

4 Times Square

Location:	Broadway and 42nd Street, New York City, New York
Owner:	Durst Corporation
Date Completed:	September 1999
Architect & Designer:	Fox & Fowle Architects, building architects; Kiss + Cathcart Architects, PV system designers
PV Structural Engineers:	FTL/Happold
Electrical Engineers:	Engineers NY
Tradesmen Required:	PV glazing done by shop labor at curtain wall fabricator
Applicable Building Codes:	New York City Building Code
Applicable Electric Codes:	New York City Electrical Code and National Electric Code
PV Product:	Custom-sized BIPV glass laminate
Size:	14 kWp
Projected System Electrical Output:	13,800 kWh/yr
Gross PV Surface Area:	3,095 ft ²
PV Weight:	13.5 lb/ft ²
PV Cell Type:	Amorphous silicon
PV Module Efficiency:	6%
PV Module Manufacturer:	Energy Photovoltaics, Inc.
Inverter Number and Size:	Three inverters; two 6 kW (Omnicor Corp.), one 4 kW (Trace Engineering)
Inverter Manufacturers:	Omnicor Corp. and Trace Engineering
Interconnection:	Utility-Grid-Connected



Kiss + Cathcart, Architects/PIX08458

Close-up view of curtain wall illustrates that BIPV panels (dark panels) can be mounted in exactly the same way as conventional glazing (lighter panels).

Thoreau Center for Sustainability

Presidio National Park, Building 1016

Location:	Presidio National Park, Building 1016, San Francisco, California
Owner:	U.S. Department of Interior, National Park Service
Date Completed:	May 1996
Architect & Designer:	Tanner, Leddy, Maytum, Stacy
Structural and Electrical Engineers:	Equity Builders
Tradesmen Required:	Glaziers
Applicable Building Codes:	California structural and seismic codes
Applicable Electric Codes:	National Electric Code
PV Product:	Roof-integrated, translucent glass-laminate skylight
Size:	1.25 kWp
Projected System Electrical Output:	716.4 kWh/yr/AC
Gross PV Surface Area:	215 ft ²
PV Weight:	8 lb/ft ²
PV Cell Type:	Polycrystalline silicon
PV Efficiency:	11% cell, 7% module
PV Module Manufacturer:	Solar Building Systems, Atlantis Energy
Inverter Size:	4 kW
Inverter Manufacturer and Model:	Trace Engineering Model 4048
Interconnection:	Utility-Grid-Connected

The first application for integrating photovoltaics into a Federal building is the skylighted entryway of the Thoreau Center in Presidio National Park.



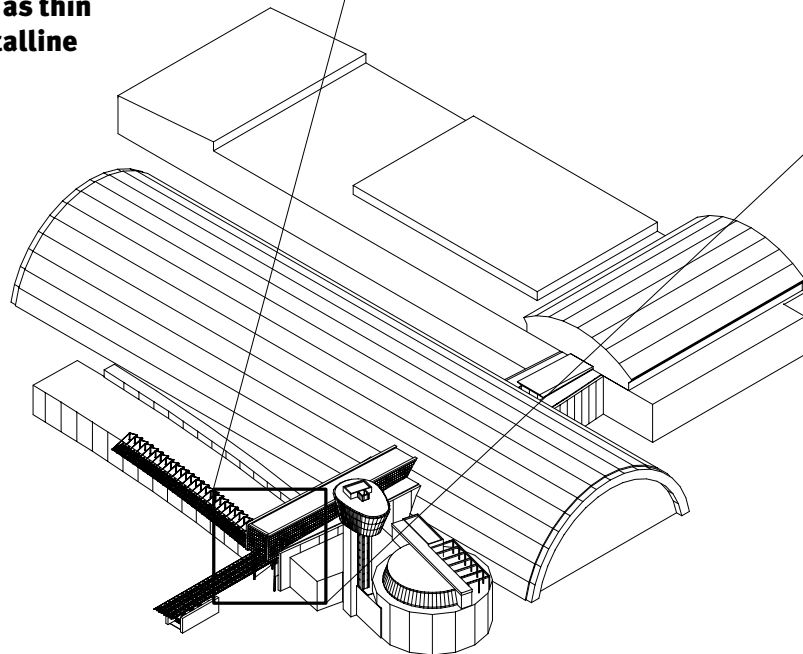
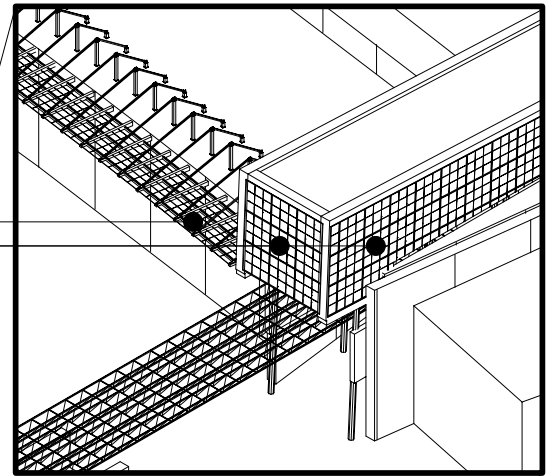
Atlantis Energy, Inc./PIX04779

National Air and Space Museum

Location:	Dulles Center, Washington, DC
Owner:	Smithsonian Institution
Date Completed:	Construction begun in 2000, scheduled for completion in 2003
Architect & Designer:	HOK, Building Architects; Kiss + Cathcart Architects, PV System Designers; Satish Shah, Speigel, Zamel, & Shah, Inc.
Structural Engineers:	N/A
Electrical Engineers:	N/A
Tradesmen Required:	Building tradesmen
Applicable Building Codes:	BOCA, Metropolitan Washington Airport Authority
Applicable Electric Codes:	National Electric Code
PV Product:	Various BIPV systems
Size:	To be determined for BIPV curtain wall, facades, and canopy
Projected System Electrical Output:	15.12 kWh for the canopy system
Gross PV Surface Area:	223 m ² for the canopy system
PV Weight:	5 lb/ft ² for the canopy system
PV Cell Type:	Polycrystalline cells, amorphous silicon film for various systems
PV Efficiency:	Systems will range from 5% to 12%
PV Module Manufacturer:	Energy Photovoltaics, Inc., for the canopy system
Inverter Number and Size:	To be determined
Inverter Manufacturer & Model:	To be determined
Interconnection:	Utility-Grid-Connected

The BIPV installations at the entryway will demonstrate different BIPV systems and technologies, such as thin films and polycrystalline solar cells.

PV Canopy
PV Curtain Wall



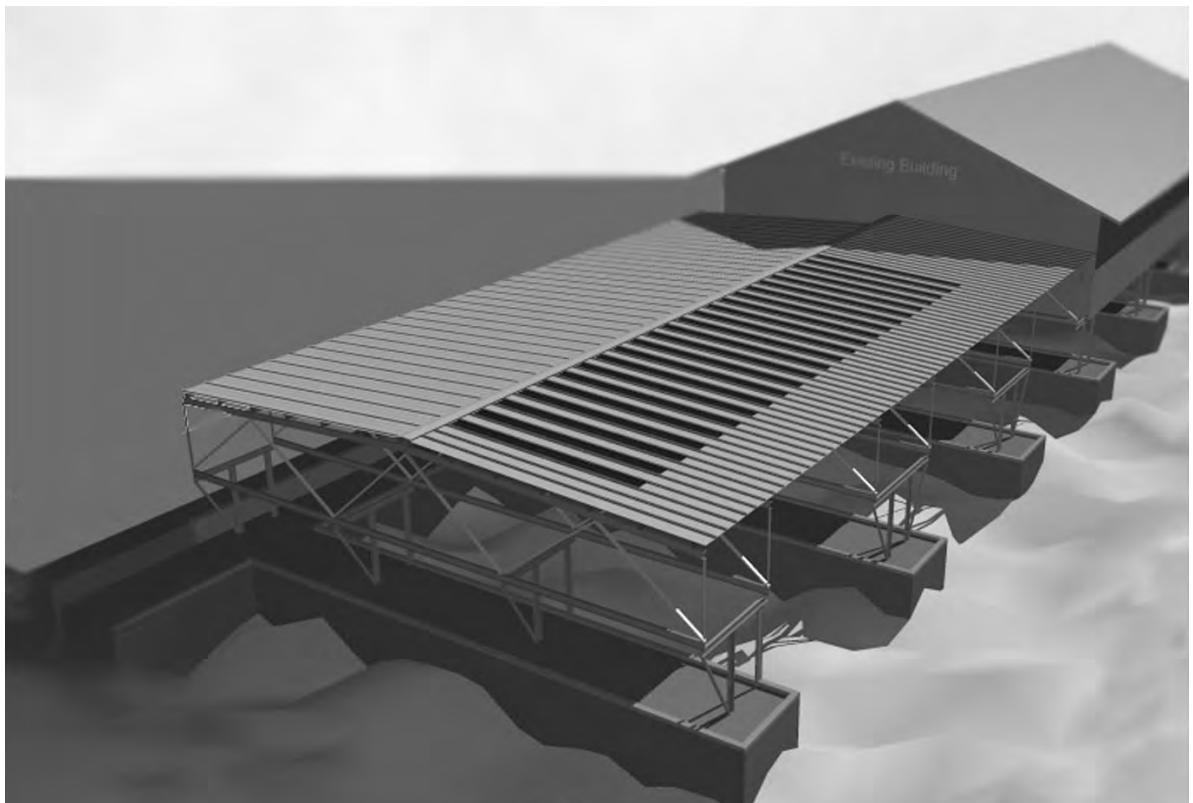
Project Overview:
Axonometric

02527218m

Ford Island

Building 44, Pearl Harbor Naval Station

Location:	Honolulu, Hawaii
Owner:	U.S. Navy, Department of Defense, and Hawaiian Electric Company
Date Completed:	September 1999
Architect & Designer:	Victor Olgay, Fred Creager, and Stephen Meder, University of Hawaii, School of Architecture
Structural Engineers:	Hawaiian Electric Co.
Electrical Engineers:	Hawaiian Electric Co.; Peter Shackelford, Renewable Energy Services, Inc., system integrator
Tradesmen Required:	Roofers, electrical contractors
Applicable Building Codes:	Uniform Building Code
Applicable Electric Codes:	National Electric Code
PV Product:	Integrated standing seam metal roof
Size:	2.8 kW DC
Projected System Electrical Output:	9,720 kWh per month
Gross PV Surface Area:	571 ft ²
PV Weight:	4 lb/ft ² , with the roof
PV Cell Type:	Multijunction amorphous silicon
PV Module Efficiency:	5%-6%
PV Module Manufacturer:	Uni-Solar
Inverter Number and Size:	One, 4-kW
Inverter Manufacturer and Model:	Trace SW 4048PV
Interconnection:	Utility-Grid-Connected



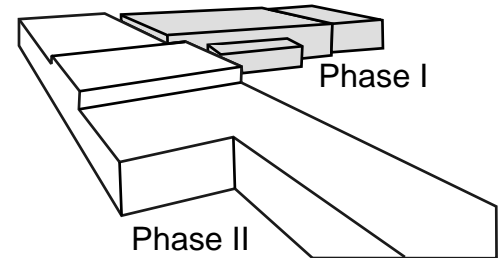
This illustration is a view of the building from the southwest corner; the dark areas represent the photovoltaic standing-seam metal roofing material.

Western Area Power Administration

Elverta Maintenance Facility, Phases I and II Phase I

Location:	Elverta, California
Owner:	U.S. Department of Energy (DOE) Western Area Power Administration
Date Completed:	May 1996
Architect & Designer:	DOE Western Area Power Administration, PowerLight Corporation
System Integrator:	PowerLight Corporation
Structural Engineers:	DOE Western Area Power Administration
Electrical Engineers:	DOE Western Area Power Administration
Tradesmen Required:	Roofers, electrical contractors
Applicable Building Codes:	Standard California building codes
Applicable Electric Codes:	National Electric Code
PV Product:	PowerGuard™ BIPV roof tiles
Size:	40 kW DC
Projected System Electrical Output:	70,000 kWh/year
Gross PV Surface Area:	5,400 ft ²
PV Weight:	4 lb/ft ²
PV Cell Type:	Polycrystalline silicon
PV Efficiency:	12%
PV Module Manufacturer:	Solarex
Inverter Number and Size:	8 inverters, 6 kW each
Inverter Manufacturer:	Omnion Corp.
Interconnection:	Utility-Grid-Connected

A 38-kW BIPV system supplements a 40-kW system installed in 1996.



PIX08451

Photovoltaic Manufacturing Facility

Location:	Fairfield, California
Owner:	BP Solar
Date Completed:	1993
Architect & Designer:	Kiss Cathcart Anders, Architects
Structural Engineers:	Ove Arup & Partners
Electrical Engineers:	Ove Arup & Partners
Tradesmen Required:	Glaziers, electricians
Applicable Building Codes:	BOCA and California Title 24
Applicable Electric Codes:	National Electric Code
PV Product:	Glass laminates as curtain wall spandrel, skylight, and awning
Size:	9.5 kWp
Projected System Electrical Output:	7.9 kW
Gross PV Surface Area:	1,975 ft ²
PV Weight:	3 lb/ft ²
PV Cell Type:	Amorphous silicon
PV Efficiency:	5%
PV Module Manufacturer:	APS
Inverter Number and Size:	6 kW
Inverter Manufacturer:	Omnion Corporation
Interconnection:	Utility-Grid-Connected

Views looking north (top) and south show how BIPV is integrated into both the facade and the canopy that runs the length of the building.



PIX08446



PIX08449

Sun Microsystems Clock Tower

Location:	Burlington, Massachusetts
Owner:	Sun Microsystems
Date Completed:	October 1998
Architect & Designer:	HOK Architects and ASE Americas, Inc.
Structural Engineers:	Whiting-Turner Contracting Co.
Electrical Engineers:	Enertech Engineering
Tradesman Required:	Glaziers, electricians
Applicable Building Codes:	Uniform Building Code
Applicable Electrical Codes:	National Electric Code Section 620
PV Product:	BIPV curtain wall
Size:	2.5 kWp
Projected System Electrical Output:	2.5 kWp
Gross PV Surface Area:	827 ft ²
PV Weight:	8.3 lb/ft ²
PV Cell Type:	Polycrystalline silicon manufactured by ASE Americas, Inc.
PV Efficiency:	12.8%
PV Module Manufacturer:	Pilkington Solar International
Inverter Number and Size:	One 2.5 kWp inverter
Inverter Manufacturer and Model:	Omnion Power Corp.
Interconnection:	Utility-Grid-Connected

North-facing view of the clock tower at Sun Microsystems facility.



ASE Americas, Inc./PIX07044

State University of New York, Albany

Location:	Albany, New York
Owner:	State University of New York, Albany
Date Completed:	Summer 1996
Architect:	Cannon Architects
Electrical Engineer:	Cannon Architects
Solar Consultant:	Solar Design Associates, Inc.
Tradesmen Required:	Beacon Sales Corporation, roofing contractors
Applicable building codes:	New York State Building Code and ANSI Z97.1
Applicable electrical codes:	National Electric Code
PV product:	Kawneer 1600 PowerWall™
Size:	15 kWp
Project System Electrical Output:	19,710 kWh / yr.
Gross PV Surface Area:	1,500 ft ²
PV Weight:	1.93 lb / ft ²
PV Cell Type:	Polycrystalline silicon
PV Cell Efficiency:	12%
PV Module Manufacturer:	Solarex
Inverter Number and Size:	AES 250 watt
Inverter Manufacturer and Model:	Advanced Energy Systems Micro Inverter
Interconnection:	Utility-Grid Connected

**Looking southeast
at the Center for
Environmental
Sciences and
Technology
Management**



Gordon Schenck/PIX084

Navajo Nation Outdoor Solar Classroom

Location:	Seba Dalkai, Navajo Reservation, Arizona
Owner:	Seba Dalkai Boarding School
Scheduled Completion Date:	Fall 1999
Architect:	Kiss + Cathcart, Architects
Electrical Engineer:	Energy Photovoltaics, Inc.
Solar Consultant:	Kiss + Cathcart, Architects
Tradesmen Required:	Electricians, laborers
Applicable Building Codes:	Standard building codes
Applicable Electrical Codes:	National Electric Code
PV Product:	Energy Photovoltaics EPV-40 modules
Size:	4.0 kWp
Projected System Electrical Output:	5,818 kWh/yr
Gross PV Surface Area:	625 ft ²
PV Weight:	3.75 lb/ft ²
PV Type:	Amorphous silicon
PV Efficiency:	6%
PV Module Manufacturer:	Energy Photovoltaics, Inc.
Inverter Number and Size:	Four 2.5 kW inverters
Inverter Manufacturer:	Trace Engineering
Interconnection:	Stand-Alone System



02527276m

Each new BIPV structure at the Seba Dalkai School will serve as an open-air classroom supported by timber columns in a concrete foundation.



02527274m

General Services Administration, Williams Building

Location:	408 Atlantic Avenue, Boston, Massachusetts
Owner:	U.S. General Services Administration
Date Completed:	September 30, 1999
Project Developers:	Enron Energy Services and U.S. General Services Administration
Electrical Engineer:	PowerLight Co.
Solar Consultant:	PowerLight Co.
Tradesmen Required:	Electricians and roofers
Applicable Building Codes:	Standard building codes
Applicable Electrical Codes:	National Electric Code, Boston Electric Interconnection Guidelines, and IEEE Specifications
PV Product:	PowerLight, using ASE Americas, Inc., solar panels
System Size:	37 kW DC, 28 kW AC
Projected System Electrical Output:	50,000 kWh/yr
Gross PV Surface Area:	Approx. 3,800 ft ²
PV Weight:	4 lb/ft ²
PV Cell Type:	Amorphous silicon
PV Efficiency:	12%
PV Module Manufacturer:	ASE Americas, Inc.
Inverter Number and Size:	1 30 kVa
Inverter Manufacturer:	Trace Engineering
Interconnection:	Utility-Grid-Connected



PIX08465

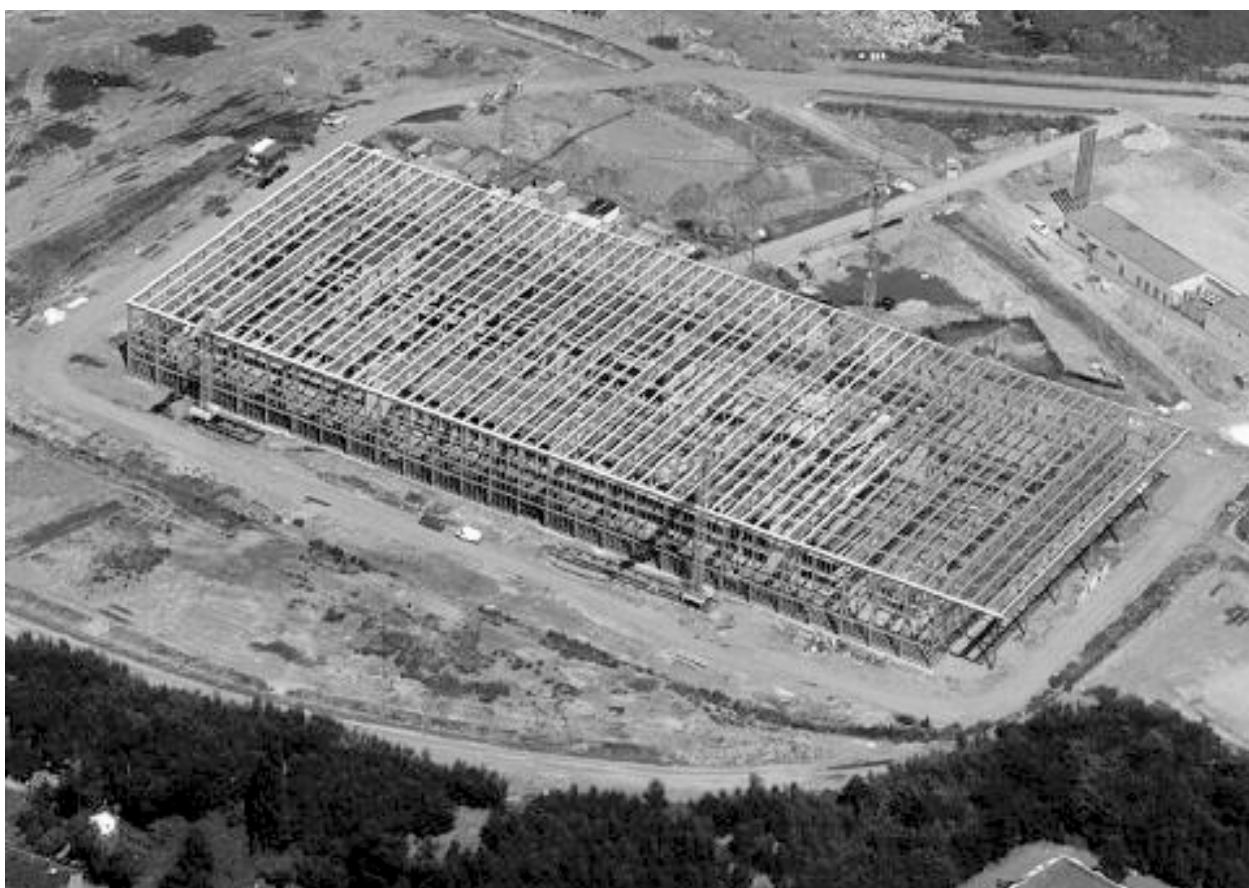
The nine-story Williams Building in Boston (at right in photo above) has a new BIPV roof (bottom, lower right photo) rather than a conventional one.



PIX08474

Academy of Further Education

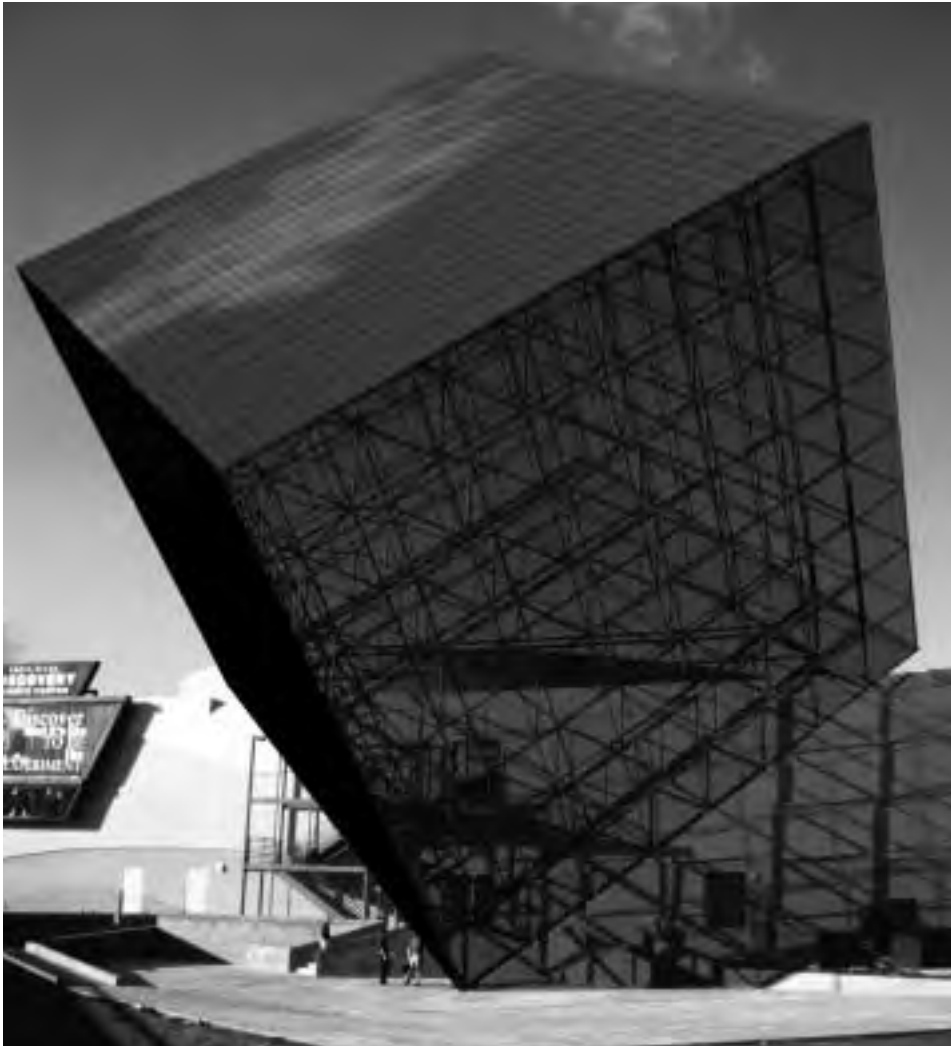
Location:	Herne, North Rhine-Westphalia, Germany
Owner:	EMC, Ministry of Interiors of North Rhine-Westphalia, City of Herne
Date Completed:	May 1999
Architect & Designer:	Jourda et Perraudin Architects, HHS Architects
Structural Engineers:	Schleich, Bergermann and Partner
Electrical Engineers:	HL-Technik
Tradesmen Required:	Glaziers, electricians
PV Product:	BIPV roof
Size:	1 MWp
Projected System Electrical Output:	750,000 kWh/yr
Gross PV Surface Area:	10,000 m ²
PV Weight:	130 kg per each 3.2 m ² module
PV Cell Type:	Polycrystalline and monocrystalline silicon
PV Efficiency:	12.8% to 16%
PV Module Manufacturer:	Pilkington Solar International, Cologne
Inverter Number and Size:	600, 1.5 kW
Inverter Manufacturer and Model:	SMA, Kassel
Interconnection:	Utility-Grid-Connected



The Academy of Further Education under construction in Herne, Germany

Discovery Science Center

Location:	Santa Ana, California
Scheduled Completion Date:	November 1999
Architect & Designer:	Arquitectonica for the cube, Solar Design Associates for the PV system
Structural Engineers:	Advanced Structures, Inc.
Electrical Engineers:	Solar Design Associates, Inc.
Tradesmen Required:	Electricians
Applicable Building Codes:	Building Administrators Code Administrators International (BOCA)
Applicable Electrical Codes:	National Electric Code
PV Product:	Thin-film photovoltaic system
Size:	20 kWp
Projected System Electrical Output:	30,000 kWh/yr
Gross PV Surface Area:	4,334 ft ²
PV Weight:	3 lb/ ft ²
PV Cell Type:	Thin-film technology
PV Efficiency (%):	5.1 %
PV Module Manufacturer:	BP Solarex
Inverter Number and Size:	4
Inverter Manufacturer and Model:	Omnion 2400, Model 5015
Interconnection:	Utility Grid-Connected



Solar Design Associates, Inc./02527271

Architect's rendering of the Discovery Science Center Cube in Santa Ana, California

Solar Sunflowers

Location:	Napa, California
Date Completed:	N/A
Architect & Designer:	Solar Design Associates, Inc.
Structural Engineers:	Solar Design Associates, Inc.
Electrical Engineers:	Solar Design Associates, Inc.
Tradesmen Required:	Electricians
Applicable Building Codes:	Building Officials Code Administrators International (BOCA)
Applicable Electrical Codes:	National Electric Code
PV Product:	BP Solarex
Size:	36,000 Wp
Projected System Electrical Output:	N/A
Gross PV Surface Area:	3,456 ft ²
PV Weight:	3.4 lb/ ft ²
PV Cell Type:	Polycrystalline
PV Efficiency:	11.1%
PV Module Manufacturer:	BP Solarex
Inverter Number and Size:	6
Inverter Manufacturer and Model:	Omnion Series 2400, Model 6018
Interconnection:	Utility-Grid-Connected



PIX08468

These Solar Sunflowers track the sun to produce electricity.

Ijsselstein Row Houses

Location:	Ijsselstein Zenderpark, Ijsselstein, The Netherlands
Date Completed:	Scheduled for completion in late 2000
Architect & Designer:	Han Van Zwieten, Van Straalen Architecten, co-designer; Gregory Kiss, Kiss + Cathcart Architects, co-designer
Structural Engineers:	N/A
Electrical Engineers:	N/A
Tradesmen Required:	Building tradesmen
Applicable Building Codes:	Dutch Building Code
Applicable Electrical Codes:	Dutch Electrical Code
PV Product:	Standard-size BIPV glass laminate panels
Size:	1.6 kWp per housing unit
Projected System Electrical Output:	1150 kWh/year per housing unit
Gross PV Surface Area:	30 m ² per housing unit
PV Weight:	3.75 lb/ft ²
PV Cell Type:	Amorphous silicon, both opaque and 15% translucent
PV Efficiency:	6%
PV Module Manufacturer:	EPV
Inverter Number and Size:	N/A
Inverter Manufacturer and Model:	N/A
Interconnection:	Utility-Grid-Connected



02527269m

Fourteen planned new row-house units in the Netherlands demonstrate the aesthetic use of building-integrated photovoltaics: front (above) and back views.



02527270m

Denver Federal Courthouse

Location:	Denver, Colorado
Owner:	U.S. General Services Administration
Date Completed:	Scheduled for completion in 2002
Architect & Designer:	Anderson Mason Dale (Architects); Hellmuth, Obata, & Kassabaum, St. Louis (Designers); Architectural Energy Corporation (Energy Consultants)
System Integration:	Altair Energy (PV Consultant)
Structural Engineers:	Martin/Martin, Inc.
Electrical Engineers:	The RMH Group, Inc.
Tradesman Required:	Building tradesmen/glaziers
Applicable Building Codes:	Uniform Building Code (1997)
Applicable Electric Codes:	National Electric Code (1999)
PV Product:	Custom-sized BIPV glass laminate
Size:	15 kWp (roof); 3.4 kWp (skylight)
Projected System Electrical Output:	20,150 kWh per year (roof); 4,700 kWh per year (skylight)
Gross PV Surface Area:	172 m ² (roof); 59 m ² (skylight)
PV Module Weight:	4,661 kg (roof); 2,749 kg (skylight)
PV Cell Type:	Single- or polycrystalline silicon
PV Efficiency:	10% or greater
PV Module Manufacturer:	Pilkington Solar
Inverter Number & Size:	One 20-kW and one 3.4-kW inverter
Suggested Inverter Manufacturers:	Trace Technologies, Trace Engineering, Omnion
Interconnection:	Utility-Grid-Connected



02527279m

The U.S. Court House expansion in Denver will be a showcase for sustainable building design.