Amonix
Concentrated Photovoltaic Systems

Center for Energy Research UNLV

Amonix
Concentrated PV System

A State-of-the-Art Solar Power System

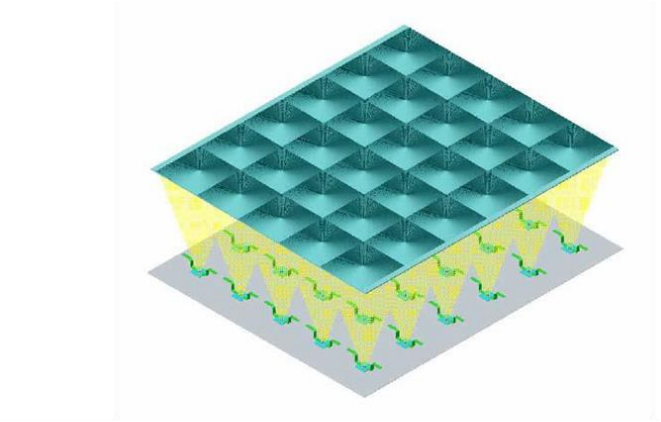
- The most common photovoltaic (PV) systems are stationary flat-plate ‘one-sun’ systems, as commonly seen on roof-tops.
- ‘One-sun’ systems are:
  - Costly,
  - Covered in expensive solar cells, and
  - Rely upon the direct illumination of the entire surface.
- In 2004, UNLV’s Center for Energy Research -- in partnership with the Nevada Southwest Energy Partnership (NSWEP) -- installed a different kind of solar power generating system: the Amonix IHCPV system – an Integrated High-Concentration Photovoltaic System.
- Manufactured by Amonix™, the first Megamodule™ system – Model 5500 – was a single junction silicon system with a 25 kW rating and 250X concentration.
- It had a conversion efficiency of sunlight to AC electricity of 16%.

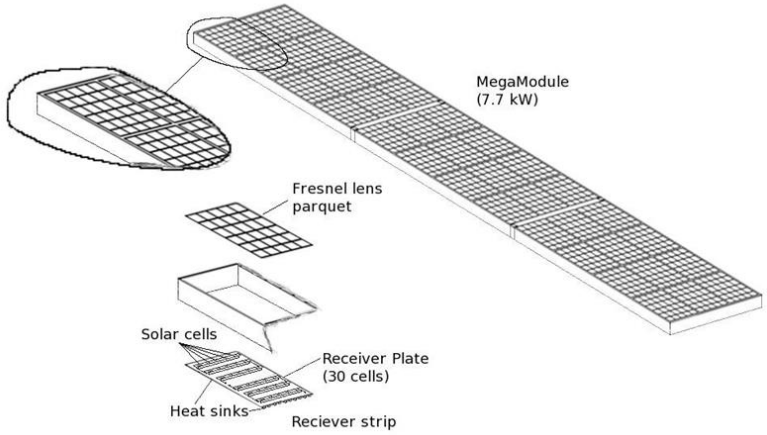
Unique Design

- In 2009, the 5500 model was upgraded to the 7500 model with a 25% efficiency, the first to be produced by Amonix.
- Each MegaModule has 1080 cells and Fresnel lenses. This requires two axis tracking, which is an advantage for generating the most energy and power possible.
- Each module has a rating of about 7.7 kW AC per module, making the 7700 rating a 53 kW system and the 7500 a 38 kW system.
- The controller, hydraulic package, drive, and software of the 7700 also was newly designed.

Concentrated Solar Power

- This system uses Fresnel lenses
- between the sun and the cell.
- These act like magnifying lenses to focus sunlight onto the solar cell, which is 500 times smaller than the cell area of a ‘one-sun’ cell.
- Fresnel lenses are made of inexpensive plastic, replacing expensive silicon solar cells





Energy Efficiency

- In order to absorb the most direct normal light, the efficiency of any solar-electric system increases if the sun is tracked.
- The Amonix system is an example of a ‘concentrator’ system – it is not stationary, but instead uses a tracking concentration scheme by use of Amonix’s proprietary hydraulically-driven, dual-axis tracker.

Nevada Power Clark Station

- In July 2006, Amonix partnered with Nevada Power, UNLV, the National Renewable Energy Laboratory, and Bombard Electrical to install and maintain three CPV systems using MegaModule technology – Model 5500 – at the Nevada Power Clark Station. Later, these were converted to multi-junction cells.
- One of the great benefits of these solar power systems is that they do not use water for power generation, very important in the desert climate of Nevada.

Publications

A. Sahm, A. Gray, R. Boehm, K. Stone, Cleanliness maintenance for an Amonix lens system, Proceeding of ISEC2005, Solar Energy Conference, Orlando, August 6-12, 2005.

"Analysis of five years of field performance of the Amonix high concentration PV system" Kenneth W. Stone, Vahan Garboushian, Robert Boehm, Rick Hurt, Allison Gray, Herb Hayden, Powergen 2006, April, 2006, Las Vegas, NV.

K. Stone, A. Gray, V. Garboushian, K. Markarian, R. Boehm, R. Hurt, G. Wood, H. Hayden, and T. Fletcher, "Installation and operation of the Amonix High Concentration PV System At Nevada Power Company in Las Vegas, Nevada", IEEE 4th World Conference on Photovoltaic Energy Conversion, May 7-12, 2006, Waikoloa, Hawaii.

K. Stone et al., “Operation and Performance of the Amonix High Concentration Photovoltaic System at the University of Nevada, Las Vegas during the Second Year of Operation,” Paper ISEC2006-99076, 2006 International Solar Energy Conference, July 8-13, 2006, Denver, CO.

K. W. Stone, R. Gordon, D. Dutra, A. Gray, R. Hurt, R. Boehm, M. J. Hale, F. P. Eddy, Field testing and performance of an Amonix multijunction cell mode at the University of Nevada Las Vegas, Proceeding of Energy Sustainability 2007, June 27-30, 2007, Long Beach, California, USA.

A. Gray, R. Boehm, K. W. Stone, Modeling a passive cooling system for photovoltaic cells under construction, Proceeding of Heat Transfer Conference, June 27-30, 2007, Long Beach, California, USA.

A. Sahm, K. Stone, R. Boehm, A. Gray, Modeling a High Concentration Photovoltaic System, SOLAR 2008 Conference Proceedings, May3-8 2008, p115, San Diego, California, USA.

Sahm, R. Boehm, K. Stone, K. Johnson, Performance of the Amonix High Concentration Photovoltaic System at the NV Energy Clark Station, Proceedings of the Inaugural US-EU-China Thermophysics Conference, May 28-30, 2009 Beijing, China.

Publications Continued

L. Banchik, A Sahm, R. Boehm, K. W. Stone, Fresnel lens soiling characterization and effect upon performance, Proceedings of ES2009, Energy Sustainability 2009, July 19-23, 2009, San Francisco, California, USA.

G. Wood, K. W. Stone, A. Sahm, R. Hurt, R. Boehm, Installation and Operation of Southern Nevada Water Authority High Concentration Amonix Multi-Junction System, Proceedings of the ASME 2010 4th International Conference of Energy Sustainability, ES2010, May 17-22, 2010, Phoenix, Arizona, USA.

KM N. Ahsan, R. F. Boehm, Y. Chen, and J. Nie, "Numerical Modeling of Turbulent Natural Convection in Concentrating Photovoltaic System," Proceedings of the 4th International Conference on Energy Sustainability, ES2010-90187, ICOES4, May 17-22, 2010, Phoenix, Arizona, USA.

G. Wood, K. W. Stone, A. Sahm, R. Hurt, R. Boehm, Performance of the Amonix's High Concentrating Multi-junction Photovoltaic System at Southern Nevada Water Authority River Mountain Water Treatment Facility. Proceedings of the ASME 2011 5th International Conference on Energy Sustainability, ESFuelCell2011, August 7-10, 2011 Washington D.C., USA.

A. Sahm, K Agyenim-Boateng, K. Hynes, K. Hammer, T. Roberts, R. Boehm, K. W. Stone, Two Types of Calorimeters for Assessing Fresnel Lens Performance in Concentrating Solar Systems, Proceedings of the ASME 2011 5th International Conference on Energy Sustainability, ESFuelCell2011, August 7-10, 2011 Washington D.C., USA.

Resources

- Nevada Southwest Energy Partnership (NSWEP)
  - www.nswep.org
- Amonix
  - www.amonix.com
- Spectrolab
  - www.spectrolab.com

For More Information

Center for Energy Research at UNLV
100 Taylor Hall
University of Las Vegas, Nevada Box 454027
Las Vegas, NV 89154-4027
Phone: (702) 895-1125
Fax: (702) 895-1123

Rick Hurt
Rick.hurt@unlv.edu
Aaron Sahm
Aaron.sahm@unlv.edu

Yitung Chen, Ph.D
Phone: (702) 895-1202
Email: yitung.chen@unlv.edu

Co-Director:
Yahia Baghzouz, Ph.D., P.E.
Phone: (702) 895-0087
Email: yahia.baghzouz@unlv.edu