



# Lunar Surface Innovation C O N S O R T I U M

---

## LSIC ISRU Focus Group Monthly

<http://lsic.jhuapl.edu/>

<http://lsic-wiki.jhuapl.edu/> (sign-up required)

**September 23, 2020**

Karl Hibbitts, Michael Nord, Kirby Runyon

[Karl.Hibbitts@jhuapl.edu](mailto:Karl.Hibbitts@jhuapl.edu)

[Michael.Nord@jhuapl.edu](mailto:Michael.Nord@jhuapl.edu)

[Kirby.Runyon@jhuapl.edu](mailto:Kirby.Runyon@jhuapl.edu)



JOHNS HOPKINS  
APPLIED PHYSICS LABORATORY

# Today's Agenda

- Recap of the Supply & Demand Workshop
- Discussions on Confluence
- Water ISRU Technology Needs
- Setting Year 1 Objectives
- Notices:
  - Artemis Plan: [https://www.nasa.gov/sites/default/files/atoms/files/artemis\\_plan-20200921.pdf](https://www.nasa.gov/sites/default/files/atoms/files/artemis_plan-20200921.pdf)
  - LSIC Fall Meeting: <http://lsic.jhuapl.edu/Events>
  - Next Monthly tag-up (subsumed by the Fall Meeting). Continue discussions on Confluence!

# LSIC Objectives – where we are now

1. Harness the creativity, energy and resources of academia, industry and government in order for NASA to keep the United States at the forefront of lunar exploration → Reflected in our membership  
***Keep working at it.***
2. Provide a central resource for gathering and disseminating information, results, and documentation → Meetings, website, emails.  
***Confluence – now active.***
3. Identify lunar surface technology developments most in need of sponsor support and communicate those to NASA → ***Addressing Needs. Next.***

# The ISRU Supply & Demand Workshop

## September 17, 12-1700, EST

- *Future commercial demand for O<sub>2</sub> propellant bracketed.*
- *Updates on potential supply approaches.*
- *Break-out sessions for each speaker.*
- *A 2-page white paper & pptx being written to be presented to STMD.*
- *Website: <http://lsic.jhuapl.edu/Events/103.php?id=103>*
- *Participants: 219 (max)*

# Supply & Demand Workshop Stats

- **Total Unique Attendees: 219**
  - LSIC Member Attendees: 122 (56%)
  - Non-Member Attendees: 97 (44%)

112 different organizations were represented.

- Government: 42 (28%)
- Industry: 62 (41%)
- Nonprofit: 10 (7%)
- University: 37 (24%)

# Supply & Demand Workshop Take-aways

- There is a real, and near term (less than a decade) potential for a commercial market for liquid oxygen and water sourced from the Moon. Commercial demand ranges from the 10s to hundreds of metric tons a year for O<sub>2</sub>. Smaller needs will exist for crew consumables.
- Demand for metals are expected to quickly follow.
- “Anchor Tenants”, such as NASA and DoD, would be enabling for developing this new marketplace.
- Major outstanding questions are not over quantities or types of products, but secondary issues such as timelines, purity requirements, delivery locations, etc...
- STMD should emphasize ISRU demonstration missions in their near future CLPS allocations and, if possible, consider a full CLPS lander(s) dedicated to ISRU.
- Some predicated on understanding the nature of the water resource.

# Fall LSIC workshop

## October 14-15

Register at: <http://lsic.jhuapl.edu/Events>

- Technical focus *interrelationships between the six LSIC focus areas*
- 45 abstracts submitted
- Day 1 Highlights: NASA HQ updates on Artemis and LSII, funding and flight opportunities panel, posters and networking session
- Day 2 Highlights: Technical break-out sessions discussing how to achieve sustained presence, and what that means, for three different levels of power available (what you bring yourself to the pole, a TBD reasonable, effectively unlimited and continuous).

# ISRU Water-ice Open Discussion

- What technologies do we need to pursue for developing a complete system for extracting, processing water ice, and storing as propellant or for crew consumables. Consider how current uncertainties in water's physical state, abundance, and distribution affects which technologies it would be most useful to pursue.
- Related to the above question, what is the lowest resolution (e.g., 10s km, km, 100s m, etc.) knowledge of the water ice abundance and distribution needed for site selection of a water-ice ISRU pilot plant? And Why? (In other words, what is the spatial scale at which heterogeneity of the distribution at smaller spatial scales doesn't matter?)
- What technologies needs to be pursued to enable a system capable of oxygen extraction from the illuminated polar regolith?

# ISRU Water-ice Open Discussion

- What in-situ resources are NOT being discussed enough? What resource should we be talking about extracting and why?
- What information do you need about the surface for helping you refine technologies to extract, purify, and store resources?
- ISRU is a system challenge. What system's level questions are not being addressed sufficiently? Storage? Purification? Power?
- Should the ISRU FG work with other FGs to solve ISRU needs? Which ones, if so? What are the major concerns? (This has been on our minds LSIC wide for a while and will be a topic at the Fall LSIC meeting.)
- Related: In what areas should we beware of 'stovepiping' ....
- Should we develop sub-FG groups on O<sub>2</sub> and H<sub>2</sub>O extraction? The response to our query has been tepid. Does that mean we should discuss O<sub>2</sub> and H<sub>2</sub>O topics together, or at least at the same meeting? (we can always do breakout groups even if there is interest among only a few for it).
- Add your idea here!

# Upcoming Fall LSIC workshop

## October 14-15

### Draft Agenda

#### Day 1 - October 14, 2020

| PT    | MT    | CT    | ET    | Duration    | Topic  |
|-------|-------|-------|-------|-------------|--|
| 8:00  | 9:00  | 10:00 | 11:00 | 2 hrs       | Welcome and Introduction   |
|       |       |       |       |             | Artemis Update   |
|       |       |       |       |             | LSII Update  |
|       |       |       |       |             | LSIC Status  |
| 10:00 | 11:00 | 12:00 | 13:00 | 45 min      | Lunch break  |
| 10:45 | 11:45 | 12:45 | 13:45 | 1 hr        | ASU Overview and Feature   |
| 11:45 | 12:45 | 13:45 | 14:45 |             | Systems Integration Concerns   |
| 12:00 | 13:00 | 14:00 | 15:00 | 10 min      | Break  |
| 12:10 | 13:10 | 14:10 | 15:10 | 1 hr 20 min | Space Tech Opportunities: Panel Discussion including SBIR, STRG, NIAC, Centennial Challenges, Flight Opportunities |
| 13:30 | 14:30 | 15:30 | 16:30 | 10 min      | Break  |
| 13:40 | 14:40 | 15:40 | 16:40 | 1 hr 20 min | Mentoring, Networking and Posters  |
| 15:00 | 16:00 | 17:00 | 18:00 |             | Adjourn  |

**Key Note Speakers to be announced next week**

#### Opportunities Panel Speakers:

Chris Baker, NASA Flight Opportunities

Jason Derleth, NASA NIAC

Jenn Gustetic, NASA SBIR

Claudia Meyer, NASA STRG

Amy Kaminski, Prizes and Challenges



# Upcoming Fall LSIC workshop

## October 14-15

### Draft Agenda

#### Day 2 - October 15, 2020

| PT    | MT    | CT    | ET    | Duration | Topic   |
|-------|-------|-------|-------|----------|---|
| 8:00  | 9:00  | 10:00 | 11:00 | 15       | Envisioned Future Outbrief  |
| 8:15  | 9:15  | 10:15 | 11:15 | 45       | Power Panel: Systems level concerns & current status                            |
| 9:00  | 10:00 | 11:00 | 12:00 | 20       | BREAK/TRANSITION  |
| 9:20  | 10:20 | 11:20 | 12:20 | 60       | Scenario sessions 1: 2028-2030 timeframe: establishing sustained presence       |
| 10:20 | 11:20 | 12:20 | 13:20 | 20       | BREAK/TRANSITION  |
| 10:40 | 11:40 | 12:40 | 13:40 | 60       | Scenario sessions 2: 2024-2026 timeframe: building towards a sustained presence |
| 11:40 | 12:40 | 13:40 | 14:40 | 20       | BREAK/TRANSITION  |
| 12:00 | 13:00 | 14:00 | 15:00 | 60       | Scenario Outbrief preparation: discuss findings, prepare report for plenary     |
| 13:00 | 14:00 | 15:00 | 16:00 | 10       | BREAK/TRANSITION  |
| 13:10 | 14:10 | 15:10 | 16:10 | 50       | Scenario Report out; Discussion and Next Steps                                  |
| 14:00 | 15:00 | 16:00 | 17:00 |          | Adjourn   |

#### Power Panel Speakers:

Ray Beach, NASA Current status

Anthony Calomino, NASA

Chuck Taylor, NASA

Marija Ilic, MIT

(+1 TBD)



# Fall LSIC workshop

## October 14-15

### Preparation for Fall Meeting Break-outs

- How do you envision a sustained presence in 2028-30 timeframe?
- Existing Resources to consider
  - Artemis Plan [https://www.nasa.gov/sites/default/files/atoms/files/artemis\\_plan-20200921.pdf](https://www.nasa.gov/sites/default/files/atoms/files/artemis_plan-20200921.pdf)
  - Lunar Exploration Roadmap (LEAG) - <https://www.lpi.usra.edu/leag/LER-2016.pdf>
  - Global Exploration Roadmap (GER) -  
[https://www.nasa.gov/sites/default/files/atoms/files/ger\\_2018\\_small\\_mobile.pdf](https://www.nasa.gov/sites/default/files/atoms/files/ger_2018_small_mobile.pdf)

# Focus Group Goal

## (this will be a discussion on the wiki)

- The ISRU FG is charged to define a single 1-year goal.
- **Possible draft:** There is a need for up to 100 metric tons (is this the number?) of O<sub>2</sub> per year for propellant use by the 2030 timeframe (S&D workshop, 2020). The first-year goal of the ISRU focus group is to provide specific recommendations to NASA for maturing the systems-level (end to end processes), and for identifying the ground truth data needed to inform the technology/capability development, for both O<sub>2</sub> extraction from regolith and water extraction from PSRs at the above level.
- Is this
  - Impactful?
  - Address a clear need by NASA (refer to the previously described challenges)?
  - Doable within 1 year?
  - Uses capabilities of focus group members?
  - Can be accomplished by us with existing resources?
  - Beneficial broadly-speaking to all stakeholders?

