



Solar Powered Electrical Appliances of Metro Train

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ABSTRACT

Transportation plays a key role in overall development of the Society both economically and socially. Metro is one of the Special Purpose Vehicle (SPV) created for the smooth implementation and operations of the Nagpur Metro Rail Project and is a joint venture of the Government of India and the Government of Maharashtra.

Nevertheless, it has many spills over effects such as traffic congestion, safety global warming and depletion of nonrenewable sources of energy. Electricity is required for the operation of the Metro system for running trains, station services (e.g., lighting, electrical appliances, signaling & telecom, firefighting etc..) workshops, depots & other maintenance infrastructure within premises of metro system. The power requirements of a metro system are determined by peak-hour demands of power for traction and auxiliary applications. Talking about a single Nagpur metro project, The Nagpur metro system is being designed to cater to crush load about 17000 passengers per direction during peak hours when trains are expected to run at 3.5 minutes intervals in 2041. On techno-economic consideration, it is recommended to adopt 25 KV single phase AC Traction.

Incidences of any power interruption, apart from affecting train running, will cause congestion at stations. Interruption of power at night is likely to cause alarm and increase risk to traveling public. Therefore, reliable and continuous power supply is mandatory for efficient metro operations. To ensure reliability of power supply, it is essential that both the sources of Supply and connected transmission & distribution networks are reliable and have adequate redundancies built in. It is desirable to obtain power supply at grid voltage of 220KV, 132 KV or 66kV from stable grid sub-stations and further transmission & distribution is done by the Metro Authority themselves.

INTRODUCTION

A metro train is a train that is specifically designed to run in metropolitan cities while local trains are designed to connect the distances within the city and its suburbs areas. The first subway system was proposed for London by Charles Pearson, a city solicitor, as part of a city-improvement plan shortly after the opening of the Thames Tunnel in 1843. Elattuvalapil Sreedharan is an Indian engineer, popularly known as the "Metro Man", He is credited with changing the face of public transport in India with his leadership in building the Konkan Railway and the Delhi Metro. Kolkata Metro Rail is the Oldest Metro Rail in India.

The most popular metro cities in India are Delhi metro, Hyderabad metro, Bengaluru metro, Chennai metro and now Nagpur metro also. All subways today are powered by electricity, usually from the same source that supplies power to homes and Industrial sector. The Metro Train runs on electricity and is therefore an eco-friendly urban transport mode. A large amount of electricity is required to run metro trains. The current monthly power requirement for the metro rail alone is around 65 lakh units (kWh) for the 56km operational network. Carrying out structural works related to uninterrupted power supply for Metro is a challenging task. In the near future, a large number of passengers will travel by metro, so it is important to provide a continuous power supply for 17 to 18 hours of metro service and related facilities. Due to this the large amount of electric power supply is contentiously consume by Metro rail which directly contributes in the load shedding problems in small towns and cities.

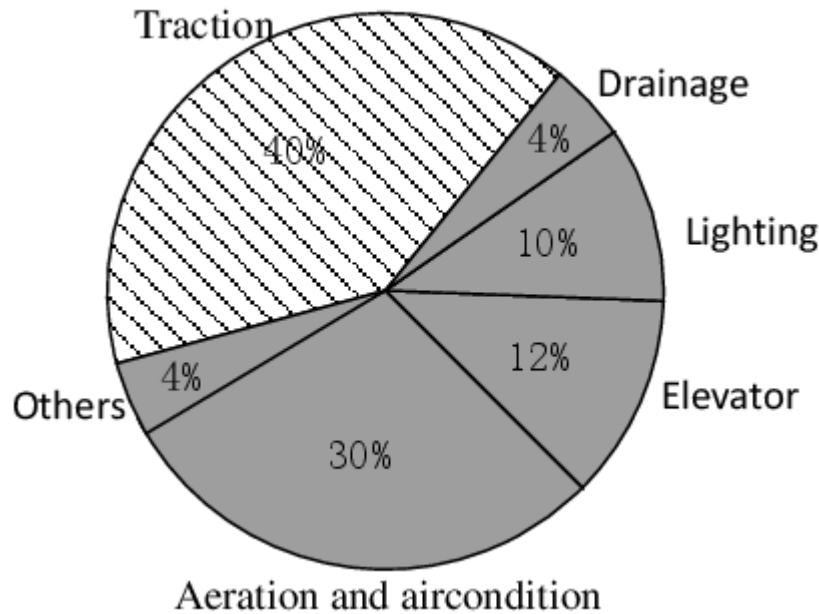
Design Objectives

The purpose of the project is to establish a trending and non-traditional concept of powering electrical appliances like (Air conditioning, lights, LED Screens, Audio Speaker, Fans, mobile charging port etc..) of metro train by Solar energy. The design permitted the minimal use of electricity consumable by the metro train. Concept tends the metro train to use electricity for its running purpose only.

Traditional Method Of Powering Electrical Appliances Of Metro Locomotive.

Currently the metro is continuously powered by overhanging traction Supply of 25KV. Metro consume this power supply for its running purpose form one place to another as well as the the all accessories mounted on its like electrical appliances and other facilities.

Considerable Electric power consumption of Metro for Various Purpose.



Consumption calculation

Energy consumption can be calculated as follows:

Let's calculate the power consumed by a 1.5-ton 5-star rated split a/c operated for 10hrs

Number of Units consumed = (Power consumed in kW) x Operation Hour.

Consider if 25 watt bulb is used for one hour it will be 25 watt hours. If it runs for 24 hours it will be 10000 watt hour .

10000watts = 10kw

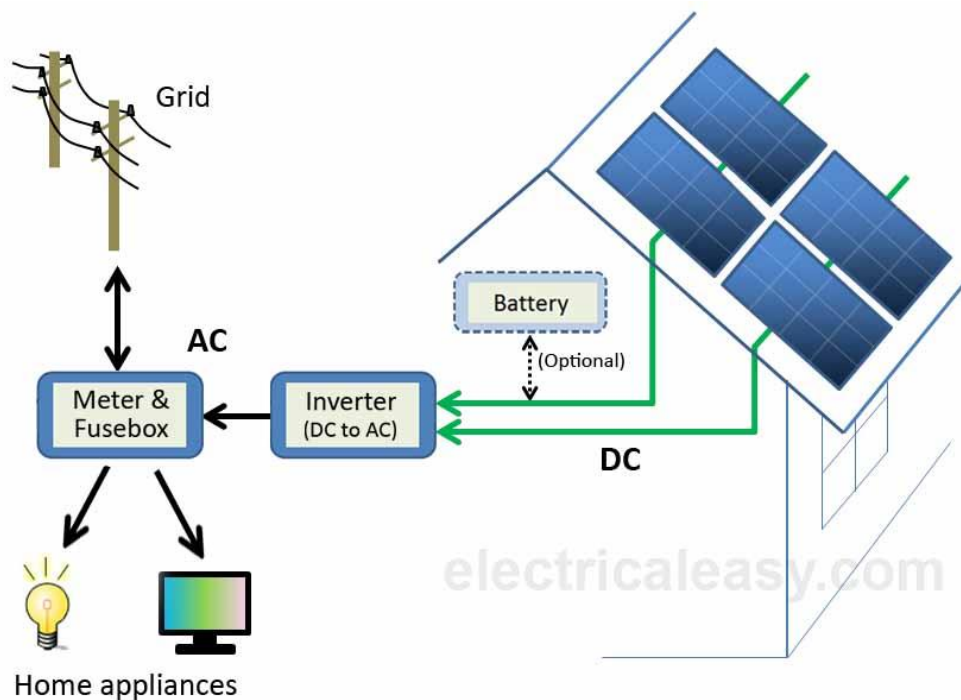
Hence 10000watt hour = 10kwh

1kwh = 10unit of electricity

Hence if the bulb runs for 24 hours it will consume 10 unit of electricity.

Construction and Working principle of Solar powering

Electrical energy can be harvested from solar power by means of either photovoltaic or concentrated solar power systems. Based on the principle of photovoltaic effect, solar cells or photovoltaic cells are made. They convert sunlight into direct current (DC) electricity. But, a single photovoltaic cell does not produce enough amount of electricity. Therefore, a number of photovoltaic cells are mounted on a supporting frame and are electrically connected to each other to form a photovoltaic module or solar panel. Commonly available solar panels range from several hundred watts (say 100 watts) up to few kilowatts (ever heard of a 5kW solar panel?). They are available in different sizes and different price ranges. Solar panels or modules are designed to supply electric power at a certain voltage (say 12v), but the current they produce is directly dependent on the incident light. As of now it is clear that photovoltaic modules produce DC electricity. But, for most of the times we require AC power and, hence, solar power system consists of an inverter too.



Concept Evaluation

Does this system will work in night time and Winter Solstice ?

Basically in this concept the main component is solar panel and Solar cell , we are using the mono-crystalline solar panels which posses high efficiency of energy conversion and highly sensitive in nature which sense the low amount of sun light very fastly and covey it for further process rapidly . Even while providing electricity to appliances it charges the solar Photovoltaic cell also, which we can use in night time and again in day with presence of sunlight the cell will get charge.

When the sun shines onto a solar panel, energy from the sunlight is absorbed by the PV cells in the panel. This energy creates electrical charges that move in response to an internal electrical field in the cell, causing electricity to flow. This cell helps solar contribute to the electricity supply even when the sun isn't shining. It can also help smooth out variations in how solar energy flows on the grid. These variations are attributable to changes in the amount of sunlight that shines onto [photovoltaic \(PV\)](#) panels or [concentrating solar power](#) systems. Solar energy production can be affected by season, time of day, clouds, dust, haze, or obstructions like shadows, rain, snow, and dirt. Sometimes energy storage is co-located with, or placed next to, a solar energy system, and sometimes the storage system stands alone, but in either configuration, it can help more effectively integrate solar into the energy landscape.

Advantages

- A truly renewable energy source.
- Significantly reduces High electric energy consumption by metro.
- Setup is Cheap and easy to install (and getting cheaper all the time)
- Improves your energy security and independence.
- It helps your green credentials and CSR.
- It's very well suited to batteries and the electricity grid.
- The concept is technologically versatility.
- System is silent and space-saving.
- Reduced dependence on foreign oil and fossil fuels.
- Less global warming.
- All the systems and equipment are easily available and can be easily install.

- Minimal maintenance required.
- Increased monetary saving of railways treasury.

Summery

In today's costly world "Solar Powered Electrical Appliances of Metro Train" is one of the conceptual project which tends us to use freely available solar energy . project is basically a new way of powering the appliances of metro train by free renewable source of Solar energy which will directly give a good impact on consumption and saving of Electrical energy.

Powering the appliances of Metro train by solar is great concept which brings new tradition and advancement in transportation facility with considering all comfort of passengers and helps our rail ministry of India to save electricity, which indirectly gives possessive result for saving economy of our country and development.

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