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## Framework

#### The standard is maximizing expected wellbeing

#### [1] Uncertainty means extinction comes first as a meta constraint

Nick **Bostrom 13** [Faculty of Philosophy & Oxford Martin School, Oxford], “Existential Risk Prevention as Global Priority”, Global Policy, Vol 4, Issue 1 (2013): 15-31, BE

**These reflections on moral uncertainty suggest an alternative, complementary way of looking at existential risk**; they also suggest a new way of thinking about the ideal of sustainability. Let me elaborate.¶ **Our present understanding of axiology might well be confused. We may not now know — at least not in concrete detail — what outcomes would count as a big win for humanity**; we might not even yet be able to imagine the best ends of our journey. **If we are indeed profoundly uncertain about our ultimate aims, then we should recognize that there is a great option value in preserving — and ideally improving — our ability to recognize value and to steer the future accordingly. Ensuring that there will be a future version of humanity with great powers and a propensity to use them wisely is plausibly the best way available to us to increase the probability that the future will contain a lot of value. To do this, we must prevent any existential catastrophe**.¶ We thus want to reach a state in which we have (*a*) far greater intelligence, knowledge, and sounder judgment than we currently do; (*b*) far greater ability to solve global-coordination problems; (*c*) far greater technological capabilities and physical resources; and such that (*d*) our values and preferences are not corrupted in the process of getting there (but rather, if possible, improved). Factors *b* and *c* expand the option set available to humanity. Factor *a* increases humanity's ability to predict the outcomes of the available options and understand what each outcome would entail in terms of the realization of human values. Factor *d*, finally, makes humanity more likely to want to realize human values.

#### [2] Util is the only moral system that assumes a fundamental equality of all beings.

David **Cummiskey 90** [Associate prof of philo @ UChicago], “Kantian Consequentialism”, University of Chicago Press, Ethics, Vol. 100, No. 3 (Apr., 1990), pp. 586-615, BE

We must not obscure the issue by characterizing this type of case as the sacrifice of individuals for some abstract “social entity.” It is not a question of some persons having to bear the cost for some elusive “overall social good.” Instead, **the question is whether some persons must bear the inescapable cost for the sake of other persons.** Robert Nozick, for example, argues that “to use a person in this way does not sufficiently respect and take account of the fact that he is a separate person, that his is the only life he has.” But why is this not equally true of all those whom we do not save through our failure to act? **By emphasizing solely the one who must bear the cost if we act, we fail to sufficiently respect and take account of the many other separate persons, each with only one life, who will bear the cost of our inaction.** In such a situation, what would a conscientious Kantian agent, an agent motivated by the unconditional value of rational beings, choose? A morally good agent recognizes that the basis of all particular duties is the principle that “rational nature exists as an end in itself”. Rational nature as such is the supreme objective end of all conduct. **If one truly believes that all rational beings have an equal value, then the rational solution to such a dilemma involves maximally promoting the lives and liberties of as many rational beings as possible.** In order to avoid this conclusion, the non-consequentialist Kantian needs to justify agent-centered constraints. As we saw in chapter 1, however, even most Kantian deontologists recognize that agent-centered constraints require a non- value-based rationale. But we have seen that Kant’s normative theory is based on an unconditionally valuable end. How can a concern for the value of rational beings lead to a refusal to sacrifice rational beings even when this would prevent other more extensive losses of rational beings? If the moral law is based on the value of rational beings and their ends, then what is the rationale for prohibiting a moral agent from maximally promoting these two tiers of value? **If I sacrifice some for the sake of others, I do not use them arbitrarily, and I do not deny the unconditional value of rational beings.** Persons may have “dignity, that is, an unconditional and incomparable worth” that transcends any market value, but persons also have a fundamental equality that dictates that some must sometimes give way for the sake of others. The concept of the end-in-itself does not support the view that we may never force another to bear some cost in order to benefit others.

## Contention 1 is Access To Medicine

#### International property protections protect developed countries and allow them to maintain extended monopolies in pharma, disproportionately hurting low-income countries

Economist Dean Baker writes in 2017 (Dean Baker is an American macroeconomist and co-founder, with Mark Weisbrot, of the Center for Economic and Policy Research in Washington, D.C. He is credited as one of the first economists to have identified the 2007–08 United States housing bubble., Arjun Jayadev is an Associate Professor of Economics at Azim Premji University and University of Massachusetts Boston., Joseph Stiglitz is an American economist, public policy analyst, and a professor at Columbia University. He is a recipient of the Nobel Memorial Prize in Economic Sciences and the John Bates Clark Medal.), “Innovation, Intellectual Property, and Development: A BETTER SET OF APPROACHES FOR THE 21st CENTURY”, July 2017, Azim Premji University & Columbia University, pg. 27-28, <https://www8.gsb.columbia.edu/faculty/jstiglitz/sites/jstiglitz/files/IP%20for%2021st%20Century%20-%20EN.pdf> NT

We have, thus far focused on how innovation may be better protected and incentivised in general. The IP regime as we noted in the introduction does not work very effectively in both developed and developing countries. In the former, several pathologies, such as the problems associated with patent thickets, patent trolls and evergreening are well documented. **High tech companies are often confronted with being unable to innovate without violating other companies’ intellectual property rights since innovation often requires the use of currently existing IP.** This leads to blocks (sometimes called a patent thicket), that delays and reduced IP because of the long and costly negotiations involved in obtaining the multiple permissions needed. Patent trolling, whereby innovators face suit from others who simply own IP to proft by licensing of litigation rather than undertaking production themselves is well known with particularly egregious cases. Estimates suggest that this cost the US roughly $30 billion a year (Bessen and Meurer, 2014). **Similarly, the process of evergreening, whereby companies extend their patent protection by inventing new follow-on patents that are closely linked but which allow for a longer period of monopoly than would otherwise be permitted, is an important impediment to competition, especially in the pharmaceutical industry.** 28 Our focus in this section is on the impact of the current IP regime on global development. Developing economies are, almost by definition, significantly distant from the global innovation and production frontier. While individual industries and firms can often be close to the frontier, the generalised adoption of latest generation technologies and the garnering of the positive externalities that often result from these is a key feature of advanced industrialised economies. What separates developing from developed countries is as much a gap in knowledge as a gap in resources. The artifcial scarcity created by IPR generates economic inefficiencies. One person’s access to knowledge does not detract from another’s. One country’s use of a new technology does not compromise the ability of the rest of the world to beneft from it. **The temporary monopoly conferred by IPR creates a market distortion, resulting in less access than is socially optimal.** At a time when learning is increasingly recognised as foundational to development, we should be skeptical of institutions that remove knowledge from the common pool without a clear justifcation (Stiglitz and Greenwald, 2014). From a development perspective, it is therefore necessary to evaluate whether IPR remains fit for the purpose, in the sense that it results in greater overall production of knowledge and the advancement of standards of living than would be achieved without it. There is an extensive literature that attempts to answer these questions. The evidence is uncertain at best and there are alternative mechanisms to protect intellectual effort, as noted before. In any case, from a development perspective, the inquiry must go further than this. First, the developing country needs to ask, what IPR (or more broadly, innovation system) best advances its own standard of living. **Stronger IPR may constitute a barrier to the ability of its firms catching up to the frontier, even if it enhances innovation within the country.** Because developing countries are engaged in catching up, the optimal IPR regime for them will in general differ from that for a more advanced economy. **Moreover, stronger IPR regimes will entail the transfer of more money in the form of royalty payments from developing to developed countries.** The benefits to developing countries from these increased payments (beyond the direct transfer of knowledge) are minimal, i.e. it is not likely that these payments will significantly affect either the amount or direction of research. **This is most apparent in the drug industry, where pharmaceutical company devote relatively little of their research budget towards the diseases that afflict developing countries, and the incremental returns that they receive from developing countries are sufficiently smaller that they are unlikely to affect significantly the overall pace of innovation.**

#### Patents and market exclusivity, a type of IPP, are vital to these monopolies, preventing generic medicines from entering the market and allowing heavily marked-up drug prices.

Harvard Professor Aaron Kesselheim writes (Aaron S. Kesselheim, MD, JD, MPH, Program On Regulation, Therapeutics, And Law (PORTAL), Division of Pharmacoepidemiology and Pharmacoeconomics, Department of Medicine, Brigham and Women’s Hospital and Harvard Medical School. Jerry Avorn, Professor of Medicine at Harvard Medical School and Chief of the Division of Pharmacoepidemiology and Pharmacoeconomics at Brigham and Women’s Hospital. Ameet Sarpatwari is an Assistant Professor of Medicine at Harvard Medical School and the Assistant Director of the Program On Regulation, Therapeutics, And Law (PORTAL) within the Division of Pharmacoepidemiology and Pharmacoeconomics at Brigham and Women's Hospital.), “The High Cost of Prescription Drugs in the United States Origins and Prospects for Reform”, Journal of the American Medical Association, 8-23-16, <https://jamanetwork.com/journals/jama/article-abstract/2545691> NT

The most important factor that allows manufacturers to set high drug prices for brand-name drugs is market exclusivity,28 which arises from 2 forms of legal protection against competition. Together, these factors generate government-granted monopoly rights for a defined period. Initial regulatory exclusivity is awarded at FDA approval. **New small-molecule drug products automatically earn a guaranteed period of 5 to 7 years before a generic competitor can be sold, 29 and new biologic drugs are protected from competition for 12 years**.30 The second type of market protection is patent-related exclusivity because manufacturers can receive patents lasting 20 years or more for their inventions.31 The US Patent and Trademark Office issues this intellectual property right—originally written into the US Constitution to encourage innovation—for inventions that are “novel,” “useful,” and “non-obvious.”32 Although regulatory exclusivities often set a lower-bound duration for market exclusivity, the actual length of such exclusivity is most commonly dictated by patent time. Because initial patents protecting the active ingredient are usually obtained when a drug is first synthesized, and the clinical trial and FDA review process usually takes on average 6 to 8 years, only half of the patent period may be left by the drug approval date.33However, a company can apply to have this period extended by up to 5 years to account for the time spent during regulatory review and half the time in clinical trials (“patent term restoration”), to a maximum of 14 years.34 In addition, sponsors can also earn 6 more months of market exclusivity by testing their products in children,35 an incentive earned by more than 200 drugs since legislation created the pediatric exclusivity program in 1997.36 Overall, the median length of post approval market exclusivity is 12.5 years for widely used drugs (interquartile range, 8.5- 14.8 years) and 14.5 years for highly innovative, first-in-class drugs (interquartile range, 13.3-15.8 years).37,38 During that exclusivity period, the availability of treatment alternatives might be expected to exert pressure to reduce the price of a drug.39 For example, approximately a year after Gilead introduced sofosbuvir, AbbVie received approval for a 4-drug, direct acting, antiviral regimen that achieved similar clinical response rates against the hepatitis C virus, leading some payers to negotiate sofosbuvir discounts of more than 40%.40 In practice, however, competition between 2 or more brand name manufacturers selling drugs in the same class does not usually result in substantial price reductions.41 For example, of the 8 cholesterol-lowering statins that the FDA has approved, 2 have until recently remained patented: rosuvastatin (Crestor) and pitavastatin (Livalo). Despite the similar performance of these drugs in decreasing low-density lipoprotein cholesterol to other off-patent statins,42 the price of rosuvastatin increased 91% between 2007 and 2012, from $112 to $214 per prescription.43 During the same time, the price of the comparably effective atorvastatin decreased from $127 to $26 per prescription owing to the expiration of its patent protection in 2011.44 Similar effects have been observed for other drug classes.45 One factor that undermines competition among treatment alternatives is the separate roles of patients, prescribers, and payers: physicians write prescriptions, pharmacists sell medications, and patients or their insurers pay for them.46 This separation has traditionally insulated physicians from knowing about drug prices or considering those prices in their clinical decisionmaking47 and can similarly remove many patients with good drug coverage from considering the price of the medications they “purchase.” **The only form of competition that consistently and substantially decreases prescription drug prices occurs with the availability of generic drugs, which emerge after the monopoly period ends.** With FDA approval, these products can be substituted for bioequivalent brand-name drugs by the pharmacist under state drug product selection laws. In states with less restrictive drug product selection laws, **generic products comprise up to 90% of a drug’s sales** within a year after full generic entry.48 Drug prices decline to approximately 55% of brand-name drug prices with 2 generic manufacturers making the product, 33% with 5 manufacturers, and 13% with 15 manufacturers.49 In 2012, the US Government Accountability Office estimated that generic drugs accounted for approximately 86% of all filled prescriptions and saved the US health care system $1 trillion during the previous decade.50 **Entry of generic drugs into the market, however, is often delayed. For pharmaceutical manufacturers, “product life-cycle management” involves preventing generic competition and maintaining high prices by extending a drug’s market exclusivity.** This can be achieved by obtaining additional patents on other aspects of a drug, including its coating, salt moiety, formulation,51 and method of administration.52,53 In an example of this strategy, the manufacturer of the proton-pump inhibitor omeprazole (Prilosec) received an additional patent on the drug’s S-isomer, despite the absence of any compelling pharmacologic difference. This led to the creation of esomeprazole (Nexium) as a newly branded product that was sold for $4 a pill, a 600% markup over the over-the-counter version of omeprazole.54 Because permissive US Patent and Trademark Office standards for novelty or usefulness make it relatively easy to patent many nontherapeutic aspects of a drug, companies can strategically patent small changes and try to influence prescribers and patients to transition from one linked product to the next, sometimes discontinuing production of older versions of the drug. For their part, generic manufacturers have engaged in litigation with brand-name manufacturers that could lead to the patents being invalidated, but these suits are frequently settled.55 Historically, brand-name manufacturers have offered substantial financial inducements as part of these settlements to generic manufacturers to delay or even abort generic introduction.48 Settlements involving large cash transfers are called “pay for delay”; for example, in a patent challenge case related to the antibiotic ciprofloxacin (Cipro), the potential generic manufacturer received upfront and quarterly payments totaling $398 million as part of the settlement and agreed to wait until patent expiration to market its product.56

#### These big pharma monopolies are disproportionately detrimental to developing countries – patent law decreases access to medicine

Proffessors Saeed Ahmediani and Shekoufeh Nikfar write (Saeed Ahmadiani and Shekoufeh Nikfar both work in the Department of Pharmacoeconomics and Pharmaceutical Administration at Tehran University of Medical Sciences), “Challenges of access to medicine and the responsibility of pharmaceutical companies: a legal perspective”, 5-4-16, DARU Journal of Pharmaceutical Sciences, pg. 2-3, DOI 10.1186/s40199-016-0151-z, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4855755/> NT

Huge part of barriers in access to medicine returns to patent law and its consequences. Although patent law generally has been used for centuries [2], the manifestation of TRIPS agreement in 1994 turned it to a new form of challenge. This agreement force the World Trade Organization (WTO) members to take action for protecting intellectual property rights, which entails that any patented product should be produced, imported, sold or used under permission of the patent owner [3]. This includes medicine, thus the production of each medicine is initiated with a period of monopoly in the market with the highest possible price. In this period there will be no low price generic drugs in the market after signing the agreement by one state (for those drugs which are still under patent), and hence, patients should provide the expensive branded medicine either out of pocket or by using their insurance. **The problem will rise up when it comes to a developing country where population not only have lower economic status, but also lower health status and higher needs to medicine**. According to WHO, life expectancy in developed countries was 1.7 fold higher than developing countries in 2002, showing a 32-years gap in life expectancy between these societies [4]. Also, data shows that infectious diseases such as TB have a negative relationship with GDP per capita of the country [5] (also see Fig 1). These health measures make it obvious that in developing countries there is a higher need to medical technologies which many of them are under patent. At the same time, health insurance coverage is usually poor in these countries and patients often have to pay for the branded medicine out of their own pockets. Evidence shows that the lower the national income is, the higher the out of pocket share of health spending will be [6]. **With higher needs and lower economic ability, providing branded medicine will result in a large load of expenditure for states, catastrophic expenditures for patients [7] and increase of mortality and/or morbidity because of low access to medicine** (see Fig 2). Moreover, if any TRIPS member produce or provide an under patent product, the company can sue the member state and ask for a fine compensating the market loss. This was the case for South Africa in late 90s, when giant pharmaceutical companies such as GlaxoSmithKline filed a lawsuit to the Pretoria High Court against the South African government because of importation of generic anti-retroviral medicine- for treating HIV/AIDS endemic situation [8]. The Pharmaceutical Association was using this law to save their presence in the pharmaceutical market of South Africa. However, there were millions of people suffering from HIV/AIDS while could not afford the original brand medicine and the South African state was trying to find a way to guarantee their health. After three years of clashes, the court overruled the patent law in the case and recognized the right to health as a basic human right for the South African patients. Consequently big pharma companies withdrew the lawsuit and started negotiations for dropping the price of original brand to come into the South Africa market [9]. Although this was a happy-ending experience, no country can be sure that the court will give the right to the member state again and hence, in many cases the government prefer to import the branded medicine from the beginning, even if it is not affordable for a part of population. The TRIPS agreement is not the end of story. Less than a decade after the first TRIPS agreement, United States started to make bilateral trade agreements with other TRIPS members to expand and deepen the TRIPS agreement. **These agreements (generally known as TRIPS-plus) decrease the flexibilities which were anticipated for some exceptional situations- particularly for developing countries- and increase the duration of patents in some cases.** Until now, there are 20 countries that accepted such an agreement with US [10], which surprisingly 80 % of them are developing countries. If we consider the economic power of United States and its role in pharmaceutical industry, then it is not hard to guess about the effect of these agreements on the access to medicine in the subjected developing countries. Besides the patent law and TRIPS-plus agreements, there is always a bias towards maintenance medicine- the controlling medicine for chronic conditions. Pharmaceutical companies have a substantial desire in developing drugs which are focused on disease areas within the developed world, such as chronic diseases and cancer treatments, not only because of high prevalence, but also because these drugs are often used in long term, which means a long term costumer for the company, particularly if one can take the advantage of patent. As an instance, a new anti-hypertensive medicine not only has more costumers, also most of the costumers have to use the medicine until the end of their lives, let’s say 10–15 years in average. On the other side, giant pharmaceutical companies are less interested in modern anti-parasites, antibiotics and other medicines related to acute conditions, while these medicines are more needed in developing countries and this bias cause a lower access to medicine- and a lower health in result- in these low income areas. The mentioned bias also can be seen against “rare diseases” (i.e., diseases with prevalence less than 1/2000), even if they might be chronic. This inattentiveness to some specific diseases forms when the disease is rare or restricted to some particular areas and population, hence pharmaceutical companies find no incentive to invest on research and development of new medicine specified for a limited population, specifically when there is a large possibility that the state does not have the ability to pay for the medicine and the company should provide it underprice. To see it evidently, from over 1500 drugs which have been approved during 1975–2004, only about 1 % of them were related to the diseases which are known as neglected [11], while over 10 % of global burden of disease is caused by these diseases [12]. This is also reflected in 10/90 phenomena: only 10 % of R&D expenditures is related to problems of 90 % of world population [13]. These facts clearly show an insufficient attention from pharmaceutical companies to this field of health needs. According to WHO, already over one billion people are affected by neglected tropical diseases [14], which may considerably decrease both the life expectancy and quality of life. By considering the higher rate of these diseases in low income countries, it is to say that this situation can cause a huge discrimination between high and low income societies, not only in terms of health, but also economically as a consequence of low health level. All these modern structures, from patents and TRIPS-plus agreements to bias in pharma industry, cause a decrease or imbalance in access to medicine, and hence an inequity in health between and within the communities, which can be considered as a breach of human rights as will be explained further.

#### This decreases innovation - pharma patents are rewarding failure and benefit the least innovative parts of the industry

Feldman 8/8/21 (Robin Feldman’s work focuses on the role of intellectual property law in technology and innovation; drug patents, pricing, and health care law; and artificial intelligence and data. She is the Arthur J. Goldberg Distinguished Professor of Law, the Albert Abramson ’54 Distinguished Professor of Law Chair, and Director of the UC Hastings Center for Innovation (C4i).), “Our patent system is broken. And it could be stifling innovation.”, The Washington Post, <https://www.washingtonpost.com/outlook/2021/08/08/our-patent-system-is-broken-it-could-be-stifling-innovation/> NT

Incentivizing failure is particularly problematic in light of a historic shift in the pharmaceutical industry over the past decade. Faced with stagnating research results, the industry has shifted to outsourcing innovation. Specifically, the majority of innovation in the pharmaceutical industry comes from academia or from small life-science companies. Large pharmaceutical companies then shepherd the drugs through the FDA approval process and into production. And so, **at the end of the day, the big companies — the ones arguing for compensation for failure through hefty patent returns — are not the ones taking the greatest risks for drug development.** Rather, they are gaming the patent system: maintaining high prices and keeping competitors out with patent protections. Consider Gilead’s hepatitis C cure, Sovaldi. The company more than recouped what it paid for the drug in the first year of sales alone. And after five years, the company reaped in excess of $58 billion dollars from sales of the drug, more than five times what it paid to acquire the drug from the start-up that took the initial risk and engaged in the innovation. Or consider Merck’s immunotherapy drug, Keytruda. In 2020 alone, the drug’s sales topped $14 billion, with no signs of flagging. Forbes estimates that the value of Keytruda is $200 billion — a far cry from the $300 million the company paid to acquire it. And Keytruda’s boatload of patents insulates the company’s pricing scheme from competition. Yet the true innovator — that is, the company that took the research risk — isn’t the one reaping the lion’s share of the reward. Rather, the bulk of the patent reward is going to the company that walked the last mile. Examples such as these show how **modern pharmaceutical markets allow large companies to be over-rewarded while innovators are under-rewarded.** If society actually wanted a patent system that compensates for failure, the dollars would go to those who make the investment in the research and take the risk of failure — the inventors. None of that is happening here. Instead, by passing so little of the profit to those who perform the successful research, the system dilutes the incentive for research. **We are not just incentivizing failure, we are sending those dollars to the least inventive part of the innovation chain.** In short, incentivizing failure is as counterproductive as the phrase sounds. Why would we want a patent system in which the less efficient person — the one who fails more along the way — gets a larger reward? Unless we recognize that problem, the nation may find itself sliding quietly into an approach that undermines the contours of the patent system from time immemorial, hampering our ability to innovate in crucial areas.

## Contention 2 is Climate Change

#### Removing patents for drugs removes the incentive for pharma companies to merge by removing the common threat of patent cliffs, which solves innovation and increases drug research

Feldman 4/6/21 (Robin Feldman’s work focuses on the role of intellectual property law in technology and innovation; drug patents, pricing, and health care law; and artificial intelligence and data. She is the Arthur J. Goldberg Distinguished Professor of Law, the Albert Abramson ’54 Distinguished Professor of Law Chair, and Director of the UC Hastings Center for Innovation (C4i).), “Drug companies keep merging. Why that’s bad for consumers and innovation.”, The Washington Post, <https://www.washingtonpost.com/outlook/2021/04/06/drug-companies-keep-merging-why-thats-bad-consumers-innovation/> NT

The Federal Trade Commission’s acting chairwoman, Rebecca Kelly Slaughter, recently announced that the agency would collaborate with regulators in Canada and the European Union to review its guidelines for evaluating drug company mergers. This move may signal more active policing of consolidation in the pharmaceutical industry. For prescription drug users and society at large, this is a welcome — and long overdue — change, one with the potential to spur innovation and offer more treatment options to Americans. **In the past few decades, three waves of mergers have substantially increased concentration in the pharmaceutical industry.** The first wave occurred from approximately 1988 to 1991, with the second following between approximately 1996 and 2002. The third began in 2010 and remains ongoing. The result of these merger waves has been a dramatically consolidated industry. In 1987, the combined market share of the eight largest drug companies stood at a relatively low 36 percent. By the conclusion of the first merger wave, it had grown to 42 percent; by 2012, in the wake of the second merger wave, the ratio had climbed to 53 percent. All told, between 1995 and 2015, the 60 leading pharmaceutical companies merged to only 10. **As a result, now only a handful of manufacturers are responsible for sourcing the vast majority of prescription drugs: Just four companies, for example, produced more than 50 percent of all generic drugs in 2017.** This dramatic consolidation has remade the pharmaceutical industry. Before 1988, a robust cohort of drug manufacturers often competed across multiple therapeutic areas. This competition encouraged exploring different possible approaches for treating the same disease state as well as treatments for a wider range of health concerns, **increasing the potential for innovations that might improve lives**. Although this marketplace was better for innovation, drug companies were drawn to merging because of the lure of increased market power, improved synergies, larger economies of scale and more diverse product portfolios. Abrupt changes to the environment surrounding the pharmaceutical industry also encouraged consolidation. In the late 1980s, widespread deregulation at both the state and federal level may have facilitated an uptick in mergers, particularly as companies with expiring drug patents sought to make up for their revenue losses by acquiring other profitable drugs. The second merger wave beginning around 1996 can be traced in part to another external shock, as globalization spurred firms to join forces to reach more potential markets. **Similar to the first merger wave, “patent cliffs,” in which many of a company’s drugs were set to lose their lucrative patent monopoly around the same time, also helped push firms to combine forces.** But the newly consolidated pharmaceutical industry actually stifled innovation. In the period following merger waves one and two, the industry generated fewer new molecular entities each year compared to pre-merger levels. Merged drug companies also spent proportionally less on research than their non-merged competitors.

#### The pharma industry exacerbates climate change, with big pharma causing significantly more carbon emissions than even the automotive industry

Belkhir 4/19/21 (Dr. Lotfi Belkhir, tenure track Associate Professor, Walter G. Booth School of Engineering Practice, and Class of 1962 Mechanical Engineering Endowed Chair in Eco-Entrepreneurship. Dr. Belkhir is a visionary and results-driven academic and business practitioner. He is a researcher, teacher, inventor and entrepreneurial leader with 17 years of distinguished industrial experience in sustainable and innovation-powered business creation and economic growth. Dr. Belkhir is an expert and thought-leader in the field of Total Sustainable Management, Eco entrepreneurship, digital convergence and its socio-environmental impact. Possesses proven leadership skills in research and development, IP protection, business development, finance, strategic planning, and general management. He possesses strong and successful international experience and alliances, public speaking, and relationship building. Multicultural, and fluent in English, French and Arabic, Dr. Belkhir earned his Ph.D. in condensed matter physics from SUNY and MBA in Management of Technology, Walden University.), “How big pharma contributes to climate change”, Global News, first published 6-1-19 and updated 4-19-21, <https://globalnews.ca/news/5330863/climate-change-pharmaceutical-companies/> NT

Rarely does mention of the pharmaceutical industry conjure up images of smokestacks, pollution and environmental damage. **Yet our recent study found the global pharmaceutical industry is not only a significant contributor to global warming, but it is also dirtier than the global automotive production sector**. It was a surprise to find how little attention researchers have paid to the industry’s greenhouse gas emissions. Only two other studies had some relevance: one looked at the environmental impact of the U.S. health-care system and the other at the pollution (mostly water) discharged by drug manufacturers. Our study was the first to assess the carbon footprint of the pharma sector. More polluting More than 200 companies represent the global pharmaceutical market, yet only 25 consistently reported their direct and indirect greenhouse gas emissions in the past five years. Of those, only 15 reported their emissions since 2012. One immediate and striking result is that the pharmaceutical sector is far from green. We assessed the sector’s emissions for each one million dollars of revenue in 2015. Larger businesses will always generate more emissions than smaller ones; in order to do a fair comparison, we evaluated emissions intensity. We found it was 48.55 tonnes of CO2e (carbon dioxide equivalent) per million dollars. That’s about 55 per cent greater than the automotive sector at 31.4 tonnes of CO2e/$M for that same year. We restricted our analysis to the direct emissions generated by the companies’ operations and to the indirect emissions generated by the electricity purchased by these companies from their respective utilities companies. The total global emissions of the pharma sector amount to about 52 megatonnes of CO2e in 2015, more than the 46.4 megatonnes of CO2e generated by the automotive sector in the same year. The value of the pharma market, however, is smaller than the automotive market. By our calculations, the pharma market is 28 per cent smaller yet 13 per cent more polluting than the automotive sector. Extreme variability We also found emissions intensity varied greatly within the pharmaceutical sector. For example, the emissions intensity of Eli Lilly (77.3 tonnes of CO2e/$M) was 5.5 times greater than Roche (14 tonnes CO2e/$M) in 2015, and Procter & Gamble’s CO2 emissions were five times greater than Johnson & Johnson, even though the two companies generated the same level of revenue and sell similar lines of products. **Energy use, including heating, ventilation and air conditioning, in the manufacturing facilities of pharmaceutical companies produces large amounts of greenhouse gas emissions**. We found outliers, too. The German company Bayer AG reported emissions of 9.7 megatonnes of CO2e and revenues of US$51.4 billion, yielding an emission intensity of 189 tonnes CO2e/$M. This intensity level is more than four times greater than the overall pharmaceutical sector. In trying to explain this incredibly large deviation, we found that Bayer’s revenues derive from pharmaceutical products, medical equipment and agricultural commodities. While Bayer reports its financial revenues separately for each division, it lumps together the emissions from all the divisions. The company also reports and tracks its emission intensity in terms of tonnes of CO2e produced for each tonne of manufactured goods, whether fertilizer or Aspirin, for example. This level of opacity makes it not only impossible to assess the true environmental performance of these kinds of companies. It also raises questions about the sincerity of these companies’ strategies and actions in reducing their contribution to climate change. Climate compliance We also estimated how much the pharmaceutical sector would have to reduce its emissions to comply with the reduction targets in the Paris Agreement. **We found that by 2025, the overall pharma sector would need to reduce its emissions intensity by about 59 per cent from 2015 levels**. While this is clearly a far cry from their current levels, it is interesting to note that some of the 15 largest companies are already operating at that level, namely Amgen Inc., Johnson & Johnson and Roche Holding AG.

#### Warming causes extinction, mass inequality and guarantees every other impact—only the plan can reduce emissions

Spratt and Dunplop 19, David Spratt [Research Director for Breakthrough National Centre for Climate Restoration, Melbourne, and co-author of Climate Code Red: The case for emergency action] & Ian Dunlop [member of the Club of Rome. Formerly an international oil, gas and coal industry executive, chairman of the Australian Coal Association, chief executive of the Australian Institute of Company Directors, and chair of the Australian Greenhouse Office Experts Group on Emissions Trading 1998-2000], “Existential climate-related security risk: A scenario approach,” Breakthrough - National Centre for Climate Restoration, May 2019, pg. 8-10, beckert. Brackets in original text

2020–2030: Policy-makers fail to act on evidence that the current ​Paris Agreement path — in which global human-caused greenhouse emissions do not peak until 2030 — will lock in at least 3°C of warming. The case for a global, climate-emergency mobilisation of labour and resources to build a zero-emission economy and carbon drawdown in order to have a realistic chance of keeping warming well below 2°C is politely ignored. As projected by Xu and Ramanathan, by 2030 carbon dioxide levels have reached 437 parts per million — which is unprecedented in the last 20 million years — and warming reaches 1.6°C.18 2030–2050: Emissions peak in 2030, and start to fall consistent with an 80 percent reduction in fossil-fuel energy intensity by 2100 compared to 2010 energy intensity. This leads to warming of 2.4°C by 2050, consistent with the Xu and Ramanathan “baseline-fast” scenario.19 However, another 0.6°C of warming occurs — taking the total to 3°C by 2050 — due to the activation of a number of carbon-cycle feedbacks and higher levels of ice albedo and cloud feedbacks than current models assume. [It should be noted that this is far from an extreme scenario: the low-probability, high-impact warming (five percent probability) can exceed 3.5–4°C by 2050 in the Xu and Ramanathan scheme.] 2050: By 2050, there is broad scientific acceptance that system tipping-points for the West Antarctic Ice Sheet and a sea-ice-free Arctic summer were passed well before 1.5°C of warming, for the Greenland Ice Sheet well before 2°C, and for widespread permafrost loss and large-scale Amazon drought and dieback by 2.5°C. The “hothouse Earth” scenario has been realised, and Earth is headed for another degree or more of warming, especially since human greenhouse emissions are still significant.20 While sea levels have risen 0.5 metres by 2050, the increase may be 2–3 metres by 2100, and it is understood from historical analogues that seas may eventually rise by more than 25 metres. Thirty-five percent of the global land area, and 55 percent of the global population, are subject to more than 20 days a year of lethal heat conditions, beyond the threshold of human survivability. The destabilisation of the Jet Stream has very significantly affected the intensity and geographical distribution of the Asian and West African monsoons and, together with the further slowing of the Gulf Stream, is impinging on life support systems in Europe. North America suffers from devastating weather extremes including wildfires, heatwaves, drought and inundation. The summer monsoons in China have failed, and water flows into the great rivers of Asia are severely reduced by the loss of more than one-third of the Himalayan ice sheet. Glacial loss reaches 70 percent in the Andes, and rainfall in Mexico and central America falls by half. Semi-permanent El Nino conditions prevail. Aridification emerges over more than 30 percent of the world’s land surface. Desertification is severe in southern Africa, the southern Mediterranean, west Asia, the Middle East, inland Australia and across the south-western United States. Impacts: A number of ecosystems collapse, including coral reef systems, the Amazon rainforest and in the Arctic. Some poorer nations and regions, which lack capacity to provide artificially-cooled environments for their populations, become unviable. Deadly heat conditions persist for more than 100 days per year in West Africa, tropical South America, the Middle East and South-East Asia, contributing to more than a billion people being displaced from the tropical zone. Water availability decreases sharply in the most affected regions at lower latitudes (dry tropics and subtropics), affecting about two billion people worldwide. Agriculture becomes nonviable in the dry subtropics. Most regions in the world see a significant drop in food production and increasing numbers of extreme weather events, including heat waves, floods and storms. Food production is inadequate to feed the global population and food prices skyrocket, as a consequence of a one-fifth decline in crop yields, a decline in the nutrition content of food crops, a catastrophic decline in insect populations, desertification, monsoon failure and chronic water shortages, and conditions too hot for human habitation in significant food-growing regions. The lower reaches of the agriculturally-important river deltas such as the Mekong, Ganges and Nile are inundated, and significant sectors of some of the world’s most populous cities — including Chennai, Mumbai, Jakarta, Guangzhou, Tianjin, Hong Kong, Ho Chi Minh City, Shanghai, Lagos, Bangkok and Manila — are abandoned. Some small islands become uninhabitable. Ten percent of Bangladesh is inundated, displacing 15 million people. Even for 2°C of warming, more than a billion people may need to be relocated and In high-end scenarios, the scale of destruction is beyond our capacity to model, with a high likelihood of human civilisation coming to an end.21 National security consequences: For pragmatic reasons associated with providing only a sketch of this scenario, we take the conclusion of the ​Age of Consequences ‘Severe’ 3°C scenario developed by a group of senior US national-security figures in 2007 as appropriate for our scenario too: Massive nonlinear events in the global environment give rise to ​massive nonlinear societal events.​ In this scenario, nations around the world will be ​overwhelmed by the scale of change and pernicious challenges, such as pandemic disease. The internal cohesion of nations will be under great stress, including in the United States, both as a result of a dramatic rise in migration and changes in agricultural patterns and water availability. The flooding of coastal communities around the world, especially in the Netherlands, the United States, South Asia, and China, has the potential to challenge regional and even national identities.​ Armed conflict between nations over resources, such as the Nile and its tributaries, is likely and nuclear war is possible. The social consequences range from increased religious fervor to ​outright chaos.​ In this scenario, climate change provokes ​a permanent shift in the relationship of humankind to nature​’.22 (emphasis added) DISCUSSION This scenario provides a glimpse into a world of “outright chaos” on a path to the end of human civilisation and modern society as we have known it, in which the challenges to global security are simply overwhelming and political panic becomes the norm. Yet the world is currently completely unprepared to envisage, and even less deal with, the consequences of catastrophic climate change.23 What can be done to avoid such a probable but catastrophic future? It is clear from our preliminary scenario that dramatic action is required this decade if the “hothouse Earth” scenario is to be avoided. To reduce this risk and protect human civilisation, a massive global mobilisation of resources is needed in the coming decade to build a zero-emissions industrial system and set in train the restoration of a safe climate. This would be akin in scale to the World War II emergency mobilisation. There is an increasing awareness that such a response is now necessary. Prof. Kevin Anderson makes the case for a Marshall Plan-style construction of zero-carbon-dioxide energy supply and major electrification to build a zero-carbon industrial strategy by “a shift in productive capacity of society akin to that in World War II”.24 Others have warned that “only a drastic, economy-wide makeover within the next decade, consistent with limiting warming to 1.5°C”, would avoid the transition of the Earth System to the Pliocene-like conditions that prevailed 3-3.3 million years ago, when temperatures were ~3°C and sea levels 25 metres higher.25 It should be noted here that the 1.5° goal is not safe for a number of Earth System elements, including Arctic sea-ice, West Antarctica and coral reefs.

#### The plan solves - WTO is crucial to global equity and reduce poverty

Narlikar, PhD, 18

(AMRITA NARLIKAR is President of the GIGA German Institute of Global and Area Studies and a professor at the University of Hamburg. <https://www.foreignaffairs.com/articles/2018-03-05/trade-war-poor>, 3-5)

Recurrent deadlocks have plagued the Doha negotiations since their launch in 2001, damaging the credibility of the organization that oversees this unfortunate negotiation process. The WTO’s Ministerial Conference in Nairobi in 2015, which coincided with the 20th anniversary of the WTO’s founding, should have been a moment for celebration. Instead, it turned out to be an embarrassment: for the first time the Ministerial Declaration reflected not consensus but fundamental division over whether even to reaffirm the Doha mandates, which had sought to launch an ambitious round of multilateral trade liberalization with a close eye on development issues. At its Ministerial Conference in Buenos Aires, in 2017, the WTO sank to a new low: this conference was unprecedented in its failure to even produce a Ministerial Declaration. The WTO seems to be whimpering its way to an inglorious end. And if the global trading mechanism does indeed collapse, the consequences will be adverse for all parties, but especially so for the poorest of the world. PUNISHING DEVELOPING COUNTRIES AND THE POOREST PEOPLE In 2010, the Millennium Development Goals reached one of its targets, of cutting extreme poverty by half. The most important factor that contributed to this achievement was economic growth in many developing countries, especially China and India. Although such growth was fueled by several factors, one critical driver was international trade. Extensive research shows that the countries and regions that harnessed the opportunities afforded by low tariffs and open markets did particularly well, aided as they were by a reliable system of enforceable trade rules—all negotiated, monitored, and implemented under the auspices of the WTO. Still, between 600 million and 700 million people currently live under $1.90 per day and are concentrated in middle-income and lower-income developing countries. For instance, 4.5 percent of Brazilians live below the extreme poverty line, six percent do in India, and 34 and 42 percent do in Afghanistan and Nigeria. Much work still has to be done to address the concerns of the poor worldwide, and a minimal step toward this would be to ensure continued market access for developing countries and to maintain the predictability of tariff and non-tariff barriers. If the WTO collapses, rich countries would easily be able to crank up tariffs against poorer countries, while introducing many other protectionist measures to discourage imports. Developing countries, which have experienced growth through exports, and have adapted their production chains to export markets, would be hit hard. A decline in their exports would directly affect their producers and workers in the affected industries, resulting in losses for poor people who can least afford such losses. The costs, moreover, would go beyond the immediate job losses and price hikes in basic goods. The first fundamental benefit that poor countries derive from the WTO is that they get a relatively level playing field for negotiating with more powerful countries. Outside the WTO, in bilateral and regional settings, it is much easier to coerce countries into accepting harsh terms in a trade deal, such as through stringent environmental and labor standards that they would find virtually impossible to meet. In contrast, the institutional setting of the WTO offers developing countries some indispensable advantages. Formally, all members in the WTO have one vote each (very different from voting procedures at the UN Security Council and the International Monetary Fund). This is a powerful equalization tool, which is rendered all the more potent by the fact that consensus-based decision-making allows even the smallest and weakest player de jure veto power. Informally, having an audience within the institution, and a range of partners to work with, enables poor countries to form coalitions with like-minded states. Some powerful coalitions have emerged over the years, which have allowed poor and middle-income countries to band together (sometimes also with developed countries) to punch considerably above their weight in the Doha negotiations. One example is the G-33. It began as a coalition of 33 developing countries including China, India, Indonesia, Nigeria, Pakistan, and others, but now comprises 47 members and has managed to resist calls for greater market opening for agricultural products in developing economies. The G-20, a coalition led by Brazil, China, and India at the time of its founding, which now includes 23 developing countries, has demanded more ambitious market opening for agricultural products in developed country markets. Without the WTO, developing countries would have neither the institutional rules to protect them nor the support of coalitions to enhance their bargaining power. The second important benefit that developing countries derive from the WTO is its Dispute Settlement Mechanism (DSM), which allows members to take another member “to court” over violating trade rules. In the event a judgment is made, the WTO can then authorize retaliatory measures against the responding party. Even though there are several deterrents that might make poor countries reluctant to make use of this facility (including the fact that bringing a dispute against a rich country requires extensive technical and legal know-how, and low-income countries sometimes lack the resources and capacity to initiate a case), the figures show considerable learning and growing effectiveness on their part. While the United States and the European Union have been the most avid users of the DSM (they have brought 115 and 97 cases, respectively, since 1995), many large developing countries have also frequently lodged complaints. China, for example, has brought 15 cases; India, 23; and Brazil, 31. Nor should one assume that the DSM has been the stomping ground of only developed countries and rising powers. David has sometimes taken on Goliath. Ecuador, for example, filed a complaint against U.S. action against its shrimp exports in 2005, and won, despite the extreme asymmetry of power. Allow the WTO to wither away and the world returns to a system of unchecked power politics. The costs, moreover, would not necessarily be limited to the “global South” and its poorest people. FROM WIN-WIN TO LOSE-LOSE Even if a WTO collapse would strike the poorest nations the hardest, rich countries will not escape its impact, as the resulting protectionism would greatly hurt poor consumers in developed economies. They would lose access to cheap and competitive imports from developing countries, including essential items such as fruits and vegetables, garments, footwear, and other items on which the average person spends a large proportion of his or her disposable income. The impact of increased tariffs on employment, however, would be, at best, mixed. Any gains would be restricted to specific sectors. For instance, a tariff increase on steel imports may see job increases in that particular industry—although tariffs would not save the job losses that have occurred due to technological innovation—but many other U.S. industries that rely on steel imports, such as producers of cars or electrical machinery, would see their production costs rise. This, in turn, would negatively affect their domestic and international competitiveness, profit margins, and their ability to hire and pay wages. Further, it is unlikely that other countries will accept such treatment sitting down. Retaliatory action could potentially go considerably beyond the steel and steel-consuming sector. China is the second-largest market for agricultural exports from the United States; if China increased trade barriers against soybeans, coarse grains, meat products, and cotton, it could hurt U.S. jobs across several sectors. Of course, such measures by China would be welfare-reducing for its own consumers too, who benefit from these key and competitive U.S. imports. Almost all parties would thus end up in an entirely unnecessary and sad lose-lose situation. In sum, a trade war would be a lose-lose for all, but particularly the poorest in developed and rising powers.

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#### Emissions are exacerbating warming now--they’ll largely determine how much warming happens—only a sustained commitment to reducing emissions has any shot at reversing the effects climate change

Jay et al. 18, Alexa [works w/ US Global Climate Research Program, a Federal program mandated by Congress to coordinate Federal research and investments in understanding the forces shaping the global environment, both human and natural, and their impacts on society. USGCRP facilitates collaboration and cooperation across its 13 Federal member agencies to advance understanding of the changing Earth system and maximize efficiencies in Federal global change research. Together, USGCRP and its member agencies provide a gateway to authoritative science, tools, and resources to help people and organizations across the country manage risks and respond to changing environmental conditions], D.R. Reidmiller, C.W. Avery, D. Barrie, B.J. DeAngelo, A. Dave, M. Dzaugis, M. Kolian, K.L.M. Lew- is, K. Reeves, and D. Winner, 2018: “Overview.” In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kun- kel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Wash- ington, DC, USA, pp. 33–71. doi: 10.7930/NCA4.2018.CH1, pg. 40-43, beckert

Greenhouse gas emissions from human activities will continue to affect Earth’s climate for decades and even centuries. Humans are adding carbon dioxide to the atmosphere at a rate far greater than it is removed by natural processes, creating a long-lived reservoir of the gas in the atmosphere and oceans that is driving the climate to a warmer and warmer state. Some of the other greenhouse gases released by human activities, such as methane, are removed from the atmosphere by natural processes more quickly than carbon dioxide; as a result, efforts to cut emissions of these gases could help reduce the rate of global tempera- ture increases over the next few decades. However, longer-term changes in climate will largely be determined by emissions and atmospheric concentrations of carbon dioxide and other longer-lived greenhouse gases (Ch. 2: Climate, KM 2). Climate models representing our understand- ing of historical and current climate conditions are often used to project how our world will change under future conditions (see Ch. 2: Cli- mate, Box 2.7). “Climate” is defined as weather conditions over multiple decades, and climate model projections are generally not designed to capture annual or even decadal variation in climate conditions. Instead, projections are typically used to capture long-term changes, such as how the climate system will respond to changes in greenhouse gas levels over this century. Scientists test climate models by comparing them to current observations and historical changes. Confidence in these models is based, in part, on how well they reproduce these observed changes. Climate models have proven remarkably accurate in simulating the climate change we have experienced to date, particularly in the past 60 years or so when we have greater confidence in observations (see CSSR, Ch. 4.3.1). The observed signals of a changing climate continue to become stron- ger and clearer over time, giving scientists increased confidence in their findings even since the Third National Climate Assessment was released in 2014. Today, the largest uncertainty in projecting future climate conditions is the level of greenhouse gas emissions going forward. Future global greenhouse gas emissions levels and resulting impacts depend on economic, political, and demographic factors that can be difficult to predict with confidence far into the future. Like previous climate assessments, NCA4 relies on a suite of possible scenarios to evaluate the implications of different climate outcomes and associated impacts throughout the 21st century. These “Representative Con- centration Pathways” (RCPs) capture a range of potential greenhouse gas emissions pathways and associated atmospheric concentration levels through 2100. RCPs drive climate model projections for temperature, precipitation, sea level, and other variables under futures that have either lower or higher greenhouse gas emissions. RCPs are numbered according to changes in radiative forcing by 2100 relative to preindustrial condi- tions: +2.6, +4.5, +6.0, or +8.5 watts per square meter (W/m2). Each RCP leads to a different level of projected global temperature change; higher numbers indicate greater projected temperature change and associated impacts. The higher scenario (RCP8.5) represents a future where annual greenhouse gas emissions increase significantly throughout the 21st century before leveling off by 2100, whereas the other RCPs represent more rapid and substantial mitigation by mid-century, with greater reductions thereafter. Current trends in annual greenhouse gas emissions, globally, are consistent with RCP8.5. Of the two RCPs predominantly referenced throughout this report, the lower sce- nario (RCP4.5) envisions about 85% lower greenhouse gas emissions than the higher scenario (RCP8.5) by the end of the 21st century (see Ch. 2: Climate, Figure 2.2). In some cases, throughout this report, a very low scenario (RCP2.6) that represents more imme- diate, substantial, and sustained emissions reductions is considered. Each RCP could be consistent with a range of underlying socio- economic conditions or policy choices. See the Scenario Products section of Appendix 3 in this report, as well as CSSR Chapters 4.2.1 and 10.2.1 for more detail. The effects of different future greenhouse gas emissions levels on global climate become most evident around 2050, when temperature (Figure 1.3) (Ch. 2: Climate, Figure 2.2), pre- cipitation, and sea level rise (Figure 1.4) (Ch. 2: Climate, Figure 2.3) projections based on each scenario begin to diverge significantly. With substantial and sustained reductions in greenhouse gas emissions (e.g., consistent with the very low scenario [RCP2.6]), the increase in global annual average temperature relative to preindustrial times could be limited to less than 3.6°F (2°C) (Ch. 2: Climate, Box 2.4; CSSR, Ch. 4.2.1). Without significant greenhouse gas mitigation, the increase in global annual aver- age temperature could reach 9°F or more by the end of this century (Ch. 2: Climate, KM 2). For some aspects of Earth’s climate system that take longer to respond to changes in atmo- spheric greenhouse gas concentrations, such as global sea level, some degree of long-term change will be locked in for centuries to come, regardless of the future scenario (see CSSR, Ch. 12.5.3). Early greenhouse gas emissions mitiga- tion can reduce climate impacts in the nearer term (such as reducing the loss of arctic sea ice and the effects on species that use it) and in the longer term by avoiding critical thresholds (such as marine ice sheet instability and the resulting consequences for global sea level and coastal development; Ch. 29: Mitigation, Timing and Magnitude of Action). Annual average temperatures in the United States are projected to continue to increase in the coming decades. Regardless of future scenario, additional increases in temperatures across the contiguous United States of at least 2.3°F relative to 1986–2015 are expected by the middle of this century. As a result, recent record-setting hot years are expected to become common in the near future. By late this century, increases of 2.3°–6.7°F are expected under a lower scenario (RCP4.5) and 5.4°–11.0°F under a higher scenario (RCP8.5) relative to 1986–2015 (Figure 1.3) (Ch. 2: Climate, KM 5, Figure 2.4). Alaska has warmed twice as fast as the global average since the mid-20th century; this trend is expected to continue (Ch. 26: Alaska, Background). High temperature extremes, heavy precipitation events, high tide flooding events along the U.S. coastline, ocean acidification and warming, and forest fires in the western United States and Alaska are all projected to continue to increase, while land and sea ice cover, snowpack, and surface soil moisture are expected to continue to decline in the coming decades. These and other changes are expected to increasingly impact water resources, air quality, human health, agriculture, natural ecosystems, energy and transportation infrastructure, and many other natural and human systems that support communities across the country. The severity of these projected impacts, and the risks they present to society, is greater under futures with higher greenhouse gas emissions, especially if limited or no adaptation occurs (Ch. 29: Mitigation, KM 2).