# NASA: Moon or Bust

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# Vision for Space Exploration

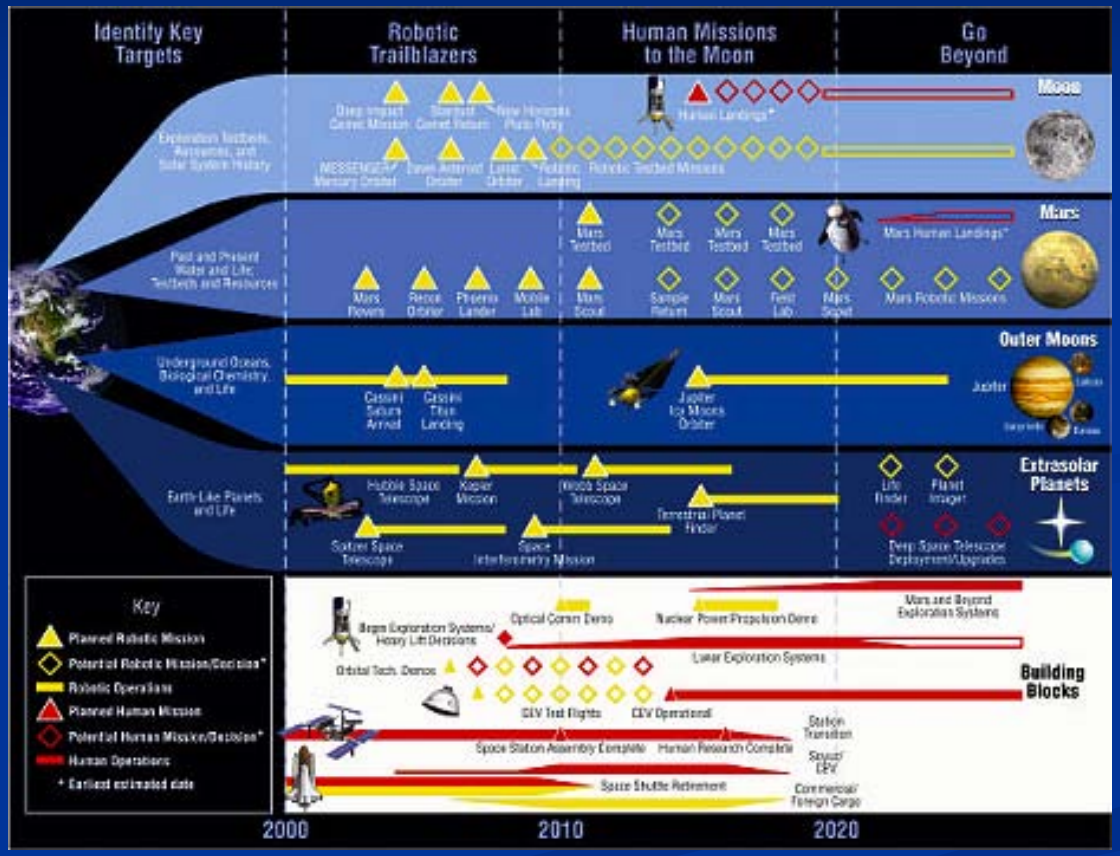
- Complete ISS by 2010
- Manned CEV by 2014
- Return to moon by 2020

# Cost Constraints

- The President has projected the annual resources available to NASA at roughly the same level as in the past, growing only slightly in the coming years. Within these annual levels, the journey will need to be managed within available resources using a “go as you can pay” approach, which allows specific exploration goals to be adjusted as technology advances and periodic milestones are achieved.
  - Aldridge Report p 6

# NASA Timeline

- Shuttle retired by 2010
- Station retired by 2015
- Test flight of CEV by 2014
- CEV to moon by 2020
- JIMO by 2015
- Mars in 2030's



# How do we get there?

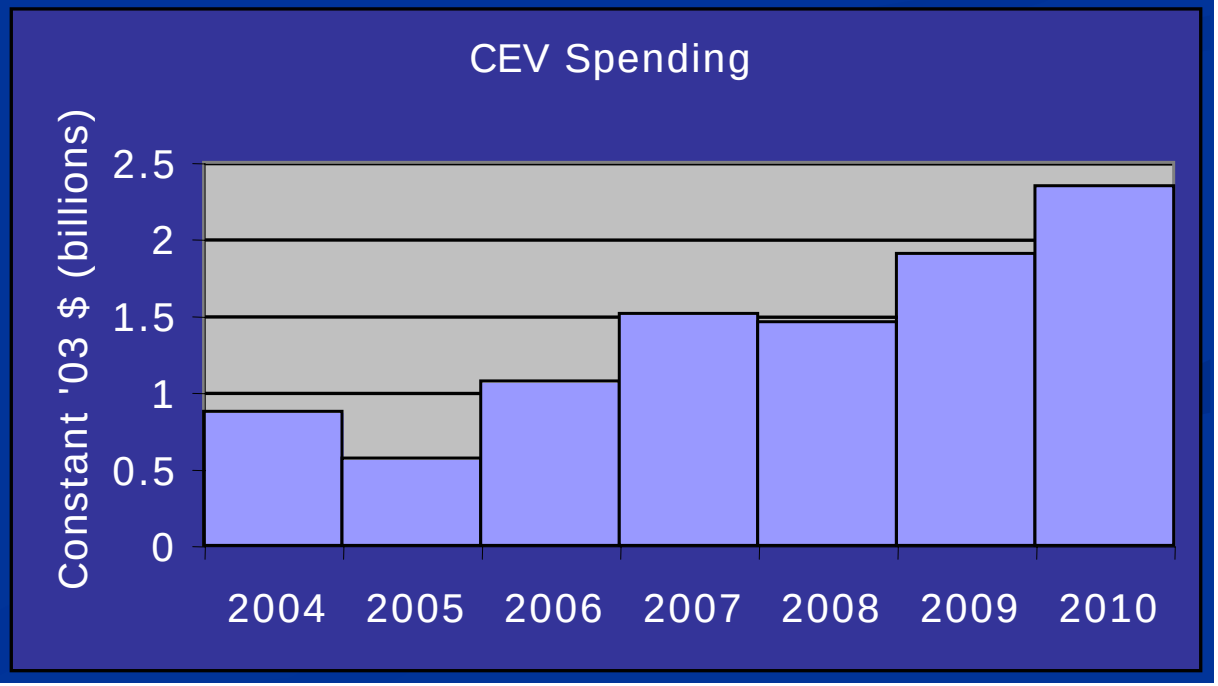
- Through the Constellation Systems Theme NASA will develop, demonstrate, and deploy the collection of systems that will enable sustained human and robotic exploration of the Moon, Mars, and beyond.
  - Crew Exploration Vehicle (CEV) for the transport and support of human crews traveling to destinations beyond low Earth orbit,
  - Launch vehicles for transport of the CEV and cargo to low Earth orbit,
  - Ground or in-space support infrastructure for communications and operations.

# CEV

- Our second goal is to develop and test a new spacecraft, the Crew Exploration Vehicle, by 2008, and to conduct the first manned mission no later than 2014.
- The Crew Exploration Vehicle will be capable of ferrying astronauts and scientists to the Space Station after the shuttle is retired.
- But the main purpose of this spacecraft will be to carry astronauts beyond our orbit to other worlds.

# CEV

- Budgeted costs: $9.7b
- Projected development costs: $20b



# Heavy Lift Launch Vehicles

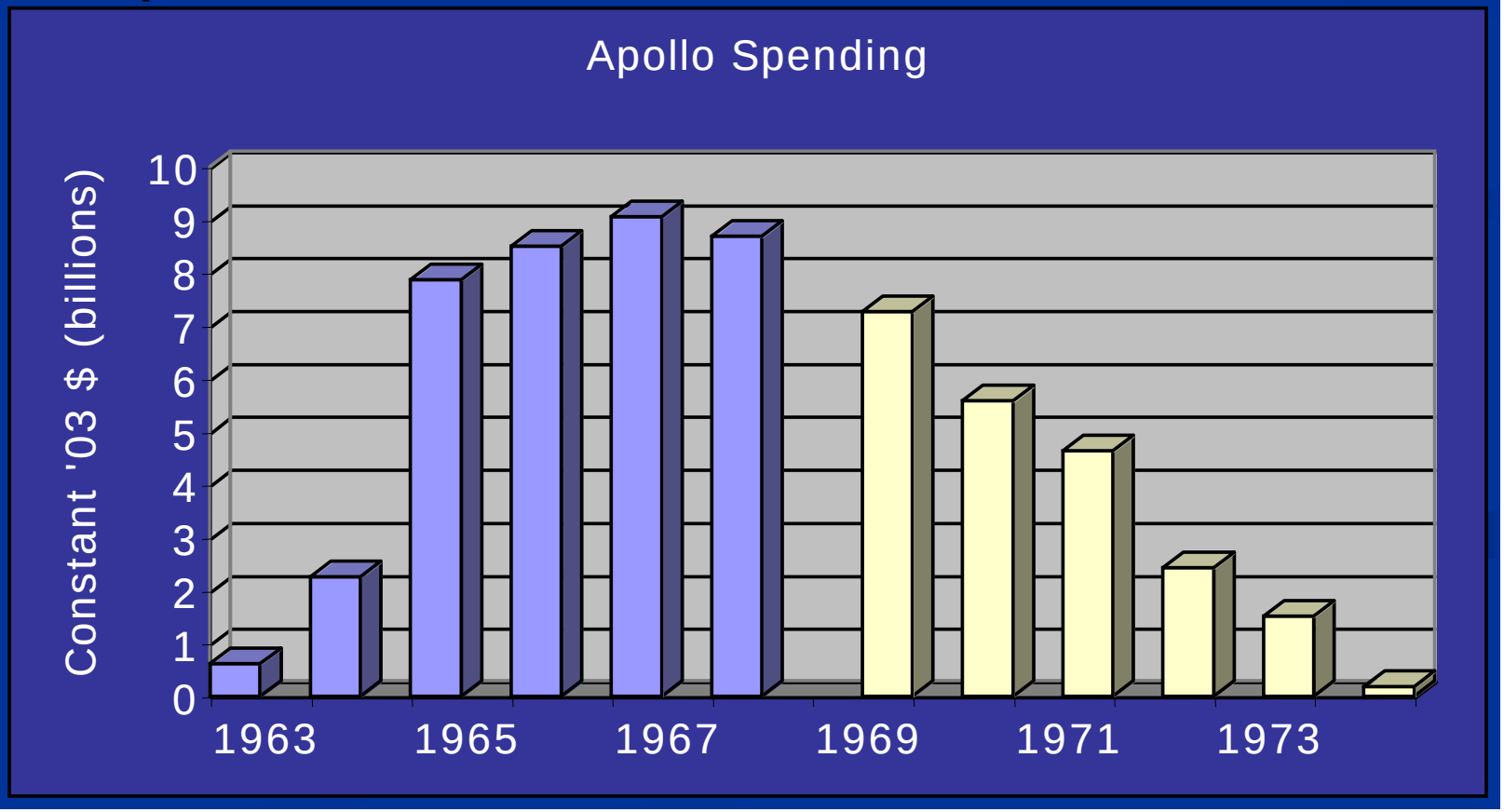
- Since completion of the Apollo program and the last launch of a Saturn V, the United States has relied on the Space Shuttle for placing large payloads (roughly 55,000 pounds) into low-Earth orbit. Saturn V carried a far greater payload, approximately 250,000 pounds to low-Earth orbit. The heavy-lift variants of the Evolved Expendable Launch Vehicles (EELV) will soon come on-line with a capacity of lifting up to 50,000 pounds into low-Earth orbit or 30,000 pounds into geosynchronous transfer orbit.
  - Aldridge Report p 30

- The conferees are concerned that the current implementation plans for the new vision do not properly address the requirements for the heavy lift capability that may be necessary to carry out the space exploration initiative. A complete review of such plans must be conducted prior to embarking fully upon the implementation of the initiative.
  - FY2005 NASA Appropriations Report, p 1603

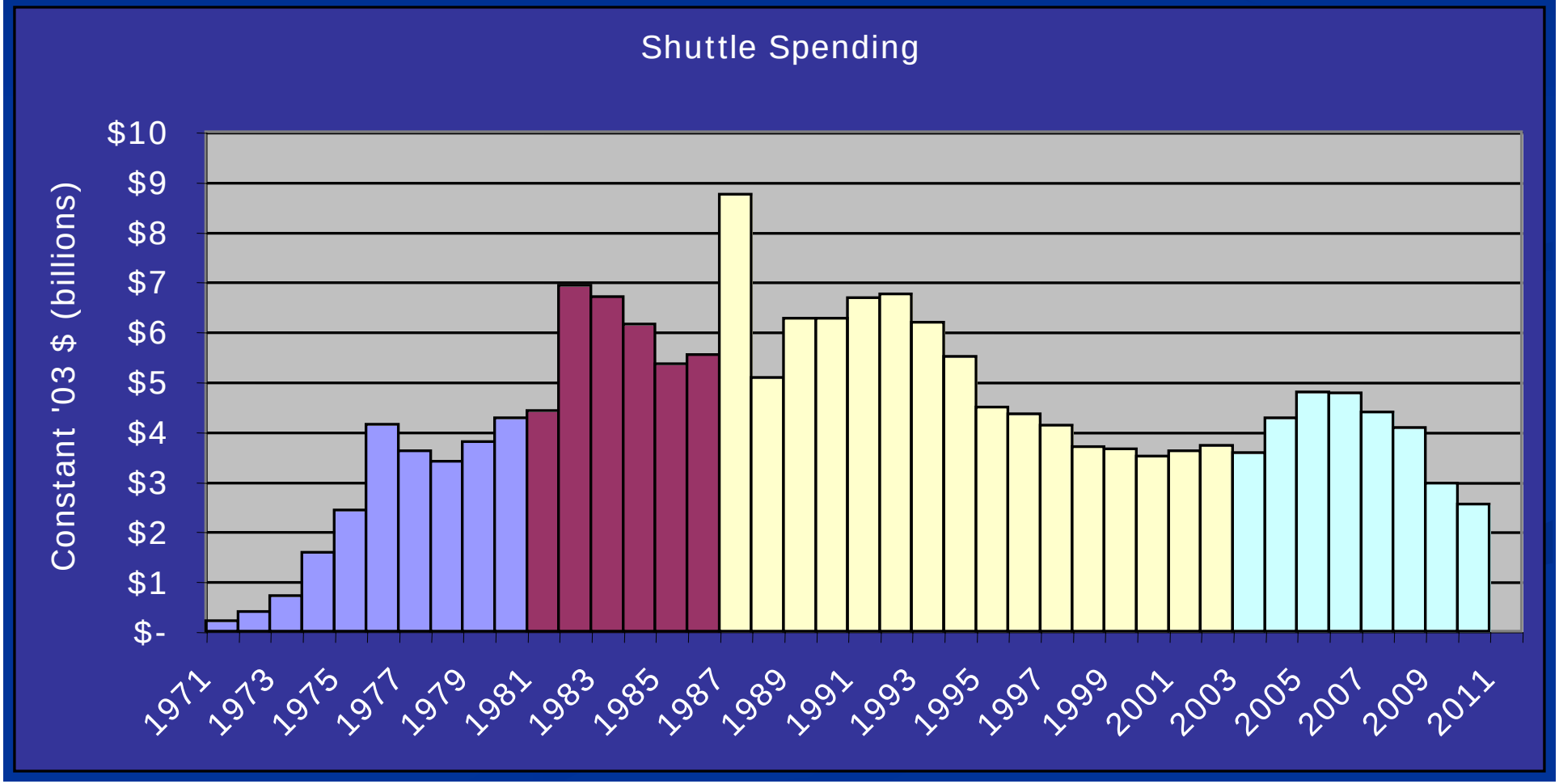
- NASA projected cost
  - CEV: $20b by 2014
  - Heavy Launch Vehicle: $17b by 2014

# Historical Development Costs

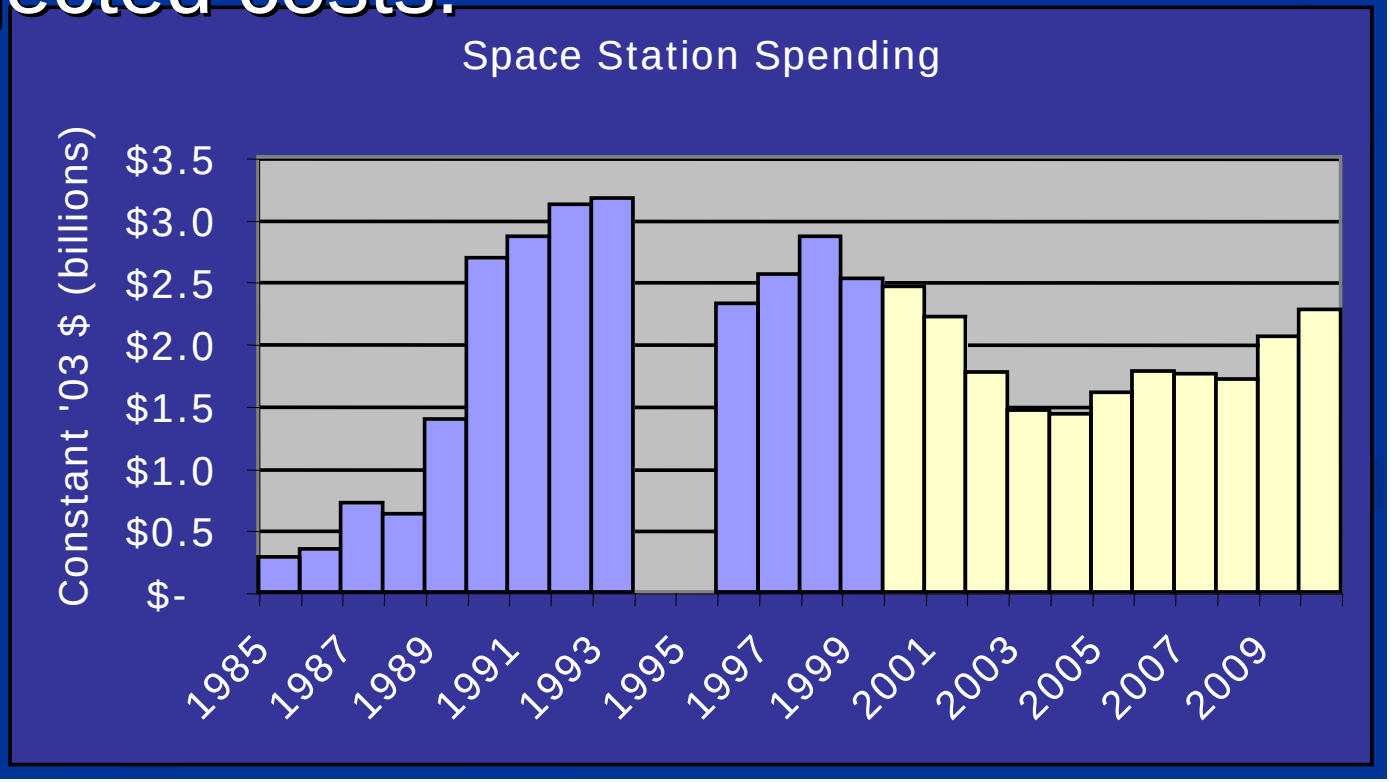
- Total costs: $58.6b
- Development costs: $37.0b



- Total costs: $166b, $1.3b / flight
- Development costs: $28.9b
- Cost predictions per flight: ~$500m / flight



- Total costs > $46.0b
- Development costs: $25.5b
- NASA projected costs:
  - 1984: $8b
  - 1985 $14b
  - 1994 $34b

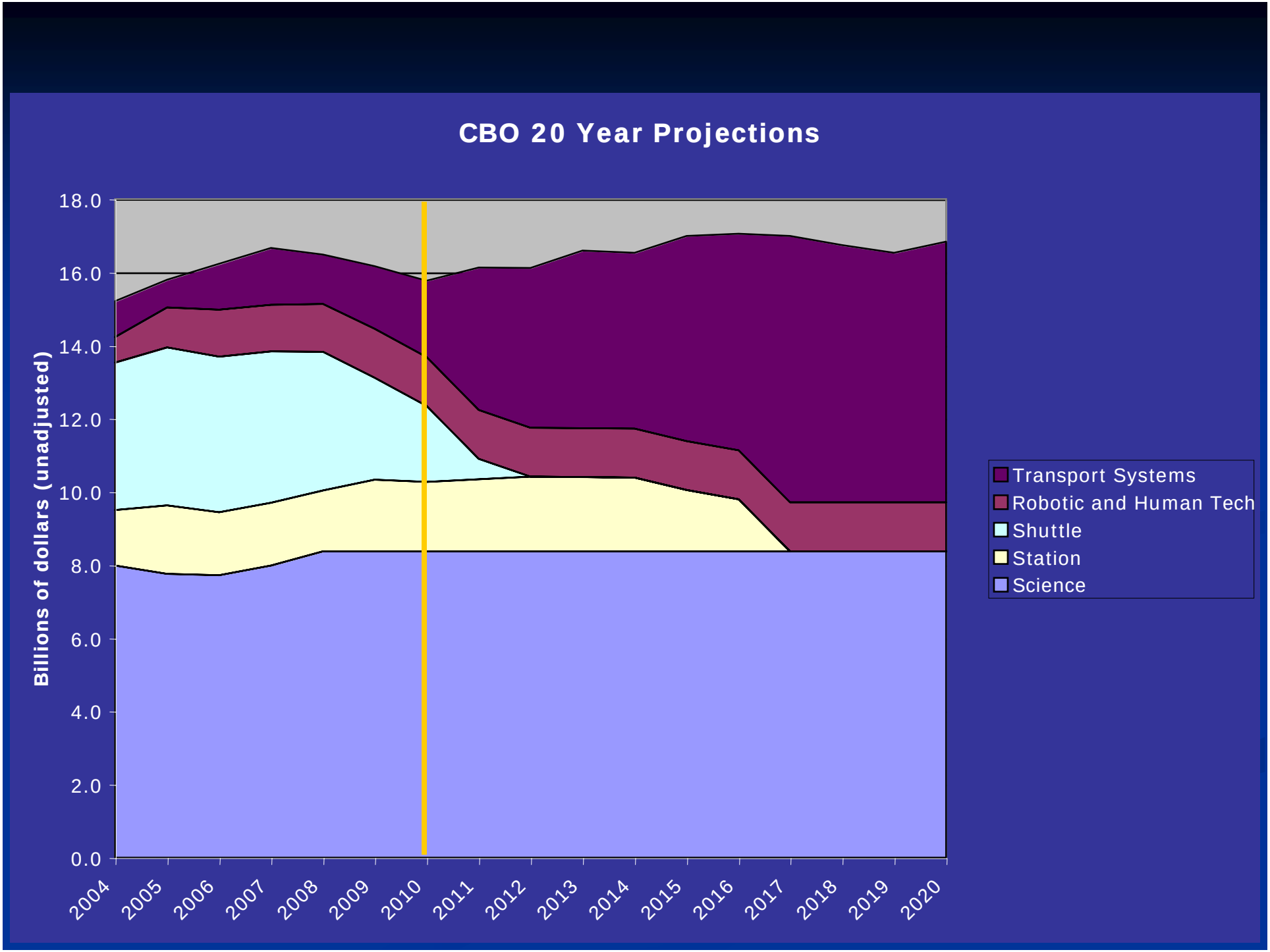


# EELV Costs

- Evolved Expendable Launch Vehicle
- Boeing Delta IV
- Lockheed Martin Atlas V
- DoD funded
  - $20b over 8 years (nonadjusted)
  - $1b per vehicle

# CEV by 2015?

- Yes, if all goes well.
  - ~$40b available
  - < $2b per year till 2010
  - < $6b per year available after 2010
    - $16b NASA budget
    - $8b Science office
    - $2b ISS
    - $3-4b Shuttle
  - CEV: $20b
  - HLV: $17b


CBO 20 Year Projections
Billions of dollars (unadjusted)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Transport Systems
Robotic and Human Tech
Shuttle
Station
Science

# CEV by 2015?

- RAND/CBO - average 69% overrun
  - CEV: $34b
  - HLV: $30b
  - Other requirements?
    - Lunar lander?
    - Access to ISS through 2005?
- Need $27b, or at least 4 more years

# ISS Ends

- NASA will refocus U.S. Space Station research on activities such as the development of countermeasures against space radiation and the long-term effects of reduced gravity that prepare human explorers to travel beyond low Earth orbit.
  - NASA FY06 Budget Estimates p. 222
- NASA will leave ISS by 2015
  - Freeing up at least $2b / yr for CEV/Moon.

# Constellation Revisited

- CEV launch by 2014 unlikely
- CEV costs will exceed $20b
- Man-rated heavy lift not available
- HLV costs will also exceed $20b
- NASA will walk away from ISS to fund CEV / Moon

# Questions?