Minister McKenna: Where Is the Science?

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Abstract

Nearly two years ago, we submitted a petition to the Auditor General of Canada (No. 408 dated 27 May 2017) questioning how the government intended to meet its sustainability goals. We cited a number of scientific studies published in peer-reviewed journals warning that continued growth in human numbers and consumption would destroy the natural systems that support all life. We wanted to know how the Canadian government intended to address these urgent warnings.

The primary question in our petition was directed to Catherine McKenna, Minister of Environment and Climate Change: “What peer-reviewed science—not neoclassical economics—is the government relying on to make the claim that we don't need to choose between a healthy environment and a strong, *growing* economy?”

The answer we received was unsatisfactory. Despite our request for peer-reviewed science, that is not what the Minister supplied. She pointed to a "significant body of published research," chiefly related to economic theories such as the Porter hypothesis and the environmental Kuznets curve, to support her claim that Canada does not have to choose between a healthy environment and economic growth. But, as we demonstrate in this paper, the evidence for these theories is disputed and unconvincing. She also referred to reports from organizations such as the World Bank, the OECD, and the Smart Prosperity Institute. These reports, which are based on little, if any, science, focus on two unproven concepts—green growth and decoupling—that supposedly will eliminate the environmental costs of continued economic growth. However, the scientific evidence—that is, peer-reviewed evidence supported not just by a few studies but by many—demonstrates that green growth and decoupling are fantasies. After examining the research cited by the Minister, we cannot help but conclude that this government's economic growth policies are founded on discredited theory, wishful thinking, and a perilous tendency to discount future harms in the interest of present benefits.

We are in trouble, and we cannot get out of it with the reassuring falsehoods that the government is delivering. We need public policy and action based on science and on an honest, clear-eyed assessment of our problems. Nothing in the Minister's response to our petition or in the

government's Sustainable Development Strategy suggests that she is developing policy on the basis of "solid scientific knowledge."

The scientific evidence is clear. At the saturation point we have reached in the Anthropocene – with real, dangerous human-induced global environmental risks, and with interactions, feedback and tipping points connecting every ecosystem and biome – it is now necessary to recognize that human wellbeing in one place requires planetary health. In every nation today, we all depend on the stability and functioning of the Earth system.—Nakicenovic et al. 2016

Now is the time to acknowledge you were lied to. It is never too late to change course. But it is untenable to say you care about future generations yet still support politicians and policies that lead to future destruction. You have to choose one or the other; there is no middle ground, and we need to quit pretending there is.— Abraham 2018.

Adults keep saying: "We owe it to the young people to give them hope." But I don't want your hope. I don't want you to be hopeful. I want you to panic. I want you to feel the fear I feel every day. And then I want you to act. I want you to act as you would in a crisis. I want you to act as if our house is on fire. Because it is.—Thunberg 2019

Introduction

Nearly two years ago, we submitted a petition to the Auditor General (No. 408 dated 27 May 2017). Our petition questioned how the government intends to meet its sustainability goals. We cited a number of scientific studies published in peer-reviewed journals warning that continued growth in human numbers and consumption will destroy the natural systems that support all life (e.g., Meadows et al. 1972; Science Summit on World Population 1994; Czech 2000; Millennium Ecosystem Assessment (Program) 2005; Rockström et al. 2009; Barnosky et al. 2012; IPCC - Intergovernmental Panel on Climate Change and Edenhofer 2014; Newbold et al. 2016). We wanted to know how the Canadian government intends to address these urgent warnings.

Our original petition focused on the growth paradigm that dominates political thinking. We are not alone in believing that this paradigm must shift if we are to avert collapse. The IPCC report in 2014 noted that economic growth and population growth had outpaced all the GHG emission reductions resulting from improvements in efficiencies. Both economic growth and population growth continue to be the primary drivers of CO_2 emissions, with the contribution of economic growth showing a significant increase (IPCC - Intergovernmental Panel on Climate Change and Edenhofer 2014: 8,47).

Then, in November 2017, a second *Scientists' Warning to Humanity* also identified economic and population growth as the cause of the present crisis: "We are jeopardizing our future by not reining in our intense but geographically and demographically uneven material consumption and by not perceiving continued rapid population growth as a primary driver behind many ecological

and even societal threats." This document was endorsed by over 20,000 scientists from over 180 countries (Ripple *et al.* 2017; Alliance of World Scientists 2018).

The Liberal Party promised in its platform that it would "ensure the federal government rebuilds its capacity to deliver on evidence-based decision-making." But the letters we received in response to our petition give very little indication that the government is actually looking at the evidence. In the present document, we point out how the responses fail to address the core problems of economic and population growth and their impacts on the environment.

Response from Minister McKenna, Environment and Climate Change Canada

The first question we directed to Catherine McKenna, Minister of Environment and Climate Change, expressed our fundamental concern: "What peer-reviewed science—not neoclassical economics—is the government relying on to make the claim that we don't need to choose between a healthy environment and a strong, *growing* economy?" (Office of the Auditor General of Canada 2007).

No politician could find this an easy question to answer. Whatever the problem—income inequality, housing shortages, decaying infrastructure, even our high per capita energy use—every political party argues that we can grow our way out of it. Questioning the need for economic growth is often regarded as far-fetched or foolish. But it is worth remembering that prior to 1950, economic growth hardly featured as a policy objective of any western country (Victor 2008: 13). Our obsession with economic growth as the *sine qua non* of human well-being is a recent affliction.

McKenna's answer began by reassuring us that the government has carefully considered its policy: "the Government of Canada recognizes that these are challenging issues and is working to employ evidence-based measures that promote sustainable development. There is a significant body of published research outlining the potential for growing the economy while protecting the environment." We have examined this "significant body of published research" that the Minister cites, and it does not give us confidence. And, despite our specific request for peer-reviewed science, the Minister based her response primarily on economic theory.

It would be useful here to explain why we wanted the Minister to focus on scientific evidence and not economics. First, economics is a social science, not a physical science. As Rosenberg and Curtain (2013) point out, "the fact that the discipline of economics hasn't helped us improve our predictive abilities suggests it is still far from being a science, and may never be." Second, as Nadeau (2008a) notes, neoclassical economists "developed their theories by adapting equations from 19th-century physics that eventually became obsolete." The tenets of neoclassical economics have not been revised in light of new science developed over the last 200 years (Daly and Farley 2004; Nadeau 2008b; Kosoy *et al.* 2012; Ritholtz 2013). But the most important reason is that "neoclassical economics does not even acknowledge the costs of environmental problems and the limits to economic growth, [and thus] *it constitutes one of the greatest barriers to combating climate change and other threats to the planet* [our emphasis]" (Nadeau 2008a).

The assumptions of neoclassical economics are inconsistent with current science (Nadeau 2008b), and fail to recognize that the global and local economies lie within the biosphere and its limits (Moldan *et al.* 2012; Nakicenovic *et al.* 2016). "The simple, but to many unthinkable, fact is that you cannot get to a flourishing or even sustainable Earth if you start with the assumptions of neo-classical economics" (Kosoy et al. 2012). However, one branch of economics—ecological economics—*does* acknowledge our dependence on the natural environment (Daly and Farley 2004; Bina 2013). Ecological economics stresses that any economic system must recognize that the economy is embedded in the Earth's biosphere and its biogeochemical systems, and that those systems are finite. But the economists cited by Minister McKenna are not in this school.

In the following sections, we look in more detail at the questionable sources Minister McKenna uses to support her contention that we can "grow the economy while protecting the environment."

The Porter Hypothesis

The first "evidence-based measure" that the minister cites is the Porter Hypothesis (PH), which "proposes that well-designed environmental regulations can provide benefits for companies by encouraging innovation and boosting competitiveness." No one could be against regulations that encourage people to earn a living while doing the right thing—recycling, reusing waste products, making manufacturing more efficient. But can regulations simultaneously protect the environment and "boost competitiveness"? This is not at all certain.

To understand discussion of the Porter hypothesis, one needs to recognize that it comes in two forms: the weak and the strong (Jaffe and Palmer 1997). The **Weak Porter Hypothesis** suggests that environmental regulation will lead to more innovation. Many studies find that this hypothesis is fairly well established (Chowdhury and Das 2011; Lanoie *et al.* 2011; Ambec *et al.* 2013; Franckx 2015; Rubashkina *et al.* 2015; van Leeuwen and Mohnen 2017). In fact, some authors suggest it would be surprising if environmental regulations did not stimulate innovation.

However, Ojwando (2016) points out that small and medium enterprises merely comply with regulations; they do not innovate. For these enterprises, the cost of compliance with environmental regulation is a relatively small fraction of the total cost of production and does not determine the competitiveness in most industries.

The **Strong Porter Hypothesis** (SPH) claims that properly designed regulation may induce cost-saving innovations that more than compensate for compliance. In other words, good environmental regulations will ultimately be good for business. About the strong form of the hypothesis, there is a range of results. Some researchers have found limited evidence for the SPH. For example, Chowdhury and Das (2011) believe that the SPH is "likely to hold if the new technology is relatively efficient in production, but not otherwise." Lanoie et al. (2011) find "qualified support"; Koźluk and Zipperer (2013) found the evidence for the SPH "largely inconclusive." van Leeuwen and Mohnen (2017) state that they "cannot conclude anything concerning the strong version." Both Franckx (2015) and Rubashkina et al. (2015) found no evidence that regulations lead to an overall increase in productivity.

André (2015) warns that not all environmental policies will induce the required innovations (the weak hypothesis); he finds that it is even less likely that such innovations will offset the compliance costs (the strong hypothesis). Thus a win-win situation—the company gets more competitive and environmental quality is improved—is an exceptional result that appears only under specific conditions. André (2015) also suggests that if environmental regulations were to get even tougher, they would probably not render additional economic benefits "because the low hanging fruits have already been collected and there are no more of them to be harvested." He emphasizes that even if environmental policy is beneficial *it should not be used* primarily to pursue economic benefits but rather should be used to protect the environment. Mohr (2002) predicts that while regulation-induced innovation will probably improve technology and increase output, it will not necessarily decrease environmental impact.

A more positive view is held by Clemenz (2012), whose research showed that the Porter Hypothesis may hold if the implementation of environmental policies leads to a change in consumer behaviour or if it induces R&D by the regulated firms that may subsequently enable them to exploit economies of scale. But it is apparent that even if there are some cases in which environmental regulation leads to more successful businesses, this outcome is by no means guaranteed. Brännlund and Lundgren (2009) found that the empirical literature did not generally support the Porter Hypothesis. Their close look at the "Swedish case" provided no support even though Swedish environmental policy over the last 15–20 years seemed to meet all the criteria postulated in the hypothesis.

Rassier and Earnhart (2010) found that tighter water regulation increased costs and lowered profitability, thereby negating the Strong PH. Ambec et al. (2013) found in their review that there was conflicting evidence and alternative theories that might explain the PH, and oftentimes a misunderstanding of what the PH does and does not predict. On the other hand, they found the empirical evidence on the strong version (stricter regulation enhances business performance) is mixed, with more recent studies providing more supportive results.

Albrizio et al. (2014) found that tightening of environmental policy had no long-term effects on productivity growth, but the short-term effects may translate into a permanent increase in productivity levels in some industries. Short-term effects were positive for technological leaders, while negative for low-productivity firms. These effects were unlikely to be large for the economy as a whole.

These disparate results demonstrate that the evidence for the Porter Hypothesis is too weak to justify the Minister's confidence that the government can simultaneously improve firms' competitiveness *and* environmental quality.

Environmental Kuznets Curve

The minister then invokes the Environmental Kuznets Curve (EKC). The EKC proposes that the relationship between economy and environment can be graphed as an inverted "U." In the early stages of growth, environmental pressures increase (the upward slope of the inverted "U"), but, as the economy grows richer, they diminish. In other words, the environmental degradation created in the early stages of development will be limited as the economy expands. (As an aside,

Simon Kuznets originally devised his theory to explain income inequality, not environmental health: he hypothesized that in the early stages of economic development, market forces would cause income inequality, but over time, inequality would decrease. Whether the Kuznets Curve holds true for income distribution is not at all certain: as Acemoglu and Robinson (2002) point out, “The empirical validity of this "Kuznets Curve" has been intensively investigated, but the evidence is mixed.” It is worth noting that in the past three decades, income inequality has steadily increased in the developed world, quite the contrary of Kuznets's prediction. In fact, by the late 1990s, researchers found that “the correlation discovered by Kuznets is more often disproved than confirmed” Lyubimov (2017). And more recently, Piketty and Goldhammer (2014), with a century of data, show that there is no automatic decrease in inequality at the mature stage of economic development and view significant inequality as an integral property of capitalism. Nonetheless, this unproven theory has been adapted to the problem of environmental degradation, and has been used to suggest that we can grow our way out of environmental problems.)

The Minister refers to a paper by Kaika and Zervas (2013) as a “comprehensive source of information” on the EKC. It turns out that Kaika and Zervas do not entirely support the EKC hypothesis. They note that a number of studies suggest that the EKC pattern may result from other factors, such as “the distribution of income, the international trade (pollution haven hypothesis), structural changes, technical progress and improvements in energy efficiency, institutions and governance and consumer preferences." Their paper then discusses CO_2 emissions and concludes that “In fact, the EKC literature is quite large, and results are at best mixed. A large part of studies that deal with CO_2 emissions indicate that the process of economic growth is not reducing such emissions over time...” (Kaika and Zervas 2013).

Most of the studies that did find evidence for the EKC dealt only with local pollutants, such as NO_x, CO, SO_2, and CO_2 emissions, and particulates. Even in these studies, researchers were tentative. Here, for example, are some ways they qualified their conclusions:

- there *may be* an inverted U-shaped relation
- should be tested with more rigorous time-series or panel data methods
- does not mean that countries with a higher level of income have lower levels of pollution
- over recent decades the relationship between economic growth and pollution emissions is monotonic
- applies to only some pollutants
- the EKC growth strategy is resource intensive and has huge environmental cost that this planet may not be able to absorb in future
- any improvements in environmental quality as incomes increase are likely to be a result of the enactment of environmental policy rather than endogenous changes in economic structure or technology
  (See Ekins 1997; Egli 2003; Lieb 2004; Stern 2004; Kunnas and Myllyntaus 2007; Jalil and Mahmud 2009; Urheim 2009; Subba and Sahu 2012; Taguchi 2013; Zambrano-Monserrate et al. 2016; Gill et al. 2017)

Moreover, many peer-reviewed studies have found *no* evidence for the EKC (just as no solid evidence has been found for the original Kuznets Curve). For example, Grossman and Krueger (1995) concluded that, “contrary to the expectations of the EKC, increased affluence apparently

exacerbates rather than ameliorates impacts." Clausen and York (2008) found that the "EKC" does not hold for aquatic biodiversity, suggesting that further economic growth is likely to exacerbate the biodiversity crisis. Subba and Sahu (2012) could not find an EKC for biodiversity loss or natural resource extraction issues. Gill et al. (2017) concluded that EKC proponents have "blind faith in technology and efficiency." Ekins (1997) found that unequivocal evidence for an EKC relationship is very scant for any environmental indicator and declared that "insofar as the EKC studies permit any conclusions at all, they provide evidence of unsustainable development rather than the reverse." The studies by Dietz and Adger (2003); Dinda (2004); Gergel et al. (2004); Czech (2008); Bradshaw *et al*. (2010); Ben Jebli and Ben Youssef (2015); Islam (2015); Stern (2015) also cast doubt on the EKC. We belabour this point to emphasize that it is not just a few studies that question the EKC.

Even more troubling is the fact that some studies conclude that the relationship between economic growth and environmental degradation actually follows an 'N-shaped' pattern rather than the inverted U-shape predicted by the EKC. (See, for example, Jha and Murthy 2003; Dinda 2004; Masih and De Mello 2007; Van Alstine and Neumayer 2008; Paraskevopoulos 2009; Goldman 2012; Babu and Datta 2013; Almeida et al. 2017; Neve and Hamaide 2017; Özokcu and Özdemir 2017.) That is, following the early stages of growth and increasing environmental pressures, increasing GDP may *for a time* be associated with decreasing environmental impacts. However, this trend reverses itself and increasing GDP is once again associated with increasing environmental degradation. Could it be that studies showing some evidence for the EKC are in fact documenting only the first and second phases of a three-phase curve? As Babu and Datta (2013) point out, "This is rather a matter of grave concern." If indeed the EKC takes an N-shaped path, there are significant policy implications (Masih and De Mello 2007; Paraskevopoulos 2009).

The Minister also refers to a World Bank report (which we discuss in more detail below). This report explicitly rejects the Kuznets curve: "... overall environmental performance does not first get worse and then improve with income—no Kuznets curve [EKC] here …." (World Bank 2012: 5). The report also states that Kuznets' "now disproved theory was extended to the environment, where it has also been *rejected*" (World Bank 2012: 41; italics added). There is no support here for the Minister's claim that the EKC justifies the continued growth of Canada's economy.

But even if the Environmental Kuznets curve were in some way to hold true—which it evidently does not – there are a number of reasons why it *should not be used* to formulate policy:

- During the early growth stage, the EKC theory holds that environmental degradation is unavoidable, yet the damage economic growth causes may be permanent. As Özokcu and Özdemir (2017) point out, "irreversibility of the ecological damages and resilience capacity of ecosystems are apparently neglected with this perception. Deterioration of ecosystems and environment may persist even after reaching the specific income level when irreversible damages have already been done." They also suggest that "actions to slow down the release of CO_2 emissions should not wait until reaching high income levels or raising awareness about environmental concerns. Global, regional, and local policies are needed independently from the income level to combat climate change, or at least to adapt to climate change."

- Some studies based on short-term data have observed the EKC in the case of vehicle emissions and other microeconomic factors such as SO_2 and CO_2 emissions, but there is no evidence that the EKC might apply to other environmental pressures such as ecosystem loss and its corollary, biodiversity loss. As a nation gets wealthier, its overall ecological footprint increases, with predictable negative effects on ecosystems and biodiversity. Mills and Waite (2009) argue that "the presence or absence of evidence for an EKC is insufficient information on which to draw conclusions regarding the relationship between income and biodiversity." They suggest that rich countries are likely fueling their own consumption by expropriating resources from poorer nations. The rich countries they reviewed *did not exhibit improved conservation*, which strengthens the arguments made by Stern (2004b, 2015) that the EKC is not a robust representation of the relationship between economic growth and environmental quality. Mills and Waite (2009) strongly discourage any use of a biodiversity EKC *per se* in policy applications. They agree with Czech (2008) that the necessary policies to preserve biodiversity will never be achieved unless those creating the policies recognize the fundamental conflict between economic growth and biodiversity conservation (Czech 2000).
- An extinct species cannot be recovered to function with ecological and evolutionary integrity no matter how much money is expended after the fact. Similarly, it is exceedingly difficult to restore wholly transformed ecosystems for the purposes of species recovery.
- Most environmental problems stemming from economic growth, such as pollution and climate change, are problematic for nonhuman species as well as for humans. Therefore, biodiversity is likely to decline not only due to the principle of competitive exclusion (Czech 2000), but also as an indirect function of economic growth.
- Biodiversity loss has a particularly macroeconomic aspect, with the human (macro) economy growing at the competitive exclusion of the (macro) economy of nature (Czech 2000). The few studies specifically designed to detect a biodiversity Kuznets curve have not been able to do so (e.g., Naidoo and Adamowicz 2001; Asafu-Adjaye 2003; Majumder et al. 2006; Clausen and York 2008).
- Many studies of the EKC do not consider how trade disguises the real environmental impact of economic growth. Tighter regulations in an advanced nation may cause domestic pollution-intensive industries to relocate to countries with looser regulations, increasing emissions in a foreign country. Thus, the comparative advantage that developing countries have is low environmental standards (Özokcu and Özdemir 2017). In effect, wealthy nations export the GHG emissions and pollutants created by the manufacture of the goods that they import from poorer nations. These emissions and pollutants may be pushed off a rich nation's environmental balance sheet, but they remain on the global one.
- Most of the world's people live in low-income developing countries. Thus, according to the EKC, the worldwide pollution level will worsen over a considerable period of time, as those countries located on the upward-sloping part of the EKC continue to grow economically. As Ekins (1997) puts it: "most of the world's population is still on the section of the curve that is increasing, so that growth in income on the basis of this relationship would result in considerable further environmental damage; ... reviews of overall environmental quality even in the richest countries show that it is still declining."

The Minister's reference to the EKC will not reassure anyone who has read the scientific literature. Instead, it provides yet another alarming demonstration that the government's policies on sustainability have no foundation in peer-reviewed science.

The OECD Report

Another source cited by Minister McKenna is a 2017 study by the OECD that, in her words, "recognizes that growth and climate protection can be achieved in conjunction." Actually, the study does not "recognize" this. It merely "argues that boosting economic growth, improving productivity and reducing inequalities need not come at the expense of locking the world into a high-emissions future" (OECD 2017a). This is a much more tentative assertion. Moreover, the OECD report deals only with our climate predicament, not with ecosystem loss or biodiversity loss.

The OECD Report (OECD 2017b) presents a detailed plan for arresting climate change. The plan calls for strong climate policies, including carbon pricing, and large-scale investments in low-emission infrastructure. The report recommends the G20 countries adopt and implement the plan with financial support from private investment. But the report does not call for any fundamental change to the ideology of permanent economic growth.

The underlying assumption of the OECD plan is that we can simultaneously achieve emission reductions and boost economic growth. Some recent non-peer reviewed publications have also made this argument. For example, the Brookings Institute's findings show that from 2000 to 2016, 33 states in the U.S. experienced small degrees of growth while maintaining the same or lower emission levels (Saha and Muro 2016). In 2017, the World Resources Institute identified a number of countries where emissions had peaked each decade from 1990 to 2010 as had the estimated emissions by 2020 and 2030 (Levin and Rich 2017). Their data show a steady increase in countries with peaking emissions by decade, 19 countries in 1990 up to an anticipated 57 by 2030. Most of these gains have come from improved efficiency and from a shift from coal to lower-carbon-intensity fuels. For example, China showed growth while reducing emissions when changing from coal as the primary energy source to natural gas or oil (Green and Stern 2017).

However, these achievements were short-lived. In 2017, total global fossil CO_2 emissions rose; the same is projected for 2018 (Le Quéré *et al.* 2018). And although some technologies have shown promise for a global clean energy transition, most are not on track. In fact, progress on technologies such as carbon capture and storage has stalled (International Energy Agency 2018). We emphasize that *these technologies remain speculative*—no one knows if they can be scaled up to make a real impact on emissions. Thus they cannot and should not be factored into any realistic climate plan. Despite the leveling of fossil fuel use, atmospheric CO_2 is still increasing, reaching 414.27 ppm on 9 February 2019 (CO2.Earth 2018). Furthermore, even if lower emissions are achieved this decade, the small reductions in atmospheric greenhouse gases will likely not be sufficient to reach the Paris Agreement goal (Deutch 2017).

And a range of political and economic obstacles may well derail the OECD plan. For example, there is no guarantee that the G20 countries will adopt it. And the financial investment that the plan would require may be beyond the means of many nations. China, the largest emitter with

about 26% of the world's total, is expected to produce higher emissions in 2018 and for several years beyond (Liu 2016). The withdrawal of the United States from the Paris Agreement, scepticism about climate change among decision-makers, and funding cuts for climate research and for aid to emerging countries all reduce the likelihood of realizing the OECD plan (Zhang *et al.* 2017).

In short, the OECD report does not provide a credible, science-based blueprint for Canada's future.

The World Bank Report: *Inclusive Green Growth – The Pathway to Sustainable Development*

As a further example of the "significant body of published research outlining the potential for growing the economy while protecting the environment," the Minister refers to the work of the World Bank, in particular its 2012 report *Inclusive Green Growth* (World Bank 2012).

The report begins with a grim assessment: "current growth patterns are not just unsustainable; they are also deeply inefficient." The authors note that "for the past 250 years, growth has come largely at the expense of the environment. And environmental damages are reaching a scale at which they are beginning to threaten both growth prospects and the progress achieved in social indicators" (World Bank 2012: 1–2). But the authors propose a solution: green growth, "using the standard tools of mainstream growth and environmental economics" (World Bank 2012: 3). Unfortunately, green growth, based as it is in "mainstream growth and environmental [not ecological] economics," does not take into account the finite limits of the biosphere.

The green growth model used in the World Bank report rests on the claim that economic, social, and environmental sustainability are "not only compatible, but also largely complementary." The authors argue that economic growth "has come largely at the expense of the environment … which is why green growth aims to ensure that economic and environmental sustainability are compatible" (World Bank 2012: 2). In brief, the report is focused on poverty alleviation and improvement of well-being, and it argues that these goals can be achieved in only two ways: wealth redistribution and/or economic growth under policies that assure equality in the distribution of the benefits of growth (World Bank 2012: 1,2).

But there is not much evidence that economic growth, in itself, reduces income inequality, as noted earlier. In addition, since the 1950s, per capita GDP in Japan, the UK, and the US has grown between 3- and 8-fold, with mean levels of well-being unchanged. As well, the factors of consumption between the poorest and the affluent groups of countries (Affluent North America–Europe–Oceania; Affluent Asia; fast developing BRICs and CIVETS; high income Resource Extractors; Poor with Green Peaks; and the Poorest) differ from 5- to 100-fold globally; the gap between the fast developing and affluent, 2- to 10-fold (Pretty 2013). As Pretty (2013) points out, "A finite planet cannot resource such convergence."

In rich countries such as Canada, poverty could be alleviated through redistribution; economic growth is not necessary. But in poor countries, there is not enough wealth to redistribute to provide a satisfactory level of well-being for all citizens. So, according to the World Bank report,

green growth "is necessary because sustainable development cannot be achieved without it" (World Bank 2012: 3). But how much growth is required to lift out of poverty the nearly 4 billion people who at present struggle to meet their daily needs? How many planets would we need to supply the required resources? (We discuss below the problem of equity and the imperative to reduce consumption in rich countries.)

The World Bank report asserts that green growth can be realized through technological innovation, creative policies, and investment in the environment. But as the economy grows, it must consume ever more of the ecosystems of the biosphere (Daly and Farley 2004: 15–16). The economy is simply a subset of the biosphere, which is a finite, materially-closed source of raw materials. Alleviating poverty and increasing human well-being are important goals, but the World Bank's route to achieving them—green growth—is not realistic, for it rests on the dubious assertion that we can somehow decouple economic growth from the biosphere on which we all depend.

Here again, the Minister has used a source that does not appear to be based on peer-reviewed science.

Smart Prosperity Institute

The Minister also offers a Canadian study, *New Thinking* (Smart Prosperity Institute 2016), produced by the University of Ottawa, "which indicates that the old idea that we must choose between a strong economy and a healthy environment has been proven false" (quoted by the Minister directly from the study's summary).

The Smart Prosperity Institute describes itself as a "think/do tank"; its membership is made up of business leaders, academic researchers, and NGO executives (Smart Prosperity Institute 2016). Conspicuously absent from the leadership team are scientists. Nowhere could we find any indication that *New Thinking* had been peer-reviewed. But then *New Thinking* is not a scientific assessment of green growth; it is a motivational document promoting its merits. It defines "smart prosperity" as a thriving economy, healthy environment, and high quality of life, achieved by decoupling environmental harm from economic success. Significantly, *New Thinking* contains no systematic study of the relationship between the human economy and the natural world.

The Smart Prosperity approach seems to rest on reinventing traditional industries and on building capacity for emerging clean-tech entrepreneurs (Smart Prosperity Institute 2016: 1–2). The report recognizes that we have to have smaller environmental footprints. This, we are told, will be achieved by smart and compact urban design, improved green transit and bike lanes, efficient buildings, more green spaces, and stewardship incentives. The report mentions two environmental victories—reducing acid rain and protecting the ozone layer—as examples of the grit we have managed to muster to get big tasks done. But these victories, important though they were, do not compare at all to the global dilemma we now find ourselves in regarding climate change and biodiversity loss.

The claim in this report that (in the Minister's words) "the choice between a strong economy and a healthy environment has been proven false" seems to rest on the fact that most of the world's

highly competitive economies also rank among the top environmental performers (Smart Prosperity Institute 2016: 18). But this ranking is based only on market efficiencies; it has little connection to the material limits of the biosphere. Moreover (as we have already noted), many of the world's highly competitive economies have improved their environmental performance by offshoring their resource needs and GHG emissions and by not including imports and associated emissions in their calculations of environmental performance (see, for example, Mills and Waite 2009).

BC's carbon tax and Ontario's coal phase-out are offered as examples of the "smart policies that work"; however, the success of BC's carbon tax has been questioned (Lee 2016). The document also refers to the Porter Hypothesis to claim that environmental regulations can lead to competitiveness and profit (Smart Prosperity Institute 2016: 23–24). But, as we have seen, there is little solid evidence to support the Porter Hypothesis.

According to *New Thinking*, "conserving and valuing nature is in our DNA." For example, we learn that Canada is making significant strides towards conservation with parks and protected areas now covering 10% of Canada's land. This is twice the area that was protected just two decades ago. The government has also committed to increase ocean protection from 2% to 10% by 2020 (Smart Prosperity Institute 2016: 40–55). But ecologists believe that roughly 50% of nature's ecosystems need to remain intact if they are to provide the goods and services on which humanity depends—food, carbon sequestration, pollination, climate regulation, pest control, water managements and so forth (Terborgh 2006; Noss *et al.* 2012; Locke 2015; Wilson 2017). Given that Canadians have one of the highest per capita ecological footprints, we have little reason to pride ourselves on our nature-valuing "DNA."

The report's section on evidence-based decision making is especially alarming. Apparently, Canadians' trust in "smart prosperity" will emerge from decisions made using the best available evidence, shared openly and transparently: "The most credible and up-to-date science, data, and economic analysis will not only ensure smart decisions, it will enable every contributor to the smart prosperity transition to fully understand how decisions were reached, what they are intended to do, and what they mean for the daily lives of all Canadians" (Smart Prosperity Institute 2016: 58–62). Yet *New Thinking* does not even mention or attempt to refute the most up-to-date science on these issues.

Green Growth and Decoupling

> *The vision offered by green growth is beguiling: a lush, eco-balanced affluence engineered through ethical enterprise and smart markets. It is also, this essay has argued, a smokescreen. It is a red herring, a pink elephant, a delusion; it is a strategic mirage, a pied-piper panacea that seduces even critical spirits into complicity with capitalist hegemonic projects that do little or nothing to repair humankind's relationship with the environment. … So ingrained has it become that even when existentially threatening growth-related environmental problems loom, the program for their alleviation assumes the form of green growth.*— (Dale 2015)

We turn now to examine in greater detail two key concepts—green growth and decoupling—that underlie the claim, made frequently by both the Minister and the Prime Minister, that we do not need to choose between a healthy environment and a strong, growing economy. (Note: These concepts were the focus of question 9 in our original petition: “What peer-reviewed science is the government using that indicates this 'clean growth' or green growth approach is actually possible and efficacious and will not further degrade the biosphere? How is the government applying the Precautionary Principle when there are so many studies that posit a contrary view to a green, clean growth economy?” The minister's response to these questions referred us back to her answer to the first question—in other words, to the same "significant body of published research" that the present document critiques.)

The goal of Green Growth originated at the Fifth Ministerial Conference on Environment and Development (MCED) held in March 2005 in Seoul, where 52 Governments and other stakeholders from Asia and the Pacific agreed to move beyond the rhetoric of sustainable development and pursue a path of green growth (United Nations 2018). Decoupling through technology, efficiencies, market forces, and conservation is foundational to this goal (Alexander *et al.* 2017; Fletcher and Rammelt 2017). A 2011 UNEP report claimed that decoupling “provides a basis for enhancing human well-being while reducing the intensity of resources being used in economic activities (resource decoupling) and reducing negative environmental impacts from any use of natural resources (impact decoupling)” (UNEP 2011).

As Demaria (2018) notes, “Mainstream economists—finally convinced by the existence of biophysical limits—have started to argue that economic growth can be decoupled from the consumption of energy and materials.” Arratia (2011) suggests the two should not be incompatible and that “we haven’t really tried yet,” although he does point out that our recent 30-year trend “is not encouraging.” Former World Bank president Jim Yong Kim believes that “We have to keep the economy going – there is no turning back on growth. What we have to do is decouple growth from carbon emissions” (Pollution Probe 2015). Green growth, achieved through decoupling, is now the global economic paradigm (Alexander *et al.* 2017).

The literature on decoupling identifies two forms: relative and absolute. *Relative* decoupling occurs when GDP expands more quickly than environmental damage and resource use. Environmental impacts continue to grow, but the economy is growing faster. To achieve *absolute* decoupling, environmental impacts and resource use must fall or remain stable even as the economy grows.

The 2018 IPCC report notes that regional accounting schemes suggest that some decoupling has occurred. However, the decoupling is significantly lessened when total consumption-based accounting is used (IPCC - Intergovernmental Panel on Climate Change 2018: 288). Reductions claimed by one country often come at the expense of increased emissions in another, leading to a net global growth in GHG emissions (Isenhour and Feng 2016). Similarly, apparent absolute decoupling in some countries does not necessarily signify they have achieved green growth, particularly if they are out-sourcing resource-intensive production to another country (Bringezu *et al.* 2004; Dittrich *et al.* 2012; Giljum *et al.* 2014; Wiedmann *et al.* 2015). Wiedmann et al. (2015) suggest that decoupling claims in advanced economies have been exaggerated; decoupling may not in fact be occurring at all, due to the use of non-domestic resources. In

addition, Vavrek and Chovancova (2016) note that even if strong decoupling were achieved, the impacts caused by economic growth would not necessarily be improved: some impacts, such as GHG concentrations, are already too high and they are long-lasting. Even if we managed to halt the growth of emissions or even achieve slight reductions, levels would still be high enough to exacerbate climate change.

Is it possible to achieve a strong enough decoupling between economic growth and environmental impacts to avert the worst consequences of climate change and biodiversity loss? Naess (2016) lists four conditions that would have to be met:

1. Relative decoupling is not sufficient. Decoupling must be absolute: the correlation between economic growth and environmental impacts needs to be zero or negative – not just positive but weaker.
2. Absolute decoupling would need to apply to all environmental impacts, i.e., not only greenhouse gas emissions and other pollutants (e.g., water contamination, SO_2, NO_x, soot), but also biodiversity loss, ecosystem loss, impacts to ecosystem functioning and the provision of their life-support services, deforestation, desertification, loss of productive soils, and other such impacts to the biosphere.
3. Absolute reduction of some impacts would be necessary. Non-growth of impacts, alone, would not be sufficient. For example, current annual emissions of greenhouse gases are unsustainable. Canada is not on track to meet even the modest Copenhagen target of 17% below 2005 emissions levels.
4. Available frameworks and mechanisms would need to ensure that efficacious technical solutions for decoupling were implemented everywhere.

So far, none of these conditions exist (Naess 2016).

It must be acknowledged that some level of relative decoupling has occurred: the world economy today uses 30% fewer resources to produce a unit of GDP than it did 30 years ago. However, there is no sign of absolute decoupling. The amount of resource extraction and use is still increasing globally. We are more efficient in resource use, but economic growth and population growth are simply outpacing efficiency gains. To achieve global sustainability, we would need to achieve *absolute* decoupling (Smith *et al.* 2010; Jackson 2011; Dittrich *et al.* 2012; Wiedmann *et al.* 2015; Alexander *et al.* 2017).

The scientific literature (as opposed to the work of conventional economists and business leaders) makes it clear that absolute decoupling is impossible. Continued economic growth will lead to overshoot and ultimately the collapse of global civilization sometime in this century (Matthews 2000; Næss 2006; Ockwell 2008; Næss and Høyer 2009; Smith et al. 2010; Brand 2012; OECD 2015; Malmaeus 2016; Naess 2016; Ward et al. 2016; Fletcher and Rammelt 2017; Caradonna et al. 2018; Econation 2018; Hickel 2018b). The stakes in this debate, therefore, could not be higher (Alexander *et al.* 2017).

To underscore the folly of relying on the hope we can decouple, we may already have transgressed four planetary boundaries: climate, biodiversity, land-use (deforestation), and biogeochemical cycles (Rockström *et al.* 2009; Nakicenovic *et al.* 2016; Steffen *et al.* 2018). Furthermore, a variety of global metrics indicate that we have also overshot the Earth's capacity

to supply source and sink resources without substantial negative feedback (Krausmann *et al.* 2013; Pretty 2013; Nakicenovic *et al.* 2016). Based on humanity's collective ecological footprint, we are already in overshoot and have been since the early 1970s (World Wide Fund for Nature 2016, 2018). Currently, the global ecological footprint is 2.84 global hectares per person (2014 values) while the global biocapacity is only 1.68 global hectares per person. It is sobering to realize that if everyone on Earth had Canada's ecological footprint of 8.05 global hectares per person, we would need five planet Earths to supply the required resources (Global Footprint Network 2018).

Other models of resource use give similar results. Assuming economic growth continues increasing at its current rates of 2–3% each year, by 2050, human consumption of natural resources would rise to 180 billion tonnes annually (Dittrich *et al.* 2012). A sustainable level is about 50 billion tonnes per year (Bringezu *et al.* 2004), an amount we exceeded at the turn of the century (Hickel 2018a). In 2017, the UN Environment Program ran a more sophisticated scenario with a carbon price of $573 per tonne, a resource extraction tax, and an assumption of significant technological innovation; they even factored in the "rebound effect [see below]." Yet even with these highly optimistic conditions, their scenario showed resource consumption reaching 132 billion metric tons by 2050—i.e., two and half times the sustainable level (UNEP 2017; Hickel 2018b).

An economy with resource demands this large cannot serve all humans equitably within the biocapacity of the planet; that would require a degree of decoupling that is in the realm of fantasy (Dittrich *et al.* 2012; Alexander *et al.* 2017; Fletcher and Rammelt 2017; Ward *et al.* 2017).

According to Fletcher and Rammelt (2017), the fantasy of decoupling "presents both the prospect of sustainable development at some unknown future point and a convenient *a priori* explanation for why this aim is not achieved." This framing requires neither evidence nor coherent conceptualization but simply faith—"faith that cannot be dispelled until the project has been rolled out in a coherent global program." And since "a coherent global program" will be difficult to achieve, a definitive disproval of decoupling remains safely distant. The centrality of economic growth for consumer capitalism is never questioned, and the discourse of green economy/growth obscures the fact that there are limits to growth (Wanner 2015).

There is an obvious danger in waiting to see if decoupling will work. If it does not—and the current science suggests that it cannot—then substantial time will be lost and the environmental crisis will deepen. Economic growth will continue to steamroll over environmental sustainability, and its advocates can continue their business as usual. The fantasy of decoupling allows us to continue our destructive actions while "both the promise of success and demonstration of its impossibility [are] deferred into the future" (Wanner 2015; Fletcher and Rammelt 2017)**.**

Given that we are already in ecological overshoot, *and* that human population is still growing, *and* that poor nations need some form of economic growth to improve their standard of living, it is evident that developed nations will have to enter a planned economic recession or contraction, otherwise known as degrowth (Anderson and Bows 2008; Alexander et al. 2017; Demaria 2018; Hickel 2018b; O'Neill et al. 2018). A purposeful recession—shrinking our economy to an

optimal size that takes into account economic dependence on natural resources—is the only way to scale down human consumption to levels that the Earth can sustain.

Another factor that confounds the decoupling claim, one which its proponents seldom mention, is the rebound effect or Jevon's paradox. When efficiencies allow production costs to decrease, the costs of goods and services therefore decline. Consumers then are able to purchase more with the same financial resources. The result is that when efficiency is increased, consumption almost always increases too, driving an attendant increase in the extraction and use of resources. This paradox effectively negates any inherent savings potential of efficiency measures, suggesting that any technological progress we make will not solve the environmental problems related to resource use (SERI 2009; Dittrich *et al.* 2012; Santarius 2012; Fletcher 2016; Caradonna *et al.* 2018). Jevon's paradox demonstrates the "fatal fallacy of green growth": efficiencies and increased production raise demand, stimulating economic growth, thus preventing the required reduction of absolute energy consumption (Santarius 2012). If we want to attain a reasonable standard of living within the biogeophysical limits of the biosphere, we need both efficiency gains *and* reduced consumption in rich countries (Isenhour and Feng 2016). This is even more true if poor countries are to develop and attain a decent standard of living. Efficiency gains alone will not save us.

In short, there is no indication that absolute decoupling has occurred to any significant degree or that it is even possible. For example, since 1970, there has been relative but no absolute decoupling of CO_2 emissions (Smulders *et al.* 2014). Cleveland and Ruth (1998) point out that, despite claims to the contrary, "there is no compelling macroeconomic evidence that the U.S. economy is decoupled from material inputs." In fact, the recent IPCC report notes that "Ultimately, absolute levels of resource use and environmental impact—including GHG emissions—generally continue to rise with GDP (robust evidence, high agreement)" (IPCC - Intergovernmental Panel on Climate Change 2018).

Sustainable development is often promoted as a way to ensure a better standard of living for the world's poor. Back in the 1980s, the Brundtland Commission on Environment and Development called for expansion of the world economy by a factor of five to ten (Brundtland 1987). But currently the human economy appropriates between 25 and 40% of the Net Primary Productivity (NPP) of the economy of Nature (Vitousek *et al.* 1986; Haberl *et al.* 2007). Using the lower value, expansion of even a factor of four is impossible as we cannot appropriate more than 100% (Daly 2013: 13). Even what we are appropriating currently is a "staggering human impact on the biosphere" (Foley *et al.* 2007). And, as we have mentioned, our potential ability to expand is much less when we factor in the call from ecologists to preserve a minimum of 50% of all ecosystems in their natural state in order to maintain biodiversity and the ecosystem services that keep us all alive. It is clear that sustainable development or green growth is not the answer to global inequality.

The 2018 IPCC report and other recent studies (Dittrich *et al.* 2012; Alexander *et al.* 2017; Ripple *et al.* 2017; Järvensivu *et al.* 2018; O'Neill *et al.* 2018) constitute convincing evidence that even the present economic scale is unsustainable. "How then can people keep on talking about 'sustainable growth' when: (a) the present scale of the economy shows clear signs of unsustainability, (b) multiplying that scale by a factor of five to ten as recommended by the

Brundtland Commission would move us from unsustainability to imminent collapse, and (c) the concept itself is logically self-contradictory in a finite, non-growing ecosystem?" (Daly 2013).

Moreover, there is no reason to suppose that growth in and of itself will lead to social justice. Economic growth, the supposed "rising tide that lifts all boats" has not, despite the many years of global GDP growth, been effective in reducing poverty but has been instrumental in increasing inequality (Næss and Høyer 2009). Sustainable development must be development *without growth*—but with population control and wealth redistribution—if it is to be a serious attack on poverty (Daly 2013: 13).

Many researchers pin their hopes on technical solutions. But it is not clear that we can develop and implement technologies soon enough or at the necessary scale (Gerlach 2015; Jackson 2016). Negative-emission and carbon-capture technologies remain highly speculative. Research on those technologies should, of course, continue, but as mitigation solutions they cannot be factored into policy until we have unquestionable evidence of their utility. "The implications of failing to do otherwise are a moral hazard par excellence" (Anderson and Peters 2016). Indeed, considering past trends in innovation and implementation, new technologies are not advancing quickly enough to avert irreversible climate change (Demaria 2018).

If we are to achieve real green growth—that is, qualitative growth "in which economic stability can be achieved without relentless consumption growth"—we will need at the very least a structural change in our macro-economic model (Jackson and Victor 2011). Ultimately, addressing global sustainability and social inequality requires humanity to live within planetary limits; it requires those of us who live in rich countries to reduce our consumption and impacts. If that is to happen, we need a new economic system based on a scientific foundation, a system that recognizes planetary limits and rejects the endless pursuit of economic growth. We need to develop a resilient and sustainable, steady state economy that lies within the regenerative and assimilative capacity of the biosphere (Daly 1996; Daly and Farley 2004; SERI 2009: 31; Burton 2015; Isenhour and Feng 2016; Ward *et al.* 2016; World Wide Fund for Nature 2016; Hickel 2018a; O'Neill *et al.* 2018).

Ecosystem degradation and biodiversity loss

We turn now to a striking omission from the Minister's response—the problem of ecosystem degradation and biodiversity loss.

Much of the supporting documentation from the Minister focuses on emissions of CO_2 and other greenhouse gases. But, as we emphasized in our original submission, climate change is not the only threat. Many scientists believe that impacts on ecosystem structure and biodiversity may present an even greater danger. The odds of decoupling economic growth from greenhouse gas emissions are poor; the odds of decoupling it from ecosystem impacts are non-existent. Studies show that higher biodiversity losses occur with further economic growth, even in an already wealthy country (Naess 2016).

Ceballos et al. (2017) suggest that "as much as 50% of the number of animal individuals that once shared Earth with us are already gone, as are billions of [regional] populations." The

proximate causes of this rapid defaunation are familiar: habitat conversion, climate disruption, overexploitation, toxification, species invasions, and disease. Much less frequently mentioned, however, are the ultimate drivers of biotic destruction, namely, human overpopulation and overconsumption. These, of course, are also the drivers of economic growth (Heilbroner and Thurow 1987). Ceballos *et al*. (2017) emphasize that the sixth mass extinction is already here, and the window for effective action is very short, probably two or three decades at most. A recent review of research on insect populations concludes that over 40% of insect species are threatened with extinction. The causes of this decline are overwhelmingly anthropogenic: habitat loss and conversion to intensive agriculture and urbanisation, and pollution from synthetic pesticides and fertilisers (Sánchez-Bayo and Wyckhuys 2019) all driven by demands to grow the economy. As the authors of this study point out, "the repercussions this will have for the planet's ecosystems are catastrophic to say the least, as insects are at the structural and functional base of many of the world's ecosystems."

Another recent study – a highly complex modelling of 2000 scenarios – concluded that "climate change and human activity are dooming species at an unprecedented rate via a plethora of direct and indirect, often synergic, mechanisms" (Strona and Bradshaw 2018). The extinctions we are now witnessing "could be just the tip of an enormous extinction iceberg." All signs point to ever more powerful assaults on biodiversity in the next two decades.

Scientists have tried to alert citizens and policy makers to the peril that this poses to human civilizations. Jose Sarukhan, coordinator of the Mexican government's National Commission for the Knowledge and Use of Biodiversity (Conabio), believes the threat to humanity posed by the loss of biodiversity is as great or even greater than that posed by climate change (Anonymous 2018a). Bloomfield (2010) notes the increasing recognition of the economic and health costs to humanity from biodiversity loss. For example, the annual losses from deforestation alone mount to $3–4bn; no government can sustain such losses indefinitely. To the public and most politicians, biodiversity is about saving endangered species, or securing natural habitats. But biodiversity is an issue of mainstream economic importance with wide-ranging implications, from flood and drought mitigation to soil conservation, marine food resources, pollination, food plant development, pest control, and medical research. Moreover, if we do not protect and enhance biodiversity, we will lose our biggest ally in fighting climate change. Living systems can lock away carbon at a fraction of the price that it will cost us to design and implement carbon capture and storage technologies (Carrington 2019); moreover, these technologies will in themselves require energy inputs, thus compounding our problems.

Gerben-Jan Gerbrandy, the European Parliament's rapporteur on biodiversity, has warned that the loss of biodiversity poses an unprecedented threat to our existence. "This is not just a matter of morality. Our human race can simply not survive without all the services nature provides us with. Food, clean air, clean water and fertile soil—we can thank only nature for all of this" (Anonymous 2018b). Maxwell et al. (2016) observe that "It is also crucial that the World Conservation Congress delegates — and society in general — ensure that efforts to address climate change do not overshadow more immediate priorities for the survival of the world's flora and fauna."

Economist Pavan Sukhdev, author of a recent United Nations report, states the economic case for global action to stop the destruction of the natural world is even more powerful than the

argument for tackling climate change. He notes we need a change in human attitudes towards nature that involve a wholesale revolution in the way we do business, consume, and think about our lives. Sukhdev calls the damage currently being inflicted on the natural world as "a landscape of market failures" (Jowit 2010).

Until our policy-makers recognize Czech's (2000) tenet of the fundamental conflict between economic growth and biodiversity conservation, we will continue to lose ecosystems and their attendant biodiversity, placing the future of humanity at risk. Dealing with the biodiversity crisis will require political will, and policies need to be based on solid scientific knowledge if we are to ensure a safe future for the planet (University of Copenhagen 2012). Unfortunately, nothing in the Minister's response to our petition or in the Sustainable Development Strategy suggests that she is developing policy on the basis of "solid scientific knowledge."

Conclusions

Despite the rhetoric of progress and reform—"sustainable development," "sustainable growth," "smart growth," "green growth," and "decoupling"—human impact on the biosphere has steadily increased over the past three decades. Ecosystems have become more degraded, biodiversity has declined, more species have gone extinct, greenhouse gas concentrations have risen, and human appropriation of net primary production has increased (Caradonna *et al.* 2018). Sustainable development policies have largely failed (Brand 2012). As Kosoy et al. (2012) observe, "Cynics might be forgiven for wondering how many more slogans are needed before governments accept that real change is needed."

Is decoupling just another slogan or can it be the foundation for sound environmental and economic policies? Decoupling is typically presented as a relationship between increasing Gross Domestic Product (GDP) and decreasing greenhouse gas (GHG) intensity. The minister points to the fact that the Canadian economy has grown more rapidly than its GHG emissions. This is true, but over all, of course, our emissions continue to grow; they just aren't growing as fast as the GDP. Since 1990, GHG emissions per person in Canada have declined; unfortunately, because of population growth, emissions have actually increased about 17% overall (Environment and Climate Change Canada 2017). In other words, we have achieved some measure of relative, not absolute, decoupling.

Moreover, in focusing on GDP and GHG emissions, we are not getting the whole picture. GDP cannot be considered a good proxy for human well-being, for income inequality has increased at the same time that GDP has grown (IPCC - Intergovernmental Panel on Climate Change and Edenhofer 2014: 289, 310; Ward *et al.* 2016; Conference Board of Canada 2018). Measures of GHG emissions, while obviously central to discussions of climate change, tell us nothing about other environmental impacts—declining biodiversity, deteriorating soil quality, shrinking water resources, plastic pollution, and so forth.

Environment and Climate Change Canada claims that "Science and data underpin our sustainable development agenda, from climate change policy to water stewardship to biodiversity protection" (Environment and Climate Change Canada 2016: 11). As the research we have done demonstrates, this is simply not the case. Ignorance or suppression of science has been a problem

with past governments both in Canada (CropLife Canada 2009; Dupuis 2013; Chung 2014; Dvorsky 2018) and elsewhere (Swain and Robbins 2009; Abraham 2018; Carter *et al.* 2018; Schulman 2018). As (Swain and Robbins 2009) emphasize, "Science is at the heart of our modern world, and it deserves to be at the heart of political discussion too. To make informed choices on the challenges facing us we need evidence backed up by robust science...." Unfortunately, our government's solution to the climate crisis and biodiversity loss is decoupling and green growth, a theory that is neither evidence-based nor "backed up by robust science." Yet on this foundation, the government has built its sustainable development strategy.

The Minister has specifically stated that in setting environmental policy the federal government follows the precautionary principle. The precautionary principle requires governments to err on the side of caution in situations where harm might result. If there is scientific uncertainty—as there most assuredly is in the case of decoupling—the Minister's own embrace of the precautionary principle dictates that she should act with caution. For if decoupling fails, the resultant harm—runaway climate change, ecosystem collapse—will be very great indeed.

We return to our original argument about the dangers of economic growth. Anyone who looks at the scientific evidence—that is, peer-reviewed evidence supported not just by a few studies but by many—cannot help but conclude that this government's economic growth policies are founded on discredited theory, wishful thinking, and a perilous tendency to discount future harms in the interest of present benefits. We are in trouble, and we cannot get out of it with the reassuring falsehoods that the government is delivering. We need public policy and action based on science and on an honest, clear-eyed assessment of our problems.

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