



National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California



JPL Introduction for Intersolar North America

11 July 2012

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Chief Technologist Mechanical Systems Division
NASA Jet Propulsion Laboratory
California Institute of Technology





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NASA's Vision and Mission

- **NASA Vision:**

- *To improve life here;*
- *To extend life to there;*
- *To find life beyond.*

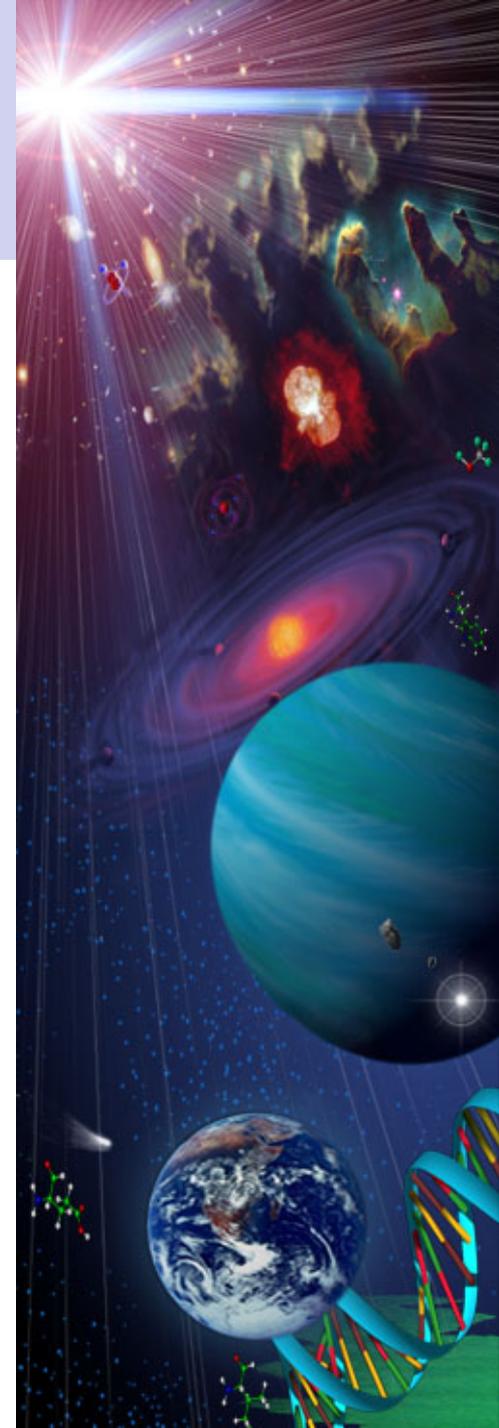
- **NASA Mission:**

Previous

- *To understand and protect our home planet;*
- *To explore the universe and search for life;*
- *To inspire the next generation of explorers as only NASA can.*

Revised

NASA's mission is to pioneer the future in space exploration, scientific discovery and aeronautics research.





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JPL' s Mission

We enable the nation to explore space for the benefit of Humanity. Our Mission is to :

- 1. Explore our own and neighboring planetary systems*
- 2. Search for life outside the Earth ' s confine*
- 3. Further our understanding of the origins and evolution of the Universe and the laws that govern it*
- 4. Make critical measurements to understand our home planet and help protect its environment*
- 5. Apply JPL ' s unique skills to address problems of national significance and security*
- 6. Enable a virtual presence throughout the solar system by creating the Interplanetary Network*
- 7. Inspire the next generation of explorers*





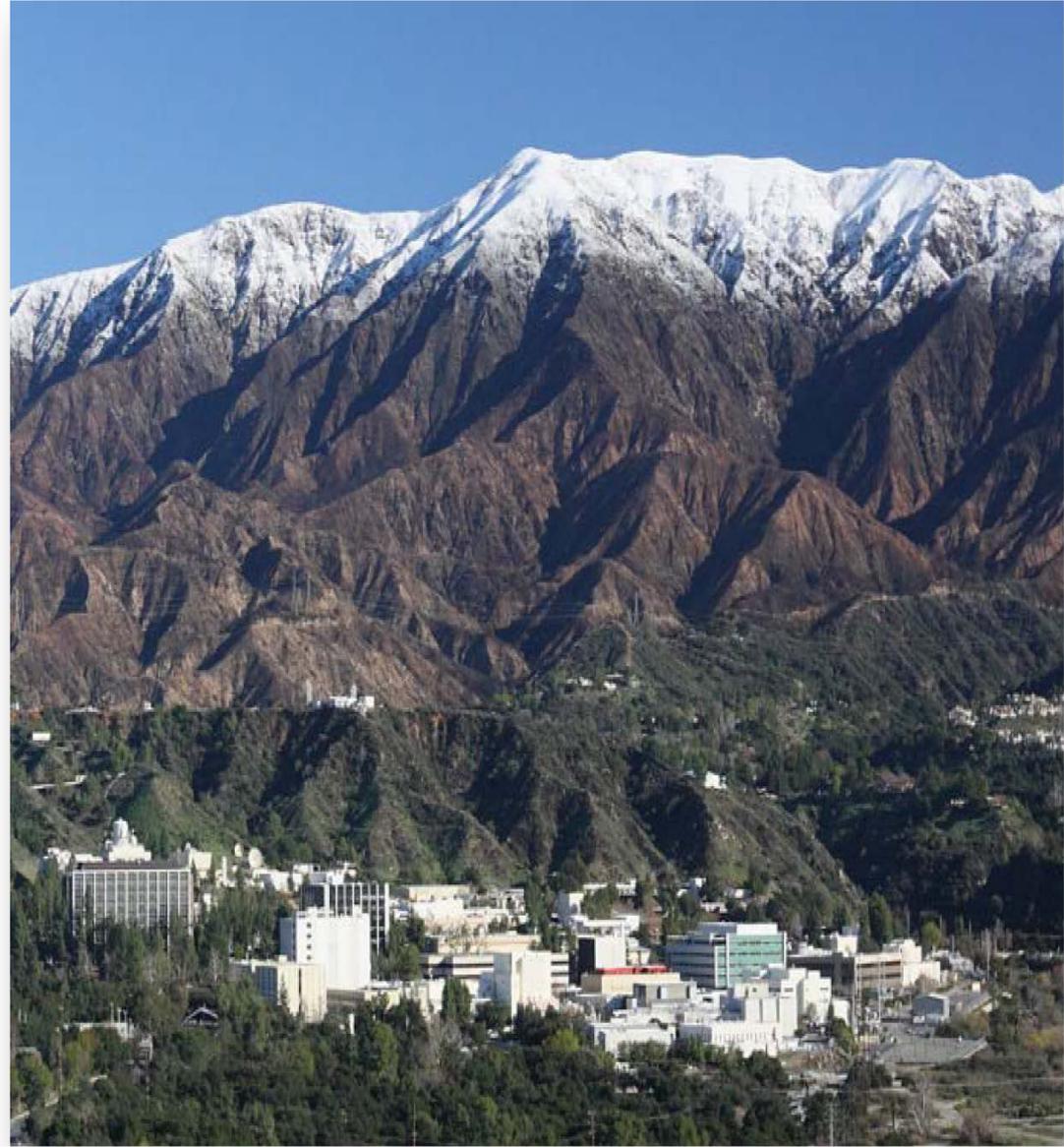
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JPL Is Part of NASA and Caltech



- Federally-Funded (NASA-owned) Research and Development Center (FFRDC)
- University Operated (Caltech)
- \$1.5B Business Base
- 5,000 Employees
- 177 Acres (includes 22 acres leased for parking)
- 139 Buildings; 36 Trailers
- 673,000 Net Square Feet of Office Space
- 906,000 Net Square Feet of Non-Office Space (e.g., Labs)

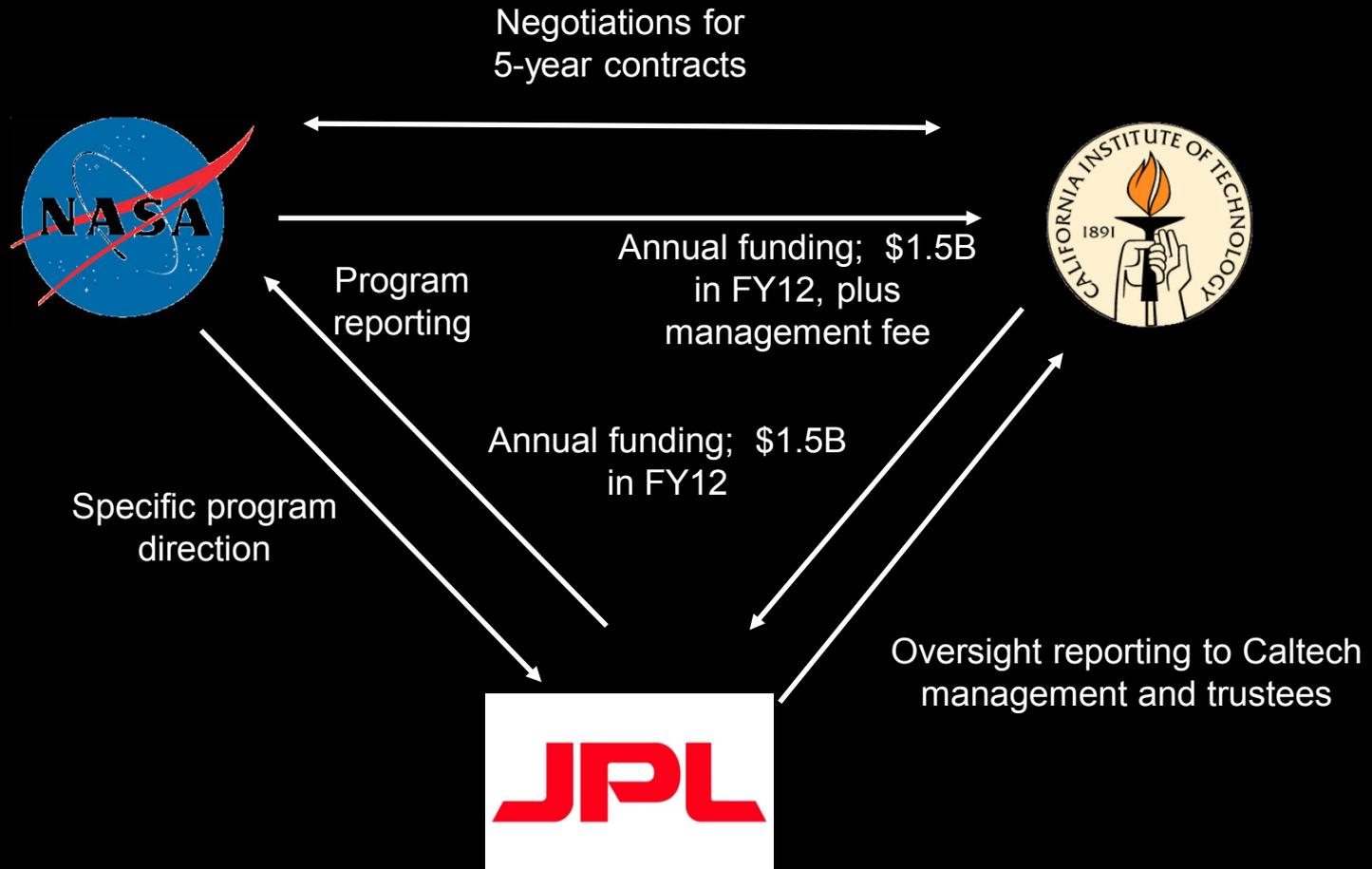




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Caltech Operates JPL for NASA



JPL is a NASA FFRDC and a Division of Caltech



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JPL Organization



California Institute of Technology
Jean-Lou Chameau, President

JET PROPULSION LABORATORY
Charles Elachi, Director
Eugene Tattini, Deputy Director
Chris Jones, Associate Director, Flight Projects and Mission Success
Jakob van Zyl, Associate Director, Project Formulation & Strategy
Dan McCleese, Chief Scientist
Jonas Zmuidzinas, Chief Technologist

Office of the General Counsel
(Reports to Caltech President)

Victoria Stratman, General Counsel
Jennifer Lum, Deputy General Counsel

Office of the Chief Engineer
(1010)

Brian Muirhead, Manager

Office of
Safety & Mission Success
(5000)

Matt Landano, Director for

Office of Legislative
Affairs
(1070)

Rich O'Toole, Manager

 Administrative Operations
 Technical Divisions
 Program/Project Offices

Human Resources
Directorate
(1100)

Cozette Hart, Director for
Rick Roessler, Deputy Dir. for

Information Technology
Directorate
(1700)

Jim Rinaldi, CIO & Director for
Mag Powell-Meeks, Deputy Dir. for

Communications & Education
Directorate
(1800)

Blaine Baggett, Director for
Stephen Kulczycki, Deputy Dir. for

Business Operations
Directorate
(2000)

Steve Proia, CFO & Director for

Engineering & Science
Directorate
(3000)

Leslie Livesay, Director for
René Fradet, Deputy Dir. for
Randy Friedl, Dep. Dir. for - Research

Solar System Exploration
Directorate
(4000)

Firouz Naderi, Dir. For
Keyur Patel, Deputy Dir. for

Mars Exploration
Directorate
(6000)

Fuk Li, Director for
Roger Gibbs, Deputy Dir. for

Astronomy, Physics, & Space
Technology Directorate
(7000)

David Gallagher, Director for
Jim Marr, Acting Dep. Director for

Earth Science & Technology
Directorate
(8000)

Diane Evans, Director for
Jim Graf, Deputy Dir. for
Robert Cox, Deputy Dir. for

Interplanetary Network
Directorate
(9000)

John McNamee, Director for
William Rafferty, Deputy Dir. for

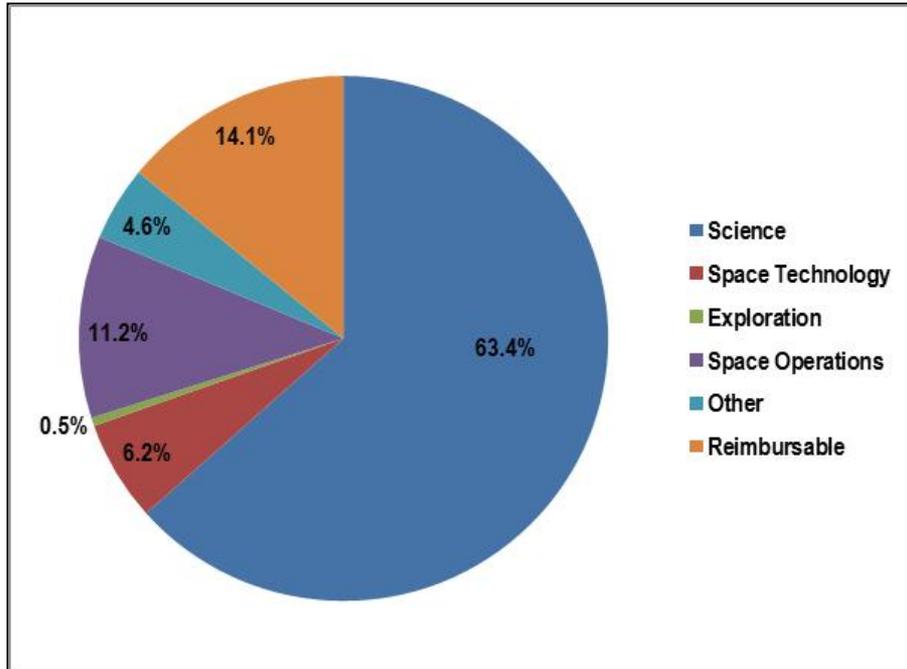


JPL Funding Distribution for FY'12

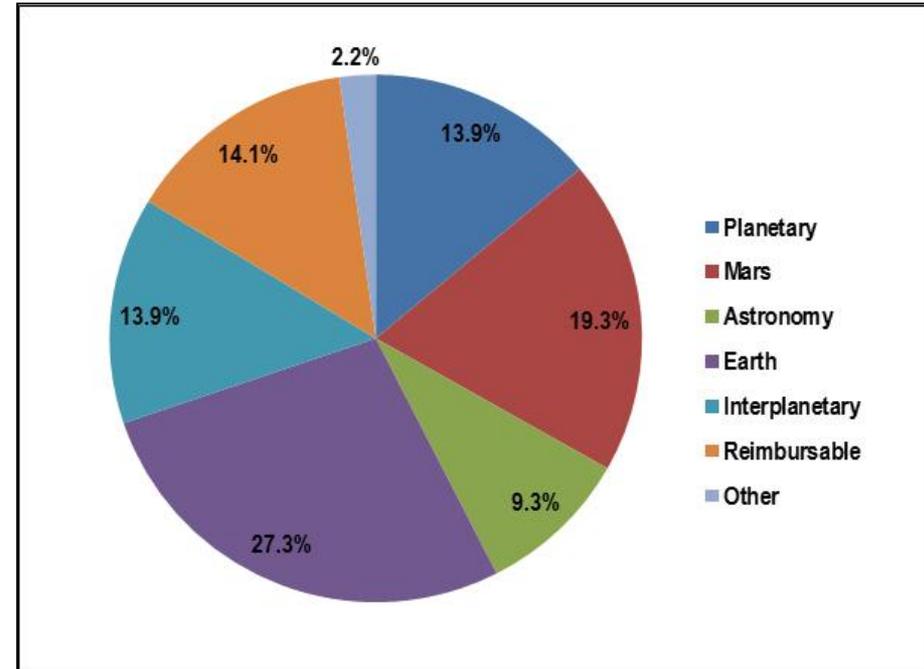
Business Base = \$1.5B



By NASA Office or Other Sponsor



By Implementing JPL Directorates



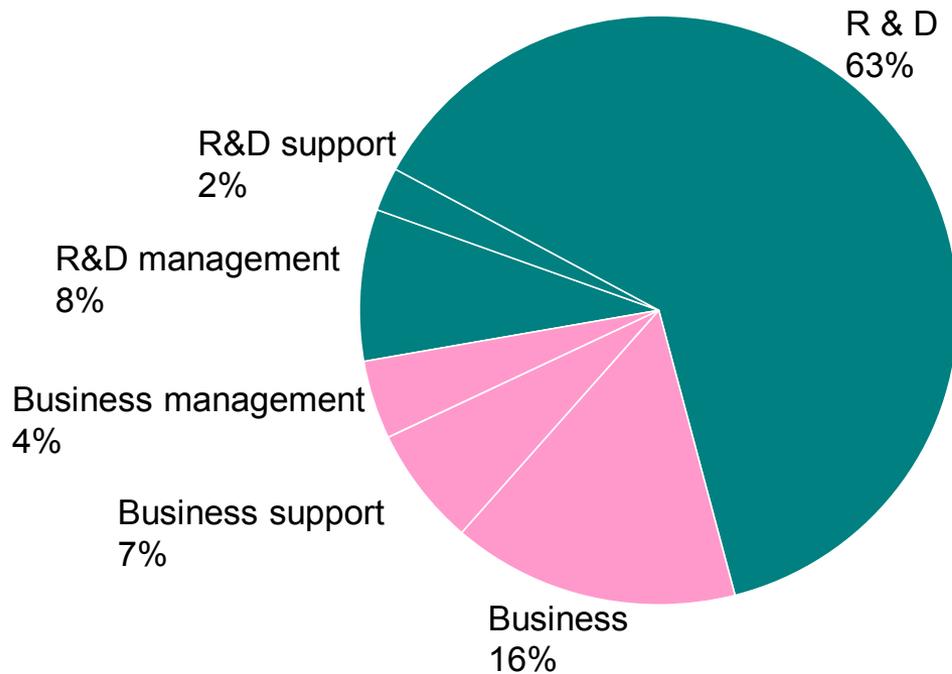
NASA percentages based on FY'12 budget within the 2013 Office of Management and Budget (OMB) Submit dated 9/6/11



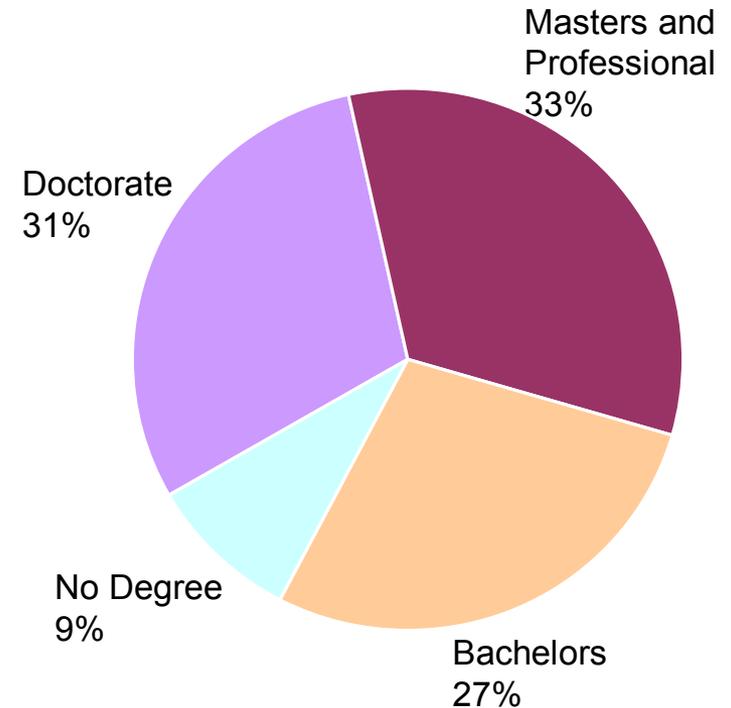
JPL Workforce by Job Classification and Academic Degree



- Staff composition by job classification for 4979 employees (4887 FTEs)



- R&D staff distribution by academic degree for 3536 employees





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JPL Historical Mosaic



1936
1958



JPL today



1940s
1950s



PHOTOGRAPH BY
DORIS W. BEE

NASA
National Aeronautics and Space Administration

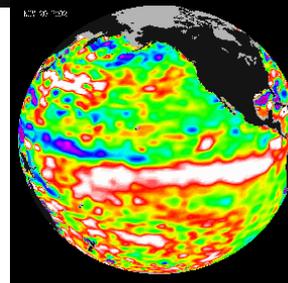
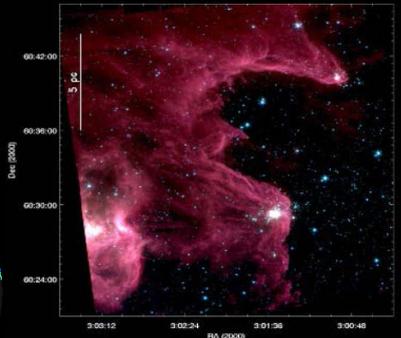
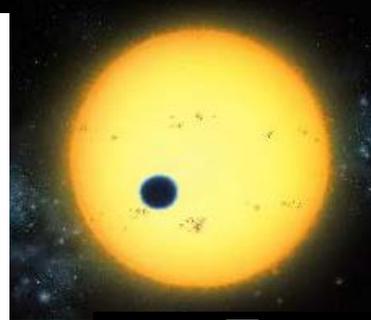
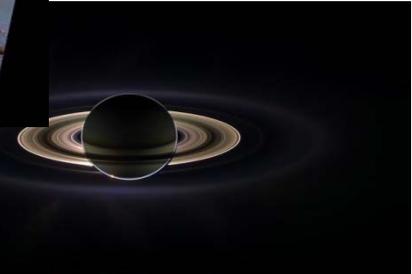


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JPL's Mission for NASA is Robotic Space Exploration



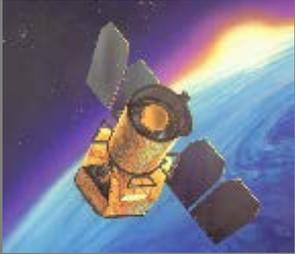
- Mars
- Solar system
- Astrophysics
- Earth Science
- Interplanetary Network
- Problems of “National Significance”





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JPL Has Launched 24 Spacecraft, 9 Instruments Across the Solar System (and Beyond)



GALEX



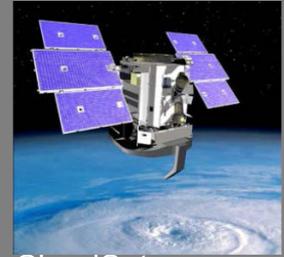
ACRIMSAT



Mars Odyssey



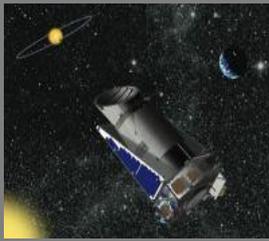
Cassini



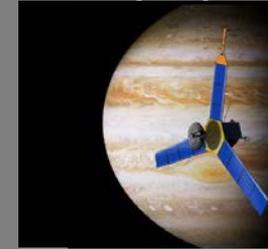
CloudSat



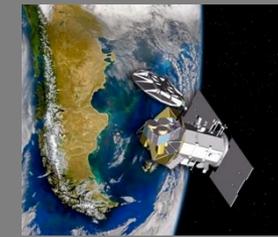
Spitzer



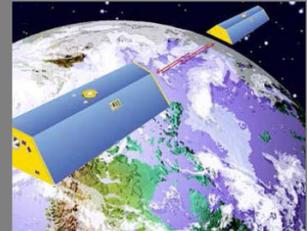
Kepler



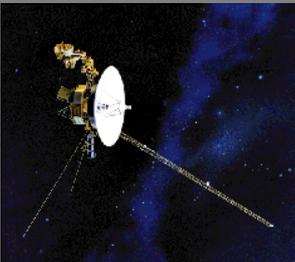
Juno



Aquarius



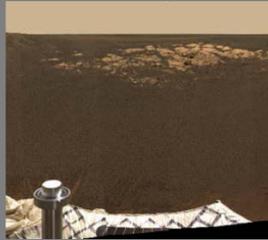
GRACE



Two Voyagers



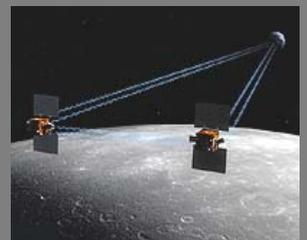
Dawn



Opportunity



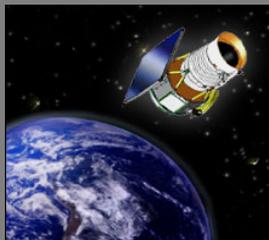
EPOXI-Deep Impact



GRAIL



Mars Science Laboratory



Wide-field Infrared Survey Explorer (WISE)



Mars Reconnaissance Orbiter



Jason 1 and Jason 2

Instruments:

Earth Science

- ASTER
- MISR
- TES
- MLS
- AIRS

Planetary

- MIRO
- Diviner
- MARSIS

Astrophysics

- Herschel
- Planck



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Mars Science Lander "*Curiosity*"

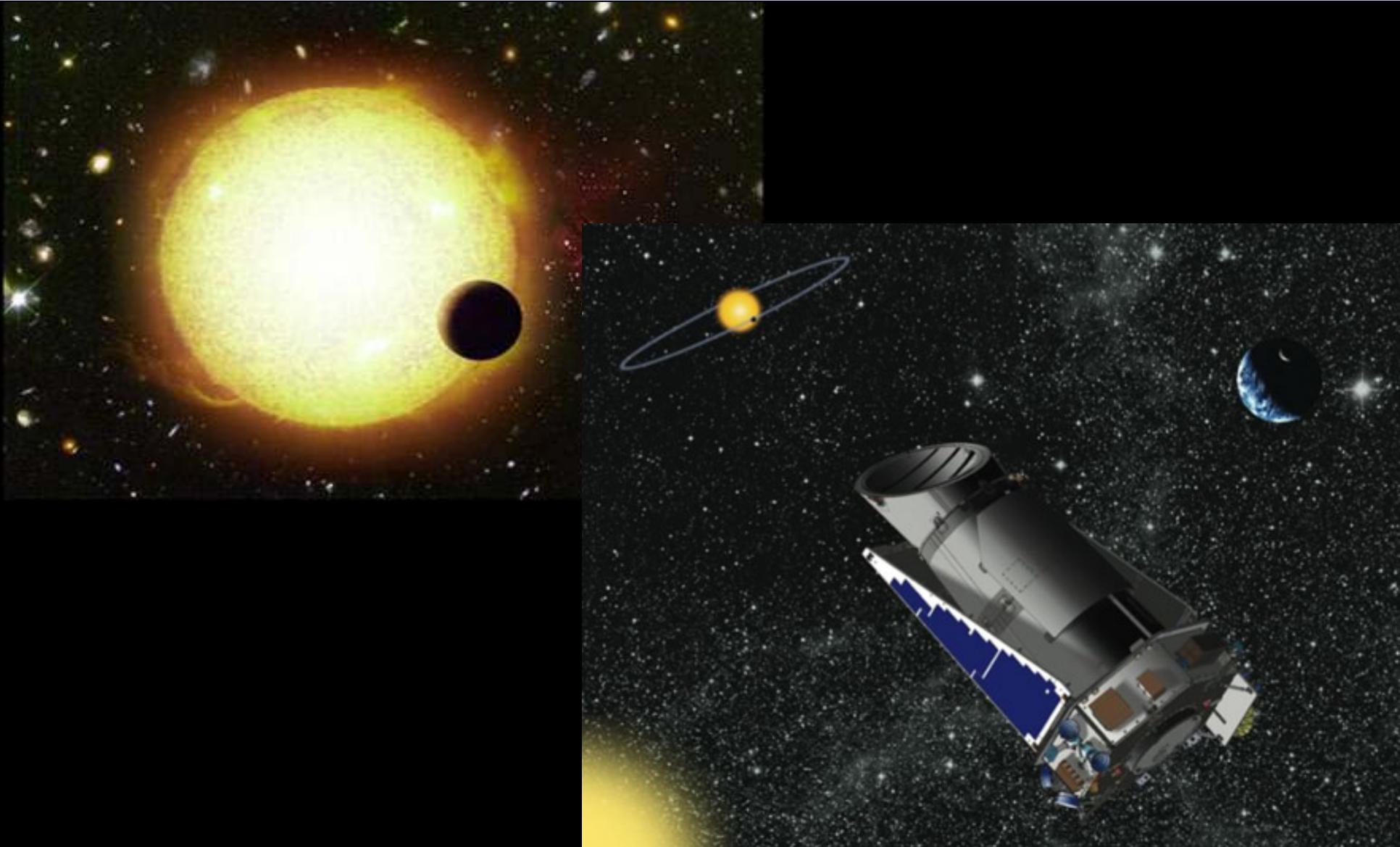




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Kepler's Observing Transits of 100,000 Earth-sized Exoplanets





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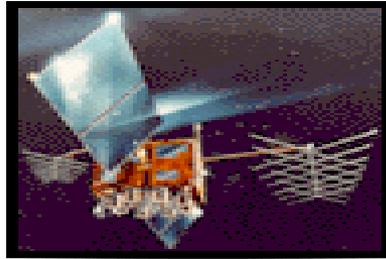
Non-NASA programs

National Space Technology Applications (NSTA)



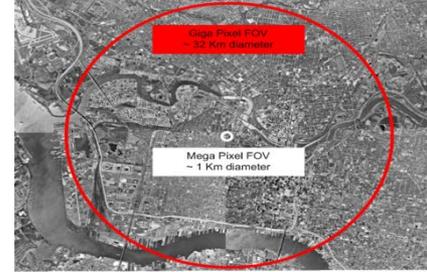
Defense

Large, lightweight structures, electronics, optics, radar, GPS



Intelligence

Nano-laminate optics, Dual blaze -convex gratings, unique image processing



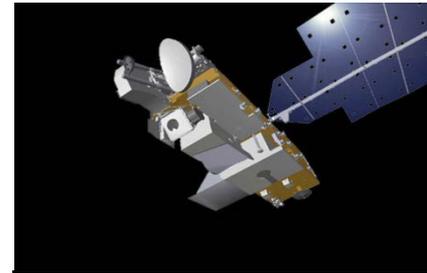
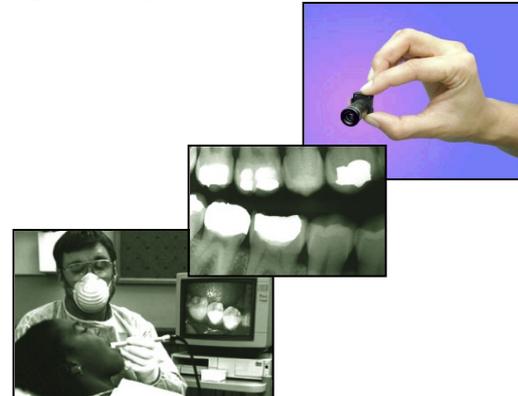
Civil

Advanced sensors for climate monitoring: altimeters, radiometers, scatterometers, radar



Commercial

APS, QWIP cameras, composite optical surfaces, lightweight electronics





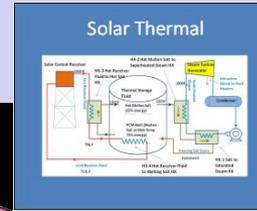
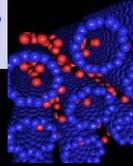
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Present JPL Energy Technology Portfolio

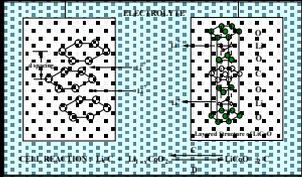


H2 Storage

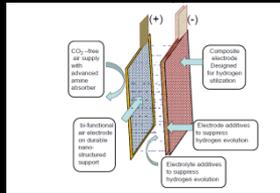


SCHEMATIC DIAGRAM OF A LI-ION CELL

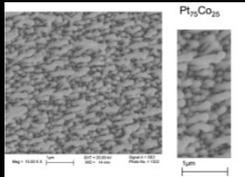
CARBON ANODE 3.7V 0.5V under load OXIDE CATHODE



Ad. Li Ion Battery



Fe-Air Batteries



Low Cost FC Catalyst



Direct Methanol Fuel Cells

Adv. Energy Technologies

Alternate Fuels

Solar Thermal

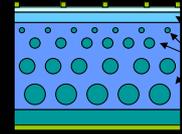
Batteries

Solar

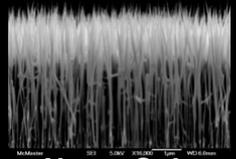
Fuel Cells

Thermal Conversion & Storage Systems

Power Management & Distribution



Quantum Dot PV



Nano Solar



TE Waste Heat Recovery



Smart Grid



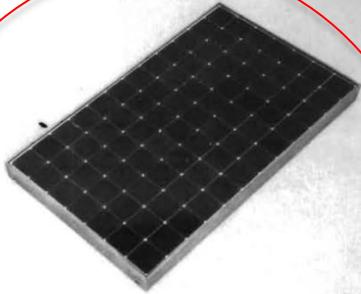
Active heated and cooled seating system



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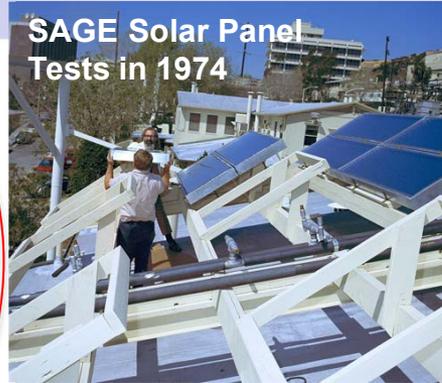
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JPL Terrestrial Energy Technology Programs: 1970's & 1980's



A 15.2% efficiency prototype module (21 x 36 in.) was made by Spire Corp. using float-zone silicon wafers. Recently, similarly efficient modules were fabricated from Czochralski silicon wafers.

Flat Plate Solar Array Project



SAGE Solar Panel Tests in 1974



Solar Thermal System - ORC



Solar Thermal Test Facility at AFB



ETV-1



Hydrogen Car



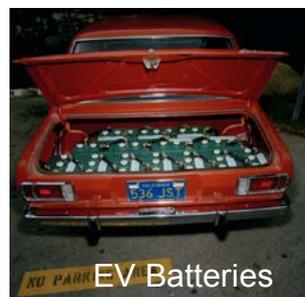
Water Treatment Tested



Wireless Power Transfer



ETV-2



EV Batteries



Davis Sempra

Clean coal Technology



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JPL Energy Technology Programs: 1990's



Li-SOCl₂ Batteries



DS1 SCARLET WING



AMTEC



Li-Ion Battery



Regenerative PEM Fuel Cells



Ag-Zn Batteries



Direct Methanol Fuel Cells

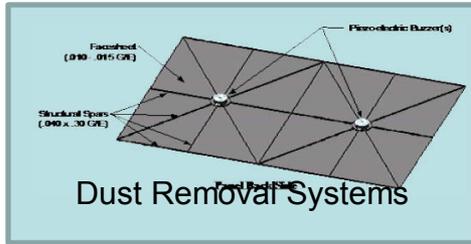
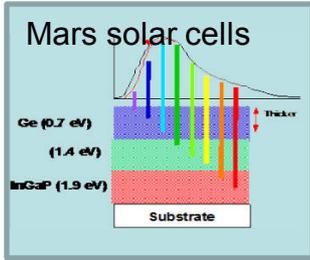




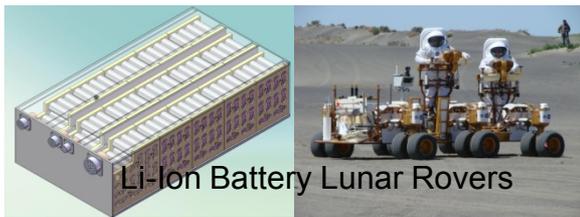
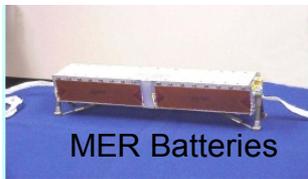
JPL Energy Technology Programs: 2000's



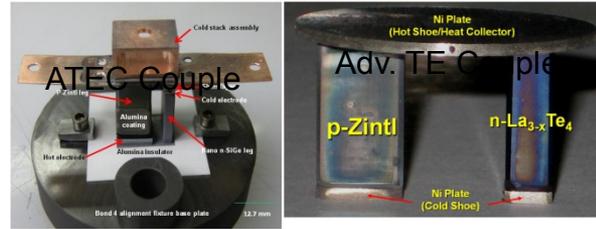
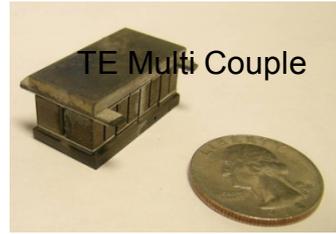
Solar Cells Activities



Battery Activities



TE Activities



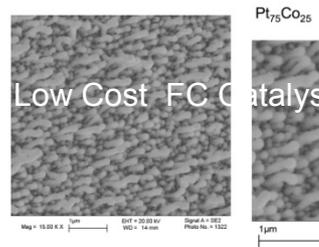
Aerogel insulation



Hydrogen Storage



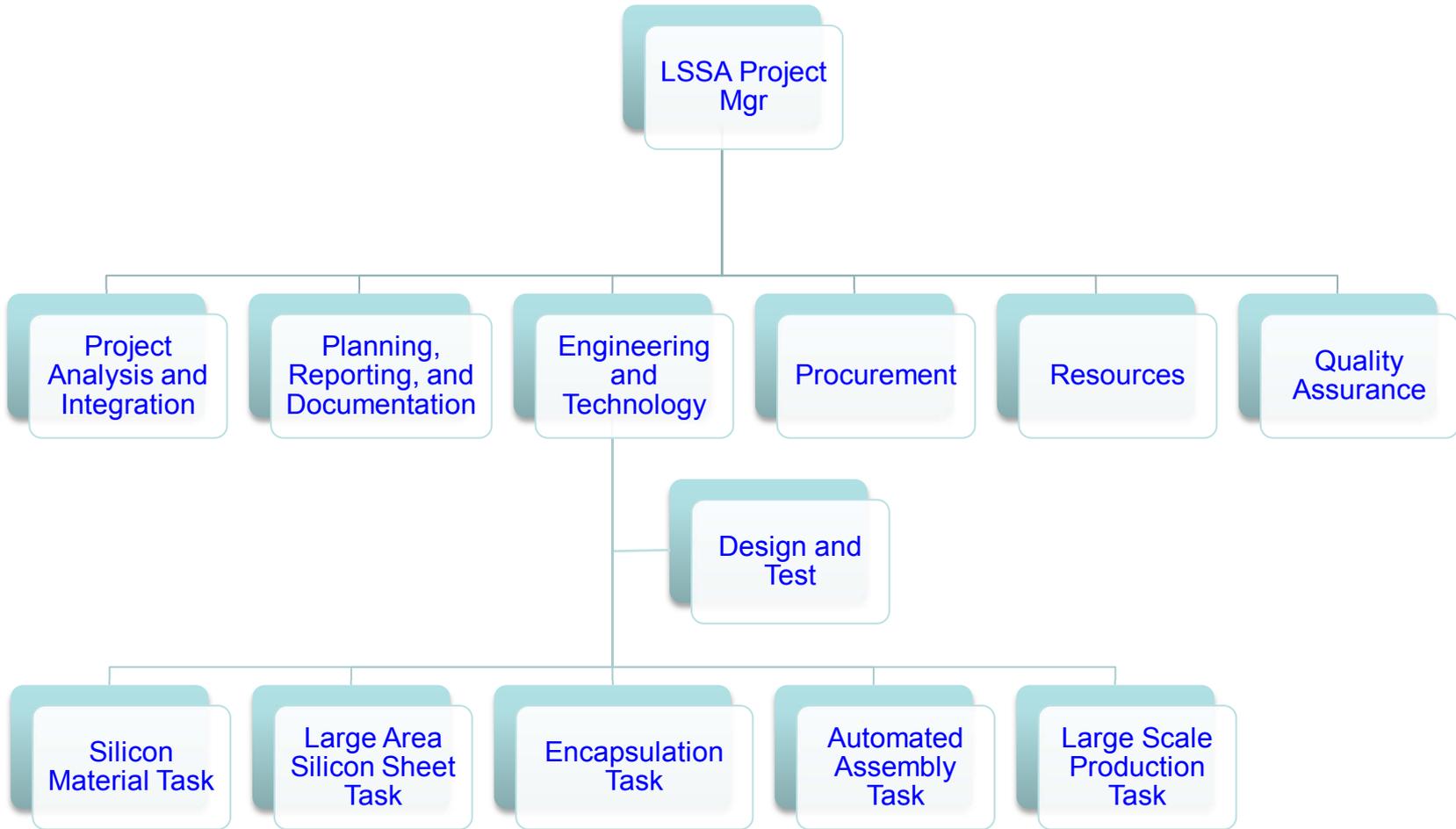
Fuel Cell Activities





The Beginnings of the FSA Project

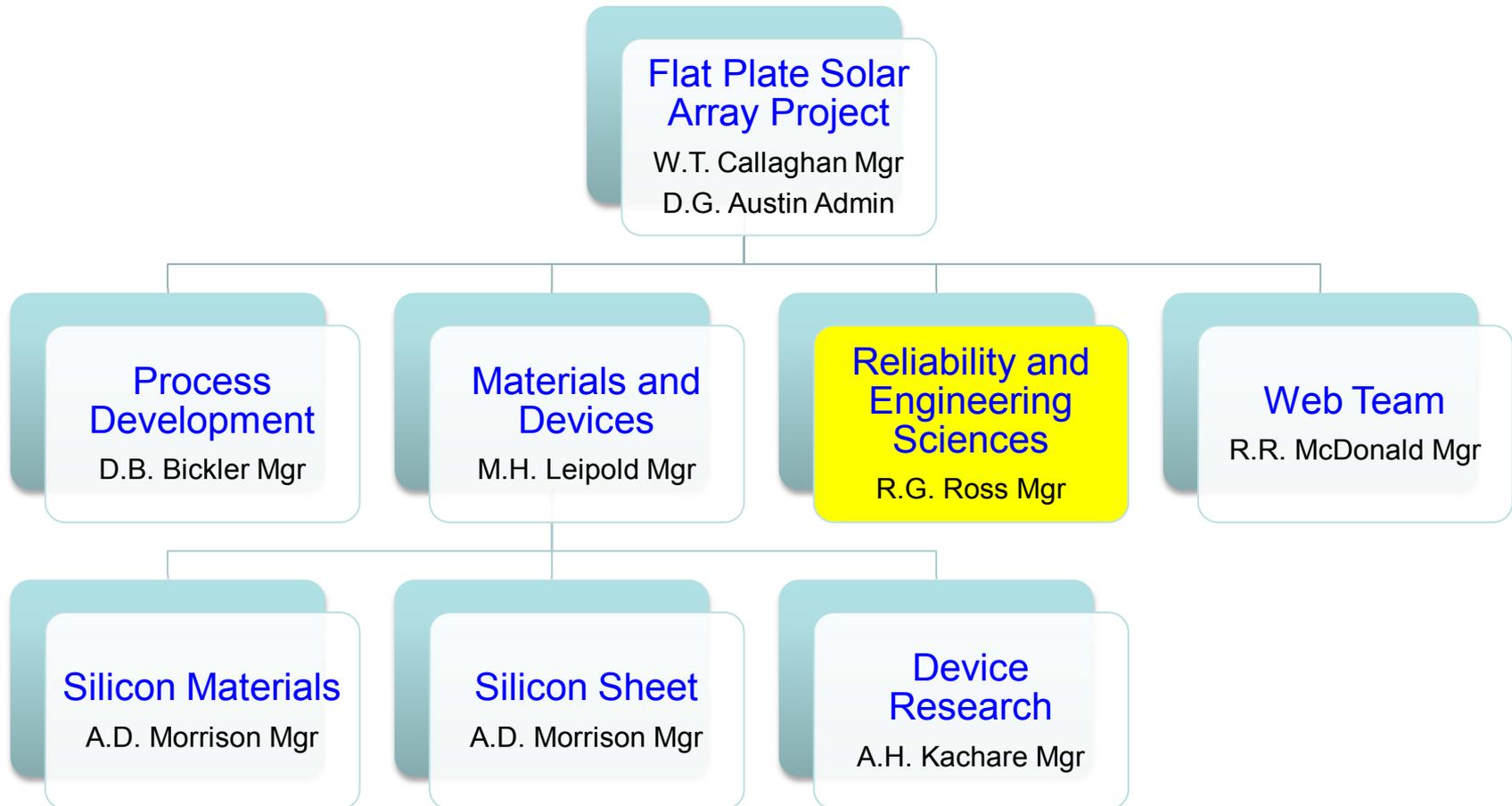
A Comprehensive Approach from Sand to PV Systems



Low-Cost Silicon Solar Array Project 1975 Org Chart



Evolved FSA Program Organization



Flat Plate Solar Array Project 1983 Org Chart

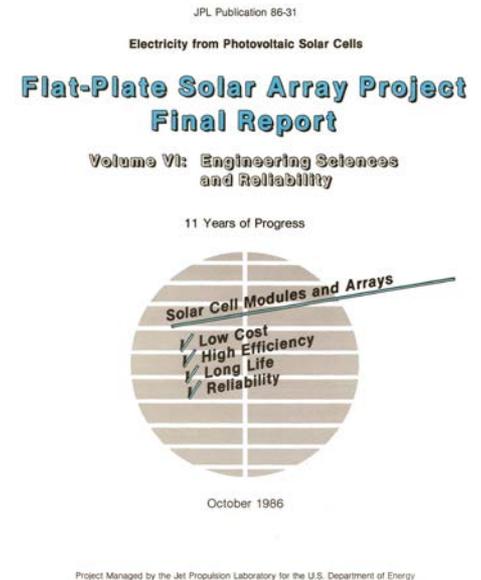


FSA Reliability and Engineering Sciences Synopsis



JPL led federally funded activity directed at developing the engineering technology base required to achieve modules that meet the functional, safety and reliability requirements of large-scale terrestrial photovoltaic systems applications. These activities included:

- Development of functional, safety, and reliability requirements for such applications
- Development of the engineering analytical approaches, test techniques, and design solutions required to meet the requirements
- Synthesis and procurement of candidate designs for test and evaluation; and
- Performance of extensive testing, evaluation, and failure analysis to define design shortfalls and, thus, areas requiring additional research and development.





Concluding Remarks



- JPL has been very active in the development of advanced power systems for over 40 years, and brings strong capabilities to bear in this area.



- Through the FSA Project, JPL made seminal contributions in PV Reliability studies in the 80s
- As a National Laboratory (FFRDC), JPL is well positioned to be an unbiased investigator and evaluator of sensitive scientific and engineering data. This function is in keeping with our charter to contribute solutions to “problems of national significance.”
- We would like to contribute solutions to this community