

National Aeronautics and Space Administration



# MEPAG

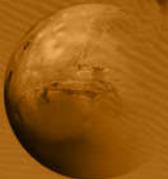
## July 2009



# MARS

*—the search for life*

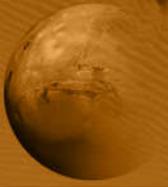
**Doug McCuiston**  
Director, Mars Exploration Program



# Accomplishments & News

- New NASA Administrator!
- MSL remains a major factor for the Program
  - Progress has been good, and MSL remains within its FY09 funding wedge
  - PSS and NAC-SC reiterated support for MSL as a critically-important planetary mission, but expressed continued concern about cost impacts outside MEP
  - Congressional and OMB visibility continues
- Joint NASA-ESA Mars program/initiative agreed to
  - Bi-Lateral meeting June 29-30
  - Establishes a joint “program” beginning in 2016
  - The goal is to return Martian samples in the 2020’s
- National Academies
  - Decadal Survey activities have started
    - Steering Committee kick-off meeting July 6-7
    - First Mars Panel September 9-11
- FY10 Budget still on the Hill

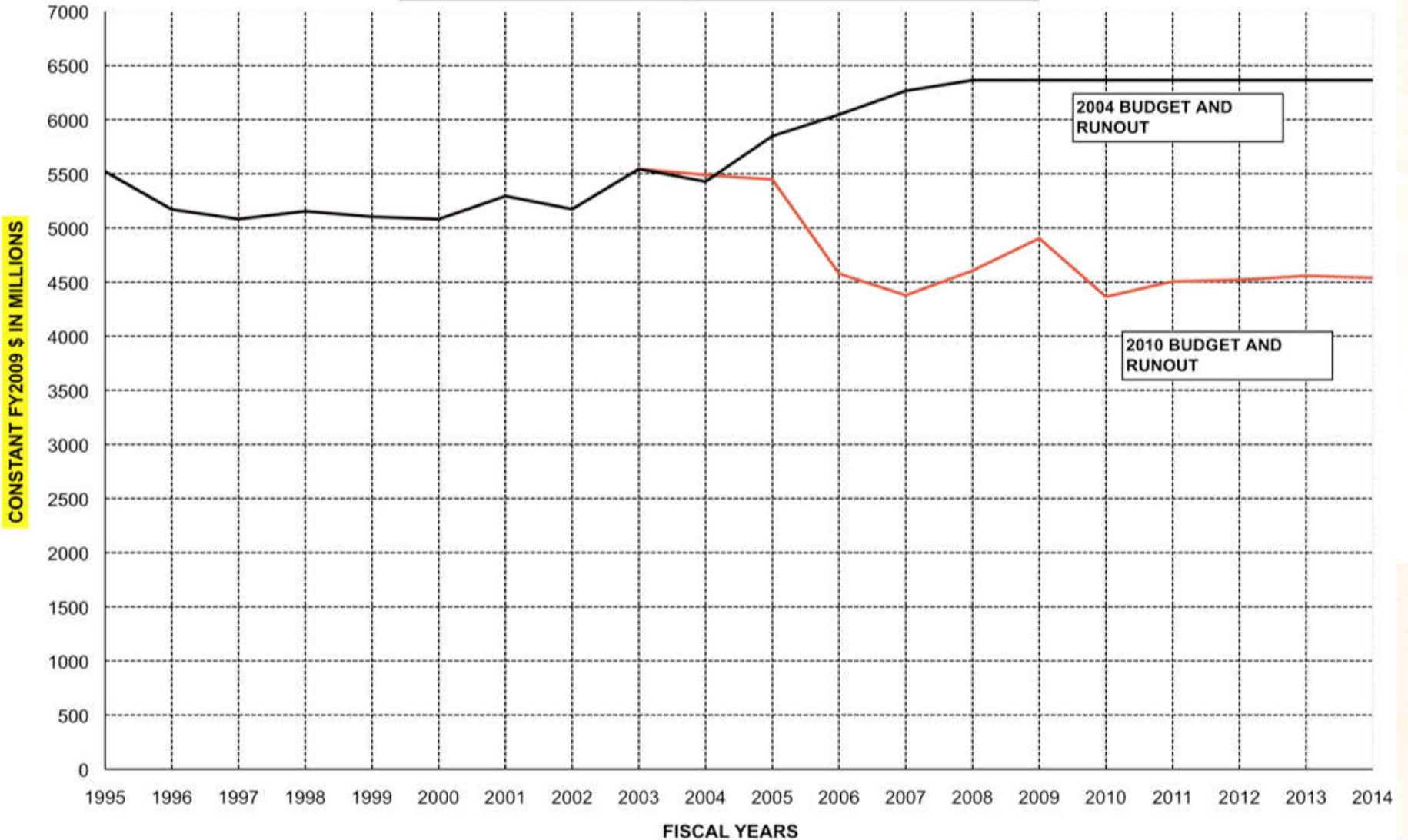




# Unrealized Expectations

## SMD Budget History (\$M)

(FY04 VS. FY10 BUDGETS, NORMALIZED TO INCLUDE ELV'S IN ALL YEARS; TO REMOVE CROSS ENTERPRISE TECHNOLOGY, DEEP SPACE NETWORK AND GROUND NETWORK; AND ADJUST FOR FULL COST ELEMENTS)



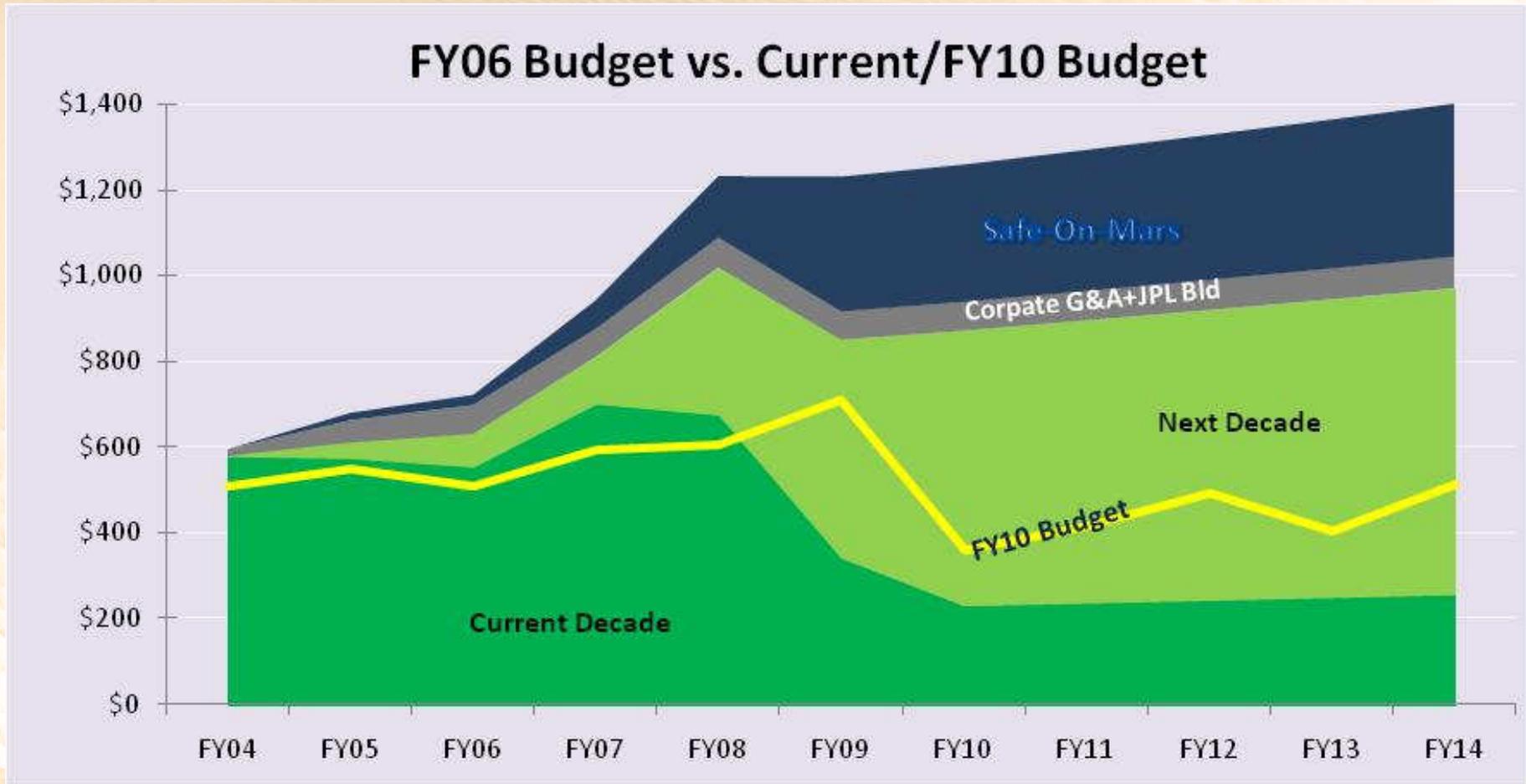
# Mars Program and Planetary Science Division Budget History (\$M)

Combined  
budgets of Mars  
Exploration  
Program  
and  
Solar System  
Exploration  
Division



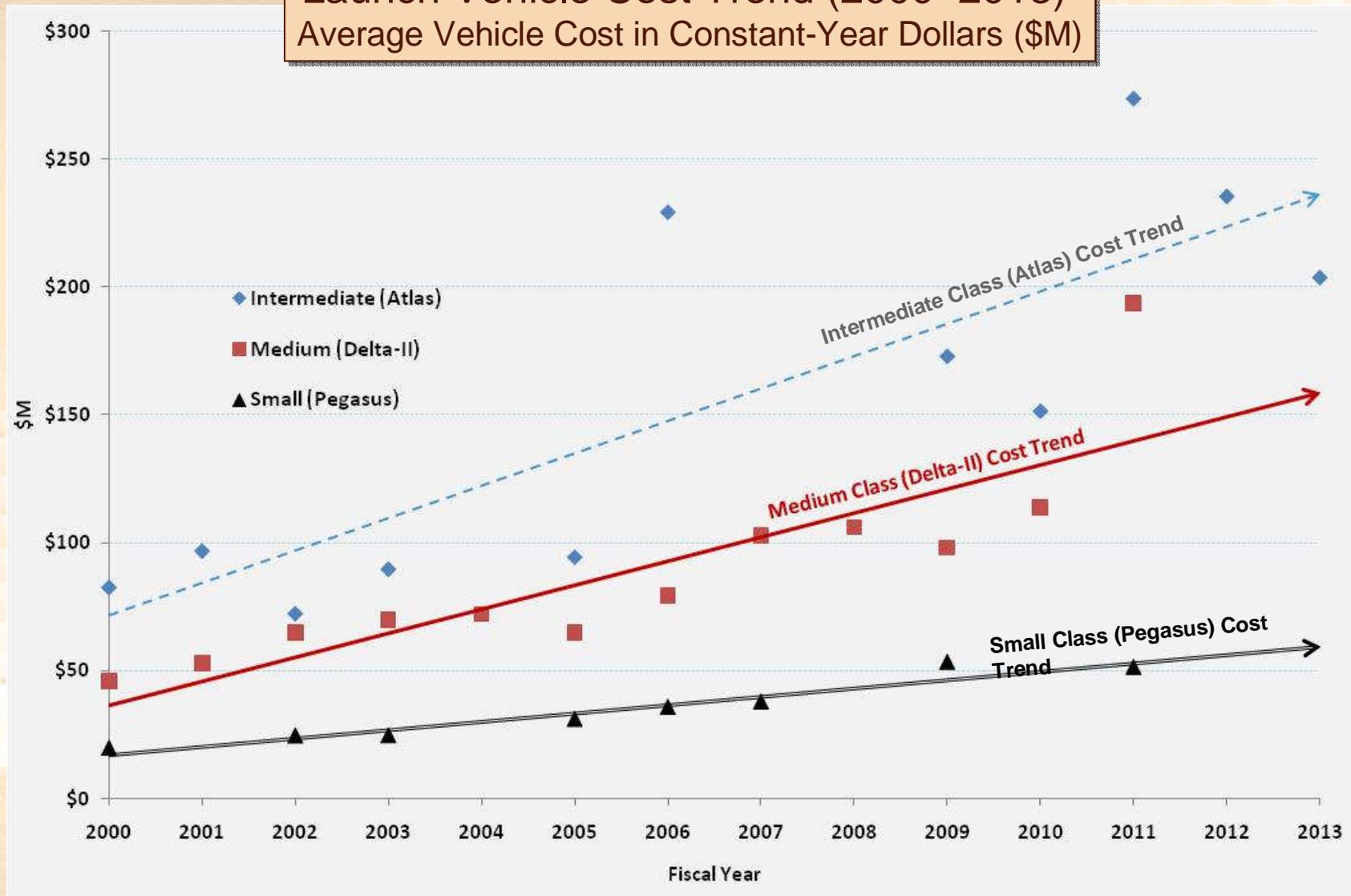
|  | FY08    | FY09    | FY10    | FY11    | FY12    | FY13    | FY14    |
|--|---------|---------|---------|---------|---------|---------|---------|
| FY05 PFP (w/ DSN, O/H, & Lunar Robotics) | \$2,955 | \$3,126 |         |         |         |         |         |
| FY06 PFP (w/DSN, O/H, & Lunar Robotics)  | \$2,832 | \$2,999 | \$3,066 |         |         |         |         |
| FY07 PFP (w/ DSN & O/H)                  | \$1,599 | \$1,840 | \$1,900 | \$1,847 |         |         |         |
| FY08 PFP (include O/H)                   | \$1,396 | \$1,677 | \$1,720 | \$1,738 | \$1,748 |         |         |
| FY09 PFP                                 | \$1,247 | \$1,334 | \$1,410 | \$1,537 | \$1,570 | \$1,609 |         |
| FY10 PFP                                 | \$1,313 | \$1,288 | \$1,346 | \$1,501 | \$1,578 | \$1,600 | \$1,633 |

# Resultant MEP Budget History



# Launch Vehicle Costs Infringe on Science Capacity

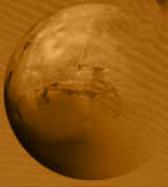
Launch Vehicle Cost Trend (2000–2013)  
Average Vehicle Cost in Constant-Year Dollars (\$M)



# MSL Status

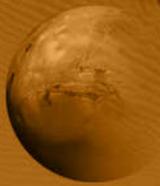
- MSL Replan Status
  - MSL technical progress has been good; still on-track for 2011 LRD
  - MSL replan approved at June Agency Program Management Council (APMC)
    - Restructured project, technical progress, and go-forward plan accepted
    - Replan budget remains around \$400M, but reserves were considered low for just entering ATLO
  - Additional resources to restore reserves to adequate levels expected in FY10/11
    - Multiple cost models resulted in wide range of predictions: \$15M to \$115M
- Budget Solution Space
  - MEP budget has essentially been exhausted in dealing with MSL budget needs w/o direct impact to content
  - Future impacts must be contained in Planetary Division
    - The Mars Program will repay non-Mars “loans”
  - Impacts to cover low- to mid-range budget needs, in order:
    - Reduce or eliminate Mars Program APA in FY10 and FY11
    - Reduce US portion of Mars-16/18/20 missions
    - Rephase Discovery future and New Frontiers mission lines (no impact to current schedules)
  - Impacts increase to cover mid- to upper-range budget needs, in order:
    - Further reduce US portion of Mars-16/18/20 missions
    - Delay LADEE and ILN missions
    - Delay New Frontiers 3 phase B selection





# NASA-ESA Joint Program Studies

- Joint studies began the first week of January, 2009
  - Joint ESA-NASA Engineering Working Group (JEWG)
    - Developed cooperative architecture options for shared mission responsibilities
  - Joint Instrument Definition Team (JIDT)
    - Defined minimum investigation capabilities for orbital science, to focus EWG studies
    - Focused on orbital measurements: Trace Gas Detection and mapping, aerosols, surface mapping
  - Joint Executive Board
    - JEWG and JIDT reported to an Executive Board made up of senior ESA and NASA Managers
      - NASA: McCuiston, Meyer
      - ESA: Coradini, Ellwood
    - In-depth analyses and meetings occurred, January –June 2009
    - The Board's determined that multiple options for mission portfolios are budgetarily and technically feasible, but additional analyses are required to determine the most feasible
    - June 2009 ESA-NASA Bi-lateral meeting endorsed the determination and authorized additional studies encompassing a broader range of mission portfolio studies
- 



# Study Principles Established to Guide Collaboration Development

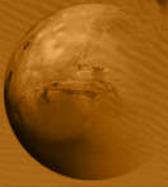
## NASA Principles

1. Partnership must address NASA/MEP/NRC, as well as ESA, science goals
2. NASA-ESA establish a strategic partnership for Mars exploration in 2016/18/20 and beyond, with immediate focus on ExoMars and 2016-18
3. *Plans must be budgetarily and technically realistic*  
3a. *Develop two plans: what we can afford to do, and the "best" partnership*
4. Shared science and science efforts on all missions, including sharing science data
5. Substantial collaboration will create dependencies, and must build on both party's strengths and strategic interests
6. Missions should be segmented with clean interfaces (ITAR requirements must be complied with as well)
7. US does EDL in at least one opportunity of 2016-18 (NASA core competency)
8. US has a surface system in at least one opportunity of 2016-18 (NASA core competency)
9. US provides an ELV in no more than one opportunity of 2016-18

## ESA Principles

4. ESA science priority for ExoMars—Exobiology
1. ESA-NASA establish a strategic partnership for Mars exploration in 2016/18/20 and beyond, with immediate focus on ExoMars and 2016-18
2. Shared science and science efforts on all missions, including sharing science data
5. ESA technology tenants for ExoMars-EDL, rover, drilling, sample preparation and distribution
7. Missions should be segmented with clean interfaces
6. *Lead agency to be defined for each mission. For ExoMars (2016), ESA would like to be the lead agency*
9. Shared opportunities require shared credit for outreach, public relations and national/organizational prestige
3. Missions must show identifiable progress toward Mars Sample Return
8. *Need a communications data relay orbiter for 2016 opportunity which could be used as a science opportunity as a secondary objective*

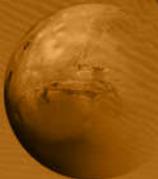
**NOTE: Red/italics items do not have a specific cross-reference**



# MEP Architecture Review Team (MART)

- The Mars Architecture Review Team (MART) is a Program-level team established to in 2008 to assess MEP architecture's, science “compliance”, risks and alternatives—essentially a Program-level “Standing Review Board”
  - Reports to the NASA Mars Program Director
  - *No scientific requirements, or competition with community recommendations* (NRC, PSS, MEPAG)—assess MEP’s ability to accomplish desired science with architectures being planned
  - *No development of architectures*—that’s an inherently governmental activity
- Review of ESA-NASA planning was not originally the intent, but became highly appropriate
  - Two meetings have been held (April and June 2009) to provide input on possible architectures options for a bi-lateral Mars Program with ESA
- Findings focused on US accommodation of the then-current ExoMars mission on the 2016 NASA orbiter mission, and follow-on 2018 opportunity
  - Initial findings indicated too much risk to accomplishing NASA’s (and ESA’s) science in the plans being investigated
- No MART meetings since the NASA-ESA July bi-lateral meeting agreements
  - The plan is to internationalize MART to support the joint ESA/NASA Mars Initiative





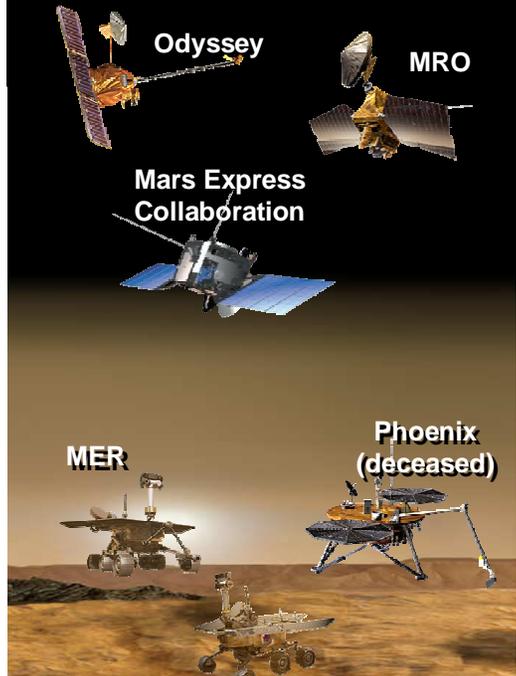
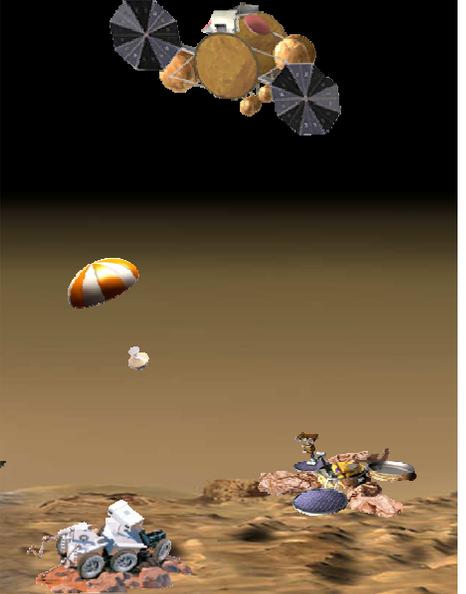
# Joint NASA-ESA Mars Exploration Initiative

- The Initiative's mission portfolio will span 2016 through 2020 opportunities
  - The goal is Mars Sample Return in the 2020's
- Follow-up on the recent methane discovery, and emplacement of long-term telecommunications relay capability, are important (a NASA-priority)
- Completion of the ExoMars mission is important (an ESA-priority)
- Studies underway, focusing on 2016-18:
  - Astrobiology is the overall scientific focus
  - Sample return technologies will factor prominently in mission design, such as
    - Precision sample handling
    - Sample preparation and caching
    - Precision landing
- A series of intense studies have been initiated under these premises
  - Results timed to provide more detail on mission queue to the Decadal's Mars Panel in September, and the ESA Council Meeting in October



# Joint NASA-ESA Mars Initiative Initial Portfolio Overview

← NASA-ESA Joint Mars Initiative (in final planning) →

| Operational<br>2001-2009   | 2011   | 2013   | 2016   | 2018   | 2020 & Beyond<br>The Era of Mars<br>Sample Return   |
|--|--|--|--|--|---|
|  <p>Odyssey</p> <p>MRO</p> <p>Mars Express<br/>Collaboration</p> <p>MER</p> <p>Phoenix<br/>(deceased)</p> |  <p>Mars Science Lab</p> |  <p>MAVEN<br/>Aeronomy<br/>Orbiter</p> <ul style="list-style-type: none"> <li>• Decadal Science</li> <li>• Proximity link (limited)</li> </ul> |  <p>ESA—NASA<br/>Trace Gas<br/>Mapper w/Imager<br/>(+ telecom)</p> <ul style="list-style-type: none"> <li>• <b>ESA Lead</b></li> <li>• NASA's trace gas science/ mission concept (TGMI)</li> <li>• 110kg payload &amp; ~1m imaging</li> <li>• Long-lived comm capability</li> <li>• Possible ESA ~200kg EDL tech demo lander</li> </ul> |  <p>NASA—ESA<br/>Rovers<br/>(Astrobiology/<br/>Sample Return<br/>Tech. and<br/>ExoMars)</p> <ul style="list-style-type: none"> <li>• <b>NASA Lead</b></li> <li>• Astrobiology and MSR tech precursor</li> <li>• Rover sizes limited based on EDL and ELV constraints</li> <li>• US science needs based on community input</li> </ul> |  <p>The Era of Mars<br/>Sample Return</p> <ul style="list-style-type: none"> <li>• Leadership TBD—dependent on missions and budget contributions</li> <li>• Targeting sample return in the mid-2020's</li> <li>• 2020 mission is TBD based on MSR dates and cost</li> <li>• Tech development and landing site selection important in preceding opportunities</li> <li>• NASA-ESA will be MSR leads, but iMARS will be a coordinating body for other countries to participate</li> </ul> |



# The Next Decade of Exploring Mars: *Seeking the Signs of Life*

- Mars science is evolving:
  - From finding pervasive evidence of water
  - To seeking the signs of life
- The Mars Program is evolving as well
  - A joint ESA-NASA Initiative is vital to accomplishing an astrobiologically-intensive investigation of Mars, and preparation for the return of samples