

Nouvelles solutions photovoltaïques pour l'environnement construit : technologies, prix et acceptation

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active
interfaces

PV2050

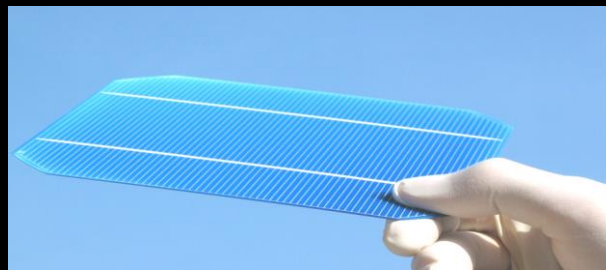
EPFL
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Virage énergétique

Programme national de recherche PNR 70

Une cellule solaire "standard" ?



Une plaquette de silicium très pur transformée ...

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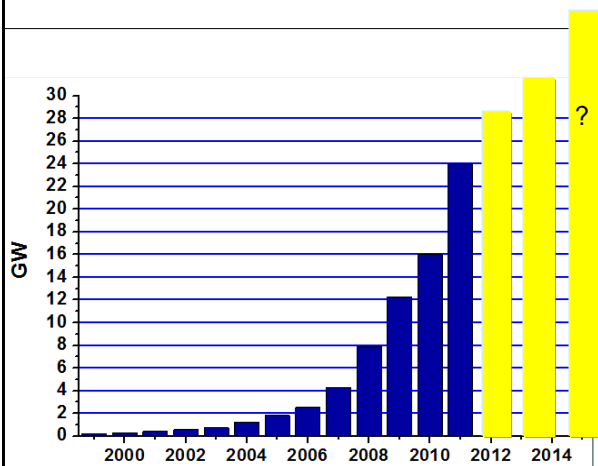
Cellules solaires en silicium

En 1998, 40 millions de cellules produites
(à 25 CHF/pièce)

En 2014, 10 milliards de cellules produites
(à 2 CHF/pièce)



Le marché du solaire



Un marché en forte croissance grâce aux impulsions politiques : Allemagne, Espagne, Japon, Italie, France, ...

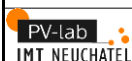
Nouveaux panneaux
0.15 GW en 2000
37 GW en 2013
55 GW en 2015 ?
65 GW en 2016

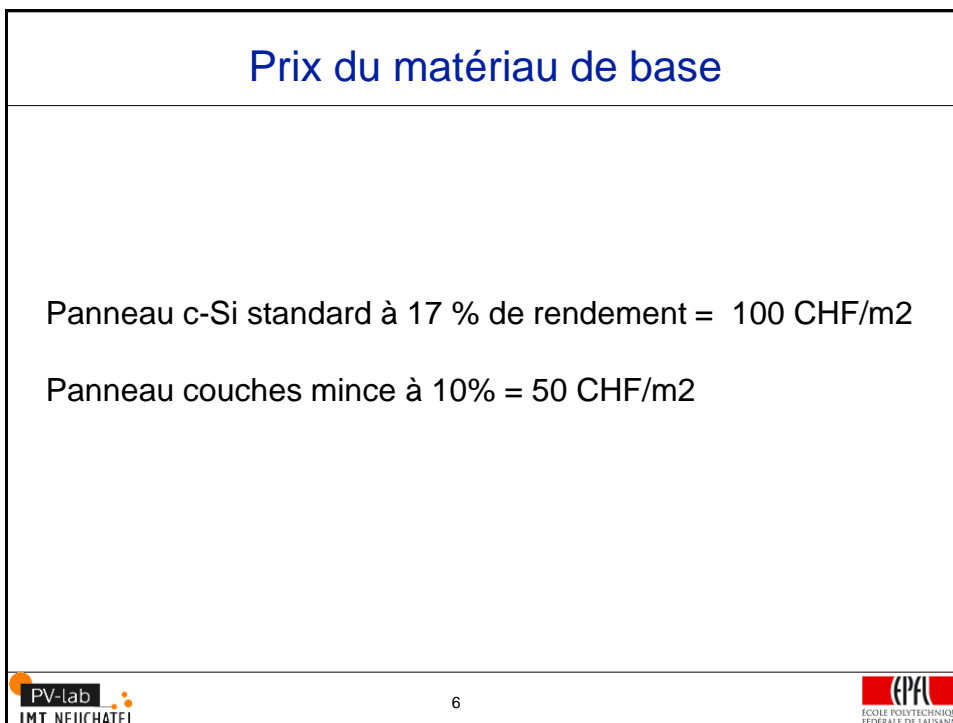
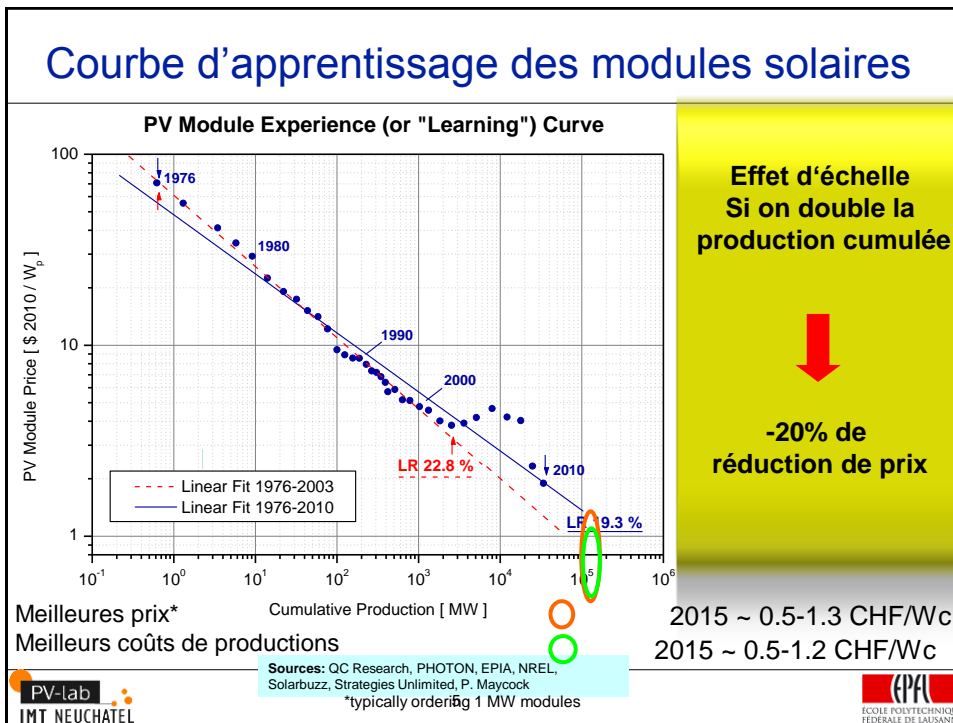


Fabrication de panneaux solaires annuelle

A midi
65 nouvelles
centrales

Source
Solar Buzz/Photon Magazine





Baisse des coûts de l'électricité solaire pour les grands systèmes

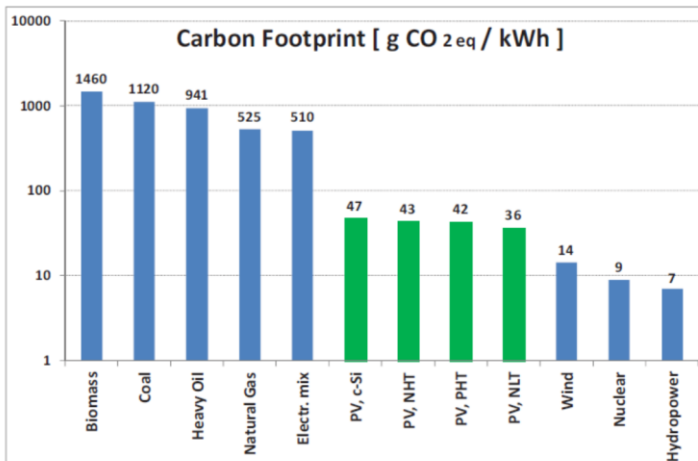
Suisse: de 100 à à 12-20 cts/kwh en 12 ans

Sud EU/USA: 6-8 ct/kWh

Avenir proche Sud EU/USA: 4.2-5 ct/kWh



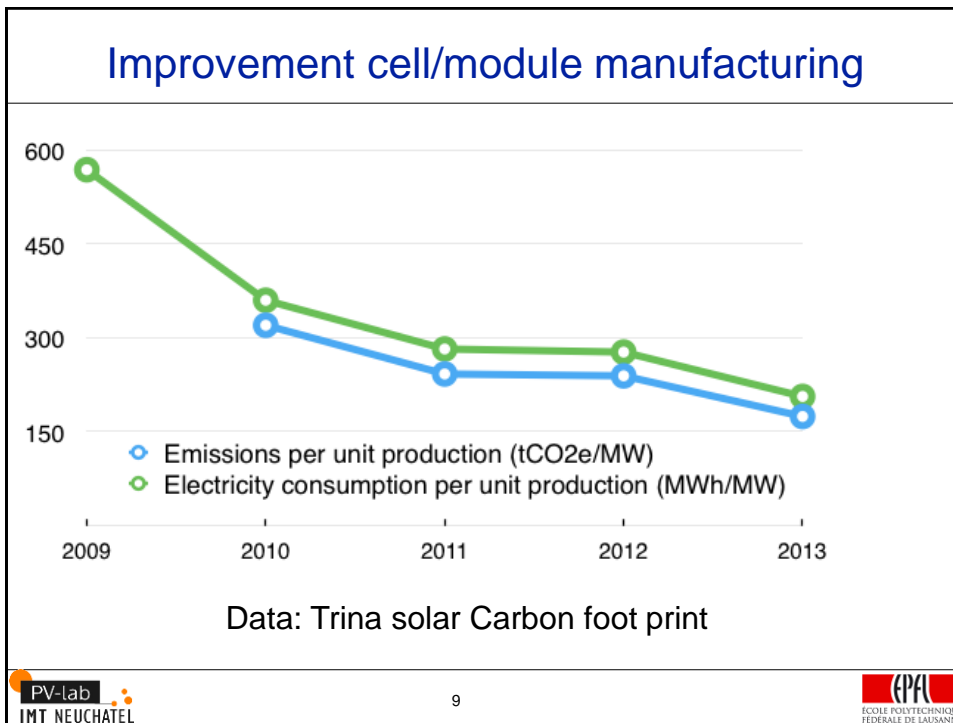
Equivalent CO2 systèmes cristallin PV en sur-toiture



Terheiden et al. PSS 2014

36-47 g EqCO₂ (20 years/ southern Europe) (50-70 CH)

But: in permanent improvement → potential for 50% reduction...



Ou sur des toits

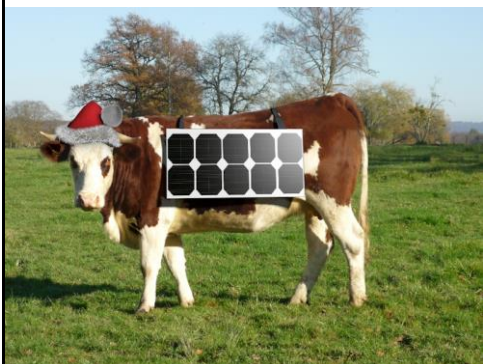


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La Suisse un pays idéal pour les produits PV innovants



Sensibilité à l'esthétique



Solutions suisses

- Meyer Burger (including module production)
- Megasol * (including some module production)
- Schweizer
- Eternit
-
- Panotron
- SwissInso
- Designergy
- Userhuus...
- In preparation: Solaxess, G2E, Flisom...

Which approach

- Fully customised product ?
- Attempt for standardisation ? (reach mass)
- How to lower the price of custom manufacturing ?
- Who acts ? Consumers, architects, roofers ?

//// active
interfaces

Semi-transparent amorphous-custom-size thin film silicon by Malibu/Schüco




Panotron
Elegant, expensive


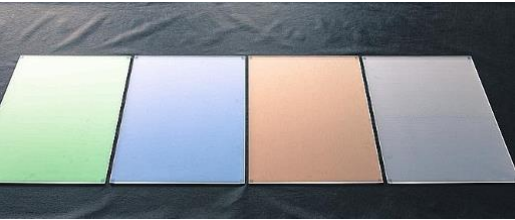


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A collage of three images. The top-left image is a close-up of a Panotron solar tile, showing its dark, textured surface and electrical connections. The top-right image shows a house with a solar tile roof, with a yellow umbrella in the foreground. The bottom-left image shows a person working on a solar tile roof. The text "Panotron" and "Elegant, expensive" is centered in the bottom-right area, and "Copyright CSEM 2014" is at the bottom right.

Swissinso/Kromatix



Collaboration with
LESO EPFL



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Aesthetics in PV

Thermal Insulation

H2O-tightness

Structurally tough





- Designergy is penetrating the roof market with the first real solar building material and system
- New developments will include new applications for both buildings and civil engineering

«BIPV 2.0», Designergy is launching the next level: Structurally Integrated PV (SIPV)

Integrated «Megaslates»

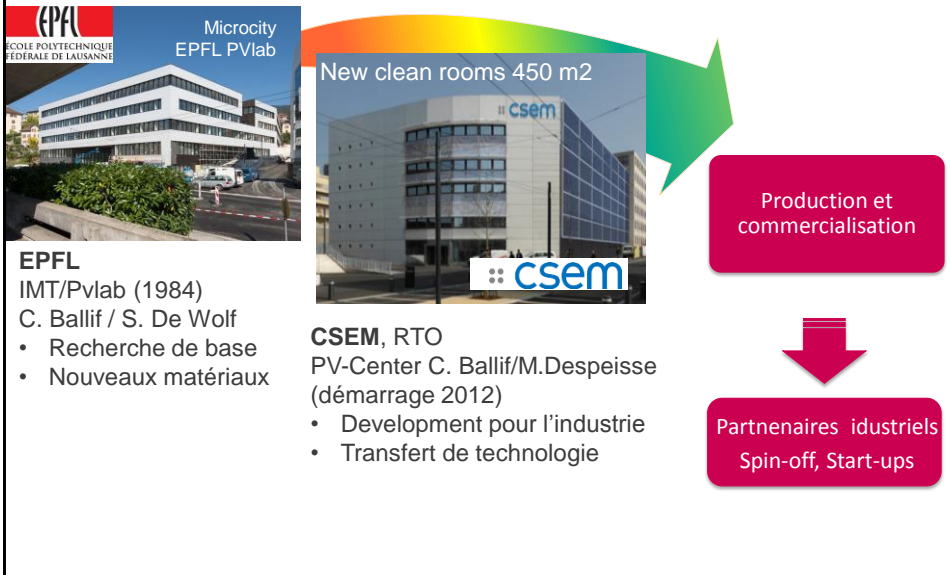


Prix solaire rénovation 2015





Recherche et développement en photovoltaïque à Neuchâtel



Recherches modules et systèmes au CSEM

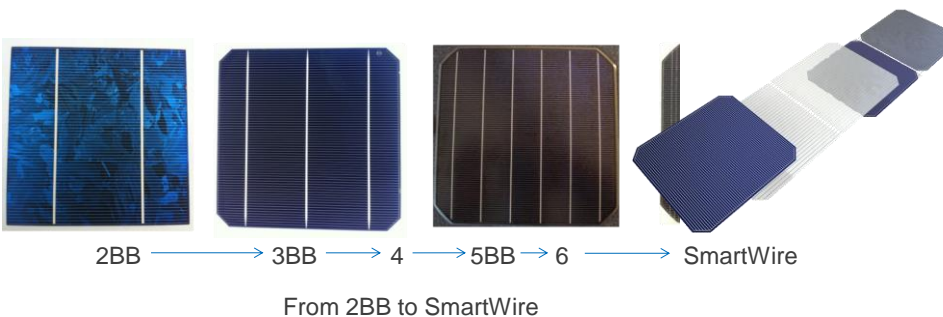
- Modules avec technologies avancées
- Polymères d'encapsulation
- Modules PV customisés
- Modules hyperlégers
- Fiabilité, temps de vie des modules
- Tests, caractérisation, fabrication



New fabrication and reliability test center at innoparc

Market trend

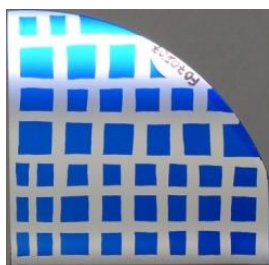
- C-Si domine, situation plus difficile pour les couches minces
- Amélioration de la technologie standard → cellules PERC (modules → + 10-15 W)
- Technologies «avancées» pour nouvelles entreprises
- Modules verres-verres avec 30 ans de garanties



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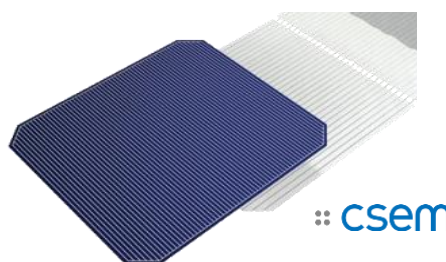
Copyright 2015 CSEM | Diverse Metallization Schemes Enabled by SmartWire Connection Technology | Page 25

Amélioration de la technologies : cellules cristallines à hétérojonction



19% en 2007 sur cellules de 5x5 mm²
Sur une plaquette de silicium, IMT Neuchâtel

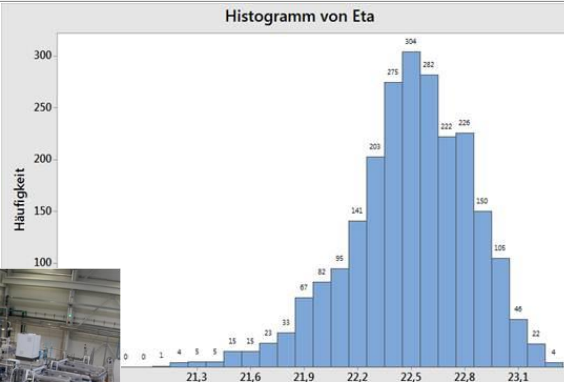
22.8 % 16x16 cm² cells, CSEM 2015
(sans busbars)



Demo line at Meyer Burger German/ Germany, Production tools With support of Meyer Burger Research/ Neuchâtel

2000 cells run

**22.5% average efficiency,
Measured with grid touch**



MEYER BURGER

Courtesy J. Zhao

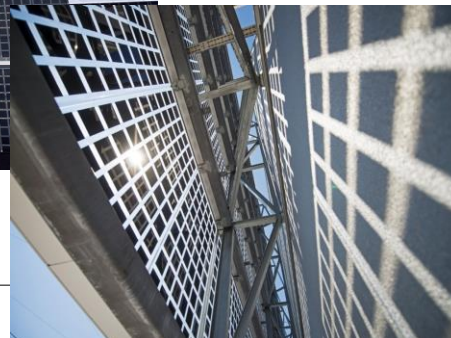
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Modules bifaciaux à hétérojonctions



- Cellules à 22%
- Bifaciales
- Tcoeff excellent

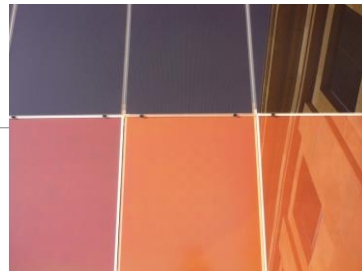


 PV-lab
IMT NEUCHÂTEL

- **Transformative approach for PV modules**

Goal: simple adaptation of existing product to keep down the manufacturing price, and give some room for extra-price of dummy elements

Terra-cota like thin film



 **ÜSERHUUS**

Userhuus
Development within Archinsolar
project by EPFL PV-lab,
industrialisation by CSEM

Private house Corcelles...Neuchâtel



Fully transforming crystalline silicon modules....

Architecture & Energy

Integration & Aesthetic

The dream of an architect...

Please draw me the perfect solar module..



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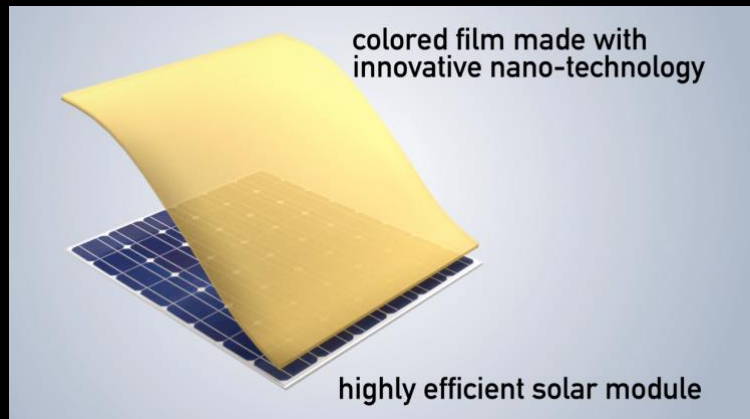
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White photovoltaic modules

How does it work

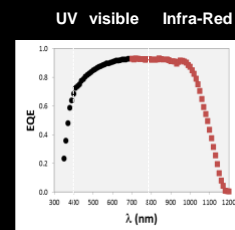
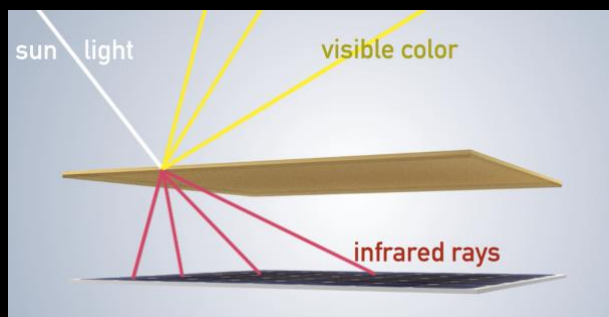


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White photovoltaic modules

How does it work



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White photovoltaic modules

A new building material

- Better aesthetics
- Easiest integration
- Building façade are becoming active

➤ A new building material



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If you can do white, you can do any color.....

A new building material



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White photovoltaic modules
from lab to fab

SOLAXESS
white solar technology

Visit the website: www.solaxess.ch

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Et si Neuchâtel se transformait ?



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Et si Neuchâtel se transformait ?



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Conclusion

- Beau marché potentiel en nouvelle et ancienne toiture, façades, rénovations
- Beaucoup d'innovation, mais pour faire baisser les prix, il faut un volume minimum



- Faire aimer le solaire
- Impliquer les différents acteurs

Solarstratos