

# Sustainable Clean Energy Left Unused - Finding Hidden Potential in Warehouse Solar Photovoltaic (PV) Systems

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**Solar panels are becoming a common sight on warehouse rooftops as many leading logistics companies strive to reduce their carbon footprint and move towards a cleaner and stable sustainable future. But the question is what happens if these solar systems do not generate as much electricity as expected?**

Basically, installing solar panels is not enough, since they need to function efficiently during their lifespan in order to achieve their full environmental and financial benefits. This study screened 54 rooftop solar PV sites across 22 countries and six continents, with a total installed capacity of approximately 41.5 MWp. Among the 26 sites with usable data, only five were classified as excellent performers, while nine were either underperforming or critically underperforming. Most strikingly, several UK sites operated below a 20% Performance Ratio, meaning that some systems generated less than one fifth of their expected potential. Understanding why such differences occur became the starting point for exploring how such logistics companies can get better returns on investments in renewable energy.

At first glance, it is easy to assume that poorly performing solar systems always suffer from technical and environmental factors. However, this story turned out to be far more complex. Underperformance is also driven by some operational and management-related factors. Basically, it includes examples such as lack of monitoring, no performance records, delayed maintenance practices, inverter downtime, and restrictions on exporting electricity to the grid.

Actually, what makes this surprising is that some of the largest energy losses did not come from the solar panels themselves, but rather it depends on how the systems are being controlled, managed and monitored. In some instances, poor performance went completely undetected due to lack of operational data and specific key performance indicators (KPIs) monitoring or

automated monitoring systems in place. Also, in many cases there were restrictions on the amount exported to the grid, while others struggled to make full use of the energy they had generated.

These hidden energy losses have implications that go far beyond electricity production. Importantly, when solar energy is lost, these logistics companies not only miss out on financial savings but further lose opportunities to reduce their environmental impact as well as their carbon emission.

On the other hand, the good news is that many of these losses can actually be prevented. So, simple actions such as better monitoring, smarter cleaning schedules, predictive maintenance practices, and improved coordination between solar panels, battery storage systems, and energy management systems can unlock energy that is currently being left unused and wasted.



With the rising number of logistics companies adopting renewable energy solutions for their operations, there will be many sustainability and economic benefits from learning about what makes solar power installations inefficient. Hence, sometimes the most sustainable source of energy is not created through additional new infrastructure, but by unlocking the energy that is already being lost on the roof above us.

**This popular scientific article is derived from the master thesis project: “Enhancing Warehouse Sustainability Through Solar Panel Performance Analysis” by Sumit Gaikwad. and Tianchan Yang. (2026)”**