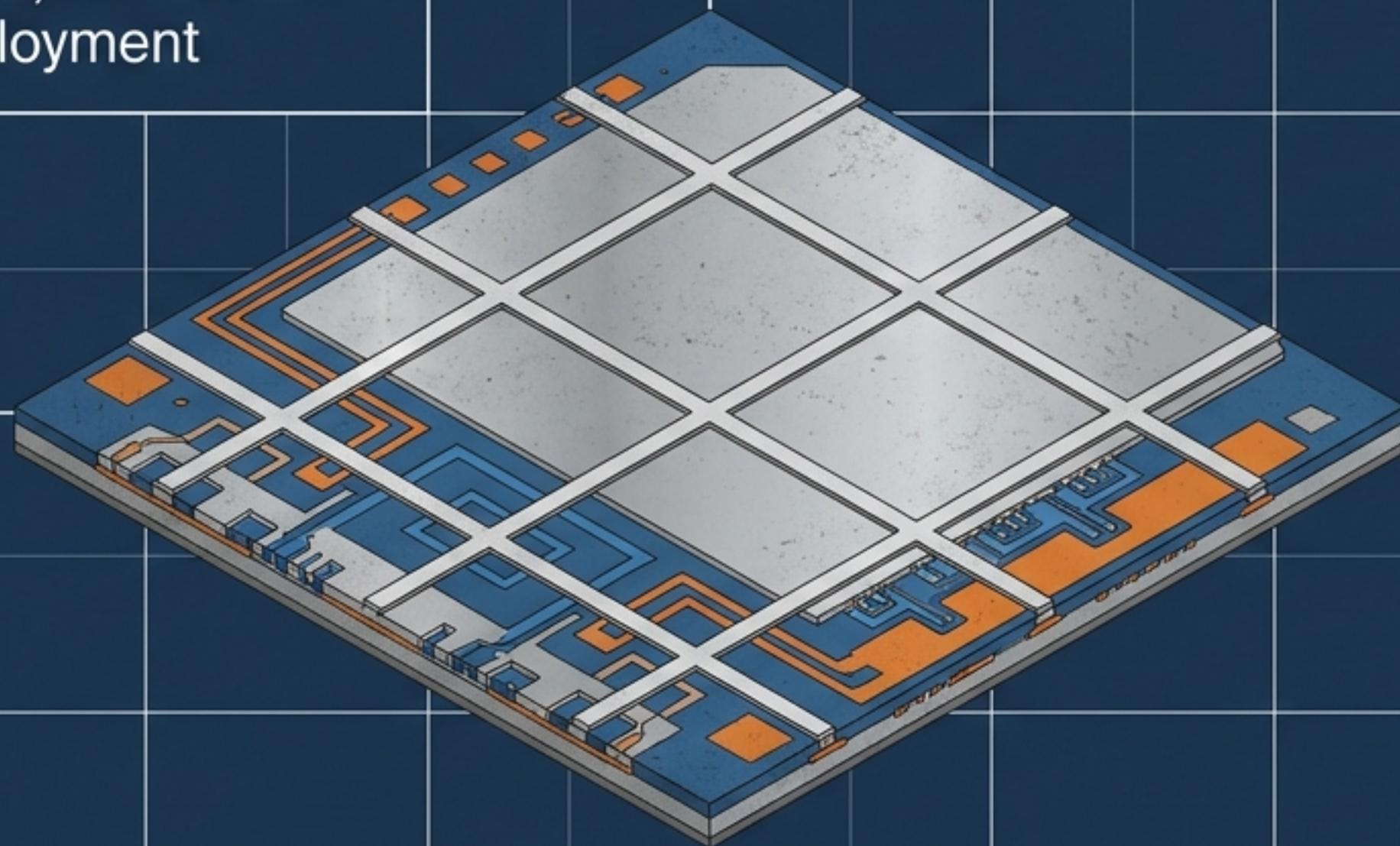


2026 High-Efficiency Solar Procurement Briefing

Evaluating TOPCon, HJT, and Bifacial
Systems for Tier-1 Deployment



TARGET: Property Developers & EPCs

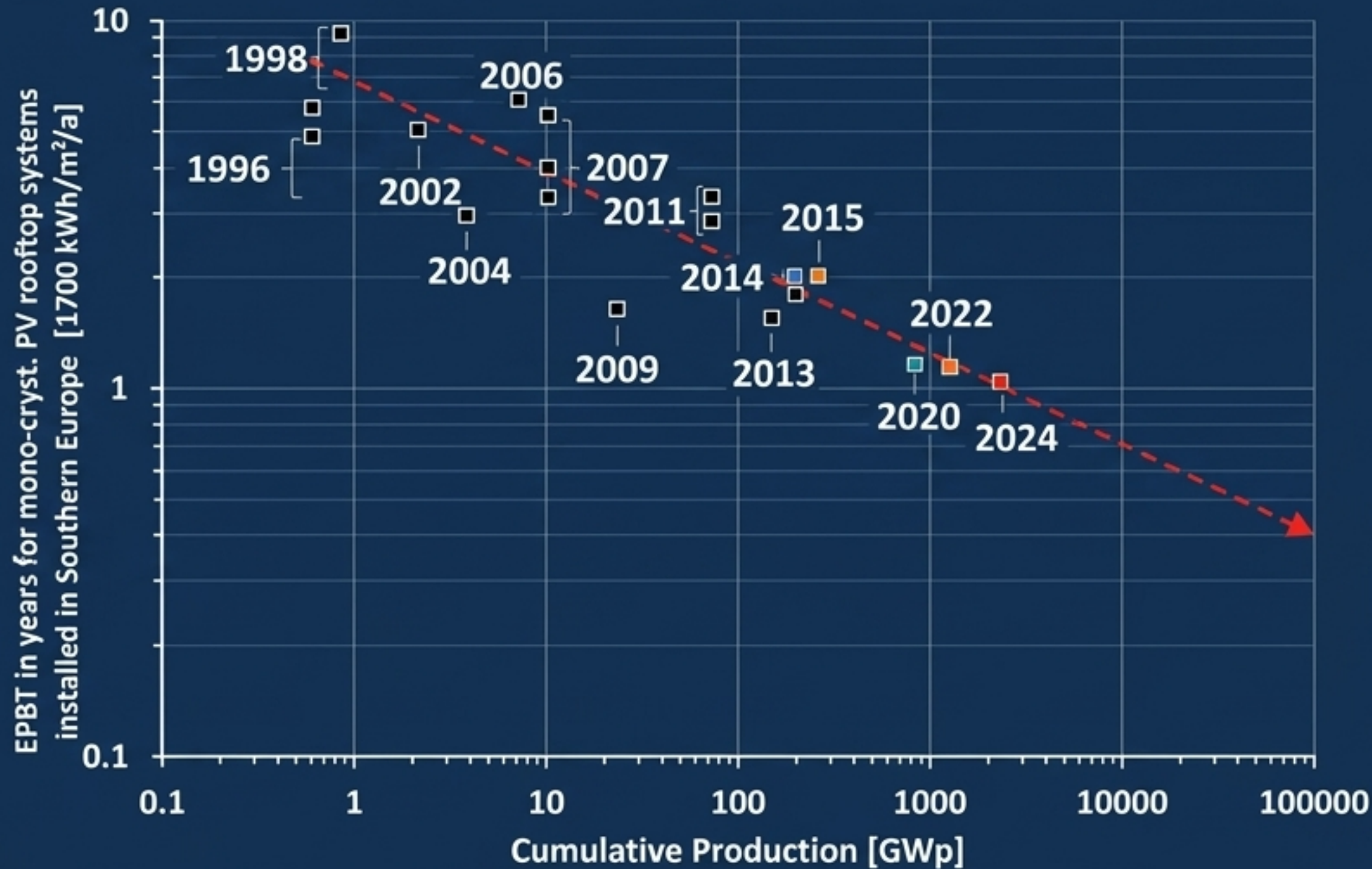
FOCUS: Cell Architecture, Extreme Microclimates, BOS Economics

STATUS: 2026 Q3 Briefing

The 2026 Paradigm Shift: A New Commercial Standard

 Legacy (PERC)	 The Volume Standard (TOPCon)	 The Premium Tier (HJT)	 The Pilot Phase (Perovskite-Si Tandem)
STATUS: Phased Out DATA: 20–22% Efficiency NOTE: Production lines retired; mostly clearance inventory.	STATUS: Active Default DATA: 22–24% Efficiency. ~70%+ of new shipments. NOTE: Displaces PERC at near-equivalent pricing.	STATUS: High-Performance Deployment DATA: 24–26% Efficiency NOTE: Superior temperature coefficients; ideal for constrained roofs and hot climates.	STATUS: MW-Scale Testing DATA: 28%+ Pilot Modules NOTE: Do not specify for standard 25-year residential/commercial yet.

The Economics of Scale: 15.7% EPBT Reduction Per Doubling



Learning Rate taking into account efficiency improvements.
Irradiation: 1700 kWh/m²/a at an optimized tilt angle; Years: Estimated average year of original data.

METRIC:
Energy Payback Time (EPBT)

LEARNING RATE:
-15.7% every time cumulative production doubles.

TIMELINE:
1996 – 2024.

Module costs and energy pay-back times follow a relentless downward trajectory. The shift to TOPCon and HJT represents the next necessary leap to maintain this learning rate in 2026.

The Efficiency Race: TOPCon vs. Heterojunction (HJT)

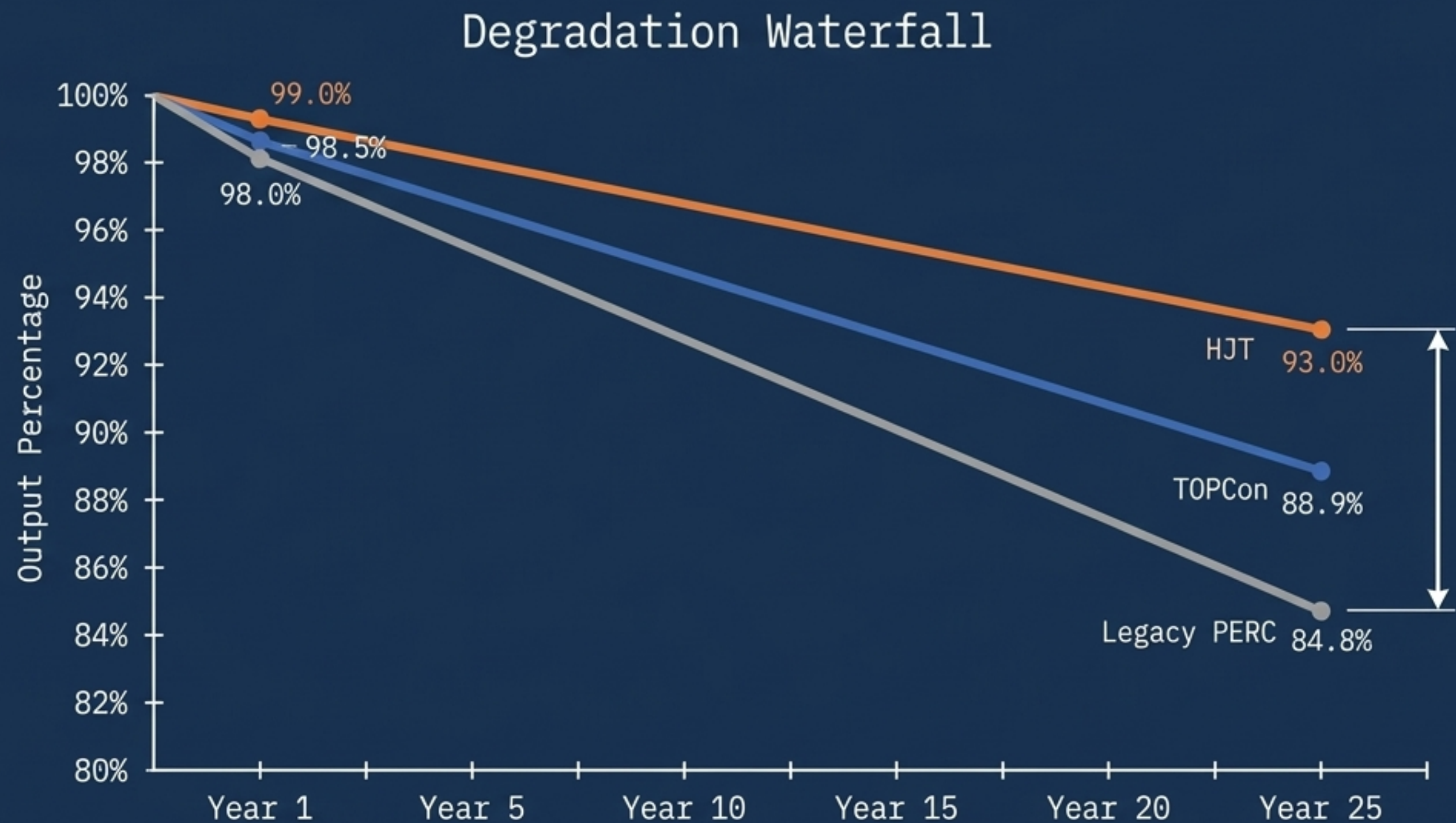


Specs Comparison

Architecture	Architecture
TOPCon: Tunnel Oxide Passivated Contact	HJT: Amorphous/Crystalline Silicon Hybrid
Module Efficiency	Module Efficiency
22–24%	24–26%
Temperature Coefficient	Temperature Coefficient
-0.30%/°C	-0.25%/°C
First-Year Degradation	First-Year Degradation
1.5%	1.0%
Relative Cost	Relative Cost
Low-Moderate (New Default)	Moderate-High (Premium Class)

**HJT is superior
in high heat.**

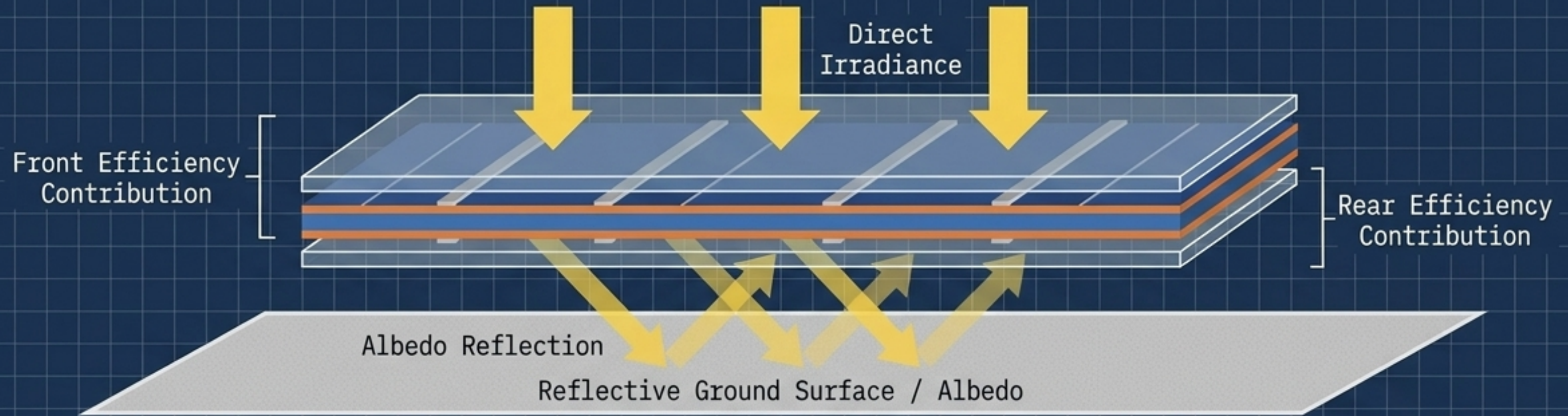
The 25-Year Degradation Math



On a standard 10kW array, the spread between legacy PERC and modern HJT equates to an 820W capacity gap at Year 25.

Efficiency headlines grab attention; degradation rates determine 25-year asset value.

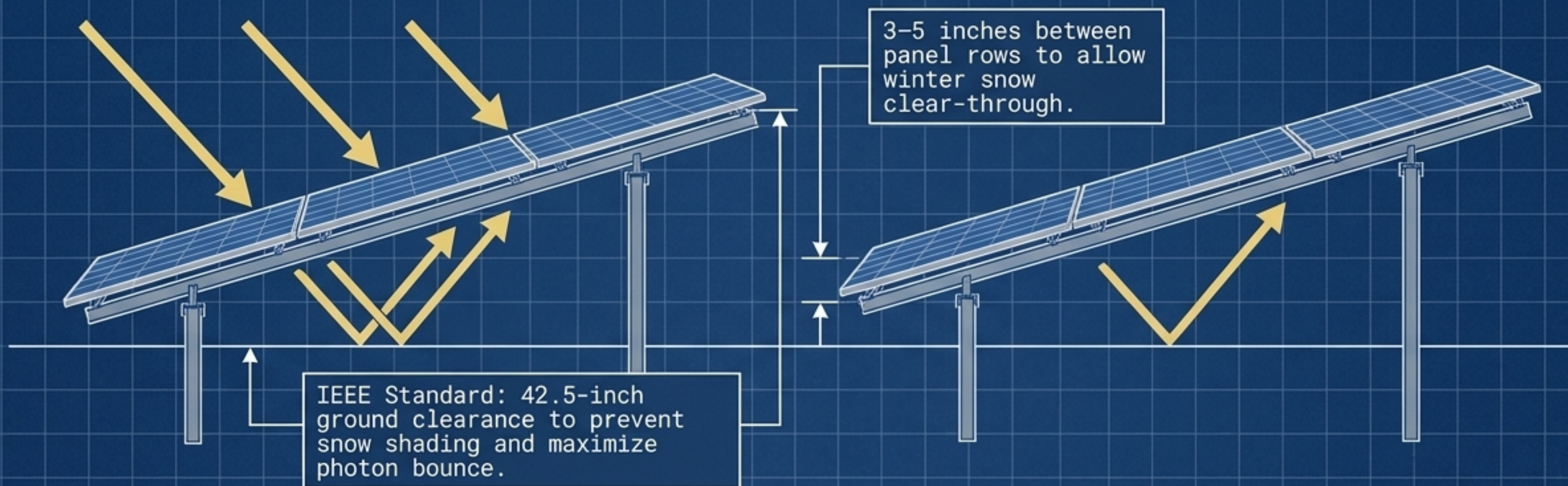
Bifacial Module Economics: The Dual-Sided Advantage



Bifaciality Factor	Yield Gain	Durability Upgrade
65% – 90% capability to absorb rear-side light.	Generates 5% to 30% additional energy per watt.	Double-glass design minimizes Potential Induced Degradation (PID) and extends weather resistance.

**Bifacial panels are now the default for ground-mounts.
The cost premium is minimal; the yield gain is bankable.**

Optimizing Bifacial Yield: The Ground Rules



Albedo Yield Matrix

White Gravel / EPDM	60-80% Albedo	20-30% Yield Gain
Light Concrete / Sand	30-50% Albedo	12-20% Yield Gain
Dry Soil / Grass	15-25% Albedo	5-12% Yield Gain

High-Altitude Microclimate Dynamics: The Flagstaff Case

The Counter-Intuitive Principle:
Photovoltaic panels lose efficiency as they get hotter. They produce peak power in cold, high-UV environments.

Elevation Advantage

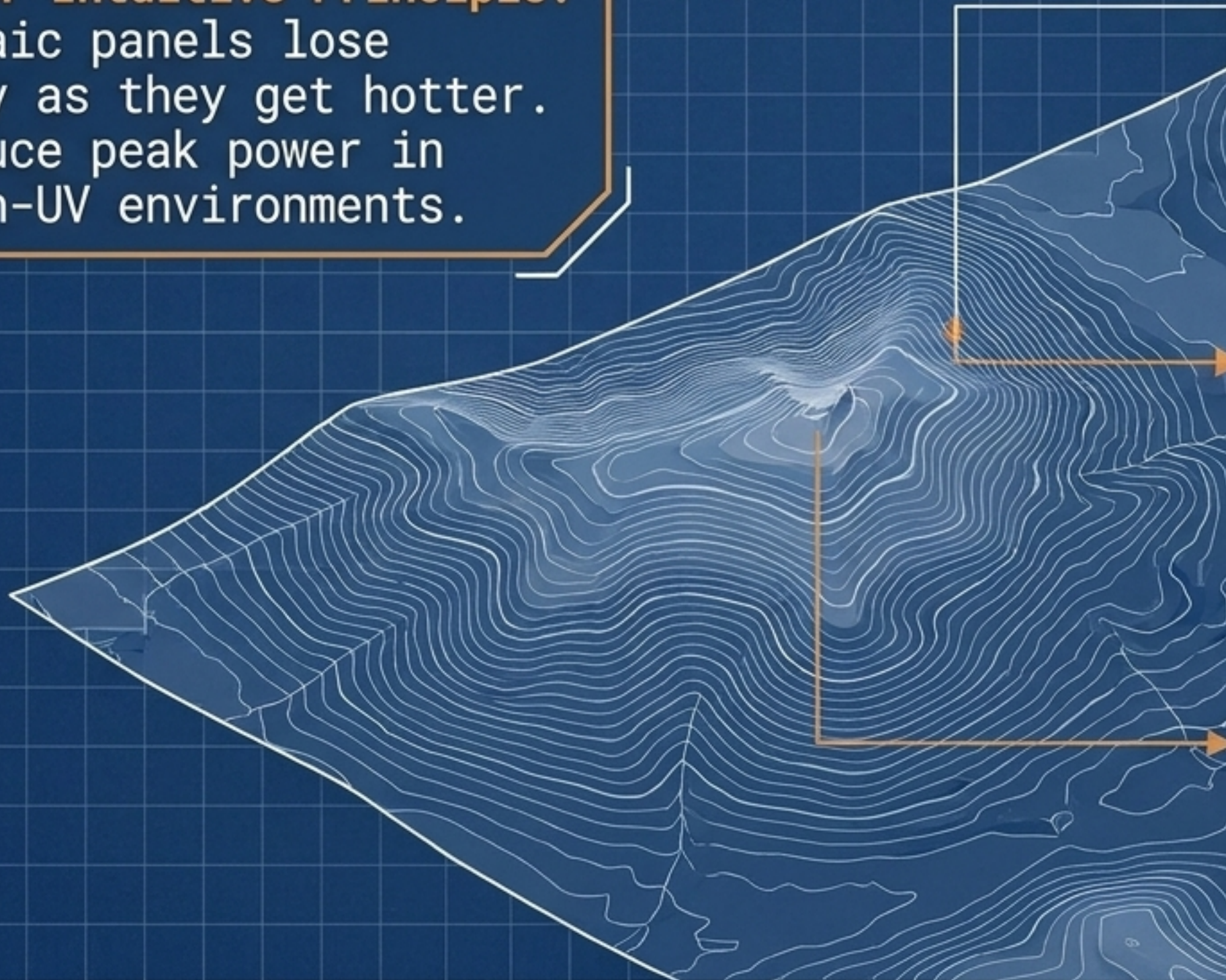
7,000 ft altitude means thinner atmosphere, resulting in significantly higher direct UV exposure.

Solar Fuel

266 sunny days per year provide a massive solar resource.

Thermal Dynamics

Frigid winter temperatures naturally cool panels, offsetting the traditional thermal derating seen in lower-altitude desert regions.

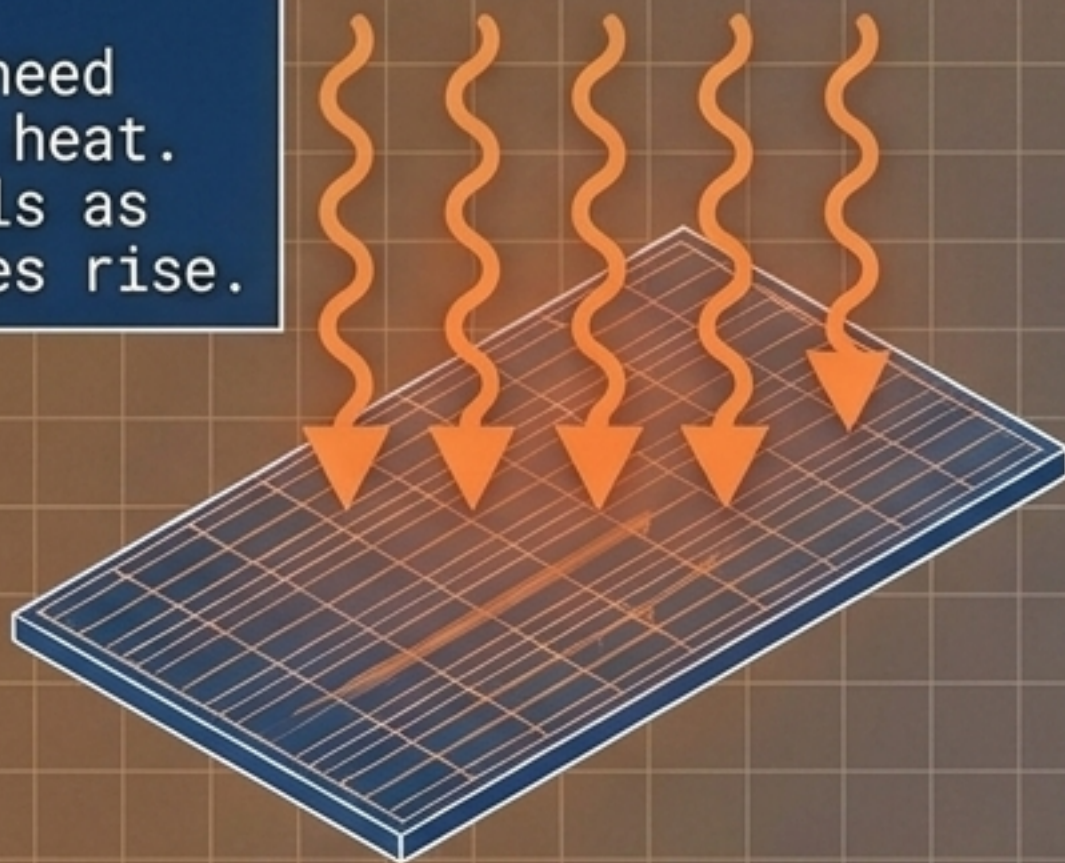


Extreme Weather Defense Systems

Thermal Management (Heat)

DATA:

PV panels need light, not heat. Output falls as temperatures rise.



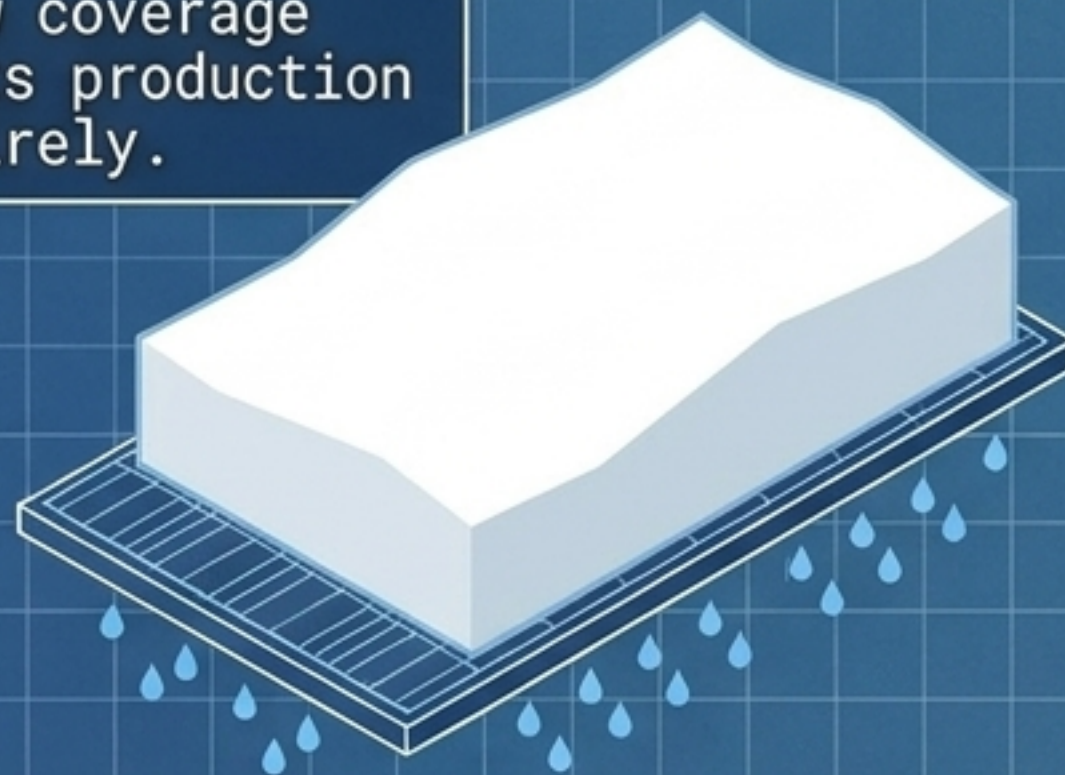
SOLUTION:

Specify HJT Modules. The ultra-low $-0.25\%/^{\circ}\text{C}$ temperature coefficient prevents massive yield loss during summer peaks and monsoons.

Load Management (Snow)

DATA:

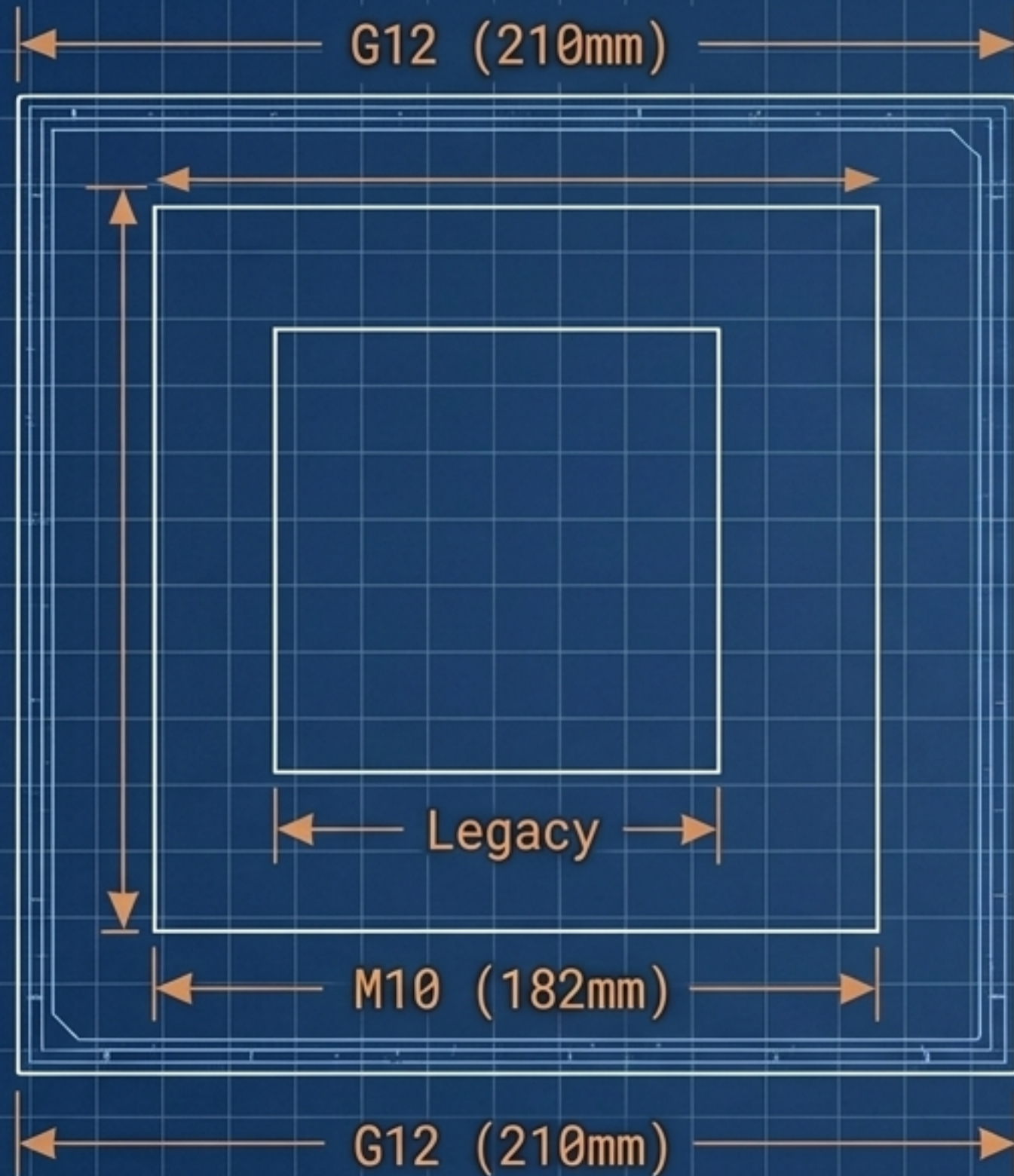
Snow coverage halts production entirely.



SOLUTION:

Specify Bifacial Double-Glass. Airflow and rear-side generation create micro-heat, accelerating snow melt. Double-glass prevents micro-cracks under heavy snow loads.

The Scale Advantage: M10 & G12 Wafers



Format Specs

- Legacy: Sub-400W outputs.
- M10 (182mm): The new commercial standard.
- G12 (210mm): The utility-scale heavyweight.

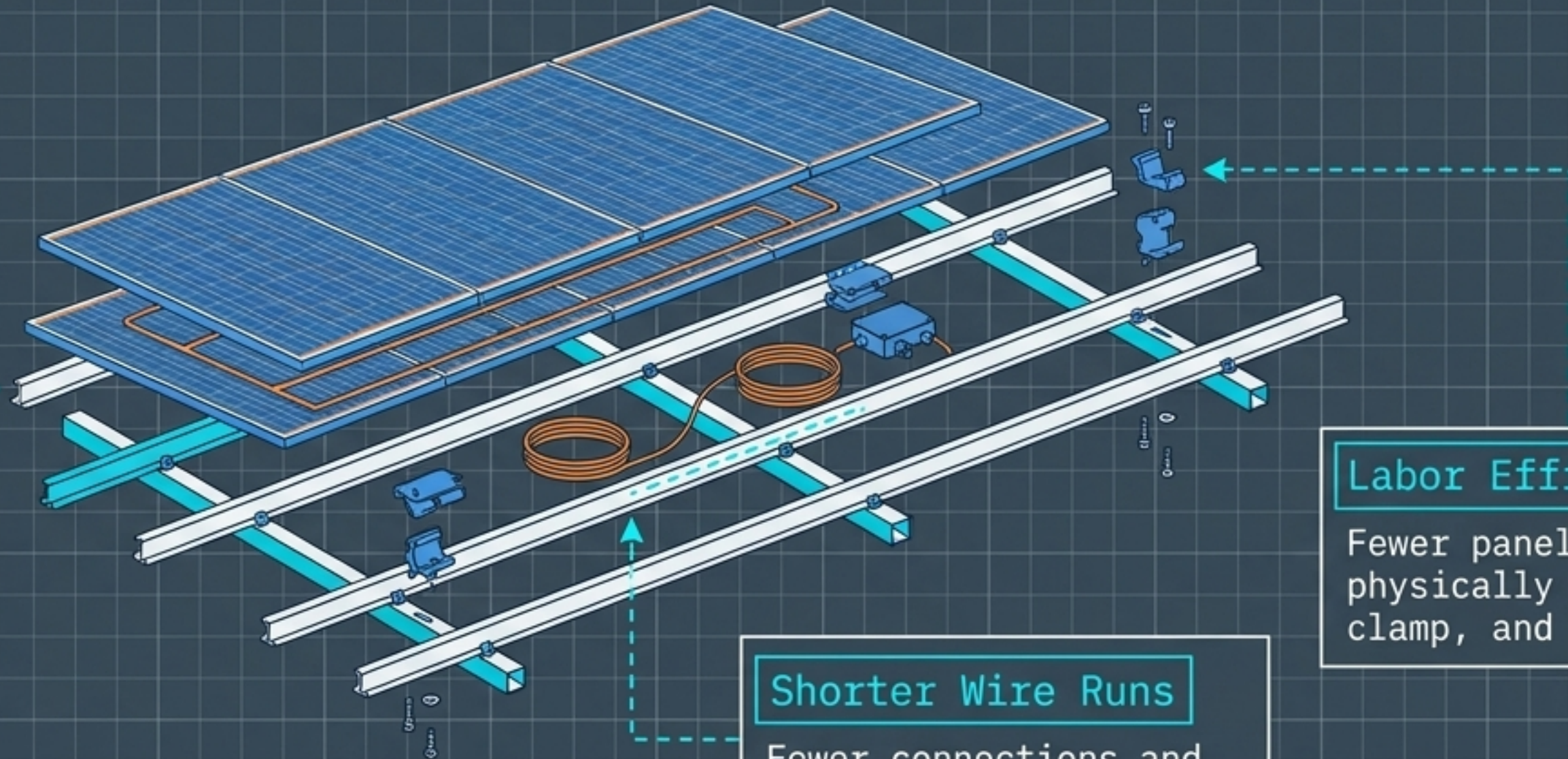
The Physics of Cost

Larger wafers enable module outputs of 550W to 700W+ per panel.

This size increase does not proportionally increase manufacturing costs, driving down the base price per watt before the panels even leave the factory.

Balance-of-System (BOS) Cost Teardown

Core Concept: Higher wattage panels = Fewer total panels required for the same system capacity.



Fewer Rails

Less aluminum racking required per MW.

Shorter Wire Runs

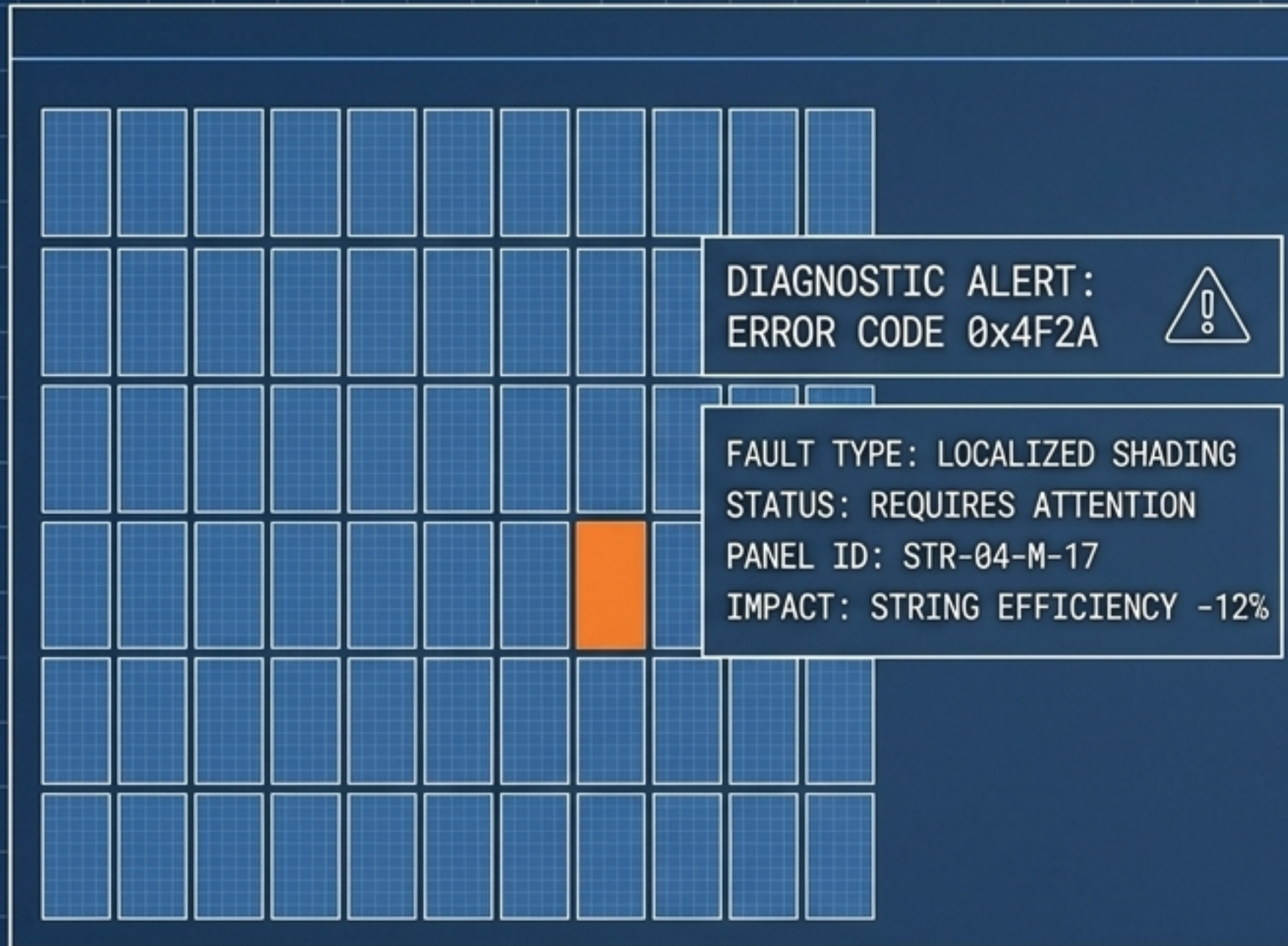
Fewer connections and reduced copper cabling.

Labor Efficiency

Fewer panels to physically lift, clamp, and wire.

The Bottom Line: Utilizing M10/G12 format panels strips \$0.02 to \$0.05 per watt out of commercial installation costs purely through reduced hardware and labor.

Intelligent Operations: AI & Smart Monitoring



Legacy (Passive)

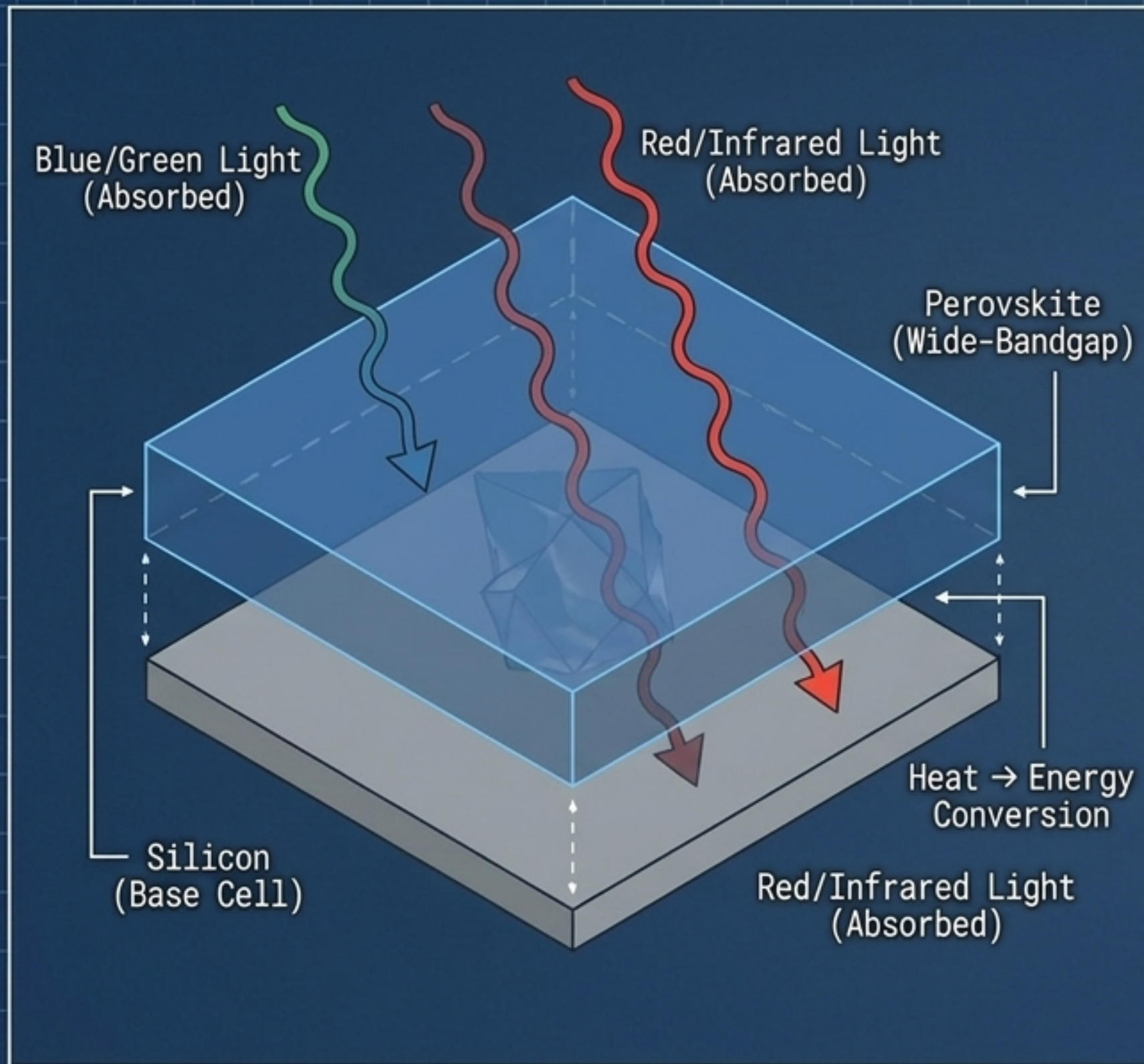
String-level data. A single shaded or dirty panel drags down the entire string invisibly.

Faults require manual truck rolls to diagnose.

2026 Standard (Active)

- Pinpoints exact module faults in real-time.
- Identifies localized soiling (dust, tree pollen) to optimize cleaning schedules rather than relying on fixed calendar dates.
- Transforms distributed rooftop arrays into dispatchable virtual power plants (VPPs).

The Next Horizon: Perovskite-Silicon Tandem



The Physics Barrier

The Shockley-Queisser Limit dictates a maximum 33.7% efficiency for single-junction silicon cells.

The Tandem Solution

Stacking a wide-bandgap perovskite cell (absorbs blue/green light) over a silicon cell (absorbs red/infrared light). Wasted heat is converted to captured energy.

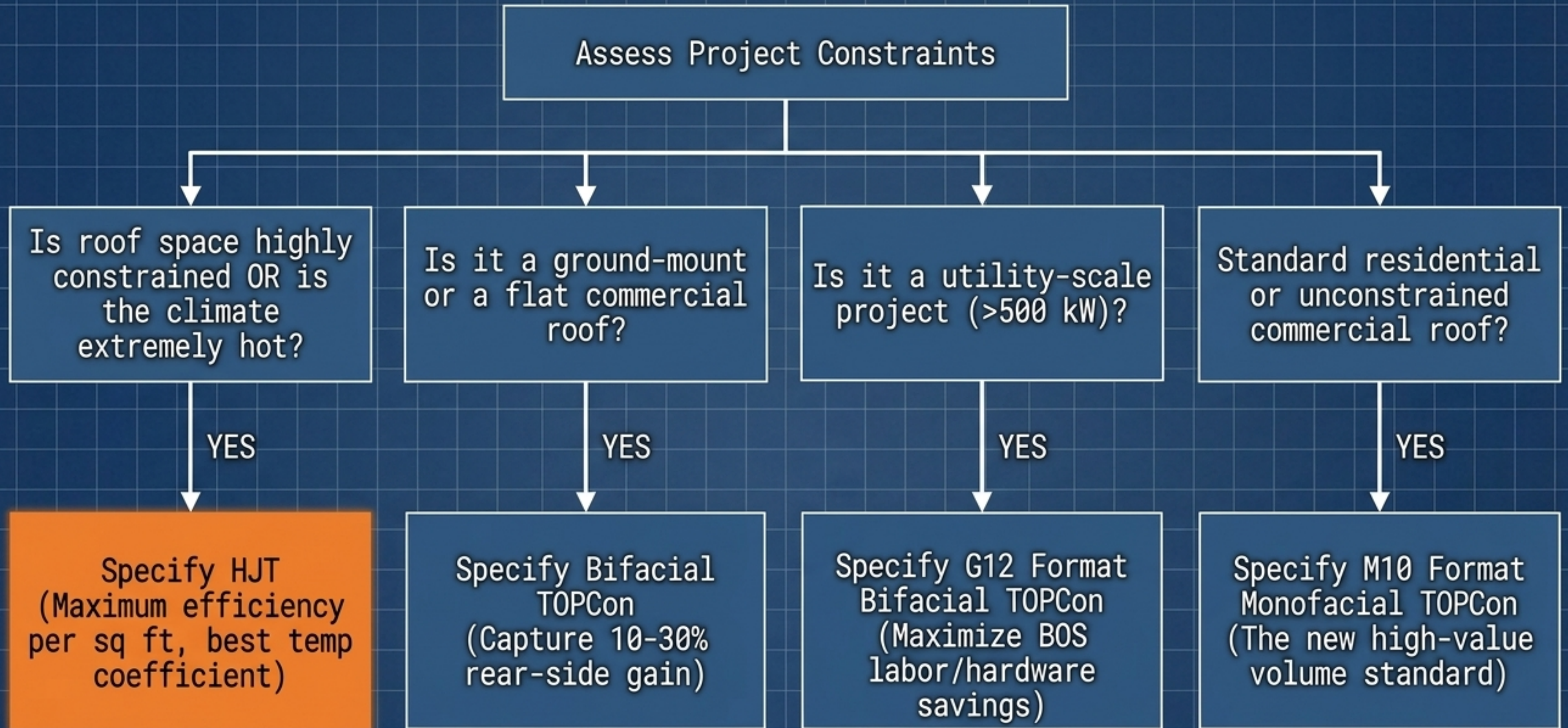
Current Status

Record Lab Efficiency: 34.85%

Commercial Reality: 28%+ modules in MW-scale pilot testing only.

Procurement Advice: Monitor for 2027-2028. Do not specify for standard 25-year commercial assets in 2026.

The 2026 Procurement Decision Matrix



2026 Procurement Imperatives

1. Update Specifications

Strip PERC from standard spec sheets; model TOPCon as the new financial baseline.

2. Factor Degradation

Evaluate vendor bids on Year-25 output, not Year-1 nameplate efficiency.

3. Optimize the Ground

For bifacial arrays, engineer the ground albedo (white gravel/EPDM) alongside the electrical sy.

4. Leverage Scale

Demand M10/G12 formats to capture BOS savings on racking and labor.

The solar industry has moved from an era of crude capacity to an era of precision telemetry. Specify accordingly.

