policymakers should bear in mind and that shall be considered in the next section.

2.3. Consequences of unmitigated climate change

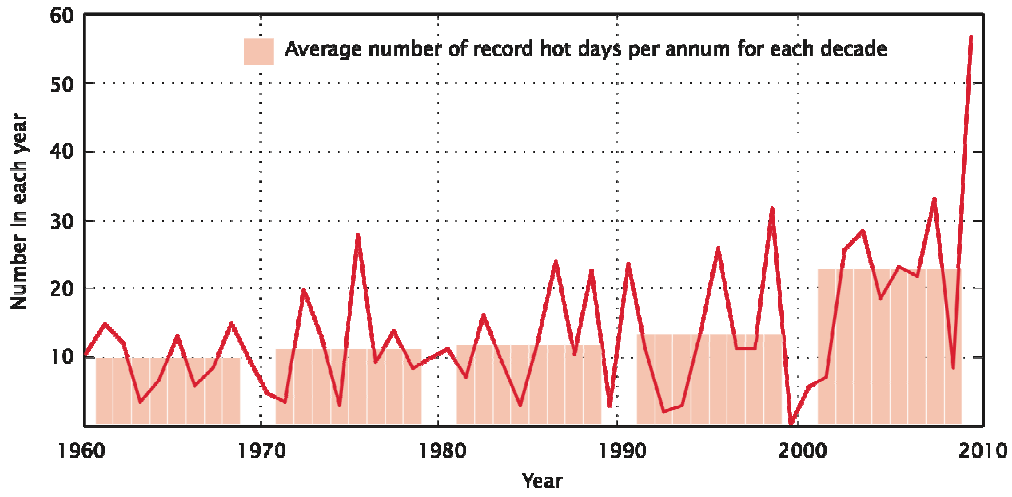
As depicted in the previous two sections, either directly through consumption or indirectly through exports, Australia is a major contributor to global emissions of CO_2 into the atmosphere. As a consequence of these emissions, Australia is also a contributor to the increasing greenhouse effect and, therefore to global warming. If Australian politicians would decide to change the country's energy and export mix, shift trade policy and foster collaboration in the international arena (assuming other major emitters join the struggle), the consequences of climate change could be mitigated. This section deals with the effects of climate change on the Australian economy, assuming no action is taken.[18]

Climate change has occurred over thousands of years and is not a new phenomenon for this planet. However, what is alarming is the speed and intensity at which more extreme weather events have been occurring in the past century and their relation to global emissions of greenhouse gases. In the case of Australia, most variables that are

[17] Jim Falk, Jim Green and Gavin Mudd. "Australia, uranium and nuclear power." *International Journal of Environmental Studies* 63 (December 2006). P847.
[18] Note: this section draws heavily on "Garnaut, Ross. *The Garnaut climate change review; economic modelling technical paper 5.* Cambridge University Press, 2008."

indicative of climate change (rainfall and snowfall, surface temperature, sea temperature and levels, forest fires) have been more volatile and indicate that climatic conditions are undergoing alarmingly rapid changes in our time. In terms of surface temperatures, it has been recorded that surface temperatures have risen about 1ºC from 1909 to 2007 and around 0.7ºC since the 1950's.[19] This rise in surface temperatures is strongly linked to a global increase in emissions of greenhouse gases over the last 60 years. The rise in temperatures has been even more pronounced since the 1990's. Moreover, the frequency of warm weather has increased relative to the frequency of cold weather, indicating a gradual warming trend.

Figure 8: Average number of record hot days per year for each decade for the period 1960 to 2010.[20]

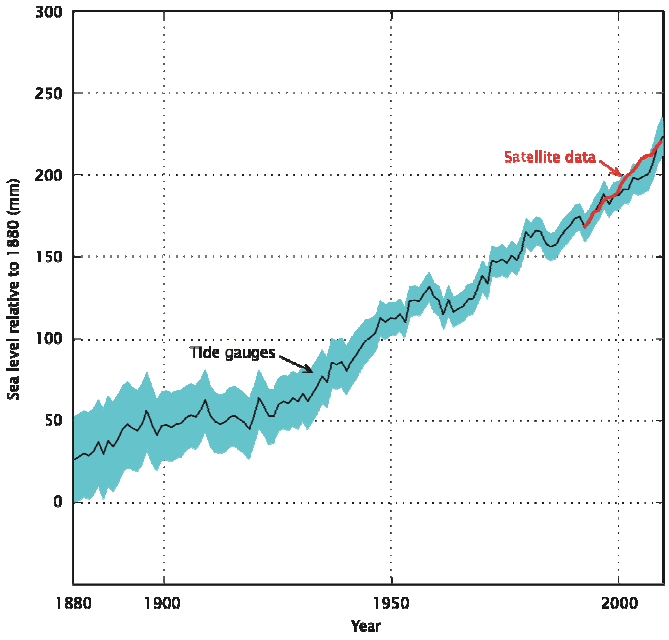


In terms of snowfall, the situation is even more obvious: "The last 5 years of the 1990s had the lowest 5-year [snowfall] average of the series, 7.5% less than the previous lowest 5 years, and 53% less than the highest 5 years."[21] Furthermore, there are other climatic phenomena that can indicate harsh changes in the Australian climate, such as "El Niño Southern Oscillation."[22] There has been concern among

[19] Cleugh, Helen et al. *Climate change: science and solutions for Australia.* CSIRO Publishing, 2011. Chapter 1, p2.
[20] Cleugh, Helen et al. *Climate change: science and solutions for Australia.* CSIRO Publishing, 2011. Chapter 1, p3.
[21] Hughes, Lesley. "Climate change and Australia: Trends, projections and impacts." *Austral Ecology*, 2003: P425.
[22] Note: El Niño Southern Oscillation is a climatic pattern that occurs every five years and affects the surface temperature of the southern Pacific Ocean. This oscillation is divided into "El Niño" effects (cooling) and "La Niña" effects (warming).

scientists due to the increasing intensity of rainfall during "La Niña" years and the increasing intensity of droughts during "El Niño" years. This lack of rainfall caused by interaction between these events, combined with higher than average temperatures, has helped trigger catastrophic droughts, such as those that occurred in 2002 in areas of the Murray-Darling Basin.[23] The last climatic variable that will be considered is sea level. Rises in sea level due to global warming and melting of the ice caps pose a great threat to countries with most of their population in coastal zones. A continued rise in sea level may require moving entire areas and populations of cities, causing great destruction to coastal economies and ecosystems. The following figure provides additional information on sea level in Australia.

Figure 9: Sea level in Australia relative to 1880.[24]



In the case of Australia, most of its population is located in coastal areas and could, therefore, be highly affected by rises in sea level. Moreover, coastal industries such as construction, shipping, transportation, and minerals are of great importance to the Australian economy. These industries could be severely affected by rises in sea level and coastal destruction, as could all buildings (whether industrial or residential)

[23] Hughes, Lesley. "Climate change and Australia: Trends, projections and impacts." *Austral Ecology*, 2003: P424-425.
[24] Cleugh, Helen et al. *Climate change: science and solutions for Australia.* CSIRO Publishing, 2011. Chapter 1, p10.

located in low coastal plains. It is estimated that the value of existing residential buildings at risk from inundation is between $41 and $63 billion.[25]

Another major industry that could be severely affected by climate change and rises in sea level is the tourism sector. It goes without saying that, without beaches, beach tourism will vanish. Even though it may seem obvious, we must take into consideration the importance of the tourism industry for a country like Australia; in 2008 alone, tourism provided jobs to over 5% of all those employed and contributed approximately $33 billion to Australian gross domestic product.[26] Therefore, dramatic changes in climatic phenomena could have catastrophic consequences for the tourism sector and, in turn, for the national economy. However, not only beach tourism will be affected, but also one of Australia's jewels and major tourist attractions: the Great Barrier Reef. The Great Barrier Reef would experience extreme deterioration if carbon dioxide levels were to surpass 550 ppm.[27] This extreme deterioration would negatively affect the tourism sector (measurable effects) and also create losses in terms of coastal ecosystems and biodiversity (more difficult to measure but still must be considered). Finally, there is one more phenomenon that should be considered when dealing with coastal areas: extreme wind events. These events have been occurring more frequently over the past years and are subject to what is known as a threshold effect; that is, damages from these phenomena are increasingly elevated once a certain threshold is surpassed. The following graph may provide some insight as to why we should be concerned and reveals that the approximate threshold for extreme winds is around 50 knots.

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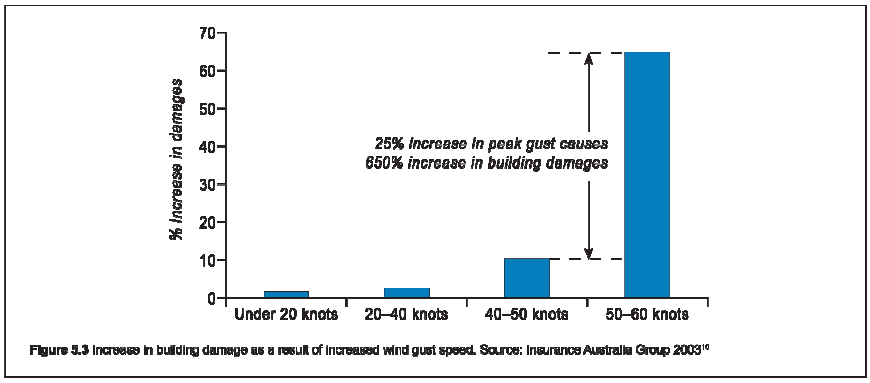
[25] Australian Government Department of Climate Change. *Climate Change Risks to Australia's Coast: a First Pass National Assessment.* Department of Climate Change, 2009. Chapter 5, p76.

[26] Australian Government Department of Resources, Energy, and Tourism, *Key Facts: Australian Tourism Sector*, (Australian Government, 2009).

[27] Garnaut, Ross. *The Garnaut climate change review.* Cambridge University Press, 2008. Chapter 6.

Figure 10: Increase in building damage as a result of increased wind gust speed.[28]



Now that we have examined where Australian climatic phenomena are heading, we arrive at the main part of the section: assessing the macroeconomic losses associated with such events and their effects on the Australian economy as a whole and to specific sectors as well. To meet this aim, the Garnaut Climate Change Review (2008) provides an excellent framework and uses a general equilibrium model[29] for analyzing the economic effects of climate change in Australia. It takes a reference case of no climate change and distinguishes between four different types of climate change impacts on the Australian economy; however, only type 1 costs are easily quantifiable and will be relevant to our analysis.[30] The Review uses the aforementioned general equilibrium model to predict effects for the period 2005-2100 on four macroeconomic variables (real GDP, real consumption, real wages, and real GNP) and on four industrial sectors (agriculture, mining, manufactures, and services). Moreover, it distinguishes between two different scenarios: the standard unmitigated climate change case and the hot and dry case. We will proceed to examine the findings of the Review.

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[28] Cleugh, Helen et al. *Climate change: science and solutions for Australia.* CSIRO Publishing, 2011. Chapter 1, p10.
[29] MMRF: http://www.monash.edu.au/policy/mmrf.htm
[30] Note: the Garnaut Climate Change Review (2008) distinguishes between the following four types of climate change impacts:
-Type 1: currently measurable market impacts.
-Type 2: market impacts not readily measurable.
-Type 3: insurance value against high damages.
-Type 4: non-market impacts.

Figure 11: Changes to select macroeconomic variables, median, unmitigated scenario, 2005-2100.[31]

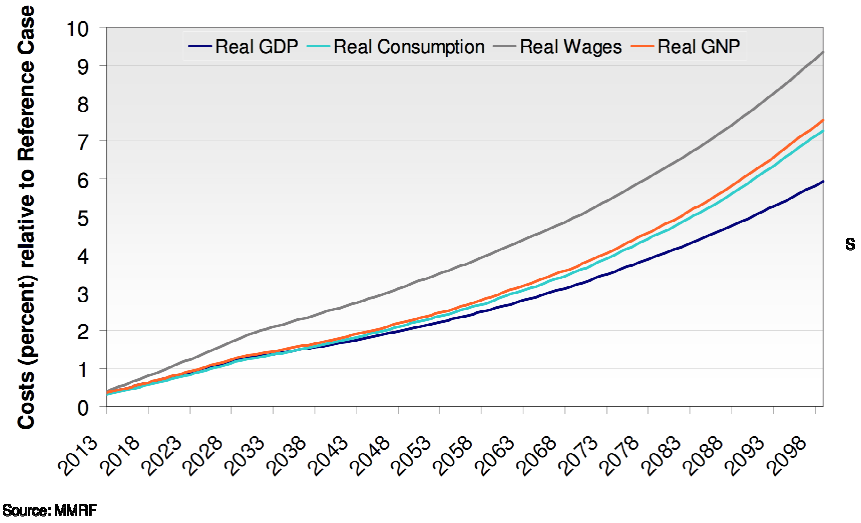
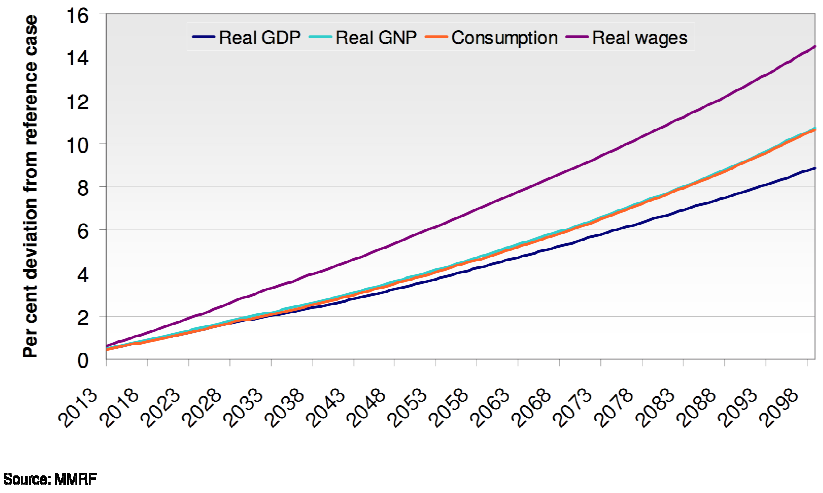


Figure 12: Changes to select macroeconomic variables for the hot and dry unmitigated climate change scenario, 2005-2100.[32]

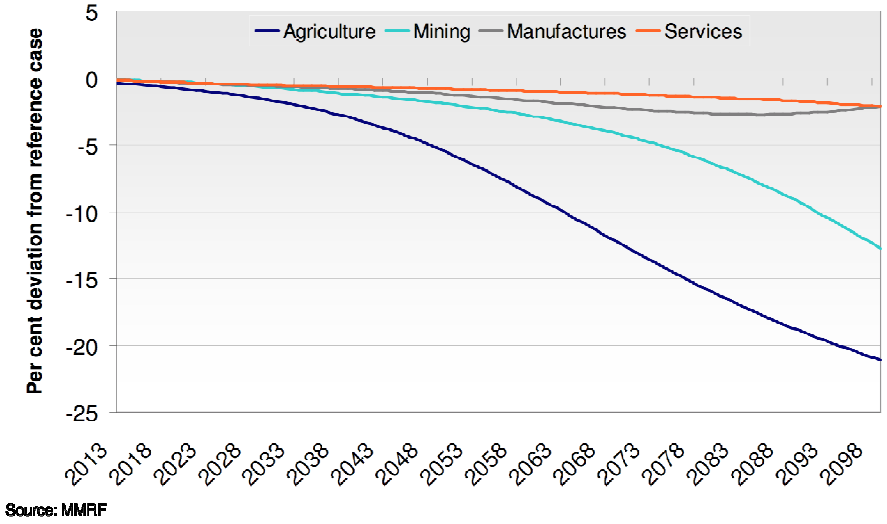


According to the Garnaut Climate Change Review (2008), if we only take type 1 costs into account, there will be a 5.9% reduction in GDP relative to the reference case of no climate change. If we take type 2 costs into account as well, then GDP reduction relative to the reference case reaches 8% of GDP. However, GDP is not the only value we must consider. At the end of the day, what matters to the inhabitants of a

[31] Garnaut, Ross. *The Garnaut climate change review.* Cambridge University Press, 2008. Economic Modelling Technical Paper 5, P8.
[32] Garnaut, Ross. *The Garnaut climate change review.* Cambridge University Press, 2008. Economic Modelling Technical Paper 5, P15.

country are their ability to consume and their real wages. As can be observed in both figures 11 and 12, consumption and real wages are the macroeconomic indicators that are most severely affected by climate change. The large sensitivity of real wages to climate change can be explained through reduced demand for labor due to decreased economic activity and through increased consumer prices. In the standard case and taking only type 1 costs into account, the losses amount to 9.4% of GDP relative to the reference case of no climate change.[33] Moreover, when taking the hot and dry case as the standpoint, the losses grow for every category. These damages are even more severe if type 2 costs are taken into account. In this case, GDP is expected to decrease by around 12% and all other variables are expected to experience higher losses, with losses in real wages greater than 14%.[34] Furthermore, even though these macroeconomic variables are of immeasurable importance to the economy, we must also consider the differences among sectors within the economy and how these will be affected separately.

Figure 13: Changes in activity.[35]



Not all sectors in the Australian economy will be equally affected by climate change. As depicted in figure 13, manufacturing and services will experience modest reductions in activity, whereas mining and agriculture will be most severely damaged

[33] Garnaut, Ross. *The Garnaut climate change review.* Cambridge University Press, 2008. Economic Modelling Technical Paper 5, P7.
[34] Garnaut, Ross. *The Garnaut climate change review.* Cambridge University Press, 2008. Economic Modelling Technical Paper 5, P15.
[35] Garnaut, Ross. *The Garnaut climate change review.* Cambridge University Press, 2008. Economic Modelling Technical Paper 5, P12.

by climate change. In the case of mining, the Garnaut Climate Change Review (2008) predicts reductions in activity mainly due to reductions in world demand. As for agriculture, it is by far the most affected sector by climate change. These losses in agricultural production, as we have pointed out, are caused by increased temperatures and decreased rainfall. This has serious implications for food security in the region, as the Australian population is now around 22 million. Irrigated agriculture in the Murray-Darling basin is predicted to fall to half of its current production by the mid-century and be reduced by 92% by the end of the century.[36] This region is of great importance to Australia, as it is located near (and supplies agricultural products to) some of the main urban centers of the country. Reduction in agricultural production of such magnitude cannot be understated; however, climate change will also impose negative consequences for Australian agricultural exports, which will be drastically reduced as a result of limited supply and will result in significant foregone profits for the industry.

Given the consequences examined in this section, such as destruction of seaside infrastructure, losses in GDP, reduction in industry production and exports, food security issues; it becomes obvious that climate change foretells catastrophic consequences for Australian welfare. These trends should be anticipated, taken into account and contribute to pushing Australia towards a path of international climate change negotiation and mitigation. Yet this process seems in gridlock at the moment. Even if the mitigation efforts do not depend entirely on Australia (but also on an international agreement), it is of prime importance to examine the possible consequences, as they stress the need for imminent global action and show just how costly a no-mitigation policy would result.

[36] Garnaut, Ross. *The Garnaut climate change review.* Cambridge University Press, 2008. Chapter 6, P125-126.

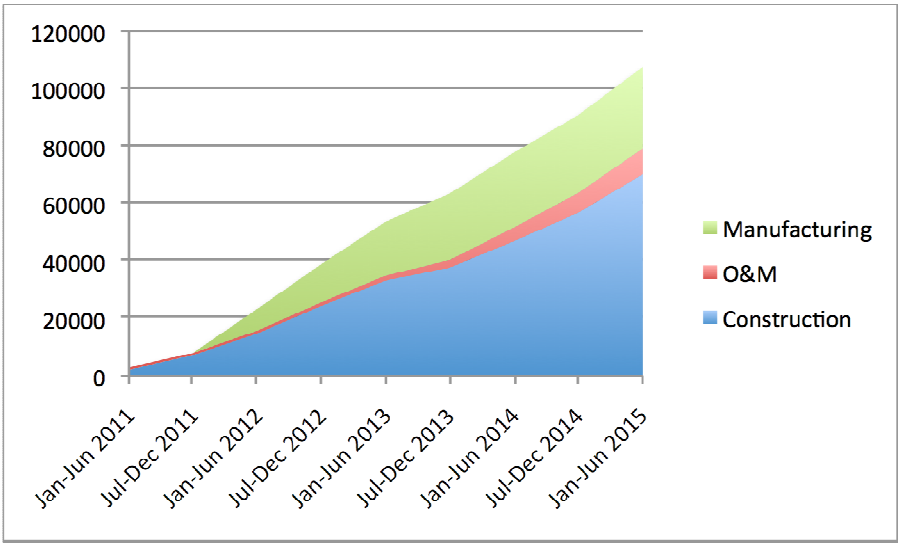
2.4. The Economic Feasibility of the Transition to a Zero Emission Australia[37]

After having dealt with the negative consequences of maintaining the *status quo*, it is time to deal with the hopeful and inspiring bottom line of the situation: the positive consequences of a change in Australia's current energy policy. Even though a change is potentially possible for any economy, what matters is the potential of implementing it at an acceptable cost and maintaining or increasing social welfare in the meantime. This reminds us of the major challenge that reconciling those economic and environmental "goods" poses.

The University of Melbourne (2010) has put forward an energy plan, named Zero Carbon Australia Stationary Energy Plan 2020 (ZCA2020), in which they explain how Australia can become a zero-emissions economy within the next 10 years (that is, by 2020). The ZCA2020 plan will be the basis for this section and the information it provides will be crucial to understanding how the transition to a zero-emission economy does not necessarily mean economic disaster, but rather the contrary. The plan projects an Australian energy supply mix that is entirely renewable. This ambitious energy transition will be mainly powered by wind turbines, approximately 40% of the total demand, and Concentrating Solar Thermal Power (CST), approximately 60% of the total demand. The rest of the renewable energy technologies (small-scale solar, hydroelectric and biomass) will be used as backup energy for the larger plants and to smooth demand shocks, when necessary. The main variable that we shall be taking into account is job creation and destruction, as it is what matters at the end of the day for policy-makers and their constituents.

[37] Note: this section draws heavily on Patrick and Wright, Matthew Hearps, *Zero Carbon Australia Stationary Energy Plan*, The University of Melbourne Energy Research Institute (University of Melbourne, 2010), 1-171.

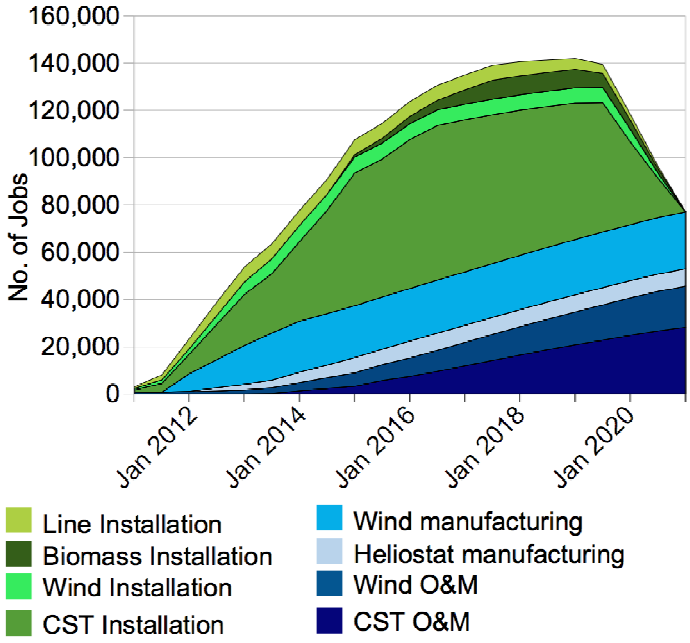
Figure 14: ZCA2020 jobs created 2011-2015.[38]



For starters, the ZCA2020 report proposes a timeline, at which the peak of job creation will be reached around 2016. It assumes a feasible 10-year period and plans a ramp up of jobs until 2016. The above graph depicts the job growth situation through 2015. As expected, jobs in construction and manufacturing of the ZCA2020 infrastructure are plenty whereas O&M (operations and maintenance) will grow and eventually stabilize. Jobs in construction are nearly at their peak within 5 years, reaching almost 80,000. During the second half of the decade, jobs in construction will level off (and eventually disappear), whereas manufacturing and O&M jobs will continue their increase until they reach the required levels. The predictions for the entire decade in terms of job creation are depicted in the following graph:

[38] Data source: Patrick and Wright, Matthew Hearps, *Zero Carbon Australia Stationary Energy Plan*, The University of Melbourne Energy Research Institute (University of Melbourne, 2010), Appendix 7.

Figure 15: ZCA2020 total jobs.[39]



The graph provides what can be called "the big picture" of the ZCA2020 job creation. Installation (construction) employment eventually peaks and vanishes; however, 45,000 jobs are created by the end of the decade in O&M and an additional 30,000 jobs are created due to wind power and heliostat manufacturing. Jobs are superior in wind than in heliostat manufacturing because of the nature of the technologies, and because the plan suggests 50% of the windmills are built domestically (the other half would take advantage of the existence of cheap windmill manufacturing in China). As mentioned by the report, "there are significant advantages in developing a substantial turbine manufacturing industry in Australia: to be part of the global boom in renewable energy technology and to develop domestic jobs, expertise, and capacity."[40] Furthermore, the bottom line of the argument is the fact that these 75,000 ongoing jobs provided by the plan in 2020 far surpass the 20,000 jobs lost in the production of traditional energy from fossil fuels. This is even truer at the peak of employment, in which 140,000 jobs eclipse the losses in the traditional energy sector.

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[39] Patrick and Wright, Matthew Hearps, *Zero Carbon Australia Stationary Energy Plan*, The University of Melbourne Energy Research Institute (University of Melbourne, 2010), p110.

[40] Patrick and Wright, Matthew Hearps, *Zero Carbon Australia Stationary Energy Plan*, The University of Melbourne Energy Research Institute (University of Melbourne, 2010), 1-171.

Along with this information, the ZCA2020 plan becomes even more convincing, as is provides a net increase in employment at the expense of only around 3% of GDP.[41] On the other hand, many of the jobs in the coal and gas sectors will be able to transfer to the new renewable energy sectors. Low skilled labor will be easily transferable between industries and, therefore, the plan will not entail the massive layoffs to mining workers. In the case of wind energy, this is even more convenient, as the regions with the highest wind speeds happen to be coastal and close to all the main Australian urban centers. This situation will be beneficial for the development of the national energy grid, thus linking renewable energies produced through wind power and Concentrated Solar Thermal (CST), providing additional employment creation. Furthermore, the creation of this grid and the possible creation of a Southeast Asian-Oceanic grid could enable Australia to become an exporter of electrical energy by taking advantage of its solar and wind energy abundance and the available energy transportation options.[42]

Figure 16: Proposed and operating wind farms within Australia.[43]

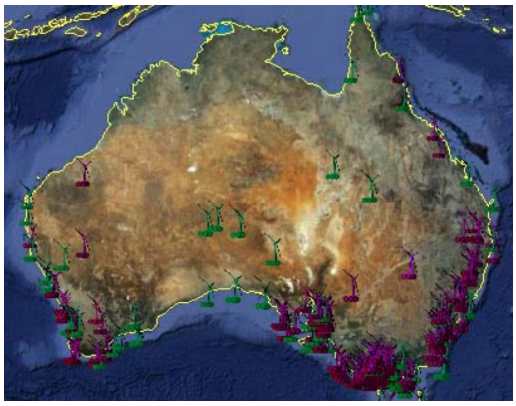
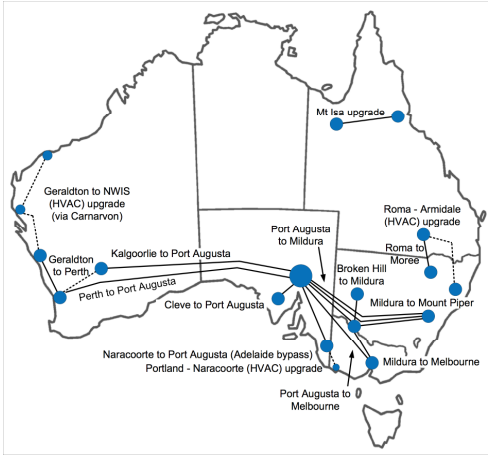


Figure 17: Proposed high voltage grid upgrades.[44]



[41] Patrick and Wright, Matthew Hearps, *Zero Carbon Australia Stationary Energy Plan*, The University of Melbourne Energy Research Institute (University of Melbourne, 2010), 1-171.
[42] David Mercer, *"A Question of Balance": Natural Resources Conflict Issues in Australia.* (The Federation Press, 1995).
[43] Elemental Power industries (EPI): http://elementalpower.com.au/news/?p=812
[44] Patrick and Wright, Matthew Hearps, *Zero Carbon Australia Stationary Energy Plan*, The University of Melbourne Energy Research Institute (University of Melbourne, 2010), 1-171.

In this section, we have examined the economic feasibility of the Zero Carbon Australia 2020 plan, and the plausibility of the transition to a green economy without massive layoffs of workers or great damage to economic performance. The argument is certainly sound and inspiring for other economies in similar situations and should can serve as a guideline (if not followed explicitly) for the upcoming years.

3. Concluding Remarks

There comes a time in which one must decide to sacrifice profits and political correctness for what can be considered as a "greater good." Australia is now faced with one of these vital decisions: it can decide to continue polluting and contributing to greenhouse gas emitting cycles, or it can decide to hop on the renewables train. As we have argued, the former choice or "business as usual" may not be very attractive. First of all, we have seen that Australia's booming exports contribute to global pollution and externality-inducing consequences. However, these exporting industries may be subject to excessive monopsony power and Dutch Disease issues. Moreover, Australia is, as a country and an economy, extremely sensitive to changes in climatic conditions. Possible changes in climate and extreme weather phenomena could have catastrophic consequences for the economy and ecosystems that would cause it to take a step back in development. Reaching an international agreement and acting aggressively could mitigate these catastrophic effects.

Fortunately, Australia boasts excellent renewable energy resource endowments, such as strong winds and solar radiation. By taking advantage of these vast resources, Australia could adopt renewable energy policies and could attain a 100% clean energy-powered economy. Moreover, the adoption of these policies and the necessary technology could be developed with a net increase in employment at a modest cost. These findings and projections should be considered and taken into account by Australian policymakers. It is their obligation to review the available data, the potential consequences and push for solutions. These solutions can be reached by actively pursuing climate agreements at the international level and convincing the major nations, like the U.S. and China (both in total emissions and per capita terms) to get on board. It is true that no change can be expected from abroad if it does not start at home. The solution, therefore, calls for a firm reduction in fossil fuel exports from Australia to other emitting countries. Australia, as the owner of these resources,

in a way has the key to others' fossil fuel consumption. This can be regarded as a powerful weapon against global pollution. Furthermore, the massive profits from the current fossil fuels and resource industries may be used to create a sovereign fund and finance part of the renewable energy infrastructure, thus "balancing off" short term emissions until the Australian economy can function without traditional energy sources, as these are replaced. Once Australia has taken this primary step, it can use the available guidelines for becoming a zero emissions economy and set an example for the rest of the polluting countries of the world. By doing this, Australia will be able to convince other nations of the necessary steps for adopting renewable energy technologies, contribute to a global agreement for climate change mitigation, become a leader in the energy technologies of the future and guarantee that our grandchildren have the same opportunities and live in the world that they deserve.

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