Statement of
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before the
Defense Policy Panel
and the
Subcommittee on Research and Development
Committee on Armed Services
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Mr. Chairman, thank you for the opportunity to discuss the budget of the Strategic Defense Initiative (SDI). For fiscal year 1988, the Administration has requested $5.2 billion for SDI research in the Department of Defense (DoD). Over the next five years (1988-1992), the request totals about $37 billion. (The total request for SDI research--$5.8 billion in 1988--includes about $600 million for work to be done by the Department of Energy, but I will focus on DoD funds.)

My testimony describes this SDI request and discusses some important trends in funding. Those trends suggest that SDI will consume a sharply growing share of all DoD research funds. There are also shifts in funds within SDI that suggest growing emphasis on more mature technologies, though SDI continues substantial funding for many types of technologies.

It is beyond the scope of my testimony to judge the desirability of these requests. SDI has a far-reaching goal: to deter nuclear war by defending populations against a nuclear attack rather than by relying primarily on retaliation to provide deterrence. The desirability of SDI's funding requests depends on an assessment of the importance of that goal and the likelihood of achieving it. It also requires examining the impact of SDI funding on other research programs for defense.

OVERALL SDI BUDGET TRENDS

The Administration is requesting $5.2 billion of DoD budget authority for

SDI in 1988. The 1988 request makes SDI by far the largest single program within DoD's budget for research, development, test, and evaluation (often shortened to research and development or R&D). The next largest R&D funding request for which data are publicly available is for the small ICBM at $2.2 billion. Excluding SDI, the three most expensive R&D programs in 1988 average $1.5 billion each. Indeed, SDI's 1988 budget request exceeds that of any single procurement program and rivals the R&D budget of at least one of the military services. The Army--the service with the smallest R&D budget--is requesting $5.5 billion for R&D in 1988 compared with $5.2 billion for SDI.

Over the next five years, requested SDI funds for DoD would grow in real terms by an average of 14 percent a year to $9.8 billion in 1992 (see Table 1). Total five-year funding would amount to $37.1 billion. SDI's rapid growth is not unusual for a research and development program. Requested real growth is, however, sharply higher in 1988 (at 56 percent) than the average growth over the next five years. This request is presumably to make up for reductions in SDI's budget in the previous year (higher growth in the first year has been a characteristic of recent budget plans for SDI).

Because SDI is large, its growth means it is consuming a large and sharply growing share of DoD's budget for research and development. In 1984, SDI consumed 4 percent of DoD's R&D funds; by 1987 that amount had

TABLE 1. TRENDS IN SDI RESEARCH BUDGETS (In billions of current dollars)

					Administration's Request				
	1984	1985	1986	1987	1988	1989	1990	1991	1992
DoD SDI Funds	1.0	1.4	2.7	3.2	5.2	6.3	7.4	8.4	9.8
Real Growth (In percents)	--	36	85	17 a/	56 a/	17	14	11	14
Total DoD Research and Development Funds	26.9	31.3	33.6	36.7	43.7	44.2	39.6	39.7	42.3
SDI as a Percent of Research and Development	3.7	4.5	8.0	8.7	11.9	14.3	18.7	21.2	23.2
DoE SDI funds	n.a.	n.a.	.285	.360	.569	.390	n.a.	n.a.	n.a.

SOURCE: Congressional Budget Office from Department of Defense data.

n.a. = not available.

a. Excludes supplemental appropriation request of $0.5 billion. If this request were included, real growth in 1987 and 1988 would each be 35 percent.

grown to 9 percent (see Table 1). According to the Administration's request, SDI will use 12 percent of all R&D funds in 1988 and 23 percent by 1992.

Moreover, SDI is consuming a growing share of a relatively constant R&D pie. Between now and 1992, DoD is requesting little real growth in total R&D funding (substantial real growth in 1988 will be offset by planned real declines in future years). As a result, R&D programs other than SDI will experience real declines.

These budget trends for SDI could continue beyond 1992. Currently, some technologies in SDI are in their advanced development stage, in which they are developed and validated. Around 1992, the Administration plans to decide whether to proceed to the more expensive stage of full-scale development, during which prototype components would be developed and tested. In addition, increased research spending in the 1990s on SDI's companion program--Air Defense Initiative (ADI)--could exacerbate effects on other R&D programs. The purpose of ADI is to improve air defenses to protect this country against nuclear-armed bombers and cruise missiles, much as SDI is designed to protect against ballistic missiles.

These various trends clearly suggest that, under the Administration's plans, R&D projects other than SDI face tough fiscal times in the next few years. The Congress must weigh any adverse effects on other projects against SDI's importance.

TRENDS WITHIN SDI BUDGET

Most SDI funds are apportioned within five broad budget categories called program elements. Figure 1 summarizes the key aspects of these five program elements. The first two include funds for weapons that would be used to destroy enemy missiles:

- Kinetic Energy Weapons (KEW) are those that would destroy an enemy missile by hitting it with another object ("hitting a bullet with a bullet"). Kinetic energy technology is more mature and would probably be emphasized in any full-scale development of SDI in the 1990s.
- Directed Energy Weapons (DEW) are those that would destroy an enemy missile with bursts from a laser or particle beam weapon. Directed energy technology is generally much less ready for development into weapons than is kinetic energy technology.

In addition to two program elements dealing with weapons, there are three SDI program elements that deal with sensors, system integration, and other support:

- The program element for Surveillance, Acquisition, Tracking, and Kill Assessment (SATKA) provides funds primarily for developing sensors and other systems that would detect and track enemy missiles and determine if they have been destroyed;

FIGURE 1. DESCRIPTION OF FIVE SDI PROGRAM ELEMENTS

Acronym	Title	Description
	Weapons Program Elements	
KEW	Kinetic Energy Weapons	Weapons that use speed or energy of motion for destruction. Examples include rocket-propelled projectiles and electromagnetically propelled projectiles.
DEW	Directed Energy Weapons	Weapons that destroy by delivering lethal amounts of energy at or near the speed of light. Examples include lasers and particle beam weapons. Directed energy technology may also play an important role in SATKA, especially in distinguishing warheads from myriad decoys.
	Other Program Elements	
SATKA	Surveillance, Acquisition, Tracking, and Kill Assessment	Includes sensors, pointers, trackers, and other systems to target enemy ballistic missiles and assimilate information about their destruction.
SABM	Systems Analysis and Battle Management	Includes the software "brains" and hardware to control the operation of an integrated SDI system; also includes development of the system's architecture.
SLKT	Survivability, Lethality, and Key Technologies	Includes critical background analyses and support. Power for an SDI system and space transportation and support are the focus of key technologies.

- The program element for Systems Analysis and Battle Management (SABM) pays for developing the "brains" to control an integrated system as well as its overall architecture.
- The program element for Survivability, Lethality, and Key Technologies (SLKT) includes many important support systems, including those to provide power to space-based SDI systems and those to transport the system into space.

In addition to these five program elements, total SDI funds include a small amount for headquarters ($22 million of the 1988 request). An additional amount ($569 million in 1988) would be spent by the Department of Energy on nuclear-based concepts, perhaps the most well-known being the X-ray laser concept. My testimony will not discuss these dollar amounts further.

Dollars in the 1988 budget request are spread widely over these five program elements (see Table 2). The largest share (29 percent) goes to the SATKA program element for developing sensors and related equipment; the smallest share (12 percent) goes to the SABM program element to develop the overall architecture and brains to control the SDI system. The two program elements that pay for weapons systems to destroy enemy missiles (DEW and KEW) would each get about 21 percent of the request.

Compared with previous five-year plans, there are some shifts in priorities among these five program elements, but the overall trend is toward equalizing the budget shares of these elements. In terms of planned

TABLE 2. COMPARISON OF BUDGET PLANS FOR FIVE PROGRAM ELEMENTS
(In millions of current year dollars)

Program Element	1988 Request		1988 Request in Last Year's Plan	
	Program Element Funding	Percent of Total Program Element Funding	Program Element Funding	Percent of Total Program Element Funding
Kinetic Energy (KEW)	1,075	20.7	1,217	22.4
Directed Energy (DEW)	1,104	21.2	1,582	29.1
Surveillance, Acquisition, Tracking, and Kill Assessment (SATKA)	1,493	28.7	1,558	28.6
Systems Analysis and Battle Management (SABM)	627	12.1	564	10.4
Other Systems (SLKT)	900	17.3	524	9.6
Total a/	5,199	100.0	5,445	100.0

SOURCE: Congressional Budget Office from Department of Defense data.

a. Details may not add to totals because of rounding. Excludes Management Headquarters and Department of Energy funds.

funding for 1988 in last year's plan versus planned funding in this year's plan, the portion of total SDI funding devoted to the two weapons program elements has gone down from 52 percent to 42 percent. The portion devoted to the SATKA program element for sensors and related equipment has stayed about the same. There has been a modest increase in the percentage of planned funding devoted to developing the overall architecture and brains to control the system (the SABM program element goes from 10 percent to 12 percent). The largest shift occurs in the SLKT program element that pays for many items, including space transportation. That program element rises from 10 percent of 1988 SDI funding in last year's plan to 17 percent of 1988 SDI funding under this year's plan, largely because of increases in funding to develop new space launch capabilities.

NEAR-TERM SHIFTS

One specific concern about the SDI budget involves the degree of shifts of funds toward technologies that could be used in a near-term deployment--that is, sometime in the next decade or early in the next century--versus those applicable primarily to deployments in later periods. Let me discuss those shifts and then address their importance.

There has been a gradual increase in the share of funding for kinetic energy weapons (the KEW program element). These weapons could be made available more quickly than directed energy weapons (the DEW program

element). Table 3 shows that, of total dollars spent on the two program elements that research and develop weapons, the portion spent on kinetic energy weapons has increased from 38 percent of funds in 1984 to 46 percent in 1987. In the requests for 1988 and 1989, kinetic energy and directed energy weapons would each have roughly 50 percent of funding for weapons. Another way to assess this change in emphasis is to look at planned funding for 1988 in the current request and in the five-year plan submitted a year ago. The latest request devotes roughly 50 percent of weapons funds to kinetic energy; one year ago, the plan was to devote only about 44 percent to nearer-term kinetic energy weapons technology.

When one examines funding within the five program elements in more detail, there are other signs of emphasis on developing technologies useful in a near-term deployment. In general, within the program elements, funding is largest in absolute terms, and growing at a faster rate, for experiments dealing with integration and demonstration of technologies as compared with funding for the development of technology. Tables A-1 to A-5 at the end of my testimony provide a detailed review of projects within each program element. These tables suggest that funding is largest in absolute terms for experiments. For example, in the Directed Energy Weapons program element, the project called "Technology Integration Experiments" contains over 50 percent of the funds requested in 1988 for the total DEW program element. In the SATKA program element that develops sensors, the three largest projects in terms of dollars involve experiments ("Boost

TABLE 3. TRENDS IN FUNDING FOR KEW AND DEW
(In millions of current year dollars)

	Nearer-Term Weapons (Kinetic Energy)		Longer-Term Weapons (Directed Energy)	
	Program Element Funding	Percent of Total Weapons Funds	Program Element Funding	Percent of Total Weapons Funds
Actual Funding				
1984	196	37.8	323	62.2
1985	256	40.4	378	59.6
1986	596	42.6	803	57.4
1987 a/	730	46.4	844	53.6
Requested Funding				
1988	1,075	49.3	1,104	50.7
1989	1,200	49.1	1,246	50.9
Requested Funding as of Last Year's Plan				
1988	1,217	43.5	1,582	56.5

SOURCE: Congressional Budget Office from Department of Defense data.

a. Excludes supplemental request which, if included, would provide total funding of $790 for KEW and $914 for DEW. Including this request yields the same percentages.

Surveillance and Tracking System Experiment," "Integrated Experiments," and "Space Surveillance and Tracking System Experiment"). Funds for experiments also seem to be growing fastest. For example, within the program element for Kinetic Energy Weapons, "Kinetic Kill Vehicle Experiments" have the largest percentage increases between 1987 and the request for 1988.

What is the importance of these trends? SDI technologies are in varying stages of maturity. Some technologies like ERIS--a concept that would use kinetic energy to destroy enemy missiles as they near their targets--have been the focus of research for many years, and are relatively advanced. Other technologies, like Free Electron Laser (FEL) weapons concepts, were and still are in stages of early research. Moreover, some technologies are maturing even more rapidly than expected--like some Kinetic Energy concepts--while others are still very much in their infancy--for example, much of the Directed Energy research.

The goal of SDI managers has always been to develop technologies sufficiently to support some full-scale development beginning in the early 1990s. To achieve that goal, they must spend relatively larger sums on the more mature technologies, and they must begin to emphasize advanced hardware and integration experiments of these technologies. The trends in funding noted above seem consistent with this goal.

On the other hand, these trends may mean less emphasis on infant technologies. Yet, most analysts would agree that these less mature,

higher-risk technologies are also the most likely to achieve an effective defense against ballistic missiles, especially since the Soviets will have more difficulty countering these approaches. Hence, the dilemma: does one emphasize more mature technologies now in order to be able to make full-scale development decisions in the early 1990s at the risk of shorting higher-promise but less mature technologies? Or does one risk delaying a decision on full-scale development in order to continue emphasis on less mature technologies?

The dilemma may soon become more pressing. According to General Abrahamson, Director of the Strategic Defense Initiative Organization, the choice of whether or not to emphasize more mature technologies will have to be made more clearly if the Congress imposes further reductions in SDI's budget requests. Abrahamson argues that, in the face of further reductions in his requests, he will not be able to maintain a balance between developing less mature technology and undertaking expensive efforts to validate and integrate more mature concepts. Actual decisions to initiate full-scale development are likely to exacerbate such an imbalance. Thus, it may be increasingly important for the Congress to consider how any future funding reductions should be made since maintaining a balance may require altering SDI's timetable.

CONCLUSION

In summary, Mr. Chairman, the SDI budget for R&D is very large compared with any other research project. SDI's budget is more comparable to the R&D budget for a military service than to the budget for a particular research project. Under the Administration's request, SDI will grow sharply as a percent of total R&D funding, from a level of 12 percent in 1987 to 23 percent by 1992. That will leave fewer dollars for other R&D projects, especially since the Administration does not plan major real growth in total R&D spending over the next five years.

In its 1988 request, SDI would continue to spend widely on a variety of approaches to missile defense, though there are signs of shifts toward more mature technologies. If budget limits continue to be imposed on SDI, however, the Administration and the Congress may soon have to make a clear choice: maintain a balance of spending between mature and less advanced technologies, or emphasize those technologies that could lead to deployment in the 1990s or early in the next century.

SUPPLEMENTARY TABLES

TABLE A-1. KINETIC ENERGY WEAPONS (KEW) (In millions of current year dollars)

	1987	1988
Largest Dollar Project		
1988 Budget Plan a/	Test and Evaluation (252)	SBKKV Systems (304)
Smallest Dollar Project		
1988 Budget Plan	Innovative Science and Technology (13)	Innovative Science and Technology (28)
	1986-1987	1987-1988
Largest Percent Increase		
1988 Budget Plan	EXO KKV Systems (75)	SBKKV Systems (139)
Largest Percent Decrease		
1988 Budget Plan	Allied/Theatre Defense (-37)	Test and Evaluation (-57)

SOURCE: Congressional Budget Office from Department of Defense data.

a. Consistent detail at project level not available between 1987 and 1988 budget plans.

TABLE A-2. DIRECTED ENERGY WEAPONS (DEW) (In millions of current year dollars)

	1987	1988
Largest Dollar Project		
1987 Budget Plan	Technology Integration Experiments (1,073)	Technology Integration and Experiments (1,097)
1988 Budget Plan	Technology Integration Experiments (402)	Technology Integration Experiments (588)
Smallest Dollar Project		
1987 Budget Plan	Concept Formulation (30)	Concept Formulation (50)
1988 Budget Plan	Innovative Science and Technology (13)	Innovative Science and Technology (28)
	1986-1987	**1987-1988**
Largest Percent Increase		
1987 Budget Plan	Technology Integration Experiments (247)	Concept Formulation and and Technology Development Planning (67)
1988 Budget Plan	Support Programs (217)	Innovative Science and Technology (121)
Largest Percent Decrease		
1987 Budget Plan	Technology Base Development (-7)	Technology Base Development (-28)
1988 Budget Plan	Technology Base Development (-22)	Technology Base Development a/ (0)

SOURCE: Congressional Budget Office from Department of Defense data.

a. No decreases in funding planned; Technology Base Development has smallest planned increase at 0.2 percent.

TABLE A-3. SURVEILLANCE, ACQUISITION, TRACKING AND KILL ASSESSMENT (SATKA)
(In millions of current year dollars)

	1987	1988
Largest Dollar Project		
1987 Budget Plan	Integrated Experiments (178)	Boost Surveillance and Tracking System (270)
1988 Budget Plan	Integrated Experiments (150)	Boost Surveillance and Tracking System (256)
Smallest Dollar Project		
1987 Budget Plan	Technology Base Development (22)	Technology Base Development (32)
1988 Budget Plan	Interactive Discrimination (5)	Technology Base Development (23)
	1986-1987	**1987-1988**
Largest Percent Increase		
1987 Budget Plan	Interactive Discrimination (213)	Space Surveillance and Tracking System (109)
1988 Budget Plan	Boost Surveillance and Tracking System (60)	Interactive Discrimination (616)
Largest Percent Decrease		
1987 Budget Plan	Airborne Optical Surveillance (-26)	Optical Discrimination and Data (-26)
1988 Budget Plan	Interactive Discrimination (-41)	Optical Discrimination and Data (-3)

SOURCE: Congressional Budget Office from Department of Defense data.

TABLE A-4. SYSTEMS ANALYSIS AND BATTLE MANAGEMENT (SABM)
(Dollars are in millions of current year dollars)

	1987	1988
Largest Dollar Project		
1987 Budget Plan	BM/C3 Technology (159)	BM/C3 Technology (184)
1988 Budget Plan	BM/C3 Technology (89)	BM/C3 Experimental Systems (173)
Smallest Dollar Project a/		
1987 Budget Plan	National Test Bed (77)	National Test Bed (108)
1988 Budget Plan	Countermeasures (5)	Innovative Science and Technology (28)
	1986-1987	1987-1988
Largest Percent Increase		
1987 Budget Plan	National Test Bed (325)	National Test Bed (41)
1988 Budget Plan	Theater Architecture (2,241)	BM/C3 Experimental Systems (114)
Largest Percent Decrease		
1987 Budget Plan	BM/C3 Technology b/ (49)	BM/C3 Technology b/ (16)
1988 Budget Plan	Countermeasures (-18)	Countermeasures (-100)

SOURCE: Congressional Budget Office from Department of Defense data.

a. Excludes civil and medical applications projects.
b. No decreases in funding planned; entry shows project with smallest increase in planned funding.

TABLE A-5. SURVIVABILITY, LETHALITY, AND KEY TECHNOLOGIES (SLKT)
(In millions of current year dollars)

	1987	1988
Largest Dollar Project		
1987 Budget Plan	Power and Power Conditioning (140)	Space Transport and Support (170)
1988 Budget Plan	Power and Power Conditioning (86)	Space Transport and Support (434)
Smallest Dollar Project		
1987 Budget Plan	Materials and Structures (21)	Materials and Structures (0)
1988 Budget Plan	Materials and Structures (14)	HELSTF (19)
	1986-1987	**1987-1988**
Largest Percent Increase		
1987 Budget Plan	Space Transport and Support (226)	Space Transport and Support (152)
1988 Budget Plan	Countermeasures (207)	Space Transport and Support (1,092)
Largest Percent Decrease		
1987 Budget Plan	Systems Survivability a/ (19)	Materials and Structures b/ (-100)
1988 Budget Plan	HELSTF (-2)	HELSTF (0)

SOURCE: Congressional Budget Office from Department of Defense data.

a. No decreases in funding planned; entry shows project with smallest increase in planned funding.
b. This project was resurrected in the 1988 budget plan and funded at $22.5 million.