PVcase

RAY TRACING TECHNOLOGY

OBJECTIVE:

Explore how 3D ray-tracing based yield simulation technology can improve the accuracy of PV project modeling. Learn how it differs from traditional 2D view factor-based modeling especially when assessing plants with terrain following technology and bifacial models.

METHODS:

Ray tracing is a lighting simulation technique that relies on following individual light rays between the sky and the solar cell surfaces, taking interactions with the detailed 3D scene into account.

RESULTS:

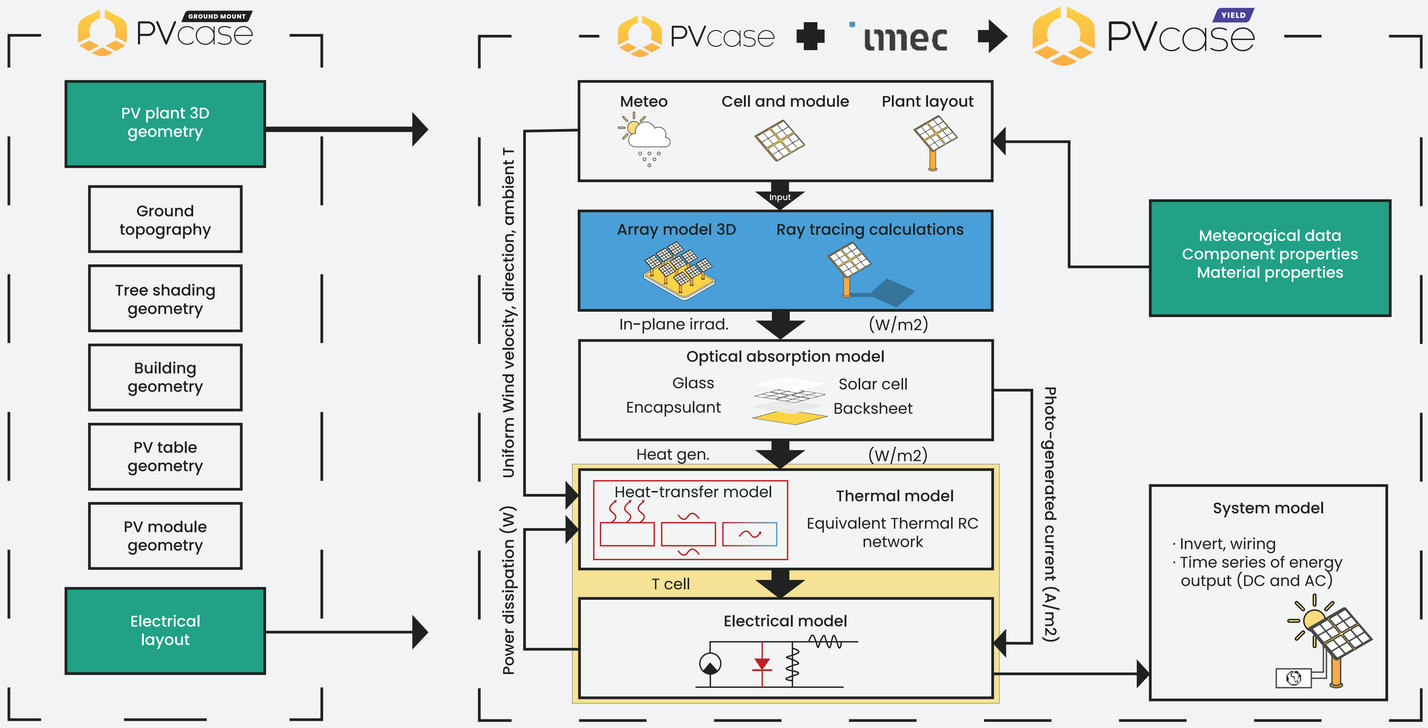
Ray-tracing based yield simulations take into account hilly terrain without limitations, speed is unaffected by geometry complexity, and is capable of taking in 3D models as provided by designers.

CONCLUSION:

Applying ray-tracing technology to yield simulation tools will revolutionize the way the industry solar projects by increasing the speed and accuracy of models. This improved information will serve all stakeholders from asset owners, financiers, technical advisors, and developers.

PVCASE AND IMEC:

PVcase Yield, a cloud-based solar energy modeling software, was co-developed with imec's R&D expertise in physics-based PV energy yield simulation. The model provides solar engineers and developers, the estimated performance of PV plants, which can then be used to optimize and influence their designs. The end result is higher quality designs and yield predictions that solar investors can be confident in relying on when evaluating PV assets or their economic potential



RAY TRACING EXPLAINED:

Ray tracing is a lighting simulation technique that relies on following individual light rays between the sky and the solar cell surfaces, taking interactions with the detailed 3D scene into account.

Ray tracing helps simulate how different aspects of a 3D PV plant model affect energy generation. Some examples:

- how localized shading leads to non-uniform string illumination and electrical mismatch losses;
- how a terrain-following frame placement leads to varied module orientation and row-to-row shading;
- how the combination of frame geometry, sun position and ground albedo impacts bifacial performance.

AVAILABLE ILLUMINATION MODELS IN PV SIMULATION SOFTWARE	
2D VIEW FACTOR-BASED	**3D RAY TRACING-BASED**
Loss of information: 3D layout is reduced to 2D	3D layout is simulated as provided
Not applicable for sites with hilly terrain	Takes hilly terrain into account without limitation
Computation time highly sensitive to geometry complexity	Computation time unaffected by geometry complexity
Limited to simple isotropic surface reflection models	Can incorporate a large variety of surface reflection models