A Pilot Project on Solar-Energy-Based Electric Vehicle Charging

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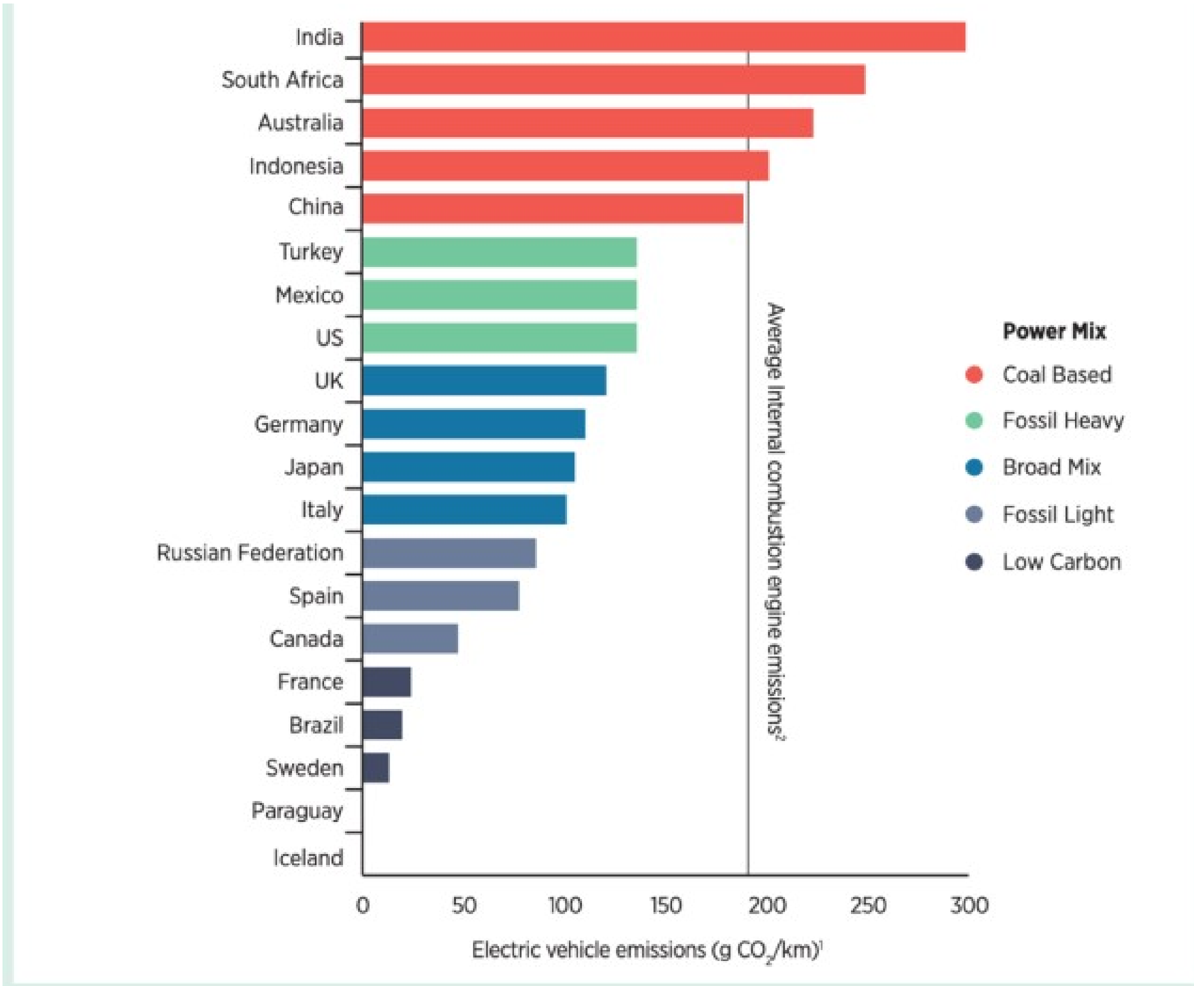
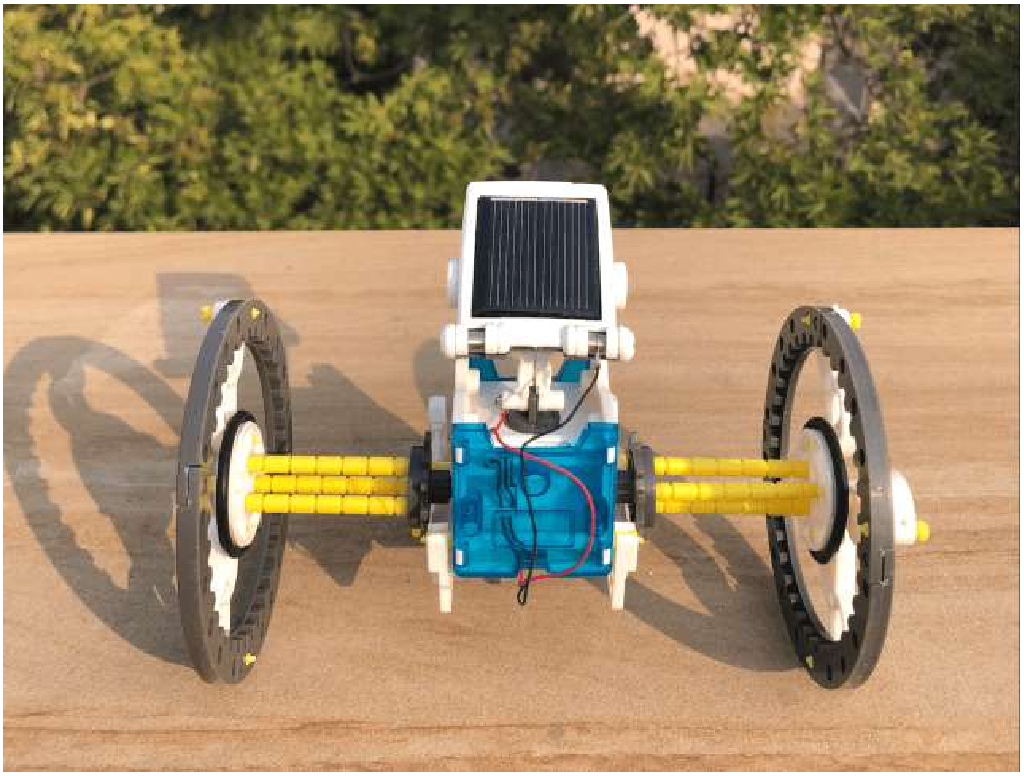
EVs are being aggressively pursued by many countries across the world as one of the solutions to address climate change. Owing to their zero tailpipe emissions, they are expected to counter the harmful effects of emissions from fossil-fuel-based vehicles. However, it is important to note that EVs are sustainable in the long run only if they run on an eco-friendly form of energy. The below figure shows the CO_2 emissions related to EVs powered by the electrical grid across different countries. The Indian grid is predominantly based on coal as the primary energy source as a result of which EVs, upon drawing energy from the grid, will add to a net increase in the overall CO_2 emissions. Hence, replacing coal with cleaner energy sources such as renewables is the way to go. Solar Rooftop Photovoltaic (SRTPV) is a popular technology to source clean energy and can be easily scaled within cities. In this regard, solar energy-based EV charging seems a sustainable and interesting option.



Electric vehicle emissions in different countries. [1]Results include direct grid emissions, indirect grid emissions and losses, [2]GreenVehicle Guide, Australian Government. Source: Creara, 2017

The Center for Study of Science Technology and Policy (CSTEP) is working with the Bangalore Electricity Supply Company (BESCOM) to demonstrate this concept at their premises in Bengaluru. The system design for the pilot project consists of a Power Conversion Unit (PCU), SRTPV panels, a lithium ion battery bank, and EV chargers as the main components. An intelligent computing unit in the PCU commands the energy flow across these components to maximise the generated solar energy for self-consumption. In other words, the PV energy is prioritised over the grid energy for charging EVs. The battery bank not only complements the PV energy source but also helps in addressing the fluctuating nature of the latter.



The key learnings from the project will guide the large-scale deployment of such solar-energy-based EV charging solutions. A number of benefits can be derived from such an integrated system. Apart from the obvious environmental benefits, the decreasing costs of RTPV systems is increasingly making the generated solar energy cheaper than grid electricity. Currently, certain states have special tariffs (cheaper than usual) for EV charging. This is not sustainable in the long-run for the DISCOMs. In this context, RTPV systems (excluding BESS), whose cost of generation has become very competitive to the grid tariff forms an effective alternative. Furthermore, RTPV systems are modular and can be installed easily on rooftops of buildings such as car parks, commercial premises, and offices, where vehicles are parked for a considerable time. Solar energy generated during the day in close vicinity of the chargers can be consumed locally, thereby reducing the detrimental effects of power demand surge on the grid.

The mentioned project represents the scenario wherein both EV chargers and the solar panels are co-located. However, this may not always be feasible due to reasons such as insufficient or unsuitable roof top area over the EV charging station. In such cases, novel regulatory and policy mechanisms can be explored to enable off-site sourcing of the generated solar energy. Few such mechanisms include peer-to-peer energy trading and virtual net metering.