

Solar cells – key players in our future energy systems

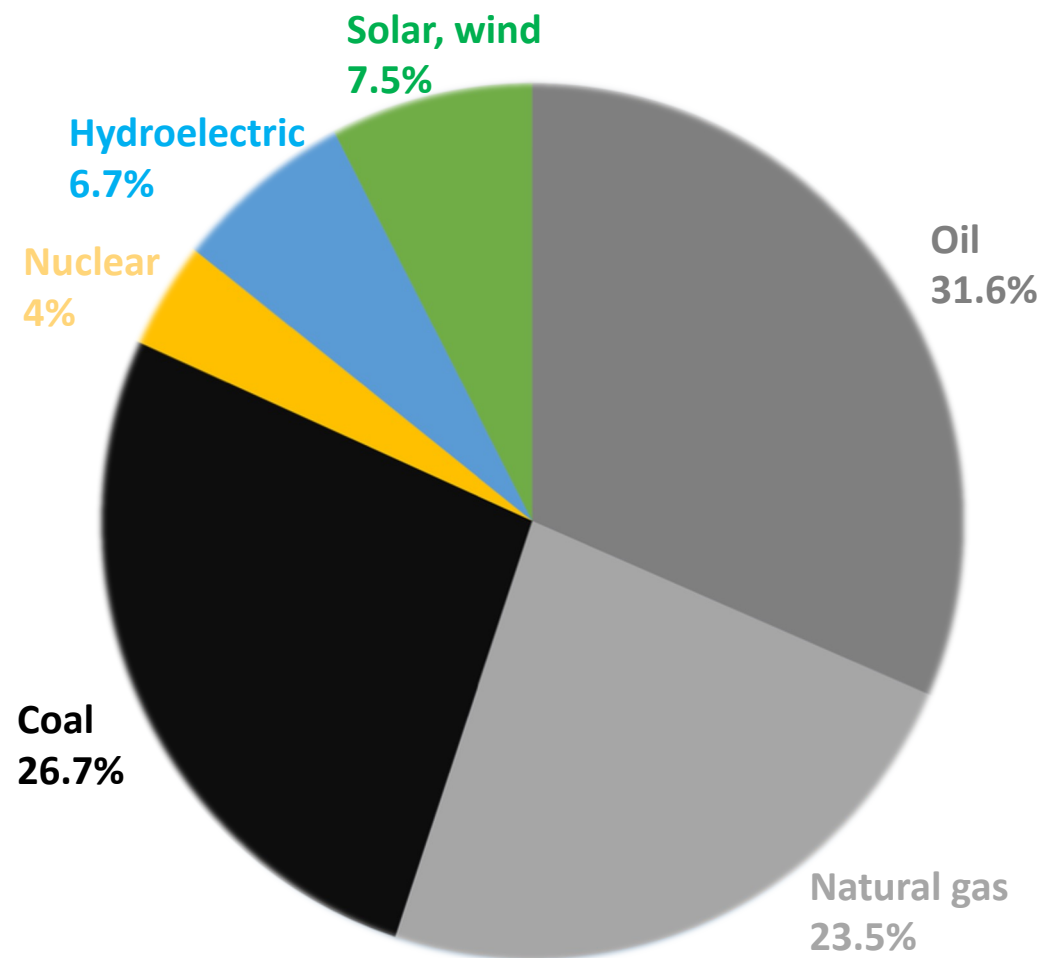
A large array of solar panels is shown from a low angle, receding into the distance. The panels are dark blue with a grid of silver lines. The sky is a mix of orange, yellow, and blue, suggesting a sunset or sunrise. The overall scene is bright and optimistic.

Natalia M. Martin | Solar Cell Technology
Department of Materials Science and Engineering



Global energy consumption, 2022

- **Huge energy consumption (~25k TWh)**
- **Fossil fuels ~ 82% share of the total energy consumption**
- **Renewable energy: solar and wind – 7.5% share, growing**
- **Solar energy – the biggest available resource(1000 W/m²)**





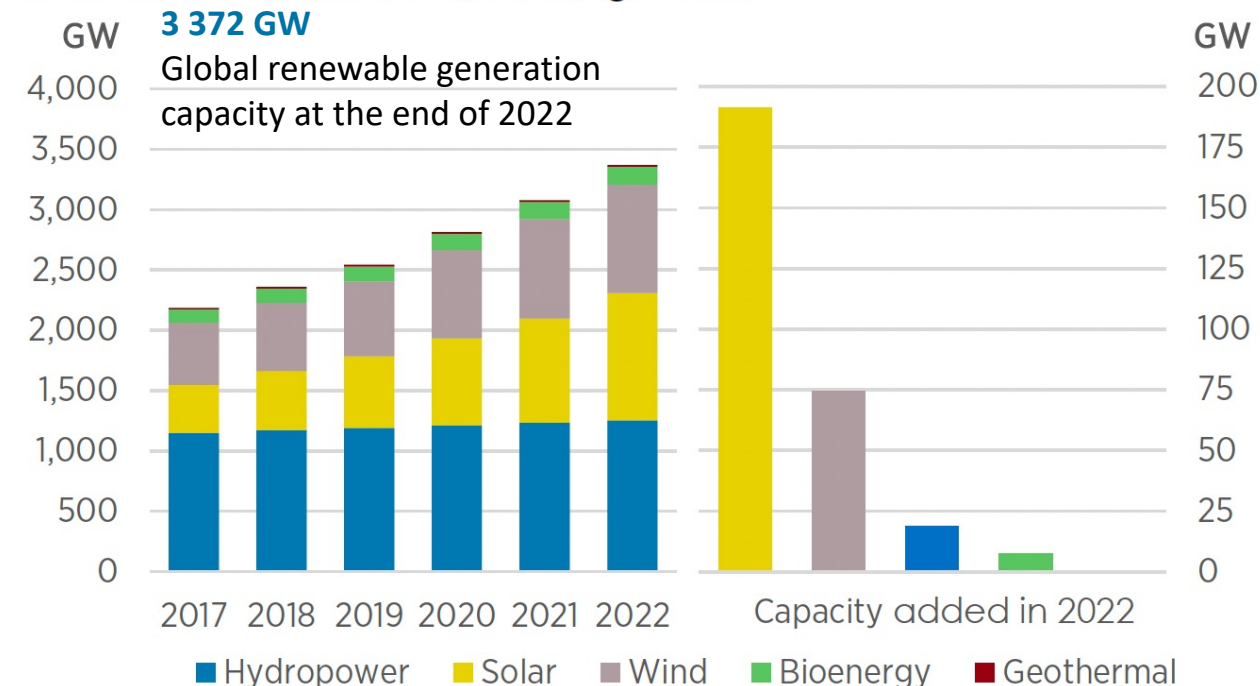
Solar energy

- **Renewable energy**
- Biggest available resource— we need a good way to harvest it

Why solar cells:

- Directly convert the solar radiation into electricity
- Solar cells costs dropped by a factor of 5 since 2010

Renewable power capacity growth





Trend— PV growing fast

2022

- **>1TW cumulative capacity**
- **Global solar electricity production: 6.2%**
- **Annual capacity of 235.8 GW (China 45%, Europe 17%)**
- **Strong growth in China, Europe, USA**

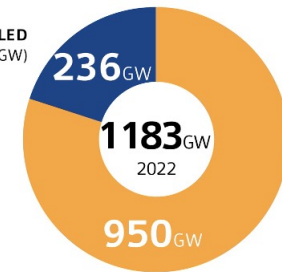
PV CONTRIBUTION TO ELECTRICITY DEMAND



6.2%

Share of PV in the global electricity demand in 2022

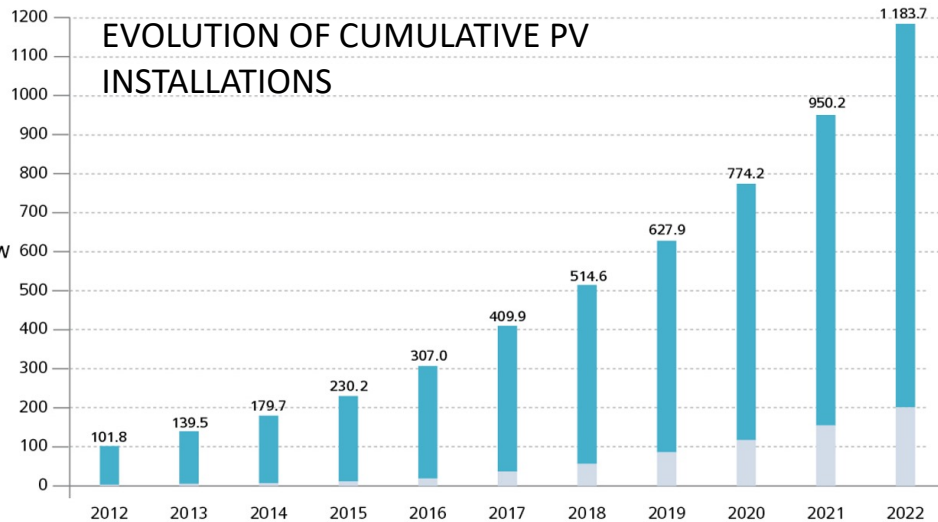
ANNUAL INSTALLED CAPACITY IN 2022 (GW)



GLOBAL PV CAPACITY END OF 2022

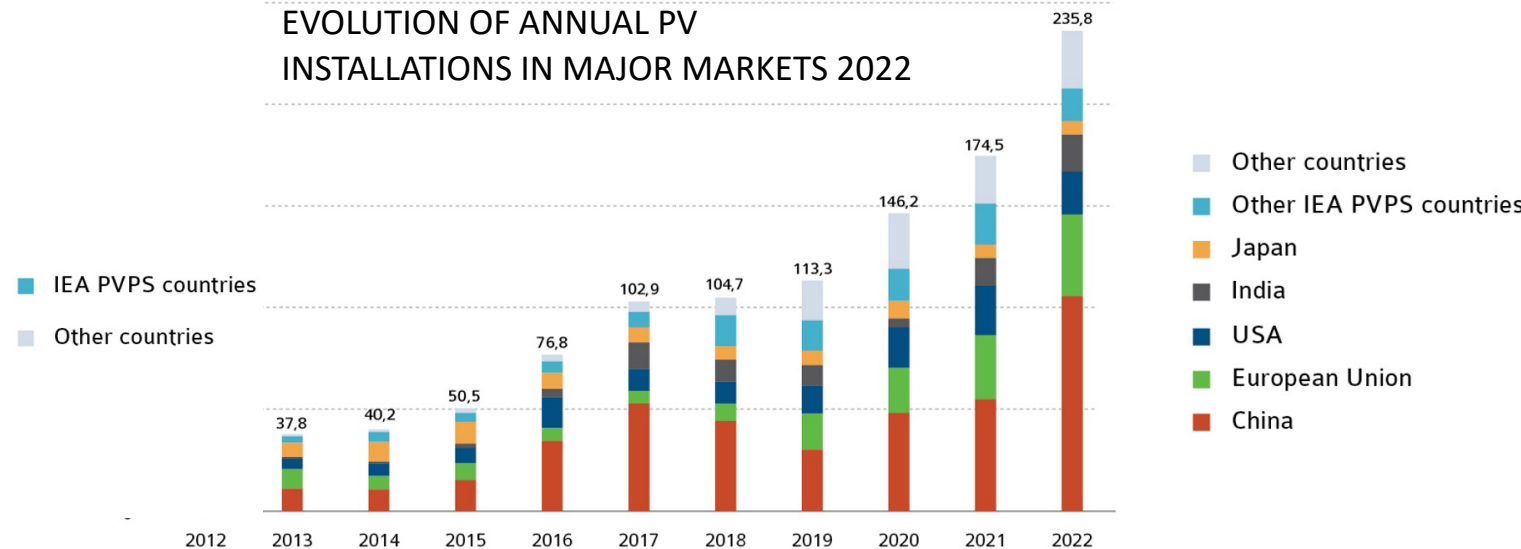
GLOBAL PV CAPACITY END OF 2021 (GW)

EVOLUTION OF CUMULATIVE PV INSTALLATIONS



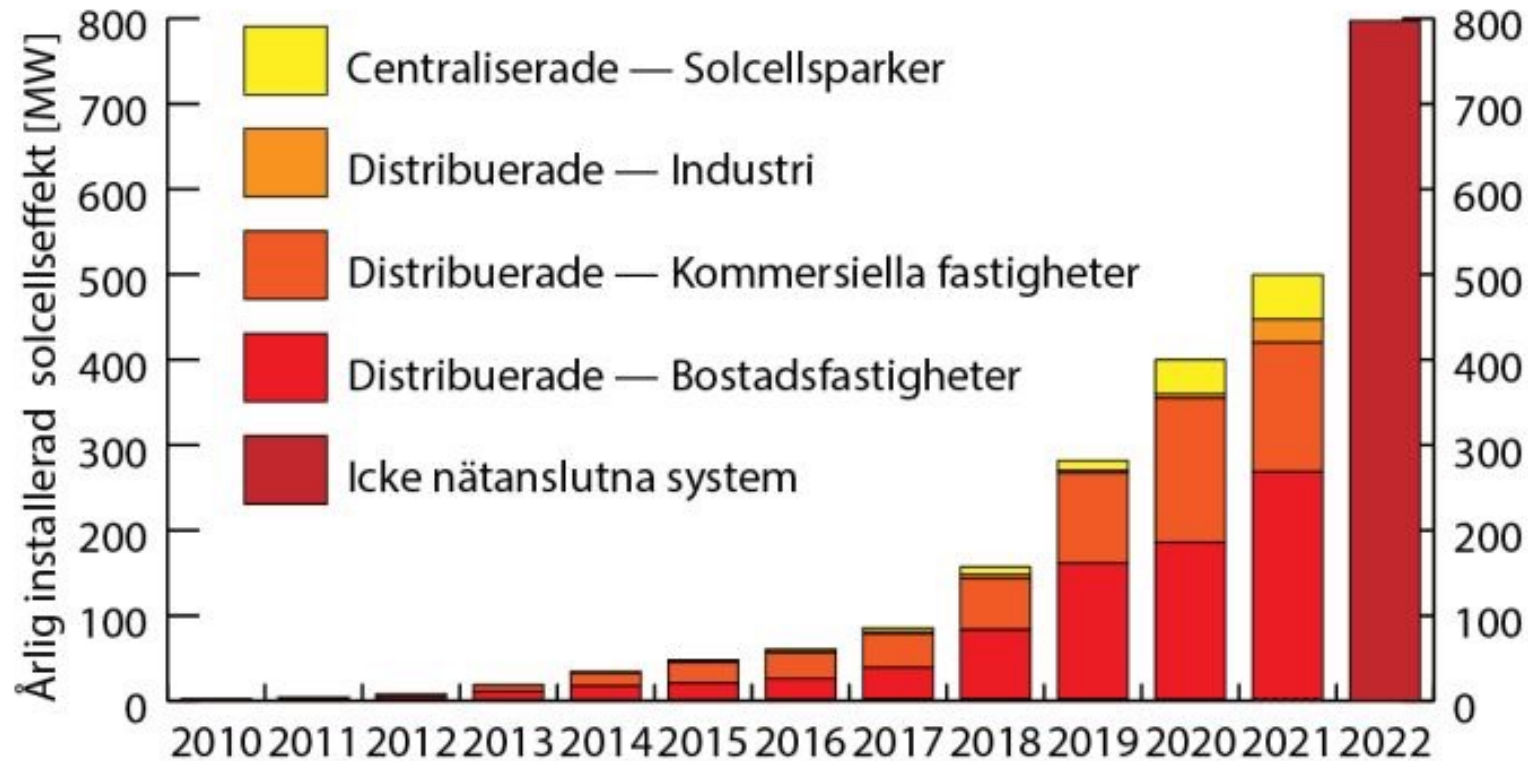
Source: [PVPS trends in Photovoltaic Applications 2023](#)

EVOLUTION OF ANNUAL PV INSTALLATIONS IN MAJOR MARKETS 2022





PV trend in Sweden, 2022



- 800 MW installed in 2022
- 60% increase compared to 2021



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PV trend – building/product integration

➤ A solution to achieve self-sustainable buildings/products

Material requirements:

- Uniform appearance
- Flexible
- Lightweight
- (Semi-)transparent/bifacial and colored
- low-toxicity and earth abundant
- Stability/lifetime
- Cost efficiency

Roof integration/ solar roofs

Thin film modules by
Midsummer



SwissTech
Convention Center,
Dye-sensitized PV by
Solaronix



Smart solar bench with
charging station, Wifi,
display by EnGo Planet



Product integration
Dye sensitized PV by Exeger



Façade integration
Uppsala "Frodeparken"
Thin film modules by Solibro



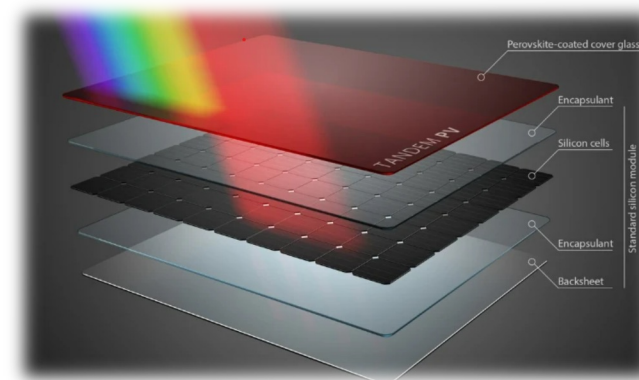
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PV trend— tandem or multijunction

Challenging the limits—**multijunction**:
each solar cell absorbs a different
part of the solar spectrum



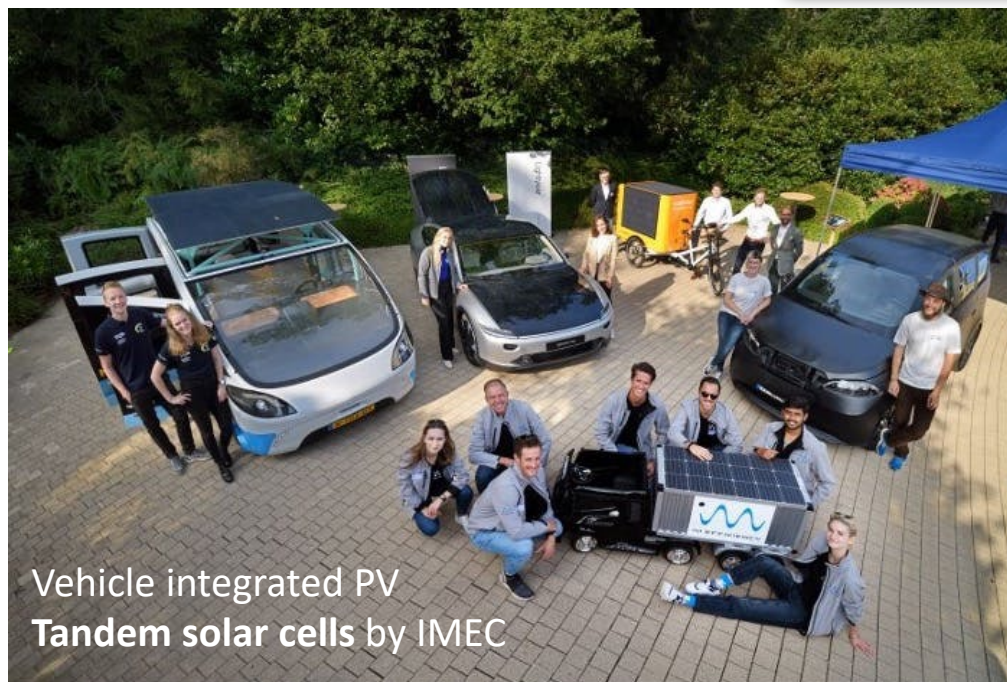
higher efficiency



Examples: Si/Thin films; Thin
films/Perovskites; Si/Perovskites

Material requirements:

- (Semi-)transparent and energetically aligned layers
- Fabrication compatible
- Low-toxicity and earth abundant
- Stability/lifetime
- Cost efficiency



Vehicle integrated PV
Tandem solar cells by IMEC



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PV trend– Agrivoltaics

Kärro Prästgård, Västerås

- Combining PV and farming
- Agriculture and electricity production coexist on the same land



Improved land productivity

Material requirements:

- Low-toxicity and earth abundant
- Alternative strategies for maximum land productivity: bifacial PV, semi-transparent
- Stability/lifetime
- Cost efficiency





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PV trend— large solar parks

Nu inviger vi Sveriges största solcellsparkeller

Nu är HSBs solcellspark utanför Strängnäs invigd. Med sina 35 hektar och en energiproduktion som motsvarar årselanvändningen för nära 5 000 lägenheter är det den största solcellsparken i Sverige.



41.600 solar panels / 0.35km²
14 MW / 3 000 000 kWh

Sveriges hittills största solcellspark - 22 MW

Under hösten 2022 påbörjades byggnationen av Sveriges hittills största solcellspark, Kungsåra solcellspark utanför Västerås. Projektet är utvecklat av Helios Nordic Energy AB åt tyska investeraren Commerz Real. Solkompaniet är kontrakterad EPC-leverantör för parken som kommer bli nära 22 megawatt, vilket motsvarar behovet för mer än 7 000 elbilar.



22 MW