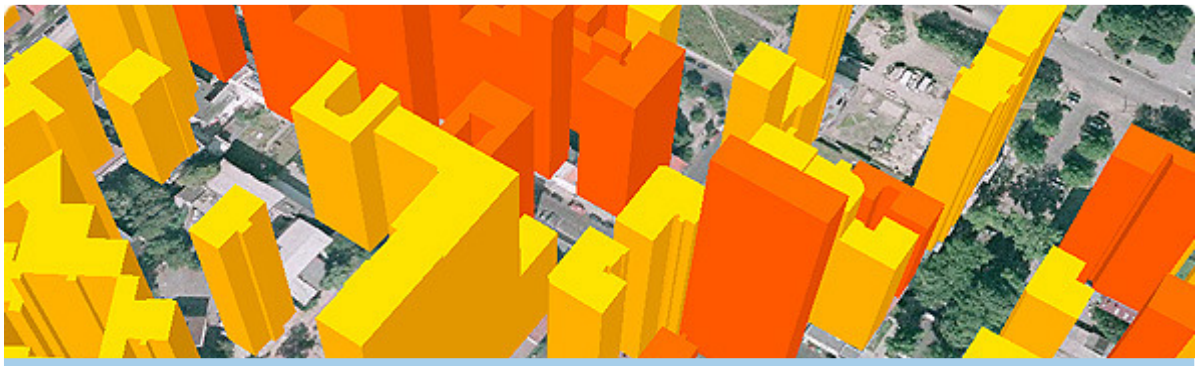
Berlin Business Location Center



Solar Atlas Berlin – Data Documentation

FACTORS STUDIED AT THE LOCATIONS

In calculating the solar potential using the SUN AREA method, the following parameters were determined for each rooftop within the project area (19 km²):

- Inclination
- Orientation
- Shadows cast
- Size of the area
- Global irradiance

Shadows cast:

In analyzing the factor of shadows cast, those shadows were taken into account that are cast under direct irradiance of the sun during the entire year, to the exception of the period from December 15th until January 15th, when the angle between the sun and the horizon is 15°. Trees, neighboring buildings or roof structures will cast shadows across rooftops; these overshadowed areas were classified as unsuitable areas of the rooftops and were not included in the calculation.

Size of the area:

In order to operate solar cell systems in an economically viable manner, an area of at least 15 m² (inclined rooftops) is required as the module area. For solar heating facilities, a minimum size of the area of 5 m² (inclined rooftop) was used as a basis. Because the modules must be mounted on supports if they are to be located on flat roofs, the area must have a size of at least 45 m² for use by solar cell systems, and 15 m² for solar heating facilities. The size cited for the module areas for flat roofs has already taken into account the need to mount the systems on supports; in

other words, the actually suitable size of a rooftop was multiplied by a factor of 0.4 in order to calculate the size of the module area. Flat roofs are assessed across the board as “well suited” for such systems.

Global irradiance:
The value for global irradiance given for Berlin is used as a basis, averaged over 20 years, as the irradiance hits a horizontal plane (1,000 kWh/a). For each rooftop, the factual irradiance is calculated.
Areas suitable for solar cell systems are identified in the atlas as having an irradiance ratio upwards of 75%.
Areas suitable for solar heating facilities are identified in the atlas as having an irradiance ratio upwards of 70%.

DATA BASE

The data used as a basis for the calculations were gained from two sources: the building floor plans as given in the automated property map for Berlin (ALK), in order to ensure that official data were being used, and high-resolution data obtained from aerial laser scanners flown over Berlin in 2007 (4 dots per m^2 of the grid).

CALCULATION PARAMETERS

Degree of efficiency of the solar cell modules:
In order to calculate the potential power yield, two different efficiencies of solar cell modules were assumed, one at 15% and the other at 12%. In the information system, the results to be expected from systems with an efficiency of 15% were visualized.

CO_2 emissions reduction:
The calculation is based on the average CO_2 equivalent value given in all of the Federal Republic of Germany, of 0.624 kg/kWh (Source: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2007). The results obtained in calculating the power yield form the basis for the potential CO_2 reduction. In the information system, the reduced emissions to be expected for systems with an efficiency of 15% were visualized.

KW capacity:
The kilowatt capacity designated as the nominal capacity of solar cell systems was defined as 7m² per KW. In the information system, the kilowatt capacity to be expected for systems with an efficiency of 15% was visualized.

Investment volume:
The cost factor on which the calculations were based was defined as € 3,500 per KW. This corresponds to the average expected investment volume given at the time at which the calculations were done.

RESULTS

The results show all of the buildings that are well suited, in terms of the above location factors, for the installation of solar cell systems and/or solar heating facilities.

Solar cell systems:
Areas on rooftops suited for solar cell systems have a solar potential of 100% to 75% of irradiation energy, will be at least 15 m² (inclined rooftops) or 45 m² (flat roofs) in size and will not have any shadows cast over them. In all cases, the sizes given for the module area on flat roofs in the results data have already taken account of the fact that the modules must be mounted on supports (rooftop size multiplied by 0.4).

Solar heating systems:
Rooftop areas suited for solar heating facilities have a solar potential of 100% to 70% of irradiation energy, will be at least 5 m² (inclined rooftops) or 15 m² (flat roofs) in size and will not have any shadows cast over them.

Classification by suitability:
- Excellently suited, > 95% of the irradiation energy potentially available in Berlin
- Well suited, 80 - 95% of the irradiation energy potentially available in Berlin
- Suitable subject to restrictions, 75 - 80% of the irradiation energy potentially available in Berlin

Information on the features:

The field names and explanations regarding entries in the features data base have been set out below.

The optimum angle at which a thermal solar cell system should be mounted depends on its primary use. Steeper inclinations are not detrimental for solar heating facilities; in fact, this will achieve a higher yield especially during the colder periods of the year (when the sun is low) and during the heating period. It is not possible to make any more differentiated statement regarding the suitability of areas for use by solar heating facilities since this depends on the primary use. All of the areas included in the atlas have been classified, across the board, as “suitable” for solar heating facilities.

RESULT OF THE CALCULATIONS

The following statistics evaluate the calculations done for the regions of Berlin forming part of the model:

Project area “Friedrichstrasse” (10 km²)

5,837 buildings are located in the project area “Friedrichstrasse”.

Of these 5,837 buildings, 3,345 are suitable for use by solar cell systems and have the following solar potential:

Table 1: Results of the solar potential analysis for Berlin Friedrichstrasse

Suitability	Solar cell module areas in m^2	Power yield in MWh/a (at an efficiency of 15%)	CO_2 emissions reduction in kg (at an efficiency of 15%)	Investment volume in €
Excellent	124,742	16,202	10,109,843	62,371,390
Good	438,717	56,097	35,004,740	219,358,736
Subject to restrictions	4,939	509	317,898	2,469,737
Total	**568,399**	**72,808**	**45,432,482**	**284,199,864**

1,939 of the buildings with flat roofs are suited for use by solar cell systems having a cumulative module area size of 281,783 m². 3,926 of the buildings are suited for use by solar cell systems; their cumulative rooftop area is 710,212 m².

The values set out in Table 1 may be retrieved from the 2D information system for each individual building.

Project area "Lichterfelde" (9 km²)

There are 8,515 buildings in the area "Lichterfelde".

Of these 8,515 buildings, 3,657 are suitable for use by solar cell systems and have the following solar potential:

Table 2: Results of the solar potential analysis for Berlin Lichterfelde

Suitability	Solar cell module areas in m^2	Power yield in MWh/a (at an efficiency of 15%)	CO_2 emissions reduction in kg (at an efficiency of 15%)	Investment volume in €
Excellent	61,482	7,929	4,947,835	30,741,322
Good	214,393	27,185	16,963,798	107,196,673
Subject to restrictions	2,797	289	180,794	1,398,936
Total	**278,673**	**35,404**	**22,092,428**	**139,336,931**

1,436 of the buildings with flat roofs are suited for use by solar cell systems having a cumulative module area size of 120,367 m².
4,958 of the buildings are suited for use by solar cell systems; their cumulative rooftop area is 369,624 m².

The values set out in Table 2 may be retrieved from the 2D information system for each individual building.

Source:
SUN-AREA
Status as per September 9th, 2009