DoD Space Launch Modernization Plan

Briefing to
Congressional Staffers
17 May 1994

Lt Gen Thomas S. Moorman, Jr.

Agenda

- Introduction/Background
- State of Play - Current Launch Situation
- Centers of Gravity
- Requirements
- Options
- Findings and Recommendations
- Summary

Congressional Tasking

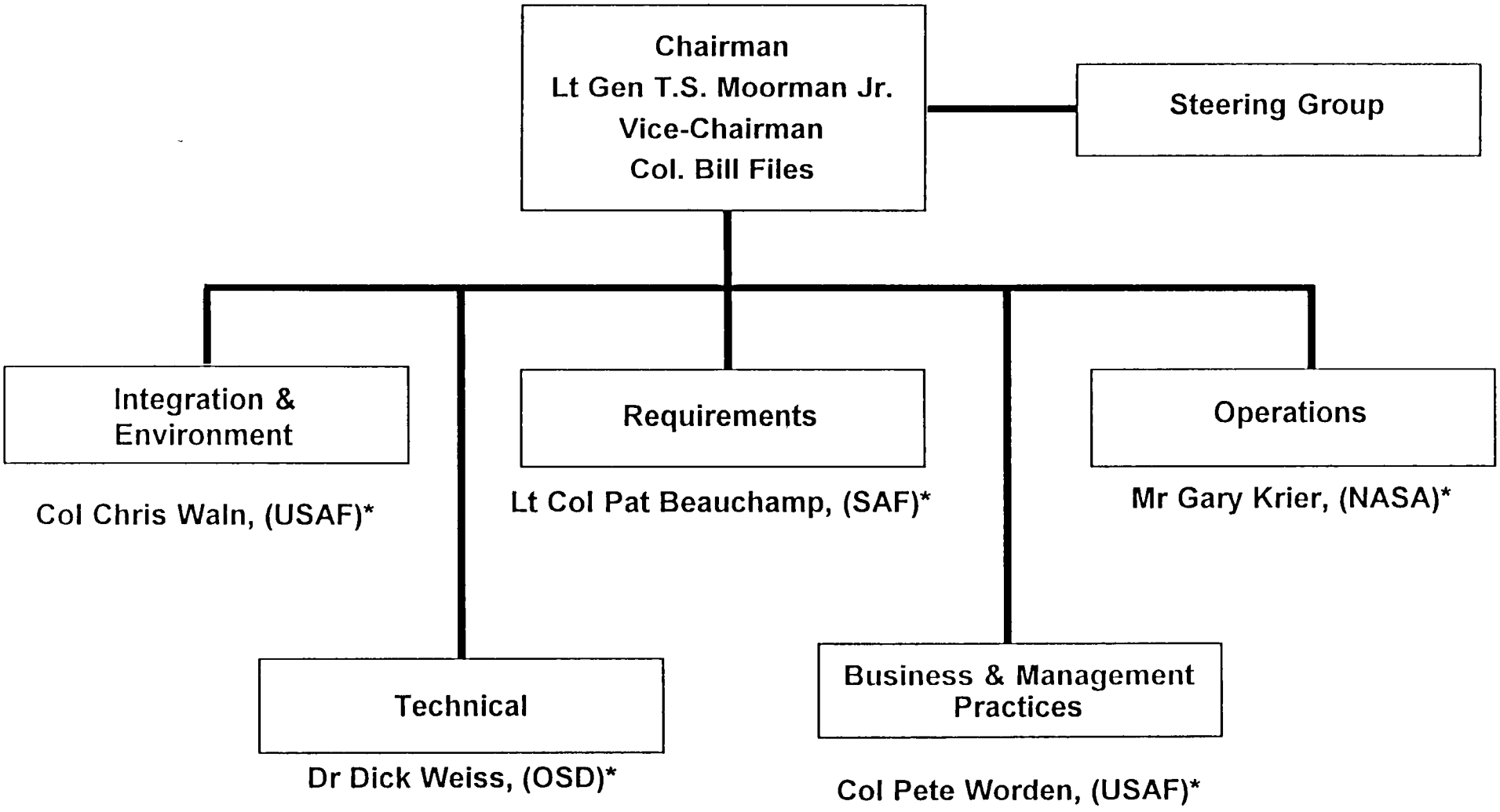
- FY 1994 Defense Authorization Act directed SECDEF to
  - Develop a plan
    - » Establish priorities, goals, and milestones for space launch modernization for DoD, or if appropriate, the government as a whole
    - » Consult with Director of OSTP
  - Allocate funds
    - » $60M for ARPA
  - Identify new launch system requirements (if required)
    - » Pursue innovative government and industry funding, management, and acquisition strategies
  - Define cost reductions for current launch vehicles
  - Study differences between U.S. and foreign space launch systems

Terms of Reference
USD(A&T) - 23 Dec 93

- **Purpose**
  - Study group to address Congressional tasking
  - Develop plan to modernize space launch capabilities
    - Goals
    - Objectives
    - Priorities
    - Decision opportunities
    - Funding profiles
    - Milestones
- **Products**
  - Space Launch Modernization Plan (by 31 Mar)
    - Requirements
    - Past Studies
    - Production cost reduction
    - Technology development
    - New system development
    - Innovative funding and management
  - Comparison with foreign systems (by 1 Oct)
    - Differences in design, manufacturing, processing, management, and infrastructure
    - Effects on cost, reliability, and operational effectiveness

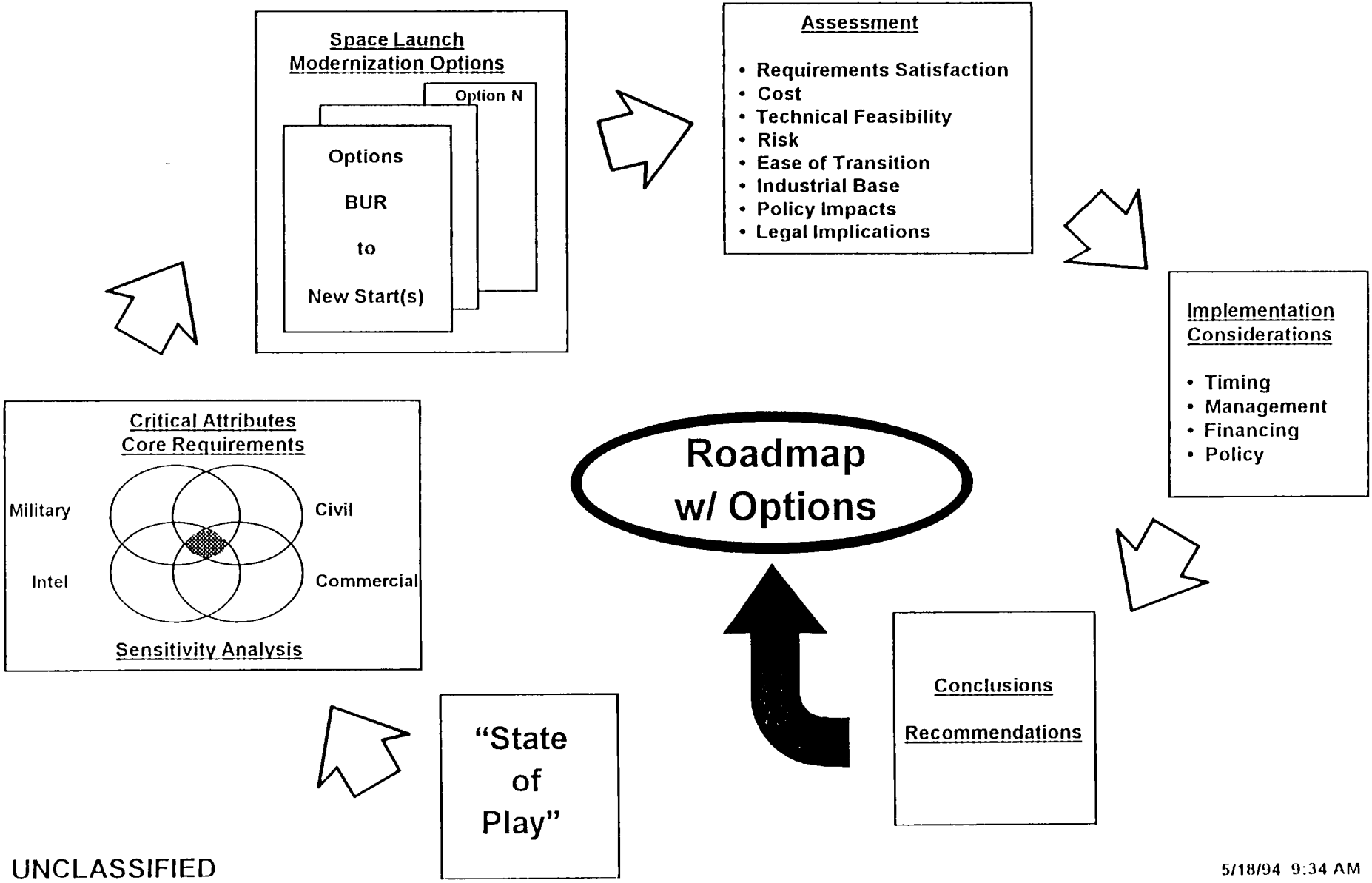
Study Process

Study Organization

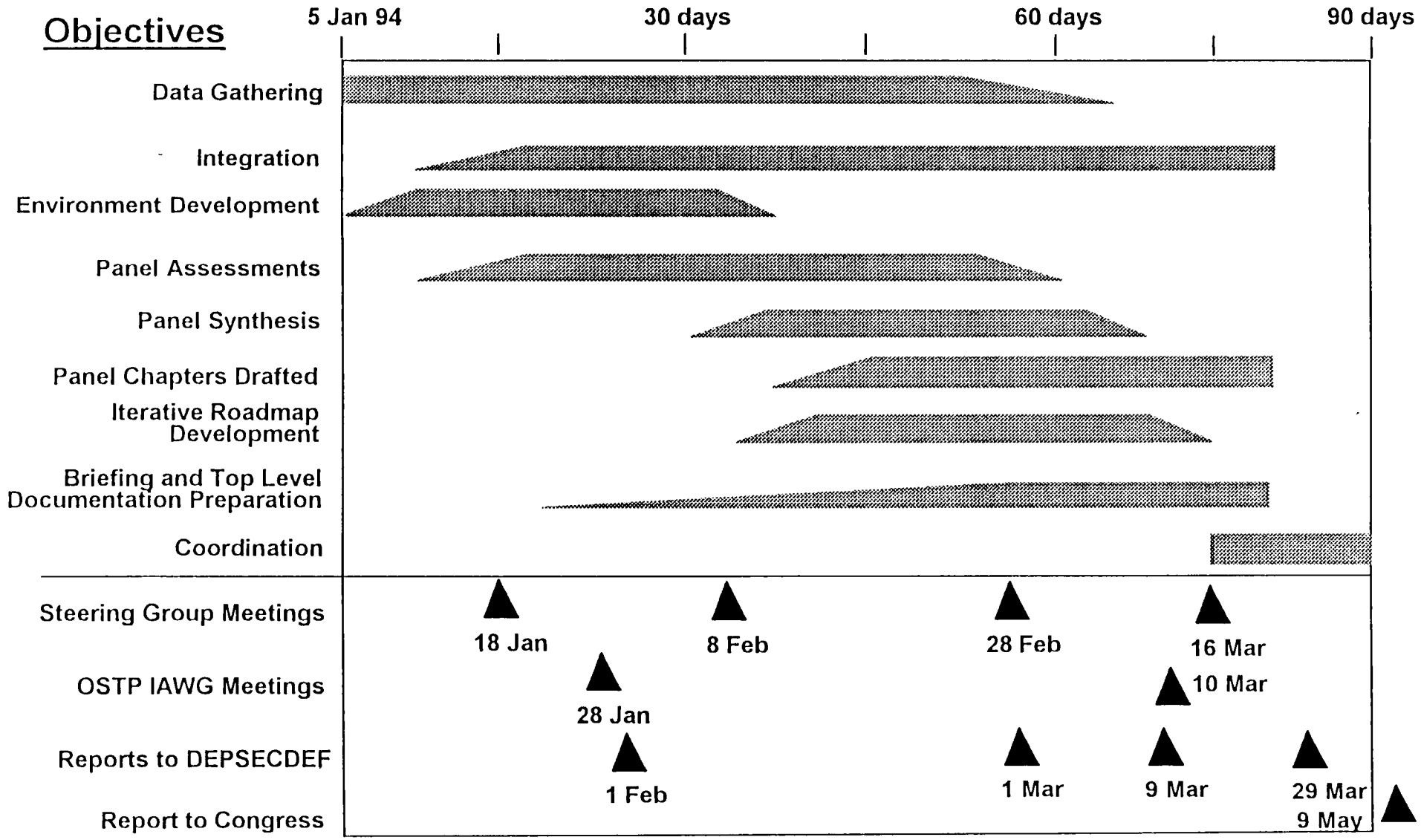


* Panel Leader

Methodology



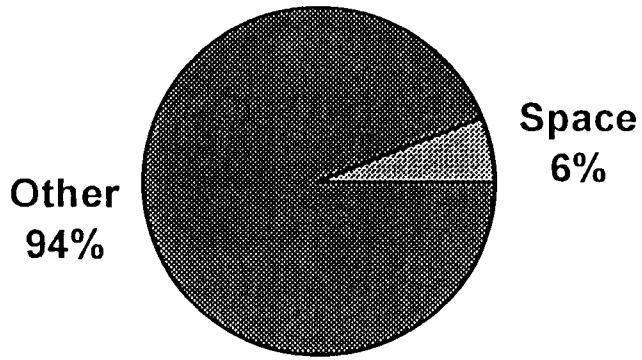
Space Launch Modernization Study Milestones



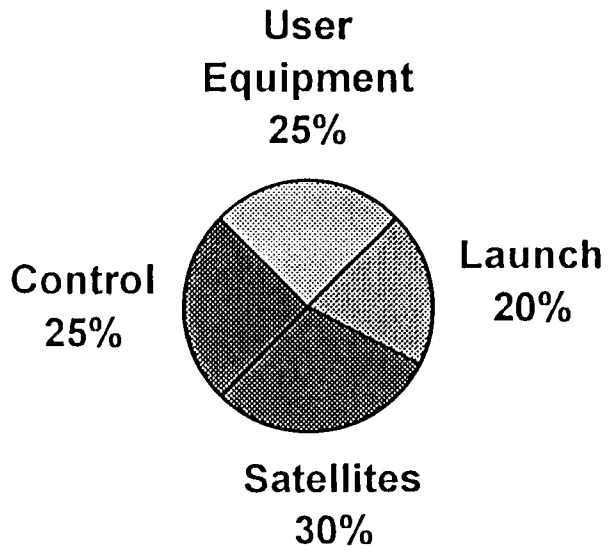
State of Play

DOD Space Economics

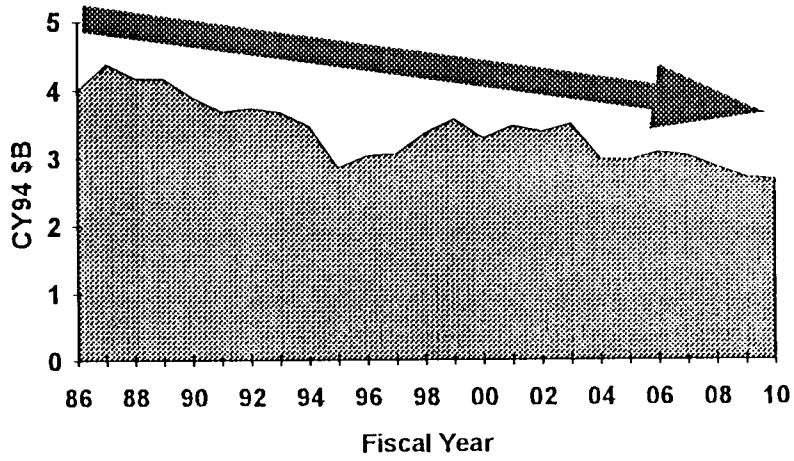
- National Security Budget



- Space Budget Allocation



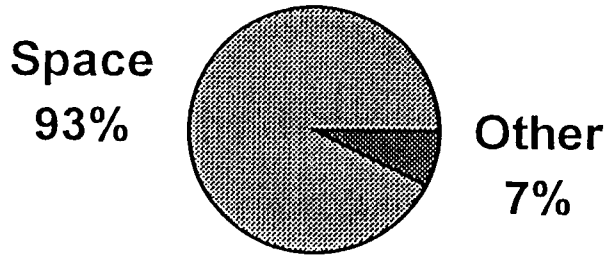
- Air Force Space Budget is Declining and Zero-Sum



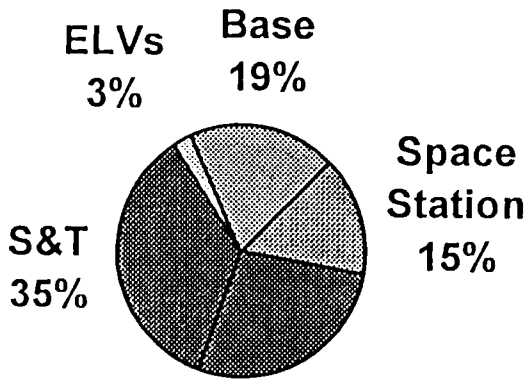
Source: Space Investment Strategy

NASA Space Economics

- NASA Space Budget

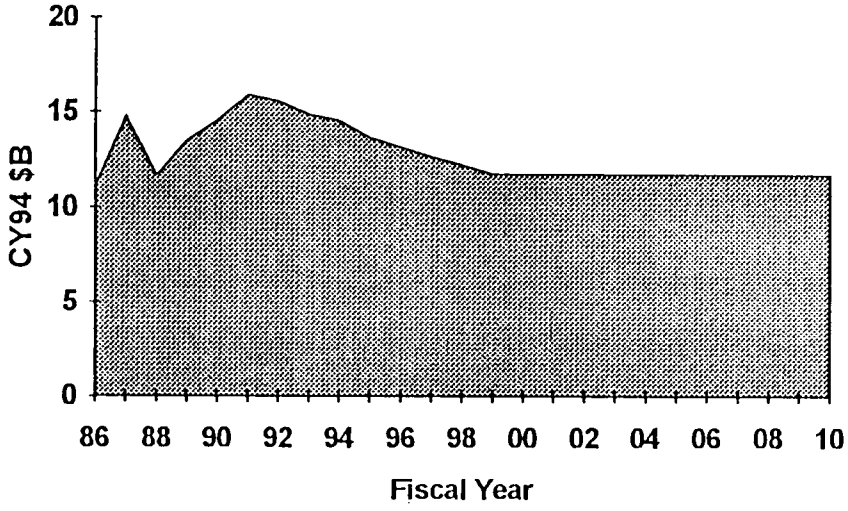


- Space Budget Allocation



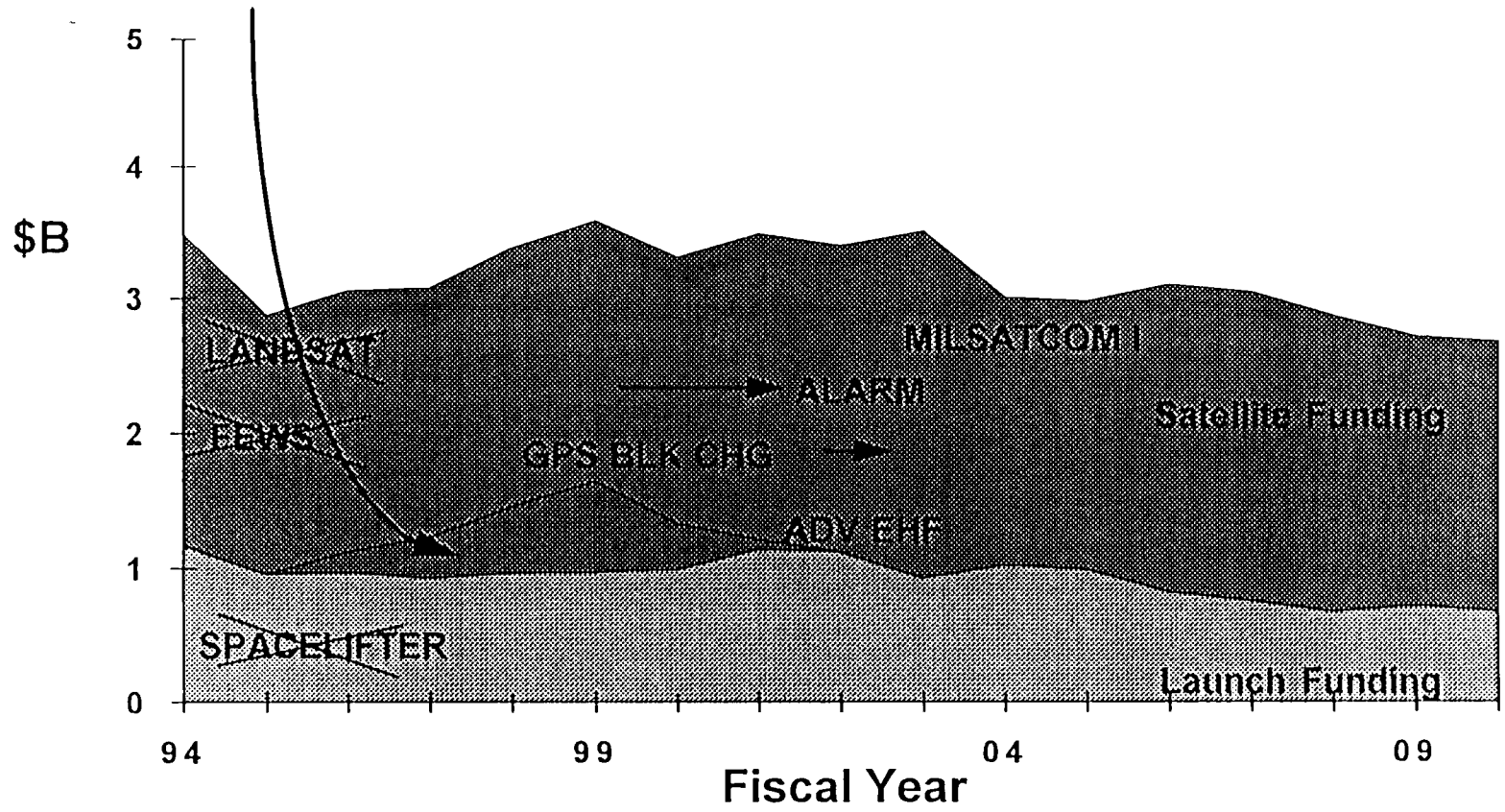
Excludes
Aero & Associated Base

- NASA Budget is relatively flat



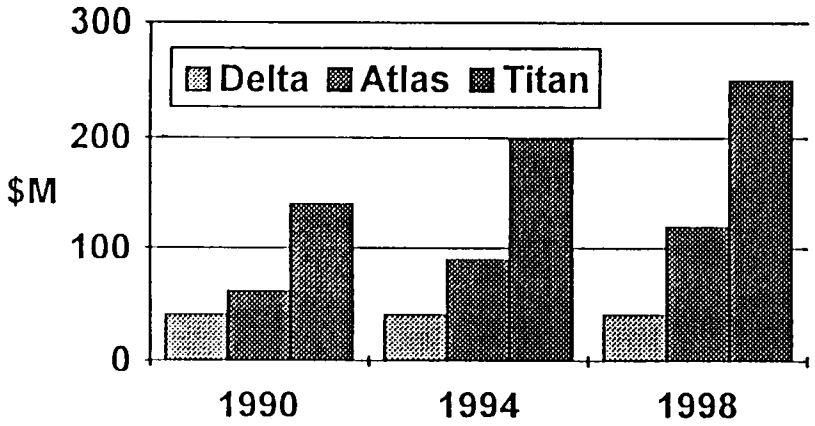
Impact of Launch Funding on Mission Investment

Booster Impact on Mission Funding

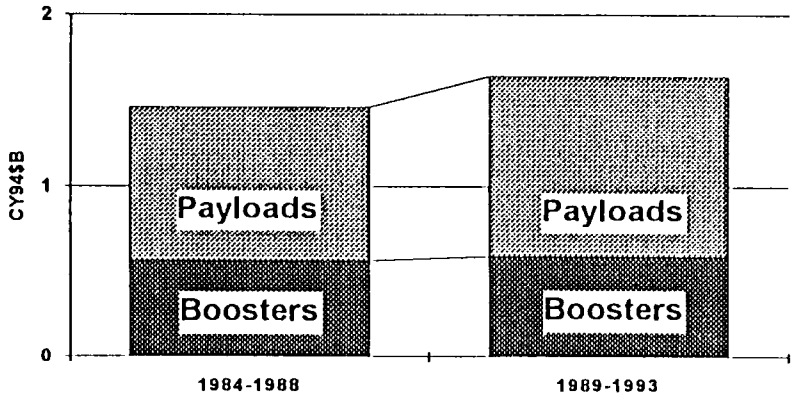


Space Launch Economics

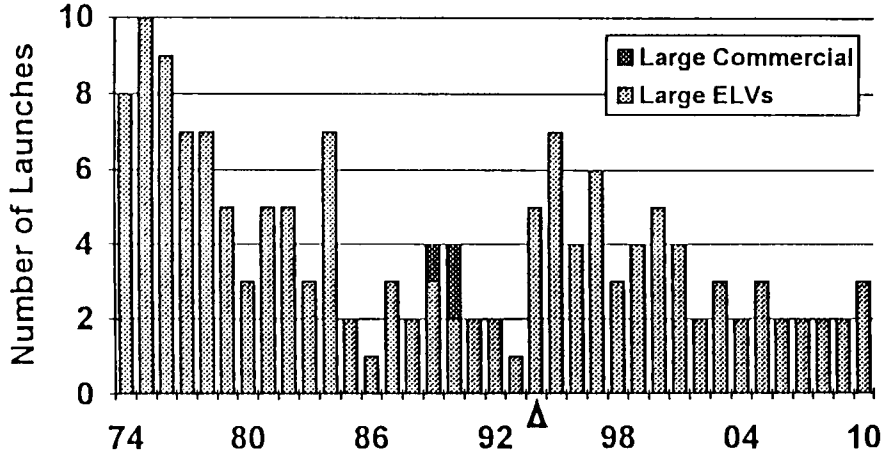
Hardware costs are rising



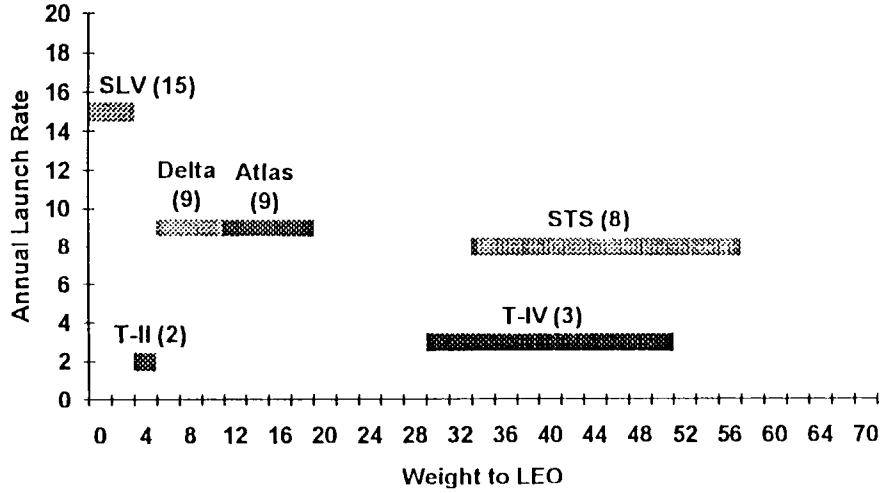
Loss costs are high and increasing



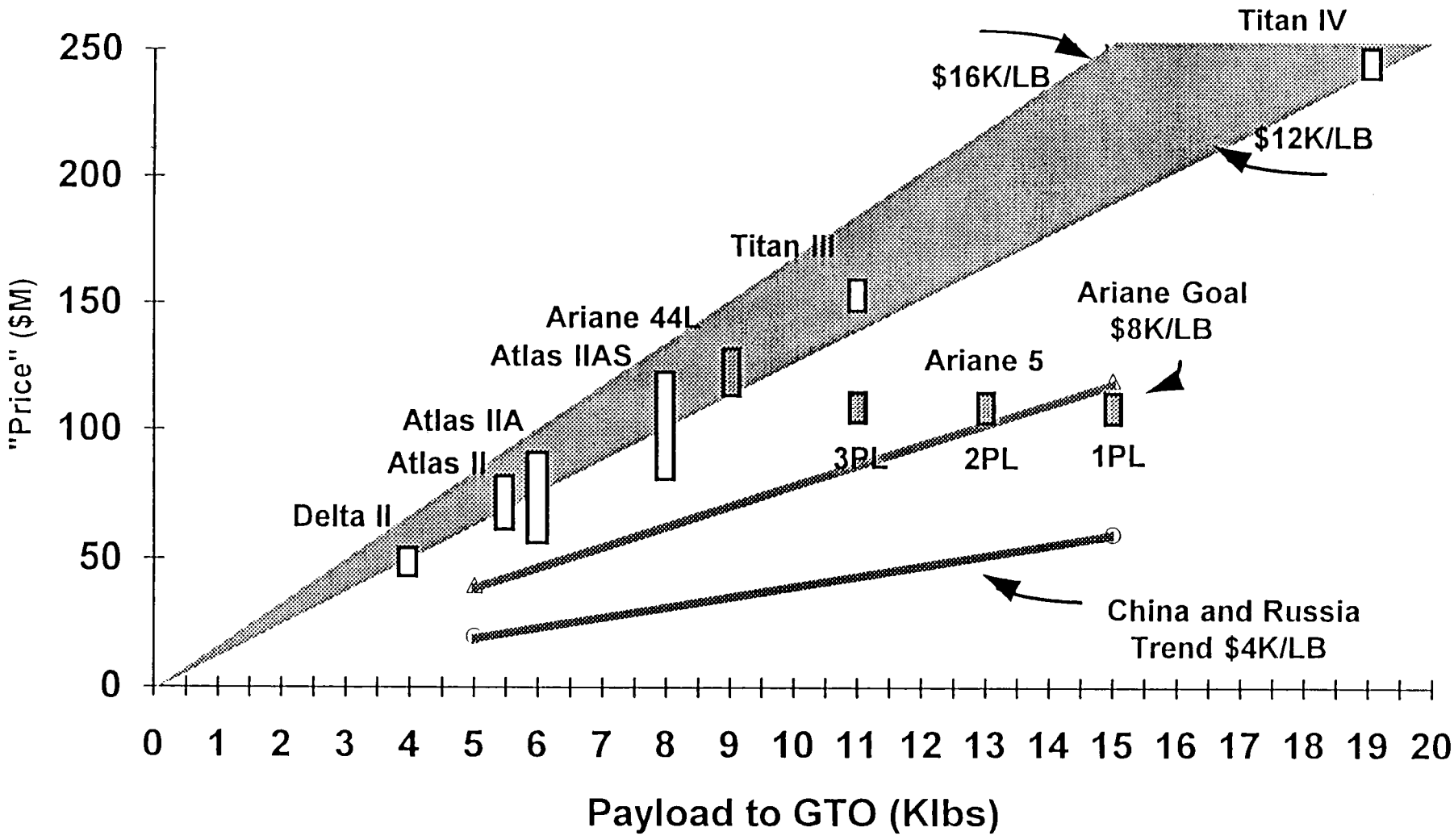
Heavy lift ELV volume has dropped significantly -- FYDP shows backlog



Niche markets preclude efficiency

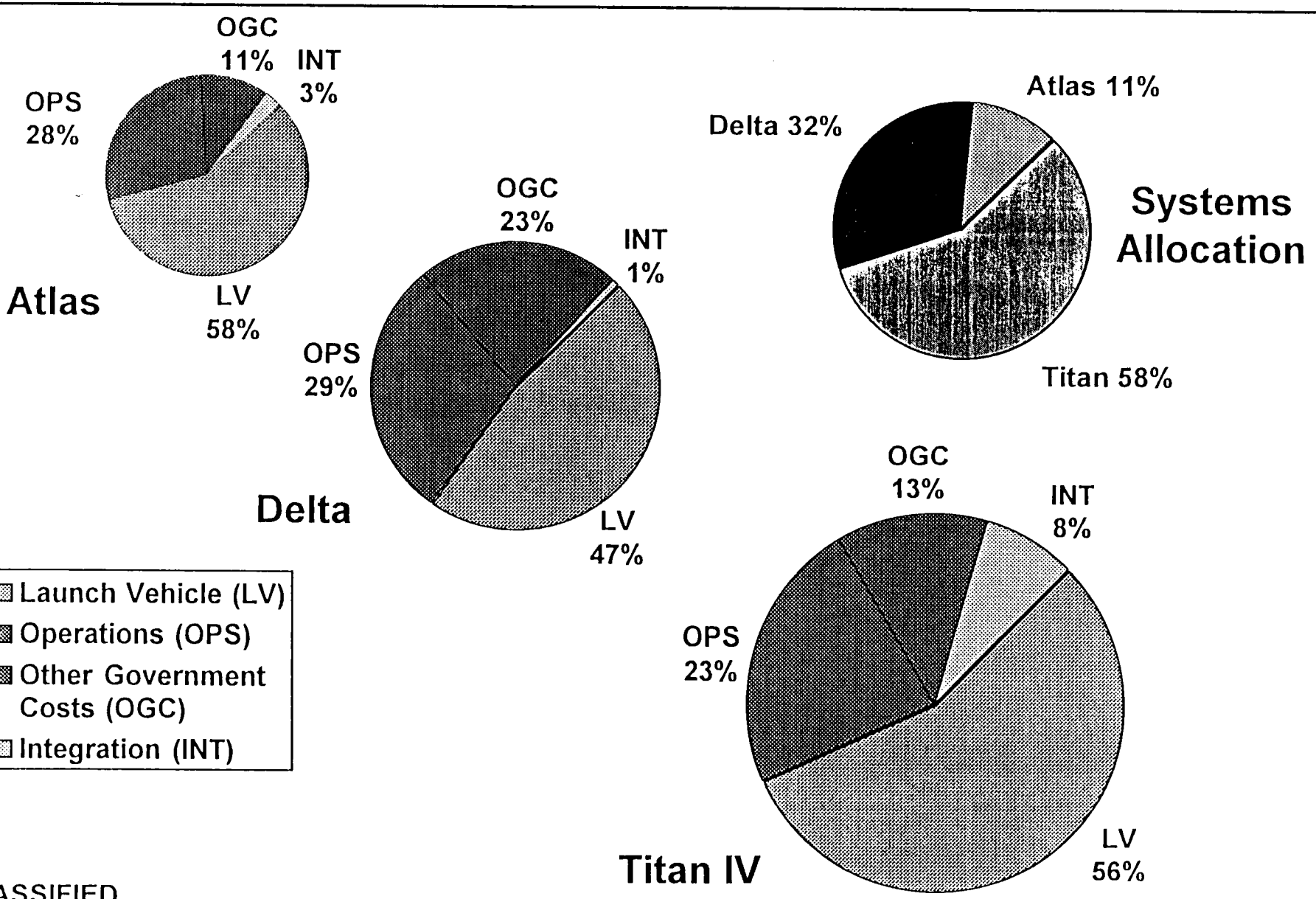


Cost Per Pound



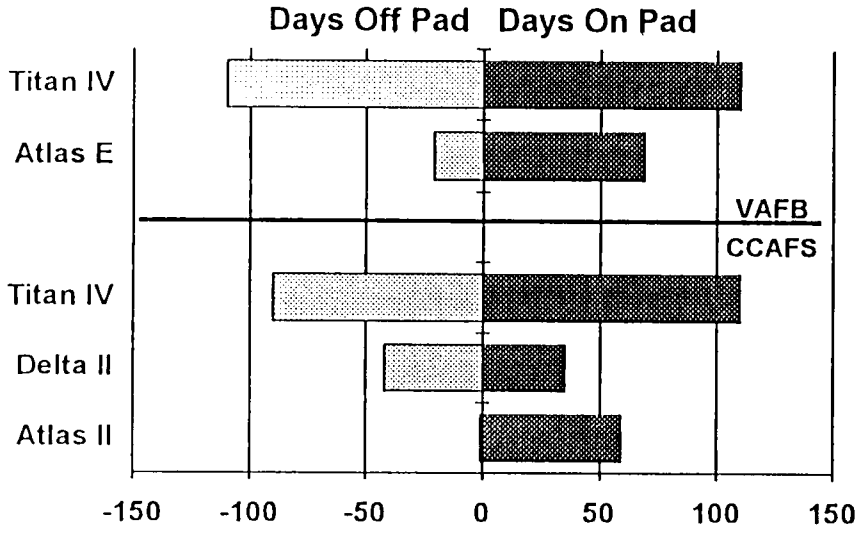
Source: DOD Space Launch Systems Bottom Up Review

Cost Allocation by Launch System

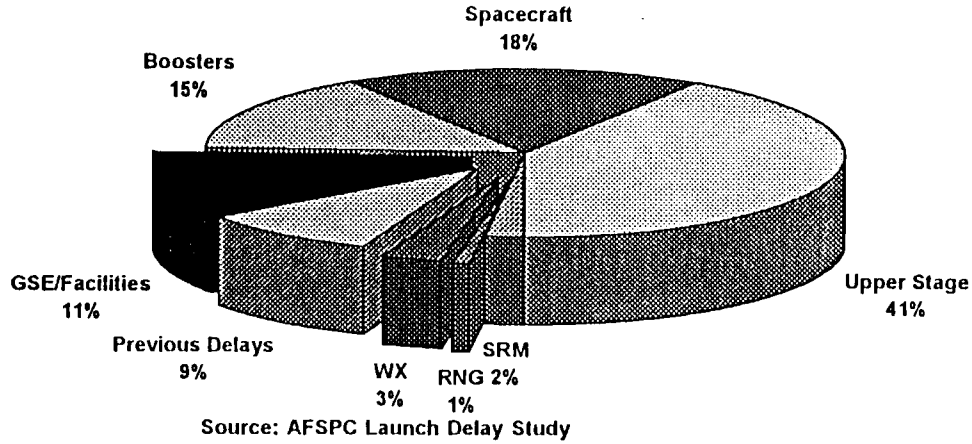


Space Launch Operations

- Launch systems "processing" time is high
  - Manufacturing has migrated to launch base
- Hardware dominates launch delays
  - Hardware instrumentation frequently the source



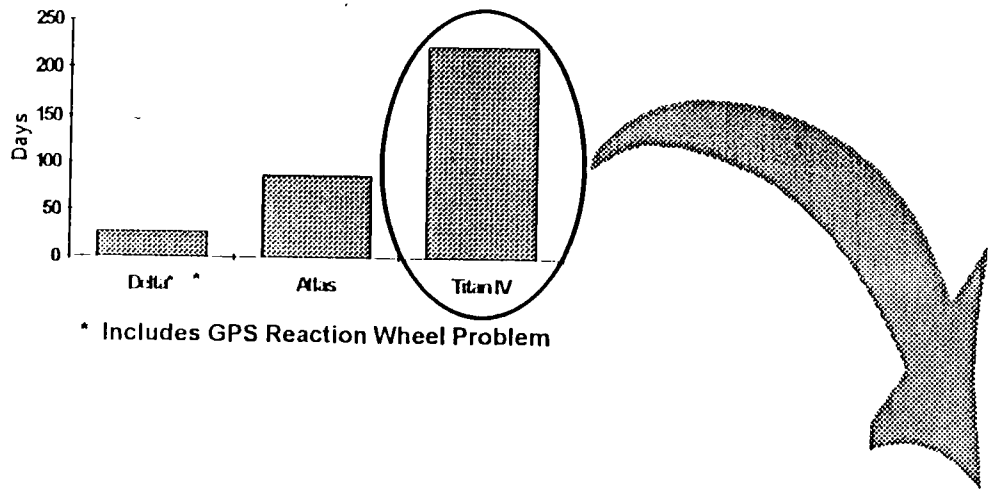
- Nominal processing time by system



- Hardware dominates launch delays

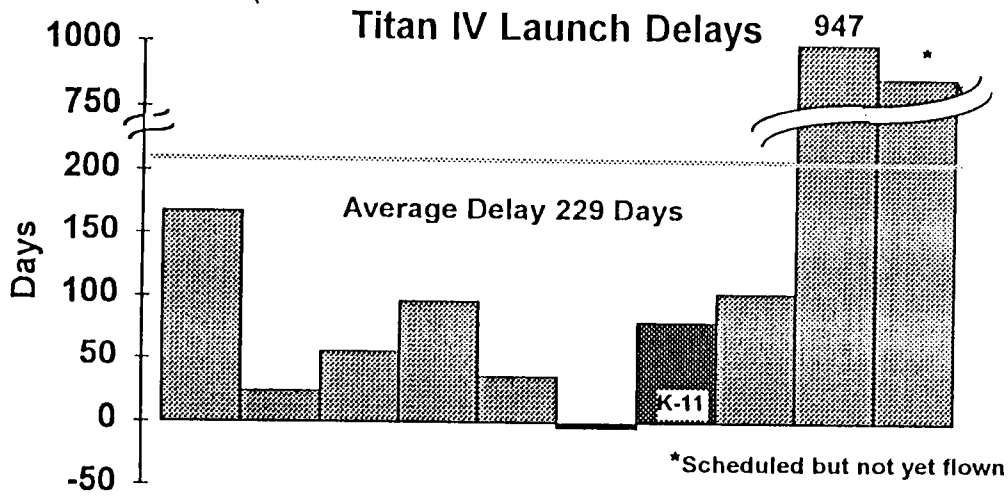
Space Launch Operations

Average Launch Delays (89 - Present)



* Includes GPS Reaction Wheel Problem

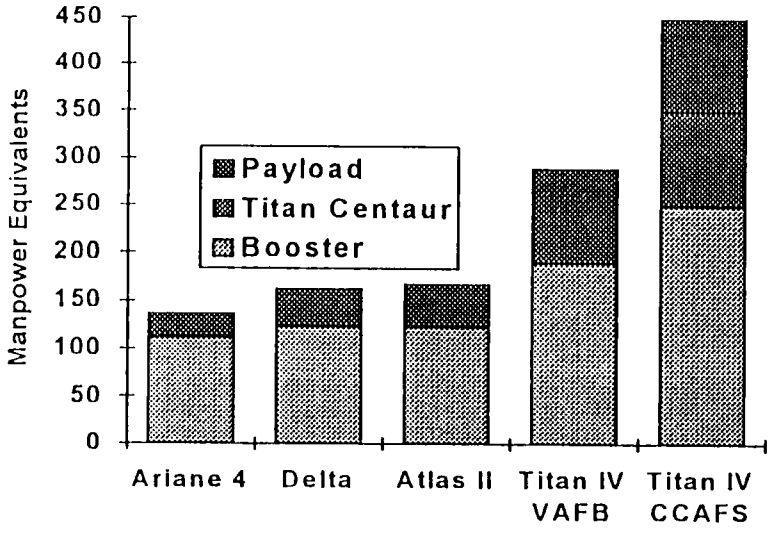
- Delta is most operable system
- Atlas and Titan launch delays influenced by
  - –Flight failures on Titan and Atlas/Centaur
  - –System immaturity - Centaur development not complete
- Still it takes too long...there's room for improvement!

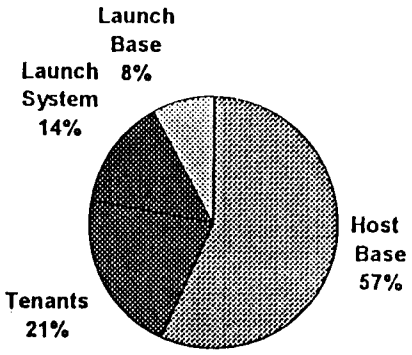


*Scheduled but not yet flown

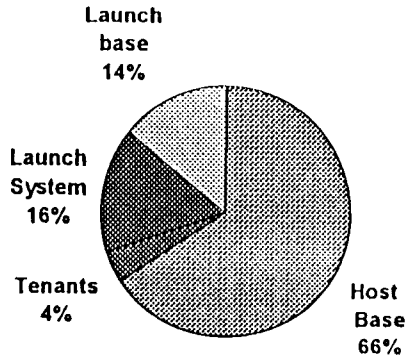
Space Launch Operations

- U.S. launch on-pad manpower for mature systems roughly equivalent to foreign systems
- Large "launch" base supports more than space launch



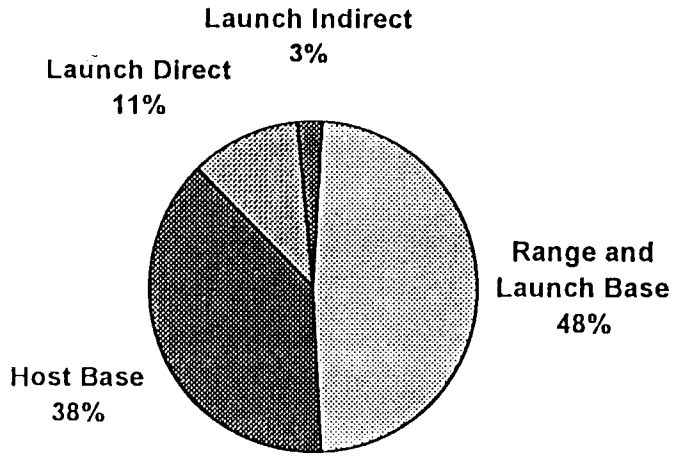


CCAFS & PAFB: 12,190

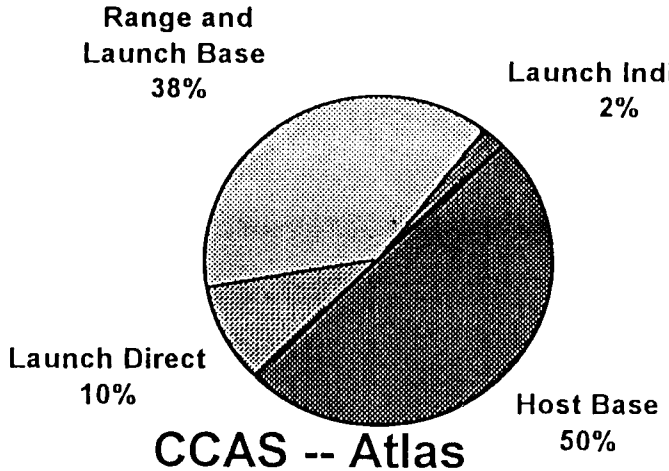


VAFB: 7,271

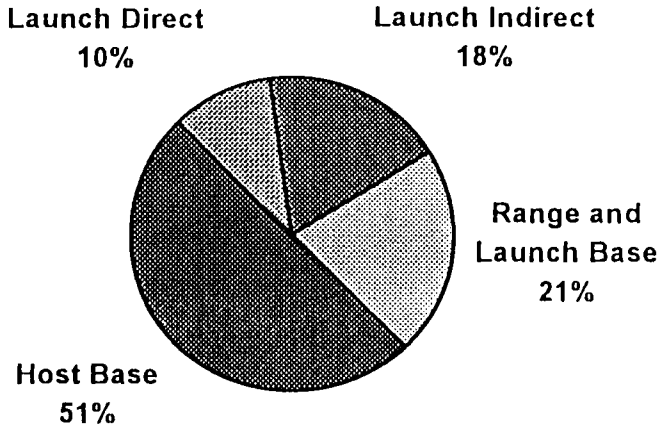
Launch Systems Manpower Comparison



Kourou -- Ariane 4
Total Personnel 1300



CCAS -- Atlas
Total Personnel 2380

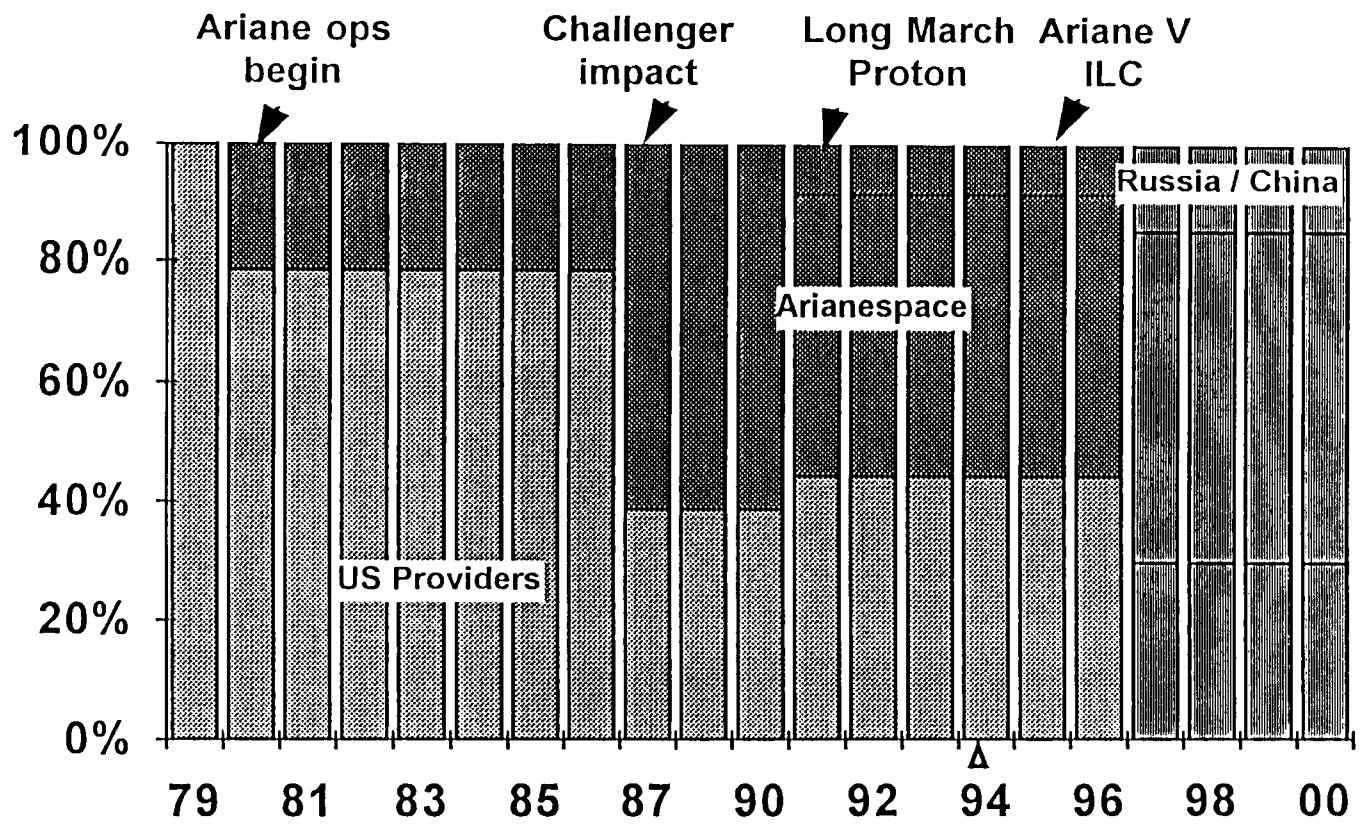


CCAS -- Titan IV
Total Personnel 4300

Notes:
Ariane numbers do not include 900-man French Foreign Legion stationed at Kourou
Sources: Arianespace
AFSPACECOM/XPM and 45th Space Wing

International Activity

- Percentage of non-government satellites launched by U.S. boosters has dropped



(mostly communication satellites to GEO)

Space Launch Management

Defense

- –Need new launch vehicle for cost effectiveness and operability
- –Medium lift sufficient in the long term
- –New system desired, but unaffordable now

Intelligence

- –Focus on payloads
  - – Boosters are just transportation
- –Currently getting the job done
- –Heavy lift required for long term
- –Shuttle syndrome -"Show me"

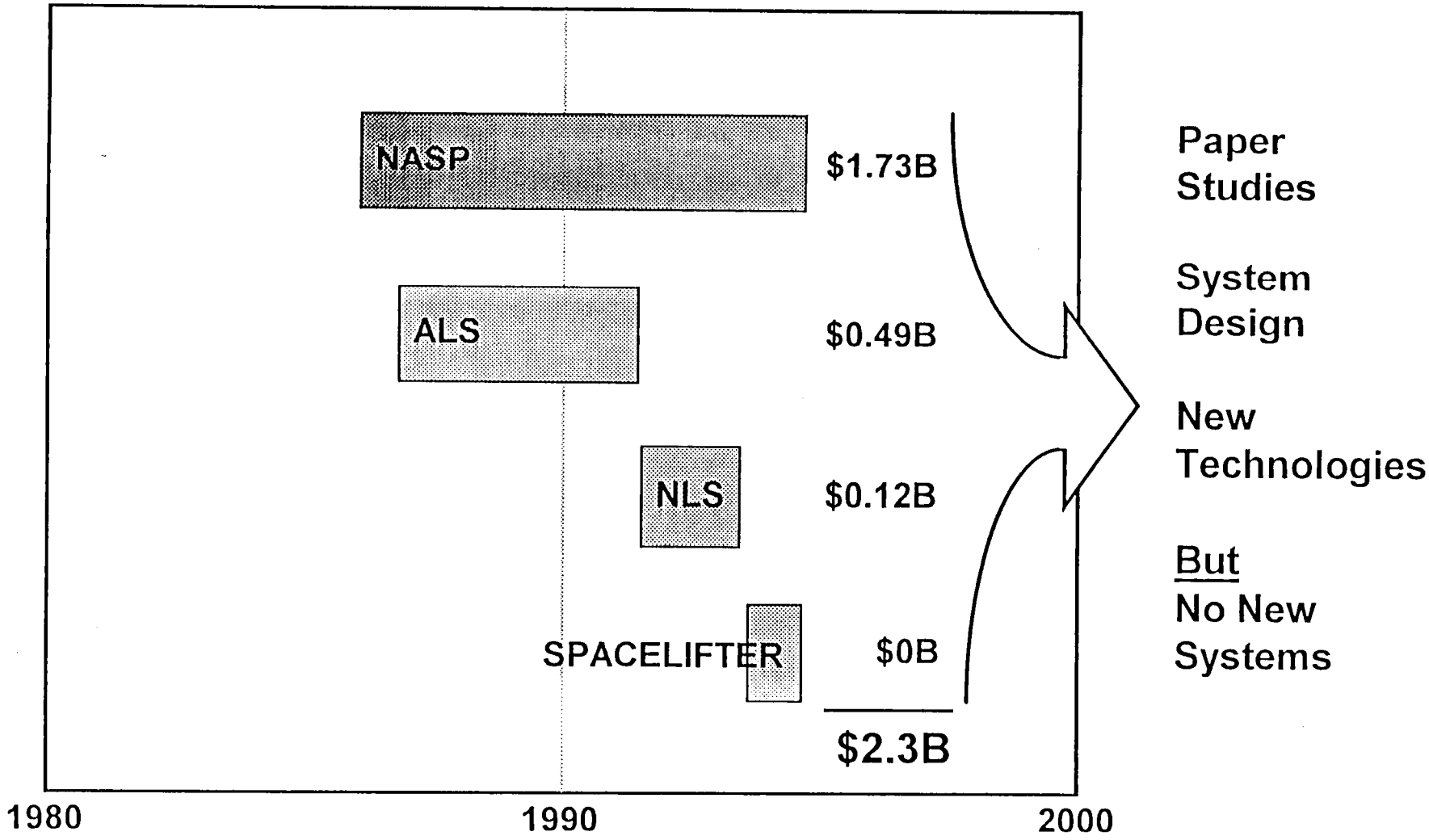
Civil

- –Human access -- Shuttle replacement for cost effectiveness and safety
- –Open the space frontiers
- –Space Station resupply
- –Management equity

Commercial

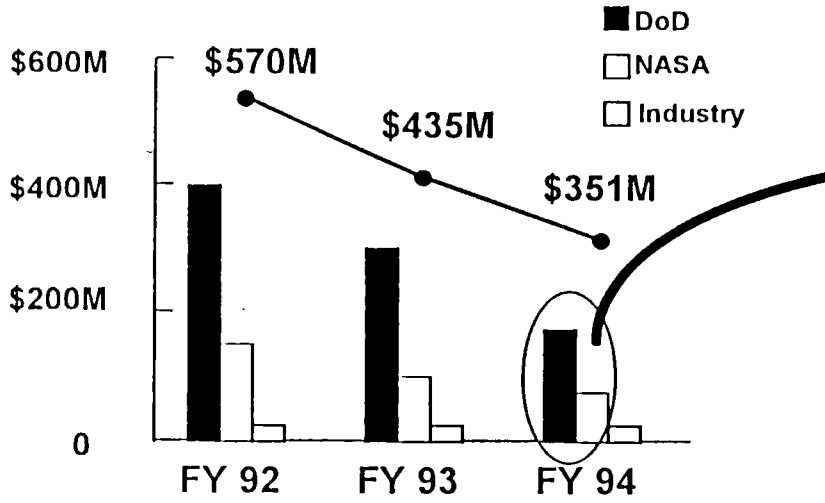
- –International competitiveness
- –Government investment
- –Medium lift & smaller
- –Low price
- –Schedule dependability

Past Initiatives



Space Launch Technology Investment

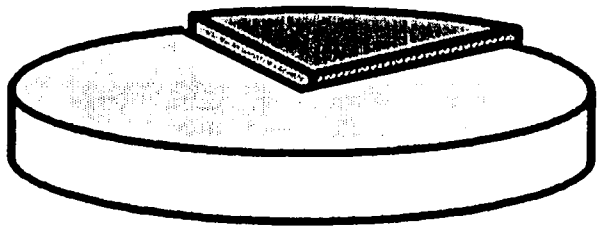
Declining Technology Investment



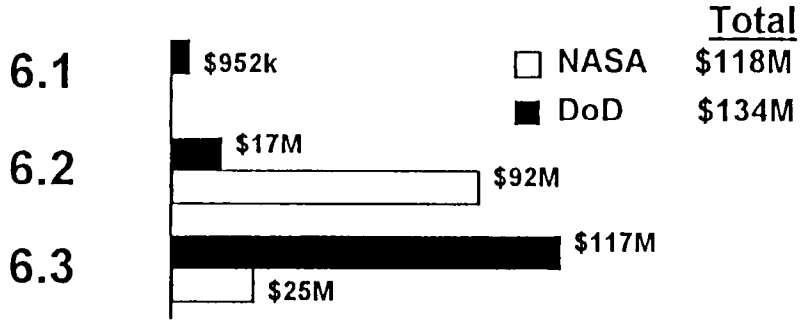
Source: CSAF Space Launch Technology Assessment

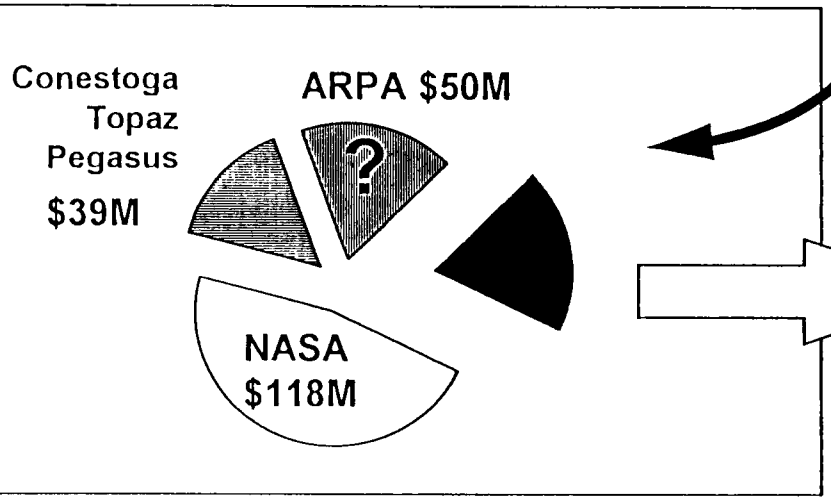
$312M total

NASP $60M



$252M for FY 94





$45M Current Core DoD Technology

Facts Of Life

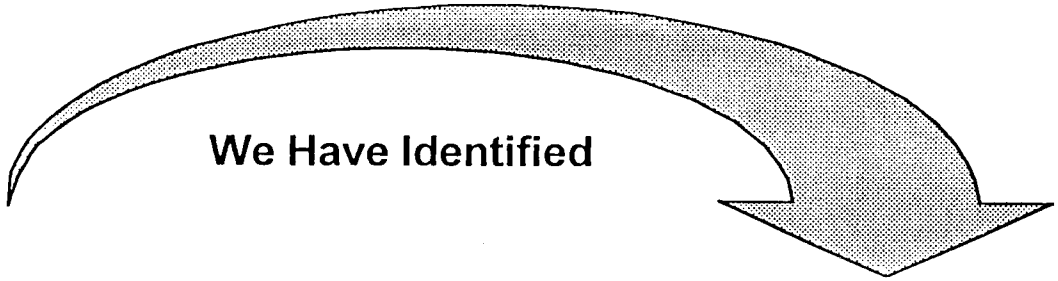
- Significant problems exist in today's systems
- Systems design and program phase determine operability
  - Titan still in development
  - Marginal return on operations investment
- Current manned and unmanned systems and infrastructure must be maintained through modernization transition
- Freedom of action is circumscribed by:
  - Four space sectors with differing missions
  - Many stakeholders with differing objectives
  - Declining budgets
  - Zero-sum space budgets
  - Tyranny of the customers (payload timing, size, and character)
  - Availability of technology

Facts Of Life (Cont'd)

- Too many providers - too much production capacity
  - Traditional providers unlikely to fund major modernization
- Government demand is dominant, but launch rate is dropping
- Commercial medium-class market is not a near term solution
  - Market is relatively small, steady, and inelastic
  - Effective foreign competition has grown and will continue
- Technology funding is diffuse and declining
  - Limited liquid propulsion investment over the last 20 years
- Major investment decisions today bear fruit no earlier than ~2000
  - There are no quick fixes
- Foreign policy situation has created exploitable opportunities for international (especially Russian) cooperation

Centers of Gravity

Centers Of Gravity



- From a National Perspective on:
  - The Environment
  - The Opportunities
  - The Risks

Points which when pushed upon provide the highest leverage

- Production Rate & Stability
- Reliability
- Technology Availability
- Space Launch Management
- Funding Commitment

Provide a focus for action

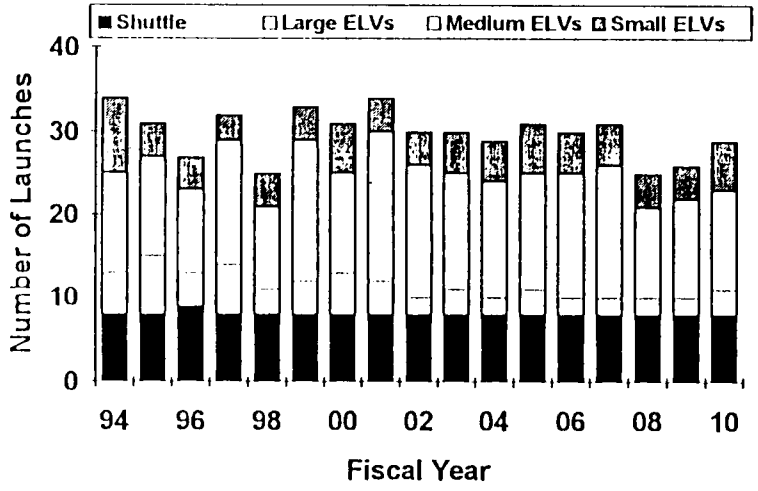
Centers of Gravity for Space Launch

- Rate & Stability
  - Reduce the costs of launch
  - Maintain production, processing, and operations continuity
  - Aid in meeting reliability goals
- Reliability
  - Reduce/control costs of failure
- Technology Availability
  - Provide foundation for force modernization -- protect options for the future
- Space Launch Management
  - Achieve and maintain consensus
  - Improve intersector management/coordination mechanisms on technology and development efforts
- Funding Commitment/Stability
  - Plan more effectively
  - Move beyond austere upgrades to current systems
  - Compete better in the international market place

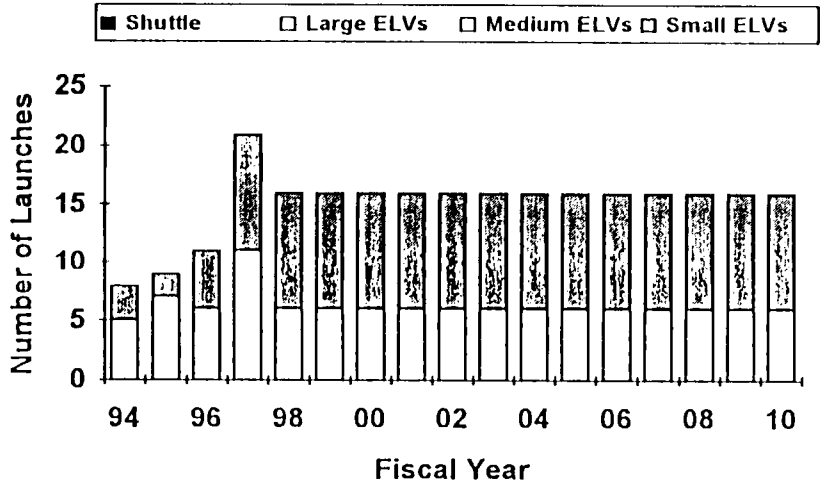
Requirements

U.S. Space Launch Requirements

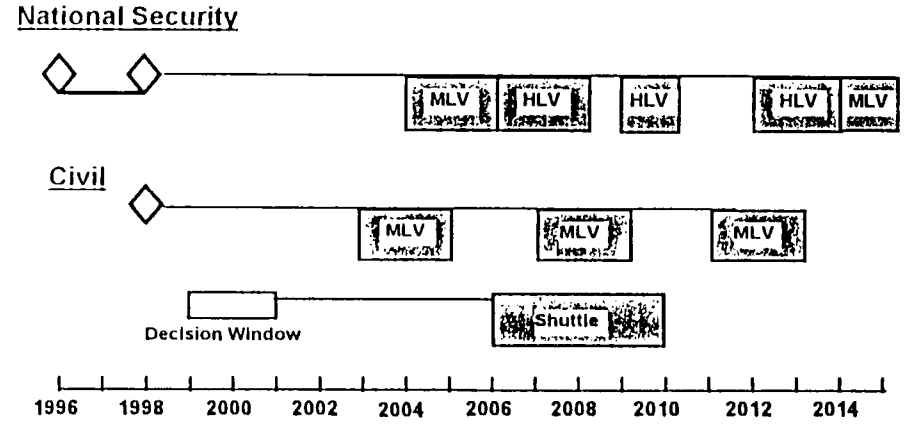
U.S. Government Mission Model



U.S. Commercial Mission Model



Transition Opportunities



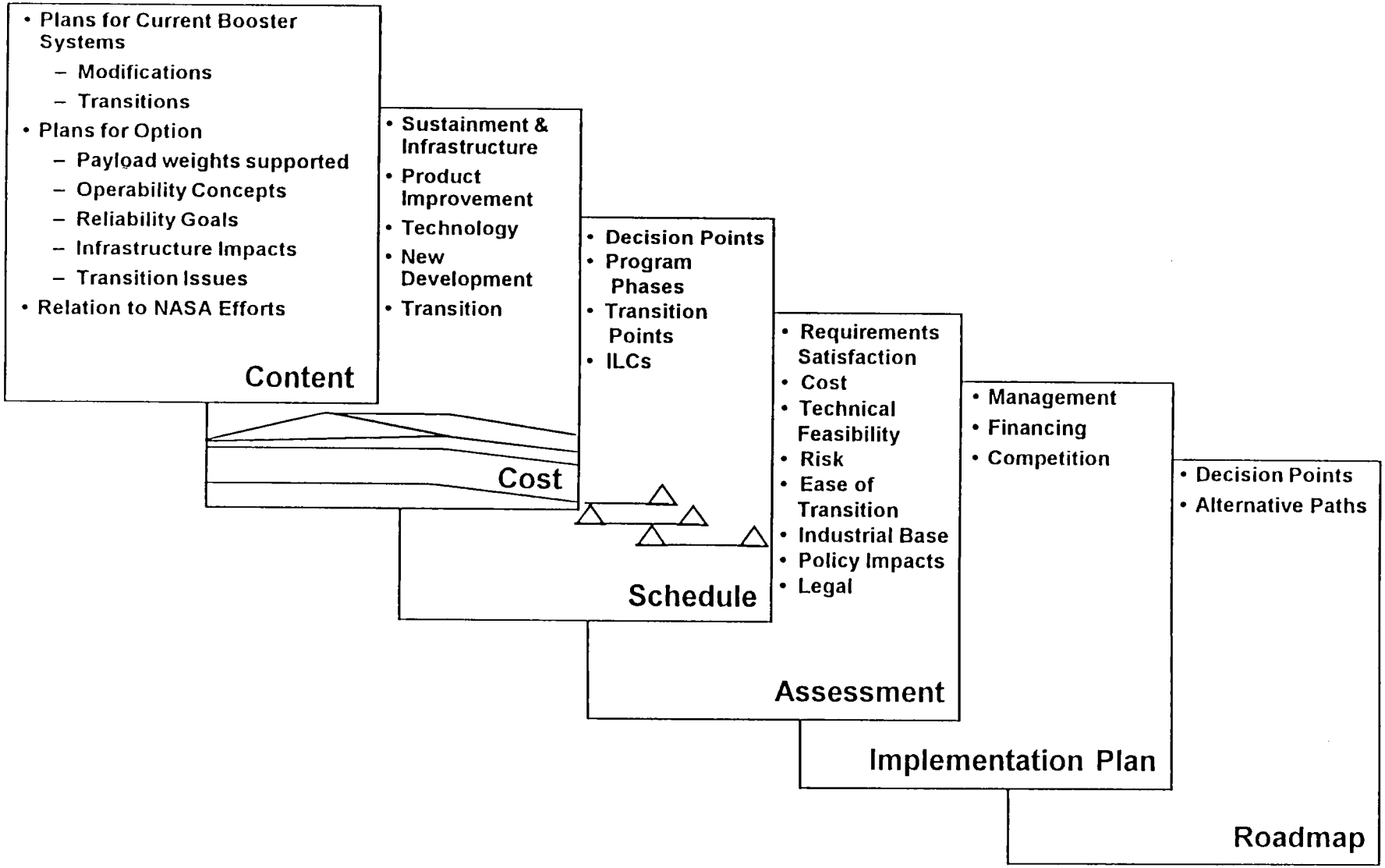
◇ Minimum Lead Times to Transition
• Lead Times Vary with Satellite, Payload, and Choice of Vehicle

Launch System Attributes

CAPABLE	OPERABLE	ECONOMICAL	RESPONSIVE	MISSION SUCCESS
Access To Mutiple Orbits	Supportable	Low Operating Cost	Resilient	Reliabilty
Launch System Performance	Maintainable	Low Procurement Cost	Launch On Need	Effective
Sustainable Launch Rate	Available	Low Development Cost	Flexible	Payload Survival
Accomodate Paylaods	Schedule Dependability	Competitive		Crew Survival
Crew Transport	Operable Design	Producible		
Payload Return	Operable Process			
Future Growth				

Options

Option Descriptions



Options

- Option 1 -- Baseline - Sustain Existing Systems (FY95 President's Budget)
- Option 2 -- System Evolution - $1.0 to $2.5B (CY 94$)
- Option 3 -- "Clean Sheet" ELV
  - 3A ELV only - $5.0 to $8.0B (CY 94$)
  - 3B ELV and manned - $10.0 to $14.0B (CY 94$)
- Option 4 -- Reusable Launch Vehicle - $6.0 to $20B + (CY 94$)

Included in all options:

Strengthen and Focus Core Technologies

Continue Sustainment and Infrastructure Investments

DoD Core Technology Program

	Propulsion	Vehicle	Operations
Expendable Unique	Low Cost Engine Storable Propellants Clean Solid Propellants Hybrid Propulsion	Low Cost Booster	
Common	Upper Stage Propulsion Russian Engine Test Simple Pumps Chambers/Injectors Test Beds High Energy Fuels	Adaptive GN&C Al/Li Structures Composites Low Cost Mfg ManTech	Automated Processes Health Management Non Destructive Inspection Leak Free Joints Fault Isolation
Reusable Unique	Linear Aerospike Advanced Propulsion Preburner Turbopumps Tripropellants	Primary Structure Insulation Reliable Sensors CryoTanks Aerothermo	Recovery/Refurbishment

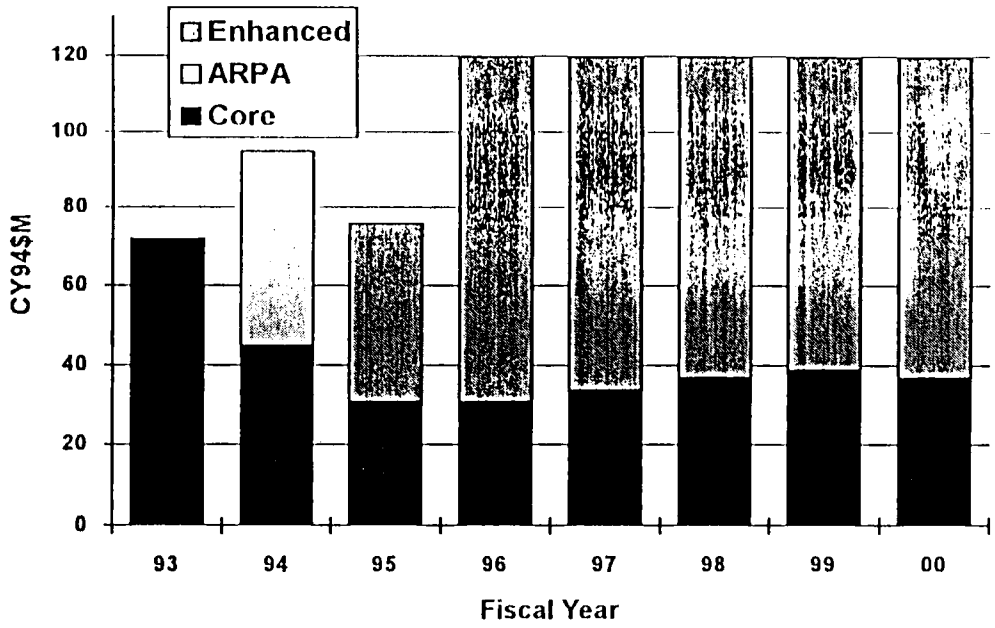
Total FYDP Unfunded Core Technology Investment $384M (CY94$)

94	95	96	97	98	99
$0M*	$45M	$89M	$86M	$83M	$81M

*Assumes FY 94 ARPA $50M is allocated to Core Technology Program

Space Launch Technology Revitalization

- FY94 - $50M ARPA funding
  - DC-X
  - Russian engines
  - Reusable "long poles"
  - Low cost ELV
- FY 95 - Desired level ~$75M (DoD)
  - Structures
  - ELV/RLV propulsion
    - » Booster
    - » Upper stage
  - Tankage -- Al/Li, composites
  - Thermal protection system
  - Russian engines
  - Launch operations
    - » Instrumentation & Diagnostics



DoD/NASA Technology Coordination

- DoD and NASA need better coordination
  - Self-contained and justified programs -- not joint programs
- Management of reusable technology
  - Leader - NASA
  - Follower - DoD
  - Assign primary DC-X responsibility to NASA in FY95
- DoD leads expendable technology and Russian engine technology for ELVs

Option 1 - Sustain Existing Systems
(FY 95 President's Budget)

Option 1: Sustain Existing Systems (FY95 PB)

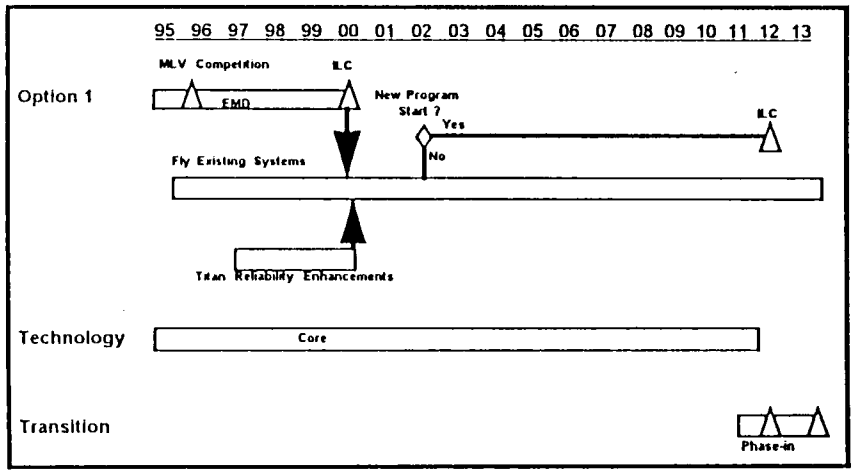
Content

- Maintain existing fleet/capability
  - Titan IV/II -- Atlas II -- Delta II
  - Shuttle -- RSA -- SLVs
- Austere upgrades
  - Mission enabling
  - Reliability/Safety
  - Obsolescence
- Core space launch technology enhanced

Cost (CY94$)

- Product improvement
  - Heavy: $592M (within budget)
- Development
  - Medium: $294M (within budget)
- Recurring cost per flight
  - Medium: $50 to $125M
  - Heavy: $250 to $325M
  - Shuttle: $375M

Schedule



Management

- Management
  - –Maintain existing infrastructure and programs
  - –No management structure changes
- DoD/NASA technology coordination
  - –NASA leader in reusables
  - –DoD leader in expendables

Option 1 Assessment

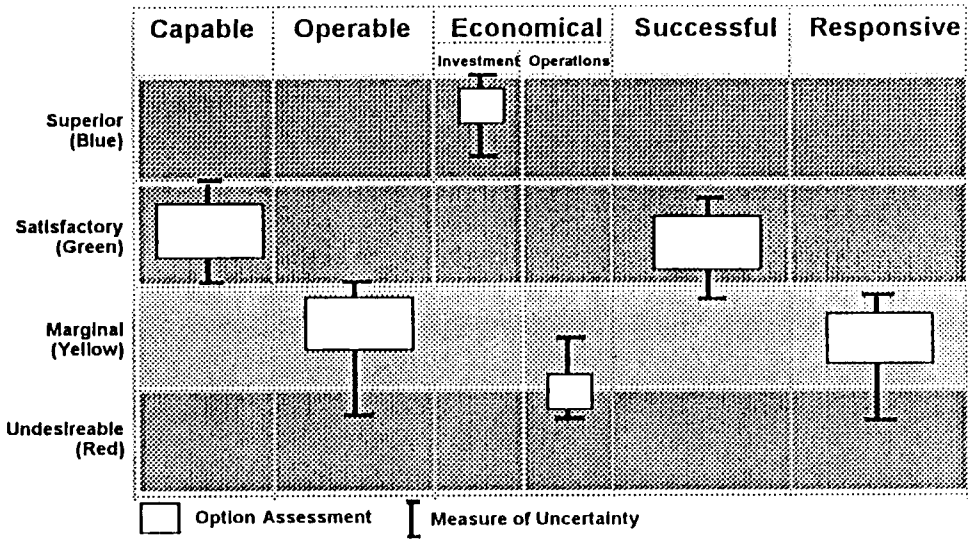
Pros

- Meets existing requirements
- Minimal investment
- Adequate technology base

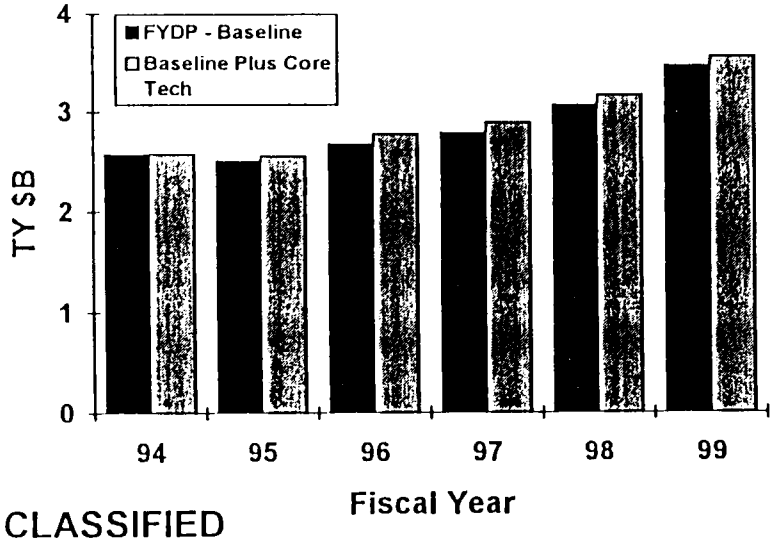
Cons

- Marginal improvement in operability and responsiveness
- High operating cost (operations/production)

Requirements Satisfaction



DoD Funding



Risks

- Cost (Low)
  - Well defined, fully funded programs
  - Majority of development work complete
- Schedule (Low)
  - Major developmental activities nearly complete
- Technical (Low)
  - Technical issues understood and plans in place to correct deficiencies

Option 2 - Evolved ELV

Option 2: Evolved ELV

Content

- Fly out currently contracted ELVs
- Consolidate medium/heavy launch families
  - Derive from current Delta, Atlas, and Titan launchers
  - "Right Size" payload-launcher
  - Phase to MLV/ HLV payload transitions
- Maintain STS for human spaceflight

Cost (CY94$)

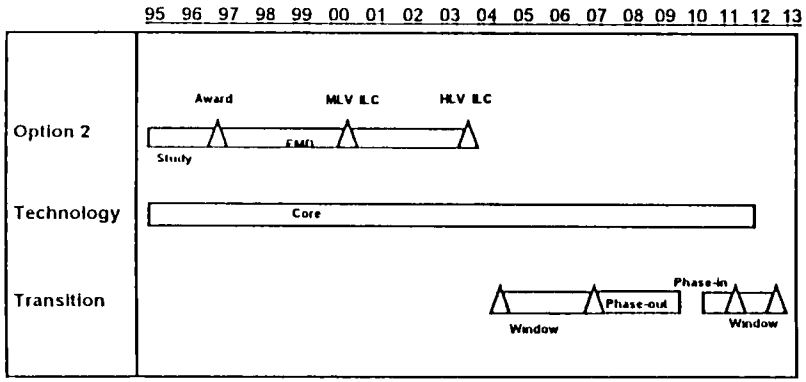
- Total development: $1.0 - $2.5B
- Recurring cost per flight

  Medium: $50 - $80M

  Heavy: $100 - $150M

  Shuttle: $375M

Schedule

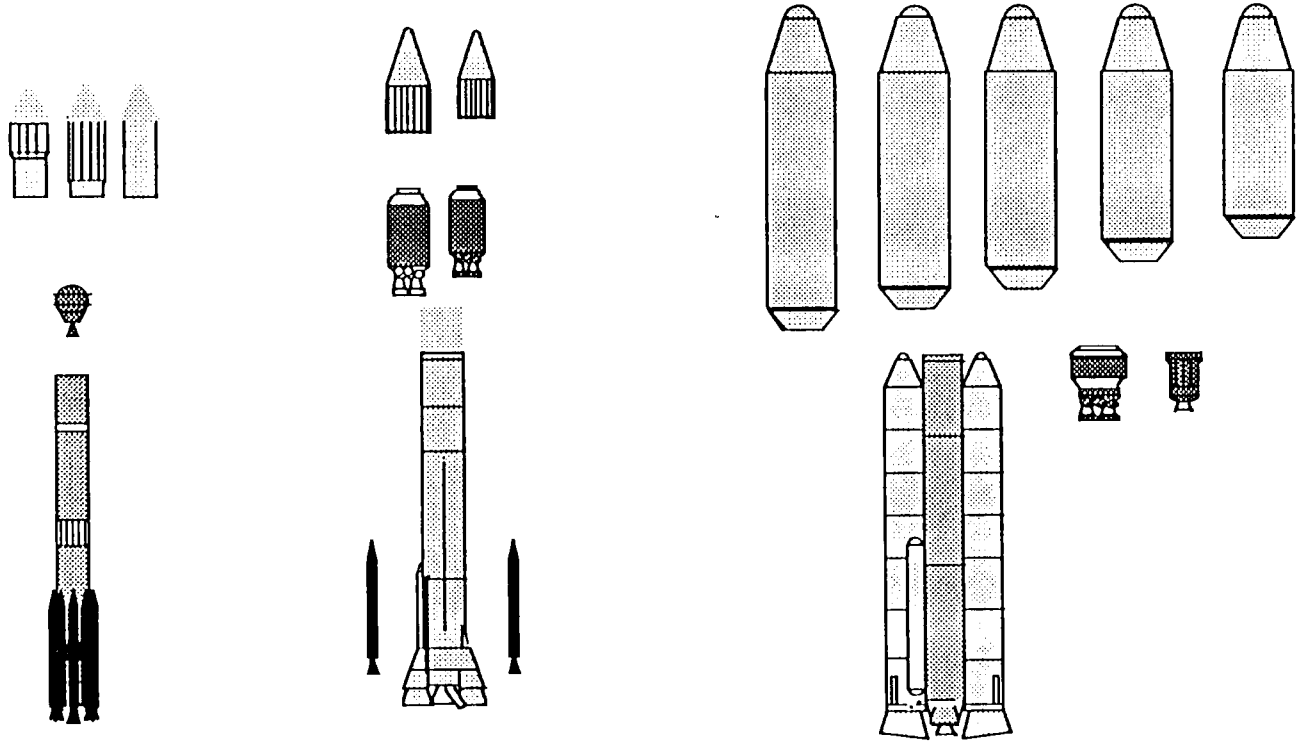


Management

- Continue cooperative DoD/NASA technology program
- Form Government-industry partnerships
- Negotiate up-front priced options
- Elicit maximum private capital investment
  - –"Indemnify" contractor up-front investments
  - –Requires Government "anchor-tenancy"
  - –Guarantee low-interest loans
  - –Requires Congressional approval

Evolved ELV Concept

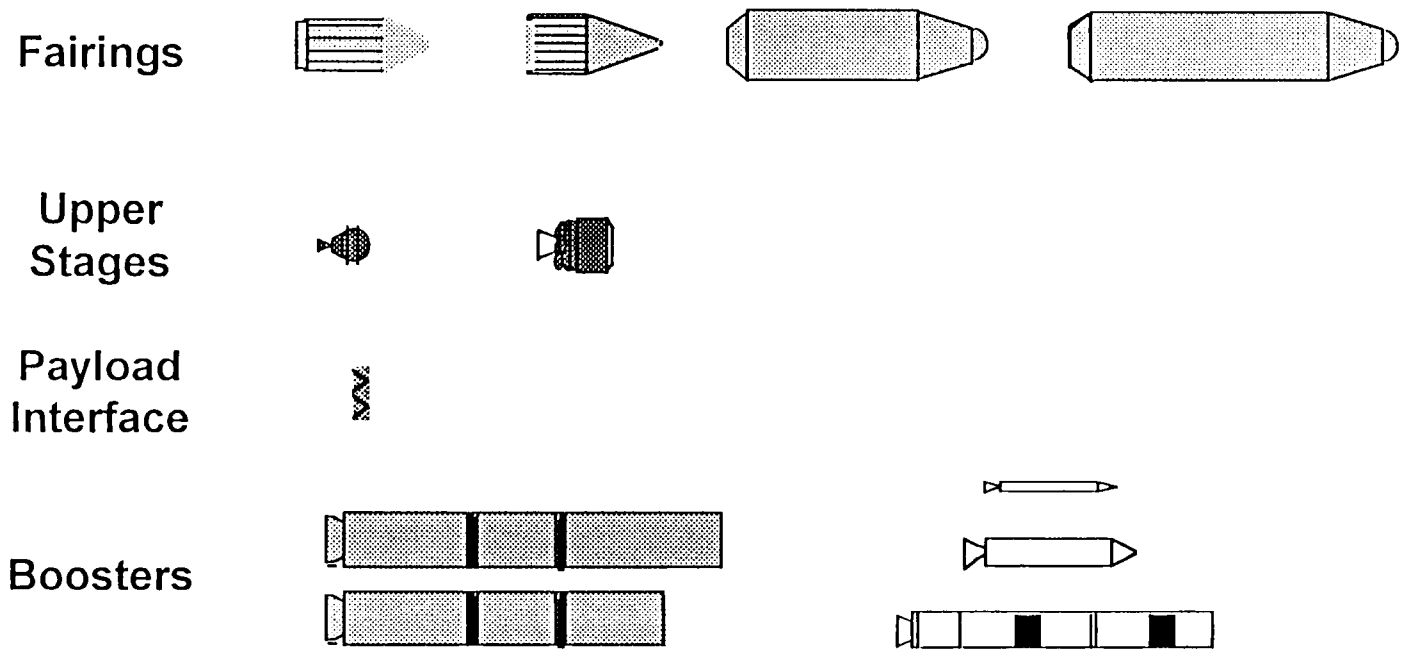
- Current US space launch systems are built from diverse and unique components



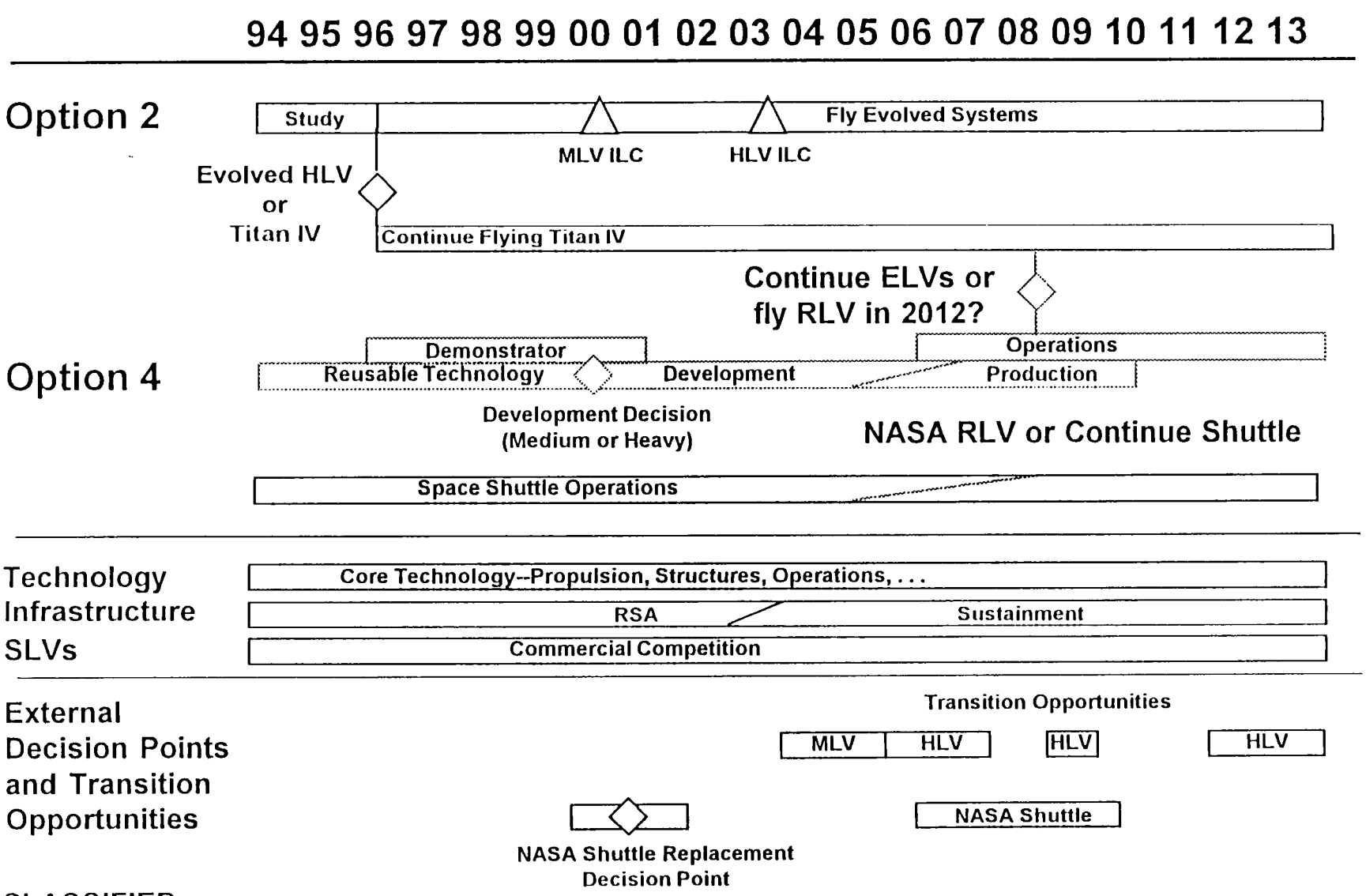
Delta Atlas Titan

Evolved ELV Concept

- **Conceptual evolved ELV family would use common, standardized components evolved from current systems**



Roadmap 2: Evolved ELV



Option 2 Assessment

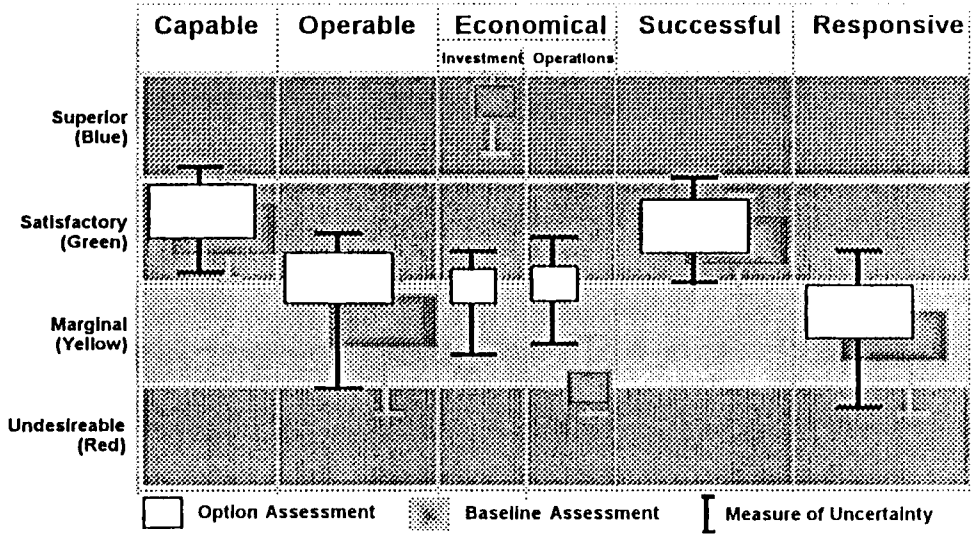
Pros

- Right-sizes launchers-payloads, industrial base, and infrastructure
- Increased rates for consolidated family(ies)
- Timely improvements for international competitiveness

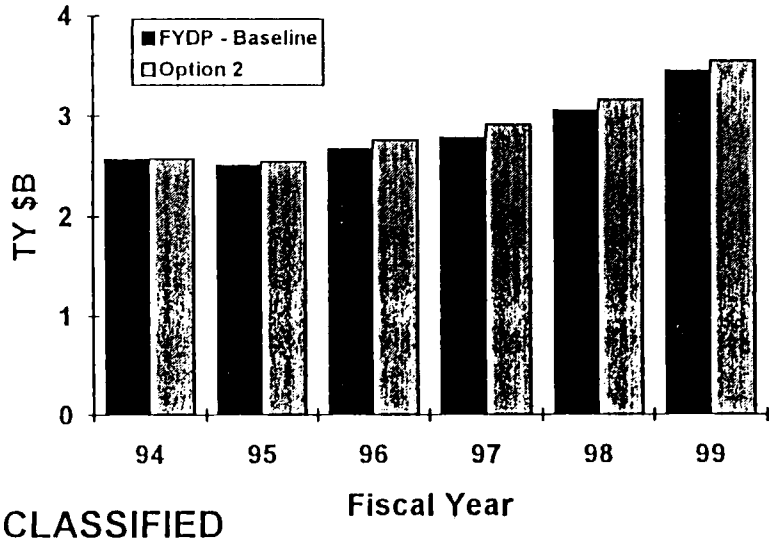
Cons

- No direct contribution to human spaceflight
- Reduced competition within U.S. launch industry
- Limited improvements in production, reliability, operability

Requirements Satisfaction



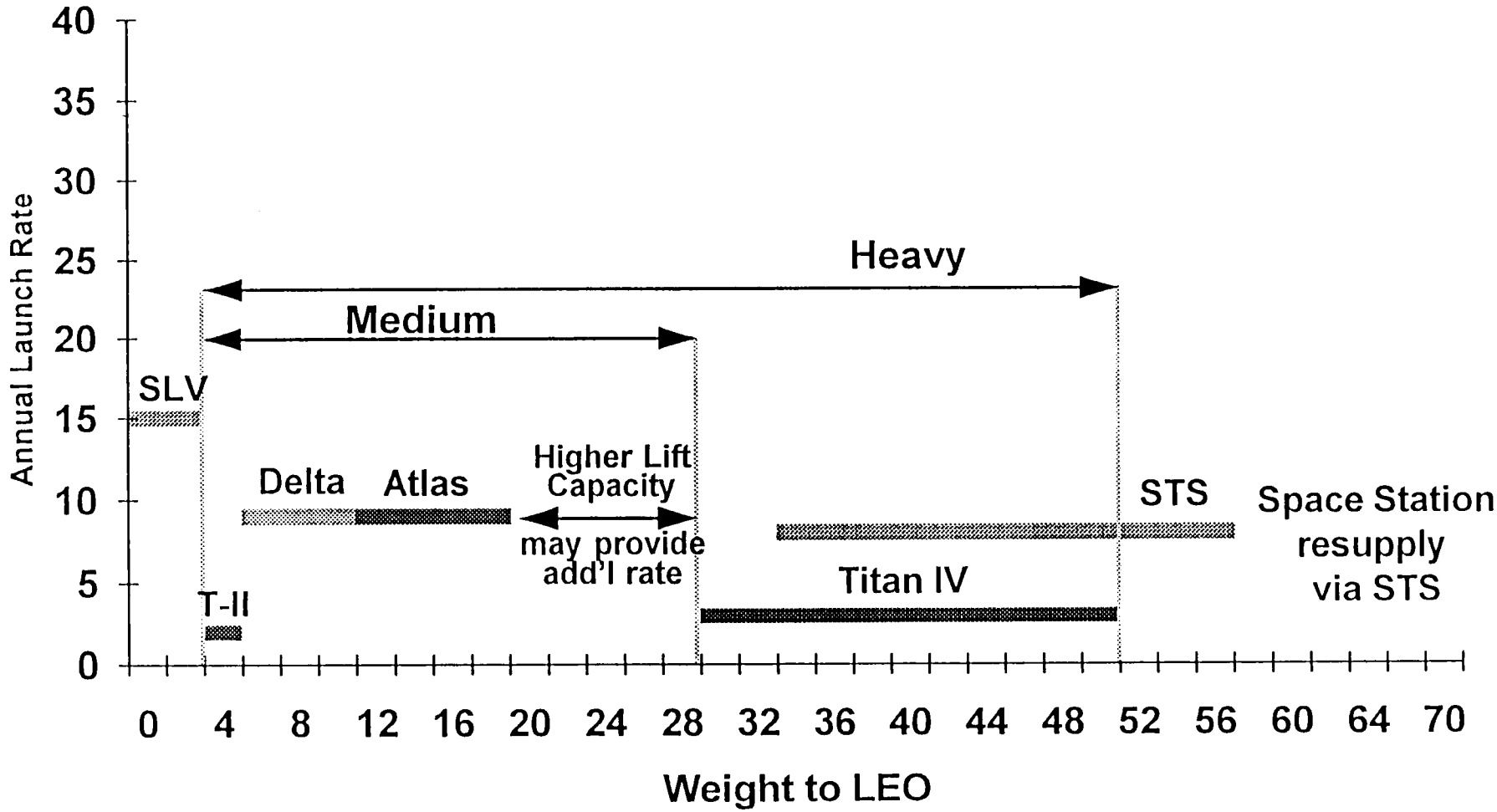
DoD Funding



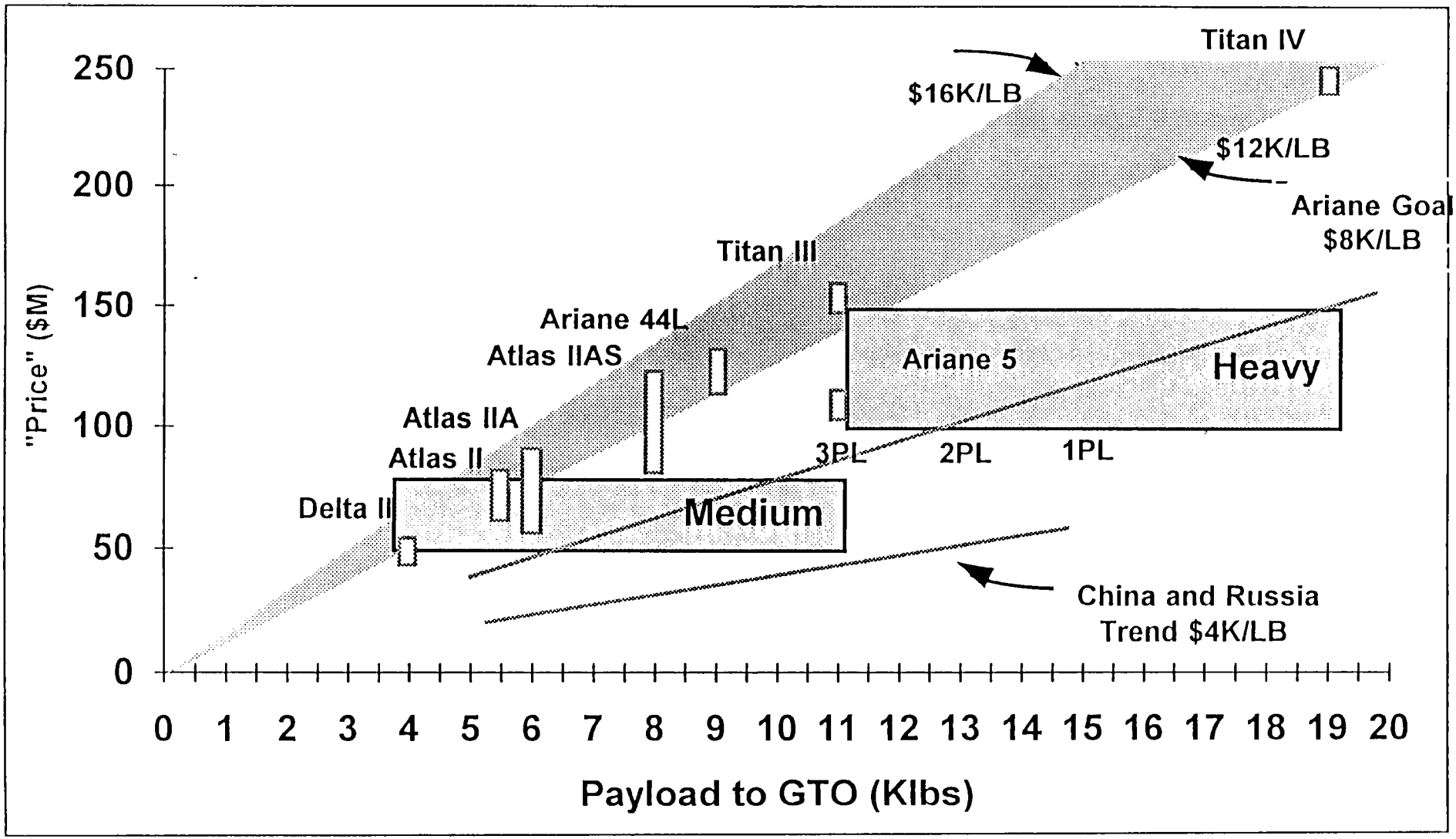
Risks

- Cost — Low to Moderate
  - Medium vehicle competition funded in FYDP
  - Varies with implementation
- Schedule — Low to Moderate
- Technical — Low to Moderate
  - Payload "right sizing" may not reduce HLV maximum weight

Option 2 Annual Launch Rate



Option 2 Cost Per Pound



Option 3 - "Clean Sheet" ELV

Option 3: "Clean Sheet" ELV

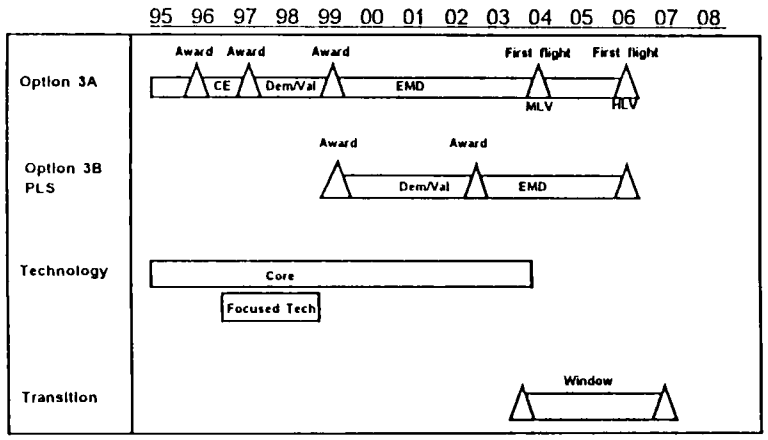
Content

- Modular approach for MLV & HLV missions
  - 3A: Transition off current ELVs
  - 3B: Transition off current ELVs & STS
    - Reusable PLS for crew transport
    - Expendable CTV for cargo
- Minimum technology maturation required

Cost (CY94$)

- Total Development:
  - Option 3A: $5.0 to $8.0B
  - Option 3B: $10.0 to $14.0B
    (Includes 3A Costs)
- Recurring Cost Per Flight:
  - MLV: $40 to $75M
  - HLV: $80 to $140M
  - SS Cargo: $180 to $240M
  - SS Crew: $130 to $190M

Schedule



Management

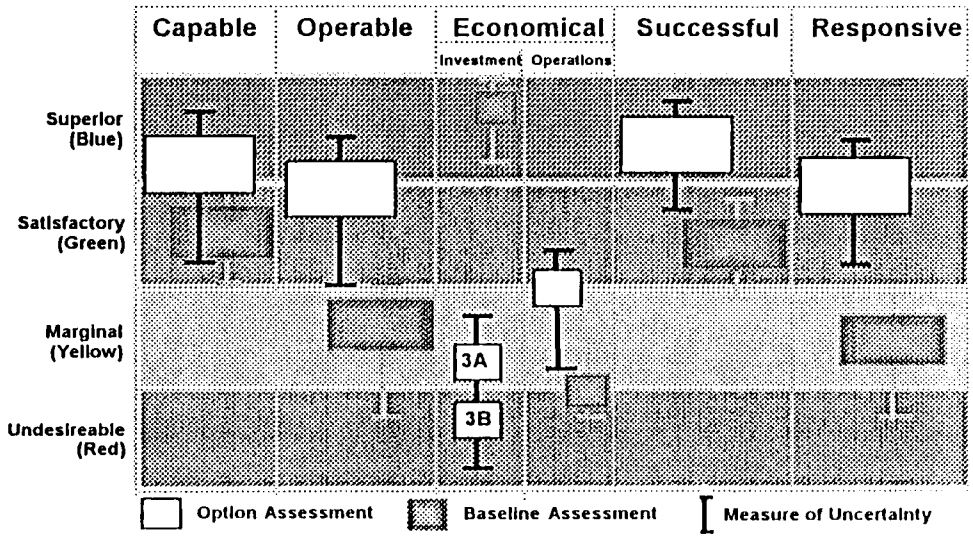
- Continue cooperative DoD/NASA technology program
- National priority necessary
  - Large "Up-Front" investments
  - Contractor cost sharing
  - Potential for third-party financing

Option 3 Assessment

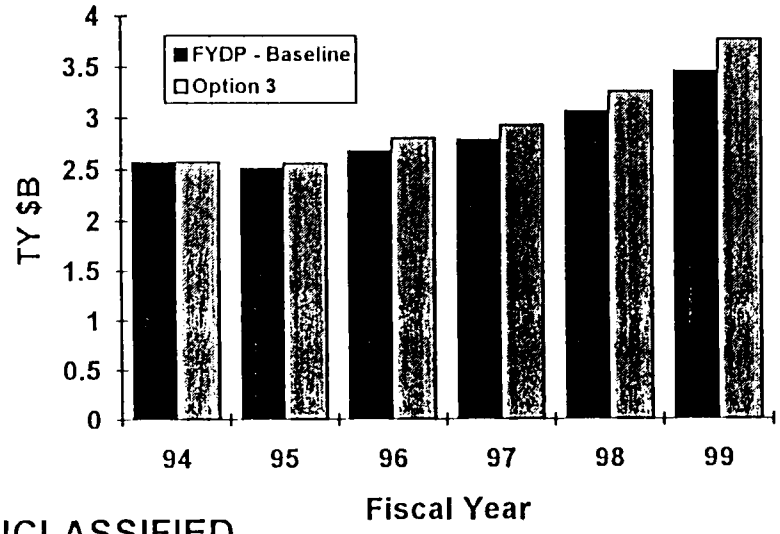
Pros
- –Right-sizes launchers, industrial base and infrastructure
- –Increases ELV operability and reliability
- –Replaces Shuttle (Option 3B) - improves crew safety with abort capabilty
- –Improves long term commercial competitiveness

Cons
- –Requires large non-recurring cost
- –Reduces competition within U.S. launch industry
- –Necessitates change to Space Station logistics (Option 3B)
- –May negate ability to later pursue RLVs

Requirements Satisfaction



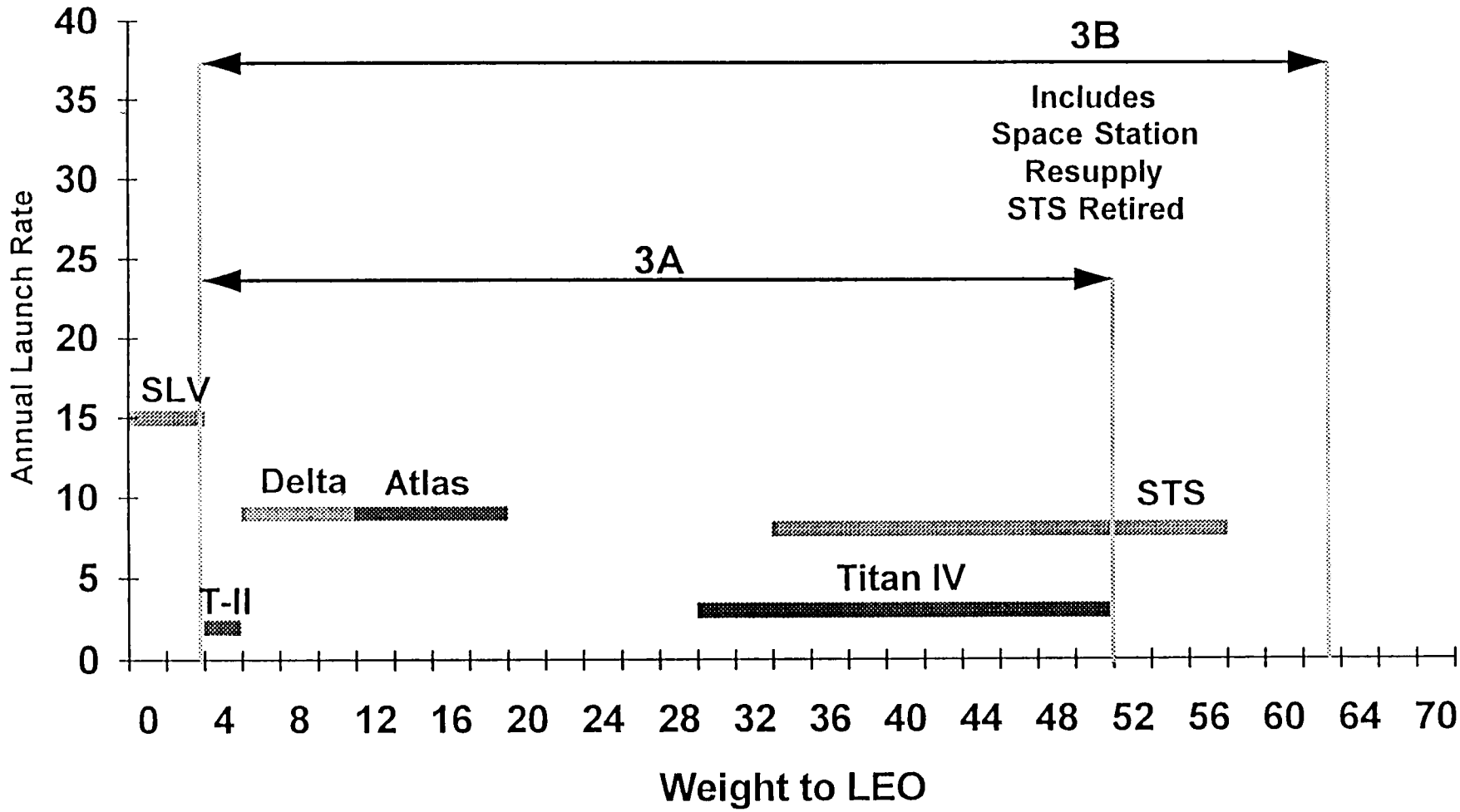
DoD Funding



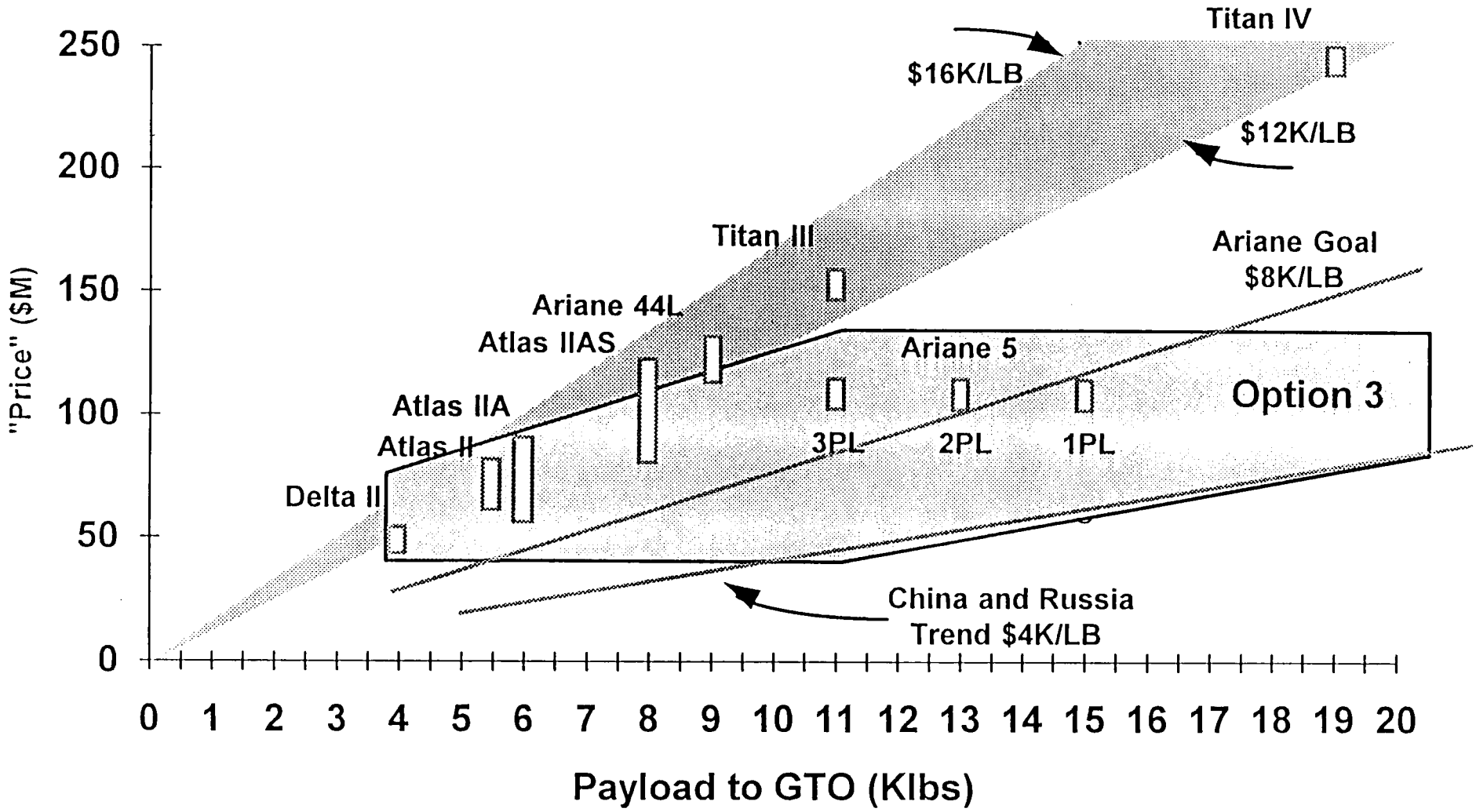
Risks

- Option 3A
  - – Cost (Moderate)
    Wide range of cost
  - – Schedule & Technical (Low to Moderate)
    Adequate concept studies completed
- Option 3B
  - – Cost (Moderate to High)
    Uncertainty in non-recurring and recurring for Space Station logistics and experiments
  - – Schedule (Low to Moderate)
    Integration of cargo carrier and booster
  - – Technical (Moderate)
    Sized for extremely wide range of payloads

Option 3 Annual Launch Rate



Option 3 Cost Per Pound



Option 4 - Reusable Launch Vehicle

Option 4: Reusable Launch Vehicle

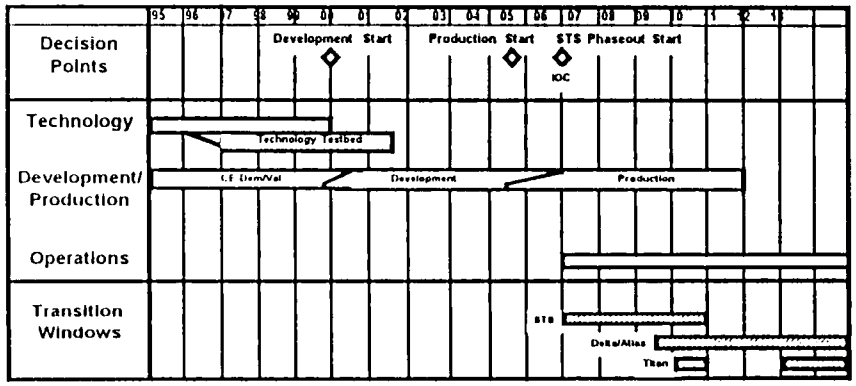
Content

- Fully reusable rocket powered launch vehicle
  - –Transitions off Shuttle and medium ELVs
  - –Potentially transitions off of HLV
  - –Carries passengers and returns cargo
- Incremental implementation provides at decision opportunities
  - –First phase technology maturation focused
  - –Concept exploration in parallel with technology

Cost (CY94$)

- Technology/Demonstration = $0.6 -$ 0.9 B
- Development: $6 - $20 B +
- Production: $2.5 - $10.5 B (Four vehicle fleet)
- Annual Ops Cost = $0.5 - $1.5 B
  - – Cost per flight = $13 - $39M +Upper Stage

Schedule



Management

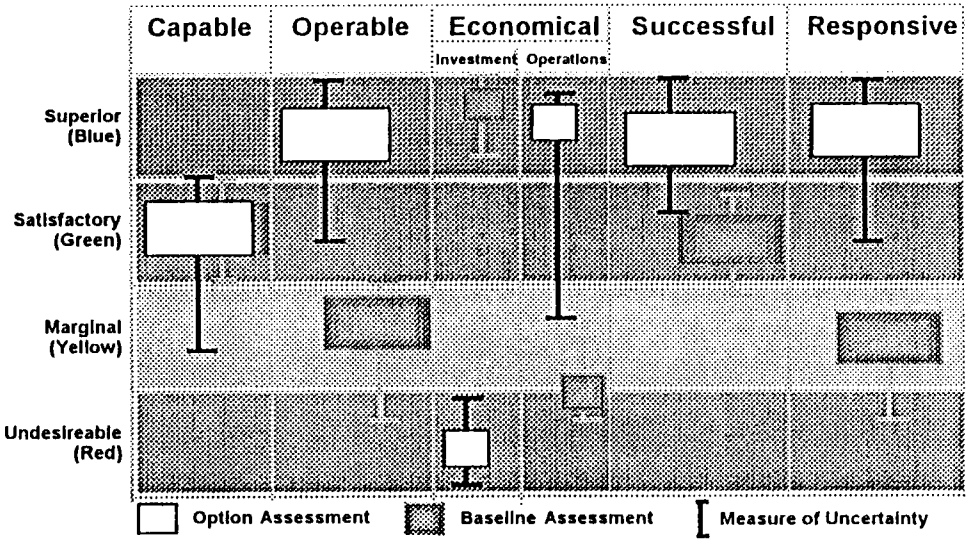
- Continue cooperative DoD/NASA technology program
- Consider chartering a Government-mandated, U.S. launch corporation
  - –Public and private financing
  - –Government and contractor cost sharing
- Reusable launch vehicles could ignite a commercial space boom -- *IF* costs can be decreased by a factor of ten

Option 4 Assessment

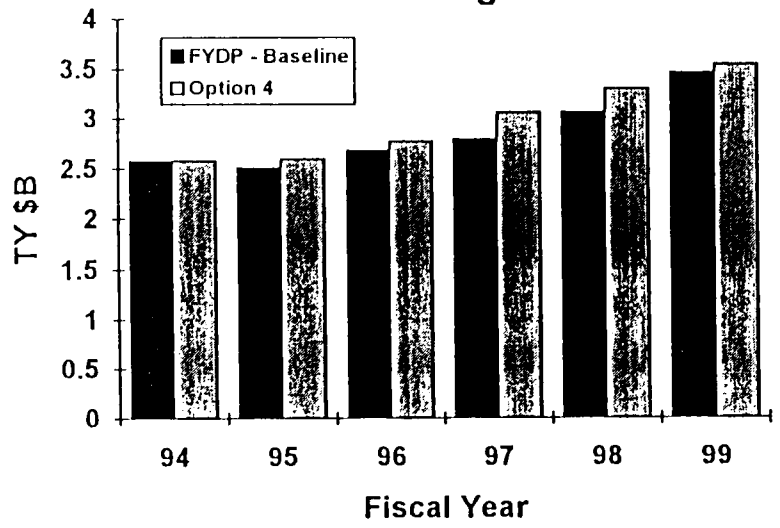
Pros
- Stimulates U.S. space technology
- Right sizes launcher, industrial base and infrastructure
- Substantially reduces operational costs
- Increases operability, reliability and safety
- Improves long term international competitiveness

Cons
- Requires high non-recurring cost
- Reduces competitiveness within U.S. launch industry
- Requires significant technology maturation

Requirements Satisfaction



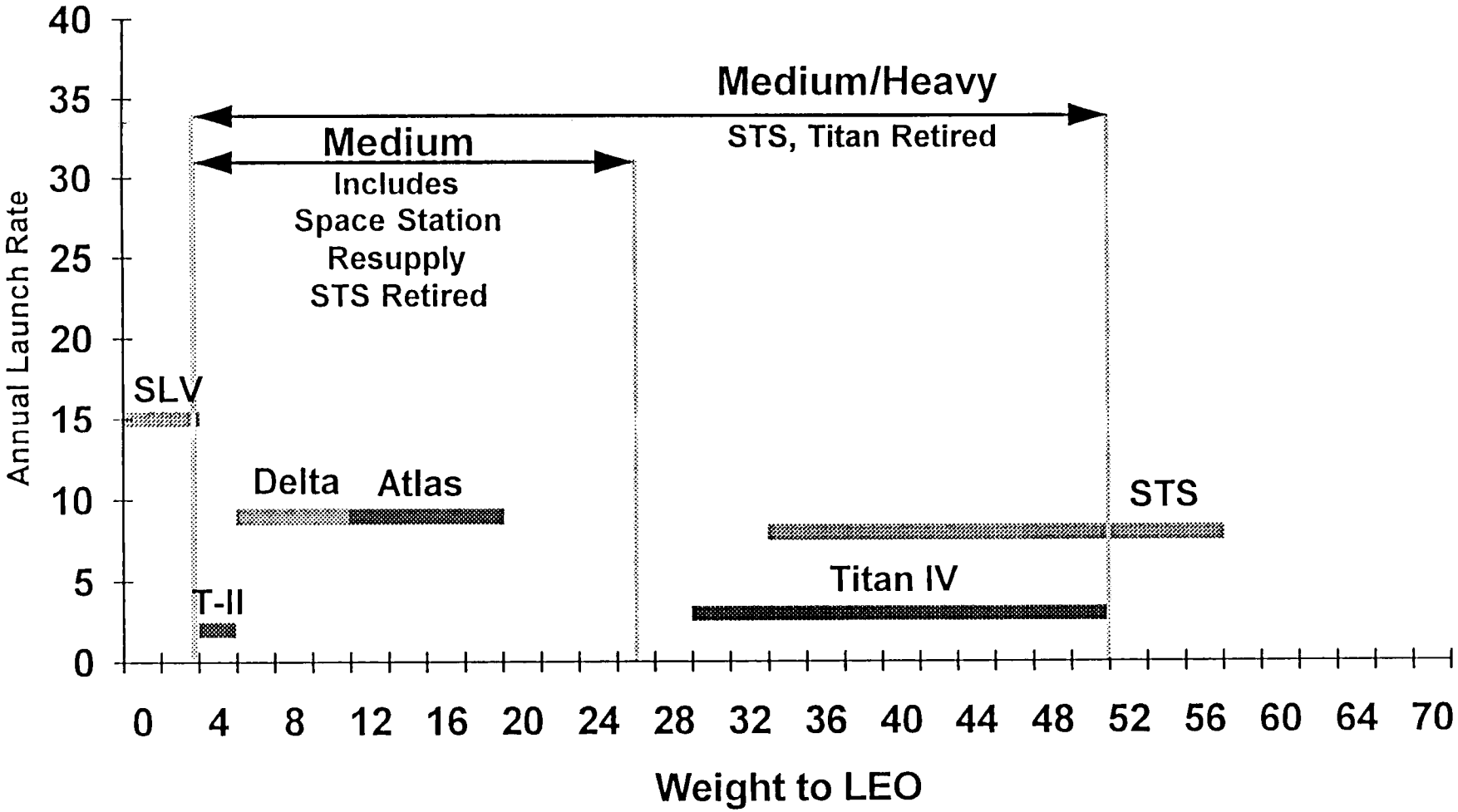
DoD Funding



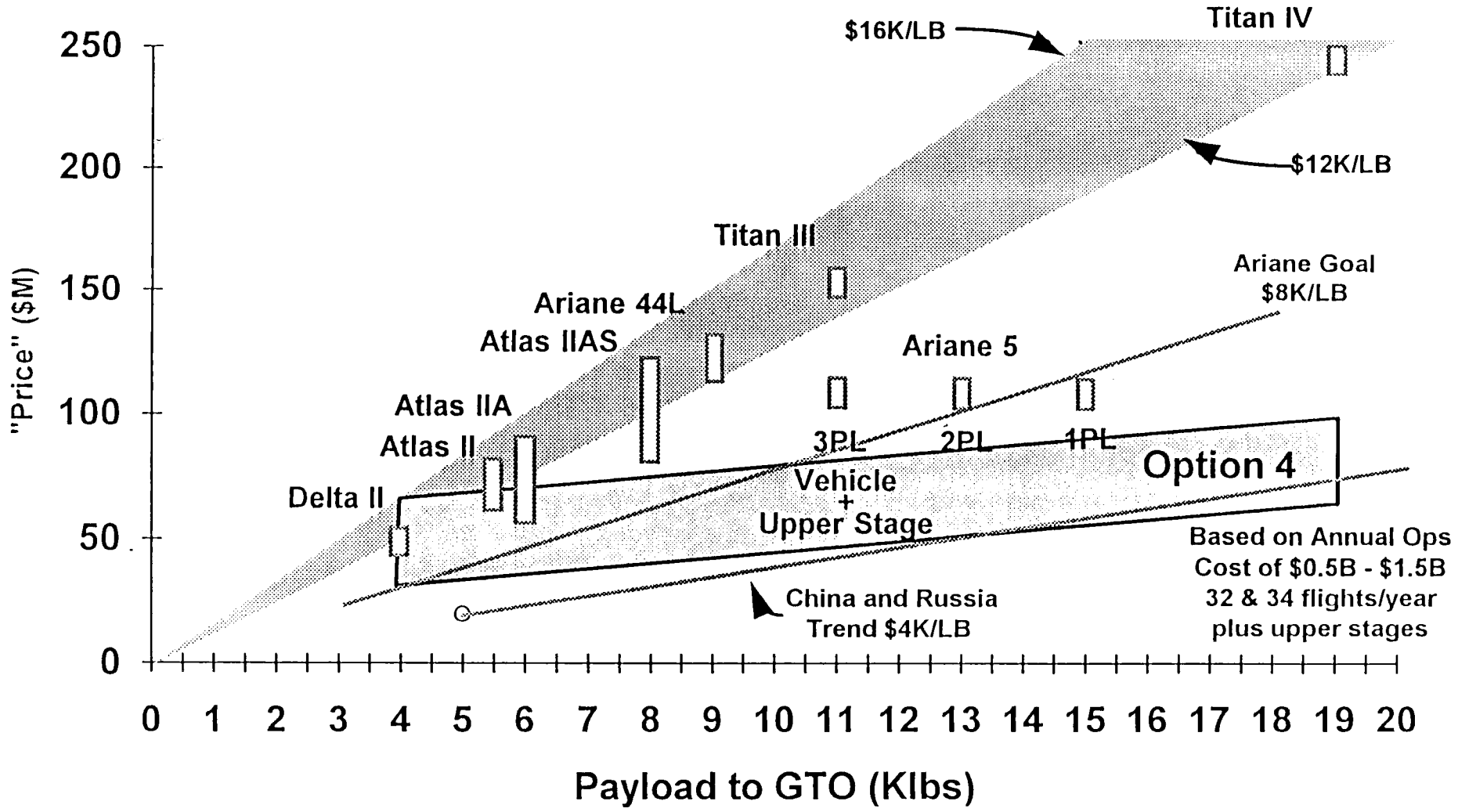
Risks

- Technical (Moderate to High)
  - Integration of propulsion/airframe
  - Demonstration of reusability/operability
- Cost (Moderate to High)
  - Very wide range in cost
- Schedule (Moderate to High)
  - Highly technology dependent
  - Success oriented schedule

Option 4 Annual Launch Rate



Option 4 Cost Per Pound



Option Comparisons

Options

(1) Sustain Existing Systems
- Incremental improvements

(2) Evolved ELV ($1-2.5B)
- Consolidates existing ELVs
- Reduces outyear launch costs

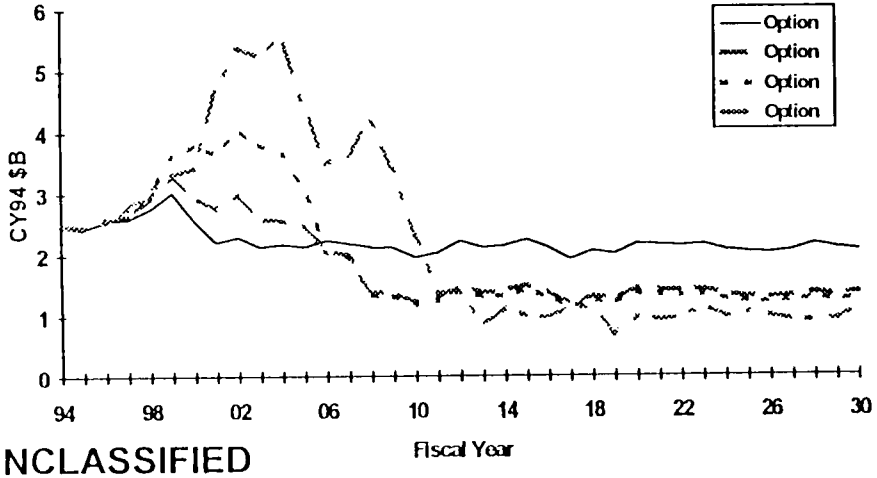
(3) Clean Sheet ($5-8B)
- New ELV (family)
- Achieve high reliability/low cost

(4) Reusable ($6-20B)
- Replace ELVs

Funding Above FYDP (TY$M)

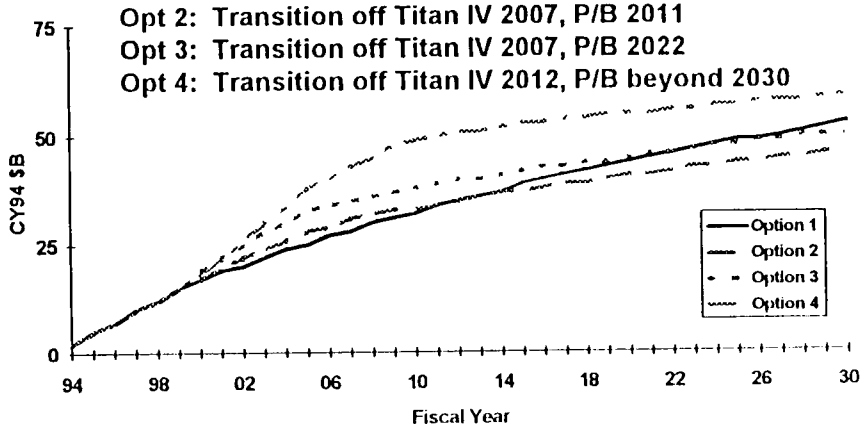
	Fiscal Year						
	94	95	96	97	98	99	Total
Option 1	0	46	94	94	93	94	421
Option 2	0	46	147	212	399	464	1268
Option 3	0	56	189	228	507	709	1690
Option 4	0	98	147	367	541	442	1594

Cash Flow Comparisons (DoD Only)



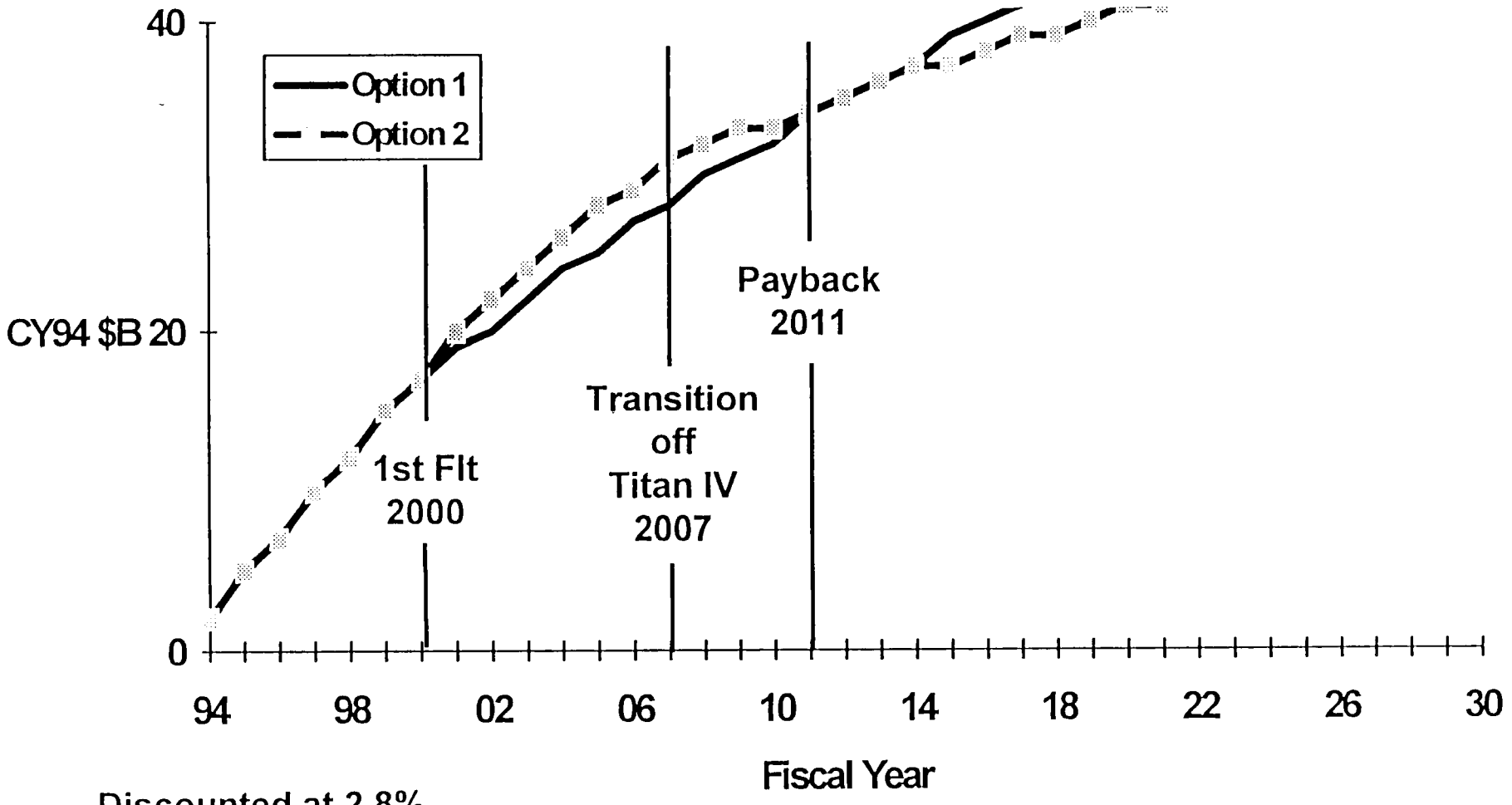
Payback Comparison (DOD Only)

Opt 2: Transition off Titan IV 2007, P/B 2011
Opt 3: Transition off Titan IV 2007, P/B 2022
Opt 4: Transition off Titan IV 2012, P/B beyond 2030



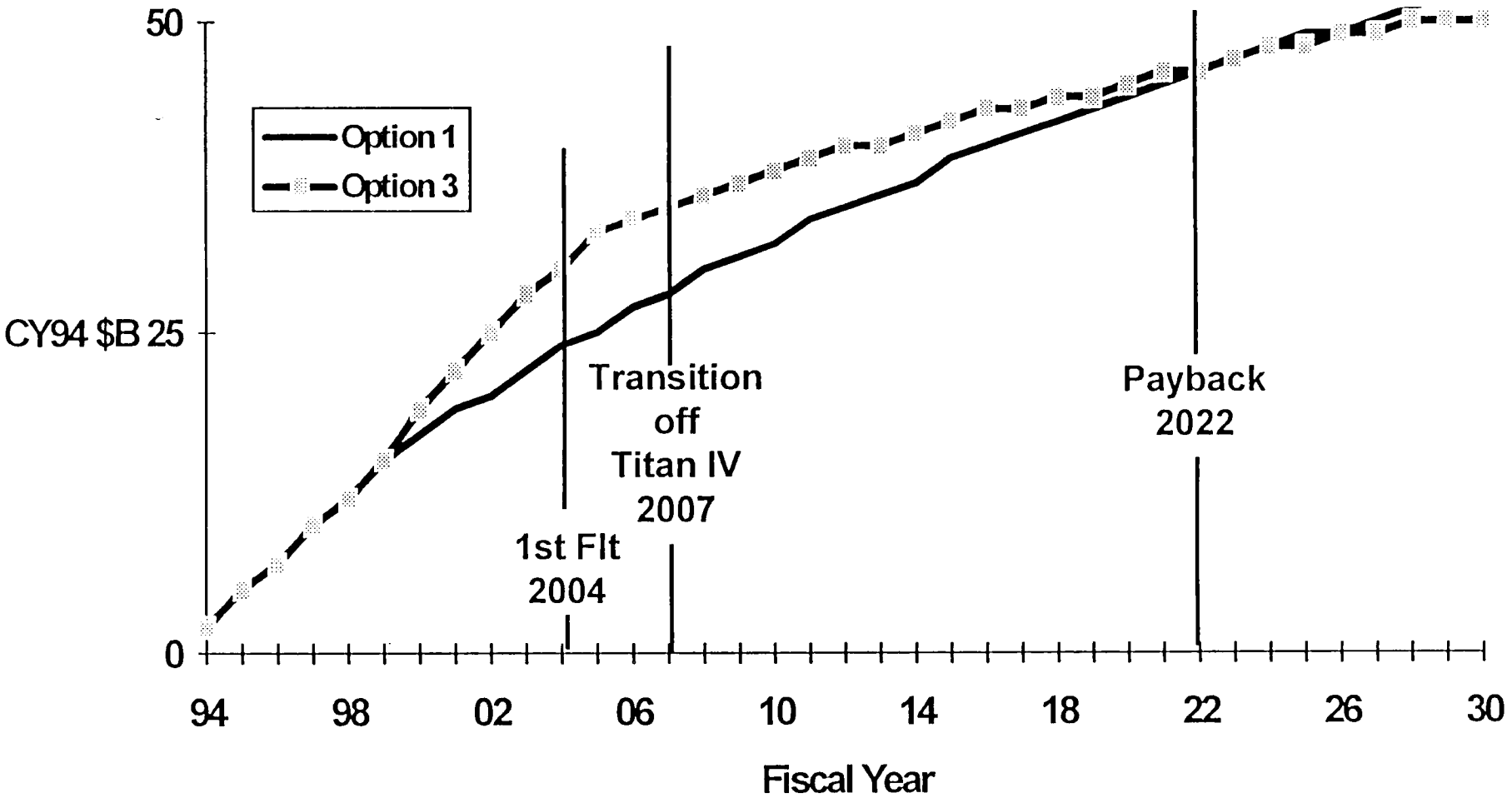
Discounted at 2.8%

Option 2 Payback (DoD Only)



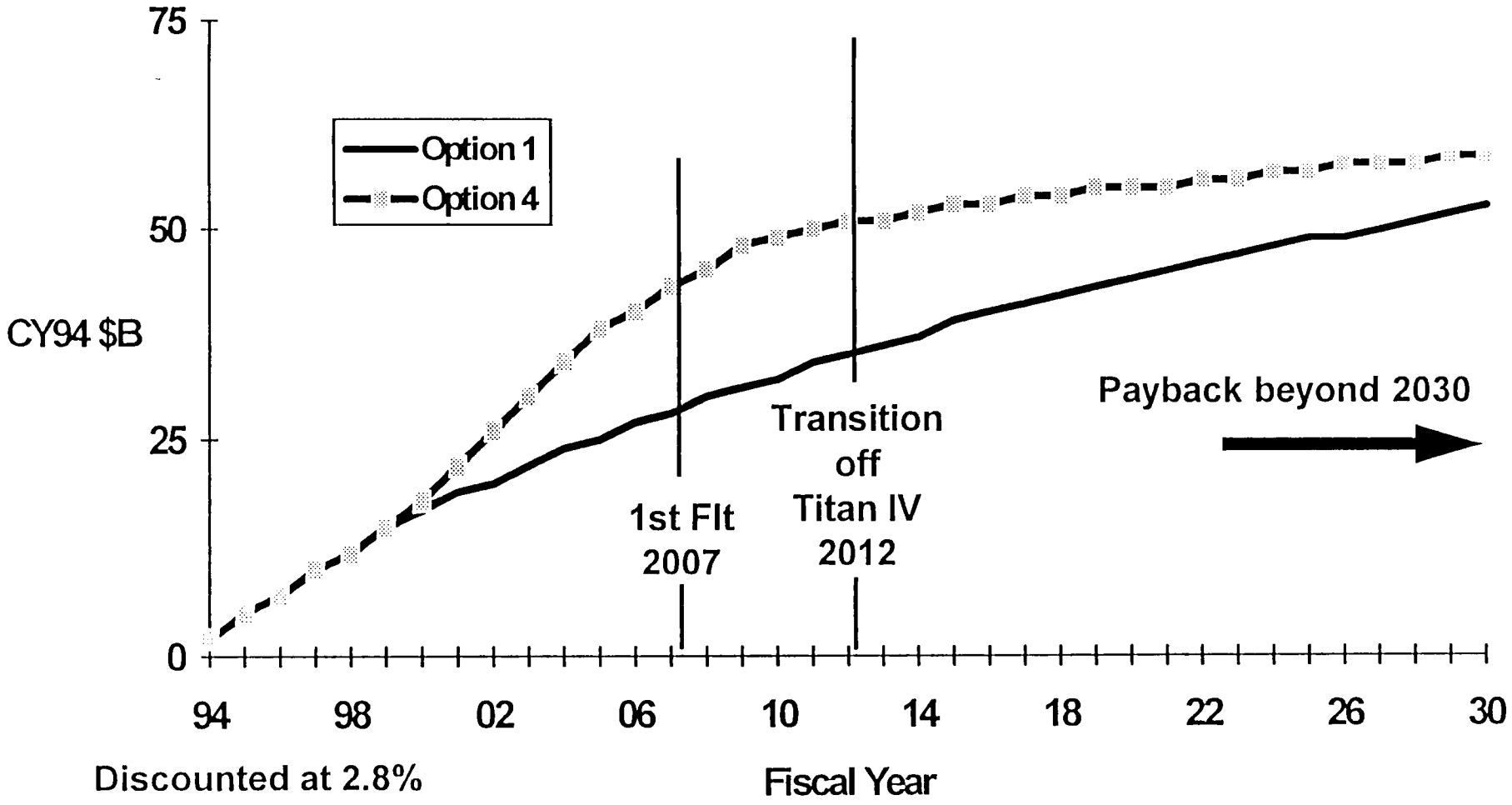
Discounted at 2.8%

Option 3 Payback (DoD Only)



Discounted at 2.8%

Option 4 Payback (DoD Only)



Findings and Recommendations

Findings and Recommendations

	Finding
• Fundamental Industry Drivers	1 - 4
• Critical Drivers of Cost, Capability, or Operations	5 - 9
• Special Focus Areas	10 - 13
• Current Operations Enhancements	14 - 15

Findings and Recommendations
Fundamental Industry Drivers

- Finding
  - As a result of decreasing requirements and multiple ELV families (Titan, Atlas, Delta), excess production and processing capacity exists within the space launch industry
    - » Titan requirements
      - 1989: 10/yr
      - 1994: 3/yr
    - » No single provider has launch rate greater than 9/yr
- Recommendation
  - A major objective of future modernization efforts should be to reduce industrial overhead and niche capabilities

Findings and Recommendations
Fundamental Industry Drivers

- Finding
  - Industry is unwilling to fund major space launch modernization alone, but private "up front" investment may be available given U.S. Government guarantees
- Recommendation
  - DoD should pursue innovative incentives to encourage private and industrial investment in space launch modernization
    - » Innovative financing -- e.g. loan guarantees, tax incentives, government indemnification
    - » Anchor tenancy -- guaranteed minimum launch rates and prices
    - » Government-industry partnerships
    - » May require special legislation

Findings and Recommendations
Fundamental Industry Drivers

- Finding
  - Heavy lift is required for the foreseeable future
    - » Driven by user requirements and current technology (booster and spacecraft)
- Recommendation
  - In the near term,
    - » DoD must continue and improve heavy lift capability
  - In the longer term,
    - » If launch cost considerations continue to dominate, DoD should review and revalidate its intelligence requirements (operational and S&T) which drive heavy lift
    - » NRO should continue to examine advanced spacecraft technologies which could provide major reduction in size/weight

Findings and Recommendations
Fundamental Industry Drivers

- Finding
  - Opportunities for payload-booster transition are currently not fully coordinated to maximize the cost benefit to the Government
- Recommendation
  - If a new or evolved space launch system is pursued, the initial launch capability (ILC) should be planned to coincide with anticipated payload block changes and/or new starts
    - » Windows of opportunity
      - Medium lift: 2003 - 2005
      - Heavy lift: 2005 - 2007, 2009, 2011 - 2013
      - Shuttle: 2006 - 2010

Findings and Recommendations
Critical Drivers of Cost, Capability, or Operations

- Finding
  - Increased cost of failure demands an increased emphasis on improved reliability
    - » 1984 - 1988: ELV hardware/spacecraft losses $1.4 B
    - » 1989 - 1993: ELV hardware/spacecraft losses $1.7 B
- Recommendation
  - Support and sustain funding for launch system and infrastructure reliability improvements
    - » Fault tree and failure mode analysis and improved process control for all launch systems
    - » Improved instrumentation to enable data collection and supporting analysis

Findings and Recommendations
Critical Drivers of Cost, Capability, or Operations

- Finding
  - Operations costs per launch for Titan IV are significant and rising
    - » 1989: $34M (CY94$)
    - » 1994: $54M
    - » 1999: $72M
- Recommendation
  - Aggressively restructure and streamline Titan launch base operations to reduce current and future operations costs
    - » Launch crew sizing
    - » Pad requirements
    - » Work structure

Findings and Recommendations
Critical Drivers of Cost, Capability, or Operations

- Findings
  - A cross-sector process to collect, coordinate, and consolidate requirements does not exist
    - » Definition of "requirement" varies by sector
    - » No single forum for coordination
- Recommendation
  - Institutionalize a process to gain and sustain community agreement on requirements and associated metrics
    - » Performance, sustainability, reliability, and cost-effectiveness must be balanced

Findings and Recommendations
Critical Drivers of Cost, Capability, or Operations

- Finding
  - The DoD core space launch technology program is significantly underfunded and externally constrained -- this has hindered the opportunities for space launch modernization
    - » Big programs lead to boom and bust (ALS, NLS, NASP)
    - » Rocket propulsion -- past emphasis on performance vice cost
- Recommendation
  - Increase funding for a core space launch technology program as an enabler to future investment
    - » Allocate the FY94 ARPA $50 M to the Air Force for execution -- consistent with Congressional guidance

Findings and Recommendations
Critical Drivers of Cost, Capability, or Operations

- Finding
  - Air Force launch base operations are constrained by antiquated and unsupportable ground systems and facilities
    - » Some Range systems average 3 failures per mission
    - » Range caused 22 delays on 16 Delta missions (Feb 92-Sep93)
- Recommendation
  - Continue funding Range Standardization and Automation and launch base infrastructure improvement programs

Findings and Recommendations
Special Focus Areas

- Finding
  - A detailed understanding of Russian engine technology can potentially lead to reduced cost for modernization
    - » Improved performance, robust margins, proven ruggedness
    - » Foreign policy and dependency implications
- Recommendation
  - DOD should lead and fund a cooperative effort, including NASA and industry, to investigate the use of Russian engines/technology in future ELVs
    - » Prime candidate : RD-170 engine
    - » Air Force execute a near term test and inspection program

Findings and Recommendations
Special Focus Areas

- **Finding**
  - There exists general consensus on the potential benefits of a new reusable system; widely divergent views on timing, approach, cost, and risk
- **Recommendation**
  - Pursue a cooperative DoD/NASA technology maturation effort which includes experimental flight demonstrations

Findings and Recommendations
Special Focus Areas

- Finding
  - DoD and NASA space launch program coordination needs to be improved
- Recommendation
  - Assign DoD the lead role in expendable launch vehicles and NASA the lead in reusables
    - » Each agency manages and funds efforts within their respective responsibilities
    - » Maintain top level oversight and coordination -- e.g. Aeronautics and Astronautics Coordination Board (AACB)

Findings and Recommendations
Special Focus Areas

- Finding
  - Small launch vehicle market is uncertain, but could be a major growth area -- key is development of distributed communications and sensor systems
    - » Low altitude comsats may demonstrate viability of the concept
    - » Brilliant Eyes may be DoD analog for sensors
- Recommendation
  - DoD continue to monitor the development of this market
    - » Let commercial market forces function

Findings and Recommendations
Current Operations Enhancements

- Finding
  - Substantial data on DoD launch operations exists, however, the information is difficult to access and use effectively
- Recommendation
  - Establish a standardized program for metrics, data collection, and supporting analysis

Findings and Recommendations
Current Operations Enhancements

- Finding
  - There is a lack of standardization within the Air Force space launch systems and operations
- Recommendation
  - Develop standardized procedures, systems, interfaces, processes, and infrastructure
    - » Define standards and implement through a program involving launch wings, System Program Offices and NASA

Pushing On The Centers Of Gravity

Recommendations \ Centers of Gravity	Rate & Stability	Reliability	Technology Availability	Management	Funding Stability
Downsize Industry	✓	✓			
Incentivize Investment				✓	✓
Continue Heavy Lift	✓				
Review Heavy Lift Rqts	✓				
Examine Lightweight Tech			✓		
Introduce LV in Trans Window				✓	
Improve Reliability		✓			✓
Reduce Titan IV Launch Operations Costs	✓				
Institutionalize Cross Sector Rqts Process				✓	
Increase Core Tech $			✓		
Fund RSA & Infrastructure		✓			
Investigate Russian Eng		✓	✓	✓	
Pursue RLV Tech			✓	✓	
Coordinate via AACB				✓	
Leader/Follower on ELV/RLV				✓	
Monitor Small LV Development	?				
Standardize Launch Ops data		✓			
Develop Standard Procedures & Hardware		✓			

Summary

Briefing Schedule

• 29 March	Mr Deutch	• 27 April	OMB
• 7 April	Air Force SAB	• 28 April	USD (A&T)
• 11 April	SAF/AQ, AF/PE	• 28 April	ASD (SR&R)
• 11 April	Study Group	• 10 May	COMSTAC
• 12 April	JCS (DJS and J-3)	• 10 May	Industry CEOs
• 12 April	OSD Staff	• 11 May	USSPACECOM
• 18 April	NASA and OSTP	• 17 May	Congressional Staffers
• 21 April	General McPeak	• May	Defense Science Board
• 21 April	JROC	• May	Industry Reps/Groups
• 22 April	SMC	• 8 June	NSIA

Summary

Space Launch Modernization Plan answers Congressional tasking

- Develop a plan with roadmap(s) ✓
- Consult with OSTP ✓
- Recommend allocation of FY94 ARPA funds ✓
- Identify launch system requirements ✓
- Define cost reduction for current launch systems ✓
- Study differences between U.S. and foreign launch systems
  - Provided a foundation for the 1 October report