The Dark Side of Solar Glass: Antimony, Geopolitics and the Energy Transition

written by Tracy Hughes | December 11, 2025

If you stand in front of a utility-scale solar farm at dusk, the panels look serene: a regimented field of dark blue rectangles, quietly drinking in the last photons of the day. It’s easy to forget that buried in that glass is a critical, controversial, and increasingly strategic element with the wonderfully awkward name of **antimony**.

Antimony, symbol Sb (from the Latin *stibium*), is a silvery metalloid most people never think about until it starts showing up in export-control headlines. Yet it sits on every major critical mineral list—from the European Union to the United States, Japan, and Australia—to yes, the CMI…because it is hard to substitute, heavily import-dependent, and essential to everything from fire safety to munitions.

For most of the modern era, antimony lived in the shadows of the periodic table as a supporting actor. It hardened lead in car batteries, made plastics and textiles less flammable, and served as a catalyst in PET plastics and rubber. Flame-retardant applications alone have recently accounted for roughly half of global antimony use, with lead-acid batteries and alloys taking most of the rest.

Now, however, the energy transition has pulled antimony into a decidedly brighter spotlight—literally. To understand why, you have to look through the glass.

What antimony actually does in solar glass

The front sheet of a conventional crystalline-silicon solar module is a special low-iron glass, typically 3.2 mm thick, engineered to let in as much sunlight as possible while surviving hailstorms, sand, salt spray, and decades of UV radiation. Nearly all PV manufacturers use some variant of low-iron patterned or float glass for this purpose.

Antimony enters the story in its oxide form, Sb_2O_3 (antimony trioxide). In the glass furnace, it plays three critical roles:

- **Fining agent.** Antimony oxides help "fine" the melt—tiny oxygen bubbles that would scatter light are oxidized, grown, and floated out, resulting in clearer glass.
- **Color control.** Sb can change the oxidation state of iron and manganese in the melt, nudging them toward less light-absorbing forms and keeping the glass closer to water-clear than bottle-green.
- **UV stability.** In solar glass specifically, small amounts of antimony oxide help stabilize optical properties under years of UV exposure, reducing "solarization" (the tendency of glass to brown or lose transmission over time).

Industry estimates suggest typical solar glass contains on the order of 0.2–0.3% antimony by weight; one analysis pegs it at about 0.25%, or roughly 40 grams of antimony in the front glass of a standard module. In the PV business, where a one-percentage-point gain in module efficiency can make or break a factory's margins, the clarifying and transmission boost from antimony-doped glass is not trivial—some producers estimate

10–20% relative improvements in energy yield from better-performing glass.

This is why consultancies now talk about photovoltaics becoming one of the fastest-growing uses of antimony, potentially rivalling traditional flame-retardant demand as global solar installations scale toward multi-terawatt levels.

The geopolitical twist

Here’s the catch: antimony supply is tight and highly concentrated. According to the latest U.S. Geological Survey data, China produced about 48% of mined antimony in 2023, followed by Tajikistan with about a quarter; no meaningful mine production has occurred in the United States in years.

Over the past year, antimony has been living the same geopolitical drama we’ve seen with rare earths and gallium. In 2024, Beijing moved to require export licenses for antimony ores, metals and oxides, then went further—banning exports of antimony to the United States and effectively freezing shipments to the European Union. Prices promptly spiked, roughly doubling from mid-2024 levels and surging more than 300% for some grades in Europe.

The U.S. military has responded by funding portable refineries for antimony trisulfide, the form used in ammunition and detonators, as part of a broader push to de-risk critical mineral supply. Meanwhile, refiners like Umicore in Europe talk about stock management and diversification strategies to ride out the curbs.

Solar manufacturers sit squarely in the crosshairs of that tension, because the same Chinese ecosystem that dominates antimony production also dominates solar glass and module manufacturing. As more of that antimony is consumed domestically to feed China’s own PV build-out, less is left for export.

The antimony-free glass backlash

On top of supply risk, antimony trioxide carries a health warning label. It has been classified as a carcinogen in recent toxicology assessments, and regulators are increasingly uncomfortable with large volumes of Sb-bearing glass entering recycling streams.

European recyclers have flagged the “uncertain antimony content” of solar glass as a barrier to closed-loop recycling: if you don’t know how much Sb is in the cullet, you can’t easily reuse it in new glass without risking off-spec product.

That is driving a quiet but powerful countertrend: high-purity, ultra-low-iron silica sands that allow glassmakers to hit transmission targets without antimony at all. Companies are already announcing “antimony-free solar glass” lines, and bans or restrictions in parts of Europe and Brazil are nudging the industry in that direction.

In other words, antimony is simultaneously indispensable to today’s solar glass and under active pressure to be designed out of tomorrow’s solar technologies. That tension is exactly what makes it a critical mineral.

Beyond glass: antimony as a solar absorber

While most of the discussion focuses on glass, there’s a second antimony–solar story quietly unfolding in laboratories. Antimony chalcogenides—compounds like Sb_2S_3 and Sb_2Se_3—are emerging as promising absorber materials for thin-film solar cells. Researchers in the United States and Europe have recently reported Sb_2S_3 devices with efficiencies climbing above 7% and excellent long-term stability, with theoretical limits much higher.

These materials are attractive because they are relatively earth-abundant, non-volatile, and compatible with lower-temperature, potentially cheaper manufacturing routes than traditional silicon or CdTe. If they scale, the solar industry’s relationship with antimony could deepen rather than fade—even as glassmakers try to wean themselves off Sb_2O_3.

Top five reasons we still need antimony

So why, despite the toxicity flags and supply-chain headaches, does antimony remain so hard to quit? Let’s be explicit:

1. **It makes today’s solar glass work.** Sb_2O_3 is still the workhorse clarifying and fining agent in much of the world’s low-iron photovoltaic glass, improving light transmission, reducing bubbles, and stabilizing performance under UV. Without it, many existing production lines would need significant re-engineering.
2. **It keeps our infrastructure from burning.** Antimony trioxide is the main synergist in halogenated flame-retardant systems used in electronics housings, textiles, building materials, and cables. Roughly half of global antimony demand is still tied to flame retardants, and there is no perfect plug-and-play substitute at scale.
3. **It underpins legacy and backup energy storage.** Lead–antimony alloys strengthen the grids in lead-acid batteries, improving durability and deep-cycle

performance. Even in a lithium-ion world, lead-acid remains ubiquitous in vehicles, backup power systems and off-grid solar installations.

4. **It is embedded in defense and high-end electronics.** Antimony compounds are critical for ammunition primers, tracer rounds and other military pyrotechnics, as well as for some infrared detectors, diodes, and specialty semiconductors. Defense planners treat secure antimony supply as a matter of national security, which is why the U.S. Army is now funding mobile antimony refineries.
5. **It is structurally hard to replace and geopolitically exposed.** High import dependence, limited substitutability and concentrated production have earned antimony "critical" status across major economies. As solar glass and advanced batteries add new demand on top of existing uses, any supply disruption—such as China's recent export controls and bans—reverberates through multiple sectors at once.

The uncomfortable conclusion

Antimony is an object lesson in the messy reality of the energy transition. We want cleaner grids and safer buildings; we also want to avoid toxic substances and reduce dependence on politically fraught suppliers. In solar specifically, every stakeholder—from miners to glassmakers to recyclers—now has a direct interest in how quickly the industry can move from "antimony-dependent" to "antimony-aware," and eventually to "antimony-optional."

Until then, the shimmering surface of a solar farm will remain, in part, a mirror of our antimony problem: the glass looks beautifully simple, but the chemistry and geopolitics behind it are anything but.