



OPTICAL POWER BEAMING

Laser beam incident on NREL-fabricated photovoltaic receiver cell. Photo by Daniel Friedman, NREL

Reliable Power for Remote Applications

Optical power beaming has the potential to fundamentally change how remote devices receive power, leading to technological innovation across many sectors. NREL is interested in teaming with partners to engineer field-ready (and space-ready) solutions for long-range power beaming and adapt new ideas to important applications.

A Wireless Extension Cord

The advantage of power beaming is to deliver energy to end-uses that might be otherwise impractical to serve with standard power lines. Remote power also means that remote devices can free up space for on-site payloads and supplies. Potential applications include:

- Forward operating bases/remote communities
- Remote disaster recovery
- Unmanned aerial vehicles
- Remote sensors and communication towers
- Field personnel

Why Partner with NREL?

NREL has a long history of developing record-efficiency photovoltaic devices that shape industry. Our impact starts in the lab with capabilities and expertise that are unmatched. Partnering with NREL means access to:

- Fabrication and design of PV receiver cell architectures with extremely high performance over a range of bandgaps and across all major epitaxy techniques
- Thermal and optoelectronic characterization at irradiances comparable to those in commercial application
- Technoeconomic and life-cycle studies of product designs and costs
- Reliability and degradation testing, and root-cause failure analysis
- Simulation and experimental testing of power beaming system integration with the grid
- Researchers that have designed record-setting and award-winning solar technologies
- Comprehensive modeling of PV devices and their thermal management.

Enabling Remote Power to Go the Distance

With remote power, devices can stay in the field longer and support hard-to-reach, critical applications. NREL capabilities can help to jumpstart innovation and advance the state of the art in optical power beaming.

- **Development:** NREL's considerable research expertise in solar cells is applied to receiver cells which are very similar conceptually. We can develop and fabricate PV receiver cells designed to function at irradiances as high as 100 watts/cm² and at bandgaps from 0.6–2.1 eV (wavelengths from 600 to 2000 nanometers). Our fabrication methods include all major III-V epitaxial growth techniques—including low-cost hydride vapor-phase epitaxy—as well as substrate removal, photolithography, and optical coatings.
- **Characterization:** We are able to characterize optoelectronic, reliability, and mechanical aspects of devices in experimental settings that replicate real-world operation.
- **Technoeconomic analysis:** We have models and analytical resources to study the supply chains, electricity costs, and future market applications of optical power beaming. We can help partners foresee the impact of new products under a range of technoeconomic scenarios.
- **Systems integration:** We use modeling, simulation, and integrated experiments with real power hardware to develop methods for real-time co-optimization with the grid. Housed in NREL's Energy Systems Integration Facility, our systems integration infrastructure allows us to study device performance within larger energy systems.

Partner with Us

We have multiple paths for partnering including licensing NREL intellectual property, testing and characterization, technoeconomic analysis, and generating new technology solutions through cooperative R&D agreements.



Researchers at the National Renewable Energy Laboratory Flatirons Campus near Boulder, Colorado, partner with a team from the Pacific Northwest National Laboratory to improve wildlife impact minimization efforts. Unmanned Aerial Vehicles (UAV) were being used to simulate bird flight patterns near the wind turbines at the facility. Power beaming to UAVs could be used to enable unlimited UAV flight times, greatly improving the productivity of this and other UAV applications.

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