VIII. Environmental Economics and Sustainability (Finally)

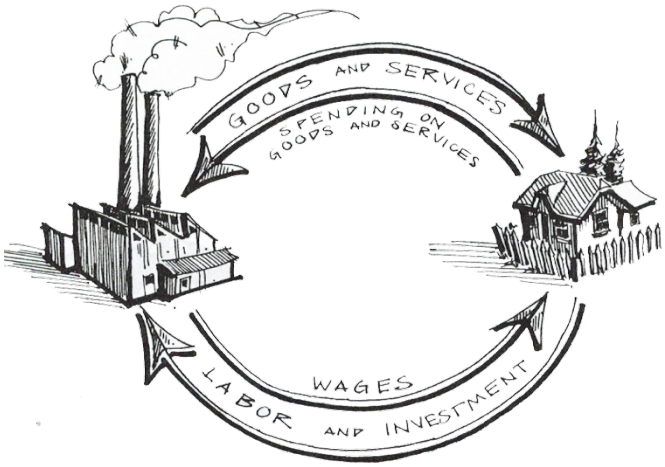
Some writers connect economics to ecology by showing that they have the same root, *oikonomia*, the management of the household so as to increase its value to all members of the household over the long run. Paul Hawken expands this to include the larger community of the land, of shared values, resources, biomes, institutions, language, and history so that we have a good definition of "economics for community." But the dictionary definition of economics is "a social science concerned chiefly with the description and analysis of the production, distribution, and consumption of goods and services."

A. Open or Closed System: The Preanalytic Vision

Herman Daly's belief is that the main issue in the sustainability controversy truly does revolve around what economist Joseph Schumpeter called "preanalytic vision." Analysis has to start somewhere – there has to be something to analyze. That something is given by a preanalytic cognitive act that Schumpeter called "vision." This vision could be described as the basic pattern that the right brain abstracts from experience and supplies to the left brain for analysis. Whatever is omitted from the preanalytic vision cannot be recaptured by subsequent analysis.

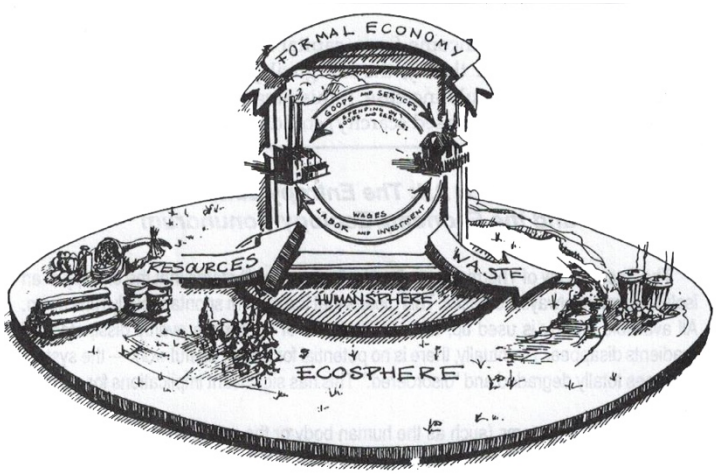
Daly illustrates the conflict between economic preanalytic visions with the standard textbook diagram consisting of a square labeled "economy," with an arrow coming in labeled "inputs" and an arrow going out labeled "outputs" - nothing more. Daly suggested that there should be a larger box containing the one depicted, to represent the environment. Then the relation between the environment and the economy would be clear - specifically, that the *economy is a subsystem of the environment* and depends upon the environment both as a "source" of raw material inputs and as a "sink" for waste outputs. The chief economist of the World Bank responded "That's not the right way to look at it."

The preanalytic vision of standard economics is that the economy is an isolated system in which exchange value circulates between firms and households. The physical dimension of commodities and factors of production is at best totally abstracted from (left out altogether) and at worst assumed to flow in a circle, just like exchange value. Nothing enters from the environment; nothing exits to the environment. It does not matter how big the economy is relative to its environment. For all practical purposes an isolated system has no environment.



For environmental economics, the preanalytic vision is that the economy is an open subsystem of a finite and non-growing ecosystem (the environment). The economy lives by importing low-entropy matter-energy (raw materials) and exporting high-entropy matter-energy (waste). Any subsystem of a finite non-

growing system must itself at some point also become non-growing. At some optimal, or at least sustainable, scale the economic subsystem should be maintained in a steady state as far as possible.



If we start from the isolated circular flow as our preanalytic vision, then the issue of sustainable or optimal scale, and how to maintain a steady state at that scale, cannot arise. If we begin with the preanalytic vision of the economy as an open subsystem, then the issue of its optimal scale relative to the parent ecosystem, and its steady-state maintenance at that scale, cannot be avoided. It would be like studying physiology solely in terms of the circulatory system without ever mentioning the digestive tract. The dependence of the organism on its environment would not be evident. The absence of the concept of throughput in the economists' vision means that the economy carries on no exchange with its environment. It is, by implication, a self-sustaining isolated system, a giant perpetual motion machine.

Unless one has the preanalytic vision of the economy as subsystem, the whole idea of sustainability - of a subsystem being sustained by a larger system whose limits and capacities it must respect - makes no sense whatsoever. On the other hand, a preanalytic vision of the economy as a box floating in infinite space allows people to speak of "sustainable *growth"* - a clear oxymoron to those who see the economy as a subsystem. The difference between these two visions could not be more fundamental, more elementary, or more irreconcilable. It is interesting that such a huge issue should be at stake in a simple picture. Once you draw the boundary of the environment around the economy, you have said that the *economy cannot expand forever*.

Daly later characterized policies formulated by traditional economists to accelerate “sustainable growth” as “the unison snoring of supine economists in deep dogmatic slumber.” And when they’re awake they appear to be living in denial. Why there was such denial was proposed by another economist, Earl Cook, in 1982:

“The concept of sustainable development or limits to growth threatens vested interests and power structures; even worse threatens value structures in which lives have been invested... Abandonment of belief in economic perpetual motion was a major step toward recognition of the true human condition. It is significant that "mainstream" economists never abandoned that belief and do not accept the relevance to the economic process of the Second Law of Thermodynamics; their position as high priests of the market economy would become untenable did they do so.”

B. Sustainable Development: Economics of Quality of Life

Sustainable development, Daly argues, necessarily means a radical shift from a growth economy and all it entails to a steady-state economy (SSE). Growth, as here used, refers to an increase in the physical scale of

the matter/energy throughput that sustains the economic activities of production and consumption of commodities. Growth is *quantitative* increase in the physical scale of throughput. *Qualitative* improvement in the use made of a given scale of throughput, resulting either from improved technical knowledge or from a deeper understanding of purpose, is called "development". "Development" refers to qualitative change, realization of potentialities, transition to a fuller or better state. The two processes are distinct - sometimes linked, sometimes not. For example, *a child grows and develops simultaneously; a snowball or a cancer grows without developing; the planet Earth develops without growing.* It is precisely the recognition that growth in scale ultimately becomes impossible - and already costs more than it is worth - that gives rise to the urgency of the concept of sustainability. Sustainable development is development without growth in the scale of the economy beyond some point that is within biospheric carrying capacity.

To develop a way of living that is fulfilling *and* sustainable within nature, we need to rethink our relationships with each other and with the rest of nature. The human enterprise cannot be separated from the natural world even in our minds because there is no such separation in nature. In terms of energy and material flows, there is simply no "out there". The premise that human society is a subsystem of the ecosphere, that human beings are embedded in nature, is so simple that it is generally overlooked or dismissed as too obvious to be relevant. But as the authors of *Our Ecological Footprint* [4] point out:

> "Taking this "obvious" insight seriously leads to some profound conclusions. The policy implications of this ecological reality run much deeper than pressing for improved pollution control and better environmental protection, both of which maintain the myth of separation. If humans are part of nature's fabric, the "environment" is no mere scenic backdrop but becomes the play itself. The ecosphere is where we live; humanity is dependent on nature, not the reverse. Sustainability requires that our emphasis shift from "managing resources" to managing ourselves - that we learn to live as part of nature. *Economics at last becomes human ecology*."

Daly [1] has given the definitive description of the scale issue with his analogy to the Plimsoll line:

> "The term scale is shorthand for "the physical scale or size of the human presence in the ecosystem, as measured by population times per capita resource use." Optimal allocation of a given scale of resource flow within the economy is one thing (a microeconomic problem). Optimal scale of the whole economy relative to the ecosystem is an entirely different problem (a macro-macro problem). The micro allocation problem is analogous to allocating optimally a given amount of weight in a boat. But once the best relative location of weight has been determined, there is still the question of the absolute amount of weight the boat should carry, even when optimally allocated. This absolute optimal scale of load is recognized in the maritime institution of the Plimsoll line. When the watermark hits the Plimsoll line the boat is full, it has reached its safe *carrying capacity*. Of course if the weight is badly allocated the waterline will touch the Plimsoll mark sooner. But eventually, as the absolute load is increased, the watermark will reach the Plimsoll line even for a boat whose load is optimally allocated. Optimally loaded boats will still sink under too much weight, even though they may sink optimally! The major task of environmental macroeconomics is to design an economic institution analogous to the Plimsoll mark - to keep the weight, the absolute scale, of the economy from sinking our biospheric ark.
>
> Many believe that the present scale is beyond long-term carrying capacity and that sustainable growth in its initial phase will require a period of negative growth. Even if one is a technological optimist and believes that development in the productivity of the resource throughput can increase faster than the volume of the throughput needs to diminish, this is still very radical. The term "sustainable growth" aims to deny this radical transformation, and to suggest that growth is still the number one goal, that *growth just needs to be a bit more environmentally friendly*. Sustainable growth is just one more adjustment to the standard view. Sustainable development is an alternative to the standard growth ideology and is incompatible with it. Sustainable development, development

without growth, does not imply the end of economics - if anything, economics becomes even more important. But it is a subtle and complex economics of maintenance, qualitative improvement, sharing, frugality, and adaptation to natural limits. It is an economics of better, not bigger."

Per economic theory, we have three basic problems to consider: *allocation, distribution, and scale*. *Allocation* refers to the apportioning of resources among alternative product uses - food, bicycles, cars, medical care. An allocation is efficient if it corresponds to effective demand; that is, the relative preferences of the citizens as weighted by their relative incomes, both taken as given. An inefficient allocation will use resources to produce a number of things that people will not buy, and will fail to produce other things that people would buy if only they could find them. It would be characterized by shortages of the latter and surpluses of the former. *Distribution* refers to the apportioning of the goods produced (and the resources they embody) among different people (as opposed to different commodities). Distributions are just or unjust; allocations are efficient or inefficient. There is an efficient allocation for each distribution of income. *Scale* refers to the physical size of the economy relative to the ecosystem. The economy is viewed, in its physical dimensions, as a subsystem of the larger ecosystem. Scale is measured as population times per capita resource use - in other words total resource use - the volume of the matter/energy throughput (metabolic flow) by which the ecosystem sustains the economic subsystem. Scale may be sustainable or unsustainable. An efficient allocation does not imply a just distribution. Neither an efficient allocation nor a just distribution, nor both, implies a sustainable scale. The three concepts are quite distinct, although relations among them exist, as noted above

The tradable pollution permits scheme, explained below, is, per Daly [1], a beautiful example of the independence and proper relationship among allocation, distribution, and scale. Consider step by step what this policy requires in practice.

"First, we must create a limited number of rights to pollute. The aggregate or total amount of pollution corresponding to these rights is determined to be within the absorptive capacity of the airshed or watershed in question. That is to say, the scale impact is limited to a level judged to be ecologically sustainable - an economic Plimsoll line must be drawn as the very first step. Far from ignoring scale, this policy requires that the issue of sustainable or optimal scale be settled at the beginning. It may be done on the basis of a carrying capacity estimate, a safe minimum standards estimate, or a cost-benefit study, but *some limit to total pollution must be set*.

Second, the limited number of rights corresponding to the chosen scale must be distributed initially to different people. Perhaps equally to citizens, or to firms, or perhaps collectively as public property then to be auctioned or sold by the government to individuals. But there must be an initial distribution before there can be any allocation and reallocation by trading.

Only in third place, after having made social decisions regarding an ecologically sustainable scale and an ethically just distribution, are we in a position to allow reallocation among individuals through markets in the interests of efficiency. A separation between allocation and scale requires that the total quantity of permits be fixed, but that the price at which the permits trade be free to vary. If the total quantity were determined by a willingness-to-pay study that also gave a shadow price as well as an aggregate quantity, then the neoclassical economist who wants to avoid separating allocation and scale must insist that trading take place at the calculated shadow price. Otherwise there will be a separation between allocation and scale. In practice, the price is always free to vary, clearly indicating that the pragmatic, operational solution has been to separate allocation and scale.

It is clear that scale is not determined by prices, but by a social decision reflecting ecological limits. Distribution is not determined by prices, but by a social decision reflecting a just distribution of the newly created assets. Subject to these social decisions, individualistic trading in the market is then able to allocate the scarce rights efficiently. For some reason economists have analyzed the tradable

> pollution permits scheme almost entirely in relation to the command and control allocative schemes. They have indeed shown it to be superior to command and control in terms of allocative efficiency. But with all the emphasis on allocation the critical role of scale went unnoticed, and the role of distribution, while certainly noticed, was not sufficiently emphasized. Tradable permits have been considered the individualistic 'free market" solution, without emphasizing that *this market is free only after having been firmly and collectively fixed within scale and distributive limits*.
>
> Environmentalists, too, have shown considerable misunderstanding of this scheme, condemning it as "giving away licenses to pollute." The point is that this scheme limits the total scale of pollution, need not give away anything but can sell the rights for public revenue, yet allows reallocation among individuals in the interest of efficiency. Some complain that under this scheme the rich have an advantage. The rich *always* have an advantage, but does this scheme increase or decrease the preexisting advantage of the rich? It could do either, it all depends on the initial distribution of ownership of the new assets, and not on the fact that they are tradable."

C. The Cowboy in the Spaceship

Everyone, including economists, knows perfectly well that the economy takes in raw material from the environment and gives back waste. So why is this undisputed fact ignored in the circular flow paradigm? Economists are interested in scarcity. What is not scarce is abstracted from (ignored). Environmental sources and sinks were considered infinite relative to the demands of the economy, which was more or less the case during the formative years of economic theory. Therefore it was not an unreasonable abstraction. But it is highly unreasonable to continue omitting the concept of throughput after the scale of the economy has grown to the point where sources and sinks for the throughput are obviously scarce.

Per Kenneth Boulding's analogy, the Cowboy of the infinite plains (frontier economy) lives off a linear throughput from source to sink, with no need to recycle anything. The Spaceman in a small capsule lives off of tight material cycles and immediate feedbacks, all under total control and subservient to his needs. For the Cowboy, scale is negligible; for the Spaceman, scale is total. But we are on a middle ground searching for optimal scale.

This is such a difficult question, and since we cannot go back to the Cowboy economy, we have acquired an unwarranted tendency to jump all the way to the Spaceman economy and take control of the Spaceship Earth. But David Orr points out that God, Gaia, or Evolution was doing a nice job of managing the earth until the scale of the human population, economy, and technology got out of control. We need to manage ourselves more than the planet, and our self-management should be, in Orr's words, *"more akin to child-proofing a day care center than to piloting spaceship earth.*" The way to childproof a room is to build an optimal scale playpen within which the child is both free and protected from the excesses of its own freedom. It can enjoy the light and warmth provided by electrical circuits beyond its ken, without running the risk of shorting out those circuits, or itself, by experimenting with the *"planetary management technique" of teething on a lamp cord.*

D. On Natural Capital

Natural capital refers to any stock of natural assets that yields a flow of valuable goods and services into the future. For example, a forest, a fish stock or an aquifer can provide a harvest or flow that is potentially sustainable year after year. The forest or fish stock is "natural capital" and the *sustainable* harvest is "natural income." Natural capital also provides such services as waste assimilation, erosion and flood control, and protection from ultraviolet radiation. (Thus, the ozone layer is a form of natural capital.) These life-support services are also counted as natural income. Since the flow of services from ecosystems often requires that they function as intact systems, the structure and diversity of the system may be an important component of natural capital.

Gretchen Daily [10] gives a comprehensive list of these ecosystem life-support services:

- Purification of air and water
- Mitigation of floods and droughts
- Detoxification and decomposition of wastes
- Generation and renewal of soil and soil fertility
- Pollination of crops and natural vegetation
- Control of the vast majority of agricultural pests
- Dispersal of seeds and translocation of nutrients
- Maintenance of biodiversity supporting agricultural, medicinal, and industrial enterprise
- Protection from the sun's harmful ultraviolet rays
- Partial stabilization of climate
- Moderation of temperature extremes and the force of wind and waves
- Support of diverse human cultures
- Providing aesthetic beauty and intellectual stimulation that lift the human spirit

Daly [1] expands on the importance of the concept of natural capital:

> "Researchers typically focus on three categories of natural capital: renewable, replenishable and non-renewable. Renewable natural capital, such as living species and ecosystems, is self-producing and self-maintaining using solar energy and photosynthesis. Replenishable natural capital includes surface and ground water supplies and the stratospheric ozone layer. These stocks are non-living but are continuously restored, often through some other solar mechanism. By contrast, non-renewable forms of natural capital such as fossil fuel (coal: the stored sunlight of paleozoic summers) and minerals are analogous to inventories. Any use implies liquidating part of the stock. Since adequate stocks of renewable and replenishable natural capital are essential for life-support (and are generally non-substitutable), we consider these categories of natural capital to be more important to sustainability than non-renewable forms.
>
> This proposition gives rise to the following thesis: that the world is moving from an era in which man-made capital was the limiting factor into an era in which remaining natural capital is the limiting factor. The production of caught fish is currently limited by remaining fish populations, not by number of fishing boats; timber production is limited by remaining forests, not by sawmills; barrels of pumped crude oil is limited by petroleum deposits (or perhaps more stringently by the capacity of the atmosphere to absorb $C0_2$), not by pumping capacity; and agricultural production is frequently limited by water availability, not by tractors, harvesters, or even land area. We have moved from a world relatively full of natural capital and empty of man-made capital (and people) to a world relatively full of the latter and empty of the former."

But how could the pattern of scarcity have changed so dramatically without economists noticing it? Several factors account for this development. First, exponential growth is deceptive. The surprising consequences of exponential growth have fascinated people for centuries. There is an old Persian legend about a clever courtier who presented a beautiful chessboard to his king and requested that the king give him in exchange 1 grain of rice for the first square on the board, 2 grains for the second square, 4 grains for the third, and so forth. The king readily agreed and ordered rice to be brought from his stores. The fourth square on the chessboard required 8 grains, the tenth square took 512 grains, the fifteenth required 16,384, and the twenty-first square gave the courtier more than a million grains of rice. By the fortieth square a million million rice grains had to be piled up. The payment could never have continued to the sixty-fourth square; it would have taken more rice than there was in the whole world.

A French riddle for children illustrates another aspect of exponential growth - the apparent suddenness with which an exponentially growing quantity approaches a fixed limit. Suppose you own a pond on which a

water lily is growing. The lily plant doubles in size each day. If the plant were allowed to grow unchecked, it would completely cover the pond in 30 days, choking off the other forms of life in the water. For a long time the lily plant seems small, so you decide not to worry about it until it covers half the pond. On what day will that be?

On the twenty-ninth day! You have *just one day to act* to save your pond! (On the twenty-fifth of the month the plant covers just 1/32nd of the pond; on the twenty-first it covers just 1/512th of the pond. For most of the month the plant, though it is steadily doubling, is invisible or inconsequential. You can see how exponential growth, combined with inattention, can lead to overshoot!)

Second, as Daly points out, economists have considered man-made and natural capital to be substitutes, when they are basically complements. If factors are substitutes, then a shortage of one does not limit the productivity of the other. Neither factor can be limiting if they are good substitutes. So even as the world moves from 40% to 8o% full in the next roughly forty-year doubling time, technological optimists are counting on *man-made capital* to restore the conditions of relative emptiness by substituting for natural capital.

Third, if we subconsciously realize that production growth cannot continue, then the only way to cure poverty is to confront both sharing and population control. Since these are considered impossible by political "realists," it is gratuitously concluded that whatever argument gave rise to this conclusion must be wrong. The three biases discussed above may have kept us from seeing the obvious - namely, that man-made and natural capital are complements, and that natural capital has become the limiting factor.

Daly goes on to propose:

> "Nonrenewable natural capital cannot be increased either actively or passively. It can only be diminished. We can only divest nonrenewable natural capital itself, even though we invest in the man-made capital equipment that hastens its rate of extraction and divestment. Nonrenewable natural capital is like an inventory of already produced goods, rather than a productive machine or a reproducing population. For nonrenewable natural capital the question is not how to invest, but how to best liquidate the inventory, and what to do with the net wealth realized from that liquidation. Currently, we are counting this liquidated wealth as income (included in both gross national product and net national product), which is clearly wrong, because it is not a permanent or sustainable source of consumption.
>
> A better alternative would be to dedicate all or part of the net receipts of nonrenewable resource liquidation to finance waiting investments in renewable natural capital - that is, to allow reduction of the offtake of renewables in order to build up renewable stocks to larger levels producing larger sustainable yields which represent true income. *The basic idea is to convert nonrenewable natural capital into a renewable substitute, to the extent possible*. The general rule would be to deplete non-renewables at a rate equal to the rate of development of renewable substitutes. Probably a broad definition of "substitute" would be indicated initially - at least broad enough to encompass improvements in energy efficiency as a renewable substitute for petroleum depletion, and improvements in recycling as a renewable substitute for copper depletion."

E. On Natural Capitalism

What would our economy look like if it fully valued all forms of capital, including human and natural capital? What if our economy were organized not around the lifeless abstractions of neoclassical economics and accountancy but around the biological realities of nature? What if Generally Accepted Accounting Practice booked natural and human capital not as a free amenity in putative inexhaustible supply but as a finite and integrally valuable factor of production? What if, in the absence of a rigorous way to practice such accounting, companies started to act as if such principles were in force? This choice is possible and such an economy would offer a stunning new set of opportunities for all of society, amounting to no less

than the next industrial revolution. This view is detailed in the book Natural Capitalism [5] which should become a primary reference for environmental and resource economists.

Natural capitalism and the possibility of a new industrial system are based on a very different mind-set and set of values than conventional capitalism. Its fundamental assumptions include the following:

- The environment is not a minor factor of production but rather is "an envelope containing, provisioning, and sustaining the entire economy."
- The limiting factor to future economic development is the availability and functionality of *natural capital,* in particular, life-supporting services that have no substitutes and currently have no market value.
- Misconceived or badly designed business systems, population growth, and wasteful patterns of consumption are the primary causes of the loss of natural capital, and all three must be addressed to achieve a sustainable economy.
- Future economic progress can best take place in democratic, market-based systems of production and distribution in which all forms of capital are fully valued, including human, manufactured, financial, and natural capital.
- One of the keys to the most beneficial employment of people, money, and the environment is radical increases in resource productivity.
- Human welfare is best served by improving the quality and flow of desired services delivered, rather than by merely increasing the total dollar flow.
- Economic and environmental sustainability depends on redressing global inequities of income and material well-being.
- The best long-term environment for commerce is provided by true democratic systems of governance that are based on the needs of people rather than business.

The following four central strategies of natural capitalism are a means to enable countries, companies, and communities to operate by behaving as if all forms of capital were valued. Ensuring a perpetual annuity of valuable social and natural processes to serve a growing population is not just a prudent investment but a critical need in the coming decades. Doing so can avert scarcity, perpetuate abundance, and provide a solid basis for social development; it is the basis of responsible stewardship and prosperity for the next century and beyond.

1. Radical Resource Productivity: Radically increased resource productivity is the cornerstone of natural capitalism because using resources more effectively has three significant benefits: It slows resource depletion at one end of the value chain, lowers pollution at the other end, and provides a basis to increase worldwide employment with meaningful jobs. The result can be lower costs for business and society, which no longer has to pay for the chief causes of ecosystem and social disruption. Nearly all environmental and social harm is an artifact of the uneconomically wasteful use of human and natural resources, but radical resource productivity strategies can nearly halt the degradation of the biosphere, make it more profitable to employ people, and thus safeguard against the loss of vital living systems and social cohesion.
2. Biomimicry: Reducing the wasteful throughput of materials - indeed, eliminating the very idea of waste - can be accomplished by redesigning industrial systems on biological lines that change the nature of industrial processes and materials, enabling the constant reuse of materials in continuous closed cycles, and often the elimination of toxicity.
3. Service and Flow Economy: This calls for a fundamental change in the relationship between producer and consumer, a shift from an economy of goods and purchases to one of *service and flow.* In essence, an economy that is based on a flow of economic services can better protect the ecosystem services upon which it depends. This will entail a new perception of value, a shift from the acquisition of goods as a measure of affluence to an economy where the continuous receipt of quality, utility, and performance

promotes well-being. This concept offers incentives to put into practice the first two innovations of natural capitalism by restructuring the economy to focus on relationships that better meet customers' changing value needs and to reward automatically both resource productivity and closed-loop cycles of materials use.

4. Investing in Natural Capital: This works toward reversing world- wide planetary destruction through reinvestments in sustaining, restoring, and expanding stocks of natural capital, so that the biosphere can produce more abundant ecosystem services and natural resources.

All four changes are interrelated and interdependent; all four generate numerous benefits and opportunities in markets, finance, materials, distribution, and employment. Together, they can reduce environmental harm, create economic growth, and increase meaningful employment.

F. Technological Saviorism

Many economists hang on to the infinite-resources assumption in one way or another, because otherwise they would have to admit that economic growth faces limits, and that is "unthinkable." The usual ploy is to appeal to the infinite possibilities of technology and resource substitution (ingenuity) as a dynamic force that can continuously outrun depletion and pollution. Therefore, much ingenuity is devoted to "proving" that ingenuity is unlimited. Every technical accomplishment, no matter how ultimately insignificant, is celebrated as one more victory in an infinite series of future victories of technology over nature. The Greeks called this hubris.

The basic science of thermodynamics teaches us that matter and energy can neither be created nor destroyed, only transformed from one into the other. It also teaches that matter and energy tend to disperse (increase in entropy). Material value is measured in concentration and structure. For example, a small bottle of ink and a large tub of pure water both have a value based on their potential use. However, if we pour the ink into the tub of water, the combination may no longer have any value at all. The only thing that can use external energy to create a net increase in concentration and structure from dispersed elements around it, and thus value, is the plant cell through photosynthesis. We can burn a log to keep us warm at night. Theoretically, we could capture all the solids, gases, and energy that resulted from burning that log and build a machine to put them all back together into a new log. The only problem is that no one can conceive of how to build a practical machine to do this. In fact, the only machine that exists that can create a new log for our fire is a tree!

Daly believes the technology argument is flawed in many respects:

> "First, technology and infinite substitution mean only that one form of low-entropy matter/energy is substituted for another, within a finite and diminishing set of low-entropy sources. Such substitution is often very advantageous, but we never substitute high-entropy wastes for low-entropy resources in net terms. Second, the claim is frequently made that reproducible capital is a near-perfect substitute for resources. But this assumes that capital can be produced independently of resources, which is absurd. Man-made capital (including technological innovation) is itself a physical transformation of natural resources which come from natural capital. Therefore, *producing more of the alleged substitute (man-made capital), physically requires more of the very thing being substituted for (natural capital).*
>
> Furthermore, it flies in the teeth of the obvious complementarity of capital and resources in production. The capital stock is an agent for transforming the resource flow from raw material into a product. More capital does not substitute for fewer resources, except on a very restricted margin. *You cannot make the same house by substituting more saws for less wood***.** One cannot build the same wooden house with half the timber no matter how many saws and carpenters one tries to substitute. Conversely, trees cannot become houses with no work! Also, to process more timber into more wooden houses in the same time period requires more saws and carpenters. Clearly the

basic relation of man-made and natural capital is one of complementarity, not substitutability. Of course, one could substitute bricks for timber, but that is the substitution of one resource input for another, not the substitution of capital for resources. In making a brick house one would face the analogous inability of trowels and masons to substitute for bricks.

The complementarity of man-made and natural capital is made obvious at a concrete and commonsense level by asking, What good is a saw-mill without a forest, a fishing boat without populations of fish, a refinery without petroleum deposits, an irrigated farm without an aquifer or river? We have long recognized the complementarity between public infrastructure and private capital - what good is a car or truck without roads to drive on? Following Lotka and Georgescu-Roegen, we can take the concept of natural capital even further and distinguish between *endosomatic* (within-skin) and *exosomatic* (outside-skin) natural capital. We can then ask what good is the private endosomatic capital of our lungs and respiratory system without the public exosomatic capital of green plants that take up our carbon dioxide in the short run, while in the long run replenishing the enormous atmospheric stock of oxygen and keeping the atmosphere at the proper mix of gases - that is, the mix to which our respiratory system is adapted and therefore complementary."

Many technological innovations have not reduced our use of resources, but only substituted capital – resources and machines – for labor. In present circumstances, gains in technological efficiency often encourage increased consumption. This is especially true when economic models based on traditional unit cost measures *omit the massive substitution of fossil fuels for human labor that has underscored the nation's development of natural resources*. If new technology is to reduce our ecological footprint, it must be accompanied by policy measures to ensure that efficiency gains are not redirected to alternative forms of consumption.

G. The Ambivalent "Information Economy"

The much touted "information economy" is often presented as a strategy for escaping biophysical limits. Its modern devotees proclaim that "whereas matter and energy decay according to the laws of entropy... information is... immortal." And, further, "The universe itself is made of information - matter and energy are only simple forms of it." Such half-truths forget that information does not exist apart from physical brains, books, and computers, and, further, that brains require the support of bodies, books require library buildings, computers run on electricity, etc. At worst the information economy is seen as a computer-based explosion of the symbol manipulations of the paper economy. More occult powers are attributed to information and its handler, the computer, by the silicon gnostics of today, says Daly, "than any primitive shaman ever dared claim for his favorite talisman". Even well meaning advocates of environmental solutions can be seen fantasizing about the benefits of telecommunications and the Internet. Some extrapolate from the present ease of information exchange to the future existence of some great mass mind into which the human race will evolve - an organoelectric Gaia protector.

Daly [1] thinks information should be more widely accessible without excessive cost. He believes the best question to ask about the information economy is that posed by T. S. Eliot in "Choruses from 'The Rock'":

> Where is the wisdom we have lost in knowledge?
> Where is the knowledge we have lost in information?

Daly goes on to say:

> "Why stop with an information economy? Why not a knowledge economy? Why not a *wisdom economy*? Wisdom involves knowledge of techniques plus an understanding of purposes and their relative importance, along with an appreciation of the limits to which technique and purpose are subject. To distinguish a real limit from a temporary bottleneck, and a fundamental purpose from

> a wish or inclination, requires wise judgment. Growthmania cannot be checked without wise judgment. Since events are forcing us to think in terms of an information economy, it is perhaps not too much to hope that we will follow that thrust all the way to a wisdom economy, one design feature of which, I submit, will be that of a dynamic steady state.

Roughly half of world trade is intra-industry trade - that is, simultaneously exporting and importing basically the same commodity. For example, the United States imports Danish butter cookies, and the Danes import U.S. butter cookies. Somewhere on or above the North Atlantic the cookies pass each other. Surely the gains from trading such similar products cannot be large. But regardless of their size, could not these gains be had more efficiently simply by exchanging recipes?

In general, might not the free international flow of information be preferable to the flow of goods or capital? When you sell or give away information (as opposed to goods), you do not give it up - you still have it. What you give up is your monopoly, which is what gave the information its exchange value. But you still have the full use value. Once information exists, an argument can be made that its price should be zero for efficient allocation. But the cost of production of new knowledge is usually not zero, and so we reward inventors with a temporary monopoly. But might there not be a better way to reward creators of knowledge? Prizes? Grants? High salaries? Something that does not require that knowledge be kept artificially scarce?

> Knowledge is so largely a social product, in any case, that it is quite arbitrary and unjust to give property rights for minor applications of basic knowledge but not for the discovery of basic knowledge itself. Do the genetic engineers, eager to patent new organisms, share their royalties with Watson and Crick? Or with the teachers who taught them about the double helix? Or with the heirs of Gregor Mendel? The early Swiss economist Sismondi noted that inventions motivated by a desire to serve mankind are less likely to be socially destructive than inventions motivated by the desire for personal enrichment. Maybe he was right. Maybe the quality of the incentive is more important than the quantity. Maybe Thomas Jefferson was right in his statement, carved in stone at the University of Maryland's MeKeldin Library: "The field of knowledge is the common property of mankind".

H. Sustainability Alert: A Bigfoot Sighting!

Humans are facing an unprecedented challenge: there is wide agreement that the Earth's ecosystems cannot sustain current levels of economic activity and material consumption let alone increased levels. At the same time, economic activity on the globe as measured by Gross World Product is growing at four percent a year, which corresponds to a doubling time of about 18 years. One factor driving this expansion is the growth of the world's population. In 1950, there were 2.5 billion people, while today there are 5.8 billion. There may well be 10 billion people on Earth before the middle of the next century.

Even more ecologically significant is the rise in *per capita* energy and material consumption, which, in the last 40 years, has soared faster than the human population. An irresistible economy seems to be on a collision course with an immovable ecosphere.

As described by Wackernagel and Rees [4], ecological footprint analysis is an accounting tool

> "that enables us to estimate the resource consumption and waste assimilation requirements of a defined human population or economy in terms of a corresponding productive land area. Typical questions we can ask with this tool include: how dependent is our study population on resource imports from "elsewhere" and on the waste assimilation capacity of the global commons? And will nature's productivity be adequate to satisfy the rising material expectations of a growing human population into the next century?

> To introduce the thinking behind Ecological Footprint analysis, let's explore how our society perceives that pinnacle of human achievement, "the city." No question, cities are among the most spectacular achievements of human civilization. In every country cities serve as the social, cultural, communications and commercial centers of national life. But something fundamental is missing from the popular perception of the city, something that has so long been taken for granted it has simply slipped from consciousness. Imagine what would happen to any modern city or urban region - Vancouver, Philadelphia or London - as defined by its political boundaries, the area of built-up land, or the concentration of socioeconomic activities, if it were enclosed in a glass or plastic hemisphere that let in light but prevented material things of any kind from entering or leaving. The health and integrity of the entire human system so contained would depend entirely on whatever was initially trapped within the hemisphere. It is obvious to most people that such a city would cease to function and its inhabitants would perish within a few days. The population and the economy contained by the capsule would have been cut off from vital resources and essential waste sinks, leaving it both to starve and to suffocate.
>
> How large would the bubble have to become, how much surface area consisting of all of nature's services, before the city could sustain itself indefinitely and exclusively on the land and water ecosystems and the energy resources contained within the capsule? In other words, what is the total area of the terrestrial ecosystem types needed continuously to support all the social and economic activities carried out by the people of the city as they go about their daily activities? The ecological footprint represents the corresponding population's total "appropriated carrying capacity"."

Carrying capacity is not defined here as a maximum population but rather the maximum "load" that can be safely and persistently imposed on the ecosphere. Human load is not only the function of population but also of per capita consumption. The latter is increasing more rapidly than the former due to expanding trade and technology. The world is being required to accommodate not just more people but "larger" people. Using averages often misses the point about population and carrying capacity. Some approaches are as statistically inept as the famous recipe for "fifty percent rabbit stew" (one rabbit, one horse).

The studies performed by Wackernagel and Rees show that the present ecological footprint of a typical North American represents *three times his/her fair share* of the Earth's bounty. Indeed, if everyone on Earth lived like the average American or Canadian, *we would need at least three such planets to live sustainably*.

Acknowledging these facts presents us with any even bigger question. How do we provide for future generations? Robert Costanza [18] attempts to provide some insight:

> "In the age of exponential population growth, resource depletion, species extinction, and global environmental damage, the most adaptable and essential heritage which can be set aside for the future is large scale functioning ecologies, such as rain forests, estuaries, wild life sanctuaries, river basins, grasslands, wetlands, polar regions, and coral reefs. The important criterion for protecting ecologies is that they be large enough to provide contiguous habitats of air, land, and water needed by far ranging species. The policy instruments needed for intergenerational transfers of living ecologies should include economic incentives both to reduce environmental damage and to insure that part of the proceeds which result from activities which do result in environmental damage are used to acquire and protect offsetting environmental assets.
>
> The economics of intergenerational transfer has been discussed for decades. Determining the correct interest (discount) rate has been the focus of most research. This research recognizes and tries to deal with what is called the "conservationist's dilemma." Though high interest rates discourage the long term management of slow growing resources (forests) and the protection of long term environmental assets (biodiversity), high interest rates also discourage investments in projects which transform environments (dams) and in projects which are necessary to extract resources (oil wells). However, this dilemma results from a mis-specification of the problem.

Research shows that when rights are *consciously* reassigned between generations as the instrument of conservation and sustainability, interest rates are derivative – they themselves change. Unfortunately, neither economic rationality nor ecological rationality can provide the full set of data needed to determine human affairs. *The economy and the ecology of humans, the rights of future generations to the resources of their past, are embedded in politics and the exercise of political will*."

I. Three Uphill Battles to Achieve Sustainability

In a culture where much is good, more is better, and too much may not be enough, it may not seem possible to improve the quality of life while reducing our ecological footprint. We need to recognize that achieving sustainability will require fighting three uphill battles. Wackernagel and Rees [4] characterize these as *the boiled frog syndrome, mental apartheid, and the tragedy of the commons*.

"First, our reductionist propensity to focus on mere symptoms of problems or on individual events detracts from our seeing the whole. We end up ignoring - or at least failing to anticipate - the cumulative effects of individual events. Neurologist Robert Ornstein and biologist Paul Ehrlich believe that our focus on isolated and immediate incidents is linked to the way the human brain functions: slow changes, long-term implications, and multiple connections cannot easily be perceived. This can be likened to the *boiled frog syndrome*. Ornstein and Ehrlich explain that "...frogs placed in a pan of water that is slowly heated will be unable to detect the gradual but deadly trend.... Like the frogs, many people seem unable to detect the gradual but lethal trend in which population and economic growth threaten to boil civilization...."

If we do not wake up to the slow but steady deterioration of the planet, we will ultimately become victims of the "tyranny of now." Society's penchant for trading off the ecosphere in tiny bits to satisfy immediate wants is the ecological equivalent of the fire under the frog's pan. But that fire is now not just from the stove itself, but from the whole house burning down around the pan.

We also seem plagued by a form of *mental apartheid* that has erected an imposing psychological barrier between modern humans and the rest of reality. This perceptual dualism is clearly embedded in our language (which is itself a map of how we see the world). For example, the very term "environment" separates the really important stuff "in here" from everything else "out there." Our exemptionist attitude is also evident in the way we resist the notion that humankind is an integral part of nature, that we are just one of many millions of species occupying this planet. This artificial mind-body split is clearly dysfunctional at the ecological limits of a finite world; our mental apartheid must be broken down. Sustainability requires a profound sense that the fate of the ecosphere is the fate of humankind - we do not *have* a body, we *are* a body; we are not surrounded by an "environment," we are an intimate part of the ecosphere.

The third behavioral syndrome that inhibits us from acting sustainably is the so-called *tragedy of the commons* (more accurately *the tragedy of open access*). Ecologist Garrett Hardin reiterated Aristotle's wisdom that "...what is common to the greatest number gets the least amount of care..." and emphasized its tragic social implications. In general, this problem emerges whenever the benefits to an individual of (over-) exploiting an open-access resource exceed that individual's share of the resulting damage costs. Hardin compared an individual shepherd's gain from increasing his/her herd size on an open pasture to the same shepherd's share of the costs of doing so. Since the net benefits will always seem greater to the individual shepherd, each has a continuing incentive to add more animals to the pasture, eventually destroying it for all. Even if one good shepherd recognizes the imminent tragedy there is no incentive for him/her to exercise personal restraint - someone else will simply fill the void. We see this particularly clearly in the fate of today's ocean fisheries."

Wackernagel has continued to expand the ecological footprint concept internationally through his organization: Global Footprint Network, www.footprintnetwork.org.

J. Do Real People Really Matter?

How do the issues we've discussed so far impact real people? If you're a real person, think about your own situation. The following stories are not meant to be lessons, but explorations. Feel yourself in these places, living and working. What are your hopes? What do you want for your family? What's your next career move? Do you have free will? What are the forces driving you?

1. Hong Kong: Boom Town

While working with an electronics manufacturing company in Honk Kong years ago, I was immersed in an environment of rapid growth, financial success, international business cooperation, and the palpable positive energy of the people. Many Hong Kong business people had become wealthy through the movement of manufacturing from the United States to Hong Kong. And I was moving even more - to continue to lower our costs. But we had a difficult time finding enough workers to perform manual electronics assembly, even offering free lunches, free lunchboxes, more training. Hong Kong's sustained boom had created an upwardly mobile population and Chinese parents had high aspirations (surprise!) for their well-educated children. They wanted better paying opportunities for them, as engineers, programmers, or bankers, for example. Much of Hong Kong's manual assembly work was transferred to Thailand, and subsequently to China.

2. China: Boom Country

While making a telecommunications proposal to the Chinese government in Beijing (before Tienanmen Square), I again felt the excitement of a society with a purpose, in the midst of an economic boom and some of the freedoms it brings. The streets were filled with people (mostly on bicycles) going to their jobs. I walked freely in neighborhoods made up of small but clean apartments, seeing men and women cooking, feeding their families (usually a single child), playing in the park. In Tienanmen Square, Americans were stopped by Chinese tourists who wanted to take a picture of them with their children. My Chinese friends said that many of the people who visited Beijing on vacation from remote parts of China had never seen a tall Caucasian.

One of the city-dwellers' frustrations at the time was that they could not get telephones fast enough because the government gave telecommunications priority to the agricultural areas and towns so the farmers could better distribute their products, nationally and internationally. Unfortunately, on trips to south China I passed through cities choking on smoke from factories and power plants. On one of these trips I was with a tour group of older retired Americans. We had stopped in one of the new Chinese cities (a whole city of 10,000 - built from scratch) in a special free trade zone. The outdoor market was brand new, with clean concrete floors and tables with running water. Fresh produce was everywhere. Well-dressed people from the nearby new apartment buildings were haggling over the price of fish. Butchers were chopping up animals, but the blood was washed away by flowing water. I flashed back to my Jakarta experience as I realized how nice this market was. But when we got back on the bus all the American women could talk about was how horrible the place was. "How could people live like that!"

3. Philippines: Boom Lost

I visited my son in Manila a few years ago. He was a fashion photographer there at the time. During his second week in the Philippines he was invited to a banquet and sat next to Imelda Marcos and her son. Imelda joked about how she would help her country with the hundreds of millions of dollars she had "accumulated" previously. Imelda is now rehabilitated as a Filipino heroine, especially since the newly-

elected president at the time (a B-movie star) was her supporter. My son sat across from several rich land developers. One developer asked him to do a photo shoot of some young Filipino socialites at a resort on the island paradise of Boracay. Unfortunately he was artistically frustrated because the young ladies did not want to get up early or work very hard at being models.

At Easter we flew from Manila to Cebu to scuba dive and experienced the emotional impact of flying over literally dozens of islands with no trees. Deforestation has to be seen to be felt. As divers we knew about the reef and fish destruction being caused in the Philippines by dynamite and cyanide fishing, both for food and to supply the international aquarium trade. Two scuba divers had been killed by fishermen dropping dynamite on them. Cebu itself, which is the shipping center of the Philippines, is beautiful; the resorts on Mactan Island are great; and the diving is good.

There was still a serious drought while we were there and much of the island of Palawan was burning. International fire experts were assisting in the attempt to quench the blazes. The lack of food due to drought was so severe that people on one island were eating a known poisonous root to try to survive – apparently you became ill but only sometimes died. The president promised to send tons of emergency rice. On a deck overlooking the ocean on Mactan Island, surrounded by rich Filipinos, we had one of the best seafood buffet dinners I've ever eaten.

My son lived across from the Philippines Women's University in Malate, which is a "nice" section of Manila. But the sidewalks and curbs are filled with decaying trash. He tended to walk in the street to stay away from the garbage. Every now and then it smells as if a sewer has broken. The sky is black with smog, except after a rain, and the only snow he saw was one of fine ash and soot. Traffic clogs the streets – it takes an hour to go two miles. His Filipino friends like to take their cars out at Easter and Christmas when there is less traffic just to get the feel of driving around freely.

When you get to the business and banking section, Makati, everything is much nicer. Many foreign expatriates live there and the streets are even clean. The very rich live in another nice section of Manila, inside walled estates. One benefit of life in Manila is that you can have a live-in maid (young girls from the country) for only about two dollars a day.

The main river is a noisome sewer along which thousands of people live in shacks. An environmental movement exists but is weak. There was an environmental initiative to clean up the river, and donations were accepted in department stores. Nothing happened. Another strange sight was the line of hundreds of squatters' shacks built along the railroad tracks through the city. Main power lines follow the railroad right of way and almost every shack was pirating electricity by running wires up to the main power cable. (This is the case in many areas of India also.) But new office buildings, I counted six when I was there, were going up all over the city.

My son recently went diving in Mindoro, another Philippine island. He was told that in the last few years the average water temperature had increased to the point where sharks don't come around (considered a good thing by most divers) because they stay in the cooler depths. But the warm temperature also killed the algae that live in a symbiotic relationship with the coral organism causing massive die-offs (bleaching) of coral and creating vast areas of dead white coral heads. Having dived in many beautiful places around the world, he said that the sight of the bleached coral was eerie. He was told that it was much worse in the Gulf of Thailand. Of course, this is probably just a "statistical anomaly" and not really global climate change!

4. Honduras: The Boom Comes Down

My sons and I went on a dive trip to Roatan, Honduras the year before Hurricane Mitch. The resort owner was a member of the Honduran government and prided himself on how ecologically-friendly he had designed his resort, including expensive water and sewage treatment systems. It was a paradise and a great

place to dive with dolphins. (There were about 25 dolphins living voluntarily at the adjacent Institute for Marine Sciences.)

We took a side trip to go river rafting on the mainland near La Ceiba. A long bus trip through town and into the mountains took us past small houses built along the road and river. Although adequate, none of the dwellings would pass for a California lifestyle statement. But in several large fields along the road cardboard and tin villages had sprung up. Our guide told us these were squatter towns where landless poor people had built small shacks. Our guide happened to be an American from Colorado who had started a river-rafting company and bought land on a beautiful beach for his dream house in the tropics. He had partnered with a river rafting company in Colorado so that when it was winter in Colorado they would bring the rafts from the Colorado River operation down to Honduras – very synergistic.

Although the Honduran economy was mainly based on export crops, we saw new industrial parks (much clothing manufacturing) being built near the expanded and modernized airport in San Pedro Sula (better than the airport in Tegucigalpa, the capital). Apparently Honduras was considered a stable enough political environment for manufacturing investment by the international financial community, at least before the hurricane.

Hurricane Mitch later destroyed sixteen of sixty cabins at our resort and all the dolphins fled. It was closed for three months for repairs. All but five of the dolphins had returned within a week of the hurricane. The rest of Honduras did not fare as well, and I don't know what happened to our rafting guide's dream home. Commentators said the situation is like the United States having 40 million people homeless after a big storm! La Ceiba had heavy damage, as did the Sula Valley. People actually broke into the clothing plants in San Pedro Sula to scavenge material for clothes. It is commonly recognized that much of the flood damage was caused by excessive deforestation of the hillsides, not by logging companies but by the migrant poor clearcutting to build small houses and cook food. One Honduran leader, speaking on American television, proposed that his country now had an opportunity to rebuild without repeating its original mistakes and to create a society that was more sustainable. Unfortunately, stories of corruption and graft were also circulating – much food and money was not actually getting to the people who need it most.

My teenage son and I worked for several days at a local church packing donated food and clothing for Honduran relief. The donations never stopped. Truckloads of clothes and supplies were brought in by local people cleaning out their drawers and closets. Much of it was junk and inappropriate for use in Honduras (ski jackets, formal clothes, jewelry and makeup, outdated pharmaceuticals). From what I saw I couldn't understand why people had bought some of it in the first place.

5. Switzerland: Your Boom, My Boom

On a trip to Switzerland a few years ago I couldn't find any poor people (I think they're actually banned by law in Zurich)! Banking and skimming the froth off the top of international financial transactions appears to provide enough income to support even the least skilled but hard working citizen through various subsidies. The Swiss low-income housing was comparable to high-priced apartments in many other countries. No cardboard villages or muddy subsistence markets were in evidence, but they are no doubt part of the Swiss ecological footprint. It's an exceedingly beautiful country with houses and villages located on the sides of mountains I thought only an eagle could reach. Every square inch that can be is cultivated, and very aesthetically at that. A train ride from Brig to Laussane along Lake Geneva takes you through miles of vineyards with occasional huge natural gas pipelines and high voltage power lines dropping from over the mountains into the valley. Switzerland, which has a positive "dollar" trade balance, provides little ecological productivity (even if you could live on wine and chocolate) to the world, while importing a great deal from other places to maintain its high levels of consumption.

6. Gedanken Americans: What's Your Sympathy Factor?

After traveling the world, let's bring our economic principles closer to home. In science we do something called "gedanken" experiments – thought experiments – which let you create a set of assumptions and see where the physics leads you. I want to create just a few gedanken Americans and see where the economics leads you. Try to become these people. Again, these aren't lessons but hopefully your personal explorations of *Homo economicus*, the invisible hand, and fairness (if that can even be defined). You may want to consider them extra credit questions on your Economics 101 exam.

1. You're a factory worker. You just lost your job (choose one):
   - Your company moved production to Mexico or Malaysia.
   - Your company went out of business since it didn't move production to Mexico to lower costs.
   - There was a downturn in the Asian economy so your company's sales dropped.

   You have no savings because you've been paying your ex-wife child support. There are no jobs available. What do you do?

2. You're a bank teller who just lost her job to an ATM machine. Your ex-husband has not paid child support since he lost his job. You have no money or food, and your baby is crying. It's 4:30 PM Friday. What do you do?

3. You're a low-paid welfare worker for the county. It's 4:45 PM on Friday. You're looking forward to going home in fifteen minutes to spend the weekend with your family, although you need to go shopping for school clothes. You'll have to check the thrift stores because your credit card is at the limit. A crying woman with a baby comes into the waiting room asking for emergency assistance, which will take at least an hour of paperwork. What do you do?

4. You're a manufacturing manager who just laid off 200 workers in a cost cutting move. It's Friday at 6:00 PM. As you drive home past the Welfare Department, you stop for a woman with a baby in the crosswalk. You wish you could spend time with your family this weekend, but you were told to finish that financial analysis, by Monday, to decide whether to move the rest of your manufacturing operation to either China or Mexico. What do you do?

5. You're the CEO of a company that has had a good but not exceptional year. You think you probably should have fired more workers sooner, but at least moving the rest of manufacturing to China should help because you can also get rid of a whole layer of middle management. Unfortunately, your bonus will only be $500,000 this year and the yacht you had your heart set on runs $750,000. What do you do?

6. You're a salmon fisherman with a 50-foot fishing boat, which is still mortgaged to the bank. The number of wild salmon has decreased. The price has also gone down due to competition with salmon from fish farms. You're barely breaking even and are thinking about buying new sonar gear to begin to fish for another species which you hope you can find more easily. The sonar costs as much as the new personal computer you'd been thinking about buying so you could get training for a new job. But the company in town you wanted to work for moved to Mexico. What do you do?

7. You're a restaurant owner in a logging part of the country. The sawmill isn't running anymore because the timber company has started sending whole logs to Japan rather than milling them locally. Your daughter is in college taking environmental studies and you're helping her with her tuition although business is getting worse. The local chamber of commerce is supporting the timber company's move to weaken the endangered species act, but you think something else may be the culprit. What do you do?

8. You're a lawyer working with several large corporations on mergers and acquisitions. You just built a new house in a semi-rural area. A large telecommunications company you work with wants to put up a huge microwave tower on the hill above your house and have the county build an access road along your property line. Your neighbors are concerned about the development and the possible electromagnetic radiation issues. They band together to fight the development and ask for your help. What do you do?

9. You're a teacher, bus driver, stockbroker, banker, carpenter, student, housewife, photographer, software engineer, marketing manager, sales person, economist, travel agent… Make one up yourself. What do you do?

10. You die without doing anything. Now what do you do?