

IoT enabled Smart Solar Tree for Smart Cities, Villages & EV Charging Infrastructure

Technology Indigenously Developed by CSIR-CEERI

Conventional solar photovoltaic installations require approximately 8-10 m² of shadow free land area per kW. Such huge free land is not readily available in urban dwellings. Hence, solar tree designs have been proposed to reduce the ground foot print significantly by a factor of 10 times. However, commercially available solar tree designs suffer from large shading losses (>30%) due to non-optimized placement and orientations of panels in a solar tree. Further, these solar trees are not optimized for each geographic location.

CSIR-CEERI has come up with a novel indigenous solar tree design framework optimized for each geographical location with extremely low shading losses (<2 %). In addition, multi-objective optimization is carried out to ensure low structural cost while maintaining the energy output of the solar tree. An additional novelty of the developed solar trees is the integration of IoT framework for continuous performance monitoring, environmental parameters and pollution monitoring (Temperature, Humidity, CO₂, PM_{2.5}, PM₁₀ etc.), and cameras for security and surveillance. IoT enabled solar trees is an excellent platform for Smart cities. In addition, the inherent decentralized power generation capabilities of the solar tree along with integrated LED lighting, Wi-Fi, mobile charging makes it an attractive solution for smart villages. IoT enabled solar tree can also cater to the needs of the agricultural community in providing electricity for solar powered agricultural pumps and IoT enabled features can enable precision agriculture, ubiquitous soil health monitoring and smart fencing. CSIR-CEERI has already developed and deployed two 500 W IoT enabled solar trees at Pilani campus (Figure 1 and 2) and 3 kW solar trees will be deployed shortly in Chennai. **Five solar trees are also being deployed at Sirohi Aspirational district (a scheme initiated by NITI-AAYOG).**

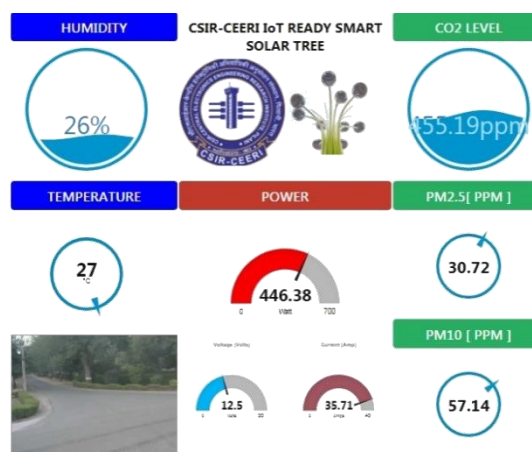


Figure 1. 500 W solar tree installed at CSIR-CEERI, Pilani

Figure 2. Remote Monitoring Dashboard on Web Server

Recently, CEERI has started integration of EV charging stations with the developed solar tree. Government of India plans to get 6-7 million electric vehicles on roads by 2020 as a part of National Electric Mobility Mission Plan¹. EVs also form an important part of the smart city mission of the Govt. of India. In particular, there is an increasing focus on the use of electric vehicles (EVs) such as e-bikes and e-rickshaws as they have significant effect on reducing the pollution as well as reduction in the use of fossil fuels. A promising number of 54,800 units of electric two-wheelers were sold in FY2017-2018 alone². EV market is predicted to grow at a CAGR of over 37% during FY 2018-2023³. However, charging infrastructure has been a main bottle neck limiting the wide scale adoption of EVs. **The full benefit of EVs as a "Zero Emission Solution" can be realized only when they are charged through reliable charging stations powered by renewable sources.** Solar tree having high power density of approximately 3 kW/m² of ground footprint area, will enable the technology to be deployed in the major hubs of the cities like bus stands, parking lots, and road side pavements and so on, where there is public accessibility. Moreover, smart queuing facility will enable EV owners to get fast access to the nearest charging station and hence, promote reliable mobility. Also, the multi-vehicle EV charging facility being developed by CSIR-CEERI will provide a common platform for charging any e-bike/e-rickshaw. The EV charging technology will be ready to be deployable in a time frame of 1 year.

With the growing price of diesel, e-rickshaws in the form of e-cargo are becoming popular in the rural community also especially for transport of good and materials. In the rural areas, EV charging infrastructure will lead to faster adoption of e-cargos and enable easy reach out to the market, thereby, improving standards of living. Moreover, Government of India targets 1 million solar pumps by 2021⁴. Solar tree will not only boost the installation of these water pumps for the benefit of the rural community but also provide necessary knowledge regarding the soiling nutrients requirements. Drone based imaging integrated to the solar tree can also provide information regarding crop health from remote location. **IoT enabled smart solar tree can help India realize green and sustainable smart villages and smart cities.**

¹ <https://dhi.nic.in/UserView/index?mid=1347>

² <https://auto.ndtv.com/news/electric-car-sales-in-india-fall-in-fy18-electric-two-wheelers-record-healthy-growth-1934323>

³ <https://www.techsciresearch.com/report/india-electric-vehicle-market/1360.html>

⁴ <https://bridgetoindia.com/indias-solar-water-pump-market-struggling-take-off/>