**Structural Barriers to Avoiding Catastrophic Climate Change**

*Extract from forthcoming PhD dissertation by Milan Ilnyckyj*

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Understanding why the politics of climate change are contentious requires examining the structural barriers which make it so hard for humanity to stop burning fossil fuels and adding greenhouse gases to the atmosphere. Why – despite the credible scientific assessments and reputable organizations highlighting the dire threat from climate change – does humanity show undiminished enthusiasm for fossil fuel extraction and the lifestyles it facilitates?[1] Many structural factors help perpetuate the *status quo* and inhibit change. Each actor involved (I generally mean states, but firms and individuals may be in a similar position) arguably faces a social dilemma, as defined by Elinor Ostrom: "choices in which the maximization of short-term self-interest yields outcomes leaving all participants worse off than feasible alternatives." [2] Many analysts and scholars have taken a game theory view of the problem, calling it a 'prisoner's dilemma' or 'tragedy of the commons.' In short, curbing climate change requires coordinated action and if the majority of other actors persist in climate-damaging choices then those who do act will essentially be as badly off as if they hadn't restrained themselves.[3] In Canada

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[1] Since the 1970s scientists have observed warming at an average rate of 0.2 °C per decade. Samset, B.H., J.S. Fuglestvedt, and M.T. Lund. "Delayed Emergence of a Global Temperature Response After Emission Mitigation". In: Nature Communications 11.1 (2020), pp. 1–10. url: https://www.nature.com/articles/s41467-020-17001-1.pdf (visited on 2020-07-15).p. 5

[2] Ostrom, Elinor. "A Behavioral Approach to the Rational Choice Theory of Collective Action: Presidential Address, American Political Science Association, 1997". In: American Political Science Review 92.1 (1998), pp. 1–22. url: https://www.jstor.org/stable/2585925 (visited on 2020-04-03). p. 1

[3] The relevant set of participants is also dynamic in a way which can impede climate action, since newly discovered and exploited fossil fuel reserves will be a temptation for governments as long as they are valuable.

For example, the IMF expected 53% GDP growth in Guyana in 2020 as offshore oil deposits begin producing. An international agreement to constrain fossil fuel use will therefore need to be resilient when new reserves are discovered. The Economist. "Oil Futures." 2020. url: https://www.economist.com/the-americas/2020/08/06/democracy-wins-in-guyana-and-suriname (visited on 2021-01-21).

Fossil fuel advocates also use the prisoner's dilemma framing to justify projects in countries with comparatively demanding environmental regulation. For example, Tim McMillian, CEO of CAPP, argued: "The global demand increase most certainly will be looking for supply. Is Canada the right place to be the supply or should we letting the other nine large [oil- and gas-producing countries] ... be the ones that step in and offer that supply?" Taylor, Matthew. "Does Canada Need Another Pipeline? That's the Question Federal Officials Were Asking After Keystone

particularly, deep economic interlinkages and competition with the US have often been the basis for arguments that Canada cannot act faster than the US or it will simply lose industry to the south.[4] Climate change magnifies the frequent political challenge in environmental policy making: with the cost of action concentrated on a smaller and comparatively organized set of polluters and the benefits of action accruing to a larger and more abstract group without coordinated lobbying power.[5] As Lindblom argues, business has a privileged position within interest group politics, both because businesses have important influence over the economic security and standard of living of citizens and because business exerts influence over public opinion.[6] Polluting industries have also been able to capture the regulators meant to bring their

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XL Cancellation." 2021. url: https://www.theglobeandmail.com/business/industry-news/energyand-resources/article-does-canada-need-another-pipelinefederal-officials-grapple-with/ (visited on 2021-06-20).

[4] The considerable importance of US politics and policy for Canada is one reason why this dissertation contains many references to research on and events in the US. Economic competitiveness with the US has also been part of a two-part delaying strategy used by subsequent Canadian governments, sometimes asserting that only a "made in Canada" solution is appropriate, and sometimes emphasizing that only coordinated action with the US would be economically responsible. For instance, in 2002 the Business Council on National Issues advocated a "made in Canada" program of subsidies for research and development and voluntary emission mitigation measures. Lemphers, Nathan C. "Beyond the Carbon Curse: a Study of the Governance Foundations of Climate Change Politics in Australia, Canada and Norway". PhD thesis. Toronto: University of Toronto, 2019. url: https://tspace.library.utoronto.ca/handle/1807/101303 (visited on 2020-08-15). p. 130

Lemphers describes Canada and Australia as "relatively weak states with major trading partners that are known as climate policy laggards." He notes that: "The climate policy vacillations and fossil fuel dependence of its southern neighbour have, at times, catalyzed and inhibited climate policy development north of the border." Lemphers, Nathan C. "Beyond the Carbon Curse: a Study of the Governance Foundations of Climate Change Politics in Australia, Canada and Norway". PhD thesis. Toronto: University of Toronto, 2019. url: https://tspace.library.utoronto.ca/handle/1807/101303 (visited on 2020-08-15). p. 16, 105

[5] Interest groups facing concentrated costs from a change in policy are likely to be more organized and effective than the population at large which could obtain diffuse benefits. Olson, Mancur. *The Logic of Collective Action: Public Goods and the Theory of Groups.* Cambridge: Harvard University Press, 1965. p. 33, 8

The Economist noted: "The costs of environmental improvements tend to fall on a few groups –typically, those doing the polluting. In domestic environmental politics, progress typically relies on going some way to placate those groups while increasing the enthusiasm for action among others and the public. If emissions had been down to just a few companies, as with CFCs [chlorofluorocarbons, responsible for stratospheric ozone depletion], or sectors of the economy, as with the smogs tackled by clean air acts, such trade-offs might have been possible internationally. But fossil-fuel use permeated rich economies. Those countries knew the cost of reducing them would be severe – and that the benefits would accrue mostly to people in other countries and future times." The Economist. "Why Tackling Global Warming is a Challenge Without Precedent." 2020. url: https://www.economist.com/schools-brief/2020/04/23/why-tackling-global-warming-is-a-challenge-withoutprecedent (visited on 2020-04-29).

[6] Lindblom explained: "In the eyes of the government officials, businessmen do not appear simply as representatives of a special interest, as representatives of interest groups do, they appear as functionaries performing functions that government officials regard as indispensable." Lindblom, Charles E. *Politics and Markets: The World's Political Economic Systems.* New York: Basic Books, 1977.

behaviour into compliance with the public interest, influencing their rulemaking through lobbying and other means in order to maintain and enhance profitability.[7] These industries have also manipulated elite and public opinion in order to avoid or delay environmental action by self-

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Stokes, Leah C. *Short Circuiting Policy: Interest Groups and the Battle over Clean Energy and Climate Policy in the American States*. New York: Oxford University Press, 2020. p. 78

Marsh, David, Sadiya Akram, and Holly Birkett. "The Structural Power of Business: Taking Structure, Agency and Ideas Seriously". In: Business and Politics 17.3 (2015), pp. 577–601. url: https://www.academia.edu/19059018/The_structural_power_of_business_taking_structure_agency_and_ideas_seriously._Journal_of_Business_and_Politics_2015_ (visited on 2020-05-09).

Lemphers describes a "clientelistic relationship" which can emerge when government independence is limited and especially when there is a high mobilization of business interest. He describes how "economic elites from polluting industries often see grave political risks from climate policy and thus seek to marginalize actors who may threaten business-as-usual." In summary, he describes how interview participants in Canada and Australia "referred to an emasculated government that easily capitulated to industry demands to weaken climate policy." Lemphers, Nathan C. "Beyond the Carbon Curse: a Study of the Governance Foundations of Climate Change Politics in Australia, Canada and Norway". PhD thesis. Toronto: University of Toronto, 2019. url: https://tspace.library.utoronto.ca/handle/1807/101303 (visited on 2020-08-15). p. 32, 40, 146, 262

Harrison, Kathryn. "The Struggle of Ideas and Self-interest in Canadian Climate Policy". In: *Global Commons, Domestic Decisions: The Comparative Politics of Climate Change.* Ed. by Kathryn Harrison and Lisa Mcintosh Sundstrom. Cambridge, MA: MIT Press, 2010.

Macdonald argues that "Governments in the carbon provinces have always had an automatic interest in furthering the well being of those [oil and gas] firms, long before their premier took a call from the CEO." Macdonald, Douglas. *Carbon Province, Hydro Province: The Challenge of Canadian Energy and Climate Federalism.* Toronto: University of Toronto Press, 2020. p. 13

Describing the role of the industry group the Australian Industry Greenhouse Network (AIGN), one of Lemphers' interview subjects said Australian business interests get more of a role in international climate negotiations than industry groups elsewhere, and noted how industry has an extent of institutional memory which government lacks. He quotes former bureaucrat Howard Bamsey saying: "I don't think business has ever had a problem with access to government… They can get in any door they like at any time." Lemphers, Nathan C. "Beyond the Carbon Curse: a Study of the Governance Foundations of Climate Change Politics in Australia, Canada and Norway". PhD thesis. Toronto: University of Toronto, 2019. url: https://tspace.library.utoronto.ca/handle/1807/101303 (visited on 2020-08-15). p. 189-90, 218

See also: Taylor, Matthew and Fiona Harvey. UK Held Private Talks With Fossil Fuel Firms About Glasgow Cop26. 2020. url: https://www.theguardian.com/environment/2020/oct/01/uk-held-private-talks-withfossil-fuel-firms-about-glasgow-cop26 (visited on 2020-10-12).

[7] Stokes also notes: "One of the darkest parts of this story is that politicians and lobbyists leading these climate delay efforts rose in power over time. [Troy] Balderson went on to be a Congressman. [William] Seitz became the majority leader in the House. [Sam] Randazzo became the Chair of PUCO [Public Utility Commission of Ohio]. And [Keith] Faber became Ohio's state auditor. Everyone involved in the effort to pass the worst energy policy in the country got promotions." Stokes, Leah C. *Short Circuiting Policy: Interest Groups and the Battle over Clean Energy and Climate Policy in the American States*. New York: Oxford University Press, 2020. p. 222

See also: Hirsh, Richard F. *Power Loss: The Origins of Deregulation and Restructuring in the American Electric Utility System*. Cambridge: MIT Press, 1999.

Stokes, Leah C. *Short Circuiting Policy: Interest Groups and the Battle over Clean Energy and Climate Policy in the American States*. New York: Oxford University Press, 2020. p. 1, 229

Culpepper, Pepper D. *Quiet Politics and Business Power: Corporate Control in Europe and Japan.* Cambridge: Cambridge University Press, 2010.

interestedly and falsely calling into question the scientific validity of environmental impacts including mercury toxicity, acid rain, and climate change.[8] While this could be interpreted simply as misconduct or even crime by specific organizations, their campaign to spread climate denial has been facilitated by structural factors, including how legislatures and courts establish and interpret the burden of proof. As documented extensively in the US case by Stokes, polluting industries have worked to strengthen inhibitory policy feedbacks (policy retrenchments and reversals once polluting actors realize that they are threatened) and interrupt reinforcing feedbacks (strategizing to prevent the emergence of coalitions to defend climate-safe energy policies once they are established).[9] These efforts will be especially determined when industry

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[8] The role of the fossil fuel industry in promoting climate denial has been one of the major arguments in favour of divestment. See: Stokes, Leah C. *Short Circuiting Policy: Interest Groups and the Battle over Clean Energy and Climate Policy in the American States.* New York: Oxford University Press, 2020. p. 2

In some cases industry has taken a long-term approach to spreading disbelief about legitimate climate science. For instance, the Heartland Institute spent $100,000 spreading the message that "the topic of climate change is controversial and uncertain" among kindergarten through grade 12 students. Goldenberg, Suzanne. "Leak Exposes How Heartland Institute Works to Undermine Climate Science." 2012. url: https://www.theguardian.com/environment/2012/feb/15/leak-exposes-heartland-institute-climate (visited on 2020-05-10).

DeMelle, Brendan. Heartland Institute Exposed: Internal Documents Unmask Heart of Climate Denial Machine. 2012. url: https://www.desmogblog.com/heartland-institute-exposed-internal-documentsunmask-heart-climate-denial-machine (visited on 2020-05-10).

Stokes, Leah C. *Short Circuiting Policy: Interest Groups and the Battle over Clean Energy and Climate Policy in the American States*. New York: Oxford University Press, 2020. p. 154

[9] Stokes, Leah C. *Short Circuiting Policy: Interest Groups and the Battle over Clean Energy and Climate Policy in the American States*. New York: Oxford University Press, 2020.

Campbell, Andrea Louise. *How Policies Make Citizens: Senior Political Activism and the American Welfare State.* Princeton: Princeton University Press, 2003.

Mettler, Suzanne. *Soldiers to Citizens: The G.I. Bill and the Making of the Greatest Generation*. Oxford: Oxford University Press, 2005.

Pierson, Paul. "When Effect Becomes Cause: Policy Feedback and Political Change". In: World Politics 45.4 (1993), pp. 595–628. url: https://www.cambridge.org/core/services/aop-cambridge-core/content/view/EB310F82411B3E31406E03C S0043887100008911a.pdf/when_effect_becomes_cause_policy_feedback_and_political_change.pdf (visited on 2020-05-05).

Skocpol, Theda. *Protecting Soldiers and Mothers: The Political Origins of Social Policy in United States.* Cambridge: Harvard University Press, 1992.

Pierson, Paul. "Increasing Returns, Path Dependence, and the Study of Politics". In: American Political Science Review 94.2 (2000), pp. 251–267. url: https://www.cambridge.org/core/services/aop-cambridgecore/content/view/AC2137B913363E33D97FC5CEC17CC75D/S0003055400221059a.236 pdf/increasing_returns_path_dependence_and_the_study_of_ politics.pdf (visited on 2020-05-05).

Schmidt, Tobias S. and Sebastian Sewerin. "Technology as a Driver of Climate and Energy Politics". In: Nature Energy 2.6 (2017), pp. 1–3. url: https://www.nature.com/articles/nenergy201784 (visited on 2020-05-09).

faces an existential threat, like the call to abolish their chief product.[10] Climate change mitigation efforts are frequently compared to policies to phase out CFCs to protect the ozone layer.[11] However the small group of manufacturers involved in that case were able to transition to alternatives with relatively little disruption – they were not being directed to abstain forever from using something as valuable as the world's fossil fuel reserves.[12] With fossil fuels at the

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Robert Brulle notes that the US electrical utilities sector alone spent $554 million lobbying on climate policy at the federal level between 2000 and 2016. Brulle, Robert J. "The Climate Lobby: a Sectoral Analysis of Lobbying Spending on Climate Change in the USA, 2000 to 2016". In: Climatic Change 149.3-4 (2018), pp. 289–303. url: https://link.springer.com/article/10.1007/s10584-018-2241-z (visited on 2020-05-09).

Stokes, Leah C. *Short Circuiting Policy: Interest Groups and the Battle over Clean Energy and Climate Policy in the American States*. New York: Oxford University Press, 2020. p. 72

A 2020 study of 3,000 utilities worldwide found that "60% of the renewables-prioritizing utilities had not ceased concurrently expanding their fossil-fuel portfolio, compared to 15% reducing it." This author said this "points to power utilities lagging behind, and even hindering, the global transition" to renewable energy. Alova, Galina. "A Global Analysis of the Progress and Failure of Electric Utilities to Adapt Their Portfolios of Power-generation Assets to the Energy Transition". In: Nature Energy (2020). url: https://www.nature.com/articles/s41560-020-00686-5 (visited on 2020-09-02).

Ambrose, Jillian. "Only One in 10 Utility Firms Prioritise Renewable Electricity — Global Study." 2020. url: https://www.theguardian.com/business/2020/aug/31/only-one-in-10-utility-firms-prioritiserenewable-electricity-global-study (visited on 2020-09-02).

[10] The degree of threat posed to the fossil fuel industry by decarbonization adds substantially to the contentiousness of climate change mitigation policy. Stokes, Leah C. *Short Circuiting Policy: Interest Groups and the Battle over Clean Energy and Climate Policy in the American States.* New York: Oxford University Press, 2020. p. 4

[11] The ozone layer has an important role in the history of life on Earth, which is believed to have emerged about 3.5 billion years ago and become photosynthetic about 3 billion years ago. Multi-cellular life dates back about 1 billion years (and complex life via the Cambrian explosion about 540 million years) but it was only when oxygen levels from photosynthesis became high enough about 500 million years ago to allow the formation of an ozone layer that ultraviolet radiation was blocked sufficiently to allow life on land. Jaffe, Robert L. and Washington Taylor. *The Physics of Energy*. Cambridge: Cambridge University Press, 2018. p. 721

See also: Morton, Oliver. *Eating the Sun: How Plants Power the Planet.* New York: Harper Perennial, 2009. p. 170

For a good summary of the hope that climate change can be controlled through methods akin to past successes of ozone depletion and acid rain, see: Humphreys, Rachel, Fiona Harvey, and Janet Alty. "Leaded Petrol, Acid Rain, CFCs: Why the Green Movement Can Overcome the Climate Crisis." 2020. url: https://www.theguardian.com/news/audio/2020/oct/19/leaded-petrol-acid-rain-cfcs-why-the-greenmovement-can-overcome-the-climate-crisis (visited on 2020-10-21).

Geyer, Roland. "It's Unavoidable: We Must Ban Fossil Fuels to Save Our Planet. Here's How We Do It." 2021. url: https://www.theguardian.com/commentisfree/2021/mar/09/its-unavoidable-we-must-banfossil-fuels-to-save-our-planet-heres-how-we-do-it (visited on 2021-03-16).

[12] To some extent even the 1985 Vienna Convention for the Protection of the Ozone Layer and 1987 Montreal Protocol — often cited as the most encouraging examples of an environmental problem being addressed through multilateral negotiation — have substituted one problem for another instead of providing a complete fix, as the CFC replacements mandated through the agreements and domestic implementation legislation break down into short-chain fluorinated alkyl acids which are long-lived contaminants. Weber, Bob. "Ozone Layer Deal May Have Led to

foundation of the global economy, the stakes involved in a campaign to phase them out are as big as human civilization, especially when the catastrophic projected impacts of unmitigated climate change are also considered.

In examining the structural issues which impede the implementation of effective climate change mitigation policies, we can proceed from those which manifest at the level of individual psychology to those experienced at the level of organizations to those which arise from and constitute the structure of the international system.

We face structural barriers at the level of individual psychology, as summarized in an excellent section of Jacobs' *Governing for the Long Term* describing cognitive limits as they apply to policy making.[13] People are impeded from acting on climate change because "abstract and spatially distant phenomena" fail to engage our emotions; because we often consider harm arising from unintentional actions blameless; because ego self-defence drives us to reject implied personal criticism; because we fail to respond appropriately to uncertainty; because we are split into political tribes, including some defined by hostility to environmentalism; and because we grant lesser moral standing to people outside our groups.[14] As a phenomenon with long time

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New Contaminant Problem, Researchers Say." 2020. url: https://www.cbc.ca/news/technology/ozone-contaminant-1.5571201 (visited on 2020-05-18).

[13] Jacobs, Alan M. *Governing for the Long Term: Democracy and the Politics of Investment.* Cambridge: Cambridge University Press, 2011. p. 30-42

[14] Markowitz, Ezra M. and Azim F. Shariff. "Climate Change and Moral Judgement". In: Nature Climate Change 2.4 (2012), p. 243. url: https://www.nature.com/articles/nclimate1378 (visited on 2019-12-29).p. 243-5

Robert Gifford describes seven "dragons of inaction": "limited cognition about the problem, ideological worldviews that tend to preclude pro-environmental attitudes and behavior, comparisons with key other people, sunk costs and behavioral momentum, discredence toward experts and authorities, perceived risks of change, and positive but inadequate behavior change." Gifford, Robert. "The Dragons of Inaction: Psychological Barriers That Limit Climate Change Mitigation and Adaptation". In: American Psychologist 66.4 (2011), p. 290. url: https://www.researchgate.net/publication/254734365_The_Dragons_of_Inaction_Psychological_Barriers_That_Limit_Climate_Change_Mitigation_and_Adaptation (visited on 2019-12-29).

Levin et al. describe four key features of climate change as a "super wicked" problem: "time is running out; the central authority needed to address it is weak or non-existent; those who cause the problem also seek to create a solution; and hyperbolic discounting occurs that pushes responses irrationally into the future" Levin, Kelly, Benjamin Cashore, Steven Bernstein, and Graeme Auld. "Playing it Forward: Path Dependency, Progressive Incrementalism, and the "Super Wicked" Problem of Global Climate Change". In: International Studies Association 48th Annual Convention. Chicago, February. Citeseer. 2007. url: https://iopscience.iop.org/article/10.1088/1755-1307/6/50/502002/meta (visited on 2019-12-29). p. 2

Stephen Gardiner groups the causes of political inertia on climate change into three categories. Economically, people accept the incorrect view that adapting to climate change will be cheaper than preventing it. Psychologically,

lags, climate change doesn't easily become highly salient or motivational.[15] Also, climate change, as a frightening but unintended consequence of actions which we may otherwise

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people have their analytical reasoning system overwhelmed by their affective reasoning in cases involving risk and uncertainty and can only sustain a "finite pool of worry" where climate change gets crowded out by other concerns. Intergenerationally, people are inclined toward "buck passing", especially when problems emerge gradually. Gardiner, Stephen M. *A Perfect Moral Storm: the Ethical Tragedy of Climate Change.* Oxford: Oxford University Press, 2011. p. 191-7

Malin et al. found "partisan motivated cognition" in how Colorado residents viewed unconventional oil and gas production, with people's perceptions of its impact on their lives partly a function of their political identities. Malin, Stephanie A., Adam Mayer, James L. Crooks, Lisa McKenzie, Jennifer L. Peel, and John L. Adgate. "Putting on Partisan Glasses: Political Identity, Quality of Life, and Oil and Gas Production in Colorado". In: Energy Policy 129 (2019), pp. 738–748. url: https://www.sciencedirect.com/science/article/pii/S0301421519300503 (visited on 2020-07-30).

Mayer found that Colorado conservatives misjudge the severity of existing regulation. Mayer, Adam. "Political Identity and Paradox in Oil and Gas Policy: A Study of Regulatory Exaggeration in Colorado, US". In: Energy Policy 109 (2017), pp. 452–459. url: https://www.sciencedirect.com/science/article/pii/S030142151730455X (visited on 2020-07-30).

Ronald Brownstein quotes Yale climate program director Anthony Leiserowitz on how even Americans who are concerned about climate change consider the threat to be distant in space and time, believing "the impacts won't be felt for a generation or more" and will strike "polar bears and maybe some developing countries, but not the United States ... not my friends, not my family, not me." Brownstein, Ronald. "Why Republicans Still Don't Care About Climate Change." 2020. url: https://www.theatlantic.com/politics/archive/2020/09/california-wildfires-and-politics-climate-change/616380/ (visited on 2020-10-21).

It is also noteworthy that even for fossil fuel project opponents, local concerns like pipeline and tanker spills are often much more salient than global climate concerns. This offers an advantage to activists because place-based motives can be highly salient to their supporters, but it risks replacing the 'keep it in the ground' logic of controlling the cumulative impacts of climate change with a 'not in my back yard' attitude of fossil fuel projects being acceptable as long as they don't create local risks.

The U.S. satirical newspaper The Onion lampooned this tendency of elevating spill risk above concern about climate change, with an article about an oil supertanker catastrophically unloading its contents as intended: "[V]ast amounts of the black, toxic petroleum in the ship's hold were unloaded at an alarming rate into special storage containers on the mainland. From there, experts confirmed, the oil will likely spread across the entire country's infrastructure and commit unforetold damage to its lakes, streams, and air." The Onion. "Millions Of Barrels Of Oil Safely Reach Port In Major Environmental Catastrophe." 2010. url: https://www.theonion.com/millions-of-barrels-of-oil-safely-reach-port-in-major-e1819571678 (visited on 2021-02-05).

For more on how climate change "fails to activate our moral intuitions" see: Bazerman, Max H. and Ann E. Tenbrunsel. *Blind Spots: Why We Fail to Do What's Right and What to Do About It.* Princeton: Princeton University Press, 2011.

Haidt, Jonathan. "The Emotional Dog and its Rational Tail: A Social Intuitionist Approach to Moral Judgment". In: Psychological Review 108.4 (2001), p. 814. url: https://www.ncbi.nlm.nih.gov/pubmed/11699120 (visited on 2019-12-29).

[15] Banerjee and Duflo explained: "Research in psychology has now been applied to a range of economic phenomena to show that we think about the present very differently from the way we think about the future (a notion referred to as 'time inconsistency'). In the present, we are impulsive, governed in large part by emotions and immediate desires: Small losses of time (standing in line to get the child immunized) or petty discomforts (glutes that need to be woken up) that have to be endured right now feel much more unpleasant in the moment than when we think about them without a sense of immediacy (say, after a Christmas meal that was heavy enough to rule out all thoughts of immediate exercise). The reverse, of course, goes for small 'rewards' (candy, a cigarette) that we really crave in the

consider beneficial or benign, challenges the idea that the universe is morally ordered and just. Feygina et al. describe how people "rationalize 'the way things are' and, in so doing, deny environmental problems and resist meaningful attempts to create and implement a new, more sustainable status quo." [16] We also inappropriately assume that climate change is akin to familiar problems where it is possible to try one approach for a short time and promptly see the resulting effects, rather than a "complex dynamical system with long delays, multiple positive feedbacks, and nonlinearities that may cause abrupt, costly, and irreversible regime changes." [17][18] Even 84% of graduate students at MIT (70% of them from STEM fields) failed to grasp the dynamics between $CO_2$ emitted today, its accumulation in the atmosphere, and what is needed to stabilize the climate.[19] Among the greatest psychological barriers to action is a profound sense of

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present; when we plan for the future, the pleasure from these treats seems less important. Our natural inclination is to postpone small costs, so that they are borne not by our today self but our tomorrow self instead." Banerjee Abhijit V. abd Duflo, Esther. *Poor Economics: A Radical Rethinking of the Way to Fight Global Poverty.* New York: Hachette, 2011. p. 64-5

Time inconsistency is even more of a problem for reasoning about insurance against catastrophic effects, since people are reluctant to imagine a future where the insured-against thing has transpired. Banerjee Abhijit V. abd Duflo, Esther. *Poor Economics: A Radical Rethinking of the Way to Fight Global Poverty.* New York: Hachette, 2011. p. 154

[16] They describe how under system justification theory "our evaluations of social systems and institutions are influenced by epistemic needs to maintain a sense of certainty and stability, existential needs to feel safety and reassurance, and relational needs to affiliate with others who are part of the same social systems." They also describe "a destructive situation in which the psychological motivation to defend the socioeconomic system paradoxically leads people to ignore and therefore increase their vulnerability to events that threaten that system." Feygina, Irina, John T. Jost, and Rachel E. Goldsmith. "System Justification, the Denial of Global Warming, and the Possibility of 'System-sanctioned Change'". In: Personality and Social Psychology Bulletin 36.3 (2010), pp. 326–338. url: https://journals.sagepub.com/doi/abs/10.1177/0146167209351435 (visited on 2019-07-18). p. 327, 335

[17] Sterman describes how, unlike with processes where there are short lags between action and effect, with climate change: "there are substantial delays in every link of a long causal chain stretching from the implementation of emissions abatement policies to emissions reductions to changes in atmospheric GHG concentrations to surface warming to changes in ice sheets, sea level, agricultural productivity, extinction rates, and other impacts" and concludes: "Mitigating the risks therefore requires emissions reductions long before additional harm is evident." Sterman, John D. "Risk Communication on Climate: Mental Models and Mass Balance". In: Science 322.5901 (2008), pp. 532–533. url: https://science.sciencemag.org/content/322/5901/532.full.pdf p. 532

[18] Of particular note, the ability of the ocean and terrestrial biospheres to absorb carbon may not remain constant, for instance as sea water warms and becomes increasingly saturated with $CO_2$. Jaffe, Robert L. and Washington Taylor. *The Physics of Energy.* Cambridge: Cambridge University Press, 2018. p. 725

[19] Sterman, John D. "Risk Communication on Climate: Mental Models and Mass Balance". In: Science 322.5901 (2008), pp. 532–533. url: https://science.sciencemag.org/content/322/5901/532.full.pdf p. 533

In June 2011, The Economist's science and technology section published an explanatory article entitled: "Emissions slashed today won't slow warming until mid-century" which noted: "greenhouse-gas emissions do not cause an

entitlement: an expectation that life as people have come to expect it is the norm and should by default continue indefinitely. The central challenge from environmentalism is to this view, with growing awareness particularly since the 1960s that life as we know it in the rich world is not 'sustainable' and the concomitant question of if and how it could be made to be so.[20] Even the invisibility of GHG pollution has been cited as a barrier to action, with Shue noting how "the invisible non-solid wastes that seem to be drifting off harmlessly into the sky and on into the endless universe" impedes people from understanding and confronting the consequences of fossil fuel use.[21] While some climate-linked events may serve as focusing events which motivate policy makers, the impossibility of attributing specific adverse consequences to specific emissions limits the degree to which this can drive policy.[22] Jacobs argues that:

> the range of unfamiliar, complex, and spatially dispersed economic, health, and environmental consequences of pollution or climate change are far more difficult for

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instantaneous rise in global temperatures, and neither does cutting them result in instantaneous cooling. Instead, it will take decades for today's policy efforts to result in measurable impacts on global temperature." The Economist. "Emissions Slashed Today Won't Slow Warming Until Mid-century." 2020. url: https://www.economist.com/science-and-technology/2020/07/11/emissions-slashed-today-wont-slow-warming-until-midcentury (visited on 2020-07-15).

It chiefly referenced: Samset, B.H., J.S. Fuglestvedt, and M.T. Lund. "Delayed Emergence of a Global Temperature Response After Emission Mitigation". In: Nature Communications 11.1 (2020), pp. 1–10. url: https://www.nature.com/articles/s41467-020-17001-1.pdf (visited on 2020-07-15).

[20] "[A]ny event or broad social process that serves to undermine the calculations and assumptions on which the political establishment is structured occasions a shift in political opportunities." McAdam, Doug. *Political Process and the Development of Black Insurgency, 1930-1970: Second Edition.* Chicago: University of Chicago Press, 1999. p. xviii

[21] As an illustrative contrast, he provokes readers to consider someone who chooses to bury landmines on public trails which will only become active during some distant generation, where people may have different preferences and more wealth and technology. Shue, Henry. *Climate Justice: Vulnerability and Protection.* Oxford: Oxford University Press, 2014. p. 79, 162-3

[22] On focusing events, see: Kingdon, John W. *Agendas, Alternatives, and Public Policies.* Boston: Little, Brown, 1984.

Jacobs, Alan M. *Governing for the Long Term: Democracy and the Politics of Investment.* Cambridge: Cambridge University Press, 2011. p. 264, 48

Krosnick, Jon A., Allyson L. Holbrook, Laura Lowe, and Penny S. Visser. "The Origins and Consequences of Democratic Citizens' Policy Agendas: a Study of Popular Concern About Global Warming". In: Climatic Change 77.1-2 (2006), pp. 7–43. url: https://link.springer.com/content/pdf/10.1007/s10584-006-9068-8.pdf (visited on 2020-07-12).

Oppenheimer, Michael and Alexander Todorov. "Global Warming: The Psychology of Long Term Risk". In: Climatic Change 77.1-2 (2006), p. 1. url: https://search.proquest.com/docview/198502837 (visited on 2020-07-12).

most citizens to concretely imagine and are thus likely to play a modest role in their policy evaluations. [23]

This connects to the discussion of framing below: if policy makers and the public have adopted a world view in which extreme weather is taken as demonstrative of climate change risks then rising numbers of heat waves, wildfires, and other extreme events may help motivate effective $CO_2$ mitigation policies.[24] Because of motivated reasoning – where people decide what they believe based on what they want to do – unfortunately they may fail to do so. Climate change is subject to a problem of shifting baselines which impair cognitive salience. Daniel Pauly coined the term in 1995 to describe how fisheries scientists are misled because as time passes they use recent experience as their baseline of comparison, thus missing long-term trends.[25] In a way,

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[23] Jacobs, Alan M. *Governing for the Long Term: Democracy and the Politics of Investment.* Cambridge: Cambridge University Press, 2011. p. 265

Nicholls and Lowe note: "uncertainty pervades the issue of benefits of mitigation on the future magnitude of sea-level rise and other climate change, and the benefits in terms of avoided impacts." Nicholls, Robert J. and Jason A. Lowe. "Benefits of Mitigation of Climate Change for Coastal Areas". In: Global Environmental Change 14.3 (2004), pp. 229–244. url: https://www.sciencedirect.com/science/article/pii/S0959378004000445 (visited on 2020-07-12).

[24] Unfortunately, some research indicates that the experience of extreme weather may not bolster support for climate change mitigation. Giordono, Gard-Murray, and Boudet found that: "Exposure to extreme weather often yields policy change, but changes are typically adaptation-oriented, rather than mitigation-focused." Giordono, Leanne, Alexander Gard-Murray, and Hilary Boudet. "From Peril to Promise? Local Mitigation and Adaptation Policy Decisions after Extreme Weather." 2021. url: https://www.researchgate.net/profile/Leanne-Giordono/publication/349724801_From_Peril_to_Promise_Local_Mitigation_and_Adaptation_Policy_Decisions_after_Extreme_Weather/links/603ea7304585154e8c724195/FromPeril-to-Promise-Local-Mitigation-and-Adaptation-PolicyDecisions-after-Extreme-Weather.pdf (visited on 2021-03-16).

The Toronto Star's "Undeniable Climate Change" series is an example of a deliberate journalistic effort to cultivate such a world view, as is The Guardian's decision to systematically change the terminology they use in climate reporting. Toronto Star. "Undeniable: Canada's Changing Climate." 2019. url: https://projects.thestar.com/climate-change-canada/ (visited on 2020-07-12).

Ogilvie, Megan. "What We Can Do Now." 2019. url: https://projects.thestar.com/climate-change-canada/what-you-can-do/ (visited on 2020-07-12).

Carrington, Damian. "Why the Guardian is Changing the Language it Uses About the Environment." 2019. url: https://www.theguardian.com/environment/2019/may/17/why-the-guardian-is-changing-the-language-ituses-about-the-environment (visited on 2019-07-06).

[25] Shifting baselines have the opposite properties to events which Kingdon argues will focus attention on policy change, since they smear into the general tone of background conditions rather than standing out in contrast. Pauly, Daniel. "Anecdotes and the Shifting Baseline Syndrome of Fisheries". In: Trends in Ecology & Evolution 10 (10 1995), p. 430

Hance, Jeremy. "Proving the 'Shifting Baselines' Theory: How Humans Consistently Misperceive Nature." 2009. url: https://news.mongabay.com/2009/06/proving-the-shifting-baselines-theory-how-humansconsistently-misperceive-nature/ (visited on 2020-07-12). JacksonAlexanderSala2011

climate change policy also involves another form of invisibility: if adverse consequences are avoided by limiting fossil fuel use and atmospheric $CO_2$ accumulation, then citizens and policy makers may not perceive or may question whether those losses would ever have occurred.[26] In a world where not enough is done and catastrophic climate change occurs we will never know for sure whether different choices at this stage could have avoided it; in a world where fossil fuels are rapidly phased out and the climate stabilizes, we will never know for sure how a scenario where we did not act would have played out.[27]

Another way of describing feelings of entitlement to lifestyles which people have come to expect is in terms of "psychological reactance" to efforts by individuals or institutions to constrain individual freedoms.[28] Here the issue is not internal to one person's psychology, but pertains to how people react psychologically when they perceive that someone else is seeking to influence or prescribe their behaviour. People may have an impulse to reject all efforts at external influence, which in turn may help explain why messaging about 'taxes on everything' and having valued activities and belongings taken away has been adopted so enthusiastically by pro-fossil conservatives. In 2007, Dillard and Shen found that people encouraged to floss more

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Pauly, Daniel. *Vanishing Fish: Shifting Baselines and the Future of Global Fisheries.* Vancouver: Greystone Books, 2019.

As John Sutter put it for CNN: "I fear that as we become increasingly trapped in a revolving door of climate-related disasters, we'll become numb — more numb than we already are — to the magnitude of what's actually happening." Sutter, John D. Let's Talk About the Climate Apocalypse. 2020. url: https://www.cnn.com/2020/10/13/opinions/lets-talk-about-climatechange-apocalypse-sutter/index.html (visited on 2020-10-15).

See also: Jones, Lizzie P, Samuel T Turvey, Dario Massimino, and Sarah K Papworth. "Investigating the Implications of Shifting Baseline Syndrome on Conservation". In: People and Nature (2020). url: https://besjournals.onlinelibrary.wiley.com/doi/full/10.1002/pan3.10140 (visited on 2020-08-28).

Frost, Rosie. The Younger You Are, the Less You Notice Environmental Changes, Says Study. 2020. url: https://www.euronews.com/living/2020/08/27/the-younger-you-are-the-less-you-notice-climatechange-says-study (visited on 2020-08-28).

[26] See also: Jacobs, Alan M. *Governing for the Long Term: Democracy and the Politics of Investment.* Cambridge: Cambridge University Press, 2011. p. 267

[27] Ilnyckyj, Milan. "Expertise and Legitimacy: The Role of Science in Global Environmental Policy-Making". M.Phil. Oxford: Oxford, 2007. url: http://individual.utoronto.ca/ilnyckyj/research/ExpertiseLegitimacy.pdf p. 96-7

[28] Brehm and Brehm define the term as "the motivational state that is hypothesized to occur when a freedom is eliminated or threatened with elimination." Brehm, Sharon S. and Jack W. Brehm. *Psychological Reactance: A Theory of Freedom and Control.* Cambridge, MA, 1966. p. 37

or drink less experienced feelings of threat and anger.[29] In 2018, Ma et al. found that emphasizing the scientific consensus on climate change produces reactance among those who already question it, though van der Linden et al. subsequently challenged that interpretation.[30] Other research has looked at reactance in the context of the potential threat to the ability to travel from climate change mitigation policies.[31] While clearly not definitive, this psychological research provides some support for the idea that some people will resist decarbonization simply because it is an objective imposed from outside which has the potential to impinge on what they perceive as their entitlements and legitimate freedoms. These connections between policy proposals and individual emotional responses may also explain why so many articles and public statements seek to discredit advocates of climate action on the basis that they supposedly show hypocrisy by continuing to use fossil fuels themselves. Rather than a logical argument, these justifications for inaction may be better understood as psychological reactance coupled with motivated reasoning, as those who are unwilling to change find rhetorical arguments to legitimate that decision.

While the gravity of climate change is broadly recognized – including by university administrations targeted by CFFD campaigns – there are also grave institutional problems which inhibit an effective response, including the low priority given to climate change impacts which are distant in space and time in comparison to financial impacts of investment choices which have immediate and specific relevance to universities.[32] Climate change impacts are uncertain in

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[29] Dillard, James Price and Lijiang Shen. "On the Nature of Reactance and its Role in Persuasive Health Communication". In: Communication Monographs 72.2 (2005), pp. 144–168. url: https://www.tandfonline.com/doi/full/10.1080/03637750500111815 (visited on 2020-10-24).

[30] Linden, Sander van der, Edward Maibach, and Anthony Leiserowitz. "Exposure to Scientific Consensus does not Cause Psychological Reactance". In: Environmental Communication (2019), pp. 1–8. url: https://www.tandfonline.com/doi/full/10.1080/17524032.2019.1617763 (visited on 2020-10-24).

[31] Font, Xavier and Ann Hindley. "Understanding Tourists' Reactance to the Threat of a Loss of Freedom to Travel due to Climate Change: A new Alternative Approach to Encouraging Nuanced Behavioural Change". In: Journal of Sustainable Tourism 25.1 (2017), pp. 26–42. url: https://www.tandfonline.com/doi/full/10.1080/09669582.2016.1165235 (visited on 2020-10-24).

[32] Simon Caney, for instance, describes how "[p]olitical life is dominated by 'presentism' and a focus on the short-term" and this prevents governments from protecting the long-term interests of current and future generations. Caney, Simon. Democratic Reform, Intergenerational Justice and the Challenges of the Long-Term. 2019. url: https://www.cusp.ac.uk/54 themes/m/m1-11/ - 1475182667098-0328ae0f-4bcbf2c7-159efa7b6ee7f265-97da (visited on 2019-11-14).

timing, magnitude, and geographic breakdown – impeding the formation of constituencies to resist them – while the constituencies employed in or benefiting from the fossil fuel *status quo* have already formed and possess great political influence.[33] The Economist summarized these barriers and challenges:

> It is the stock of carbon in the atmosphere that determines how much warming there will be, not the flow. Warming today is the consequence of past emissions. Correspondingly, cuts are irksome when they are made but bring benefits only in the future. Furthermore, the benefits of reducing emissions are spread globally whereas the costs – of new power plants, vehicles and so on – are local. That creates an incentive to free-ride: to continue using dirty fuels while hoping other countries' efforts will avert future disaster. To decarbonise knowing that the benefits will take decades to arrive, and even then only if every other big country also acts, is a lot to ask of a political system.[34]

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In April 2017, the head of the Harvard Management Corporation said: "I clearly feel that we are stealing from the future generations." Toffel, Michael W. and Sarah Gulick. Harvard Business School Case: Fossil Fuel Divestment. 2019. url: https://www.hbs.edu/faculty/Pages/item.aspx?num=56528 (visited on 2019-10-25). p. 11

Alan Jacobs' Governing for the Long Term emphasizes how inter-temporal considerations have an importance which is missed in accounts of politics which consider the distribution of costs and benefits at a particular junction in time. In particular, strategic political actors will seek to offload costs which would otherwise be imposed on them through policy changes to other groups in the future, and establishing policies which carry short-term costs and which need to be kept in place for long spans of time often requires commitment devices which alter the incentives for governments and private actors who might otherwise be able to entirely prioritize their own short-term interests.

[33] See: Weber, Elke U. "Experience-based and Description-based Perceptions of Long-term Risk: Why Global Warming Does not Scare Us (Yet)". In: Climatic Change 77.1-2 (2006), pp. 103–120. url: https://www8.gsb.columbia.edu/sites/decisionsciences/files/files/experiencebased%20perceptions%20of%20long-term%20risks.PDF (visited on 2019-12-29)

Macdonald argues that "those living today are asked by climate-change policy to pay for actions that will help them less than they will benefit those living in the future." Macdonald, Douglas. *Carbon Province, Hydro Province: The Challenge of Canadian Energy and Climate Federalism.* Toronto: University of Toronto Press, 2020. p. 20

[34] The Economist. "Political Economy Suggests That Geoengineering is Likely to be Used." 2019. url: https://www.economist.com/finance-and-economics/2019/04/27/political-economy-suggests-that-geoengineeringis-likely-to-be-used (visited on 2019-07-18).

Jaccard summarizes the structural barriers as the rarity of sincere politicians and the danger that they will go off course; climate change as a global problem in a world with no global government; the political power of the fossil fuel industry; and the difficulty of enacting and sustaining effective decarbonization policies. Jaccard, Mark. *The Citizen's Guide to Climate Success: Overcoming Myths that Hinder Progress.* Cambridge: Cambridge University Press, 2020.p. 163

He summarizes the reasons why success is so difficult: "a global governance problem without a global government; phasing out the combustion of high-quality fuels that have so benefitted humanity and could still benefit the poorest among us; the combination of wealth and power seeking to continue the burning of fossil fuels for self-interest reasons; the inability of our national and subnational democratic processes to initiate and sustain an effective decarbonization effort; and our human penchant for self-delusion in the face of inconvenient truths." Jaccard, Mark. *The Citizen's Guide to Climate Success: Overcoming Myths that Hinder Progress.* Cambridge: Cambridge University Press, 2020. p. 262

As Alan Jacobs argues:

> [F]or elected governments the problem of timing may be among the thorniest of policy predicaments: while the electoral calendar forces politicians to court voters in the near term, many of the most important social problems and policy ramifications lie in the distant future. … If the policy's costs must be imposed long before those benefits will arrive, however, then the politician faces a dilemma of timing just as brutal as any distributive trade-off.[35]

Multi-decadal time lags between when carbon pollution is released and when its full effects are felt hampers the instinctual approach of using ongoing feedback to modulate behaviour. In day to day life, we can set the temperature on a water tap, check within seconds if it is suitable, and adjust it in real time. We don't need to wait decades to check what temperature each position of the tap ends up producing, or worry that if we turn the tap too far we will be stuck with scalding water for centuries. With climate change, choices made at one point in time have consequences which won't be felt for decades or centuries, making it impossible to choose how much climate change humanity will experience based on a prompt relationship between damaging activities and harm arising.[36] Research by Samset et al. concluded that because of inertia and variability within the climate system the effects of climate change mitigation efforts would only produce a delayed and ambiguous signal: "any emergence of a significant change in surface temperature—

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[35] Jacobs, Alan M. *Governing for the Long Term: Democracy and the Politics of Investment.* Cambridge: Cambridge University Press, 2011. p. 3, 5

Lemphers argues that "outsourcing" emission reductions "shields highly organized major industrial emitters and shifts emission reductions towards other sectors, citizens, developing countries, and future generations." Lemphers, Nathan C. “Beyond the Carbon Curse: a Study of the Governance Foundations of Climate Change Politics in Australia, Canada and Norway”. PhD thesis. Toronto: University of Toronto, 2019. url: https://tspace.library.utoronto.ca/handle/1807/101303 (visited on 2020-08-15). p. 274

[36] Fossil fuel $CO_2$ reaches equilibrium with carbon reservoirs in the atmosphere, oceans, and biosphere on the timescale of centuries, though the fraction which remains in the atmosphere until it is absorbed by the slow weathering of rock takes 3,000-7,000 years. Archer, David, Michael Eby, Victor Brovkin, Andy Ridgwell, Long Cao, Uwe Mikolajewicz, Ken Caldeira, Katsumi Matsumoto, Guy Munhoven, Alvaro Montenegro, et al. “Atmospheric Lifetime of Fossil Fuel Carbon Dioxide”. In: Annual Review of Earth and Planetary Sciences 37 (2009). url: https://www.academia.edu/27465730/Atmospheric_Lifetime_of_Fossil_Fuel_Carbon_Dioxide (visited on 2020-12-21).

Dan Tong, a researcher at UC Irvine, has calculated that the coal plants operating around the world in 2019 would be able to breach the Paris Agreement temperature limits by themselves if operated for the rest of their lives, cumulatively emitting 360 gigatonnes of $CO_2$. Staying below a 2 °C increase would require that 2020's 7% drop in coal consumption be repeated every year for a decade, while a 1.5 °C would require 11% annual cuts. The Economist. "The Dirtiest Fossil Fuel is on the Back Foot." 2020. url: https://www.economist.com/briefing/2020/12/03/the-dirtiestfossil-fuel-is-on-the-back-foot (visited on 2020-12-14).

relative to a higher-than-realized emission scenario—will not occur until decades after efforts are put in place." [37] With the "substantial costs and short-term perceived burdens [of climate change mitigation] on society" being unable to promptly document the effects risks undermining public support.[38] This breaks the chain of accountability between policy makers who make climate-relevant choices and citizens who will suffer the consequences long after the leaders have lost power. At the most extreme level, we have no opportunity to cause catastrophic climate change once and thus learn where the relevant boundary lies; instead, we can only avoid the worst outcomes by trusting and acting upon projections about the eventual consequences of our choices.[39] Like the cartoon coyote chasing the roadrunner, we may run well past the edge of the cliff before we notice that there is no ground beneath us.

Since those climate projections require knowledge and resources unavailable to individuals, the projections' credibility requires trust in the institutions which generate them, contributing to a political context in which citizens struggle to adjudicate between contradictory claims from different parties with their own claims to expertise, even though the strength of the scientific consensus on climate change is great. Also – as Jacobs describes – uncertainty about whether a policy will be overturned in the future further complicates the cognitive challenge of interest groups and decision makers as they work to form preferences.[40] In particular, interest

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[37] Samset, B.H., J.S. Fuglestvedt, and M.T. Lund. "Delayed Emergence of a Global Temperature Response After Emission Mitigation". In: Nature Communications 11.1 (2020), pp. 1–10. url: https://www.nature.com/articles/s41467-020-17001-1.pdf (visited on 2020-07-15). p. 8

[38] Samset, B.H., J.S. Fuglestvedt, and M.T. Lund. "Delayed Emergence of a Global Temperature Response After Emission Mitigation". In: Nature Communications 11.1 (2020), pp. 1–10. url: https://www.nature.com/articles/s41467-020-17001-1.pdf (visited on 2020-07-15). p. 2

The problem of delayed benefits is less severe for co-benefits from decarbonization, most notably the reduction in toxic emissions and resulting benefits to human health and ecosystems.

[39] The time lag between the harmful behaviour of smoking cigarettes and the unwanted consequence of cancer and other health problems similarly impaired rational policy making and choices by individuals. Indirectly, however, it provided epidemiological evidence of the connection when disease rates for men were found to track smoking rates with a 25 year lag, with the same pattern for women delayed by their later adoption of the habit. Jaccard, Mark. *The Citizen's Guide to Climate Success: Overcoming Myths that Hinder Progress.* Cambridge: Cambridge University Press, 2020. p. 31

[40] Jacobs, Alan M. *Governing for the Long Term: Democracy and the Politics of Investment.* Cambridge: Cambridge University Press, 2011. p. 51-2

Perhaps ironically, the decision to design Canada's Pension Plan to focus strictly on returns and not political considerations arose from industry concern that without a robust commitment device the funds would be put to other

groups given the chance to pay a price now which will lead to a larger benefit for them in the future will do so only if they cannot "shift their long-run burdens onto others" – which is essentially McKibben's perspective on the business model of the fossil fuel industry *in toto*.[41] For individual financial actors, legal obligations to maximize returns to the exclusion of other considerations and a narrow view of fiduciary duty may compel trustees to prioritize pollution-increasing but profitable choices over those that protect the Earth and even the holistic long-term interests of their own beneficiaries.

Multilateral institutions are also challenged in addressing climate change.[42] Carlarne describes how international law on climate change is "fragmented" including in the areas of the law of the sea, human rights, biodiversity and trade.[43] Jaccard notes how states where fossil fuel resources are concentrated in specific regions will experience more "intra-national political and even constitutional tensions" if they seek to implement strong decarbonization policies,

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purposes: "industry was specifically concerned about the robustness of the mechanisms that would tie future governments' hands and called for ironclad institutional safeguards that would minimize the risk of political interference." Jacobs, Alan M. *Governing for the Long Term: Democracy and the Politics of Investment.* Cambridge: Cambridge University Press, 2011.p. 208

The widespread view that trustees of investment funds are strictly obligated to maximize returns to the exclusion of all other considerations has been a major impediment to the fossil fuel divestment movement.

On policy uncertainty, see also: Hovi, Jon, Detlef F. Sprinz, and Arild Underdal. "Implementing Long-term Climate Policy: Time Inconsistency, Domestic Politics, International Anarchy". In: Global Environmental Politics 9.3 (2009), pp. 20–39. url: https://muse.jhu.edu/article/270498/pdf (visited on 2020-07-12).

North, Douglass C. "Institutions and Credible Commitment". In: Journal of Institutional and Theoretical Economics 149.1 (1993), pp. 11–23. url: https://www.jstor.org/stable/pdf/40751576.pdf (visited on 2020-07-12).

Moe, Terry. "The Politics of Structural Choice: Toward a Theory of Public Bureaucracy". In: *Organization Theory: From Chester Barnard to the Present and Beyond.* Ed. by Oliver E. Williamson. New York: Oxford University Press, 1990.

[41] Jacobs, Alan M. *Governing for the Long Term: Democracy and the Politics of Investment.* Cambridge: Cambridge University Press, 2011. p. 186

The idea that interest groups will act to secure private benefits while passing costs to others also accords with Shue's emphasis on how future generations are completely powerless against us.

[42] McKibben argues: "we're going to need human solidarity on an unparalleled level, and right now that seems a long ways away." McKibben, Bill. "A Letter to My Colleagues at 350.org (and Friends in the Broader Movement)." 2020. url: https://350.org/bill-mckibbens-letter/ (visited on 2020-07-15).

[43] Pi˜non Carlarne, Cinnamon. "Good Climate Governance: Only a Fragmented System of International Law Away?" In: Law & Policy 30.4 (2008), pp. 450–480. url: https://sciencepolicy.colorado.edu/students/envs_4100/carlarne_2008.pdf (visited on 2020-01-10).

especially if they have a federal system of government.[44] Globally, effective action on climate change is impeded by the absence of institutions which can enforce agreements among states. Even when states voluntarily agree to formal measures like the Paris Agreement there are no adequate measures to mandate the implementation of policies capable of meeting the agreed target, and there is no way to compel future governments to keep the promises of their predecessors.[45] Domestically, democratic governments compete for the popularity of those alive and voting today and may savagely discount the interests of their descendants and non-human nature. Even if clear attribution can be made between harm experienced in one part of the world and GHG emissions in another there are not yet mechanisms for making those costs relevant to the polluters. The absence of sufficient mechanisms to initiate and sustain cooperation risks giving rise to a self-reinforcing political feedback where, as climate impacts worsen and states face more stress, they increasingly prioritize short-term self interest, even though only widespread and sustained cooperation can actually solve the problem.

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[44] Jaccard, Mark. *The Citizen's Guide to Climate Success: Overcoming Myths that Hinder Progress.* Cambridge: Cambridge University Press, 2020. p. 67, 86

Describing the Canadian process of intergovernmental negotiations on climate policy, Macdonald says: "In summary, when they engage in intergovernmental relations Canadian governments work in secret to produce vaguely worded, lowest-common-denominator agreements that have no legal status and so cannot be enforced, and that lack accountability since limited information is available on the extent to which those agreements are being implemented." Macdonald, Douglas. *Carbon Province, Hydro Province: The Challenge of Canadian Energy and Climate Federalism.* Toronto: University of Toronto Press, 2020. p. 44

An important legal explanation for this trend is provincial government ownership of natural resources. (p. 52) On the process of intergovernmental relations which is meant to reconcile the interests of Canada's constituent components, he calls it "a rickety, jury-rigged contraption which can barely stay afloat, let alone navigate to a safe harbour." (p. 234)

When the Pierre Trudeau government announced the budget which included their National Energy Program in 1980, the Calgary Herald printed a front-page editorial on why "Alberta must fight this flawed policy" – saying: "It is a travesty that not only remorselessly invades provincial jurisdiction, but changes the very character of the oil industry and the country itself." Corbella, Licia. "40 Years Later, National Energy Program has Lessons to Teach Today." 2020. url: https://calgaryherald.com/news/localnews/corbella-nep (visited on 2020-10-26).

[45] Peiran Liu and Adrian Raftery calculate that the United States has only a 2% chance of meetings its self-chosen target under the Paris Agreement, with China 16% likely to succeed. They also note the insufficiency of promised emission reductions for staying below the 2 ˚C target stating that to have an even chance of staying below the target the global decline in emissions must increase from 1% per year to 1.8%. Liu, Peiran R. and Adrian E. Raftery. "Country-based Rate of Emissions Reductions Should Increase by 80% Beyond Nationally Determined Contributions to Meet the 2 C Target". In: Communications Earth & Environment 2.1 (2021), pp. 1–10. url: https://www.nature.com/articles/s43247-021-00097-8 (visited on 2021-07-20).

In addition to psychological and political (game theoretical) barriers, there are structural barriers in existing capital stock.[46] Levin et al. describe how most societies have invested heavily in carbon-intensive energy production and industries; continue to train new professionals to staff those industries; depend on fossil fuels for transportation; feed themselves through carbon-intensive agriculture; and demand consumer goods which require fossil fuels through their lifecycles from creation to disposal.[47] Sepulveda et al. describe how power system investments made in the next decade are likely to remain operational until 2050, meaning promises about mid-century decarbonization which may feel comfortably distant to today's politicians actually require immediate action.[48] Gunningham notes how almost two thirds of GHG pollution arises from energy production, meaning our climate change problem is fundamentally an energy problem and that climatic stability is at odds with the continued operation of our current global energy system.[49] Pollin argues that governments are unwilling to cut emissions, despite the ecological threat, because reduced coal, oil, and gas use would lead to adverse impacts on fossil-fuel-producing workers and communities; a sharp drop in corporate profits and the revenues of state-owned energy companies like Saudi Aramco, Gazprom, and Petrobras; and higher energy

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[46] These would grow with further fossil fuel investment, as with Lemphers' argument that buying the Trans Mountain pipeline and allowing "large-scale LNG build-out on Canada's west coast deepens Canada's carbon lock-in." Lemphers, Nathan C. “Beyond the Carbon Curse: a Study of the Governance Foundations of Climate Change Politics in Australia, Canada and Norway”. PhD thesis. Toronto: University of Toronto, 2019. url: https://tspace.library.utoronto.ca/handle/1807/101303 (visited on 2020-08-15). p. 170

On decommissioning various types of energy capital investments, including coal and renewables, see: Invernizzi, Diletta Colette, Giorgio Locatelli, Anne Velenturf, Peter E.D. Love, Phil Purnell, and Naomi J. Brookes. “Developing Policies for the End-of-life of Energy Infrastructure: Coming to Terms With the Challenges of Decommissioning”. In: Energy Policy 144 (2020), p. 111677. url: https://www.sciencedirect.com/science/article/pii/S0301421520304067 (visited on 2020-08-28).

[47] Levin, Kelly, Benjamin Cashore, Steven Bernstein, and Graeme Auld. “Playing it Forward: Path Dependency, Progressive Incrementalism, and the “Super Wicked” Problem of Global Climate Change”. In: International Studies Association 48th Annual Convention. Chicago, February. Citeseer. 2007. url: https://iopscience.iop.org/article/10.1088/1755-1307/6/50/502002/meta (visited on 2019-12-29). p. 16

[48] Sepulveda, Nestor A., Jesse D. Jenkins, Fernando J. de Sisternes, and Richard K. Lester. “The Role of Firm Low-carbon Electricity Resources in Deep Decarbonization of Power Generation”. In: Joule 2.11 (2018), pp. 2403–2420. url: https://www.sciencedirect.com/science/article/pii/S2542435118303866 (visited on 2020-03-12).p. 2416-7

[49] Gunningham, Neil. “Review Essay: Divestment, Nonstate Governance, and Climate Change”. In: Law & Policy 39.4 (2017). url: https://onlinelibrary.wiley.com/doi/abs/10.1111/lapo.12085 (visited on 2019-01-04). p. 309

costs harming economy-wide competitiveness.[50] Specific to Canada, Macdonald describes the growth of the bitumen industry from the start of operations at the first plant near Fort McMurray in 1967, rising to 350,000 barrels per day of production by 1992, one million barrels per day in 2006, and 2.5 million barrels per day in 2016.[51] This immense investment – over $200 billion between 1999 and 2013 – has created interest groups with a strong motive to delay or prevent the transition off fossil fuels.[52]

Further to the psychological and institutional barriers against phasing out fossil fuels, there are structural impediments to non-fossil or climate-safe forms of energy which add to the challenge of stabilizing the climate.[53] Vaclav Smil notes how changing an energy system requires overcoming resistance to multiple interrelated developments – not just developing electric vehicle technology, for instance, but also creating the charging and zero-carbon electricity infrastructure necessary to achieve its benefits.[54] Some reject renewables because of their land use and impacts on wildlife; most environmentalists oppose nuclear energy; and

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[50] Polychroniou, C.J. Are Fossil Fuel Divestment Campaigns Working? A Conversation With Economist Robert Pollin. 2018. url: https://truthout.org/articles/are-fossil-fuel-divestment-campaignsworking-a-conversation-with-economist-robert-pollin/ (visited on 2020-01-19).

[51] He also argues that a large part of this growth was facilitated by industry lobbying which led to reductions in tax and royalty payments to the federal and provincial governments in the 1990s. Macdonald, Douglas. *Carbon Province, Hydro Province: The Challenge of Canadian Energy and Climate Federalism.* Toronto: University of Toronto Press, 2020. p. 83-4

Urquhart, Ian. *Costly Fix: Power, Politics, and Nature in the Tar Sands.* Toronto: University of Toronto Press, 2018.

[52] Turner, Chris. *The Patch: The People, Pipelines, and Politics of the Oil Sands.* Toronto: Simon & Schuster, 2018. p. 96

Leahy, Stephen. "What if Canada had Spent $200bn on Wind Energy Instead of Oil?" 2018. url: https://www.theguardian.com/world/ng-interactive/2018/jun/15/canada-oil-sands-pipeline-trans-mountain-whatif-invest-renewable-wind-energy (visited on 2021-09-05).

[53] The Economist noted in 2020 that decarbonization is outside the time horizon of most venture capitalists, who want to see returns within five to seven years, though they also note that between 2014 and 2018 global green VC investments produced annual returns of 20%. The Economist. "Climate-conscious Venture Capitalists are Back." 2020. url: https://www.economist.com/business/2020/10/29/climate-consciousventure-capitalists-are-back (visited on 2020-11-09).

[54] Smil, Vaclav. *Energy Transitions: History, Requirements, Prospects. 2nd edition.* Santa Barbara, CA: Praeger, 2017.

Jaccard, Mark. *The Citizen's Guide to Climate Success: Overcoming Myths that Hinder Progress.* Cambridge: Cambridge University Press, 2020. p. 203

environmentalists often oppose carbon sequestration.[55] Among challenges facing renewables, Stokes cites intermittency and the concomitant need for expensive energy storage and unpopular grid interlinkages, as well as local resistance.[56] A 2007 wind energy bill in Kansas was opposed

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[55] On renewables, for instance, Brianne Hogan describes the "tug-of-war between wind turbines and wildlife preservation." Hogan, Brianne. "Is it Possible to Build Wildlife-friendly Windfarms?" 2020. url: https://www.bbc.com/future/article/20200302-how-do-wind-farms-affect-bats-birds-and-other-wildlife (visited on 2020-03-10).

Among the thoughtful critics of renewables, Neville argues that they "must be further scrutinized before being championed as forging a path toward a low-carbon future" on the basis of their land, water, and labour inputs and the social and environmental harms arising from community dispossession, raw material requirements, and waste production. Neville, Kate J. "Shadows of Divestment: The Complications of Diverting Fossil Fuel Finance". In: Global Environmental Politics 20.2 (2020), pp. 3–11. url: https://www.mitpressjournals.org/doi/abs/10.1162/glep_a_00555 (visited on 2020-05-27). p. 6

Hoberg described how the Ivanpah concentrating solar facility — "a top priority of the Obama administration" — was opposed over concern about migratory birds and desert tortoises, and how the Sierra Club cheered the cancellation of the Soda Mountain solar project because of similar wildlife impacts. Hoberg, George. "How the Battles over Oil Sands Pipelines have Transformed Climate Politics". In: APSA Preprints (2019. url: https://preprints.apsanet.org/engage/apsa/articledetails/5d7c66f02f41c7001256af20 (visited on 2022-02-05). p. 14-5

Hunold, Christian and Steven Leitner. "'Hasta la vista, baby!' The Solar Grand Plan, Environmentalism, and Social Constructions of the Mojave Desert". In: *The Politics of Energy*. Ed. by Christian Hunold and Steven Leitner. Routledge, 2013, pp. 89–106.See also: IPBESReport2021

Briggs, Helen. "'Quick Fixes' to the Climate Crisis Risk Harming Nature." 2021. url: https://www.bbc.com/news/science-environment57425311 (visited on 2021-06-20).

McKibben and 350.org argue that renewable costs are falling so rapidly that nothing like CCS or nuclear power will be required, however other analyses find that incorporating nuclear power, bioenergy, and natural gas with CCS can reduce costs and raise the changes of successful decarbonization.

Sepulveda et al note that "[g]lobal deployment of nuclear and CCS is lagging well behind the pace envisioned by scenarios to limit global warming to 2 ˚C in the 2014 Intergovernmental Panel on Climate Change assessment report." They also calculate that a purely renewable system would need capacity of 5 to 8 times peak demand, whereas one incorporating non-renewable low-carbon options would only need 1.3 to 2.6 times peak demand. Sepulveda, Nestor A., Jesse D. Jenkins, Fernando J. de Sisternes, and Richard K. Lester. "The Role of Firm Low-carbon Electricity Resources in Deep Decarbonization of Power Generation". In: Joule 2.11 (2018), pp. 2403–2420. url: https://www.sciencedirect.com/science/article/pii/S2542435118303866 (visited on 2020-03-12).p. 2405, 2409

Ocean thermal electric conversion (OTEC), for example, would generate power from the temperature difference between deep and shallow ocean water but would require "covering a sizable fraction of the ocean's surface with low-efficiency energy capture devices" to produce terawatt-scale output. Jaffe, Robert L. and Washington Taylor. *The Physics of Energy*. Cambridge: Cambridge University Press, 2018. p. 768

[56] Stokes, Leah C. *Short Circuiting Policy: Interest Groups and the Battle over Clean Energy and Climate Policy in the American States*. New York: Oxford University Press, 2020. p. 19

Grid interlinkages and energy storage are both means of addressing the intermittency problem with renewables like solar and wind. While the latter store energy directly, the former allow variable output from various zones to help balance demand across a large (continental or inter-continental) grid. For example, the UK and Denmark are building a 475 km long undersea cable to transfer 1,400 MW of electricity between Lincolnshire and Jutland, adding up to 12.3 TWh per year. Ambrose, Jillian. "Work Begins in Lincolnshire on World's Longest Subsea Power Cable."

by the Kansas Audubon Society and Nature Conservancy, leading to changes in the bill which would have strengthened future 'Not In My Backyard' (NIMBY) opposition.[57] Stokes notes that there were 11 anti-wind groups in Ohio and five in Kansas in 2014.[58] In 2020, the 400 person community of Anse-Bleue in New Brunswick was able to reject a plan for five wind turbines after 85% of residents signed a petition to oppose them.[59] In Ontario's Paintearth County, resident Chris Blumhagen who is opposing a particular local wind farm proposal also said that "most residents aren't against the idea of wind power or other forms of renewable energy." [60] The Ontario Clean Air Alliance devotes much of its energy to resisting nuclear power and encouraging the premature shutdown of nuclear power stations, despite how they produce electricity without toxic air emissions.[61] Some local residents of Meaford, Ontario are opposing a

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2020. url: https://www.theguardian.com/environment/2020/jul/13/work-begins-in-lincolnshire-on-worlds-longest-subseapower-cable-viking-link (visited on 2022-04-04).

To illustrate the challenge of energy storage as electricity in comparison with fossil fuels, consider that coal has an energy density ranging from 15-35 MJ/kg while gasoline is 47 MJ/kg and lithium ion batteries have energy density below 1 MJ/kg. Jaffe, Robert L. and Washington Taylor. *The Physics of Energy*. Cambridge: Cambridge University Press, 2018. p. 645

Stokes calls a clean grid "the first linchpin," arguing that as the electricity sector decarbonizes it will ease the transition off fossil fuels in other sectors. BakerEckhouseRathi2020 Jaffe and Taylor note: "it would seem there is no obstacle in principle to replacing most human energy use with energy from renewable carbon-free energy sources within the coming 30-50 years, though the need for expanded capacity for grid storage may slow this transition and make it more expensive." Jaffe, Robert L. and Washington Taylor. *The Physics of Energy*. Cambridge: Cambridge University Press, 2018. p. 771

[57] Stokes, Leah C. *Short Circuiting Policy: Interest Groups and the Battle over Clean Energy and Climate Policy in the American States*. New York: Oxford University Press, 2020. p. 144

[58] Stokes, Leah C. *Short Circuiting Policy: Interest Groups and the Battle over Clean Energy and Climate Policy in the American States*. New York: Oxford University Press, 2020. p. 205

[59] Poitras, Jacques. "Wind Shifting Against Green Energy Project in Northern Community." 2020. url: https://www.cbc.ca/news/canada/new-brunswick/wind-farm-anse-bleue-1.5765614 (visited on 2020-10-21).

[60] Collins, Erin. "Alberta Community's Concerns About Wind Farm Echo Familiar Challenges of Canada's Energy Transition." 2020. url: https://www.cbc.ca/news/canada/edmonton/paintearth-county-windpower-project-1.5708296 (visited on 2020-10-21).

[61] For example: Ontario Clean Air Alliance. "Proposal to Extend Life of Pickering Nuclear Station is Reckless and Financially Irresponsible." 2020. url: https://web.archive.org/web/20200820024102/https://www.cleanairalliance.org/pik25/ (visited on 2020-08-19).

Contrast with: Ontario Ministry of Energy, Northern Development and Mines. "Ontario Supports Plan to Safely Extend the Life of the Pickering Nuclear Generating Station." 2020. url: https://news.ontario.ca/mndmf/en/2020/08/ontario-supports-plan-to-safely-extend-the-lifeof-the-pickering-nuclear-generating-station.html (visited on 2020-08-19).

1,000 MW pumped hydroelectric storage project which would store surplus energy from nuclear stations at times of low demand and help address the intermittency problem with renewable sources.[62] Even the media may create an institutional barrier, both because it receives considerable revenues from the fossil fuel industry and related sectors like automobile

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In 2021, Ontario Clean Air Alliance president Jack Gibbons argued: "It turns out that OPG does not have the data to show that Pickering's pressure tubes are still safe for service. If the pressure tubes aren't fit for service they could potentially rupture or break, and in the worst case scenario there could be a Fukushima-type accident." Mandel, Charles. Nuclear Plant at Risk of 'Fukushima-type Accident,' Ontario Group Says. 2021. url: https://www.nationalobserver.com/2021/04/07/news/ontario-nuclear-plant-risk-fukushima-accident-cleanair-alliance (visited on 2021-04-12).

In 2020, the group Protect Our Waterways - No Nuclear Waste sent flyers to 50,000 Ontario homes opposing the nuclear waste storage facility proposed for the Bruce site, arguing that "a leak from the dump site could eventually contaminate the Great Lakes." This disregards how the proposed repository would be in rock 680 m below the surface, in what Ontario Power Generation called "stable rock formations over 450 million years old." Butler, Colin. "Anti-nuclear Flyers Sent to 50,000 Homes are 'Fear Mongering,' Says Top Scientist." 2020. url: https://www.cbc.ca/news/canada/london/nuclear-waste-canada-lake-huron-1.5717703 (visited on 2020-10-21).

CBC News. "Nuclear Waste Site on Lake Huron Concerns Michigan, Sarnia." 2013. url: https://www.cbc.ca/news/canada/windsor/nuclear-wastesite-on-lake-huron-concerns-michigan-sarnia-1.1398750 (visited on 2020-10-21).

In 2013, Kharecha and Hansen estimated that global nuclear power use "prevented an average of 1.84 million air pollution-related deaths and 64 gigatonnes of CO2-equivalent greenhouse gas emissions" and that by 2050 the use of nuclear energy could prevent a further 420,000 to 7.04 million deaths and 80-240 gigatonnes of GHG emissions depending on which fuel it replaces. Kharecha, Pushker A. and James E. Hansen. "Prevented Mortality and Greenhouse Gas Emissions from Historical and Projected Nuclear Power". In: Environmental Science & Technology 47.9 (2013), pp. 4889–4895. url: https://pubs.acs.org/doi/abs/10.1021/es3051197 (visited on 2021-06-16).

Rhodes, Richard. *Energy: A Human History*. New York: Simon & Schuster, 2018. p. 324-5

[62] Pittis, Don. "Fossil Fuel Giant Faces Uphill Push to Build Green Mega-project." 2020. url: https://www.cbc.ca/news/business/oil-green-energydon-pittis-fossil-fuels-tc-energy-1.5662311 (visited on 2020-07-30).

Dunn, Scott. "Meaford Mega Power Storage Project Draws Concerns." 2019. url: https://www.owensoundsuntimes.com/news/local-news/meaford-mega-power-storage-project-draws-concerns (visited on 2020-07-30).

Vance, Stephen. "Residents Take Pumped Storage Protest to Tank Range Gates." 2020. url: https://www.themeafordindependent.ca/news/community-news/799806-residents-take-pumped-storage-protestto-tank-range-gates (visited on 2020-07-30).

The Meaford Independent. "Professor Launches 'For the Love of Georgian Bay' Virtual Puppet Making & Drama Camp to Raise Environmental Awareness." 2020. url: https://www.themeafordindependent.ca/news/community-news/799997-professor-launches-for-the-love-of-georgian-bay-virtual-puppet-making-drama-camp-toraise-environmental-awareness (visited on 2020-07-30).

MacKay uses the 9 GWh capacity of the Dinorwig pumped-storage hydroelectric scheme in Wales – describing it evocatively as "an astonishing cathedral inside a mountain in Snowdonia" – as a reference for comparison, noting that this stored energy represents a head of between 494 and 542 metres on a reservoir with a volume of 6.7 million cubic metres. He further notes that at the time of writing, Britain could store about 30 GWh in total in all their pumped storage facilities. Mackay, David. *Sustainable Energy: Without the Hot Air*. Cambridge: UIT Cambridge, 2009. url: https://www.withouthotair.com/ (visited on 2019-07-18). p. 191

manufacture and aviation and because it has an incentive to be aligned with prevailing ideological views of mainstream politicians and parties, given that media sources which endorse policies well outside the mainstream risk being marginalized in favour of those with views within the spectrum of views held by political parties with a chance of winning power.[63] This may inhibit the media's ability to act as an effective conduit for pertinent and factual information between scientific experts, the public, and politicians. MacKay warns that the public tends to reject anything other than fossil fuel power systems and that an environmental movement centred around saying no to anything with unwelcome costs of impacts will prevent us from building the alternative energy sources which offer the only way to reconcile the energy-intensive lives people have come to expect with what the Earth can endure.[64]

There are also deeply embedded ideas among environmentalists which impede the prospects for building new climate-safe energy at a sufficient pace to avoid the worst impacts of climate change, including the appealing but unjustified view that conservation and simply using less can be a major part of the solution and the expectation that non-fossil forms of energy will themselves be problem-free in terms of environmental issues like land use and impacts on non-human animals.

While popular among environmentalists, the idea that we can solve much of the problem by simply using less energy is flawed and ultimately unconvincing. There is a basis to the criticism that environmental advocates are better at highlighting problems than at proposing credible solutions. No matter where the energy comes from, powering a world like the one which

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[63] On the basis of 1,768 press releases, Rachel Wetts found that press releases opposing climate action are twice as likely to be cited in the media; business coalitions and large businesses are the most likely to receive positive coverage; and "organizations providing scientific and technical services" are the least likely to be cited. Wetts, Rachel. “In Climate News, Statements from Large Businesses and Opponents of Climate Action Receive Heightened Visibility”. In: Proceedings of the National Academy of Sciences (2020). issn: 0027-8424. url: https://www.pnas.org/content/early/2020/07/21/1921526117 (visited on 2020-07-30).

Winters, Joseph. "The Curse of ‘Both-sidesism’: How Climate Denial Skewed Media Coverage for 30 Years." 2020. url: https://grist.org/climate/the-curse-of-both-sidesism-how-climate-denial-skewed-mediacoverage-for-30-years/ (visited on 2020-07-30).

On the risk that the media will tend to support *status quo* industries for financial reasons, see: Carney, Bryan. "Do We Still Want Our News Paid for By the Car Lobby?" 2020. url: https://thetyee.ca/Mediacheck/2020/06/25/NewsPaid-By-Car-Lobby/ (visited on 2020-07-12).

[64] Mackay, David. *Sustainable Energy: Without the Hot Air*. Cambridge: UIT Cambridge, 2009. url: https://www.withouthotair.com/ (visited on 2019-07-18). p. 250

exists now requires a base of infrastructure which will inevitably have adverse effects on people, the environment, and other species through the exploitation of raw materials, wastes from ongoing operation of facilities, and their eventual decommissioning or disposal. That impact will be even larger if ethics or pragmatism drive us to accept that those living in energy poverty around the world should gain a lifestyle equivalent to Europe, Japan, or North America today.[65] Mackay calculated that producing the 125 kilowatt-hours per day (kWh/d) presently enjoyed per person in Europe could be achieved with a 600 km by 600 km concentrating solar array for every billion people on Earth, which is about the size of Germany.[66] Alternatively, covering 10% of the UK with onshore wind turbines would produce 20 kWh/d for the approximate present population of that territory.[67] Countries with large nuclear fleets produce a fraction of the 125 kWh/d level through fission: 2.8 kWh/d in Russia, 5.7 in Japan, 7.4 in Canada, 7.5 in the US, 11.8 in Finland, 19.0 in France, and 19.6 in Sweden.[68] Mackay calculates that with 110 gigawatts of installed nuclear capacity (about nine times what the UK had at the peak in 1995) the UK

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[65] 800 million people globally are still without electricity, and the world's poor burn more traditional biomass for energy than the entire world did in 1900. The Economist. "The World's Energy System Must be Transformed Completely." 2020. url: https://www.economist.com/schools-brief/2020/05/23/the-worlds-energy-system-must-be-transformed-completely (visited on 2020-06-19).

Looking at electricity only, Sapan Thapar describes how in a study of 20 urban families in Delhi with an average income of $25,000 power consumption was 6,400 kWh per year or about 18 kWh per day. Thapar notes that this is "double the national average and comparable to developed countries." Thapar, Sapan. "Energy Consumption Behavior: a Data-based Analysis of Urban Indian Households". In: Energy Policy 143 (2020), p. 111571. url: https://www.sciencedirect.com/science/article/pii/S030142152030313X (visited on 2020-06-19).

[66] Mackay, David. *Sustainable Energy: Without the Hot Air*. Cambridge: UIT Cambridge, 2009. url: https://www.withouthotair.com/ (visited on 2019-07-18). p. 179

Alternatively, Jaffe and Taylor estimate that covering 10% of the world's deserts (2 million km2) could provide for all world energy needs. Jaffe, Robert L. and Washington Taylor. *The Physics of Energy*. Cambridge: Cambridge University Press, 2018. p. 739, 443-4, 765

[67] Mackay, David. *Sustainable Energy: Without the Hot Air*. Cambridge: UIT Cambridge, 2009. url: https://www.withouthotair.com/ (visited on 2019-07-18). p. 33

A map in MacKay's book shows what a large fraction of the UK would be used for an energy plan using wind, wave, solar, tidal, biofuels, CCS, nuclear, and international links to solar farms abroad: MacKay, David. "A Plan that Adds Up, for Scotland, England, and Wales." 2009. url: http://www.withouthotair.com/c28/page_215.shtml (visited on 2020-07-23).

[68] Mackay, David. *Sustainable Energy: Without the Hot Air*. Cambridge: UIT Cambridge, 2009. url: https://www.withouthotair.com/ (visited on 2019-07-18). p. 161

could produce 44 kWh/d – still a fraction of today's total energy use in rich countries.[69] Large hydroelectric dams are also highly controversial, including the Site C dam in BC which would be the largest built in the province since 1984, but which is opposed by many eNGOs, environmentalists, and climate activists, in part because of the view that its construction violates Indigenous rights.[70] It is not hard to envision the political and activist opposition that a global effort to build out non-fossil energy to this degree would generate.[7172] When Stokes analyzed

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[69] Mackay, David. *Sustainable Energy: Without the Hot Air*. Cambridge: UIT Cambridge, 2009. url: https://www.withouthotair.com/ (visited on 2019-07-18). p. 211

Roberts, Tim and Helene Clark. "Nuclear Electricity in the UK." 2018. url: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/789655/Nuclear_electricity_in_the_UK.pdf (visited on 2020-01-19).

[70] For example, over 200 Canadian scholars expressed their opposition to the dam to prime minister Trudeau in 2016. Lassonde, Maryse. "I am writing regarding the Site C hydroelectric dam project on the Peace River in northern British Columbia." 2016. url: https://web.archive.org/web/20161220145948/https://rscsrc.ca/sites/default/files/pdf/PM_Trudeau_19.05.2016.pdf (visited on 2020-01-19).

For further discussion of the Site C dam in the context of climate change, see: Behn, Caleb and Karen Bakker. "Rendering Technical, Rendering Sacred: The Politics of Hydroelectric Development on British Columbia's Saaghii Naachii / Peace River". In: Global Environmental Politics 19.3 (2019), pp. 98–119. url: https://www.mitpressjournals.org/doi/full/10.1162/glep_a_00518 (visited on 2021-03-02).

Stokes also argues that most areas with geography compatible with large hydroelectric dams have already been used in developed countries, with remaining dam locations in the US only potentially able to supply 5% of current electricity production. Stokes, Leah C. *Short Circuiting Policy: Interest Groups and the Battle over Clean Energy and Climate Policy in the American States*. New York: Oxford University Press, 2020. p. 21

On environmentalist resistance to other large dams see: Khagram, Sanjeev. *Dams and Development: Transnational Struggles for Water and Power*. Ithaca, NY: Cornell University Press, 2004.

Ratcliffe, Rebecca. "Cambodia Scraps Plans for Mekong Hydropower Dams." 2020. url: https://www.theguardian.com/world/2020/mar/20/cambodia-scraps-plans-for-mekong-hydropower-dams (visited on 2020-03-30).

Contenta, Sandro. "Plans for a Massive Hydro Plant on the Shores of Georgian Bay have Residents 'Devastated'." 2020. url: https://www.thestar.com/news/gta/2020/03/12/plans-for-a-massive-hydro-planton-the-shores-of-georgian-bay-have-residents-devastated.html (visited on 2020-03-30).

Hongoltz-Hetling, Matt. "US Demand for Clean Energy Destroying Canada's Environment, Indigenous Peoples Say." 2020. url: https://www.theguardian.com/environment/2020/jun/22/us-clean-energy-demand-destroyingcanadian-environment-indigenous-peoples-say (visited on 2020-06-29).

Brennan, Rosamund. "Critics Call Out Financial and Social Costs of Georgia Hydro Dam." 2020. url: https://www.aljazeera.com/ajimpact/critics-call-financial-social-costs-georgia-hydro-dam-200617114603688.html (visited on 2020-07-12).

[71] Schenk and Stokes identify "[e]nvironmental and social concerns, ranging from impacts on wildlife to neighbors worried about property values or their health" as barriers to renewable energy deployment. schenk2013power p. 56 They also note that "[t]hose opposed are often louder and more committed than the passively supportive, whether they be protesting a nuclear plant or a wind turbine." Schenk, Todd and Leah C. Stokes. "The Power of Collaboration: Engaging all Parties in Renewable Energy Infrastructure Development". In: IEEE Power and Energy

wind energy construction in Ontario by the Liberal government after 2003, she found it plausible that they lost their majority in the 2011 election because of opposition to wind power projects, noting that every district with a wind turbine had at least one anti-wind group.[73] Stokes concluded: "Taking the point estimates across all models, wind turbine proposals were associated with a 5% decline and operational wind turbines with a 10% decline in the incumbent provincial government's vote share." [74] People prioritize perceived near-term risks above the long-term need to constrain climate change, perhaps most evidently in Germany and Japan's retreat from nuclear power after the 2011 Tohoku earthquake and tsunami caused core meltdowns in units 1, 2, and 3 of the Fukushima Daiichi nuclear generating station after its emergency diesel generators were flooded and both offsite and onsite power routing were damaged.[75] In Ontario,

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Magazine 11.3 (2013), pp. 56–65. url: https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6506853 (visited on 2020-01-19). p. 64-5

[72] See also: The Economist. "Why many Greek Greens Oppose Wind Power." 2020. url: https://www.economist.com/europe/2020/02/01/why-many-greek-greensoppose-wind-power (visited on 2020-02-21).

[73] Stokes, Leah C. "Electoral Backlash Against Climate Policy: A Natural Experiment on Retrospective Voting and Local Resistance to Public Policy". In: American Journal of Political Science 60.4 (2016), pp. 958–974. url: https://onlinelibrary.wiley.com/doi/abs/10.1111/ajps.12220 (visited on 2020-01-19). p. 962, 971

[74] Stokes, Leah C. "Electoral Backlash Against Climate Policy: A Natural Experiment on Retrospective Voting and Local Resistance to Public Policy". In: American Journal of Political Science 60.4 (2016), pp. 958–974. url: https://onlinelibrary.wiley.com/doi/abs/10.1111/ajps.12220 (visited on 2020-01-19). p. 971

Theoretically, royalties paid to those who have renewable generation sited on their land may help soften opposition. See for instance: The Economist. "A Renewable-energy Boom is Changing the Politics of Global Warming." 2020. url: https://www.economist.com/united-states/2020/03/12/a-renewable-energy-boom-is-changing-the-politics-of-global-warming (visited on 2020-04-08).

[75] For a good technical account of the Fukushima disaster, delivered with a commendable degree of context and empathy for all the earthquake victims, see: Budnitz, Robert. "The Fukushima Nuclear Reactor Accident: What Happened and What Does It Mean?" 2011. url: https://www.youtube.com/watch?v=LS6kqo9qZnM (visited on 2020-10-28).

Following the disaster Japanese nuclear generating stations were taken offline, with their output largely replaced by fossil fuels. As of June 2020, the Japanese government wanted coal's share of the electricity supply to grow and had approved plans for 22 new coal plants. The Economist. "The Reinvention of Japan's Power Supply is not Making Much Headway." 2020. url: https://www.economist.com/asia/2020/06/13/thereinvention-of-japans-power-supply-is-not-making-muchheadway (visited on 2020-07-11).

Even after publicly committing to reach net-zero emissions by 2050, Japan's government remains hesitant to re-open facilities shut down after the Fukushima disaster, leading to greatly increased fossil fuel use for electricity generation, much less to propose enlarging the country's fleet of reactors. In 2020, economy minister Hiroshi Kajiyama said that construction of new nuclear plants was not under consideration because of the lack of public trust arising from the Fukushima accident. Bloomberg. "Japan Sees Muddled Messaging on Nuclear's Role in Carbon Target." 2020. url: https://www.japantimes.co.jp/news/2020/10/28/national/science-health/japan-nuclear-plant-carbon/ (visited on 2020-10-28).

eNGOs like the Ontario Clean Air Alliance are pushing for the accelerated decommissioning of the six CANDU reactors at Pickering which produce about 14% of the province's electricity.[76] Whether motivated by other-regarding concerns about the impact of wind turbines on bats, fear of earthquakes from geothermal energy, the risks posed to future generations by nuclear waste, or self-regarding concerns about land use and property values, a substantial amount of resistance can be expected to a major effort to decarbonize by replacing existing fossil fuel facilities with all known low- or non-emitting alternatives. This resistance could be carried out using the same methods which climate activists are using to block fossil fuel projects, from lobbying to lawsuits to physical blockades. In a way, then, not only are there structural factors which impede the deployment of low-carbon energy, but they may actually grow stronger as the result of some phenomena generally praised and welcomed by climate change activists, such as more rigorous approval processes for energy projects and a higher degree of local control over planning.

Environmentalist opposition to nuclear energy illustrates some of the barriers to zero-carbon or climate-safe energy deployment. The environmentalist movement of the 1970s was partly motivated by and largely inter-linked with an anti-nuclear movement, and most environmentalists and environmental organizations continue to resist nuclear energy.[77] To some degree this resistance is habitual and aesthetic. 'Small is beautiful', natural is better than artificial, and local is better than centralized are all environmentalist mantras, irrespective of whether they

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The disaster initiated a sharp rise in Japanese GHG emissions, with 25% of Japanese electricity coming from nuclear generating stations before 2011 and just 6% in 2020. The Economist. "Japan Promises to be Carbon-neutral By 2050." 2020. url: https://www.economist.com/asia/2020/10/29/japan-promises-to-becarbon-neutral-by-2050 (visited on 2020-11-09).

[76] Lyash, Jeffrey. "Pickering is a Boon to Ontario, says Ontario Power Generation CEO. 2017. url: https://business.financialpost.com/opinion/letter-pickering-is-a-boon-to-ontario-says-ontariopower-generation-ceo (visited on 2020-01-19).

Interestingly, Dr. Rob Oliphant, president of the Asthma Society of Canada, has praised the impact of the Bruce Power reactors on Ontario's air quality. Asthma Society of Canada and Bruce Power. Bruce Power and Asthma Society of Canada Release Emissions Report. 2014. url: https://asthma.ca/wp-content/uploads/2017/06/Press-Release-BrucePower-and-Asthma-Society-of -Canada-release-Emissions Report.pdf (visited on 2020-01-19).

[77] See: Plumer, Brad, Henry Fountain, and Livia Albeck-Ripka. "Environmentalists and Nuclear Power? It's Complicated." 2018. url: https://www.nytimes.com/2018/04/18/climate/climate-fwd-green-nuclear.html (visited on 2020-07-20).

Van Munster, Rens and Casper Sylvest. "Pro-Nuclear Environmentalism: Should we Learn to Stop Worrying and Love Nuclear Energy?" In: Technology and Culture 56.4 (2015), pp. 789–811. url: https://pubmed.ncbi.nlm.nih.gov/26593709/ (visited on 2020-07-20).

actually produce environmental benefits when applied in practice.[78] At the same time, there are grave and high-minded reasons to question the prudence of further nuclear deployment, from a record of unresolved waste, to high costs, to the risk nuclear power technology and facilities will fuel weapon proliferation.[79] Environmentalists also sometimes assume that fossil fuel alternatives should be painlessly better. Despite being an organization founded to try to control climate change, 350.org has adopted a position of "100% renewables" as the solution, with McKibben arguing that the falling cost and faster pace of deployment for renewables makes them the superior solution to the climate-energy problem.[80] This is at a time when hydroelectricity is the only renewable energy form which produces a substantial amount of

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[78] Wapner argues: "The early environmental movement arose partly as a critique of the synthetic revolution" and "Better living through chemistry" mantra of the 1950s and 1960s. Wapner, Paul. "Horizontal Politics: Transnational Environmental Activism and Global Cultural Change". In: Global Environmental Politics 2.2 (2002), pp. 37–62. url: https://www.mitpressjournals.org/doi/abs/10.1162/15263800260047826 (visited on 2020-05-22).p. 56

Neville notes that "[f]or some climate activists, the promise of renewables rests on their ability not only to reduce emissions but also to provide distributed, democratized access to energy." Neville, Kate J. "Shadows of Divestment: The Complications of Diverting Fossil Fuel Finance". In: Global Environmental Politics 20.2 (2020), pp. 3–11. url: https://www.mitpressjournals.org/doi/abs/10.1162/glep_a_00555 (visited on 2020-05-27).p. 7

International Renewable Energy Agency. "A New World: The Geopolitics of the Energy Transformation." 2019. url: https://www.irena.org//media/Files/IRENA/Agency/Publication/2019/Jan/Global_commission_geopolitics_new_world_2019.pdf (visited on 2020-08-01).

[79] The connection to weapons also somewhat diminishes the nuclear industry's record of clean electricity production. Richard Rhodes notes that after president Harry Truman scaled up U.S. nuclear weapon production in the mid-1950s 6.7% of all U.S. electrical power production was used in the nuclear weapon production complex. Rhodes, Richard. *Arsenals of Folly: The Making of the Nuclear Arms Race.* New York: Vintage Books, 2008.p. 79

Since large amounts of electricity are needed to run nuclear reactors for plutonium production and to enrich uranium (and some plutonium production reactors like the U.S. reactors at the Hanford site and U.K. reactors at Windscale produced no electricity while using grid electricity to run their machinery) all nuclear weapon states have run conventional power stations to produce electricity for weapon manufacture.

Lifton and Oreskes argue that nuclear is not a climate change solution because it costs more per megawatt-hour than renewables; contamination and accidents; waste; and weapon proliferation. They argue that if "nuclear power is embraced as a rescue technology" and the current set of 450 reactors is much expanded it will create "a worldwide chain of nuclear danger zones — a planetary system of potential self-annihilation." Lifton, Robert Jay and Naomi Oreskes. The False Promise of Nuclear Power. 2019. url: https://www.bostonglobe.com/opinion/2019/07/29/the-false-promise-nuclear-power/kS8rzs8f7MAONgXL1fWOGK/story.html (visited on 2020-09-26).

On the weapon proliferation risk from further nuclear energy deployment, see: Sabga, Patricia. "Nuclear Gulf: Experts Sound the Alarm over UAE Nuclear Reactors." 2020. url: https://www.aljazeera.com/ajimpact/nuclear-gulf-experts-sound-alarm-uae-nuclear-reactors 200628194524692.html (visited on 2020-07-30).

Sagba, Patricia. "Nuclear Gulf: Is Saudi Arabia Pushing Itself Into a Nuclear Trap?" 2020. url: https://www.aljazeera.com/ajimpact/nuclear-gulf-saudiarabia-pushing-nuclear-trap-200718155513128.html (visited on 2020-07-30).

[80] McKibben, Bill. *Eaarth: Making a Life on a Tough New Planet.* Toronto: Random House, 2010. p. 57-8

global energy: about 0.43 TW of electrical power in 2013, or 3% of global energy use.[81] As one of the most significant deployed sources of climate-safe energy in the world (producing about 10% of global electricity in 2018) existing nuclear facilities have likely created a significant cut in global cumulative GHG emissions compared to a hypothetical scenario where they were not built, estimated by the IEA at over 60 gigatonnes in the last 50 years.[82] If these facilities can be kept in operation it will contribute to maintaining the share of global energy production which does not worsen climate change, whereas the shutdown of these facilities would increase the already-massive gap between how much low- and zero-carbon power has been deployed and the amount needed to constrain warming to 1.5–2.0 ˚C, as the world committed to do under a series of multilateral agreements. As Stokes notes, the climate situation is shifting the position of some environmental advocates on nuclear power.[83] While it is a subjective judgment, I suspect that opposition to nuclear energy among many environmental activists is reflective of policy positions derived from aesthetics rather than knowledge, or simply from the inertia of nuclear energy being singled out as an early environmentalist target. Simple heuristics like 'natural is better' are widespread to the point that they are routinely exploited in advertising, with consumers being bizarrely promised that their shampoo contains no chemicals and that their hummus contains chick peas which have only been altered through selective breeding in

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[81] Jaffe, Robert L. and Washington Taylor. *The Physics of Energy*. Cambridge: Cambridge University Press, 2018. p. 769

[82] International Energy Agency. "Nuclear Power in a Clean Energy System." 2019. url: https://webstore.iea.org/download/direct/2779 (visited on 2020-07-20).

[83] Stokes, Leah C. *Short Circuiting Policy: Interest Groups and the Battle over Clean Energy and Climate Policy in the American States*. New York: Oxford University Press, 2020. p. 20

Clemmer, Steve, Jeremy Richardson, Sandra Sattler, and Dave Lochbaum. "The Nuclear Power Dilemma: Declining Profits, Plant Closures, and the Threat of Rising Carbon Emissions." 2018. url: https://www.ucsusa.org/sites/default/files/attach/2018/11/Nuclear Power-Dilemma-full-report.pdf (visited on 2020-05-05).

See also: Ilnyckyj, Milan. “Climate Change, Energy Security, and Nuclear Power”. In: St. Antony’s International Review 4.2 (2009). url: https://www.sindark.com/NonBlog/Articles/CCNuclear.pdf (visited on 2020-05-08).

Bryce, Robert. "After 48 Years, Democrats Endorse Nuclear Energy In Platform." 2020. url: https://www.forbes.com/sites/robertbryce/2020/08/23/after-48-years-democrats-endorse-nuclear-energy-in-platform/ (visited on 2020-08-28).

Monbiot, George. "Nuclear Opponents Have a Moral Duty to Get Their Facts Straight." 2020. url: https://www.theguardian.com/environment/georgemonbiot/2011/apr/13/anti-nuclear-lobby-interrogate-beliefs (visited on 2020-08-28).

agriculture rather than in a genetics lab.[84] The use of heuristics in considering policy questions of great complexity and uncertainty is understandable, as is a general skepticism about the environmental beneficence of industry, but if climate change is truly an over-riding and existential problem it should provoke re-evaluation of old stances among environmentalists as well as among decision-makers and the public. There is indeed some evidence that the seriousness of climate change is driving a reconsideration of nuclear energy among some environmentalists, though those growing more open to the idea also seem to be aware of how much an openness to fission as a source of low carbon energy still alienates them from most of the environmental movement.[85] Nonetheless, a limited trend toward greater openness to nuclear energy doesn't amount to the kind of wholehearted commitment which we will see is necessary for avoiding climate change of much more than 2 ˚C. Enthusiasm for devoting much of the landscape to renewable energy production or crop growing for biofuels is also not evident, taking us back to MacKay's point about how societies which have grown to see the advantages of fossil fuels as normal will be resistant to climate-safe alternatives which have less convenience and new drawbacks (though that psychological normalization also leads people to dismiss or treat as acceptable non-climatic harms from fossil fuels like toxic air and water pollution).[86]

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[84] Literal poison, which I found under the sink in my shared apartment, is labeled "Earth Blends" — a registered trademark of Raid. The label promises: "KILLS ON CONTACT" before noting: "Contains an insecticide derived from the Chrysanthemum flower," which I suppose in a roundabout way makes sense since plants have three or four hundred million years of experience in killing insects which are trying to eat them, a history that takes us back to the rise of the angiosperms and the beginnings of the reserves of buried carbon which now so threaten us. Before the Carboniferous period of about 300 million years ago, terrestrial plant cover was insufficient to create large coal reserves. Jaffe, Robert L. and Washington Taylor. *The Physics of Energy*. Cambridge: Cambridge University Press, 2018. p. 649

[85] In June 2020, former editor of the Extinction Rebellion's newspaper The Hourglass called for environmentalists to support nuclear energy, calling it "a reliable low-carbon energy source that we can invest in now." Lights, Zion. "A Message from a Former Extinction Rebellion Activist: Fellow Environmentalists, Join me in Embracing Nuclear Power." 2020. url: https://www.cityam.com/a-message-from-a-former extinction-rebellion-activist-fellow-environmentalists-joinme-in-embracing-nuclear-power/ (visited on 2020-06-29).

Grimston, Malcolm. "Letter: Even Climate Activists are Shifting on Nuclear." 2020. url: https://www.ft.com/content/b3e8b0a1-c4744be9-bb95-801654177db5?segmentid=acee4131-99c2-09d3-a635873e61754ec6 (visited on 2020-06-29).

See also: Monbiot, George. "Nuked by Friend and Foe." 2009. url: https://www.monbiot.com/2009/02/20/nuked-by-friend-and-foe/ (visited on 2021-09-05).

[86] In an interesting historical parallel regarding competition for land use between food and energy production, Rhodes describes how "half the land in New England was devoted to hay by 1909" to sustain the horses which provided much of society's motive power prior to the general transition to fossil fuel use. Rhodes, Richard. *Energy: A Human History*. New York: Simon & Schuster, 2018. p. 211

The idea that climate change can be solved through efficiency and using less is also at odds with some of the fuel switching and technological replacement which decarbonization requires.[87] Humanity will likely require considerably more electricity production than at present to replace fossil fuels in applications like transport and building heating.[88] Stokes argues that the US electricity system must grow by 50-120% to electrify other sectors that currently use fossil fuels.[89] Maintaining global civilization in the absence of intensive fossil fuel use also requires new processes and energy sources for agriculture and the production of materials like steel. As widely noted in the environmental and energy policy literatures, it is also oversimplistic and misleading to assume that increasing the energy efficiency of particular products and processes will lead to reduced energy consumption.[90] Jevons' Paradox (also referred to as the rebound effect of the Khazzoom–Brookes postulate) holds that increased efficiency may actually *increase*

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[87] On the prominence and persistence of confusion about efficiency in energy policy debates, see: Goh, Tian and BW Ang. "Four Reasons Why There is So Much Confusion About Energy Efficiency". In: Energy Policy 146 (2020), p. 111832. url: https://www.sciencedirect.com/science/article/abs/pii/S0301421520305498 (visited on 2020-10-19).

[88] Stokes, Leah C. *Short Circuiting Policy: Interest Groups and the Battle over Clean Energy and Climate Policy in the American States*. New York: Oxford University Press, 2020. p. 13, 19

In 2016, humanity used about 15 TW of energy. If current trends continue that would rise to about 30 TW within a few decades. Jaffe, Robert L. and Washington Taylor. *The Physics of Energy*. Cambridge: Cambridge University Press, 2018. p. 765

[89] Stokes, Leah C. *Short Circuiting Policy: Interest Groups and the Battle over Clean Energy and Climate Policy in the American States*. New York: Oxford University Press, 2020. p. 13, 226 Iyer2017 jenkins2018getting WilliamsHaleyKahrlMoore2015 davis2018net McKinsey2009

[90] Stokes, Leah C. *Short Circuiting Policy: Interest Groups and the Battle over Clean Energy and Climate Policy in the American States*. New York: Oxford University Press, 2020. p. 20

Charles, Dan. "Leaping the Efficiency Gap". In: Science 325 (2009). url: https://science.sciencemag.org/content/sci/325/5942/804.full.pdf (visited on 2020-05-05).

Analyses of energy efficiency can be enhanced by considering exergy, meaning the "maximum amount of usable work that can be provided by a system or a material as it is brought into thermodynamic equilibrium with its environment." For example, while the atmosphere contains a great deal of thermal and mechanical energy in its temperature and pressure, we cannot extract energy from it and so it has no exergy. Exergy is present in all the phenomena which humanity can use for energy sources: solar radiation and the currents it induces in the air and oceans; the planet's internal heat; and the chemical and nuclear energy in fossil fuels and fissile materials. Jaffe, Robert L. and Washington Taylor. *The Physics of Energy*. Cambridge: Cambridge University Press, 2018. p. 749, 755

energy use, by making whatever process is at work more affordable.[91] Make cars or air conditioners twice as energy efficient and you may induce so much more usage that total energy use rises. An extreme version of this was involved in the self-reinforcing history of the industrial revolution itself, where more efficient steam engines improved the economic efficiency of coal mining, steel production, and transport which in turn led to enormous increases in the amount of these activities taking place.[92] Smil calculated that global energy use increased about 15 times between 1850 and 2000.[93] At a more pedestrian level, more efficient lighting, heating, and cooling in buildings or more efficient vehicles may lead to people increasing usage to a degree that lessens or even counteracts the efficiency gains, with more total energy use at a lower price level for each unit of use.

There is also an assumption, perhaps, that whatever lifestyle changes are needed will be the responsibility of someone else, as with assertions that a small wealthy segment of the population consumes vastly disproportionate resources (implying that climate change can be solved by changing principally their lives), that corporations are responsible for GHG emissions and can somehow avoid them without affecting individual lifestyles, or that land assumed to be abundantly available elsewhere can be used to site renewable facilities or sequester carbon

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[91] For example, one 2020 study on rebound effects "as household demand rises in response to cheaper electricity prices due to the increasing shares of wind power" in Columbia concluded that the environmental rebound effect "has thus the potential to render decarbonization policies largely ineffective, which calls for rebound mitigation policies, such as environmental taxes." Velez-Henao, Johan-Andre, Claudia-Maria Garcıa-Mazo, Jaume Freire-Gonzalez, and David Font Vivanco. “Environmental Rebound Effect of Energy Efficiency Improvements in Colombian Households”. In: Energy Policy 145 (2020), p. 111697. url: https://www.sciencedirect.com/science/article/abs/pii/S0301421520304250 (visited on 2020-10-15).

See also: Owen, David. *The Conundrum: How Scientific Innovation, Increased Efficiency, and Good Intentions Can Make Our Energy and Climate Problems Worse.* New York: Riverhead Books, 2012.

[92] See: Jenkins, Rhys. “Savery, Newcomen and the Early History of the Steam Engine”. In: Transactions of the Newcomen Society 4.1 (1923).

Rhodes, Richard. *Energy: A Human History.* New York: Simon & Schuster, 2018. p. 32, 55

[93] Smil, Vaclav. "World History and Energy." 2004. url: http://vaclavsmil.com/wp- content/uploads/docs/smil-article- 2004world- historyenergy.pdf (visited on 2020-06-19).

See also: The Economist. "The World’s Energy System Must be Transformed Completely." 2020. url: https://www.economist.com/schools-brief/2020/05/23/the-worlds-energy-system-must-be-transformed-completely (visited on 2020-06-19).

through soils, afforestation, or different agricultural practices.[94] These diversions bolster MacKay's argument that saying no to all the energy options which have some sort of disagreeable impact is incompatible with avoiding the worst impacts of climate change.[95] It also justifies George Hoberg's concern that the environmental movement's increased emphasis and expertise in blocking disagreeable projects can be counterproductive, since the same pressure techniques can be used against climate-safe options like nuclear and renewables as against coal, oil, and gas.[96]

From the 2006 Stern Review on the Economics of Climate Change to Bill McKibben's 2012 Rolling Stone article which helped kick off the CFFD movement, many public policy

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[94] An especially odious manifestation of the idea that environmental degradation is chiefly caused by others and thus that it is there behaviour which must be constrained can be found in the Malthusian thinking Rhodes describes. Rhodes, Richard. *Energy: A Human History.* New York: Simon & Schuster, 2018. p. 310-3

Gates notes that the number of trees necessary to absorb the lifetime emissions of Americans alive today would take up roughly half the land mass of the world, and those trees would need to be maintained forever. Gates, Bill. *How to Avoid a Climate Disaster: The Solutions We Have and the Breakthroughs We Need.* New York: Random House, 2021. p. 129

The idea that 100 corporations are responsible for 71% of global emissions is a bit like saying that supermarkets drink 75% of all the orange juice. Riley, Tess. "Just 100 Companies Responsible for 71% of Global Emissions, Study Says." 2017. url: https://www.theguardian.com/sustainablebusiness/2017/jul/10/100-fossil-fuel-companies-investorsresponsible-71-global-emissions-cdp-study-climate-change (visited on 2021-09-05).

Griffin, Paul. The Carbon Majors Database: CDP Carbon Majors Report 2017. 2017. url: https://b8f65cb373b1b7b15feb-c70d8ead6ced550b4d987d7c03fcdd1d.ssl.cf3.rackcdn.com/cms/reports/documents/000/002/327/original/Carbon-Majors-Report-2017.pdf?1499691240 (visited on 2021-09-05).

[95] Mackay, David. *Sustainable Energy: Without the Hot Air.* Cambridge: UIT Cambridge, 2009. url: https://www.withouthotair.com/ (visited on 2019-07-18). p. 250

[96] Hoberg, George. *The Resistance Dilemma: Place-Based Movements and the Climate Crisis.* Cambridge: The MIT Press, 2021.

Klein does attempt to refute the idea that "Blockadia" is all about saying no: "There may have been a time when engaging in resistance against a life-threatening system and building alternatives to that system could be meaningfully separated, but today we have to do both simultaneously … The denizens of Blockadia live and know this. Which is why theirs is neither a movement of negation (no to the miners/drillers/pipe layers/heavy haulers), nor solely of protection (defending cherished but static ways of life). Increasingly, it is also a constructive movement, actively building an alternative economy based on very different principles and values." Klein, Naomi. *This Changes Everything: Capitalism vs. The Climate.* Toronto: Alfred A. Knopf Canada, 2014. p. 405

Note that she does not specifically emphasize or mention building energy alternatives to fossil fuels.

analyses highlight the importance and enduring consequences of infrastructure choices.[97] Because the consequences of greenhouse gas emissions develop over the course of decades – and because infrastructure decisions have a similarly lengthy impact on the form of subsequent energy use – investments being made now in fossil fuel infrastructure will exacerbate the degree of climate change experienced around the world through many years to come.[98] Such investments are also being made with what is arguably insufficient attention to regulatory risk. If governments increase the stringency of their climate mitigation policies, investments made on the basis that the right to unlimited or free $CO_2$ emissions will persist are likely to become stranded assets. This argument has been popularized and given considerable attention because of the divestment movement, alongside being validated by credible bodies not known for their environmental advocacy such as central banks, insurance companies, and financial experts.

In Canada, the enduring influence of a staples or extractivist mindset can be seen in Prime Minister Trudeau's 2017 comment: "No country would find 173 billion barrels of oil in the ground and leave them there." [99] If this is interpreted as his sincere view and not dishonest

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[97] Stern, Nicholas. "The Economics of Climate Change: The Stern Review." Cambridge University Press, 2007. url: http://webarchive.nationalarchives.gov.uk/+/http:/www.hm-treasury.gov.uk/sternreview_index.htm (visited on 2017-01-23).

McKibben, Bill. "Global Warming's Terrifying New Math." 2012. url: http://www.rollingstone.com/politics/news/global-warmings-terrifyingnew-math-20120719 (visited on 2017-01-23).

[98] As Simon Lewis put it: "Fossil fuels have gone from an ingenious enabler of human progress to a trap that undermines it. The climate crisis is not caused by vague 'human actions'; nor is it a result of some innate aspect of human nature. It is caused by specific investments by specific people in specific things. Change those, and we can change the future." Lewis, Simon. "Let's Say it Without Flinching: The Fossil Fuel Industry is Destroying our Future." 2021. url: https://www.theguardian.com/commentisfree/2021/aug/10/fossil-fuel-companies-ipccclimate-report-governments (visited on 2021-08-29).

[99] CBC News. "Trudeau: 'No Country Would Find 173 Billion Barrels of Oil in the Ground and Leave Them There'." 2017. url: https://www.cbc.ca/news/world/trudeau-no-country-would-find-173-billion-barrels-of-oil-in-the-ground-and-leave-them-there-1.4019321 (visited on 2019-10-12).

McKibben equated this to saying that: "Canada, which is 0.5% of the planet's population, plans to use up nearly a third of the planet's remaining carbon budget." McKibben, Bill. "When it Comes to Climate Hypocrisy, Canada's Leaders Have Reached a New Low." 2020. url: https://www.theguardian.com/commentisfree/2020/feb/05/when-it-comes-to-climatehypocrisy-canadas-leaders-have-reached-a-new-low (visited on 2020-02-05).

A 2020 Pembina Institute report said: "Carbon emissions from the oilsands sector are the fastest-growing source of emissions in Canada. This continuing upward trajectory not only reduces the country's ability to meet its 2030 reduction commitments, but is on a clear collision course with Canada's plan to become carbon-neutral by 2050." Israel, Benjamin, Nina Lothian, Chris Severson-Baker, and Nikki Way. "The Oilsands in a Carbon Constrained Canada: The Collision Course Between Overall Emissions and National Climate Commitments." 2020. url:

pandering, it indicates a total lack of comprehension about the nature of climate change as a problem and what is necessary to stabilize global climatic conditions.[100] This statement is a direct rejection of the central idea of a carbon budget and the core concept in international climate change negotiations that all parties must alter their behaviour from business as usual. Burning any substantial fraction of that oil is also fundamentally at odds with the 1.5 °C stabilization target which Trudeau's government supported during the Paris COP in 2015.[101] In the Paris Agreement negotiations, Canada committed to a target of 30% below 2005 levels by

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https://www.pembina.org/reports/the-oilsands-in-a-carbon-constrained-canada-march-2020.pdf (visited on 2020-10-26).p. 4

This figure is similar to the enlarged estimate of Canada's oil reserves produced by BP in 2000, as technological innovation and rising oil prices increased the share of the bitumen sands which they assessed as economically recoverable from 40 billion barrels in 1990 to 180 billion in 2000. Jaccard, Mark. *The Citizen's Guide to Climate Success: Overcoming Myths that Hinder Progress*. Cambridge: Cambridge University Press, 2020. p. 136

[100] Macdonald argues "there is an inherent contradiction between policy intended to *reduce* emissions, such as the Pan-Canadian Framework, and policy intended to build new pipeline capacity, such as the purchase of the Trans Mountain pipeline by the Trudeau government in 2018, which will facilitate an *increase* in emissions." Macdonald2020 p. 24 (italics in original)

See also: Ballingall, Alex. "Justin Trudeau Said Canadians Could Have it all on Energy and the Environment. It isn't Working." 2021. url: https://www.thestar.com/politics/federal/2021/01/21/justin-trudeau-said-canadianscould-have-it-all-on-energy-and-the-environment-it-isntworking.html (visited on 2021-01-22).

[101] In a statement after the Paris COP, prime minister Trudeau said: "Together with our international partners, we agreed to strengthen the global response to limit global average temperature rise to well below 2 degrees Celsius as well as pursue efforts to limit the increase to 1.5 degrees." Trudeau, Justin. "Statement by the Prime Minister of Canada on Successful Conclusion of Paris Climate Conference." 2015. url: https://pm.gc.ca/en/news/statements/2015/12/12/statement-prime-minister-canada-successful-conclusion-paris-climate (visited on 2019-12-26).

Trudeau's comment also demonstrates how climate change politics is often about imagining differences between possible or expected futures. People often project an idea of a "business as usual" world where economic growth and fossil fuel use just keep rising, then compare the difference between that and a decarbonizing world as a financial loss. Others more focused on projected climate change scenarios imagine mass global disruption by the end of the century and persisting for centuries into the future, making improvements to those outcomes via decarbonization seem like a gain.

In September 2020, Trudeau's natural resources minister argued that "Canadian LNG is the best choice for global energy investors looking for sustainable and competitive natural gas production." Rabson, Mia. "LNG Can Help Address Climate Change, Provide Safe Energy Investment: Minister." 2020. url: https://globalnews.ca/news/7320678/lng-climate-change-oregan/ (visited on 2020-10-21).

The Trudeau administration's support for the 1.5 degree target has also been used to argue that the Canada Pension Plan should stop investing in fossil fuels: Rowe, James, Steph Glanzmann, Jessica Dempsey, and Zoe Yunker. "The Canada Pension Plan's Failure to Respect the 1.5-Degree Celsius Limit." url: https://www.policyalternatives.ca/sites/default/files/uploads/publications/BC%20Office/2019/11/ccpa-bc_FossilFutures.pdf (visited on 2020-02-06).

See also: McCarthy, Shawn and Eric Reguly. "Catherine McKenna Pushes for 1.5 C Target in Paris Climate Talks." 2015. url: https://www.theglobeandmail.com/news/world/climate-talks-hinge-on-financing-for-developing-nations/article27626639/ (visited on 2019-12-26).

2030. According to the figures supplied in Canada's 2019 National Inventory Report to the UNFCCC, 2005 emissions were 730 megatonnes of $CO_2$ equivalent across Canada, implying emissions of 487 Mt cross-country in 2030 in a scenario where the target is achieved.[102] Canada's 2021 National Inventory Report documents Canada-wide emissions of 730 MT.[103] By comparison, the Alberta NDP government of Rachel Notley, after being advised by a Climate Change Advisory Panel formed in the summer of 2015, proposed a 100 Mt pet year limit for the bitumen sands alone, permitting 30 Mt of further growth.[104] As of 2018, all oil and gas

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[102] Government of Canada. "Greenhouse Gas Sources and Sinks: Executive Summary 2019." 2019. url: https://web.archive.org/web/20190427013118if_/https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/sourcessinks-executive-summary-2019.html (visited on 2020-01-18).

[103] Canada. "National Inventory Report 1990–2019: Greenhouse Gas Sources and Sinks in Canada." 2021. url: https://unfccc.int/sites/default/files/resource/can-2021-nir-12apr21.zip (visited on 2021-04-12).

Government of Canada. "Greenhouse Gas Sources and Sinks: Executive Summary 2021." 2021. url: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/sourcessinks-executive-summary-2021.html (visited on 2021-04-12).

Taylor, Stephanie. Canada's Greenhouse Gas Emissions Increased Slightly in 2019: Report. 2021. url: https://www.thestar.com/politics/2021/04/12/canadas-greenhouse-gas-emissions-increased-slightly-in-2019-report.html (visited on 2021-04-12).

[104] Leach, Andrew, Angela Adams, Stephanie Cairns, Linda Coady, and Gordon Lambert. "Climate Leadership: Report to Minister." 2015. url: https://open.alberta.ca/dataset/212a6266-b8d3-4822-b208-9221da2a0966/resource/9f52cd8e-5477-45a6-a337-f2d64d091cf9/download/2015-climate-leadership-report-to-minister.pdf (visited on 2020-05-18).

Government of Alberta. "Capping Oil Sands Emissions." 2016. url: https://web.archive.org/web/20161215182229/https://www.alberta.ca/climate-oilsands-emissions.aspx (visited on 2020-05-18).BakxSeskus2015

Wilt, James. "Alberta Climate Announcement Puts End to Infinite Growth of Oilsands." 2015. url: https://thenarwhal.ca/alberta-climateannouncement-puts-end-infinite-oilsands-growth (visited on 2020-05-18).

See also: Bakx, Kyle and Tony Seskus. "Notley's Oilpatch Overhaul." 2015. url: https://newsinteractives.cbc.ca/longform/notley-and-the-oilpatch (visited on 2020-05-18).

Bennett, Dean. "Notley Government Set to Cap Oilsands Emissions." 2016. url: https://globalnews.ca/news/3039347/notley-governmentset-to-cap-oilsands-emissions/ (visited on 2020-05-18).

Graney, Emma. What You Need to Know About Alberta's Emissions Cap. 2019. url: https://edmontonjournal.com/news/politics/what-you-needto-know-about-albertas-emissions-cap/ (visited on 2020-05-18).

Denson, Felixe. "Wilkinson Asks Alberta to Enforce Legislated 100-megatonne Cap." 2020. url: https://ipolitics.ca/2020/02/20/the-drilldownwilkinson-asks-alberta-to-enforce-legislated-100-megatonnecap/ (visited on 2020-05-18).

Macdonald, Douglas. *Carbon Province, Hydro Province: The Challenge of Canadian Energy and Climate Federalism.* Toronto: University of Toronto Press, 2020. p. 24

extraction represented about 7% of Canada's GDP.[105] Whether measured in terms of provincial population, employment, or share of GDP, the growing bitumen sands industry is asking for a disproportionate share of Canada's total GHG emissions, implying the need for other sectors to cut by a greater amount in order to meet the targets.[106][107]

In an official submission to the UNFCCC in 2019, Canada's government acknowledged that it will substantially miss its pledged 2030 GHG reduction target based on current policy commitments.[108] The 2019 Energy Future report from the Canada Energy Regulator projects continued growth in oil and gas production until 2040 based on the assumption that new pipelines will raise the prices for Canadian fossil fuels and that large-scale liquefied natural gas

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[105] Fletcher, Robson. "Oil and Gas Surpasses Banking and Insurance as Share of GDP in May." 2018. url: https://www.cbc.ca/news/canada/calgary/oil-and-gas-gdp-growth-may-data-statscan-1.4768508 (visited on 2020-05-18).

[106] Out of Canada's population of about 38 million, Alberta's population of 4.4 million is about 12% of the total while Saskatchewan's 1.2 million is about 3%. Statistics Canada. "Population Estimates, Quarterly." 2020. url: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710000901 (visited on 2020-05-18).

[107] According to Natural Resources Canada "400, 000 people deriv[e] direct, indirect and induced employment from the oil sands and supporting sectors." By comparison, Statistics Canada places total employment at over 19 million, making bitumen sands employment about 2% of the total. Natural Resources Canada. "Oil Sands: Economic Contributions." 2016. url: https://www.nrcan.gc.ca/energy/publications/18756 (visited on 2020-05-18).

Statistics Canada. "Labour Force Characteristics by Province, Monthly, Seasonally Adjusted." 2020. url: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410028703 (visited on 2020-05-18).

[108] Walsh, Samuel. "Canada on Track to Substantially Miss 2030 Emissions Reduction Targets, Government Data Shows." 2019. url: https://www.theglobeandmail.com/politics/article-canada-on-track-to-substantially-miss-2030-emissions-reduction-targets/ (visited on 2019-12-26).

Earlier rounds of Canadian climate policy making similarly involved targets which were not realized. In their 1993 election platform, the Liberal Party pledged to go beyond the Conservative target of stabilizing emissions at 1990 levels by 2000, promising instead the 'Toronto Target' of a 20% reduction below 1988 levels by 2005. Lemphers, Nathan C. “Beyond the Carbon Curse: a Study of the Governance Foundations of Climate Change Politics in Australia, Canada and Norway”. PhD thesis. Toronto: University of Toronto, 2019. url: https://tspace.library.utoronto.ca/handle/1807/101303 (visited on 2020-08-15). p. 115 LiberalParty1993

The Chretien government's own assessment of their post-Kyoto "Action Plan 2000" found that the $500 million initiative would only achieve one third of the reductions Canada had pledged. Lemphers, Nathan C. “Beyond the Carbon Curse: a Study of the Governance Foundations of Climate Change Politics in Australia, Canada and Norway”. PhD thesis. Toronto: University of Toronto, 2019. url: https://tspace.library.utoronto.ca/handle/1807/101303 (visited on 2020-08-15). p. 127 GoCResponding2001

The Martin government's 2005 "Project Green" plan had a 100 Mt gap between the possible emission reductions and Canada's Kyoto target. Lemphers, Nathan C. “Beyond the Carbon Curse: a Study of the Governance Foundations of Climate Change Politics in Australia, Canada and Norway”. PhD thesis. Toronto: University of Toronto, 2019. url: https://tspace.library.utoronto.ca/handle/1807/101303 (visited on 2020-08-15). p. 136 Macdonald2007

(LNG) exports will develop in B.C.[109] The report predicts a rise in Canadian crude oil production by 50% by 2040, based on the assumption that global oil demand will continue to grow, domestic demand will fall only modestly, and that renewables will grow only slowly.[110] In 2019, the Ecofiscal Commission estimated that a $210 / tonne carbon tax would be necessary to meet Canada's 2030 Paris Agreement target; the Parliamentary Budget Office (PBO) estimated that the tax would need to be $102 per tonne to meet the 513 Mt target.[111] In October 2020, the PBO calculated that an additional broad-based carbon tax of $117 per tonne would be needed to meet Canada's Paris commitments if it was applied equally to consumers and industry, increased to between $131 and $289 if separate systems for heavy industry and consumers are maintained, with the highest estimate necessary if energy-intensive and trade-exposed industries are protected.[112] By contrast, the Trudeau government's carbon pricing is set to increase from $20 per tonne in 2019 to $50 per tonne in 2022, and facilities can avoid it by using banked credits or offset credits.[113] The government has released no serious plan to meet its objective of having net zero GHG emissions in 2050, and ministers pressed by reporters on whether that means an end to

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[109] Canada Energy Regulator. "Canada's Energy Future 2019." 2019. url: https://www.cer-rec.gc.ca/nrg/ntgrtd/ftr/2019/index-eng.html (visited on 2020-02-04).

[110] Dusyk, Nichole. "Why Canada's Energy Future Report Leads us Astray." 2020. url: https://www.pembina.org/blog/why-canadas-energy-future-reportleads-us-astray (visited on 2020-02-04).

[111] Canada's Ecofiscal Commission. "Bridging the Gap: Real Options for Meeting Canada's 2030 GHG Target." 2019. url: https://ecofiscal.ca/wp-content/uploads/2019/11/Ecofiscal-Commission-Bridgingthe-Gap-November-27-2019-FINAL.pdf (visited on 2020-02-05).

Office of the Parliamentary Budget Officer. "Closing the Gap: Carbon Pricing for the Paris Target." 2019. url: https://www.pbo-dpb.gc.ca/web/default/files/Documents/Reports/2019/Paris_Target/Paris_Target_EN.pdf (visited on 2020-02-21).

[112] Bagnoli, Philip and Raphael Liberge-Simard. "Carbon Pricing for the Paris Target: Closing the Gap With Output-based Pricing." 2020. url: https://www.pbo-dpb.gc.ca/web/default/files/Documents/Reports/RP-2021-019-S/RP-2021-019-S_en.pdf (visited on 2020-10-12).

Walsh, Marieke. "Without Other Policies, Carbon Tax Must Rise Substantially to Meet Climate Goals, PBO Says." 2020. url: https://www.theglobeandmail.com/politics/article-without-other-policies-carbon-taxmust-rise-substantially-to-meet/ (visited on 2020-10-12).

[113] Government of Canada. "Pricing Carbon Pollution from Industry." 2019. url: https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/industry/pricing-carbon-pollution.html (visited on 2020-02-05).

Shivji, Salimah. "Carbon Tax Must Hit $210 per Tonne by 2030 to Meet Paris Targets, Report Concludes." 2019. url: https://www.cbc.ca/news/politics/carbon-pricing-tax-climate-change-emissions-1.5374481 (visited on 2020-02-05).

the fossil fuel industry have dodged the question or made vague statements that perhaps technology will allow the oil industry to continue in a decarbonized future.[114] As Jaccard explains: "faking-it politicians know they will have retired by the time their false GHG promise is exposed." [115] Even more likely, politicians may simply choose to believe that they are somehow laying a long-term groundwork for success, allow wishful thinking to keep justifying fossil fuel development, and delay decarbonization beyond the point where a 1.5 or 2.0 ˚C carbon budget remains possible.[116]

In his effort to describe how rich nations could cut their emissions by 90% by 2030, George Monbiot describes how climate change is unusual as a social movement in response to a grievance:

> [T]he campaign against climate change is an odd one. Unlike almost all the public protests which have preceded it, it is a campaign not for abundance but for austerity. It is

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[114] Particularly absurdly, Environment Minister Jonathan Wilkinson argued that the expansion of the Trans Mountain oil pipeline from 300,000 barrels per day to 890,000 barrels per day would somehow be helpful, telling the CBC: "We are delineating a long-term transition strategy that will get us to net zero. The pipeline is part of that transition." Watson, Bridgette. "Jonathan Wilkinson Talks Targets and Transition as he Takes on Challenging Role of Environment Minister." 2019. url: https://www.cbc.ca/news/canada/british-columbia/jonathanwilkinson-new-role-canada-environment-minister-1.5367925 (visited on 2019-12-26).

Wilkinson reiterated the point in August 2021, saying: "Canada needs to ensure that in the context of that transition, it's extracting full value for its resources and using that money to push forward in terms of reducing emissions... What we're doing is saying it's got to be part of the transition, but part of the transition is being able to raise the revenues that enable you to actually make the investments that are required to go there." Boisvert, Nick. "Ottawa says it Must Maximize Revenue from the Trans Mountain Pipeline to Fight Climate Change." 2021. url: https://www.cbc.ca/news/politics/wilkinson-climate-report-1.6135502 (visited on 2021-08-10).

[115] Jaccard, Mark. *The Citizen's Guide to Climate Success: Overcoming Myths that Hinder Progress.* Cambridge: Cambridge University Press, 2020. p. 101

[116] In November 2020, the Globe and Mail reported that a year after pledging to strengthen their 2030 climate target, legislate a net zero target for 2050, and plant two billion trees "the government has yet to move ahead on any of those plans." Walsh, Marieke. Environment Minister Jonathan Wilkinson Grilled on Liberal's Delayed Climate Policies. 2020. url: https://www.theglobeandmail.com/politics/article-environment-minister-jonathan-wilkinsongrilled-on-liberals-delayed/ (visited on 2020-11-08).

Referring to net zero carbon pledges, Greta Thunberg said: "They mean something symbolically, but if you look at what they actually include, or more importantly exclude, there are so many loopholes. We shouldn't be focusing on dates 10, 20 or even 30 years in the future. If we don't reduce our emissions now, then those distant targets won't mean anything because our carbon budgets will be long gone." Carrington, Damian. "'Hypocrites and Greenwash': Greta Thunberg Blasts Leaders over Climate Crisis." 2020. url: https://www.theguardian.com/environment/2020/nov/09/hypocrites-and-greenwash-greta-thunberg-climatecrisis (visited on 2020-11-09).

> a campaign not for more freedom but for less. Strangest of all, it is a campaign not just against other people, but also against ourselves.[117]

Indeed, this limits the applicability of past social movements for devising a strategy to address climate change. Levin et al. argue:

> Unlike other environmental problems with discrete antagonists and protagonists, human-induced climate change results from individual and collective activities at multiple scales, as well as marketplace activities.[118]

Feygina et al. note: "

> the threat posed by environmental destruction is the result of the status quo itself; the practices of our socioeconomic system have brought about the current crisis and thus constitute a threat that is internal (or endogenous) to the system.[119]

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[117] Monbiot, George. *Heat: How to Stop the Planet from Burning.* Toronto: Doubleday Canada, 2006. p. 215

This view – that individuals are responsible for the climate damage they cause, even if individual action isn't a plausible route to decarbonization – is in tension with the enemy naming strategy discussed in chapter 5: "These fossil fuel companies are responsible for melting glaciers; *they* are polluting rivers; and *they* are destroying the planet, hence they must be stopped." Mangat, Rupinder, Simon Dalby, and Matthew Paterson. "Divestment Discourse: War, Justice, Morality and Money". In: Environmental Politics 27.2 (2018), pp. 187–208. url: https://www.tandfonline.com/doi/abs/10.1080/09644016.2017.1413725?journalCode=fenp20 (visited on 2019-01-04).p. 195 (italics in original)

Jocelyn Timperley draws a distinction between allocating emissions to someone and saying they are responsible, for instance because they don't have a connection to a reliable electricity grid and so use high-emission diesel generators instead. This shades into questions about which choices are voluntary: "If you can only afford a home in an edge-of-town housing estate without access to public transport, is it really your fault for becoming dependent on a car?" Timperley, Jocelyn. "Who is Really to Blame for Climate Change?" 2020. url: https://www.bbc.com/future/article/20200618-climatechange-who-is-to-blame-and-why-does-it-matter (visited on 2020-06-29).

[118] Levin, Kelly, Benjamin Cashore, Steven Bernstein, and Graeme Auld. "Playing it Forward: Path Dependency, Progressive Incrementalism, and the "Super Wicked" Problem of Global Climate Change". In: International Studies Association 48th Annual Convention. Chicago, February. Citeseer. 2007. url: https://iopscience.iop.org/article/10.1088/1755-1307/6/50/502002/meta (visited on 2019-12-29).p. 7

[119] Feygina, Irina, John T. Jost, and Rachel E. Goldsmith. "System Justification, the Denial of Global Warming, and the Possibility of 'Systemsanctioned Change'". In: Personality and Social Psychology Bulletin 36.3 (2010), pp. 326–338. url: https://journals.sagepub.com/doi/abs/10.1177/0146167209351435 (visited on 2019-07-18).p. 328

Rowe et al. list "we all use them," "everyone is to blame," and "we are our own enemy" as barriers to climate action, asking: "How can we speak a collective withdrawal of consent from carboniferous capitalism, while we all still rely on fossil fuels?" [120]

[120] Rowe, James, Jessica Dempsey, and Peter Gibbs. The Power of Fossil Fuel Divestment (and its Secret). 2016. url: https://www.academia.edu/14081780/The_Power_of_Fossil_Fuel_Divestment_And_its_%20Secret_ (visited on 2018-08-22).p. 4