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Hard and soft paths for climate change adaptation

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Amory Lovins' distinction between 'soft' and 'hard' paths of energy technologies is applied, *mutatis mutandis*, to humanity's efforts to adapt to climate change. It is argued that hard adaptive measures involve capital-intensive, large, complex, inflexible technology and infrastructure, whereas soft adaptive measures prioritize natural capital, community control, simplicity and appropriateness. The prevalence of these two types of adaptation pathways is illustrated through two case studies from the Maldives: The Safer Island Development Program and the Integrating Climate Change Risks Program. Policymakers must be aware that hard and soft adaptation measures may trade off with each other, and give both paths due consideration.

Keywords: adaptation paths; climate policy; development paths; low carbon society; Maldives

La distinction faite par Amory Lovins entre trajectoires « douces » et « dures » pour les technologies d'énergie est appliquée, *mutatis mutandis*, aux efforts humains à s'adapter au changement climatique. Il est postulé que des mesures dures d'adaptation impliquent des technologies intenses en capitaux, larges, complexes, rigides, alors que les mesures d'adaptation douces priorisent le capital naturel, le contrôle communautaire, la simplicité, et la justesse. La prévalence de ces deux types de trajectoires d'adaptation est illustrée à l'aide de deux cas d'études aux Maldives, le Programme de développement pour des îles plus sûres « *Safer Island Development Program* » et le Programme intégrant les risques du changement climatique « *Integrating Climate Change Risks Program* ». Les décideurs politiques doivent être vigilants quant à la possibilité de compromis entre mesures douces et dures d'adaptation, et dans le degré approprié d'attention à porter aux deux trajectoires.

Mots clés : capacité d'adaptation; élévation du niveau de la mer; Maldives; resilience; trajectoires d'adaptation

1. Hard and soft energy paths

Writing during the energy crises of the 1970s, Amory Lovins (1976–1977, 1978, 1979a, 1979b) famously identified 'hard' and 'soft' paths for energy production and use. He argued that the dominant energy strategy for the US and other industrialized countries was 'strength through exhaustion', that is, expanding the supplies of energy to meet the extrapolated demands of a dynamic economy. Lovins termed this strategy the 'hard path', which treats energy demand as homogeneous – as aggregated numbers representing total energy in a given year. It also relies on large, mammoth, centralized fossil-fuel and nuclear facilities to meet energy demand. Lovins noted that the hard path

- depends on non-renewable resources such as coal, uranium, oil and natural gas,
- is poorly matched in scale and quality to energy end-uses,
- is complex and cannot be understood by any single person,
- lacks resilience, so failures affect the entire system, and
- has proven incapable of adapting to sudden changes in energy demand.

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He argued that the hard path suffers from a number of problems. For example, large electricity generators cannot be mass-produced, and their centralization requires costly transmission and distribution systems. They are inefficient and do not recycle excess thermal energy. They are much less reliable and take longer to build than smaller installations, exposing hard path technologies to escalated interest costs, mistimed demand forecasts and wage pressure by unions.

In contrast, Lovins proposed what he termed the 'soft path', promoting energy technologies that are

- diverse, providing energy in smaller quantities, from decentralized sources,
- renewable, operating on non-depletable fuels,
- simple, or relatively easy to understand,
- modular, or matched in scale to energy needs, and
- qualitative, or matched in energy quality to end-use needs.

Lovins claims the soft path is inherently more democratic, flexible and appropriate than its larger and more expensive hard path counterpart.

Lovins argued that the true contest between the hard and soft paths is less to do with the technologies involved, and more about the way that policymakers, planners and system builders *think* about energy. For example, one can conceivably integrate a series of solar panels on the cooling tower of a large nuclear facility, thus combining a technology of the soft path with the hard. However, he believed that the two approaches are 'culturally incompatible', because 'each path entails a certain evolution of social values and perceptions that makes the other kind of world harder to imagine' (Lovins, 1979b:12). Herman Daly (1979) added that he thought the choice between the hard and soft paths relied on different orders of thinking – much like the difference between chess and checkers. The soft path recognizes both permanence and ecological discipline as guiding principles. The hard path prioritizes resource extraction and profit-making. Daly further mused that a good move in the checkers of the hard path is not usually a wise one in the chess of the soft path.

2. Hard and soft climate adaptation paths

The distinction between hard and soft energy paths is applied here, *mutatis mutandis*, to measures that promote adaptation to climate change. A hard adaptation path might

- rely predominately on artificial human-built infrastructure,
- involve large-scale disturbances to local communities and/or ecosystems,
- be complex and capital-intensive,
- use technologies and/or processes owned by foreign firms, and
- lack flexibility and adaptability to sudden changes in projections of climate change.

Although this path would bring communities and ecosystems into line with the needs and priorities of adaptation schemes, it would be expensive, relatively rigid and dependent on large technological systems. For example, upgrading building stock could enable structures to better handle flooding or changes in temperature. Because buildings can last for hundreds of years, they could 'lock in' patterns of development and growth around them and condition the behaviour of their occupants (Hassler, 2009; Cole et al., 2010).

In contrast, a soft adaptation path might involve

- forms of natural infrastructure or natural capital, such as ecosystems and forests, together with low-impact technology,
- empowering local communities, and building institutional capacity and community assets,
- simple and modular technologies, relatively easy to understand, that do not require large outlays of capital or human resources,
- technologies and/or processes owned by local people, and
- the ability to respond to alterations in climate change projections.

This path would be less expensive, relatively flexible, and would involve small-scale decentralized adaptation measures. It would also bring adaptation needs and priorities in line with the needs of communities and the natural environment. Owing to their scale, soft paths are similar to 'community-based adaptation' schemes that operate at the local level, rely on participatory processes of stakeholder inclusion and build on existing cultural norms to address local development concerns. Such schemes are designed to address the 'locally and contextually specified nature of climate change' by incorporating community-based and indigenous knowledge into 'locally appropriate' adaptation projects (Ayers and Forsyth, 2009).

3. The Maldives: hard and soft paths in tension

Some of the differences between hard and soft adaptive paths can be observed in the Maldives, as both strategies have been used there. Many geological and economic factors that put the Maldives at grave risk to the impacts of climate change include changes in sea level, precipitation, sea surface temperature, storm activity, swell waves and ocean acidification. The geographic and geophysical traits of the Maldives (its small size, low elevation, narrow width and dispersed nature of its coral islands and reefs) make the country susceptible to rain- and ocean-induced flooding. About half the human settlements in the country are within 100m of the shoreline, as well as almost three-quarters (70%) of the critical infrastructure, including airports, power plants, landfills and fisheries (UNDP, 2007). Khan and colleagues (2002) note that the Maldives is the 'flattest country on earth' and 'extremely vulnerable' to climate change, to the extent that 85% of its geographic area could be under water by 2100. As the Global Environment Facility summarized, 'no settlement on the Maldives is entirely safe from the predicted impacts of climate change' (GEF, 2009:3). The Maldivian government has therefore prioritized adaptation efforts over the mitigation of greenhouse gas emissions, although the particular form of these adaptation efforts differs markedly.

3.1. The Safer Island Development Program

The past decade has seen the Maldivian government support the idea of 'safer islands' through the 'Safer Island Development Program' (SIDP), the basic goal of which is to identify islands with favourable geophysical and economic characteristics and make them more resilient to climate change. (Such islands have also been called 'focused islands' or 'primary islands'.) The SIDP strategy has been to identify and populate a range of islands that could act as 'safe havens' for people forced to migrate before or after climate change-induced natural disasters. It has been heavily funded and backed by the Seventh National Development Plan, one of whose targets is to develop and demarcate 10 safer islands.

The SIDP exhibits many features of the hard path. Its government sponsors have promoted the use of human-built infrastructure, such as sea walls and desalination plants, to cope with rising sea levels and saltwater intrusion into freshwater supplies. This has involved widespread disturbances to human communities and natural ecosystems. Coastal protection measures under the SIDP, such as dredging to create sandbars or erecting seawalls, have unintentionally reduced the flow of nutrients to coral reefs, weakening a natural shield against storm swells and surges. Coastal communities have also removed vegetation to make way for the expansion of ports and harbours to improve the efficiency of transport corridors, and mined sand for use in construction, but this has only increased the exposure of the Maldives to flooding and tidal inundation (UNDP, 2007).

SIDP projects are also capital-intensive, complicated and large in scale. One aspect of the SIDP encompasses building artificial islands (sometimes called 'designer islands'). Hulhumalé in Malé Atoll, intended to act partly as a home for climate refugees, was reclaimed from the sea by converting a natural coral reef and lagoon into a 2km^2 city. Sand ridges were repeatedly levelled during land reclamation. The dredging took five years and cost $32 million to complete (to say nothing of the expense of building and populating the island). Dhuvaafaru Island in Raa Atoll was also unveiled in March 2009. Formerly an uninhabited forest, the entire 40 hectare island was raised and a new village built for the 4,000 survivors from Kandholhudhoo, an island destroyed by the 2004 tsunami, at a cost of more than $40 million (Vince, 2009). In addition, although not technically part of the SIDP, the sea wall around Malé cost a sobering $54 million to erect. Sea walls similar to it, as planned by the SIDP, would therefore cost approximately $12.4 million per kilometre.

The SIDP has not been able to respond to unexpected variabilities, and has degraded some forms of community resilience. Already, the island drainage systems installed under the programme cannot withstand heavier amounts of rainfall, and cannot cope with more severe storms. Other land-use modifications have lowered ecosystem resilience and accelerated coastal erosion and accretion. One recent study of the social and economic vulnerability of 10 Maldivian islands has noted that the structure of economic activity had little diversification, with basic sectors composed of fishing, manufacturing, trade in wholesale products, agriculture and tourism (UNDP, 2009). On every island, at least one of these economic sectors was deemed to be vulnerable, and in most, four or five were. The United Nations Development Program (UNDP) cautioned that 'all establishments', from hospitals and homes to power plants and parking lots, were still at 'significant risk during a flooding event'.

3.2. Integrating Climate Change Risks Program

The Maldivian government has also initiated a programme called 'Integrating Climate Change Risks into Resilient Island Planning' (ICCR), which exemplifies the soft path. The US$9.3 million project, begun in 2010 and backed by the government, UNDP and the Global Environment Facility, has offered funding for the assessment and prioritization of four demonstration islands:

- Kulhudufushi: resilience is to be bolstered through the replenishment of natural ridges, coastal afforestation and 'climate-proofing' of the island drainage system;
- Thinadhoo: coral ridges are to be restored and vegetation planted along the shoreline; water storage tanks and drains are to be repaired and refurbished to withstand flooding and sea swells;
- Thulusdhoo: new coral reefs are to be propagated to repair breaches in its coral sea wall; and
- Kudhahuvadhoo: mangroves are to be planted and beach nourishment activities are to increase the capacity of the island to handle flooding and storm swells.

In contrast with the SIDP, these ICCR projects integrate a suite of natural, small-scale, low-impact technologies and practices. Instead of using man-made sea walls or tetrapods to counteract rising sea levels, the ICCR programme relies on mangrove afforestation, thickening of coastal vegetation and beach nourishment. Instead of desalinating water to deal with water shortages, it uses larger catchment areas for rainwater and elevated water storage tanks. Instead of reclaiming land to deal with tidal inundation, it uses dune replenishment. And instead of erecting artificial designer islands, the ICCR programme promotes coral propagation around existing islands, all at a fraction of the scale and cost of the SIDP.

Rather than committing funds primarily towards hard infrastructure, the ICCR programme also aims to build capacity among policymakers and communities. Nationally, the ICCR programme will coordinate government work on climate policy so that information across various ministries is consolidated. At the provincial and atoll level, the ICCR programme works with planners to enable them to better identify and respond to climate risks and vulnerabilities. It also decentralizes adaptation investment planning so that each island decides what to spend its own budget on, therefore creating an incentive for islands to 'pick best value for the money' so that they have resources left to improve community welfare in other ways. It also augments community awareness about proper investments based on risk, so that communities can stop putting resources and investments into technologies that are either too expensive or (even worse) counterproductive.

This integration of soft measures ensures that a range of technologies and practices are utilized to fight climate change rather than a 'one-size-fits-all' model. It builds institutional resilience by training government stakeholders, consolidating climate-related data and funding demonstration projects. It enhances community resilience by incorporating indigenous knowledge and input about local island topography into climate planning, and increases their understanding of climate risks and the appropriate responses to them.

4. Discussion

If climate adaptation measures include both hard and soft attributes, then, like energy technologies, a few conclusions emerge.

First, the choice between hard and soft paths may require different orders of thinking and involve different types of risk. Two distinctions arise, one between deciding whether to promote artificial or natural infrastructure, another about the control and direction of adaptation efforts. Is adaption best accomplished by large-scale, built infrastructure, or smaller-scale, environmentally and socially sensitive technology? Should adaptation efforts, indeed the importance of strengthening adaptive capacity, take priority over community preferences and the vitality of natural ecosystems? Or should the relationship be inverted? Clearly these types of questions have no easy answers.

Second, hard and soft adaptation paths may be mutually exclusive. The two paths may be culturally incompatible in that one might involve elite experts embracing complex technology and, in the other, local communities employing simpler devices. They may be institutionally incompatible, requiring organizations and policy actions that inhibit each other. They may be logistically incompatible, needing money, materials, work, skills, political attention, time and commitment in a world of finite and limited resources. They may be physically incompatible, in that many investments in the hard path will mark the landscape with capital-intensive projects that narrow future choice. The intellectual, financial and institutional resources required for the hard adaptation path may limit the efficacy of the soft adaptation path, and vice versa. Given these possibilities, it remains unlikely that planners and policymakers will effectively embrace both paths at once.

However, hard and soft adaptation paths may also be complementary. For example, building a seawall makes sense if it protects a densely populated urban area, while relying on beach nourishment or dune replenishment may produce more effective results in less dense rural areas. It may be more cost-effective for city planners that have already invested in capital-intensive urban infrastructure (such as roads or sewage networks) to upgrade and maintain these systems rather than transition to softer measures. A massive hydroelectric dam might be the only way to protect one large city from flooding, while coastal afforestation might work best for another.

The sequence of adaptation interventions also matters; softer paths could be tried at smaller scales, initially only to be supplemented with harder measures should they fail. The same goes for scaling up programmes: even soft path measures, done on a national or international level, will require some elements of the hard path (e.g. centralization and human-built technology). The recent Nobel Laureate Elinor Ostrom (2009, 2010) has argued that polycentric interventions are in fact needed that blend local and national scales of action with regional and global ones to address climate change; see Sovacool (2011) for the application of Ostrom's ideas to energy policy and planning. Given this, soft and hard adaptation paths could work most effectively when elements of each are mixed together. According to this logic, optimal adaptation policy involves finding synergies between hard and soft measures.

Third, soft and hard adaptation measures appease different interests. Wilbanks and colleagues (2007) have noted how climate change mitigation interventions have different timeframes, scales and benefits compared to adaptation interventions. They have shown that adaptation benefits stay largely within a community, whereas mitigation benefits are distributed globally, meaning they tend to be promoted by different sets of stakeholders and create differing configurations of winners and losers. Similarly, stakeholders may push (and benefit from) different adaptation paths. For example, developed countries, their development institutions and elites may advocate hard paths that benefit their economy by creating export markets or distributing intellectual property, or accrue economic rents directly to them. Some planners might be tempted by the scale and sophistication of hard adaptation measures, believing that the bigger and more expensive the technology, the more people benefit. There is also an element of hubris involved: some may take comfort in the belief that humanity can engineer itself out of the climate problem using advanced technology rather than the 'primitive' or 'regressive' indigenous methods that in some cases involve nature and no technology at all. Ayers and Forsyth (2009) have noted that most international donors, for example, seem predisposed towards adaptation efforts that have been 'proven' to work in the western world. If this is the case, such donors may unintentionally discount local knowledge and input, demonstrating bias against the soft path.

The international community and existing local institutions may advocate soft measures that distribute their benefits to targeted populations, for example to rural farmers, indigenous people, the poor or other vulnerable groups. In the Maldives, soft and hard adaptation paths are seen together, perhaps because almost everyone there accepts that the country is seriously at risk from climate change. It is, of course, a challenge for policymakers to decide whose interests they appease and which path they pursue, guided by a rigorous analysis of winners and losers.

This is not to say that soft adaptation measures are always better or more cost-effective than hard measures, just that they might remain undervalued in discussions of climate policy. No simple formula for building adaptive capacity exists, and aspects of both paths may be necessary depending on the circumstances at hand. In a world of limited resources, however, policymakers must be aware that hard and soft adaptation measures may trade off with each other, and therefore weigh the costs and benefits of each carefully.

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