Examining the Impact of BIPV on Embodied Energy: Towards Understanding the Predictive Role of Computer Network Simulation in Informing Conventional Building Development

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Abstract--- In photovoltaic technology, one of the fastest growing elements constitutes Building-Integrated Photovoltaic (BIPV). BIPV materials are used to replace conventional building materials on roofs, skylights, facades and other structures. Thus, BIPV have gained increased application due to their capacity to not only reduce the amount of building materials but also the resultant labor. Imperative to understand is whether BIPVs yield significant reductions or their use ends up increasing the buildings' embodied energy. Notably, BIPVs form a promising avenue through which on-site electricity is produced directly from the sun without depleting resources, pollution, or harming the environment.

Keywords--- Building Development, BIPV, Computer Network, BAPV.

I. Introduction

THUS, BIPVs serve a dual purpose. One of the functions entails the collection of solar energy, upon which it is integrated into the envelopes of buildings as part of their design. On the other hand, BIPVs' PV modules are used with the intention of replacing conventional building envelope materials (Bangyin, Shanxu and Tao 1429).

The purpose of this paper is to examine the emergence of BIPV in the wake of social, economic and environmental concerns. Specifically, the paper examines some of the merits and demerits that continue to accrue from the use of BIPV. In so doing, findings will inform about the possible cost effectiveness that users of these systems are likely to experience and whether the systems are promising and might dominate the future of the industry, especially through computer network incorporation. Apart from examining sustainability-related attributes arising from the adoption of BIPV, the paper focuses on trends in the manufacture of these systems to make inferences about some of the motivations behind the resultant adoption.

Earlier generations of photovoltaic would use directly mounted solar panels, especially on roof tops. However, it is worth no ting that this technique placed and continues to place little emphasis on the realization of aesthetic values. This demerit has seen recent developments experience the emergence of seamless integrations of photovoltaic materials in thin-filmed photovoltaic technologies that have yielded superior flexibility, minimal weight, and improved performance.

II. BIPV Functionality

With the emergence of BIPVs, a major demerit lies in the need for higher amounts of energy in recycling, demolishing, and constructing (Chen, Wu and Lee et al. 213). However, various merits are associated with BIPVs.

For example, BIPVs are clean and pose variations in degrees of transparency while providing multiple color options, further accounting for higher performance. When compared to the amount of energy used during the demolition and recycling of conventional materials, BIPVs are sustainable because the resultant amount of greenhouse gas emission is lower, posing a tertiary and positive effect on efforts seeking to curb global warming. It is further notable that BIPVs are associated with a reduced release of incinerators, sparing materials that could have been directed into landfills. Similarly, BIPVs are environmentally-friendly because they account for significant reductions in the amount of energy required by materials such as copper (at 85 percent lower than the energy required by manufacturers) and aluminum (at 95 percent less), with the exploitation of resultant secondary materials (through BIPV recycling) accounting further for the significant reduction in energy requirements.

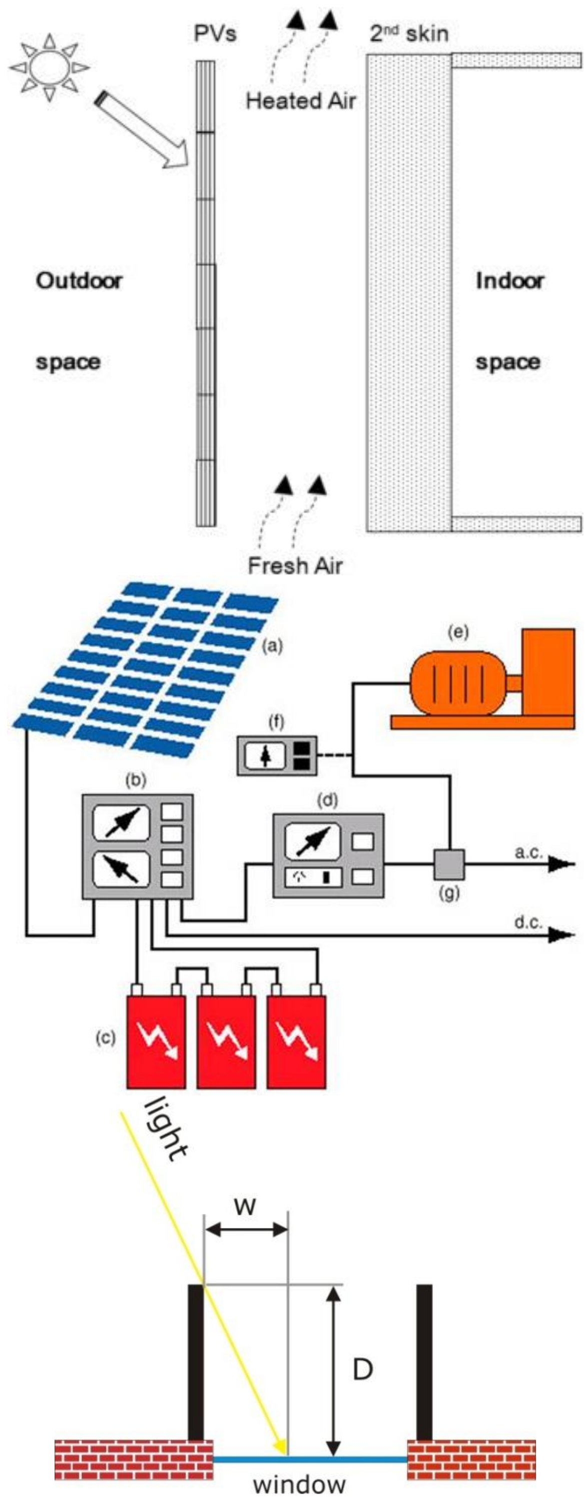

Figure 1 - An Illustration of BIPV Functionality

Apart from the positive outcome of reduced environmental degradation, the marginal costs undergone during the installation process is offset by the resultant renewable energy that BIPVs produce. On the other hand, the aesthetic value is achieved because BIPVs are perfect answers to homeowner associations. From these outcomes, it is evident that BIPVs check on the amount of waste and the effect that these wastes pose on the environment. In addition, BIPVs and their recycling processes conserve the environment's natural resources by saving spaces that could have been used as landfills, checking on greenhouse gas emissions whose contribution to global warming cannot be overemphasized, reducing air and water pollution, and supporting energy conservation efforts. The tertiary effect is that BIPVs reduce the rate of depletion of natural resources such as fossil fuels and metals. In turn, the level of encroachment into other drilling and mining areas is checked, saving on adversities such as air, water and soil pollution.

III. EMBODIED ENERGY

With higher levels of energy consumption reported in regions such as Australia and, in turn, the consumption accounting for high living standards and population growth, both the environment and the natural resources that it houses are threatened. An example is a case in which the period 1994-1995 witnessed residential and commercial building operations in Australia witness a 20-percent increase in levels of energy consumption. Thus, BIPV adoption is an ideal option because of the significant extent to which it saves fossil fuel consumption; translating further into environmental friendliness.

Embodied energy refers to that which is consumed by the entire process involved in building production, stretching from the processing and mining of natural processes to the delivery of products, transportation, and manufacturing. Whether embodied energy is saved or increased during the use of BIPVs is worth understanding. One of the demerits accruing from BIPVs is that the cost of installation is high. However, the resultant merits outperform the demerits. The potential of BPIVs to yield zero energy buildings has been documented, allowing these structures to function as auxiliary power plants in such a way that utility grids are complemented to aid in supplying most or all of the involved buildings' electrical needs. In addition, excess energy that BIPVs produce may be sold back into the grids while countering the high initial cost of installation (Li, Lam, Chan & Mak 727).

A key difference between building applied photovoltaic (BAPV) and BIPVs is that the latter are used as building substitutions. In turn, the substitution process leads to the realization of significant economic benefits, compared to BAPVs. With new constructions implying that costs of building are attributed to the glazing products and facades, the implication is that the building products ought to be installed into building superstructures, having been transported from the site and purchased from suppliers (Chow et al 887). However, the case of BIPVs suggests that these expenses are covered in the cost of building, leading to the reduction of the cost of enabling BIPVs' product capability to the cost of inversion, electrical connectivity, and the technology itself. Thus, the use of BIPVs implies that the product is included in building costs, rather than an independent and added cost that would enable its purchase and utilization.

IV. CONCLUSION

In summary, this paper has focused on the use of BIPV and its potential impact on the resultant embodied energy, with particular focus on the utilization of computer network simulation. It has been found that the technology comes in the wake of new demands for buildings to adhere to environmental friendliness and other sustainability-related operations. On the one hand, it is evident that the initial cost of BIPV utilization may be high; despite being incorporated as part of the building cost, rather than independently manufacture, transported and installed product. On the other hand, the perceived initial costs are compensated by trickledown positive effects that BIPVs offer. For example, BIUPVs are aesthetically pleasing, save the environment by reducing the use of natural resources such as fossil fuels (due to the dual purpose of both covering buildings and producing renewable energy), and yield significant reductions in the amount of energy required by materials such as copper (at 85 percent lower than the energy required by manufacturers) and aluminum (at 95 percent less). Therefore, it is recommended that BIPVs be adopted in current buildings to save the environment because the initial or marginal cost is offset by the resultant and positive long-term effects.

REFERENCES

[1] Liu, B., Duan, S., & Cai, T. (2010). Photovoltaic DC-building-module-based BIPV system—Concept and design considerations. *IEEE Transactions on Power Electronics*, 26(5), 1418-1429.

[2] Chen, Y.M., Wu, H. C., Chen, Y.C., Lee, K.Y., & Shyu, S.S. (2009). The AC line current regulation strategy for the grid-connected PV system. *IEEE Transactions on Power Electronics*, 25(1), 209-218.

[3] Chow, T.T., Chan, A.L.S., Fong, K.F., Lin, Z., He, W., & Ji, J. (2009). Annual performance of building-integrated photovoltaic/water-heating system for warm climate application. *Applied Energy*, 86(5), 689-696.

[4] Li, D.H., Lam, T.N., Chan, W.W., & Mak, A.H. (2009). Energy and cost analysis of semi-transparent photovoltaic in office buildings. *Applied Energy*, 86(5), 722-729.