

# LSIC Surface Power Focus Group

April 22, 2021

Begins at 11:03



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Confluence Discussion:  
<https://lsic-wiki.jhuapl.edu/display/SP/22+April+2021+SP+Telecon>

# Overview

- LSIC community updates

- LSIC Spring Meeting
- LSIC Executive Committee
- Updates on other FG activities
- Funding opportunities
- Your Community Announcements
  - regular feature/report out from confluence/emails/etc.?

- Upcoming activities and discussion

- Power Beaming Workshop
- Super-telecon on Vertical Solar
  - Surface Power, Dust, Extreme Environments
- Who's Who in Surface Power
- Annual Goal – finalization and next efforts
  - Power User Survey
- Executive Committee at the spring meeting: How can LSIC build to serve the Community?



## EVENT DETAILS

**Date:** Tuesday, May 11, 2021 - Wednesday,  
May 12, 2021

**Location:** Virtual

[Register Now](#)

Keynote address by



**Dr. Bhavya Lal**  
NASA Acting Chief of Staff

<http://lsic.jhuapl.edu/News-and-Events/Agenda/index.php?id=124>



## Lunar Surface Innovation Consortium Spring Meeting

Tuesday, May 11, 2021 -Wednesday, May 12, 2021

Venue: Virtual

The LSIC Spring Meeting will be held virtually on May 11-12, 2020. The meeting will feature a keynote address from the Acting NASA Chief of Staff, Dr. Bhavya Lal, and will include updates from NASA, networking opportunities, and contributed technical content from the community (the abstract deadline has passed). Registration for the LSIC Spring Meeting is required in order to access the live poster and networking sessions as well as discussion breakout sessions. The registration portal is now open, and will close on May 3, 2021.

### Meeting Information

**Day one** of the meeting (Tuesday, May 11th) will feature the keynote address and LSIC-wide plenary sessions, including networking sessions for the community. Pre-registration is required to attend the networking sessions (due to technical limitations, no exceptions can be made on the day of the meeting). A panel discussions will focus on funding and flight opportunities.

**Day two** (Wednesday, May 12th) will include panel discussions, technical lightning talks from the community, a poster and networking session, and group breakout sessions to discuss meeting topics in more detail.

# LSIC Executive Committee



- Kickoff meeting January 12th
- Ensure Alignment with NASA lunar exploration goals
- Establish Charter
- Formalize institution membership
- Advise on Strategy
- Approve FG Goals
- Build Community
- Develop Talent



 <b>Niki Werkheiser</b> NASA STMD, LSII Lead	 <b>Jacob Bleacher</b> NASA HEOMD
 <b>Joel Kearns</b> NASA SMD	 <b>Greg Schmidt</b> SSERVI



 <b>Michelle Rodrigues</b> SRI International	 <b>Jessy Kate Schingler</b> Open Lunar Foundation
 <b>Rachel Klima</b> LSIC Director	 <b>Michael Miller</b> Southwest Research Institute



 <b>Sean Mahoney</b> Masten Space Systems	 <b>Sandy Magnus</b> AstroPlanetView	
 <b>Candice Matthews Brackeen</b> Lightship Capital	 <b>Kris Zacny</b> Honeybee Robotics	 <b>Dave Murrow</b> Lockheed Martin




 <b>George Sowers</b> Colorado School of Mines	 <b>Jose Hurtado</b> LEAG/UTEP	
 <b>Ahsan Choudhuri</b> Univ of Texas at El Paso	 <b>Lindy Elkins-Tanton</b> Arizona State University	 <b>Ariel Ekblaw</b> MIT



# LSIC | Workshop on Lunar Mapping for Precision Landing

Precision landing and hazard avoidance systems are necessary to enable access across the lunar surface. Communication between lunar data providers and data users is necessary and, to date, has been inefficient.

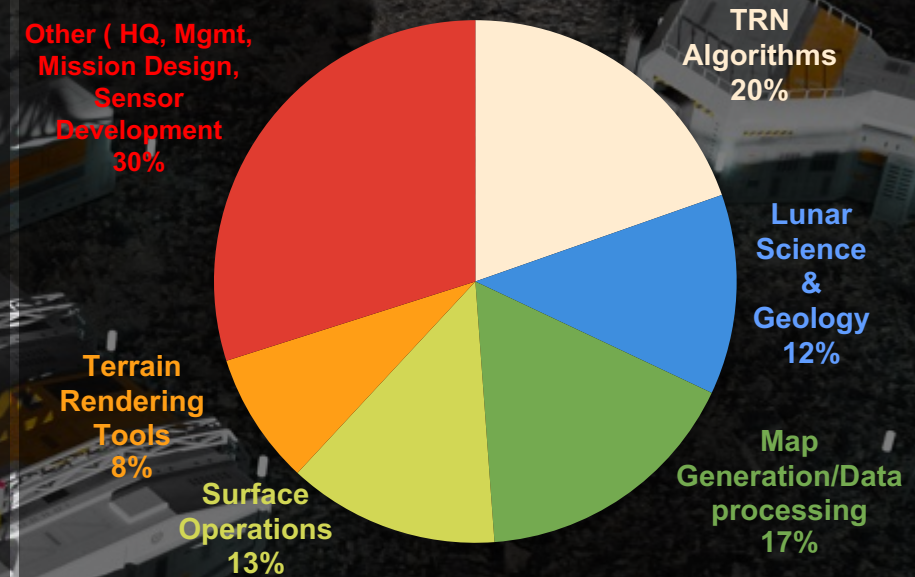
Workshop held March 2-4, 2021

425 attendees from over 138 institutions: 18% Academia, 34% Government, 34% Industry, and 12% Nonprofit

## High priority challenges and needs identified:

- Terrain Relative Navigation (TRN) systems need lunar maps with unique characteristics.
- Industrial partners and navigation engineers are not fully utilizing existing lunar data.
- Standard data sets and controlled maps would be beneficial for testing algorithms.
- Current flight processor capability may be insufficient for advanced TRN algorithms and map processing.
- Targeted new missions and instrumentation would fill gaps in data needed for TRN systems.
- Standardized rendering tools, data verification and validations metrics, and metadata are desired.

425 REGISTERED ATTENDEES




# Extreme Environments – Apr 2021

## Current Activity: Identifying and Classifying Specific Lunar Surface Environments

- Purpose and Products
  - “Breaking Down the Lunar Environment Monolith”
  - How do different environments stress technologies in different ways
  - How do specific lunar environment differ from descriptions of the general lunar environment?

### April 13<sup>th</sup> LSIC-EE Working Meeting

- Brief backgrounds from each of the five subgroups
- Two smaller breakout groups collected opinions regarding the following:
  - The importance and urgency of exploring the different environments
  - Specific concerns and hurdles to technology development
  - Environmental impacts from exploration and habitation
  - Draw connections between different environments that could drive technology development

Polar Environments	Non-Polar Environments
Permanently Shadowed Regions (PSRs)	Apollo-style Environments
Areas of High Illumination (>55% Illumination)	Topographic Margins
Mixed Polar Environments	Lunar Pits & Lava Tubes
	Surface Anomalies

- You can still participate; discussion pages are open with **nearly 300 comments** (as of 4/20/21)!
  - Polar Environments: <https://lsic-wiki.jhuapl.edu/display/EE/Polar+Environments+Breakout>
  - Non-Polar Environments: <https://lsic-wiki.jhuapl.edu/display/EE/Non-Polar+Environments+Breakout>

# Updates

- “Who’s Who in ……”
  - ISRU– 33 contributions...keep this up! <https://lsic-wiki.jhuapl.edu/display/ISRU/Who%27s+Who+in+ISRU>
  - Extreme Access. <https://lsic-wiki.jhuapl.edu/display/EA/Who%27s+Who+in+EA>
  - Extreme Environments. <https://lsic-wiki.jhuapl.edu/display/EE/Who%27s+Who+in+LSIC-EE>
  - Excavation and Construction. <https://lsic-wiki.jhuapl.edu/pages/viewpage.action?pageId=6260179>
  - Surface Power. <https://lsic-wiki.jhuapl.edu/display/SP/Who%27s+Who+in+LSIC-Surface+Power?moved=true>
- The Power FG will be hosting a workshop in May on Power Beaming, 2-day. There will be an ISRU break-out, or focus, session.
- The LSIC Spring Workshop is May 11-12. Registration is open and draft agenda available. <http://lsic.jhuapl.edu/News-and-Events/Agenda/index.php?id=124>
- Abstracts for the Joint NASA Exploration Science Forum/European Lunar Symposium are due this Friday, **April 23rd**. <https://sservi.nasa.gov/articles/joint-nasa-exploration-science-forumeuropean-lunar-symposium/>
- Next ISRU FG meeting is May 19.
  - May include a recap/take-aways from the LSIC Spring meeting from an ISRU perspective.



# ISRU FG Survey

A Survey Monkey request was sent out after the last focus group meeting to canvas the ISRU on ‘how are things going?’

## Three questions:

1. What were you hoping to get out of joining the LSIC ISRU Focus Group?
2. What benefits have you gotten out of LSIC ISRU activities?
3. What specific requests or suggestions do you have?

## Results

30 responses (~ 30% of active participants)

Responses fell into a few general themes

Details available on Confluence – your comments?

### Expectations?

Number	Category
13	Networking
15	Insight and better understand the community/NASA and/or influence tech development
2	Just get involved

### Usefulness?

Number	Category
9	Networking
13	Insight and better understand the community/NASA and/or influence tech development
3	enjoyed the presentations and discussions
5	no time to participate or no value

### Suggestions

Number	Category
7	more technical resources and networking
3	better understanding of community/NASA including schedule and path forward
8	clear goals and deliverables
5	speakers suggestions
7	no change or no comment

# LSIC | Funding Opportunities

## Watts on the Moon

*Phase 2 being formulated. Do NOT have to have been in phase 1 to participate in phase 2.  
Potentially will have a feedback session during the Spring Meeting*

Energy distribution, management, and/or storage that address NASA technology gaps and can progress toward flight readiness and future operation on the lunar surface.

<https://www.herox.com/WattsOnTheMoon>

## Other opportunities:

<https://www.nasa.gov/directorates/spacetech/solicitations>

MUREP Space Technology Artemis Research (M-STAR) solicitation

Proposals Due: May 10, 2021

Nuclear Thermal Propulsion Reactor Preliminary Design (DoE)

Proposals due: April 30, 2021

(DARPA Award Announced April 12<sup>th</sup>)

# LSIC | Recent Funding Awards: VSAT Awards

NASA selected the following **five** companies for base period contracts to complete their 10 kW vertical solar array designs and conduct analysis.

- Astrobotic Technology, Pittsburgh
- ATK Space Systems (Northrop Grumman), Goleta, California
- Honeybee Robotics, Brooklyn, New York
- Lockheed Martin, Littleton, Colorado
- Space Systems Loral (Maxar Technologies), Palo Alto, California



**LSIC** | Long-form telecon May 27<sup>th</sup>

## Solar Power: VSAT and Implications to Other LSIC Focus Areas

Current plan: 11:00 to 1:00 ET, Thursday May 27<sup>th</sup>

- 30 minutes of talks from each focus area
  - **Surface Power**
    - VSAT out-brief from Chuck Taylor
    - Thoughts on additional speakers?
  - **Dust Mitigation:** active DM for solar panels
  - **Extreme Environments:** Illumination considerations
- 30 minutes of discussion

How to make this interactive and valuable? What are the critical connections between SP Solar, DM, EE?

# LSIC | Recent Funding Awards: Power Beaming

## LuSTR

- The University of California in Santa Barbara, led by principal investigator Philip Lubin, will research **wireless power transfer** feasibility from a base station to multiple distant assets on the Moon. Small rovers, for example, could be equipped with low-power beacons capable of receiving around 100 Watts of power in regions where solar or tethered power transfer is impractical, such as in the Moon's deep and dark craters.

## Watts on the Moon

*Phase 2 being formulated. Do NOT have to have been in phase 1 to participate in phase 2.  
Potentially will have a feedback session during the Spring Meeting*

Energy distribution, management, and/or storage that address NASA technology gaps and can progress toward flight readiness and future operation on the lunar surface.

<https://www.herox.com/WattsOnTheMoon>

# LSIC | Open Discussion: Power Beaming Workshop

**Tentative Date: July 8-9<sup>th</sup> , ~4-5 hours each day**

## **Day One: High-level talks on Power Beaming.**

- Role in the larger system – in particular cost and infrastructure trade
- Current Capabilities, including overview of modes
- Breakouts – use-cases for power beaming

## **Day Two: Deeper Technical Discussions**

- Latest updates in Power Beaming - lightning talks and/or poster presentations
  - WoTM winners anticipated end of May, relevant LuSTR winner
- Panel on challenges and critical steps to advance power beaming
- Small-group breakouts
  - If possible, centered on *specific* topics.
  - Ranked choice of technical breakout sessions – fill the rooms by priority and lottery, randomize/duplicate beyond top choices?

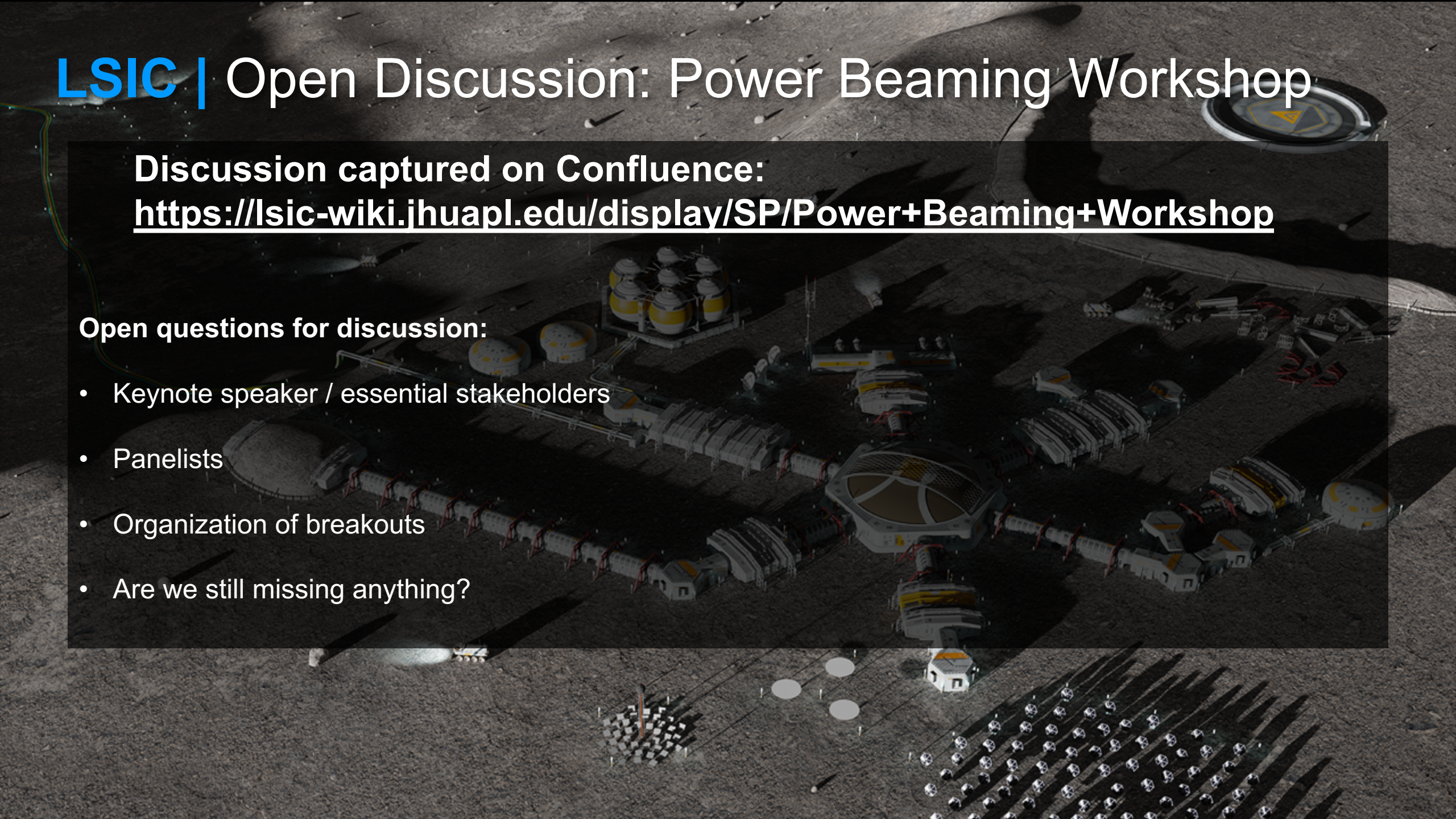
# LSIC | Open Discussion: Power Beaming Workshop

Discussion captured on Confluence:

<https://lsic-wiki.jhuapl.edu/display/SP/Power+Beaming+Workshop>

Open questions for discussion:

- Keynote speaker / essential stakeholders
- Panelists
- Organization of breakouts
- Are we still missing anything?



# LSIC | Open Discussion: Power Beaming Workshop

Discussion captured on Confluence:

<https://lsic-wiki.jhuapl.edu/display/SP/Power+Beaming+Workshop>

## Follow up topics:

- How soon will power be a legitimate demand? White Paper Suggested on “Lunar Utilities”
- Discussion of economics always seems to come up... thoughts on suggesting an LSIC-wide workshop?
- Seeded ideas and technical focus topics for breakout sessions
- **What information should the SP Focus group coalesce prior to the Power Beaming Workshop?**
  - **LSIC-wide Power User Survey**



# LSIC | Surface Power: How can we serve the community?

At the Spring Meeting, the LSIC Executive Committee to panel a discussion on how LSIC can build to serve the community.

What are we doing well?  
What can we do moving forward?

ISRU Focus Group Asked Three questions about how things are going:

1. What were you hoping to get out of joining the LSIC ISRU Focus Group?
2. What benefits have you gotten out of LSIC ISRU activities?
3. What specific requests or suggestions do you have?

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# LSIC | Surface Power Consortium Annual Goal

An aerial view of a lunar base on the dark, cratered surface of the moon. The base consists of several interconnected white and grey structures, including a central hub and various smaller modules. A large array of solar panels is deployed in a grid pattern on the right side. Several rovers and landers are scattered across the terrain, some with their solar panels extended. The scene is illuminated from the upper left, casting long shadows across the lunar surface.

## **Vision Statement:**

*NASA needs power systems which can survive the lunar night and enable exploration. The over-arching goal of the surface power focus group is to provide specific recommendations to NASA for rapidly achieving appropriate-scale power-related technologies needed to enable sustained presence and exploration.*

## **Annual Goal:**

To work towards this, we will first focus on **connecting power experts to their potential user base**, framed by the **economic and institutional drivers that set the scale of power demand**. This will enable us to identify near-term needs for immediate prioritization and long-term goals that impact early architectural decisions.

# LSIC | Annual Goal Actions

- Connecting power experts to their potential user base
  - Workshops, including VSAT and Power Beaming
  - Who's Who in Surface Power, other FGs
  - Power User Survey
- Economic and institutional drivers that set the scale of power demand
  - Discussion within telecon, invited speakers, etc.
  - Follow-on work on economic drivers (e.g. ISRU Supply & Demand Workshop)
  - Evaluation/study of institutional drivers (e.g., the SP FG does a critical read-through of STP)

Additional topics/actions?

- ...

Metrics for success?

- ...

# LSIC | Surface Power: Who's Who in Surface Power

Confluence link:

<https://lsic-wiki.jhuapl.edu/display/SP/Who%27s+Who+in+LSIC-Surface+Power>

Who are you?

(individual or institution)

What do you do?

What do you want others to know about you?

Other Comments

Contact info, POC, etc.

- Are these entries sufficient?
- Please start filling this out!
  - Email about Confluence set-up if you need access

# LSIC | Surface Power: Power Users Survey

An aerial view of a lunar base on the moon's surface. The base consists of several interconnected modules, including a central hub with a large circular structure, and various smaller units. A long, narrow structure, possibly a power bus or cable run, extends across the middle. In the foreground, there are large, rectangular solar panel arrays and a small rover-like vehicle. The lunar surface is dark and covered in small rocks and craters. A circular hatch or vent is visible in the upper right corner.

**Temporary subgroup** to decide on how to best conduct survey of power users.  
Email coming shortly looking for participants.

- Critical information needed from every user
  - Dynamic power needs under conditions expected
- Additional information that aids our efforts
- Critical unknowns/gaps
- What information can we solicit from the SP FG to provide to power users?



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