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In Search of a Robust Strategy for Governing Climate Change Adaptation

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Abstract

This paper identifies the governance of adaptation to climate change as a significant case of problems of deep uncertainty, a class of societal problems confronting society. This combined with the myriad of natural resource and human settlement decisions affected by climate change requires a dynamic framework policy together with locally contextual-based, continuously evolving decision rules and decision processes, commensurate with the rapidly evolving reality and science of climate change.

We contend that there is deep uncertainty in three domains relevant to establishment of a governance of adaptation. The first is the death of ‘stationarity,’ as the operational paradigm of the bio-physical world, in the legal framework for the built environment that has heretofore assumed stationarity, and in the ability of humans to grasp the extent of dramatic effects of climate change being projected. The second is “the dictatorship of the present”, the absence of a political philosophy that adequately addresses the needs of future generations and the failure to date of even the most ardent environmental theorists to move beyond intra-generational distributive justice. Consequently policymakers, particularly in the United States though elsewhere also, lack an agreed upon value base or practical method for attaining intertemporal social goals. Finally, we identify the absence of a framework policy and formal (hierarchical) governing institutions or effective coordinating, monitoring, and enforcing organizations to ensure justice and equity in coping with adaptation.

In response to these issues, we outline a governing framework that enables policy, planning, and major adaptation choices to be made in the face of deep uncertainty. It builds on and extends the work of the California Adaptation Advisory Panel to develop a robust approach to governing adaptation (2010), for which one of the authors served as executive director. In developing the strategy the Panel engaged a bi-partisan, cross-regional, multi-sector body – from environmental, agricultural, business, civic to environmental and natural resource stakeholders – to chart an adaptation path forward for California.

A universal and unifying ‘covering framework’ for adaptation is needed that will apply to all long-term development and infrastructure decisions, public and private. A framework embedded in the operating rules and multi-year plans of all relevant public agencies and applied to all major public or private investments with an expected lifetime extending 30 years or more into the future. In effect, a framework that can then serve as the overall goal of adaptation analogous to the IPCC goal of holding global warming to two degree centigrade by 2050. The approach identified provides a path forward with respect to more effective governing of adaptation, though it does not completely address the three dimensions of deep uncertainty considered.

The paper concludes with a discussion of the particularly vexing challenge in the temporal versus inter-temporal dimensions of environmental governance in a democratic society.

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Section 1. Deep uncertainty as the context for governing adaptation

In a series of publications, Robert Lempert and colleagues have argued that the projected effects of climate change and other rapidly evolving bio-physical processes are of sufficient scale to be unlike those experienced by prior human communities. The risks accompanying the projected effects in these situations is sufficiently uncertain that conventional approaches to decision making are inadequate to the task of developing viable and reliable paths forward in governing society. Also, the language associated with past experiences is inadequate in characterizing these phenomena and our understanding of their dynamics is poorly understood. In short, governing strategies for addressing situations of uncertainty are inadequate for the emerging class of many of the new, often referred to as ‘wicked’, societal problems of the twenty-first century (Lempert, Popper, & Bankes 2003; Lempert, Scheffran, & Sprinz 2009; Lempert & McKay 2011). Hence, Lempert and colleagues have adopted the term *deep uncertainty* and call for decision making strategies far more robust and adaptable¹. In particular, turning to our specific concern, “one of the most difficult of such deeply uncertain decision challenges remains the attempt to systematically describe and assess responses to potentially ‘dangerous climate change’” (Lempert & Collins 2007, 1009).

Lempert, et al., do not provide a detailed answer to the challenge presented to decision makers working in a world of deep uncertainty, though they argue that the design of decision-making processes – of governing laws, rules, policies, and institutions – must be robust. Despite this deep uncertainty over long-term environmental and societal conditions, there is the practical and political necessity of acting in the present on issues of long-term duration and consequences. This decision process must “perform well over a wide range of possible futures”—i.e., it must be “robust”. This also implies that there will necessarily be trade-offs between identifying decision-making strategies that ‘optimize’ versus ‘satisfice’ for any give state of knowledge about the future. Implicit in erring on the side of a satisficing approach is that, in the light of deep uncertainty, it is

¹ Deep uncertainty about key dimensions of a system undergoing a more rapid rate of change than heretofore experienced, such as the increasing rate of climate change on the earth, or the precise nature of the effects that can be expected, especially the further into the future one is projecting, “By deeply uncertain, we mean the condition where decision makers do not know or cannot agree upon the system model relation actions to consequences or the prior probabilities or key parameters of the system model (Lempert and Collins 2007, 1010).

politically, economically, and morally important for decision makers to avoid a decision process that in the past might well have led to optimal or second best outcomes but, if applied in cases of deep uncertainty can also lead to truly undesirable, even worst-case outcomes (Lempert & McKay, 2).

Developing a robust governance strategy requires utilizing methods of assessing vulnerability and estimating levels of risk that go beyond existing conventional linear, quantitative methods. Given the limited certainty about the vulnerabilities to climate change a host of other less technically reliable but insightful methods are being developed--from simulations to narratives and Delphi and Foresight exercises where individual and groups participate in imagining plausible scenarios about future states based on alternative projections of climate change. Scenarios that help policy makers gauge what courses of action ought, or ought not, to be approved in light of their particular context (Van Vuuren *et al* 2011; Lempert, Scheffrand, & Sprinz 2009). Adopting more robust methods of analysis in climate change is an important step forward though, to be useful, doing so needs to be matched with comparable changes in the analytic framework utilized in the policy-making process. As Hallegatte (2009) suggests, this can involve any one of several more robust decision-making approaches, including selection of 'no-regrets' strategies, buying 'safe margins' when making new investments, or reducing decision time horizons, all of which error on the side of avoiding worst-case outcomes.

We subscribe to the premise that adopting robust decision processes is essential to addressing the evolving effects of climate change, even if some degree of optimality is sacrificed in order to reduce down-side risks. The question we address is: What factors, at a minimum, should be considered in designing this robust governance strategy? In order to answer this question, we begin by recognizing three critical decision attributes: *the death of stationarity in climate science, the dictatorship of the present in the political arena, and the weakness of any intertemporal ethic in human decision making*. Any viable strategy, at a minimum, needs to address (or at least be cognizant of) these three dimensions of the challenge.

The death of stationarity

In designing and calculating the cost/benefit of any major infrastructure or development project throughout much of the world, it is conventional to project the life of the project from 30 to 100 year. In doing so, it is typically assumed that past is prologue. That the future course of a river can be known from its past flows and migration patterns, that sea water intrusion can be calculated from past tidal and storm event patterns, or that the availability of arable land for agriculture can be based on precipitation and weather from the recent past. For the purposes of human development so far, this approach has proven relatively effective since stationarity in these patterns has been the norm. This has allowed the myriad of natural resources and land-use decisions, and corresponding investment and business decisions to be made with a reasonable degree of certainty about the long-term consequences. To the extent that past patterns may be abruptly

altered due to the accelerating rate of climate change, stationarity as a convenient 'simplifying' assumption and 'legal fiction' is rendered extremely problematic. Because past projections were relatively accurate in forecasting actual experience as it unfolded over time, stationarity served human societies in making long-range development and investment decisions. Even in exceptional cases such as earthquakes, where the presumption of stationary is not the prevailing doctrine, land use planning and the design and engineering of the built environment have been specified based on the historically experienced levels of earth movement and vulnerabilities. The accumulated knowledge has enabled the professional communities involved to develop reasonable risk parameters that are used to inform decisions about the future and to guide the specific designs of intelligent investment and development projects.

The rapid acceleration of climate change is fraught with far greater uncertainty, however, especially with respect to the extent that human activity (primarily the emission of GHGs) may be adding to 'natural' causes of climate change. This has fueled a growing challenge to the efficacy of stationarity as a useful assumption, evident most clearly in the areas of hydrological processes and water resources management and sea-level rise and coastal zone planning and management.² The challenge to stationarity as the operational premise in planning and management in these areas was captured by Milly and colleagues in 2008 in their challenge to fellow water management professionals in the prestigious SCIENCE magazine. The long-standing and professionally codified assumption of stationarity – “the ideal that natural systems fluctuate within an unchanging envelope of variability” – which “permeates training and practice in water-resource engineering” (Milly et al; 573) is dead, they asserted. It can no longer serve conceptually or practically as a useful foundational assumption at a moment in history when it has become evident that natural processes are undergoing substantial fluctuation due to climate change within the time-horizon for the expected life of most water (and other major infrastructure) projects. As a result, “we need to find ways to identify nonstationary probabilistic models of relevant environmental variables and to use those models...” (573).

This challenge has been taken seriously by water management professionals and the viability of stationarity as a core assumption in water resources planning and management was taken up at a meeting in 2010 of the leading agencies responsible for water management in the United States. After several days of consideration, the meeting concluded without resolving whether to replace the assumption of stationarity with a more suitable principle in federal guidelines. Nonetheless, the issue remains uppermost in the internal deliberations of the professional community (Galloway 2011).

² A point illustrated by the important discoveries being made about the stability of the Antarctic ice sheet, see: “Huge Crack Discovered in Antarctic Glacier”: <http://www.foxnews.com/scitech/2011/huge-crack-discovered-in-antarctic-glacier/>.

Dead or not in principle, in both water and transportation planning in the United States the effects of accelerating climate change is beginning to be incorporated into major project plans and developments, as exemplified by the recently released guidelines by the US Army Corps of Engineers, ‘Sea-level Change Consideration for Civic Works Programs,’ (U.S. Army Corps of Engineers 2011); the ‘Progress Report of the Interagency Climate Change Adaptation Task Force’ (U.S. Interagency Adaptation Task Force 2011) ‘The Climate Change Handbook for Regional Water Planning,’ produced by a California State- Federal government partnership (California Department of Water Resources 2011); and the California Department of Transportation’s ‘Guidance on Incorporating Sea level Rise’ (California Department of Transportation 2011).

The *death of stationarity* as principle and guide to practice is beginning to be incorporated into the planning requirements for resource and infrastructure agencies not just in the United States but worldwide (*citation* TBA). In both the theory and the practice of forecasting the course of physical and biological processes, the death of stationarity has brought with it enormous challenges. These challenges include: (1) for climate scientists, projecting the pace of climate change and modeling the effects on natural resources and land masses at both the macro and micro level; (2) for engineers and architects, designing appropriate structures for the built environment, and; (3) for decision makers, making responsible decisions about long-range projects and human activities.

The ‘death of stationarity’ has equally important implications for the legal designation of real property. Traditionally, real property has been assumed to be fixed in place, as with the dominant legal tradition that incorporates stationarity as a central legal principle, as the ‘legal fiction’, at least so where we are most familiar, in the United States. In places like California, this has extended to constitutionally establishing the dividing line between public and private property along the state’s 1,100 coastline as the mean high tideline, never anticipating this could and would change, not in geological but within human timeframe. *Citations TBA*).

The ‘dictatorship of the present’

The absence of a recognized political philosophy that addresses the needs of posterity (the intergenerational equity issue) and the very strong tendency to date of most environmental political theorists to focus on intra-generational equity and justice considerations to the exclusion of intergenerational considerations has led to a very serious deficiency in the appropriate design of structures to govern adaptation (Adger *et al* 2006). Neither mitigation nor adaptation will be addressed sufficiently without confronting the vexing challenge humanity has had throughout history to address the needs of *posterity*; the concerns not only our children, our children’s children, but our children’s children’s children and beyond. This became quite evident in the pushback by economists to the Stern report (2006), criticizing him on his treatment of intergenerational equity issues.

Political theorists from the ancients up through the enlightenment and into the modern environmental epoch have dwelt on the issue of the obligation of contemporary populations to posterity. The pros and cons of the case for this obligation have long been debated, as well as the recognition of the human propensity to discount the interest of future generations to the extent that it conflicts with current human needs, desires, and capacities (Eckersley 1992).

Following in this tradition and in a search for a philosophical foundation applicable to contemporary environmental and ecological challenges, Brian Berry, in an insightful essay at the beginning of the modern environmental movement observed that, “We scan the ‘classics’ in vain for guidance on this question, and for understandable reasons.” He goes on to say that there is a fundamental difference in “our relations with successors and our relations with our contemporaries” ... and it is power! That is, “that people alive in several centuries’ time will not be able to do anything that will make us better or worse off now, although we can do some degree make them better off or worse off” (1991;242-243).

This, combined with the deep uncertainty about the future has *permitted*, in a sense, humans to avoid extending recognition and moral, political, and all-important legal *standing* to future generations. There is no formally established political forum where future generations can be heard or governing institutions that take future generations into account. Albeit, there is a long-standing but controversial “public trust doctrine” that designates the government as responsible for conserving and managing “common resources” (beaches, etc.) in the public trust, which by implication takes into account the interest of future generations. The legal and political rights of different classes of contemporaries have been progressively expanded over time in most societies – non-property owners, slaves, women, children – and in selective circumstance non-human species and natural settings have been protected and, in a sense granted standing, but as exceptions not as a rule (Stone 1988).

Intertemporal Ethics

Hardin (1981) observed that the primary ethical response to the environmental challenges of air, water, land-use, and like industrial pollutants has focused on *distributive justice*; that is, our relations between contemporaries and the concerns of justice among individuals, economic classes, developed and developing countries, or polluters and those people and places upon which the pollution of the industrial system were disproportionately visited. The philosophical foundation for the focus on distributive justice can be traced to the writings of John Rawls, whose theory of justice (1971) animated the discourse on justice in the latter decades of the 20th century. For Rawls, the basic values principle for any government action (any collective action) was that its effects must disproportionately benefit the least well off in society. As Hardin pointed out (1981; 222), while Rawls powerfully addressed the need for distributive justice among and between present contemporaries, he made only passing reference to the implications across generations and far into the future. Hardin concludes that both our

ethics and our democratic institutions are largely devoid of an ethical basis for attending to the needs of posterity.

To cast the situation somewhat differently, there is a substantial mismatch between the 18th-20th century democratic discourse – of intra-generational power, equity, and justice – and institutions designed to respond to the needs and wants of current generations, and the inter-generational (intertemporal) issues raised by many environmental and sustainability challenges of today. Challenges such as in ozone depletion, ocean dumping, overfishing on the high seas, species and habitat protection, and the need to dramatically reduce greenhouse gas emissions, on the one hand, and develop strategies for adapting to the looming effects of climate change, for which there is need for contemporary action to avoid the demise of species, collapse of ecosystems and many other aspects of the natural environment as we have known them up to this point in the human experience. These are all situations where remediation requires that the costs of addressing them be borne by contemporary generations, while the benefits will accrue disproportionately to those who follow.

At their best, the purpose of political institutions is to overcome the inherent self-interested behavior of individuals and groups in pursuit of common, collective goals. Yet the institutions we have are not well-suited to address over-the-horizon, intertemporal issues of common, collective needs. In effect, we face a situation of institutional incapacity, a failure of our governing processes to cope. This is not a situation unique to any single community or nation alone, but characteristic of most all contemporary political systems, designed to facilitate the sharing of power and thus the distribution more broadly of the benefits of citizenship and the material goods and quality of life of society.

Finally, the United Nations' efforts under the Framework Convention on Climate Change notwithstanding, we are operating in the absence of either a single governing institution or effective global coordinating, monitoring, and enforcing organizations, real or virtual, sufficient in scale to ensure justice and equity in coping with the challenges of climate change adaptation (Goodin 1992³; Young 2009). Kohane and Victor have found sufficient evidence of a number of international climate change accords emerging today in climate change mitigation to characterize the governing process as a *regime*

³ The dilemma of a decentralized approach has remained basically unchanged since pointed out by Robert Goodin early on in the environmental era.

“Committed as they are to a programme of radical decentralization – ‘thinking globally’ but ‘acting locally’ – greens at one and the same time especially require but also singularly lack a theory of how the necessary coordination is to be achieved among all those autonomous smaller units” (1992;5).

complex—i.e., as a “loosely coupled set of specific regimes” (Kohane and Victor 2011;7). They also conclude that this falls short of what is needed in terms of authoritative and administrative governing institutions for the effective coordinating, monitoring, and enforcing of mitigation policy. Nonetheless, even this less-than-ideal level of governance is well ahead of where things stand with respect to the governance of adaptation. A central focus of this paper is to explore why this is the case and what can be learned from the experience in mitigation policy for developing, if only at this early stage, a regime complex for adaptation, equal to that which has emerged for mitigation.

Taken individually, the above three factors have led us to the current logjam in governing adaptation. When one considers outcomes from the interactions between the three factors, the need to focus our attention on ‘deep uncertainty’ and how to govern adaptation in light of it becomes even more pressing.

Governing mitigation vs. adaptation

There is growing recognition that the challenges of governing mitigation and the policies addressing GHG emission reductions are different in several respects from the challenges of governing adaptation. The most widely recognized difference is that mitigation requires collective action among the preponderance of GHG emitting nations if not universally (Young 2009), whereas the effects of climate change will, by their very nature, be addressed individually, selectively, differentially, and on timelines dependent on the location and characteristics of local climate change effects, and in light of the local capacity to respond (Adger 2003; Zahram *et al* 2008; Farber 2009). Commensurate with the scale of challenge and in response to it, the need for GHG emissions reductions has been led by the international scientific community, with the support of the United Nations Framework Convention on Climate Change. The series of International Panel on Climate Change (IPCC) reports over the course of a quarter century and the attention they have received has been unprecedented.

There is also growing attention to the vulnerability at different locations to the adverse effects of climate change, in particular among the island nations, the EU, at the city level around the world, and by the IPCC, which will be emphasizing adaptation in its forthcoming report. To date, however, there has been no international scientific body that has set forth a rationale together with a unifying quantitative goal for adaptation. No equivalent ‘covering framework’ has yet emerged for adaptation analogous to the IPCC goal for mitigation, i.e., of limiting climate change to no more than 2 degree Celsius by 2050.

These differences plus others appear to account for the absence of a governing strategy for adaptation akin to that for mitigation. We review them in a bit more depth, therefore, as the potential barriers challenges that any viable governing strategy must anticipate.

Barriers to a governing strategy for adaptation⁴

First, as a policy type, climate change adaptation appears to fit Gormley's (1986) criteria as a *low salience and high complexity* policy. That is, it is multifaceted and complex, it is not well appreciated by most citizens and policy makers, and it is not given high priority for action. As such, we would not expect strong and pro-active legislative action as there are very few electoral incentives associated with these types of policy issues. If there is to be any action at all, one would expect it among responsible agencies and authorities as an extension of their normal operations and professional interest in looking ahead. The same can be said of mitigation policy, of course. Moreover, until recently there was a reticence on the part of environmental and climate change groups to give attention to adaptation, for fear that it would distract focusing on mitigation and imply recognition that mitigation might not succeed—i.e., that the IPCC and similar GHG reduction goals would not be reached. If anything, attention in at least the U.S. has continued to focus on mitigation, with adaptation relegated to further study and to simple platitudes that adaptive action is needed, without stating any substantive objectives or standards to guide action.

That said there is every reason to believe that salience will increase if and when *retreat* policies are compelled by the reality of a rising sea that requires that homes and businesses step back from coastlines around the globe. Salience will also increase as the other effects of climate change are felt. The message will not always be well received. This should not come as a surprise, since people often respond to unwanted consequences with denial, at least until those consequences have been unambiguously realized and can no longer be denied.

Second, it is possible that although GHG mitigation is complex (Nelson *et al* 2011), adaptation is even more so, conceptually, technically and politically (Landy 2010). To address adaptation, decision makers and the public need to understand local ecology in much finer detail than is the case with mitigation. And while there is a strong consensus among the scientific community about rising temperatures – thus the need for mitigation via GHG reduction – there is less consensus about the potential impacts, from forest fires, spread of disease, droughts, sea-level rise, and the like. In the simplest terms, mitigation is about reducing GHG emissions. While far easier said than done, the concept of reduction of environmental pollutants is well understood and appreciated after decades of living under clean air and clean water public policies of the past half century. There is no comparable frame of reference⁴, however, when it comes to sea-level rise, although there are some analogous situations.

Third, another possible explanation is the issue of proximity to the problem—both locational and temporal proximity. That is, the closer one gets to a problem and the point of decision, policy makers come to realize how truly complex it is and cannot

⁴ This section is drawn from Mazmanian, Jurewitz & Nelson (2011).

agree on what to do. In effect, there is a natural tendency to avoid taking action on a potential problem of uncertain magnitude and timing, especially when many are skeptical that it even will happen and most believe that there will be time to respond after seeing more certain signs. This is not like preparing for an earthquake that will certainly happen sometime, and when it does happen it will be sudden with no time remaining to prepare for it.

This is especially relevant with respect to sea-level rise where “lost opportunities” dominate; that is, where there are long-lived investments that need to be ‘climate-proofed’ today in order to avoid them becoming stranded assets. This would be true in terms of technical considerations for adaptation at an individual site, for instance, what should be the height and performance requirements for housing stilts? The answer, presumably, is a function of climate variability, the forecasted sea level rise (which is difficult to ascertain for specific sites and for which no current scientific consensus exists, even on the most general level), and intended longevity of the dwelling. Making preventative investment decisions across many sites – ‘collectively’ – such as with sea walls along a coastline might best be delayed until we see better what is likely happening and what its likely/possible magnitude may be.

A fourth possible explanation is that land-use regulation inherently involves imposing restrictions on peoples’ use of real property, and people and business enterprises are far more emotionally tied to and possessive of ‘their’ real property than other assets and aspects of life. Consequently, property rights are treated as sacred, they are held by individuals (not collectively), and decisions over them to protect or enhance ‘collective’ or ‘public’ goods or community needs are inevitably suspect and usually resisted. The fact that decisions about real property are decentralized and left to the most local of jurisdictions across the state reflects this reality. Politicians surely realize this and are unlikely to be interested in being seen as advocates of comprehensive ‘land use’ regulation or mandatory adaptation legislation usurping individual property rights.

Fifth, as a possible explanation, the broader the scope of coverage of an adaptation policy, the more and varied the stakeholders who will become involved in its deliberation and adoption, many of whom will raise issues and can block significant action that for whatever reason they oppose. Also, the greater the diversity and number of stakeholders, the more ideological conflicts will arise. In this case, environmentalists are conflicted about adaptation (Brody *et al* 2010). Some support pro-active adaptation policies, but others believe that adaptation policies, without global mitigation policies, are unethical. On the other hand, conservatives are less likely to believe in the physics of anthropogenic warming and unlikely to support new regulations.

Sixth, as touched on above, in contrast to mitigation where the IPCC has identified a specific goal to guide emission reductions, adaptation suffers from the absence of clear, authoritative and quantitative goals. The IPCC’s mitigation policy goal was a quantifiable target on the basis of which GHG emission reductions could be calculated and allocated to the various sectors of a community or nation, or distributed globally, at

least in concept. No comparable target has been identified in the scientific or policy-making communities with respect to adaptation, as for example, requiring all coastline development to be planned in anticipation of a two meter (plus or minus) sea-level rise by the end of the century or forest fires management strategies to be designed to keep the number of acres charred to that experienced in the preceding fifty or one-hundred years. Absent a ‘scientifically’ established target, *a la*, the IPCC, or any public and thus political consensus on what the target(s) should be, the adaptation debate is reduced to advocating prudence and planning ahead, but lacks any definition of what that means.

Adaptation, in one sense, is about planning for contingencies depending on the extent to which the 2050 GHG target is met. It is about protecting ourselves from ‘public bads’ – rising temperatures and the adverse effects. Once a public bad is created, we all ‘enjoy it’ equally, but we can take private actions to mitigate or avoid it – e.g., private sea walls, air conditioning, taking long summer vacations in the artic. Thus, while private actions to avoid GHG emissions does not make much ‘rational’ sense (i.e., just one emission source in a billion) and only collective action seems to make rational sense, adaptation does have ‘rational’ private strategies. Rational adaptation may also, and probably does, involve collective action strategies that are a necessary component of an overall rational adaptation response if we can manage to orchestrate these rational collective adaptation responses. Thus, while private actions to reduce emissions do not make rational sense (or only make sense if we assume that everyone else will follow), private actions to adapt do make sense – but *by themselves alone* may not be a socially optimal response.

Seventh, considering all of the above possibilities, the nature of the decision to enact an adaptation governing strategy might be viewed as different not only in degree but in kind from mitigation. Dealing with the causes and the effects are simply not the same. Adaptation is largely about land use, it involves a suite of risk management problems (Kunreuther and Useem 2010), and it is absent clear and identifiable targets. With mitigation there is one target. Choosing an appropriate level for this target is an exercise in judgment in the face of deep uncertainty. However, once chosen, the challenge of allocating the burden of emission reductions across sources in a cost-effective manner is an exercise in reasonably straightforward cost minimization. Market solutions for mitigation by ‘getting the price right’ cannot be so readily applied to the diversity of actions needed for adaptation. There are many different policy attributes that need to be optimized.⁵ Moreover, unlike mitigation where the source of the problem is GHG

⁵ However, complete optimization implies a balancing of costs and benefits at the margin. But, we really do not have a clue about the benefit side of reducing GHG emissions and seldom, if ever, apply such a reference point in determining an emissions reduction target. Instead, most approaches are based on agreeing to some target such as 450 PPM atmospheric concentration and then working back from there to some total emission reductions. This approach is “cost-effectiveness” analysis—not “cost-benefit” optimization. Such approaches as cap and trade or carbon taxes are based on trying to achieve whatever reductions we choose to target in the least-cost pattern of reductions across the various emissions sources.

emissions regardless of location, rational adaptation expenditures must inherently consider local economic phenomena. For example, least-cost mitigation requires that the marginal cost of reducing GHG emissions be the same across all opportunities for emission reductions. No similar overarching cost-effectiveness rule applies to adaptation. Instead, some coastline features may be very valuable and worth spending large sums of resources to protect, while other parts of a coastline may be more expendable.

When it comes to adaptation governance, things are a bit different. There is no avoidance of a public bad whose mitigation cost is to be spread across all sources in a least-cost way that minimizes the overall cost of avoidance. The issue instead is what specific projects are to be incurred, at what level, and who is going to pay for them. At best, these projects are only quasi-public goods; the incidence of their benefits will be unevenly spread across the population. Moreover, the appropriate optimal solution would seem to be comprised of some pattern of both collective and private investments. The optimal solution would seem to provide for some collective investments that benefit many in conjunction with allowing individuals to undertake certain supplementary private investments (so long as these investments are not anti-social investments that simply shift costs to others or cause the overall cost of adaptation to be increased). The choices to be made about the collective public investments are:

- (1) What exactly are they technologically?
- (2) At what scale should they be built (a classic risk analysis of a safety investment – shall I plan the bridge for the 25-year flood or the 100-year flood)? and
- (3) Who should pay for them?

Eighth, and finally, per the third point above, there is always the issue of who pays how much. In the case of adaptation policy, the analogue of ‘getting the price right’ is likely getting the locus of responsibility and liability assigned unambiguously. Markets cannot even begin to work if accountability is not clarified first. Private responses and markets are not the whole answer as the politics cannot possibly work smoothly without first assigning the liability for inaction reasonably clearly. The price on adaptation (or really failing to adapt) is the cost consequence of failing to adapt. This is a price that will vary widely depending on the peculiar circumstances involved. There is no single price like the per-ton price of carbon. That is why a specific price does not apply across the board. Nonetheless, certain things should apply across the board unambiguously – especially – who pays, i.e., in effect, who is liable.

The efficiency issues (i.e., incentives) and equity issues involved are far from being self-evident. The ‘polluter pays principle’ would certainly see some equity in using some of the revenues possibly collected from carbon taxes or auctioned emission permits to fund adaptation projects. However, and focusing only on the prototypical example of protecting seaside neighborhoods from sea level rises, some critics would point to: (1)

the already wealthy status of the local seaside residents, (2) the fact that ‘they assumed the risk’ as any property owner does, and (3) the fact that the societally least-cost adaptation strategy might be that these residents should simply move rather than have an expensive seawall constructed on their behalf using public funds (i.e., the efficient incentives issue). There are also sticky issues of tort liability. If I take an action as a property owner to protect my property but it has adverse spillover effects on neighboring property owners, should I be liable to them under tort law? What if my action was in some sense ‘reasonable’ and their corresponding failure to protect themselves (perhaps by doing something similar) was not ‘reasonable’? What should be the standards for ‘reasonable’ and, therefore, excusable behaviors to adapt?

The death of stationarity itself is also likely to present new important efficiency and equity issues in sorting out simple property rights. Again using the prototypical example of oceanfront property and rising sea levels, what exactly happens to the property boundary between private property and public beach as the sea level rises? Although definitions vary from place to place, a common practice is to designate some boundary such as the ‘mean high-tide line’ as the boundary. Thus, it would seem that rising sea levels would effectively ‘condemn’ private property and convert it into public property. Would private landowners have a viable case under the law in bringing a lawsuit against the government for failing to take actions to mitigate climate change that thereby results in a taking of their property without just compensation? Would the private installation of a sea wall be sufficient under the law to protect the landowner’s private property? It would seem so on its face, but what if the property owner took such action five years after the encroachment initially took place? Could the landowner push back the sea to reclaim his property without first seeking a government permit much like someone who wants to fill in a shallow natural waterway, bay or estuary in order to ‘create’ new land *de novo*? If the landowner abandoned the flooded property, but later the sea level receded or some public project resulted in the recovery of this land as dry land, would the property owner have retained under the law some sort of contingent claim on the temporarily flooded property that the property owner could then assert? There are likely legions of such interesting legal questions that courts will likely have to grapple with, perhaps for the first time, as stationarity along the coastline disappears.

Both mitigation and adaptation will bury the costs of the policies in the goods purchased as a consequence of policies, whether it is in the form of a carbon tax, increased sea rise flood insurance rates, raising the height of bridges, etc. Unless adaptation costs are somehow “socialized”, they will be borne by those who are affected by sea-level rise, forest fires and other direct effects that, in turn, will investment patterns as well. New public investments such as higher elevation roads and other infrastructure will also be required. How much of the private costs to individuals will be, or should be, socialized is an important political economy question.

In theory, increased insurance rates are readily identifiable and specific to those who desire such insurance – i.e., they are specific private costs. Yet there can be a political backlash to such ‘true costs’ insurance strategies as experienced in Florida when the

state's political leaders felt compelled to step in and subsidize the insurance when home owners balked at the trust cost of hurricane insurance and as private insurers began to 'flee' in the last few years (Scism 2011).

Section 2. Dimensions of a robust governing framework

Incremental steps forward

For one or more if not all of the above reasons, adaption has been treated gingerly and with great circumspection in policy and decision making. Nonetheless, a number of nonprofit organizations and governing bodies have recommended and in some cases adopted a host of informational, educational, planning, and procedural steps to move adaptation governance forward (Berkhout 2006; Farber 2009; State of CA 2009; Kelly 2010; State of Florida 2011; Agrawala *et al* 2011; ICLIE ; WRI 2010; United States Federal Government 2011).

Farber (2009) contends, for example, that the fastest and possibly best approach to developing an adaption strategy for the United States is to build on existing resource and environmental policies and the traditional division of labor between local, state, and the federal government. Local and state governments have historically been and will in all likelihood continue into the far future be the 'first responders' to the most likely effects of climate change, he asserts. "They own or license critical infrastructure, provide health services, and control land use." The path of least political resistance, therefore, is to add to myriad of existing agencies and authorities the obligation to incorporate knowledge about and responsibility for addressing the potential effects of climate change to their existing mission.

This includes asking of the United States government what it often does best, which is providing "mandatory standards for adaptation efforts or (to) finance adaptation" (2009, 260). In effect, Farber argues as a general rule for insinuating adapting into the fabric of existing governing agencies and institutions. When it comes to enabling legislation, he sees this as little different than how Americans responded in the second half of the 20th Century to air, water, waste, and other unwanted pollutants, with a tiering of obligations from Federal to local level, with shared funding, and ultimate responsibility for implementation by the state and local governing entities closest on the ground. He acknowledges that as conventional and incremental his approach it will nonetheless require significant negotiations among all concerned, and substantial political leadership. But, as he poses rhetorically, what is the alternative?

Another kind of approach is represented by the California Adaptation Advisory Panel (2010) that was designed to test the programmatic boundaries and political feasibility for an adaptation governing strategy for the state. The panel was initiated by a leading NGO, which invited two dozen of the state's major stakeholder groups to participate in a fifteen month, closed-door, policy consensus dialogue on adaptation, in 2009-10. While initiated outside of the halls of government it worked closely with key state agency

leaders and the recommendations of the panel were ultimately embraced by the governor as the advisory panel to the state. The panel was bi-partisan, cross regional, multi sector – from environmental, agricultural, business, civic and environmental group – in composition, reflective of many of the state’s major diverse communities and interests, brought together in order to develop a ‘consensus’ adaptation path forward for California. The panel came to share the belief that moving forward would require:

- Developing more effective, comprehensive and long-term data gathering on the uses of, and changes to, California’s natural resources and land use patterns so that we could know more about the many ways in which the bio-physical effects of climate change would visit on California.
- Giving primacy to adaptive science-based approaches in framing the policy discourse, given that both the science of climate change and the climate itself are evolving such that the science and policies based on it will need to be revisited as more is learned.
- Instituting at all levels (i.e. federal, state, regional, and local) and across all economic sectors meaningful and continuous public engagement about climate change and its potential effects.
- Finally, and most important, the panel recommended that a small Climate Risk Council be established in the state, located directly under the governor (analogous to the Council of Environmental Quality at the national level). Its function would be to digest and disseminate the growing science-based knowledge of the most likely climate change effects to affect the state, develop guidelines and decision tools based on that knowledge for long-term development and infrastructure decisions in the state, and develop guidelines for use in conducting cost-effectiveness analyses of proposed projects.

The need for a central overarching framework

We believe that as important as these recommendations and steps are for promulgating science based decision making and engagement, taking meaningful and timely steps toward adaption governance requires additional complementary dimensions to provide the superstructure for all the governing steps being taken within and across nations today. Information and engagement are only a first step, and provides the basis for policy change. A covering framework must be universal enough to cover most if not all circumstances where adaptation is necessitated, while being sufficiently pragmatic to enable practical decision making to move forward. It must do all this while staying ever sensitive to the deep uncertainty surrounding climate change discussed in section 2. In effect, a high level, universal policy framework is needed to establish a goal for adaptation governance and decision making as the driver for the myriad of place-

specific, decentralized planning tools and approaches that are, and will be, evolving over the coming decades.⁶

To our knowledge, there is no universal guiding principle for adaptation governance stated in explicit and operational terms. There is no level of government or intergovernmental agreement that provides both the broad policy goal for society and operational direction for those responsible for making day to day policy and project decisions—not by international governing bodies, national governments, sub-national and local bodies, nor any other authoritative entity responsible for the long-term well-being of those whom they govern. What is needed is a clear statement of principle that when adhered to enables actions to proceed on their merit and is not perceived as a barrier to action, as a hurdle used to impede otherwise meritorious human settlement and development.

What is needed is a principle that provides transformative yet enabling direction that is analogous to what the 2 degree Celsius by 2050 guideline promulgated by the IPCC provides in the arena of climate change mitigation--a principle that has moved mitigation to the heart of policy discussions among the major nations of the world in the United Nations Conference of Participants (COP), that serves as the guiding policy goal of the member states of the EU, the 24 states within the United States that have developed climate action plans, and the 800 plus city mayors around the world who have signed the ICLIE climate change pledge.

A universal and unifying “covering framework” for adaptation is needed that will apply to all long-term development and infrastructure decisions, public and private. A framework embedded in the operating rules and multi-year plans of all relevant public agencies and applied to all major public or private investments with an expected lifetime extending 30 years or more into the future.

The need for such common planning standards may seem self-evident to many while striking others as just one more example of encroaching ‘Big Brother’. Others may wonder why having everyone focus on common planning assumptions might not simply result in everyone ‘getting it wrong’ *en masse*. These are legitimate conceptual

⁶ We want to acknowledge at the outset that our approach does not ensure the emergence of an authentic intergenerational ethic of sustainability of the sort needed for the new Anthropocene age (German Advisory Council on Global Change 2012). However, in view of the fact that there are significant historic instances where a fundamental (transformational) change in policy that had been strenuously resisted has led to a change in behavior and, over time, to a change in deeply held values, gives us hope (e.g., establishment of a national framework policy for school desegregation and the requirement for health care warnings on cigarettes in the US *citations TBA*). Working within a universal framework that requires greater intergenerational consideration provides us with hope that an intergenerational ethic of responsibility to future generations of human and all other species and the ecology of the earth will emerge.

concerns that need to be addressed. At the core of the question is whether the benefits of a coordinated common response exceed the benefits of decentralized and diversified individual responses. A *laissez faire* approach to adaptation in which ‘everyone should simply protect themselves’ might be appropriate if (1) there were no interdependencies between the adaptation actions of individuals, (2) no economies of scale in collective action, and (3) no intergenerational impacts to be protected by ‘the public trust’. For some dimensions of adaptation, this may certainly be approximately the case so that no common planning standards are needed or appropriate. However, it is our judgment that many important dimensions of adaptation are strongly characterized by one or more of the three previously stated conditions not being true and, therefore, justifying and requiring a collectively chosen common response.

This being said, depending on exactly how common planning standards are implemented and understood, they may present some downside risks, especially if they lead to rather far-reaching inferences that insulate or limit individual responsibilities. In particular, a good deal of thought should be given to the appropriate interaction between compliance with planning standards and residual private tort liability. It seems likely that in most cases planning standards should be regarded as *minimum* standards, and further private actions may be appropriate depending on specific circumstances. Further thought should be given to whether, and under what circumstances, compliance with planning standards should be sufficient to indemnify a property owner against private torts. Across many dimensions of potential adaptation measures, it would seem that planning standards should convey information about minimum standards of care and should require compliance, but that compliance in itself should not be sufficient to shield the property owner from tort actions based on common-law standards of negligence and the property owner’s obligation to exert due care.

Of extreme importance in view of the deep uncertainty regarding the emerging knowledge of the severity and extent of climate change and its future effects, the framework will itself need to undergo continuous scrutiny and revision as new information is gleaned from the climatological and ecological sciences. In order to establish and maintain credibility with decision makers and the constituencies they represent, climate change information must come from a professionally credible and financially disinterested source; a provider of science-based information that stands above the fray though acknowledged by those in the fray as legitimate. For this to occur, to the greatest extent possible it will need to be unhindered by ideology, vested interest, and political expediency.

At present, the scientifically most widely vetted, publicly recognized, and legitimate source of the scientific information on climate change requisite for a covering framework is IPCC and its periodic reports on the extent and potential effects of climate change. Implicit in the reports is an appreciation of deep uncertainty, that past is not prologue, which renders problematic the certitude of any specific projection of the effects of climate change, especially with respect to different locations on the planet. It is for this reason that IPCC projections are presented in terms of a range of uncertainty

about the extent of future GHG emissions and their aggregate effects, with scenarios ranging from a high based on 'business as usual' to dramatic reductions.

Currently, there is no covering framework that addresses adaptation policy and assists project level decision makers to decide on whether and what type of activities to authorize in the face of climate change. Our recommendation is designed to fill this void. It is to establish as *prima facie* criteria for approving a project or activity that is based on the range of reasonably likely climate change effects projected by the intermediate IPCC projection(s), down-scaled to the specific project location. For example, if the intermediate scenario projects sea-level rise of one meter by 2050 along the coastline of Netherlands, any development, infrastructure project or other major activity with a lifespan of 30 years or more proposed for the coastline would need to demonstrate that it could be successfully undertaken with a one meter sea rise mind. Success, that is, in terms of structural and physical integrity, business plan, and environmental requirements at the location involved. Of importance, regulators and land use managers could not deny the development based on its failure to meet a project of more extreme effects, such as a two-meter sea-level rise. The framework could be applied across all affected policy arenas , e.g., the urban and rural built environment, along coastlines, bays and inlets, and low-lying landward intrusions; long-range land use planning, water management, public health, etc.

Whether the parties (public or private) investing in a given development chose to act more cautiously with respect to possible vulnerabilities to climate change would be for them to decide. The point being that an affirmative decision would rest on adapting to the IPCC intermediate scenario, presuming that it is the best estimate available at the time of decision. A proposed project could not be held up, all else being equal, simply because policy makers or other interested parties disagreed with the intermediate scenario, for whatever their reason. In terms of legal and financial liability, those approving of going forward and those responsible for building adaptively within the parameters of the prevailing intermediate scenario would not be deemed liable if, during the life of the project the effects of climate change turn out to be more severe (e.g., sea level rise more than one meter along the coast of Netherlands). Conversely, they would be held liable if they were to approve and develop to a lesser standard than indicated by the IPCC scenario.

In view of the evolving knowledge of climate change and the uncertainties surrounding projected effects, and thus changing vulnerabilities associated with those effects, as the parameters of the 2014 IPCC intermediate projections are revised over time and with each subsequent release of an IPCC report (based on practice to date, every 6-7 years) so too would the particulars of any multi-decade (30 year) projection. This would, in turn, require revision in the operational guidelines for development and long-term activities in a continuing, periodic updating over time, adjusting and adapting the parameters for adaptation development as atmospheric and site-specific conditions evolved.

Although we believe that the IPCC intermediate case is the best available and makes for a good reference point, we must confess that we doubt whether the elected leaders in our own state of California – as progressive as anywhere in enacting climate policy – could at this time in time, memorialize by reference in a state statute such a specific finding as the IPCC intermediate scenario, if for no other reason than it is outside the control of anyone in California. This is probably too much to ask, at least for now, in terms of the relinquishing of a state (and by extension any nation’s) sovereignty — perhaps even illegally so under existing law. Nonetheless, as an important first step toward a universal ‘covering framework’ it is imaginable that the elected leaders of California could and under the right conditions may well delegate and empower an agency (such as the proposed Climate Risk Council) to be responsible for periodically revising comprehensive adaptation guidelines to inform long-range development project planning and permitting decisions. The statute might go so far as to require that the agency consider the latest findings of the IPCC, though not be required automatically accept them. The agency could even be required to state cogently in its ultimate administrative rulemaking decision why it used some guidelines not entirely consistent with the IPCC scenario.

With the evolution and wide-spread adoption of a covering framework one can imagine how it would enhance the multiplicity of planning and processes oriented efforts on the ground, currently absent the kind of steering policy needed to guide and move adaptation decisions forward. It could and probably would also be viewed as a burden by those responsible for periodic updating the assessment of local effects resulting from each subsequent release of an IPCC intermediate scenario. This would seem to be a small price to pay, however, in view of improving the assessment of long term effects of climate change on projects and development and the long-term public good this would provide.

Finally, the IPCC scenario projections might be complemented by and/or at some future date substituted by an equivalent science-based and widely accepted climatological projection, vetted by the scientific community. This, however, is beyond the scope of our proposal.

Section 3: Motivating place-based and media-based adaptation

We also believe that as important it is to have a covering framework in place; it does not guarantee that actions on the ground will be taken or taken on a timely, cost-effective basis. Even more could be accomplished in practice, we believe, if incentive-based approaches were used to animate and motivate ‘voluntary’ adaptation. To this we now turn our attention.

Incentives policies as the key to near-term on-the-ground adaptation

As with many development and infrastructure activities, the more distant the benefit yet immediate the costs – for example with long term infrastructure projects designed

in anticipation of sea-level rise projections for 2050 or 2099 – the more difficult it is to persuade people to want to pay the upfront costs. There are situations, however, that it is just such upfront investments that are in the best interest of society in the long-run (intertemporally) and therefore should be pursued. We see as particularly problematic those situations where the benefits of taking longer-range adaptation action early and collectively, in anticipation of climate change effects, are seen as highly desirable though the benefits accrue largely to future generations. It is this category of activity that appears to be most difficult to embrace for the individual living in the present (as rational utility maximizes). The problem is exacerbated in a democratic political system where most voters appear unwilling to invest heavily in intertemporal collective goods over their near term needs and wants.

Anticipate today for investments tomorrow

In spite of an apparent congruence between local expenditures on adaptation and local benefits, there are larger structural barriers or failures in incentives for investments in adaptation. We now turn to consideration of the types of actors involved in formulating and implementing adaptation policies. We suggest that there is a middle-ground, a way forward imaginable in this context thorough contingent planning and a certain amount of decision making (i.e., commitments to specific strategies contingent on the evolving contingencies actually experienced). Establishing this approach in practice will be will not be easy. Its advantage, though, is that it will not involve anywhere near the high degree on intertemporal trade-offs that are encountered when thinking about mitigating the timing and intensity of temperature increases being projected for future decades.

Incentivize doing good while doing well

Some adaption activities can be undertaken by individuals or groups of individuals voluntarily, acting on their own initiative. Other adaptation activities will be best carried out as collective (public) activities. The latter require collective decision making, of course, and can encounter significant public opposition from those that do not see a benefit proportionate to what they are being asked to pay in the present rather than when the problem becomes more acute, or who disagree on the need to act at all or the response (activity) selected by policy makers.

A starting point in moving forward is recognition that by necessity there will be a large number of actors involved in adaptation actions. While linked to complexity, this consideration centers around all the individual measures that need to be taken, for example, in the case of sea rise in moving the built environment back from the shoreline, to raising houses above the new high water marks, to building sea walls around ports. This suggests several likely response patterns.

Private individual responses with low-levels of spillovers or free riding effects: This category of adaptive responses would include steps taken by individual private citizens to protect themselves and their property values. They would include such things as building your own sea wall or buying private insurance (and surely paying higher premiums to the extent the threats are widely recognized). When individuals make these choices, there will certainly be collective ramifications as there always are (e.g., greater supplies of adaptation measures will need to be supplied) and there will be problems if these collective ramifications are not anticipated and planned for appropriately, but the decisions themselves are usually choices that we want to respect and seek to satisfy as appropriate individual decisions. In other words, there are no overwhelming market failures (no large spillovers or free riding), and certainly nothing not already addressed by existing institutions (even though these institutions, like zoning institutions, may need to strain a bit harder). These adaptation measures will be totally decentralized: *caveat emptor*. As one example, Oakland Airport, which is located along the shoreline of the San Francisco Bay, has already begun designing a seawall around most of its property and anticipates retreating from some existing older, less valuable land. Presumably, the airport has working for it the economy of scale needed to self-adapt, including significantly independent revenue raising authority.

Private collective (community) responses with low-levels of spillover or free-riding effects: This response pattern is not markedly different from the first except that the private voluntary decisions are being made by groups of individuals (classic “club goods”⁷). The dividing line between a club and a government gets a bit murky, but certainly has something to do with the degree of coerciveness involved in membership and individual decision-making. For instance, wealthy communities typically have small numbers of actors with significant financial resources and may respond on their own (as has Balboa Island in Newport Bay), but this option isn’t available to most communities. Our default assumption, therefore, is that individuals will attempt to protect themselves but there will be an unwillingness to pay for other’s adaptation. Communities living in more elevated regions will have little incentive to pay for low-lying and coastal protection and vice versa. Given the likely under-provision of collective action in this context, one can imagine the growing failures of private decision-making and a need for some level of collective action.

The public policy implication in these first two contexts would seem to be to develop and disseminate to individual decision-makers better information about likely/possible dimensions of climate change (especially since developing and disseminating such information is a public good). Also, “upstream” institutions such as transportation and zoning laws should be “forced” somehow to consider this information in their scenario planning. Land-use regulatory institutions matter for these first two categories, but the nature of the individual decisions being made are assumed (by definition of these first two categories) to not escalate these questions to new heights already present in the

⁷ See Matthew Potoski and Aseem Prakash (2009).

absence of climate change. Also, we presume, a high political price will be paid requirements and rules are imposed on individuals designed to try to keep people from making a decision about their property that some elite thinks is “stupid”. If a person wants to do something that some elite thinks is stupid, it may simply come down to simply warning them against doing it, unless there are meaningful adverse spillovers on others.

Private or collective decisions plagued by significant spillovers or free riding: This category is intended to include all decision-making contexts that suffer from a significant “prisoners’ dilemma” effect in which individual privately “rational” decision-making leads to clearly sub-optimal collective results. Thus, in concept, there may be adaptive steps that individuals could take that would be better decided collectively because of their collective interactions. Thus, individuals might take adaptive steps that while affording themselves an extra degree of protection, actually increase the threat to others or increase the costs of others taking adaptive steps. An example of this is if one homeowner installs a sea barrier in front of his/her property, storm surges will flow around the walls and push additional water onto neighboring properties.

The likely implication is that there are two different kinds of regulatory “rules” that need to be considered in this category. First, rules that constrain individuals from doing things that serve their own interest but have negative spillovers on others. Second, rules that require individuals to undertake some action, or undertake it to a greater degree, because of its positive spillover effects on others.

Adaptive steps involving such scale economies that they virtually require centralized collective action: This category of adaptive responses includes such obvious candidates as extensive construction of geographically extensive sea walls. Sea walls have been proposed for San Francisco Bay that can protect 1000 miles of interior shoreline (Source). These could be possible for Newport Bay or San Diego Bay as well. Major additions to the state water canals, pumping facilities, and storage capacities, including the Sacramento Delta and the state water project which provides fifty percent of the water being transferred today from the northern to southern half of the state.

The main policy implication in this category is that existing institutions responsible for our large-scale infrastructure need to be confronting the potential climate change problem and at least developing planning scenarios for handling such things as higher storm surges. Note that there are missing institutions. For instance, to the extent that sea-level rises are likely, the appropriate response might well be the undertaking of one or more collective large-scale projects. However, there currently does not appear to be any large regional or statewide institutions authorized to undertake such projects.

This list of contexts and implications highlights the fact that libertarian arguments for purely market solutions to climate change are entirely unsatisfactory. At best they apply to the first two categories of action. Successful adaptation encompasses many public and large-scale club goods that cannot be provided by individuals or local communities.

The scale and level of the problem does not match the level of authority and decision making.

Section 4. Concluding thoughts

The question remains, granting a covering framework, place-specific needs and plans, and aligning incentives to encourage adaptation behavior, do these institutional designs and governing mechanisms adequately or sufficiently address/protect inter-generational interests of the sort implied by the scientific understanding of the potential substantial effects of climate change? Is more needed?

It was Garrett Hardin who proposed an ingeniously strategy for enabling utility maximizing individuals, to enact policies that would be beneficial to those living far into the future; those without any leverage or political power in the present. This is his often cited adage of “*mutual coercion, mutually agreed upon by the majority of those affected*”. Within existing democratic process people can vote to bind themselves to a commitment to future generations, and impose whatever the costs might be on themselves. Though, of course, the purpose would need to be compelling – he thought preserving the carrying capacity of the earth as we know it was one such purpose – and since most would nonetheless attempt to avoid paying the cost, carrying out the plan would require strong government regulation and enforcement, coercion of the state, if you will.

To say that people mutually agree to mutual coercion is not to say that they are required to enjoy it, or even to pretend to enjoy it. Who enjoys paying taxes, being restricted in their mobility or in their patterns of consumption, possibly even restricted in the number of off-spring they may bare? Yet people accept compulsory taxation in order to provide collective goods (and restrictions on individual behavior) because they recognize that voluntary taxation and restrictions would favor the conscienceless; those who see noncompliance as a personal gain and rationalize their noncontributing as being too little to make any difference. In effect, according to Hardin, people collectively institute and support taxation and other coercive policies as the only way to accomplish what they also agree is needed to maintain order and a civilized society.

Of course, achieving mutual coercion among contemporaries is difficult enough in a democratic society before considering the *equity and justice* considerations policy making in a democracy entails. In asking people to mutually agree to mutually coerce themselves for future generations, the problem is doubly difficult. It seems highly improbable without assurances in advance that some will not be asked to bear the burden while others allowed evading doing so. Absent a persuasive case that burdens and benefits will be shared justly among contemporaries, how can mutual coercion for posterity be mutually agreed upon?

It is unrealistic to ask for support for climate change or other long-term environmental concerns without first engaging in discussion of first principles, those of values and

ethical obligations to future generations. Absent a social compact, a consensus on this, it is extremely difficult to imagine how the transformational and costly policy to protect the earth and human society can be enacted and implemented; it is imperative first to establish the connection between the present generation and those who will follow – for posterity.

It is imperative to move beyond the historic human practice of current generations exercising their power for their own self-interest, oblivious or indifferent to, or absent a viable path forward in addressing the ramifications of anticipatable harms, some of potentially catastrophic proportion, that we are in the process of bequeathing posterity. What may have been ecologically, morally, and politically acceptable in a world of many million human inhabitants is no longer tolerable or admissible in one of seven billion people and their offspring. Climate change policy, if you will, is only the tip of the iceberg!

The absence of a political theory that addresses the needs of posterity (the intertemporal generations problem) and the failure to date of even the most ardent environmental theorists to move beyond intra-generational equity and justice, though we see Hardin as suggesting the direction in which this might take.

The absence of either formal (hierarchical) governing institutions or effective coordinating, monitoring, and enforcing horizontal world-wide organizations to either address ensure justice and equity in addressing the needs of adaptation.

Finally, adaptation is not a policy or merely a set of policies, but a top to bottom transformation of thinking and ever-evolving steps in making choices about long-term investments (individual to collective). As such, it requires both a top-down and bottom-up approach; a covering law focused on goals and a set of tools and approaches to address the myriad of actions and micro-policy choices that will be needed around the globe.

In short, the greatest need in governing adaptation are strategies for governing a societal transformation based on science of (the death of) stationarity, deep uncertainty, and an intergenerational ethic and how best to do so in the face of ethics, political processes, and human propensities that evolved in the prior epoch of human existence.

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