

# Sunwire® EVOLUTION



## Four, five or more - how many busbars do you go for?

As photovoltaic (PV) module manufacturers look to upgrade from three busbars to four, five or six, it makes their choice of PV ribbon far more important.

Raising the number of busbars puts less residual stress on the crystalline silicon cells, reducing the probability of micro-cracks which can lead to malfunctions and power degradation. Increasing the number of busbars also increases the number of ribbons while enabling shorter distances for electrons to travel along the grid lines and requiring narrower ribbon to reduce cell to module (CTM) power losses. This lowers module manufacturers' costs by reducing the use of expensive silver paste in the cell metallization process without sacrificing efficiency.

For module manufacturers looking to do this, Luvata has the answer. Sunwire® – the flattest, straightest, softest and now narrowest PV ribbon. The Sunwire Evolution continues.

### Benefits of increasing busbars:

- Improved solar module efficiency
- Cost savings using less silver paste
- Reduces chance of cell breakage in the module assembly process
- Decreases power degradation
- Increases durability

Sunwire® photovoltaic ribbon

by LUVATA

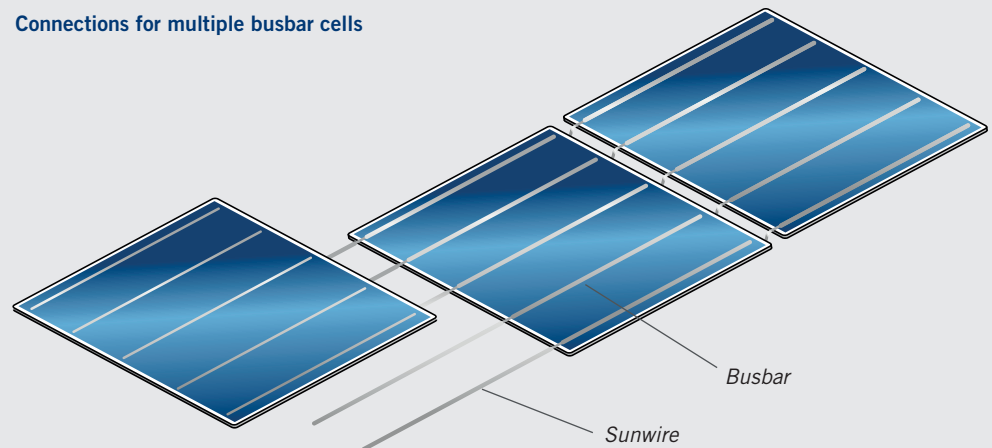
### PV ribbon manufacturing expertise required for optimal results

In order to enable module manufacturers to increase the number of busbars, without sacrificing efficiency, PV ribbon manufacturers must be able to meet module expectations for softer, straighter, thicker and now much narrower ribbon. The value-add Luvata offers as a PV ribbon manufacturer is understanding the delicate balancing in finding the optimal Sunwire PV ribbon characteristics for each unique module manufacturing process.

The proprietary Sunwire manufacturing process is highly automated. From drawing, rolling, annealing, plating and spooling the system ensures superior product quality, cleanliness and dimensional conformity from the beginning of one spool, to the end of another.

The PV ribbon expertise and state-of-the-art manufacturing process is the advantage Luvata Sunwire offers module manufacturers whether they are using three, four, five or even six busbars.

### Connections for multiple busbar cells



## With Sunwire – more busbars come with less compromise

#### Softness vs. reliability

The fatigue strength of PV interconnecting wires is proportional to the measured elongation at rupture. Often low elongation increases the risk of material failure due to alternating thermal stresses. With extreme softness, excessive grain growth can degrade the elongation. With Sunwire ES, there is no reason to compromise between yield strength and reliability.

#### Optical vs. electrical losses and alignment

With the exceptional softness of Sunwire, interconnecting wires can be made narrower with added thickness without increasing the risk of cell breakage during the module assembly process. Additional electrical losses are avoided as long as the cross-sectional area of the connecting wires remains the same. Sunwire can be perfectly aligned onto the silver busbars, so there is no reason to sacrifice efficiency with wider PV ribbon.

#### Solder coating thickness vs. cost

The profile of Sunwire's hot-dipped tin coating aligns perfectly to the silver busbar, while its soft copper core acts as the stress absorber for the delicate PV cell. Module manufacturers can achieve significant costs savings by using a thinner solder coating without risking cell breakage.



#### Advantages of Sunwire:

- Extreme softness to prevent cell breakage
- Good reliability due to high elongation
- Improved electrical conductivity with high-purity oxygen-free copper
- Narrow for less shading
- Consistent plating thickness
- Consistent quality
- High-quality homogeneous structure
- Superior formability
- Predictable de-spooling
- Reduced scrap during module manufacture
- Reduction in camber at spool flanges
- Burr-less (made from round wire)

## The Sunwire Evolution

Sunwire's evolution is the journey from where we began, to where we want to be in reaching grid parity and beyond. From a product that made the automated mass-production of photovoltaic solar panels possible, to the straightest, softest, flattest and narrowest PV ribbon available on the market today. Sunwire continues to bring notable leaps forward in the evolution of photovoltaic ribbon.