Innovative Solar Electric Solutions

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Overview

- INNOVATIVE SOLAR ELECTRIC TECHNOLOGIES *
- UNI-SOLAR MANUFACTURING & TECHNOLOGY
- UNI-SOLAR SYSTEMS FOR SCHOOLS
- UNI-SOLAR SYSTEMS FOR OTHER INNOVATIVE APPLICATIONS

*Summary of US DOE Energy Technologies Program Overview & Highlights
*DOE/GO-102006-2314 – May 2006

DOE-SOLAR ENERGY TECHNOLOGIES PROGRAM OVERVIEW

Cadmium Telluride

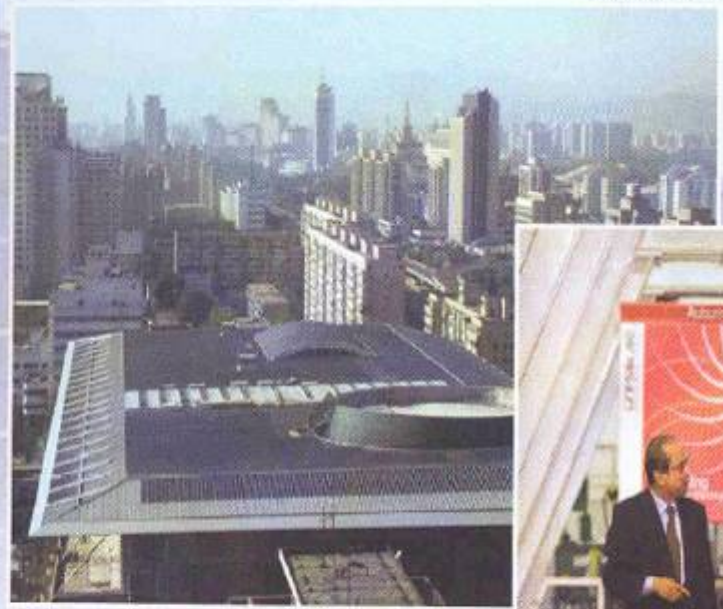
First Solar, LLC, is the major Thin Film PV Partnership industry partner focusing on cadmium telluride (CdTe) thin films. The company sold about 20 MW of CdTe PV in 2005 and is planning to increase its production capacity to 100 MW in 2007. In 2003, First Solar and NREL shared an R&D 100 Award for developing an innovative CdTe module manufacturing process.

First Solar CdTe thin-film modules in a 1.3-MW solar field, Germany.

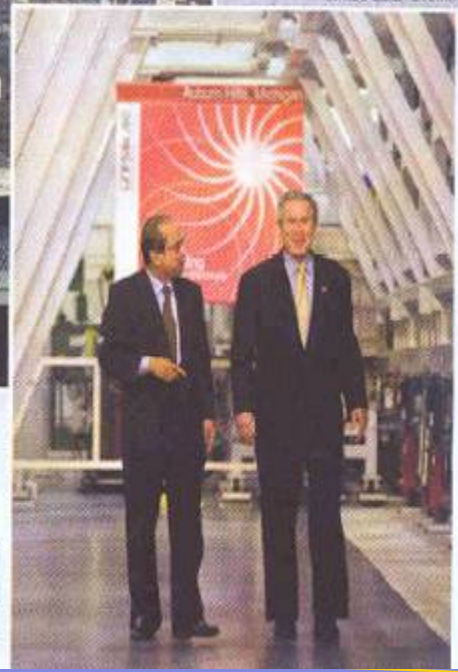
DOE-SOLAR ENERGY TECHNOLOGIES PROGRAM OVERVIEW

Amorphous Silicon

United Solar Ovonic (Uni-Solar) manufactures a 136-watt (W) "peel-and-stick," flexible, multijunction amorphous silicon (a-Si) thin-film module for commercial rooftop applications. Its sales in 2005 were about 22 MW. Uni-Solar has also reported achieving a record 15.1%-efficient (active area, initial efficiency) tandem a-Si/nanocrystalline-Si cell. Improving this technology to the point of commercial production is a major focus of Uni-Solar's continuing R&D efforts.



Uni-Solar "peel-and-stick" a-Si thin-film modules in a 300-kW array, Beijing Capital Museum, China.

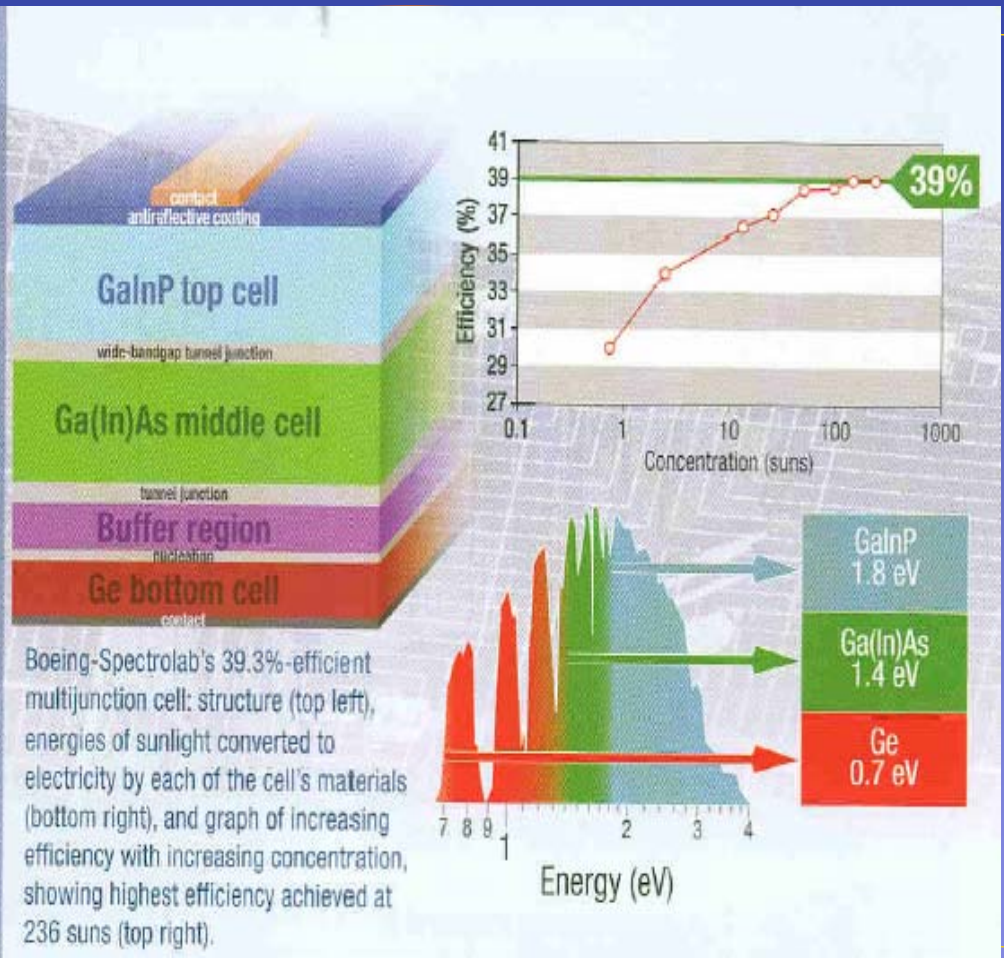


President George W. Bush tours Uni-Solar's manufacturing plant in Michigan to highlight his 2006 Solar America Initiative.

DOE-SOLAR ENERGY TECHNOLOGIES PROGRAM OVERVIEW

Multijunction Concentrators

PV concentrator systems use relatively inexpensive optics to concentrate sunlight onto a small area of high-efficiency multijunction cells. When sunlight is concentrated onto multijunction cells, they become even more efficient than under normal ("1-sun") conditions. As part of the HiPer PV project, NREL recently fabricated an "inverted" multijunction cell with a world-record efficiency of 37.9% at a concentration of 10.1 suns—see the Electronic Materials & Devices highlight on page 7. Boeing-Spectrolab achieved a world-record 39.3% efficiency for another type of multijunction cell—the highest NREL-confirmed efficiency ever measured for a PV device.

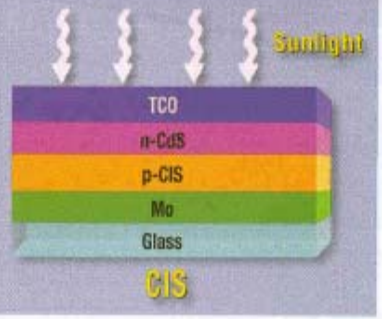


Boeing-Spectrolab's 39.3%-efficient multijunction cell: structure (top left), energies of sunlight converted to electricity by each of the cell's materials (bottom right), and graph of increasing efficiency with increasing concentration, showing highest efficiency achieved at 236 suns (top right).

DOE-SOLAR ENERGY TECHNOLOGIES PROGRAM OVERVIEW

Copper Indium Diselenide

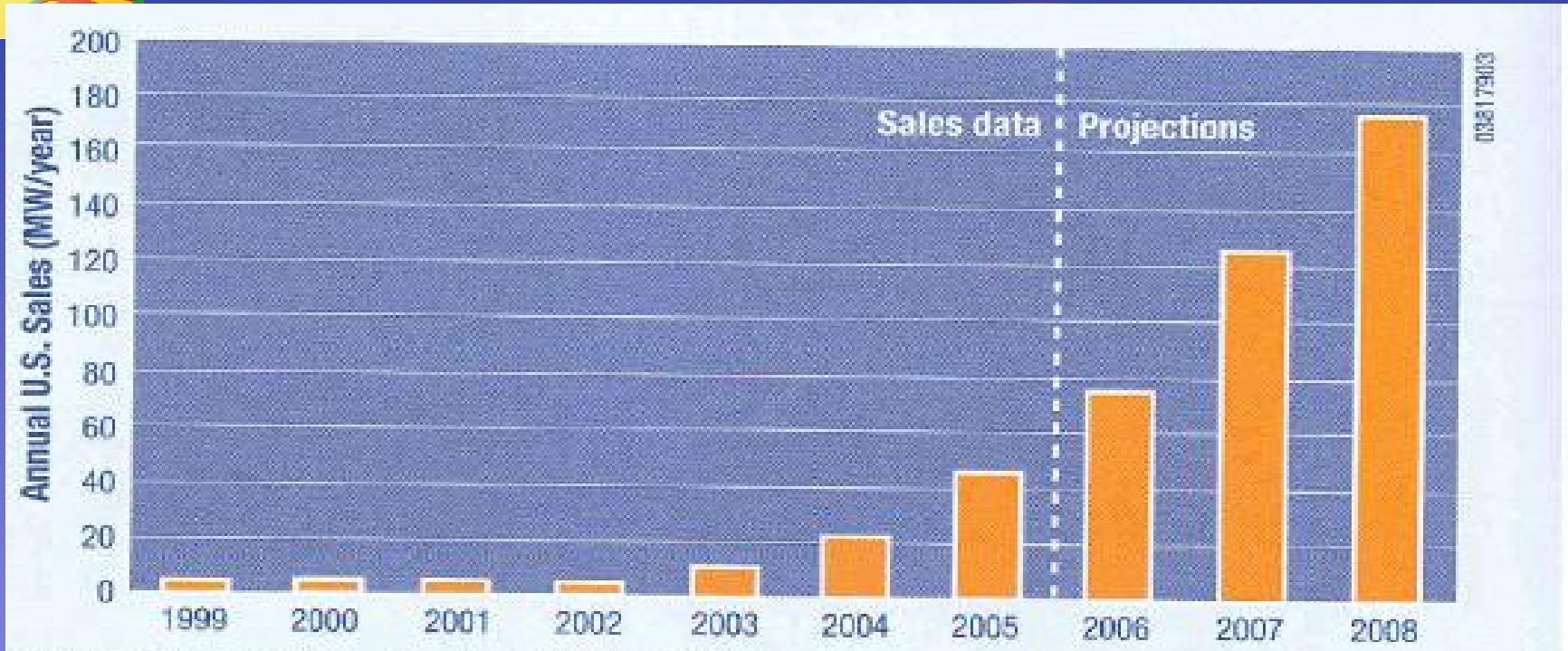
Shell Solar Industries manufactures thin-film modules based on copper indium diselenide (CIS, which is called CIGSS when the elements gallium and sulfur are added). The company has fabricated an 11.7%-efficient, 86-W thin-film CIGSS module, which is entering the European market in 2006. Shell Solar collaborates extensively with NREL and the Partnership's National CIS R&D Team. Among other accomplishments, NREL researchers have fabricated a thin-film CIGS solar cell with a record total-area efficiency of 19.5% using an NREL-patented three-stage process.



Shell Solar 1.5-kW array composed of 80-W CIS modules undergoing long-term reliability testin at NREL's Outdoor Test Facility.

DOE Solar Energy Technologies Program Overview

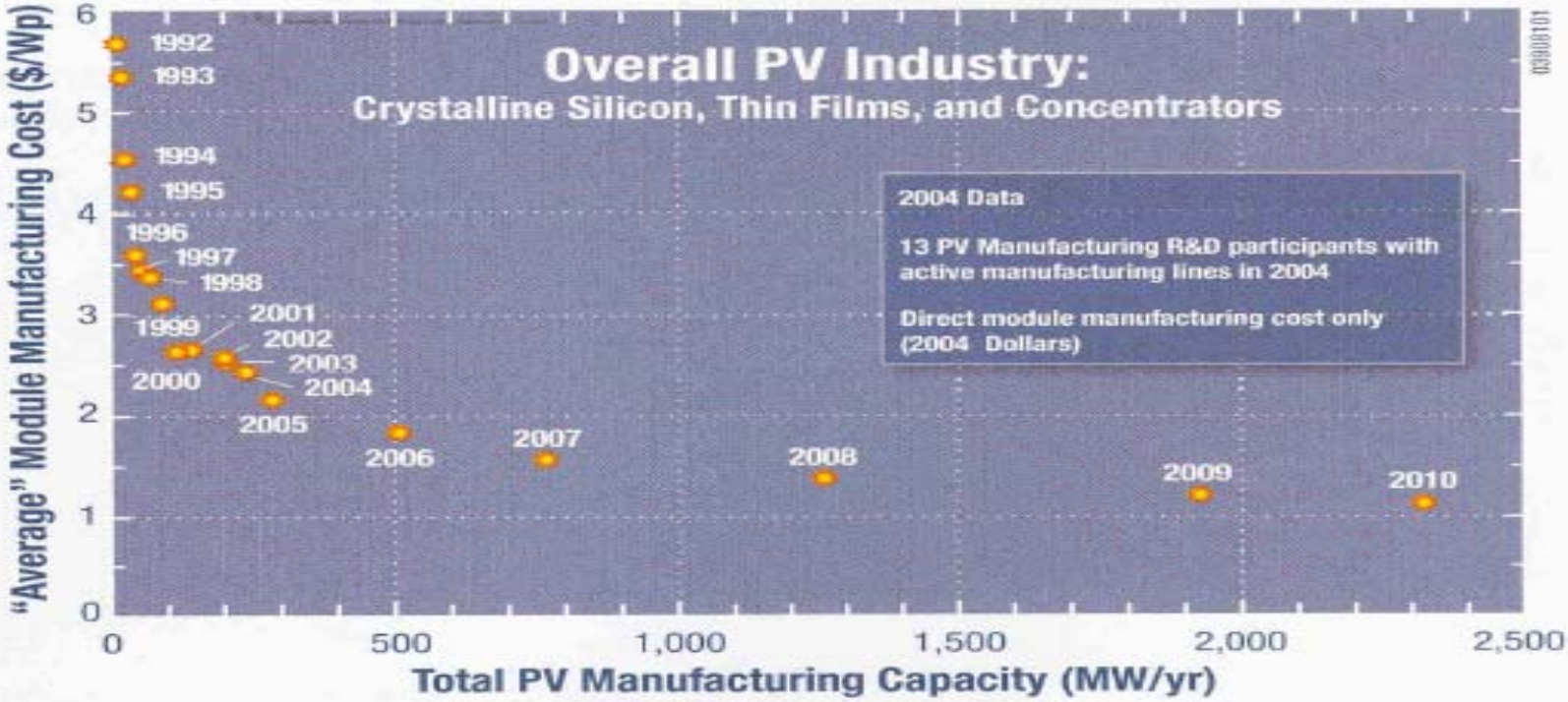
DOE-SOLAR ENERGY TECHNOLOGIES PROGRAM OVERVIEW



Historical (through 2005) and projected (2006–2008) U.S. sales of thin-film PV modules made in the United States. Source: NREL.

DOE Solar Energy Technologies Program Overview

DOE-SOLAR ENERGY TECHNOLOGIES PROGRAM OVERVIEW



U.S. PV module manufacturing cost vs. capacity, 2004. Since 1992, production capacity of PVMR&D participants grew from 14 to 240 megawatts at the close of 2004—a 16-fold increase. At the same time, direct manufacturing costs (in 2004 dollars) declined from $5.70 to $2.44 per peak watt, a 57% decrease. Year 2005–2010 projections shown on the graph are PVMR&D goals.

Corporate Profile

UNI-SOLAR is a world leader in thin-film solar technologies. A company with years of experience in photovoltaics, ***UNI-SOLAR*** is fast-growing in advanced materials and renewable energy, and owned by U.S. technology leader Energy Conversion Devices, which holds 335 U.S. patents and 590 foreign patents. Our technology has proven itself over decades under the most extreme conditions imaginable, including satellites, ocean buoys and military applications

Corporate Sales and Marketing Office:
3800 Lapeer Rd.
Auburn Hills, MI 48326
(248) 475-0100

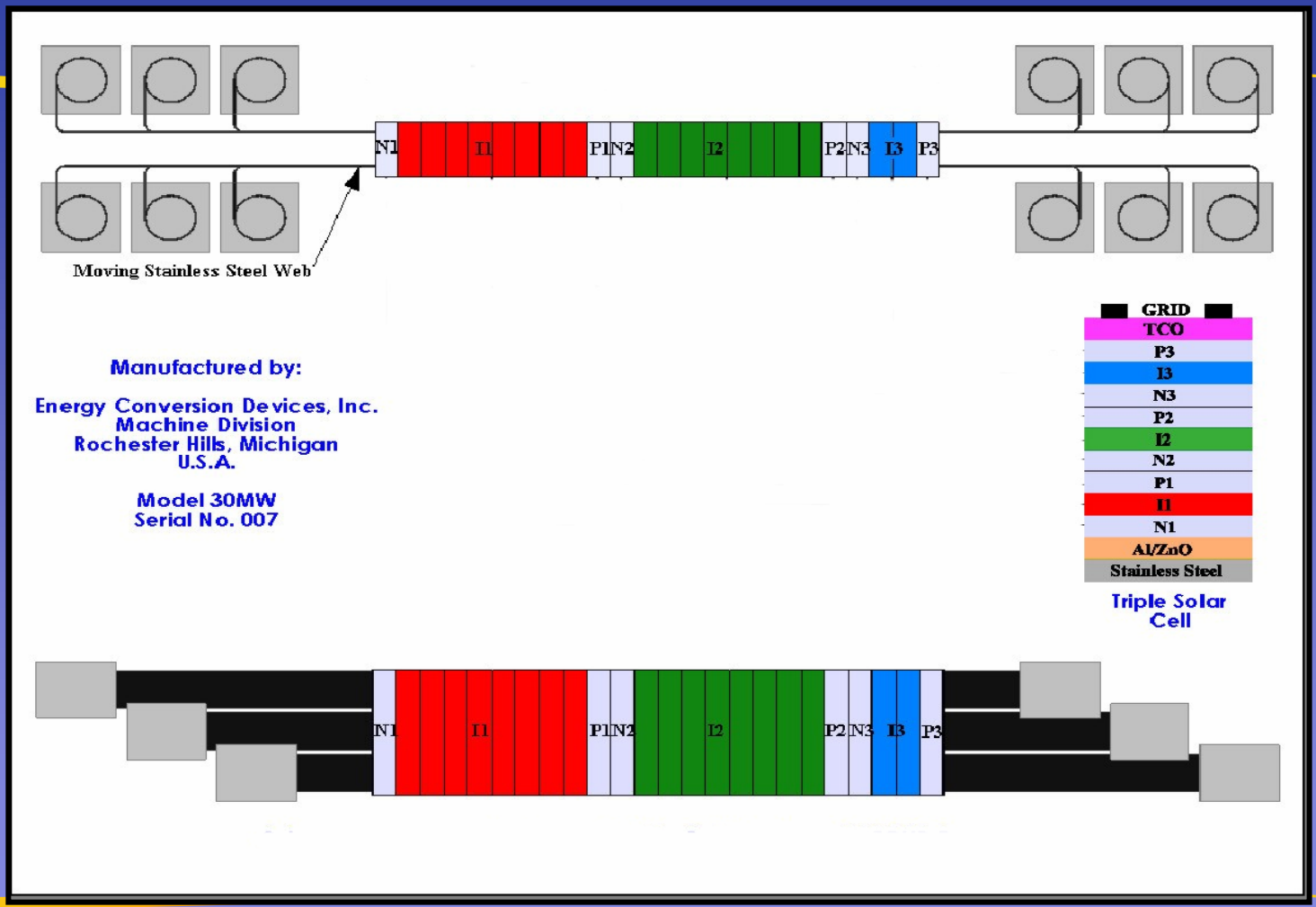
Manufacturing Technology

- Roll-to Roll Manufacture
- Tight tolerances
- Every 62 hours
  - 6 tons steel
  - 9 miles of solar cells
- Each roll 1.5 miles long

✓High volume thin film PV technology

✓Encapsulation automated for large roofing products

Manufacturing Process



United Solar Ovonic Expands Capacity

- Auburn Hills, MI - Current production capacity of 58+ MW per year with second production facility in full operation in 2007.
- Greenville, MI - First phase of the expansion – 60 MW per annum – under way in 2007.
- **Capacity expansion to 300 MW+ per annum by 2010.**

Industrial Roofing Applications

330kW membrane roofing at the Coca Cola plant in Los Angeles, California.

PV Laminates for Membrane Roofing Systems

UNI-SOLAR® products are **easier to install** on commercial building's requiring fewer man-hours for installation.

UNI-SOLAR® products are **flexible and light weight** (less than 1 lbs/sq ft) cf. more than 5 lbs/sq ft for the competition

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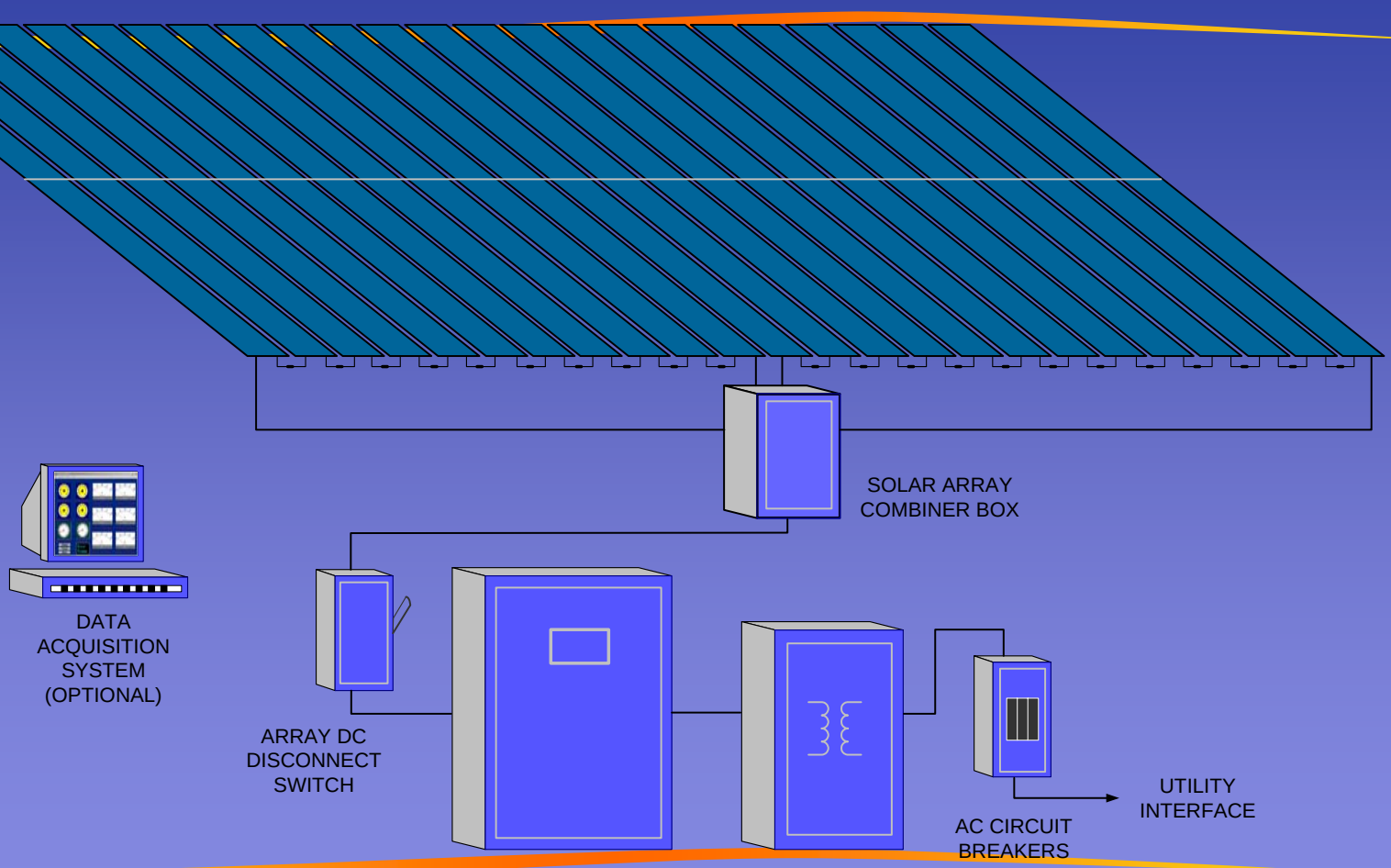
UNI-SOLAR Product Benefits

- Extremely durable – able to withstand flying debris & stays adhered to roofing material even in category 4 winds
- Shadow Tolerant
- Superior High Temperature Performance
- More Real Power per Rated Watt
- More Delivered Energy (Up to 25%)

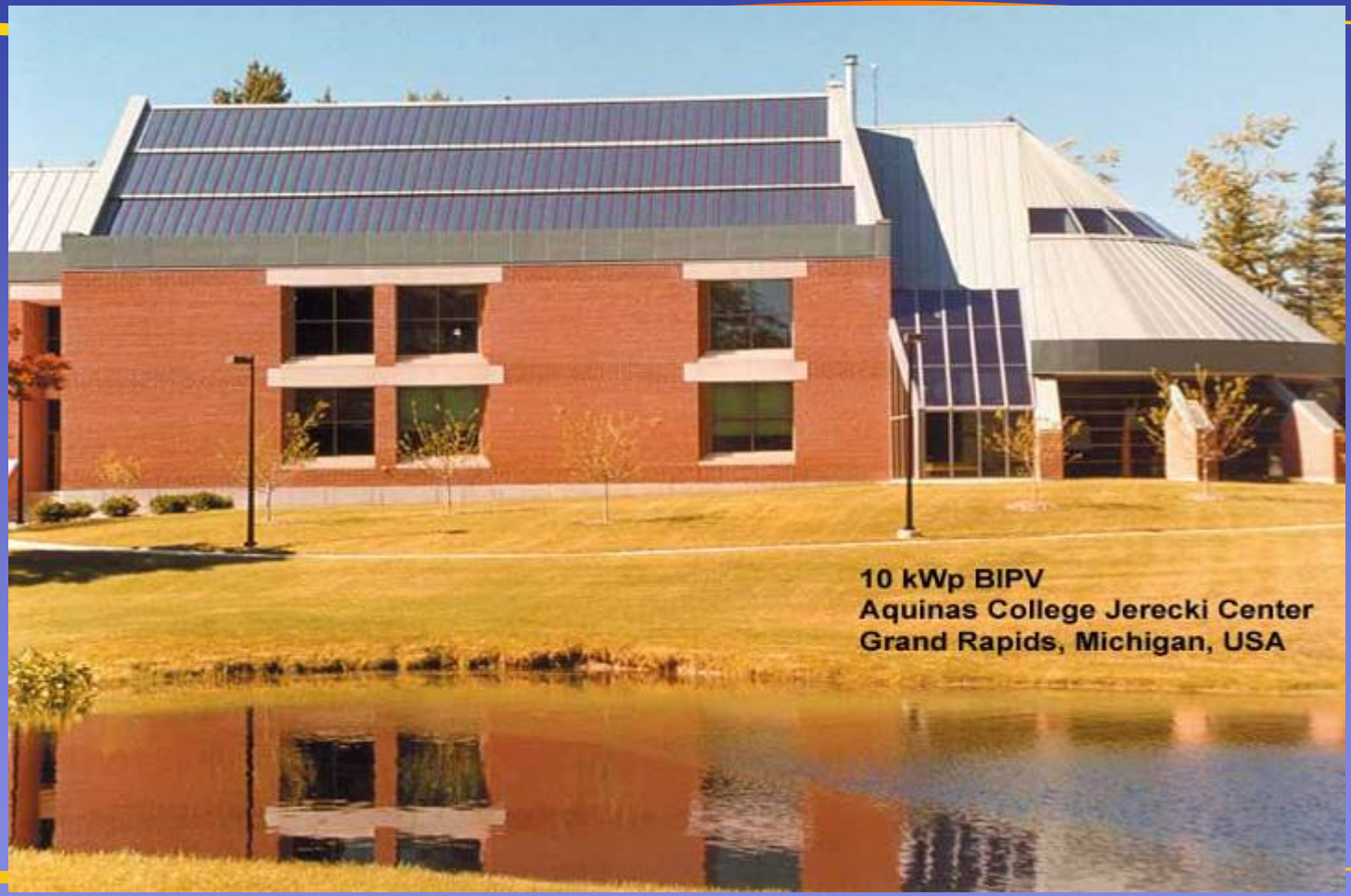
System Components



UNI-SOLAR SYSTEMS FOR SCHOOLS

4kW PV on Metal, Montara Elementary School, South Gate, CA

10 kWp BIPV Aquinas College
Jerecki Center, Grand Rapids, MI

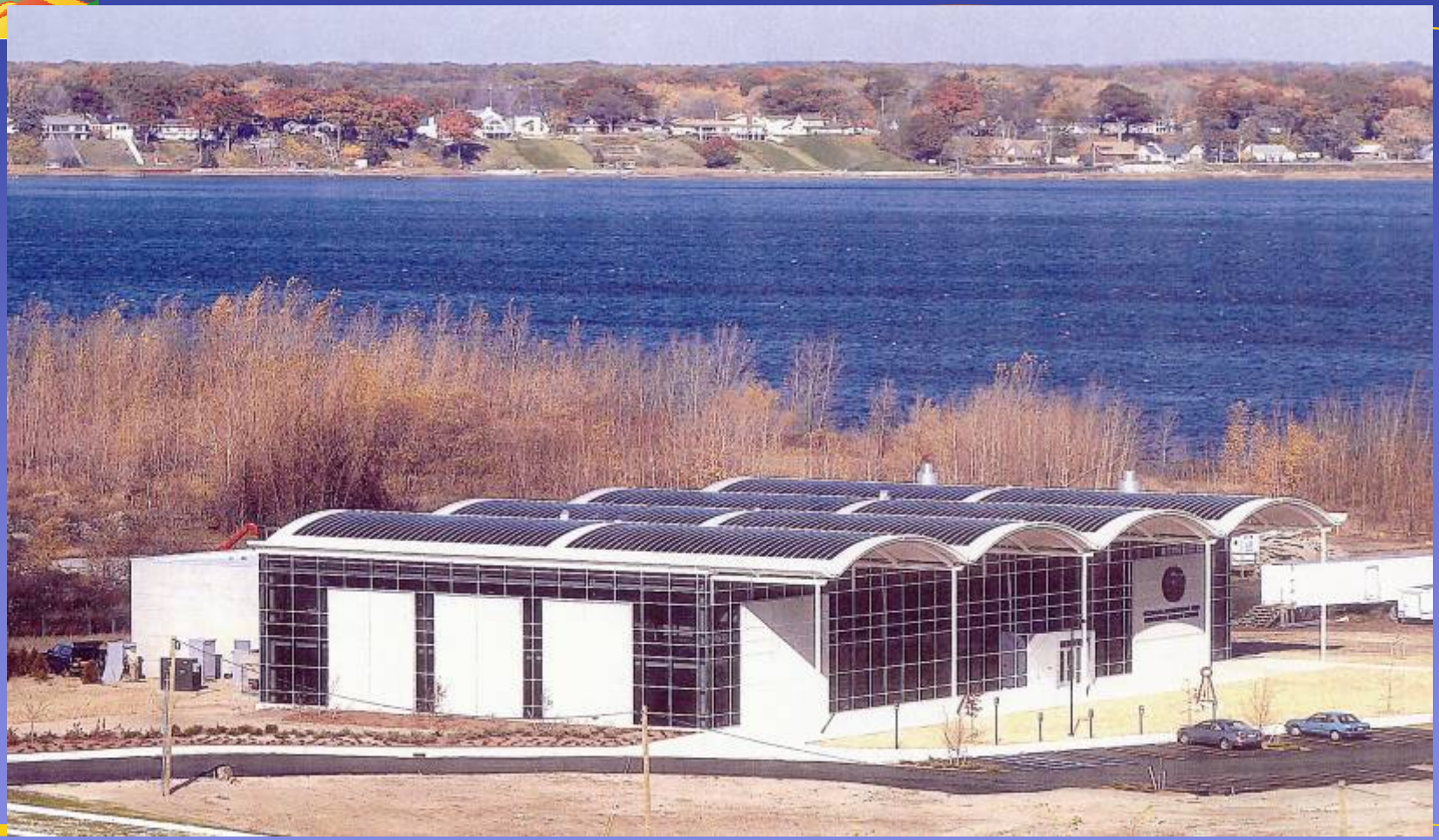


10kW PV on Metal Mendoza School Building, Imperial Beach, CA

10kW Shingle System, Oakland University, Rochester, MI

30kW PV on Metal, Samuel T. Dana Bldg, University of Michigan, Ann Arbor, MI

30kW Integrated Roofing system, Grand Valley State University, Muskegon, MI



42kW System at Pioneer Elementary School, Brentwood, CA

12.5 kWp Shingle Roof System Student Residence Townhouses, Fairfield University, Connecticut

PV Shingles, Cass Tech Students, Detroit, MI

11kW PV on Metal, Glenmead Elementary School, Chino Hills, CA

39 Ground Mounted 2.3 kW
Uni-Solar Systems for Rural Schools in Thailand

OTHER INNOVATIVE APPLICATIONS OF UNI-SOLAR SYSTEMS

51kW PV on Metal, Façade, ThyssenKrupp Stahl, Duisburg, Germany

Innovative Laminate Applications
Germany

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August 7

10kW PV Shingle System, Emergency Power Back-up for Public Radio Communication systems, Troy, MI

Laos Telecommunications – One of 6 installed microwave repeater systems-each powered by a 3kW system

California's First Solar Project to Power Oil Production

This 500 kWac ***UNI-SOLAR*** amorphous-silicon solar technology was installed in 2002 and is reliably producing 900,000 kWh/year as predicted.

Housing – U.S. Army – 6 MW

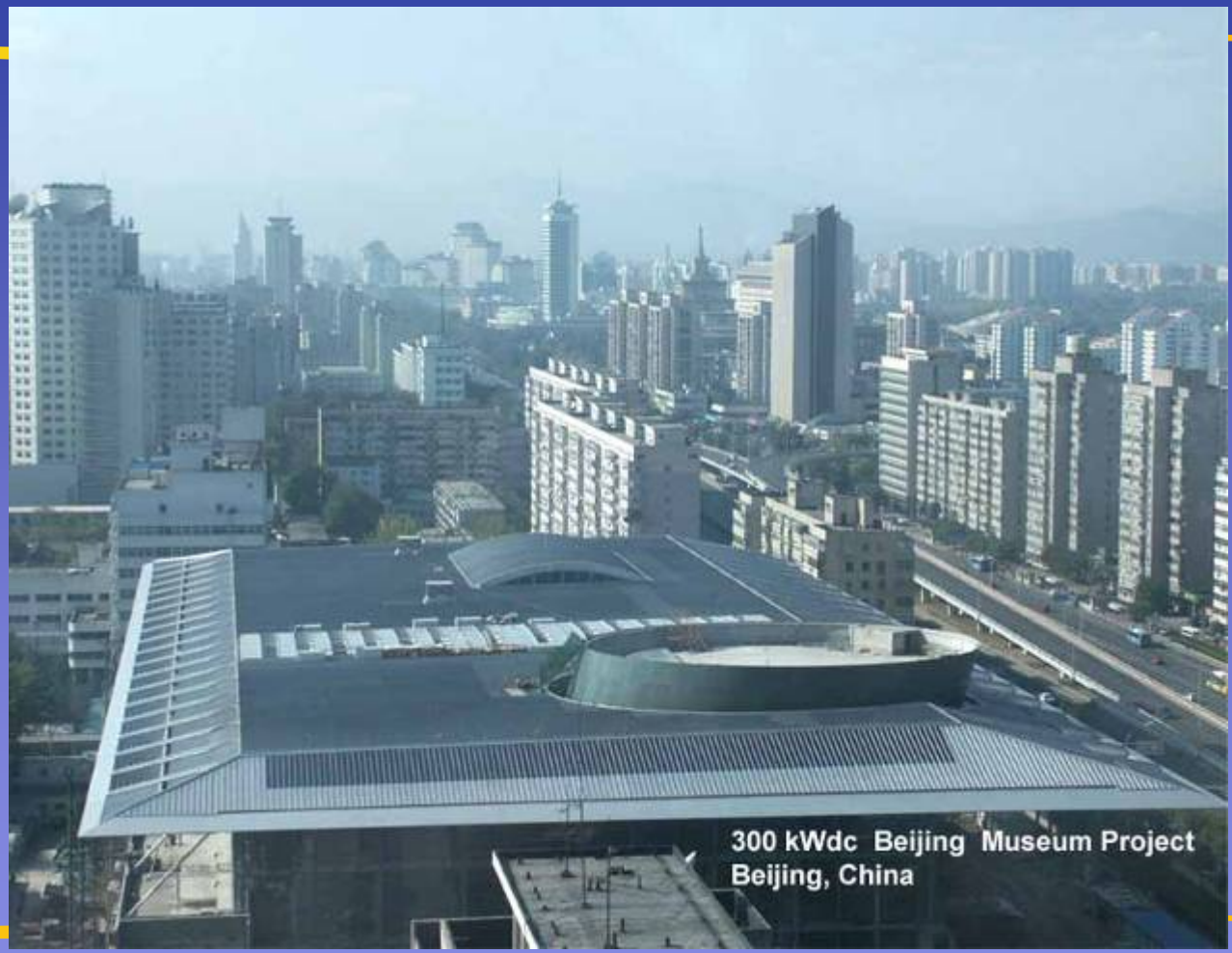
- U.S. Army Residential Communities Initiative and Actus Lend Lease building world's largest solar powered community on Oahu, Hawaii – 6 MW Uni-Solar PV
- 5,388 New Homes
- 2,506 Existing Home Renovations
- 10 New Community Centers
- Will Save 18,000 barrels of oil annually

Solar Opportunity in States with Incentives (CA, NY, NJ, etc.)

- Solar systems can be purchased or made available under 20-year Power Purchase Agreements
- Clean Energy Production with good ROI
- Distributed generation and back up power capability improves energy security
- Hedge against future electricity price increases

329 kW PV Membrane System, Coca-Cola Bottling Plant, Los Angeles, CA

300 kWdc Beijing Museum Project Beijing, China



Thank You!

30 kW SolarPort at the Santa Monica Civic Auditorium
using UNI-SOLAR's building-integrated, standing seam metal roof PV product

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August 7

Would you like to know more about this session?

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- Don’t forget to fill out and drop off your session evaluations.

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