



# Research Report

## EXECUTIVE SUMMARY:

### **Building-Integrated Photovoltaics**

BIPV and BAPV: Market Issues, Technology Issues, Key Industry Players, and Global Market Forecasts

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## Section 1

### EXECUTIVE SUMMARY

For centuries, humans around the globe have built structures with sun-facing roofs and walls. Why, then, have we yet to install solar modules and panels on buildings throughout the world? If we can greatly reduce our use of carbon-fuel-generated power simply by constructing buildings that include solar panels and modules, why have residences and businesses not embraced solar as a construction material? After all, much of the world's population wants to "go green" and prevent global warming, right?

Simply put, solar has yet to be widely viewed as a viable replacement for roof and wall building materials, and building-integrated photovoltaics (BIPV) have failed to grow beyond a small niche market for a host of reasons, including concerns about cost, ease of installation, and aesthetics.

Starting in 2010, however, BIPV market dynamics will change. Worldwide demand for solar panels, shingles and modules will surge to almost 2.4 GW by 2016. Pike Research analysis reveals that this will occur because:

- Cost per watt of BIPV/BAPV (building-integrated PV, building-applied PV) installations plunged in 2009 and early 2010 with the fundamental shift of the solar market from supply-driven to demand-driven. In fact, we anticipate that BIPV/BAPV installed cost/watt will likely reach about \$2.50/W in 2016.
- The aesthetics of BIPV/BAPV materials have substantially improved. There are now solar tiles and shingles that blend into rooftops and c-Si solar panels in various shapes, sizes, colors, transparencies, and patterns that appear to seamlessly blend into a building's structure.
- Building on existing feed-in tariffs (FITs) enacted in Italy, Japan, and a few other EU countries, France, the United Kingdom, and Ontario, Canada instituted generous FITs for BIPV/BAPV installations. Even the United States is likely to introduce BIPV/BAPV incentives beginning in 2011.
- Efficiency improvements in both c-Si modules (to 16-20%) and flexible thin-film panels and shingles (led by CIGS panels at 10.7%) have improved BIPV/BAPV project return and payback. Moreover, incremental efficiency improvements are likely to continue through 2016.
- BIPV/BAPV solar products will increasingly be available through normal building materials suppliers and, eventually, through common retailers for residences.
- Rooftop installations will be far easier to perform, and competent roofers will be able to install solar panels and shingles much as they would common roofing materials. As importantly, roofers and building construction companies alike will grow to understand solar products and regard them as an alternative building material.
- As a result of the BP oil spill, rising energy costs, and an improved awareness of the benefits and costs of solar, an increasing number of residence and commercial building owners are now showing a desire to "go green."

Several novel BIPV/BAPV solar products stand out as providing much-improved aesthetics, lower roof loading, and ease of installation. For example, new frameless, glass-on-glass c-Si modules offer varying levels of transparency, a selection of colors and

patterns, and designs that ensure unobtrusive supports and electrical connection. Companies offering these modules include Solarfun, Canadian Solar, Swiss Solar Systems, and Scheuten Solar. Additionally, Ascent Solar and Global Solar have introduced high-efficiency CIGS panels that currently deliver 10.7% efficiency, but could improve to 12% in two years while maintaining a cost per watt of about \$2.00. Dow Solar Solutions' solar shingles (made from Global Solar's panels) could be a game-changer in the BIPV/BAPV rooftop market: their promise of greatly simplified installation allows competent roofers to install shingles that simultaneously connect mechanically and electrically.

In addition, Scheuten, Sunways, Shuco, and a few others continue to manufacture highly customized c-Si modules in a variety of sizes, shapes, colors, and visible patterns. These modules will continue to win BIPV/BAPV wall and atria applications if they are cost competitive with similar products from low-cost Chinese manufacturers.

Two key issues emerged during the course of study for this report: the need for a clear understanding of key market drivers and segments and the need for a clear definition of building-integrated PV and building-applied PV. Accordingly, along with a BIPV/BAPV market overview, we have provided examples of each market segment. We have based our market review and forecasts on the following definitions:

- BIPV tiles, panels, shingles or modules replace common building materials, are aesthetically appealing, and are completely integrated into the structure of a rooftop or building envelope.
- BAPV tiles, panels, shingles or modules are integrated or installed in a rooftop or a building after initial construction; these must also be architecturally and aesthetically appealing – not just solar modules mounted on an available and conveniently oriented rooftop.

Defined this way, we forecast the combined BIPV/BAPV market to grow from 215 MW in 2009 (about 3% of the overall solar market) to 2,385 MW in 2016 (about 7% of the overall market) at a compound annual growth rate (CAGR) of 41%. Should conditions prove ideal, we believe BIPV/BAPV installations could reach as high 3,475 MW in 2016. To attain this loftier level of growth, the BIPV/BAPV market would need to experience a breakthrough in terms of reduced production costs, substantial growth in demand in developing markets such as the Czech Republic, India, and the United Kingdom, and a much better recovery than we currently expect in the global economy – particularly within the construction industry.

In terms of dollars, we forecast that the BIPV/BAPV market will earn wholesale revenues (i.e., from sales to installers, building materials suppliers, and other wholesale end markets) of approximately \$4 billion in 2016 – and potentially up to \$6 billion under ideal conditions – from a start of about \$740 million in 2009.

By region, we expect the EU (primarily Germany and France) to continue to lead the BIPV/BAPV market in terms of MW installed per year; however, this region will decrease in terms of market share – from 55% in 2009 to 32% in 2016 – as Asia and NAFTA surge in demand. In fact, in 2016, we expect that demand in Asia will exceed that of the EU to top 800 MW. Driven primarily by installations in California and Ontario, Canada, we also believe that the NAFTA region will install just over 700 MW of BIPV/BAPV modules, panels and shingles, reaching 30% market share in 2016.

Historically, nearly all (about 93% in 2009) BIPV/BAPV solar products were based on c-Si and a-Si technologies (produced mainly by Uni-Solar). Beginning in 2011, we believe that CIGS panels and shingles will take market share from c-Si and a-Si to compose approximately 50% of the market by 2016. As a result, we anticipate that market share for c-Si and a-Si modules and panels will decrease to 39% and 8%, respectively, in 2016. We base this projection on analysis that shows CIGS panels and shingles will likely increase their efficiency and cost/W lead over a-Si and overtake a-Si in the rooftop market. Note that we still project that installations of a-Si and c-Si BIPV/BAPV products will increase and reach 190 MW and 930 MW, respectively, by 2016. CIGS panels and shingles, however, will simply grow at a faster rate and win 1,200 MW of new installations in 2016.

In summary, the market for BIPV/BAPV solar products will move from a small, largely disregarded sub-segment of the market to a segment that commands considerable attention from many major solar manufacturers. In addition, the market for rooftop BIPV/BAPV, in particular, will see intense competition in 2011 and beyond as a large oversupply of c-Si modules causes manufacturers to look toward new markets and as BIPV/BAPV project IRRs exceed 8% and reach as high as 15-20% in countries with generous FITs.

## Section 8

### TABLE OF CONTENTS

<b>Section 1</b> .....	<b>1</b>
<b>Executive Summary</b> .....	<b>1</b>
<b>Section 2</b> .....	<b>4</b>
<b>Market Issues</b> .....	<b>4</b>
2.1 Market Overview .....	4
2.2 Definition of the BIPV/BAPV Market .....	5
2.2.1 Residential Segment .....	5
2.2.2 Commercial Segment .....	6
2.2.3 BIPV/BAPV on Public Buildings .....	8
2.2.4 Other BIPV/BAPV Applications .....	9
2.3 What is BIPV/BAPV? .....	10
2.3.1 BIPV: Commonly Accepted Definition .....	10
2.3.2 BAPV Consensus Definition .....	10
2.4 Key Types of BIPV/BAPV Installations .....	12
2.4.1 Façade-Integrated Installations .....	12
2.4.2 Rooftop Installations Remain the Largest Share of BIPV/BAPV .....	12
2.4.3 Wall-Integrated Installations .....	12
2.4.4 Shading Structures .....	13
2.4.5 Other Types of Installations .....	14
2.5 Solar Products Used for BIPV/BAPV Applications .....	16
2.5.1 Standard Modules .....	16
2.5.2 Flexible TF Laminate Panels – Amorphous Silicon Technology .....	17
2.5.3 Flexible TF Laminate Panels - CIGS Technology .....	17
2.5.4 Semi-Transparent Laminate c-Si Modules or Panels .....	17
2.6 Drivers and Barriers of BIPV/BAPV Market Growth .....	18
2.6.1 Project ROI .....	18
2.6.2 Special Architectural Needs for Building Envelopes .....	18
2.6.3 Power Generation Constrained By Building Orientation and Shading .....	19
2.6.4 Perceptions of General Building Contractors about BIPV/BAPV .....	19
2.6.5 Sales through Retail Stores for Residential Markets .....	19
2.6.6 Inconsistent, Uncertain Regulatory Environment .....	20
2.7 Improvements Likely to Drive BIPV/BAPV Market Growth .....	20
2.7.1 Improved BIPV/BAPV Payback .....	20
2.7.2 Lower Weight Loading for Rooftop Applications .....	23
2.7.3 Increased Efficiencies .....	23
2.7.4 Generous FITS and Other Incentives .....	23
2.7.5 Supply Chain Integration .....	24
2.7.6 End Market Consumers Increasingly Want to “Go Green” .....	25
<b>Section 3</b> .....	<b>27</b>
<b>Technology Issues</b> .....	<b>27</b>
3.1 Introduction .....	27
3.2 Performance as a Building Material .....	27
3.3 Aesthetics .....	28
3.4 Ease of Installation .....	28
3.5 Efficiency .....	29
3.6 Low-Cost Production of Shingles, Modules and Panels .....	29
3.7 Back Ventilation of Modules Can Improve Efficiency .....	29

3.8	Design to Minimize Roof Loading and Penetration.....	30
3.9	Design to Prevent Power Loss from Shading .....	30
<b>Section 4</b>	<b>.....</b>	<b>32</b>
<b>Key Industry Players.....</b>	<b>.....</b>	<b>32</b>
4.1	Thin Film Panel and Shingle Manufacturers .....	32
4.1.1	UniSolar.....	32
4.1.2	Global Solar.....	33
4.1.3	Ascent Solar .....	34
4.1.4	Dow Solar Solutions .....	34
4.1.5	SoloPower .....	35
4.1.6	Other TF companies.....	36
4.2	Specialized c-Si/TF Module Manufacturers .....	36
4.2.1	Schüco.....	37
4.2.2	Scheuten Solar .....	37
4.2.3	Odersun.....	37
4.2.4	Sunways.....	37
4.3	Conventional c-Si module manufacturers and suppliers .....	38
4.3.1	Swiss Solar Systems.....	39
4.3.2	SunTech .....	40
4.3.3	Lumeta.....	40
4.3.4	Atlantis Energy Systems .....	41
4.3.5	Kyocera .....	41
4.3.6	Solarcentury .....	41
4.3.7	Solarfun .....	41
4.3.8	Canadian Solar.....	41
4.3.9	Aide Solar .....	42
4.3.10	Würth Solar.....	42
<b>Section 5</b>	<b>.....</b>	<b>43</b>
<b>Market Forecasts.....</b>	<b>.....</b>	<b>43</b>
5.1	Introduction.....	43
5.2	Worldwide BIPV/BAPV Market Demand, 2009-2016.....	43
5.3	BIPV/BAPV Growth by Region.....	47
5.4	BIPV/BAPV Growth by Technology .....	48
<b>Section 6</b>	<b>.....</b>	<b>50</b>
<b>Company Directory .....</b>	<b>.....</b>	<b>50</b>
<b>Section 7</b>	<b>.....</b>	<b>52</b>
<b>Acronym and Abbreviation List.....</b>	<b>.....</b>	<b>52</b>
<b>Section 8</b>	<b>.....</b>	<b>54</b>
<b>Table of Contents .....</b>	<b>.....</b>	<b>54</b>
<b>Section 9</b>	<b>.....</b>	<b>56</b>
<b>Table of Figures .....</b>	<b>.....</b>	<b>56</b>
<b>Section 10</b>	<b>.....</b>	<b>57</b>
<b>Scope of Study .....</b>	<b>.....</b>	<b>57</b>
<b>Sources and Methodology .....</b>	<b>.....</b>	<b>58</b>
<b>Notes .....</b>	<b>.....</b>	<b>58</b>

## Section 9

### TABLE OF FIGURES

Chart 2.1	Rooftop and Cladding Materials Cost: 2010 .....	21
Chart 2.2	Module and Panel Cost: 2010-2011 .....	21
Chart 2.3	c-Si Module Cost Discounted for Materials Replaced: 2010-2011 .....	22
Chart 2.4	TF Flexible Panel Cost Discounted for Materials Replaced: 2010-2011 .....	22
Chart 5.1	BIPV/BAPV Capacity, World Markets: 2009-2016 .....	44
Chart 5.2	BIPV Capacity, World Markets: 2009-2016 .....	45
Chart 5.3	BAPV Capacity, World Markets: 2009-2016 .....	46
Chart 5.4	Wholesale BIPV/BAPV Revenues, World Markets: 2009-2016 .....	47
Chart 5.5	BIPV/BAPV Capacity by Region, World Markets, Base Case: 2009-2016 .....	48
Chart 5.6	BIPV/BAPV Capacity by Technology, World Markets: 2009-2016 .....	49
Figure 2.1	Residential BAPV Installation .....	5
Figure 2.2	Residential BIPV Installation .....	6
Figure 2.3	Commercial BIPV Installation, BMW World, Munich .....	7
Figure 2.4	Public Building BIPV Installation, Stillwell Avenue Terminal, New York City .....	8
Figure 2.5	BIPV Installation Over Landfill .....	9
Figure 2.6	BAPV Example, Façade on Commercial Building .....	11
Figure 2.7	Shading Structure BIPV Example, Bahnhof in Berlin .....	13
Figure 2.8	Noise Barrier BAPV Example, Amstelveen, Netherlands .....	14
Figure 2.9	Noise Barrier BIPV Example, Railway Station, Münsingen, Switzerland .....	15
Figure 2.10	Free-standing Solar Canopy BIPV Example, Rome, Italy .....	16
Figure 4.1	UniSolar Solar Panel Manufacturing Process Schematic .....	32
Figure 4.2	Dow Solar Solutions Powerhouse Solar Shingles .....	35
Figure 4.3	Example of Multi-crystalline Wall Integrated Installation .....	38
Figure 4.4	Example of Multi-crystalline Wall Integrated Installation .....	39
Figure 4.5	JustRoof Residential Installation in Japan .....	40

## Section 10

### SCOPE OF STUDY

The market for building-integrated photovoltaics (BIPV) has long been regarded as a small niche market and has drawn scant attention from most of the solar industry's major players. Today, this is changing: demand for BIPV has ramped, many new solar products have recently been introduced into the market, and much improved incentives have raised returns of BIPV projects in many countries. As a result, Pike Research has prepared this report to forecast the growth of the BIPV market and to demonstrate how and why solar product manufacturers, building materials suppliers, architects, solar installers, roofers, construction firms, and any company interested in winning business in the solar market should enter the BIPV market.

Specifically, this report:

- Defines BIPV and BAPV (building-applied photovoltaics) as solar products that not only function as building materials but must also be aesthetically appealing (i.e., not just solar panels mounted on a roof).
- Provides illustrative examples of each type of BIPV/BAPV installation, such as residential and commercial rooftops, building walls, atria and other structures.
- Details barriers that have inhibited growth of the BIPV/BAPV market thus far as well as key market drivers that have overcome these barriers to spur growth.
- Focuses on technological issues that define winning value propositions.
- Reviews leading companies in the BIPV/BAPV market, their products, and competitive positioning.
- Forecasts the growth of the BIPV/BAPV market in terms of power generation capacity (MW) and revenues (\$) as well as by region and by solar technology.

The BIPV/BAPV report from Pike Research enables industry participants to understand the BIPV/BAPV market, to assess market drivers and competition, and to project potential revenues by participating in this surging market.

## SOURCES AND METHODOLOGY

Pike Research's industry analysts utilize a variety of research sources in preparing Research Reports. The key component of Pike Research's analysis is primary research gained from phone and in-person interviews with industry leaders including executives, engineers, and marketing professionals. Analysts are diligent in ensuring that they speak with representatives from every part of the value chain, including but not limited to technology companies, utilities and other service providers, industry associations, government agencies, and the investment community.

Additional analysis includes secondary research conducted by Pike Research's analysts and the firm's staff of research assistants. Where applicable, all secondary research sources are appropriately cited within this report.

These primary and secondary research sources, combined with the analyst's industry expertise, are synthesized into the qualitative and quantitative analysis presented in Pike Research's reports. Great care is taken in making sure that all analysis is well-supported by facts, but where the facts are unknown and assumptions must be made, analysts document their assumptions and are prepared to explain their methodology, both within the body of a report and in direct conversations with clients.

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## NOTES

CAGR refers to compound average annual growth rate, using the formula:

$$\text{CAGR} = (\text{End Year Value} \div \text{Start Year Value})^{(1/\text{steps})} - 1.$$

CAGRs presented in the tables are for the entire timeframe in the title. Where data for fewer years are given, the CAGR is for the range presented. Where relevant, CAGRs for shorter timeframes may be given as well.

Figures are based on the best estimates available at the time of calculation. Annual revenues, shipments, and sales are based on end-of-year figures unless otherwise noted. All values are expressed in year 2010 U.S. dollars unless otherwise noted. Percentages may not add up to 100 due to rounding.

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