

Economic Advantages of Installing Solar Power Plants in Private Enterprises

Maryna Silchenko

Product Manager in AdNet LLC, USA

Abstract— This article examines the economic benefits that private enterprises can gain from installing solar power plants. The decreasing cost of solar technologies, combined with their increasing efficiency, has made this energy source increasingly appealing for businesses, allowing them to reduce dependence on traditional energy sources and enhance profitability. The paper presents a theoretical analysis and a review of current literature highlighting the economic aspects of transitioning to solar energy, including the increase in market value of commercial real estate and the reduction in operating expenses. Examples of solar system implementation in industries such as agriculture and manufacturing demonstrate that adopting solar solutions contributes to decreased electricity costs and carbon dioxide emissions, which is of great importance for environmental sustainability. The article also discusses modern trends, including BIPV (building-integrated photovoltaic) technologies, as well as potential obstacles for businesses, such as substantial initial costs and organizational complexities. The conclusion emphasizes the importance of investment in solar energy as a strategic step toward sustainable development and strengthening companies' competitiveness in an environmentally oriented market.

Keywords— Solar Energy, solar panels, economic efficiency, renewable energy, BIPV, energy savings, corporate social responsibility, sustainable development.

I. INTRODUCTION

The development of solar energy utilization technologies has significantly improved their accessibility and economic viability for both consumers and businesses. According to a report by the Lawrence Berkeley National Laboratory (LBNL) of the U.S. Department of Energy, the cost of large-scale solar projects decreased by 70% from 2010 to 2020, creating favorable conditions for investment in renewable energy sources [2]. This reduction in production costs coincided with lower utility rates, making solar energy an attractive option. Additionally, as fossil fuel prices fluctuate, the profitability potential of solar energy remains stable regardless of oil market conditions. According to the latest report from the Intergovernmental Panel on Climate Change (IPCC), solar energy is the fastest-growing source of electricity worldwide [4]. While the environmental aspects of solar energy are widely discussed, its economic advantages are becoming increasingly evident. Homeowners, businesses, and communities are realizing that investing in solar technologies leads to significant savings on utility bills, tax incentives, and job creation.

Energy expenses continue to rise, often comprising around 15% of total operating costs for warehouses and similar facilities. Solar energy rates are approximately 20% lower than traditional electricity, making solar energy a stable and economically viable alternative for business owners with fixed costs and a service life of 25–30 years [2]. This shift not only increases the predictability of electricity bills but also reduces overall expenses. Moreover, the costs of maintaining and monitoring solar systems are comparatively low, providing additional advantages for enterprises that consume substantial amounts of energy for operations, lighting, and equipment.

II. MATERIALS AND METHODS

The methodological basis of this study is rooted in a systematic analysis of literature focusing on the transformation

of the energy landscape in enterprises that have adopted solar technologies. A multi-sector analysis, covering the agro-industrial complex and manufacturing sectors, allowed for identifying correlations between solar installations and key economic parameters: operating costs, return on investment (ROI), and energy consumption [1].

The foundational study by A. Hayes and A. Ganti [2] explores the investment potential of solar energy, where primary beneficiaries are specialized companies and exchange-traded funds. S. Melo [3], through the lens of economic analysis, demonstrates the significant advantage of solar power plants in reducing an enterprise's fixed costs. Notably, A. Schreiber's findings [4] emphasize the energy independence of businesses from external suppliers, which minimizes pricing risks and logistical disruptions. M. Asad's research group [5] presented a quantitative assessment of the profitability of an industrial solar power plant with a capacity of 100 MW, confirming the economic feasibility of the project alongside environmental benefits in the form of reduced greenhouse gas emissions.

A cost-benefit analysis was a key tool for assessing the economic efficiency of solar installations. The comprehensive study covered a range of financial indicators: capital expenditures, energy savings, operating costs, and government incentive mechanisms. The environmental component of the analysis focused on quantifying emission reductions resulting from the shift from fossil fuels to solar generation.

Previously conducted surveys of enterprises that have implemented solar energy solutions were analyzed to gather qualitative data on their experiences, anticipated benefits, and challenges encountered during installation and operation [1]. These data were supplemented by interviews with industry experts and stakeholders involved in the implementation of solar energy.

III. RESULTS

The photoelectric effect, which underpins solar energy, is a quantum-mechanical process in which electrons are released from a material under the influence of electromagnetic

radiation. In modern solar cells, this effect is implemented through semiconductor materials, primarily silicon-based. The structural composition of a solar panel (Figure 1) illustrates a complex, multi-layered architecture in which each layer plays a critical role in the energy conversion process.

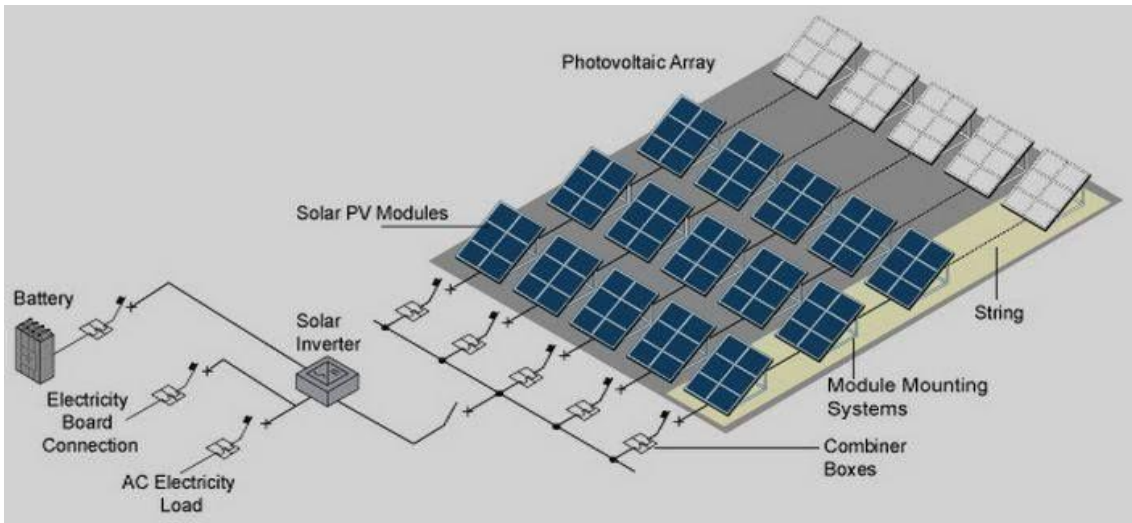


Figure 1. The structure of the solar battery [1]

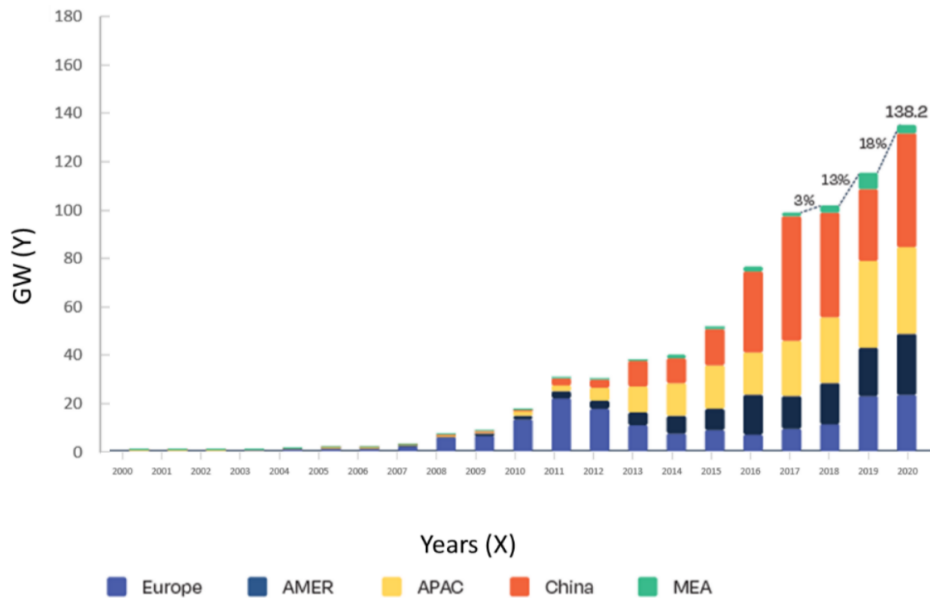


Figure 2. Annual solar PV installed capacity [5]

The top layer of the structure is composed of tempered glass with a textured surface, providing both mechanical protection and optimal light transmission with minimal reflection. An anti-reflective coating in the next layer significantly increases photon absorption, reducing reflection losses to approximately 3%. The key component is the semiconductor layer with a p-n junction, where direct conversion of light energy into electricity occurs via the photoelectric effect. Metallic contacts forming the front and back sections of the structure ensure efficient collection and transport of generated charge carriers. The rear contact additionally acts as a reflector, increasing the likelihood of photon absorption in the active layer [1].

Economic analysis of solar technology implementation demonstrates a substantial reduction in operating costs for enterprises. Manufacturing facilities and warehouse complexes that have integrated photovoltaic systems report energy cost reductions exceeding 50%. Notably, in regions with high solar insolation, the payback period for investments ranges from 5 to 8 years, generating significant long-term savings [5]. The growth trajectory of solar energy is reflected in Figure 2, illustrating the exponential increase in installed capacities across various geographic regions.

The installation of solar panels also increases the value of commercial real estate. Buildings equipped with solar energy

systems are often seen as more attractive, leading to faster sales and potentially higher sale prices. This factor can be especially advantageous for companies considering future real estate transactions. Additionally, in regions such as the United States, there are numerous state and federal programs, such as the Investment Tax Credit (ITC). Through ITC, homeowners and businesses can deduct a percentage of their solar energy costs from their taxes, which further incentivizes the shift to solar energy [1]. There are also Solar Renewable Energy Certificates (SRECs), which homeowners and businesses producing solar energy receive. Each SREC corresponds to one megawatt-hour of generated solar energy. These certificates encourage businesses to adopt solar energy, either fully or partially, by using hybrid solutions [4].

Switching to solar energy significantly reduces carbon dioxide emissions compared to fossil fuel-based energy sources. Implementing solar systems helps meet corporate

social responsibility (CSR) goals, attracting environmentally conscious consumers and investors. As stakeholders increasingly focus on sustainable development, businesses that use solar energy can enhance their market positioning and brand image [3].

Government incentives for solar energy use, including tax credits and relief, have stimulated local economic growth. As more businesses invest in renewable energy, job opportunities in the production, installation, and maintenance of solar panels increase, benefiting the local economy. Sectors, where solar energy use is particularly relevant, include shopping centers, as five of the 20 largest corporations using solar energy operate in retail. Two other sectors that already actively utilize solar energy for their benefit are agricultural companies and technology companies, such as Apple, Facebook, and Microsoft [3]. Figure 3 illustrates the electricity production from solar panels for QASP.

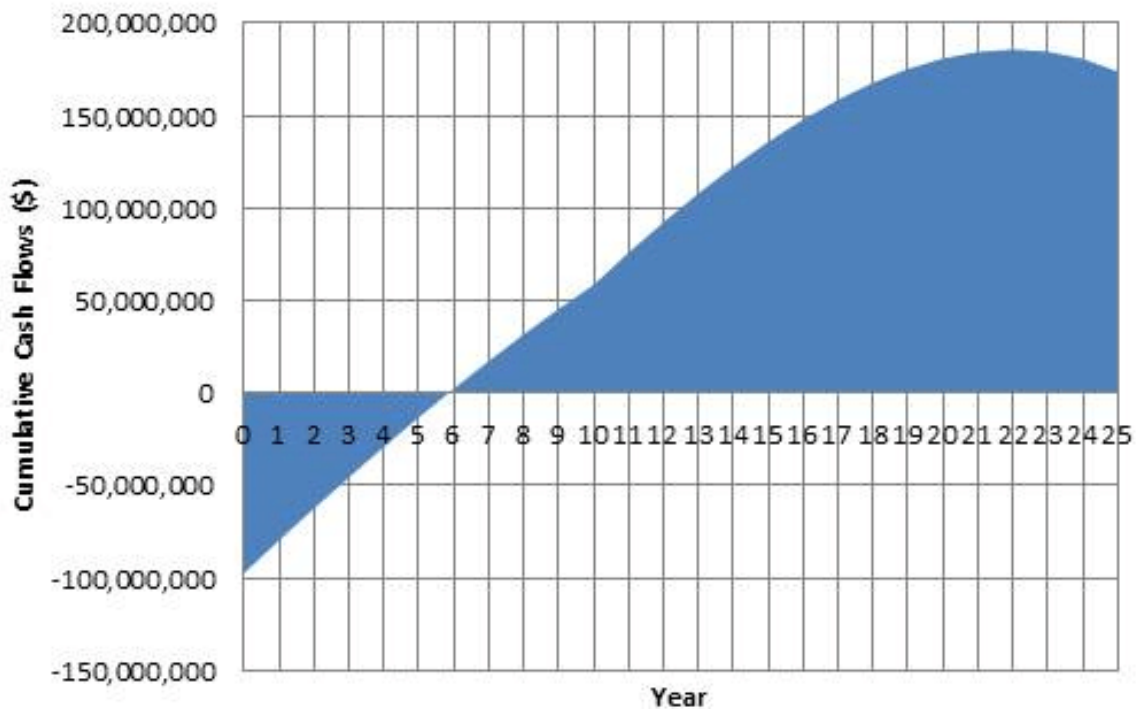


Figure 3. A histogram showing the monthly energy production for QASP [5]

Advancements in solar technology have led to the development of more efficient panels, reducing the space and materials needed for installation. Modern panels achieve efficiencies of up to 23%, increasing energy output and thus enhancing profitability for businesses [2]. Most solar panels have an efficiency range of 15% to 20%. The highest efficiency ratings are held by the following models: SunPower: 22.8%; LG: 21.8%; CSUN: 21.2%; REC Solar: 20.5%; Solaria: 20.4%. Decreasing installation costs, alongside innovations in solar technology, allow businesses to capitalize on this evolving landscape [5].

IV. DISCUSSION

The growing reliance on renewable energy sources, such as solar power, is essential for mitigating climate change impacts and achieving energy independence. By reducing dependence on fossil fuels, businesses not only contribute to environmental sustainability but also shield themselves from volatility in fossil fuel markets.

As consumer awareness of climate change grows, businesses using renewable energy gain more opportunities to meet the expectations of socially responsible consumers. This shift is especially relevant among younger generations, who tend to prefer environmentally conscious companies.

In examining the economic advantages of solar power plants, it is necessary to consider current trends and related technologies. BIPV (Building-Integrated Photovoltaics) technology enables the integration of solar panels directly into building structures, such as windows, facades, and even walls. This approach embeds the ability to generate energy within the building materials themselves, transforming static surfaces into active energy sources. BIPV technology is particularly advantageous for commercial spaces where large-scale panel installations may not be feasible. With BIPV, businesses benefit from both energy efficiency and architectural innovation, significantly reducing dependence on traditional power grids and aligning with sustainable building goals [5].

Despite the numerous benefits, businesses must consider initial capital investments and potential entry barriers, such as zoning regulations and permitting procedures. Education and outreach efforts can help remove these barriers, enabling more companies to transition to solar energy. However, it is worth noting that extreme weather events can adversely affect solar energy production. Weather conditions such as hurricanes and heavy rain can damage solar infrastructure. Additionally, rising average temperatures may reduce the efficiency of solar panels.

V. CONCLUSION

The economic benefits of installing solar power plants in private enterprises are substantial and include cost savings, increased property value, and reduced carbon emissions. As solar energy technologies continue to advance, companies investing in these systems can anticipate a rapid return on investment and long-term financial stability. Integrating solar energy not only serves immediate economic interests but also aligns with broader environmental goals, positioning

enterprises as leaders in the transition toward a sustainable future.

Thus, solar energy represents a strategic investment for companies seeking to reduce operational costs, enhance their public image, and contribute to the creation of a greener economy. As awareness of solar energy's advantages grows, businesses need to adopt this renewable energy source to secure a competitive advantage in an increasingly eco-conscious market.

REFERENCES

- [1]. Bailey, E. Economic Benefits Of Solar Energy: A Comprehensive Understanding For Homeowners And Businesses / E. Bailey // SolVoltaics : electronic journal. – URL: <https://solvoltaics.com/economic-benefits-of-solar-energy/>. – Publication date: 2023.
- [2]. Hayes, A. How to Profit From Solar Energy / A. Hayes // Investopedia : electronic journal. – URL: <https://www.investopedia.com/articles/personal-finance/042315/how-profit-solar-energy.asp>. – Publication date: 2022.
- [3]. Melo, S. How solar energy is transforming the industry: Learn the benefits and best practices / S. Melo // DataScope: electronic journal. – URL: <https://datascope.io/en/blog/benefits-of-using-solar-power-in-the-industrial-sector/>. – Publication date: 2020.
- [4]. Schreiber, A. Economic Benefits of Solar Energy: Profiting from Green Power / A. Schreiber // FinImpact : electronic journal. – URL: <https://finimpact.com/personal-loans/solar-panels/economic-benefits.html>. – Publication date: 2023.
- [5]. The Cost Benefit Analysis of Commercial 100 MW Solar PV: The Plant Quaid-e-Azam Solar Power Pvt Ltd / M. Asad, F.I. Mahmood, I. Baffo, A. Mauro // ResearchGate : electronic journal. – URL: https://www.researchgate.net/publication/359053859_The_Cost_Benefit_Analysis_of_Commercial_100_MW_Solar_PV_The_Plant_Quaid-e-Azam_Solar_Power_Pvt_Ltd. – Publication date: 2022.