

The Challenge of Anthropogenic Climate Change for the Social Sciences

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Abstract: This paper argues that climate change throws down a challenge for the social sciences. They can no longer rely on exclusively social indicators and relative ones, but must include absolute biophysical indicators in their investigations. Accurate analyses of the social causes and consequences of anthropogenic climate change require that they capture the complexity of lay and scientific knowledge, and the nuances of uncertainty, of nature, and of language rather than relying on oversimplified notions. The paper examines whether resilience is a protective strategy under uncertainty and whether disasters are likely to impel mitigation of global warming. It assesses lofty post-carbon utopia discourse and suggests instead the comparative analysis of successful and unsuccessful societies in preventing anthropogenic global warming. To illustrate such an analysis, the paper sketches a study of the different developmental channels of Northern Europe and North America.

Keywords: *uncertainty, resilience, science, biophysical indicators, developmental channels, post-carbon utopia*

Introduction

In this issue, Redclift argues that sociology can make an important contribution to dealing with climate change by investigating how and why socio-economic structures are unsustainable: 'Rather than speak loftily of the need to 'transform' human behavior, we could make a start

by analyzing how current behavior is tied into patterns and cycles of carbon dependence'. Most sociologists would agree with that suggestion and its starting point, including this author. Disagreement arises, however, about how to conduct that analysis. This paper proposes elements for such an analysis that imply some new directions for social science. It focuses

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on climate change, but the analysis is applicable to most other environmental problems caused by human activities, such as depletion of the ozone layer, acid rain, degradation of the oceans, loss of biodiversity, deforestation, etc.

Climate Change Throws Down the Challenge to Construct a Stronger Social Science

The Need for Absolute Indicators and Interdisciplinary Research

Three sets of indicators or methodologies must be distinguished in the assessment of the management of the risk of climate change (see Murphy, forthcoming a). The first consists of discourse about mitigation and adaptation, including rhetoric, plans and policies. Such discourse has often been a public relations success but a mitigation or adaptation failure (Simpson, Jaccard and Rivers, 2009). It can cultivate a false consciousness that global warming is being dealt with even as it gets worse. The second set involves improvements in a relative sense and attempts. Reduction in emissions per unit of GDP (usually referred to as the intensity of emissions) gives the reassuring illusion of a solution even as the amount of absolute emissions increases. It is not attempts that are important, but instead the success of attempts to reduce overall emissions. The third consists of material indicators that the problem is being resolved. Since the atmosphere is affected by the absolute amount of greenhouse-gas emissions, no matter how they are emitted, this is the only methodology that yields a

valid assessment. For example, there are good indicators that the ozone layer is no longer being depleted, hence the Montreal Protocol can be judged a success. On the other hand, since the carbon content and the temperature of the atmosphere continue to rise, this indicates that the Kyoto Protocol, local solutions, and other remedies for anthropogenic climate change have so far been insufficient despite talk about mitigation and attempts at mitigation. The performance of countries can best be assessed by examining changes in their absolute levels of emissions.

It is important to anchor social science research in the recognition that it is the absolute amount of carbon in the atmosphere that results in anthropogenic climate change. The atmosphere is indifferent to whether the carbon comes from high emissions per unit of GDP or high GDP. The tar sands industry prides itself on its 29 per cent reduction of emissions per barrel of oil extracted and upgraded, but emissions per barrel remain 60 per cent higher than conventional oil (Environment Canada, 2011: 8). This, plus the fact that the number of barrels is quickly increasing, results in heightened emissions. Relative improvements have been insufficient because tar sands oil still adds more carbon to the atmosphere per barrel than conventional oil thereby making global warming worse.

The physical fact of anthropogenic climate change caused by the absolute amount of emissions has implications for the validity of social science theories. For example, ecological modernization conclusions are convincing only if they are based on reduced absolute levels of emissions.

Assertions of ecological modernization based on lower intensity of emissions per GDP or per barrel are misleading if they are associated with an increased absolute amount of emissions and the worsening of global warming. The weakness of ecological modernization is that it slides ambiguously between the above methodologies. Unfortunately absolute indicators reveal that, behind the reassuring rhetoric, economic modernization that is ecologically harmful has been occurring in most nations with respect to global warming. It is not that ecological modernization has been tried and found wanting, rather it has not yet been tried in terms of what is ecologically needed, namely a decrease in the absolute level of emissions. Depicting environmental problems like climate change as market failure is not invalid. Usually the market is credited with bringing prosperity, but the dark side is that it has failed to maintain a healthy, sustainable relationship with the land, the atmosphere, and the oceans. Nor is there anything wrong with transforming threats into opportunities if those opportunities reduce global warming and other environmental problems. Lord Stern is to be preferred over economists who excessively discount the future. Conclusions become superficial, however, if claims are made that the market is solving the environmental problems it caused when the claims are solely based on relative indicators such as fewer emissions per unit of GDP. Assessments based on what is physically necessary, namely a reduction in the absolute amount of emissions, demonstrate the shallowness of such conclusions.

The necessity of absolute material

indicators reveals the depth of the challenge for society and for the social sciences of environmental problems like climate change. Truly interdisciplinary analysis that bridges the nature – culture divide is needed. Otherwise societies will lapse into the attenuation of risk awareness during the amplification of risk and into discourse assuming safety being mistaken for safety, which is typical of the incubation of disasters (Turner and Pidgeon, 1978).

Scientific and Lay Knowledge: Capturing Complexity

There are two generic types of estimates of safety or risks: 1) Routine lay assessments of safety or risk are trial-and-error estimates based on past or present experience and cultural habitus. 2) Scientific calculations of risk are based on attempts to reach a deeper understanding of underlying processes. Both of these forms of knowledge are valuable (Murphy, forthcoming a), but social science becomes misleading if it romanticizes lay, unscientific knowledge and assumes that it is possessed only by underprivileged groups. The issue of climate change requires a correction of that erroneous presumption. There is a consensus among scientists (Hansen et al., 2005; IPCC, 2007) that human activities are causing new risks of climate change and that the dangers are so massive and novel that prevention should have been started years ago. They warn that change away from the present beneficial climate threatens to be irreversible. The main groups that presume the risk to be acceptable and discount future harm are i) lay,

unscientific groups holding economic, political and media power (McCright and Dunlap, 2010) as well as ii) a large part of the lay population whose consumption aspirations and habitus are tied to the fossil-fuel economy and who agitate for cheap energy. They both typically take for granted that present well-being can be extrapolated into the distant future and presume that if there is anthropogenic climate change, then societies can adapt to it in a timely fashion without harm.

Far from being allied with powerholders concerning climate change, scientists struggle against these powerful lay forces to convince societies to mitigate the risk (see Schneider, 2009 for an insider description of the struggle). In most societies, the message of powerful oil and transportation companies to a receptive lay audience is currently overwhelming the message of the IPCC. The conflict between science and power is not peculiar to the issue of climate change. Scientists had to struggle against the CFC industry and unscientific assertions to enact the Montreal Protocol and stop the depletion of the ozone layer. Science has produced evidence demonstrating the hazardousness of asbestos, but the Conservative Canadian government, lobbied by the asbestos industry and local communities where asbestos is mined, has vetoed the listing of asbestos as a hazardous substance in the Rotterdam Convention. In some cases, science wins the struggle, whereas in others economic and political power drowns out scientific assessments of risk. Rather than oversimplified notions of lay and scientific knowledge, the full complexity of their character and

relationship to political and economic power needs to be taken into account.

Both powerholding lay groups and the lay population share a paradoxical relationship to science in modern society. On the one hand, they are reluctant to heed warnings by science when it brings troubling news about environmental problems, such as climate change, that imply a need to reconfigure practices of production and consumption. On the other, they have a blind faith in science, which borders on magical thinking, to solve in a timely fashion the environmental problems caused by modern production, consumption, and the market as well as to find substitutes when resources become depleted. This faith in science yet refusal to follow its guidance when scientific findings are inconvenient, which is not unlike the churchgoing comfortable-pew relationship to religion, could be called the bipolar disorder of the public understanding of science in modern market society.

Is Climate Change Uncertain?

After the disaster in New Orleans, George W. Bush said that no one anticipated the breach of the levees. That was, however, precisely what numerous scientific studies had predicted in advance. Uncertainty has frequently been used as an ideology to avoid mitigating risk. The 'framing of the climate problem as 'unproved', 'lacking a consensus', and 'too uncertain for preventive policy' has been advanced strategically by the defenders of the status quo' (Schneider, 2009: 259). After all, if anthropogenic climate change is uncertain, why bother sacrificing

money and amenities to avoid a risk that is uncertain? This way of thinking fails to examine the question: uncertain about what? Knowledge of global warming, like knowledge of tectonic plates, is admittedly partial. In both cases the force, precise location, timing, scope, and duration of specific threats, such as tremors and extreme weather respectively, are still unforeseeable. Nevertheless both seismology and climatology have found evidence and developed understanding that yield solid indications of risk of earthquakes and climate change. It is misleading to dismiss that knowledge as uncertain in order to avoid stronger building codes and emissions mitigation respectively (Murphy, forthcoming b). Increased risk is known without being able to predict precisely what it will be. Only when risk is actualized into unambiguous harm do the specifics become definitively known, that is, when the earthquake occurs and the climate changes, but in both cases there are valid scientific indications in advance that there will be damage. Risk is maximized when uncertainty is used as an ideology to avoid preparing for earthquakes or preventing anthropogenic climate change. It is important that social science differentiate specifics, about which there remains much uncertainty, from the overall risk, about which there is high-quality knowledge, in order to avoid misconceiving of the risk of anthropogenic global warming as uncertain.

Is Resilience a Protective Strategy Under Uncertainty?

Building resilience and adaptive

capacity are clearly necessary because of the carbon already transferred from storage in the ground to the atmosphere by human activities. Wynne (1992) argued that risk management should rely upon resiliency when there is uncertainty and Renn (2008: 179) claimed that ‘resilience is a protective strategy against unknown or highly uncertain hazards’. Studies of disasters (Murphy, 2009) have, however, shown that this is an oversimplification and have drawn much more nuanced and complex conclusions. They have documented that, although resilience has given wealthy societies the capacity to bounce back after disasters, it involved much suffering and expense. Even in those cases, resilience did not protect. Its success was only as a restorative strategy, but at great human and financial cost (Murphy, forthcoming b). Resilience and adaptation are important, but they are last-resort strategies when societies fail to prevent harm. Furthermore only wealthy, well organized societies are resilient, not poor societies like Haiti when the earthquake struck in January 2010. Their very poverty prevents them from having the capacity to bounce back. Most important, the capacity to bounce back (resilience) has only been of use when nature’s dynamics are reversible, for example when normal weather returns after an extreme weather event. Climatologists (Flannery 2005, 2009; Hansen et al., 2005; Hansen, 2009; Schneider 2009) argue, however, that the most troubling risk of climate change is that of irreversibly tipping into a harmful climate. Positive feedback loops threaten to result in runaway global warming where bouncing back

and adaptation would be impossible. Hence those who advocate a reliance on resilience and adaptation have to assume that climate science is wrong about the risk of irreversibility, which is itself a particularly risky assumption to make. The strategy of not mitigating global warming and adapting when it happens is a risk aggravating scheme that generates uncertainties, particularly for poor nations. It consists of letting human activities destroy nature's capacity to return the environment to its benign state, and then relying on socially constructed resilience all by itself to bounce back. That risky approach is currently being done in most countries.

Note that it is important not to confuse lack of near-term harm with lack of urgency, which some social scientists do (Weber, 2008), because there can be a significant time lag between tipping points and harmful effects. Human activities resulting in the melting of the frozen tundra releasing its methane into the atmosphere could produce an irreversible tipping point soon, even if its harmful effects are only experienced a century later, just like smoking by a young person can tip the body into generating lung cancer where death only occurs decades later.

The global failure to reduce carbon emissions has led increasing numbers of social scientists to turn toward adaptation and building resilience (O'Brien, Hayward and Berkes, 2009; Prins et al., 2010). However the serious deficiencies with that way of thinking enumerated above can have perverse consequences if it deflects attention away from mitigation. Unlike earthquakes, which can only be prepared for, anthropogenic climate

change can be prevented because it is caused by human activities. Prevention is preferable to bouncing back after disaster or adapting to disaster, especially for the most vulnerable societies that don't have the resources to adapt or be resilient. Since the force, location, timing, duration, and scope of climate change hazards are indeed uncertain, it is also uncertain what specifically needs to be adapted to. But since the causes of anthropogenic climate changes are known, the ways to mitigate climate change are also known. In this sense, mitigation of climate change is easier than adapting to it or building resilience. Furthermore the political resistance to adapting and building resilience now for harm that will likely only occur in a century is just as high as for mitigating carbon emissions and reducing carbon dependence. Greenhouse-gas emitting societies have been no more willing to aid vulnerable societies like Bangladesh to adapt and be resilient than they are to reduce their own emissions. Resilience and adaptation are not just clumsy, inelegant solutions to anthropogenic climate change; they are flawed solutions if they have the effect of reducing prevention (mitigation). In fact, letting climate change happen and adapting is precisely what big emitters have proposed.

Is Nature Socially Constructed and Is Language Constitutive of It?

The short answer to both questions is no. Several necessary distinctions have typically been circumvented when affirmative answers to these questions are implied. First, the word

'nature' must not be mistaken for its referent. Discourse about nature and knowledge of nature are indeed socially constructed. Science is a social construction. It has nonetheless its specificity, having a unique relationship with biophysical forces and processes that enable science to bestow a much greater capacity to manipulate dynamics of nature than other social constructions. Second, although applied science and technologies such as nuclear reactors, aeroplanes, and other fossil-fuel combustion engines are social constructions, care is needed to avoid oversimplification. Technology that recombines and manipulates nature's dynamics to attain social goals needs nature's materials and dynamics for these constructions to be built. Hence it is more accurate to refer to technological social constructions as recombinant nature (Murphy, 2002: 325) in order to draw attention to the processes of nature that remain embedded in technologies. Recombinant nature embedded in technology can escape its leash if it is presumed harnessed and not accurately monitored and adapted to, thereby resulting in 'man-made disasters' (Turner and Pidgeon, 1978). Thus it is particularly important for social scientists and the population to take into account that socially constructed technology builds on nature's constructions and does not do away with them. Third, in a broader sense, human activities and social and technological constructions do not eliminate nature but instead unleash new dynamics of primal nature. Anthropogenic climate change is but one of many examples. Fossil-fuel emissions from machines of all sorts, deforestation, etc., are placing

carbon in the atmosphere and directly generating anthropogenic first-order global warming. This then melts Arctic ice, permafrost, and previously frozen tundra thereby absorbing even more of the sun's energy and releasing more carbon into the atmosphere in the form of methane. The latter constitutes second-order global warming. Whereas the first is directly caused by human activities, the second is their indirect effect in which nature's dynamics take off on their own, like a nuclear meltdown, and threaten to become unstoppable.

If nature and reality were nothing but social constructions, environmental problems could be solved without having to deal with autonomous biophysical dynamics. But since nature can not be reduced to a social construction, it has often resulted in its own emergent constructions that surpassed the worst-case scenarios that had been socially constructed. Language is constitutive of worst-case scenarios, but not of the worse cases. The latter result from the interaction of human constructions and nature's constructions. There remain primal forces of dynamic nature that have always interacted with and continue to interact with human constructions, both beneficial ones like the sun's light-and-energy-producing nuclear reactions and threatening ones like earthquakes. It is misleading to reduce nature and reality to social constructions. On the contrary, it would be more accurate to state that social constructions are a subset of nature's constructions. Human social constructions are one particular type of nature's constructions, just as a beehive is, because the human species is a

construction of nature's evolutionary dynamics.

Will Disasters Impel Social Change to Deal with Climate Change?

Although the material experience of disaster sometimes prompts social changes to protect against yesterday's devastation happening again (Murphy, 2010), the changes made are not always sufficient to prevent future calamities. Financial and other priorities take precedence as time passes after a disaster (Murphy, 2009). Hence repeat disasters are not uncommon (Platt, 1999). Research has documented that socially constructed discourse can attenuate risk awareness and lead to social practices inappropriate for nature's dynamics and hence to the incubation of disasters (Turner and Pidgeon, 1978). Entire societies have collapsed when their discourse, assumptions, and practices were unsuitable for emerging constructions of nature (Diamond, 2005). That anthropogenic climate change could result in something similar can not be ruled out.

The specific character of anthropogenic climate change makes it unlikely that disasters will act as timely prompts to mitigate it, namely the long time lag between causes and consequences as well as possible tipping points into irreversibility. Most people have not experienced a disaster that can be visibly attributed to climate change, even though their activities are presently generating emissions of carbon into the atmosphere that will cause warming for a century. The threat is distant in time or in space. Talk of extreme weather, ocean level rise, etc.,

remains just that - mere talk – when compared to the experience of normal weather and beautiful oceans. Warnings by scientists like those affiliated with the IPCC can easily be put to the back of the mind by reassuring discourse claiming that risk has been exaggerated and that other matters have priority. Such claims are often propagated by lay people with a material or ideal interest in present practices. Both the population and economists can be easily incited to discount future harm. Adapting and building resilience now for climate change in a century or in distant poor countries faces similar obstacles. Mitigating climate change and reducing dependence on carbon require foresight and reflection that heeds the warnings of science before risk is actualized into disaster. This is particularly challenging.

Analysis Instead of Lofty Post-Carbon Utopia Discourse

Distinctions need to be made between different types of concepts, in particular, between descriptive, explanatory and aspirational concepts. For example, taxonomy in biology is replete with descriptive concepts and 'group' is a descriptive concept in the social sciences. 'Force' (whether gravitational or electromagnetic) is an explanatory concept in physics, as is 'power' in the social sciences. 'Virtue' is an aspirational concept in philosophy, as is 'post-carbon society' in the social sciences. Although there is some overlap between these ideal types, it is important not to mistake aspirational concepts for descriptive or explanatory ones. The world needs a post-carbon society, much like it needs

virtue, but these needs are not being met.

Concepts that much more accurately describe the current situation and movement toward the future are ‘hypercarbon societies’ and ‘hypercarbonization’. We may not like to hear that inconvenient truth, but problems can only be solved if they are accurately described and analyzed. Mechanization using fossil fuels has resulted in huge amounts of greenhouse gases emitted into the atmosphere at a time when forests that absorb it are being destroyed. ‘Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial levels, as determined from ice cores spanning many thousands of years’ (IPCC, 2007: Figure SPM.1). Worse still, extraction of new sources of oil and gas is more energy and emissions intensive than previous sources. To get the same amount of energy in 2011 from tar sands, shale tight oil and gas, deep sea drilling, and Arctic drilling as from the Saudi Ghawar oil field in 1951 requires much more energy and produces greatly increased greenhouse-gas emissions (Hughes, 2009; Murphy, forthcoming b). And far from being constant, the world demand for liquid fuel and energy is rising sharply. Emissions are produced not only when energy is combusted, but also when it is extracted, upgraded, and transported. The risk of hitting a ceiling on oil extraction (peak oil) is being temporarily attenuated by extraction from unconventional sources, but at the cost of energy-intensive extraction and associated higher carbon emissions.

As the price of oil increases, decreases in its consumption are more than offset by the use of dirtier, riskier sources to increase energy supply and restrain price increases. Feelings of entitlement to cheap energy obstruct attempts to mitigate greenhouse-gas emissions.

It is likely that society will remain tied to the carbon economy for a long time (Jaccard, 2005) because of problems of scale, namely the amount and increase of energy used and the tiny proportion now based on renewable sources, as well as because of the embeddedness in societies of present carbon infrastructure and technology. A geologist writing in *The Post Carbon Reader* puts it this way: ‘The fossilized sunshine that hydrocarbons represent is an extremely convenient, dense form of energy for which there are no alternatives at the scale of energy throughput we enjoy at this point in humanity’s existence’ (Hughes, 2010: 10). Furthermore when carbon is transferred from storage in the ground to the atmosphere, it produces global warming for approximately a century before returning to the forests or oceans. It then affects the oceans in a harmful way (Rogers and Laffoley, 2011). Even if all societies miraculously stopped emitting carbon tomorrow, they would remain carbon societies for a century in terms of suffering the consequences of their previous emissions. And emissions are accelerating rather than stopping. Societies will be coupled to carbon for the foreseeable future in terms of both practices and consequences. The issue is how tight the coupling will be.

The expression ‘post-carbon society’ has no empirical referent in terms of what exists and what is emerging.

Discourse about a post-carbon utopia is severely disconnected from social and physical dynamics and has accomplished little if anything towards decoupling societies from carbon. In fact, such discourse can have perverse emissions-increasing consequences if it incites states with carbon resources to extract and sell them more quickly for fear that post-carbon substitutes will be developed, as argued by a salesperson for Alberta's tar sands.

Conceptions of 'post-carbon societies' involve lofty aspirations that require major transformations of human behavior. They are so grand that proposing them is likely to remain irrelevant to solving the pressing problem of anthropogenic climate change. Researchers like Hughes have made valuable contributions by analyzing the dependence of societies on hydrocarbons and wisely relegating the concept 'post-carbon society' to window dressing. The popularity of that concept relies more on the current fetish in academic circles with 'post everything' than on its analytical value. The literal meaning of 'post-carbon society' is so far fetched as a goal that it should be replaced by the practical objective of decreasing the absolute level of emissions and hydrocarbon usage in societies. Even that is challenging. Analyzing how current behavior is tied to carbon dependence, as well as the conditions that have led to all-too-rare successes in reducing that dependence, offers a more modest but promising sociology for dealing with climate change. Hence a comparative analysis of carbon lowering societies with carbon intensifying societies is called for.

A Suggestion for the Analysis of Differences in the Carbon Dependence of Societies

Redclift (this issue) has suggested the concept of path dependency and Freudenburg and Gramling (1993, 1994) and Gramling and Freudenburg (1996) have proposed the similar concept of developmental channelization that, once started, facilitate development in one direction rather than another and make changing channels difficult. I would argue that these concepts are particularly valuable for empirically comparing societies that have been relatively successful in mitigating global warming and moving towards sustainability with those that haven't. This holds promise for leading to a better understanding of the conditions underlying success or failure.

Successful and Unsuccessful Societies in Preventing Anthropogenic Global Warming

I would suggest comparing Northern Europe and North America as a good starting point for investigating success and failure at mitigation. Both are longstanding emitters, but significant differences are emerging between them concerning the evolution of their greenhouse-gas emissions. Canada and the United States are amongst the highest per capita emitters of greenhouse gases in the world (UNFCCC, 2010). They have more than double the per capita emissions of Sweden. In its Kyoto commitments, Canada promised to reduce its emissions during the 2008-2012 period by 6 per cent compared

to its 1990 level but instead exceeded it in 2007 by 26.2 per cent (UNFCCC, 2009: 9). This contrasts with Sweden which lived up to its commitment of a reduction of 9 per cent. The American Senate voted 100-0 against making a Kyoto commitment despite the fact that the Clinton-Gore Administration was in power. American emissions increased 14 per cent beyond their 1990 levels by 2006. When compared to other OECD countries for CO₂ equivalent emissions to produce US\$10,000 worth of GDP, Canada at 8.4 megatonnes and the USA at 6.0 megatonnes are among the highest emitters whereas Sweden generates only 2.2 megatonnes (UNFCCC, 2010). On Yale University's broader Environmental Performance Index that includes climate change, the ranks of Sweden, Norway, and Finland are 4th, 5th, and 12th respectively whereas Canada and the USA rank 46th and 61st (Yale University, 2010).

In the United States, President Obama is facing fierce opposition to his proposed cap-and-trade and fuel efficiency regulations, and doesn't dare suggest a carbon tax. In Canada, the Conservative government is lobbying internationally against Low Carbon Fuel Standards and promoting tar sands oil, even though recent studies have documented that its extraction still produces 60 per cent more emissions per barrel than conventional oil (Environment Canada, 2011: 8). In the 2008 federal election, Canadians voted against a political party whose platform included a carbon tax offset by reduced income taxes. Sweden on the contrary has developed centralized, low emissions heating systems using bio-energy from waste, Denmark and Germany have high proportions of wind

energy compared to other countries, and all of northern Europe are world leaders in the efficient use of energy. Northern Europe is leading the push for binding international commitments to reduce emissions, whereas the United States and Canada are leading the reaction of wealthy countries against them. The comparison of oil producing states is most interesting. Those societies are always laggards in introducing carbon taxes and cap-and-trade measures as well as being opposed to binding commitments in international agreements. This is certainly true for Texas and Alberta in North America. There is but one exception: the Northern European country of Norway.

These findings disprove the hypothesis of some social scientists (Prins et al., 2010) that attempts at the elegant solution of the Kyoto Protocol stifle inelegant, clumsy, local solutions. The issue is more complex and deeper than that simple affirmation. Northern European states that are leading the effort for an international agreement are also leading mitigation at the local level, whereas North American countries that refused to ratify or implement the Kyoto Protocol are also laggards in implementing local, inelegant, clumsy mitigation.

Why is there such a significant difference between Northern Europe and North America and what can be learned from their comparison? There are physical differences, in particular, North America is geographically larger and has had a lower population density. There are historical differences: North American cities were constructed after the invention of the automobile and hence are characterized by a much

higher degree of dependence on the automobile and urban sprawl, and therefore are more tightly tied to the carbon economy. However, care must be taken not to use these features as excuses: urbanization is also high in North America and densification of cities and rapid public transport could have been constructed much earlier. Most importantly, there are striking differences in governance. The United States has for almost the last half century taken the developmental channel of supply-side, trickle-down economics, deregulation, and policies of 'the least government is the best government' (except for the military and incarceration). Despite being a democracy, many Americans view their own government as the enemy. Freedom is framed as the market, businesses and individuals *free from* their democratically elected government. There is minimal entitlement to health care in the United States but maximum entitlement to cheap gas (petrol) and free highways. Income inequality of its citizens is greater in the USA than in other wealthy countries as measured by the Gini coefficient, with Canada not far behind (Simpson, 2011: A15), because of low taxes on the wealthy. Although both social theorists and lay Americans would likely object for different reasons, it is tempting to conceive of this as a strong current of anarchist thought in American culture in the form of opposition to the state.

Northern European countries, on the other hand, have higher population density, cities built before the invention of the automobile, less urban sprawl, and a long history of government as facilitator, enabler, and regulator for the betterment of the whole society.

The Gini coefficient shows that the Scandinavian countries have the least inequality among their citizens for wealthy countries (Simpson, 2011: A15) because of higher taxation of the wealthy in order to provide services to all. Northern Europeans see their democratically elected government as 'us', which does not prevent them from being critical of it. For them, the best government is smartest government, and that cannot be straightforwardly equated with the least government. Freedom is framed as all classes of society *free* to have the capacity to meet basic needs.

Comparison of Norway and Alberta concerning the state and future generations is instructive. Alberta created a heritage fund for its oil revenues, but put little in it choosing instead low royalties and low corporate taxes to attract private foreign companies, and eliminating sales taxes and value-added taxes. Norway borrowed Alberta's idea of a sovereignty fund when North Sea oil was discovered, put massive amounts in it from high royalties, created a state-owned oil company, maintained sales taxes and value-added taxes, and introduced a carbon tax. The result is that Norway has built up a huge sovereignty fund managed by the state for future generations to draw upon whereas Alberta's heritage fund contains only a pittance. Furthermore, greater political pressure can be placed on a state sovereignty fund and a state oil company than on private corporations in favour of environmentally clean investments.

To use Weber's (1958: 280) analogy, these are the different tracks created by ideas and world images along which

interests push in North America and Northern Europe respectively. The Northern European developmental track contains one less obstacle to lowering dependence on carbon, namely a North American political culture relying on the market free of government regulation and taxes. The switchmen of scientific ideas about global warming face this additional obstacle to switching North America to more environmentally friendly, sustainable tracks.

This brief sketch is meant to suggest

the usefulness of the path dependence, developmental channels framework as well as of the empirical and historical comparison of societies that have succeeded with those that have failed to minimize carbon dependence and mitigate the risk of climate change harm. Research along these lines would be a more valuable contribution by the social sciences, and sociology in particular, to meeting the challenge of anthropogenic climate change than lofty discourse.

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