



WORKING PAPER

ITLS-WP-21-19

**Riding the Storm: Humanising Our
Response to Induced Global Warming**

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October 2021

ISSN 1832-570X

**INSTITUTE of TRANSPORT and
LOGISTICS STUDIES**

The Australian Key Centre in
Transport and Logistics Management

The University of Sydney

Established under the Australian Research Council's Key Centre Program.

NUMBER: Working Paper ITLS-WP-21-19

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DATE: October 2021

Approaching Boiling Point

Although natural fluctuations in the Earth's climate system are not uncommon (AAS, 2020a), the influence of human activity is undeniable (NASA, 2020). Since industrialisation, the demand for steam and later electricity has been satiated through the burning of fossil fuels. This has created a 'greenhouse effect'. By examining ice cores, climate scientists have found that, since 1950, carbon dioxide levels have diverged from their 800,000-year band of 160-300 parts per million to over 400 parts per million in 2020 (NASA, 2010; NOAA, 2020a). Nor are burping cows a laughing matter! According to Stanford University, methane emissions, which are 28 times more potent at trapping heat than carbon dioxide, are rising by 9 percent per annum. This is equivalent to doubling Germany's emissions every year and puts global warming at risk of exceeding 4°C by 2100 (Sky, 2020): a dire scenario.

Since the mid-19th Century, rapid population growth has placed enormous strain on our ability to manage the Earth's finite resources sustainably. While it took several hundred thousand years to reach the first billion people in 1804, we are now adding close to a billion every decade. This phenomenon, fuelled by high birth rates and improved life expectancy in developing countries, is seldom recognised by policymakers as a major factor contributing to climate change.

Many economists claim correctly that technological advancements have allowed us to avoid the so called 'Malthusian Trap'; the situation in which material abundance is offset by exponential population growth. Often overlooked is that our ability to lift productivity has been attained largely through increased consumption of fossil fuels and land. Canadian scientist and policy analyst Vaclav Smil found that the ten-fold increase in agricultural yields achieved in the last century took place alongside a ninety-fold increase in energy inputs to power machinery, irrigation and fertiliser manufacture (Smil, 2019). These are worrying trends as continued conversion of wilderness into arable land results in deforestation, exacerbating the climate challenge. Research by Oliveira et. al. (2013) show that deforestation results in reduced precipitation, thereby decreasing crop yields and undermining the economic advantage of converting rainforests into farmland.

Climate change is linked to more extreme and damaging weather, poorer crop yields, rising sea levels, stressed infrastructure, human health challenges and potentially greater levels of conflict as nations are asymmetrically affected (AAS, 2020b). Higher frequencies of severe floods, cyclones and fires are costing, and will continue to cost, the global economy trillions of dollars over the next few decades. Australia's 2019-2020 'black summer' was likely exacerbated by a warming climate (Garnaut, 2008) with analysts estimating an economic cost well into the billions (Khadem, 2020). This is due to the indirect impact of the fires on lost tourism, a rise in respiratory and cardiovascular health concerns, reduced crop yields, higher insurance premiums and species extinction. Since 2000, intermittent and low rainfall across much of Australia has undermined the health of the nation's \$66 billion agricultural sector (Department of Agriculture, 2018).

Melting ice caps and glaciers, combined with thermal expansion caused by warmer water temperatures, have already caused oceans to rise by about 23 centimetres since 1880 (Nunez, 2019). Projections suggest that, even if warming is contained at 1.5°C, sea levels will rise a further 26 to 77 centimetres by 2100. This places thousands of human settlements at risk. High tide flooding is becoming the new norm for many parts of the southern United States

with the National Oceanic and Atmospheric Administration recording a near tripling since 2000 (NOAA, 2020b). Even under low carbon emission scenarios, Kulp and Strauss (2019) find that, by 2100, nearly 200 million people will occupy land projected to be below high tide level. Loss of habitable land, relocation of displaced peoples and construction of sea walls will incur both geopolitical tension and significant capital expenditure. Jakarta, a metropolis of 10 million people, is in severe difficulty. Forecasts indicate that, within a decade, 80 percent of the northern city could be below sea level (Koch, 2015). This has led to the authorisation of a \$40 billion, 40-kilometre, sea wall off the city's coast. While mitigation measures cannot be avoided, the cost of current and future expenditure required to protect society from the effects of climate change must be accounted for. Swift action to reduce emissions will result in significant long-term savings, thereby placing enormous responsibility on policymakers to develop a comprehensive approach.

Younger generations fear for their future if current trends continue. Greta Thunberg is the face of an international movement that has seen thousands of children skip school to make their voices heard. These desperate cries for action reflect humanity's intergenerational responsibility to pass on a world that is equal to, if not better than, the one inherited. Presently, we are failing to achieve this moral imperative as the cost of today's standard of living has been effectively externalised to future generations. While addressing climate change is a formidable challenge, action taken today will have a profound impact on the livelihoods of our descendants.

Yet government leadership in emission reduction remains weak in most countries. Climate change may very well be, in the words of former Australian Prime Minister Kevin Rudd, the "greatest moral, economic and social challenge of our time" (Rudd, 2007). Yet attempts to ameliorate it were a major contributor to the downfall of several Australian Prime Ministers since 2010, including Rudd (Brett, 2020). This is a trend observed across much of the world, despite the unequivocal evidence and enormous cost of climate change to future generations.

A Boiling Frog?

The incremental impact of human activity on the climate can readily go unnoticed and indeed was for many decades. Yet other very significant factors are at play in stymieing an effective response.

Action on climate change challenges vested interests in the mining and energy sector which, by denying the link to human activity, use their economic and political power to lobby politicians and the public to delay investments in renewable energy technology. It is argued that the multi-trillion-dollar outlay required to reduce emissions would do unprecedented harm to the economy and compete against other more immediate and tangible priorities such as education, health and welfare spending. This makes long-term climate action incompatible with the short-term nature of election cycles. The challenge is exacerbated in countries facing high levels of poverty. When populations are struggling to meet their basic needs, garnering support for investment in emissions reduction is a near insurmountable task.

Inaction on climate change can, in large part, be explained in terms of market failure. The impact of pollution is a negative externality: that is "a consequence of an industrial or commercial activity which affects other parties without this being reflected in market prices" (Oxford Dictionary, 2020). For well over a century, companies and individuals have burnt

fossil fuels to generate energy without incurring the cost of its effect on our climate and the living standards of future generations. Attempts at rectification have led to the formulation of emissions trading schemes (ETS) and carbon taxes. These schemes seek to correct the market failure by placing a price on emissions which reflects their cost to society. Regrettably, to contain global warming at the 1.5°C - 2°C target specified in the 2015 Paris Climate Agreement, a carbon price of around USD \$70 per tonne is required (IMF, 2019a). Given the global average carbon price of USD \$2 per tonne, most signatories remain tragically short of their emissions reduction pledges (Lagarde and Gaspar, 2019).

Despite the potential effectiveness of ETS (Burke, Jotzo and Best, 2020), the fear of devastating economic consequences and the impact of a high carbon price on national competitiveness has made them unpopular politically. Convincing society to act on climate change requires a belief and understanding that the costs of inaction far exceed the expenditures required to move immediately towards a low emission economy.

The problem with expenditure on greenhouse gas emission reduction is exacerbated because our climate is a non-excludable public good. That is, action on climate change by an individual nation provides minimal local alleviation and, in isolation, will have little impact on the global climate. This creates the dilemma of free riding, in which nations wait for a global response, rather than initiating sufficient and sustained investment themselves.

Muddling Through?

In time, continued technological progress and falling renewable energy generation costs will transition society towards a carbon neutral future. Australia added 2.2GW of large-scale renewable generation to its grid in 2019, supplementing the nation's 2GW of rooftop solar (Clean Energy Council, 2020). Furthermore, we are already seeing significant private sector interest in renewable energy export ventures such as the \$22 billion Sun Cable project from Tennant Creek (Northern Territory, Australia) to Singapore (Macdonald, 2020). This is the essence of a market economy. Scientific advancements, while enabling humanity to decisively alter the natural environment, also provide us with the necessary tools to transform our carbon intensive economy into a carbon neutral one. Technological breakthroughs have brought the cost of renewable energy generation from solar and wind down approximately 90 percent in the last decade (Latimer, 2018; Marcacci, 2020), making it the cheapest new source of electricity generation for about two-thirds of the global population (Eckhouse, 2020). Renewable energy is expected to make up 76 percent of new electricity generation capacity in the United States (US) this year and, in April 2019, briefly generated more energy than coal (EUCI, 2019; Marcacci, 2020). This is despite several attempts by the Trump Administration to support the United States' struggling coal industry. Concurrently, improvements in energy efficiency have allowed demand for electricity to fall alongside steady levels of economic growth (Gross, 2019). Scientific breakthroughs in areas such as cellular agriculture, algae and genetic modification are expected to exponentially boost food production volumes and yield. High rise apartments permit the densities required to accommodate an ever-growing global population, whilst leaving sufficient space for other uses. Technological advancements will enable human populations to continue growing to 10 billion and beyond. Notwithstanding; world fertility trends suggest that the global population will stabilise at 9.7 billion by 2064 and decline significantly thereafter (Gallagher, 2020).

Unfortunately, the speed of a market response may be sluggish, thereby resulting in unnecessarily harmful outcomes for society. More importantly, one must ponder why our society is wedded to a decision-making framework that forgoes long-term interests and overlooks important philosophical and moral questions. Surely humanity can do better than this? Don't we have a responsibility to each other, future generations and other species? Despite society's clear focus on present needs, concern about species extinction and the destruction of natural wonders is evident. Many world cultures and religions emphasise environmental stewardship and, in the case of indigenous Australians, a connection to country. This is reflected by the fact that recent protests regarding the absence of appropriate action on climate change have taken place on every inhabited continent. Human induced climate change not only impacts humanity but will, through no fault of their own, wipe out plants, animals and entire ecosystems which co-inhabit the Earth. One only needs to observe the coral bleaching experienced on Australia's UNESCO listed Great Barrier Reef to gain a glimpse of the devastation brought about by climate change. This is hardly a mark of responsible stewardship to the environment or communities that rely on these ecosystems for their livelihoods.¹

The adverse effects of climate change will disproportionately impact the world's poorest people. Emerging economies are in a far weaker position to invest in the infrastructure necessary to protect themselves from the impact of rising sea levels, extreme weather and reduced agricultural productivity. While attempts by emerging economies to shift the blame for climate change to advanced economies is a counter-productive attitude, wealthy nations have a responsibility to take the lead.

“Mental or existential distress caused by environmental change” has been coined ‘solastalgia’ by Australian Philosopher Glenn Albrecht (2005). Once everyday experiences such as a feeling of space, playing in the backyard and soaking in beautiful views have transformed into luxuries. Land is a rival good. The number of beautiful places in which to live and work is limited. We only have one Sydney Harbour and greater development along its shores will erode its natural beauty and subsequent utility. While the direction society wishes to take is a complex issue, it is not one that should be ignored. Our current focus on population fuelled economic growth, while making it easier for businesses and politicians to meet ‘growth’ objectives, is failing everyday people. Population driven growth obscures poor management practices and reduces competition through the provision of a continually expanding market. This disincentivises productivity growth/investment in research and development (R&D) and places unprecedented pressure on property prices. This isn't healthy for our economy or environment. To draw on the most famous maritime disaster in history, if we had fewer passengers on the Titanic, the repercussions would have been much less severe.

While ameliorative action on adverse climate change is inevitable and more advanced than generally recognised, a purely market driven response will be slow, costly and lack a sense of overall purpose. We should not allow what it means to be human to be hijacked by the prevailing economic paradigm. Instead, the way forward should involve explicit attention to reconceptualising the world we want to live in and how this can be achieved in a manner which harmonises environmental and economic dimensions.

¹ Australia's Great Barrier Reef has an estimated worth of AUD \$56 billion supporting 64,000 jobs (39,000 direct jobs) and contributing AUD \$6.4 billion per annum (Deloitte, 2016).

A Shining Example

If our vision of a more equitable and sustainable society is to prevail, climate action must be aligned with commerciality. One cannot, and does not seek to, overcome humanity's imperatives of self-interest, but rather to reimagine them in a manner which utilises technology to achieve sustainable goals as a matter of immediate material value.

Since the Global Financial Crisis (GFC), advanced economies have been shackled to a period of slow productivity and real wage growth. Even in Australia, which managed to stave off recession for three decades, gross domestic product (GDP) per capita has fallen since its 2013 peak (World Bank, 2020). The picture becomes even bleaker if we remove the imputed rent component of GDP. Much of the "growth" achieved in advanced economies has been the result of asset price inflation triggered by loose monetary policy, as opposed to efficiency gains. Transition to a low carbon economy presents an enormous opportunity for nations which are willing to invest in becoming powerhouses of renewable energy generation and technology (Garnaut, 2019). Expenditure on improved productive capacity and renewables technology will produce the scale of outlay necessary to overcome the economic malaise left by the GFC and COVID-19 pandemic (Rosewarne, 2020). While critics will contend that such arguments are both optimistic and require excessive government intervention, pathways for productivity enhancement, job growth, exports and technological supremacy are both very real and subject to private sector interest.

Taking Australia as an example, it is evident that the nation's opportunities in a low carbon economy surpass even those enjoyed during its multi-decade mining boom. High commodity prices and dependence on unprocessed mineral exports have left the Australian economy vulnerable (Green, 2020). Australia is ranked at the bottom of the OECD for economic complexity, which measures the research intensity and diversity of exports (OEC, 2020). Exports of unprocessed goods are lower value, in turn producing relatively minimal earnings and investment in domestic R&D. Strategically located wind and solar farms enable the generation of near limitless low-cost renewable energy. This can be utilised to undertake onshore manufacturing and processing of minerals such as aluminium and rare earths (Macdonald, 2020). Greater levels of industrialisation are valuable due to the strong links between manufacturing, R&D and productivity growth (Andreoni and Chang, 2016). This has the potential to create more resilient economies with greater sectoral and spatial diversity, underpinned by well-remunerated and high-skilled employment. Due to the falling price of renewables and increasing cost of accessing fossil fuel reserves (Vorrath, 2020), goods produced using renewable energy sources and sophisticated manufacturing techniques will be highly competitive. This creates significant export opportunities for early movers. Exports of green products and advanced technologies will not only generate enormous economic growth and returns to producer nations but facilitate the global transition to a low-emission economy. This will lift emerging economies out of poverty and is preferable to the current practice of offshoring production to low-cost countries with poor environmental standards.

Continued support of fossil fuels results in a wasted economic opportunity. The private sector is becoming increasingly wary of investments directed at expanding coal capacity (C. Carmody, 2020, pers. Comm., 11 March). According to the IMF (2019b), fossil fuel subsidies account for nearly 7 percent of global GDP. Strategically, a measured transition away from fossil fuels is in the mining industry's best interests. The gradual reduction in supply, in the

face of decreasing demand, will assist in maintaining output prices during the transition phase. Conversely, further investments in non-renewables not only attract high risk premiums but risk flooding the market and hurting the communities they support.

New industries will be highly automated. This should not be viewed as a threat to employment in a world which expresses increasing concern about an ageing population and insufficient people of working age to support them. Government has a huge role in supporting this transition.

A Vision Splendid...

Climate change is a complex challenge. Addressing it successfully requires a mindset that draws directly from the heart of what makes us human. Our moral responsibilities to each other, future generations and the planet must be balanced with the need for shared present prosperity. This can be achieved through an enhanced economic framework that acknowledges the key role of rapid technological advancement. Our vision for the future must reflect the possibilities that lie ahead in a model where addressing climate change through the creation of a competitive and innovation driven industrial base isn't just the right course of action but the profitable one. This makes emissions reduction politically achievable by eliminating the mistaken belief that there is a trade-off between environmental sustainability and economic prosperity.

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