

# Light-weight high-efficiency perovskite multi-junction solar cells

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# Optoelectronics research in Sargent lab

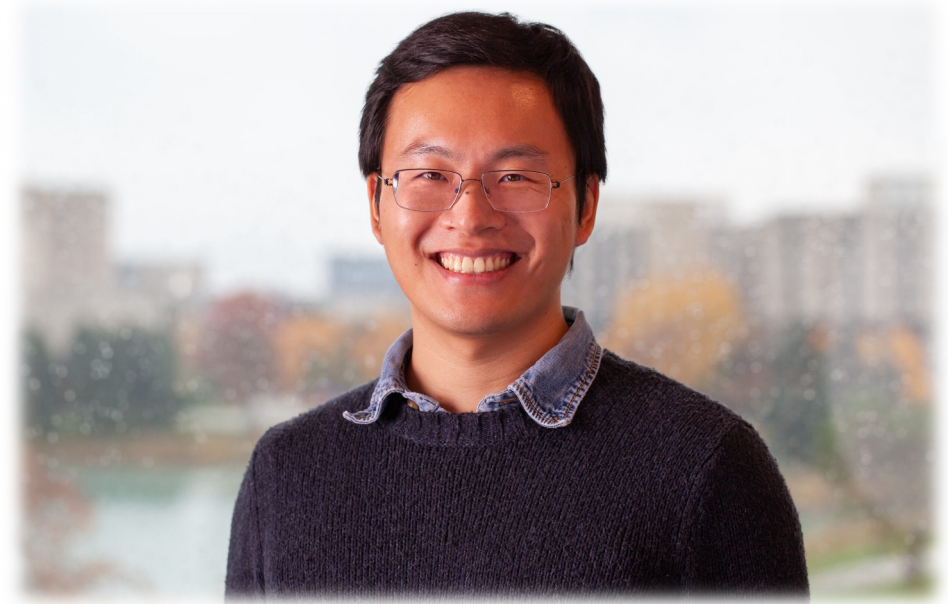


**Ted Sargent, PhD**

Lynn Hopton Davis & Greg Davis Professor

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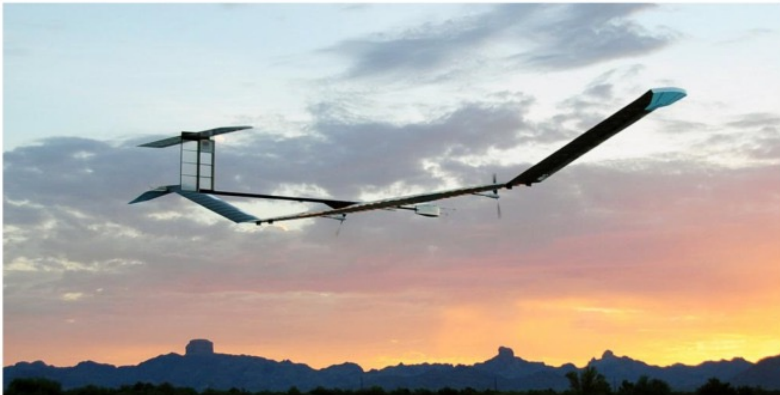
**Bin Chen, PhD**

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INTERNATIONAL INSTITUTE FOR  
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# Solar cell technology



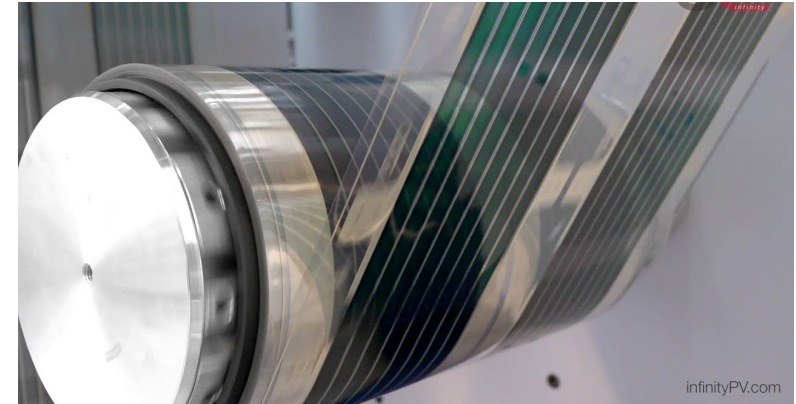
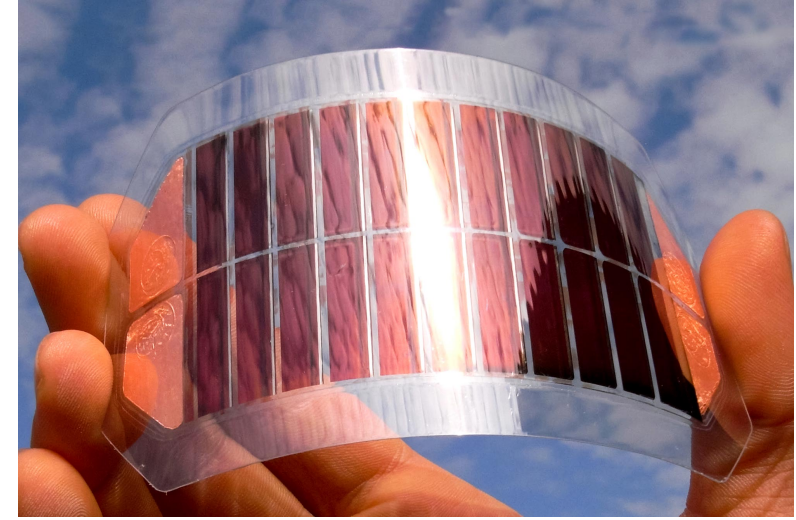
Can we have the high efficiencies of III-V solar cells at the cost of silicon cells?

III-V solar cells  
> 30% PCE, \$80/W

Silicon solar cells ~22% PCE,  
90% market share, \$0.3/W



# Solar cell technology

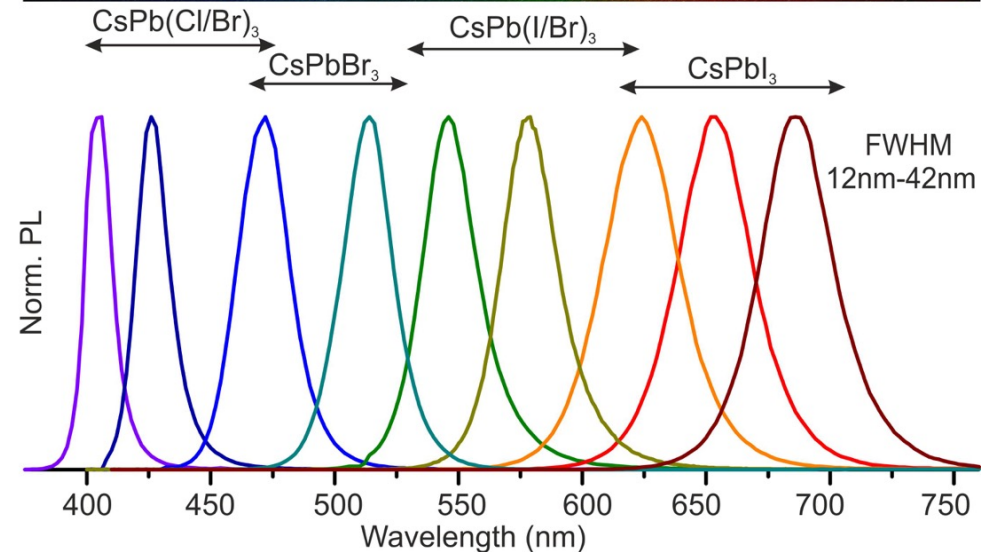
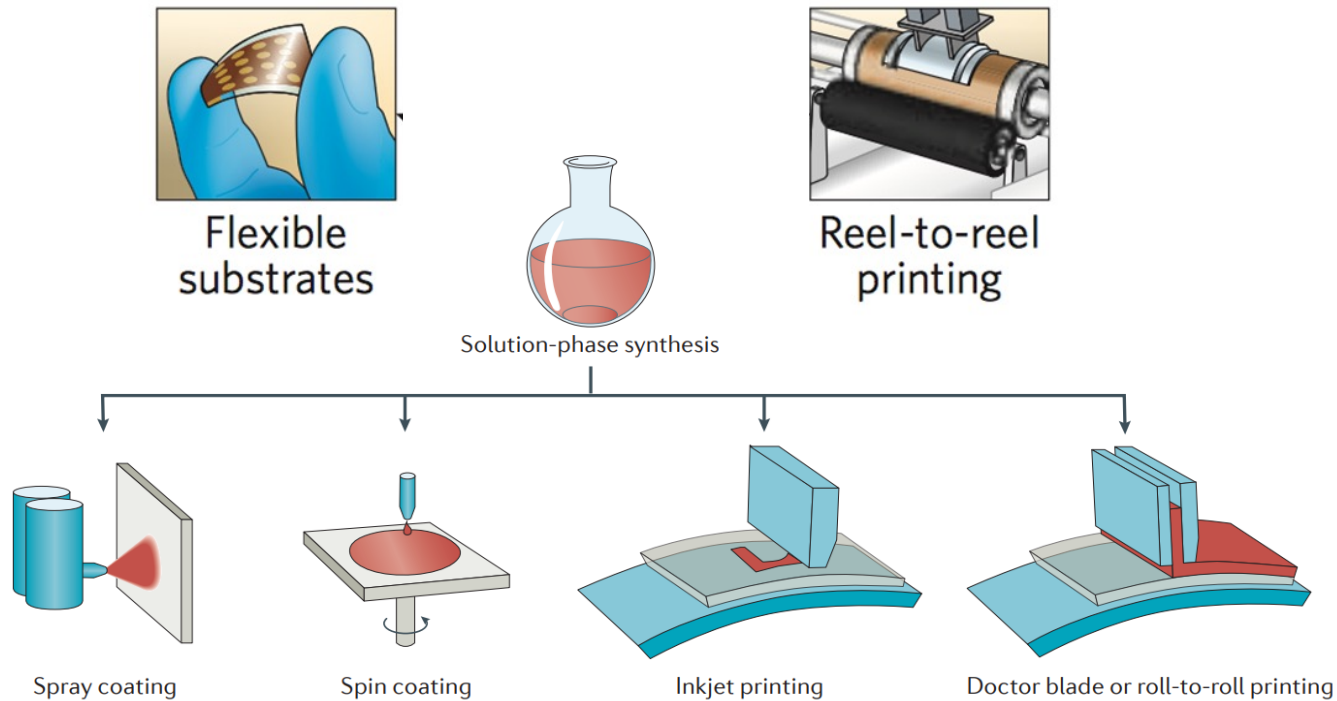


III-V solar cells  
> 30% PCE, \$80/W

Silicon solar cells ~22% PCE,  
90% market share, \$0.3/W

Perovskite solar cells  
> 26% PCE, \$0.35/W

# Combining low cost and high efficiency

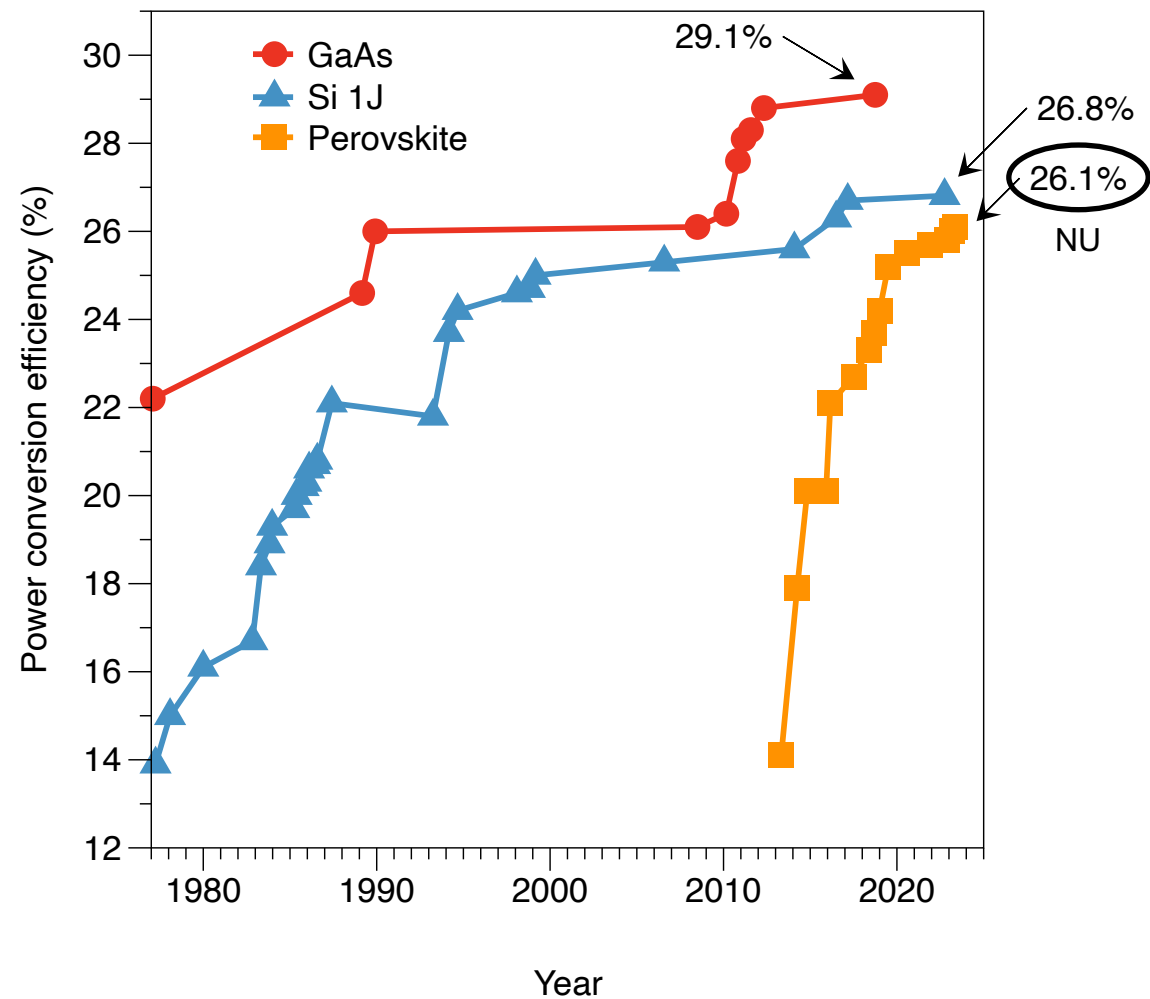
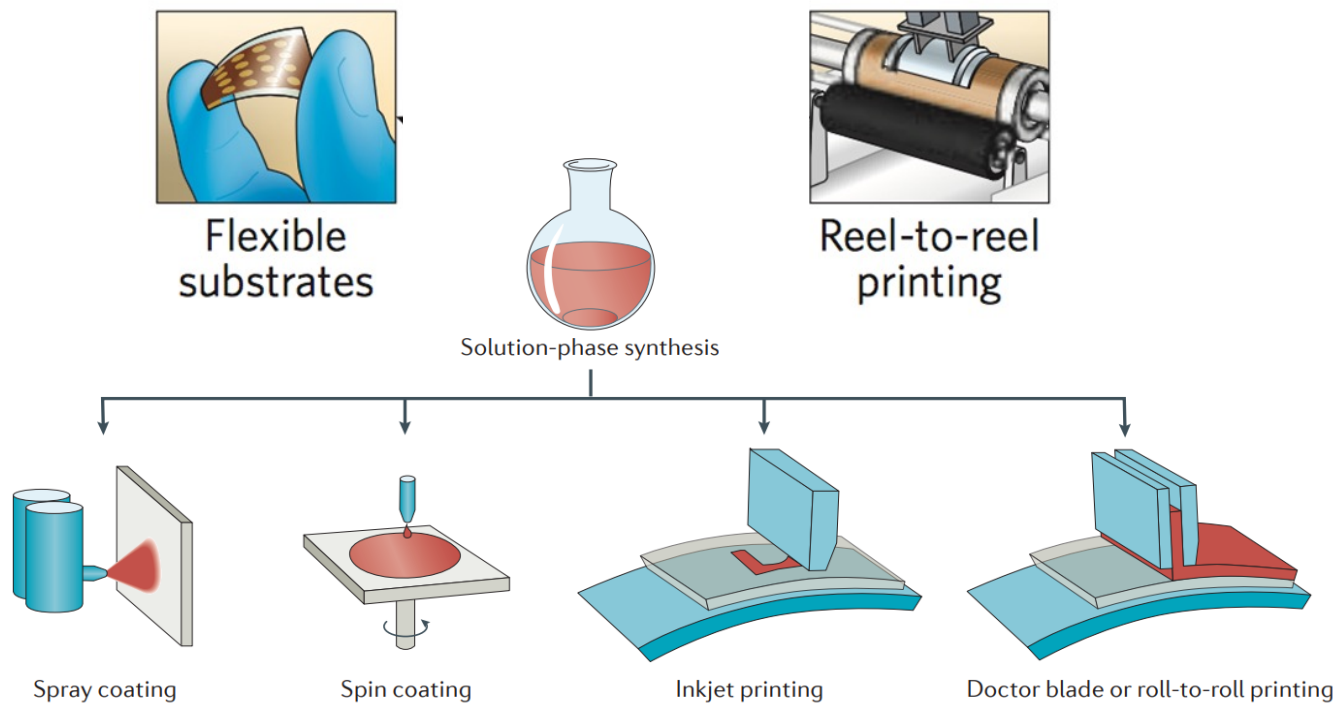


F. P. G. de Arquer, ..., E. H. Sargent, *Nat. Rev. Mat.*, 2, 16100 (2017)  
F. P. G. de Arquer, ..., E. H. Sargent, *Science*, 373, 6555, eaaz8541 (2021)

Nano Lett. 2015, 15 (6), 3692–3696.



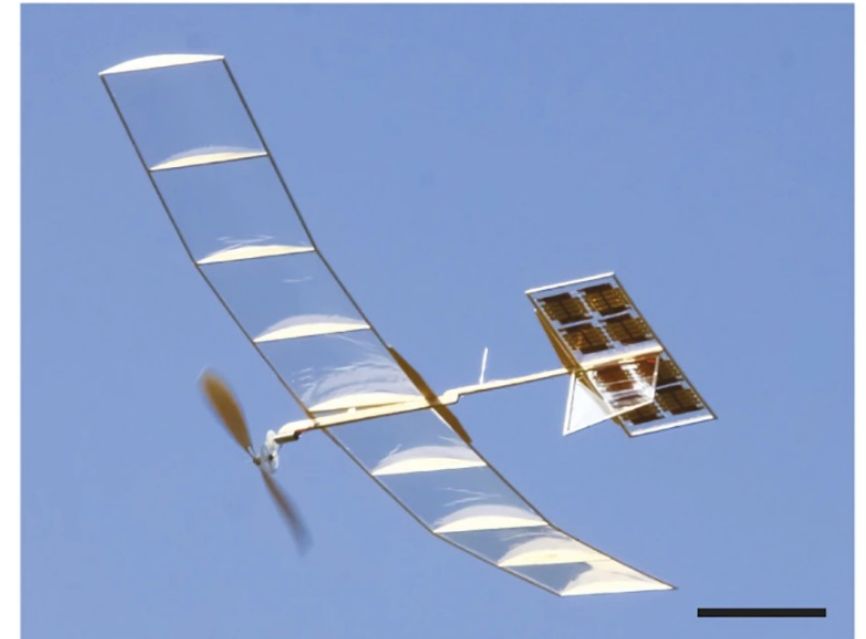
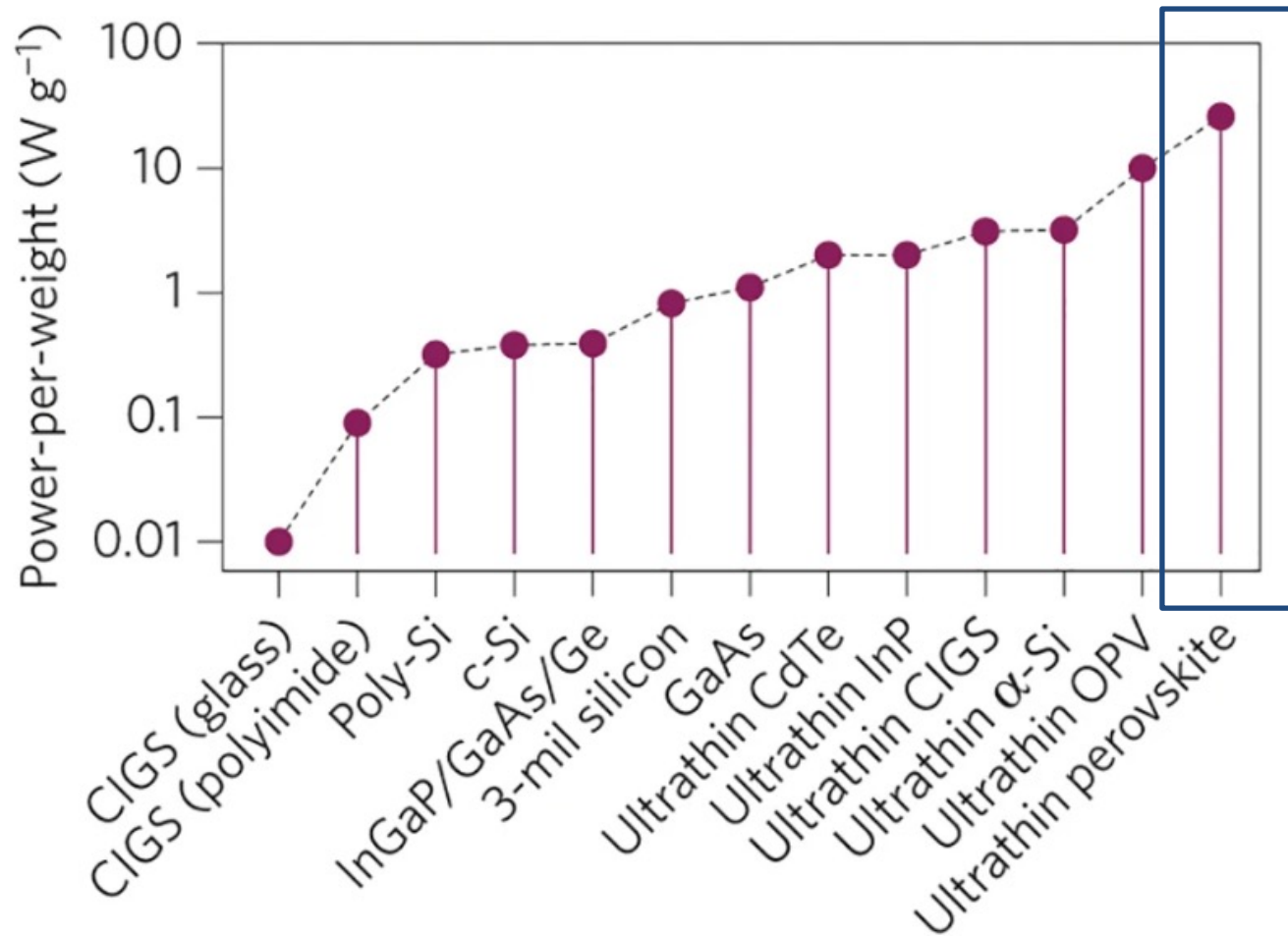
# Combining low cost and high efficiency



F. P. G. de Arquer, ..., E. H. Sargent, *Nat. Rev. Mat.*, 2, 16100 (2017)  
F. P. G. de Arquer, ..., E. H. Sargent, *Science*, 373, 6555, eaaz8541 (2021)

# High power-per-weight

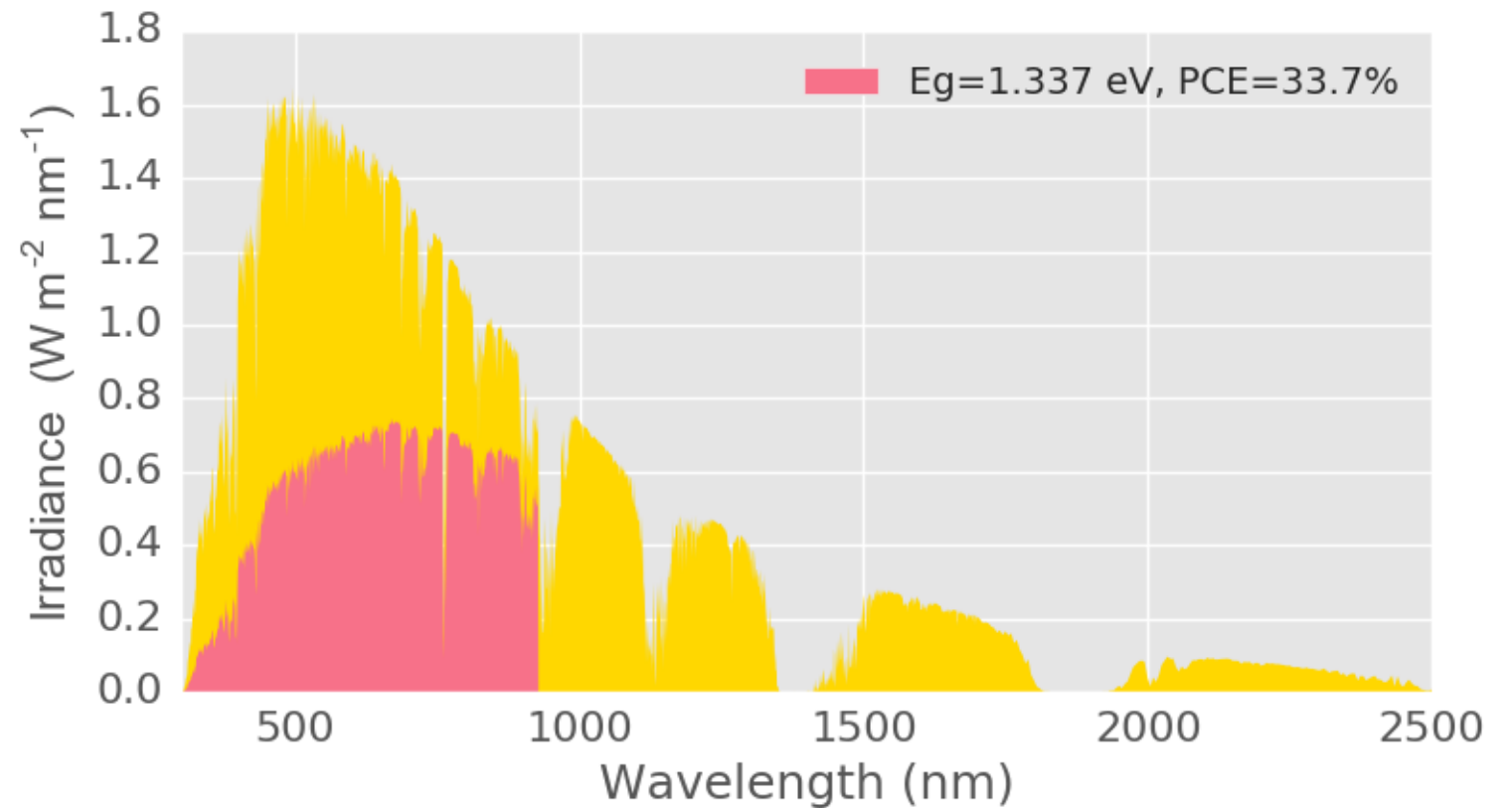
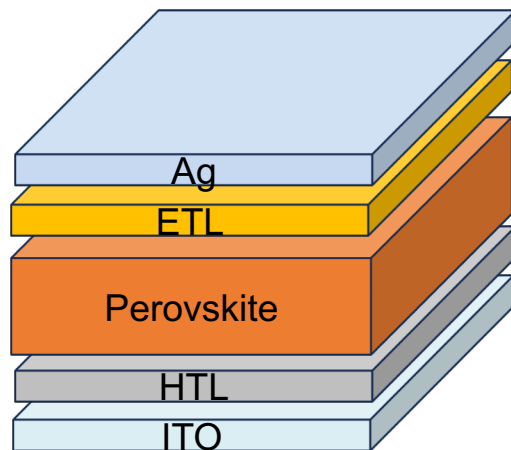
Perovskite 23 W/g



*Nat. Mater.* **2015**, 14 (10), 1032–1039.

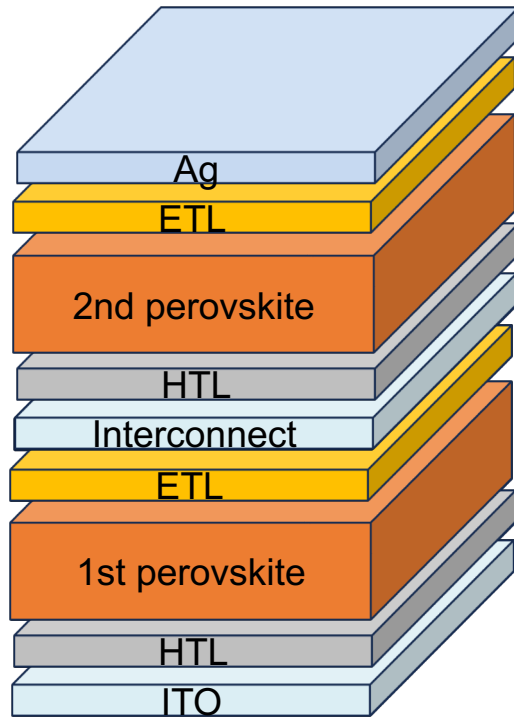
# Fundamental limit of a single layer solar cell

Single junction efficiency limit of 33%

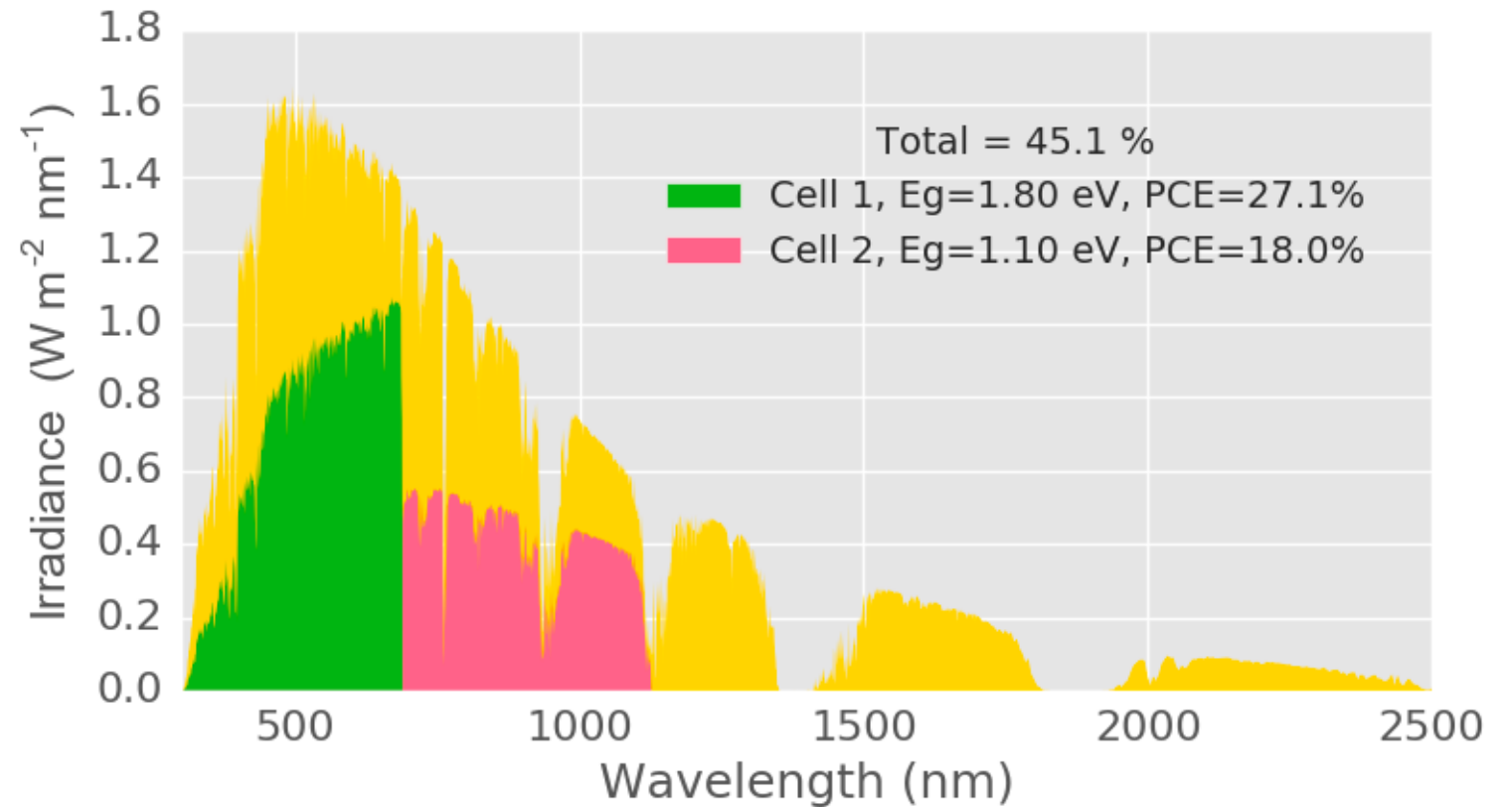




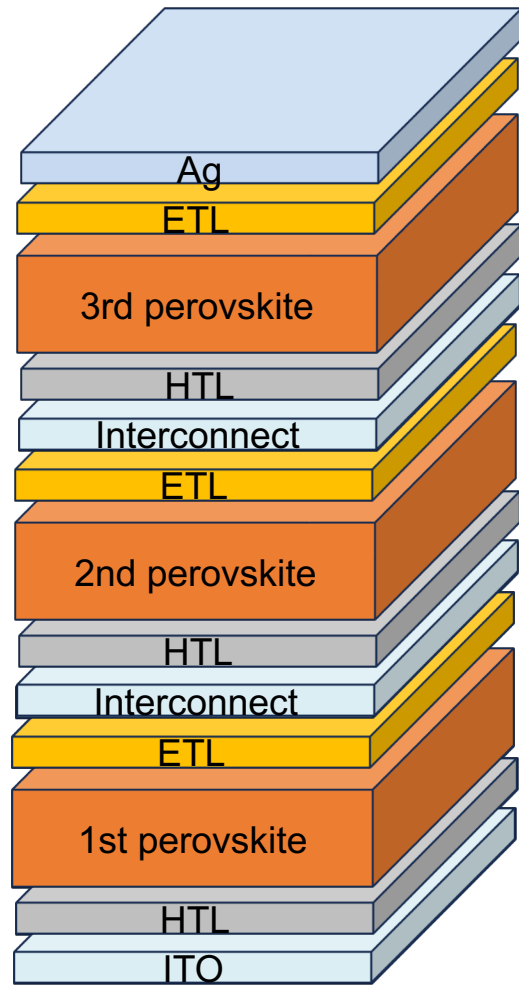
# Multi-junction solar cells offer higher efficiencies



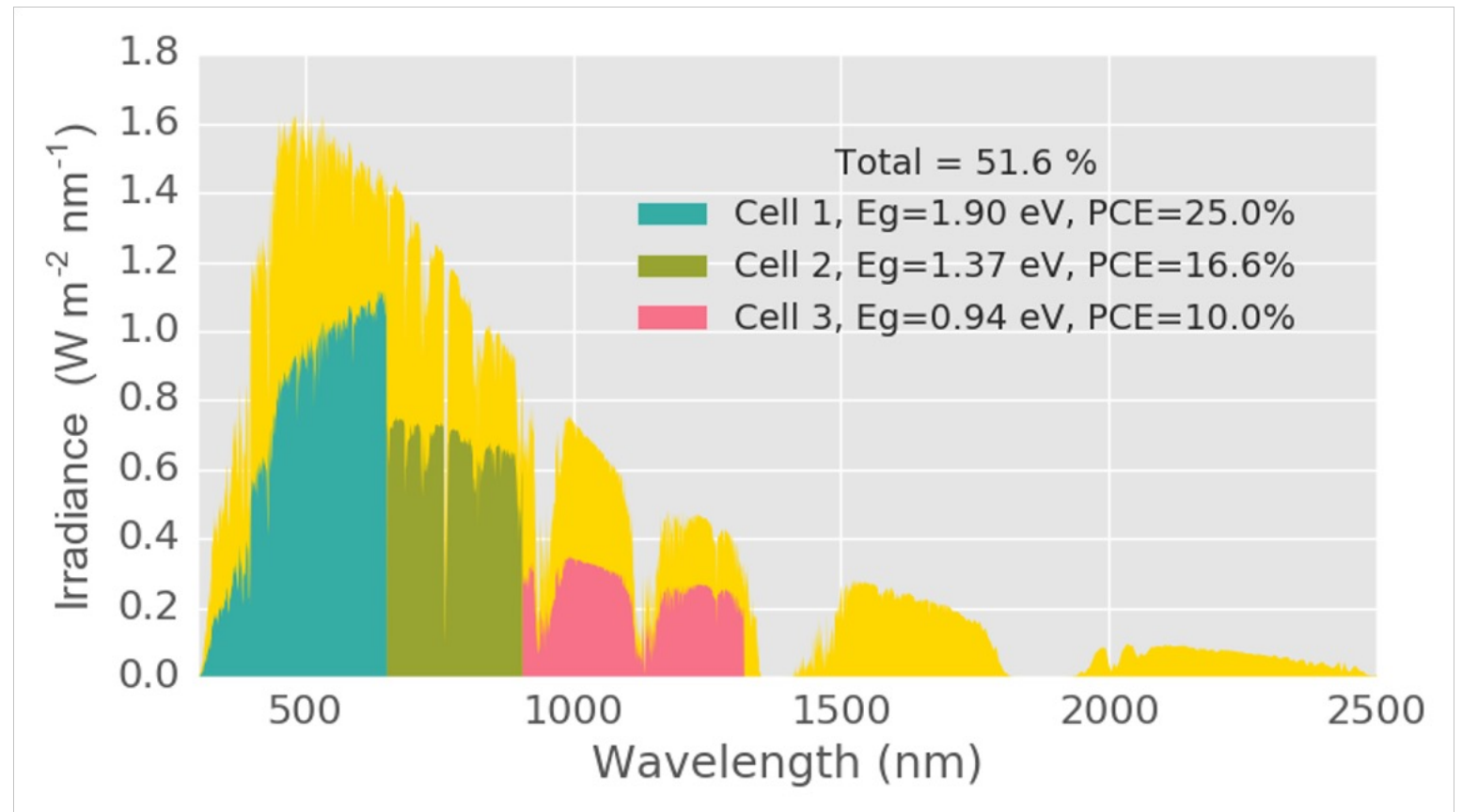
Double-junction efficiency limit of 45%



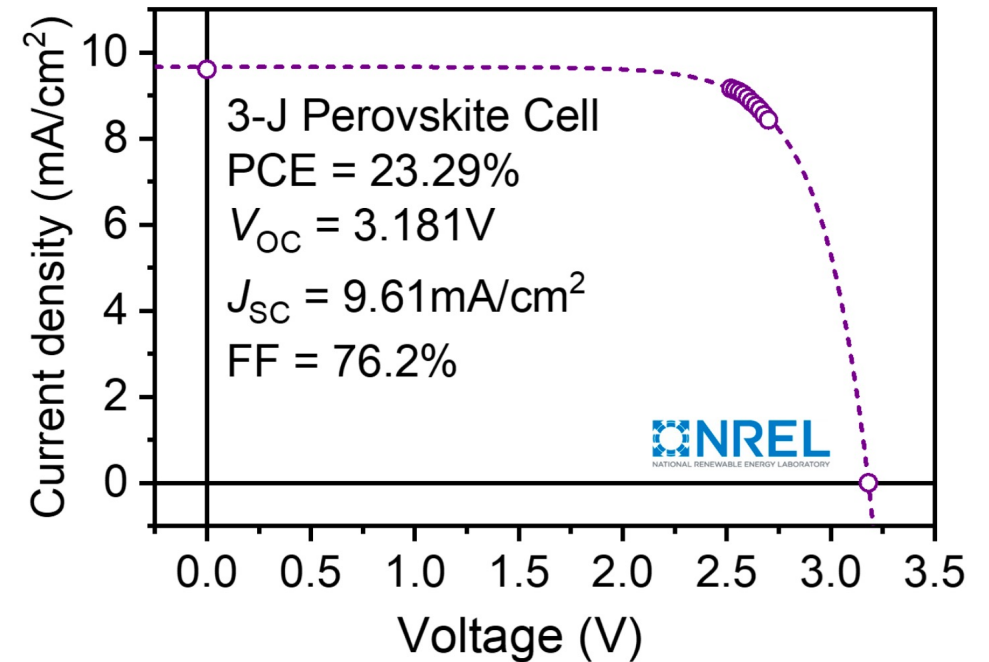
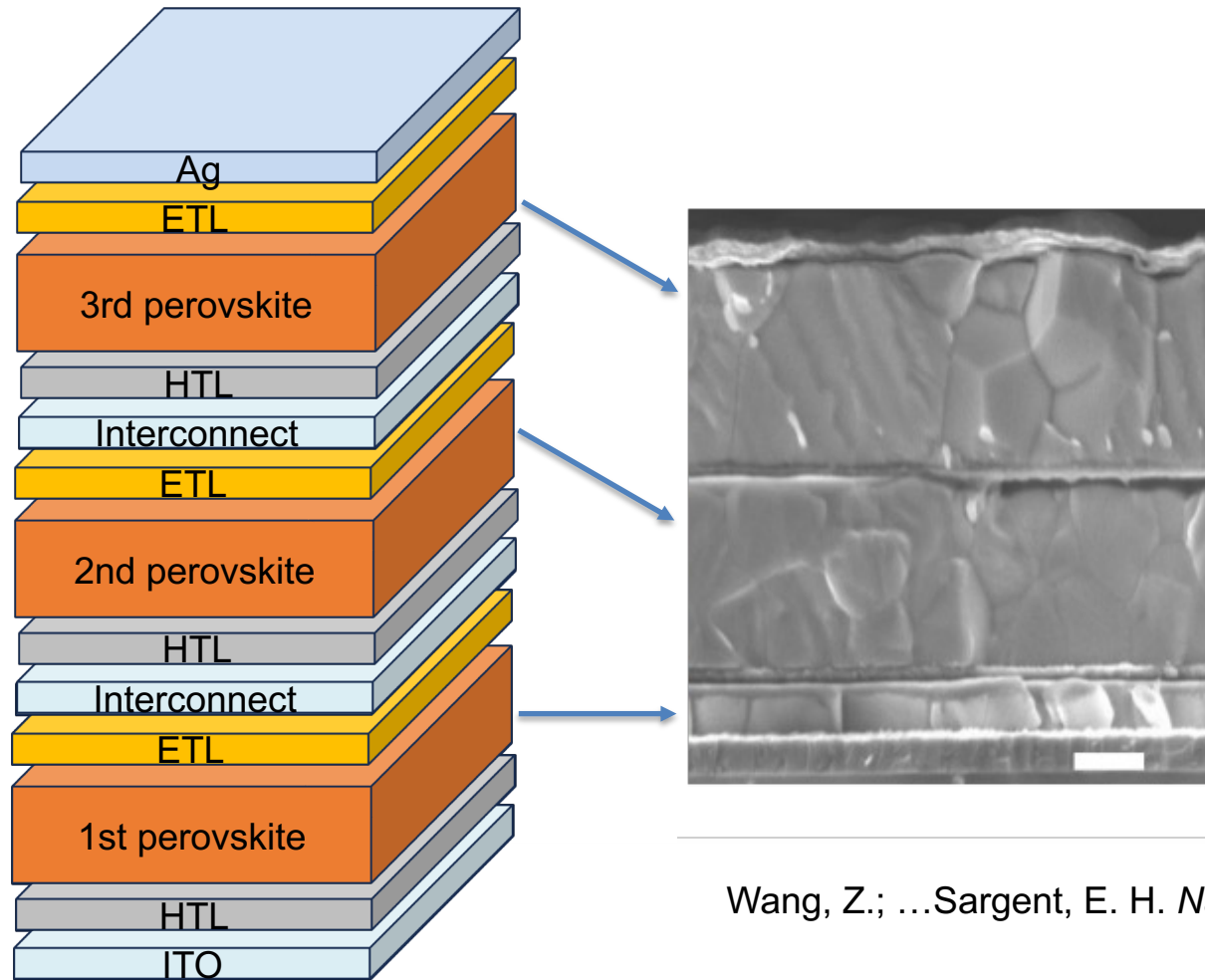
# Multi-junction solar cells offer higher efficiencies



Triple-junction efficiency limit of 51%



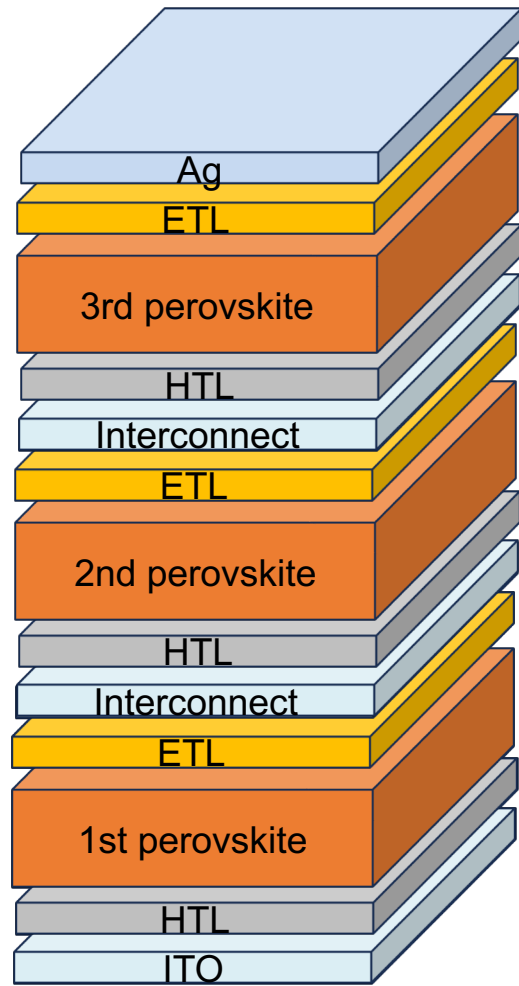
# 1<sup>st</sup> perovskite triple-junction certified by NREL



Wang, Z.; ...Sargent, E. H. *Nature* **2023**, 618 (7963), 74–79.



# Outlook for perovskite triple junctions



35% tandem at 6g/m<sup>2</sup>  
= **58 w/g**

