Co-Evolution Toward Sustainable Development:
Neither Smart Technologies nor Heroic Choices

by

Ralf Gregor Brand, Dipl. Geogr.

Dissertation
Presented to the Faculty of the Graduate School of
The University of Texas at Austin
in Partial Fulfillment
of the Requirements
for the Degree of

Doctor of Philosophy

The University of Texas at Austin

May, 2003

Pages 1-6

Chapter 2: The "Nature" of the Problem

2.1 THE TECHNOLOGY-ORIENTED APPROACH

2.1.1 General Assumptions

Advocates of the technology approach to sustainable development usually do not put much trust in the likelihood that individuals will do what they should or refrain from doing what they should not do—with "should" being defined by sustainability experts or politicians. They rather trust in technology because it can, in the technophilic's view, take care of many unsustainabilities and because it is always obedient to its designer. Therefore, they argue that the solution lies in a large-scale, qualitatively different industrial revolution focusing on eco-efficiency, high-tech ingenuity, and market forces (L. Winner, personal communication 03-07-2002). This view is the sequel to the young Lewis Mumford's hope that technology would lead to "improvements in environmental, social, and economic spheres" (according to Ebersole, 1995, ¶ 2). Concrete manifestations of this optimism range from incrementally improved resource efficiency of existing technologies such as high-mileage cars and co-generation power plants, to radical technological innovations such as hydrogen-fueled cars and nuclear fusion. The University of Texas at Austin is itself involved in a wide array of activities in this vein—including genetic engineering, energetics of industrial processes, and Supercritical Water Oxidation[6]—and its Energy Conservation Task Force dealt exclusively with the technological aspects of its mission.[7] Guy and Shove term this strategy the "techno-economic paradigm" (2000, p. 55), which Rohracher and Ornetzeder also describe with reference to architecture:

> Most dominant is a technical strategy which focuses on the use of environmentally friendly materials, thermal insulation of buildings, energy

---

[6] "An ingenious process that uses high temperature and high pressure to turn hazardous wastes into harmless substances (water and carbon dioxide)" (Center for Energy and Environmental Resources, 2002, ¶ SCWO).

[7] I had the privilege to observe this in person as an official student member of this task force.

> efficient heating and lighting, balanced ventilation systems, etc. Architects, planners and energy experts often hold the opinion, that this strategy is the most favorable one. (2002, p. 73)

2.1.2 Three Main Strands

A closer look at the technology-oriented spectrum reveals three main strands of thought. Representatives of the first recommend the installation of high-efficiency technologies that perform their salutary work regardless of the attention or reaction of individuals. The efficacy of the second strand, in contrast, is built upon a supposedly automatic "cooperation" of the people because technologies leave no non-cooperative alternatives. Activists of the third strand employ more subtle strategies, aiming to develop "really" attractive technologies, which are then marketed to an intelligent public.

Making user cooperation obsolete

Advocates of the first strand of the technology-oriented approach purport that the right technologies will take care of what experts perceive as problems, while they can "leave the others to their erratic behavior" (Latour, 1992, p. 230). Pfaffenberger mentions modern photocopy machines, which automatically reset themselves to make one copy after an interval of nonuse, as a telling example of this strategy (1992, section "Technological Regularization"). Rohracher and Ornetzeder provide an example from their discipline, green architecture, to explicate the logic of this approach. The technical strategy, they expound, "improves [the building's] environmental performance without … needing the cooperation of users after the technology has been implemented" (2002, p. 73). This account aptly presents the core idea of this strand of the technology-oriented approach, that is, to change the supply side of the sustainability equation. Proponents of this idea believe that the "right" technology and infrastructure has to be developed by engineers[8] and provided by the market so that people, that is, the demand-side, can retain their normal behavior and still avoid unsustainable outcomes. Their motto is "Pleasure

---

[8] U.S. President George W. Bush pursues this approach, as can be extrapolated from a statement in his State of the Union Address on January 28, 2003. In this speech Bush expressed his belief that "in this century, the greatest environmental progress will come about … through technology and innovation."

without sorrow"[9] (Steger, 1995, ¶ 12), because a change of individuals' lifestyles would not only be impractical but also unnecessary. Wischermann argues along these lines that "the reduction of resource use, as far as it is the result of the application of technologies, does not impose a certain way of living on humans" (2002, section 2). For most ecologically inclined engineers, this is the favored ideal, which is why they develop ever-more sophisticated technologies to eliminate any compromise to torque and horsepower as they design more fuel-efficient cars (see Berlin Snell, 2002, p. 42). Von Weizsäcker, A. Lovins and H. Lovins aspire to push the envelope even further in their seminal book *Factor Four—Doubling Wealth, Halving Resource Use* (1997). The appeal of this slogan lies in its promise that reductions in consumption are not only avoidable but that additional amenities are possible on the path to sustainability. The technology-oriented approach is, in other words, about "having your cake and eating it, too."

Sustainability experts who pursue this approach share a fascination with delegation, regardless of whether or not they use this expression. Latour defines this term as the "transformation of a major effort into a minor one" (1992, p. 229). He uses a door-closing device as a telling illustration of this phenomenon:

> When people don't automatically close the door after they have used it, sometimes a human groom is hired who closes the door, or engineers invent technical solutions like mechanical grooms who close the door. In both cases, the closing of the door is displaced, translated, delegated, shifted to a groom. (1992, p. 229)

Delegation in Pfaffenberger's sense is "a technical feature of an artifact [that] is deliberately designed to make up for presumed moral deficiencies in its users" (1992, section "Technological Regularization"). This idea assumes that it is possible to arrange major technological improvements behind the scenes so that people do not have to change their behavior.

Many examples, some of which are presented below, demonstrate the limitations of this approach. One interpretation of Gourna, a small town in Egypt designed by architect Hassan Fathy more than 50 years ago, contains such an example. The buildings in Gourna provided many canny amenities through their bioregionally adapted design.

[9] This and all following translations from Flemish and German to English are my own unless stated otherwise.

Some of the techniques applied by Fathy included "vaulted roofs punctured by small openings to direct and cool the prevailing winds, courtyards to give each owner a 'private piece of sky,' crooked streets to emphasize the intimacy of houses, [and] communal wells to invite neighborly chats" (Sachs, 2000, ¶ 1). However, the "residents have plugged up the wind catches, drastically increasing the indoor temperature in summer and lowering it in winter. They have covered the courtyards, blocking out the sky. They have crammed concrete into the windows [explaining that] 'We wanted something modern'" (Ibid., ¶ 5-6). The above example shows how people willingly pay for the subversion of well-intended technologies with reduced convenience because something else is more important to them.[10]

In other cases, individuals attempt to increase their comfort by modifying technology. A corresponding example has been conveyed to me by a student at the University of Texas at Austin who altered the air conditioning system in his research laboratory with pizza cartons and duck tape. He had moved his desk away from the place where it was anticipated to be by the designer of the air conditioning ducts. The new location was in the middle of the cold airflow so that our protagonist constructed a detour for the cold air with said material ("A. Kuhn," personal communication 10-11-2002). The same logic of subversion explains how people who live in automatically ventilated high-efficiency houses wish "to have windows slightly open in the sleeping room even in winter [although] ventilation experts contend that such habits are irrational and the effect that would make people sleep well was the low CO_2 concentration and not cold air" (Rohracher & Ornetzeder, 2002, p. 79).

Cases like these may prompt the conclusion that "humans are—to put it bluntly—too stupid, too selfish, and too neurotic to make wise judgments" (Cornish, 1999, p. 11). I argue, however, that a major part of the problem rests with the impossibility of separating the main effect of a given technology from its side effects or side meanings, which often

[10] I am grateful to B. Parmenter who suggested an alternative interpretation of this case. In her view, Gourna fell victim to a patronizing and politically motivated re-settlement campaign. The effect was that the tenants "would not [have been] be very amenable to the project no matter what the architectural approach was" (B. Parmenter, email correspondence 04-18-2003). I therefore limit the purpose of my, and not necessarily more correct, interpretation to a mere demonstration of what delegation could be and especially of how users can subvert the designers' brilliant ideas.

cannot be anticipated by the designer. Consider a scenario in which we wake up one day and find hydrogen-fueled engines under every car hood. We would still have to update our repair skills and fueling frequency, and we would have to switch from our familiar car mechanic to a different repair shop. A telling example in this context is the failed attempt to replace traditional fireplaces in Africa with more wood-efficient hearths that would direct heat better to cooking pots by encasing the fire. The main argument against this novelty was that the new fireplaces cooled and darkened the area around the hearth, which made it less pleasant to gather around. The creator of a technology usually focuses exclusively on one main purpose, whereas the users who are exposed to the technology over long periods must arrange their lives around all its effects in order to exploit the pleasant ones and to avoid those that are unpleasant. In light of the aforementioned accounts, I would argue that it is impossible to introduce new technologies that leave users completely unaffected. Hence, it is unrealistic to expect new technologies to perform the sustainability job behind the scenes while people continue doing whatever they did previous to the introduction of the innovation.

Enforcing behavior changes through prescription

Even a low-tech solution such as a mechanical door closer presupposes specific behavior from its users in certain situations. Plumbers carrying a long pipe or travelers carting their luggage through a mechanical door probably experienced this implication if the door closed too quickly. In response, they might have learned to move more quickly through the door. This "behavior imposed *back* onto the human by non-human delegates" is what Latour (after Akrich) calls prescription (1992, p. 232). Some designers of technologies make deliberate use of this mechanism, encouraging specific changes of behavior through prescriptive techniques. Their products make erratic behavior impossible (domination) or make people want to do what they ought to do—in the designers' view of course (temptation). An example of the former category is the engine that does not ignite unless the driver is buckled up (see Latour, 1992, p. 232). The latter strategy is employed, for example, in the design of Victorian children's furniture which "was specifically designed with rigidly straight backs to prevent children from 'acquiring a habit of leaning forward, or stooping'" (Forty, cited in Pfaffenberger, 1992, section

Figure 2.1, Le Corbusier's Plan Voisin for Paris. Le Corbusier, from Urbanisme (Paris, 1922).

"Technological Regularization"). The same idea, translated to the design of buildings, is "architectural determinism, the belief that architecture controls social relations or behavior" (Ingersoll, 1996, p. 122). Similarly, urban form determinism is what Thomas More envisioned for Utopia, Gottfried Feder for the "New City" in Nazi Germany,[11] Le Corbusier for Paris (see Figure 2.1), and Robert Moses for the beaches of Long Island. Moses is said to have constructed the bridges from New York to Long Island intentionally low in order to keep public buses and their typical users, low-income blacks, away from the beaches (Winner, 1980). Although Joerges (1999) has unmasked this case as an urban myth, it serves well as an exemplar of this school of thought, which considers

[11] Feder was Nazi commissioner for settlements and designed "Die Neue Stadt" (the New City) of 20,000 inhabitants as a blueprint for the ideal German settlement. One of his arguments was that people in non-metropolitan areas tend to have more children, which is crucial for the growth of the German race. I am

technology—whether at the scale of a mechanical device or urban infrastructure—the "ideology of the 'one best way'" (Postrel, 1998, p. 16).

In this view of progress, only an elite, the experts, are endowed with knowledge about the one best solution, which makes them understandably disinclined to tedious democratic decision finding processes. This position may result from impatience, from a pragmatic interest in job security or from disciplinary solipsism.[12] Regardless of the motivation behind this expertocratic logic, it always has a "totalitarian tendency of positivist utopianism" (Bisk, 2002, p. 24), which explains why Ingersoll rejects it as an "anathema to the ideals of the liberal city" (1996, p. 122).[13] Sometimes, Benthamite utilitarians might argue, the means are legitimized by the end—for example, when the goal is sustainable development. Barber (1984) calls this disposition liberal-realism, which is characterized by suppression of conflict for the benefit of the maximally effective provision of common goods. In this conceptual perspective, wise leaders skip the messy discourse of democracy in order to get those things done that have to be done. This position is actually not uncommon among "environmentalists, [who] expect enlightened dictators to bite the bullet of technological reform … if a greedy populace shirks its duty" (Feenberg, 1995b, p. 12). Moore (2002) identifies the well-reputed sustainable model city of Curitiba, Brazil, as an exemplar of this disposition, which raises the question whether liberal-realism is an advisable general strategy toward sustainability. The answer Moore derives from his scrutiny of the political mechanisms in Curitiba is a very cautious skepticism. He argues that the long-term appropriation of the undemocratically developed technologies and infrastructure by Curitiba's citizenry is not at all guaranteed. Even more questionable is the adaptability of the Curitiba model to new social or technological developments on the local and the global scale, an indispensable criterion for sustainability. The users of technologies and infrastructures have many ways to disapprove of such well-intended projects; be it on election ballots or—to come back

grateful to Bromley and Schenk (2002), who brought this manifestation of urban form determinism to my attention.

[12] This is not to say that advocates of the behavior-oriented approach are immune to such interest-laden rationalizations or disciplinary chauvinism.

[13] Lovins calls such a system "friendly fascism—a managed society which rules by a faceless and widely dispersed complex of warfare-welfare-industrial-communications-police bureaucracies with a technocratic ideology" (1979, p. 58).

to the above example of Victorian children's furniture—at the dinner table. A defiant child, for instance, could easily bear the inconvenience of sitting "wrongly" on the "right" chair, at least for the crucial hour when guests are visiting. In short, people can "easily 'subvert' the designer's 'agency' inscribed into the artifact" (S. Moore, personal communication 12-17-2002). These arguments reveal that the prescriptive approach not only suffers from insufficient democratic legitimization but also from insufficient (long-term) success.

Developing and marketing attractive technologies

I have so far described two manifestations of the technology-oriented approach to sustainability. First, the idea to install the "right" technologies behind people's backs, thus requiring neither behavior changes nor abdication of convenience and fun. Second, the attempt to impose technologies that prescribe certain actions onto the users by leaving no other choice than to behave 'properly.' A third and probably the prevailing manifestation tries to avoid the subvertability and the lack of democracy of the preceding approaches by giving users the choice whether or not to use new technologies. Its proponents strive to design technologies that are presumably attractive enough, in terms of expense, convenience and/or pleasure, to be employed voluntarily by the average citizen while simultaneously yielding some common good. Solar collectors, for example, help preserve resources (the public good) and also help users save money (individual interest). If the perceived individual benefit is too marginal, perhaps because of too long a payback period, the diffusion strategy is likely to fail because the number of people willing to make heroic choices for the sake of common goods is clearly limited. In market language, many "good" technologies "remain economically unrealistic on a large scale" (Ingersoll, 1996, p. 122). Ironically, this is the result of the deliberately built-in democratic touch within this third strategy: Individuals retain a choice whether or not to make use of the technology.

Assuming that a given technological solution serves the private interest better than its competitors, shouldn't it be taken for granted that people will discover this advantage and choose accordingly? Empirical evidence disenchants this expectation, thus supporting Guy and Shove's conclusion that "the business of getting the 'message' of science through to practice is far from easy" (2000, p. 52). This must be a blow to the optimism of idealistic modernists with respect to their belief in human ingenuity and the teleological nature of discoveries,[14] which they work to transform into universally applicable technologies. If their products fail on the market despite their 'objective' attractiveness, their explanation tends to be that "'some actors' (i.e. scientists) 'know the truth about a problem', while 'other actors' (i.e. non-scientists) 'do not and obstruct the solution in different ways'" (Hillmo cited in Guy & Shove, 2000, p. 63). A more blunt explanation for the turbulent path from the design workshop to the household states "that end users' ignorance is at the root of the problem" (Guy & Shove, 2000, p. 61). How else can it be explained that something as simple as insulation, with its fantastic amortization performance, is so infrequently installed in homes in the UK? (Ibid.). Construction companies there report that potential house buyers "are not interested [in extra insulation] because they can't see it" (Ibid., p. 106). A seemingly logical lesson from these examples suggests that "individual decision-makers [do not opt for] informed rational action" (Ibid., p. 64).

The self-evident solution to this problem is to educate and to persuade people. This is the juncture in which social scientists come in to "evaluat[e]… promotional techniques and [to] undertak[e]… surveys of people's attitudes in order to inform advertising campaigns" (Guy & Shove, 2000, p. 64). This role is described by Guy and Shove, sociologists themselves, as " 'end-of-pipe' social science" (p. 71). Those who accept this role tacitly subdue their professional role in hurrying obedience to the reign of the technological paradigm, thus missing out on the opportunity to question its dominance in the first place.

But even if people are well informed and well persuaded, there are further problems, which are not their fault. One of these obstructions is the distortion of the free market through subsidies favoring unsustainable practices such as the burning of fossil fuels. This problem has long been unmasked, which is why most national sustainability plans aim at reducing these subsidies, at least on paper. Moreover, even if market distortions are not the problem, the market itself can emerge as an obstacle to the

[14] Teleological in the sense of completing the proper path of science (see Moore, 2001, p. 13).

implementation of the "best" technology. This is because the market, not the engineer's lab, is the place where the "best" technology is determined. Schwartz Cowan provides a convincing example of this phenomenon in *How the Refrigerator Got its Hum* (1985). She demonstrates how, in the early 20th Century, the electric refrigerator was pushed to market victory over its gas-driven competitor despite its lack of compelling technical advantages. A major explanatory factor in this business success story is the alliance forged between the producers of electric refrigerators with the electricity utility companies, who had a vested interest in selling electricity. Their combined financial power permitted a more aggressive marketing campaign for the electric refrigerator than the producers of gas-powered refrigerators could afford. In this holistic and more realistic view, the humming, electric refrigerator proved to be better, or fitter, in this particular market and socio-economic environment.

Further deliberations illuminate that neither people's ignorance nor market mechanisms alone should be held accountable for the insufficient success of the attractive-technologies approach. It is simply hard to provide technologies that are attractive enough with respect to the complex constellations of individuals' legitimate priorities. Most people do not like technologies that are noisy, that require initial training or regular maintenance, that are aesthetically displeasing, or of course that are expensive. If technologies are made cheap through economies of scale, many people do not like them either because their design, targeted for the average user, does not account for the "diversity of human practice" (Guy & Shove, 2000, p. 15). Why, then, should they buy something that would make them feel patronized by a supposedly wise engineer? Rohracher and Ornetzeder refer to this symptom as "perceived restrictions on user autonomy" (2002, p. 78).[15] I understand the patronization argument quite well as I type these lines under the critical eyes of the auto-correction feature of my word processing software. only with some effort is it possible not to begin a new sentence with a capital letter, thanks to the possibility to suppress this feature using the "customize" tab. Designers of office buildings utilize the same logic when they allow users to control the

[15] "Prescriptive technologies" are often subverted for this reason after they have been installed. Technologies that may or may not be purchased by users are often ruled out before they are installed (i.e. bought). The difficulty is, however, the same.

room temperature with a moderately hidden knob, as is the case in a certain department of the University of Texas at Austin.[16] Yet, the room temperature is set too low for the skirt-dressed administrative assistants because the dean is supposed to wear a jacket and he does not want to sweat. Consequently, the low-level employees find their remedy in individual space heaters, even while outside temperatures reach 104 degrees ("E. Johnson," personal communication 10-10-2002). This example shows again how the legitimate complexity of priorities can obstruct the recommended application of seemingly attractive technologies.

2.1.3 Additional Problems

Besides and beyond the shortcomings of the technology-oriented approach described above, there are more critical points to consider, the Rebound Effect being one of them. Radermacher uses this term to describe the "subsequent erosion of the positive potential of technological innovation by increases in population size and overall activities, and the concomitant increase in consumption of material and energy" (1999, ¶ "Abstract"). In other words, the rebound effect "overcompensates for the original technological progress" (Radermacher, 1999, ¶ 5; See also Steger, 1995). A well-known example of this phenomenon is the catalytic converter, whose positive effect per mile driven has already been nullified by the absolute increase in the number of cars (Roth & Altwegg, 2001, p. 13) and by the environmental problems caused by the platinum mining industry. The mathematics behind the rebound effect is governed by the logarithmic law of growth: An increase in efficiency by 100 % is consumed by a 3 % annual growth within 24 years.[17] Increased efficiency is sometimes even used—or abused—as financial or moral justification for consuming larger quantities of a given product that has just been made more resource-efficient.

---

[16] The UT employees in fact are lucky if a manipulation of the thermostat actually changes the office climate. After all, it seems more common than one would fear that technicians who are "fed up with complaints from sweaty men and shivering women … install dummy thermostats to give workers the illusion of control" (Sandberg, 2003, ¶ 4).

[17] X = Resources used per unit of service   D = Services performed per year (e.g. miles driven)   t = Years
Scenario A, non-growth and non-efficiency: Total resources used = $X \cdot D \cdot t$
Scenario B, 3% growth and high-efficiency: Total resources used = $X/2 \cdot D(1.03)^t \cdot t$
When is $X \cdot D \cdot t = X/2 \cdot D(1.03)^t \cdot t$?   Answer: t = 23.45   (Calculation by L. Omberg)

The strategy to make more efficient use of scarce resources has another built-in problem; it does not tackle non-resource-related problems. An example would be a hydrogen-fueled car, which cannot prevent noise, accidents, sprawl or "asphalt deserts." In addition, the list of drawbacks of the technology-oriented approach to sustainable development cannot be concluded without a reference to the risk potential of some technologies. Nuclear energy is certainly the most notorious example in this context—for a good reason. Its capability to reduce the amount of carbon dioxide emitted per kilowatt-hour almost magically in a remote "machina sapiens" (Rybczynski, cited in Ebersole, 1995, ¶ 2) is certainly tempting to sustainability-inclined technocrats. But the related imposition of risks to people is only rarely democratically legitimized. Similar arguments are made by technophobic authors against, among other things, genetically altered organisms and nanotechnology. Even if the threat of these technologies is "irrational," merely perceived, and not "true," as their advocates claim, such strategies might not be sustained politically if voters elect governments that promise to phase out such technologies—as was the case for nuclear energy in Germany in 1998. And the more sophisticated and opaque technologies get, the more eerie they are perceived by voters. Therefore, the issue of risk has not only a philosophical component, as concluded in Jonas' technology-weary *Imperative of Responsibility* (1984), but also a very pragmatic one.

2.1.4 Wrapping It Up

This critical but hopefully fair assessment of the three strands of the technology-oriented approach to sustainable development is quite sobering. Attempts to secretly improve the gears in the black box usually do not go completely unnoticed or they change side effects of existing technologies, which individuals have learned to exploit. In reaction, people often look for ways to subvert or modify new technologies. A typical counter-reaction of technology designers is to built prescriptions into their products, that is, mechanisms that leave no other choice for users but to behave in a certain way. As I have tried to demonstrate, this approach is not only undemocratic but often, at least in the long run, not very successful. Common reasons for failures of the prescription strategy lie in the capability of people to find even more sophisticated ways to alter technologies, in their willingness to put up with the negative consequences of 'improper' behavior, or in the inability of static, imposed technologies to adapt to external changes. The third strand of the technology-oriented approach tries to avoid the shortcomings of the other two but runs into the well-known problem of seeming user ignorance. Attempts to educate people and to market new technologies to them might alleviate this problem but the obstacles of market distortions and vested interests among established market players still must be overcome. In addition, such attempts fail to account for the complexity of people's priorities, which in many cases are quite legitimate.

In light of these grave obstacles, advocates of this approach are invited to acknowledge that their efforts to produce the right technologies have not brought us much closer to a sustainable society. Even the World Business Council for Sustainable Development states, "technology enables change but cannot be the sole driver of innovation" (Brown, Green, Hall, Rocchi, Rutter, Dearing, 2000, p. 11). With respect to urban planning, I conclude, in agreement with Pezzoli, that "reaching an appropriate urban-ecological balance is not a purely technical issue" (1998, p. 346).

2.2 THE BEHAVIOR-ORIENTED APPROACH

The full title of the behavior-oriented approach to sustainable development should carry the addendum "without technology." The reason being that a change of behavior is often attempted through the usage of prescriptive technologies (see section 2.1). The proponents of the approach to sustainability that I describe in this section, however, pursue a change of behavior per se. [18]

2.2.1 General Assumptions

The "behavior-oriented approach without technology" targets the demand-side, commonly referred to as the people, the consumers, or the users, as the part of the equation that needs to be changed in order to reach the balance known as sustainability. This change calls for a reduction of consumption through lifestyle adaptations, that is, for sufficiency. This term implies a deliberate refutation of the technophilic dogma of

Pages 19-247