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Building Integrated Photovoltaics (BIPV) System, Future of India

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ABSTRACT

Most of the power is generated by conventional energy sources in India which produce huge pollution in the environment. The consumption of fossil fuels and other conventional energy sources are increasing due to high demand of electricity. This focuses the solution of energy crisis in India by using renewable energy sources like solar, wind, biomass, and ocean energy. Building Integrated Photovoltaics (BIPV) system is one of the electricity generation system from Sun. In this paper the design and future market of BIPV system is discussed.

Keywords- *Renewable Energy, Solar PV, Building Integration, BIPV, Environment.*

1. Introduction

The non renewable sources or fossil fuels will be the history as the consumption of the energy is increasing day by day by humans. Renewable energy sources like solar energy, wind energy, tidal energy etc. are the alternatives of the non renewable sources. In near future the fossil fuels will obsolete because 80% fossil fuels like coal, oil etc will be consumed in coming future. In India the coal is the prime source in generation of electricity but due to high consumption of electricity, the coal supply may be affected and it is predicted that it may be no longer than few years. As the electricity demand is increased and more fossil fuels burnt to fulfil the demand, the air pollution is also increased. That's why we are looking for renewable energy sources like solar energy, wind energy, ocean tides etc to generate electricity by which we can reduce not only air pollution but also we can save our environment too, and hoped to fulfil the energy demand by these sources.

2. Building Integrated Photovoltaics (BIPV) System

Building integrated photovoltaics (BIPV) are not only used to generate electricity but also used as integrated materials of the buildings. In the market there are very large categories and BIPV is a prominent product among them. It is a multifunctional technology product used for generation of electricity and also designed for weather protection, shading, curtain walls, glazing, skylights etc. Therefore it makes the product more attractive, environment friendly, attractive and of course inexpensive to the financial point of view.

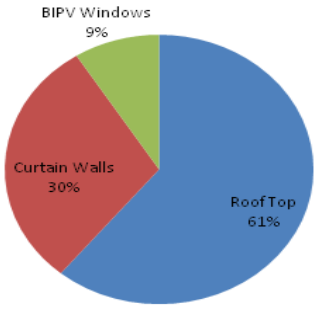

Fig 1: 2011 BIPV Installation by Market Segments (Source: Energy Trend)

According to a solar research agency Energy Trend (division of Trend Force), the roof top solar PV systems are not only accepted in the world widely but used in the residential sector too. BIPV can also be integrated with solar powered greenhouses by high-tech technology concept for commercial farming. South East Asian countries are implanting the solar policies and it seems that the BIPV will possess the strong potential for future development in the South East Asia and South Asia countries, where the electricity network is still uncommon yet.

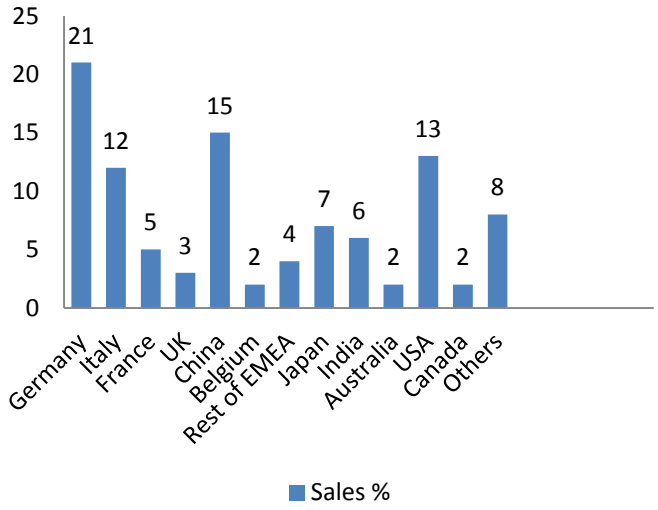

Fig 2: 2012 World PV Installation (Source: Energy Trend)

2.1. BIPV Categories

Building integrated photovoltaics (BIPV) categorizes can be defined as follows:

1. Pitched roofs
2. Flat and curved roofs
3. Facades

Today, a wide range of BIPV is present in the residential market. Tiles, shingles and slates are used in the pitched roof BIPVs. Materials such as ceramics, metal, stone or sometimes glass is used in the manufacturing of a Tile. Fiber glass or asphalt is used in Shingles manufacturing, which are roof covering materials. Slate a fine grained, foliated and homogeneous rock which is used for roofing. Slate is a type of Tile. For marketing and publication Tiles, Shingles and Slates are called as 'Solar Tiles', 'Solar Shingles', and 'Solar Slates'.

A Solar Tile is a PV module that could be combined with roof tiles for additional function of energy production and a sensitive result. Similarly Solar Shingles and Solar Slates are PV modules that could be combined with roof shingles and roof slates for additional function of energy generation and a sensitive result.

A small shingle, tile, slate are smaller than 0.5 m^2 (size of 0.4 x 0.6 = 0.24 m^2). A large slate, tile, shingles are larger than 0.5 m^2 (size of 0.6 x 1.5 = 0.9 m^2)

2.2 Pitched Roofs

2.2.1 In-roof Systems

Standard PV modules are used in these systems. For smart mounting systems, these are mounted in between the original roof elements/tiles.

Fig 3: In-roof system with conventional solar PV modules.

2.2.2 Small Solar Slates, Tiles, and Shingles

Varieties of materials are used to make these types of products which are clay, plastic etc and they are also having similar sizes.

Fig 4: Solar cells integrated Tiles for pitched roof.

2.2.3 Large Solar Tiles, Shingles, and Slates

They are glass of foil based products and usually the module size is 2-4 times width of the normal tiles shingles-slates. Usually the conventional tiles and shingles are replaced by Solar Tiles and Solar Shingles.

Fig 5: Large Solar tiles and shingles.

2.2.4 Skylights and Semi-transparent Roof Systems

These structures are designed for light and shadow into the area and usually combined with glass lamination to adjust light transmission. These systems are usually used in the greenhouses.

Fig 6: Greenhouse in Munich.

2.3 Flat and Curved Roofs

2.3.1 Flexible Laminated Roofing Products

Flexible thin film is manufactured by the number of manufacturers. The major technology family of thin film is: a-Si, CIGS, organic PV (OPV). The flexible products of thin film mostly attached to the existing flat or curved roofs of the buildings. The manufacturer of roofing products enclosed the products in the element of building, either flexible or non-flexible, or enclosed the product on complete roof.

Fig 7: Membrane Evalon Solar & BIOSOL Thin Film Plate.

2.4 Facades

2.4.1 Cladding Systems

In this BIPV system the solar modules are integrated to the building walls like conventional building materials such as marbles, granites etc. A space is created b/w the modules and the walls for temperature insulation and improved the efficiency of the PV modules by ventilation.

Fig 8: Cladding Systems.

2.4.2 Semi-transparent Facade Systems

Glass laminated c-Si is used in this system with adjustable cell spacing or a-Si thin film by laser grooved for filtered visions.

Fig 9: BIPV Transparent facade Aalst, Belgium & Semi- transparent facade a-Si.

2.4.3 Louver Systems

A Louver is a window shutter or blind which is horizontally inclined with an angle to enter the air and light, but to keep out direct sunlight, rain and noise. The angle of windows blind can be adjusted according to the requirement or it can be fixed to any angle. The solar PV modules can easily be integrated to Louver systems with some additional functions of using shading with electricity generation.

Fig 10: Outrigger PV Shading & Glass Louver System

3. Future Market of BIPV

The global market of BIPV will be increased just over 400MW to 2.25GW in 2017, Pike Research

forecasts. Another research from Design-Build Solar is that the largest BIPV market will still leaded by Western Europe. Till 2017 BIPV market includes new regions like Eastern Europe (Serbia, Poland, Lithuania, Ukraine and Slovenia), Asia Pacific (especially India, China, Japan, Thailand, Australia and Malaysia), South Africa and Latin America (Brazil and Chile).

"The growing availability of energy efficient, flexible, and transparent solar materials is transforming the way that architects and building engineers view, and use, PV systems," said Kerry-Ann Adamson, Research Director at Pike Research. In near future the BIPV will not be longer application to generate electricity. Rather, the entire building will be capable of generating electricity by itself.

4. Advantages and Limitations

Advantages:

BIPV is the future of the building designs and architecture must follow the BIPV to build green and environment friendly buildings. After that the value of the buildings will be increased and the image of the buildings will be changed. Some advantages of BIPV are as follows:

- BIPV system can be used as ventilation system after integrated PV modules into the buildings by which they can create an ambient temperature in the building. For example public buildings like schools, office complexes, shopping malls and the private buildings like gardens and terraces of the houses.
- Building materials can be replaced by PV modules by which the cost can be reduced and the safety is improved. For example using roof top BIPV may replace seam metal roofing and batten.
- BIPV as skylights at entrance, atria and courtyards can be economical for using solar energy and for additional designing feature too. BIPV protect us against rain, wind and shade from sun and they also protect from lightning as they are electrical resistor too.
- BIPV systems are small and environmental friendly and it can install anywhere in the world unlike other conventional energy generation systems and can reduce too much pollution in the air.
- BIPV system could be applied after building structure or during construction of the building. No moving parts are used in the system so no noise pollution. And the last solar energy is renewable energy source and it can get anywhere in the world. So it is easy to use.

Limitations:

Partial shading on the BIPV system can reduce the generation of power by 30%. BIPV system is normally installed either on pitched roof or facades of a building. Heat build up is also a challenge in installing this system. Limited airspace for cooling affects the power output of the BIPV system.

5. Conclusion

In this paper the future market and the categories of the BIPV system is presented. BIPV can be installed any of the building to make that one energy efficient or green building like Hotels, Colleges, Schools, Universities, Embassy, Building Apartments, Offices and Shopping Malls etc. We can save a lot of energy by implanting BIPV in these buildings and offices.

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