



AREA REQUIRED FOR THE PV ARRAY TO POWER BTS TOWERS Ver 2.0

Finding enough area inside the fence to install the PV Array for Off-Grid BTS Towers can be challenging. In some locations it became common practice to limit the fenced-in space to 15 x 15 meters or even 12 x 12 meters. We have seen sites as small as 10 x 10 meters. In order to use Solar as opposed to Diesel Generators, or to increase the amount of Solar in a Hybrid PV/DG system, the team responsible for the Design or the Installation of the Energy Systems has to get creative.

The smaller BTS sites need about 1.5kW and the sites with multiple tenants need several times that. The table below shows the results for BTS Loads up to 2.0kW for Pure Solar systems. One can start at the left side with the known amount of Area available for the solar array, or at the right side with the known amount of power needed for the BTS Load. The point is that the PV Array requires shade-free space and in Sub-Saharan African, the latitude is so low that the trigonometry does not save significant real estate.

APOLLO SOLAR - PURE SOLAR LOAD WATTS FOR SQUARE METER AVAILABLE AREA FOR PV ARRAY						
MINIMUM REAL ESTATE AVAILABLE IN SQ METERS	PV ARRAY LAYOUT IN METERS	*NUMBER OF PV MODULES	PV MODULE LAYOUT OPTIONS	PV watts WITH 370 WATT MODULES	NUMBER OF T80HV _s IF PURE SOLAR	LOAD WATTS IF POWERED BY PURE SOLAR
96	6 X 16m or 12 X 8m	48	3 X 16 or 6 X 8	17,760	4	2,000
90	6 X 15m or 3 X 30m	45	3 X 15	16,650	4	1,875
84	6 X 14m or 12 X 7m	42	3 X 14 or 6 X 7	15,540	4	1,750
78	6 X 13m or 2 x 26m	39	3 X 13	14,430	4	1,625
72	6 X 12m or 12 x 6m	36	3 X 12 or 6 X 6	13,320	3	1,500
66	6 x 11m or 3 x 22m	33	3 X 11	12,210	3	1,375
60	6 x 10m or 12 x 5m	30	3 X 10 or 6 X 5	11,100	3	1,250
54	6 x 9m or 3 x 18m	27	3 X 9	9,990	3	1,125
48	6 x 8m or 12 x 4m	24	3 X 8 or 6 X 4	8,880	2	1,000
42	6 x 7m or 3 x 14m	21	3 X 7	7,770	2	875
36	6 x 6m or 3 x 12m	18	3 X 6 or 9 x 2	6,660	2	750
30	6 x 5m or 3 X 10m	15	3 X 5	5,550	2	625
24	6 x 4m or 3 x 8m	12	3 X 4 or 6 x 2	4,440	1	500
18	6 x 3m or 3 x 6m	9	3 X 3	3,330	1	375
12	6 x 2m or 3 x 4m	6	3 X 2	2,220	1	250
6	6 x 1m or 3 x 2m	3	3 X 1	1,110	1	125

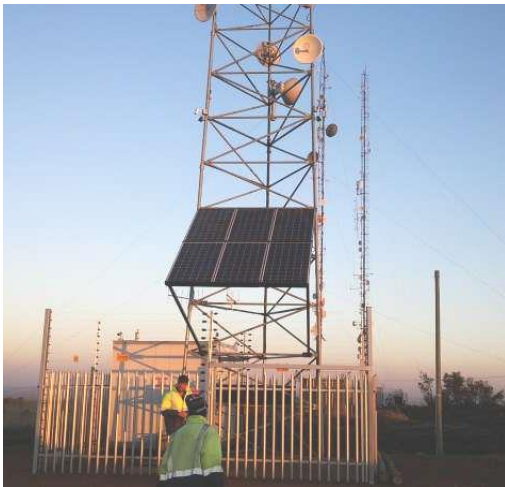
***Note, the actual number may vary depending on the Irradiance in your area.**

If we cannot find enough space inside the fence for a simple Pure Solar system, we have the following 3 choices:

1. Use a Hybrid System where a Diesel Generator makes up the difference.
2. Negotiate a lease for additional space to expand the fence. The additional cost may be less than the alternative costs which include the diesel generator, the fuel, the transport of the fuel and the frequent theft of fuel. Remember the solar energy itself is free.
3. Install the solar modules on the tower itself as shown in the following pages.



1) This site simply lifts the PV Array as high as possible above the shelter and other equipment inside the fence. This way, the only two things requiring space on the ground inside the fence are the PV array and the tower itself.



2) Here is an elegant alternative:

This site uses the tower to mount the PV Array. The top edge of the Array uses a hinge mounted to the tower and the bottom is simply pushed up and out with the struts we see in the photo. The bottom edge of the array could hang out in the air-space over the fence unless the landlord complains.

Multiple tiers can be used and the arrays can extend beyond either side of the tower. Even the East and West sides of the tower can be used when near the Equator.



3) This is one form of ultimate solution to avoid shadows near the equator. The PV Array is mounted at the very top of the tower. There are 20 PV modules. The telecom antennas and microwave backhaul dishes are below the PV array.



4) This PV Array is hung from the tower by a hinge at the top edge of the array. Then the bottom will be pushed out with struts to the proper tilt angle.

There are 24 modules in this array which is about 12 square meters.

We can see how this array is wider than the tower and hangs over each side of the tower.

Such a large array may not be appropriate at lower latitudes where the tilt angle would cause the array to be cantilevered far from the tower. See example 7 below for a better suggestion using multiple tiers.



5) A tiny version shows a simple 2 module array off the sides of a tower. This would work at, or near the Equator, but many more PV modules will be required.



6) This is a guyed pole antenna, and the PV Array is mounted to the pole in 2 tiers with 6 modules per tier. In this case they are above the trees to avoid shade.



7) This photo taken from below shows the PV Arrays at 3 different levels. The frames extend beyond the sides of the tower.



8) This is the ultimate example of mounting PV modules on a tower. There are 5 groups of 6 PV modules mounted at different levels for a total of 30 modules. From the angle of the modules we can guess that the tower is located at above 30 degrees North Latitude, but the principal is the same at any latitude.

In Sub-Saharan Africa the bottom of the modules would be pushed out so the tilt angle is about 15 degrees from horizontal facing South.

It may be necessary to split the array with half on the East and half on the West side to avoid shade during the winter months if the location is between the Tropic of Cancer and the Tropic of Capricorn.

The bottom line is that solar is FREE energy. It is worth some work to harvest it.