POPULATION GROWTH, CANADA'S ENERGY TRANSITION AND CLIMATE CHANGE: A HIGH RISK FUTURE?

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Canada's population could potentially increase by 50% over the next half century. Despite declining rates of natural increase, this is within the realm of possibility given the high level of immigration that characterizes Canada. All three major federal parties in Canada are pro-immigration, with ongoing political pressures to raise immigration targets (Saunders, 2017). Levels have recently risen to near all-time highs — for example, the federal government committed itself in late 2017 to welcoming close to a million newcomers over the next three years (Bascaramurty, 2017).

While Canada's population is expected to increase, what happens elsewhere will clearly swamp this demographic growth. Consider the United Nation's (2017) global projection with a medium growth scenario of an additional 2.8 billion persons over the next 50 years (as opposed to perhaps 15-20 million in Canada). This projection anticipates a global population of close to 10.5 billion (up by 37%) by 2067. This is not an inconsequential increase, as this growth is greater than the current population of both China and India combined. Even with the UN's low variant, which assumes a major drop in fertility to levels well below replacement, the population momentum inherent in the world's current age structure ensures an additional 1 billion people.

To put this into perspective, Canada's current share of global population (at only about 0.5%) is not expected to change much over the next half century. Yet an additional 2-3 billion people, in and of itself, will have an important impact on Canada. This is particularly true given the importance of Canada's resource sector and ongoing efforts to extend traditional trading relationships beyond North America. Not only will it impact the demand for resources and energy exports, but also global greenhouse gas emissions, the pace of global warming, and con-

sequently the health of Canada's environment.

CANADA'S ENVIRONMENTAL RECORD

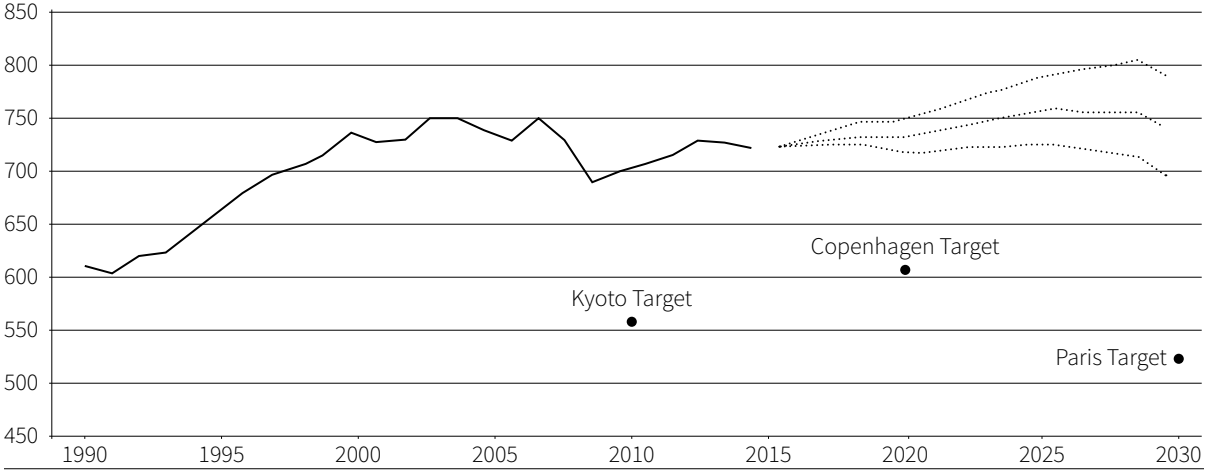
By international standards, Canada's environmental record has been mixed. As an indication of this, the Yale Centre for Environmental Law and Policy recently published a ranking of 180 countries according to a composite index meant to measure "sustainable development" (Hsu et al, 2016). The composite index summarizes data across 20 public health and environmental indicators. Canada scored 25th overall, yet its relative ranking could have been much higher had it not been for its relatively poor performance on several of the indicators meant to measure "environmental damage". As an example, Canada currently ranks 107th in terms of the indicator of "CO_2 emissions per KWH".

Environment and Climate Change Canada (2017a) has recently published estimates and forecasts on GHG emissions (Figure 1), which demonstrate the extent to which Canada has failed to meet past commitments on greenhouse emissions (Kyoto; Copenhagen) and is likely to miss future international commitments (Paris). Based on historical data and a review of all actions taken by government through to November 2016, Environment Canada has forecasted that Canada is set to miss its current international commitment at Paris of 520 megatons of CO_2 equivalent by 2030 (projected emissions range between 697 and 790 megatons under current policy/proposed regulations).

There is considerable uncertainty in these projections, as for example, it is impossible to predict with any precision future initiatives or regulations introduced by all levels of government, just as it is impossible to predict future growth in the demand for Canadian commodities (including energy). Yet in an independent set of forecasts, the International Energy Association (2017) has predicted that on a "global level", the demand for oil should continue to grow until at least 2040. This is largely due to major growth in population and the subsequent global demand as well as a lack of easy alternatives to oil in petrochemicals, road freight and aviation. In this context, it is reasonable to anticipate a growing demand for Canadian exports, and in particular, a demand for Canada's energy resources.

Although Canada's greenhouse gas emissions have levelled off somewhat (with a very slight decline since 2005), global emissions have continued to climb rapidly — up by about 20% over this same time period (Environment and Climate Change Canada, 2017b). Canada, due to the energy intensity of its economy and continued reliance on fossil fuels, has not been particularly successful in reducing its carbon footprint. Yet while the Canadian government documents the GHG emissions that result from the burning of fossil fuels internal to Canada, it is not mandated to include in its official reports the emissions that result from the end-use combustion of exported fuels. As a result, there is little awareness in Canada as to the scale of these emissions, which in reality represent a large outflow of planet-warming carbon. Remarkably, the Auditor General of Canada (2017) has recently estimated that the emissions associated with the burning of Canadian exported fossil fuels is near equivalent to the total reported above, at about 720 megatons of CO_2 equivalent in 2015.

FIGURE 1
HISTORICAL ESTIMATES 1990-2015[1] AND PROJECTED GREENHOUSE GAS EMISSIONS 2016-2030, MEGATONS OF CO_2 EQUIVALENT, CANADA



SOURCE: ENVIRONMENT AND CLIMATE CHANGE CANADA, 2017A
[1] These estimates do not include emissions that arise from the end-use combustion of exported Canadian fossil fuels

CANADA'S WARMING CLIMATE

The net effect on global warming is largely the same, regardless of where the end-use combustion of fossil fuels occurs. Over the last 69 years of careful record keeping across Canada, Environment and Climate Change Canada (2017b) has captured a linear warming trend for the country as a whole, which indicates an increase of roughly 1.5 degrees Celsius during the summer months and fully 3.3 degrees Celsius during the winter months (Figure 2). In working with annual averages rather than the aforementioned seasonal changes, Canada has warmed at a rate that is about twice the global average (Environment Canada, 2012). While Canada produces more than its share of GHG emissions, so too has it witnessed greater warming of its climate — an inference which is true across several high latitude regions. This has led to many profound changes in the north, including the melting of glaciers and sea ice, a softening of much of the northern tundra and a real impact upon the health of the boreal forest.

In contrast, the most southern and densely populated regions of the country have witnessed much less warming, particularly during the summer months, regardless of public perceptions. Over the next several decades, the International Panel on Climate Change (IPCC) forecasts that this warming will be felt increasingly in the more southern regions of Canada, with uncertain environmental and social effects (Romero-Lankao et al, 2014).

Whereas Environment and Climate Change Canada has recently documented that 2016 was its fourth warmest year on record (2010 was the warmest), temperatures were not far from average throughout much of southern Canada. While in 2016 the national average was 2.1 degrees Celsius above Environment Canada's baseline average, temperatures were of the range of 3 to 4 degrees above this same baseline throughout much of Nunavut and the eastern Arctic. In terms of winter temperatures, Yukon had its warmest winter on record (fully 6.8 degrees above average), with comparable anomalies in the Northwest Territories and the northernmost forests of Alberta, Saskatchewan and Manitoba (5.1 degrees).

A HIGH RISK FUTURE

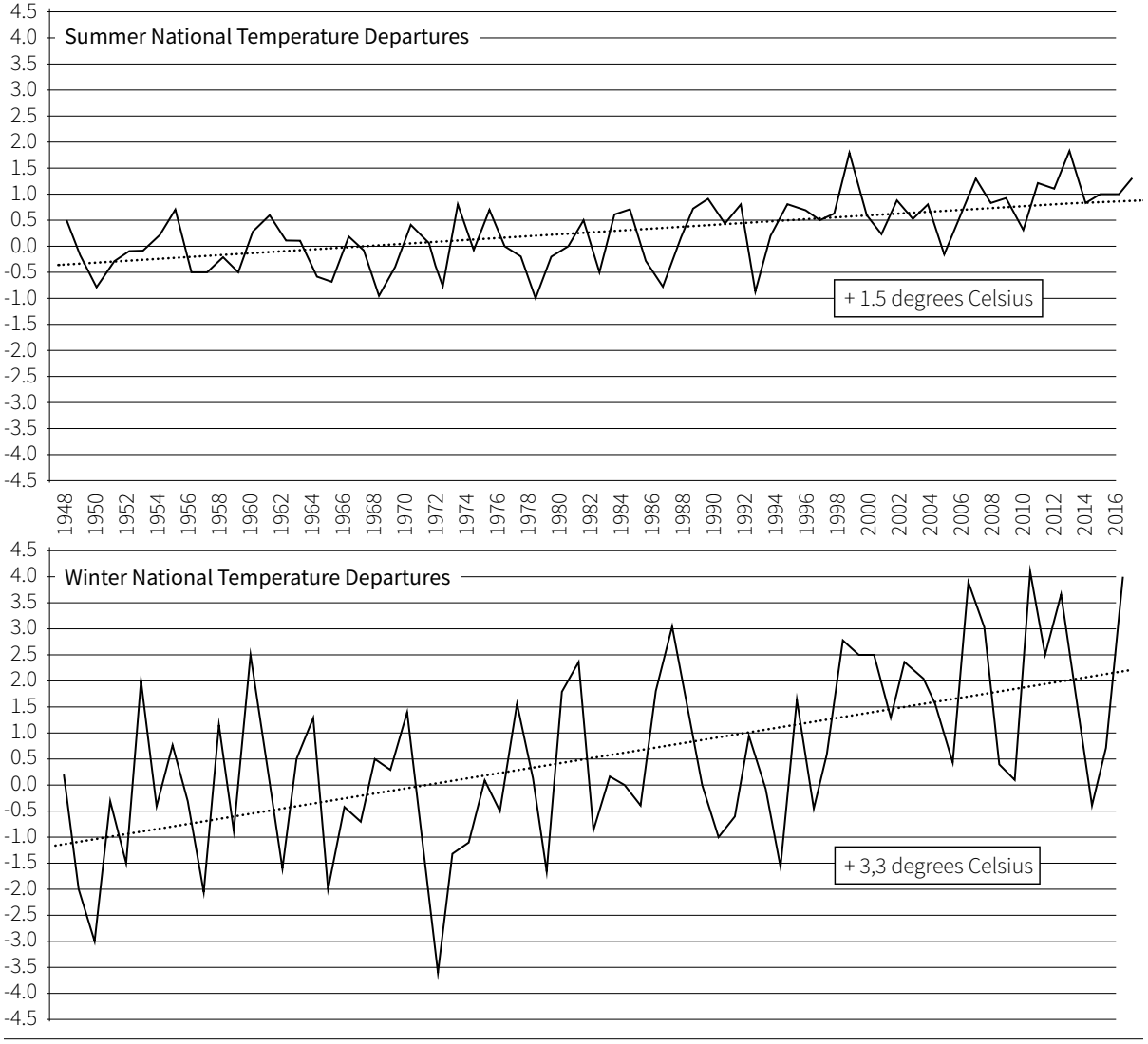
The IPCC has established with near certainty the association between increased GHG emissions and global warming. Figure 3 provides a summary of the IPCC's (2014) most recent set of forecasts (Fifth Assessment Report) on the extent to which average global surface temperatures can expect to rise over the next century. All forecasts imply a warming climate, yet the range of future outcomes is extremely wide. Four different scenarios are provided (representative concentration pathways, or RCPs) developed by the IPCC to portray four possible climate futures. RCP2.6 assumes that global GHG emissions will peak in the current decade (2010-2020), with levels declining substantially thereafter. Emissions in RCP4.5 peak around 2040, then decline, whereas emissions in RCP6.5 peak in 2080 then decline. RCP8.5 is the most pessimistic of all the scenarios in assuming a sustained growth of emissions throughout the 20th century.

Underlying each pathway is a different scenario on future population growth, which in turn is considered fundamental in forecasting emissions. For example, the most pessimistic forecast (RCP8.5) assumes sustained population growth throughout the current century, whereas the most encouraging (RCP2.5) assumes slow growth stabilizing by mid-century (van Vuuren et al., 2011). In the IPCC's most optimistic forecast (RCP2.6), the underlying assumption on population is slightly higher than the UN's low variant — with global population at about 9 billion by 2067. With the IPCC's most pessimistic forecast (RCP8.5), projected growth is only slightly higher than the UN's medium variant — with the global population of about 10.6 billion by 2067 (van Vuuren et.al. 2011).

With this wide range on future "concentration pathways", the only scenario that falls safely without the target set out in Paris is RCP2.6 — with a warming of less than 2 degrees over the longer term historical average. This latter scenario is not realistic as it implies a very stringent mitigation scenario in terms of reducing GHG emissions (i.e. the world must meet its Paris commitments) and a rather dramatic slowing in the rate of global population growth (with the global fertility rate falling below replacement within a few decades). In addition, with each RCP the IPCC has applied a broad range of climate models, which leads to a wide range of forecasts associated with each (this is captured through uncertainty associated with each RCP as represented by the bars to the right of Figure 3).

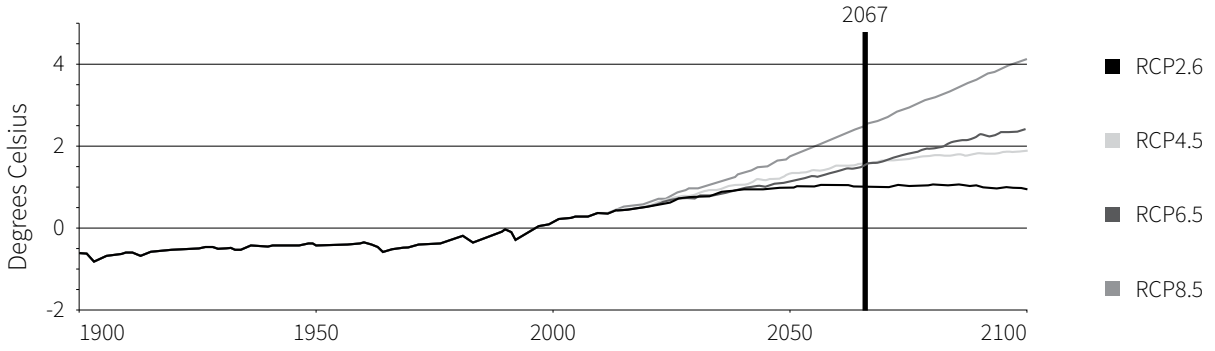
This uncertainty relates to the complexities of modelling climate beyond the uncertainties in forecasting future population and GHG emission levels. Yet well within this range of forecasts is the risk that global

FIGURE 2
NATIONAL TEMPERATURE DEPARTURES (CELSIUS) AND LONG-TERM TREND, CANADA, 1948-2016



SOURCE: ENVIRONNEMENT ET CHANGEMENT CLIMATIQUE CANADA, 2017B

FIGURE 3
FORECASTED AVERAGE SURFACE TEMPERATURE CHANGE (RELATIVE TO 1986-2005), IPCC 2014



SOURCE: IPCC FIFTH ASSESSMENT REPORT, 2014

temperatures surpass the 2 degrees of warming over pre-industrial levels by Canada's bicentennial year in 2067. And recall that the pace of warming will be far greater in the northern latitudes; i.e. the forecasts implied in Figure 3 will be amplified into far greater warming for countries like Canada. The uncertainty in these forecasts remains high, just as do the potential risks associated with some of the worst case scenarios.

CONCLUSION

The IPCC considers demography as fundamental to its forecasts on GHG emissions, with greater growth implying higher emissions. This scientific research begins with what is easily verifiable; population size can be considered a fundamental multiplier in estimating environmental impact. The consensus coming out of the IPCC is that population growth on a global scale is obviously of major consequence in terms of both future resource use and future GHG emissions. In this context, even if Canada quickly moves through its energy transition and were to experience more moderate population growth than expected or even approach population stability, what happens elsewhere will be of major consequence to Canadians as they approach their bicentennial year.

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