Passivating contacts in the perspective of PV technology development

Wim Sinke
ECN Solar Energy, UvA and AMOLF

Workshop Passivating Contacts
TU/e, 31 January 2018

ECN

UNIVERSITEIT VAN AMSTERDAM

AMOLF

Mexico: Third auction sees 1.3 GW of contracted solar capacity

Solar was awarded 55% of the contracted energy and 58.3% of the clean energy certificates in Mexico's latest auction. It concluded with an average price of $20.57/MWh, which represents a world record.

NOVEMBER 23, 2017 PILAR SÁNCHEZ MOLINA

MARKETS | UTILITY-SCALE PV | CENTRAL & SOUTH AMERICA | MEXICO

www.pv-magazine.com/2017/11/23/mexico-third-auction-sees-1-3-gw-of-contracted-solar-capacity

Lowest PPA price so far: **1.7 ¢/kWh** (dual axis tracking)

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Solar heads to 1c/kWh before 2020 after Mexico sets record low

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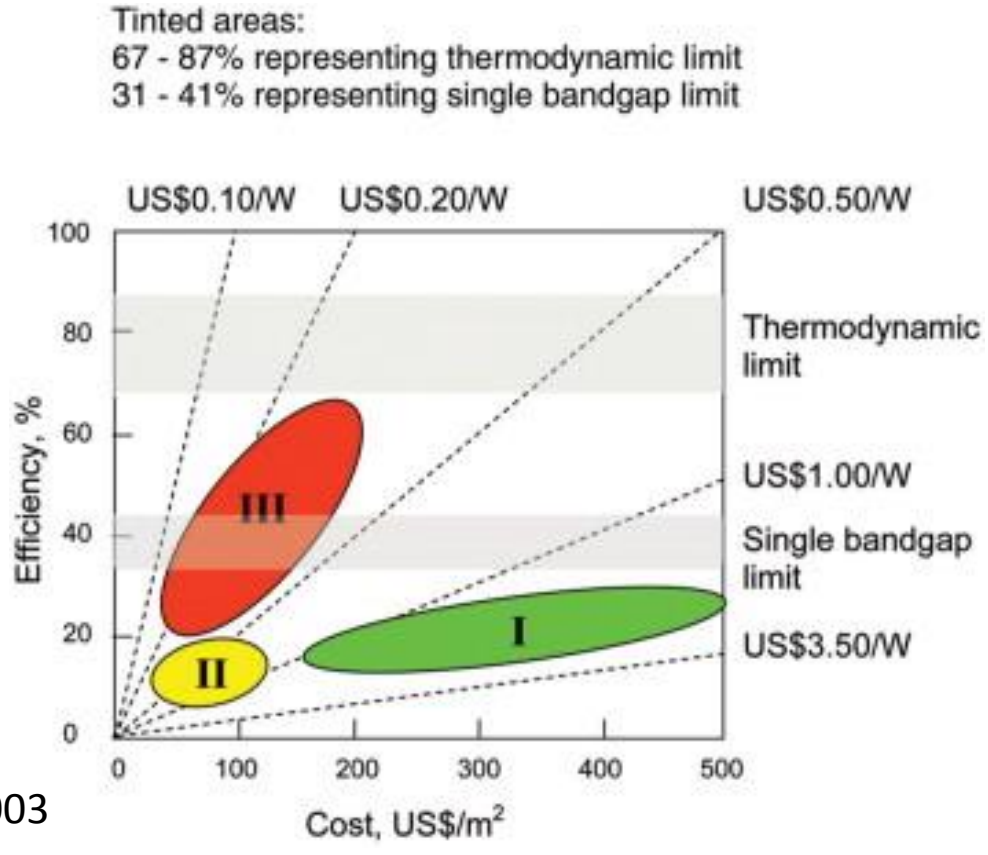
By Giles Parkinson on 20 November 2017

Print

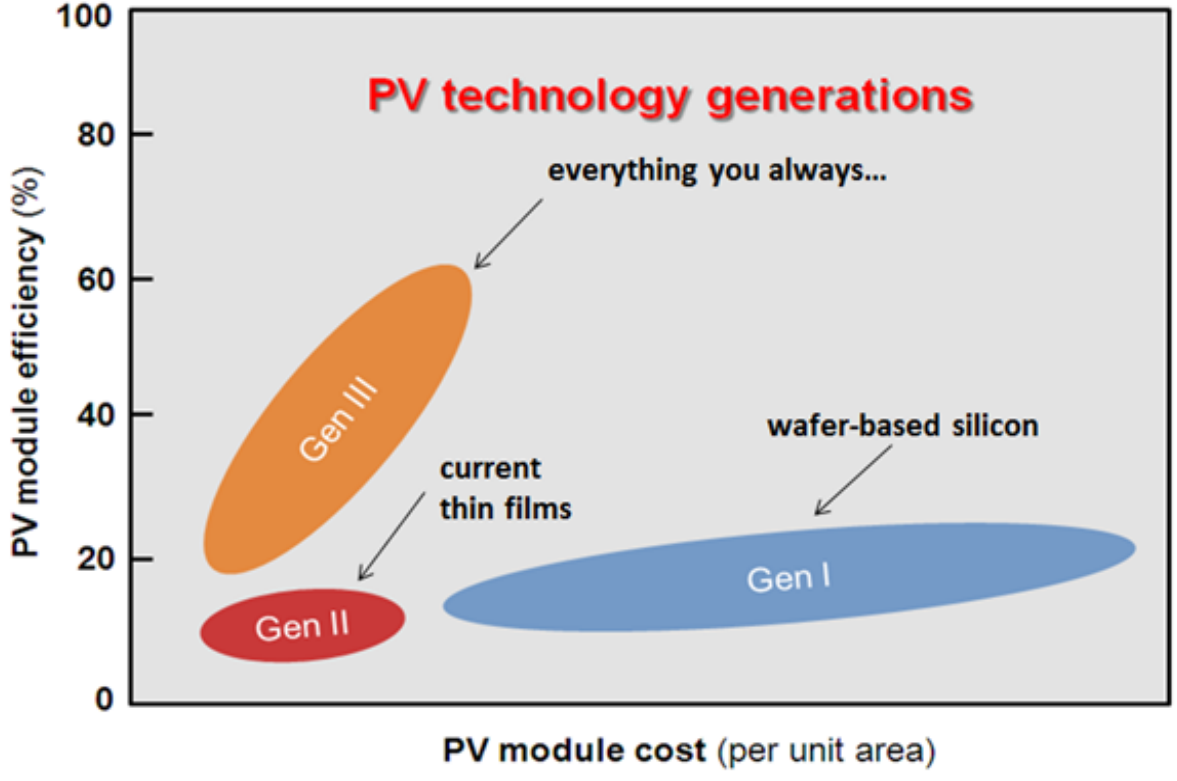
Australia's leading solar researcher Dr Martin Green predicted just a few months ago that the cost of solar would fall to around 1c/kwh by the mid 2020s. He now expects he will not have to wait that long.

PV technologies
The "generations" view



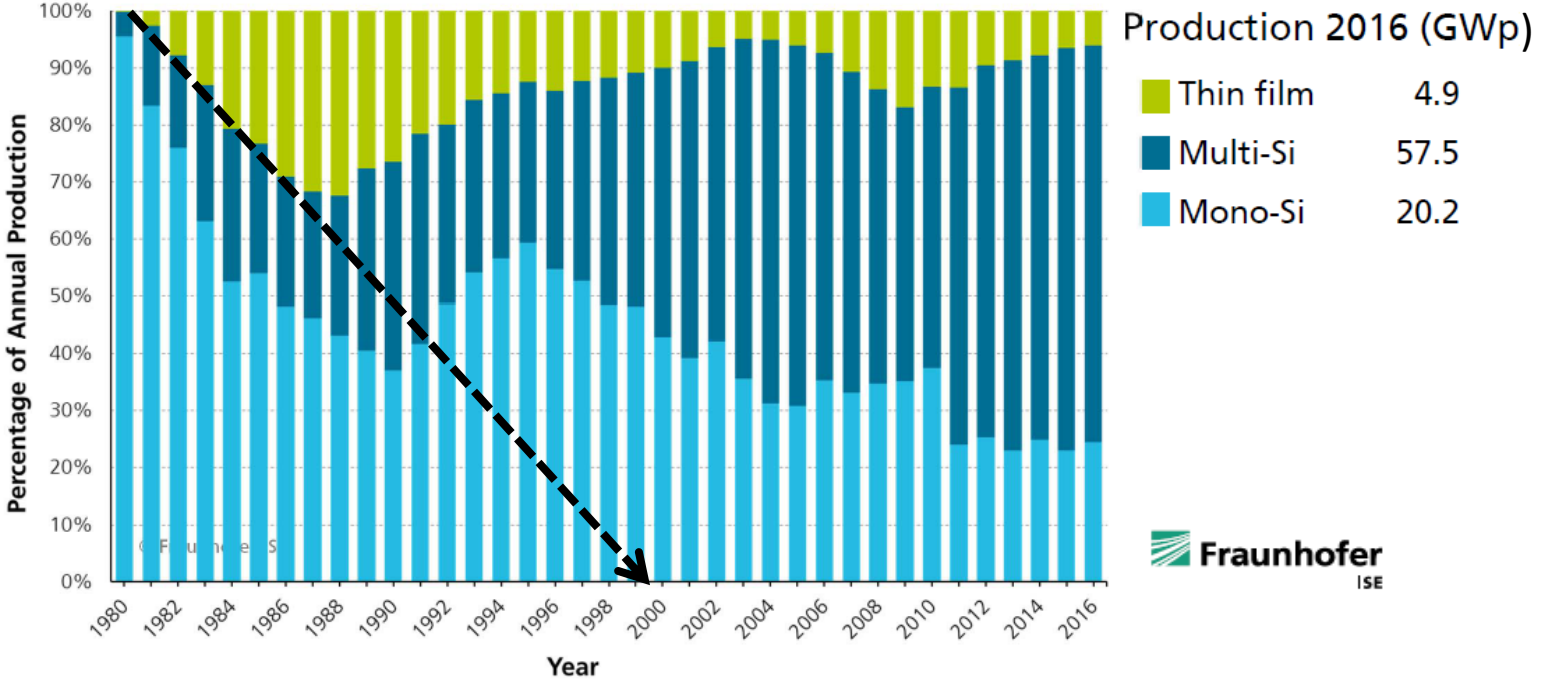
M.A. Green, 2003

PV technologies
The "generations" view



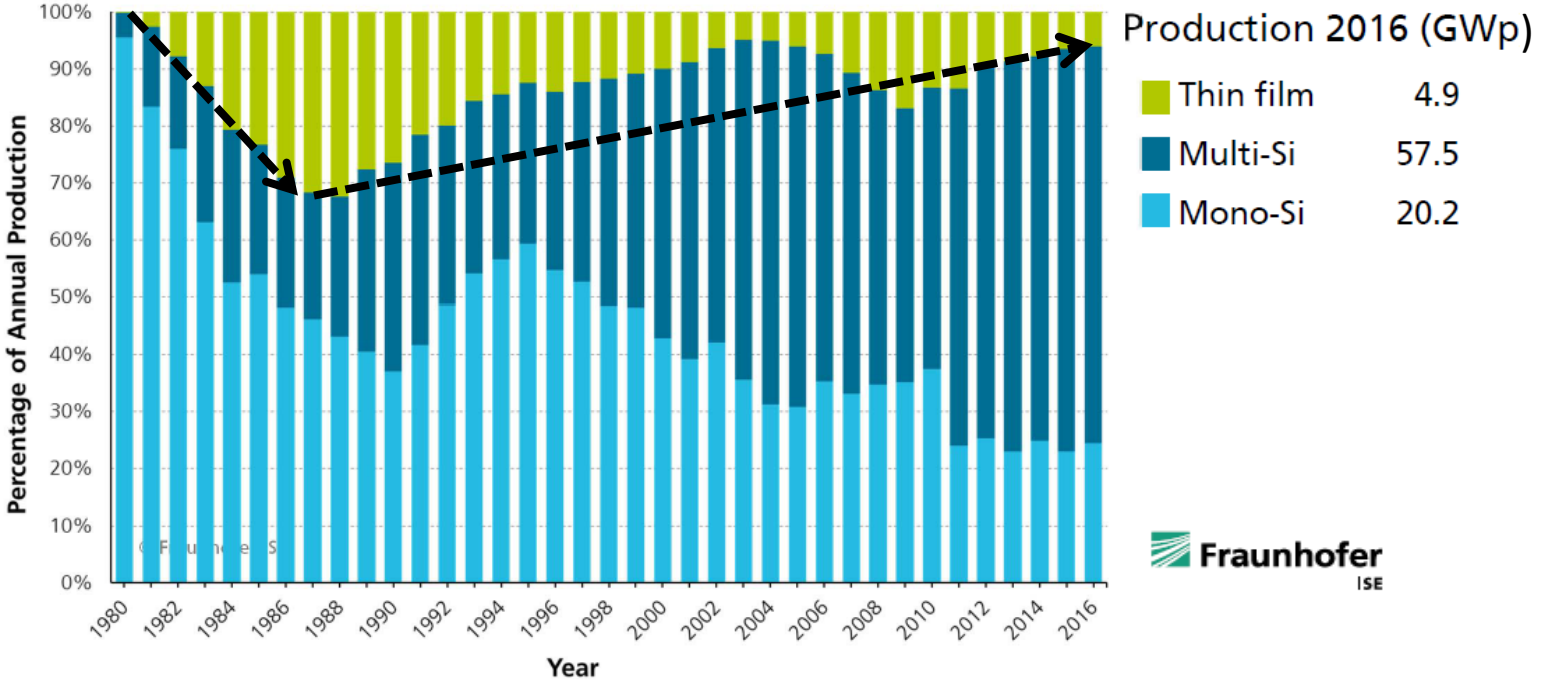
Is (silicon) PV approaching the end of its development?

PV technology market shares



Data: from 2000 to 2010: Navigant; from 2011: IHS (Mono-/Multi- proportion from cell production). Graph: PSE AG 2017

PV technology market shares



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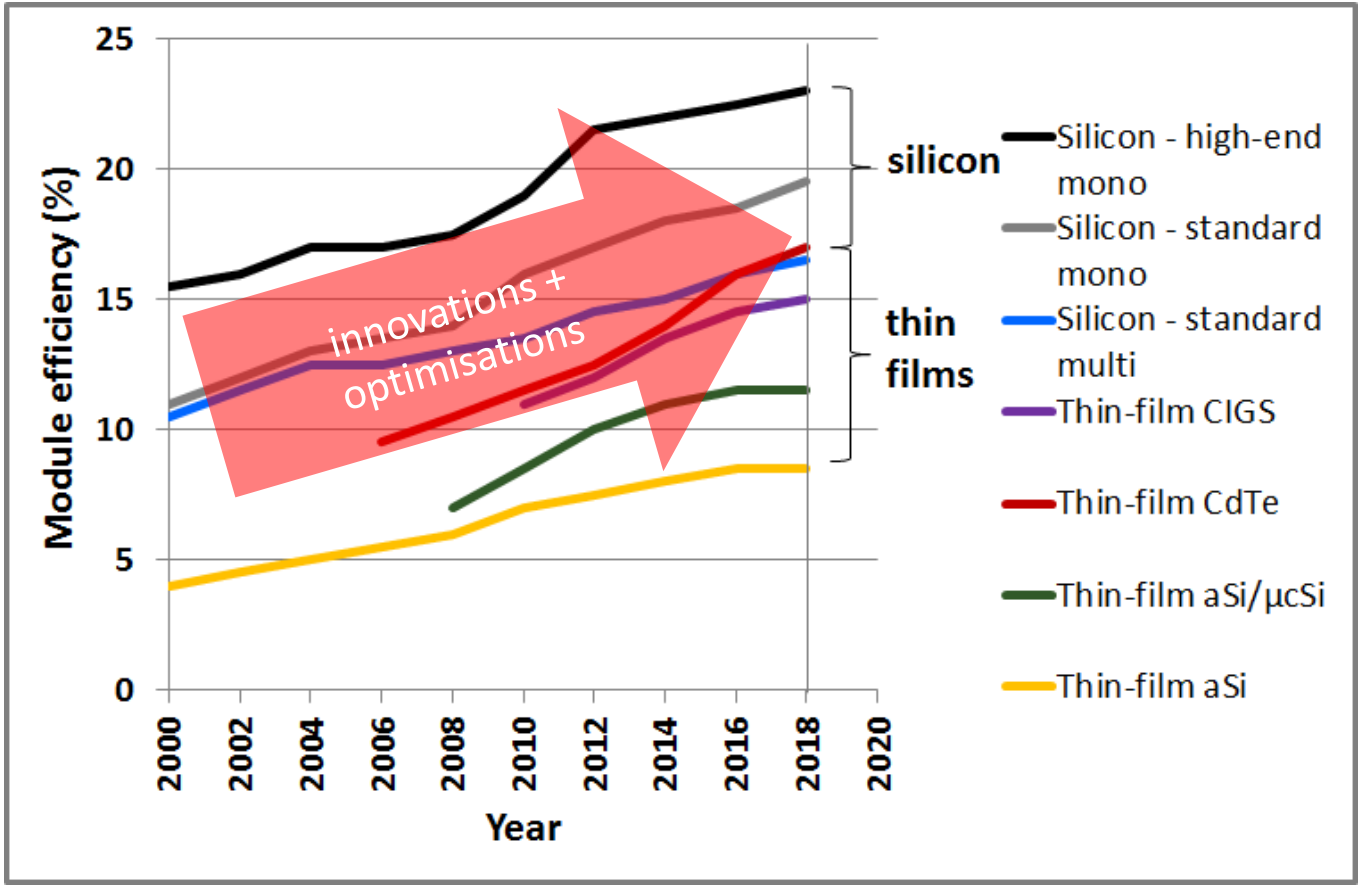
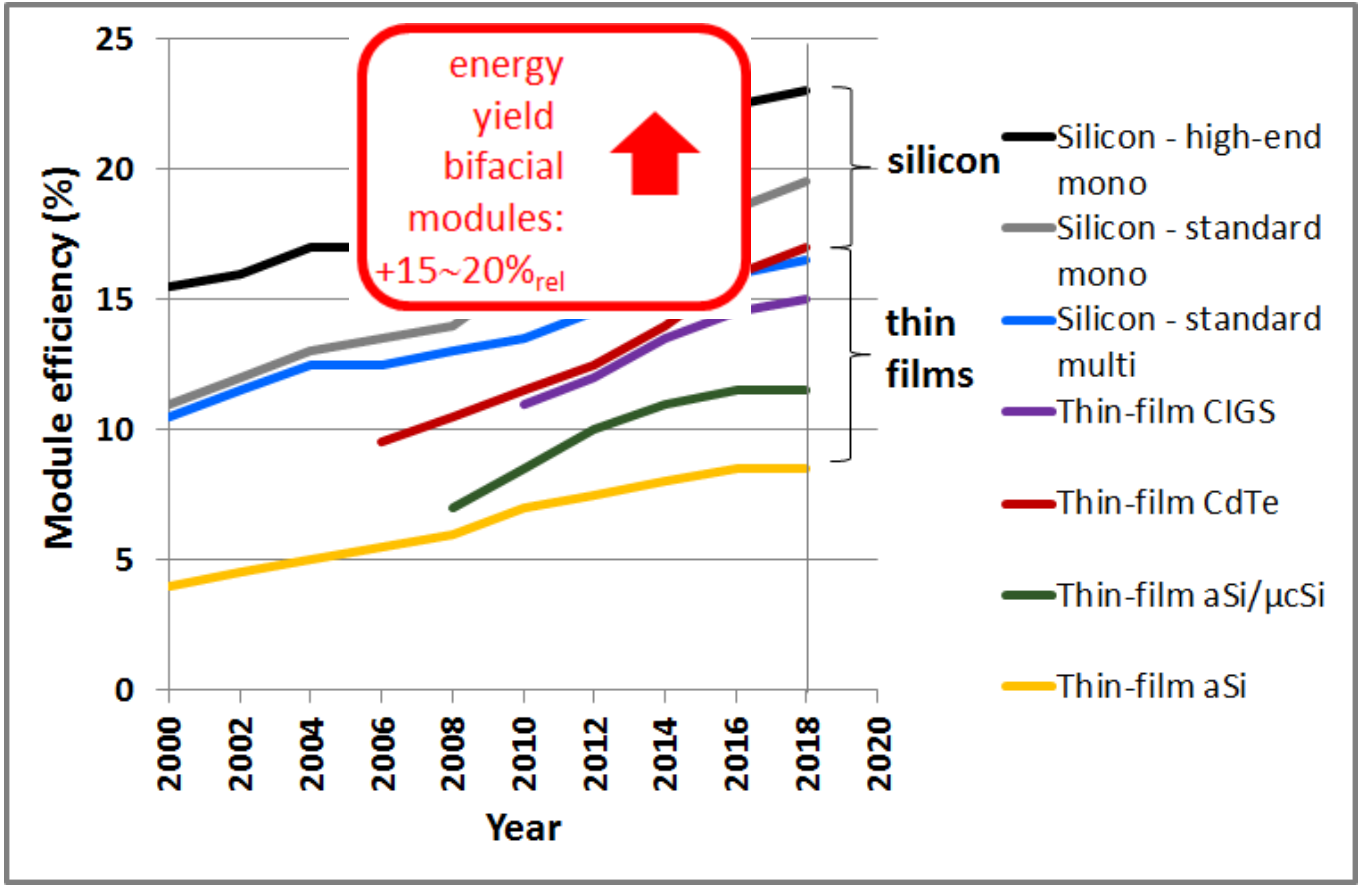
Commercial module efficiencies
Gradual but robust increase

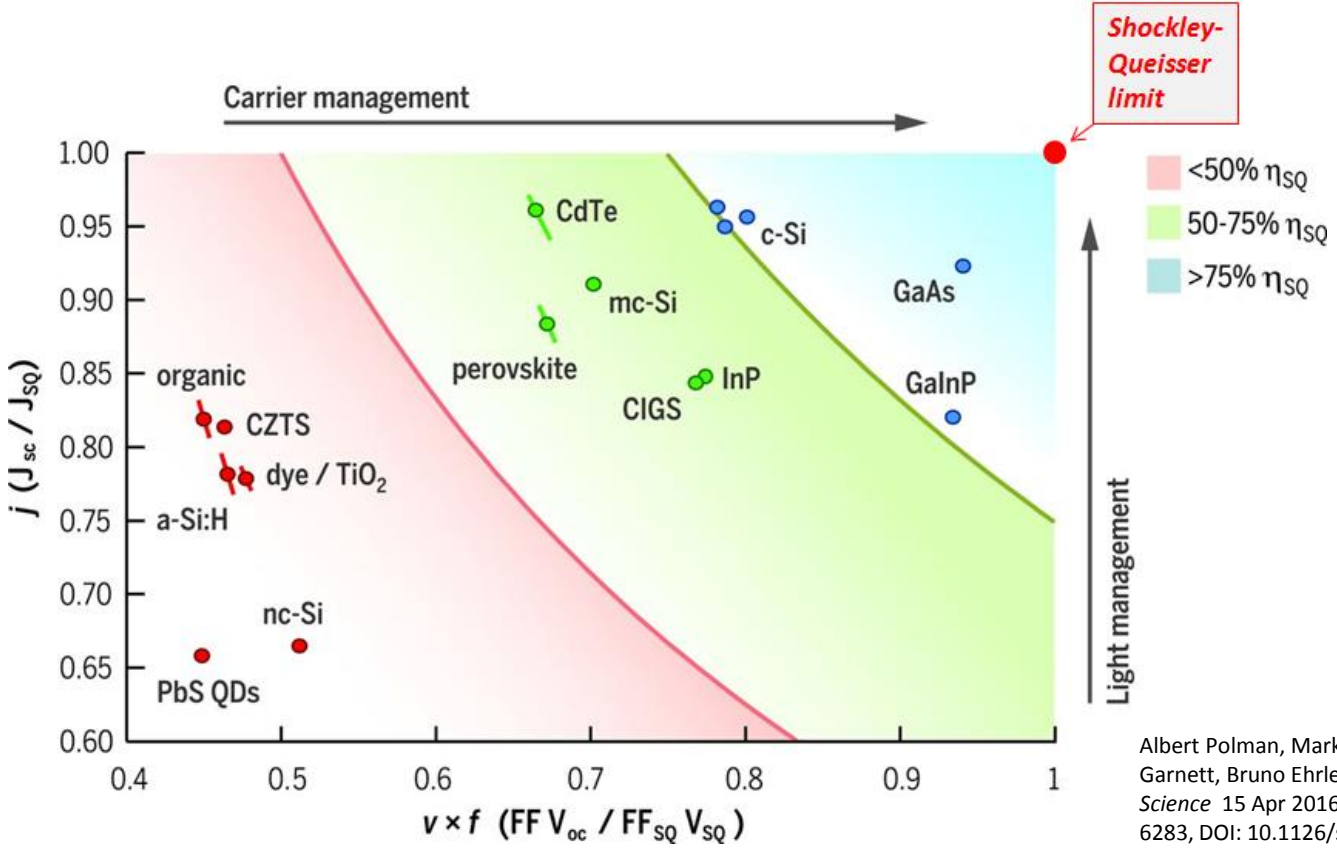


Bifacial modules

Extra energy at constant efficiency

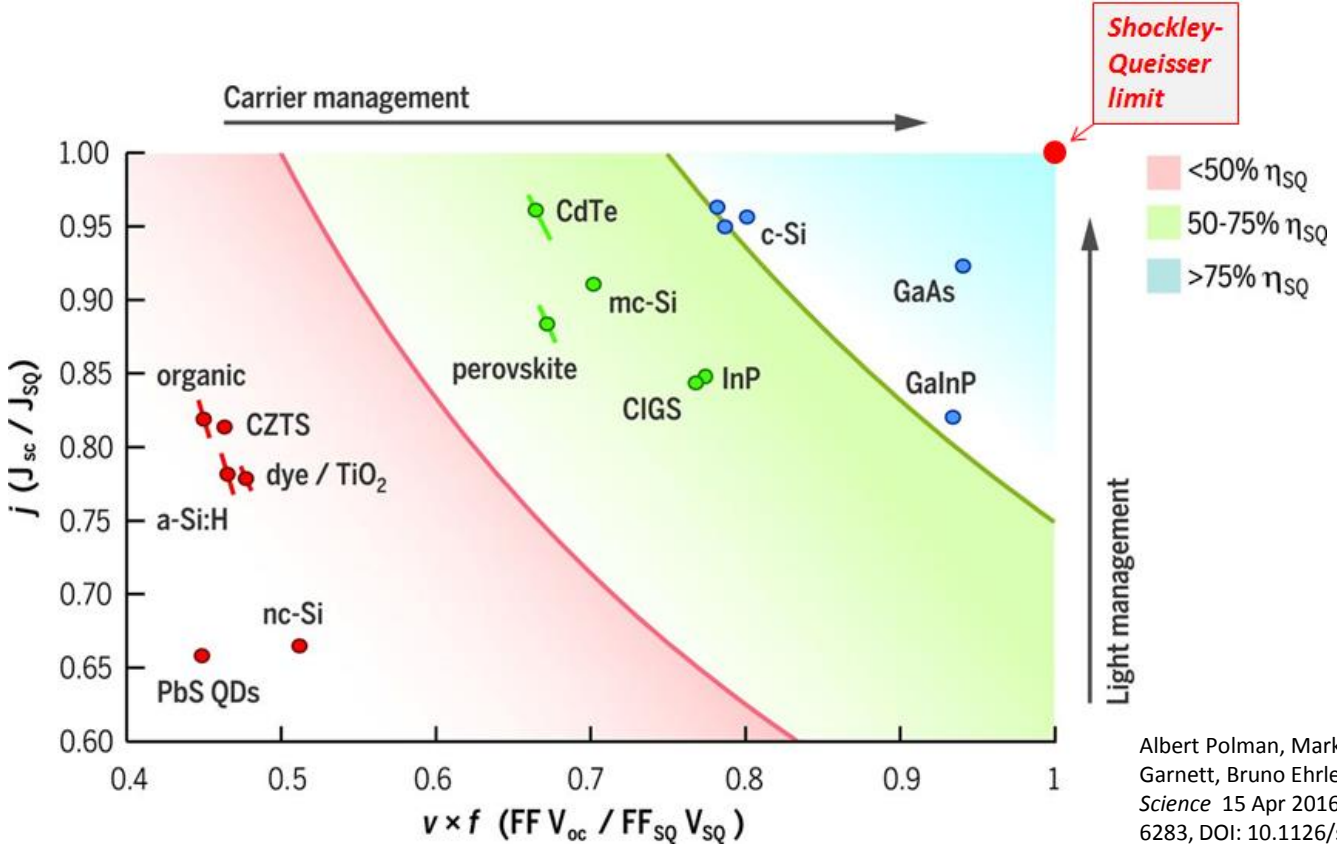


Record lab cells towards perfection



Albert Polman, Mark Knight, Erik C. Garnett, Bruno Ehrler, Wim C. Sinke *Science* 15 Apr 2016: Vol. 352, Issue 6283, DOI: 10.1126/science.aad4424

Record lab cells towards perfection (2016)



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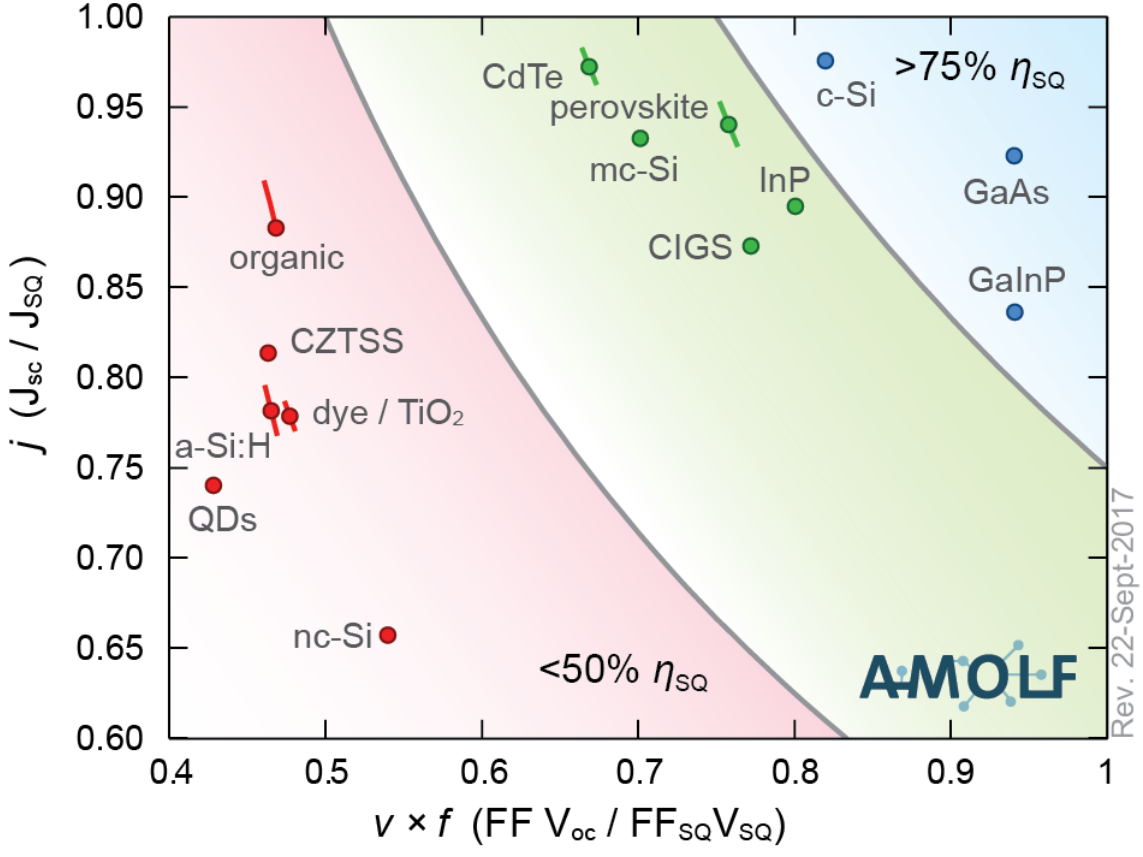
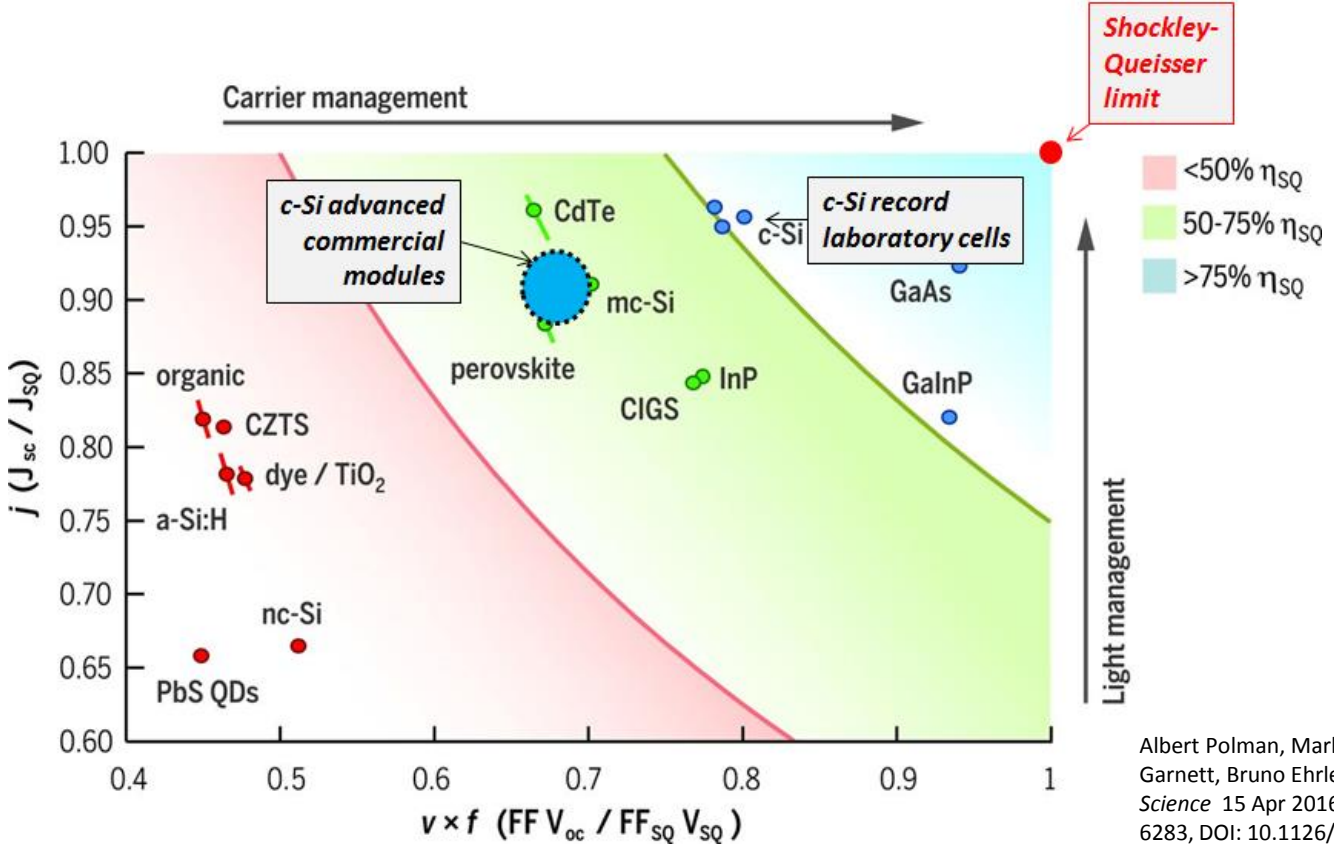


http://www.lmpv.nl/SQ/

Record lab cells towards perfection



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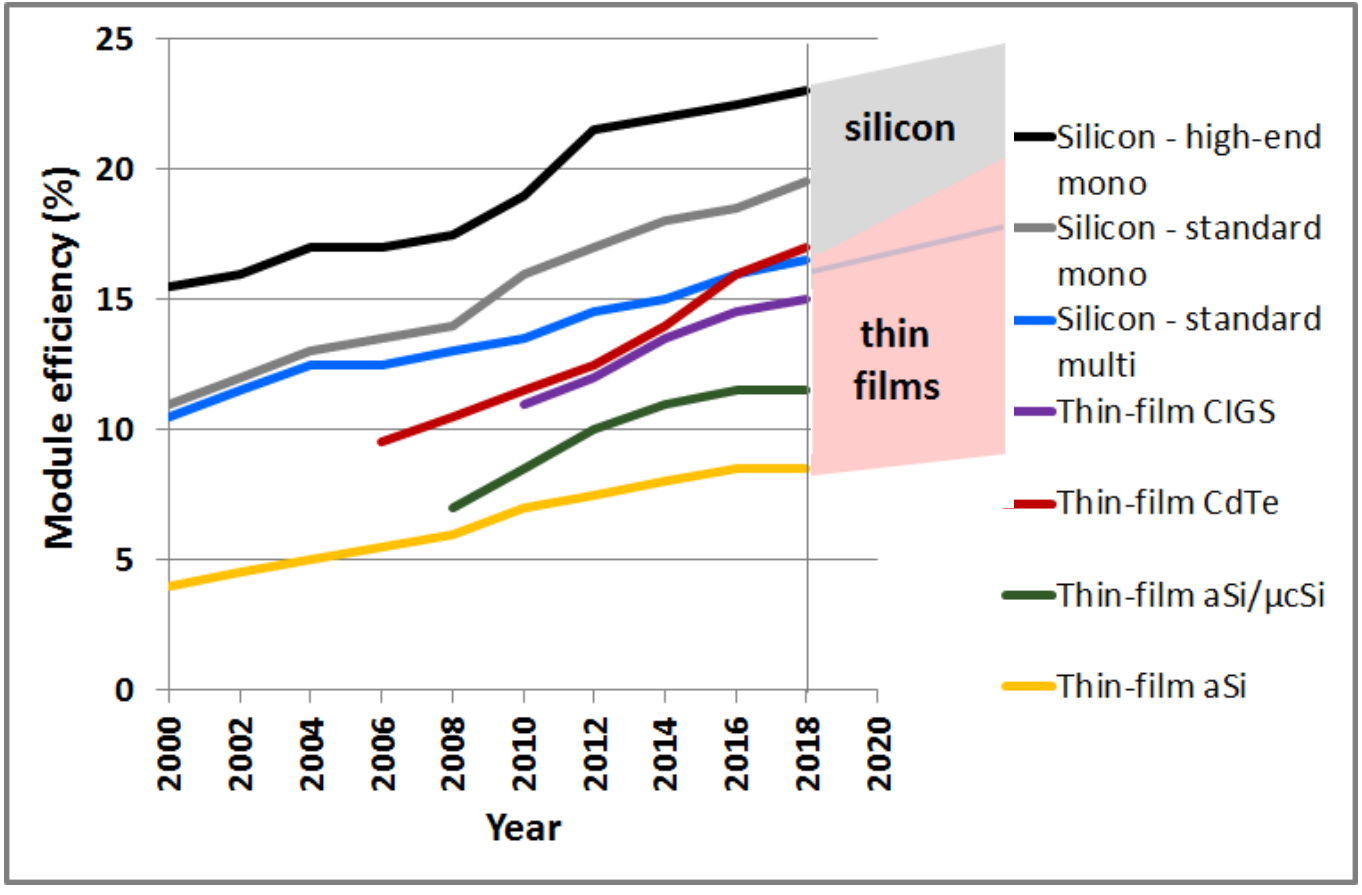
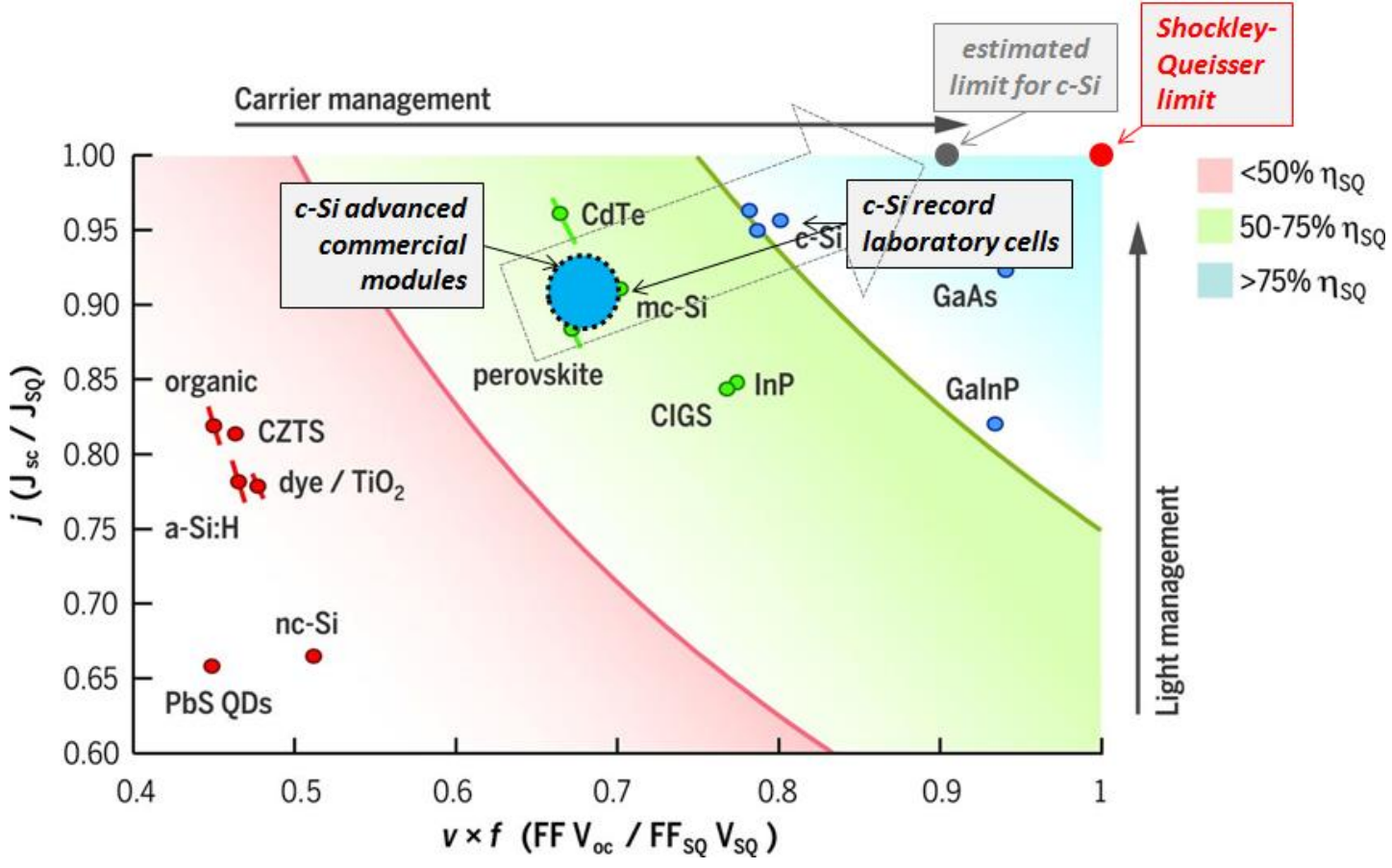
Towards higher efficiencies

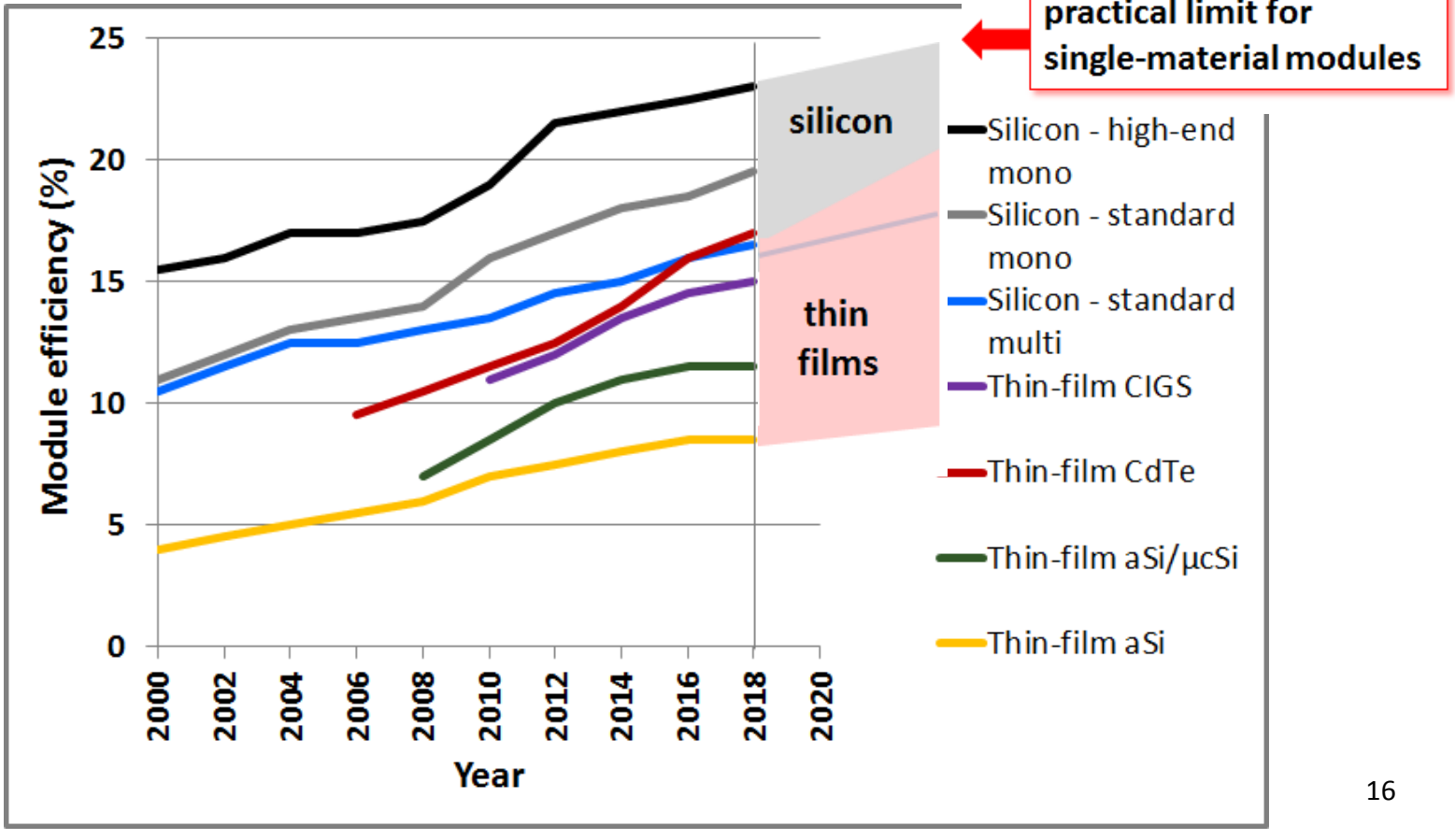
The first step: closing the lab-fab gap



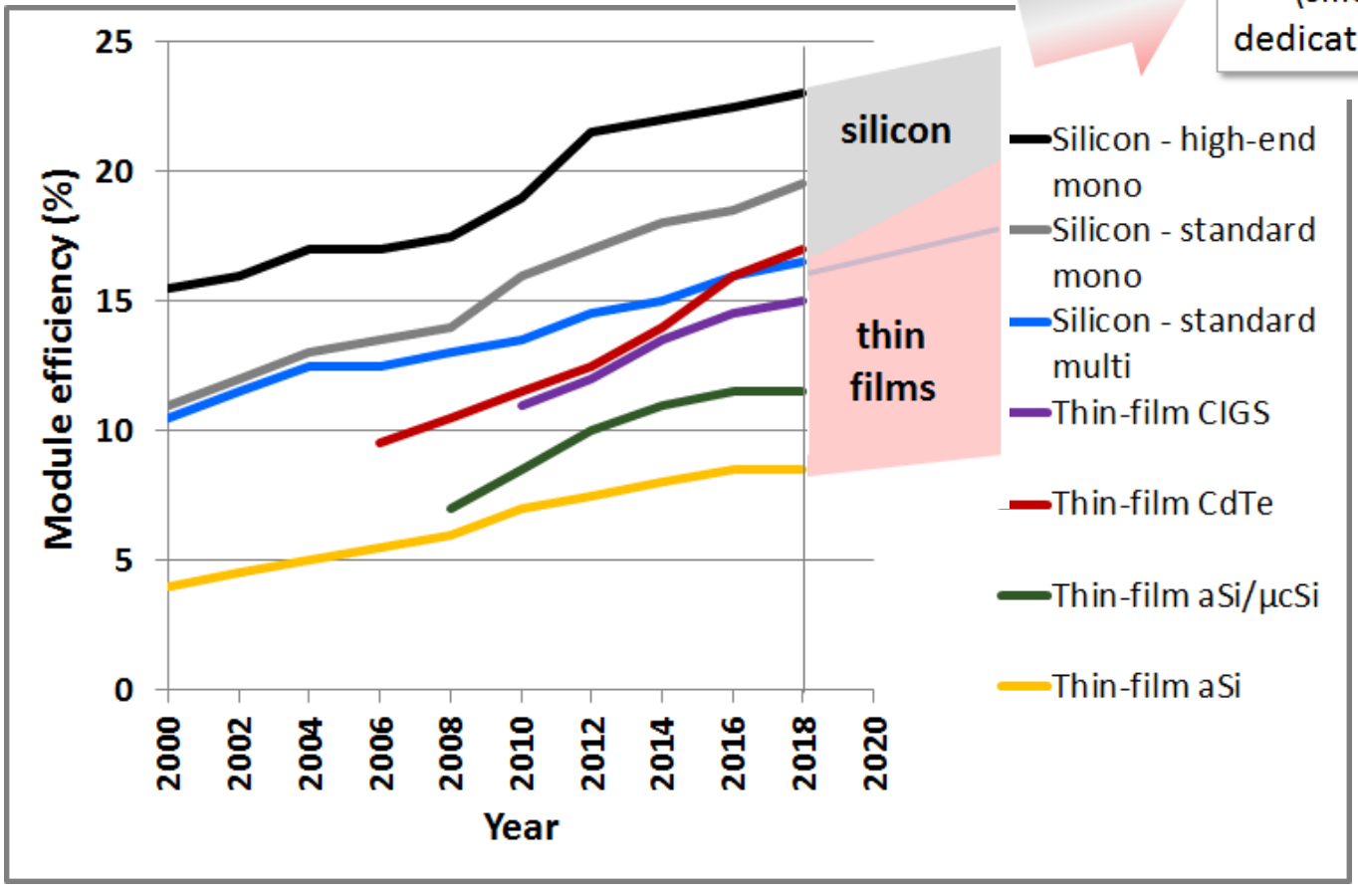
Commercial modules towards perfection



Towards higher efficiencies
T*he first hurdle*



Towards higher efficiencies
The next phase: beyond SQ



Silicon technology generations

- **Gen1**
  - Limited by (a.o.) extrinsic Si material quality:
    - Multi → mono & high-performance multi; p → n

today

- **Gen2**
  - Limited by surface & interface quality:
    - Surface passivation; passivating contacts; heterojunctions

today

- **Gen3**
  - Limited by intrinsic Si material quality:
    - Thin wafers + light trapping (to SQ)

- **Gen4**
  - Limited by Si bandgap
    - Tandems (beyond SQ)

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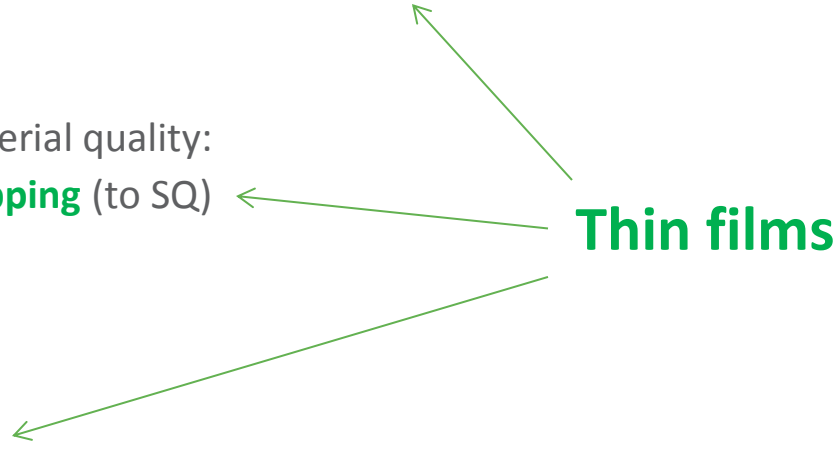

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- **Gen3?**
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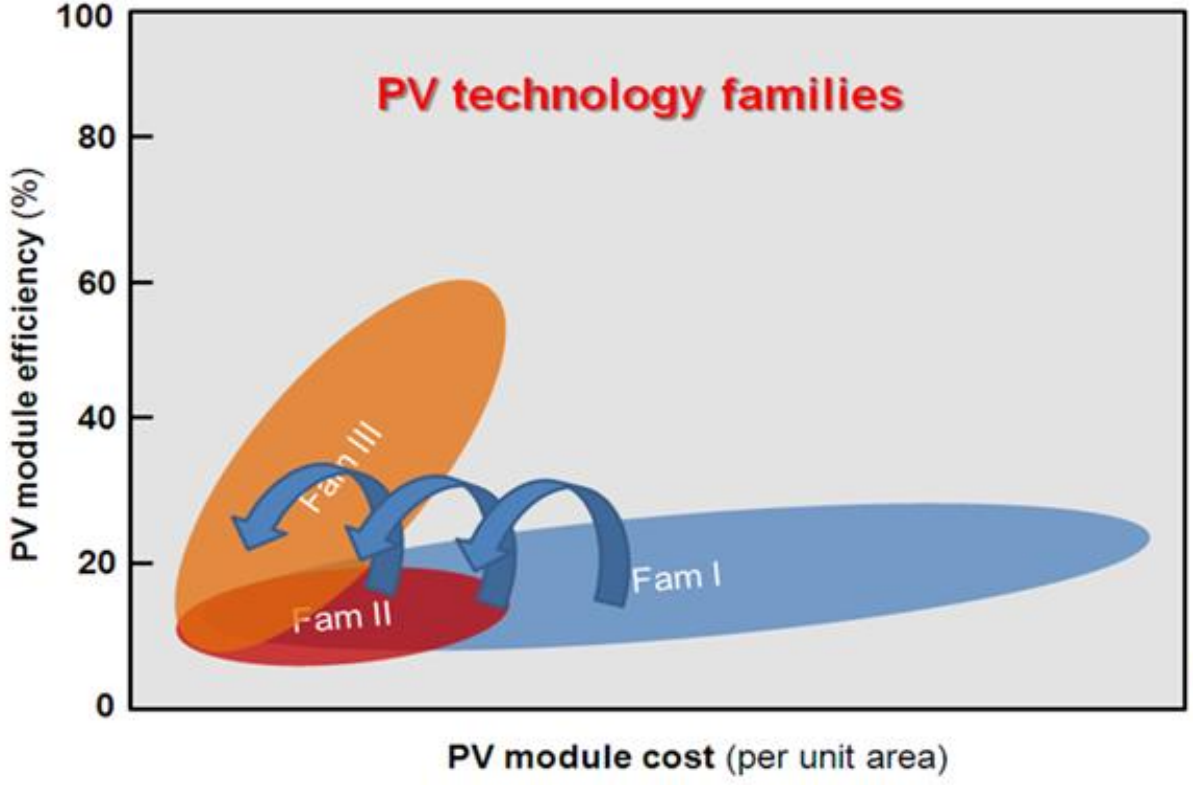
PV technologies:
an alternative view

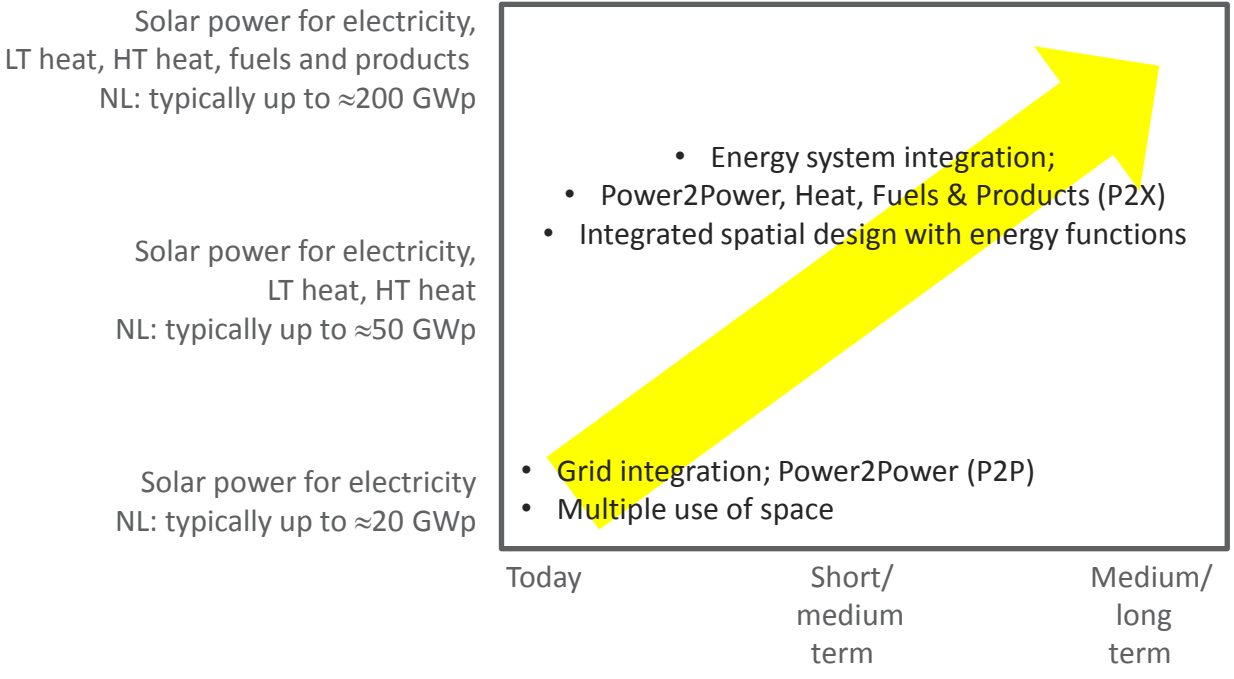


Conclusions

- Silicon-based PV is here to stay
- Silicon-based PV and thin-film technologies have succesfully partnered so far
- They may even merge for joint future success, creating the next generation in PV technology
- Introduction of passivating contacts is a natural and key step in PV development

We are only at the beginning…

Impact: solar electricity is a pillar under the energy system




Thank you for your attention!