

How Many 'Amorys' Does It Take to Save the World?

**GBN WorldView Meeting
Aspen, Colorado
March 29-31, 1992**

By Hardin Tibbs

Aspen sits in a storybook valley reminiscent of the Alps, surrounded by sparkling ski slopes which drop almost literally into its modestly-sized but not-so-modestly-priced shopping district. This proximity is probably appropriate for the playground of capitalism. The town, which seems surprisingly small given its reputation, has that feeling of mountain clarity that lifts the spirits even before the serious business of recreation begins.

For non-skiers, and for those who have not seen the slopes in years, current advanced ski technology is remarkable. Its most obvious manifestation is the expensively-creaking footwear of skiers striding around town in multiple-component machine-like plastic ski-boots that resemble slick future space-gear from Star Wars.

This combination of refined, minimalist high technology, unspoiled nature valued economically for its intrinsic attributes, and people engaging in an intensely enjoyable activity requiring skill and focused involvement, is quite possibly a glimpse into the character of the sustainable future that GBN members met in Aspen this March to discuss.

To further amplify the effect, a contingent of some 16 GBNers from the San Francisco Bay Area, both staff and members, spouses and children, traveled to Aspen by train, a trip that took a little over 24 hours, but that allowed long relaxed conversations and spectacular off-highway views of desert and mountain scenery that look much tamer from 35,000 feet. This too was possibly a paradigm of travel in a sustainable future, although we trust that by then the food will be more sustainable also.

For some, the first order of business on Sunday was to hit the slopes, while a smaller group of Network members gathered at the Hotel Jerome at lunch time for a candid critique of GBN's 1991 Scenario Book. One recommendation (coincidentally?) was that GBN's next scenario book might include a detailed sustainable future, possibly written in the form of a normative scenario.

On Sunday afternoon, the entire meeting contingent boarded a bus to visit what is quite consciously an island from a sustainable future: the Rocky Mountain Institute (RMI). Located in Snowmass, several miles down the valley from Aspen, it was established by Amory and Hunter Lovins in 1982 "as a working example of resource efficiency and renewable energy in harmony with people and the environment."

Amory gave a fascinating and eye-opening tour of the main building with a highly detailed technical commentary laced with his trademark word-efficient wit. The building is packed with energy- and resource-saving technologies, from its krypton-filled low-E Heat Mirror™ windows that offer four times the insulation of triple glazing (while the rest of us are still feeling virtuous about double glazing), and its occupancy-sensing compact fluorescent lighting, to its ultra low-water toilets and showers, and its solar-heated hot tub (this is Aspen, after all). Although very low-energy (the house actually sells its off-peak solar electricity back into the grid) and not obviously bristling with high-tech, the house is very sophisticated conceptually, and is dense with passive applied physics and biology (it has its own internal ecosystem in a semi-tropical food-producing "bioshelter" complete with ladybird (ladybug) predators). All the intrepid would-be owner

needs is a user-friendly interface. Nevertheless, it was hard not to conclude that we were indeed glimpsing the logic of homes to come. At the very least it is an impressive “scenario concrète.”

On Monday morning the WorldView meeting proper convened at the Hotel Jerome, a modest-looking red brick building with a faintly wild western flavor from the outside, but somewhat unsteady pretensions to grandeur on the inside. We met in a large brocaded ballroom where Donella Meadows, Amory Lovins and Lee Schipper regaled us with cautionary tales of the sustainable future.

Peter Schwartz opened the meeting by asking four questions that he felt were needed to understand the meaning and implications of *Beyond the Limits*:

- Does this model tell us anything about the real world?
- If we “buy” the model—how much time do we have? A few decades or a century?
- What is the nature of the challenge—do we have to change the basic premises of our industrial civilization, or do we simply have to be much more efficient?
- Does the response have to be conscious or will it be unconscious? Can policy makers respond in a coherent, intelligent, thoughtful and farsighted way on a global basis? Or will the individual responses of billions of people around the world push the system towards greater efficiency?

Donella Meadows presented a resume of the six “structural systemic points” from her new book, *Beyond the Limits*. These were: 1) the facts of growth; 2) that we are indeed “beyond the limits”; 3) that systems can easily “over-

shoot;” 4) the possibility of collapse; 5) how to prevent collapse by moving to sustainability, and 6) “love.” Since her book has been distributed through the GBN Book Club, I will not report her presentation in detail here, but will simply highlight certain details that struck me as coming across with more force from what she said than from a reading of her book.

She began her presentation by comparing actual global growth rates over the last 20 years with the forecasts in *Limits to Growth*. The data were, as she said, “sobering and interesting.” World population is up from under 3 billion to over 5 billion. World industrial production as a whole has almost doubled. World fertilizer consumption has grown exponentially. Rising atmospheric carbon dioxide almost spookily tracking a 1972 climatologist’s projection. Growth actually has been exponential. There has been a rough doubling of the physical presence of the human race on the planet. Moreover, as she pointed out, if there are no structural changes, or catastrophes, the system is geared for another doubling between now and 2010. Which means, “essentially another whole human world put down on top of the current one.”

As physical stocks grow, they create a standing demand for throughput. And it is the rate of throughput that puts current activity “beyond the limits.” As a result, biological stocks are all falling, essential resource stocks are falling. “I want to be very clear what the limit is, it’s a throughput limit, a rate limit, a speed limit—we are taking things faster than they can regenerate, and we’re putting things out faster than they can be absorbed. From what we know about where the breakdown points come—for some of them we know, for fish, for forests,

we have a pretty good idea—we have at most another 10, 20, 30 years, at which point we won't be able to take any more at all."

There are four possible ways an exponentially growing quantity can come to terms with its carrying capacity. Exponential growth forever can only happen on an infinite planet. A pure sigmoid growth pattern requires instant and accurate signals with instant and accurate reactions—like a bacterium living in its own waste. If the response time to signals is of the same order as the doubling time of the growth, there is a danger of dramatic overshoot. If growth has a 10 year doubling time, and the signal is delayed by ten years, then growth will be twice beyond its limit. There was, for example, a 13 year delay before the Montreal Protocol on CFCs was signed, in the face of a CFC doubling time of 20 years. There are "pipeline" delays, for instance it can take years for toxins to show up in groundwater supplies, before signals even appear. Existing installed capital itself is a form of delay. And when overshoot occurs, if resources are erodable, collapse will follow.

The good news is that the inefficiencies are so monumentally wasteful, that the throughput could be reduced considerably without "destroying the hopes of the poor or reducing the comforts of the rich. Twenty years ago we wouldn't have said we were beyond the limits, and we wouldn't have said we could have efficiencies of factors of two or three, or even of five or ten, that we have now. All of that has been learned both with better data about the planet, and with better technologies."

What was perhaps most interesting, and challenging, was Donella's critique of the values

driving industrial growth. Growth, she explained, is exponential not only because of the phenomenon of self-reproduction, but because the industrial value system celebrates and rewards exponential growth. We think of economic growth as percent per year. Technologies are employed through this value system to create physical growth. At the same time, we neglect values that could use growth to good effect. Poverty is the primary factor behind exponential population growth, and it is not being eliminated on a worldwide basis. Food production has doubled or even tripled, while per capita production has remained flat or declined. So as throughput has doubled or tripled, with collateral resource consumption and damage to the environment, the human condition has not been improving.

There is an ongoing debate in the UN leading up to the Earth Summit in Brazil as to who is responsible for planetary damage, the rich people who are doing much of the consuming and polluting, or the poor people who are doing most of the reproducing. "From a systems point of view," Donella said, "this is a totally sterile argument, the answer is both, and furthermore they interact and reinforce each other. It would be better if everyone took responsibility."

The solution, she suggested, is a "sustainability revolution." Systems come from a shared mindset, and we need a mindset revolution. When paradigms change, behavior follows. Under the impact of future growth we are already committed to, we will have to make a new world, so why not make it the one we want. What we need is a society that knows how to call on the goodness of its people. This is a moral issue. If we believe that we are

good, we need to act on what is good in us.

Donella recalled the reluctance her publisher had felt at including her chapter on “love.” Their attitude was, “we agree, but we can’t say it, it’s too embarrassing.” But, she said, we need to have the courage to act on this in us, not on fear or short-term greed. She had not originally intended to include this in the book, but it just seemed to be “what she had to do.” (In answer to a later question outside the meeting, she said she felt that somehow times had changed and that it was now possible to talk directly about these issues of value.)

In a conversation after the meeting she pointed out that although increased efficiency in the use of resources was very necessary, it alone would not solve the underlying problem. If it merely allowed us to do more of what we have already been doing, and more rapaciously, matters would simply be made worse. It occurs to me that a switch to an efficiency mindset might itself imply a change in values—perhaps this is why it is so hard to take these apparently simple steps. In the same conversation, she suggested that the “good” always gives the best systems outcomes. Perhaps we should think of morals as being the most parsimonious instruction set for operating the world.

The picture she succeeds in creating is of an intricate and extraordinary worldwide machine that is leaping into existence on timescales that almost defy imagination. We are indeed living at a time that, by every objective measure, is truly unprecedented. The question raised is, how should we interpret this? Should we react with apprehension, at this apparent picture of a world out of control and heading fast for apocalypse? On the other hand should we

consider this extraordinary phenomenon as being a controlled process of emergent human biological potentiality, that, however unnerving it may seem, is essentially under control, and will turn out all right? My guess is that it’s a bit of both. We need to be keenly aware that the potential exists for a collapse, through information of the type Donella is supplying, in order to act appropriately so that we will in fact be able to “shoot the rapids” to a global society of high promise. In other words, the world may be bountiful, but only if we take the right actions, and these are the signals on which we need to act. A tall order, perhaps, as meeting participants lost no time in pointing out.

Peter Schwartz asked about the dilemma of redistribution: we want to raise the living standards of the poor, but we are asking the rich to cut back. Donella replied with the familiar adage about teaching people how to fish, rather than giving them fish. We need, she said, total super-creative rethinking about how to end poverty—through a human relationship with the poor, not through an institution; about the nature of work and leisure; and about meeting non-material needs non-materially. This reminded me nicely of Jesus’ response about rendering unto Caesar what was Caesar’s—which I suppose it was meant to. The poor need growth, the rich do not, but the rich still have unmet needs for status, meaning and love, which they are trying to meet materially. We need people, she said, who can teach us about these things, and there are many such people. If Donella is right in her identification of values as the pivotal issue, perhaps what we need most is a revolution in attitude to a spirit of cooperativeness. This has always been true, so one is forced to ask what

could make it more likely to actually happen today. A possible answer is the combination of global-scale potentially terminal problems, combined with global awareness through communications media, and a unique technical knowledge of what is needed for a system-level win-win solution. The current situation provides both the tools and the challenge to "focus the mind wonderfully" better than at any prior point in history.

Both Donella and Peter Warshall, consulting ecologist to Biosphere II, referred to the clear, but poorly understood, relationship between poverty and population growth. The North, particularly the former "First World," sees the equation as "population causes poverty," which at some level of analysis indeed it does. The problem for us in such a superficial appraisal is that there is no political means of taking down overpopulation which is not dangerously repressive, eco-fascist. None of us should want this kind of new world order. But in the South, the former "Third World," the equation is seen more fundamentally as "poverty causes population." This is a more operational understanding, because for those who have nothing, children are "assets, hope, wealth." If even one of your children escapes to the city and gets a job, those earnings will be enough to feed the whole family. Such an outlook is indeed true in the short-term view in which the poor are often trapped, but in the longer run it can be disastrous. More effective than simply birth control, then, is the promise of improved economic conditions, for this is the most eloquent persuader that more children are not needed. Thus we begin to see the first glimmerings of a truly win-win solution for all of us: an all-out effort to facilitate world-wide economic improvement, using Amory Lovins-style tech-

nologies that have a minimal environmental footprint (more about this later). The North wants new products with global markets, and this is their opportunity, even if they have to divert former defense dollars to do it.

Arguably, we should not be afraid about overpopulation per se, but only of our own failure to rise to its challenges.

Anders Wijkman, director of Swedish Society for the Conservation of Nature, asked if there were absolute population growth limits for sustainability. Today three times more couples and women want birth control advice than in 1972, when only 10 percent wanted it. Today the number is nearer 50 percent. But what about the problem of leadership—corrupt Southern governments that cannot be trusted? Donella replied that the Swedish Government calculation that only 600 million to 800 million people could live on Earth could be increased under the most efficient lifestyle. Dutch Government assessment of pollution flows pointed to an 85-95 percent reduction to get within pollution limits, which implied no more physical growth. Other countries could determine their own numbers. China, for instance, had estimated 800 million, but in fact had 2 billion. But isn't this kind of number a very dangerous number, asked Peter Schwartz, for a government to calculate?

As to the problem of corrupt Southern governments, said Donella, governments come and go. You swing your effort and attention and take opportunities while they are available. For example, she had helped to rewrite antiquated Portuguese water laws during the 24 month window of a really good government.

John Rozsa of the California Energy Commission objected that the book gave a materialistic analysis of the world, and a spiritual remedy, but lacked a discussion of human processes. The concept of wealth used was physical, whereas wealth is really a combination of resources and ideas. “Over time,” he said, “what we have found is that we are using less resources and more ideas—and there is no limit on ideas, so there is no limit on wealth and growth.” Donella agreed, but wanted to replace the term growth with development using the distinction defined by Herman Daly. There was, she agreed, no dollar limit on wealth, the problem was throughput. Would an example be Van Gogh’s *Iris* selling for \$60million, asked Peter Schwartz? Yes, agreed Donella, because it doesn’t require much throughput, maybe just an air-conditioning system.

Irving Mintzer, senior research fellow at the Center for Global Change, University of Maryland, commended the benefits of Donella’s systematic approach, since it got away from Washington’s tendency to deal with problems on an isolated basis—CFCs this week, global warming next week. But, he wanted to know, how does the model cope with feedback loops that move unexpectedly from a linear to a non-linear response? Donella replied that this is dealt with in the model only in a general way with a non-linear relationship that says the more pollution there is, the slower it is neutralized—that in essence the sinks can be poisoned. She agreed that the systemic effect of this could indeed be “system traps” that were hard for us to understand mentally, in which systems which were working up to a certain point suddenly cease to work.

Irving was concerned that we would see more

problems that combined a high degree of scientific uncertainty, long lag times, and a separation in time and space between the recipients of the benefits of an action and those who carry the burden for it.

Donella felt that the only answer was the ability to see the whole system, because this demonstrated the rationality of taking care of things distant in space and time. And to end on a positive note, she wanted to emphasize that all the system interactions that can drive the system down can also work the other way to drive things up. “For instance, if we took on the Greenhouse problem seriously, and with everything we are capable of, we would solve about six other problems too.”

This was a good introduction, said Peter Schwartz, for Amory Lovins, because, although we would probably all agree that we wanted sustainability, the problem is in agreeing what we mean by it. There could be visions of a sustainable future that we probably would not want—like someone at his talk at the Institute of Electrical and Electronic Engineers (IEEE) the week before in San Francisco, who proposed that the entire population of the Earth be put in 1000 Arc cities. Amory, however, has been creating a vision of sustainability that maybe we do want.

Amory opened by recapping energy efficiency progress since his original paper in *Foreign Affairs* 15 years ago. The official forecast didn’t happen because it was “too slow, costly and disagreeable.” What happened instead was that we started asking a different question: what do we want the energy for, and then, how much of it, of what kind, at what scale, and from what source, in order to do each task in the

cheapest way? Then you get a future world which provides the same growing volume of energy services, but squeezes out the losses, and as the depletable fuels get gradually either scarcer or less agreeable, the appropriate renewable sources gradually take over. This shows, he said, that paradigms do change, and behavior does change, if people shift their idea of what question they're asking, and therefore what answer they get. We didn't do too badly. The savings achieved since 1973 are now "a national energy source two-fifths bigger than the domestic oil industry." And we weren't trying very hard, "in fact the federal government was pretty much trying to do the opposite."

Amory showed an analysis based on a disaggregation of Holdren and Ehrlich's well known equation that says that environmental harm is the product of population, affluence and impact. More closely examined, total energy reductions of at least 4-6 orders of magnitude are possible "and you can get your reduction from any combination of any of five factors." With only a small fraction of these we can get very large impacts, "so there's good news and bad news. The good news is that energy is the weakest reason to be concerned about growth in population and affluence. The bad news is that's because everything else gets us first."

Moving to the direct experience of RMI in trying to realize energy and resource savings, Amory explained his concept of "market jujitsu." This involves redirecting the market by using its own energy and ingenuity. It is already clear, he said, that simple changes in feedback signals can achieve rapid and profound shifts to sustainability. The classic example is United

States utility regulators agreeing unanimously in November 1989 to change the rules of utility regulation to bring customer interests into line with utility investor interests.

The idea of the "negawatt" (which Amory explained originated as a typo) has by now gained more than a foothold in utility thinking. But Amory wants to go further. Simply marketing negawatts isn't enough. Markets can be made in negawatts. This opens up all kinds of arcane and far-reaching possibilities. The idea is to maximize competition in "who saves and how, so as to drive down cost, by making saved electricity a fungible commodity, just like copper, wheat and sow bellies." Examples he gave included competitive bidding for saving electricity, with funds going to those who bid to save the most electricity per dollar. Opportunities for arbitrage between the cost of megawatts and negawatts are possible because saved power can be "wheeled" round the grid from one region to another. Spot, futures, and options markets in negawatts are probably not far away. Even gas utilities can sell electric efficiency. In new buildings, utilities can charge a sliding scale of hookup fees—positive or negative—depending on how energy-efficient the building is.

But what about markets where the opportunity for utility regulatory reform is not available, such as oil—for example, the car, which many people consider the toughest problem of all? Amory's goal is to "get good cars on the road, get bad cars off the road, and fewer cars driven fewer miles, by having efficient transportation systems achieved largely through markets." The Ultralite concept car from General Motors presages the most significant industrial restructuring since the microchip: "stirring in

the back of that reptilian brain are little scurrying mammals.” The Ultralite has 100 significant innovations, and its statistics are very impressive (100 mpg, 135 mph, 0-60 in 7.8 sec, etc.), considering that the automobile industry has been telling us for years that this sort of thing is impossible. But, Amory suggests, if you introduce such additional innovations as electric hybrid drive with switched reluctance electric motors, you can double or triple even this level of efficiency. (In switched reluctance motors, both turning force and speed are controlled electronically.) “We just had a bunch of car experts meeting at RMI’s skunkworks, and we didn’t have much trouble getting down to a tenth of 1990-model-average total kinetic load (drag-mass product).” These cars could be so radically simplified that “there’s practically nothing under the hood, so why have a hood?”

The most striking implications of this eye-opening technology are in the industrial structure it potentially lends itself to. Even if these cars cost twice as much to make as existing cars, they could be delivered at the same price if sold through the mail, without the 100 percent markup between factory gate and owner. In attempting this transition, the big car makers have (as Lee Schipper remarked) “two main strikes against them: they’re big and they’re car makers.” It’s tough to switch from a steel-stamping and die-making culture to a composite molding and electronics culture. And it’s only just occurred to the big automakers that their competition might not be Honda, “it might be hungry aerospace engineers in a garage.”

Amory described his “current fantasy” that the retooling could be paid for by the oil majors.

After all, “the five-million-barrel-a-day oil field under Detroit is a much better exploration play than any other that we know about.” (In answer to a later question, he explained that he was referring to the savings from accelerated scrapping of gas guzzlers.) And oil majors are “large technically oriented banks.” If the venture succeeds, “they’re hedged—with upside participation, they make less money on gasoline but more money on cars.”

But the ultimate challenge lies in redesigning transportation systems from scratch “from an end-use, least-cost perspective, in which the end use is not mobility, but access.” In other words, how to make negamile markets in which all solutions can compete. “How much is it worth paying people to stay off the road so we needn’t build and mend them so much?” How can downtown roads and parking no longer be provided as free goods—which people use infinitely? Amory listed some of the more innovative transportation policy instruments that have emerged recently, such as parking feebates, pay-as-you-drive car insurance, and commuting-efficient mortgages.

He then discussed a number of “things markets can’t do.” But many innovative initiatives are possible. An example: require that all new fuel contracts by utilities carry an indemnity against a future carbon tax. This would lead to insurance against carbon risk, and then Lloyds would decide what the carbon risk is worth. “Maybe this is worth trying.”

Amory closed with some questions he said he had been asking himself. At RMI they had a lot of fun trying to apply market solutions to a diverse range of problems. National security was one—leading to the concept of negawars:

people want to be safe and feel safe, not to have weapons per se. The same essential principle works across many areas from energy to non-provocative defense. In energy it amounts to saying that "electricity must openly compete with its efficient use." In many fields—energy, minerals, water, security, pollution prevention, and more—efficiency is turning out to be cheaper in private internal cost than the inefficient unsustainable alternative. Why is this happening across all these fields simultaneously?

Moreover, sustainability is often superior in respects other than cost. Supercars are just superior cars. Sustainability also supports the actions needed for competitiveness. To a degree this flows naturally from modern integrated design. But could it also be that there is a commercial imperative that successful products and processes are those that mimic biological principles, as in the industrial ecology idea? Minimizing regret favors options that are "small, fast, cheap and modular, with rapid feedback and rapid learning," and this has echoes in the latest ecological thinking that small, rapidly evolving species increase system stability.

Underlying all his market ju-jitsu arguments, Amory said, was the principle of using greed creatively. So, finally, he wanted to ask, "can this creative use of greed produce such good results in the world that it will ultimately elicit love—the only resource that the more you use it, the more you have?"

Peter Schwartz opened the questions by asking what reaction Amory was getting today at, say, General Motors. Amory replied that the key technical people think this approach could save

the company. Lee Schipper asked what happens when you overlay the chaotic human element on this argument? At GM, Amory said, the Ultralite had gone from an idea to road testing and the *New York Times* in eight months, and now that it's in the open there is an urgent competitive imperative to bring it to market quickly. Massive losses concentrate the mind wonderfully.

Peter Warshall asked about the prospective shift of oil products from transportation to fertilizers, and how pricing will affect poverty and food production. Amory replied that he was not sure this is what would happen. Some chemical companies are trying to get out of the business. Changes will not be driven by the price of oil. Farmers in the US are moving away from chemical inputs: they can't afford it, the inputs don't work very well, and they are worried about what it's doing to their kids. And people are making money on organic farming and ranching, and interest in this is growing.

Anders Wijkman said that the impression he got was that in the US companies were doing a lot, and the government nothing. He wanted to know how many companies were really being touched by this. He would also dispute that, outside the energy area, sustainability actions were less costly. In his view we need economic policy instruments from politicians.

Amory recalled a meeting in London with Shell Group Managing Directors. "One of them said, 'The trouble with these negabarrels is, once you've sold one to a chap, he's got it and you can't sell it to him again.' To which Hunter responded, 'The trouble with these barrels is, once you've sold one to a chap, you haven't

got it and you can't sell it to him again.' They got that." The negawatt business is growing explosively. Utilities spent \$2 billion last year, matched by customers—a \$4 billion industry up from nothing. The Electric Power Research Institute (EPRI) estimates it will be \$10-15 billion a year by 2000—as big as the whole power industry in its heyday.

As to the other question, Amory said the clearest examples are in waste minimization, where companies design processes to avoid making toxic or hard-to-dispose-of byproducts. Instead they make only valuable things, they're usually more resource efficient, and in practically every case the company ends up making more money and wondering why it didn't do so all along.

Peter Schwartz suggested that steel minimills were another example. Hunter Lovins added that in every case the original motivation was indeed regulation or constraint. The market alone will not do this if there is a free repository or low-cost resources to trash. It is easiest to work with smart governments and politicians. Peter Schwartz pointed to efficiencies in the UK electric industry through privatization exposing inefficiencies to the market. Lee Schipper, energy researcher at Lawrence Berkeley Laboratory, wanted to know, do we have any smart governments? Doug Carlston, co-founder of Brøderbund Software Inc., asked how do you transcend national boundaries to capture externalities, as with Chernobyl? What about Bulgaria that has only megawatts to sell, but the generating capacity is so lethal? Wouldn't it pay us to shut it down? Amory agreed, that would be very worthwhile. He said the biggest arbitrage opportunity today in Europe is to save Norwegian electricity and sell it

East and South, for example to replace Swedish reactors and German coal, and some people are quietly getting options on this. And one could imagine the same thing from the East.

Manager of Public Affairs at Shell Oil Company Bill Butin was concerned about the cost of composites, and pointed out that carbon fiber and epoxy manufacture are not environmentally benign. Thermoset material is not recyclable, and there is no chemical key to break it down, in essence it is one huge molecule. Crash resistance—composites will fall apart, they don't bounce. But he still hoped that we can move towards composites in the automobile industry.

Amory replied, that if no chemical key was available, then probably you would pyrolyze. Safety is complex. If you were hit by an 18-wheeler the car would go flying, like kicking an empty coffee can, but if you're suspended inside in a harness and airbag, you could probably walk away. Composites disintegrate, but have a huge energy absorption capability, and break without jagged edges. They can be combined with crushable metal foam, which is even more energy absorbing. The final cost would depend on details of production engineering, which are not yet well known. Peter Schwartz said that in the aerospace arena this transition to composites was not an easy thing.

Irving Mintzer added that the issue of markets and pollution was under active discussion in the International Negotiating Committee on a Framework Convention for Climate Change—under the rhetorical title of "Joint Implementation of Reduction." He felt that in addition to this approach there was a need to address

the issue of making institutional interfaces more friction free.

At this point the meeting broke for lunch.

After lunch Lee Schipper presented not exactly a riposte, but the "realistic" view, as Peter Schwartz put it.

Lee opened by saying that if the working unit of efficiency is the "Amory" (hence our title), the problem is that as the Amory is progressively applied, it is continuously redefined. In other words, energy efficiency is not a static concept—more efficiencies can be gained after a certain threshold is reached.

Lee's analysis focused on energy, since energy is a representative marker. Today the West is 20 percent less energy intensive than in 1973—what have we learned? That the changes were straightforward, but not always free. That the technical potential is always big, but the realization is always less. That the potential is still large.

A plot of automobile fuel intensity indicated that only the US had shown any real improvement. A gasoline tax in Italy and Denmark had a small effect. Real average fuel prices in the US had gone way up, and then come way down during this period. (This same plot also showed that the US started at an intensity level more than twice that of other countries, and has yet to decline to their levels.)

The problem, said Lee, was that human behavior eats the savings. Cars are a "macho" social symbol. Mobility is increasing—1/3 of traffic is free-time use, and in all countries people are making more, shorter trips, and

more of these shorter trips are being made per day in the US.

Taking this into account, Lee offered a series of OECD energy intensity scenarios for 2010, consisting of existing trends, a reasonable efficiency push, and a vigorous effort. These were taken from his new book *Energy Efficiency and Human Activity: Past Trends, Future Prospects* for the Stockholm Environmental Institute. The "Existing Trends" scenario embodied reductions in energy demand of 24 percent, for which many of the changes are committed already. Taking actual 1985 numbers as an index of one, the "Existing Trends" scenario achieves an energy intensity of 0.76 by 2010, the "Efficiency" scenario achieves a little over 0.6, and the "Vigorous" scenario achieves under 0.5. However, when the effects of economic growth and changes in lifestyles are factored in, total energy use actually increases by 40 percent over 1985 levels for the "Existing Trends" scenario, increases 10 percent for the "Efficiency" scenario, and only under the "Vigorous" scenario does it fall by 22 percent against 1988 levels.

Lee then discussed the possible effect on carbon dioxide emissions under each of the scenarios. The "Existing Trends" scenario is unlikely to yield reductions in carbon dioxide, the "Efficiency" scenario could stabilize them, and only the "Vigorous" scenario leads to an "absolute and certain decline." Outside the OECD, the challenges are diverse. In the formerly planned economies, an absolute reduction in carbon dioxide is likely as a result of economic reform and cleaner technologies. In industrially developing countries emissions are likely to increase greatly, and need to be balanced by OECD action.

What we need, he said, was a robust strategy for accelerating future improvements. He concluded by offering a list of policy initiatives to achieve this. These included full cost energy pricing, OECD carbon dioxide taxes, phasing out energy subsidies in all countries, agreements to improve efficiency, research into low-carbon technologies, and assistance for industrially developing countries in improving efficiency. His final question: should an energy efficiency spokesperson be optimistic or pessimistic?

At the end of Lee's presentation, Peter asked for a show of hands as to who essentially believed the "limits" argument, and the need to respond rapidly. An official count was not taken, but I estimated that about 15 people said "yes," three said "no," and five said "don't know." In the discussion that followed, it turned out that at least two of the three basically agreed as well, if the wording of the question was adjusted a little.

The discussion that followed ranged over a wide area which I will not report in detail, but I will list all the main issues and feature the highlights.

Joel Garreau, author of *Edge City*, said he was surprised that Julian Simon's name had not come up. Julian's argument being, essentially, we don't have to worry about, say, copper, because we'll all be using sand (for the glass for optical fibers). Donella said that at a superficial level the difference between Julian and herself was the difference between an economist and a physical scientist who believes that the second law of thermodynamics will ultimately win over every economic law. At a deeper level, it was an issue of fundamental

belief between the cornucopian school and what might be called the "eco-freak school." She pointed out that he had in fact switched sides, and that the reason appeared to be that he had been so scared by the pessimistic view that he decided to become a terminal optimist.

In response to a question by John Rozsa, about actual resource collapses, I (Hardin) gave the example of 16th or 17th century Spain which ran out of firewood, causing its economy to collapse. England avoided the same fate by discovering how to use coal. John said he thought the Spanish economy collapsed because of the vast amount of gold they brought from the new world, which destroyed the values in the society. I responded that was probably why they failed to make the next innovative jump.

Tom Schneider of the Electric Power Research Institute asked how do you value future generations' continuity? Do we have faith in human ability to create alternative systems? That is, the living biological response of humans to their environment. Donella responded that the fundamental question is "where are we going? Is this what we want? These are the questions that have been waiting for this civilization to answer. But it has been saying, more, more, more, instead of what for, what for..."

Chris Gebelein, general manager at Inland Steel Industries, Inc., was concerned that the model didn't seem to have a learning element in it. Where was the human adaptive response? Kevin Kelly wondered if the meeting itself should be considered as outside the system, or if it was actually the system meeting to find a response. In other words, were we part of the

system's adaptive process, or was this an emergency session that was somehow more conscious than the system itself? Pursuing this theme, Peter wanted to know if Donella felt that there were mechanisms in the world whereby information of this sort could engender a response at a high level. Donella said that this got at all of our models of social change. Her mental model was of concentric circles with idea creators in the center, feeding out to the next ring of people who were eager to combine and spread these ideas, and beyond them to the real communicators and popularizers, and so on. She said she personally had a tremendous amount of faith in the human ability to change, giving the fall of the Berlin Wall as an example, and that this could happen very fast. And she said she wouldn't be doing all this if she didn't believe that information was the key.

Peter offered to take the argument a step further, to make it more personal. He said he considered himself to be a person who cared about these things and knew a lot about them. And, he said, "I want a new Lexus SC400 with an 8 cylinder engine. Now, I know it's wrong. So do we need a policy maker who is going to impose a CAFE standard that's going to force you Schwartz, to have a six or a four cylinder, because we've got to restrain your evil impulses to pollute the air? You know, what do you do with somebody like me?" "I'll charge you a feebate," said Amory, instantly. "But this means you have to play policy maker to do that. In other words, do we have to intervene in the system to take care of jerks like me or will I eventually get the message as the air gets dirtier?" Donella wanted to talk about values: "I would say, Peter, what is it you really want?" "He wants a fast car," someone muttered, to

general laughter.

Peter suggested that maybe Danny Hillis, founding director of Thinking Machines Inc., could give him a virtual fast car so that he would not have to put out fumes. "Even better, I'll give you a virtual computer," said Danny. Donella persevered: "I want a world in which there are fulfilled, happy people, who are not endangering the security of the next generation."

Peter Warshall wanted to push beyond the book. "Look at the word 'growth'. It comes from an old Indo-European word "grei," which became three words in English: the word growth, the word green, and the word grass. The original meaning of the word was for something to turn green in the spring. Then we went through the industrial revolution, which as somebody said today, turned growth grey. And now we're going back to saying, let's look at growth in terms of both grey and green." Growth should not become a political term. "Look at the other term which is becoming the good word for environmentalists, 'develop.' It means differentiation, not simply aiming for size. But when a baby is in the womb, it has to go through both stages. You need enough cells in order to start differentiating." One of the things we needed in these models was to ask at what point do we need growth, and at what point do we move on to differentiation. "Sustainability came along as a way for the environmentalists and the new economists to put together the words growth and development into a new framework. Now notice that the whole model in *Beyond the Limits* does not have a differentiation stage. It is all based on growth." He went on to discuss sustainability. "Many of the moral issues here

have to be self-sustaining, but many of the ecological issues are sustaining only through institutional change.”

Next, Peter put on his anthropologist’s hat. “The world is in mass confusion about those basic values anthropologists look at: birth, the coming of adulthood, and death. We don’t know in the US when you actually become a human. When is someone dead? You put them on a machine, is that person really a person still, how long do you keep them there? And when do you become an adult? No one knows how sex relates to maturity, or when you actually grow up. How do you become an adult, if everyone is telling you to get a smaller and smaller car? This relates to the revival of fundamentalism all over the planet, because people cannot be left with this kind of anxiety. So we really have to address how to put a social framework on these basic values. Love is not enough: if my grandfather is on four machines and it’s costing \$10,000 a week to keep him alive, but I love him, when is death appropriate? In Africa up until the 1980s you sold your children into slavery during famine in order to keep them alive, and it was done out of love. You knew they would die, but in slavery they had the possibility of remaining alive.”

Peter also talked about soils as the most important non-renewable resource, and ecological pest control that emphasized accommodation, not winning against the pest.

Comments were then taken from around the table.

Peter Schwartz: Even business is now asking, is bigger necessarily better? If you look at GM you come away with a pretty obvious conclu-

sion. According to Drucker, in the ’90s businesses will focus on achieving their optimum size.

Malcolm Tulloch, Tulloch Research Associates Limited: The world needs growth to pay for the expanding world population, and for the aging of the population.

Don Michael: How a person interprets feedback, signals, depends on learned successful behavior in the past. But this sense of who a person is translates into a lot of resistance to change. To cope with differentiation or pluralization we need integrative processes.

Donella: The media are no longer serving as an integrative mechanism, they no longer create meaning, but almost destroy it.

Peter Schwartz: We know we don’t like the old game, but can we create a new one?

Don: One way we fail to take in new information is by the mechanism of denial.

Al Barnes, manager business research at IBM, told a powerful personal story about hiking in the Adirondacks with his son ten years ago. He came across a lake that was totally quiet, and realized there was no sound of life. Later he asked his cousin, who is number two in the New York EPA, about this, and his cousin said, “Oh, that lake is now vinegar, nothing can live in it.” But you can’t see it from the scenic highway, and anyway you have to hear it to realize what’s wrong. Part of the problem is that in schools anything that involves values cannot be taught. We have to get this into, for example, building codes, and these are local.

Peter Schwartz: Kids are hyper aware about environmental issues, so much so that they are pessimistic.

Anders Wijkman: Environmental education is not on the agenda for Rio.

Lee Schipper: The rocks in the road to efficiency are values that say, "I don't think it can be that bad." The free market isn't enough. Garret Hardin referred to the need for legislation as, "mutual coercion, mutually agreed upon." Lee was looking for a "lean toolbox, or maybe only a Swiss Army knife," of policies that would be needed and that were robust enough.

James Butcher, GBN staff: Humans are not separate from nature, but are a part of nature. For companies, what do they need to do that goes beyond traditional boundaries?

Floyd Hauffe, BellSouth Services: What is the payoff for making the sacrifice to go against the current myth of individualism? How do we remake myths to validate Peter's decision not to buy a Lexus?

Bruce Katz, Rosewood Stone Group: We have to confront what these choices mean for us personally in order to learn what it takes to be a personal new myth leader. We cannot just wait for new myths.

Merwin Brown, PG&E: The design community doesn't know how to design efficient buildings, so there's a steep learning curve. Technologies may have hidden time bombs, just as CFCs did—which we thought were marvelous when they were invented. The

"Abilene Paradox" explains why smart people do dumb things—no one wants to speak up and be different, even though most people secretly feel the same way. Groups need to sanction speaking up.

Amory Lovins: There are many reasons why electricity savings can be achieved at a faster rate than oil was saved since 1972. But, "there are of course still econometricians around who lie awake at nights worrying about whether what works in practice can possibly work in theory." We need more people who can communicate as clearly as Dana. As someone at RMI once said, "we need faith, hope, and clarity, and the greatest of these is clarity."

Irving Mintzer: Beware of technical fixes at the level of global engineering that impacts complex systems—for example feeding the iron from old gas guzzlers to Southern ocean plankton to increase their carbon dioxide uptake.

Art Kleiner: Group process and facilitation etc. are being used by companies for addressing values, but it's hard to talk about. In schools this is being opposed by fundamentalists, so there are reasons why this may not work.

Mia de Kuijper, Gebruder Sulzer AG: Governability is an important tool to achieve sustainability, but this tool is slipping. You are no longer allowed to build citizens because you cannot talk about values in schools.

Danny Hillis: I've not bought in to sustainability as the goal, it won't work, it's not positive enough, not worth all the trouble just to achieve stasis. As Jay Ogilvy said, "Its sort of like selling a game where the best you

can do is draw.” It’s the wrong rallying cry.

(This makes me wonder if sustainability can be seen as a *transitional* challenge: something we need to undertake with urgency over the next few decades, trusting that future generations will find new challenges in a world that is at least still viable. An “intellectual flatline” future certainly seems implausible—sustainability is surely more of a plank in a future world stage than the play performed on it.)

Peter Schwartz: I am really struck by the paucity of inspiring images of the future.

Tom Schneider: I reject poverty and birth control as the key to sustainability. Step changes occur through invention.

Bruce Katz: How do you manage growth-limited companies?

Anders Wijkman: For some 10 or 15 African countries, the major balance of payments problem is the oil bill, not debt service.

Doug Carlston: Serious efforts must be begun soon if our global circumstances are not to degrade, but I’m not sanguine about engineered solutions. We understand how the world works too imperfectly, and we do large, spectacular things like the Aswan Dam. Where does our response come from? Our moral and ethical belief system—both individually held and reinforced by institutional advocacy, which strengthens, shapes and rewards individual action. An example would be a belief in zero population growth, which is both reinforced by institutional support (Planned Parenthood), and greatly weakened by institutional opposi-

tion (Catholic Church). There may be unconscious, automatic processes. I noticed in the paper the other day that the sperm count of US men had dropped 50 percent since World War II, and this may be the beginning of a self-rectifying response. But these processes, if they exist, may operate for the good of the planet, not of humanity, so we had better remember whose side we are on.

Johan Vold, Statoil: I must say that I am confused at a higher level than when I came, and maybe this was in part the objective. In a way the expert response to the model is too complex. The discussion needs to be put on a simpler level in order to communicate it. I don’t yet understand how we can operate without growth, I’m not sure we can stand still without falling down. But even the Germans now realize urban living is not sustainable from a personal, “living experience,” point of view. “And Peter, I know you like fast cars, and I have one solution: try downhill skiing.”

Donella: My final word is very simple: thank you. There has been a remarkable range of responses, from technical to human. We have raised difficult questions, but even if we haven’t solved them, at least they are the right questions, and that’s very important. Please take these questions into the world, keep this going.

Attendees

Network Members

Doug Carlston
Mia A. M. de Kuijper
Joel Garreau
Danny Hillis
William Joy
Bruce Katz
Amory Lovins
Donella Meadows
Don Michael
Irving Mintzer
Lee Schipper
Peter Warshall
Anders Wijkman

GBN Staff

Eric Best
Stewart Brand
James Butcher
Napier Collyns
James A. Ogilvy
Danica Remy
Peter Schwartz
Hardin Tibbs
Lawrence Wilkinson

WorldView Members

Allen Barnes, International Business Machines
Merwin Brown, Pacific Gas & Electric
William Butin, Shell Oil Company
Per Danfors, ABB Power Systems
J. Richard Frey, Alberta Power Limited
Devinder Garewal, Kerr-McGee Corporation
Christopher Gebelein, Inland Steel Industries
Tim Griesbach, EPRI
Thomas Griffiths, CRSS Services Inc.
Floyd Hauffe, BellSouth Services
Jack Huber, BellSouth Services
Drew Overpeck, TEXACO
John P. Rozsa, California Energy Commission
Thomas Schneider, EPRI
Allan Shub, Duke Power Company
Johan Nic. Vold, STATOIL

Guests

Kevin Kelly
Art Kleiner
David Kline, Solar Energy Research Institute
Hunter Lovins, Rocky Mountain Institute
Jim Newcomb, Competitek
Joseph J. Romm, Rocky Mountain Institute
Malcolm Tulloch, Tulloch Research Assoc. Ltd

Previous Global Business Network WorldView Meetings

November 1988 Global Scenarios for the 1990s (West Coast Review) Lakeview Club Oakland, CA	June 8, 1990 Short Term Scenarios and The New Management Agenda SwedBank Stockholm
January 6, 1989 Global Scenarios for the 1990s (East Coast Review) Thinking Machines Cambridge, MA	September 13-14 1990 Environment as Infrastructure Biosphere 2 Tuscon, AZ
March 1989 Global Scenarios for the 1990s (European Review) SIFO Stockholm, Sweden	December 7, 1990 The Network Corporation CNIT Paris, France
September 22, 1989 People in the 1990s Autodesk, Inc. Sausalito, CA	March 11, 1991 Complex Adaptive Systems Santa Fe Institute Santa Fe, New Mexico
November 30, 1989 The Future of Europe International Stock Exchange London, England	June 12, 1991 1991 Scenario Book Working Meeting Delancey Street Foundation San Francisco, California
February 16, 1990 Entertainment, Media, and New Technologies Directors' Guild Hollywood, CA	September 27, 1991 The Future of Information Services INFORUM Atlanta, Georgia
April 20, 1990 The Evolution of Global Finance AT&T New York, NY	November 18, 1991 Environmental Technology Monterey Bay Aquarium Monterey, California
	January 17, 1992 The Architecture of the New Europe Brussels, Belgium