

From power to aesthetics, from nano to terawatts : how can solar change people ?

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Becquerel Prize acceptance speech, Munich 20.06.2016

The unanswered questions...

- Do we need an «ecological» terror to get people and politician to curb CO2 emission ?

Out of 2-3 TW of PV in 2030, how much will have perovskite absorber ?

Do we still need research institutes in photovoltaics ?

- Is there any value to local contents/manufacturing of PV systems ?

- When will Al-BSF cells be replaced by c-Si heterojunction and passivated contact cells ?

POWERPURE

Ultra-low cost solar electricity

2020 >20%, < 0.4€/Wp, > 30 years
2026 >23% <0.3€/Wp, > 40 years
high energy yield

ELEGANCE

Changing the cities and the way
people relate to solar and energy

All shapes, all colors, affordable PV
construction material

CONNECTED

20% indoor
autonomous

High performance
ubiquitous energy
scavenger

EXPLORE

Specialty power
applications

In the air, on water,
on the road

SMART

A more intelligent
energy supply and
management

Algorithms and
electronics/IT
services

Improve standard technologies

PERC, PERT
Selective Emitter, local doping
Low-cost Si

Passivating contacts

High T: SIPOS, TOPCON, Polo....
Lower T: TiO₂, MoO_x
A-Si/c-Si heterojunction
Variation of heterojunction

NBT

Advanced interconnection/cell and module design

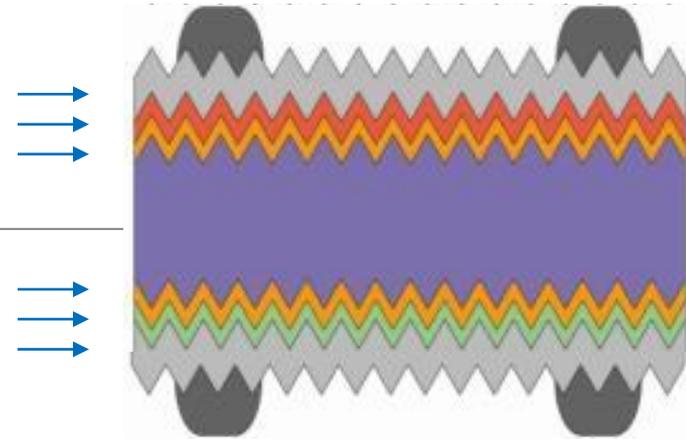
Multi-wire, shingles, conductive back-sheets
Bi-facial
MWT, IBC
Thin wafers
Ultra-long reliability



You may never know what results come of your actions, but if you do nothing, there will be no results.” *Mahatma Gandhi*



C-Si heterojunction cells



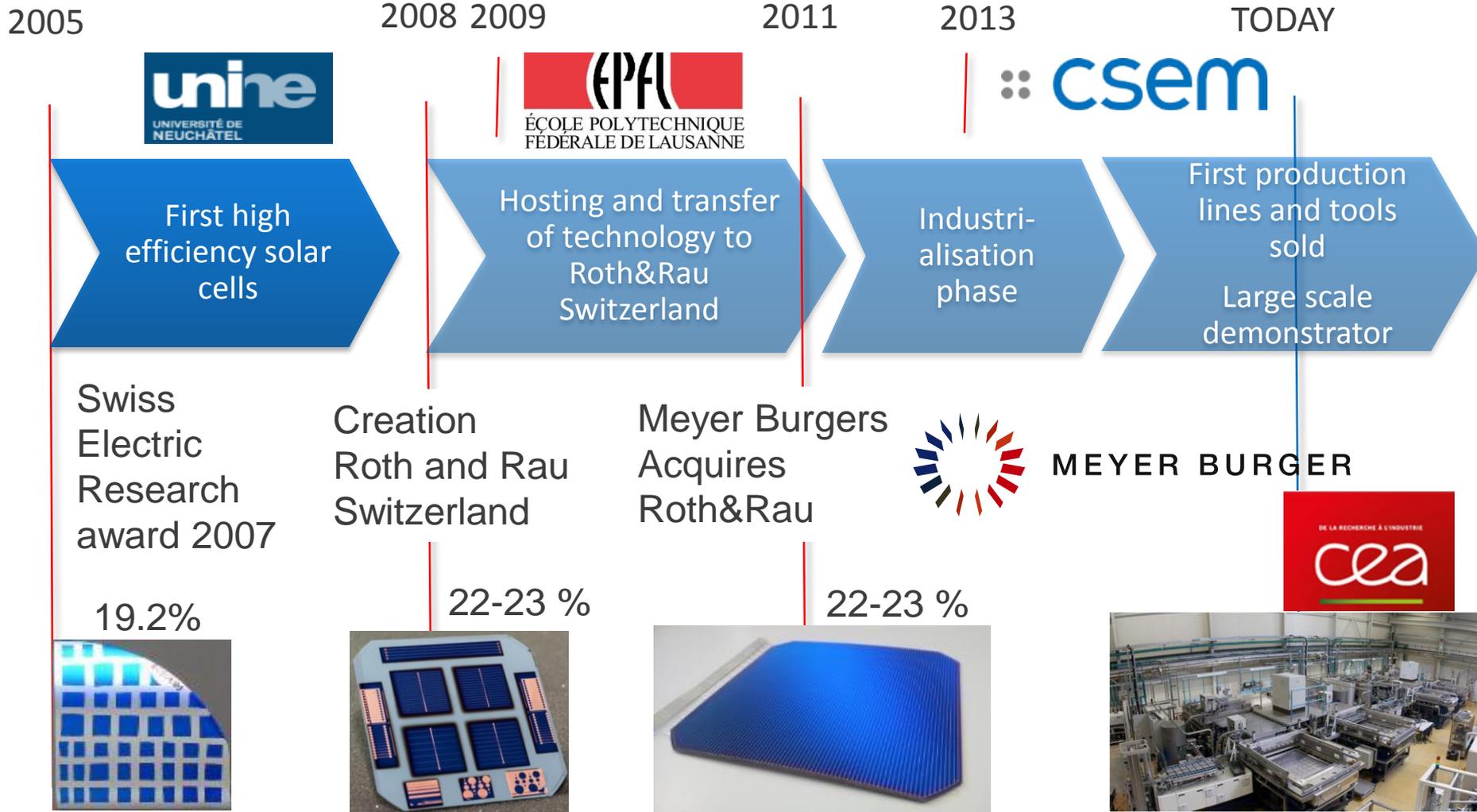
**Based on coating technologies:
all matured in the last decades, low COO**

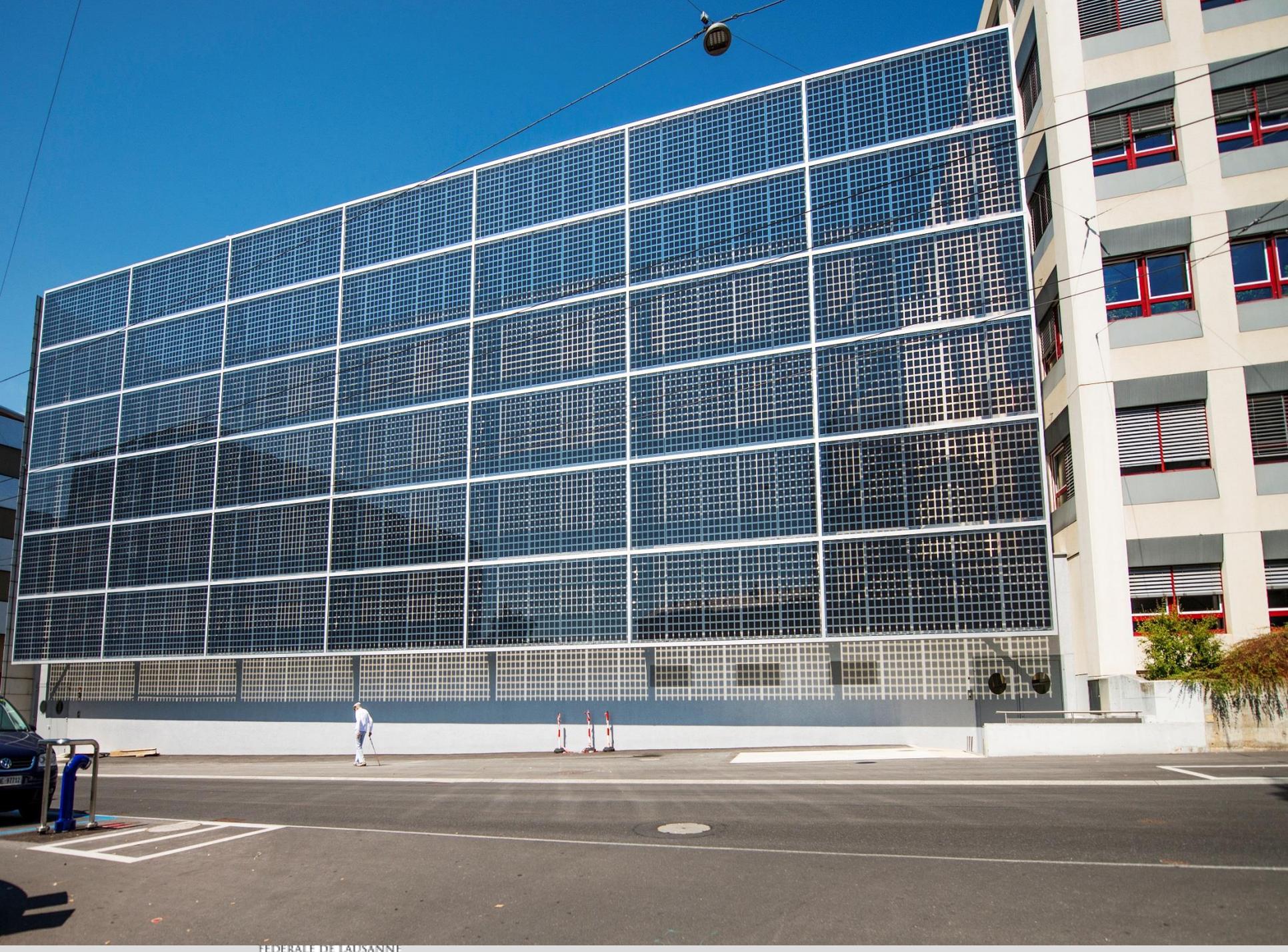
- Infinite number of possibilities to change the layers (plasma !)
→ SiO_x, SiN_x, SiC_x, SiONC, amorphous, nanocrystalline
- Wide variety of TCO's and interface
- New ways to design ideal membranes (hole and electron collectors)
- Advanced metallization (plating, multiwire...)
-

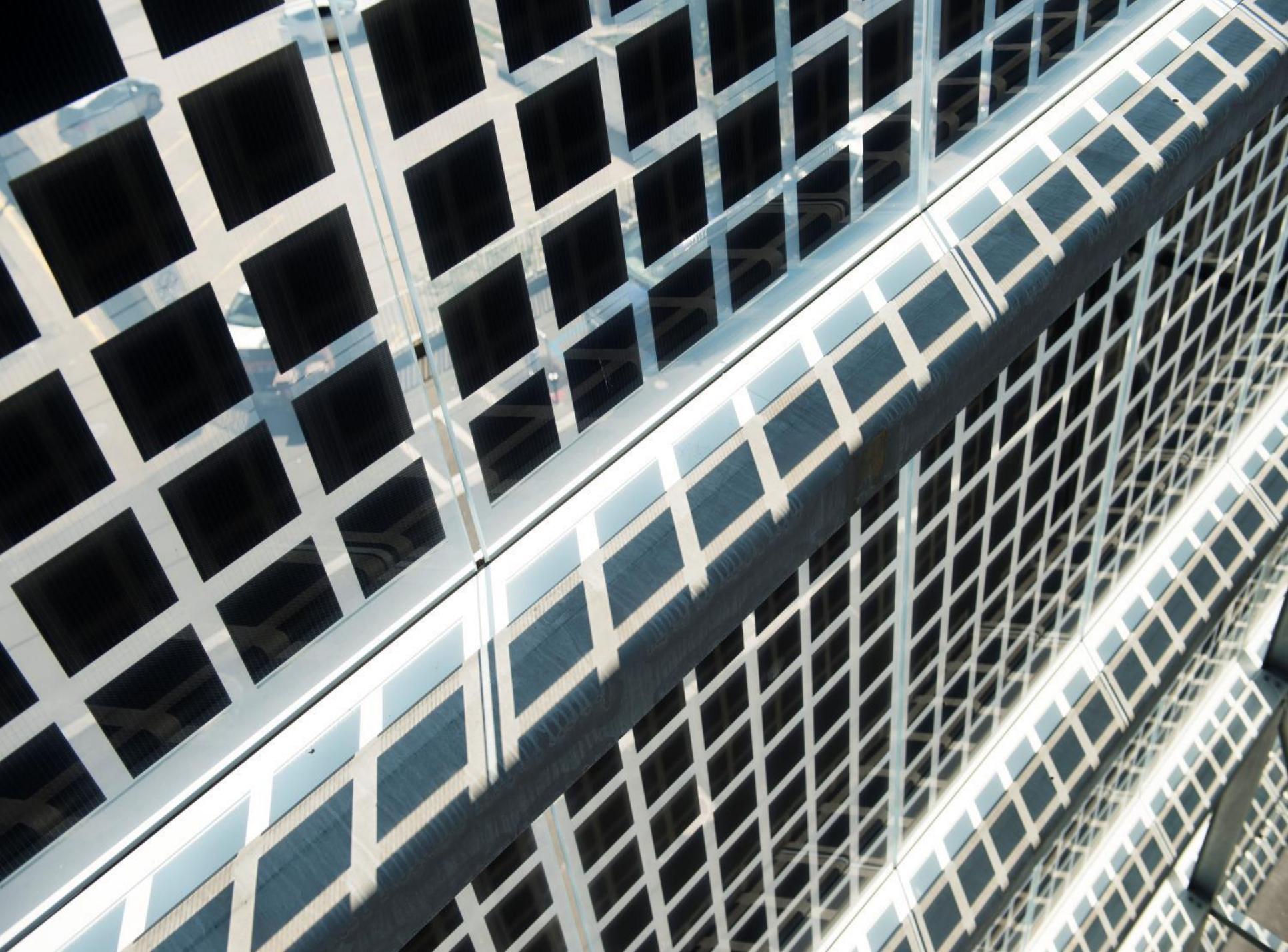


a class of technology to reach 24-26%

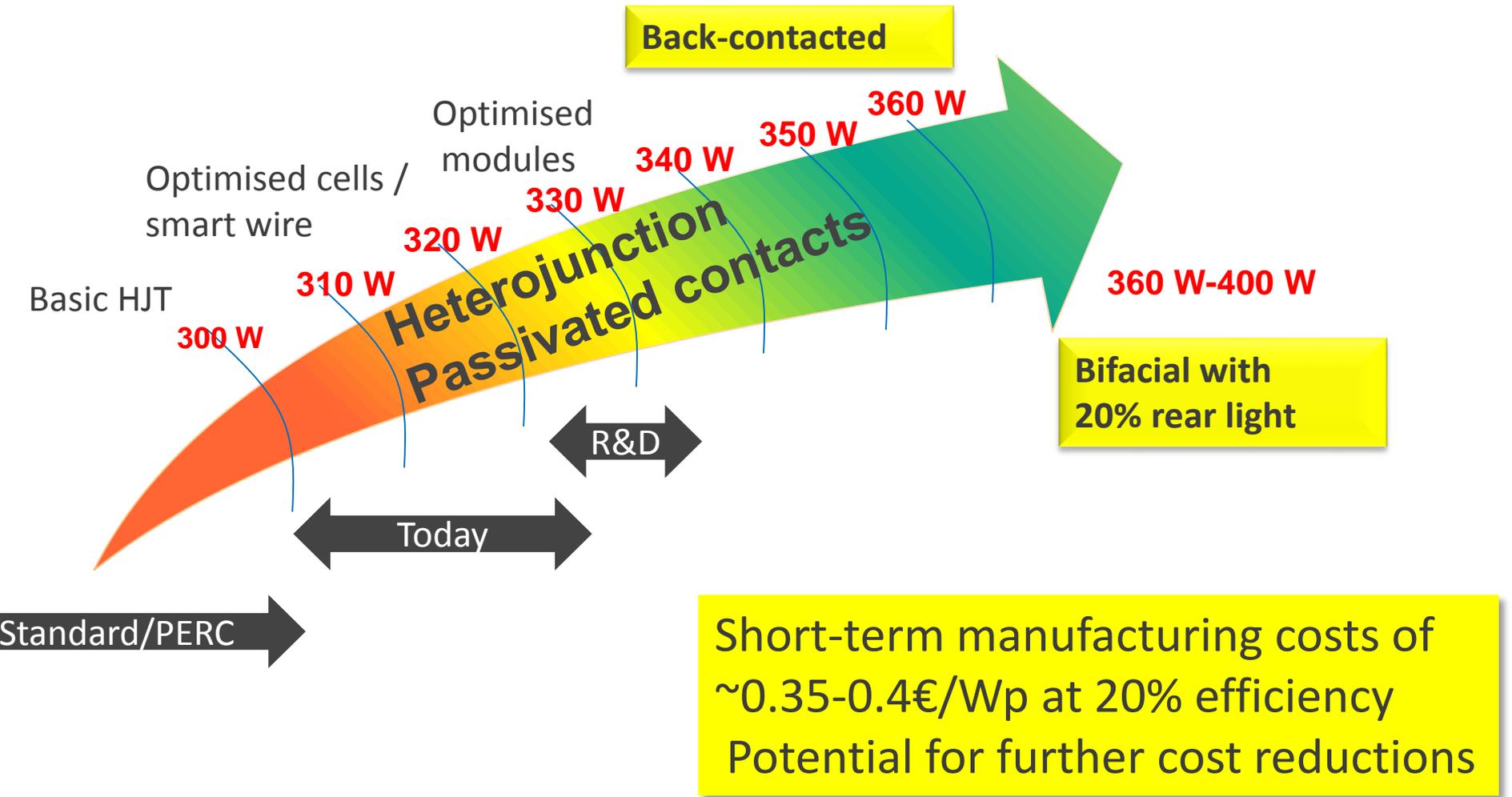
High efficiency, « lean but subtle » process for c-Si heterojunction







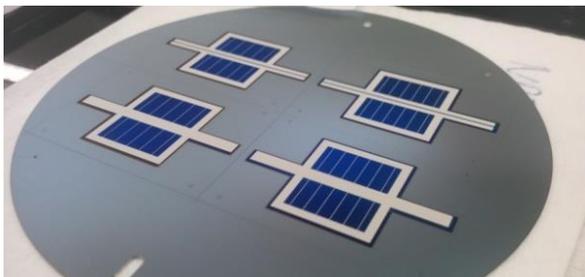
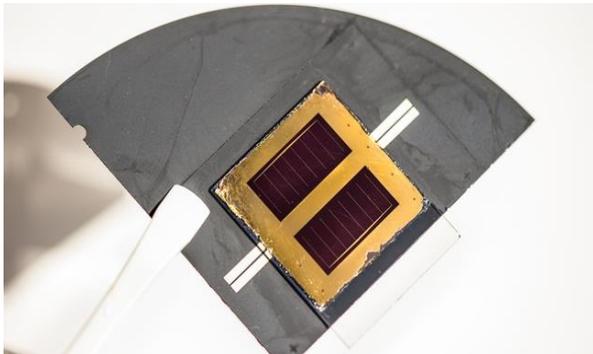
Future of c-Si SHJ modules, 60 cells, 6''



Cellules record du monde à «plusieurs jonctions» avec Silicium

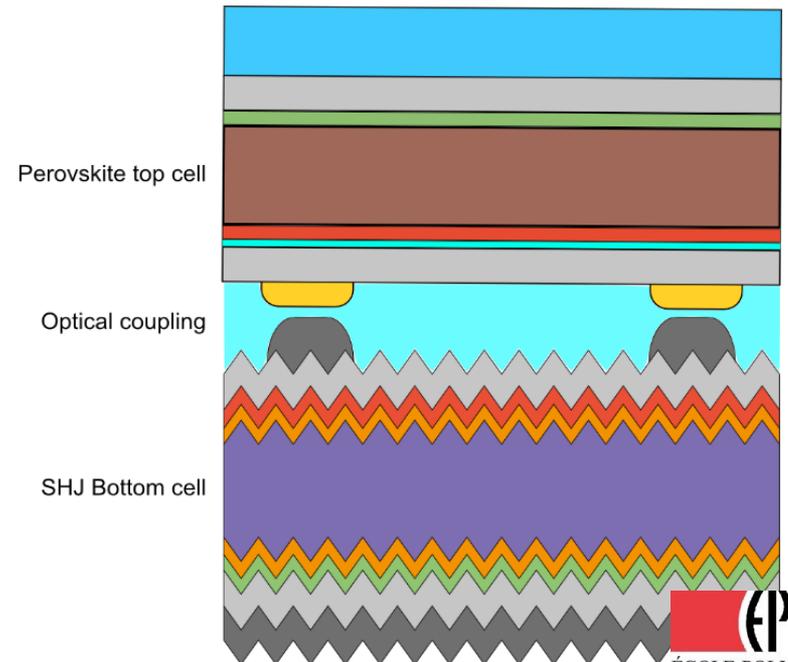
Custom designed small HJT cells
4 terminals III-V /c-Si tandem,

29.8 % Certified



«low cost» Perovskites on
Silicon, 4 terminal
measurements

25.2% in house

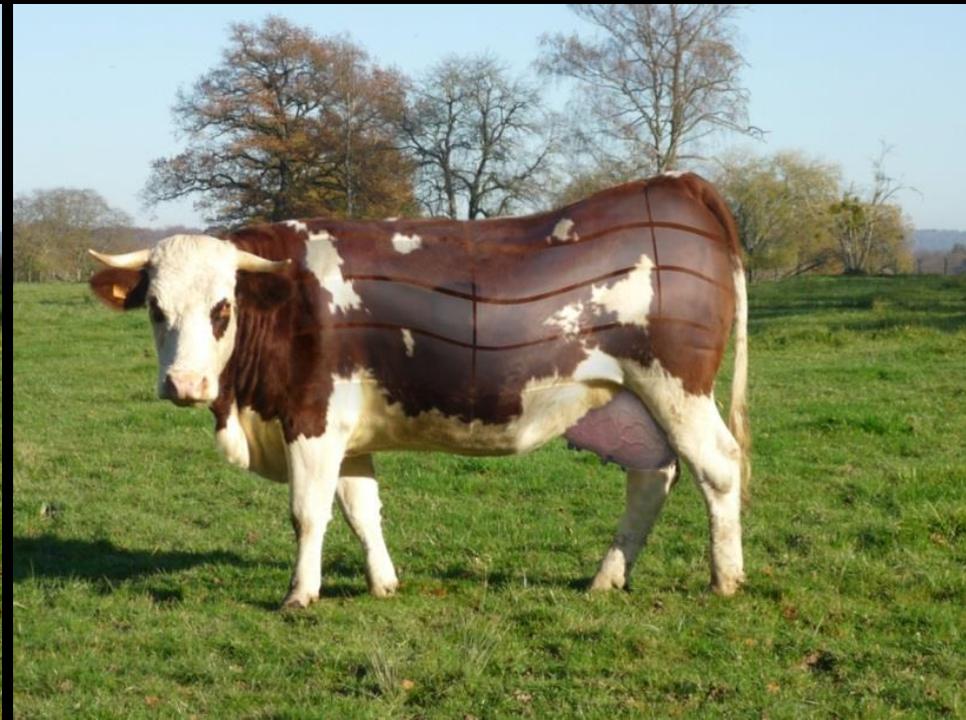
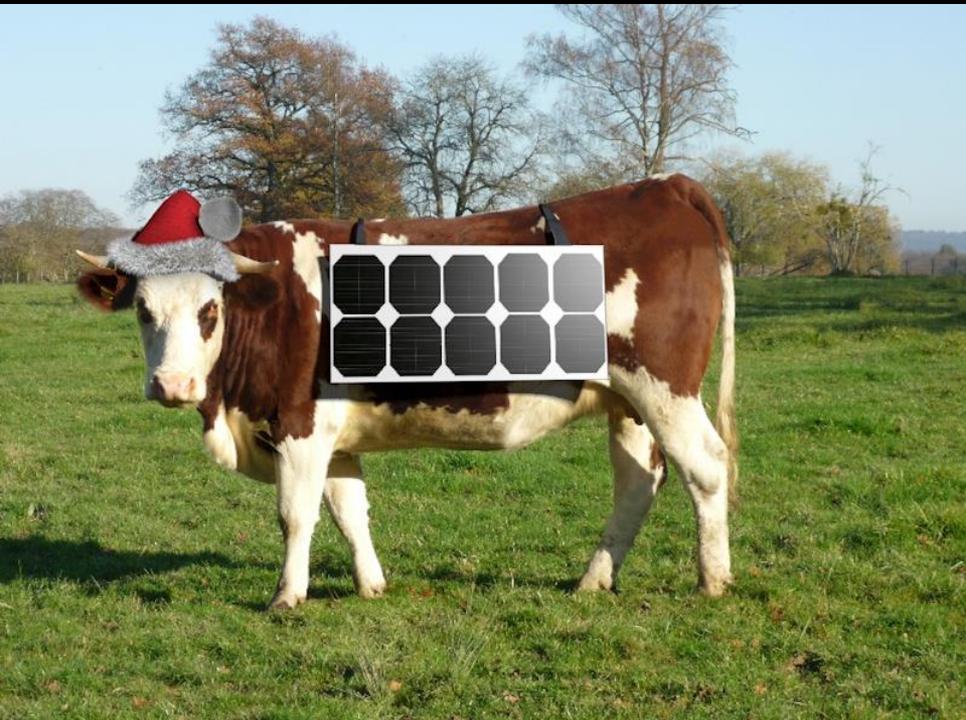


ELEGANCE

Switzerland, sensitive to acceptance in Rural and Urban Environment



Sensitive to aesthetics



Integrated «Megaslates»



Swiss Solar Award 2015 «renovation category»

Over 10'000
systems installed



Terra-cotta PV

An example of technological transfer



Thin-film terra-cotta

Mat or shiny finish

Sizes: full size (1100 x 1400) and small size available



Photovoltaic in buildings

Demonstration project in Switzerland



White photovoltaic modules

A new building material

- Better aesthetics
- Easiest integration
- Building façade are becoming active
- Possible over 10% efficiency

➤ A new building material

SOLAXESS
white solar technology

:: csem



Field testing

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Spatial patterns of solar photovoltaic system adoption: The influence of neighbors and the built environment[‡]

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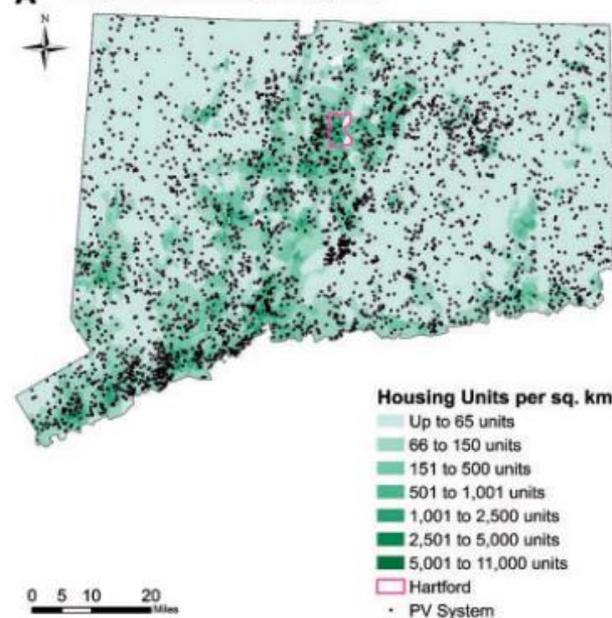
email <kenneth.gillingham@yale.edu>

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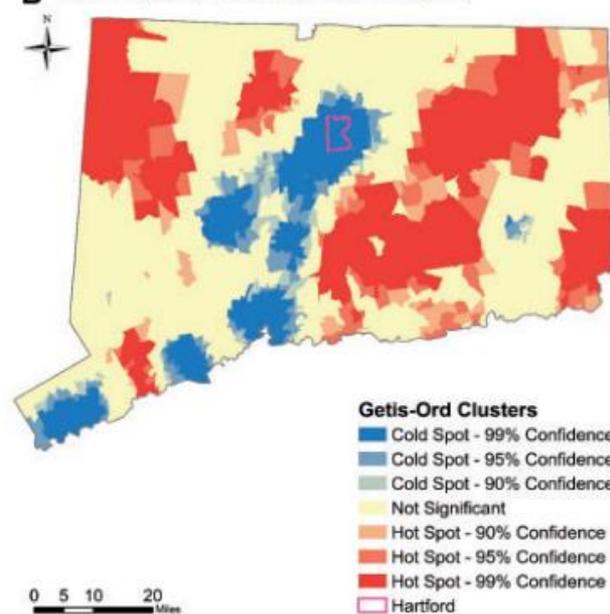
Influence your neighbors ...

“Example isn't another way to teach, it is the only way to teach”, A. Einstein

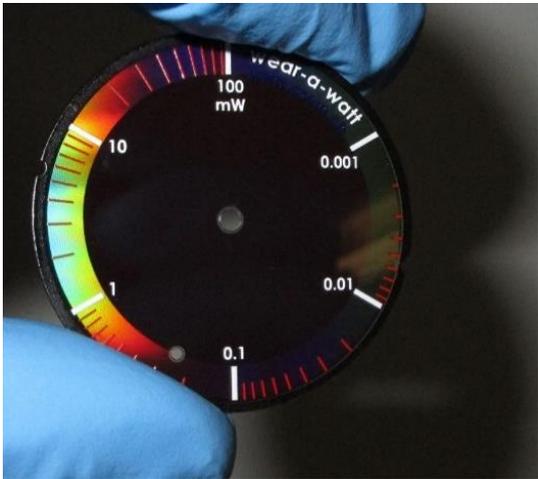
A PV Systems and Housing Density (2013)



B Block Group Level Optimized Getis-Ord Results (2013)



Connect





4 million solar products sold by members of the Global Off-grid Lighting Association (GOGLA) in the second half of 2015

2 millions in Sub-Saharan Africa.

+Micro-credit
+Smart Phone payments

EXPLORE



EXPLORE

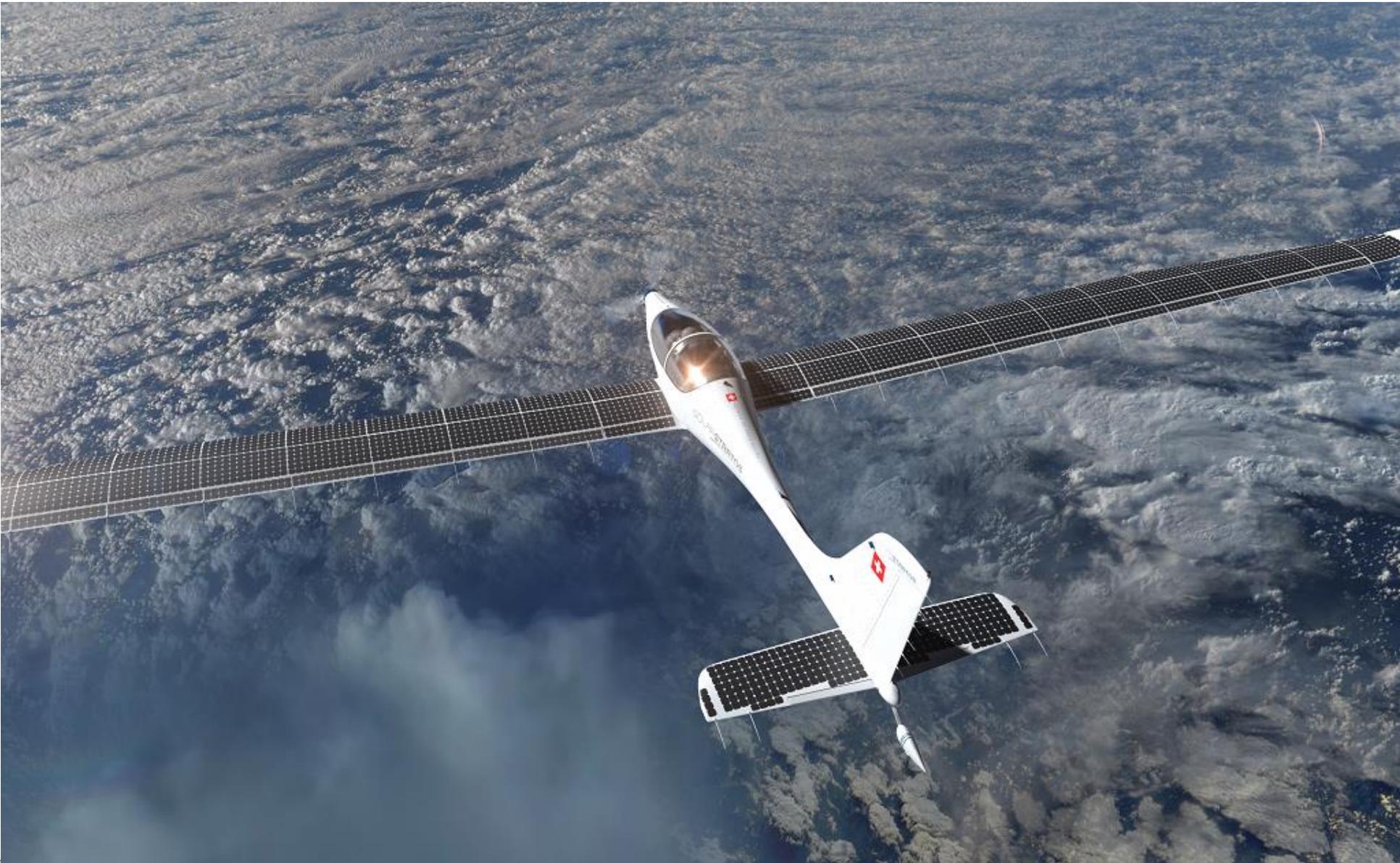




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ÉCOLE POLYTECHNIQUE
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Solar Stratos... à la frontière de l'espace



Solar Stratos... at the edge of space



Make people love solar for different reasons

Get people to see beautiful examples, everywhere

Get people to wear solar

Produce with local content, have people involved in companies

Will bring people, society and politics

- to invest in Solar

- To vote for Solar

- To support energy transition

(Re) industrialise

Local modules, local cells

XGWp

European Gigawatt Fab

Strongly supporting local partners/start-ups

oerlikon
solar

 **TEL Solar**



 **PASAN**

 **MEYER BURGER**

 **ROTH & RAU**

 **INDEOtec**

SOLAXESS
white solar technology

 **BLUEBIRD**

 **ÜSERHUUS**

 **BASF**
We create chemistry

 **BKW**



+ thanks to the 40 companies which are or have been in contract with us

Financial support and collaborations



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Federal Office of Energy SFOE

Kommission für Technologie und
Innovation KTI

Secrétariat d'Etat à la formation,
à la recherche et à l'innovation SEFRI



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SCHWEIZERISCHER NATIONALFONDS
FONDO NAZIONALE SVIZZERO
SWISS NATIONAL SCIENCE FOUNDATION



Virage énergétique
Programme national de recherche PNR 70



toutes vos énergies



solar swiss
connect



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toutes vos énergies



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BCN

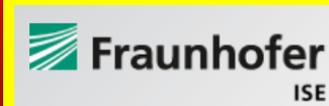


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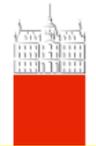


European
Commission

FP6, FP7
H2020



Univerza v Ljubljani



+ many others

ROW



NATIONAL RENEWABLE ENERGY LABORATORY



Australian
National
University

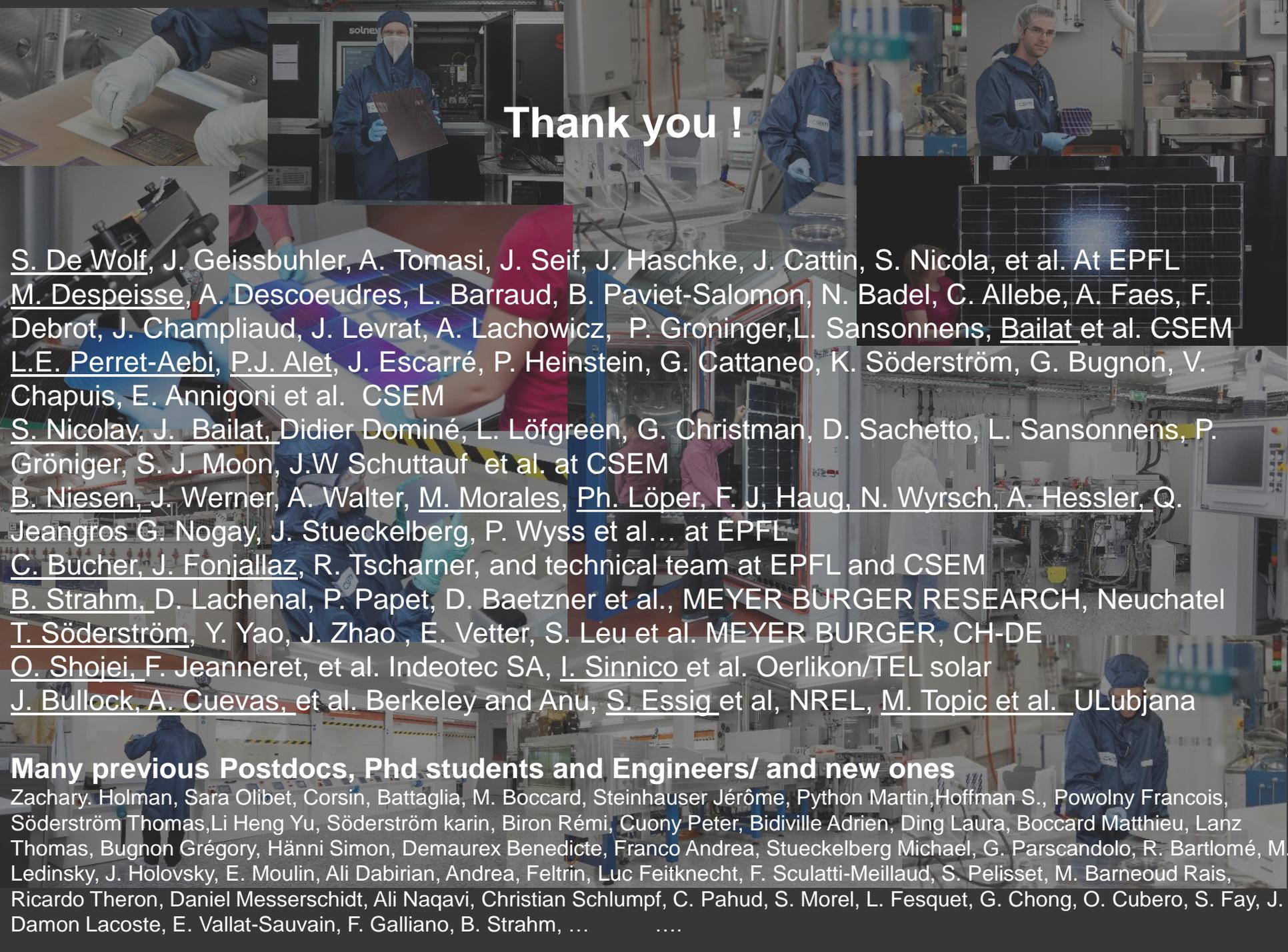
+ many others





Thanks to my research teams





Thank you !

S. De Wolf, J. Geissbuhler, A. Tomasi, J. Seif, J. Haschke, J. Cattin, S. Nicola, et al. At EPFL
M. Despeisse, A. Descoedres, L. Barraud, B. Paviet-Salomon, N. Badel, C. Allebe, A. Faes, F. Debrot, J. Champlaud, J. Levrat, A. Lachowicz, P. Groninger, L. Sansonnens, Bailat et al. CSEM
L.E. Perret-Aebi, P.J. Alet, J. Escarré, P. Heinstejn, G. Cattaneo, K. Söderström, G. Bugnon, V. Chapuis, E. Annigoni et al. CSEM
S. Nicolay, J. Bailat, Didier Dominé, L. Löfgreen, G. Christman, D. Sachetto, L. Sansonnens, P. Gröniger, S. J. Moon, J.W Schuttauf et al. at CSEM
B. Niesen, J. Werner, A. Walter, M. Morales, Ph. Löper, F. J. Haug, N. Wyrsh, A. Hessler, Q. Jeangros G. Nogay, J. Stueckelberg, P. Wyss et al... at EPFL
C. Bucher, J. Fonjallaz, R. Tschärner, and technical team at EPFL and CSEM
B. Strahm, D. Lachenal, P. Papet, D. Baetzner et al., MEYER BURGER RESEARCH, Neuchatel
T. Söderström, Y. Yao, J. Zhao, E. Vetter, S. Leu et al. MEYER BURGER, CH-DE
O. Shojei, F. Jeanneret, et al. Indeotec SA, I. Sinnico et al. Oerlikon/TEL solar
J. Bullock, A. Cuevas, et al. Berkeley and Anu, S. Essig et al, NREL, M. Topic et al. ULubjana

Many previous Postdocs, Phd students and Engineers/ and new ones

Zachary Holman, Sara Olibet, Corsin, Battaglia, M. Boccard, Steinhauser Jérôme, Python Martin, Hoffman S., Powolny Francois, Söderström Thomas, Li Heng Yu, Söderström Karin, Biron Rémi, Cuony Peter, Bidiville Adrien, Ding Laura, Boccard Matthieu, Lanz Thomas, Bugnon Grégory, Hänni Simon, Demaurex Benedicte, Franco Andrea, Stueckelberg Michael, G. Parscandolo, R. Bartlomé, M. Ledinsky, J. Holovsky, E. Moulin, Ali Dabirian, Andrea, Feltrin, Luc Feitknecht, F. Sculatti-Meillaud, S. Pelisset, M. Barneoud Rais, Ricardo Theron, Daniel Messerschidt, Ali Naqavi, Christian Schlumpf, C. Pahud, S. Morel, L. Fesquet, G. Chong, O. Cubero, S. Fay, J. Damon Lacoste, E. Vallat-Sauvain, F. Galliano, B. Strahm,