

# Centennial Challenges

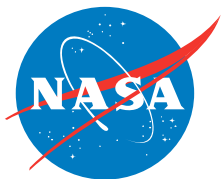
## NASA PRIZES FOR THE CITIZEN INVENTOR



Technology and Innovation Committee Meeting

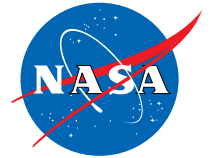
August 3, 2010

Pasadena, California

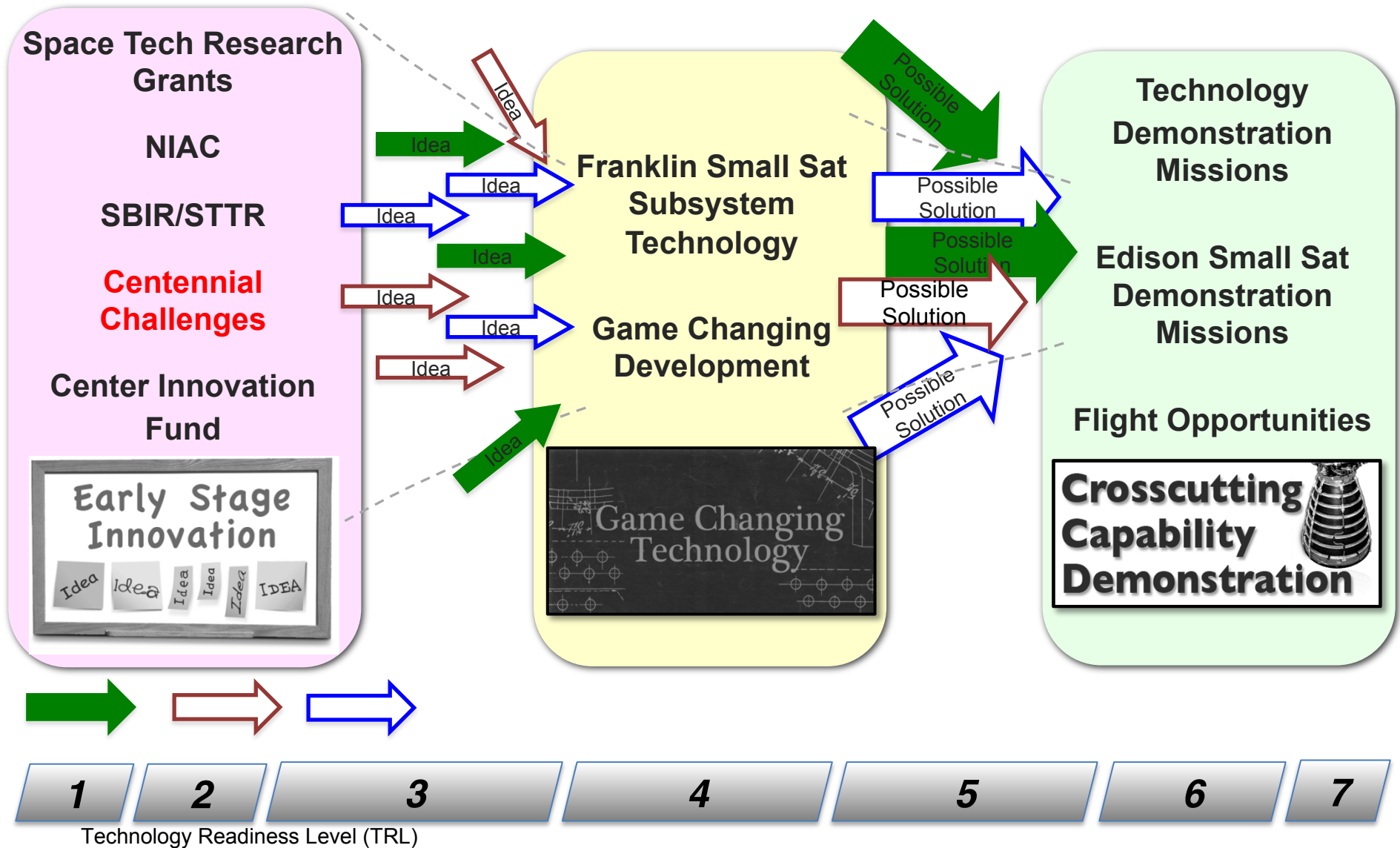


Andrew Petro  
Early Stage Innovation  
Office of Chief Technologist  
NASA Headquarters

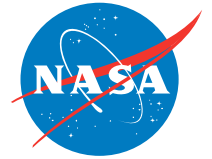




# OCT Program Overview



# Participatory Research & Development



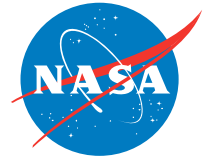
Incentive prizes to encourage novel solutions from non-traditional sources



Kansas City Space Pirates  
NASA Dryden Flight Research Center  
November 2009

Brian Turner  
Kansas City Space Pirates  
Power Beaming Team  
New York Times Magazine  
July 1, 2007

# NASA Prizes for the Citizen Inventor

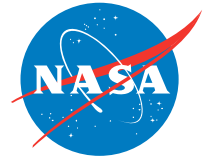


- Authorized by Congress in 2005
- NASA provides only prize money
- Administered by non-profit Allied Organizations
- Allied Organizations seek sponsors for operating funds
- Sponsors can add to prize money
- NASA concurs on rules and competition plans
- \$10M appropriated in 2005
- \$4M appropriated in 2010
- Funds do not expire – allows multi-year agreements
- Competitors cannot be supported by government funding
- Prizes can only go to US citizens, permanent residents or US entities
- Competitors retain their intellectual property



ALLIED ORGANIZATIONS 2005-2010





# Centennial Challenges Status

**Since 2005, 19 competitions held in six Challenge areas, \$4.5M in prizes awarded to 13 different teams**

## Completed

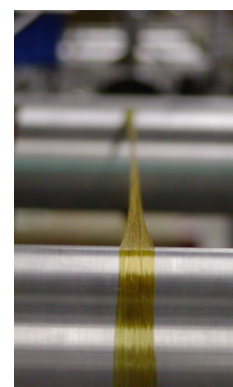
- Regolith Excavation – \$750K awarded
- Lunar Lander – \$2M awarded
- Astronaut Glove – \$550K awarded

## On-Going

- Strong Tether – \$2M available
- Power Beaming – \$900K awarded;  
\$1.1M available in 2010
- Green Flight – \$350K awarded;  
\$1.65M available in 2011

## New in 2010

Three New Challenges with \$5M available



# Model for Government-Sponsored Prizes

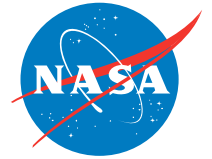
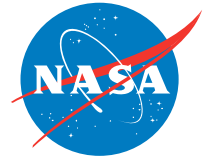


Photo: New York Times

“NASA’s Centennial Challenges have triggered an outpouring of creative solutions from students, citizen inventors, and entrepreneurial firms for technologies such as lunar landers, space elevators, fuel-efficient aircraft, and astronaut gloves.”

*Memo to all Executive Departments and Agencies from Office of Management & Budget*  
**Guidance on the Use of Challenges and Prizes to Promote Open Government,**  
March 8, 2010

# 2009 Highlights



Masten Space Systems and Armadillo Aerospace win Lunar Lander Challenge and as Space Entrepreneurs are honored as the "Persons of the Year"



Paul's Robotics, a student team beats 22 others to win \$500,000 in the Regolith Excavation Challenge



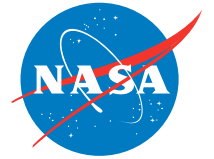
Ted Sothern and Peter Homer display their prize winning Astronaut Gloves



LaserMotive climbs to one kilometer with beamed power to win \$900,000

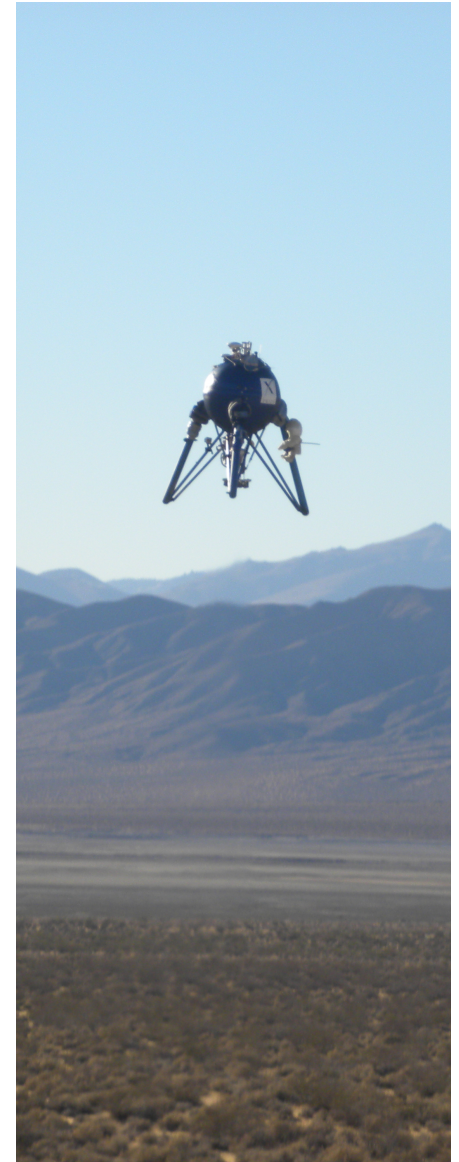






# Value of Prizes

- **Stimulate innovation in ways unlike contracts or grants**
  - Reward achievement, not effort
- **Reach new sources of innovation, new talent**
  - Multiple teams & multiple approaches to same problem
- **Stimulate new commercial ventures**
  - New startups, new partners, more commercial competition
- **Achieve returns that outweigh investment**
  - High ratio of private investment to prize value
  - Almost all funds go to prize purses
- **Educate, inspire and motivate the public**
  - Train the future workforce
  - Increase awareness of science & engineering
  - Inclusion, not exclusion

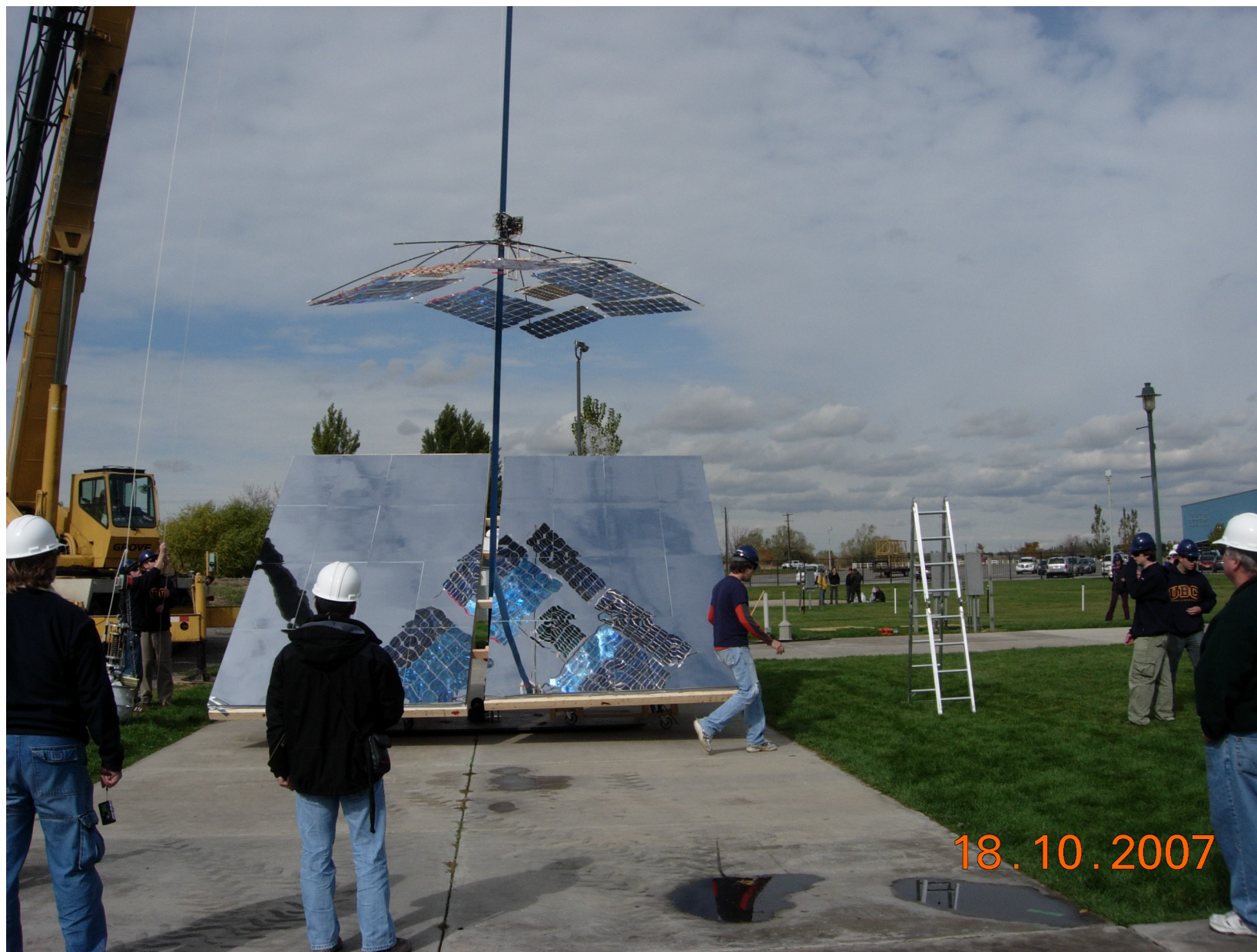




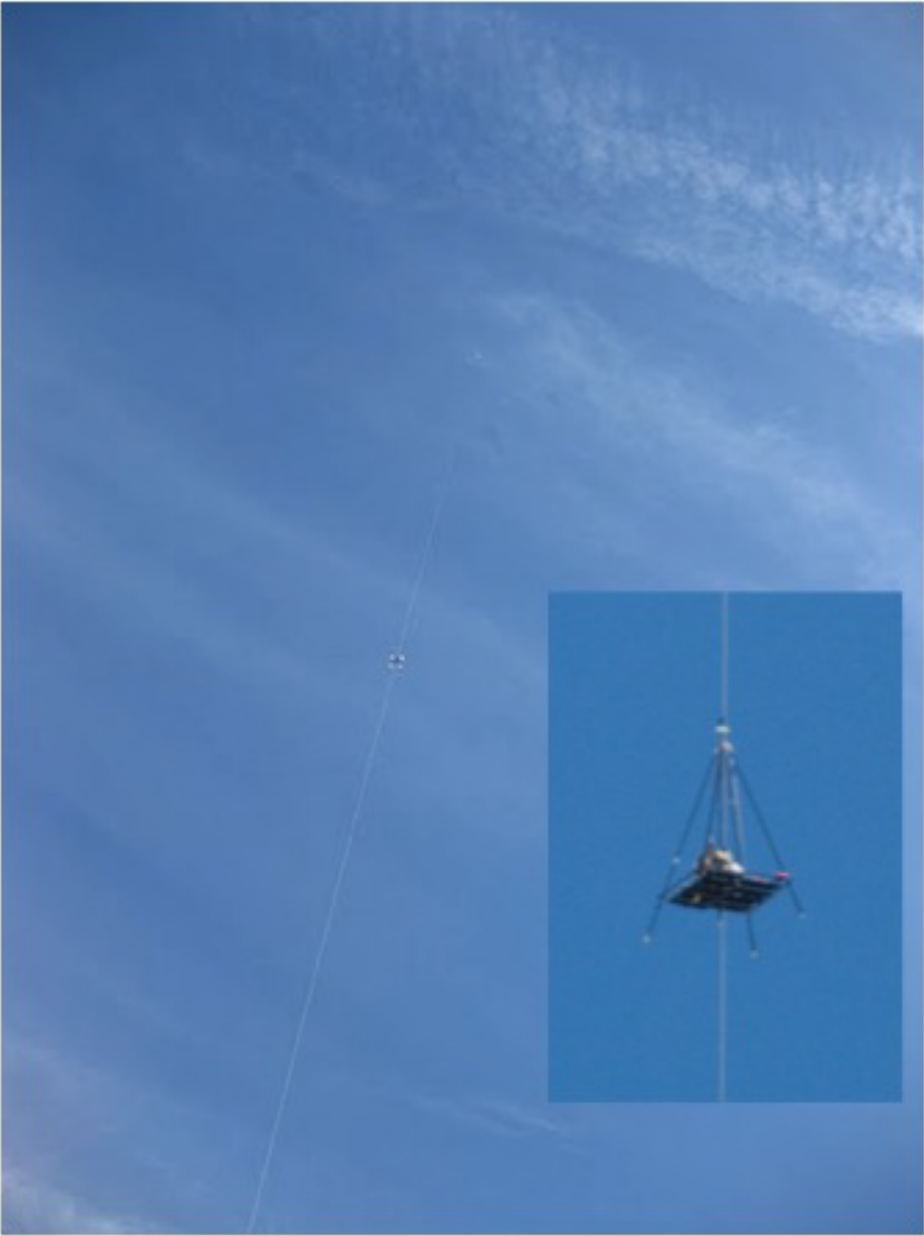
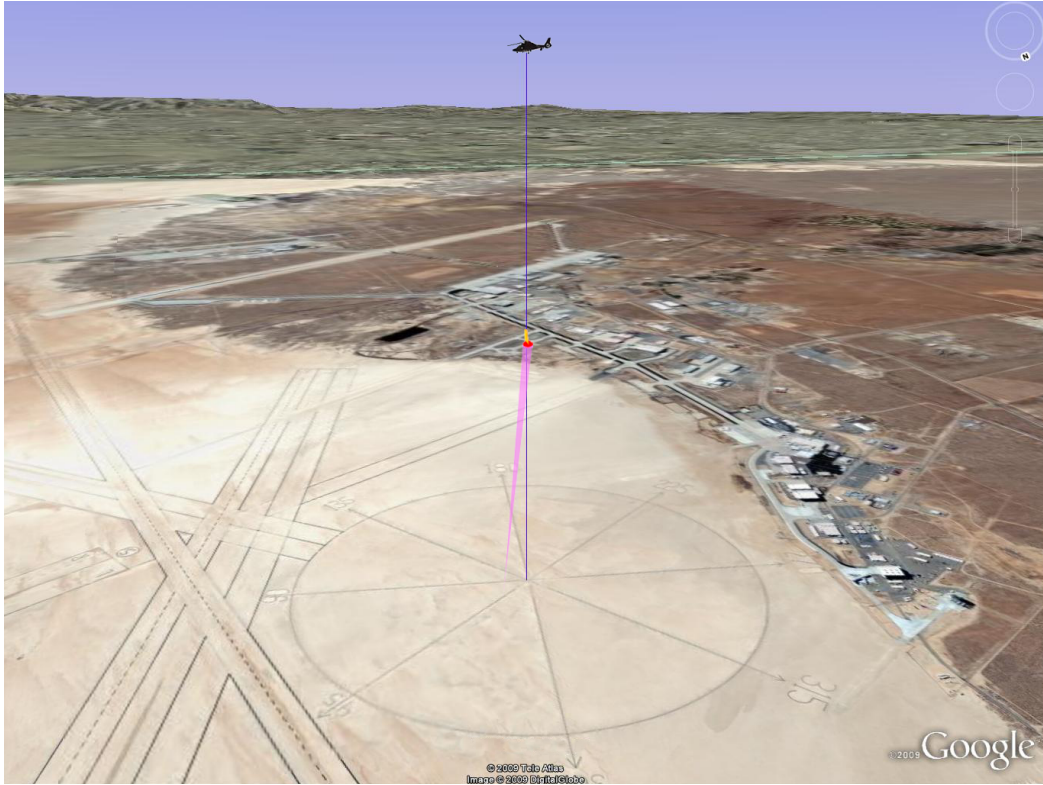




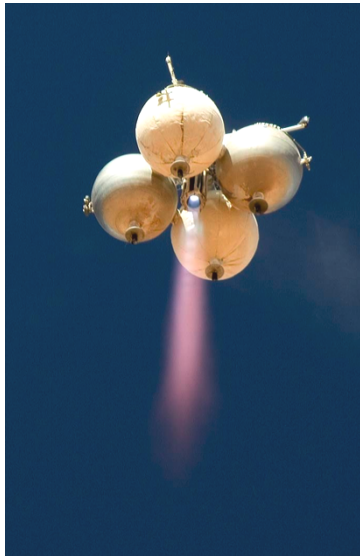
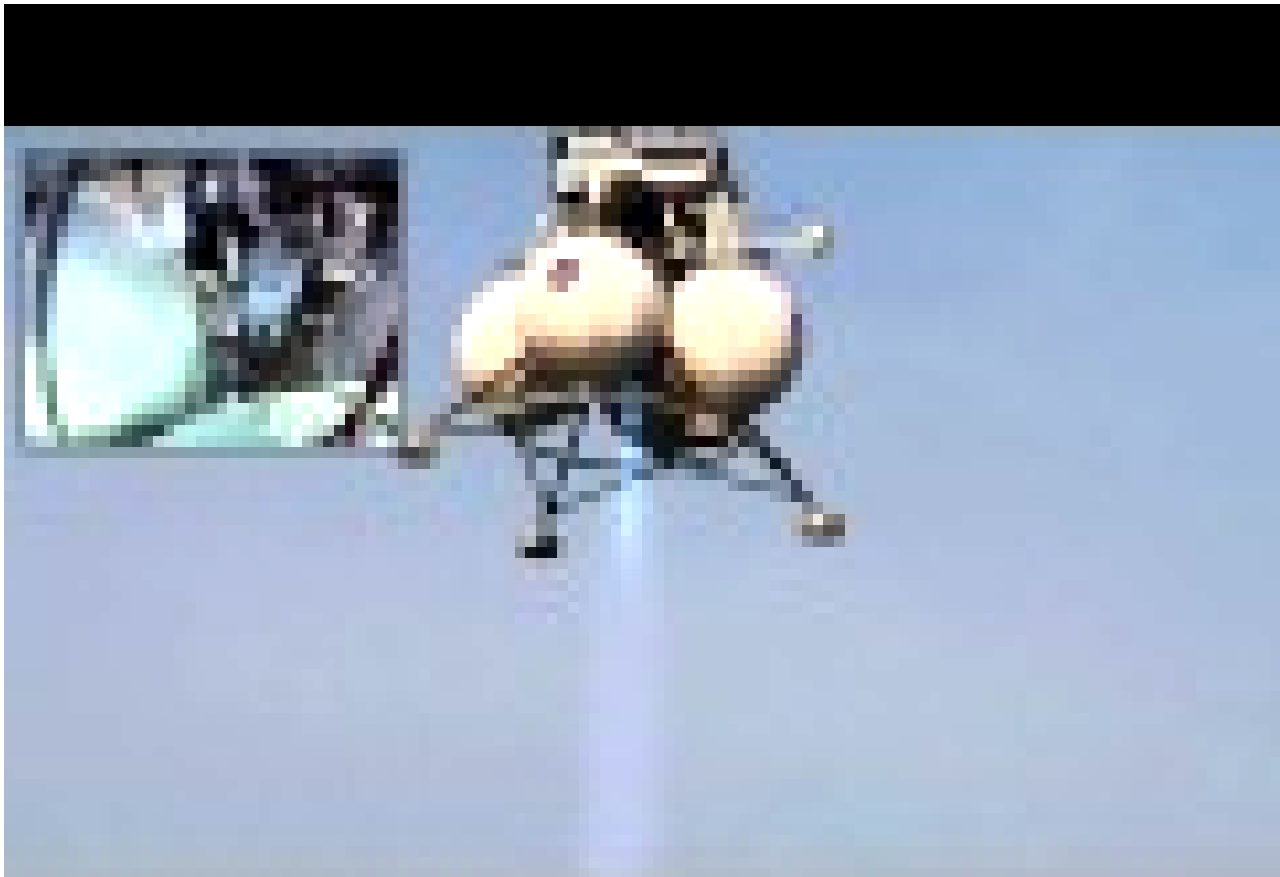








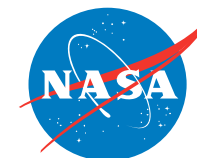








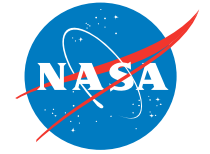
# Centennial Challenges Competitions 2005-2009



CHALLENGE	LOCATION	PURSE	DATE	AWARDS
Power Beaming	Mountain View, CA	\$50K	21-23 Oct 2005	
Strong Tether	Mountain View, CA	\$50K	21-23 Oct 2005	
Lunar Lander	Las Cruces, NM	\$2M	20 Oct 2006	
Power Beaming	Las Cruces, NM	\$200K	21 Oct 2006	
Strong Tether	Las Cruces, NM	\$200K	21 Oct 2006	
Astronaut Glove	Windsor Locks, CT	\$250K	2-3 May 2007	\$200K
Regolith Excavation	Santa Maria, CA	\$250K	11-12 May 2007	
Personal Air Vehicle	Santa Rosa, CA	\$250K	4-12 Aug 2007	\$250K
Power Beaming	Salt Lake City, UT	\$500K	13-21 Oct 2007	
Strong Tether	Salt Lake City, UT	\$500K	13-21 Oct 2007	
Lunar Lander	Holloman AFB, NM	\$2M	26-28 Oct 2007	
Regolith Excavation	San Luis Obispo, Ca	\$750K	2-3 Aug 2008	
General Aviation Technology	Santa Rosa, CA	\$350K	4-10 Aug 2008	\$97K
Lunar Lander	Las Cruces, NM	\$2M	24-25 Oct 2006	\$350K
Strong Tether	Seattle, WA	\$2M	14 Aug 2009	
Regolith Excavation	Mountain View, CA	\$750K	17-18 Oct 2009	\$750K
Lunar Lander	Various	\$1.65M	July-Oct 2009	\$1.65M
Power Beaming	DFRC, Edwards, CA	\$2M	4-6 Nov 2009	\$900K
Astronaut Glove	Titusville, FL	\$400K	19 Nov 2009	\$350K



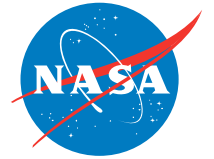
# Criteria For Assessing Candidates



- Relevant to NASA mission needs or commercial aerospace opportunities
  - Technically valuable and interesting
- Relevant to national and global needs
- Relevant to NASA educational goals and likely to attract student teams
- Practical
  - Not overly constrained – multiple solutions possible
  - Right degree of difficulty and appropriate for the prize amount
  - Competition logistics not too complex or costly
- Compelling to the public
  - High technical risk, high potential payback
  - Interesting to observe or follow
  - Futuristic
- Multiple competitors likely
- One or more NASA organizations willing to advocate
  - Provide expertise to guide competition
  - Actively seek technology infusion and partnerships
  - Remain involved through life of competition



# Centennial Challenges Upcoming Activities



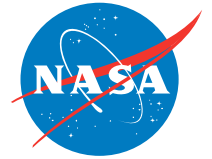
## In 2010

- Preparation underway for Strong Tether, Power Beaming and Green Flight Challenges
- Three new Challenge topics selected
- New Allied Organizations will be selected – October

## For FY2011

- As part of OCT, a Program Office will be established at the Marshall Space Flight Center – to enhance partnership opportunities and technology infusion
- Budget request is \$10M each year through 2015
  - an average of 5 new challenges per year

# Strong Tether Challenge



**August 13, 2010**

**Microsoft Conference Center, Redmond, WA**

***Managed by: Spaceward Foundation***



For advanced materials including practical carbon nano-tubes

*On-going since 2005*

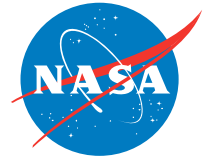
\$2M for strongest sample that exceeds strength of best commercially available material by 50% in pull test.



Prize	Length	Mass	Strength
\$300,000	$\geq 1$ cm	$\leq 0.01$ g	5.0 MYuri
\$300,000	$\geq 10$ cm	$\leq 0.1$ g	5.0 MYuri
\$400,000	$\geq 1$ m	$\leq 1.0$ g	5.0 MYuri
\$1,000,000	$\geq 1$ m	$\leq 1.0$ g	7.5 MYuri

$$1 \text{ MYuri} = 1 \text{ GPa}/(\text{g/cc})$$

# Power Beaming Challenge



**Fall, 2010**

***Managed by: Spaceward Foundation***



## **REQUIREMENTS**

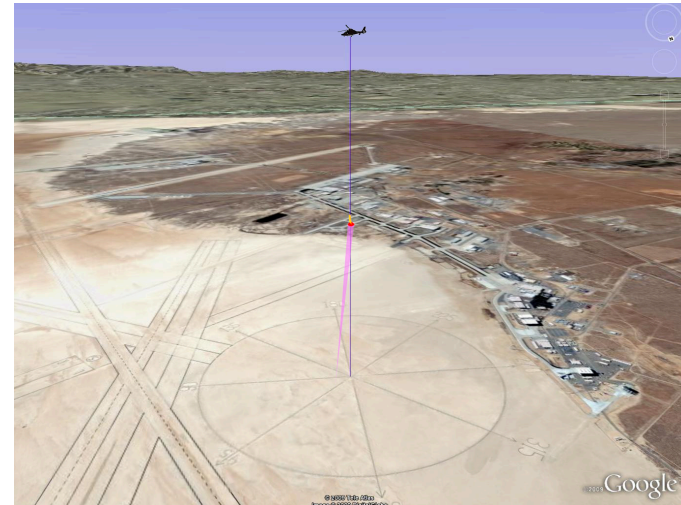
Climb vertical cable to **1 km**

With beamed energy

Score based on speed and payload

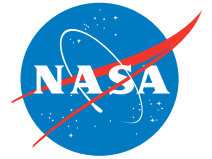
**PRIZES – \$1.1M** to be divided among teams based on score for teams that exceed 5 m/s speed

\$900 K won by one team in 2009



Ground-based lasers, up to 8 kW, used with photovoltaic receivers and active tracking

# Green Flight Challenge



**July 2011**

**Sonoma County Airport, Santa Rosa, California**

***Managed by: Comparative Aircraft Flight Efficiency Foundation***



## **REQUIREMENTS**

**$\geq 200$  mile range**

**$\geq 100$  miles/hour**

**$\geq 200$  passenger-miles/gallon**

(energy equivalent with fuel or electricity)

Repeat flight on consecutive days

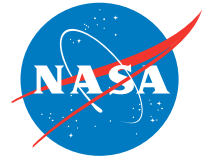
## **PRIZES**

**\$1.5M** to aircraft with best combination of efficiency and speed

**\$150K** to best-performing bio-fueled aircraft



# Three New Prize Challenges for 2010

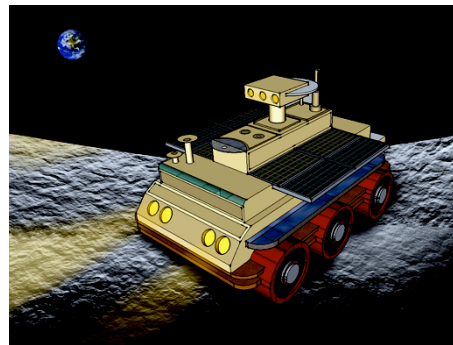
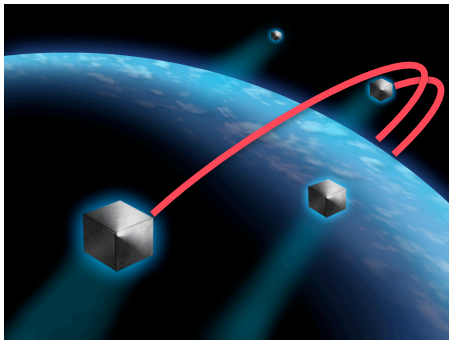


**Total prize purse: \$5 Million**

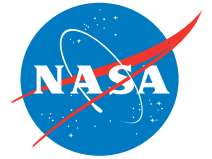
Student-Level competitions in each area

Announcement of Partnership Opportunities for new Allied Organizations - July 13, Proposals due Sept 13

Request for Information from Potential Sponsors posted in June



# Nano-Satellite Launch Challenge



to place a small satellite into Earth orbit, twice in one week.

## PRIZE PURSE: \$2 Million

Satellite mass - at least 1 kg

Satellite dimensions

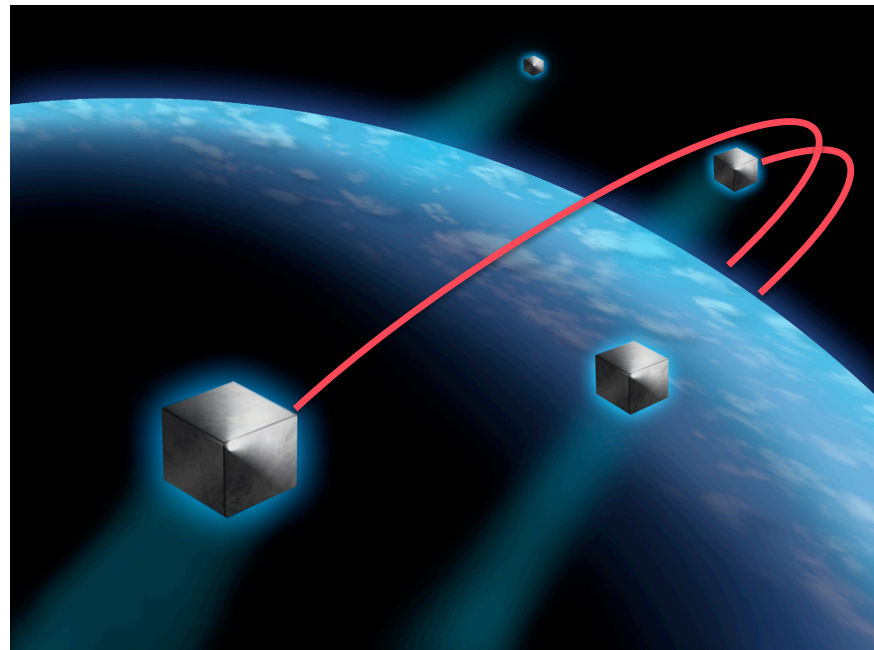
- at least 10 cm cube

Must complete at least one Earth orbit

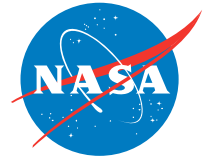
Task must be accomplished twice in one week

*To stimulate innovations in launch technology*

*To encourage creation of commercial nano-sat delivery services*







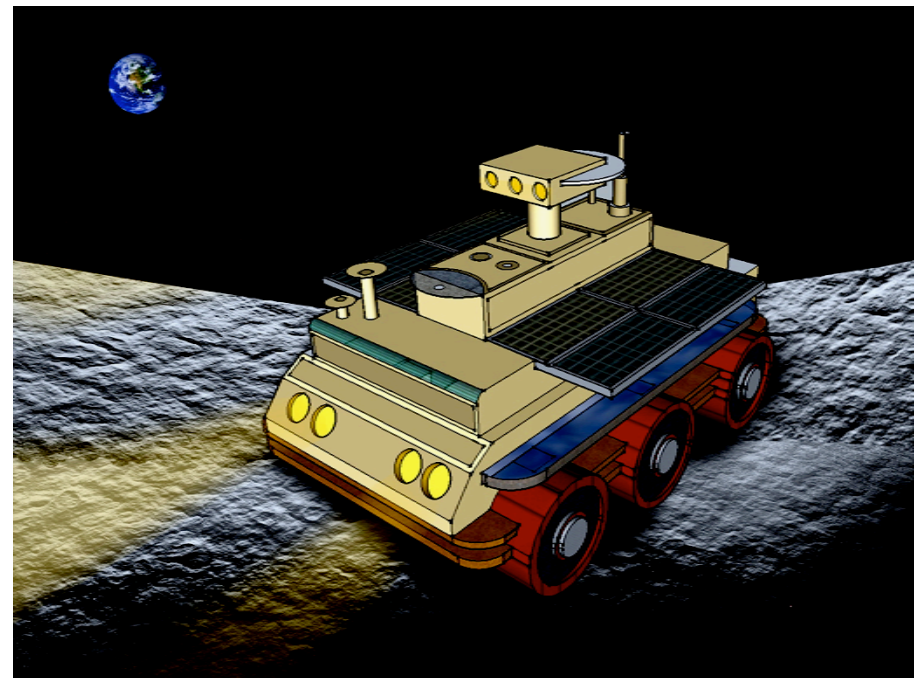
# Night Rover Challenge

to demonstrate a solar-powered exploration vehicle that can operate in darkness using its own stored energy.

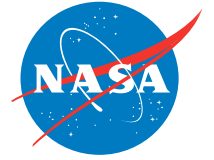
## PRIZE PURSE: \$1.5 Million

Vehicle generates and stores its own energy using a renewable source available on the Moon and operates over several daylight/darkness cycles

*To stimulate innovations in energy storage technologies of value in extreme space environments and in renewable energy systems on Earth.*



# Sample Return Robot Challenge

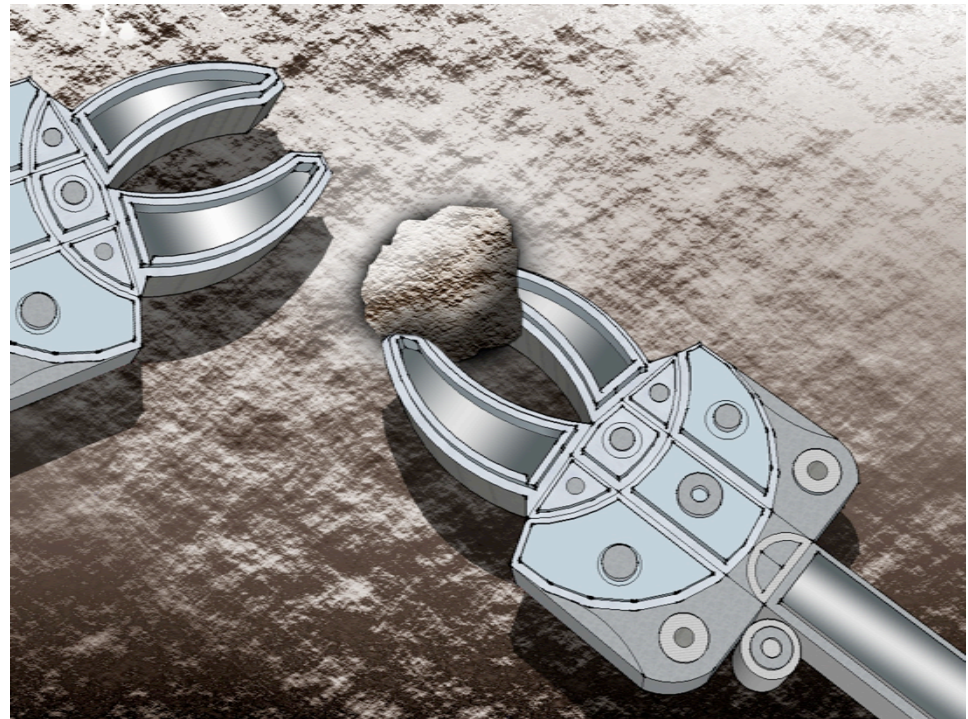


to demonstrate a robot that can locate and retrieve geologic samples from a wide and varied terrain without human control.

## PRIZE PURSE: \$1.5 Million

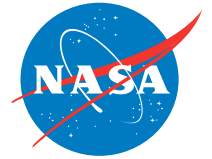
Autonomous robot  
Easily identified samples  
Terrain maps provided but  
no use of GPS

*To encourage innovations in  
robotic navigation and sample  
manipulation technologies*





# Centennial Challenges Summary



Participatory Research & Development  
with Opportunities for:

## **Competitors**

*entrepreneurs & other businesses,  
inventors, students*

## **Allied Organizations**

*private organizations*

and **Sponsors for Allied Organizations and Teams**

*businesses, organizations, individuals*



## **Contact:**

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[www.nasa.gov/challenges](http://www.nasa.gov/challenges) **Twitter: NASAPrize**