

Building Integrated Photovoltaic (BIPV) Market – Global Industry Size, Share, Trends, Opportunity, and Forecast Segmented By Technology (Crystalline Silicon, Thin Film, and Others), By Application (Roofs, Walls, Glass, Façade, and Others), By End-Use (Residential, Commercial, and Industrial), By Region, Competition 2018-2028

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Abstracts

The Global Building Integrated Photovoltaic (BIPV) Market, valued at USD 15.02 Billion in 2022, is poised for robust growth in the forecast period with a remarkable Compound Annual Growth Rate (CAGR) of 22.03% anticipated through 2028. Building Integrated Photovoltaic (BIPV) is a groundbreaking concept that involves seamlessly integrating solar photovoltaic (PV) technology into the architectural design and elements of buildings. This integration empowers structures to harness sunlight and convert it into electricity, all while serving as functional building components. BIPV systems are meticulously designed to harmonize with a building's aesthetics, providing an environmentally sustainable and visually pleasing energy generation solution.

These innovative BIPV systems are engineered to either replace or complement traditional building materials and elements such as roofs, facades, windows, and walls. Solar panels are seamlessly incorporated into these building components, effectively transforming them into active solar power generators. A compelling advantage of BIPV solutions lies in their adaptability to architectural designs, colors, and appearances, making them an attractive choice for both residential and commercial construction endeavors.

BIPV systems tap into sunlight to generate electricity, which can power various building

functionalities, including lighting, heating, cooling, and powering appliances. Surplus electricity can be either fed back into the grid or stored for later utilization. Beyond their immediate benefits, BIPV systems play a crucial role in reducing a building's carbon footprint by harnessing clean and renewable energy. They actively contribute to the principles of sustainable construction and help mitigate the environmental consequences associated with conventional fossil fuel-based electricity generation.

Furthermore, BIPV solutions can enhance a building's energy efficiency by reducing its reliance on grid-based electricity, particularly during daylight hours when solar energy production reaches its zenith. This leads to reduced energy costs and long-term savings. Continuous advancements in solar PV technology have resulted in more efficient and visually appealing BIPV solutions. These advancements encompass innovations such as transparent solar panels, solar tiles, and solar windows, expanding the possibilities for seamless integration.

The global BIPV market has experienced substantial growth, driven by escalating awareness of renewable energy, environmental concerns, and government incentives and policies aimed at promoting sustainable building practices. Building-integrated photovoltaics encompass various types of solar PV modules integrated into building exteriors, including rooftops, windows, and curtain walls. These BIPV systems not only bolster economic efficiency but also enhance a building's overall aesthetic appeal. They are becoming increasingly prominent in both commercial and residential constructions, replacing conventional building materials and contributing to a more sustainable and visually appealing built environment.

Key Market Drivers

The global Building Integrated Photovoltaic (BIPV) market is a critical sector that plays a significant role in the renewable energy landscape. The rapid expansion of the solar photovoltaic (PV) installation capacities of different countries, coupled with increasing demand for renewable energy sources, is expected to drive the growth of solar panel market across the world. Increased awareness for energy security and self-sufficiency and favorable government legislations, coupled with the unilateral obligation of countries such as Germany, Italy, France, the UK, the U.S., China, Japan, and India to the Kyoto Protocol, designated to reduce greenhouse gas (GHG) emissions, are also expected to promote the growth of the market in the coming years. The presence of a consumer base with high disposable income levels and the increasing affinity toward integrated installations in residential and commercial buildings in the country are anticipated to boost the demand for the product in the forecast period.

In addition, the growing innovation in the domain is projected to increase the operational efficiency of the product, translating into market growth. The building-integrated photovoltaics (BIPV) market in the U.S. is likely to be driven by the growing demand for alternate sources of energy. The demand for building-integrated photovoltaics is likely to be fueled by the high need for integrated roof systems in commercial and industrial establishments. Improvements in the manufacturing technology of thin film BIPV modules and the rising efficiency of the product are expected to drive the market over the forecast period.

The government of France offers the highest FiTs for electricity generated through photovoltaic components, which are essentially integrated into buildings. Capacity generated by photovoltaics integrated into building envelopes accounts for a substantial share of the overall accumulated, installed capacity generated by photovoltaics in the country. The country offers high subsidies and benefits pertaining to the use of building integrated photovoltaics in a bid to encourage such installations in the country. The building-integrated photovoltaics can be classified on the basis of module type, application, and end-use. By module type, building-integrated photovoltaics are divided as monocrystalline, polycrystalline, thin-film and others. The monocrystalline building-integrated photovoltaics have higher module efficiency compared to the polycrystalline photovoltaics. Building-integrated photovoltaics are used in industrial, commercial as well as residential buildings. Wherein, they are used for rooftop, curtail wall, glass, and facade among other applications. Increasing awareness and incentives for the use of renewable energy sources have been the key factors to attract the attention of people towards building-integrated photovoltaics. Building-integrated photovoltaics not only maintain but also improve the exterior appearance of the building. The building-integrated photovoltaics generate power which can be used to meet the energy requirement of the building. Owing to which the building-integrated photovoltaics market is expected to witness a boom in the near future. However, the capital requirement for the installation of building-integrated PV modules is higher as compared to the traditional PV modules which are expected to retard the growth of building-integrated photovoltaics.

Key Market Challenges

One of the foremost challenges in the Building Integrated Photovoltaic (BIPV) market is The global Building Integrated Photovoltaic (BIPV) market is at the forefront of renewable energy innovation, offering a sustainable solution for clean electricity generation while seamlessly integrating with building designs. However, like any rapidly evolving industry, the BIPV market faces several challenges that must be addressed to

ensure its continued growth and effectiveness in contributing to sustainable building practices. In this comprehensive analysis, we will explore the key challenges confronting the BIPV market and the strategies being employed to overcome them. One of the most significant challenges in the adoption of BIPV systems is the high initial cost of installation. The cost per watt of BIPV modules is often higher compared to traditional solar panels, making it a substantial upfront investment for builders and property owners. High initial costs can deter potential adopters, especially in regions with limited financial incentives or where the cost of electricity from conventional sources is relatively low. This can slow down the adoption rate of BIPV technology. BIPV systems are expected to seamlessly integrate with building designs while maintaining aesthetic appeal. Achieving this integration can be challenging, as it requires collaboration between architects, designers, and BIPV manufacturers to develop customized solutions that meet both energy generation and design requirements. Collaboration between architects and BIPV manufacturers is crucial to develop aesthetically pleasing and functional BIPV solutions. Manufacturers are investing in research and development to create innovative BIPV products that can blend harmoniously with various architectural styles. Customization options and design flexibility are also being emphasized to meet the diverse needs of building projects.

Technological Efficiency and Performance

The efficiency and performance of BIPV systems must match or exceed that of traditional solar panels. Achieving high conversion efficiency while maintaining architectural integration and design can be technically challenging. Ongoing research and development efforts are focused on improving the efficiency of BIPV modules, making them competitive with traditional solar panels. Innovative technologies, such as transparent solar panels and multi-functional BIPV solutions, are being explored to maximize energy generation while meeting architectural and design criteria.

Durability and Longevity

BIPV systems must demonstrate durability and longevity to provide a reliable and long-term source of clean energy. Exposure to the elements, including UV radiation, rain, and temperature fluctuations, can affect the performance and lifespan of BIPV components. BIPV manufacturers are investing in materials and coatings that enhance the durability and weather resistance of their products. Quality control measures, standardized testing protocols, and warranty programs are being implemented to assure customers of the longevity and reliability of BIPV systems.

Key Market Trends

Technological Advancements in BIPV Modules

The global Building Integrated Photovoltaic (BIPV) market is experiencing a transformative evolution driven by technological advancements, environmental consciousness, and the increasing demand for sustainable building solutions. BIPV systems have emerged as a key player in the renewable energy landscape, offering a seamless integration of solar energy generation into building structures. In this comprehensive analysis, we will explore the prominent trends shaping the global BIPV market and their profound impact on sustainable building practices. The rapid progress in solar PV technology has led to the development of advanced BIPV modules with improved energy conversion efficiency. High-efficiency solar cells, such as PERC (Passivated Emitter Rear Cell) and bifacial solar cells, are being integrated into BIPV products, allowing for higher energy yields from limited surface areas. Moreover, transparent solar panels and solar glass are becoming increasingly popular, enabling architects to incorporate solar elements into windows, facades, and roofing materials without sacrificing natural light or aesthetics. Enhanced BIPV module technology is instrumental in boosting the overall performance of BIPV systems. It enables buildings to generate more clean energy while maintaining architectural aesthetics. As a result, BIPV systems are more attractive to designers and developers seeking sustainable solutions.

Solar Energy Harvesting from Multiple Building Elements

BIPV is expanding beyond traditional solar panels to encompass multiple building elements, including windows, facades, roofing, and shading systems. BIPV technology is evolving to harness solar energy from various building components, transforming them into energy generators. Solar windows, for instance, incorporate transparent solar cells that allow natural light to pass through while generating electricity. Similarly, solar shingles and solar roofing materials are designed to replace conventional roofing materials while producing clean energy. This diversification of BIPV applications offers architects and builders more flexibility in integrating solar solutions into their designs. The ability to harvest solar energy from multiple building elements enhances the overall energy generation capacity of structures, making BIPV even more appealing for sustainable building projects. It enables buildings to maximize their energy production potential while maintaining architectural aesthetics.

Segmental Insights

Technology Insights

Crystalline silicon segment led the market and accounted for 70% of the global revenue share in 2022. Crystalline silicon cells can be integrated into building roofs by using smart mounting systems, which replace the sections of the roof while keeping its integrity intact. This type of integration does not account for large investments and provides high efficiency. Another option of integration is the replacement of roof tiles with crystalline silicon cells. In addition, the market witnesses the use of anti-reflective coatings, which aid the capture of solar energy and provide superior efficiency. Crystalline silicon has the highest energy conversion efficiency at present; commercial modules typically convert 13%–21% of the incident sunlight into electricity.

Application Insight

The roof installation segment led the market and accounted for the largest revenue share in 2022. The roof segment will maintain its lead throughout the forecast period. Photovoltaics integrated with building roofs are known to exhibit efficiency due to improved incidence of light on the roof surface. The segment accounted for the highest market share in 2022 owing to the higher strength and improved aesthetic appeal of integrated roofs and skylights. The demand for building integrated roofs is expected to increase over the forecast period due to the development of superior products. The market is anticipated to have a steady growth in all segments as the demand for BIPV increases. Superior efficiency of solar walls due to strong incident sunlight is expected to drive the demand for BIPV in walls over the forecast period. Introduction of advanced low-weight solar panels is expected to facilitate the demand for building integrated walls. The development of advanced solutions such as the combination of amorphous silicon transparent glass solar panels with an opaque glazing unit is likely to drive the demand for BIPV in these applications. The use of double- and triple-glazed insulating glass in BIPV walls is also expected to boost the product demand in the forecast period. BIPV facades experience high demand, primarily in the developed economies that have a well-established electricity distribution system. The demand for integration of photovoltaics with facades is driven by their increasing installation in the commercial sector. Glass integrations are expected to grow on account of high transparency of integrated systems coupled with superior integration of glass and BIPV cells. The development of photovoltaic materials with high absorption is expected to propel the product demand over the forecast period.

Others application segment include shading and membranes. The demand for such

products is high in residential installations due to the development of lightweight materials for use in uneven surfaces. The installations do not generally use crystalline silicon photovoltaic module, as the structure is incapable of supporting heavy weight.

Regional Insights

The Europe region has established itself as the leader in the Global Building Integrated Photovoltaic (BIPV) Market with a significant revenue share in 2022. Europe dominated the global market in 2022 and accounted for the largest revenue share of over 37.42%. Favorable outlook toward renewable energy coupled with consumer awareness for the same in European countries is likely to drive the market for BIPV over the forecast period. Germany and Italy are increasingly emphasizing the use of solar energy, which is expected to translate into higher adoption of BIPV, thus promoting industry growth in the forecast period. The demand for building-integrated photovoltaics in commercial establishments is likely to be fueled by the growing number of retrofit projects using these installations. The high emphasis on the aesthetic appeal of solar energy-harnessing systems, primarily in commercial establishments, is likely to fuel the product demand in this sector. The demand for building-integrated photovoltaics in residential sector is expected to be driven in the forecast period owing to increasing awareness regarding the use of renewable sources of energy for electricity generation among the consumers. However, high cost of integration of photovoltaics into the building envelope is expected to act as a restraint for the market growth over the forecast period.

Key Market Players

First Solar, Inc

Solaria Corporation

SunPower Corporation

Hanergy Thin Film Power Group

Trina Solar

Onyx Solar

Dow Solar:

Tesla, Inc.

Canadian Solar

Sungrow Power Supply Co., Ltd.

Report Scope:

In this report, the Global Building Integrated Photovoltaic (BIPV) Market has been segmented into the following categories, in addition to the industry trends which have also been detailed below:

Global Building Integrated Photovoltaic (BIPV) Market, By Technology:

Crystalline Silicon

Thin Film

Others

Global Building Integrated Photovoltaic (BIPV) Market, By Application:

Roofs

Walls

Glass

Facade

Others

Global Building Integrated Photovoltaic (BIPV) Market, By End User:

Residential

Commercial

Industrial

Global Building Integrated Photovoltaic (BIPV) Market, By Region:

North America

United States

Canada

Mexico

Asia-Pacific

China

India

Japan

South Korea

Indonesia

Europe

Germany

United Kingdom

France

Russia

Spain

South America

Brazil

Argentina

Middle East & Africa

Saudi Arabia

South Africa

Egypt

UAE

Israel

Competitive Landscape

Company Profiles: Detailed analysis of the major companies present in the Global Building Integrated Photovoltaic (BIPV) Market.

Available Customizations:

Global Building Integrated Photovoltaic (BIPV) Market report with the given market data, Tech Sci Research offers customizations according to a company's specific needs. The following customization options are available for the report:

Company Information

Detailed analysis and profiling of additional market players (up to five).

Contents

1. PRODUCT OVERVIEW

- 1.1. Market Definition
- 1.2. Scope of the Market
- 1.3. Markets Covered
- 1.4. Years Considered for Study
- 1.5. Key Market Segmentations

2. RESEARCH METHODOLOGY

- 2.1. Objective of the Study
- 2.2. Baseline Methodology
- 2.3. Key Industry Partners
- 2.4. Major Association and Secondary Sources
- 2.5. Forecasting Methodology
- 2.6. Data Triangulation & Validation
- 2.7. Assumptions and Limitations

3. EXECUTIVE SUMMARY

4. VOICE OF CUSTOMERS

5. GLOBAL BUILDING INTEGRATED PHOTOVOLTAIC (BIPV) MARKET OUTLOOK

- 5.1. Market Size & Forecast
 - 5.1.1. By Value
- 5.2. Market Share & Forecast
 - 5.2.1. By Technology (Crystalline Silicon, Thin Film, and Others)
 - 5.2.2. By Application (Roofs, Walls, Glass, Fa?ade, and Others)
 - 5.2.3. By End-Use (Residential, Commercial, and Industrial)
 - 5.2.4. By Region
- 5.3. By Company (2022)
- 5.4. Market Map

6. NORTH AMERICA BUILDING INTEGRATED PHOTOVOLTAIC (BIPV) MARKET OUTLOOK

6.1. Market Size & Forecast

6.1.1. By Value

6.2. Market Share & Forecast

6.2.1. By Technology

6.2.2. By Application

6.2.3. By End-User

6.2.4. By Country

6.3. North America: Country Analysis

6.3.1. United States Building Integrated Photovoltaic (BIPV) Market Outlook

6.3.1.1. Market Size & Forecast

6.3.1.1.1. By Value

6.3.1.2. Market Share & Forecast

6.3.1.2.1. By Technology

6.3.1.2.2. By Application

6.3.1.2.3. By End-User

6.3.2. Canada Building Integrated Photovoltaic (BIPV) Market Outlook

6.3.2.1. Market Size & Forecast

6.3.2.1.1. By Value

6.3.2.2. Market Share & Forecast

6.3.2.2.1. By Technology

6.3.2.2.2. By Application

6.3.2.2.3. By End-User

6.3.3. Mexico Building Integrated Photovoltaic (BIPV) Market Outlook

6.3.3.1. Market Size & Forecast

6.3.3.1.1. By Value

6.3.3.2. Market Share & Forecast

6.3.3.2.1. By Technology

6.3.3.2.2. By Application

6.3.3.2.3. By End-User

7. GLOBAL BUILDING INTEGRATED PHOTOVOLTAIC (BIPV) MARKET OUTLOOK

7.1. Market Size & Forecast

7.1.1. By Value

7.2. Market Share & Forecast

7.2.1. By Technology

7.2.2. By Application

7.2.3. By End-User

7.2.4. By Country

7.3. Asia-Pacific: Country Analysis

7.3.1. China Building Integrated Photovoltaic (BIPV) Market Outlook

7.3.1.1. Market Size & Forecast

7.3.1.1.1. By Value

7.3.1.2. Market Share & Forecast

7.3.1.2.1. By Technology

7.3.1.2.2. By Application

7.3.1.2.3. By End-User

7.3.2. India Building Integrated Photovoltaic (BIPV) Market Outlook

7.3.2.1. Market Size & Forecast

7.3.2.1.1. By Value

7.3.2.2. Market Share & Forecast

7.3.2.2.1. By Technology

7.3.2.2.2. By Application

7.3.2.2.3. By End-User

7.3.3. Japan Building Integrated Photovoltaic (BIPV) Market Outlook

7.3.3.1. Market Size & Forecast

7.3.3.1.1. By Value

7.3.3.2. Market Share & Forecast

7.3.3.2.1. By Technology

7.3.3.2.2. By Application

7.3.3.2.3. By End-User

7.3.4. South Korea Building Integrated Photovoltaic (BIPV) Market Outlook

7.3.4.1. Market Size & Forecast

7.3.4.1.1. By Value

7.3.4.2. Market Share & Forecast

7.3.4.2.1. By Technology

7.3.4.2.2. By Application

7.3.4.2.3. By End-User

7.3.5. Indonesia Building Integrated Photovoltaic (BIPV) Market Outlook

7.3.5.1. Market Size & Forecast

7.3.5.1.1. By Value

7.3.5.2. Market Share & Forecast

7.3.5.2.1. By Technology

7.3.5.2.2. By Application

7.3.5.2.3. By End-User

8. EUROPE BUILDING INTEGRATED PHOTOVOLTAIC (BIPV) MARKET OUTLOOK

- 8.1. Market Size & Forecast
 - 8.1.1. By Value
- 8.2. Market Share & Forecast
 - 8.2.1. By Technology
 - 8.2.2. By Application
 - 8.2.3. By End-User
 - 8.2.4. By Country
- 8.3. Europe: Country Analysis
 - 8.3.1. Germany Building Integrated Photovoltaic (BIPV) Market Outlook
 - 8.3.1.1. Market Size & Forecast
 - 8.3.1.1.1. By Value
 - 8.3.1.2. Market Share & Forecast
 - 8.3.1.2.1. By Technology
 - 8.3.1.2.2. By Application
 - 8.3.1.2.3. By End-User
 - 8.3.2. United Kingdom Building Integrated Photovoltaic (BIPV) Market Outlook
 - 8.3.2.1. Market Size & Forecast
 - 8.3.2.1.1. By Value
 - 8.3.2.2. Market Share & Forecast
 - 8.3.2.2.1. By Technology
 - 8.3.2.2.2. By Application
 - 8.3.2.2.3. By End-User
 - 8.3.3. France Building Integrated Photovoltaic (BIPV) Market Outlook
 - 8.3.3.1. Market Size & Forecast
 - 8.3.3.1.1. By Value
 - 8.3.3.2. Market Share & Forecast
 - 8.3.3.2.1. By Technology
 - 8.3.3.2.2. By Application
 - 8.3.3.2.3. By End-User
 - 8.3.4. Russia Building Integrated Photovoltaic (BIPV) Market Outlook
 - 8.3.4.1. Market Size & Forecast
 - 8.3.4.1.1. By Value
 - 8.3.4.2. Market Share & Forecast
 - 8.3.4.2.1. By Technology
 - 8.3.4.2.2. By Application
 - 8.3.4.2.3. By End-User
 - 8.3.5. Spain Building Integrated Photovoltaic (BIPV) Market Outlook
 - 8.3.5.1. Market Size & Forecast
 - 8.3.5.1.1. By Value

8.3.5.2. Market Share & Forecast

8.3.5.2.1. By Technology

8.3.5.2.2. By Application

8.3.5.2.3. By End-User

9. SOUTH AMERICA BUILDING INTEGRATED PHOTOVOLTAIC (BIPV) MARKET OUTLOOK

9.1. Market Size & Forecast

9.1.1. By Value

9.2. Market Share & Forecast

9.2.1. By Technology

9.2.2. By Application

9.2.3. By End-User

9.2.4. By Country

9.3. South America: Country Analysis

9.3.1. Brazil Building Integrated Photovoltaic (BIPV) Market Outlook

9.3.1.1. Market Size & Forecast

9.3.1.1.1. By Value

9.3.1.2. Market Share & Forecast

9.3.1.2.1. By Technology

9.3.1.2.2. By Application

9.3.1.2.3. By End-User

9.3.2. Argentina Building Integrated Photovoltaic (BIPV) Market Outlook

9.3.2.1. Market Size & Forecast

9.3.2.1.1. By Value

9.3.2.2. Market Share & Forecast

9.3.2.2.1. By Technology

9.3.2.2.2. By Application

9.3.2.2.3. By End-User

10. MIDDLE EAST & AFRICA BUILDING INTEGRATED PHOTOVOLTAIC (BIPV) MARKET OUTLOOK

10.1. Market Size & Forecast

10.1.1. By Value

10.2. Market Share & Forecast

10.2.1. By Technology

10.2.2. By Application

10.2.3. By End-User

10.2.4. By Country

10.3. Middle East & Africa: Country Analysis

10.3.1. Saudi Arabia Building Integrated Photovoltaic (BIPV) Market Outlook

10.3.1.1. Market Size & Forecast

10.3.1.1.1. By Value

10.3.1.2. Market Share & Forecast

10.3.1.2.1. By Technology

10.3.1.2.2. By Application

10.3.1.2.3. By End-User

10.3.2. South Africa Building Integrated Photovoltaic (BIPV) Market Outlook

10.3.2.1. Market Size & Forecast

10.3.2.1.1. By Value

10.3.2.2. Market Share & Forecast

10.3.2.2.1. By Technology

10.3.2.2.2. By Application

10.3.2.2.3. By End-User

10.3.3. UAE Building Integrated Photovoltaic (BIPV) Market Outlook

10.3.3.1. Market Size & Forecast

10.3.3.1.1. By Value

10.3.3.2. Market Share & Forecast

10.3.3.2.1. By Technology

10.3.3.2.2. By Application

10.3.3.2.3. By End-User

10.3.4. Israel Building Integrated Photovoltaic (BIPV) Market Outlook

10.3.4.1. Market Size & Forecast

10.3.4.1.1. By Value

10.3.4.2. Market Share & Forecast

10.3.4.2.1. By Technology

10.3.4.2.2. By Application

10.3.4.2.3. By End-User

10.3.5. Egypt Building Integrated Photovoltaic (BIPV) Market Outlook

10.3.5.1. Market Size & Forecast

10.3.5.1.1. By Value

10.3.5.2. Market Share & Forecast

10.3.5.2.1. By Technology

10.3.5.2.2. By Application

10.3.5.2.3. By End-User

11. MARKET DYNAMICS

- 11.1. Drivers
- 11.2. Challenge

12. MARKET TRENDS & DEVELOPMENTS

13. COMPANY PROFILES

- 13.1. First Solar, Inc.
 - 13.1.1. Business Overview
 - 13.1.2. Key Revenue and Financials
 - 13.1.3. Recent Developments
 - 13.1.4. Key Personnel
 - 13.1.5. Key Product/Services
- 13.2. Solaria Corporation.
 - 13.2.1. Business Overview
 - 13.2.2. Key Revenue and Financials
 - 13.2.3. Recent Developments
 - 13.2.4. Key Personnel
 - 13.2.5. Key Product/Services
- 13.3. SunPower Corporation.
 - 13.3.1. Business Overview
 - 13.3.2. Key Revenue and Financials
 - 13.3.3. Recent Developments
 - 13.3.4. Key Personnel
 - 13.3.5. Key Product/Services
- 13.4. Hanergy Thin Film Power Group.
 - 13.4.1. Business Overview
 - 13.4.2. Key Revenue and Financials
 - 13.4.3. Recent Developments
 - 13.4.4. Key Personnel
 - 13.4.5. Key Product/Services
- 13.5. Trina Solar.
 - 13.5.1. Business Overview
 - 13.5.2. Key Revenue and Financials
 - 13.5.3. Recent Developments
 - 13.5.4. Key Personnel
 - 13.5.5. Key Product/Services

13.6. Onyx Solar.

- 13.6.1. Business Overview
- 13.6.2. Key Revenue and Financials
- 13.6.3. Recent Developments
- 13.6.4. Key Personnel
- 13.6.5. Key Product/Services

13.7. Dow Solar.

- 13.7.1. Business Overview
- 13.7.2. Key Revenue and Financials
- 13.7.3. Recent Developments
- 13.7.4. Key Personnel
- 13.7.5. Key Product/Services

13.8. Tesla, Inc.

- 13.8.1. Business Overview
- 13.8.2. Key Revenue and Financials
- 13.8.3. Recent Developments
- 13.8.4. Key Personnel
- 13.8.5. Key Product/Services

13.9. Canadian Solar.

- 13.9.1. Business Overview
- 13.9.2. Key Revenue and Financials
- 13.9.3. Recent Developments
- 13.9.4. Key Personnel
- 13.9.5. Key Product/Services

13.10. Sungrow Power Supply Co., Ltd.

- 13.10.1. Business Overview
- 13.10.2. Key Revenue and Financials
- 13.10.3. Recent Developments
- 13.10.4. Key Personnel
- 13.10.5. Key Product/Services

14. STRATEGIC RECOMMENDATIONS

15. ABOUT US & DISCLAIMER

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