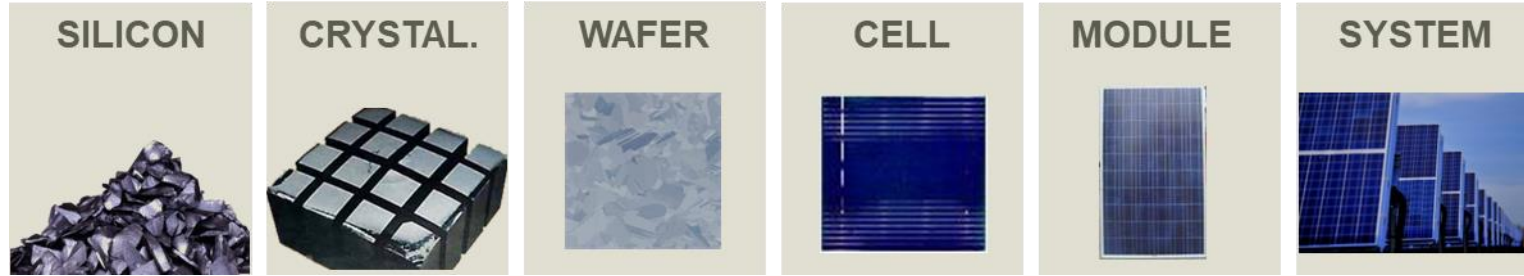
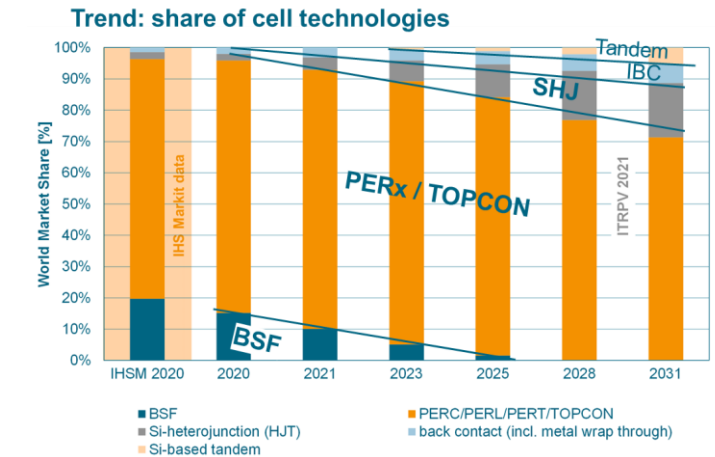
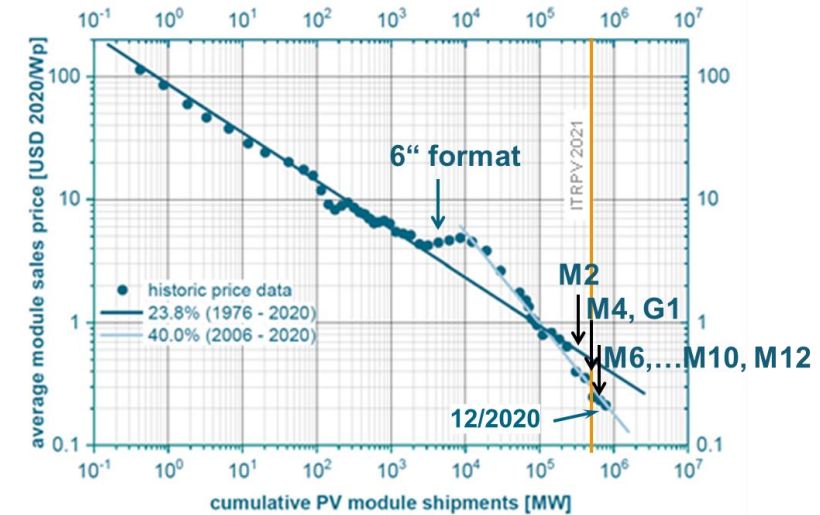


International Technology Roadmap (ITRPV)



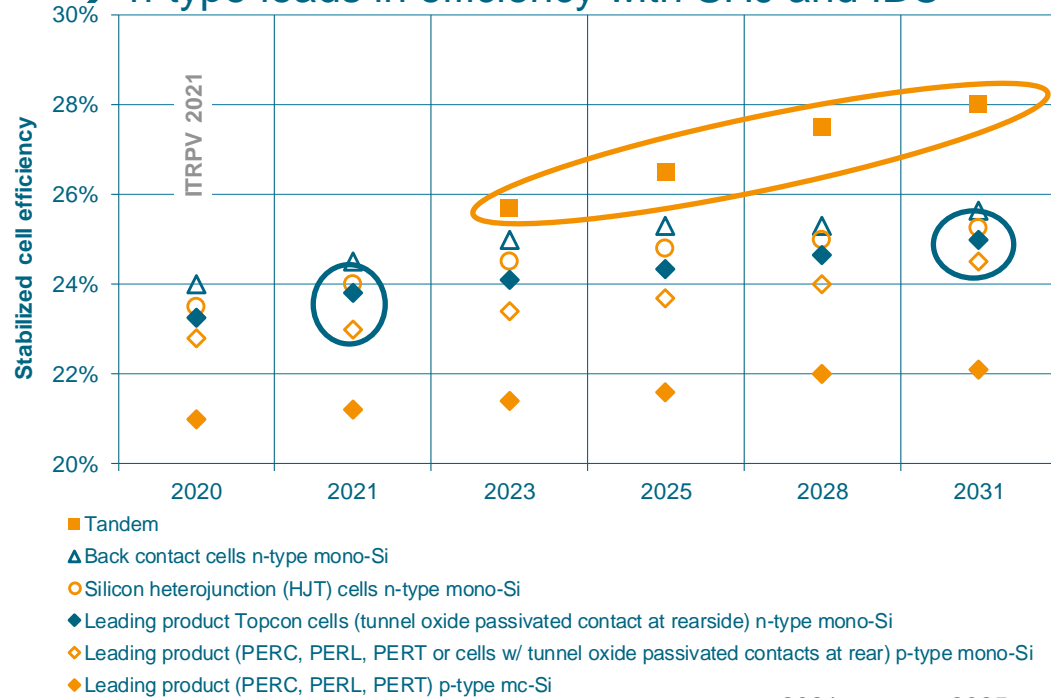
- Forecasting the complete value chain
- Mono dominance is consolidating, n-type increase share
- M6 will shift to M10 & M12
- Silver reduction will continue, n-type concepts need more Ag
- Number of bus bars mostly between 9 to 12
- Bifacial applications increasing
- Fab automation & machine learning > high quality PV



Cell efficiencies in mass production

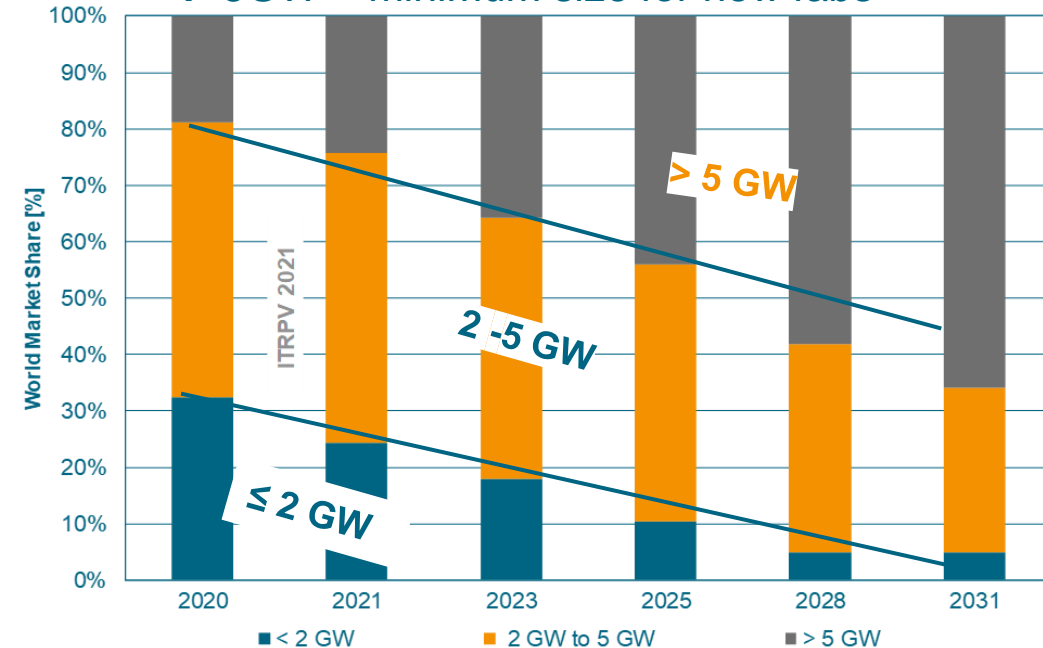
Trend: leading cell efficiencies in production

→ n-type leads in efficiency with SHJ and IBC



Trend: Cell fab size

→ 5GW = minimum size for new fabs



p-mono PERC:

n-mono PERX / passivated contacts:

SHJ:

Tandem:

	2021	2025	2031
p-mono PERC:	23.0%	23.7%	24.5%
n-mono PERX / passivated contacts:	23.8%	24.4%	25.0%
SHJ:	24.0%	24.8%	25.2%
Tandem:	-	26.5%	28.0%

→ may bridge the gap to SHJ

→ expected in 2024

→ Single junction cell efficiencies in production are approaching the theoretical limit