National Aeronautics and Space Administration

NRC Committee on Astrobiology and Planetary Science (CAPS)

May 23, 2012

Doug McCuistion
Director, Mars Exploration Program

Mars Exploration Program

An Integrated, Strategic Program

2001	2003	2005	2007	2009	2011	2013	2016 & Beyond
Odyssey	Mars Express Collaboration	MRO			MSL/Curiosity	MAVEN	*Mars future planning underway!*
	Spirit & Opportunity		Phoenix (completed)				

Mars Exploration Program Status

	TECH	COST	SCHD	PROG	COMMENTS
Odyssey (ODY)	G	G	G	G	Nominal spacecraft/instrument extended mission operations. Continuing MER UHF relay support; preparing for MSL UHF relay support
Mars Exploration Rovers (MER)	G	G	G	G	Spirit concluded its mission after 6 earth years exploring Mars. Opportunity recently began rolling again after surviving it's 5th Martian winter amd 8th earth year on
ESA/Mars Express (MEx)	G	G	G	G	Nominal extended operations; preparing for MSL UHF relay support
Mars Reconnaissance Orbiter (MRO)	G	G	G	G	Nominal spacecraft/instrument extended mission operations. Continuing MER UHF relay support; preparing for MSL UHF relay support
Mars Science Laboratory (MSL)/Curosity	G	G	G	G	On the way to the Red Planet! Arriving on August 6, 2012 EDT
Mars Atmosphere and Volatile Evolution Mission (MAVEN)	G	G	G	G	CDR successfully completed July 2011; Flight hardware build on schedule for ATLO beginning in August 2012

Progress according to plan
All commitments can be met

Area of concern; Problem can be resolved within reporting organization; Needs attention

Significant problem; Solution not identified
Needs action/help beyond reporting org.

MEP Highlights

- MSL/Curiosity
  - Launched on November 26, 2012; currently more than half way to Mars!
  - **Curiosity lands on Mars at 1:02 a.m. on August 6, 2012 EDT!**
    - Extensive outreach and educational events in the works nation-wide
  - Mars Reconnaissance Orbiter/Odyssey/Mars Express final maneuvers in support of the MSL/Curiosity landing – ongoing through August

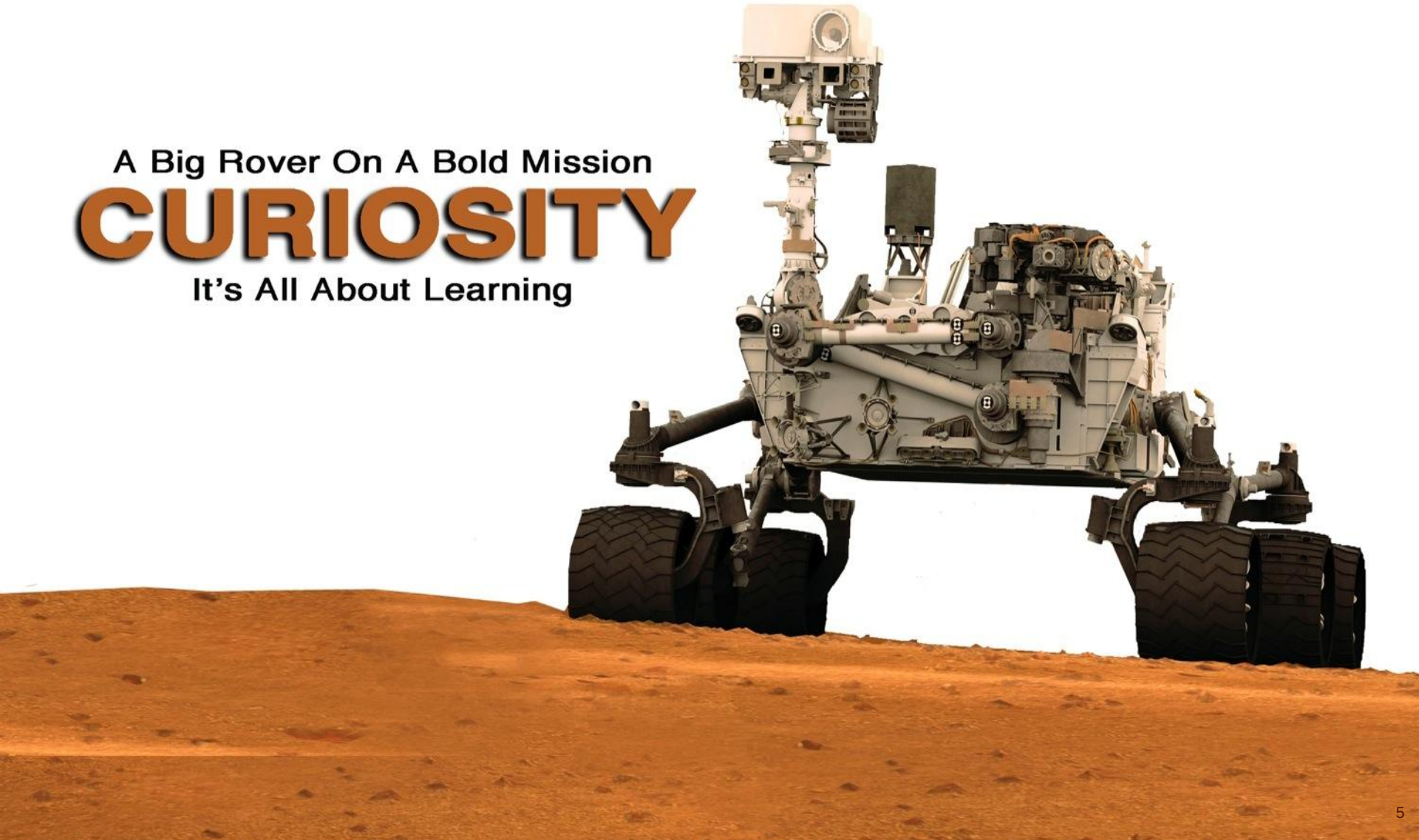
- 2013 MAVEN
  - All payload and spacecraft developments are on a good path to support "ATLO Start" later this summer
    - Four flight instruments delivered to Particles & Field package at UC Berkeley — Magnetometer, Langmuir Probe & Waves (LPW) and Extreme Ultra-Violet (EUV), Solar Wind Electron Analyzer (SWEA)
    - Systems Integration Review (SIR), June 26, 2012
  - KDP-D scheduled for September 2012

- Established independent team, Mars Program Planning Group (MPPG), to develop Mars Program reformulation options after MAVEN in response to FY13 budget and updated Agency priorities
  - Workshop at LPI, June 12-14
  - Final brief from the MPPG due in late August 2012

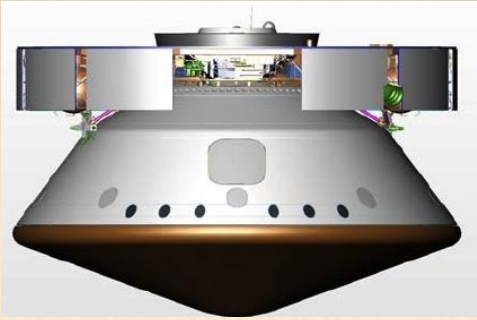
A Big Rover On A Bold Mission

CURIOSITY

It's All About Learning



Mission Overview



CRUISE/APPROACH

- 8.5 month cruise
- Arrive August 6, 2012 UTC

LAUNCH

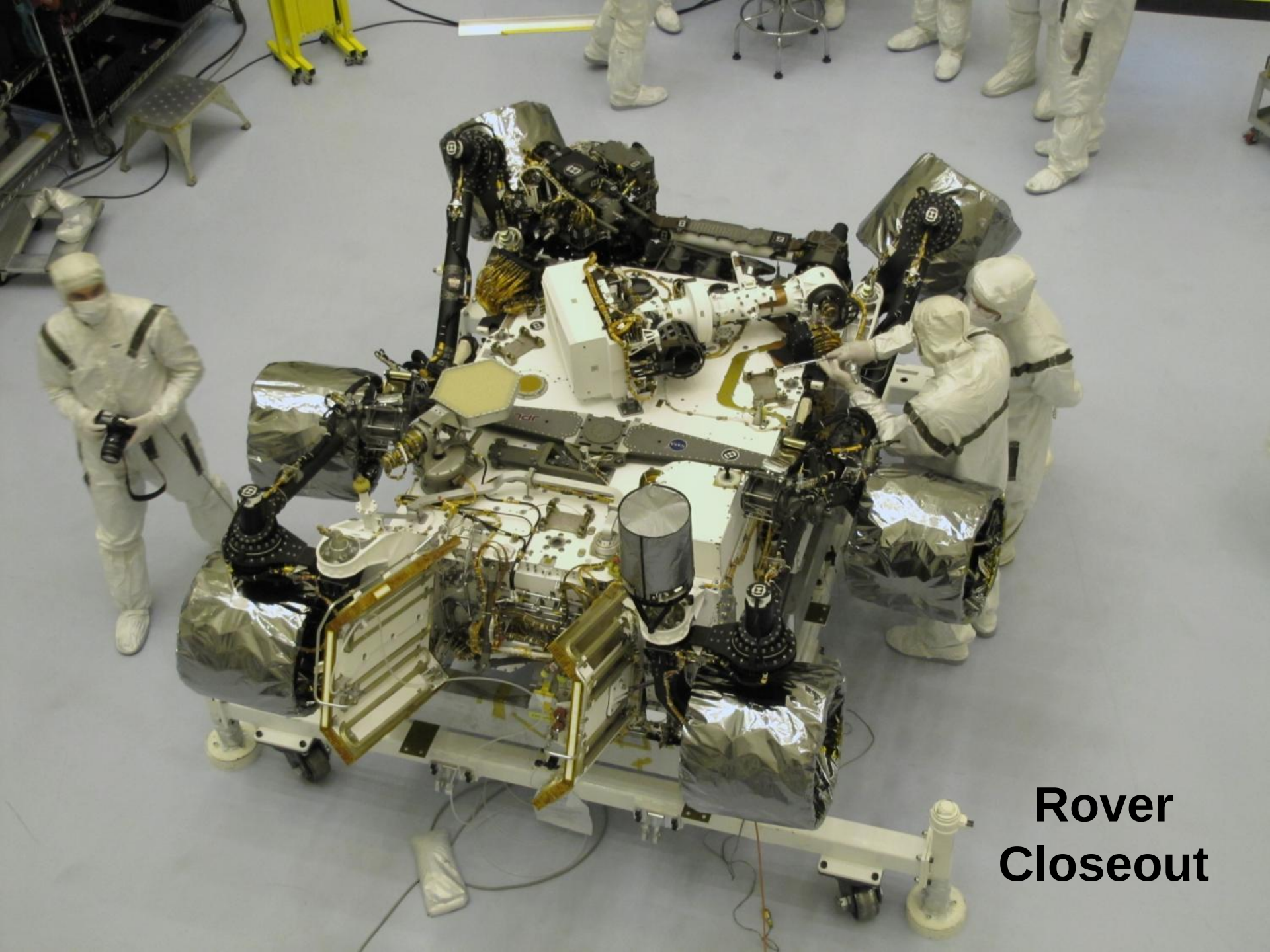
- Window was Nov. 25 to Dec. 18, 2011
- Atlas V (541)

ENTRY, DESCENT, LANDING

- Guided entry and powered "sky crane" descent
- 20km × 25km landing ellipse
- Landing sites is Gale Crater (4.5°S, 137°E; -4.5km)
- ~900-kg rover

SURFACE MISSION

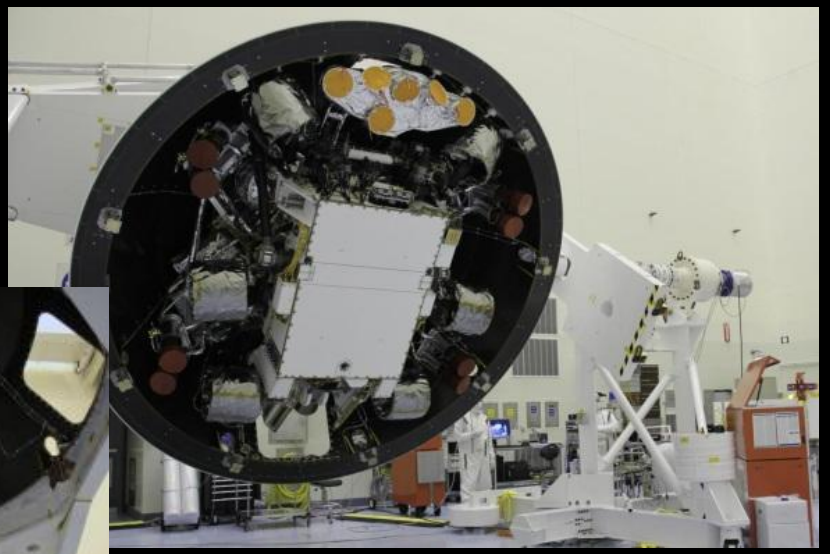
- Prime mission is one Mars year (687 days)
- Latitude-independent and long-lived power source
- Ability to drive out of landing ellipse
- 84 kg of science payload
- Direct (uplink) and relayed (downlink) communication
- Fast CPU and large data storage



Rover Closeout

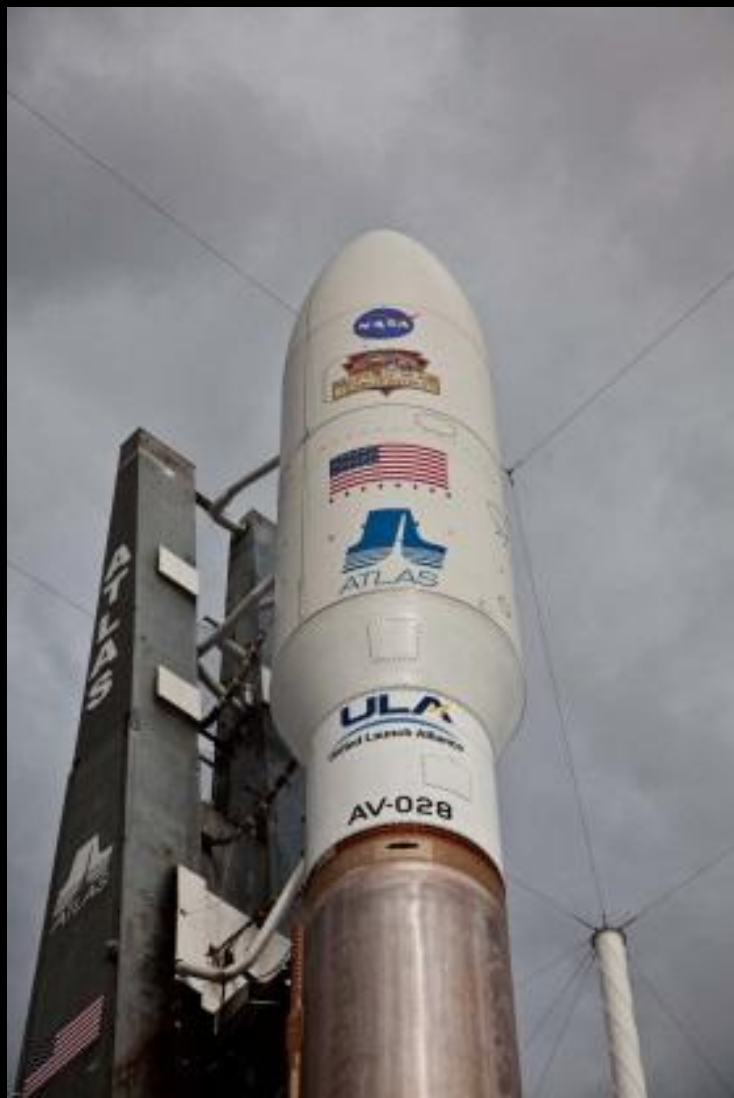
MSL/Curiosity

Final Stack

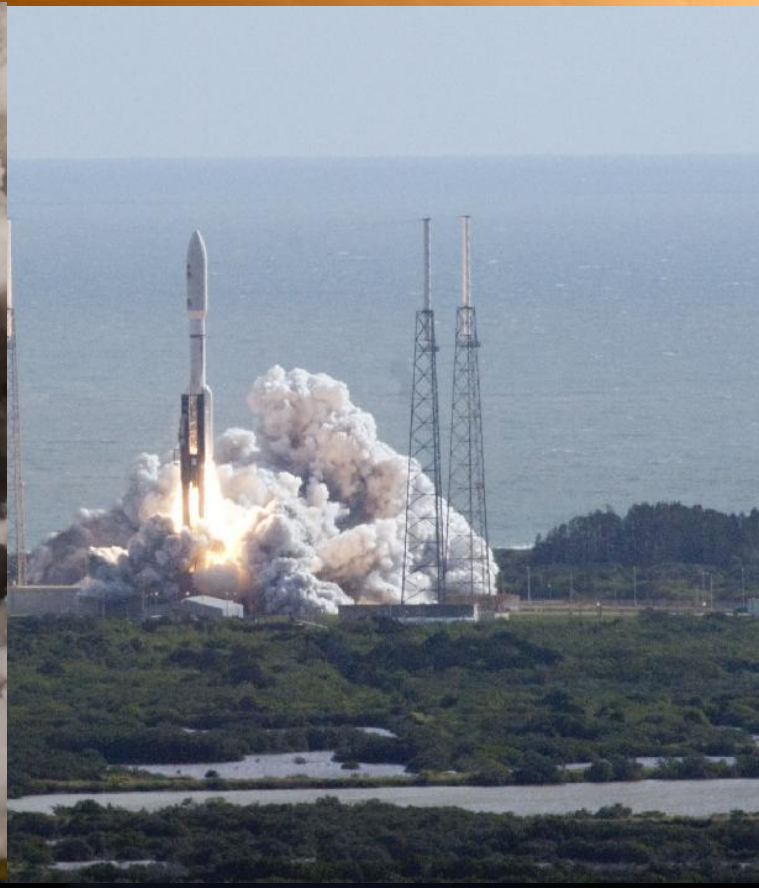


MSL/Curiosity

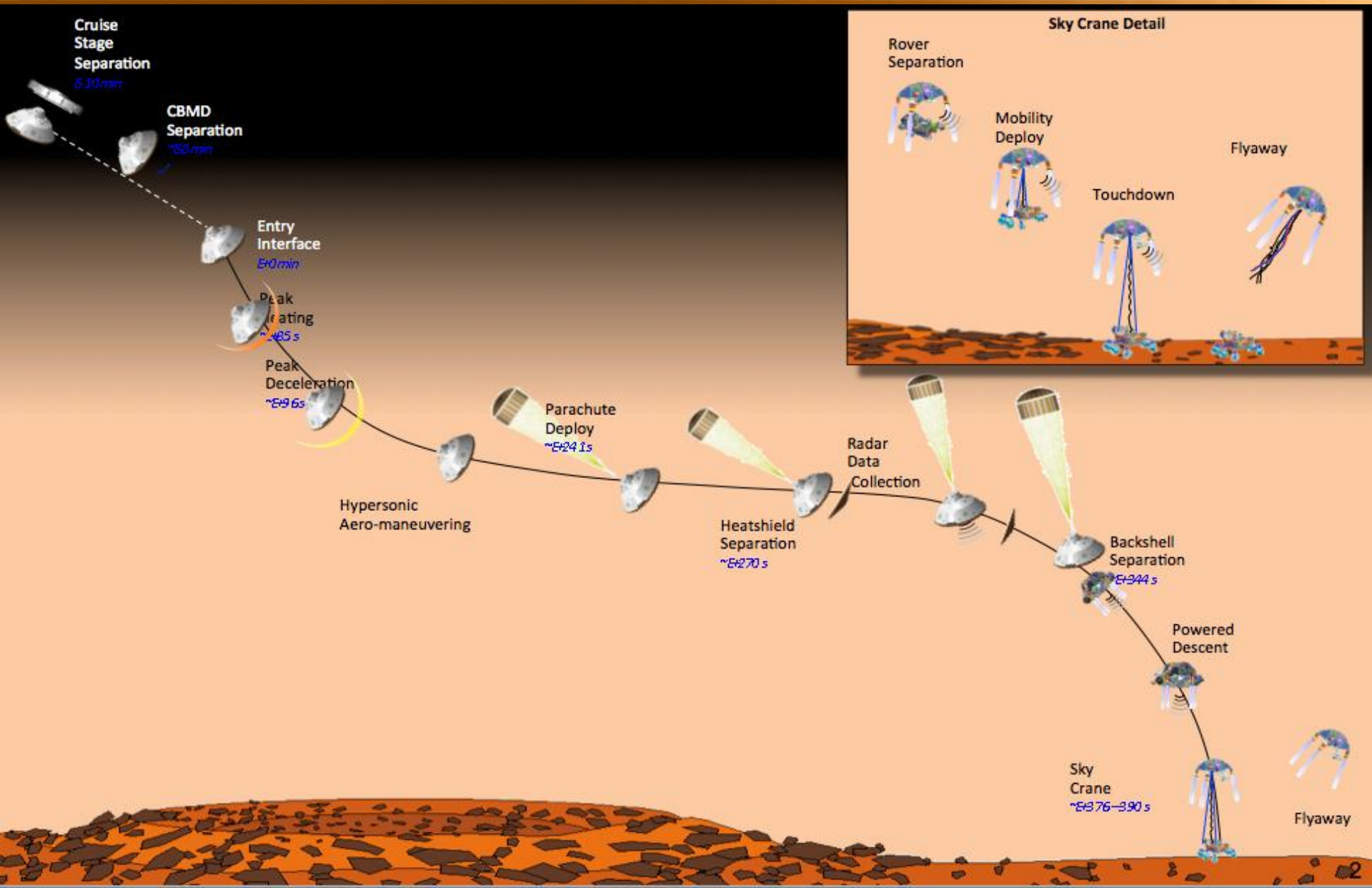
Final Stack



MSL/Curiosity Launch and Separation

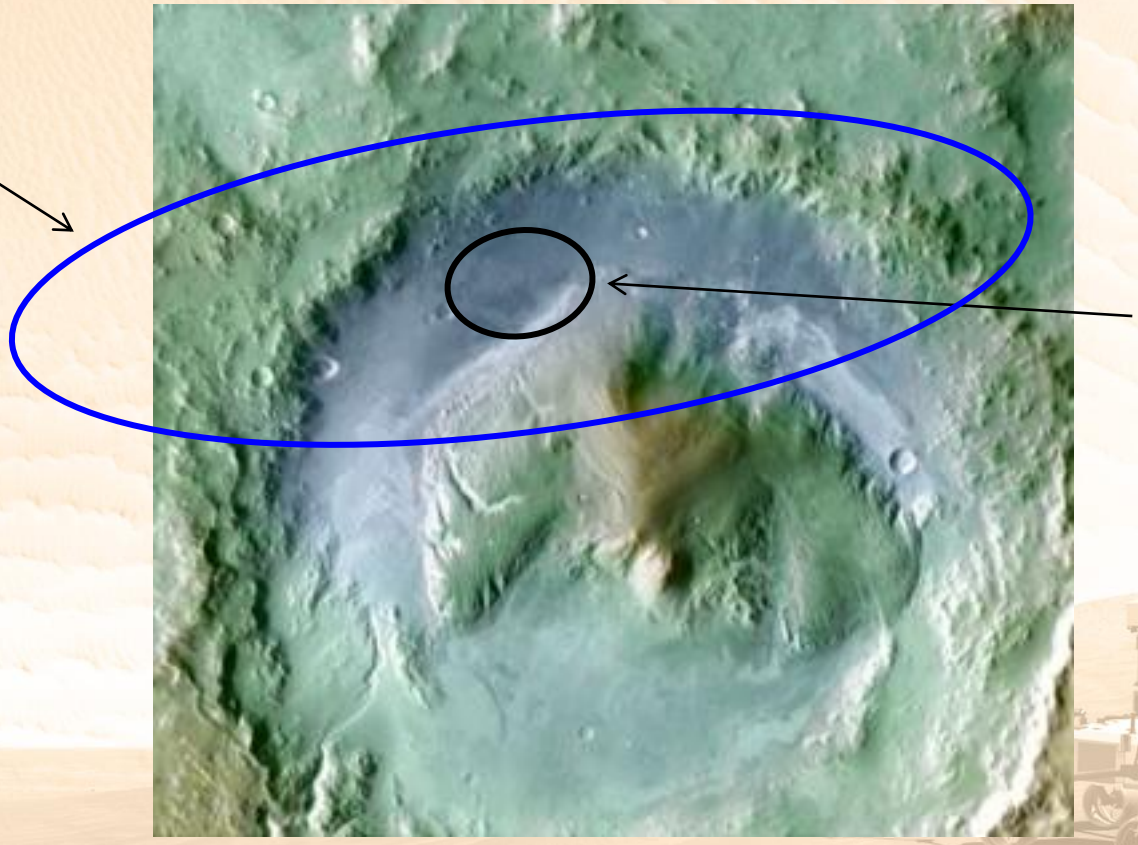


Entry, Descent, & Landing

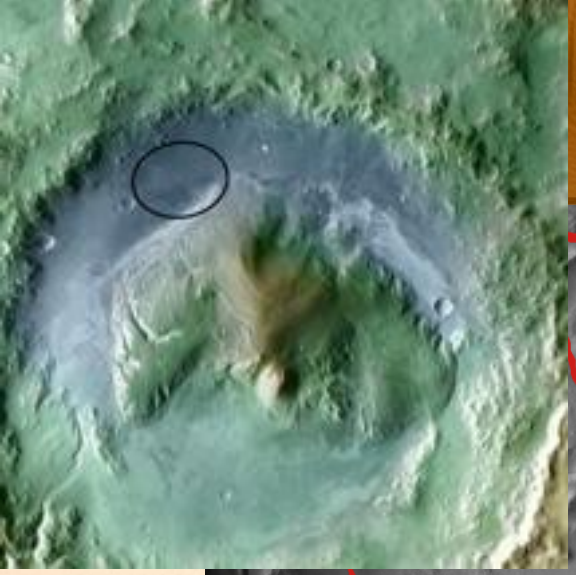


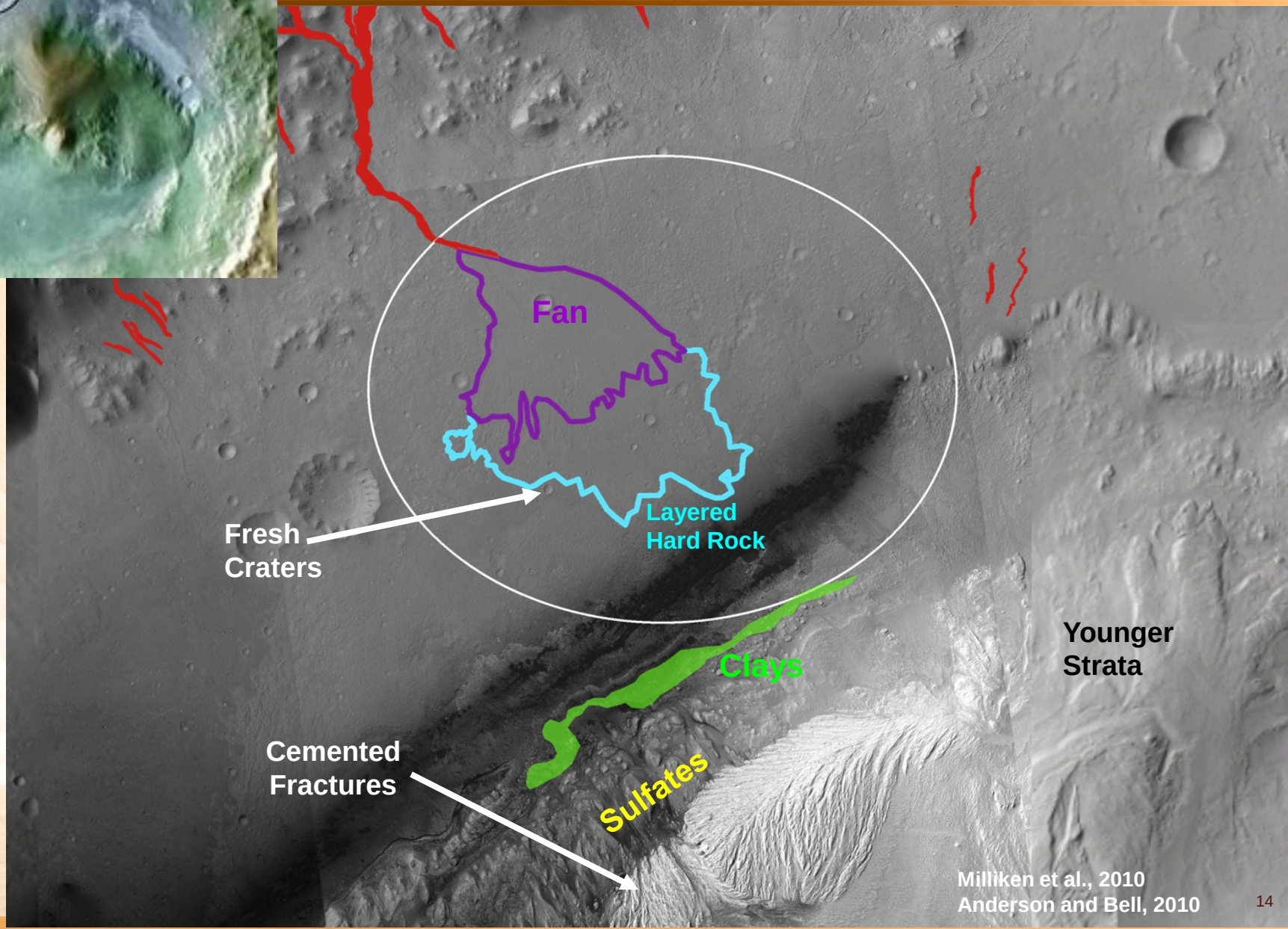
The Advantage of Guided Entry
(MSL and MER)

74 Days Until Landing!
August 5th, ~10 PM (PDT)



Gale Crater





Milliken et al., 2010
Anderson and Bell, 2010

Curiosity Landing
E/PO Coordination Team

Curiosity Landing Public Outreach
A Sampling of Events & Activities

Recent Highlights/Events

- Infinity Science Ctr Grand Opening @ Stennis (April 12)
- Welcome Discovery @ Udvar (Apr 19-22)
  - 60,000 visitors over 4 day period; rover exhibit

- Curiosity Museum Roadshow
  - St. Louis Science Ctr, (April 28 – June 1)
  - The Tech Museum, (April 1)
- US Science &Eng Festival @ DC Convention Ctr (Apr 27-29)
  - 100,000 visitors; rollover rover exhibit
- First Robotics Competition (Apr 28-29)
  - 35,000 participants/visitors

Products in Work

- Astrobiology comic book – MSL special edition
- Mars in a Minute Videos
- iPad and iPhone Apps
- Mars as Art II
- Mars book in Braille; in development

** 100's of smaller educational (schools/teacher workshops/tours) events (< 200 participants each) through the end of the year*

Examples of Events in Work

- Curiosity Museum Roadshow
  - The Museum of Science & Industry, Chicago; the Denver Museum of Science and Industry, JSC, etc.
- JPL Open House, Pasadena, June 9-10, 30, 000 visitors expected
- Centennial Challenge Program - Sample Return Robot Challenge in June
- Curiosity Museum Roadshow- The Exploratorium, San Francisco in July
- July 4th MSL on the Mall—special events/displays
- Times Square
- Activities with the Movie Industry Association
- Mars Day at NASM, July 13
- Intrepid - Curiosity exhibit in NYC, July 19-22
- Senate/House MSL/Curiosity Lunch & Learns
- Wolftrap
- Delaware Travel Plaza—Mid July until?
- MSL landing 'Watch Events' across the country through Mars Museum Alliance
- Celebrate Seattle 50th World's Fair
- Planetfest – Pasadena Convention Ctr, Aug 4-5

FY13 President's Budget
No Impact to Ongoing Missions

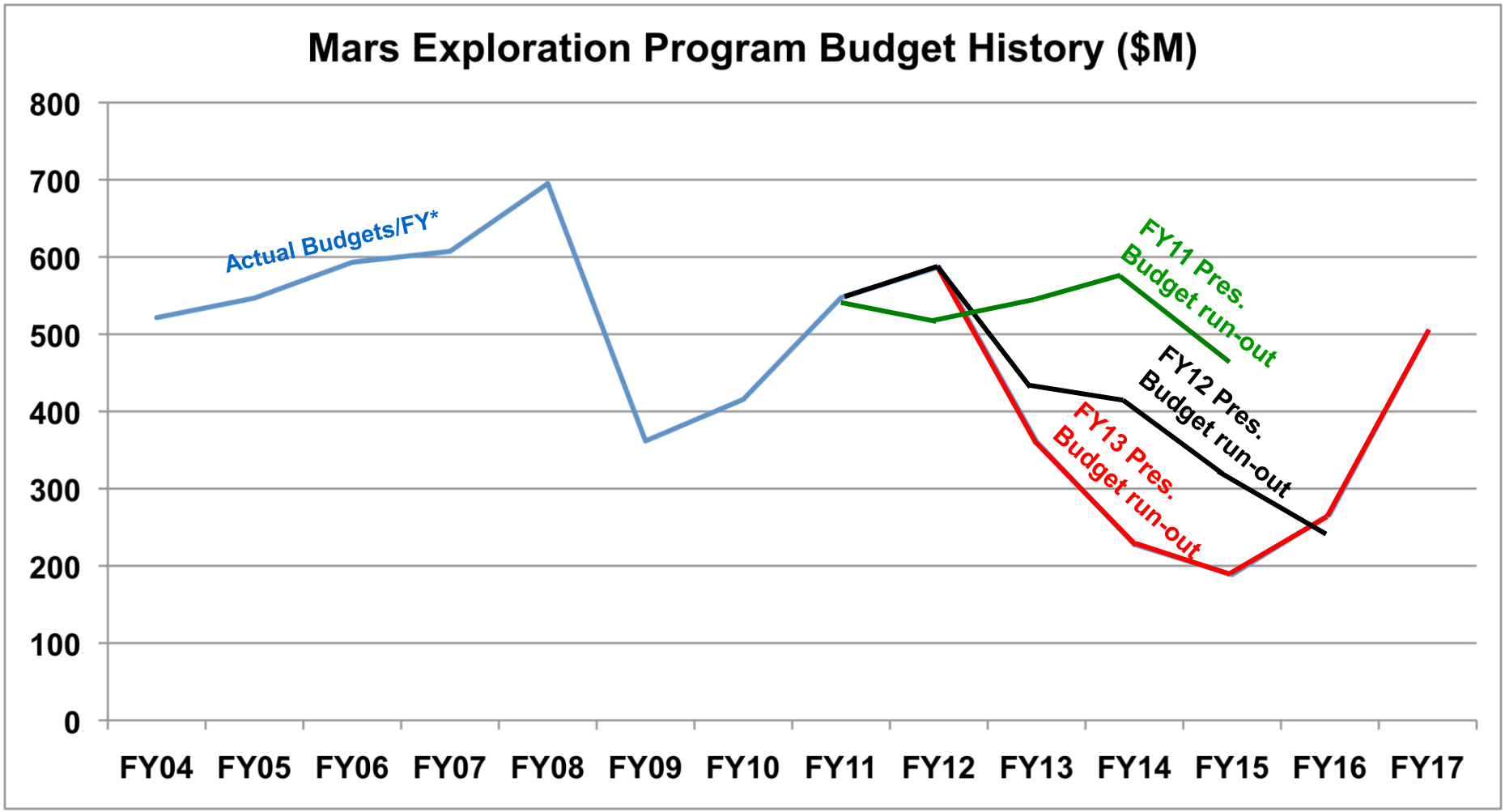
- MSL remains the highest priority of this program.
- MAVEN remains the highest-priority mission in development.
- Operating missions, Odyssey, MRO, and Opportunity are fully funded, including through the notional run-out.
- Mars opportunities in Discovery calls and Planetary Science R&A Programs will continue.

President's FY13 Budget – Planetary Science

	FY 11	FY 12	FY 13	FY 14	FY 15	FY 16	FY 17
Planetary Science	$1,450.8	$1,501.4	$1,192.3	$1,133.7	$1,102.0	$1,119.4	$1,198.8
Planetary Science Research	$158.8	$174.1	$188.5	$222.5	$233.4	$231.7	$230.3
Lunar Quest Program	$130.2	$139.9	$61.5	$6.2			
Discovery	$192.0	$172.6	$189.6	$242.2	$235.6	$193.8	$134.3
New Frontiers	$213.2	$160.7	$175.0	$269.8	$279.6	$259.9	$155.1
Mars Exploration	$547.4	$587.0	$360.8	$227.7	$188.7	$266.9	$503.1
Outer Planets	$91.9	$122.1	$84.0	$80.8	$78.8	$76.2	$76.3
Technology	$117.3	$144.9	$132.9	$84.6	$85.9	$90.9	$99.6

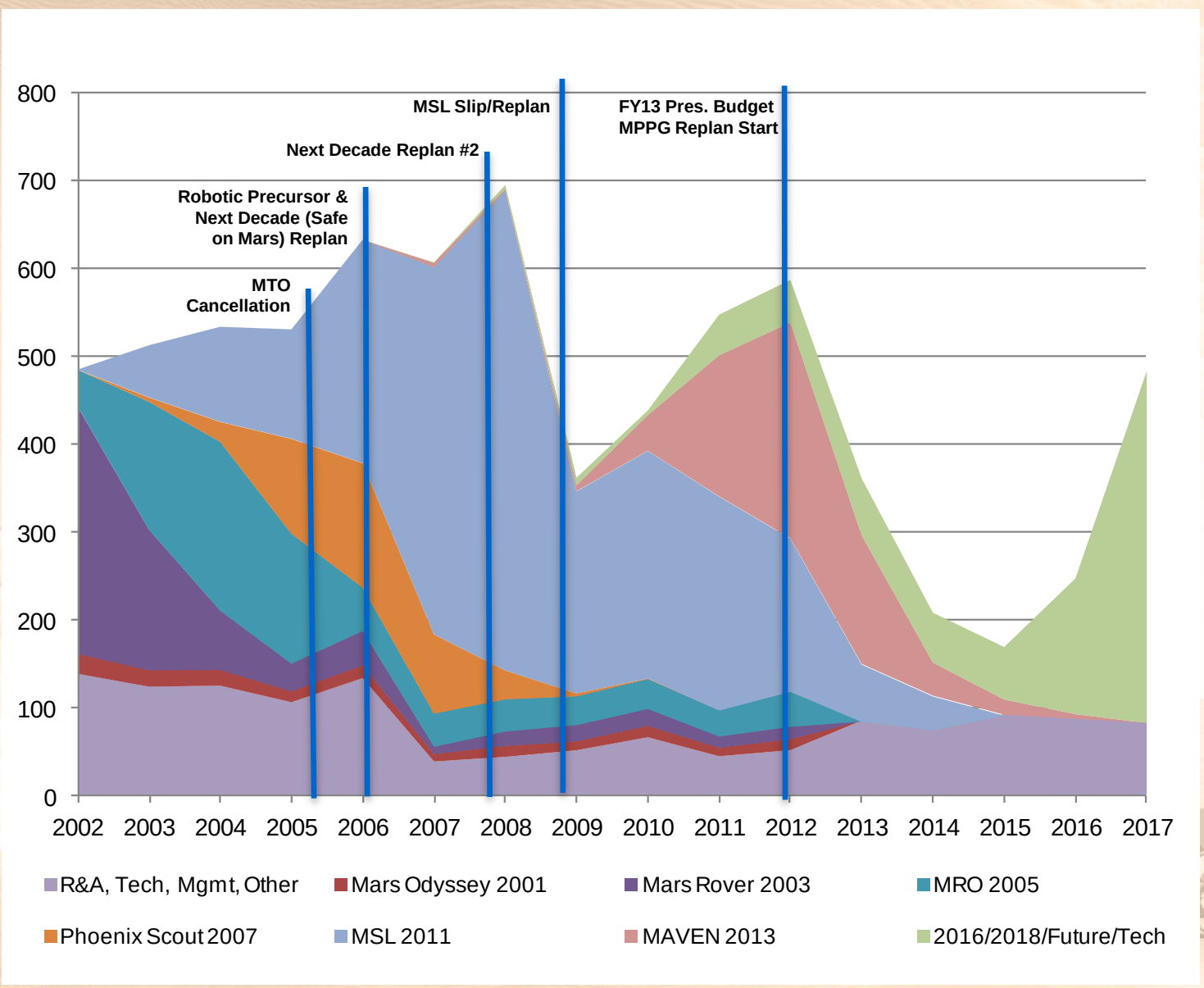
- Grey region is a "notional" budget – top line remains the same but details within may change

MEP Budget History
Including President's FY13 Request



(*) actual based on last Op Plan of each Fiscal Year

MEP Budget History
and FY13 Budget



FY13 Budget – Looking Forward 1/2

- The FY13 budget
  - MEP can no longer participate with ESA in the 2016/2018 Mars missions
    - Must skip the 2016 Mars opportunity altogether
  - A 2018 small-class mission (per Decadal definitions) is supported
    - However some rephasing will be required
  - Ramp down of existing 2016 and 2018 development activities underway
    - 2016: Electra still desired by ESA and is being continued

- The Mars Program Planning Group (MPPG) was established by the SMD, to address the next step in Mars Exploration
  - Terms of Reference signed on March 19, 2012 by SMD AA, HEOMD AA, Chief Technologist, Chief Scientist

FY13 Budget – Looking Forward 2/2

- A variable budget environment will be taken into account as the FY14 budget cycle progresses
  - Congressional interest is high
  - FY13 Appropriations Report language:
    - Senate

      "The provides $460,900,000 which is $100,100,000 above the request level for Mars Exploration. This amount includes […] and also supports any re-planned Mars program that can take advantage of upcoming opportunities to launch robotic science platforms to Mars as early as 2016. NASA is expected to use these funds to retain core U.s. competencies in areas such as entry, descent, and landing."

    - House

      "The Committee rectifies this situation [budget reduction] by increasing the funds available for Mars Next Decade to $150,000,000, or $88,000,000 above the request, in order to allow for a more substantial mission concept to be developed. According to the […] decadal survey, however, that mission concept must lead to the accomplishment of sample return in order to remain a top funding priority. Because the Committee is unable to discern whether this condition is being met from the scant information provided to date about Mars Next Decade, NASA is directed to promptly submit its Next Decade mission concept to the NRC for evaluation. […] as described in the Mars Astrobiology Explorer-Cacher section of the decadal survey. "

  - *Nothing is final until FY13 bills are passed and signed by the President*

The MPPG

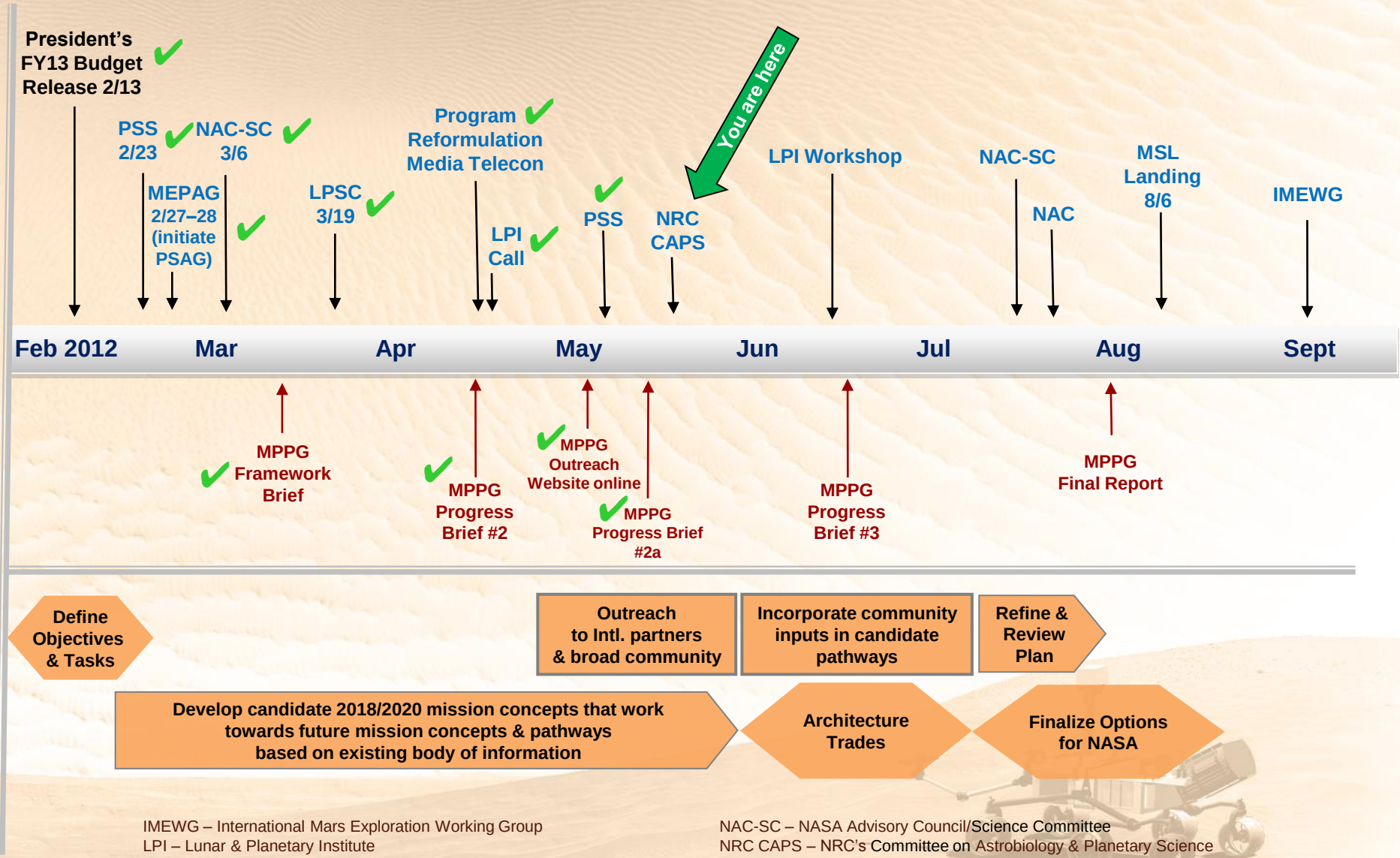
- MPPG is a focused study group assembled to:
  - Delineate options for program architectures defined in sufficient detail for NASA to be able to select high pay-off mission(s) beginning with the 2018 launch opportunity
  - Demonstrate visible progress towards advancing the knowledge and technology needed to support the exploration of Mars by humans
    - While continuing to conduct science, and be responsive to the current Decadal Survey, including traceability to Mars Sample Return
  - Engage relevant support and expert community groups in the study

- Information will be presented to stakeholders to inform the decision making process
  - Final study report due Aug 2012
  - MPPG options and recommendations will influence NASA's FY14 budget process

- Recent external communications on the path forward
  - April 12 – Senate Committee Staff Brief
  - April 13 – ESA and CSA courtesy calls; media telecon
  - April 17 – House Committee Staff Brief
  - May 7 – Joint Congressional Staff Briefing
  - May 8 – NAC's Planetary Science Subcommittee
  - Today – NRC's Committee on Astrobiology and Planetary Science

Mars Exploration Program Reformulation

FY12 Timeline & Milestones (dates are approximate)



IMEWG – International Mars Exploration Working Group
LPI – Lunar & Planetary Institute
LPSC – Lunar & Planetary Science Conference
MEPAG – Mars Exploration Program Analysis Group

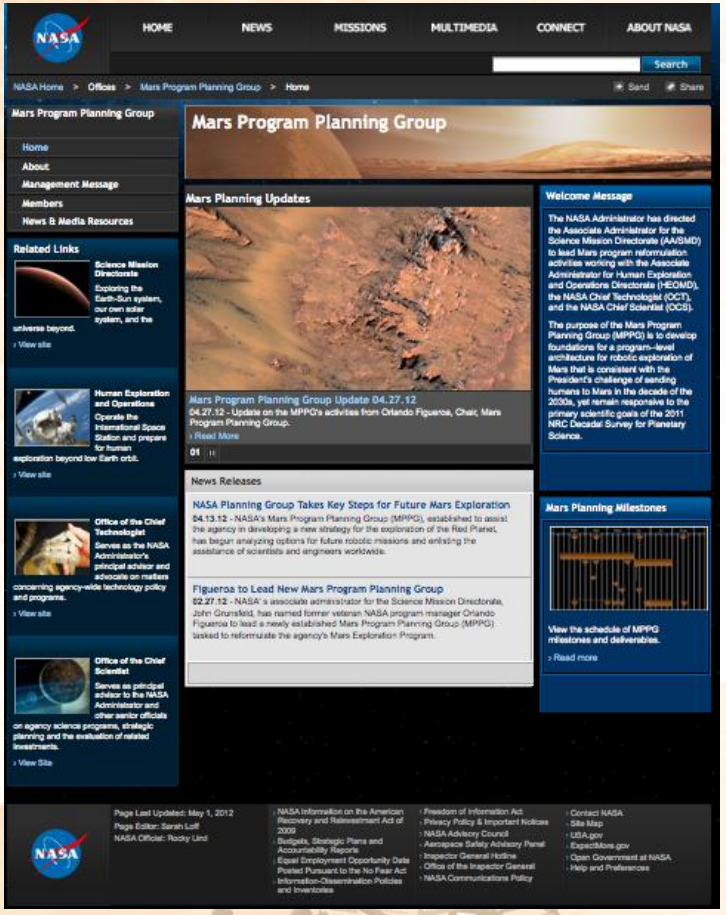
NAC-SC – NASA Advisory Council/Science Committee
NRC CAPS – NRC's Committee on Astrobiology & Planetary Science
PSS – Planetary Science Subcommittee of NAC
NRC – National Research Council

Mars Program Planning Update Website

www.nasa.gov/marsplanning

Website Roll Out: May 7

- Purpose:
  - Centralized location on NASA.gov to get the latest information and updates related to the MPPG.
- Audience:
  - Major Stakeholders
  - Informed Publics
- Content (initial roll out):
  - Updates from MPPG Executives
  - Members
  - Milestones
  - News & Media Resources



Mars Concepts & Approaches Workshop

Hosted by Lunar & Planetary Institute (LPI), June 12-14, 2012

http://www.lpi.usra.edu/meetings/marsconcepts2012/

WHAT

- Workshop forum organized by LPI for the community to discuss ideas and approaches for Mars exploration
- Includes both near-term (2018-2024) and mid- to longer-term (2024-2030s) timeframes
- Results will inform architecture trades by MPPG/MEP in June/July timeframe

WHY

- To seek science, technical, industry, & international partner community ideas, concepts, and capabilities to address key challenges areas in Mars exploration that bridge the objectives of SMD, HEOMD, and OCT.

WHEN

- Call for Abstracts: April 13
- Deadline for submission: May 10; 389 abstracts submitted
- Workshop at LPI: June 12-14
- LPI summary reports due to NASA: June 18

WHO

- Targeted to professional community, but open to all
  - Plenary sessions Livestreamed; breakout sessions on Webex
- Public & Community are Excited! as of 1:00pm 17 April:
  - 19,480 unique IP addresses have visited the workshop site
  - 13 ideas from the public via email