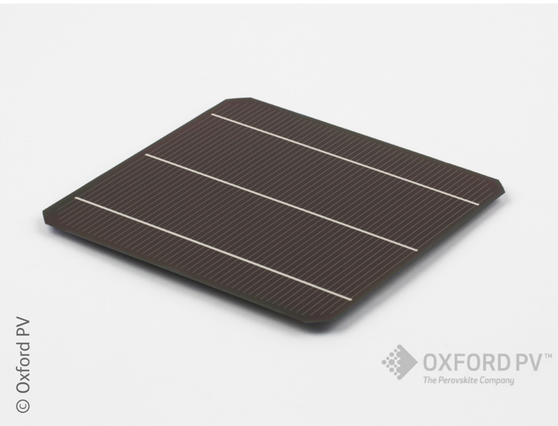
The importance of lead in the economics of solar



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Full-sized perovskite-silicon solar cell

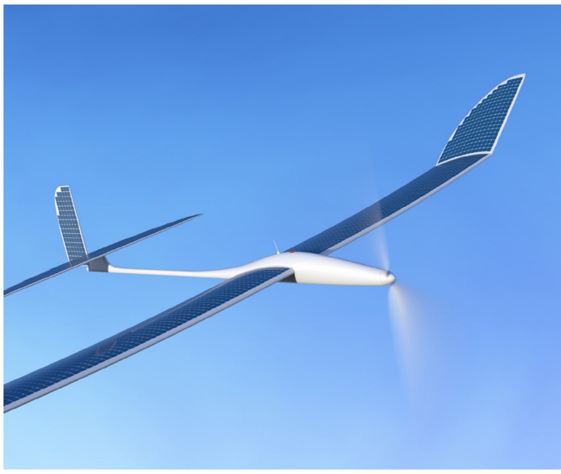
As Europe speeds towards its energy transformation, the economics of low-carbon technology are becoming increasingly important. On average, a solar panel system costs €1,000 – €1,500. With solar panels typically lasting for up to 40 years, homeowners can expect up to 32 years of energy cost savings. The longer the solar panel lasts, the longer the economic and environmental benefits period.

One of the biggest determinants of panel lifespan is, counter-intuitively, exposure to sunlight. Solar cells are sensitive to thermal stress induced by the variation in ambient temperatures as well as the temperature fluctuations due to the conversion of sunlight into electricity, impacting longevity and reliability after repeated exposure.

Addressing this issue has seen lead become an important part of current and future solar panel design, playing an essential role in the coating of the copper ribbons connecting the cells inside photovoltaic (PV) modules. The relatively low melting point of the lead-based coating means that the cells can be interconnected to modules at lower soldering temperatures – which in turn leads to fewer micro-cracks, which could be introduced through the thermal stress of higher soldering temperatures. Alternative solders with lower melting temperatures come with the disadvantage of brittleness over the lifetime – which is another failure and degradation mechanism mitigated through lead-coated solders.

There is currently no viable alternative to using lead that offers the same benefits, meaning it will continue to be the coating of choice for manufacturers for the foreseeable future. Other combinations of metals such as tin, silver and copper not only raise the price of the coating, but also its melting point. Given the increased risk of micro-cracking during hot-working, these higher melting points not only have a significant impact on solar panel production but the reliability and durability of the resulting panels themselves.

Using pure tin also runs the risk of 'tin whiskers' – almost invisible to the human eye, these conductive surface fibres bridge distances between electrical components and cause electrical short circuits. And while tin-bismuth remains technically viable, the difficulty of recovering the copper at end of life remains a barrier to its adoption as an alternative to lead when key principles of eco-design and the circular economy are considered. Thanks to the continued use of lead, EU research and innovation is already pioneering revolutionary solar technology. Developed in the EU, next-generation perovskite-based solar cells, notably tandem perovskite/silicon (Pk-c-Si), are on the cusp of commercialisation. This solution offers solar module manufacturers the opportunity to surpass the performance limits of today's crystalline silicon cells and simultaneously reduce costs. These can be applied in tandem on top of crystalline silicon cells, or alone in single or multiple junctions.



Solar panels are currently the cheapest means for governments to increase their share of renewables and reduce CO_2 emissions. Given the EU's ambitious clean energy targets and long-term vision for a prosperous, competitive and low-carbon economy, the manufacture of durable and reliable clean technology will be a key enabler of this transformation.

Fact file

- Lead is part of the alloy used to coat the PV ribbons used inside solar panels. The lead imparts durability to the solar cells inside the panel, by lowering the melting point of the metallic coating and reducing thermal stress
- The coating of the PV ribbon is typically around 40% lead, which, together with its copper base, is fully recycled at end-of-life and re-used. Companies offering solar panels on the EU market are responsible for take-back and treatment under product-specific EU quality standards to achieve specific depollution requirements
- Less than 1% of all the lead used in the EU goes into alloys and solders across all industry sectors, not just electronics. The electronics industry uses just 0.5% of the world's lead, and its use in solar panel manufacturing represents a very small but essential manufacturing sector enabling home-grown production of solar panels
- There are three PV ribbon manufacturers in the EU with a direct sectoral value of €10 million, a small sector supporting the EU's fast-growing domestic market for renewables
- Most potential alternatives to lead are more expensive and reduce the useable lifetime of a solar panel. Pure tin or tin-silver-copper alternatives have higher melting points which can lead to micro-cracks in the solar cells, eventually leading to durability issues. Pure tin also runs the risk of 'tin whiskers' causing electrical short circuits

Developed in collaboration with PVthin a.i.s.b.l. and the European Perovskite Initiative, this case study highlights just one of the many essential uses of lead that provide societal benefits and boost the EU's economy

For Europe's future, lead matters.

Lead Matters