

# Hybrid Car Efficiency Improvement

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## Situation

- The use of Hybrid Electric Vehicles (HEVs) is becoming more popular
- There are two systems used in the Hybrid Car: the Internal Combustion System (ICS) and the Electric System (ES)
- Hybrid cars depend more on the ICS, which causes environmental problems such as atmospheric pollution

## Problems

- Due to the high dependence of HEVs on the ICS, environmental problems arise
- Battery used is not efficient enough and hence the car has a short cruising range: 150-200km [1]
- The current lithium-acid battery used has low efficiency due to problems of stratification and corrosion

## Solutions

- Installing a solar panel on the roof of the car
- Increasing the usage of the electric system by supplying energy to the battery from the solar panels
- Using the multi-crystalline silicon type of solar panel as it has an efficiency of 20.3% [2]

- Using a sun tracker in order to make the solar panels face the sun directly to maximize the power delivered to the battery

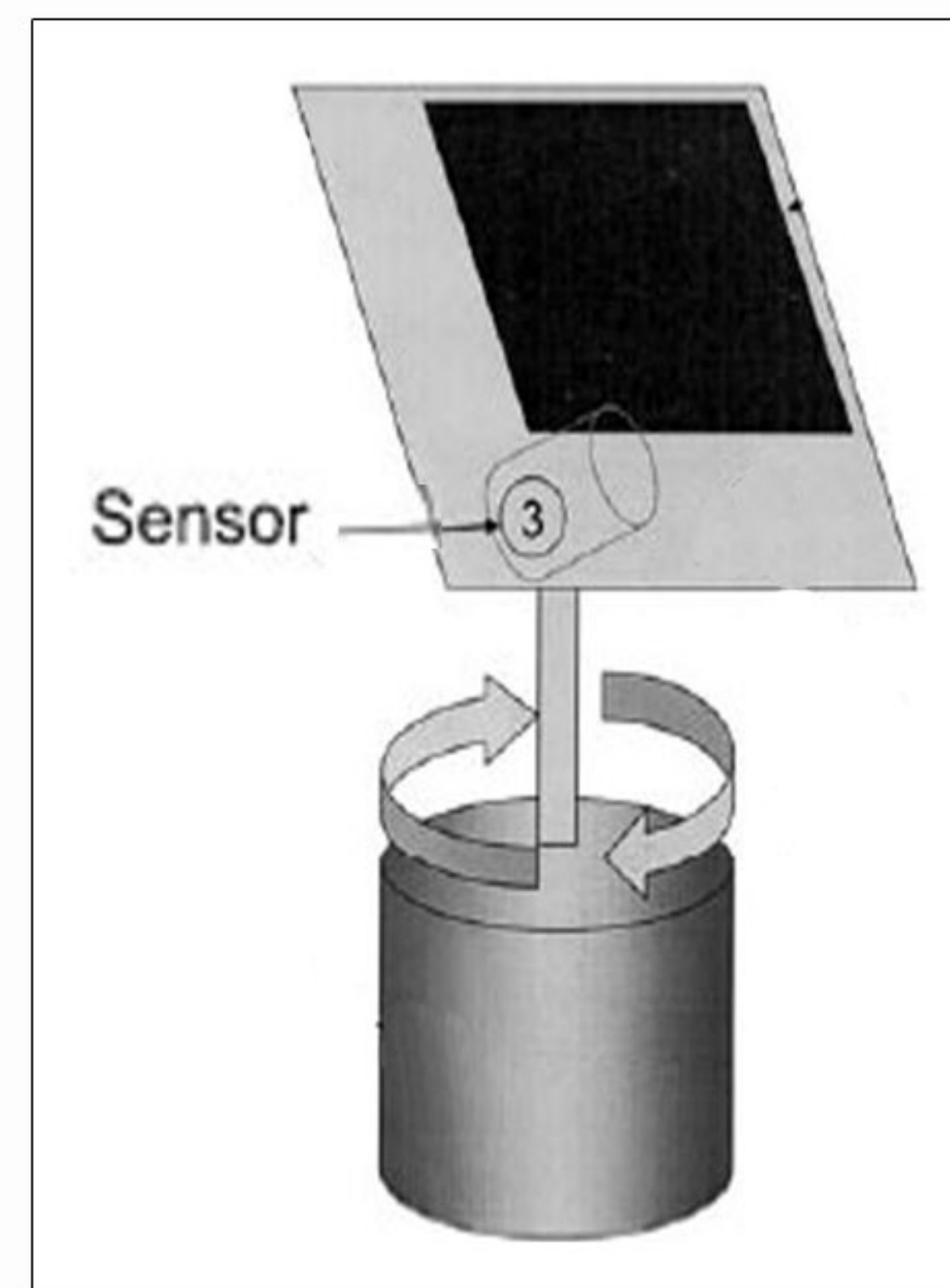


Figure 1: A Sun Tracker [3]

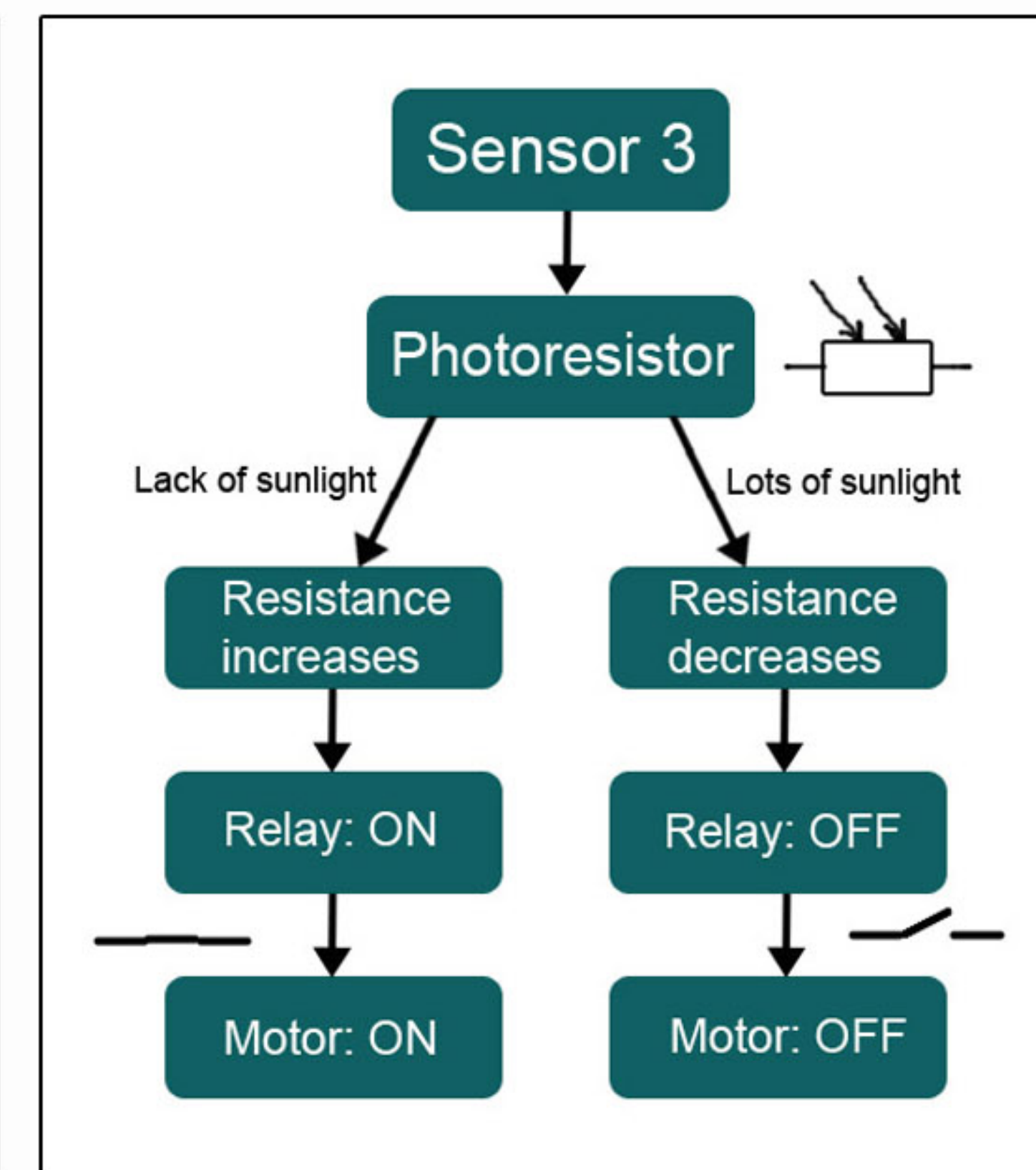


Figure 2: How the Sun Tracker Works

- Changing the original lithium-acid battery to aluminum-air battery to enhance the efficiency from 13% to 20% [4]
- Connecting a super super capacitor, which has a calculated resistance, to the main battery to charge it

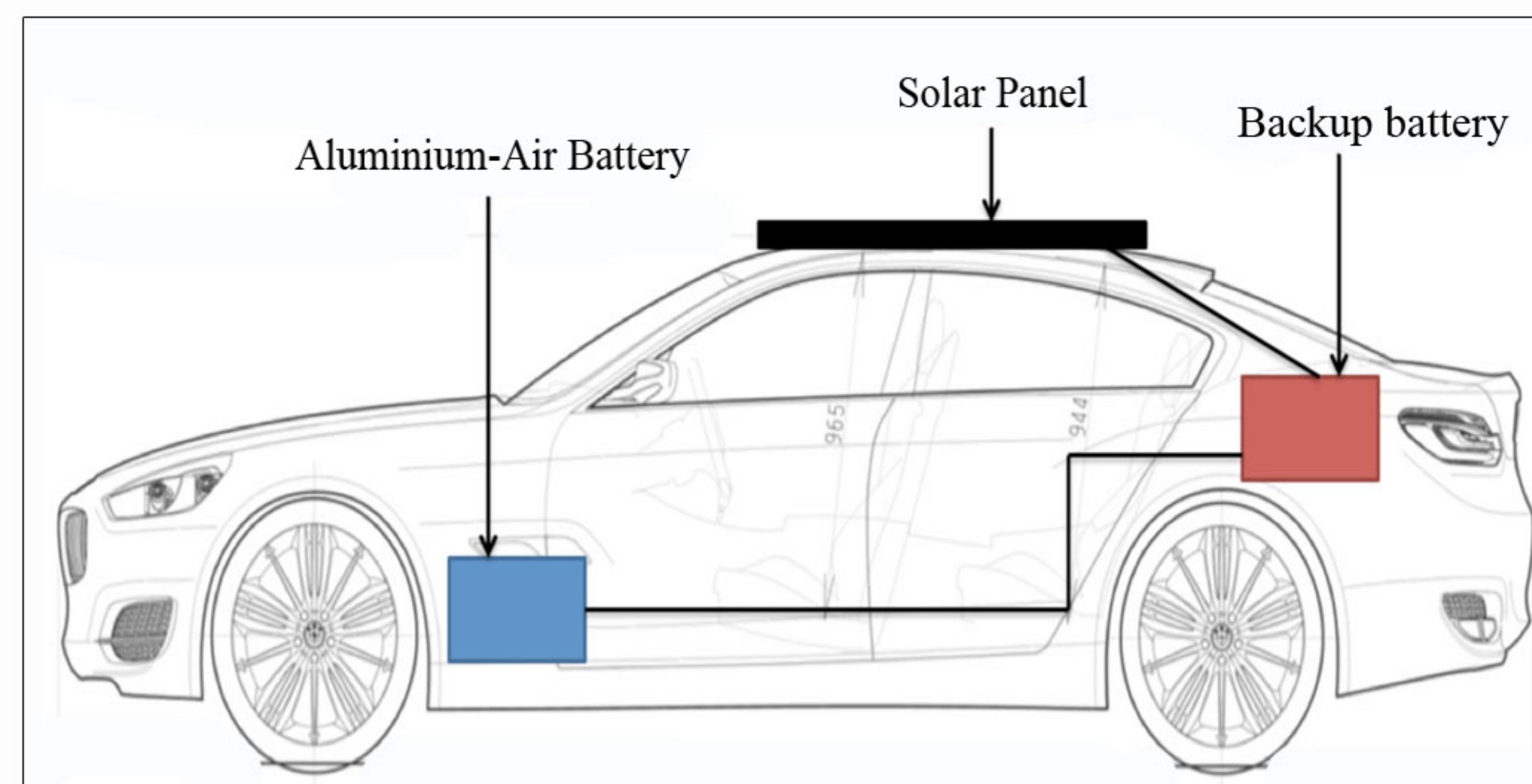


Figure 3: Connection of the Solar Panel to the Electric System

- Using Carbon Fibre Reinforced Polymer (CFRP) to construct some interior and exterior parts to make the car lighter thus improving the performance

- Performance=Power/Weight

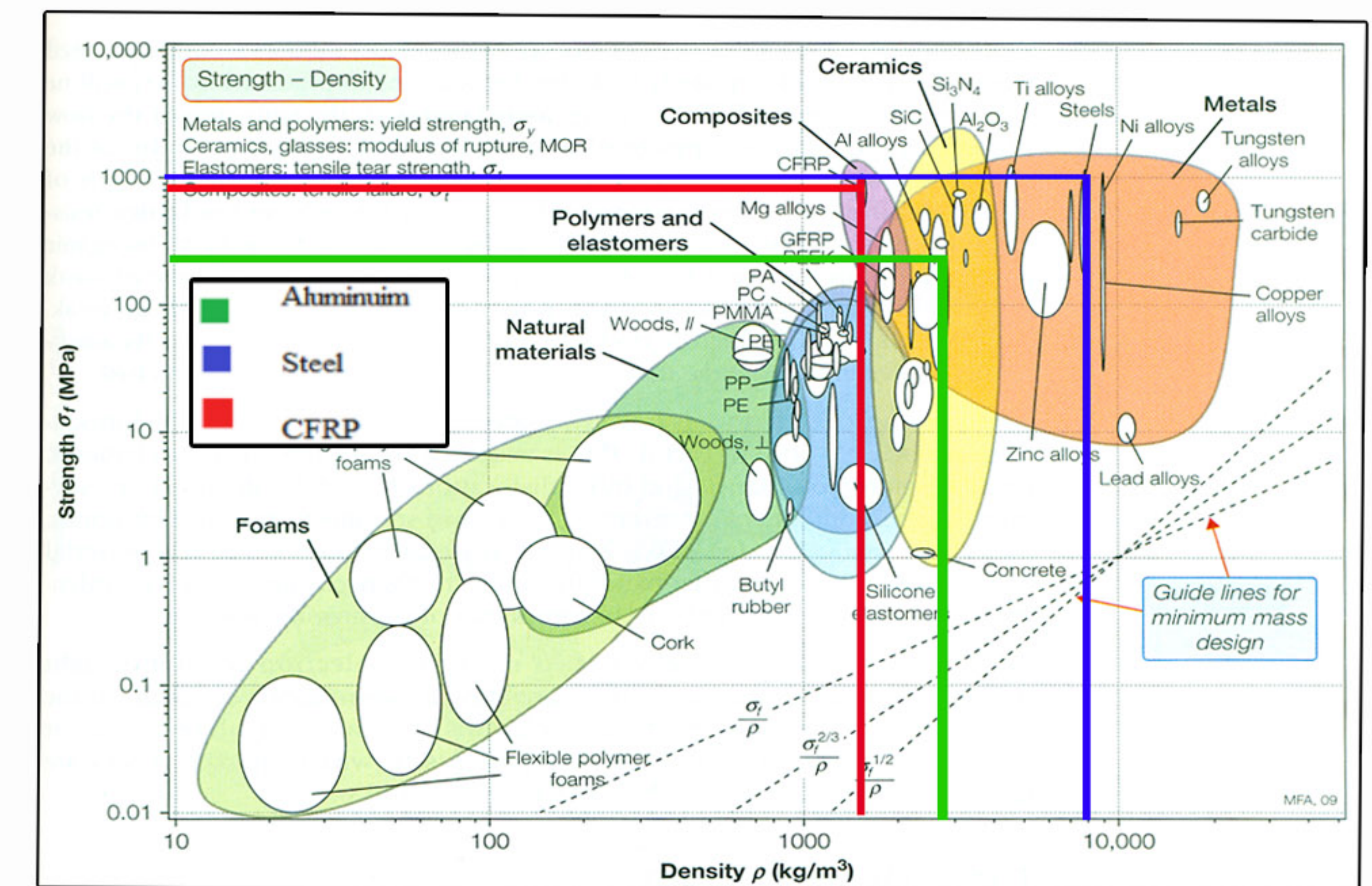


Figure 4: Strength and Density of CFRP compared to Steel and Aluminium [5]

## Evaluation

- Due to the addition of solar panels, weight is added to the car, which can further effect the movement of the car
- Possibility of having to redesign the car to make it look good with the integrated solar panels
- CFRP are too expensive and too difficult to work with for use in mass production of vehicles

## References

- [1] K. Sasaki, M. Yokota, H. Nagayoshi, and K. Kamisako, "Evaluation of electric motor and gasoline engine hybrid car using solar cells," Solar Energy Materials and Solar Cells, vol. 47, pp. 259-263, 1997
- [2] Gianfranco Rizzo, Ivan Arsie and Marco Sorrentino (2010). Hybrid Solar Vehicles, Solar (Collectors and Panels, Theory and Applications, Dr. Reccab Manyala (Ed
- [3] Building a sun tracker," July 17, 2008:<http://www.projectfreepower.com/solar-power/building-a-sun-tracker.html>
- [4] Yang, S. (2002). "Design and analysis of aluminum/air battery system for electric vehicles". Journal of Power Sources 112: 162-201
- [5] R. Budynas , J. Nisbett, 1st Initial. , Shigley's mechanical engineering design , 9th ed., New York: The McGraw-Hill Companies, 2011, p. 67