Products and system design for making PV a natural component of the building envelope

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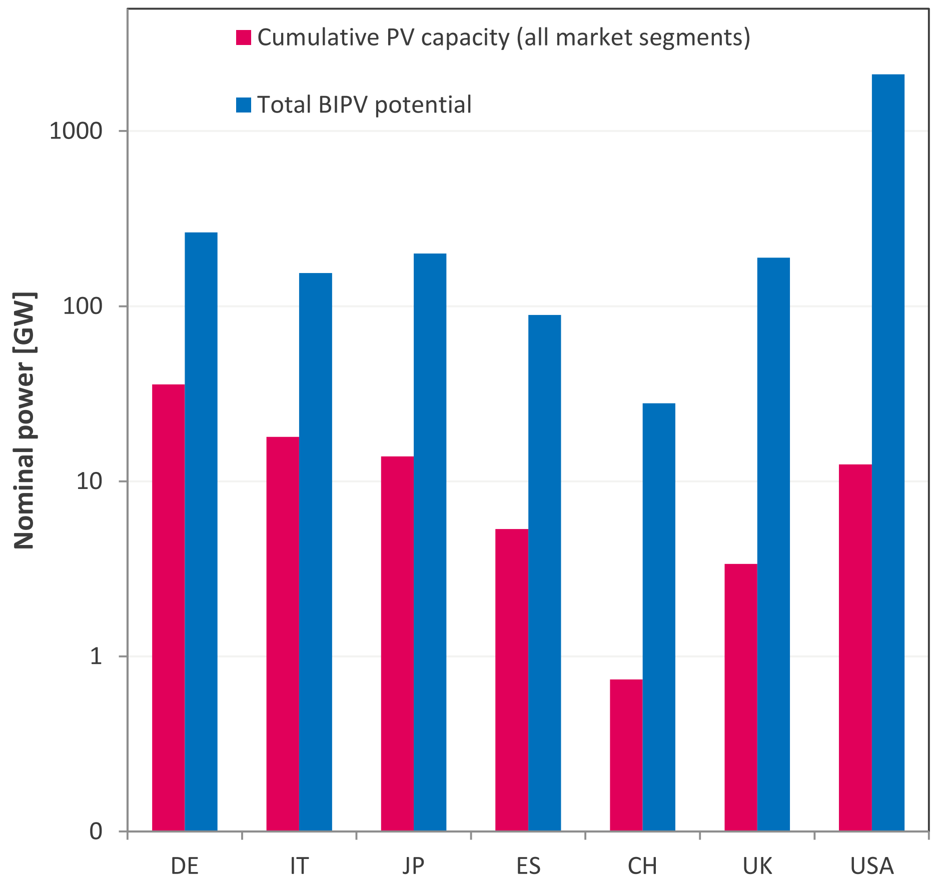
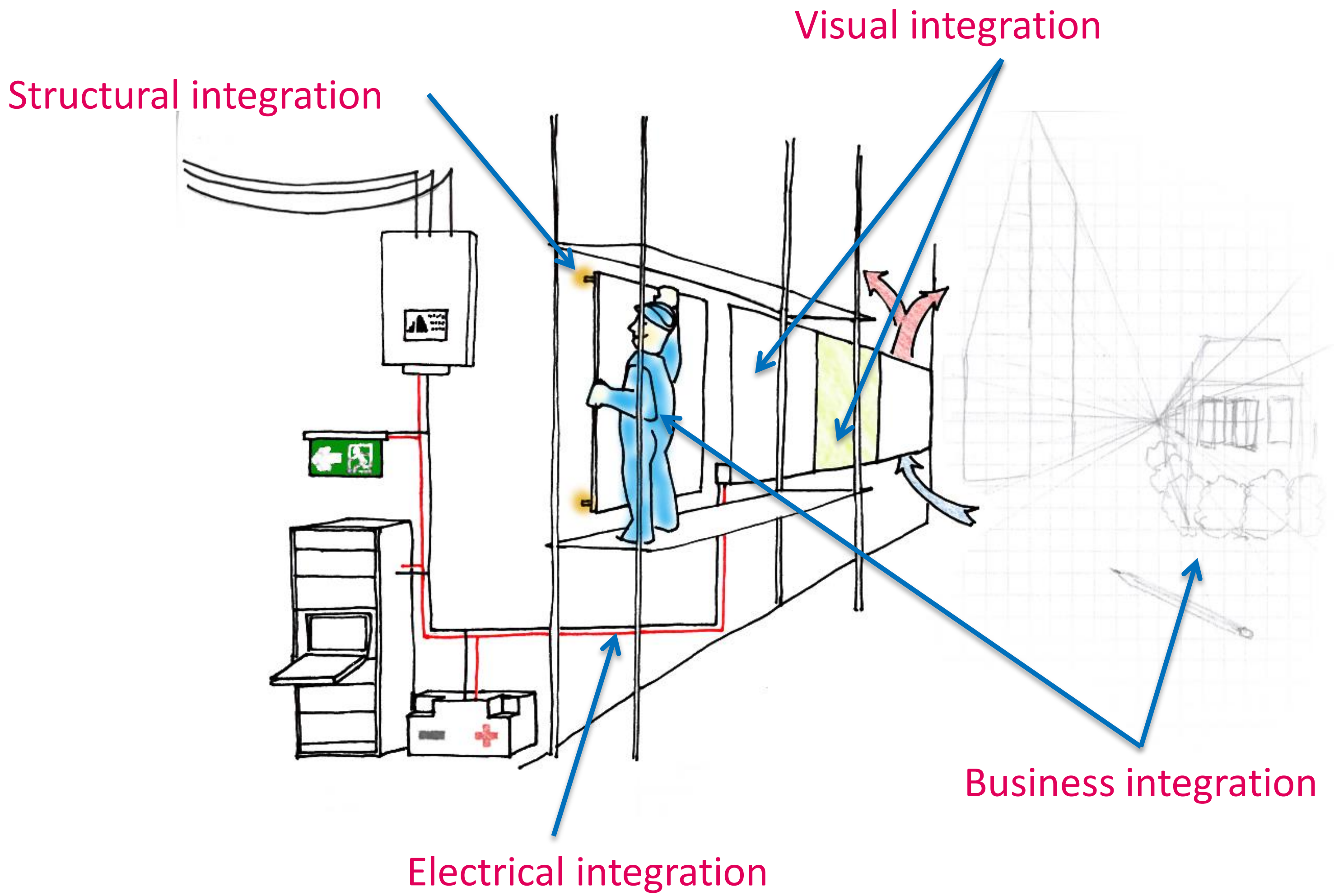
Hamburg, 15.09.2015

World first white PV modules, by CSEM

Buildings: the untapped potential



Integration challenges

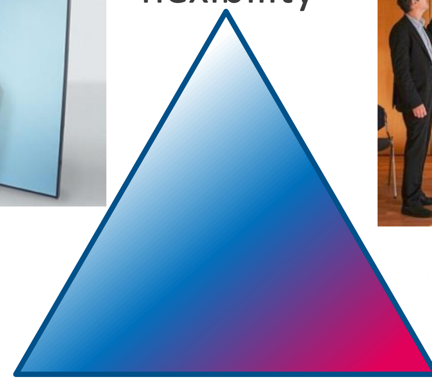


Trade-offs

Coloured glass (coated filters)

Colour flexibility

White and coloured modules based on IR filters



SOLAXESS
white solar technology

Performance

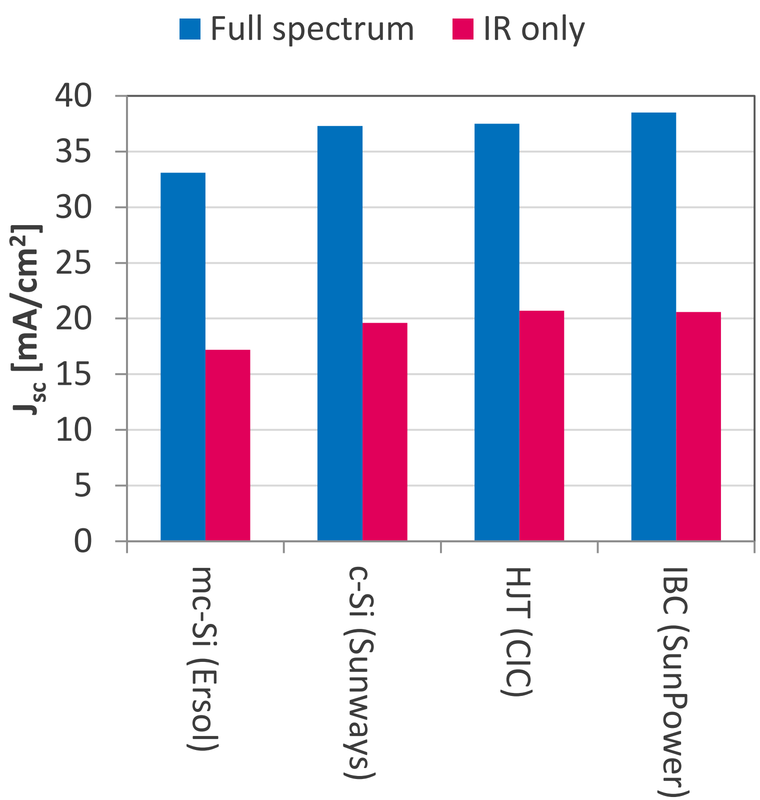
Cost

« Coloured » backsheet

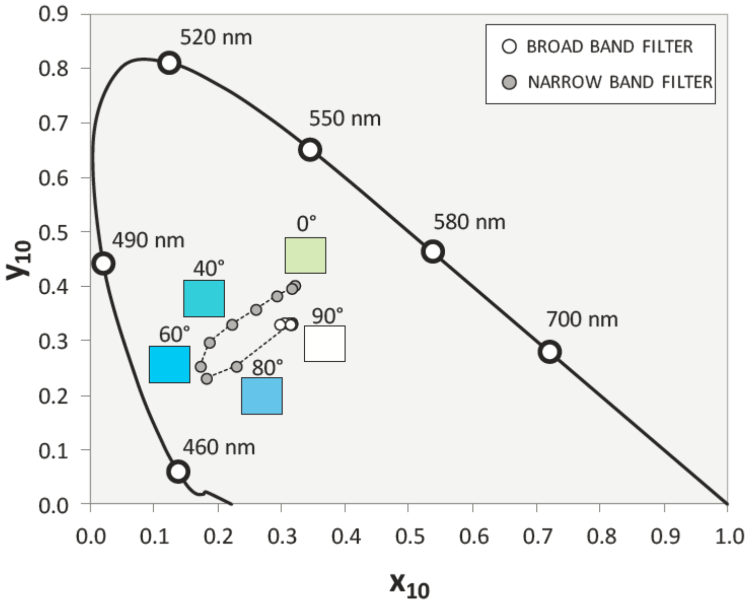
Coloured crystalline cells

IR filter technology

- Enabler: high IR response of modern cells



- Benefits:
  - High stability of colour under changing viewing angle



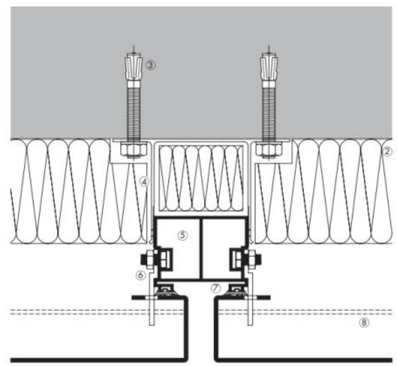
  - Dimensional flexibility thanks to invisible cells

PV modules as construction element

Multifunctional PV cladding system

Demonstration house in BRE (UK) inaugurated 11th Sept. 2015

- CSEM: PV technology
- ÜserHuus: product development
- NexPower: PV module manufacturer
- Spanwall: façade element supplier
- Solmatix: installer



Electrical integration challenges

- PV system design, wiring
  - Complex shapes and shading patterns
  - Lack of suitable standards for DC wiring in buildings
- Alignment between local consumption and production
  - For the user: energy autonomy
  - For the network: maintains quality of supply

Simplification of wiring and design

- Cornerstone: distributed power conversion
- Competing approaches: AC and DC

AC

- Accessible to any electrician
- Scalable: all conversion functions in micro-inverters
- Low efficiency
- High device cost

DC

- (Re)emerging approach
- Higher efficiency
- Lower materials costs
- Natural fit to storage and many loads
- Standards for interoperability, connectors, protection under development
- Inverter still needed for grid connection

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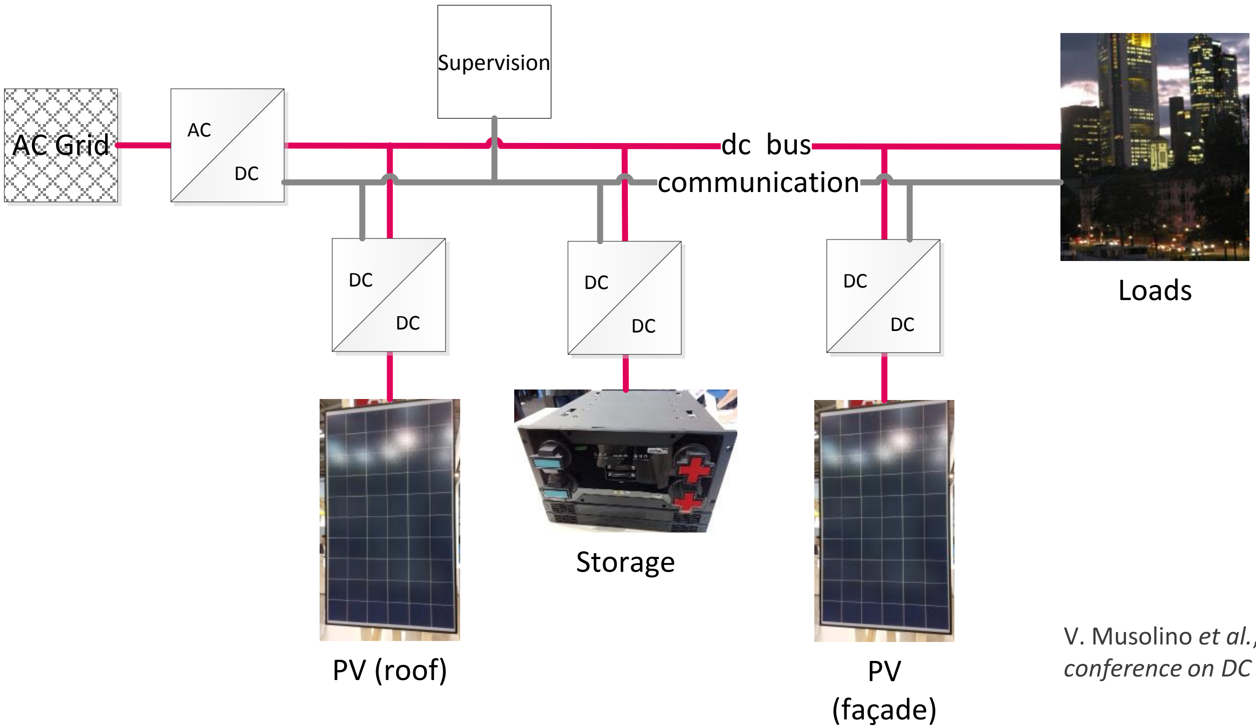
General architecture of DC microgrid



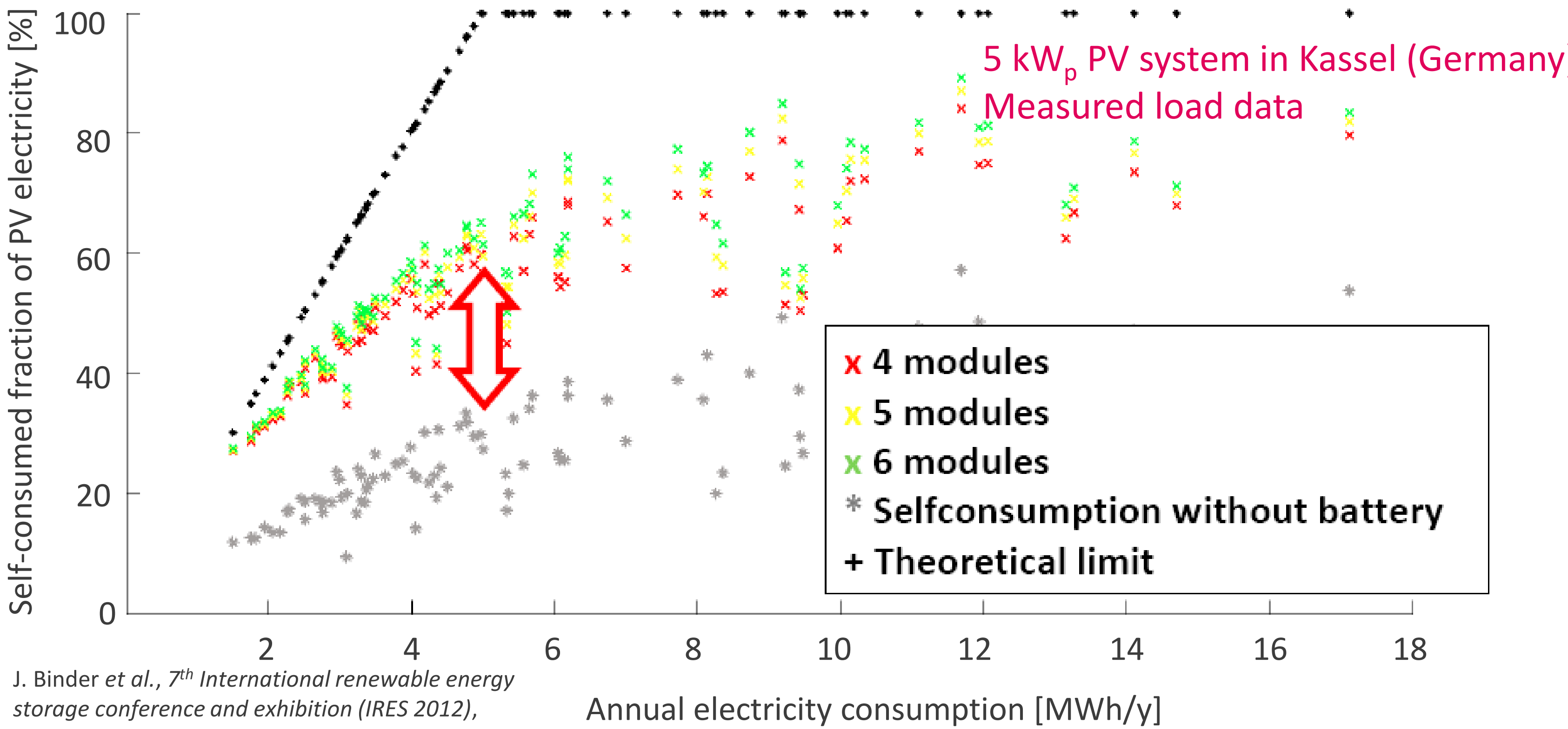
Possible PV converters

V. Musolino *et al.*, in *IEEE first international conference on DC microgrids*, 2015, 102.

Gain in efficiency with DC: 5% to 8% vs. AC[1]

[1]D. Fregosi, S. Ravula, D. Brhlik, J. Saussele, S. Frank, E. Bonnema, J. Scheib, and E. Wilson, “A comparative study of DC and AC microgrids in commercial buildings across different climates and operating profiles,” in *2015 IEEE First International Conference on DC Microgrids (ICDCM)*, 2015, pp. 159–164.

Storage

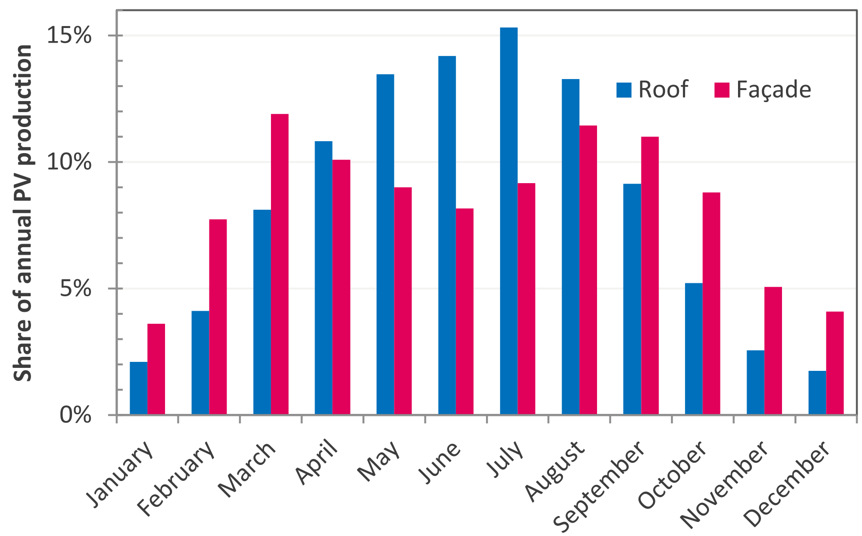


J. Binder *et al.*, *7th International renewable energy storage conference and exhibition (IRES 2012)*, 2012.

- Storage can increase self-consumption fraction by ca. 20 pc
- Does not remove demand peaks

Self-consumption by design

- Better static matching between generation and load: new criterion for system optimisation
- Daily profile: azimuth angles
- Annual profile: tilt angles e.g., roof vs. façade
- Technology choice
- Safest option for customer



Technology	PV generation % annual energy consumption		Self-consumable fraction
	Peak hours	Total	
Thin-film silicon	83%	63%	95%
Standard crystalline silicon	216%	165%	36%
High-performance crystalline silicon	232%	177%	31%

Match between generation and consumption for school building

Summary

- Large BIPV potential to be tapped by making PV a natural component of the building envelope
- Products & design to solve some integration challenges
  - Visual: many technical options, difficult trade-offs
  - Structural: technical solutions demonstrated, require strong collaboration
  - Electrical: AC and DC options, storage, design for self-consumption; much left to do
- Business integration challenge to be solved on its own.

Thank you for your attention!

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