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Research Article

Pre-Feasibility Analysis of PV Panel Supported EV Charging Station for Kocaeli University

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ABSTRACT

The importance of green energy and the reduction of carbon emissions are increasing, the importance of using renewable energy systems is also increasing. Considering the Kocaeli University Green Campus goals, increasing renewable energy production and improving energy efficiency by reducing grid dependency are the main goals. In addition, the increasing use of electric vehicles increases the need for charging stations. Therefore, in this study, a preliminary analysis of the photovoltaic panel-supported electric vehicle charging station planned to be installed in two different parking areas of Kocaeli University Umuttepe Campus was made and a system with a peak power of 605 kW was designed. This system can meet 49% of the campus energy demand and 78% of the charging station's need. As a result, grid dependency and energy costs will be reduced, and long-term financial sustainability will be supported through environmentally friendly energy production. In addition, the project will prevent 345,000 kg (CO_2) of carbon dioxide emissions annually.

Keywords: *Photovoltaic systems, Electric vehicle charging stations, Green energy, Parking lot*

Kocaeli Üniversitesi için PV Panel Destekli EV Şarj İstasyonunun Ön Fizibilite Analizi

ÖZET

Yeşil enerjinin önemi ve karbon emisyonunun azaltılmasının önemi artarken, yenilenebilir enerji sistemlerinin kullanımının önemi de artmaktadır. Kocaeli Üniversitesi Yeşil Kampüs hedefleri göz önünde bulundurulduğunda, yenilenebilir enerji üretimini artırmak ve şebeke bağımlılığını azaltarak enerji verimliliğini iyileştirmek temel hedeflerdir. Ayrıca, elektrikli araçların artan kullanımı şarj istasyonlarına olan ihtiyacı da artırmaktadır. Bu nedenle, bu çalışmada Kocaeli Üniversitesi Umuttepe Kampüsü'nün iki farklı otopark alanında kurulması planlanan fotovoltaik panel destekli elektrikli araç şarj istasyonu ön analizi yapılmış ve 605 kW pik güce sahip bir sistem tasarlanmıştır. Bu sistem, kampüsün enerji talebinin %49'unu ve şarj istasyonunun ihtiyacının %78'ini karşılayabilmektedir. Sonuç olarak, şebeke bağımlılığı ve enerji maliyetleri düşürülecek, çevre dostu enerji üretimi yoluyla uzun vadeli finansal sürdürülebilirlik desteklenecektir. Ayrıca, proje yıllık 345.000 kg (CO_2) karbondioksit emisyonunun önüne geçecektir.

Anahtar Kelimeler: *Fotovoltaik sistemler, Elektrikli araç şarj istasyonları, Yeşil Enerji, Otopark*

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I. INTRODUCTION

Nowadays, environmental awareness and sustainability goals are becoming increasingly prominent on a global scale. In this context, the transport sector is also undergoing a major transformation. Internal combustion engines based on fossil fuels contribute to environmental problems and climate change by emitting harmful emissions into the atmosphere. As a solution to these problems, electric vehicles have emerged as an important alternative. Electric vehicles offer an environmentally friendly transport solution compared to internal combustion engines. Electrical engines produce zero emissions and therefore improve air quality, while contributing to the fight against climate change by reducing the carbon footprint. Furthermore, electric vehicles use energy more efficiently and can be completely carbon neutral when recharged based on renewable energy sources.

PV panels supported electric vehicle charging stations make significant contributions to green energy by increasing the use of renewable energy sources. Unlike fossil fuel-based energy generation, PV panels convert solar energy directly into electrical energy. During this conversion process, no harmful gas emissions occur, so clean energy is produced without harming the environment. The installation of these charging stations reduces energy dependency and increases energy security. It also provides diversity in energy production and increases the sustainability of the energy grid by integrating renewable energy sources. This energy can be stored or sold back to the grid, which provides flexibility in energy management. The integration of photovoltaic (PV) panels into electric vehicle (EV) charging stations has garnered significant attention in recent years, aiming to enhance sustainability and reduce reliance on conventional energy sources. Studies have demonstrated that utilizing renewable energy sources, such as solar power, in EV charging infrastructure can lead to substantial environmental and economic benefits.

In recent years, many studies have been conducted in the literature regarding PV-supported charging stations. In China, the energy sector stands out as the largest carbon emitter and the transportation sector as the fastest growing carbon emitter. In this context, a study proposed a model of a solar-powered electric vehicle charging station in Shenzhen. The model was designed to meet the daily energy demand of 4500 kWh and was shown to be economically feasible. For example, it was determined that this model could reduce carbon dioxide (CO_2), sulfur dioxide and nitrogen oxide emissions by 99.8%, 99.7% and 100%, respectively. In addition, the cost analysis showed that the energy production cost supports the economic sustainability of the system. This study also considered how carbon pricing can encourage investment in renewable energy, and the results showed that the carbon price is more effective when it exceeds $20 per ton [1].

Another study examined the use of DC microgrids in solar-powered EV charging stations. The system used stationary battery storage, PV panels and grid connection together. The study showed that slow charging modes provide maximum benefit from PV energy during parking long times and reduce charging costs. On the other hand, it was emphasized that fast charging modes are connected to the grid with higher costs. It was stated that this system is an effective solution for the integration of solar energy into EV charging infrastructure [2]. The design of electric vehicle charging stations with grid-connected photovoltaic systems for different cities in Pakistan in 2023 was carried out in accordance with the existing roof area of existing fuel stations, and modeling studies suggested that solar energy utilization could be increased by 72 kWh by installing additional PV systems on the average roof area of existing fuel stations in Lahore and Islamabad [3]. In another study conducted in the same year in Bangladesh, the detailed design of a 300 kWp solar EV charging station for 20 EVs along the Dhaka-Mawa Highway was made with PVsyst 7.2 software, and it is expected that the system will provide a net CO_2 reduction of 6,460.2 tons over its 25-year lifespan [4].

The study conducted in 2024 using ArcGIS10.8.2 analysis program is based on technical, economic and environmental data. It has been revealed that 90.55% of the energy required for charging stations in Mahshahr District in this province can be provided by solar energy. The study also showed that this

area has the capacity to convert 11% of vehicles to electric cars by 2040, reducing CO_2 emissions by more than 30 tons [5]. In a study conducted in Antalya, EV charging infrastructure was modeled and optimized using photovoltaic (PV) panels and a grid-connected hybrid power system (HPS). Different scenarios were evaluated in terms of technical, economic and environmental criteria using HOMER software. Considering Antalya's high solar radiation levels (average daily 4.5 kWh/m²), matching the right PV capacity with load profiles increased energy efficiency and reduced grid dependency [6]. Location selection for a PV system-supported charging station is a critical issue. In a study conducted in Iran in 2022, a solar vehicle charging station planned to be built on Kish Island in Iran was selected with GIS and multivariate parameters. When selecting the station, criteria such as proximity to parks, restaurants, public areas with urban density, proximity to main arteries and intersections, proximity to public transportation, proximity to airports and bridges, accessibility, etc. were examined and the final decision was made in the location selection [7].

It was carried by a solar PV system for implementation in a parking area at the University of Nottingham, United Kingdom in 2023. A stochastic approach was used to calculate the charging demand of EVs. Furthermore, the study presents six different charging station scenarios to determine the best combination of 3kW and 7kW capacity chargers. This study conducted a preliminary investigation of future charging stations to be installed in campus parking areas to evaluate the best combination of charging capacity and charging rate, solar potential and economic viability of the installation. This study revealed that the system could save up to 36.8 kgCO_2-e per day, thus providing great support to the zero carbon targets [8]. In 2024, a storage system was implemented in an electric vehicle charging station integrated with a PV system. To verify the electric vehicle charging station power management scheme with MATLAB and Opal RT simulation, different operating conditions were considered according to the photovoltaic panel power and load. The results under different conditions were compared and examined [9]. In 2024, a city-scale energy matching optimization was carried out with smart electric vehicle charging and V2G (vehicle to grid) in a net zero energy city powered by wind and solar energy [10].

A study conducted at Kahramanmaraş Sütçü İmam University in Turkey designed a smart hybrid charging station for electric vehicles, incorporating PV modules, an intelligent inverter, and a storage unit. The system prioritizes energy from PV modules, supplemented by the storage unit, and resorts to the grid only when both sources are insufficient. This approach ensures efficient energy utilization and minimizes dependency on the grid [11]. Similarly, research from Trakya University explored a multi-objective optimal energy management strategy for a charging parking lot that includes electric vehicles equipped with onboard PV panels. The study emphasizes that such integrated systems can significantly contribute to reducing the transportation sector's reliance on fossil fuels, thereby promoting environmental sustainability [12]. Furthermore, the implementation of PV-battery hybrid systems in EV parking lots has been investigated to optimize charging management. These systems not only provide a sustainable energy source for EVs but also enhance the efficiency of energy utilization within the parking infrastructure [13].

In addition to environmental benefits, the deployment of PV-supported EV charging stations addresses challenges related to grid capacity and energy demand management. By integrating renewable energy sources, these systems can alleviate the strain on electrical grids, especially during peak charging times, and contribute to a more balanced and efficient energy distribution [14]. In a study conducted in 2024, the number of panels and inverters required for an imaginary solar energy system with an installed power of 500 kW for the Umuttepe campus of Kocaeli University was calculated. In this study, the optimum panel angle values were calculated and the albedo effect was examined. The values obtained in the PVsyst and MATLAB/Simulink simulation environments were compared. In this study, an analysis focused only on production, not on meeting the university's consumption [15].

This literature underscores the potential of PV panel-supported EV charging stations in promoting sustainable transportation solutions. By leveraging renewable energy sources, such systems can reduce greenhouse gas emissions, decrease reliance on fossil fuels, and contribute to the development of smart and sustainable urban infrastructures.

Reducing carbon dioxide emissions plays a critical role in the fight against climate change. Electrical engines emit much less CO_2 compared to internal combustion engines. However, this advantage depends on the source of electricity from which the vehicles are charged. If electricity is derived from fossil fuels, the environmental benefits are limited. PV panel-supported charging stations solve this problem. Solar energy allows vehicles to be charged without emitting CO_2. This greatly reduces the overall carbon footprint. Charging an electric vehicle with energy produced by PV panels could help avoid tons of CO_2 emissions compared to traditional energy sources. In the long term, PV panel-supported charging stations play a key role in helping cities and countries achieve their sustainable energy goals. Consisting of energy infrastructure from renewable resources contributes to the reduction of greenhouse gas emissions and improvement of air quality by reducing fossil fuels. Additionally, these projects encourage the development of innovative technologies and create jobs in the green energy sector.

In this article, a preliminary study of a Solar Carpark Project was conducted to be a pioneer in the Green Campus at Kocaeli University and to increase the incentive for green energy. In this project, a system with a total of 605 kW solar panels and 15 electric vehicle charging stations was designed in 2 regions of the campus. This system aims to allow university staff and students to charge their vehicles and at the same time reduce the grid demand of other loads in the university (faculties, gyms, cafeteria).

II. SAMPLE PROJECTS AROUND THE WORLD

Solar car parks are an innovative application that integrates sustainable energy solutions and environmentally friendly infrastructures. These car parks provide the necessary space for parking vehicles, while generating clean and renewable energy thanks to the solar panels on them. The use of solar energy reduces dependence on fossil fuels, significantly reducing the carbon footprint and minimizing negative impacts on the environment. By increasing energy efficiency, these car parks optimize energy consumption in cities and provide significant savings in energy costs.
One of the biggest advantages of car parks with solar panels is that they encourage the use of sustainable energy sources. Solar energy is an unlimited and clean energy source as it is obtained directly from the sun. In this way, it contributes to reducing carbon dioxide emissions in the atmosphere and improving air quality. In addition, as the installation costs of solar panels decrease over time, the cost of the energy produced is gradually decreasing. This offers great advantages both economically and environmentally.
Car parks with solar panels are not only limited to energy production; they also contribute to the green energy infrastructure of cities. By providing a shaded area for vehicles, it prevents overheating in summer and reduces the internal temperature of parked vehicles. This saves energy by reducing the use of air conditioning. In addition, these car parks also provide a suitable environment for charging electric vehicles, thus helping to spread electric vehicles and further reduce dependence on fossil fuels.
Solar car parks are an important part of sustainable urban development and strategies to combat climate change. By increasing the use of green energy, they contribute to the energy independence of cities and enable the creation of a more sustainable, livable environment. Therefore, car parks with solar panel charging stations play a critical role in the cities of the future.

Solar car parking projects in different areas of the world demonstrate how this innovative system can be successfully implemented in various climatic and geographical conditions. Let’s now take a closer look at the impacts and benefits of solar car parks on a global scale by examining some of the examples where this technology has been successfully implemented.

A. RUTGERS UNIVERSITY – NEW JERSEY, USA

Solar panels installed on a 32-acre car park area at Rutgers University in New Jersey generate about 10 MW of electricity annually. The project prevents the emission of approximately 10,000 tons of CO_2 per year. This amount provides an environmental benefit equivalent to removing more than 2,000 vehicles from traffic [16].

The car park with solar panels is also equipped with electric vehicle charging stations. This situation encourages the use of electric vehicles by the university community and promotes the use of green energy on campus. Electric vehicle owners can easily charge their vehicles within the campus thanks to these charging stations. Rutgers University's solar car park provides not only environmental, but also economic and educational benefits. Significant savings in energy costs are realized, while the data and experience gained from this project provide students and researchers with practical knowledge of renewable energy technologies. In this way, the university provides students with direct opportunities in sustainability and renewable energy. Rutgers University's solar car park is a successful example of innovative energy solutions and sustainable practices. The university's project not only improves energy efficiency on campus, but also raises awareness of environmental responsibility.

***Figure 1**. Rutgers University Solar Parking Lot - New Jersey, USA [17]*

B. PAIRI DAIZA ZOO CAR PARK – BRUGLETTE, BELGIUM

Pairi Daiza is a world-renowned zoo and botanical garden located in Bruglette, Belgium. Pairi Daiza, which attaches significant importance to sustainability and environmental protection issues, has implemented its solar panel car park in line with this mission.

The solar car park at Pairi Daiza has a large area that generates a large amount of renewable energy while providing shade for visitors. The car park is equipped with a total of 62,750 solar panels and can generate approximately 20 MWh of electricity annually. This energy produced both meets the zoo's own energy needs and the surplus is fed into the grid, increasing the use of environmentally friendly energy sources [18].

This solar car park is not only limited to energy generation, but also offers electric vehicle charging stations, allowing visitors to charge their electric vehicles. This encourages the use of electric vehicles and contributes to the reduction of carbon emissions.

Figure 2. *Pairi Daiza Solar Parking Lot – Bruglette, Belgium [18]*

C. COPENHAGEN AIRPORT – COPENHAGEN, DENMARK

Copenhagen Airport's solar car park has an annual electricity generation capacity of approximately 1.3 MW with 3000 solar panels. This energy makes a significant contribution to meeting the energy needs of the airport's terminal buildings and other operational areas. Thanks to the clean energy generated by solar panels, the airport's carbon footprint is significantly reduced and dependence on fossil fuels is reduced. The project prevents the emission of approximately 600 tons of CO_2 annually [19].

Copenhagen Airport continues to work on sustainability and environmental protection and plans to implement more renewable energy projects in the future. The airport management aims to increase the use of solar energy and integrate other environmentally friendly technologies in line with the goal of becoming carbon neutral. Copenhagen Airport's solar car park is a successful example of how sustainable energy solutions can be integrated into airport operations. While reducing the airport's environmental impact, the project also makes significant contributions in terms of economic efficiency and raising social awareness.

D. CINCINNATI ZOO – OHIO, USA

The Cincinnati Zoo's solar car park has an annual electricity generation capacity of approximately 1.56 MW. This solar system produces more than 20% of the zoo's energy needs. The system significantly reduces its carbon footprint by avoiding approximately 1,700 tons of CO_2 emissions annually. This is a significant achievement in terms of environmental sustainability and is considered a crucial step towards minimizing the zoo's ecological impact. [20].

Figure 3. *Cincinnati Zoo Solar Parking Lot – Ohio, USA [20]*

Solar car parks, with their successful applications around the world, demonstrate the importance of sustainable energy use and environmentally friendly infrastructure solutions. Examples such as Pairi Daiza, Cincinnati Zoo, Rutgers University, Copenhagen Airport and many others demonstrate how these innovative systems are effective in reducing carbon footprint while increasing energy efficiency. Car parks with solar panels encourage the use of renewable energy sources, reducing dependence on fossil fuels and lowering energy costs in the long term. It also contributes to the spread of environmentally friendly transportation options by offering additional benefits such as electric vehicle charging stations. Solar-powered parking lots are becoming an indispensable component in the cities and institutions of the future. These projects not only provide environmental and economic advantages, but also increase social awareness and create a model for sustainable cities of the future.

III. PRE-FEASIBILITY ANALYSIS OF PV PANEL SUPPORTED EV CHARGING STATION FOR KOCAELI UNIVERSITY

The solar panel car park project, which has been pre-analyzed for establishment at Kocaeli University, aims to increase the university's energy efficiency and contributes to its sustainability goals. Solar panel parking lots, which have many successful examples worldwide, offer eco-friendly energy solutions by reducing the carbon footprint and promoting the use of renewable energy sources.

The solar panel-supported electric vehicle charging station system is designed to have a total capacity of 605 kW, with 323 kW at the Faculty of Science parking lot and 282 kW at the Faculty of Education parking lot. Additionally, the parking lot will feature charging stations for electric vehicles. These stations are designed to accommodate 10 AC and 5 DC vehicle charging capacities. Students, staff and visitors will be able to easily charge their vehicles on campus by using the charging stations to be provided in the parking area. This once again highlights the university’s commitment to offering innovative and sustainable infrastructure solutions.

Kocaeli University's solar panel-supported electric vehicle charging station project will be an essential part of the university's vision of fulfilling its environmental responsibilities and creating a sustainable campus for the future. In addition to meeting the university's energy needs and providing economic benefits, this project will raise social awareness and offer our students practical knowledge about renewable energy technologies. This initiative will play a significant role in helping our university achieve its sustainability goals and lead the way in eco-friendly energy solutions.

A. DETERMINATION OF SYSTEM TYPE AND LOCATION

The system consists of 3 main components. First, there are 550 W PV modules. Inverters, which are used to convert the direct current (DC) generated by the solar panels into alternating current (AC), will play a critical role in the efficient operation of the system. These inverters will ensure that the energy produced is utilized in a manner that meets the campus's electricity needs and is compatible with the grid. The third and final main component is the charging station. A total of 15 charging stations with the capacity to charge vehicles have been added to the system. There is no energy storage unit for storing the energy produced by solar panels. Therefore, when the energy generated is not used in real-time, it will be sold back to the grid.

A.1. Zone 1 – Faculty of Science Parking Lot

In Zone 1, a total of 588 PV modules, each with a capacity of 550 W, have been placed in 4 separate groups over an area of 1500 m², arranged in a 21x7 configuration. A PV system with a total installed power of 323.4 kW is obtained. Each group is installed at a height of 5 meters with a 10-degree tilt. The system’s layout is shown in Figure 4. The parking lot layout plan, which has a capacity of 22 vehicles under each of the PV panel groups, a total of 64 vehicles can be parked, and where there are charging stations, is given in Figure 5.

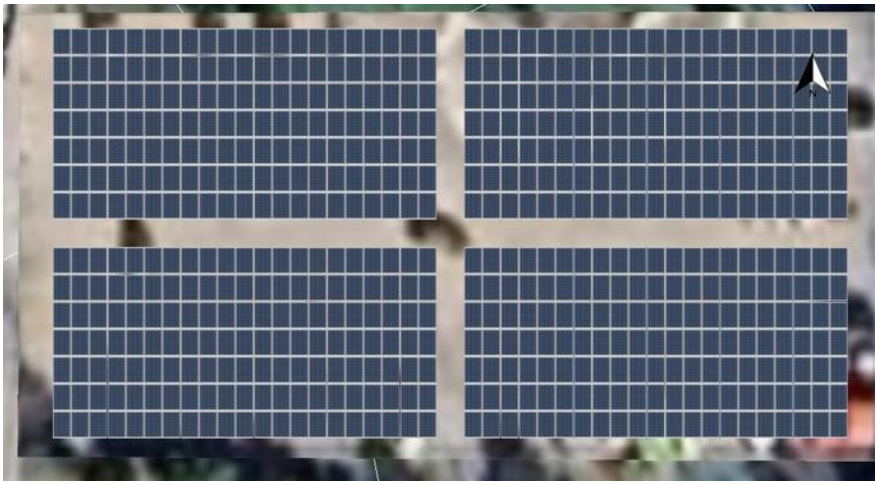

Figure 4. *Zone 1 - PV Modules Layout*

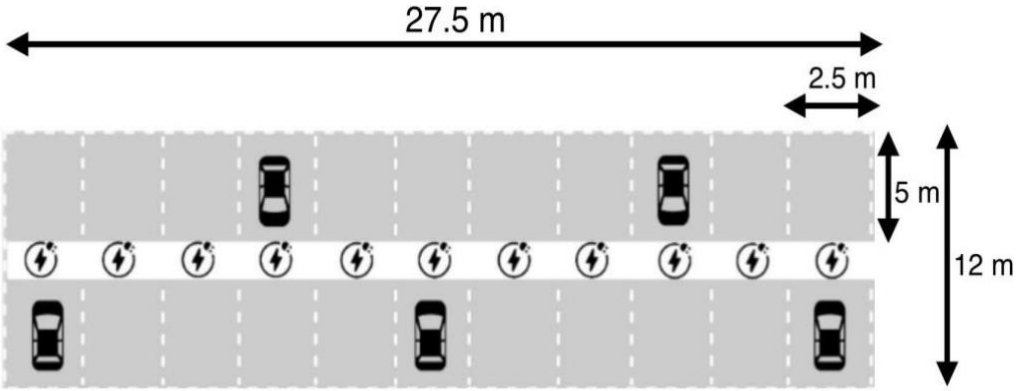

Figure 5. *Zone 1 - Parking Lot Layout*

A.2. Zone 2 – Faculty of Education Parking Lot

In Zone 2, a total of 512 PV modules, each with a capacity of 550 W, have been installed in 4 separate groups over an area of 1300 m², arranged in a 16x8 configuration. It has an installed power of 281.6 kW. Each group is mounted at a height of 5 meters with a 10-degree tilt. The system's layout is shown in Figure 6.

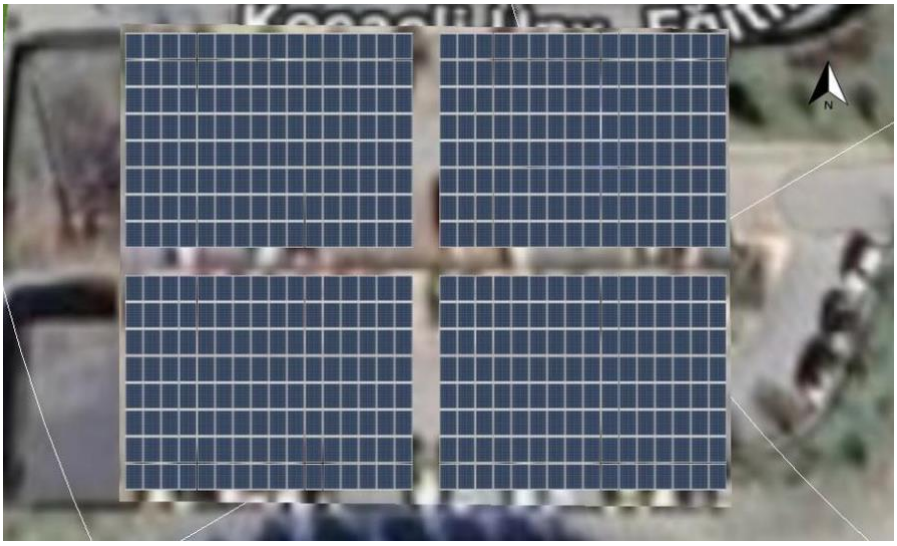

Figure 6. *Zone 2 - PV Modules Layout*

The parking lot layout plan, which has a capacity of 16 vehicles under each of the PV panel groups, a total of 64 vehicles can be parked, and where there are charging stations, is given in Figure 7.

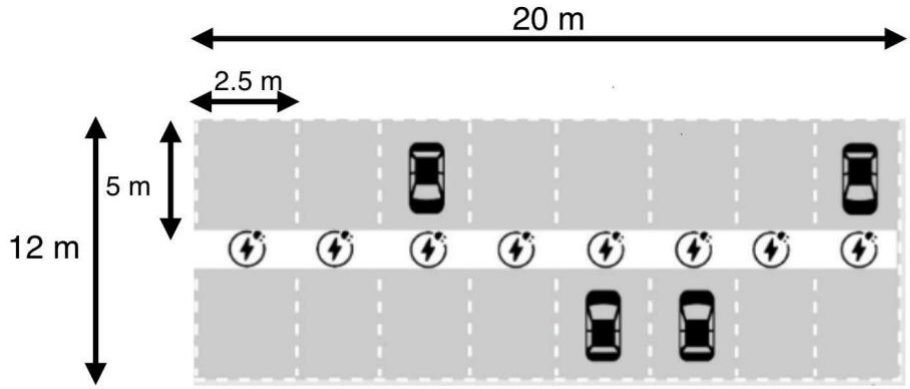

***Figure** 7. Zone 2 - Parking Lot Layout*

The annual sunshine durations for Kocaeli are shown in Figure 8, and the annual total irradiation for the PV systems is shown in Figure 9.

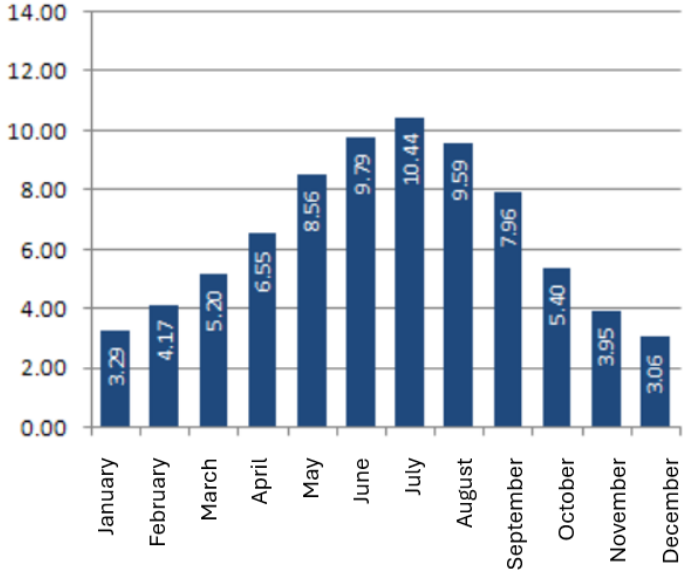

***Figure 8.** The Annual Sunshine Durations for Kocaeli [21]*

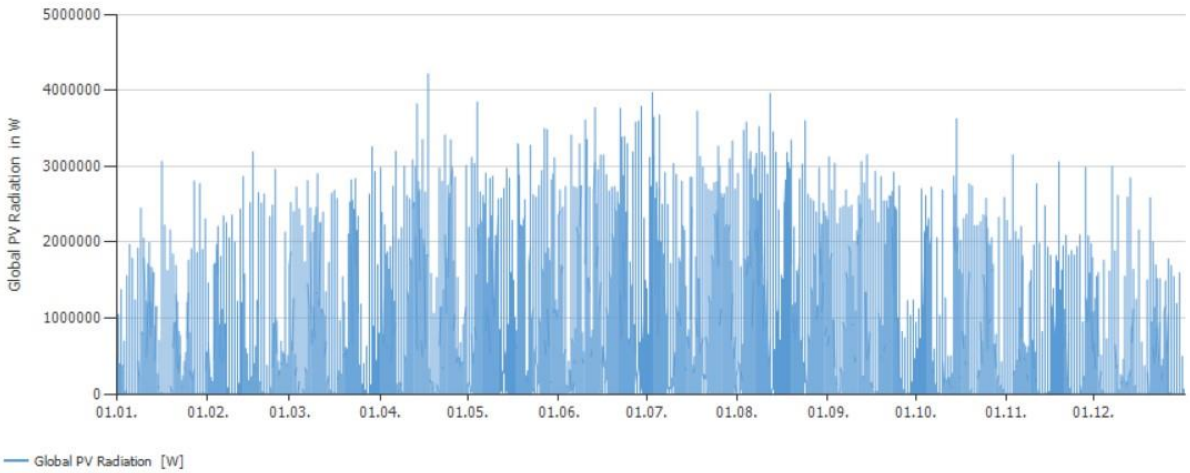

***Figure 9.** The Annual Total Irradiation for The PV Systems*

B. DETERMINATION OF GENERAL LOADS AND ELECTRIC VEHICLE CHARGING STATION LOADS

The annual average load consumption of a university with an engineering faculty, swimming pool, sports hall, and lighting units has been determined to be 800,000 kWh [22]. Based on previous studies conducted at Kocaeli University, a portion of the campus's annual consumption of 9,000,000 kWh, specifically 1,000,000 kWh, has been added as the general load to the system. The annual load profile is shown in Figure 10.

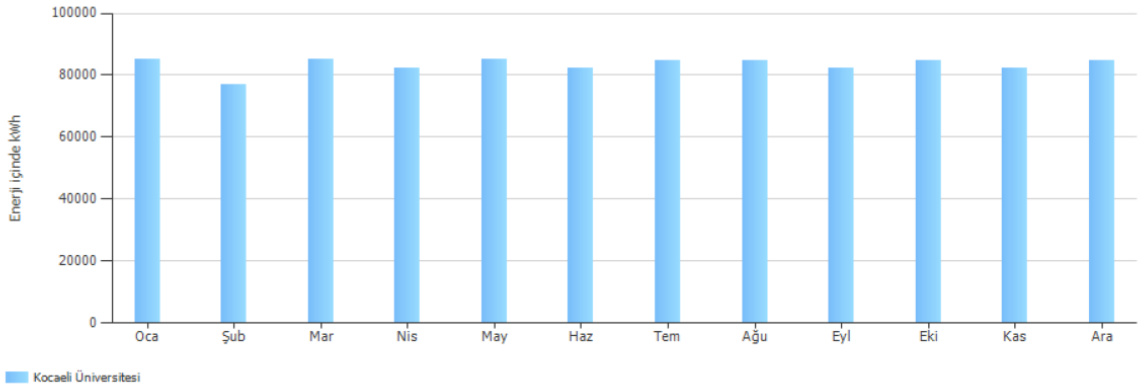

Figure 10. *The Annual Load Profile of Kocaeli University*

To create the charging station load profile, 10 AC and 5 DC charging vehicles have been selected. These vehicles are assumed to travel an average of 18,250 km per year, with a weekly distance of 350 km. The numbers of vehicles, charging types, charging powers, and consumptions are provided in Table 1.

Table 1. *Vehicles to be charged*

Vehicle Name	**Number of Vehicles**	**Charging Type**	**Power**	**Consumption**
Mercedes Benz – Maybach EQS SUV	4	AC Level 2	11 kW	21.1 kWh / 100 km
Honda – e	3	Ac Level 2	6.6 kW	16 kWh / 100 km
Hyundai – Kona	3	AC Level 2	11 kW	9,5 kWh / 100 km
Toyota – Proace Verso L	2	DC CCS	100 kW	28,8 kWh / 100 km
Audi – e-tron	3	DC CCS	120 kW	20,8 kWh / 100 km

C. ENERGY FLOW DIAGRAM AND CONSUMPTION

Based on the annual consumption and charging station consumption values determined above, the energy flow diagram of the system is shown in Figure 11.

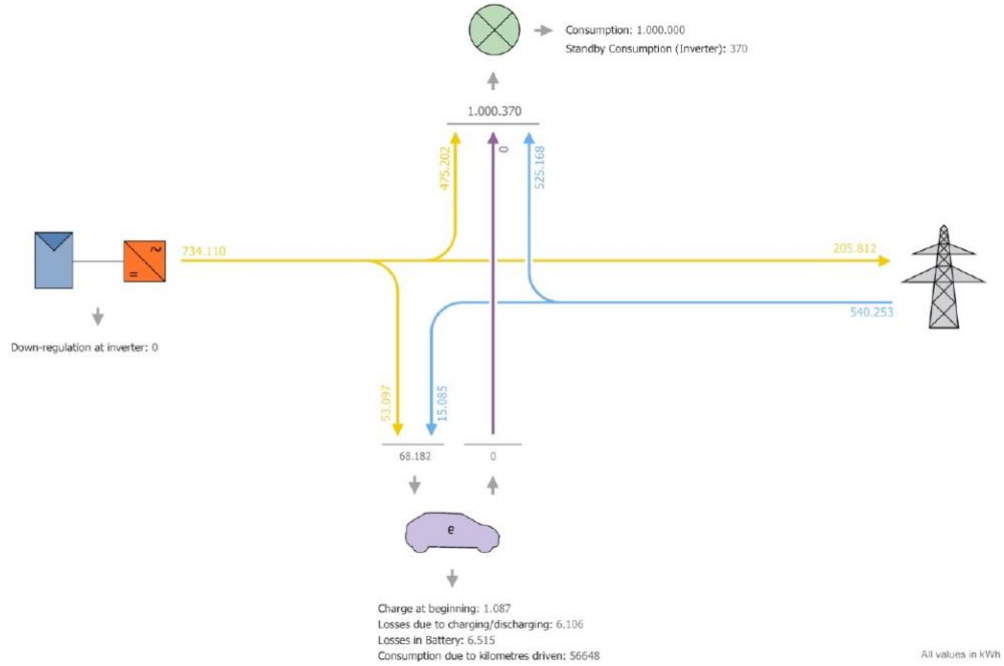

Figure 11. *Energy Flow Diagram*

The total annual consumption of the electric vehicle charging station is 68,182 kWh. 53,097 kWh of this consumption is met by the PV system. When the 15 charged vehicles travel a total of 273,750 km per year, it is observed that solar energy covers 213,184 km of this distance, which is approximately 78%.

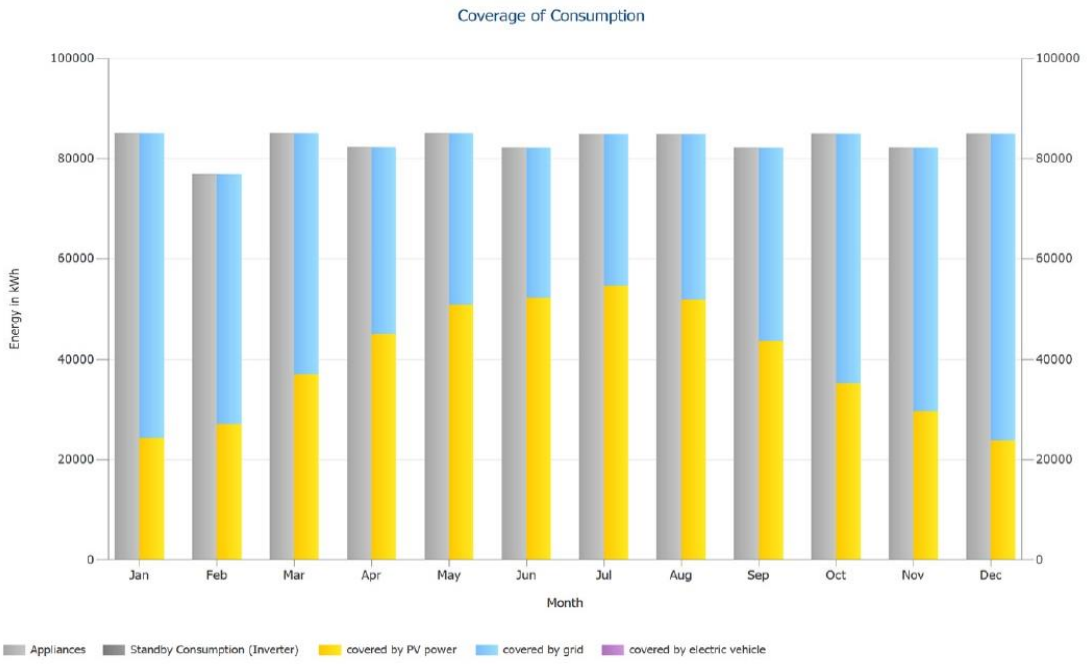

Figure 12. *Annual load consumption coverage rates (except charging stations)*

The distribution of the annual load of 1,000,000 kWh between the PV system and the grid is shown in Figure 12. The PV system covers 475,000 kWh of it, while the remaining 525,000 kWh is covered by the grid. When including all consumptions in the system, it is observed that the percentage of energy needs met by solar energy is 49.4%. The consumption coverage ratios for all loads are shown in Figure 13.

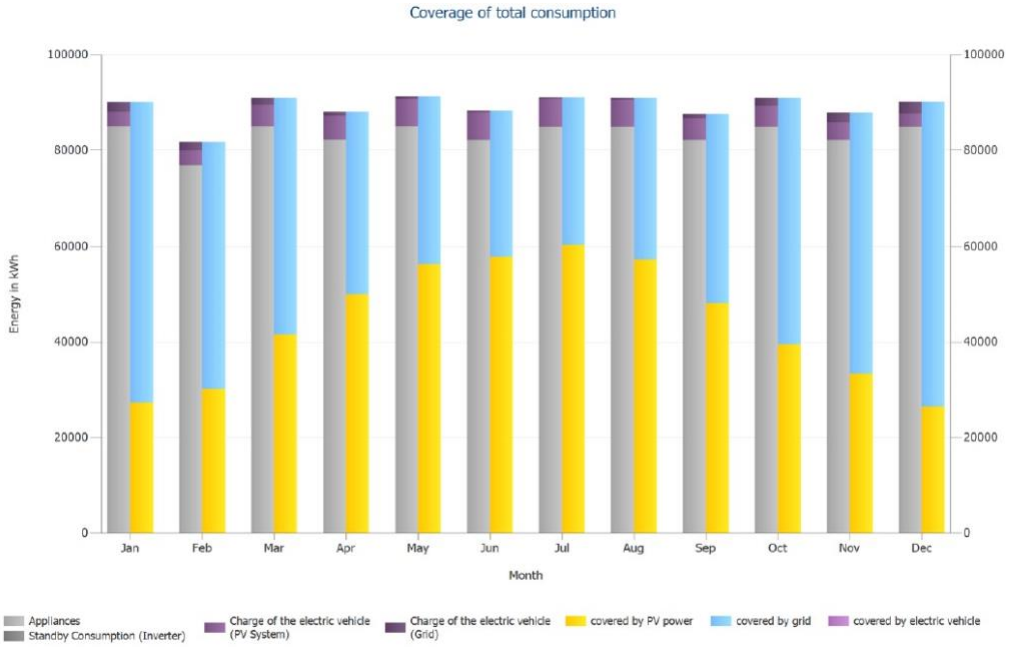

Figure 13. *Consumption Coverage Rates for All Loads*

IV. RESULTS AND RECOMMENDATIONS

Kocaeli University's sustainability and green energy goals, the planned 605 kW solar panel-supported charging station is designed to enhance the university's energy efficiency, reduce its carbon footprint, and promote eco-friendly transportation solutions. This comprehensive project plays a crucial role in fulfilling the university's environmental responsibilities for the future and leading innovative energy solutions.

The 605-kW solar panel system, which forms the basis of the project, will cover 49% of the electrical needs of a specific part of the campus, thereby reducing dependence on the grid. Moreover, approximately 78% of the charging station consumption of electric vehicles will be covered by the PV system. This system will significantly lower the university's energy costs and support long-term financial sustainability through environmentally friendly energy production. Efficient and continuous use of solar energy will minimize the environmental impact of our campus and promote the use of green energy.

One of the major environmental benefits of the project will be the prevention of 345,000 kg of CO_2 emissions annually. The corresponding consumptions are listed in Table 2.

Table 2. *Consumptions with similar carbon emissions*

Name	Value
Vehicle (Gasoline)	150000 lt
Coal	170000 kg
LPG	200000 lt
Fuel-oil	115000 lt
Natural Gas	170000 m3

Reducing carbon emissions to this extent will be a significant step in fulfilling the university's environmental responsibilities and creating a cleaner, more sustainable campus environment.

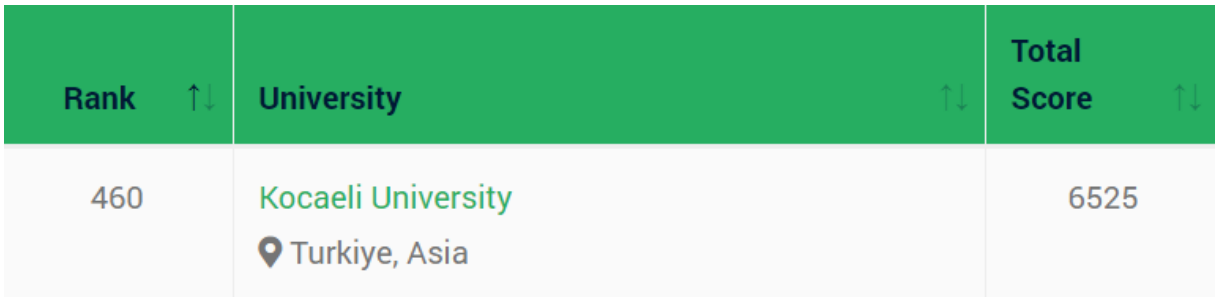

Figure 14. *Kocaeli University UI GreenMetric Ranking [24]*

The solar panel-supported charging station project will not only provide environmental and economic benefits but will also play a crucial role in raising social awareness. Our students and researchers will have the opportunity to gain practical knowledge about renewable energy technologies and enhance their awareness of sustainability. The project will be integrated into the university's sustainability curriculum, offering practical educational opportunities to students and the academic community, thereby contributing to the widespread adoption of renewable energy technologies and environmental consciousness.

UI GreenMetric is an assessment system focused on measuring the environmental sustainability performance of universities. It includes performance metrics in various categories such as energy usage, waste management, water use, transportation, education and research, and environmental planning and management. Universities from around the world apply to this index annually, and their sustainability performances are evaluated to determine their ranking. UI GreenMetric serves as a tool for universities to improve their own sustainability efforts and to promote environmental sustainability overall [23].

Kocaeli University is currently ranked 460th in the world and 41st in Turkey in the UI GreenMetric ranking. Through this project, we can enhance our university's sustainability performance and contribute to our goal of becoming a green university on an international scale.

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