

A large blue circular graphic containing the title text, set against a background of Earth from space.

DragonSCALES™ Manufacturing & Technology Update

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CTO, Founder

mPower Technology

April 23, 2026

Overview

- mPower introduction
 - Rapidly evolving space power demands
- DragonSCALES platform
- Manufacturing ramp-up
- Next generation technology and platform developments
- Annealing results
- Conclusions

mPower Overview



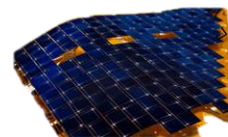
Founded in Albuquerque

- ❖ Spinout from Sandia Labs
- ❖ Manufacturing partner in Conklin, New York



Core Innovation

DragonSCALES™ –
Low-cost, flexible silicon solar modules



Intellectual Property

32 Patents Filed or
Exclusively Licensed



Funding

- ❖ Raised \$47M to date
- ❖ Builds on ~\$20M in R&D at Sandia



Target Space Markets

- ❖ LEO and MEO Constellations
- ❖ Space Mobility
- ❖ Space Logistics/Habitats
- ❖ Lunar/Mars Missions
- ❖ Space-Based Solar Power (SBSP)
- ❖ Orbital (AI) Data Centers

Rapidly Evolving Space Power Demands

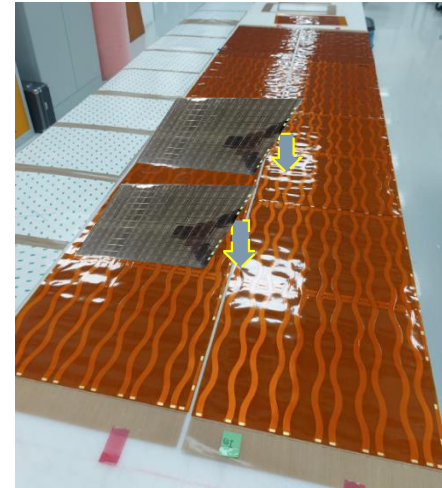
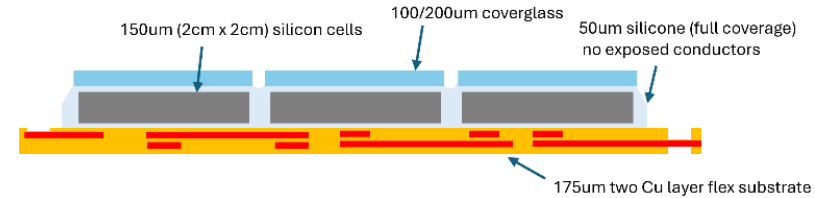
- Space solar demand is over 10MW/yr
- Projections are for 100s MW/yr within 5 years
 - Constellations
 - ~1-2MW per ~300 satellite constellation (5-10kW/sat)
 - ~20-100MW per ~1000 satellite constellation (20-100kW/sat)
 - Orbital data centers
 - 100s of MW to GW+
 - In-space logistics/lunar infrastructure
 - 10-100s of MW to GW+

DragonSCALES



Fully customizable (40cm x 50cm) solar modules composed of laser-diced high efficiency silicon cells interconnected on a flex circuit

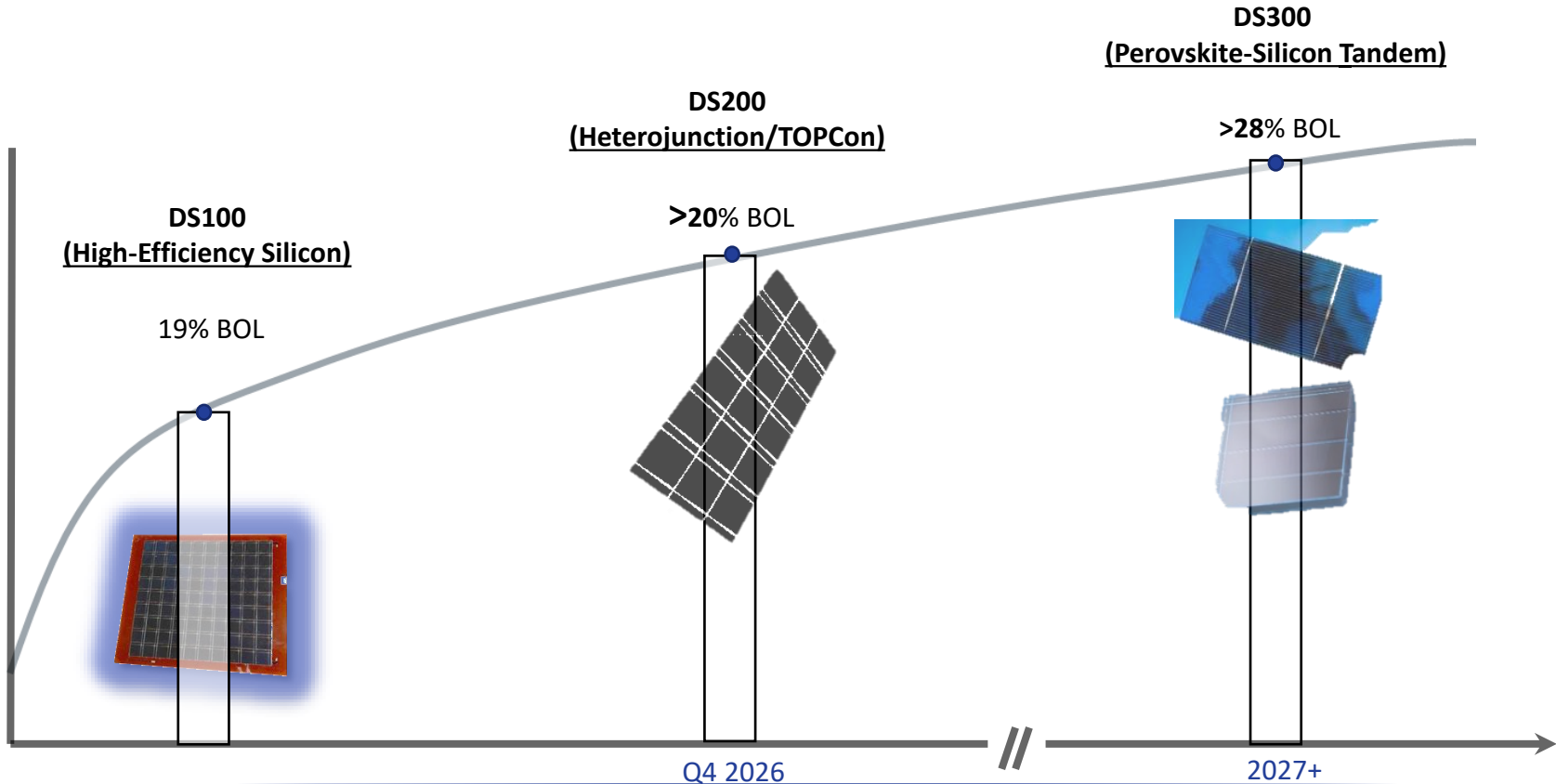
- ✓ Rapidly scalable production (multi-MWs/year)
- ✓ Resilient to damage
- ✓ Light weight and flexible
- ✓ Best-in-class packing factors > 95%
- ✓ Voltage-adjustable
- ✓ Radiation recovery with annealing



High Volume Manufacturing (2MW/yr capacity per unit line)



Next Generation DragonSCALES (cell technology)



Next Generation DragonSCALES (assembly)

DragonSCALES

- 2MW/yr per unit line
 - In production now
 - Replicable in co-located customer environments

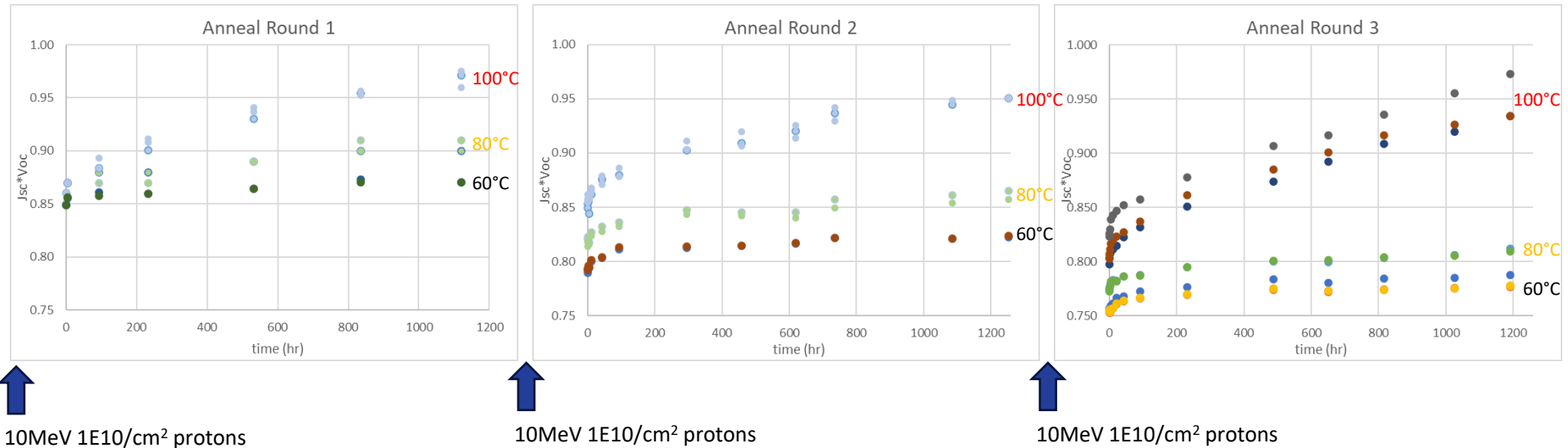
DragonSCALES-XL™

- 10-100kW engineering units available now
- 1-2MW/yr production capability by end of 2026
- 100MW/yr production ramp feasible by Q4 2027 based on customer/market segment demand
- DS100 and DS200 cell technologies
- Targeting extremely large scale and rapid deployments

Annealing Overview

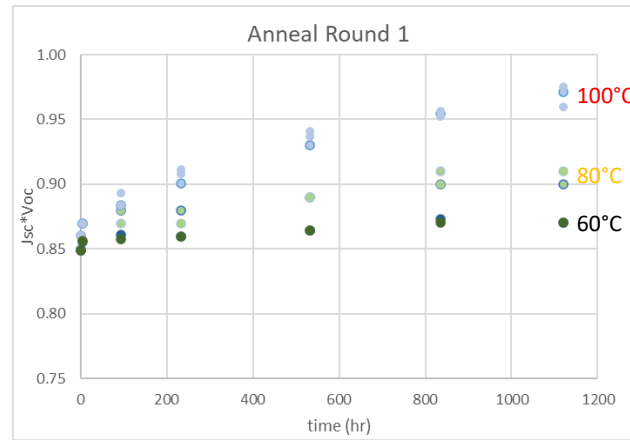
- Decades of radiation data and knowledge across silicon technology base
 - Ion implantation, radiation detectors, solar cells, integrated circuits, ...
- Modern silicon cells: higher BOL efficiency, stable recovery compared to the earlier generations of space solar cells
- Recovery is observed across wide range of cell types and substrate options (thick, thin, n-type and p-type)
- Extensive dataset on current flight cells

Annealing results update

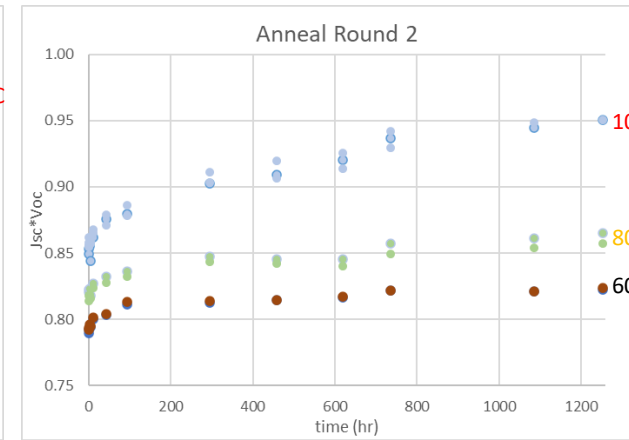


- Same devices exposed and annealed multiple times (broken cells replaced with backup devices)
- Controlled temperature and light during exposure and anneal cycles
- Very consistent recovery rates and damage accumulation behavior observed

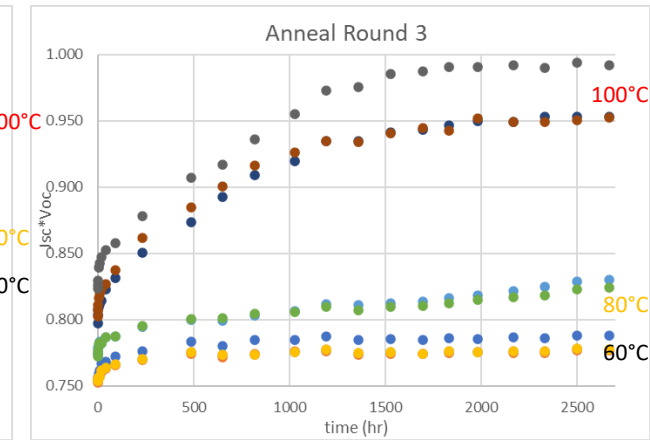
Annealing results update



10MeV 1E10/cm² protons



10MeV 1E10/cm² protons



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Annealing – operational modes

	Baseline	Passive	Active
	No changes in array operation	Open circuit sections when power positive	Route power from other sections to annealed section when power positive
Power Remaining	0.7 → 0.8-0.85	0.7 → 0.85-0.9	0.7 → > 0.95
Temp. range/time during anneal	75°C (throughout mission)	85°C (~2000-4000 hours)	100-110°C (~500-1000 hours)

- Annealing can be performed over multiple cycles over multiple orbits (it is cumulative)
- Annealing can be carried out during non-eclipse phases or during every orbit when power positive (rotating through panels to balance recovery)
- For rapid degradation case (solar flare) – dedicated anneal cycles and faster recovery is also possible (this recovery behavior with silicon cells after a flare has been observed on-orbit in previous missions)
- On-sun time for ~1000km LEO orbit (on average): 70 min/orbit x 14 orbits/day x 365 days = 5960 hours/year
- With orbit precession (53deg. inclination, 1000km), there will be 3-4 ‘always-on-sun’ periods of ~7-10 days (500-1000 hours) per year, allowing enhanced annealing cycles

Conclusions

- Space power demand has expanded rapidly over the last 5 years ($\sim 2\text{MW/yr}$ to $>10\text{MW/yr}$), and it is continuing to accelerate
- Cost effective, rapidly scalable solar arrays are critically important for commercial and government applications
- DragonSCALES has been developed and deployed to meet customer and market demands, our current and next generation products are well positioned to support the next stage of market expansion

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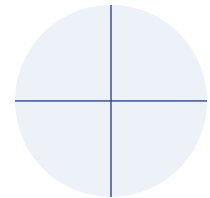
at 2MW/yr →

40 kW/week

5 kW/satellite = 8 satellites/week

20 kW/satellite = 2 satellites/week

DragonSCALES



$$\frac{d(\text{Energy})}{dt} = \text{Power}$$

at 20MW/yr →

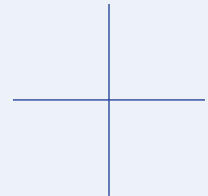
400 kW/week

5 kW/satellite = 80 satellites/week

20 kW/satellite = 20 satellites/week

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DragonSCALES-XL



$$\frac{d(\text{Energy})}{dt} = \text{Power}$$

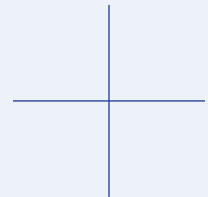
at 200MW/yr →

4,000 kW/week

5 kW/satellite = 800 satellites/week

20 kW/satellite = 200 satellites/week

DragonSCALES-XL



$$\frac{d(\text{Energy})}{dt} = \text{Power}$$

at 2,000MW/yr →

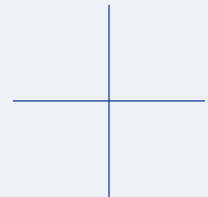
40,000 kW/week

5 kW/satellite = 8,000 satellites/week

20 kW/satellite = 2,000 satellites/week

*cars built in US = 200,000 cars/week

DragonSCALES-XL



*m*Power

Goal: support the scale and speed of deployment
of power needed by our customers and partners

DragonSCALES

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