NanoMarkets Report

BIPV Roofing Markets – 2012

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BIPV offers both the PV industry and the building products industry a way out of their current economic plights. For PV firms, BIPV provides a product strategy geared to adding value to products. For the building products industry, BIPV represents a new line of products that will enable construction firms to add saleable features to buildings of all kinds.

While all this is true of all BIPV products, there is a natural migration path from today's rooftop PV panels to BIPV roofing. With this in mind, NanoMarkets is publishing this report, which identifies and quantifies the market opportunities for BIPV roofing.

The report discusses a roadmap for BIPV roofing in which business revenues are generated initially by simple overlay products and then by conventional rigid and flexible BIPV roofing products and finally from fully-integrated products. The report also shows how the performance of BIPV roofing is expected to evolve with a special focus on lifetime requirements and the materials that will be used both for substrates and absorber layers.

This report also includes extensive forecasts of the BIPV roofing market in terms of wattage, area covered and revenues generated. Breakouts are provided by type of building, type of BIPV roofing and key materials used. In addition, we project the nations and regions that will generate the most revenues for BIPV roofing and the breakouts of the BIPV roofing market by retrofit and new construction. As usual with NanoMarkets reports, this report also includes a detailed assessment of the strategies of the leading firms currently supplying BIPV roofing products.

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Chapter One: Introduction

1.1 Background to this Report

Building-Integrated Photovoltaics (BIPV) offers both the PV industry *and* the building products industry a way out of their current economic plights:

- For PV firms, BIPV provides a product strategy geared to adding value to products in a market that is currently being decimated by commoditization

- For the building products industry, BIPV roofing represents a new line of products that will enable their construction firms to add saleable features to buildings of all kinds. As such BIPV roofing provides a useful addition to product lines that have been hurt by construction industry downturns worldwide.

1.1.1 NanoMarkets' Expectations for Future Trends in BIPV Roofing

The product/market environment currently facing the BIPV roofing industry is profiled in Exhibit 1-1. NanoMarkets' expectations are that the challenges listed in this Exhibit will gradually be resolved and that new trends will emerge in the BIPV roofing business:

- There is an obvious natural migration path from today's dominant rooftop PV panels to BIPV roofing. As a result, *NanoMarkets believes that BIPV roofing is likely to be the fastest growing sector of the BIPV market as BIPV moves from being a premium solution to a more common one*

- Revenue is already being generated in the BIPV roofing sector to some extent by simple overlay products, but we anticipate that *overlays will be quite quickly replaced as a primary source of revenues for BIPV roofing by rigid and flexible BIPV roofing products with a moderate level of integration between the PV layers and the roofing functionality. Overlays will always have a role to play for retrofits.*

The difficult path to further integration of BIPV roofing products: NanoMarkets also expects that the final resting place of the BIPV roofing market—from a commercialization perspective—will be in some kind of fully-integrated product for which it will be difficult to say definitively whether it is a building product or a PV product; in much the same way that it is hard to say whether an office "all-in-one" is a fax, printer, copier or scanner.

This fully-integrated BIPV roofing product is still more dream than reality at the present time, although sometimes one already catches a whiff of where BIPV is headed in research devices and trials. NanoMarkets believes that such a fully-integrated product could capture a significant share of the revenues from both the roofing and PV industry. But there are major struggles ahead for the BIPV roofing industry. Some of these are technical and others are marketing related.

Exhibit 1-1: BIPV Roofing Market Value Proposition and its Challenges		
	Value proposition	**Challenges**
Revenue potential	Potential for distinctive novel products that can tap into huge established markets and marketing channels for both PV panels and roofing materials. Provides new revenue potential at a time when the construction and PV industries face economic challenges	Technology is still immature and existing marketing channels are not familiar with BIPV roofing
Integration	Integration can spread costs of both PV and roofing over a common substrate. Early integrated products are already on the market	Path to full integration is not yet clear and absorber materials that seem best for integration are potentially challenging with regard to lifetimes and encapsulation.
Lifetimes	Achievable lifetimes are *good enough* for practical roofing today	Lifetimes for BIPV roofing products are still not at the best that regular roofing products offer. This is a challenge given that BIPV roofing products are premium priced. Encapsulation is again a major part of the challenge here
Competition with standard roofing products	BIPV roofing can be sold as premium priced roofing products, adding PV functionality at a moderate additional cost	At the present time premiums may be very high and decision by building owner is complex compared to simply choosing a simple roofing product
Competition with standard PV panels	BIPV roofing can be sold as a PV panel with improved aesthetics and, for those contemplating new roofing, better aggregate economics	Although BIPV roofing may offer improved aggregate value over buying PV and roofing separately, for those buyers interested primarily in PV functionality, conventional PV panels may be a better buy; especially at the current low price of standard panels
Comparison with other BIPV products	Most conventional panels for individual buildings are placed on roofs, so a transition to BIPV roofing is a natural migration suggesting that BIPV roofing may grow faster than other parts of the BIPV sector in the medium term	On larger industrial and commercial buildings, the roof may not be visible, so no chance to exploit specific BIPV aesthetics

1.1.2 Technical Challenges to BIPV Roofing Technology

The biggest technical challenge to achieving the fully-integrated BIPV roofing module described above is that there is no clear roadmap to how that will be achieved. In part, this seems to be

because the absorber materials that appear to offer the clearest road to monolithic integration seem also to have important limitations that may take a few years to overcome.

The materials that we are thinking about here are CIGS, DSC and OPV, all of which could be printed/coated as a unique layer in a BIPV roofing product. (It is possible that the same comments could be made about other absorber materials, except the fabrication techniques for the trio mentioned above are more developed.) However, CIGS, DSC and OPV all need special encapsulation for them to be viable as the basis for BIPV roofing. In addition, DSC and OPV technologies offer low efficiencies when compared to other more commonly used PV technologies.

Quite how all these various performance tradeoffs on the way to complete integration will be made in the long term is far from clear at this point in time.

The lifetime issue: The manner in which rooftop PV will shift to full integration can be dismissed by some firms as a futuristic or even an academic issue. However, of *immediate* importance is the degree to which rooftop BIPV can withstand the tests of time. To state the obvious, replacing roofs is always costly and never something that building owners and managers want to do often.

While achieving long lifetimes in "pure" roofing is a problem that was solved literally millennia ago, engineers have barely begun to solve the problem for BIPV roofing.

- *As we have already noted (in the context of the need for encapsulation), some of the most promising absorber materials with regard to integration, are also the ones where achieving long lifetimes present the greatest challenges.* Much the same thing can be said about substrate materials.

- However, early BIPV roofing products should probably be considered no more than good enough from the perspective of the roofing products industry when it comes to the matter of lifetimes.

1.1.3 BIPV Roofing and the PV Industry "Crisis"

Much of the analysis above suggests a fairly encouraging future for BIPV roofing. However, as we go to press with this report, we note that important firms in this space are apparently having serious problems:

- The basic facts behind this trend are that in all of the important markets for solar panels, the market is being flooded with low-cost, Chinese-made solar panels that are undermining suppliers with higher cost structures.

- At the same time, the subsidies that have been one of the major factors underpinning the dramatic growth of the solar industry in the past decade are either disappearing or are under threat.

These negative trends, of course, are very general and apply across the entire solar industry. However, any premium-priced solar solution—such as BIPV roofing—comes under special

challenge, because when it is possible to buy solar panels at a very low cost, higher cost solutions stand out and they must do more to prove their business case.

Some of the firms in the BIPV business are clearly not equipped to deal with such a crisis, either in terms of marketing or in terms of financial resources. This is hardly surprising in that, until a year or so ago, BIPV firms had no reason to fear a sudden downturn. As a result, NanoMarkets expects that more BIPV roofing firms will go under in the next year.

Nonetheless, NanoMarkets does not believe that BIPV roofing will turn out to be a flash in the pan. Even if the current generation of BIPV roofing companies is decimated by poor economic conditions, there are plenty of other firms ready to jump into the breach. These could potentially include firms from the roofing industry as well as firms from the PV industry.

More importantly, we expect that some of the specific factors that have hurt the PV industry in the recent past are not likely to persist for long. Of course, much will also depend on the state of the worldwide economy in general and the construction industry in particular.

The future of Chinese activity in the PV industry: The consensus is that subsidies by the Chinese government to its domestic suppliers in order to build high-volume plants has led to the collapse in PV prices and to the closing of less "competitive" plants in other parts of the world.

The fact that First Solar, a firm that has achieved a low cost structure based on building large capacities and achieving major economies of scale, could be hurt by an influx of low-cost Chinese panels, suggests strongly that the impact of Chinese subsidies goes well beyond just supplying the Chinese industry with low-cost loans.

As such, the Chinese have clearly bought themselves considerable market share and we doubt that this share is going to drop any time soon. However, what will change, NanoMarkets believes, is the kind of product that the Chinese solar firms will be supplying.

The whole focus of Chinese industrial policy these days is changing. Rather than being all about providing moderate quality, "plain vanilla" products at very low cost and for export, the new direction of Chinese industrial policy is to create much higher value products with domestic markets in mind. NanoMarkets believes Chinese solar firms will soon start to develop their own high-value products, which may well mean a direct and important involvement by Chinese solar firms in the BIPV roofing industry going forward.

This might lead to the lessening of the intense price competition that currently exists in the solar industry, and might also lead to an actual resurgence of high-value solar technologies as Chinese firms get into the BIPV space and start promoting the activity.

However, what such a change of heart by Chinese businesses and government would not mean would be that the current generation of BIPV firms would be "saved." It might simply mean that when BIPV starts to grow solidly again, the major firms in the industry will be Chinese in origin.

Impact of a changing subsidy environment: Another reason for keeping a watch on the Chinese solar industry is that China is one of a relatively few countries that has a special subsidy for BIPV in place, although there are others. Most other geographies do not distinguish between types of solar. Given that Chinese high-tech firms are currently being told to focus on domestic

consumption, this is yet another reason why, in the future, we might expect to see Chinese firms play a growing role in the BIPV roofing market.

Beyond the unique case of Chinese subsidies, we would anticipate that in other parts of the world, subsidies will begin to fade away. We have already begun to see this happen in Europe and it would be no surprise to see U.S. subsidies begin to be taken away over the next few years, too.

The immediate motivation for cutting back on solar subsidies would be the growing need in the U.S. and Europe for government cutbacks in general. Reductions in subsidies cannot but help impact all solar technologies adversely and we also note that when subsidies are reduced across the board, the absolute price difference between conventional solar and premium solar is increased.

On the other hand, the solar industry—including BIPV roofing—was never intended to be subsidized forever. Although the available market for BIPV roofing may contract compared with the days of subsidies, we have no reason to believe it will disappear completely.

1.2 Goal and Scope of this Report

The objective of this report is to pinpoint the opportunities that are likely to emerge in the BIPV roofing market in the next few years and show how these may be best developed given the changing market circumstances described above. The potential for technological improvement, which is also described above, is also taken into consideration in this opportunity analysis.

Another goal of this report is to examine current and future strategies in the emerging BIPV roofing market. Because of the radically altered strategic situation for BIPV roofing that has emerged in the past few years, we think that entirely new strategies will be required for firms in this space. Thus, we have made the required strategic changes for the future BIPV roofing sector a key theme of this report.

1.2.1 Definitions of BIPV Roofing

The scope of this report is a fairly broad, we have included all products that might make a reasonable claim to being integrated. This includes simple laminates all the way up to fully-integrated products of the kind we mention above. Definitions are important here. In some articles and reports about the BIPV sector, it is assumed (sometimes tacitly) that the "I" in BIPV stands for "fully integrated."

Under this definition, any BIPV market is made to seem very futuristic, which we think is unfortunate since it leaves out of the equation the considerable amount of effort that has gone into developing the BIPV concept for well over a decade. Indeed, this is especially true of the BIPV roofing segment that has existed (albeit in a primitive form) for almost two decades.

The broad approach that we take in this report acknowledges that there is already a substantial market around the world that is willing to buy into solar panels that are disguised in roofing in some way. This is important as it illustrates that whole idea of BIPV roofing is not just another technological flash in the pan. We have taken account of the widely varying functionality of early

BIPV roofing and future fully-integrated BIPV roofing by providing separate discussions and forecasts of different segments of the BIPV roofing market.

1.2.2 Forecasts and Strategies

Our forecasts in this report are provided in both value and volume terms. Volume shipments are forecasted in terms of area covered and MW shipped. This reflects the hybrid nature of the BIPV roofing. It is at once a roofing product (where area covered is the relevant measure) and a solar product (where MW is the relevant measure).

Breakouts in the forecasts are provided by type of building, type of BIPV roofing and key materials used. In addition, we project the nations and regions that will generate the most revenues for BIPV roofing and the breakouts of the BIPV roofing market by retrofit and new construction.

In addition, as is usual with NanoMarkets reports of this type, we have included assessments of the strategies now being deployed by BIPV roofing firms. In this analysis, we are particularly concerned with understanding how BIPV roofing firms plan to cope with the current "crisis" in the PV industry that is described in the first section of this Chapter.

1.3 Methodology of this Report

NanoMarkets has now been providing in-depth analysis for the BIPV industry for several years. As part of our ongoing coverage of this sector, we conduct interviews with leading executives in the BIPV space and these interviews have helped to inform the views expressed in this report. As necessary, we have also conducted interviews specifically related to BIPV roofing to meet the additional needs of this particular report. These newer interviews have focused on the opportunities and challenges in the BIPV roofing market that have already been mentioned.

In addition to the information we have collected from these sources, we have also made use of secondary research:

- Much, but not all of this secondary material has come from the Internet and includes articles from important trade and professional journals, as well as reports from governments and trade/professional associations around the world.

- NanoMarkets researchers have also attended trade shows in the U.S., Asia and Europe that have some relevance to the markets considered in this report and have, in part, based our analysis on conversations held with industry insiders, and publications collected at these shows

Finally, forecasting methodology is discussed in more detail in Chapter Four of this report. Here we note that our forecasting model is based on NanoMarkets' earlier reports in the BIPV sector, but has been radically updated to take account of today's market circumstances. Also, we have added considerable new granularity to these forecasts, reflecting the needs of the BIPV roofing industry in particular.

1.4 Plan of this Report

Chapter Two of this report focuses on the products and technologies that make up the BIPV roofing industry. In this Chapter, we examine the various approaches to creating BIPV roofing products and how these are likely to change—and be impacted by new technologies in the future. As part of this effort, we have discussed interesting recent efforts by firms in this space to create new products and technologies.

In Chapter Three, we provide an in-depth analysis of the markets into which BIPV roofing products will be sold. This includes analysis of the type of buildings in which BIPV roofing is being used, as well as the type of roof and geography. The main market drivers and challenges for BIPV roofing markets—including regulatory influences—are also considered in this Chapter

Finally, in Chapter Four, the report includes a granular forecast of the BIPV roofing market, with breakouts by MW, area covered and revenues.