

# Automobile Solar Air conditioner

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## Abstract

*Air conditioner is the primary accessory of a passenger car which is used to maintain the vehicle cabin temperature and humidity at comfortable levels for a passenger. But this system consumes a lot of power and negatively affects the fuel efficiency of a car. Depleting natural oil resources, increasing oil prices and environment pollution increases the awareness about the Need to use renewable sources. In past years, lot of efforts have been made towards the application of solar energy to electric and hybrid cars, but a limited work is done on particularly air conditioning case. In the present work, feasibility study of air conditioner has been discussed using solar energy. With the implementation of solar conditioner in automobile the fuel efficiency will be increased and the tail pipe emissions are reduced. Also by dis-attaching compressor from engine and making it run through the solar energy, the load on engine decreases.*

**Keywords:** Automobile, Solar, Air-Conditioner, Motor, Compressor.

## INTRODUCTION

Use of petrol and diesel cars are getting maximum day by day. We will design an Automobile air conditioner system which will work on solar energy. We will use solar panels which will charge automatically from sunlight and will power the battery. The components like compressor, DC motor, fan motor are connected in circuit through which our automobile air conditioner will work on solar energy. The main concept of this project is to reduce the use of fossil fuels and to decrease the engine load and increase the average by disconnecting compressor from engine.

The use of solar energy for cooling can be either to provide refrigeration for food preservation or to provide comfort cooling. There is less experience with solar cooling than solar heating. Several solar heated buildings have been designed, built, operated for extended periods but only a few short –time experiments have been reported on solar cooling. However, research work is expected to close the gap between the two within few years.

## Energy Resources

Global warming and the rising costs of petroleum products have become topics in the forefront of modern day science and politics. Research on renewable,

non-fossil fuel energy technology has been steadily increasing and many consumers view these “green” energy technologies as opportunities to both reduce their carbon footprints as well as save money. Some examples of these energy sources that can be readily implemented in small-scale applications for the average consumer include solar, geothermal and wind energies.

Other popular renewable energy sources, including tidal and hydroelectric, are not feasible or accessible for the average consumer. Solar energy has become more appealing because of improvements in overall efficiency and decreasing costs. Currently, compared to the cost per watt of energy produced by coal, solar energy is more expensive; however, the cost of solar cells is continually decreasing and reducing the price gap.

### Solar Cell Technology

There are two major types of renewable technologies that utilize solar energy: solar thermal plants and photovoltaic cells. Solar thermal plants utilize the

sun’s energy to heat a fluid that drives a turbine to produce electricity. Photovoltaic cells, also known as solar cells, which convert light energy directly into electricity, are the primary focus of this project.

Sunlight carries energy which normally is partly turned into heat when it hits an Object. Solar cells are constructed of materials that turn solar energy into electrical current which can be collected for power generation. To increase the voltage of the electricity generated, solar cells can be wired together in series to create larger arrays, known as solar panels. Solar cells accomplish this energy conversion by the use of semiconductor materials.

Semiconductors are the building blocks of solar cells and are materials that do not behave as insulators or conductors, but rather exhibit characteristics that fall in-between.

Silicon solar cells are a popular solar cell category because of availability and cost and will be the technology investigated. These semiconductors are broken down into two types, n-type and p-type. In order to improve its electrical conductivity characteristics, silicon is “doped.”

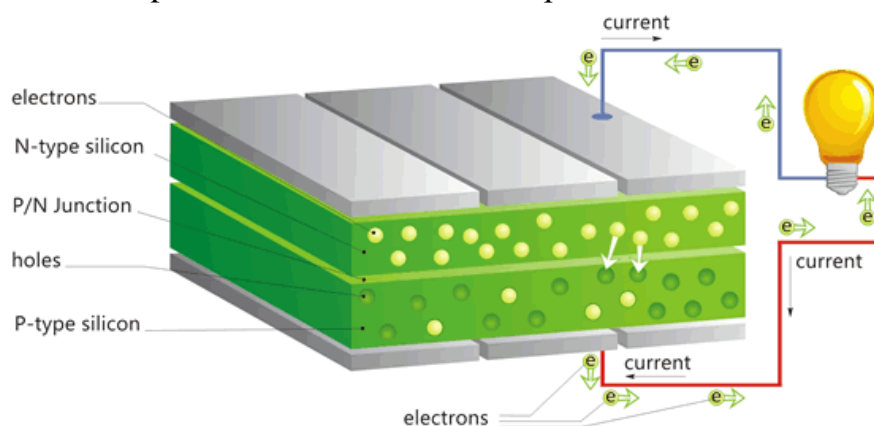


Figure 1 - Solar Cell Circuit

## Solar Panels

A solar panel is made up of many solar cells wired together. Depending on the energy required for the specific application, many solar panels can be wired together to create a large array.

Several components are necessary in a system capable of utilizing the energy generated by the solar panel array as shown in Figure 2:

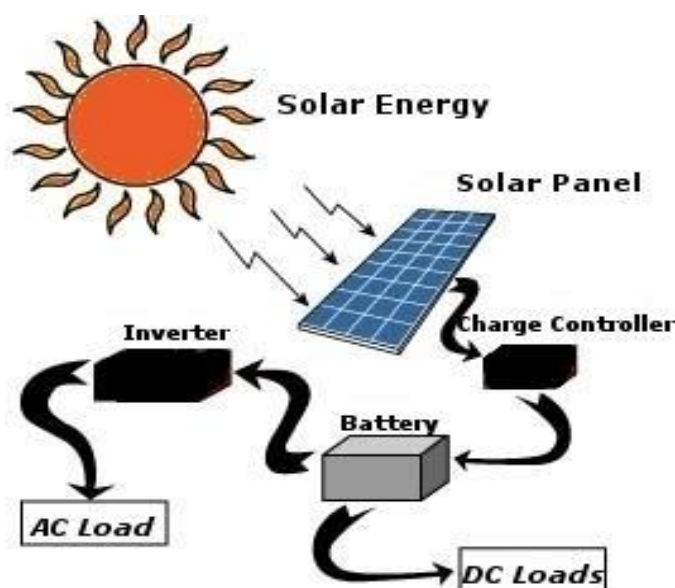


Figure 2 - Typical Solar Energy System

## Literature Review

Several people have performed research studies on energy efficient source for cooling and refrigeration.

**Yogesh Sunil Wanborikar, Abhay Sinha** studied that the renewable energy is vital for today's world as in near future the non renewable sources that we are using are going to get exhausted. The solar vehicle is a Step in

saving these non renewable sources of energy.

**Daut, M. Adzrie, M. Irwanto, P. Ibrahim, M. Fitra** investigated the design and construction of a direct current (DC) air conditioning system integrated with photovoltaic (PV) system which consists of PV panels, solar charger, inverter and batteries. how to design and construct the system with enough electrical energy supplied to it. With considering of these several

factors, it will help to improve the stability and efficiency of the system for greener solutions to the world's energy needs.

**E. Janotkova, M. Pavelek** presented new trends in the area of automobile air conditioning, which is fast becoming standard equipment. Their Attention is focused on the refrigerant and ventilation circuit of the air conditioning equipment, and on the control system.

A solar panel may be installed of the roof of the car. The generated electricity from solar panel is stored in the battery. This stored battery power is used to run the compressor of auto air conditioner with the help of electric motor. The compressor is not connected to the engine. Solar controller is attached between solar panels and battery for safety of battery.

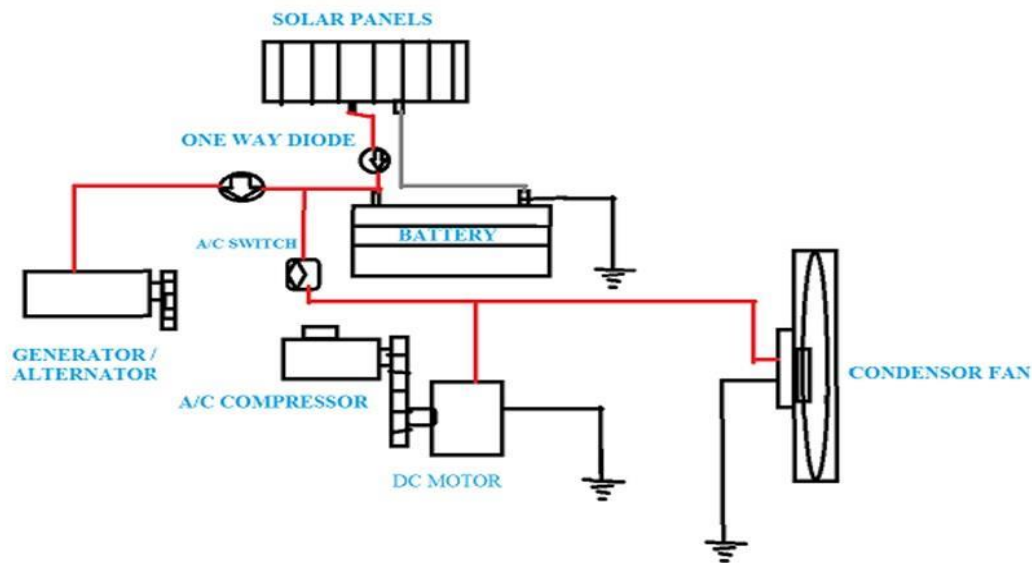
**Charles A. Lindgren** concluded that Inevitably at some point the weather will prevent the solar panels from gathering energy to use for the air conditioning. However, the solar panels will provide a source of energy, which will lessen the amount of fuel burned and reduce the output of greenhouse gases to the environment.

## Methodology

The subject components include a battery, or battery chain, charge controller and inverter. Because solar panels are generally not able to generate energy at night, a battery is needed for storage of the energy that is necessary at night-time or on cloudy days when the production from the panel is lessened or is non-existent. Deep cycle batteries are a good choice for this application because they are designed to be discharged to a greater percentage of their capacity. They are also able to deliver lower amperage levels for longer periods of time than other batteries, which is desirable for the consistent loads that would be expected.

The charge controller is also known as a voltage regulator and is included to protect the battery. When the battery is charged to its full capacity, the charge controller prevents the battery from being overcharged, which could decrease its expected lifetime or even cause an explosion.

The last component in this system is the inverter. The inverter takes the charge from the direct current (DC) output and turns it into alternating current (AC), which is the format present in household systems.



**Fig -3:** Circuit of Solar Operated Automobile AC System

## Specifications of Circuit Components

### Solar-Panel Specification

Type = polycrystalline silicon panel

Power = 100 Watt

Voltage = 24 V

A 20 ampere current rating solar charge controller is placed between panel and battery for the safety issues of battery.

Polycrystalline silicon panels are selected for this application, because this type of solar panel shows good cost to power ratio as compare to mono-crystalline and amorphous silicon panels.

Generally polycrystalline panel give an efficiency of 15%, but in this kind of

automobile application, angle between solar radiation and solar panel cannot be maintained ideally. And if a mechanism is made for variable sun tracking, then one should have to compromise with the aerodynamic shape of the vehicle.

That may cause little improvement and major harm to the vehicle performance. So panel should be placed as the vehicle aerodynamic shape.

Due to lack of possibility of ideal angle formation between sun rays and solar panels, panels may work with less effectiveness, so a lower photovoltaic efficiency of 13% is taken for this system design calculations.



**Fig -5: Swash Plate Type Compressor**

**Car's Roof And Hood Available Area  
(Maruti Suzuki WagonR)**

**Cost Comparative Analysis**

Solar operated auto air conditioner system is eco friendly as compare to the present engine driven AC system. Generally combustion of one litre of petrol emits 240 gm of carbon mono oxide, 2.5 kg of carbon Di oxide, 1 gm of hydro carbons, and 0.1 gm of nitrogen oxide. But for successful implementation of this system, it should be cost effective also.

So a cost comparison is made between the present system and solar operated system. Break even analysis (BEP) is made for this cost analysis.

i) The vehicle is run maximum 2 hours daily.

ii) Car takes complete day sunshine that may be during running or parking time.

iii) Car gives 20km/litre mileage without air conditioner work and 16km/litre with air conditioner work.

iv) Fuel price is 70 Rs/litre

v) A car runs nearly one lakh km in 10 years of life.

**Fuel saved value by solar air conditioner:**

As we have already assumed that, car gives the mileage of 20km/litre when car run without air conditioner operation and 16 km/litre with air conditioner operation.

$$\text{Fuel saved using solar energy} = \frac{x}{16} - \frac{x}{20} \text{ Litre}$$

Here x, is the distance travelled by the car with Air conditioner,

$$\text{Now, saving in Rupees} = 70 \times \left( \frac{x}{16} - \frac{x}{20} \right)$$

## CONCLUSION

Feasibility of the solar driven auto air conditioner is checked under different working conditions and following conclusions are determined through the appropriate calculations and practical consideration with reasonable assumptions:

- There is direct relation between solar energy and AC requirement i.e. more the sunshine more will be the requirement of cooling (say in summer) and less the sunshine less will be the requirement of cooling (say in winter or monsoon). This relation gives the major strength to this project feasibility.
- Air conditioner compressor can be run with the help of 230 V, AC motor of power 738 watt.
- Sufficient solar power to run the motor can be generated by installing a solar panel on the roof of the car. This solar energy can run the motor nearly 1 hour a day at peak load.
- Polycrystalline solar panel and lead acid battery are advised for such a system work. Because this combination makes a good compromise between cost and work performance.
- This solar operated Air conditioner system is both eco friendly and cost effective. It reduces the dependency of Air

conditioner on car engine i.e. air conditioner can be run without engine working like on red light etc.

- Extra solar energy can also be used for power the other car accessories like music system, light, 12 V car batteries etc.

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