



**Defense Research and Engineering:
*Enabling Transformation for the Future***

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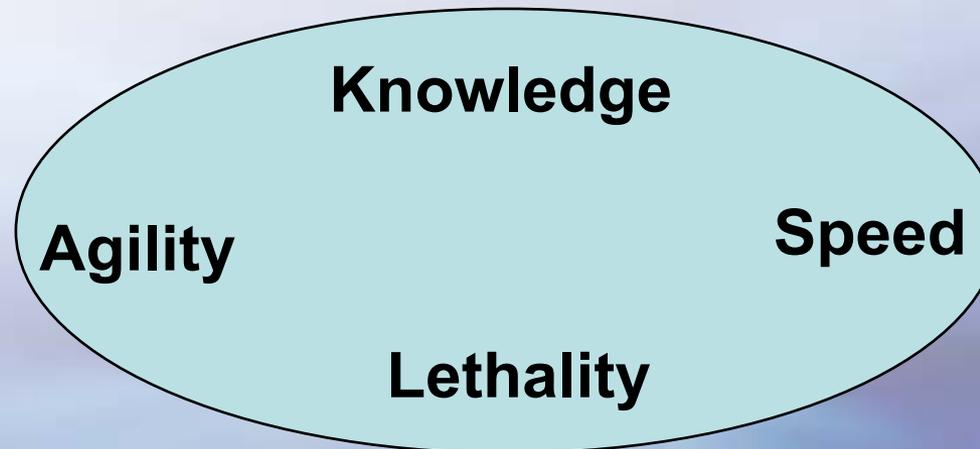
Agenda

- **Transformational Initiatives**
 - National Aerospace Initiative
 - Energy & Power Technologies
 - Surveillance & Knowledge Systems
- **Combating Terrorism Technology Task Force (CTTTF)**
- **Science & Engineering Workforce: The Need for Innovation**
- **Summary**

Transformation Technology Initiatives



- Transformation Attributes



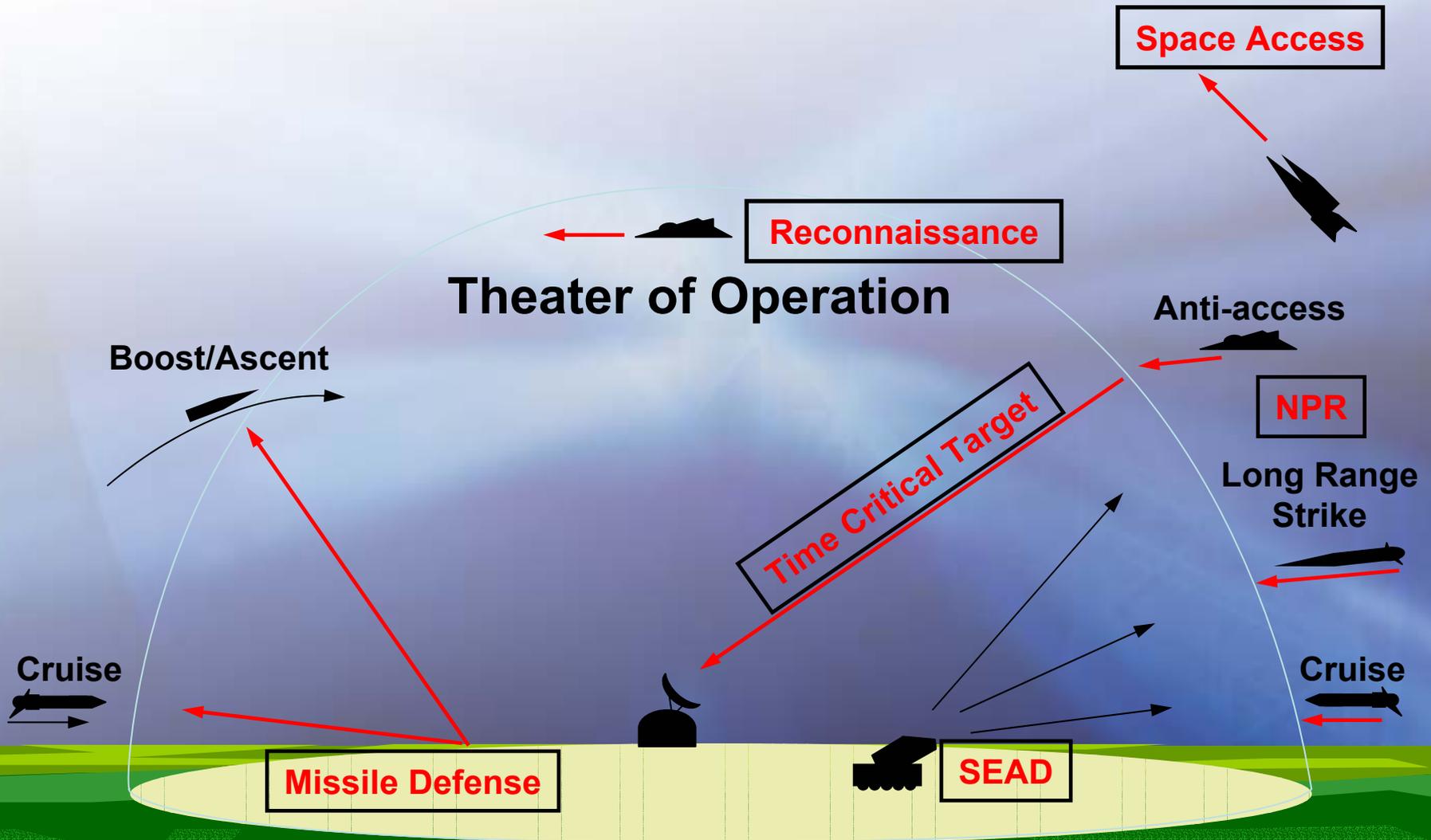
- Transformation Technology Initiatives

- National Aerospace Initiative
- Energy and Power Technologies
- Surveillance and Knowledge Systems

Value of Speed



Theater of Operation



National Aerospace Initiative

-- Technology Framework --



NAI

- Strategic Focus
- Technical Coordination
- Aerospace Workforce

High Speed Hypersonics

TCT/NPR

Expendable (Missiles)

Mach < 4

4 < Mach < 15

Long-Range Strike [Mach 0-7]

Reusable [Mach 0 - 12]

Air-Breathing 1st Stage (TSTO) [Mach 0 - 12]

Space Access

DoD/NASA

Reusable Launch Vehicle

2nd Stage Rocket Engine

Space Maneuvering Vehicle

Space Technology

Space Commission

Responsive Payloads

Flexible Comm

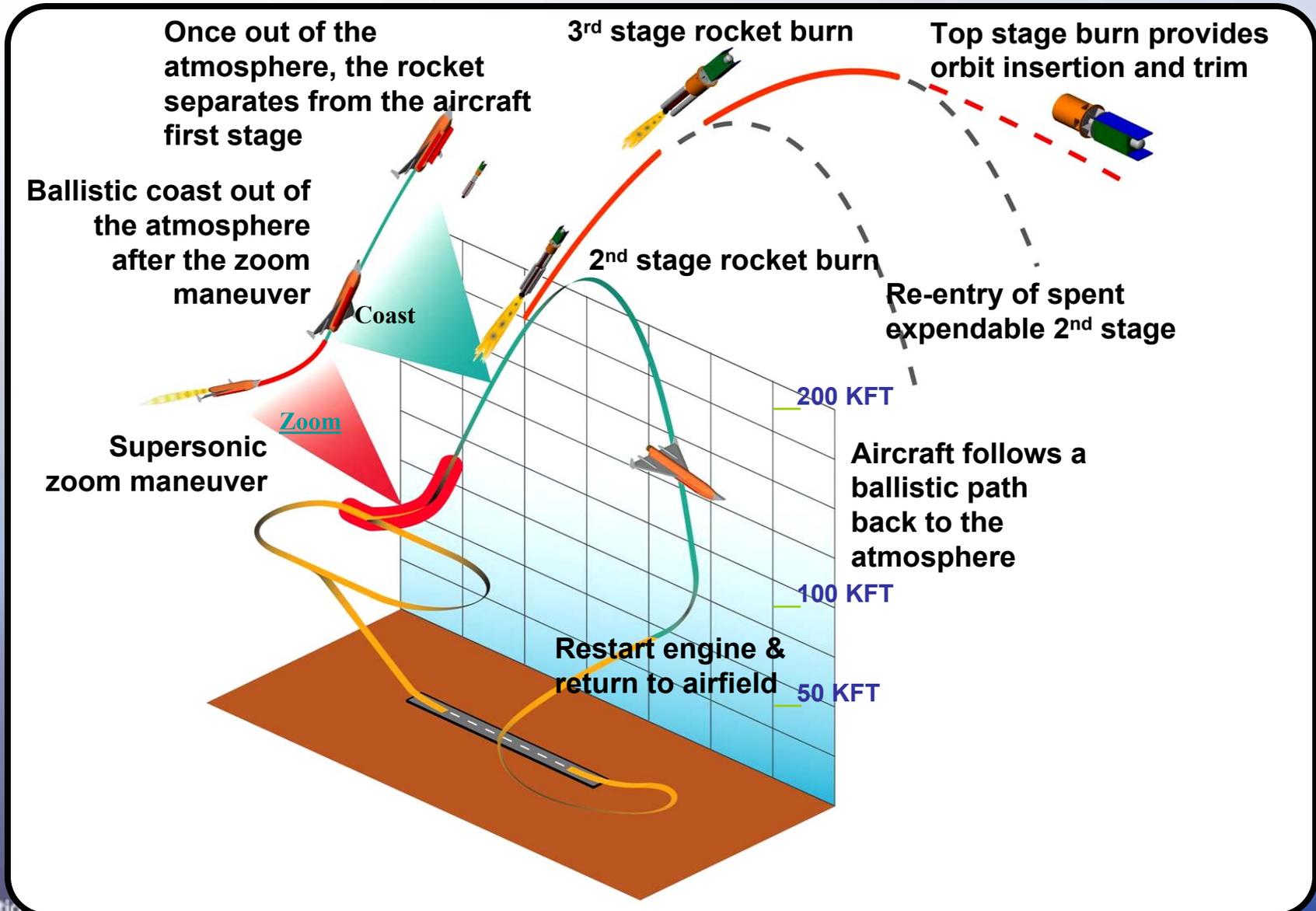
ISR

Space Control

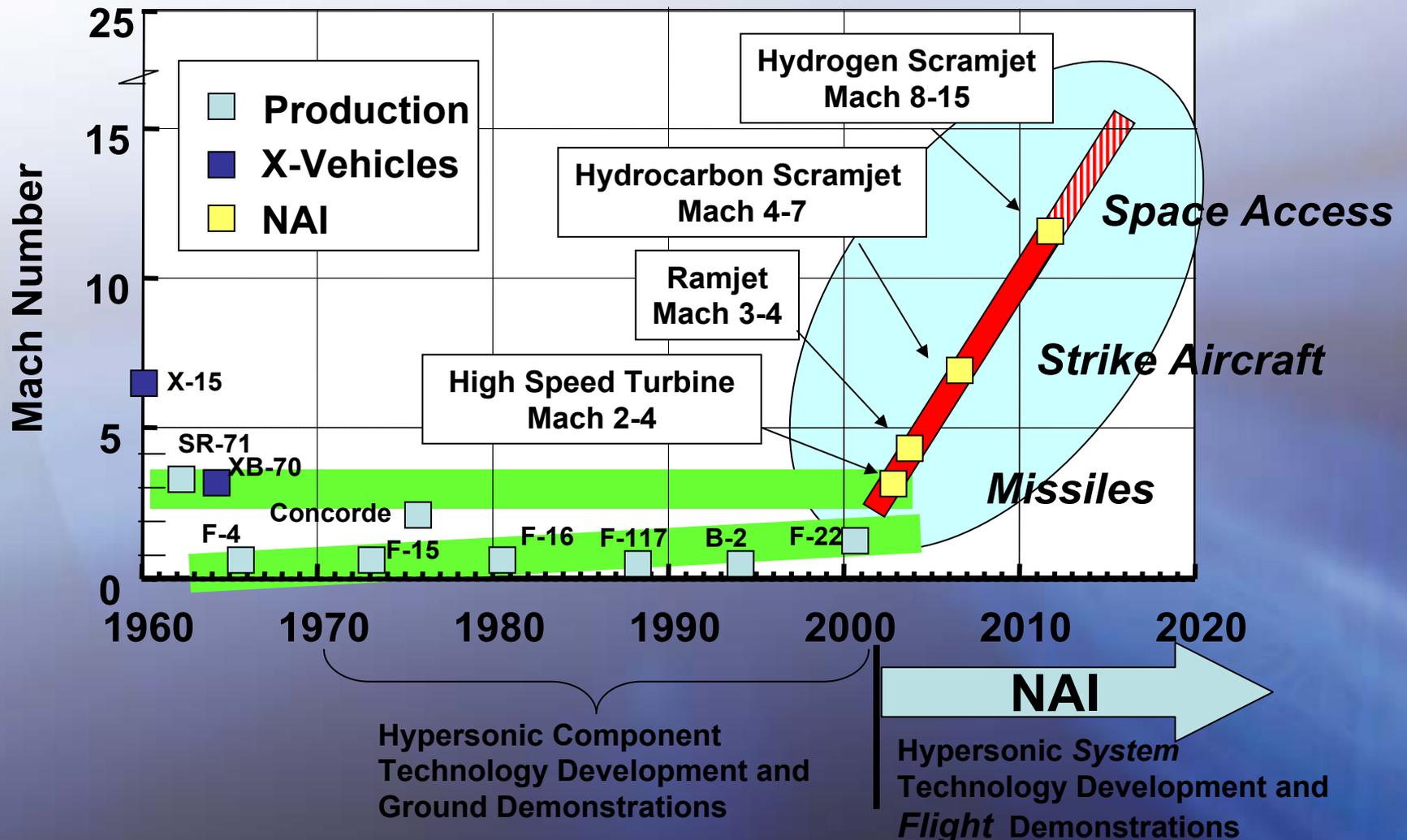
Synergy Goal: 1 + 1 + 1 > 3

DARPA RASCAL Program

-- High Speed / Hypersonics, Space Access, Space Technology --

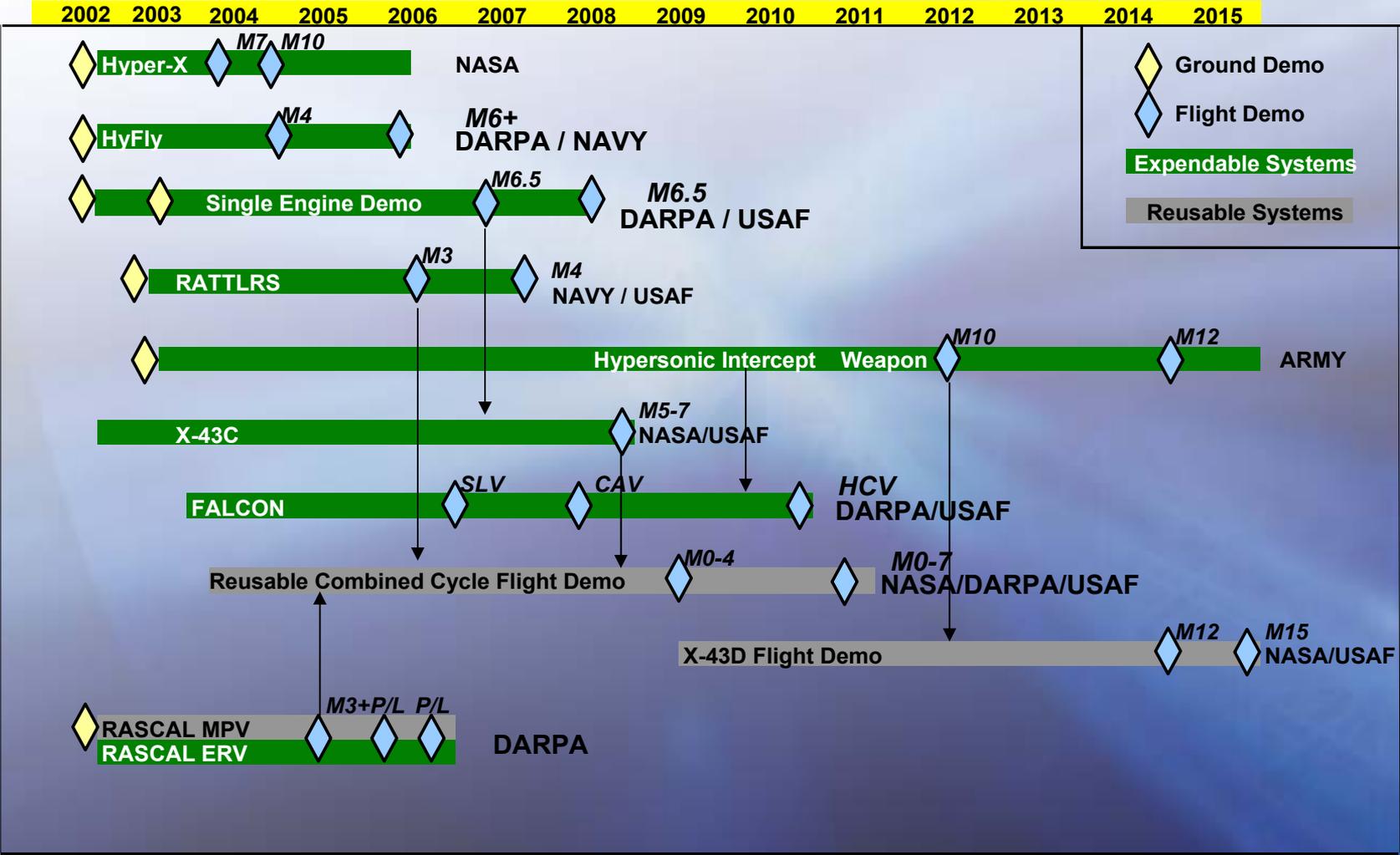


National Aerospace Initiative



Test/Demonstrator Roadmap

High Speed/Hypersonics and Space Access



UNCLASSIFIED

High Speed / Hypersonics



HyFly



(DARPA / Navy)
Ground Testing Began
- May 30, 2002

Full Scale, Fully
Integrated – 80 Tests

Data gathered at Mach
3.5, 4.1, 6.2, 6.5

Altitude 55kft up to
100kft

Single Engine Demonstration

DARPA/Air Force Flight Test Program



HyTech



AF Ground Testing

145 Tests (2001 – 2003)

Film: Mach 4.5 Test

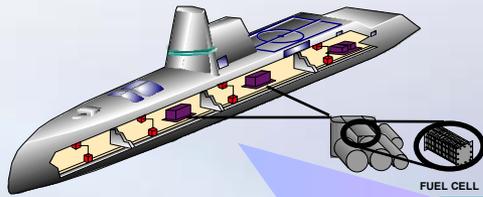
Mach 6-6.5 Testing in
Progress

Energy & Power Technologies... Enabling a More Electric Force



POWER GENERATION

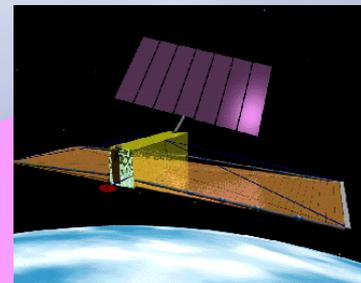
- Fuel Cells & Fuel Reforming
- Novel Power



Electric Warship



More Electric Aircraft



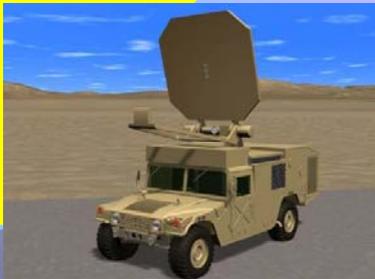
Space Based Radar

ENERGY STORAGE

- Batteries
- Capacitors



High Power Microwave



FY02

FY12

POWER CONTROL AND DISTRIBUTION

- Switching & Conditioning
- Power Transmission & Distribution
- Thermal Management

New Operational Capabilities



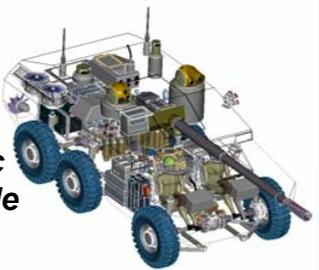
Warrior



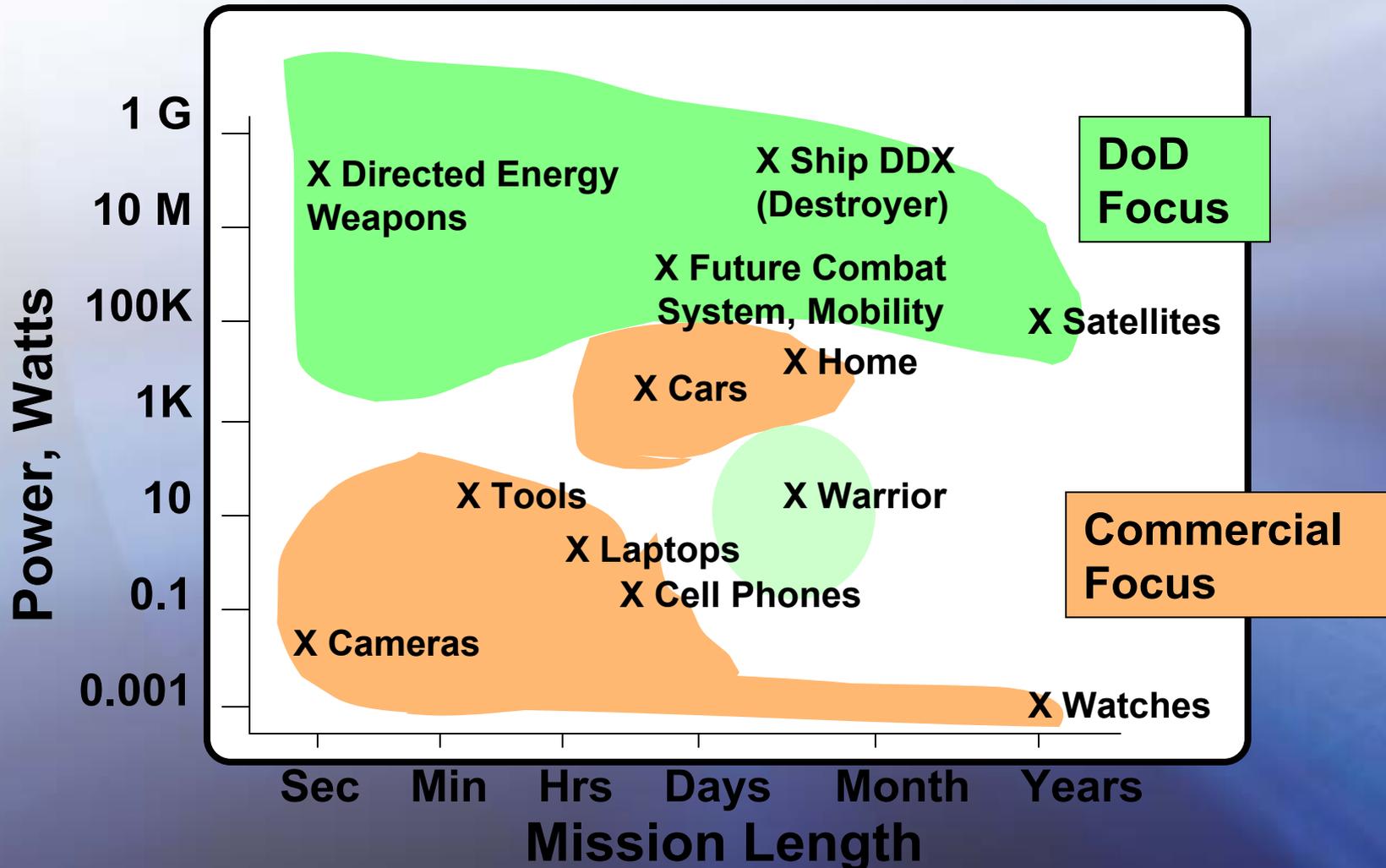
Electric/Hybrid Weapons



Hybrid/Electric Combat Vehicle



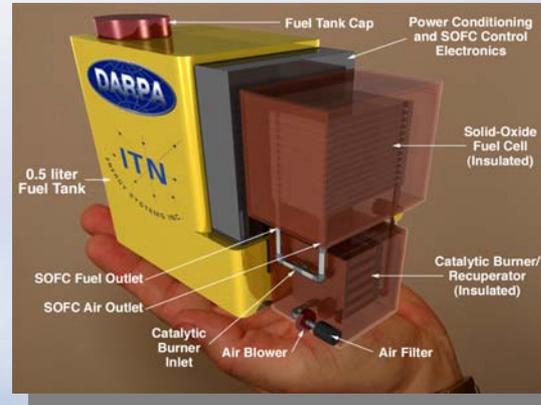
Energy and Power Technologies



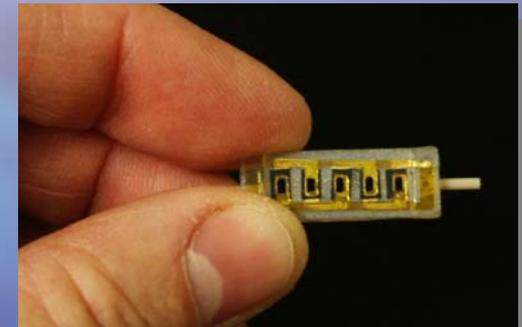
Miniaturized Electric Power



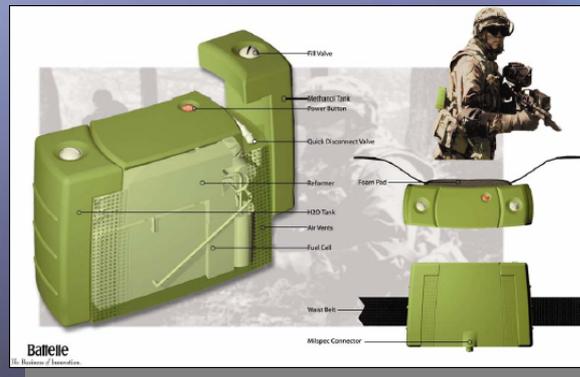
Direct Methanol Fuel Cell (Army)



Palm Power Program (DARPA)



Micro-Channel Methanol Reformer & Fuel Cell (Marine Corps)



MEMS-based Fuel Cell (DARPA / Air Force)

Surveillance & Knowledge Systems



Information and Decision Dominance achieved through integrated C4ISR technologies that enable seamless, interoperable, knowledge-based, and assured Joint & Coalition Network-Centric Operations & Warfare.

• **Sensing:**

Management and tasking of pervasive, persistent sensors for enhancing battlespace knowledge

• **Comms & Networking:**

Guaranteed, 365x24x7, mobile, information access and delivery (always-on “internet dial tone”)

• **Knowledge Management:**

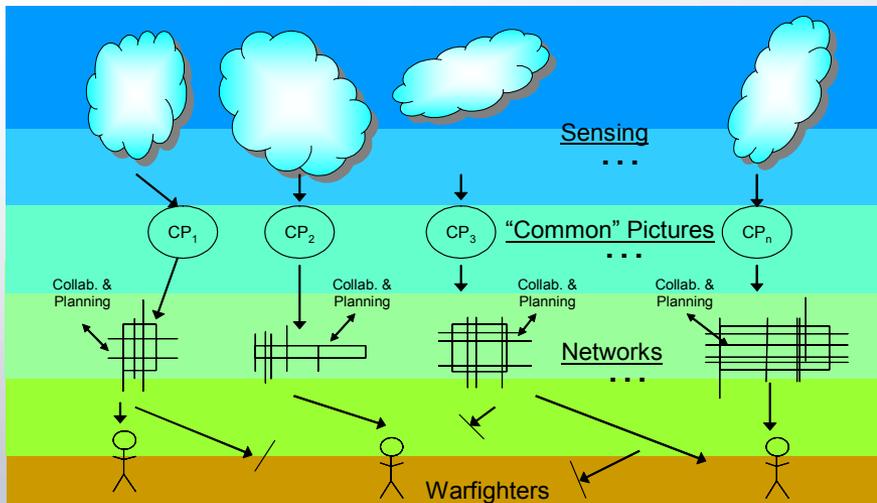
Dramatically improved speed of command through integrated Common Picture, Collaboration, and Planning

• **Information Security (Cyber Ops):**

Network protection, information assurance; offensive disruption

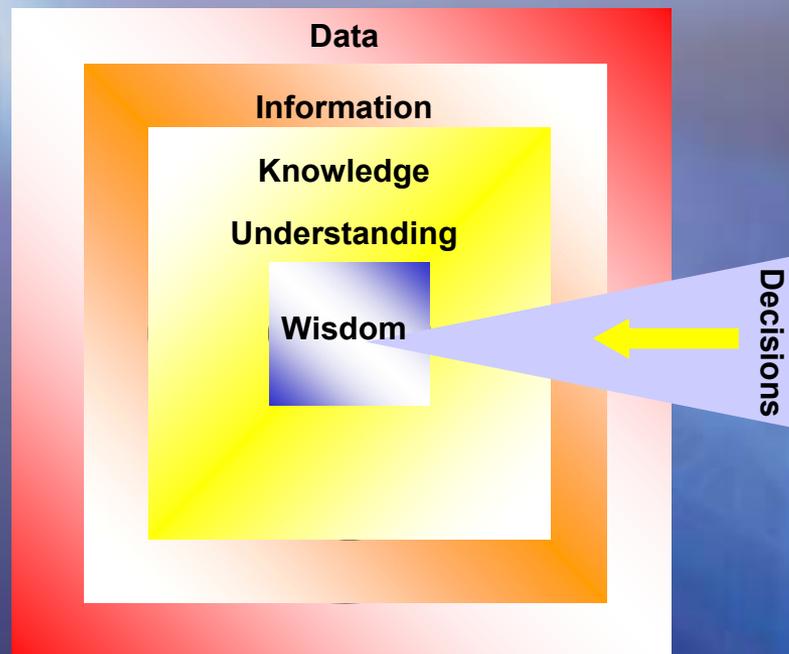
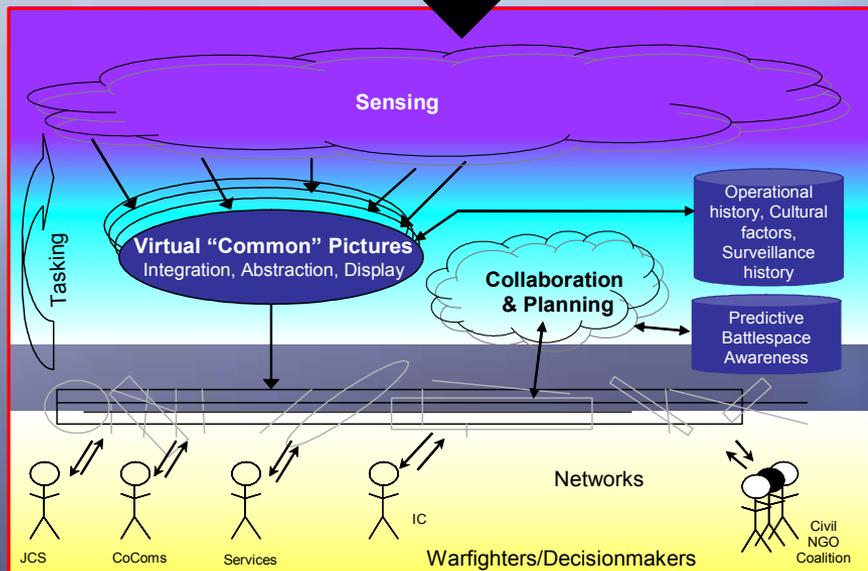
Surveillance & Knowledge

Enabling Integrated C4ISR



Technology Foci

- Adaptive Networks
- Ubiquitous Sensors
- Decision Aids



Surveillance & Knowledge Metrics: *Key Elements*



- **Sensing, Detection, & Tracking Effectiveness**
- **Common Picture Quality**
- **Decision Quality & Timeliness**
- **Network Coverage**
- **Interoperability & Flexibility**
- **Information Security, Survivability, and Response**

**There is no single “Mach Number”
metric to gauge success in C4ISR.**

Army / DARPA Collaboration

Enabling Future Combat Systems



Unmanned Air Vehicles



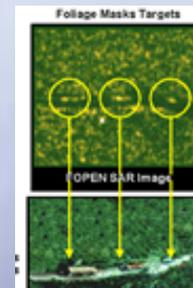
- Diesel Micro Air Vehicle (d-MAV) ACTD
- DP-5X UAV
- Organic Air Vehicle

Autonomy With Intent – UGCV

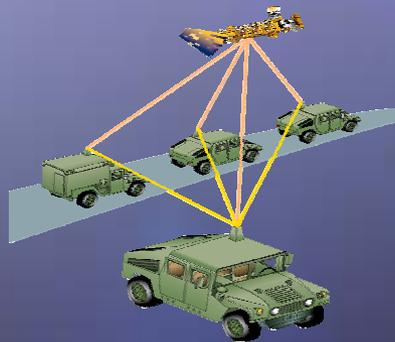


- Armed Robotic Vehicle
 - Advanced mobility
 - Advanced perception
-
- International Cooperation
 - Studies, Analyses and Experiments
 - Other

Find the Enemy – ISR



- Affordable Adaptive Conformal ESA Radar (AACER)
- Foliage Penetrating Reconnaissance, Surveillance and Tracking Engagement Radar (FORESTER)
- JIGSAW
- Sensor DART
- Wolfpack



Network and Battle Command

- FCS Communications
- Mobile Networked Multiple-Input / Multiple-Output (MNM) Communications
- FCS Multi Cell Command and Control (C2)

DoD Combating Terrorism Technology Task Force (CTTTF)



- ***Task Force Established by DDR&E - Sept 19, 2001***
- ***Collaborative effort between DoD Service/Agency Science & Technology (S&T) Organizations, coordinating with:***
 - Joint Staff
 - Combatant Commanders (CoComs)
 - Other Federal Agencies
- ***Objectives:***
 - Identify needs and technologies for the Global War on Terrorism (GWOT)
 - Prioritize technology options with users
 - Rapidly transition and field systems
 - Coordinate Force Protection technology solutions

Water Purification System/Water Pen Unit

Fiscal Year 2003 Technology Transition Initiative (TTI)



Participants:

Defense S&T Source: DARPA

Source of Procurement Funding:
Various operational units (GSA
Catalog)

Schedule:

FY03: Procured 2,494 water
purification pens and distributed
them throughout the Services and
U.S. Special Operations Command
(SOCOM).

FY 04: Procure and distribute
4,157 additional pens.



Technology:

Mixed oxidants electrochemically
generated from common table
salt via several small lithium
camera batteries kill a wide
range of resistant
microorganisms.

Comments:

The pen would enable soldiers
to treat up to 300 liters of any
available, non-brackish water
source, eliminating the risk of
their exposure to diseases and
bio-chemical pollutants.



Phraselator



Capabilities:

- Translation of spoken English to the user selected foreign language
- Supports one-way spoken dialog with gesture response
- Permits soldiers to interact with native populations
- New phrases can be added to the system by soldiers in the field using a laptop PC

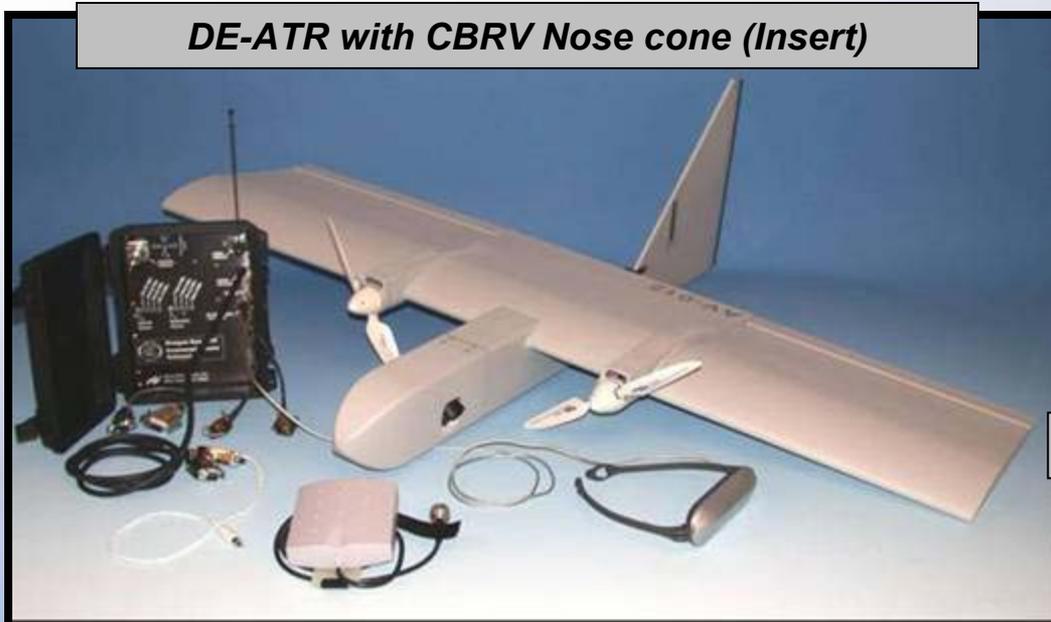
Status:

- Fielded for pilot testing. Improved hardware and software under development.
- LASER ACTD is investing in two-way speech capability for future fielding

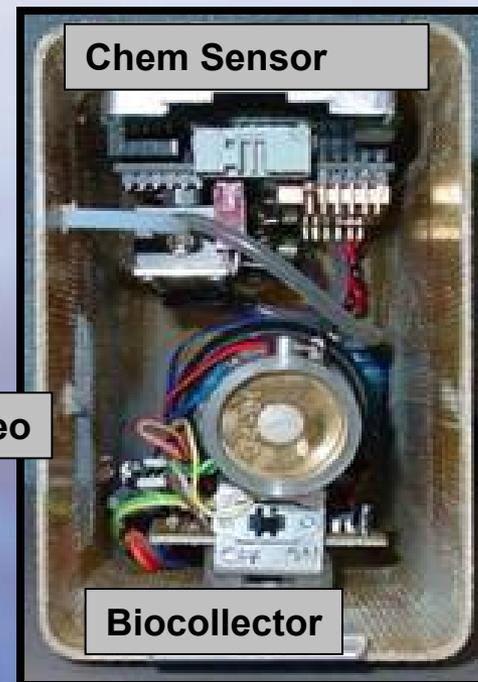
Available Languages

| | | |
|------------|------------|------------------|
| Albanian | Arabic | Azerbaijani |
| Armenian | Bulgaria | Chinese Mandarin |
| Cambodian | Croatian | Japanese |
| Czech | Dari | Polish |
| Korean | Macedonian | Portuguese |
| Punjabi | Pushtu | Brazil/Euro |
| Russian | Rwandan | Serbian |
| Singhalese | Dutch | English |
| Farsi | French | Georgian |
| German | Thai | Haitian Creole |
| Hindi | Hungarian | Indonesian |
| Italian | Slovak | Slovenian |
| Spanish | Swahili | Swedish |
| Tagalog | Turkish | Hebrew |
| Urdu | Vietnamese | Woleaian |
| | | Iranian |

Dragon Eye (DE)-ATR (Chem-Bio-Video Advanced Tactical Recce)



DE-ATR with CBRV Nose cone (Insert)



Chem Sensor

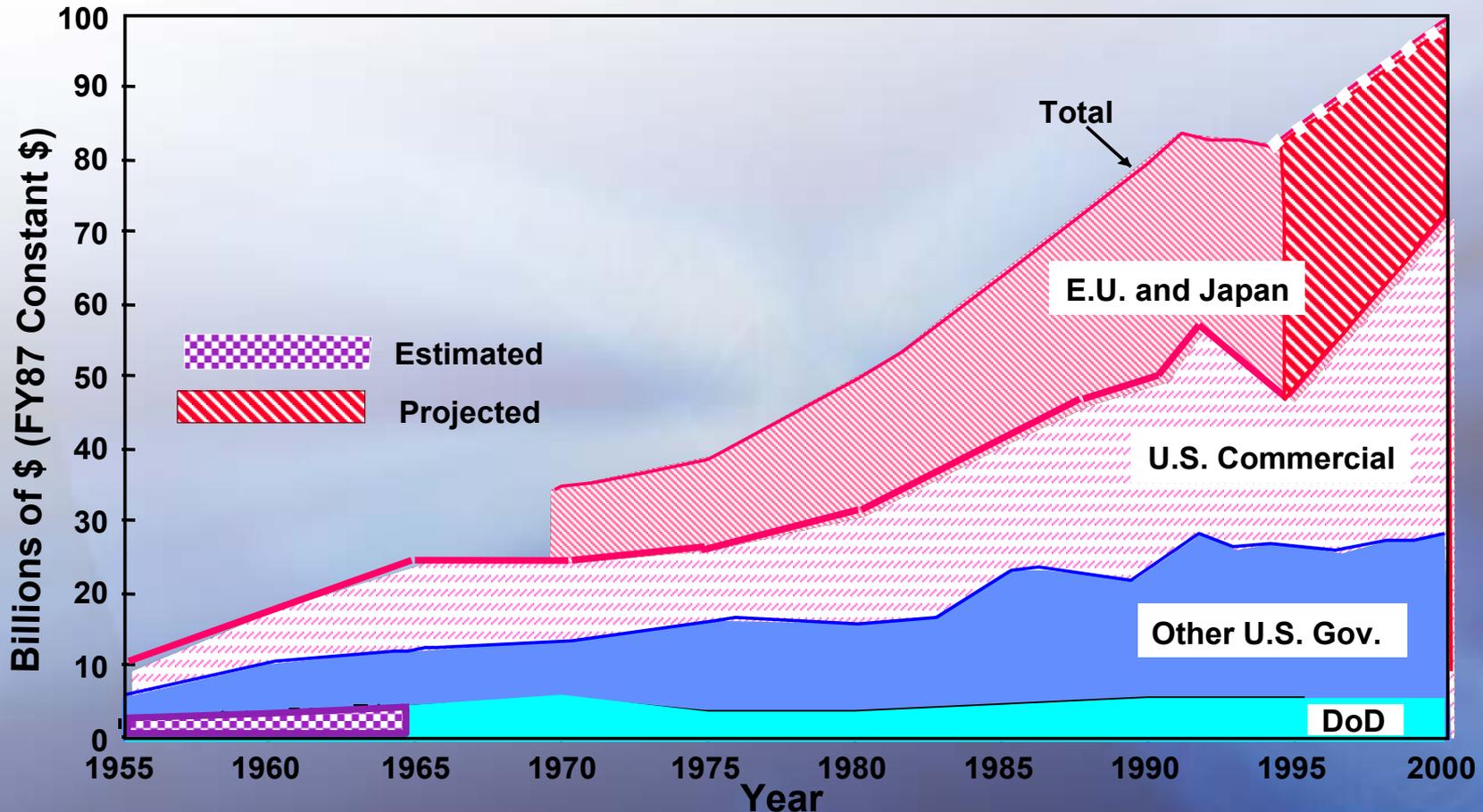
Video

Biocollector

- Visual Battle Damage Assessment (BDA)
- Real time chemical agent detection and data transmission to ground station
- Collection of biological agents
- Ground-based bioagent analysis 30 - 45 min

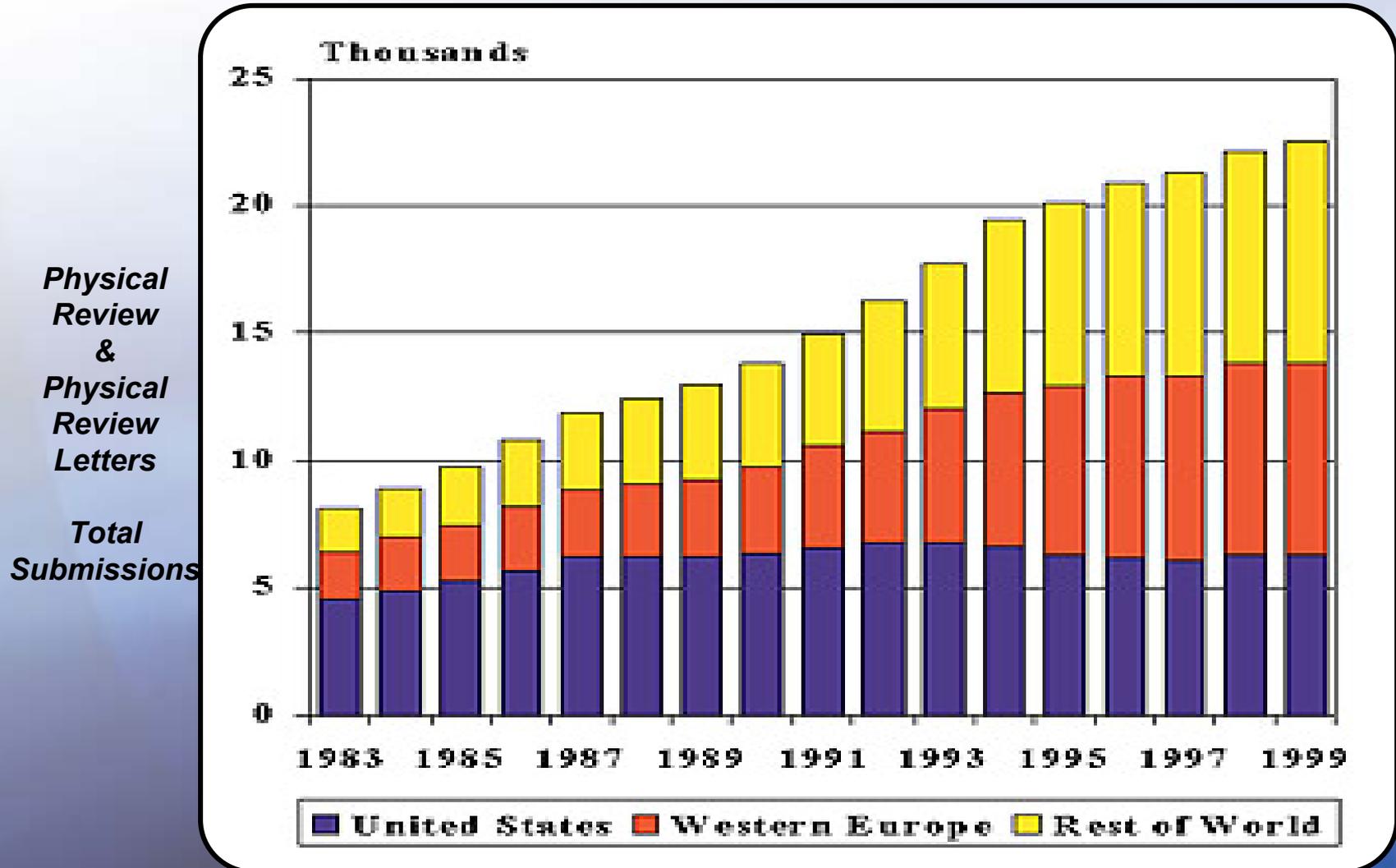
Deployed in Operation Iraqi Freedom

U.S. and Worldwide Research Base Since WWII



Source: Report of the Defense Science Board Task Force on the Technology Capabilities of Non-DoD Providers; June 2000; Data provided by the Organization for Economic Cooperation and Development & National Science Foundation

Physical Review Trends

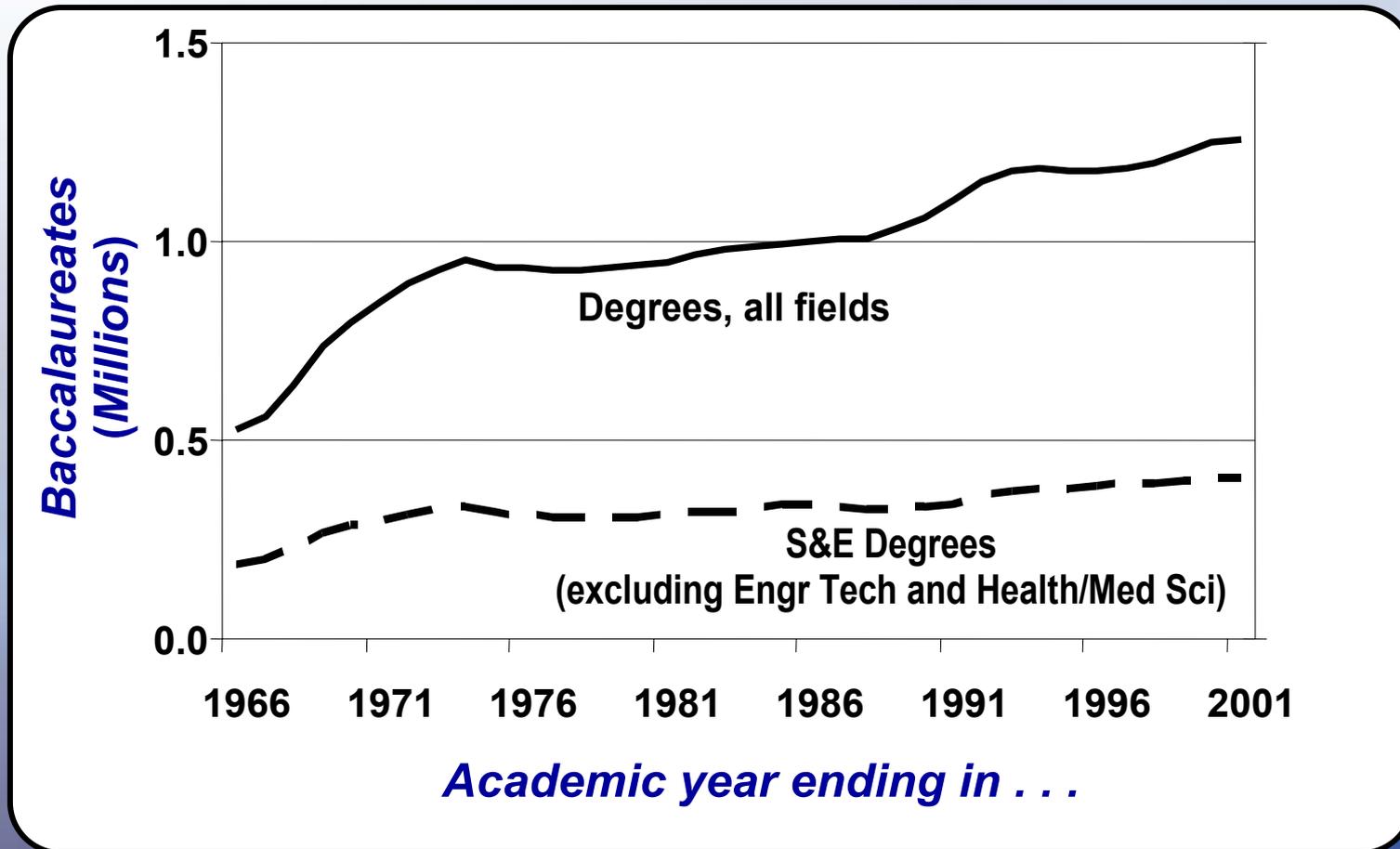


Source: American Physical Society - APS News August/September 2000 -

U.S. Production of S&E Graduates*

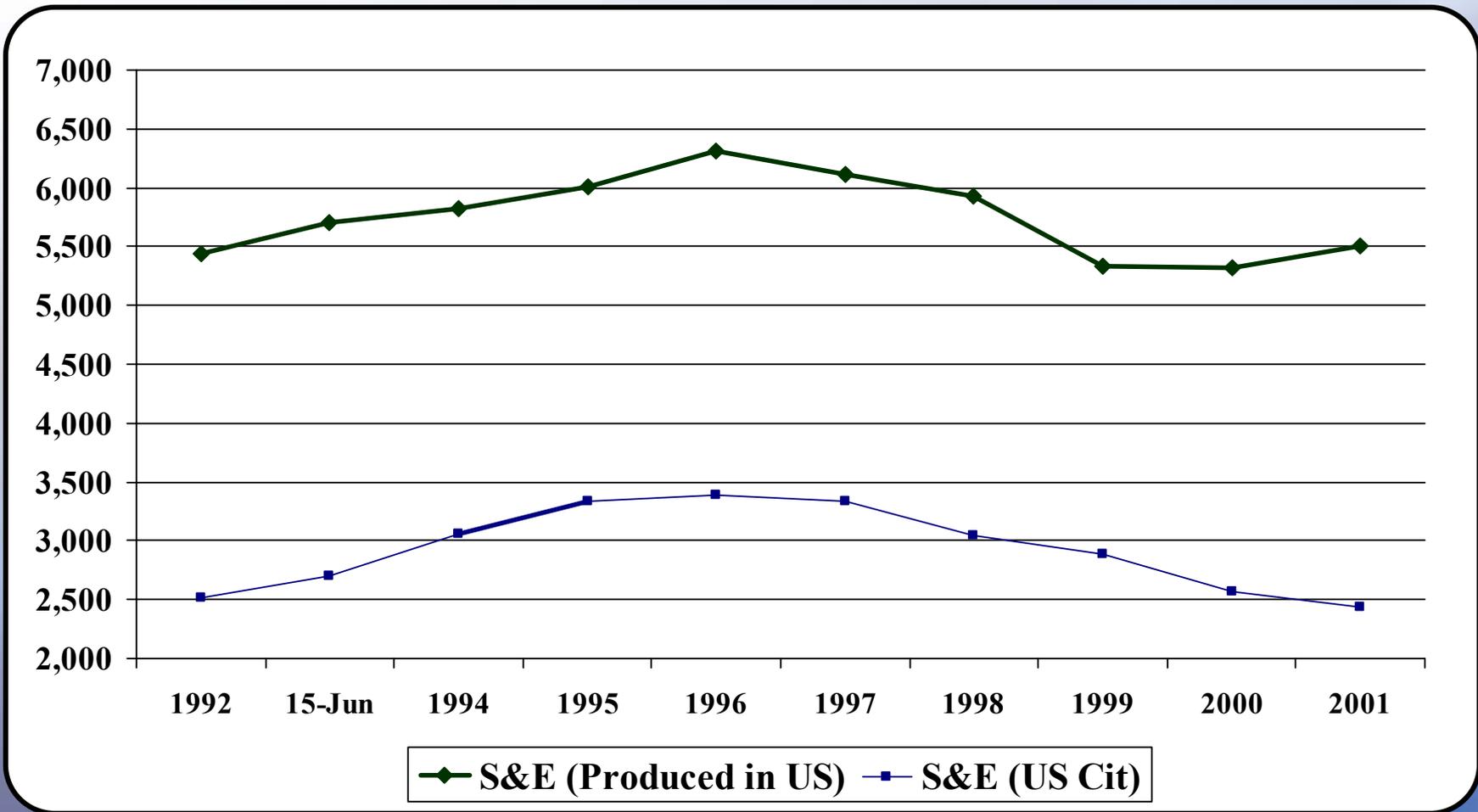


U.S. College and University Graduates, 1966-2001



*Source: Data provided by the NSF, September 2003

U.S. Engineering PhD's Awarded



*Source: Data provided by the NSF, September 2002



Summary

- **A robust, integrated, capabilities-based research and engineering program provides transformational options**
- **Cross-Cutting initiatives established:**
 - National Aerospace Initiative
 - Energy and Power Technologies
 - Surveillance and Knowledge Systems
- **Combating Terrorism Technology Task Force is supporting technical options**
- **Accelerating the technology transition**
- **Science & Engineering Workforce: Critical for Transformation**