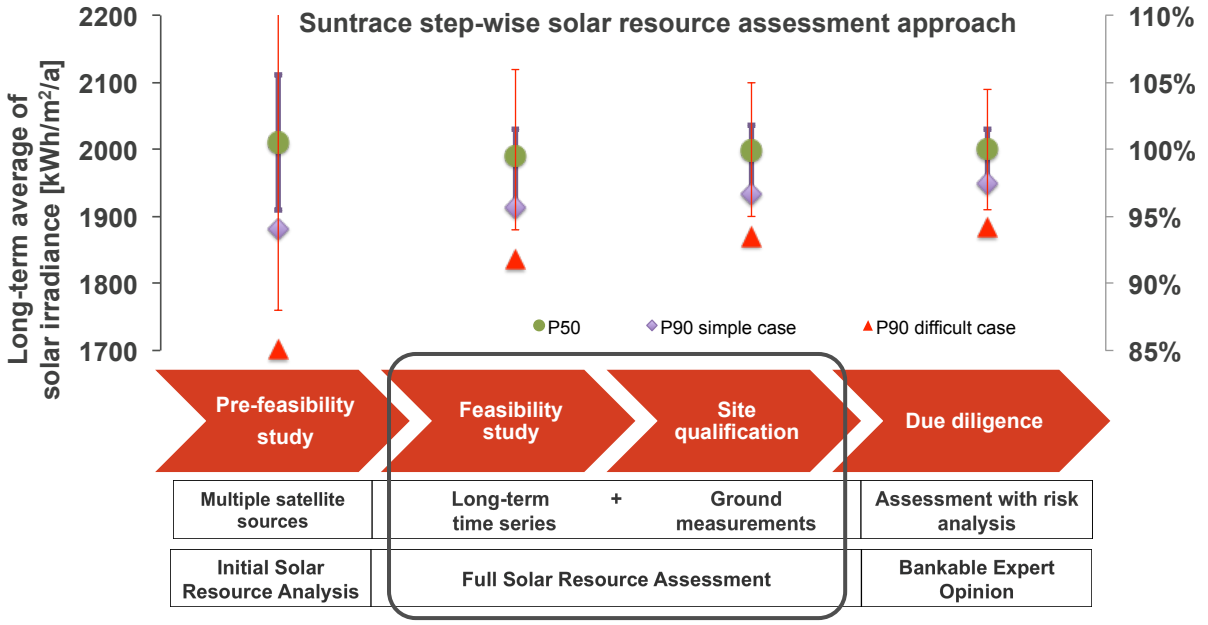
Full Solar Resource Assessment
for feasibility studies

Sites that are promising for large-scale solar energy facilities need to be investigated in detail with respect to solar radiation to check their feasibility for realization. Quality of solar radiation data at this phase of project development should be strongly improved compared to initial estimates. Engineering and financing tasks require detailed data sets at least in hourly time resolution, which are representative of the location. Our service **Full Solar Resource Assessment** provides detailed site-specific analysis of solar radiation based on time-series analysis to characterize the intensity and typical variability of solar radiation along with other auxiliary meteorological values at a site.



Analysis is done progressively in greater depth with each step, resulting in reduced uncertainty of solar radiation.

Full Solar Resource Assessments aim to get accurate long-term averages of the Global Horizontal Irradiance (GHI) for Photovoltaics (PV) projects or Direct Normal Irradiance (DNI) for Concentrating Solar Power (CSP) projects like solar thermal power plants and Concentrating PV (CPV). These long-term annual averages – P50 values –, represent the values that are expected to be exceeded in 50 % of the cases. Usually tasks of engineering such as suitable site-specific power plant layout and first financial assumptions are based on a data set called Typical Meteorological Year (TMY), which should closely represent P50 values. Thus, the main aim of such an assessment is to create a TMY data set. This TMY should also include auxiliary meteorological parameters like ambient temperature, humidity, wind speed and wind direction, which are relevant parameters for site-specific engineering and yield estimation.

Ideally at this stage on-site measurements should be already available, which (if available) are considered in our analysis for improvement of satellite-derived data sets. If no ground measurements are available at the site or if duration of measurements is less than 6 months, we consider nearby measurements. Usually such measurements also have more precise auxiliary meteorological data and could make TMY data more realistic.

TMYs that are based only on satellite data may have significantly different characteristics than those based on ground-measured data. Due to their inherent characteristics, satellite-derived solar radiation data (especially DNI) generally differ from ground-measured solar radiation data with respect to the occurrence of instantaneous values, averaged values, frequency distribution and representativity. Adjustment of satellite-derived solar radiation data to ground-measured data can help reducing such differences. Suntrace has developed methods like Schumann et al. (2011)[1] and

[1] Schumann, K., Beyer, H.G., Chhatbar, K., Meyer, R. 2011. Improving satellite-derived solar resource analysis with parallel ground-based measurements. Proc. of the ISES Solar World Congress, Aug. 30 - Sep. 1, 2011, Kassel, Germany.

Mieslinger et al. (2014)[2] for adjustment of satellite-derived data to ground-measured data. Hereby, we combine the higher precision of ground-based measurements with the long temporal coverage of satellite-derived datasets. These methods allow the adjustment of the satellite dataset to the ground dataset, even though the temporal overlap between the two datasets is generally one year.. The advantage of using Mieslinger et al. (2014)[2] is that the bias of resulting adjusted-satellite-derived data with respect to ground-measured data tends to be almost zero. Depending on the region, the duration and quality of the satellite-derived and ground-measured data, the uncertainty of long-term averages can be reduced below 5% for DNI and below 4% for GHI by using this adjustment method.

TMYs are created from the adjusted satellite-derived solar radiation data following the method of Hoyer-Klick et al. (2009)[3]. Our TMYs represent the long-term monthly average of solar radiation as close as possible. One of the main features of our TMYs is that they represent a realistic frequency distribution of solar radiation, which is an important factor in designing solar power plants especially solar thermal power plants.

Scope

- analysis of ground-measured data (if available) and quality checks using proprietary Quality Control algorithms,
- recommendation and processing of order for site specific satellite data (> 10 years) from third party in at least hourly time resolution,
- analysis of satellite-derived data from third party and ground-measured data (if available),
- inter-comparison of meteorological measurements (if available) with overlapping satellite-based time-series,
- adjustment of satellite-derived data to ground-based measurements following the method of Mieslinger et al.(2014)[2] to minimize the bias with measurements,
- analysis and improvement of solar radiation frequency distribution (annual duration curves),
- determination of long-term annual average (P50 value) of solar radiation expected at the site,
- estimation of uncertainty of the long-term annual average of solar radiation,
- determination of inter-annual variability of solar radiation,
- determination of typical annual cycle of solar radiation.

Deliverables

- Report (minimum 20 pages) summarizing the main results,
- 1 TMY data set (P50 case) representing long-term annual average conditions in 60 minutes time resolution.
- optional: 1 Meteorological Year (MY) data set representing P70 or P90 case, expected due to the uncertainty of solar radiation determined for the specific site,
- optional: 1 MY data set representing P70 or P90 case, expected due to the uncertainty **and** inter-annual variability of solar radiation determined for the specific site,
- optional: multiple year data set from the site-specific adjusted satellite data covering at least 10 years

Such analysis and data are typically used in project feasibility stage for site-specific engineering, optimization of plant layout towards high yields and preliminary financial calculations. Analysis and reporting does not cover the level of detail recommended for reaching financial close. For a more detailed assessment an “Expert Opinion on Solar Resource and Meteorological Data for Due Diligence of Solar Power Projects” should be ordered. For description of our Pre-feasibility Studies, Solar Energy Specific Meteorological Stations and Bankable Expert Opinions, please contact us at meteo@suntrace.de or +49 – 40 767 9638-0.

[2] Mieslinger, T., Chhatbar, K., Ament, F & Meyer, R. 2014. A New Method for Fusion of Measured and Model-derived Solar Radiation Time-series. Energy Procedia, Vol. 48, Pages 1617-1626.
[3] Hoyer, Carsten, Fred Hustig, Marko Schwandt, and Richard Meyer. 2009. ‘Characteristic Meteorological Years from Ground and Satellite Data’. In Proceedings of SolarPACES 2009. Berlin, Germany.