The Strategic Defense Initiative and the economy

Crash development of laser defense weapons and associated directed energy technologies, should act as the needed 'science driver' for the whole economy. Carol White reports.

At the moment, the financial collapse is dominating the news, with President Reagan playing the role of Herbert Hoover, while the Congress and assorted banking circles plan to emulate Hitler's Economics Minister Hjalmar Schacht, with plans for a vicious austerity. The general population is rightly worried about the future.

In the near future, as the reality of the depth of the economic collapse sinks in, the greatest danger which will threaten, may be that a paralyzing mood of pessimism will sweep the country. Not only must the economy be literally reconstructed, but we face a potentially devastating health crisis, with AIDS revealing its character of a species-threatening plague. Failure to rapidly transform the economy will guarantee a replay of the Dark Ages, in which as much as half of the population in urban areas was killed by the Black Death, which swept through populations rendered particularly vulnerable by the depressed living conditions that accompanied the financial collapse of the period. And before us, as we begin this task, will be the challenge of threatened Soviet hegemony, not only as an imperialist power on Earth, but as a power in space as well. The kind of emergency measures elaborated by presidential candidate Lyndon H. LaRouche, not austerity, offer the only solution to the crisis.

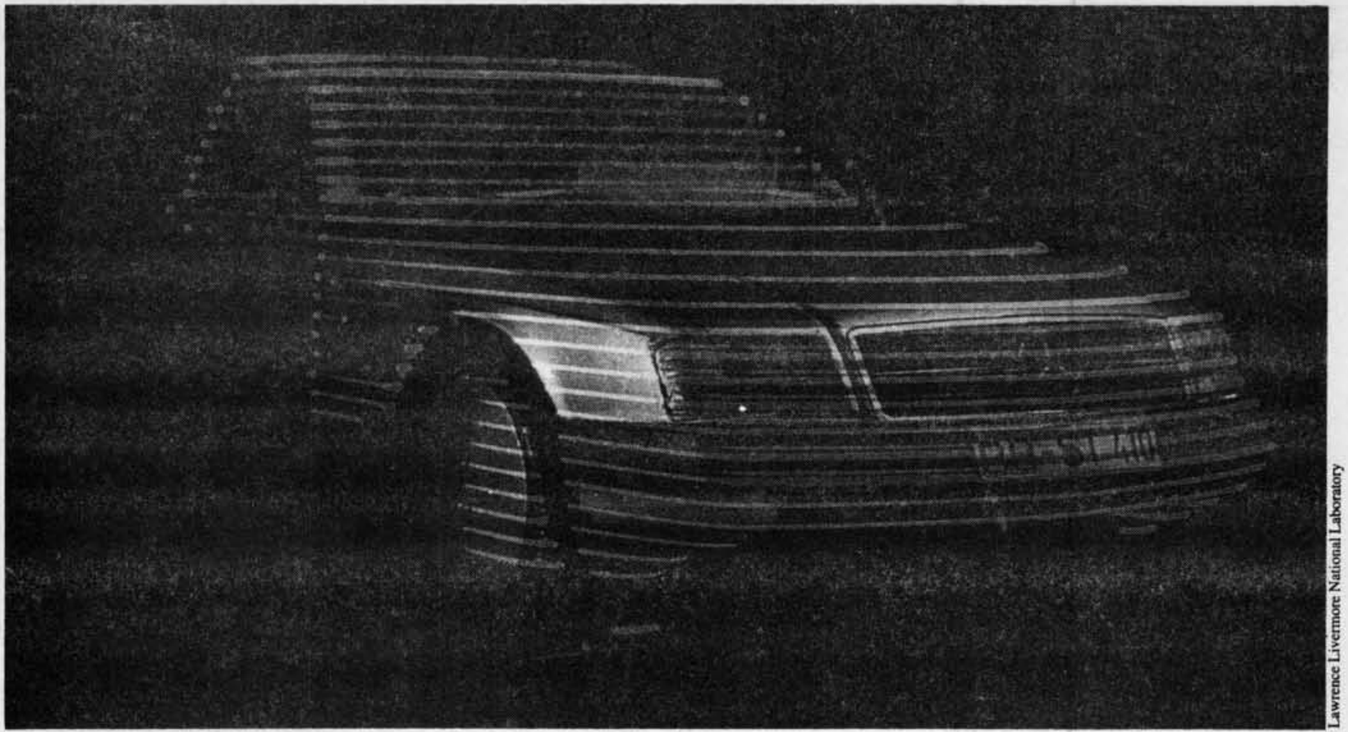
The answer to the present economic collapse, is not to destroy what remains of the functioning economy, in order to balance the budget; nor to strip the West of its capacity for a viable defense against the Soviet threat. We cannot afford to retrench; we must embark on large-scale infrastructural projects, which not only change the face of the Earth, but render the Moon and Mars habitable as well, at the same time that we reconstruct industry on the basis of the most advanced technologies known today. A crash development of laser defense weapons and associated directed energy technologies, particularly radio frequency weapons, should act as the needed science driver for the further rapid development of such advanced technolgies.

The lessons of history tell us, that the human species has so far risen to similar challenges, by developing new technologies which literally transform our species conditions (see **Figure 1**). An example of this is the introduction of steam and combustion engines and electric motors, which each revolutionized production, and transformed the face of the globe. Industrial revolutions depend upon complexes of technologies being developed simultaneously. With the development of a fusion-powered economy, the widespread use of lasers and other forms of directed energy, and various advanced forms of propulsion such as magnetically levitated trains and the hypersonic plane—for Earth and near Earth purposes—and fusion propulsion for travel to Mars, we can achieve the kind of across-the-board increase of productivity which is needed.

The status of the SDI

In 1982, Lyndon H. LaRouche, Jr. elaborated the policy upon which President Reagan's Strategic Defense Initiative was, in part, based. The key feature of LaRouche's proposal was the development of a multi-layered defense against ballistic missiles which would be based upon the most advanced technologies, namely those employing directed energy. This was appropriately expressed by the slogan "Beam the Bomb."

LaRouche's concept was to develop an SDI capability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Laser assisted automobile design.

which would incorporate an increasingly sophisticated deployment of laser and particle beam defensive weapons. These would be based upon new physical principles, and be flexibly designed to incorporate these as they were further developed. The development of the x-ray laser was a key element of the proposed system.

The kind of system which LaRouche proposed would have been a science driver for the whole economy. One of the major areas which was expected to benefit was that of medical diagnosis and biological research. With x-ray lasers and associated technologies, it should be possible to observe the processes of living tissues. Similar gains were predicted from the precision of laser etching of semiconductor circuitry.

With the proper level of investment, originally on the order of $20 billion per year, it was confidently predicted that such a system could be deployed—at least the initial phases of such a system—in a period of five years. Reality has been somewhat different.

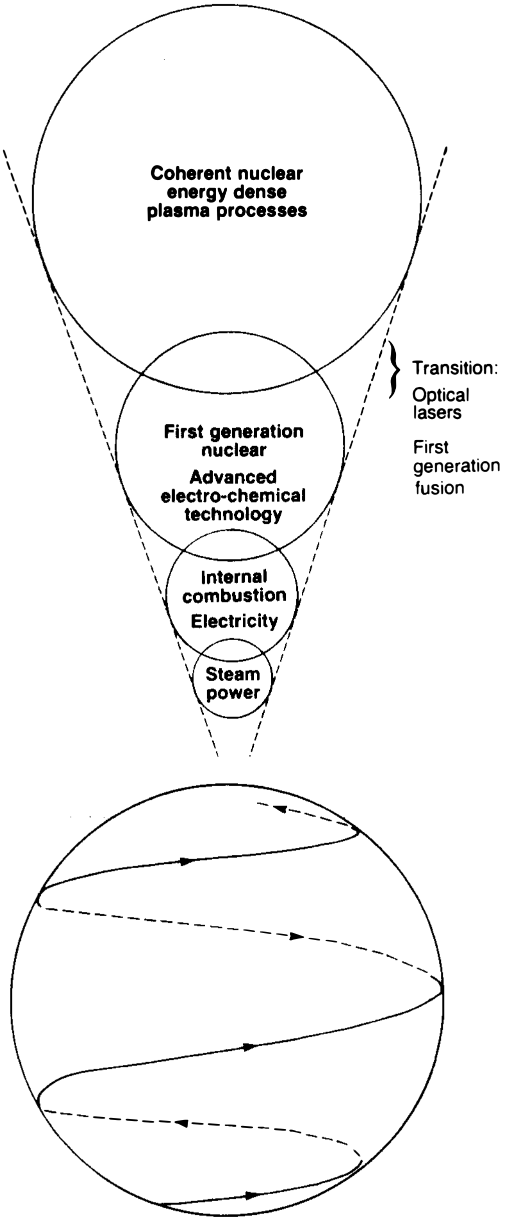
The SDI has been funded at less than one-fifth this amount, and, for political and misconceived budgetary reasons, the focus for initial deployment has been on kinetic kill vehicles—i.e. lightweight rockets. These weapons incorporate advances in homing and sensing technologies (particularly in miniaturization) and are non-nuclear in design—as opposed to the anti-missile defense systems under consideration at the time of the signing of the 1972 ABM Treaty.

Cost was definitely a factor in the choice of kinetic kill vehicles. From the point of view of industry, they were an attractive adaptation of what was virtually off-the-shelf technology, and allowed them to put their underutilized capacity to use—at the same time saving them from expending money on research and development. Considering the implications of the attack upon the defense industry by bodies such as the Packard Commission, industry was particularly doubtful about undertaking risks. The emphasis upon the development of kinetic energy anti-missile missiles was also motivated by effecting a political compromise with the crowd around Lt. Gen. Daniel Graham, who had been pushing for the deployment of space-based missiles in opposition to the LaRouche proposal.

The Marshall Institute proposed first-stage, layered anti-missile missile defense. This would utilize lasers as part of the detection and targeting systems initially, phasing them in at a later stage as laser kill-devices. At present, even the institute proposal has been whittled down to about one-fifth its original size.

The inability to implement the full multi-layered kinetic kill vehicle defense system, proposed by the Marshall Institute, and accepted by the Pentagon, can be directly correlated with the continued attrition of the budget for the SDI. In its April 1987 report to the Congress on the Strategic Defense Initiative, the SDI Organization reported that when the program for developing technologies for target Surveillance, Acquisition, Tracking, and Kill Assessment (SATKA) for FY 1987 was reduced, because of failure of the Congress to

FIGURE 1
Evolution of technology



maintain adequate funding levels for the program, a forced choice was made between the boost-phase and mid-course defense tiers, in favor of the former. The Boost Surveillance and Tracking System was maintained because it supports the highest leverage (destroying many warheads at once) and it is a relatively mature technology. Narrowing the program has meant the failure to successfully develop a mid-course discrimination system.

Another area to be affected by the budget process, was the validation work on electromagnetic launchers, which was cut back to support the technology validation of the chemically propelled kinetic kill vehicles. Now further budget cuts threaten the continued development of the extremely promising free electron laser. The upcoming Dec. 7 INF treaty summit may also be the arena for public or secret deals to further slow progress in deploying the SDI—that is, progress in the West—since the Soviets are notorious for violating treaties. (It is interesting to note that the Soviet military now admits to engaging in work on their own advanced SDI, to which they attach the acronym KSO.)

Even with the curtailed Strategic Defense Initiative program we have, we can already see an increase in potential in the economy, directly attributable to technological advances that have occurred in the development of lasers, in sensing technologies, and in the area of battle management. These can be incorporated into the economy, in the near term. What is needed is an increase in the rate of investment in the infrastructure of industry—not only to revive the currently dead U.S. machine tools industry, but also to build whole new automated and semi-automated factory complexes.

There is an obvious point of comparison between the present situation, and the U.S. economy at the point when President Kennedy announced the Apollo moonshot project. One key difference between then and now, is that the U.S. economy is on the verge of a depression deeper than the Great Depression of the 1930s. Furthermore, the budget-cutting austerity policies which are now being projected to remedy the worsening financial situation are guaranteed to exacerbate it. At the time when Kennedy proposed a manned Moon landing within the decade, the U.S. economy was stagnant, but by no means on the verge of destruction. Not only did Kennedy rally the United States behind a national mission to conquer space, but he also implemented strategies to stimulate the rapid incorporation of new technologies into the economy. These included incentives for high-technology investment, and appropriate credit policies.

The Apollo program is calculated to have returned $10 to the economy, for every dollar invested in R&D. From satellite communications to the transistor radio, to the widespread adoption of computers into our economy and the development of the semiconductor industry, we have benefited from mankind's giant step to the Moon.

It is useful to note that the transistor was developed in the fifties. Under the impetus of the expansion of the space program, there was the significant cheapening of their production. Similar benefits can accrue to us from the present stage of development of the SDI, particularly in developing mass-production methods for the laser and associated technologies, which will promote their use in industry and research.

The notion of spin-offs can be deceptive. It is worthwhile to emphasize the point: There is no such thing as the automatic assimilation of new technologies by industry. The appropriate climate stimulating a rapid rate of new investment must exist in both the civilian and the military sectors. Otherwise inventions which might otherwise be useful to the economy will be hedged in by military classifications and proprietary considerations.

The SDI and the structure of the economy

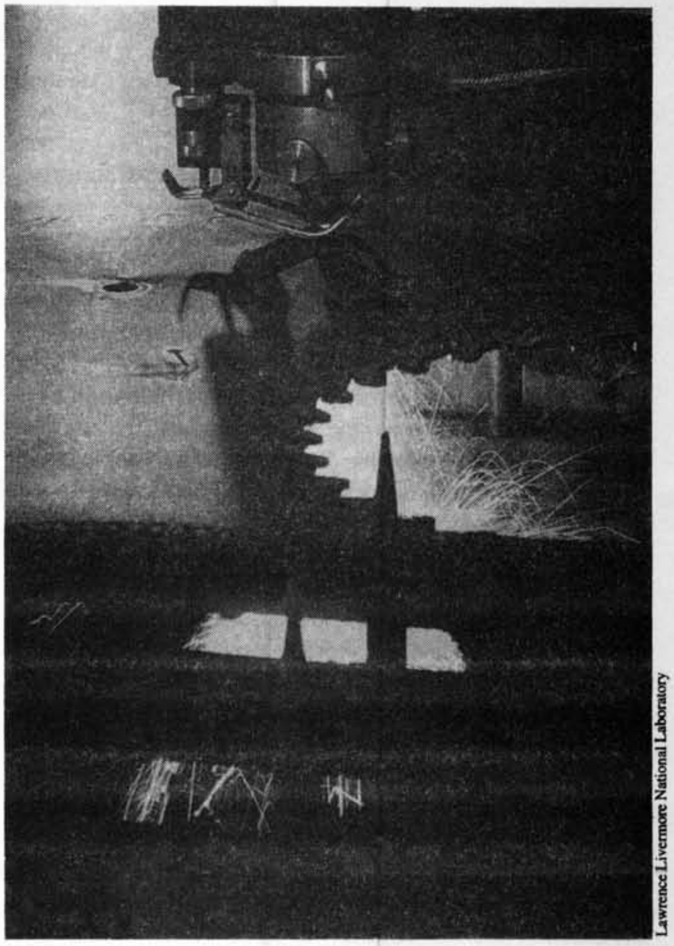
In their book *SDI and Industrial Technology Policy: Threat or Opportunity?* authors Walter Zegveld and Christien Enzing argue that the 1960s deployment of scientists and engineers into NASA and related defense employment, put U.S. industry at a disadvantage compared to Japan and Germany. This is patently ridiculous, as *EIR* documented in our 4th quarter 1986 *Quarterly Economic Report*. It was the failure of the United States to maintain a high level of investment in the development of a broad profile of frontier technologies, which gradually whittled down the advantage the United States held during the Apollo program.

Perhaps the greatest spin-off from investment in the Apollo program is that we have significantly increased the ratio of scientists and engineers to industrial operatives from 2.5 scientists and engineers for every 100 production workers in 1967 to 4.1:100 in 1985. This is a metric of the capability of industry to rapidly develop and assimilate new technologies.

During its peak year, 1967, the Apollo program generated employment for 92,000 scientists and engineers—about 25% of the national total of 367,000 engineers and scientists employed in industrial research and development. This effort has kept the aerospace industry in the United States the most technologically healthy of all U.S. industries. From 1967 to 1985, in aerospace there were between 24 and 30 scientists and engineers employed for every 100 production workers. By contrast, the rest of U.S. manufacturing industries, which have collapsed one after the other, employed only between 2.5 and 4 scientists and engineers for every 100 production workers overt he same period.

Our present dismal economic situation can, in large part, be attributed to a reversal of such intensive federal initiatives represented by the Apollo program. In 1985, there were over 570,000 scientists and engineers in the United States employed in industrial R&D; the Defense Department estimated that only about 12,000 of these (or 2%) would be employed in work on the SDI in 1987. The number is undoubtedly lower, thanks to budget cuts.

Even before President Kennedy was elected to office, Dwight Eisenhower had responded to the Soviet launch of *Sputnik* with the National Defense Education Act, which provided federal support for a significant upgrading of science education in the schools and universities. Two key elements of the program were the emphasis upon making laboratory facilities available to students and teachers, and the use of these to provide teacher-student workshops by leading scientists. The impetus of the National Defense Education Act was eroded under Lyndon Johnson into a catch-all for federal support to basket weaving forms of "special education," which is not relevant to the viability of the program's intent.



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Cutting out saw blades with a CO_2 laser.

If we take the ratio of scientists and engineers to productive workers that we find in aerospace, and generalize this to other production, we would need at least 10% of the labor force as a whole to be scientists or engineers, in other words about 12 million. Such a fivefold increase would be commensurate with the kind of leap in productivity needed over the next period, particularly if we are also engaged in shifting the structure of the economy to emphasize production, and to sharply reduce administrative overhead and the kinds of make-work characterized by the service industries.

LaRouche has proposed shifting the composition of the work force so that the productive component increases from 20% to the 40-50% range, adding 5 million workers to the productive labor force in the first four-year period. This will allow us to guarantee a rapid rate of technological obsolescence, and keep us one step ahead in the economic competition with our allies, and on the military front against the East bloc. We should not wish to compete with our friends and enemies by hoarding better secrets—i.e. superior technologies—but we should wish to have an economy which is superior in its ability to rapidly generate and assimilate new technologies.

ligence Estimate, which figures that 10,000 Soviet scientists work on the military laser program alone.

First generation spin-offs

While the Manhattan Project development of nuclear power and the Apollo program are the typical points of reference for a discussion of spin-offs, the military as a whole has made significant contributions to the civilian economy. For example, Boeing was able to develop the 707 passenger jet, because they adapted the design for the military KC-135 fuel tankers, for which Boeing had Air Force contracts, allowing them to reduce production costs of the jets. The Minuteman ICBM program was the first large user of computer chips, and government purchase of them allowed the electronics industry to produce semiconductor chips with economies of scale and improved production methods, thus lowering their costs to the point that they could be assimilated by the civilian economy.

Numerically controlled production machines were a direct offshoot from the Pentagon Manufacturing Technology Program. Another is the newer field of computer aided design (CAD). It was CAD which made possible the rapid advances in the field of large-scale integrated circuitry. Along with computer aided design is computer aided manufacturing (CAM).

The CAD/CAM combination is the key to a new level of automation technology in industry. Add to this the use of real-time computing for target acquisition, and the implication is that we can in the future have small mobile robots, which are centrally deployed to carry out assembly and other tasks on the factory floor. In many ways, present-day automation is reminiscent of the early days of the introduction of electricity into production. The first users typically converted steam engines into in-house electricity generators. It was only with the availability of cheaper electricity generated in central power stations, that the development of small motors became possible. Then electricity could be applied directly to the task at hand, turned on and off at will. Such flexibility and miniaturization, should be a major feature of the automated factory of the future.

Aside from pioneering new technologies, the military can stimulate an increase in technology, by developing or supporting new production processes which can have a broad application. The other area in which they indirectly affect the economy is in the development of standards which are then adopted to create standardization and interchangeability of parts, equipment, and instruments. In our present climate of deregulation, the military also can play an indirect regulatory role, which helps to avoid the chaotic misdeployment of resources. One glaring example of the evils of deregulation is the sad case of the airline industry.

It is still the case today that the Defense Department is the major consumer of electronics. The Defense Department can be compared with Japan's Ministry of International Trade and Industry (MITI), in this area. Both are underwriting research in very large-scale integrated circuitry (VLSIC) for use in fifth-generation high-speed computers. With the same project emphasis the Defense Department and MITI are investing in fiber optics (but also because fiber optics are not as susceptible to the effects of electromagnetic pulses as ordinary electronics). Other areas of investment in both Japan and the United States are the development of polymers and metal-matrix composites, and directly in methods of factory automation and robotics.

Separate from but related to this, is the development of space-qualified supercomputers. What is under development is a general-purpose data processor which can operate at high speeds, in an aversive environment. The very high-speed integrated circuitry (VHSIC) hardware and new computer architectures will significantly improve performance. The expected performance will be 20 times faster than the industrial standard.

One key feature of all space electronics is the need for radiation hardening. This has prompted the development of gallium arsenide semiconductors to replace silicon chips, which have the further advantage that they consume less power than silicon chips. Furthermore they are photosensitive, which means that they can be directly mated to fiber optics. They are also superior to silicon chips in amplifying a signal with lower background noise. To give an example of the great benefit that will obtain as these are produced in large scale and replace silicon chips in the civilian economy, a $1.5 million microwave relay tower, used to amplify radio wave signals, can be replaced by by a series of $15 amplifiers placed at distances of five miles apart.

Gallium arsenide (GaAs) chips are now being mass-produced on pilot assembly lines, which have recently manufactured the largest and most complex GaAs memory and logic/arithmetic chips in the United States. The U.S. lost the lead in production of these chips to Japan, in 1982, but with the development of mass-production it is recaptured. Fabrication of the first GaAs single-chip microprocessor has also been accomplished. This chip operates as quickly as an equivalent silicon chip, but requires only one-tenth the power.

Space-based sensors which may be used for mid-course surveillance need long wavelength infrared (LWIR) detectors to detect the radiation from relatively cool targets that have completed their boost phase of flight. These sensors will have to be cooled to extremely low temperatures, in order to minimize interference from the thermal radiation of the detector itself. To achieve this a three-stage cryo-cooler has been designed, fabricated, and tested. This detector uses helium as the working fluid. With the development of high-temperature superconducting materials, adaptations of this or similar technologies will be available for more general use. These will use the cheaper, more plentiful nitrogen coolant.

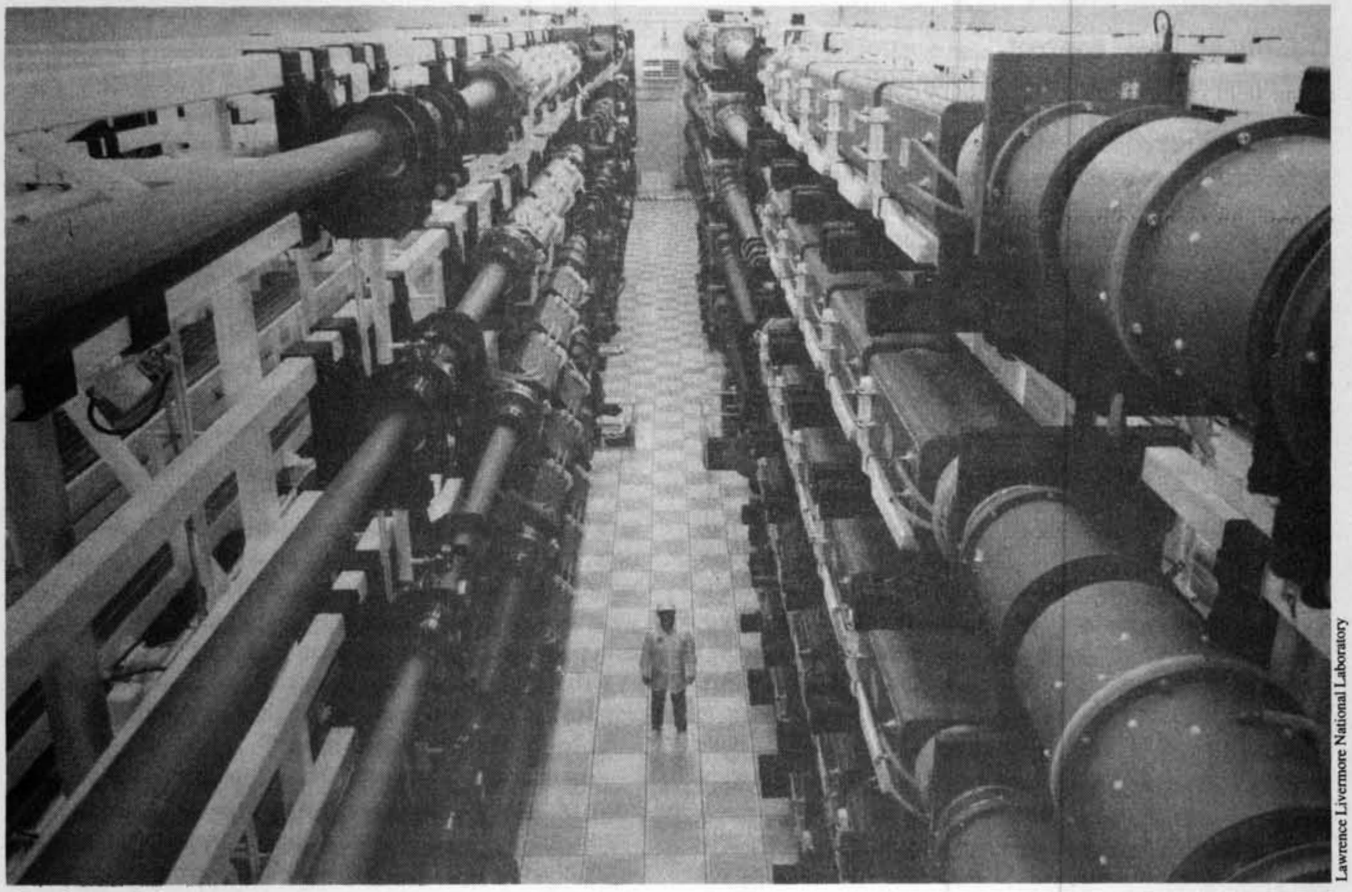
Another high-sensitivity, long wavelength infrared detector can now be constructed, which is capable of detecting single photons, and is also hardened against the effects of radiation. These high-sensitivity detectors are effective over a wide range of infrared wavelengths, and have extremely low background noise. Miniaturized, state of the art transistors have also been developed. These incorporate transmitting and receiving functions into a single block for a phased-array antenna. These can be scaled up to allow the construction of larger, more reliable phased-array radars.

Ultimately this will lead to a technology using true solid-state radar. This offers the possibility of transmitting higher power using optical fibers. It will also find use in aircraft collision-avoidance radar, and in industrial process control. The development of cheaper methods of producing infrared sensors will spill over to reduce the costs of infrared industrial lasers.

The ALPHA laser, which is a high-powered deuterium-fluoride infrared laser, is being extensively tested, but the most interesting work on chemical lasers is in the coupling of these at different frequencies. There has recently been the first experimental demonstration of mutually coherent operation of six single-line carbon dioxide lasers and the first experimental demonstration of mutually coherent operations of two multi-line deuterium fluoride chemical lasers.

One of the major directions for future research, in the lower frequency, microwave range, is the interaction of these frequencies with living tissues, so that they produce frequency-specific effects. The deployment of ultraviolet and x-ray lasers can be used to create shock effects in materials, either to fracture them or to harden them, as well as the more obvious application in the SDI, of knocking at the electronic guidance systems of enemy missiles. Of course, lasers can also be used to achieve power kills, as was the case with the Mid-Infrared Advanced Chemical Laser (MIRACL) device, which was successfully tested against a Titan booster rigged to simulate the loads of a thrusting booster in 1985.

The SDI specifically requires major advances in sensors, lasers, particle beam accelerators, computers (both hardware and software), power sources for pulse power and storage,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Nova laser at Livermore.

and materials. The anti-missile missiles presently under development, differ from those developed in the 1970s in two essential points: They are non-nuclear, thereby increasing the demand for accuracy of targeting; and anti-missile missiles of the previous decade were directed by ground-based and onboard radars, where today's are guided by onboard advanced optical sensors in the infrared range.

While emphasis has been placed on kinetic kill vehicles, development is also continuing with laser systems, which are also incorporated into shortwave laser radar systems. Ground-based laser systems rely upon space-based mirrors for redirecting the beam, but all lasers incorporate mirror focusing. For high frequencies, especially, it is necessary to develop materials which are capable of withstanding laser bombardment.

Hardening is also a military requirement. One aspect of work on the SDI is the study of countermeasures. Graphite-reinforced composites have been developed which display a high resistance to high-power laser penetration. These reinforced ceramics do not shatter, even when hit by a projectile. When they are punctured, the cracks which develop do not propagate. These materials are promising for construction of large space structures, because they also have the advantage of being lightweight and dissipate both solar heat and laser energy while maintaining their shape.

Quality and cost control

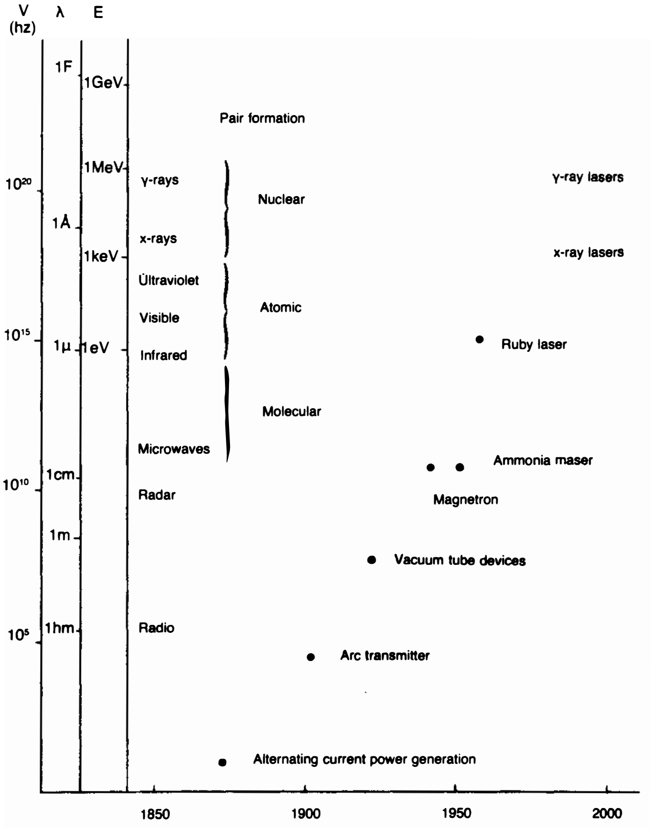
Problems have been identified in the basically hand-crafted rockets that are the basis of our launch capability. Not only are the rockets expensive, but they cannot be produced in the amounts necessary to sustain a space-based ABM or laser defense system. The kind of technologies presently under development include the development of quick-cure tough resins, use of reaction-injection molding together with new material development, and the development of low-cost non-steel motor case materials that are lightweight. One target is to reduce the size of boosters while maintaining or increasing their capacity. Another is to make them reusable or partially reusable. The increase in durability implied can affect manufacturing as well.

The highest cost today on ABMs, such as the exoatmospheric reentry vehicle intercept system (ERIS), is the high cost of the guidance systems. The infrared detectors had low production yields and their materials costs were high. The SDI is moving to cheapen these costs, by introducing automated fabrication methods. This will have a direct impact through cost reductions in the production of infrared-range lasers for all purposes. Not only are plans under way to cheapen the cost of infrared sensors, but this is true in a wide array of technologies associated with inertial navigation technology.

Guidance systems rely upon homing, navigation capability, and alignment functions. One area of direct application of this work will be their placement in all airplanes. There are also defense applications for tactical missile systems. Ultimately, all vehicles should be equipped with sensing equipment that allows them to avoid collisions and anticipate obstacles, and even perhaps travel long distances without driver intervention. The Defense Department expects to reduce the cost of inertial navigation units from $200,000 per unit to only $3,000.

FIGURE 2

Technologies for generation of coherent electromagnetic radiation



The key to this lower cost is the application of technologies in production which are not labor-intensive. At the same time, the constraints on production demand that the size and weight of sensors are not increased. No mechanical or laser gyro meets this requirement. A micro-optic gyro and a resonant fiber optic gyro are both under study.

Miniaturization of computer capacity is also necessary to control the onboard sensors in lightweight missiles, which must be radiation-hardened as well.

Associated with these SDI developments is the development of optical seeker roadmap analysis, such as is used in cruise missiles. Clearly, one of the first benefits of this whole array of technologies, which has already achieved some limited application, is real-time control of industrial processing, so as to achieve quality control while on-line rather than after the fact. A first benefit for this should be in areas such as controlling the composition of the fuel in solid-state boosters (an otherwise tricky area, in which undetected failures can lead to explosions and have extremely high costs both in lives and in material).

To solve the batch-processing problem of high-energy propellants which leads to many manufacturing difficulties, research continues in developing safe, automated, continuous-processing techniques for high specific-impulse rocket fuels. The program is based upon using beryllium-based propellants that would be mixed in a twin-screw continuous mixer. This mixer would contain about 500 times less materials in the process or at any one time. The aim is to allow for monolithic, rather than modular, fabrication of rocket motors.

The demands placed upon optical sensors are extremely diverse. Some may be cooled, but others must work in heated situations. They will need to detect boosters with plumes, boosters and post-boost vehicles without plumes, exo- and endo-atmospherical reentry vehicles, in intensities which vary by seven orders of magnitude.

In the area of sensor thermal control, telescope production, communications, and electronic power systems, the Defense Department is going for semi-automated lot production, to reduce costs. It are also researching a more advanced detection system. Presently, the effort to detect ballistic missiles in boost phase relies upon the ability to sense infrared emissions that come from the rocket exhaust. An effort is now under way to directly monitor the radiation signature emitted as a shockwave by the missile body itself. This is a difficult problem that combines three-dimensional fluid dynamics, non-equilibrium air chemistry, radiation transport, and ultraviolet spectroscopy. Even success at the level of modeling will have many applications, not least in the area of weather modeling and potentially weather control.

Because of the decision to emphasize the development of kinetic kill vehicles at the expense of a crash effort to deploy a system which would be primarily reliant upon directed energy weapons, the pace of development of Distance Early Warning systems has been slowed, although developments to date fully substantiate their feasibilty.

Perhaps the most exciting development is the highly classified x-ray laser program. The SDIO report to Congress has a subdued reference to this, commenting, "Finally, new underground nuclear tests have added important evidence of the technical feasibility of several nuclear directed-energy concepts." Independent work on the x-ray laser has been proceeding in the laboratory, which, although very exciting, is beyond the scope of this report. Low-power devices, including excimer, chemical, and free electron lasers and neutral particle beams are being built and will be available for testing the feasibility of interactive discrimination of targets from decoys, as well as determining the scalability to weapons-level output. When we are able to successfully deploy the full spectrum of coherent radiation, from microwaves to gamma-rays, a truly new era will have opened up (see **Figure 2**).

TABLE 1

The next technological manifold—characteristic parameters

	Projected	(Present)
Flux-density of primary power generation	$5 \cdot 10^9 - 10^{10}$w/m^2	(10^8w/m^2)
Per capita energy production	500kW	(10kW)
World population potential	40 billion	(12 billion)
Life expectancy	>100y	
Percentage of GNP in research and development	>10%	(3-4%)

More recently, there have been major achievements in chemical laser technology, which have yielded the brightest laser outputs in the free world. Conjointly with this is the fabrication of very large mirrors and the development of optical phased arrays. Another important area of work is the development of laser channel-guided electron beams.

The question of ensuring a reliable power source in space has spurred on the development of hundred-kilowatt nuclear reactors, the SP-100 program.

An interesting development has occurred, however, in the field of power storage. Researchers in the space power program have fabricated a miniature supercapacitor capable of storing 200 kilojoules of electrical energy in a can of less than one cubic foot in size amd 110 kg in weight. A device such as this would have great benefit in providing pulsed power at high frequencies.

In summary

In the Kennedy years, perhaps the greatest spin-off was a burst of cultural optimism. Such optimism must be based upon a firm foundation, not the delusions of a cheerleader who is touting an imaginary recovery. Even before there were any new technologies from the Apollo program to propagate through the economy, there was a capital investment boom as industry moved to meet the new national commitment.

This capital investment itself, had the immediate effect of boosting productivity throughout the basic industrial sectors of mining, manufacturing, construction, and utilities, as technologies that had been developed by previous programs, but not yet implemented, were infused into the economy. It is just such a "tidal wave" of economic impact which we can expect, using advances such as those outlined above, immediately upon the adoption of the measures specified by LaRouche to deal with the present national economic emergency (**Table 1**).