increase energy conversion productivity by 50 percent. MHD physics and technology are based directly on space-aged technology, and are yet to be implemented.

Agriculture—Food production, processing, and treatment are some of the greatest potential beneficiaries of space technology. Remote sensing satellites, developed, launched, and operated by NASA, have saved farmers billions of dollars in preventing the spread of plant disease. They have alerted them to possible floods by estimating spring run-off from winter snowfalls.

Farmers have been alerted to impending hurricanes and other damaging weather conditions by NASA-developed weather satellites, and for the first time, global food planning has been possible.

The lack of investment capital for developing nations to build the infrastructure and data handling facilities to make use of Landsat remote sensing data has hampered the full deployment of this great revolution in planning, nurturing, and processing the world's food.

Medicine—The productivity of a nation surely depends on the health and life expectancy of its greatest resource—its people. The artificial heart used to save the life of Dr. Barney Clark just weeks ago was the result of applied NASA resources—both the materials and people that had been developed by the space program created the artificial heart.

Telemetry technology needed to monitor the life functions of astronauts millions of miles away is now used to monitor the life functions of infants in incubators. Infrared scanner devices developed by the Marshall Center during the Apollo effort are used in breast cancer diagnosis as well as in industry. New generations of military sensing techniques will find highly precise medical applications.

Artificial limbs were created by applying the remote handling devices used by NASA in space and by the nuclear industry. Mass spectrometers preset to collect and analyze the atmosphere, a pilot's breath, the space environment, and the soil of Mars are now used in over 200 intensive care hospital units to measure eight critical complements of a patient's breath. All of these applications increase the productivity of the U.S. workforce.

NASA-derived technology led the infusion of new technology into the commercial economy over the 1960s. Advancements from our smaller but yet significant space program of the 1970s, by and large, never entered the marketplace in significant scale. Our productivity over those last twelve years has reflected the fact that we have allowed the by-products of our space investment to sit on shelves or in laboratories, and have not put them to work.

Now, with a national commitment to beam weapon development, a space colonization program, and the introduction of fusion energy and the plasma age, the United States can leap forward in productivity immediately by simply deploying the ready technology of our past research efforts, and plan continuing waves of new technology as these programs go forward.

How beam weapons would spur recovery

by Sylvia Brewda

The economic effect of the U.S. beam-weapon development program put forward by the National Democratic Policy Committee has been analyzed using the LaRouche-Riemann model, the only economic method competent to assess the type of non-linear changes that such a high-technology program would bring about. Model runs produced by the Economics Research Group of the Fusion Energy Foundation led to two simple conclusions:

- Without such a science driver, the U.S. economy is now so ruined that even sane credit policies will not save it.
- With the productivity improvements to be immediately gained from the adoption of the NDPC program, the economy will move rapidly to recovery and growth.

Global productivity impact

An approximate estimate of the global productivity impact of an aggressive beam weapon development and deployment program was devised using the following steps:

1) Estimate of overall efficiency impact of NASA spending during the 1960s as template for estimate of beam weapon program. A large number of correlation studies were done and it was found that close correlation exists between the amount of change of NASA expenditures and the ratio of factor productivity (total tangible profit divided by total tangible input costs) and gross capital investment lagged by one year.

2) A base run of the U.S. economy over the period 1984 to 1989. This base run, even giving very generous estimates for extrapolation of trends that have existed in the U.S. economy and assumptions of maximal efficiency in deployment of existing technologies, shows very slow growth over the coming period. Even after assuming that an initial push could be given to the economy by rationalization, the growth rate levels off to near zero by the end of the period. The accumulated obsolescence and "entropy" in the U.S. economy is too great to overcome by incremental measures.

3) The application of the observed correlation to a beam weapon spending profile that totals $30 billion over 3 years and which grows rapidly between 1982 and 1987, and levels

Figure 1 : NASA R&D SPENDING IN THE U.S. ECONOMY

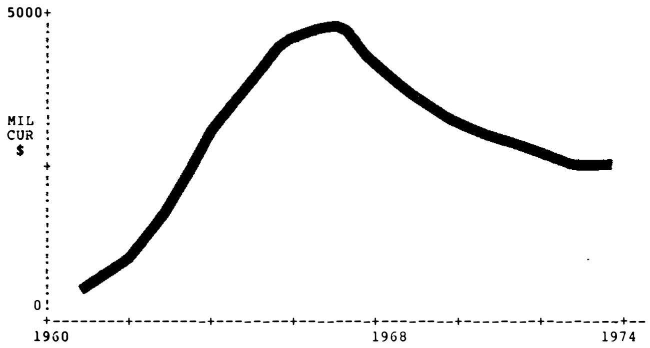


Figure 2: CHANGES IN NASA SPENDING

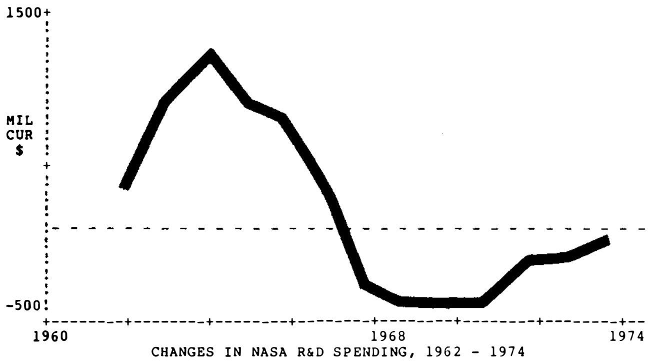


Figure 3: TIME COURSE OF FACTOR PRODUCTIVITY (S/C+V)

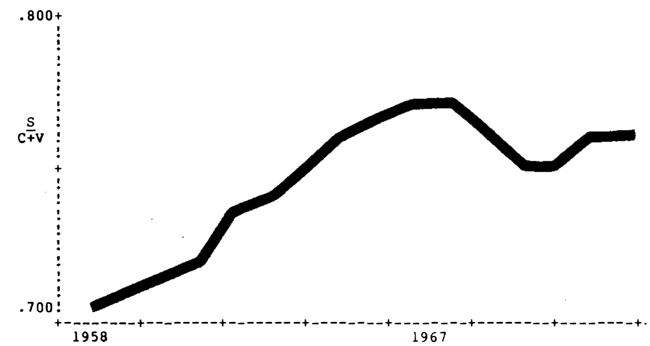


Figure 4 : Correlation (r-squared = 0.8587) between absolute amounts of changes in planned NASA R&D (non-administrative) spending and the effectiveness of total capital investment in producing factor productivity

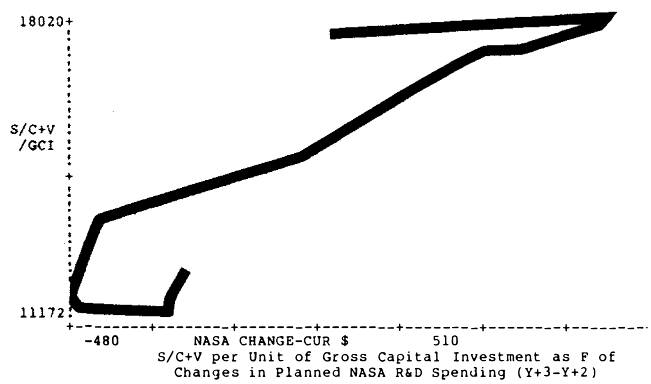


Figure 5: Time course of Gross Capital Investment

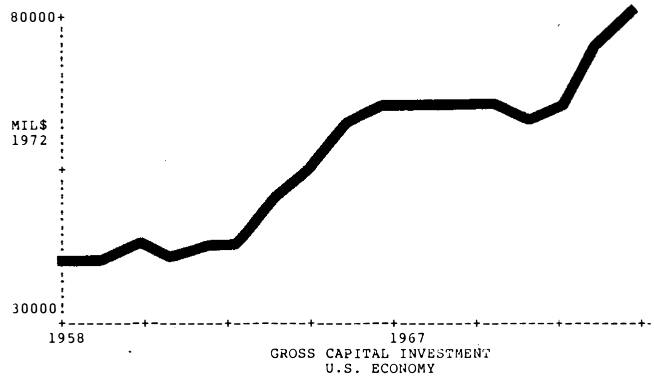


Figure 6: Total Surplus in U.S. Economy

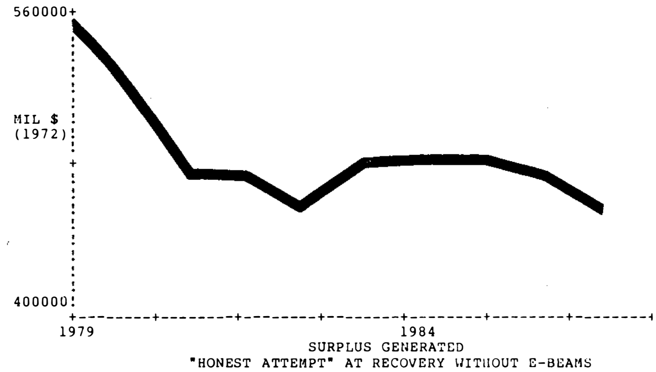


Figure 7: S/C+V or factor productivity

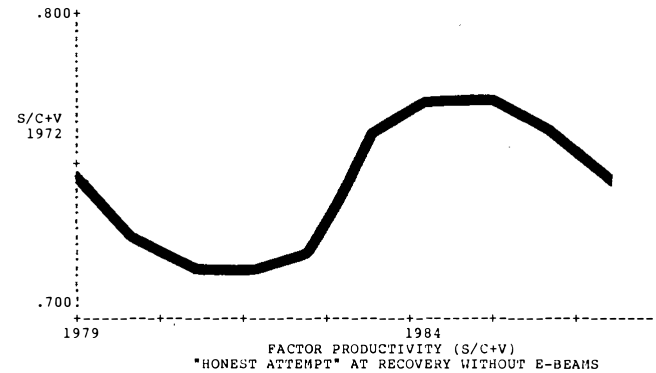


Figure 8: S'/C+V or instantaneous growth impulse

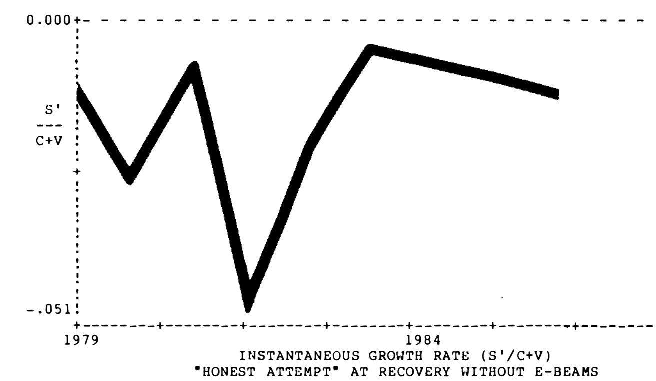
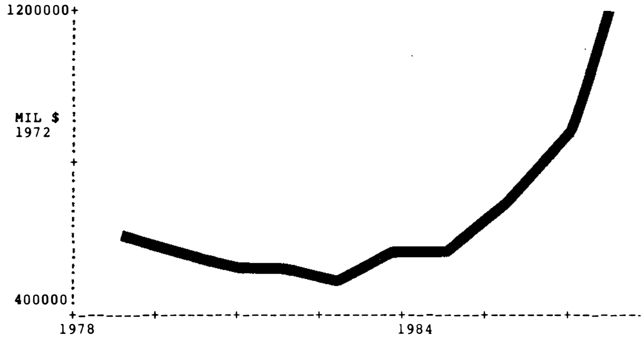
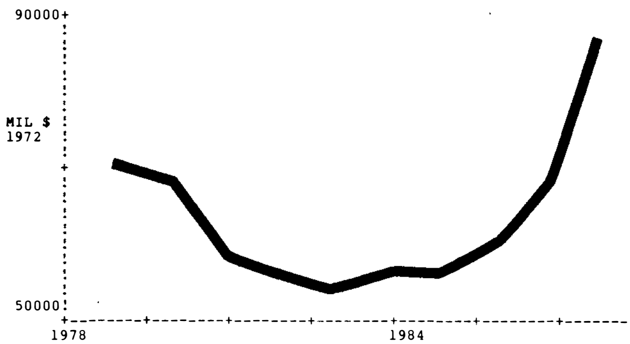


Figure 9



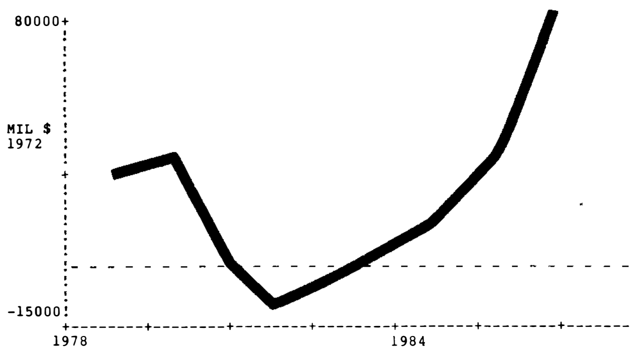
SURPLUS GENERATION
U.S. ECONOMY WITH E-BEAM PROGRAM

Figure 10



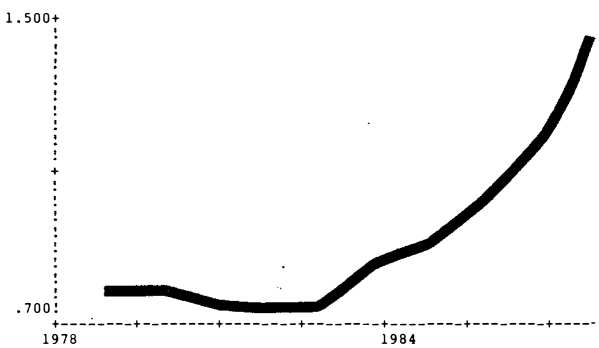
TANGIBLE WAGE BILL OF PRODUCTIVE WORK-FORCE
U.S. ECONOMY WITH E-BEAM PROGRAM

Figure 11



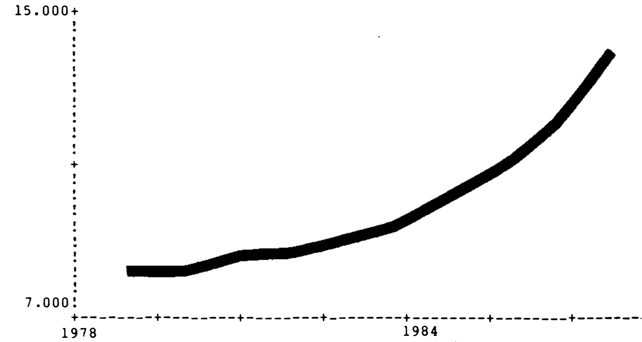
NET NEW CAPITAL INVESTMENT
U.S. ECONOMY WITH E-BEAM PROGRAM

Figure 12



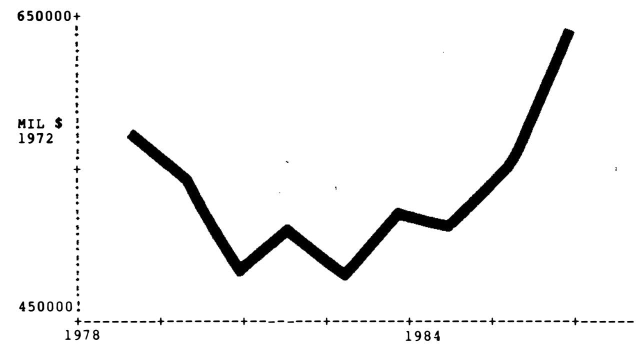
FACTOR PRODUCTIVITY (S/C+V)
U.S. ECONOMY WITH E-BEAM PROGRAM

Figure 13



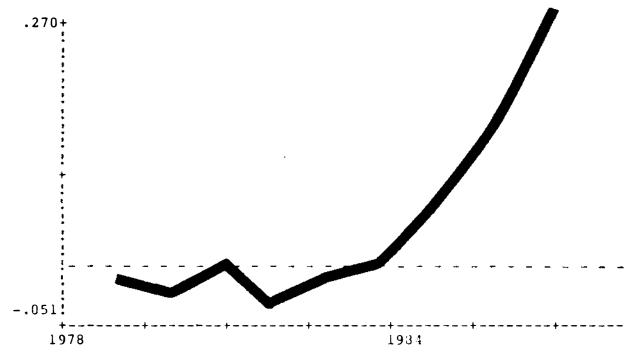
PRODUCTIVITY (S/V)
U.S. ECONOMY WITH E-BEAM PROGRAM

Figure 14



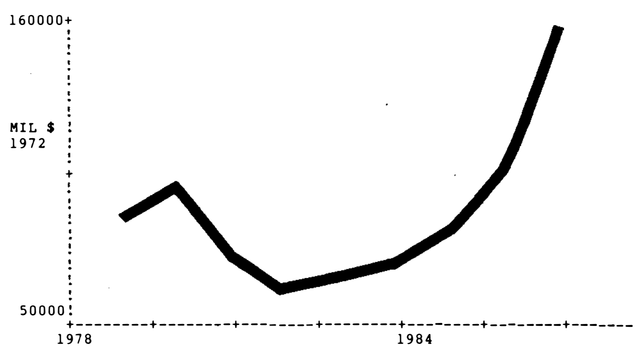
OVERHEAD COSTS
U.S. ECONOMY WITH E-BEAM PROGRAM

Figure 15



INSTANTANEOUS GROWTH IMPULSE RATE (S'/C+V)
U.S. ECONOMY WITH E-BEAM PROGRAM

Figure 16



GROSS CAPITAL INVESTMENT
U.S. ECONOMY WITH E-BEAM PROGRAM

off after 1988. The impact of this program is to significantly improve the performance of the overall economy. In every area of employment, output, profitability, and capital investment, the results of application of a high-technology research program are startling. As many other researchers have noted, the impact of spending on advanced technologies is qualitatively different than the same spending on transfer programs, conventional military procurement, or public works. The unique feature of advanced technologies is their injection into the rest of the economy of productivity and efficiency increases.

The effects of NASA on the economy

The time course of NASA R&D spending is shown in Figure 1, and the amounts of change which this represented in Figure 2 (first report). The form of Figure 1 is not surprising to most Americans, who remember the national commitment to the moon-walk, the vision of President Kennedy. The shape of the second graph is more unexpected. The greatest increase in absolute amount of spending occurred at the very start of the program, and the size of the increases, rather than growing as more hardware was built and the program was more able to "absorb" funds, decreases rapidly after 1963. The end of this growth, close to simultaneous with the Kennedy assassination, also marks the beginning of economic decline, not in amounts but in the efficiency with which productivity was being purchased.

The relationship shown in Figure 4 (second report, correlation) demonstrates quite clearly the causally important relation between planned spending on advanced R&D, investment decisions, and the overall efficiency of an economy. Note that a statistical analysis of the data shows a correlation coefficient of 0.86, a highly non-random result. One of the most notable characteristics of this relationship was that it occurred immediately—actually before the allocated money was spent. This indicates that it involves a series of decisions to look for the most advanced, and therefore most efficient, capital goods which were available, rather than depending on the introduction of newly developed capabilities.

In the same way, the commitment of the United States to develop and deploy the weapons, combined with a sane credit policy, would have an immediate effect because available high-technology types of capital goods would be installed. This effect would then create the conditions of economic health in which the direct spin-offs of the beam program itself could be effectively used as they become available, and a continuing economic shock wave be generated. As a first approximation, we assumed that the relation between increases in beam weapon spending (non-administrative) and the efficiency of total capital spending in creating factor productivity will be the same as that observed in the case of NASA, after correcting for inflation. This assumption may actually be overly conservative, since a reservoir of technological advances was created as a result of NASA, but never deployed (see article, p. 26). There was no such pool of unutilized technologies in the early 1960s.

An "honest attempt"

There are few people who will disagree that the U.S. economy at present is in the process of a disastrous crash. However, it is less obvious that this process has now reached a point of no return, under the existing conditions of the real economy. That is, a reversal of the credit and interest policies which have brought us to the point will no longer suffice to reverse the effects. The model run which we have labelled an "honest attempt" at recovery without the E-beam program makes these results clear.

To produce this run, the excessive overhead ratios generated by Federal Reserve Chairman Volcker's policies were reduced to historically observed levels, as shown in Figure 3 (of second report-overhead) and the productivity of the economy was allowed to rise as investment could be directed towards existing higher-technology sectors. In order to start some type of recovery, real wages were increased (unemployment was decreased) at the expense of new capital spending. The results show a brief halt in the process of decline, with surplus production recovering from the depths of current conditions to the levels seen in 1961 (Figure 6 [of second report—surplus]). Figure 7 (of second report—S/C + V) shows that factor productivity increases as capacity is again more fully utilized.

However, the instantaneous growth impulse, net reinvestment of surplus per unit of operating cost, remains negative, and there is no net capital spending. Under these conditions, shown as Figures 3 and 8 (of second report—net new capital and instant growth rate), the increase in factor productivity cannot be sustained, and by 1987, the economy has resumed its downward slide, without ever having regained even the levels of the late 1970s.

The power of beam weapons

Under the impulse of investment in beam-weapon development and deployment, as well as the necessary NASA spending to prepare the required capability for space bases, the economic picture is dramatically altered. The run shown here was done by using the rate of change in capital spending efficiency with changes in NASA-type R&D spending. It was notable that the starting efficiencies in today's economy were significantly lower than those of the early 1960s, so the zero-point of the regression could not be used. The time course of gross capital investment, which is the mechanism by which research spending affects productivity, is shown in Figure 16.

The amounts used were corrected for administrative overhead, and were limited by estimates of what can be absorbed by existing agencies.

The time course of spending used for the model began with an expenditure of $750 million, authorized in 1983 and spent in 1984. Three hundred million was allocated to the beam weapon program itself, and the remainder represents the portion required for upgrades of NASA. A value of 80 percent was used to calculate R&D spending from total budget, based on current NASA experience. In the following year, expenditure doubled, as the preliminary "red tape" is dispensed with, and the scientific work can be intensified. Once funding levels appropriate to a national commitment have been established, the rate of growth decreases, and the spending authorized in 1987 is $2.8 billion in 1982 dollars.

In this first, aggregate model study, total tangible wages for the productive work-force, shown in Figure 10, increases about 60 percent with the beam weapon program, not because of direct spending on beam weapons (which is always a small part of the economy), but because of indirect increases in economic activity throughout the whole economy. Along with the rise of tangible wages, the productivity of labor is also rising (Figure 13). Thus, as Figure 9 shows, the production of surplus increases even more, as the capital intensivity of the economy increases with positive values for net new capital spending (Figure 11). The depreciation rate was increased in this run, to account for the more rapid replacement of outdated equipment, but even with this higher operating cost, there is a marked, accelerating rise in both productivity and the instantaneous growth impulse (net reinvestment of surplus per unit of operating cost), which is illustrated in Figures 12 and 15, respectively. The predicted growth impulse, although far higher than what has occurred in the United States during the last 25 years, is of the order of magnitude seen in the Japanese economy during the late 1960s. This coheres with the intention of this run, which is simply to simulate the effect of technological optimism, expressing itself in an economy where a spectrum of technological advances are available, and where credit and interest policies allow such expression.

Note that transfer payments, education, services, and other overhead expenses can increase greatly under this projection (Figure 14), while they fall in the base run. That is, not only does the beam weapon program pay for itself (it is included in these overhead expenses) but it allows for the general increase in these expenses as the economy develops. In fact, these increases are necessary to support the implied increases in productivity that will be required for the introduction of the new plasma technologies.

This is, in fact, the real significance of the beam weapon development program in the larger sense of national security. By insuring the overall cultural and educational development of the domestic economy, it creates the basis for on-going progress in all areas of economic and social life. A military program that only addresses military goals (in the narrow sense) will in the long-run fail to protect a nation; the real mission of the military, as the early American military leaders recognized, was nation building. The beam weapon program is that nation building task in modern garb.