RESOURCE CONSTRAINTS: THE NEED FOR COMMUNITY MANAGEMENT IN ECONOMIC DEVELOPMENT STRATEGIES

BY:

Skip Laitner
Chief, Research Division
Nebraska Energy Office
P.O. Box 95085
Lincoln, Nebraska 68509-5085
(402) 471-2867

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INTRODUCTION

An increasing number of American communities are under a state of of economic siege. Economic pressures surround many of our mid-sized and smaller towns, forcing them to surrender their labor and resources to the larger metropolitan areas. Alleged production inefficiencies and tax policies are among the forces of transition. As a last resort, many communities are told they either "can plan or dry up" (1). For the most part, "planning" consists of promotional efforts to lure a new industry into town.

Under the "smokestack-chasing" paradigm it is believed that to survive the economic challenges, new production and a larger export base must be created. For smaller communities to reach new levels of output, they must link their economies with the larger production economies. In effect, they must be annexed as part of the global village. But a declining resource base is slowing the momentum of economic activity in an almost invisible manner. Before appropriate solutions to this growing stalemate can be identified, one has to be willing to ask new questions.

At best there is only a grudging recognition of resource constraints. Moreover, the metaphor of the global village expands the influence of transnational corporation in the economic process. Since the interests of corporation differ significantly from the community, the institution of the community may be eroded over time. This homogenization reduces the diversity of activities and perspectives which strengthens the evolutionary potential of the economic process. These and other concerns have prompted David Morris to suggest that perhaps the metaphor should be changed from "a village globe to a globe of villages" (2). Based upon the discussion which follows, I agree.

PRESENT MODELS OF DEVELOPMENT

Most policy discussions concerning national and world economies are rooted in some form of an export base theory. These, in turn, are framed in a Clark-Fisher development model. The model suggests that economic development, fueled by export activities, is a function of structural change. As summarized by William Miernyk:

> The propulsive force of economic development in the Clark-Fisher model is technological progress and gains in productivity which new technology engenders. Technological progress in the primary sectors of agriculture, forestry and fisheries leads to increases in output while reducing labor requirements. More labor is thus made available to the secondary sectors of manufacturing, construction, mining and electric power generation. Later, as an economy (national or regional) becomes industrialized, further technological progress in the secondary sector releases labor for employment in the trades and services which are called 'tertiary activities' (Miernyk, 1977).

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1. See, for example, a September, 1984 Lincoln Star article: "Towns under 5,000 can plan or dry up."

2. Personal conversation with David Morris in Lincoln, Nebraska, March 27, 1986.

As Miernyk explains, the Clark-Fisher theory stands up well through the mid-1960s. The emergence of resource constraints in the late 1960s, however, suggests that a new development model may be needed. Generally abundant and inexpensive through the 1960s, the costs and availability of natural resources are now a major, if sometimes a less than visible, influence in the world economy. Examples of the influence include the post 1973-74 rise in energy prices, spot shortages in minerals and an increased dependence upon lower grade deposits or iron, bauxite and copper ores.

RESOURCE CONTRAINTS AND SHORTCOMINGS IN DEVELOPMENT THEORY

The shortcomings of prevailing development models can be examined through the well-known Cobb-Douglas production function,

$$Q = ax_1^{b_1} x_2^{b_2} \ldots x_n^{b_n}$$

where x_1 x_2 $\ldots x_n$ are factors of production (3). The values a and $b_1 \ldots b_n$ are parameters and $b_1 + b_2 + \ldots b_n = 1$. In our simplified model we will be concerned with the output generated by the use of capital (K), labor (L) and resources (R). These are arranged as

$$Q = 1000\ K^{b_1} L^{b_2} R^{b_3}$$

In our hypothetical economy our factors of production all have a value of 50. The respective parameters are found to have values of .33, .33 and .34. Using logs to find the output, Q, we then find the following

$$\log Q = \log 1000 + .33 \log 50 + .33 \log 50 + .34 \log 50$$

$$\log Q = 3 + .33(1.69897) + .33(1.69897) + .34(1.69897)$$

$$Q = \text{antilog } 4.699$$

$$Q = 50{,}000$$

Under these conditions our economy has an annual output of 50,000 units. If we find resource constraints causing the value of R to drop from 50 to 40, the output, Q, similarly would drop. Using the same procedure above, when R = 40, Q drops to an output of 46,350 units. This represents roughly a seven percent drop in output as a result of a 20% decrease in the value of resources.

Conventional development theory tells us that productivity gains in either capital or labor can offset the decline in resources. Intuitively this possibility will fall short at some point since capital and labor consume resources; and they are a form of embodied resources.

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3. Ironically, typical discussions of production functions ignore resource factors and concentrate instead upon capital and labor. See, for instance, Economics (1980) by Michael Bradley, page 156.

We can test the extent to which productivity in the other factors can compensate for the declining resource base. Returning to our model -- with all elements remaining the same, changing only the value of R to 40 and solving for K -- we find that K must increase to 63 to maintain an output of 50,000 units. In other words, the productive use of capital must rise by 26% to offset the 20% loss of resources (that is, going from 50 to 40).

Suppose we find that a larger population demands a 20% increase in output, where Q would then equal 60,000. The value of K must rise to 75. This implies that with a decreased resource base, a 20% increase in output can occur only if K (in this example) jumps by 50%. And remembering that capital is an embodied form of resources (and labor), one wonders how far we can continue with such solutions.

Evidence of the Growing Problem

In general the exploitation of natural resources in the last 200 years has continued, seemingly with little prospect of shortages. Declining copper ore deposits, for instance, could be offset by new capital investment that allowed more tons of ore to be mined. Thus, costs continued to decrease while proven reserves of new minerals increased -- this despite the higher levels of work to produce a given level of output. New research suggests, however, that the paradox of higher work costs and decreasing total costs is the result of decreasing energy costs. Cheap energy provided a convenient means to augment the output without causing overall price increases. As we find that limits on energy conversion and mining efficiencies are being reached, and that real energy costs are increasing, the ability to turn reserves into useful ores may be diminishing (Cook, 1976; Costanza, 1980; and Cleveland, et al, 1984).

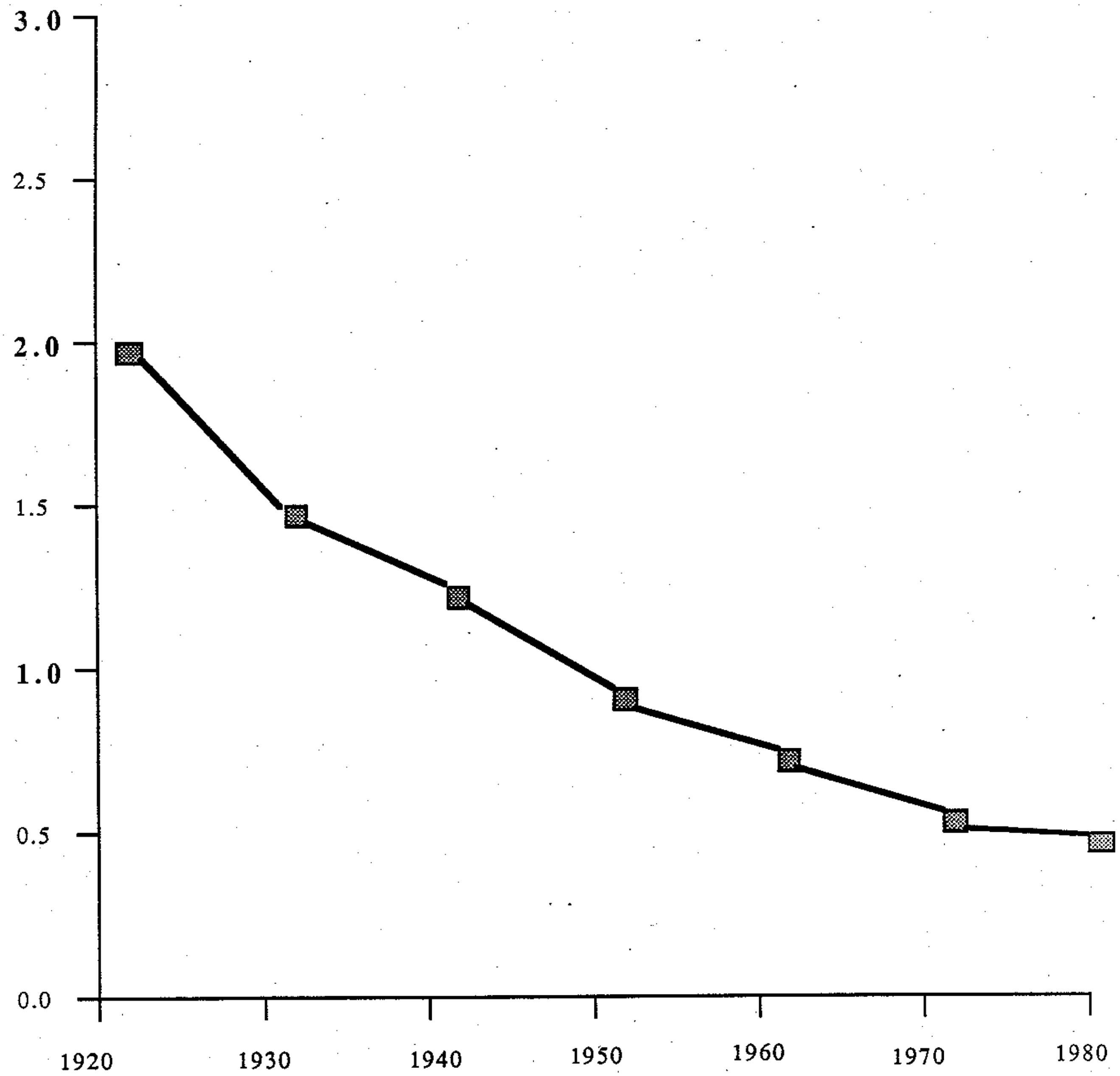
Declining mineral bases are evident in a number of examples. The hematite ores of the Mesabi range in Minnesota are depleted. Instead of mining ores with 60% iron, we are now using the familiar taconite ores with only 25% iron content. As Figure 1 shows, the quality of U.S. copper ore deposits has been eroded over the last 60 years. Figure 2 illustrates the energy requirements of extracting a ton of copper from different ore deposits. Finally, Figure 3 surveys the production of metals in the U.S. as a ratio of energy inputs.

Some observers argue that increased energy efficiencies might offset other declining resources (Goeller and Weinberg, 1976). Such improvements, they suggest, either would allow replacement of new materials for already depleted reserves, or they would extend existing reserves well into the foreseeable future. Still, as Robert Costanza notes:

> Most proposals to increase the "energy efficiency" of economic activity are ultimately based on the assumption of mutual independence of primary factors, since increasing energy efficiency entails substituting other primary factors (capital, labor, government services, or other natural resources) for fuel inputs. The question is: Are the conventional primary factors -- capital, labor, natural resources and government resources -- free from indirect energy costs? A strong case can be made for the contention that they are not (Costanza, 1980).

FIGURE 1

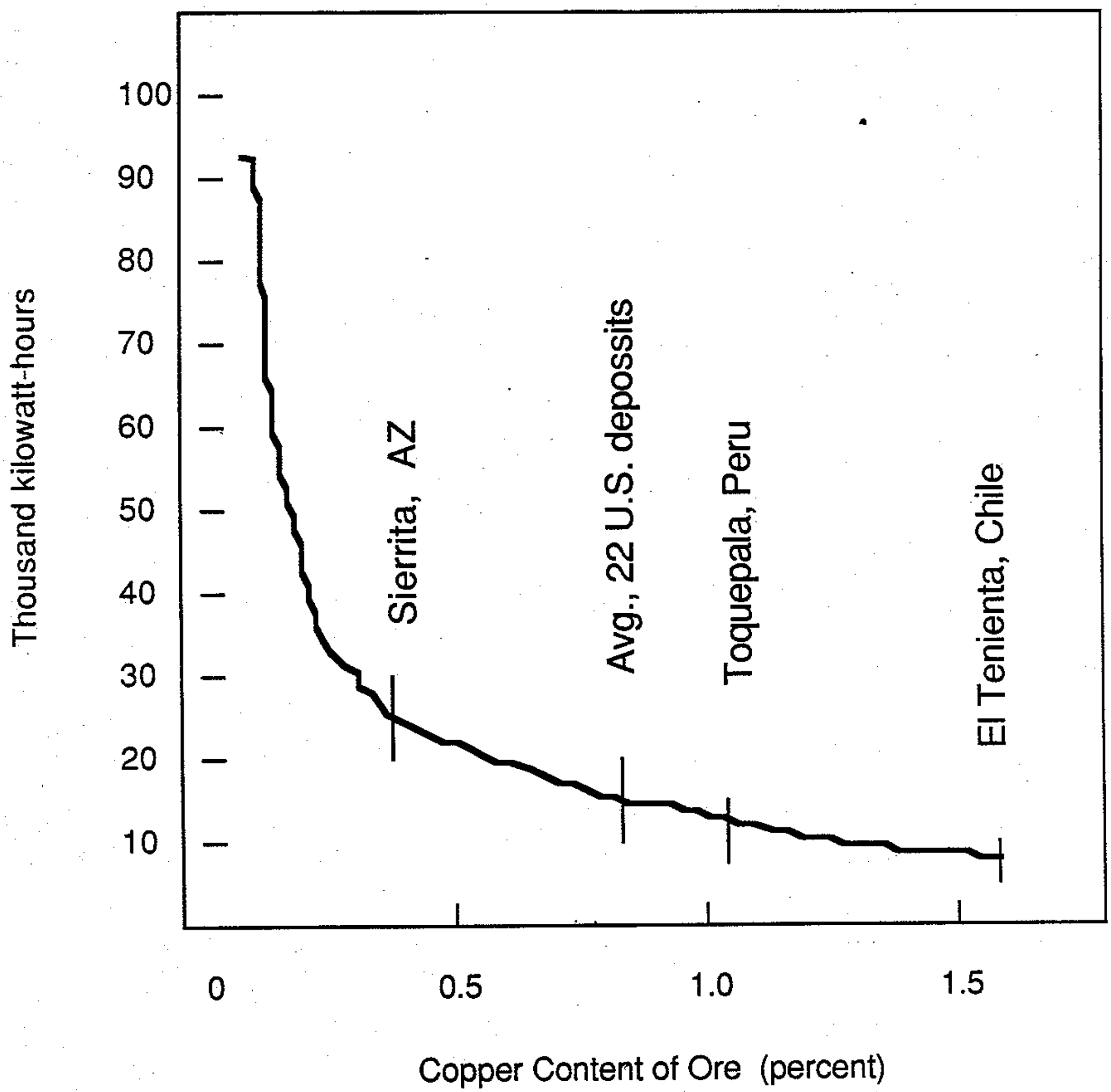
Quality of U.S. Copper Ores



Source: Cutler J. Cleveland, et al, "Energy and the U.S. Economy: A Biophysical Perspective." Science 225 (1984), 890-897.

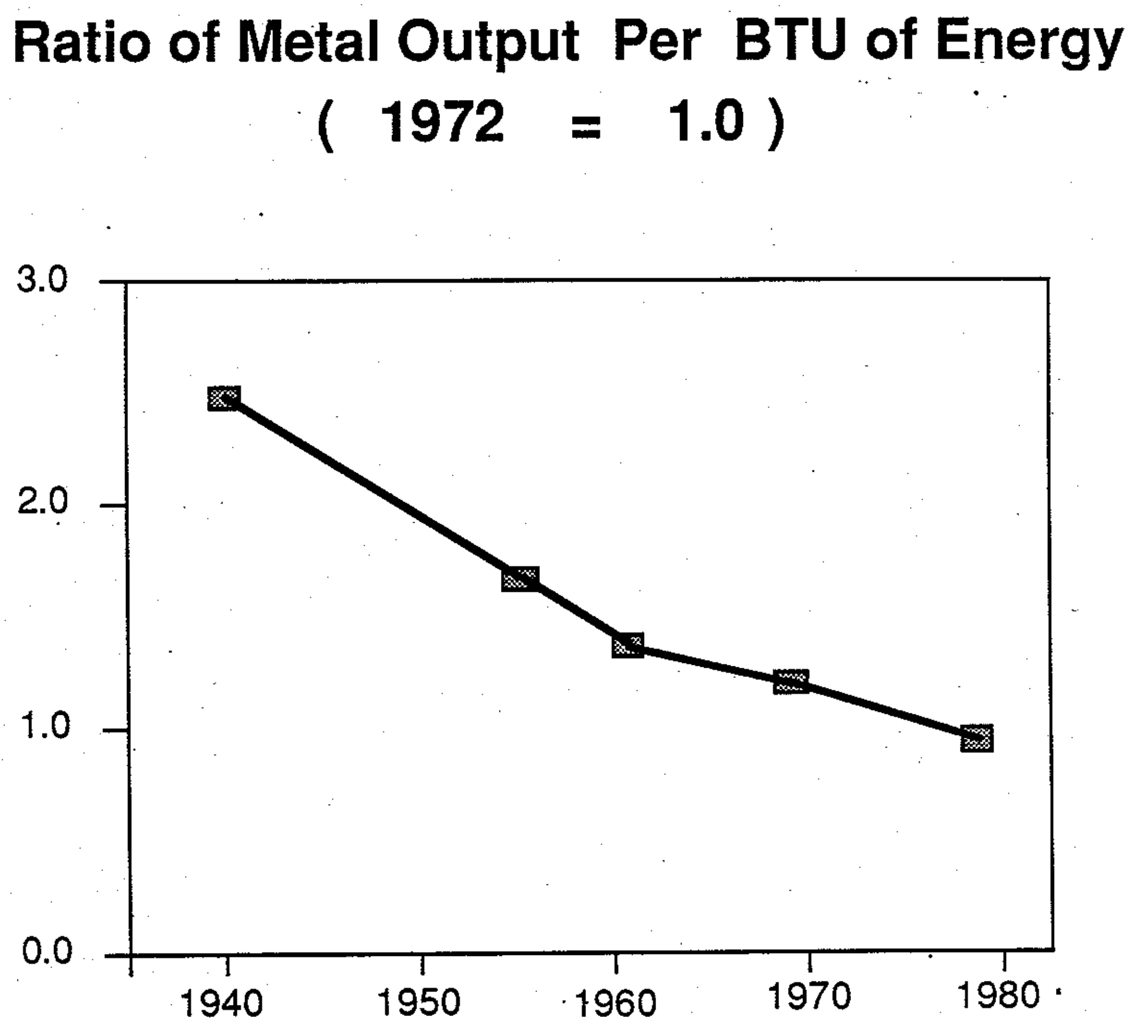
Figure 2

Quantity of Energy Required to Extract a Ton of Copper from Different Quality Deposits



Source: Earl Cook, "Limits to Exploitation of Nonrenewable Resources." <u>Science</u> 191 (1976), 677-82.

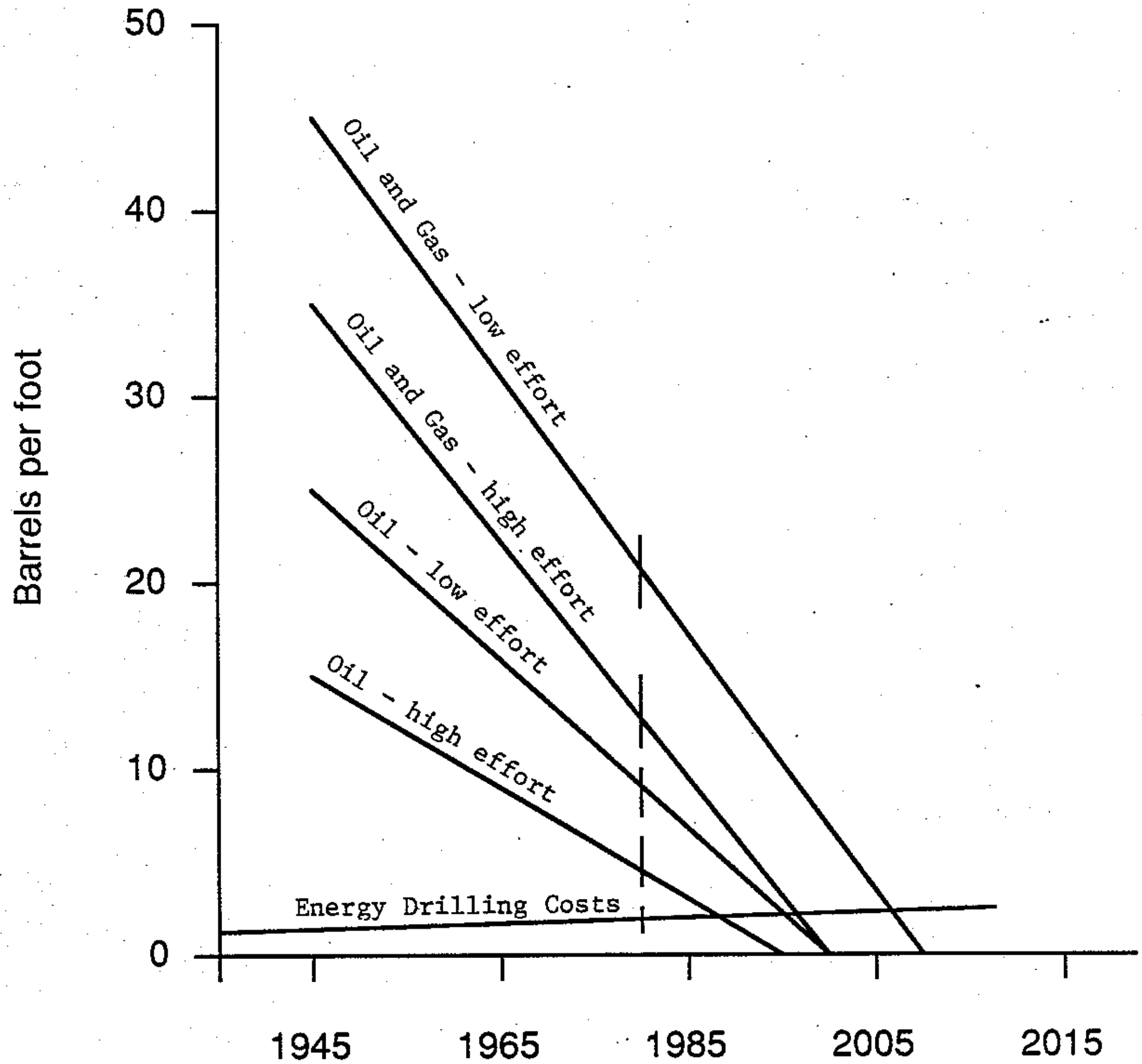
Figure 3



Source: Cleveland, et al. "Energy and the U.S. Economy."

Figure 4

Ratio Between Oil and Gas Found per Foot of Well Drilled and the Energy Costs of Drilling a Foot of Well.



Source: Hall and Cleveland, "Petroleum and Production in the United States: Yield per Effort and Net Energy Analysis," Science, 211 (1981): 576.

Using a 1967 data base, Costanza evaluated a number of sectors in the U.S. economy for their embodied energy intensities. This includes not only the direct energy to operate the machinery at the coal mines, for example, but also the energy to produce the machinery and to maintain the work force. Considering the full energy costs, surprisingly small differences in overall energy intensity were found among the various sectors. Moving toward a service economy, therefore, may not reduce greatly the total energy required. Indeed, Constaza concludes that "decoupling energy and economic activity by simply shifting production between sectors [for example, by relying on a more service rather than a production-oriented economy] is not a real possibility" (Costanza, 1980).

Other research shows that while production of energy now yields a strong net energy gain, this advantage may be lost early next century. Hall and Cleveland suggest that we should compare the rising energy costs of producing oil and natural gas against their increasingly smaller gains. Extrapolating these trends into the future indicates the production of oil and natural gas "could cease to be a net source of energy by about 2004" (1981). Figure 4 summarizes the results of their work. The deeper we drill for oil and gas, or the more we move to enhanced recovery techniques, the less we generate per foot of producing well.

In Figure 4, at the point in which the yield per foot of well fails to offset the energy costs necessary to extract the petroleum, conventional production in that year is no longer a net energy producer. If the drilling and extraction of energy requires as much energy as they produce, our ability to take advantage of lower-grade mineral deposits is seriously eroded. One can see, therefore, that approaching the economy from an embodied energy perspective begins to change the way we solve other production problems. As one paper suggests:

> If we are to sustain current levels of economic growth and productivity as minimum long-run goals, alternative fuel technologies with [energy return ratios] comparable to that of petroleum today must be developed, or there must be unprecedented improvements in the efficiency with which we use fuel to produce economic output" (Cleveland, et al, 1984).

What the emerging evidence suggests, then, is that the emphasis of development should be shifted to improved energy and other resource efficiencies. Continuing to pursue a larger and larger output while ignoring the greater efficiencies that are possible may only aggravate the nagging resource problem.

Employment and Production Constraints

But a community's larger interest is not the use of resources. Rather, it is looking for new employment and income opportunities. This means that it needs to pay attention to more than resource limits. Within the constraints of declining resources it must identify specific uses of those resources which provide the desired income effect. And each use of resources creates a different (that is, a larger or smaller) employment effect.

A study undertaken by the Nebraska Energy Office suggests that energy efficiency improvements may provide more jobs than use of conventional fuels (Laitner, 1985). Table A underscores this point. The employment effect is measured according to the jobs-hours of work supported by a dollar's investment in a specific technology (4). The data cited in the table are based upon the expected impacts within Fremont, Nebraska (population 24,000).

With few exceptions, the variety of energy efficiency improvements in a community tends to be more labor-intensive than the purchase of conventional energy supplies. There are several reasons for this impact. First, more people are put to work manufacturing and installing the improvements compared to those employed through oil, natural gas or electrical production. Second, more of the dollar invested in efficiency improvements tends to remain within the local economy compared to money spent on conventional fuels. Finally, if the improvements pay for themselves within a ten-year period, there is a higher annual income effect which recurs year after year.

It is interesting to note that the largest gain in employment over time appears from the substitution effect -- the employment generated by the spending of money saved by the improvements. As concerns about employment levels continue to mount, a "business-as-usual" approach to fuel usage may actually restrict our ability to create new jobs for a growing workforce.

Conservation Versus Preservation

Biologist use the term conservation "to denote policies and programmes (sic) for the long-term retention of natural communities under conditions which provide for continuing evolution". This meaning is contrasted to preservation "which provides for the maintenance of individual or groups but not for evolutionary change" (Frankel and Soule, 1981, p. 6).

The evolutionary response is seen as "a condition of long-term survival" since environmental change requires the capacity for continuous adaption (Ibid., p. 95). Disregarding today the reality of a declining resource base in our efforts to meet the economic challenges, denies future generations of the evolutionary prospect. What impact will that have on the expectation of 16-year olds who need a strong sense of future to mature as creative adults? With that perspective, a third area of constraint is to use resources in a way to enhance our "capacity for continuous adaption."

A MATTER OF COMMUNITY DESIGN

"We make the world by the questions we ask," says physicist John Wheeler, explaining the significance of recent discoveries in the world of quantum physics (as cited in Laitner, 1985b). Asking the right questions enabled Wheeler and his colleagues to identify the quark, a unit of matter 100 million times smaller than the atom. No one has ever actually seen the tiny subatomic particle. Yet researchers have used evidence of its existence to spark innovations in computer technology and medicine. Such advances have been made because a few pioneering scientists were willing to "make the world" by asking new questions, and by redefining their points of reference.

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4. The methodology used to estimate the relative labor impacts is largely a descriptive tool for policymakers rather than a predictive one. Persons wishing more information about the use of this measurement tool should contact the author.

TABLE A

PRELIMINARY 10-YEAR ESTIMATES OF LABOR INTENSITIES
FOR SELECTED ONE-TIME ENERGY PURCHASES IN FREMONT, NEBRASKA

Purchase	Job-hours per dollar of initial investment
Hot Water Heater Blankets	.72
Wood Stoves	.74
Gas Furnace - 93% efficient	.38
Setback Thermostats	.38
Ceiling Insulation	.35
High Efficient Refridgerators	.31
Commercial Lighting Retrofit	.29
Commercial Air Conditioning	.24
Superinsulated Home	.19
Industrial Motor Retrofits	.19
Street Lighting Improvements	.12
10-kilowatt Wind System	.09
Utility Generated Electricity	.04
Natural Gas	.02

a. Included in the measurement of labor intensities are: 1) the direct and indirect effects of the installation of improvements or the purchase of energy; 2) the induced effects of people now employed who spend their money within the community; and 3) and the income effects of annual dollar savings, if any, over a ten-year period.

b. To determine the relative job impact of a specific measure in Fremont, one would multiply the job-hour co-efficient by the total investment. This would then be divided by 1960, the number of average work hours in a year. For example, suppose the City of Fremont bought $20,000 worth of water heater blankets and simply distributed them free to its residents. Over a ten-year period the employment effect would be: $20,000 / .72 job-hours per dollar of investment / 1960 hours per year, or 7.3 job-years of work.

In a similar manner, if we are to effectively promote a resource utilization that enhances our evolutionary potential, a new decision-making framework is needed. The existing paradigm tends to restrict decisions to those which foster a corporate well-being, arguing: "What's good for GM is good for America." Strengthening instead the role of the community may provide the innovations that better enhance an evolutionary potential in spite of resource limitations. If it is the human potential that is the focus of evolution, then the paradigm should be framed: "What's good for the community, should then become a good business."

The community is defined by its human relationships and activities. Corporations, by nature, are defined by their chartered purpose. Communities produce goods and services for their ability to generate a livelihood and a furtherance of the human potential. Corporate investment, on the other hand, is channelled into the production of goods and services to earn a return on that investment -- a more restrictive purpose that often pre-empts innovation and adaptation.

When issues are framed locally, individuals within a community are not as overwhelmed by the scale of the problem. Solutions appear more manageable. Hence, they are more likely to act. And with a community definition of scale, it is easier to for human activity to adapt to the local resource base. For example, Nebraska has rich deposits of sand. Rather than depend upon imported lumber from the South or the Northwest, communities there might have developed some time ago a ceramics industry as its source of local building materials. And it might have built that industry with new efficiencies which only minimally disrupt the local environment.

The dynamics of the economy indicate a stronger community orientation is warranted in other ways as well. A growing list of studies suggest that each year 8-10% of all jobs are lost. Moreover, small businesses are creating three to four times the number of jobs as large corporations. In fact, the Fortune 500 companies have fewer employees today then in 1970. And the fastest growth has the highest costs (Birch, 1984). Community-scale enterprises foster a diversity of enterprise that is better suited to a volatile and changing economy. Systems can be tinkered with, and adjustments can be made earlier in the production process. These facts suggest a community rather than a corporate-scale may be more suitable for long-term development, especially within the boundary of limited resources.

An illustration from the housing sector underscores the importance of beginning economic response efforts with an appropriate design. In many ways the traditional housing market is controlled more for the convenience of the contractor rather than the owner/occupant. As a result, homes are built for ease and speed of construction. Also, initial costs are purposely kept low to move them off the market as quickly as possible. One consequence of the contractor-oriented market is that new homes -- even today -- tend to be energy inefficient.

Typical 1300 square foot homes in Nebraska require perhaps 100 million Btus of energy to maintain in winter comfort level of 68 degrees. At current prices for natural gas, the homeowner must pay almost $600 per year on heat. Using presently available technologies and easily understood designs, and incorporating a homeowner's perspective rather than a contractor's, homes have been built which cost only a few dollars per year to heat, even in cold winter climates.

In blending energy efficiency design principles with the longer-term operating costs of the homeowner, ingenious ways have been found to reduce the thermal load of a dwelling. What is especially intriguing is that this dramatic change in energy requirements does not depend upon any one measure or technology. The result is achieved instead through an amalgam of small steps. When they are properly designed, a series of small changes can add up to a drastic curtailment of heating demand. A similar parallel should be drawn to a community-based resource policy that supports new employment through efficiency improvements (5).

CONCLUSION

In the current economic climate, and for the foreseeable future, resource policies which emphasize efficiency improvements can pull previously fragmented development strategies into a cohesive economic tool. Such policies should be viewed by a catalysts that can help a community -- and from there a state or even a nation -- achieve its larger social goals such as an enhanced employment base. To achieve this potential, we must divorce ourselves from unproductive past concepts. The new planning constructs should:

*** Anticipate resource constraints into development plans. Such constraints may be brought about either by physical shortages or through limitations imposed by political or economic conditions.

*** Reintroduce the community as the focus of resource management and development decisions. It is not only the fundamental unit of decision-making outside the family environment, but community-scale strategies may yield more innovative and flexible development plans that reflect a volatile economy.

*** Acknowledge that increased expenditures for new resource development are not necessarily supportive of a community's need for more employment or gains in disposable income. Resource efficiency and a diversity of small development measures, coordinated by improved program design, should be emphasized.

The key element of future development policies is to ensure that community economic and social goals, within the boundaries of resource constraints, shape the decision making process. Without such considerations, neither communities nor corporations will be able to deal effectively with the erosion of the natural resource base. The new metaphor, then, should be a "globe of villages" rather than a "global village".

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5. Within the Nebraska Energy Office, this concept is referred to as 'infragrowth" -- the development of a local economy from within by the efficient use of locally available resources.

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