

Financing Projects with Bifacial Modules

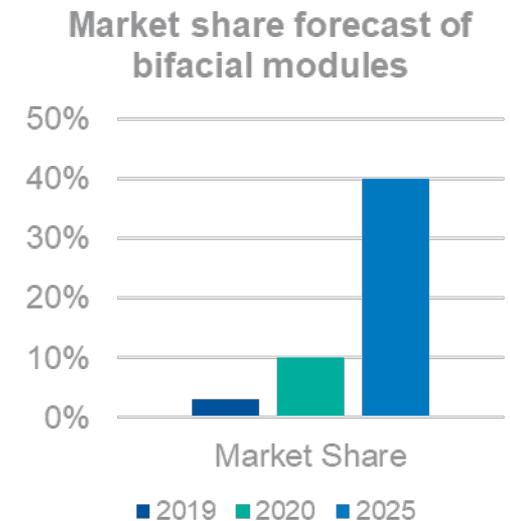
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European Bank
for Reconstruction and Development

Bifacials?

- Bi-facials modules is not a new technology, however, the pick-up rate has been slow due to cost and availability.
- The manufacturing process for bi-facial modules has become mature and cheap, and the products are now commercially available in large volumes.
- BNEF estimate the market share to grow rapidly to 40% in 2025.
- Dry desert environment is very suitable for bi-facial modules, with the right technology energy yield and higher EPC performance ratio is expected for almost the same budget as mono facial modules.



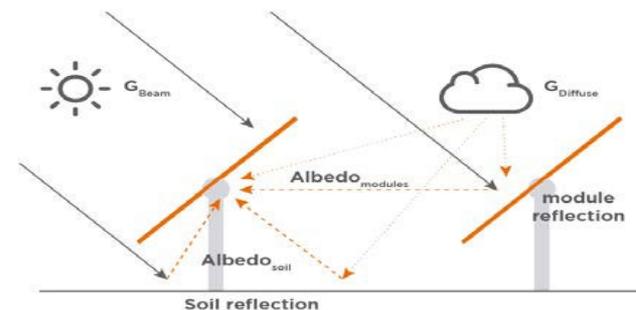
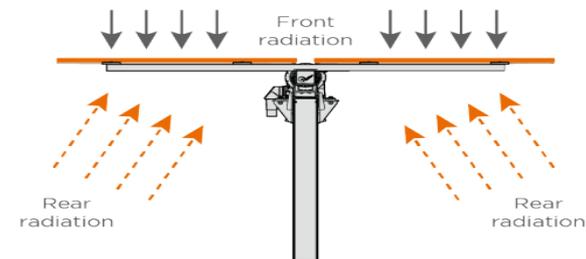
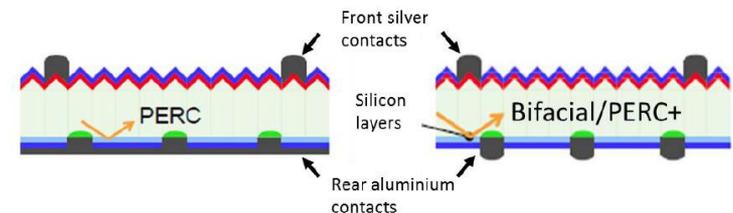
Source: Bloomberg New Energy Finance

Bifacials?



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- Unlike traditional PV modules, bifacial modules are capable of producing energy from irradiance received on both the front and back-side of the PV modules. This is made possible through evolution of the method in which the back-side contacts are implemented.
- Moving from an Aluminium layer to an Aluminium Grid exposes the rear side of the PV cell to irradiance from the sun. otherwise, the cell structure is identical to a monofacial module.
- Unlike the frontside which generates energy from the beam and diffused components, the energy generated from the backside predominantly relies on reflected radiation from the ground and adjacent modules.
- On that basis, the key driver of bifacial performance is related to the sub-structure design and surface conditions.



- **Module Bifaciality.** Ratio of the back-side rating relative to the front-side rating of the module. Typically around 75% for commercially competitive modules based on PERC technology.
- **Surface Albedo.** Reflectivity of soil or surface underneath the modules.
- **Structure Design.** Pitch, hub height, tracking range, adaptation to eliminate shading.
- **DHI/GHI Ratio.** Ratio of diffused irradiance relative to global horizontal irradiance.

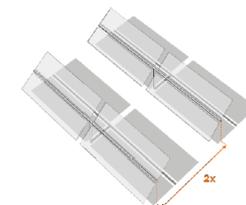
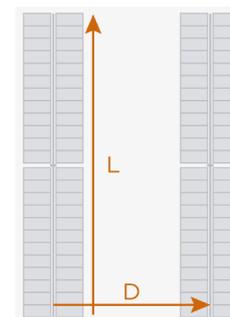
Sample albedos

Surface	Typical albedo
Fresh asphalt	0.04 ^[4]
Open ocean	0.06 ^[5]
Worn asphalt	0.12 ^[4]
Conifer forest (Summer)	0.08, ^[6] 0.09 to 0.15 ^[7]
Deciduous trees	0.15 to 0.18 ^[7]
Bare soil	0.17 ^[8]
Green grass	0.25 ^[8]
Desert sand	0.40 ^[9]
New concrete	0.55 ^[8]
Ocean ice	0.5–0.7 ^[8]
Fresh snow	0.80–0.90 ^[8]

↑ Pitch => ↑ Reflected Area

↓ GCR => ↑ Bifacial Energy

Pitch is relevant: ↑ surface = ↑ energy gain.



X2 Wider Aisles

Maximize reflected solar energy (albedo) while improve O&M accessibility for modules washing and vegetation control.

GCR: Ground Coverage Ratio
(tracker length/pitch)

Key Bankability Concerns



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Annual degradation – not known with certainty

Actual bifacial gain – can be lower than what expected

Incremental risks – how does that compare to monofacial modules?

Recipe for banking bifacials – key Components

Strong sponsor and robust construction arrangements

Technical due diligence

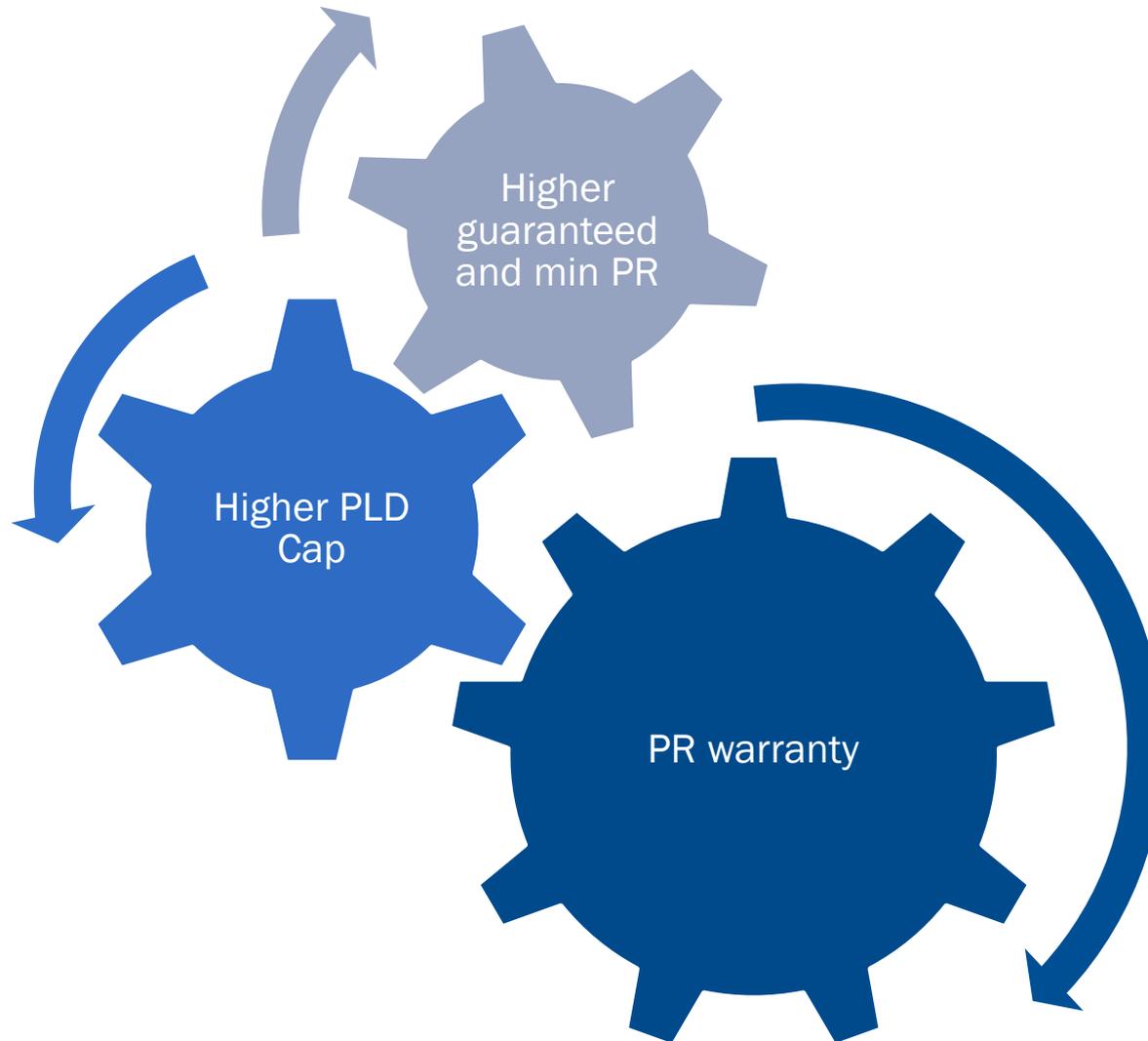
Additional guarantees

Downside risk

Recipe for banking bifacials – EPC Guarantees



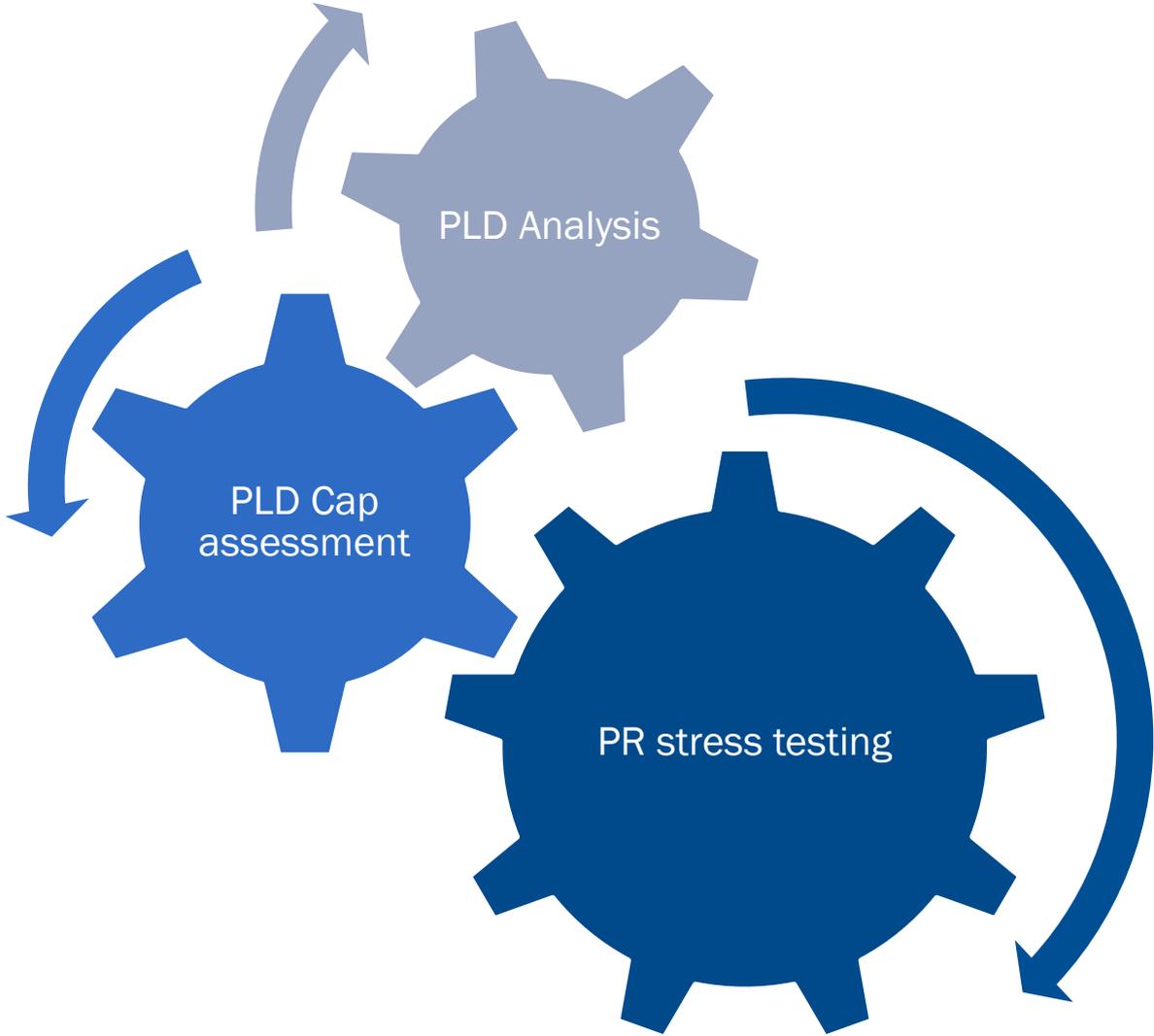
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Recipe for banking bifacials – Downside Analysis



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