
Building Integrated Photovoltaics: Opportunities 2010

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Table of Contents

<i>Executive Summary</i>	1
E.1 The Economics of BIPV: BIPV < PV + Building Materials?	1
E.2 BIPV and Aesthetic Opportunities	2
E.2.1 BIPV, Aesthetics and the New Market for BIPV	2
E.2.2 Aesthetics, Architects and BIPV	3
E.3 Market Positioning and Distinguishing Features of BIPV	3
E.3.1 Current Status of BIPV Products	4
E.3.2 Opportunities for Crystalline Silicon PV Suppliers	6
E.3.3 Opportunities for Thin-Film PV Suppliers	7
E.4 BIPV's Impact on the Construction Industry	8
E.5 Opportunities for Building Materials Suppliers	8
E.6 Firms to Watch	9
E.6.1 Ascent Solar	9
E.6.2 Dow Chemical	9
E.6.3 Dyesol and Corus.....	10
E.6.4 Konarka and Solarmer	10
E.6.5 Odersun	11
E.6.6 Pythagoras Solar.....	11
E.6.7 SRS Energy.....	11
E.6.8 Sunovation.....	12
E.6.9 United Solar Ovonic.....	12
E.7 Summary of Eight-Year Forecasts of BIPV Markets	13
<i>Chapter One: Introduction</i>	16
1.1 Background to this Report	16
1.1.1 BIPV: The New Value Proposition for Solar.....	16
1.1.2 Three Approaches to Building Integration: Rigid, Flexible, Transparent	17
1.2 Objectives and Scope of this Report	18
1.3 Methodology of this Report	19
1.4 Plan of this Report	20
<i>Chapter Two: Rigid BIPV Tiles, Roofing, and Cladding. . . and Beyond</i>	21

2.1 Introduction	21
2.1.1 The Market Dynamics of BIPV	21
2.2 Building Materials Markets: A Happy Coexistence with BIPV?	23
2.2.1 The Cost Factor	23
2.3 Crystalline Silicon PV: Approaches to Building Integration	25
2.3.1 BIPV Tiles and Slates and the Aesthetic Factor	27
2.3.2 Factors in Favor of Crystalline Silicon BIPV	29
2.3.3 Crystalline Silicon's Limitations in the BIPV Market.....	29
2.4 Thin-Film PV and the Rigid BIPV Market.....	30
2.4.1 Thin-Film PV's Value Propositions	31
2.4.2 Can Thin-Film PV Compete with Crystalline Silicon in Rigid Tiles?.....	33
2.4.3 Thin-Film PV Technologies as they Relate to BIPV	33
2.5 Key Points Made in this Chapter.....	42
<i>Chapter Three: Transparent and Semi-Transparent BIPV: BIPV Glass.....</i>	<i>46</i>
3.1 Introduction	46
3.1.1 Primary Markets for Transparent and Semi-Transparent BIPV.....	46
3.2 Architectural Glass: More than Just Windows	47
3.2.1 Cost Advantages of Transparent/Semi-Transparent BIPV.....	47
3.2.2 Applications of Transparent/Semi-Transparent BIPV	47
3.3 Semitransparent Approaches to Crystalline Silicon BIPV	48
3.3.1 Two Innovative c-Si BIPV Glass Products.....	50
3.3.2 Peekaboo Panels: The Aesthetics of Glass Encapsulated Crystalline Silicon PV Cells	50
3.3.3 The Cost of Glass vs. the Cost of the Crystalline Silicon PV Inside.....	51
3.3.4 Advantages and Disadvantages of Crystalline Silicon for Semitransparent BIPV	52
3.4 Thin-Film PV and the Semitransparent Panel	53
3.4.1 See-Through Becomes More Attractive.....	54
3.4.2 Glass Substrate Costs vs. Architectural Glass Costs.....	54
3.4.3 Advantages and Disadvantages of Thin-Film PV for Semitransparent BIPV	56
3.5 Can BIPV Glass Become Truly Transparent?	59
3.5.1 OPV, BIPV and Transparency	59
3.5.2 OPV, DSC and Transparency	60
3.6 Key Points Made in this Chapter.....	61

Chapter Four: Flexible BIPV: Laminates, Shingles, and Other Flexible Products..... 63

4.1 Introduction 63

4.2 Flexible Building Materials: Ready for BIPV? 63

4.3 Flexible BIPV Laminates and the "PV Anywhere" Concept..... 64

4.3.1 The Aesthetics of Roll-On BIPV66

4.3.2 Separate but Less Costly: BIPV Laminates67

4.3.3 Issues with Flexible BIPV Modules.....68

4.3.4 Newer Approaches to Flexible BIPV Laminates..... 70

4.4 One and the Same: Incorporating PV into Flexible Building Materials 73

4.4.1 The Aesthetics of Invisibility 75

4.4.2 Flexible BIPV Products and Cost76

4.5 Key Points Made in this Chapter..... 76

Chapter Five: Eight-Year Forecasts..... 79

5.1 Forecasting Methodology 79

5.1.1 Economics, Construction and BIPV80

5.1.2 Alternative Economic Scenarios.....81

5.1.3 Scope of Forecast.....81

5.2 Eight-Year Forecasts of Rigid BIPV Tiles and Panels 83

5.2.1 Forecast of Rigid BIPV Shipments by PV Technology83

5.2.2 Cost Assumptions for Rigid BIPV Forecasts.....86

5.2.3 Forecast of Rigid BIPV Shipments by Product Type.....87

5.3 Eight-Year Forecasts of Transparent and Semi-Transparent BIPV Products 89

5.3.1 Forecast of Transparent and Semi-Transparent BIPV Shipments by PV Technology90

5.3.2 Cost Assumptions for Transparent/Semi-Transparent BIPV Forecasts.....92

5.4 Eight-Year Forecasts of Flexible BIPV Products and Laminates..... 93

5.4.1 Forecast of Flexible BIPV Shipments by PV Technology.....94

5.4.2 Cost Assumptions for Flexible BIPV Forecasts96

5.4.3 Forecast of Flexible BIPV Shipments by Product Type97

5.5 Summary of Forecasts..... 99

5.5.1 Summary of Worldwide BIPV Markets by Product Type.....99

5.5.2 Summary of Worldwide BIPV Markets by Watts Shipped and Technology Type.....100

Abbreviations and Acronyms Used In this Report..... 103
About the Author 104

List of Exhibits

Exhibit E-1
 Cost Advantages and Disadvantages of BIPV2
 Exhibit E-2
 Aesthetic Advantages and Disadvantages of BIPV4
 Exhibit E-3
 Summary of BIPV Markets by PV Technology13
 Exhibit E-4
 Summary of BIPV Revenues by Product Type14
 Exhibit 2-1
 Cost of PV Systems per Square of Roof Area, 10 Percent Module Efficiency (\$)24
 Exhibit 2-2
 Peak Power Producible per Square of Roofing25
 Exhibit 5-1
 Rigid BIPV Shipments by PV Technology84
 Exhibit 5-2
 Rigid BIPV Average Cost.....86
 Exhibit 5-3
 Rigid BIPV Products by Product Type88
 Exhibit 5-4
 BIPV Glass Shipments by PV Technology90
 Exhibit 5-5
 BIPV Glass Average Cost93
 Exhibit 5-6
 Flexible BIPV Shipments by PV Technology95
 Exhibit 5-7
 Flexible BIPV Average Cost96
 Exhibit 5-8
 Flexible BIPV Products by Product Type97
 Exhibit 5-9
 BIPV Revenues by Product Type99
 Exhibit 5-10
 BIPV Shipments by PV Technology101

Chapter One: Introduction

1.1 Background to this Report

Building Integrated Photovoltaics (BIPV) is still a fledgling business and although a wide variety of BIPV products are now on offer the volumes sold are still low. Nonetheless, *BIPV has the potential to change the terms of reference for the solar panel industry in a number of ways. From the demand side of the equation, BIPV improves the aesthetics of PV and could potentially reduce the total costs of constructing home, offices and factories utilizing solar panels.*

Both these factors potentially open up new addressable markets. From the supply perspective, BIPV offers new ways for PV panel suppliers to distinguish themselves in the marketplace. Specifically, it becomes easier for panel makers to show that their products are different from "plain vanilla" panels and also (if they wish) to re-position their products as building materials rather than PV panels if this fits in with their product/marketing strategies.

All of the above should be very welcome news for the PV industry which has lost momentum in the past couple of years as the result of the worldwide recession and the near collapse of construction markets in a number of geographies.

1.1.1 BIPV: The New Value Proposition for Solar

Aesthetics: For the earliest adopters of photovoltaics the value obtained from the PV system has often come from a sense that they are complying with the goals of environmental ideology. In some cases, they have also certainly considered the panels and mechanical systems supporting them to be attractive works of art. However, it was always unlikely that PV could spread into large addressable markets based on such drivers.

Understanding this was what led to the first generation of BIPV product. This first generation of BIPV systems was primarily architectural in nature. It consisted of attempts to make the PV panels more unobtrusive, such as installing them parallel to the roof surface or even hidden on a flat roof—and without the sun-tracking systems that would boost performance at the expense of a much more visually conspicuous system—and choosing thinner panels. In addition to helping PV appeal to a broader audience, the first generation of BIPV also has been intended to meet the requirements of certain local governments, which have either mandated BIPV or required that PV panels be hidden from view.

These first generation BIPV systems are not our primary concern in this report. Rather we are more interested in BIPV products as opposed to BIPV design. The BIPV products we have in mind here are those that integrate smoothly with building surfaces. At a minimum, they lie flush on a rooftop or wall; more specialized products also serve as roofing or cladding themselves or even as skylights or other building features. BIPV products, properly installed, simply look better to most observers, a major concern for buildings and systems that will be present for several decades. Along with many less tangible benefits, the beauty of a building contributes to its value.

Page | 17

Costs: *Inevitably, the cost of a BIPV system is higher than a standard PV panel of a similar performance. However, the big hope for BIPV is that it can lower the total costs of construction of a BIPV-enabled building, since the cost of using BIPV materials will be lower than using conventional building materials in conjunction with conventional PV systems.*

It is not yet clear that BIPV has yet reached a point where the expectations set out in the paragraph above are being met and to some great extent, BIPV will stand or fall on whether they are. However, if costs for BIPV begin to reach the point where BIPV products can be positioned as high-end building materials it opens up a lot of new possibilities for solar panel makers who have adopted the BIPV approach; these possibilities include everything from new marketing channels, to opportunities for creating new brands, to yet another way to distinguish their products from conventional panels.

1.1.2 Three Approaches to Building Integration: Rigid, Flexible, Transparent

From a product perspective, NanoMarkets believes that the BIPV market into three broad categories, based on the function that the BIPV products serve in the building envelope. These categories are (1) rigid BIPV tiles and panels, (2) flexible BIPV products and laminates, and (3) transparent or semitransparent BIPV glass products. Each of these product categories are at a different level technological maturity and also have significantly different addressable markets.

Rigid products: *Rigid BIPV products represent a minimal departure from the manufacturing of conventional panels, which are overwhelmingly rigid. As such, they are relatively low risk, presenting customers with similar perceptions to those that they have come to expect from regular PV panels.*

NanoMarkets, however, believes that there are distinct opportunities in this space that BIPV can tap into in a manner not available to conventional PV panels. Rigid BIPV products that are available or planned include tiles that are designed to interlace with conventional roofing tiles or cladding materials; larger tiles that serve as entire roof portions or wall portions

themselves; and thin, flush-mounted panels that overlay conventional roofing or siding but are specifically designed for flush mounting on buildings.

Flexible products: Flexible PV laminates are a newer direction for BIPV than the rigid systems described above. Besides flexible PV laminates, which are designed to be glued onto existing building materials such as metal roofing, there are also products like flexible shingles that interlace with conventional asphalt shingles. *Also coming soon are flexible building materials with PV cells built or deposited directly onto them. These products aim to integrate the PV panels more completely with building materials than today's laminates which are applied in a separate installation.*

Page | 18

The flexible product segment of the BIPV market clearly involves novel products and as such they represent a riskier business proposition than the rigid BIPV products described above. They are also reliant on using newer materials platforms; primarily thin-film and organic PV, since these materials are flexible and conventional c-Si PV is not. *It is still an open question as to which of the several thin-film/organic approaches to PV is best suited to flexible PV.*

Transparent: BIPV glass products are in many cases essentially a way of using glazing to make PV cells and modules into decorative building features. For the time being, at least, they are typically not transparent enough to provide good visibility through the panel and they are thus not used where visibility is important. But they do offer the opportunity to integrate PV into buildings in places and as part of features where the penetration of some sunlight is desired.

The initial markets for BIPV glass are in skylights, facades, curtain walls, and shade structures such as canopies and it can often be easily built to custom dimensions and shapes, either by adjusting the number and spacing of crystalline silicon cells or by cutting thin-film PV panels to size. The possibility of windows that are also PV panels has been much talked about, but the materials and manufacturing platforms necessary to produce a real product of this kind, seem quite far off.

1.2 Objectives and Scope of this Report

The primary purpose of this report is to examine and quantify the revenue-generating opportunities for BIPV over the next eight years. The focus is primarily on how BIPV and the firms that make it can build value beyond what can be achieved with conventional PV. We perform this analysis for each of the product classes mentioned above and also considering the various addressable markets for BIPV—residential, commercial and (to a more limited extent) industrial; new construction and retrofits. We also consider the sizes of the various

BIPV markets, the roles and strategies of important firms in the industry, and the various PV technologies as they relate to BIPV.

In this report, we take the approach that BIPV products include those PV panels specifically designed for mounting on (or in) buildings. As we note above there are three kinds of BIPV products that fit that definition and we discuss all of these in depth in the main body of this report. Also, we have noted above, our main concern here is with BIPV *products*, rather than with design/architectural strategies to integrate largely conventional PV technology into buildings.

Page | 19

This report is international in scope. The forecasts are worldwide forecasts and we have not been geographically selective in the firms that we have covered in this report or interviewed in order to collect information. That is not to say that the markets and firms considered in this report are geographically homogeneous; in fact, the markets are concentrated in certain geographic areas and the firms are concentrated around these markets. Largely, the geographical bias of BIPV—and hence of this report—is determined by the size of the PV market as a whole in certain countries and regions.

1.3 Methodology of this Report

The information for this work is derived from a variety of sources, but principally comes from primary sources, including NanoMarkets' ongoing interview program of business development managers and technologists involved with photovoltaics of all kinds. We also drew on an extensive search of the technical literature, relevant company Web sites, trade journals, government resources, and various collateral items from trade shows and conferences.

Some of the historical and background information has also been taken from our 2009 BIPV report and, in addition, we have built on the research we conducted for other recent photovoltaics-related reports including "*Materials Markets for Inorganic Thin-Film Photovoltaics: 2010*" from December 2009 and "*Organic and Dye-Sensitized Cell Photovoltaics: Materials, Applications, and Opportunities 2010*" from May 2010. Where information has been used in an earlier report, it has been reinvestigated, reanalyzed, and reconsidered in light of current developments and updated accordingly.

The forecasting approach taken in this report is explained in more detail in Chapter Five, but the basic approach taken here is to identify and quantify the underlying needs and markets that are served by BIPV products; consider the specifics of the applications and the types of products available or under development; and assess the competitive landscape to determine the suitability and likely volume of each of the transparent conductor types over the next

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eight years. The stated plans of the key firms are of course of special interest, although NanoMarkets critically considers these claims in light of all available data.

1.4 Plan of this Report

In Chapter Two, we consider rigid BIPV products, the conventional building materials that they complement and replace, their market driving aspects, and the available opportunities that relate to them. This analysis includes a focus on the cost of BIPV relative to that of conventional building materials plus conventional PV panels.

In Chapter Three we explore the parallel products, materials, markets, and opportunities for transparent BIPV products, and in Chapter Four, for flexible BIPV products. Finally, Chapter Five contains our eight-year forecasts of the markets for BIPV products of each of these three types.

Page | 20