Design Project - SIE 2012

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Comparison of different photovoltaic modules within the framework of a technical and cultural project

Aim

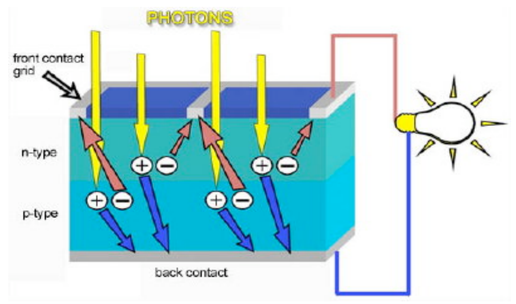
Comparison of different photovoltaic panels technologies and the study of an application strategy for an itinerant building

Strategy

① Inventory of the different technologies of solar cells

② Life cycle analysis (LCA)of the different technologies with the software Simapro 7.2 and database Ecoinvent 2.2

③ Determining the best technologies for an itinerant Minergie building in relation with its energy needs



New technologies

① Inventory of technologies

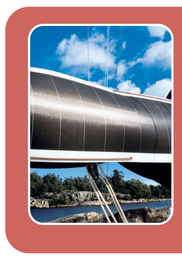
Crystalline silicon cells

Mono-Si (Monocrystalline silicon)
- Mean η: 15-18%
- Lifespan : 30 years
- ✔ mature technology
- ✖ expensive, low η under low light

Multi-Si (Polycrystalline silicon)
- Mean η: 13-16%
- Lifespan : 30 years
- ✔ Good η / price ratio
- ✖ Low η under low light

Ribbon-Si (Ribbon pulled silicon)
- Mean η: 10-14%
- Lifespan : 30 years
- ✔ Less waste of silicon
- ✖ Less efficient

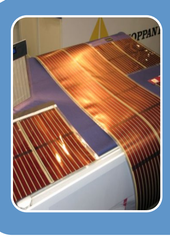
Thin film cells



A-Si (Amorphous silicon)
- Mean η: 5-7%
- Lifespan : 10-30 years
- ✔ Low cost, good η under low light
- ✖ Low η

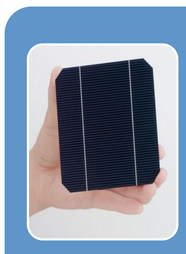
CIS (Copper indium diselenide)
- Mean η: 9-11%
- Lifespan : >25 years
- ✔ Best η among thin film tech
- ✖ Unstable in humid environment

CdTe (Cadmium Telluride)
- Mean η: 7-8.5%
- Lifespan : >25 years
- ✔ Low cost, good η under low light
- ✖ Toxicity of Cadmium



Organic
- Mean η: 5%
- Lifespan : 1.2 years
- ✔ Low cost, easy fabrication
- ✖ Low η and lifespan

Grätzel
- Mean η: 11%
- Lifespan : 20 years
- ✔ Low cost,good η under low light
- ✖ Unstable if variation of temperature



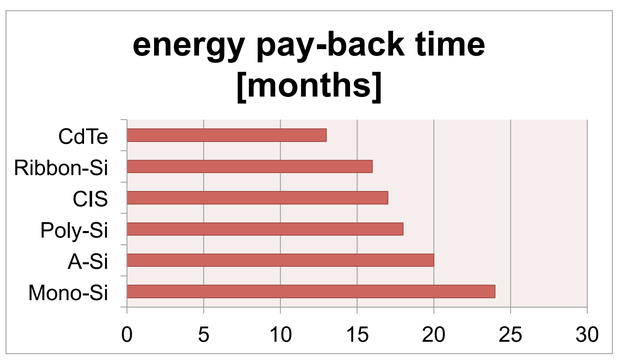
HIT (hetero-junction with intrinsic thin layer)
- Mean η: 19.3%
- Lifespan : 25 years
- ✔ Good η under low light, simple fabrication

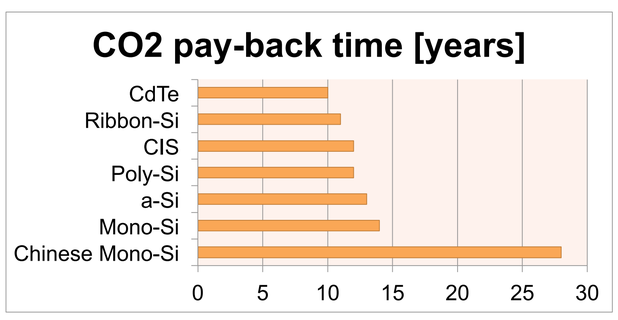
Multi-junction
- Mean η: 30%
- Lifespan : 25 years
- ✔ Best η among cells
- ✖ expensive, tracking needed

② Life cycle analysis

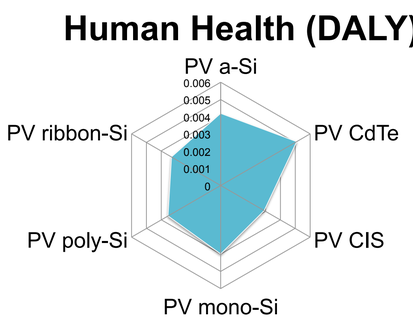
Parameters

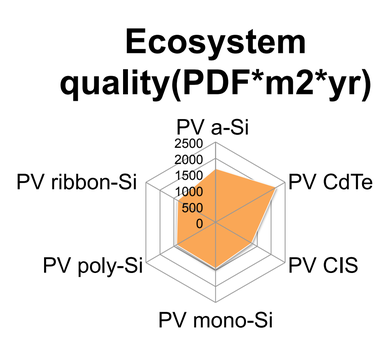
- **Reference unit** : production of 4000 kWh.year
- **Lifespan** : 30 years
- **Location** : Lausanne
- **Fabrication of PV**: Europe





Surface of panels required		
Mono-Si	**Poly-Si**	**Ribbon-Si**
30 m^2	32 m^2	35 m^2
CIS	**CdTe**	**A-Si**
42 m^2	65 m^2	82 m^2





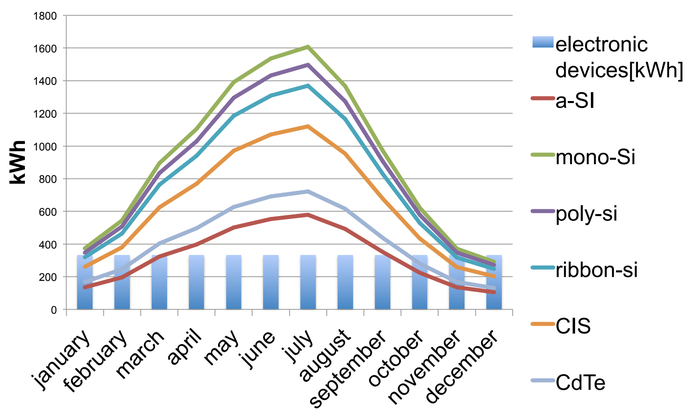
Results

- Mono-PV→biggest EPBT and CO_2PBT but smallest surface
- CdTe PV→lowest EPBT and CO_2PBT but presence of toxic Cadmium →biggest impacts in term of Ecosystem quality & Human health
- CIS and Ribbon-Si PV→good performance and low impacts
- Production of Mono-Si panel in China→ doubles the CO_2PBT

③ Optimal technology for an itinerant building

Parameters

- **Surface of the building** : 100m2
- **Surface of PV** : 60m2
- **Location** : Lausanne
- **Electronic devices** : 4000 kWh.year
- **Heating & sanitary water heating** : 4000 kWh.year→concentration panels



Optimal technology

- Optimal technologies in terms of autonomy → Mono-Si, Poly-Si and Ribbon-Si : 9 months
- **Ribbon-Si → best balance between autonomy of the building and environmental impacts**

Improvements

- Updating the process of the Ecoinvent database
- Including the LCA of new technologies
- Including the degradation factors of the cells