

## **SOLAR ENERGY APPLICATIONS VIABLE IN PAKISTAN**

Considering the solar energy potential in Pakistan, it is envisaged that most of the solar energy applications that are being used around the world are very much practical in the country.

### **Photovoltaic (PV)**

Photovoltaics is the conversion of light into electricity using semiconducting materials that exhibit the photovoltaic effect. The photovoltaic effect is commercially utilized for electricity generation and as photo sensors.

A single PV device is known as a cell. An individual PV cell is usually small, typically producing about 1 or 2 watts of power. PV Cells are connected together in chains to form larger units known as modules or panels. Several modules can be connected together to form an array which can be connected to electrical grid through inverters. Photovoltaic (PV) is the main stream and greatly deployed technology from solar energy technologies. The total global solar PV installed cumulative capacity has reached to 773 GW. Solar PV accounted for 3.1% of global electricity generation, and it remains the third-largest renewable electricity technology behind hydropower and onshore wind.

The Government of Pakistan (GoP) is very interested in developing solar energy projects in the country. At present a total of six (06) solar PV power projects with cumulative capacity of 430 MW are commissioned and are supplying electricity to the national grid. Four (04) solar PV power projects with cumulative capacity of 250 MW are under construction and many more solar PV power projects are in pipeline.

Recent advancement in the solar PV technology and cost reduction has made solar PV as the most economical option for electricity generation. Considering this GoP is envisaging to develop more than 7000MW solar PV projects in next 8 years (reference IGCEP 2021).

### **OFF-GRID APPLICATIONS OF SOLAR PHOTOVOLTAIC (PV)**

Solar Photovoltaic Technologies can be deployed for various off-grid applications as given below:

#### **Solar street lighting**

Street lighting shares around 350 MW of total electricity consumption of the country. It is anticipated that this load would reach to around 500MW in coming days due to new installations in planning and design stages. All such load can be shifted to solar energy. Solar Street Lighting Systems powered through Solar PV modules can meet with this load. The development authorities in the country are exploring the opportunities of this shift. Their planning departments are currently working out prospects for making all new installations of street lighting through solar energy applications.

#### **Commercial Lighting (Bill Board Lighting, Search Lighting, garden lighting etc.)**

Commercial lighting load is increasing as the life style of the people is changing. The provincial and city governments are planning to shift all this much load to solar energy. This renders a potential of around 10 MW for solar PV modules in coming days.

#### **Solar Water Pumping**

The irrigation system in most of the Arid Agricultural Areas is either dependent upon rain or water pumps. This load accounts for more than 1,000 MW Currently, these pumps are either operated through grid or through diesel generators. The federal and provincial governments are planning to shift this load to solar energy. Efficient solar energy water pumps are available in the market. The companies that are supplying pumps can be contacted for supply of PV modules.

## **Rural Electrification**

Under Roshan Pakistan Program and Parliamentarian Schemes for Rural Electrification, more than 8,000 villages have been electrified through renewable energy technologies. A big share out of which would be done through solar home systems powered through solar PV modules. Further, all the provincial governments are also developing off-grid village electrification schemes using solar PV technology.

## **Captive Power Generation through Solar PV Application**

Government has allowed captive power generation through renewable energies. In this regard, no license or approval from any governmental authority is required. If found economically suitable, then solar PV module can be the best choice for this purpose. It is anticipated that if 100,000 households opt for captive power generation through solar PV modules than this can account for 30 MW requirement for solar PV modules in near future.

## **ON-GRID APPLICATIONS OF SOLAR PHOTOVOLTAIC (PV)**

As like off-grid applications, Solar Photovoltaic Technologies have definite prospects for various on-grid applications. A few of them are discussed below:

### **Commercial Power Projects**

A huge acreage of land is lying barren in different parts of the country. The areas that are located in most potential areas and where grid is also available, photovoltaic technologies can be deployed for on-grid power generation project. Grid tied power projects of various capacities can be installed in various parts of the country. A total of six (06) utility scale solar PV power projects having cumulative capacity of 430 MW are operational and supplying electricity to National grid. Further, four (04) solar PV power projects with cumulative capacity of 250 MW are under construction and many more solar PV power projects are in pipeline.

### **Net Metering Projects**

Government of Pakistan allows the opportunity for net metering to the households, commercial and industrial entities. Under such mechanism a small power producer establishes a power producing facility at its premises. The power generated through this facility is sold to the national grid. In the same time the individual acts like the user as well and purchases the power from the grid. At the end of the month, the individual is liable to net meter his actual consumption and total power generation through his / her facility. The individual is liable to pay or to be paid the difference of amounts calculated through aforesaid mechanisms. All public and private stakeholders are taking part to promote net metering in the country. The distribution companies take part to better manage their peak electricity loads with net metering and few are taking lead in this regard.

Until today more than 20,000 domestic, commercial and industrial net metering customers have successfully availed the opportunity in all over the country with approximately capacity of more than 400 MW i.e. added to the national grid through this concept. The demand of net metering customers is increasing day by day. Solar energy would be having the maximum prospects and would see its maximum market share with the concept of net metering.

### **Solar Thermal – Electric**

Solar thermal technologies collect the sun's radiant energy to create a high-temperature at the source that can be converted into electricity via a number of thermodynamic conversion cycles. Though solar thermal generation system is a proven technology in the USA, Germany and France where such systems have been providing electricity to grid systems on a competitive basis with conventional fossil fuel-fired thermal power plants. At present there is no solar thermal power project in

Pakistan. However, GoP is interested to develop such projects in Pakistan under ARE Policy 2019.

### **Solar Water Heaters**

According to a Household Energy Survey Study (HESS) Project conducted by the Planning Commission in 1991, water heating in the domestic sector is estimated to have consumed about 145,600 TOE of natural gas. Companies in Pakistan manufacture these devices commercially. This amount of energy and corresponding emissions will be saved for every solar water heater that is installed. The initial investment cost of manufacturing solar water heaters will be higher than that of the natural gas and electric water heaters already available in the market. Consumers experience 20-30% higher prices when they choose a solar water heater instead of a conventional water heater. However, by replacing conventional water heaters with solar water heating systems, significant amount of natural gas will be saved annually. The cumulative potential of GHG emission reduction of the solar water heater option has been projected as 4.10 million tons of CO<sub>2</sub> by 2023. The saving in emissions will arise from reduced natural gas consumption for water heating in the domestic sector.