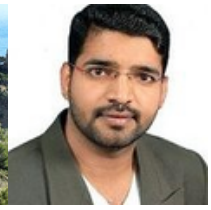
# Evaluating the Impact of Driving Style on Tailpipe Emissions in Heterogeneous Traffic

**KID: 20221206**





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This study employed a portable emission measurement system (PEMS) to examine the effect of driving style (aggressive and normal) on tailpipe emissions for diesel passenger cars in Sangareddy town, Telangana, India. The study showed that driving style, speed, acceleration/ deceleration, and road type significantly influence tailpipe emissions. Aggressive and normal driving styles on urban and rural roads significantly differed in average CO2, CO, and HC emission rates. Driving aggressively increased CO2, CO, and HC emission rates for the operating modes (acceleration, deceleration, and cruise) by 18 to 40% over normal driving. The CO, HC, and CO2 emission factors were minimal at 40-60 kmph during normal driving styles on both urban and rural roads.

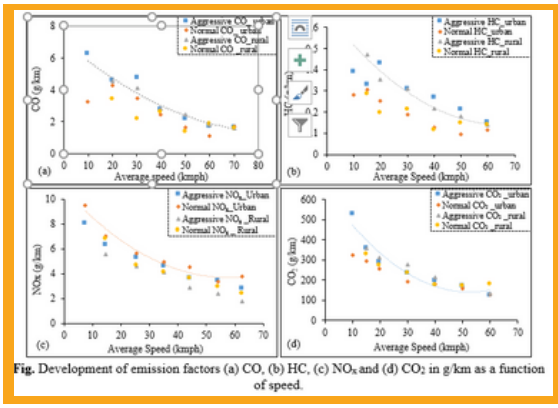


Fig. Development of emission factors (a) CO, (b) HC, (c) $NO_x$ and (d) $CO_2$ in g/km as a function of speed.

**Development of emission factors (a) CO, (b) HC, (c) NOx and (d) CO2 in g/km as a function of speed.**

The insights from this study could be used to understand the influence of driving style on emissions & for developing effective eco-driving strategies & training programs to improve air quality.

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# Development of eco-friendly and low-cost organic solar cells

**KID: 20221207**

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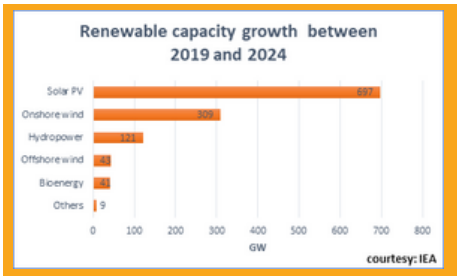
The snowballing issue of global warming and its adverse effects, means the impact of any new technology on the environment and carbon footprint can no longer be ignored. Any context, the field of renewable energy sources such as solar, wind, hydro, bioenergy, geothermal, and hydrogen have received unprecedented impetus-globally owing to the growing trends of energy requirements as well as to augment the reliance on the depleting fossil fuel reserves. As per the latest trends published by International Energy Agency (IEA), renewable power capacity is set to expand by 50% between 2019 and 2024, led by solar photovoltaics (PV). The installation of solar PV systems on homes, commercial buildings and industrial facilities is set to take off over the next five years (figure 1), transforming the way electricity is generated and consumed. [1] Solar power in India is a fast-developing industry. The International Solar Alliance (ISA), proposed by India as a founder member, is headquartered in India. The country's solar installed capacity reached 59.302 GWAC as of 31 August 2022 as per the report from Ministry of New & Renewable Energy (MNRE), India. Under the ages of MNRE, innovative initiatives like "One Sun One World One Grid" and "World Solar Bank" to harness abundant solar power on global scale is now gaining momentum.




Renewable capacity growth between 2019 and 2024 (Courtesy IEA, ref [1])

Among the key challenges faced by the Solar PV community is find a balance between manufacturing commercially viable solar panels to meet with growing consumer requirements and optimise the manufacturing technology follow an environmentally sustainable design.

Despite the tremendous success and maturity of Si-solar cell technology, it is limited by the huge fabrication costs as the silicon processing is very expensive involving very high temperature methods that leaves a large carbon footprint. Nonetheless, considering the long-term durability and stability exhibited by Si-solar cell panels, they are continued to be deployed for installations, while there is pronounced thrust towards development of alternative energy conversion technologies that are eco-friendly and cheaper. For a PV technology to satisfy the sustainable criteria, it should be economical, should have abundance of resource availability with lowest environmental impact. Organic molecule solar based energy conversion devices [4] have gained lot of interest as an attractive alternative owing to possibility of low-cost fabrication procedures, ability to print them on flexible substrates, engineering at molecular level to tune their bandgap and charge transport characteristics and a potentially less hostile environmental bearing. These devices include technologies like organic (polymer) solar cells (OSC) , dye-sensitized solar cells (DSSC),

quantum dots solar cells (QDSC) and the latest technology that boasts of efficiency close to single junction silicon solar cells, perovskite solar cell (PSC) and rapidly approaching commercialization stage.

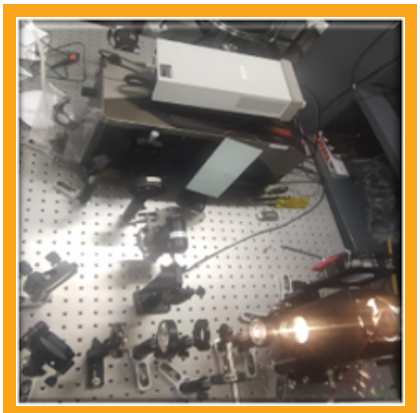
At IIT Hyderabad our research group is strongly motivated to contribute towards the development of various organic material based solar energy conversion devices mentioned above.

Demonstration of solar cell fabrication to class IX & X students

This area of research is highly interdisciplinary and our group collaborates with various other groups that's includes researchers from Chemistry, Chemical Engineering and Electrical engineering departments of IIT Hyderabad. Key focus area of our group is towards the development of charge transport interlayers for efficient interfaces to be used in the above organic material based solar energy conversion devices. Recently our group demonstrated a 'green' DSSC making use of an inexpensive magenta dye, New Fuchsin, for the first time, as a photo-sensitizer, and a water based liquid electrolyte based on Na2S and aqueous Fe3+/Fe2+ and CoS deposited on C-fabric as the counter electrode. The best device showed power conversion efficiency which is among the best obtained with DSSC with photosensitizers with a simple molecular structure. The published work established a methodology towards eco-friendly DSSC employing natural dyes and pigments. The advent of smart IoT devices in daily lives has created a tremendous requirement to find alternative sustainable solutions to power these devices. There is a great thrust to develop photovoltaic devices that work well in diffused light conditions, and the research area of indoor photovoltaics has received lot of thrust recently. In this direction along with Prof Shiv Govind Singh's group from Electrical engineering department we have developed integrated thermally evaporated OSC module with more than 50 cells integrated into 5 cm x 2 cm ITO substrate. The thermally evaporated integrated OPV devices is expected to pave way of powering numerous low power IoT devices. Additionally, we have fabricated photoanodes plasmonic gold (Au) nano particles embedded Ytterbium-doped titania (TiO2) nanowire for efficient indoor DSSC devices with efficiency close to 14% under white light emitting diode (LED) illumination. It is expected to have excellent potential when utilised as photoanodes for PSC devices as well. Complimenting the research on the energy conversion devices our group also presents strong expertise in the area of advanced transient optical spectroscopy for various functional materials characterisation and providing the critical inputs to aid in the fabrication and optimisation of devices using these materials. To this end, we employ a plethora of techniques encompassing femtosecond transient absorption spectroscopy, steady-state and time-resolved photoluminescence spectroscopy with TCSPC, cw-Photoinduced absorption Spectroscopy, Transient Photocurrent spectroscopy, etc. Our group also engages in various outreach activities like organization of ATAL Faculty development program on Energy conversion and storage devices, demonstration of fabrication and characterization of solar cells to school children etc.

Indoor solar cell (J-V) characterization

**"There is a great thrust to develop photovoltaic devices that work well in diffused light conditions**



Home-built EQE set-up

**"The thermally evaporated integrated OPV devices is expected to pave way of powering numerous low power IoT devices.**

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