

Handbook of Global Environmental Politics, Second Edition

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14 Long-term environmental policy: definition–origin–response options

*Detlef F. Sprinz*¹

A government might, for instance, want to discourage building in areas prone to hurricanes. So it warns citizens that no compensation will be given for houses in such areas should disaster strike. If people believe the warning, they will not build. But if they expect (as history suggests they should) that the government is likely to soften its stance and pay for hurricane damage after all, they will ignore the warning. Before the fact, the government wants to stop building; afterwards, it wants to compensate those who have suffered. Mr Kydland and Mr Prescott refer to such conundrums as “time consistency problems.”²

It appears that we are surrounded by long-term policy problems. Public and private pension plans for the elderly are currently redesigned so as to close the gap between implicit and explicit entitlements given out in the past and the ability to actually honor those financial obligations; public debt sharply restricts the opportunities for politicians to enjoy the fruits of the pork barrel in countries such as Germany, Japan, France, or Italy even before the onset of the financial crisis in the early years of the twenty-first century. Public healthcare systems seem to be stretched in many industrialized countries; global climate change, if unabated, may lead to severe sea-level rise and subsequently dislocate substantial parts of the earth’s population that lives in proximity of the coastal areas. Could even the 2005 Hurricane Katrina point to the emergence of a long-term policy problem?

Sustainability, interdependence, globalization, and other terms have made a career by being imprecisely used. In the following sections, I first define long-term policy problems in general. Subsequently, I outline three explanations that shed more light on potential sources of long-term policy issues, followed by a discussion of policy options to cope with long-term environmental problems. Throughout this contribution, I shall draw on examples from the field of global environmental politics. I close with an agenda for future research on long-term environmental policy challenges.

Defining Long-term Policy Issues

Before elaborating the mechanisms that generate long-term public policy challenges, it is useful to define core terminology.

Long-term policy challenges will be defined as public policy issues that last at least one human generation, exhibit deep uncertainty exacerbated by the depth of time, and engender public goods aspects both at the stage of problem generation as well as at the response stage.

¹ The first and the last substantive sections of this chapter originate, largely verbatim, from my editorial contribution to the special issue of *Global Environmental Politics* on the theme of long-term environmental policy (Sprinz 2009a, “Long-Term Environmental Policy: Definition, Knowledge, Future Research,” *Global Environmental Politics* 9 (3), August 2009: 1–8, reprinted by permission of the publisher (MIT Press); and Sprinz 2009b. Select aspects of the sections in between have appeared earlier in highly condensed form (Sprinz 2008). For comments on an earlier draft, I am grateful to Jana Ollmann.

² “Cycles and Commitment,” *The Economist*, 14 October 2004. Available at http://economist.com/PrinterFriendly.cfm?Story_ID=3292902, accessed 09 June 2011.

First, a long-term problem exists only if the mechanism creating it leads to substantial adverse effects for at least a human generation of 25 years or if the remedy would take an equally substantial amount of time. Global biodiversity may offer us a potent example: if species of flora or fauna become extinct and have no functional proxies, both the species and the functions they fulfill for ecosystems could be lost forever. Even ambitious research and development efforts may find it difficult to create functional proxies, for instance by genetically modifying still existent organisms.

Second, deep uncertainty, “a situation where the system model and the input parameters to the system model are not known or widely agreed on by the stakeholders to the decision,”³ refers to the breadth of parameter values that we may contemplate. For example, there is considerable uncertainty regarding the price of carbon offsets under various choices of policy instruments, and we have no experience with accurately predicting the price of carbon offsets for a 50 percent emission reduction over the next half century or the value of any natural resource or ecosystem.

Third, public goods aspects of long-term policy problems relate both to the generation of long-term policy challenges as well as ways to respond to them. Quite often, long-term policy challenges are generated by externalizing some cost to the public, both contemporaneously as well as inter-temporally. For example, if historical carbon emissions already lead to uncompensated climate-related impacts today, then some past decision-makers will have benefitted, knowingly or unknowingly, from carbon releases at the expense of present generations. In addition, curbing future emissions is a public goods problem by itself in a mostly decentralized world. Those countries serving as leaders in international climate policy may not witness immediate benefits for themselves, and future benefits may be quite uncertain, thereby tempting only a small range of countries to venture into global public goods production – and others to free ride.

Overall, long-term policy problems pose a rather difficult class of challenges that are beyond the scope of single parliaments and political as well as bureaucratic tenures in office, and yet many have escaped comparative research so far.

Some environmental issues can be easily solved: water can be purified with considerable ease and often at affordable cost, species can be reintroduced if they are still existent somewhere (for example, seed banks or zoos), classical air pollutants can be filtered, severely polluting chemicals replaced by less toxic ones, and so on. Climate change, loss of biodiversity, depletion of the stratospheric ozone layer, and desertification are perhaps the most prominent examples of global environmental challenges. In the case of climate change, the multi-decadal release of emissions of greenhouse gases (principally carbon dioxide, methane, and nitrous oxides) are still effective long thereafter and alter the state of the atmosphere. A shift of most energy systems from substantial reliance on fossil fuels to renewable energies will easily take a human generation or longer. Various aspects of biodiversity are of an equal long-term nature, with species extinction representing the ultimate irreversibility.

Overall, long-term policy challenges are not unique to the environmental field, yet long-term environmental policy challenges are likely to stay with us for decades to come. As a consequence, they are likely to influence the long-term policy agenda, especially if voters become more aware of how central they are to their quality of life.

³ Lempert 2002, 7309.

Why Long-term Policy Issues Arise

Why do long-term problems arise? In essence, there are three major explanatory routes. First, the time inconsistency problem may loom and not allow for consistent policy-making over time; second, even if multiple generations are included in decision-making, a coalition of older generations and segments of younger generations may support intergenerational redistribution; and third, the distribution of risk and votes may be conducive to the rise of long-term policy issues. In the following, I shall briefly sketch these three perspectives and offer response options in the context of global environmental politics in the subsequent section.

In their seminal work on time inconsistency, Kydland and Prescott⁴ demonstrate that optimal choices at one point in time may be at odds with optimal choices taken at future points in time. Policies may be designed such that one policy rule is administered in the first period, for example, encouraging low inflation by way of wage restraint. However, at a later point in time, it may be the best policy to actually permit some degree of inflation so as to reduce short-term unemployment. More generally, governments are tempted to renege on earlier promises. “The suboptimality arises because there is no mechanism to induce future policymakers to take into consideration the effect of their policy, via the expectations mechanisms, upon current decisions of agents.”⁵

For example, if it is not forbidden to build houses in flood plains, people will build houses in such locations while anticipating that the government will ultimately build dams so as to protect them or compensate them for flood damages incurred. This example was actually mentioned by Kydland and Prescott in 1977 (!),⁶ well before Hurricane Katrina damaged New Orleans and surrounding areas. Expectations about future policies impact on current behavior. Thus, these problems resemble moral hazard problems with a long-term time dimension. It would have been preferable to forbid erecting housing in such areas and stick to the announced rule of no dams and no compensation. Had such an announcement been perceived as *credible*, no houses would have been built in risk-prone areas or only been built by risk-taking investors, and governments would have been saved from paying compensation.

A second perspective on why long-term policy challenges may arise originates from models of intergenerational redistribution. For example, Tabellini⁷ builds a simple two-generation model where the parent generation lives for two periods while the children generation only lives for one period, that is, they overlap for one period when they also take common decisions. While both generations receive initial endowments financed through government bonds, the parental generation also receives unequal amounts of non-storable output, and it can bequeath parts of its wealth to its offspring. By assumption, this transfer of wealth is only possible by way of government bonds, while both generations are taxed.

Since the parental generation commands a first-mover advantage, it can issue debts, but it faces the risk that the children’s generation reneges on repaying those bonds in the second period. In his model, Tabellini⁸ demonstrates that a coalition of parents and wealthy children supports the issuance of public debt, although this has intergenerational redistributive effects. The logic supporting the finding that wealthy children favor not to repudiate debt is that they would otherwise endanger their bequests. Furthermore, repayment of debt is broadly distributed

⁴ Kydland and Prescott 1977.

⁵ Kydland and Prescott 1977, 481.

⁶ Kydland and Prescott 1977, 477.

⁷ Tabellini 1991.

⁸ Tabellini 1991.

among the children's generation and thereby intragenerational redistribution occurs. For the findings to hold, the debt originally issued must be large enough and sufficiently widely spread so that a coalition of parents and children supports such a policy and does not renege on servicing the debts.

Applied to the environmental field of pollution, the parental generation may be interpreted as the generation that has built the industrial infrastructure that leads to negative environmental externalities which are subsequently passed on to the children's generation. Even if the children's generation might muster a majority against polluting infrastructures among itself, it is plausible that a coalition of large parts of the parental generation with the disproportionately benefitting members of the children's generation might muster a majority that does not allow for reasonably fast policy change. Furthermore, infrastructures are often built for long timeframes and are inherently difficult to replace.

A third perspective is offered by Stone⁹ who suggests that agent-specific risks are unequally distributed. Given the need for majoritarian support (for example, in first-past-the-post electoral systems) or *de facto* supermajority requirements in international institutions, public goods are suboptimally supplied. As a result of the skewed distribution of risks and votes, we are likely to witness suboptimal states of the environment, especially with global environmental problems.

In his writing, Stone himself offers climate change (besides international financial stability) as a superb example to illustrate his model. Much of the recent waves of climate impact research indicates (for example, by way of illustrative maps) the projected changes of droughts, harvests, species composition, ocean sea levels, and so on. These differences are often regionally explicit and vary considerably around the world. Once we combine (i) these differences in expected levels of climatic impacts with (ii) the absence of widespread support among the G20 of major countries and economies behind ambitious and implementable climate policy goals, it becomes apparent that we are witnessing an undersupply of protection against climate change. The protection of biodiversity offers similar perspectives due to the unequal distribution of biodiversity hotspots and the varying capacities and enthusiasm for the protection of biodiversity.

In summary, the time-inconsistency challenge, the intergenerational transfer of externalities, and the combination of unequal distribution of environmental risk in the face of (super)majority requirements for ambitious policies are three mechanisms that let us better understand why long-term environmental policy issues arise.

Response Options

Given the existence of long-term problems, it is beneficial to know from which menu of options policy-makers could make selections. This exploration comprises select response options, including:

1. the "sugar daddy" solution;
2. delegation;
3. transparency; and
4. liability.

⁹ Stone 2009.

Sugar Daddy Solution

Perhaps the most straightforward solution is to buy out the constituency that accounts for the problem. I shall coin this the “sugar daddy” solution¹⁰ in an allusion to proposals by the European Commission to compensate the European sugar beet industry for downsizing under conditions of falling prices on the world market for sugar cane. In this particular case, the adjustment is essentially financed by third parties, namely the taxpayers of the EU in return for lower consumer prices. In essence, an external financier who is capable of solving the long-term policy problem has to be found.

Is this a plausible solution in the environmental field? The global environmental governance system as well as multilateral and bilateral green aid add up to modest amounts¹¹ and are largely targeted to developing countries. Overall, it is unlikely that any of the major long-term environmental problems, such as biodiversity, climate change, or soil degradation, can be solved by third parties footing the bill – worldwide or for developing countries.

Delegation of Authority

The second response option has been foreshadowed by Kydland and Prescott¹² when they proposed the creation of political institutions that follow rules over time and which are detached from day-to-day political pressure:

The implication of our analysis is that policymakers should follow rules rather than have discretion. The reason that they should not have discretion is not that they are stupid or evil but, rather, that discretion implies selecting the decision which is best, given the current situation. Such behavior either results in consistent but suboptimal planning or in economic instability. ... There could be institutional arrangements which make it a difficult and time-consuming process to change the policy rules in all but emergency situations.¹³

The adherence to rules and its positive implications for government credibility had a substantial impact on the design of institutions for monetary policy, especially the rule-based expansion of monetary aggregates that many central banks adhere to following the 1970s period of stagflation. In the environmental field, the idea of an energy agency that manages carbon emissions and secures energy supply has been suggested.¹⁴ Such an agency should be governed by conservative carbon bankers in analogy to Rogoff’s “conservative central banker” in the monetary policy area.¹⁵

Credible commitment by independent institutions could also be useful for other air pollutants such as ozone-depleting substances that negatively impact the stratosphere, or for determining the number and types of fish that can be caught during a harvest period. Delegation of authority, however, does not seem easily applicable to issues such as the issue of biodiversity which simultaneously deals with securing the survival of species, whole landscapes, diversity of species, and so on. This can potentially be generalized to a range of environmental issues where a multitude of proximate causes rather than one class of proximate causes (for example, pollution emissions) are at work.

¹⁰ “Sugar Subsidies: Beet a Retreat,” *The Economist*, 23 June 2005. Available at http://www.economist.com/printedition/PrinterFriendly.cfm?Story_ID=4112150, accessed 09 June 2011.

¹¹ Najam et al. 2006; and Hicks et al. 2010, ch. 2.

¹² Kydland and Prescott 1977.

¹³ Kydland and Prescott 1977, 477–87.

¹⁴ Helm et al. 2003.

¹⁵ Rogoff 1985.

In general, wherever the credible pursuit of just one rule or the non-conflicting pursuit of multiple rules leads in the desired direction, the delegation of authority to independent institutions and decision-makers can increase the credibility of commitment to long-term environmental policies.

Transparency

Environmental reporting on the international scale has become both more prevalent and more regular during the past decades. Regular reporting is a major tool to enhance transparency by providing information to broader audiences that are thereby enabled to hold decision-makers inside and outside of governments accountable for their (in)activity.¹⁶ While governments often commission national environmental reports, companies increasingly create their own (sometimes multinational) environmental and corporate social responsibility reports. Furthermore, a range of network-based reporting initiatives have flourished.¹⁷ Climate change even became the topic of a major report by Transparency International.¹⁸ Of more direct relevance to the issue of long-term environmental policy are environmental reports by supranational and international organizations that cover broader sets of countries or the world at large.

In general, these reporting activities cover the state of the environment, explain the causal mechanisms behind longer-term past trajectories as well as provide an outlook into the future and may offer select guidance on how to cope with pertinent environmental challenges. In the following, two such regular initiatives will be summarized, namely those by the United Nations Environment Programme (UNEP) and the European Environment Agency (EEA).

Over the past one-and-a-half decades, UNEP has produced four Global Environment Outlooks (GEOs) which have covered both the environmental regions and major classical environmental themes. The latest incarnation, Global Environment Outlook 4,¹⁹ uses a traditional classification by environmental media (atmosphere, land, water, and biodiversity) as well as crosscutting sections on vulnerability (worldwide maps), and governance issues. In the pursuit of integrated assessments, GEO is supported by a data portal.

In comparison to the global mission of UNEP, the EEA is tasked to harmonize and lead the European-wide work of environmental agencies of EU member countries as well as those of Iceland, Liechtenstein, Norway, Switzerland, Turkey, and potential future West Balkan members. Much of its work rests on standardized procedures for data and their European-wide evaluation through the shared environmental information system as well as related data centers. Every five years, the EEA is tasked to provide a synoptic overview of its environmental reporting by way of its “State and Outlook” reports. Much like UNEP’s GEO reports, it reviews the state of environmental media, yet in much finer thematic resolution. It is supported by a range of supplementary reports, an overview of the “megatrends” which drive global environmental change, and select country reports.²⁰

Both reporting activities are time- and resource-intensive undertakings that aspire to provide a data-based grand overview of the state of the environment for their respective geographic coverage (with the EEA supporting the European regional component of GEO), and they shed

¹⁶ Gupta 2010b.

¹⁷ For a recent overview, see Gupta 2010a.

¹⁸ Transparency International 2011.

¹⁹ UNEP 2007.

²⁰ EEA 2010.

light on potential policy priorities. These reporting activities may be the best we have at this point in time, yet they also seem to be suffering from lack of simpler metrics of transparency. For example, the field of inter-temporal public liabilities, a measure of the net indebtedness of public authorities (in terms of net public debts and the costs of the modern welfare state over the next century) has generated easy-to-communicate aggregate results that policy-makers may consider in preparing their policies in view of mounting public financial obligations.²¹ Would an environmental decision-maker, looking at the plethora of data and graphs across the various environmental media and potentially crosscutting themes, gain a succinct overview of the state of the environment, past achievements, and the (finite) priorities to be tackled in the future? Relevant indices have to be developed in order to provide decision-makers with a succinct overview, a dashboard on where we stand, as well as benchmarks for “perfect” policy performance in order to allow for policy evaluation. Such indices and benchmarks would facilitate communication with broader audiences as well as create a foundation for the non-arbitrary derivation of policy priorities to manage long-term environmental challenges.

Compensation

It is astonishing to see the difference in liability and accountability that chief executives of private firms face as compared to political decision-makers. Politicians and bureaucrats essentially face only the threat of not being reelected or not being re-appointed. Private sector CEOs have to fear being sued for civil damages (implying a threat to their private wealth) and being subject to criminal law and imprisonment. For example, recklessly sending a private company into bankruptcy normally constitutes grounds for exploring personal liability of private sector CEOs. Until now, politicians rarely face such threats in advanced industrial societies, although the scope of their decisions may easily trounce those of the private sector. This could lead politicians to be more risk taking than they would be in the case of more adequate rules of liability.²²

Liability for public decisions of an intergenerational nature has at least been considered in a US court case of environmental nongovernmental organizations (NGOs) against the Overseas Private Investment Corporation and the Export–Import Bank. At issue are those decisions of both entities that have climate impacts on US cities. By 2009, both banks have agreed in a court settlement to take climate concern into account in their future decisions. To provide insurance against the effects of earthquakes, the California Earthquake Authority has built a publicly backed private insurance system that allows for homeowners to insure against damages that are likely to occur over longer time intervals in earthquake-prone areas. To avoid undue moral hazard, policy holders must normally accept a 10 to 15 percent deductible.

Long-term environmental impacts will occur. A specific form of “insurance” could be the creation of structured compensation funds for damages not avoided. In the areas of transboundary nuclear impacts as well as oil spills from tankers, compensation systems have been created, and the market for compensating oil spills is frequently used.²³ Generalizing on work with Steffen von Büнау in the area of climate change,²⁴ let me suggest a fourfold architecture:

²¹ Raffelhüschen 2002, 84, 86.

²² Sprinz 2005.

²³ A detailed perspective is offered by Sprinz and von Büнау 2011.

²⁴ Sprinz and von Büнау 2011.

1. Derivation of an ambitious benchmark (for example, no exceedance of the 2°C change in global mean temperature for global climate change since the onset of industrialization; halting the loss of species in the field of biodiversity);
2. a court-like adjudication procedure that links causes with effects (for example, greenhouse gas emissions with climatic impacts, habitat fragmentation with lack of sustainable reproduction);
3. a simple formula that links responsibility with contributions to a compensation fund (for example, share of emissions determines share of compensation in the area of climate change; fixed shares to hosts of biodiversity of ultimate proceeds from access to genetic resources of biodiversity under the Nagoya Protocol²⁵); and
4. an actor or group of actors which initially endows the compensation fund (for example, a major green donor country, or an environmental NGO, or an environmentally concerned industry group).

While any such structured compensation systems raise the issue of unilateralism, credibility, and generalizability, they offer a constructive alternative to appearing empty-handed later on in the absence of building up a compensation fund.

In conclusion, I have considered four possible solutions to design institutions to deal with long-term environmental problems. In particular, the sugar daddy solution, delegation of authority to independent institutions, transparency, and compensation have been briefly considered. The broader set of possible response options and the invention of completely new options ought to be the privilege of further research.

An Agenda for Research

Given the early stage of research on long-term environmental policy, I suggest three overarching questions which would greatly benefit from sustained research due to their generic character, namely (i) how to overcome the time-inconsistency problem in practical political life, (ii) whether democracies and decentralized political systems can successfully pursue long-term environmental policies, and (iii) institutional design options to prevent and recover from undesirable long-term policy outcomes.

First, the *time-inconsistency* problem relates to the choice of optimal rules at time t_0 to actual rule adherence at t_1 when political circumstances might have changed and rule adherence at t_1 might not be optimal for decision-makers at that point in time. The possibility of this happening creates incentives to doubt the rule's credibility at time t_0 . For example, Europe wished to halt biodiversity loss by 2010 although many of the biodiversity hotspots are located outside the EU. It is all too easy to criticize a political actor for holding on to ambitious goals and yet it is also sometimes too easy to promulgate ambitious political goals whose impact can only be evaluated far in the future. While the work by Kydland and Prescott provided the academic rationale for the creation of independent central banks, it is unlikely that a forceful World Environment Organization will materialize in the near future. Thus, we are left with multilateral governance. While the world has harnessed new insights from the solution to the domestic time inconsistency problem, the equivalent of Kydland and Prescott's solution at the decentralized international level remains an open challenge. Building decentralized and

²⁵ Secretariat of the Convention on Biological Diversity 2011.

voluntary compensation systems for damages or for the maintenance of environmental quality is merely a first step in this direction.

Second, it is often doubted that *democracies* can pursue long-term policies due to the structured length of terms of the legislative, executive, and judicial branches.²⁶ Moreover, decentralization of authority, as is typical with global environmental issues, may pose additional challenges to governance. The former aspect refers to electoral terms in office. Political or legal careers in high office rarely last multiple decades. Winston Churchill's career as a democratic leader may be an exception, yet it perhaps provides some clues as to why he could survive *and* return to office. He often held principled policy positions, accepted to be out of office when such positions did not garner sufficient support, and was returned to office when such positions became attractive to the (s)electorate. Churchill opposed the Munich agreement of 1938 when many, such as Neville Chamberlain, thought that "peace for our time" was secured. In turn, he was a credible choice of democratic leader to withstand the German onslaught on Britain during World War II. The same dual clocks of relatively short-term electoral cycles (Churchill was voted out of office during the Potsdam conference of 1945) and long-term policy goals (withstand Germany during World War II) should be simultaneously modeled to see under which conditions time-limited democratic governments can survive and which characteristics their leadership personnel would have to offer to successfully pursue long-term policies.

Furthermore, how can political systems with *decentralized political authority* pursue ambitious long-term environmental problems? The German federal constitution (Grundgesetz), for example, grants authority for protecting nature to the *Länder* (states) such that the German federal government may face implementation hurdles at the level of EU directives on nature protection issues. Conversely, around 20 major countries including the EU are needed for any long-term international strategy on climate change to have an appreciable impact. It therefore remains an open question how grander political designs, if any, can reconcile decentralized political authority with the successful pursuit of long-term environmental challenges, given the time inconsistency challenge mentioned above and the domestic and international political challenges discussed elsewhere.²⁷

Third, long-term environmental issues may engender a quest for *institutional response options* to prevent unwanted outcomes or to recover from such outcomes after prevention has failed. The term "prevention" refers to the avoidance of an unwanted outcome. By contrast, "recovery" refers to having already reached the unwanted outcome, followed by subsequent attempts to substantially improve the state of the environment. This may include aiming for a return to a more desirable status quo ante.

Preventing biodiversity loss is, in the extreme, an impossible goal to pursue. We simply have no complete inventory of all species. We may lose species even without knowing that they ever existed. Nevertheless, halting the loss of biodiversity espouses some conceptual clarity: prevent losing a good (material and immaterial). The suggestion for the creation of "conservation systems"²⁸ presents a forward-looking perspective. The required characteristics for conservation systems to be successful are demanding. Can we derive a finite, relatively small set of design principles that allows us to move a desirable state of a specific environmental object (landscape,

²⁶ See also Sprinz and Aklin 2011 for a discussion and empirical results on the long-term effect of democracy on per capita carbon emissions.

²⁷ Hovi et al. 2009.

²⁸ Steinberg 2009.

river shed, or species) through an infinite “time tunnel”? Do design principles vary by spatial or temporal resolution?

A range of coastal and high seas fishing grounds have been overfished during the second half of the twentieth century, particularly in the North Atlantic, and serve as a good example of the recovery perspective which may take decades or longer. The focus of research ought to be directed toward how long-term sustainable yields and rich abundance in species can be substantially improved from an undesirably low level. Scholarly interest should be directed to institutional design options which might combine, for example, solutions to the time-inconsistency problem with solutions to the decentralization challenge in authority for open-sea fisheries.

Climate change can be seen as a combination of prevention and recovery modes. Article 2 of the United Nations Framework Convention on Climate Change explicitly directs member countries to “prevent dangerous anthropogenic interference with the climate system” (UNFCCC, Article 2). The Copenhagen and Cancun agreements of 2009 and 2010 lend credibility to the 2°C goal as a representation of the ultimate objective of global climate policy. Unfortunately, we are unlikely to prevent severely overshooting this goal given current emission reduction policies around the world. Moreover, we have to consider the recovery challenge. While there is plenty of research on both mitigation (prevention) and adaptation (akin to recovery) to climate change, the appropriate mix between both and the reciprocal strategic impact between them remains an open question for research.

The list of research challenges outlined above is suggestive, yet certainly not exhaustive. Finding convincing answers would undoubtedly advance our knowledge on how to manage long-term environmental challenges more wisely for present and future generations alike. X PRIZES have been created to establish whether private business can build spacecrafts that fly 100 km above the earth (prize awarded) and whether extremely fuel-efficient cars with more than 100 miles per gallon gasoline equivalent can be built (prize awarded). These large prizes intend to create entrepreneurship to pursue goals with potentially widespread benefits to the public. Perhaps some of the research questions outlined above on the management of long-term environmental issues are worth an X PRIZE themselves?

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