



La Salle - Barcelona, Spain (Architect : Robert y Esteve Terradas Muntanya)



SOLAR

Building Integrated Photovoltaics
Key drivers in sustainable building innovation



WE BRING
ALUMINIUM
TO LIFE

1. REYNAERS, KEY DRIVER IN SUSTAINABLE BUILDING INNOVATION

The time is right

Fact. Buildings represent up to 35% of total energy consumption. Recent studies have shown that by 2030 energy used in building and construction can be reduced by up to 45%*.

This means buildings can become a major force in reducing energy consumption.

At Reynaers we truly consider sustainability as one of the fundamental trends in the building industry. Therefore we do not only systematically improve thermal insulation of our products but also integrate green technology in our solutions. Building Integrated Photovoltaics (BIPV) combine the best of both worlds: they meet all the modern architect's standards in design and performance and actively generate clean energy at the same time. After the launch of the CW 60 Solar in 2008, Reynaers is proud to present you its new and extended product range.

The time is right, all the signs are there: systematic political support for green energy technology on local and international level, steady worldwide growth in clean energy production, rising demand for photovoltaics and falling technology production costs.

It is a booming market that is forecast to continue to grow. Reynaers rises to the opportunity.

*Source: Pathways to World-Class Energy Efficiency in Belgium. McKinsey & Company, 2009.



Reynaers - solar panels on roof of new distribution centre - Belgium

Reynaers sets an example

PRODUCE ENERGY

Since actions speak louder than words, we have installed on our new warehouse at our headquarters one of the largest roof-mounted PV plants in Belgium: 5.000 m² of surface solar panels. The results for 2008 are impressive:

- Roof surface 16.000 m²
- Energy production 571.100 kWh
(Comparative energy consumption by 166 households: 500.000 kWh)
- CO₂ reduction 342,7 tons
(Comparative energy consumption of 190 households)

2. THE FUTURE IS SOLAR ENERGY

a. What are photovoltaics?

Photovoltaics (PV) convert solar energy - sunlight, including ultra violet radiation - directly into electricity. With the rising demand for clean energy, their production has been doubling every year since 2002, making it the world's fastest-growing energy technology.

Solar power is pollution-free when used. PV hardly need maintenance and their efficiency is rapidly rising while mass production costs are falling.

b. An industry destined to grow

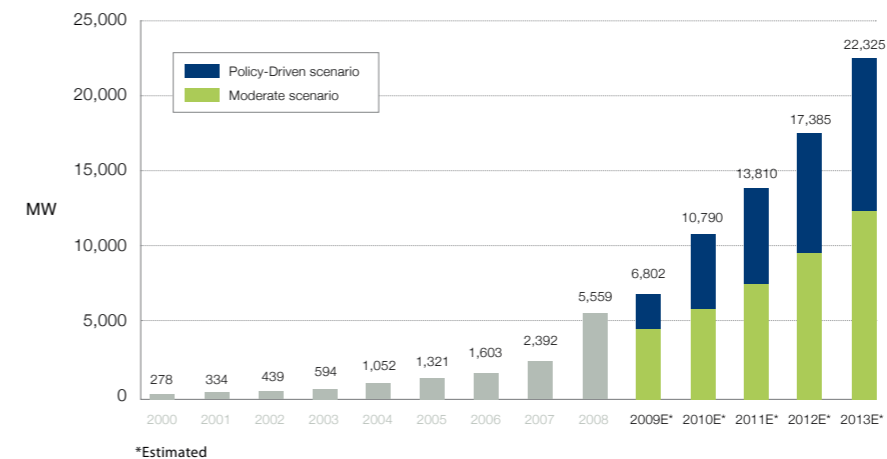
The PV industry boom is forecast to continue in the coming years. If local and international political frameworks continue to support this development, the capacity of annually installed solar power systems would reach 281 GW by 2030.

Solar electricity is destined to become one of the world's primary energy sources in a couple of decades.

"The current surge of activity in the solar electricity sector represents merely a foretaste of the massive transformation and expansion expected to occur over the coming decades."

Source: Solar Generation V - 2008 Solar electricity for over one billion people and two million jobs by 2020. EPIA, Greenpeace, 2008.

Global annual PV market outlook until 2013



Source: EPIA. "2013.Global market outlook for photovoltaics until 2013"

There are two possible scenarios to predict the future of photovoltaics. The Moderate scenario is based on the assumption of a 'business as usual' scenario which does not assume any major enforcement of existing support mechanisms. The Policy-Driven scenario is based on the assumption of the follow-up and introduction of support mechanisms, namely FiT, in a large number of countries.

c. The importance of political commitment

There is a clear commercial and political commitment to the expansion of the PV industry. Thanks to its feed-in tariff program Germany has developed the most dynamic solar electricity market in Europe. Many European states have also implemented feed-in tariffs and have adjusted it to their needs.

"PV market deployment is, to a large extent, dependent on the political framework of any given country. Support mechanisms are defined in national laws."

Source: EPIA. "2013.Global market outlook for photovoltaics until 2013."

Country	Main support scheme	BIPV €/kWh	BAPV €/kWh	Duration	Cap
Austria	FiT	0.30 - 0.46		10+1+1	3.3 MW/year
Belgium	GC	Brussels: 0.15 - 0.65		Brussels 10	
		Wallonia: 0.15 - 0.63		Wallonia 15	-
		Flanders: 0.45		Flanders : 20	
Bulgaria	FiT	0.38 - 0.42		25	-
Czech Republic	FiT	0.48 - 0.49		20	
France	FiT	0.60	0.32 - 0.43	20	-
Germany	FiT	0.33 - 0.43		20	
Greece	FiT	0.40 - 0.50		20	
Italy	FiT	0.43 - 0.48	0.39 - 0.43	20	1200 MW
Luxembourg	FiT	0.36 - 0.39		15	5 MW
Netherlands	FiT	0.29		15	15 MW (2009)
Portugal	FiT	0.62		5+10	12 MW
Romania	GC	0.11 - 0.22		10	
Slovenia	FiT	0.33 - 0.37		5+5+10	-
Spain	FiT	0.32 - 0.34		25	-
Switzerland	FiT	0.38 - 0.56	0.37 - 0.46	25	16 Mio CHF
UK	GC	0.03-0.06		lifetime	-

- FiT** *Feed-in tariff. Producers of solar electricity have the right to feed solar electricity into the public grid, receive a premium tariff per generated kWh reflecting the benefits of solar electricity compared to electricity generated from fossil fuels or nuclear power, and they receive the premium tariff over a fixed period of time. (Information 2009)*
- GC** *Green certificate. Tradable commodity proving that certain electricity is generated using renewable energy sources. Green certificates represent the environmental value of renewable energy generated. The certificates can be traded separately from the energy produced.*
- BIPV** *Building Integrated Photovoltaics. PV integrated into the construction of the building.*
- BAPV** *Building Applied Photovoltaics. PV added to a building after it was constructed.*
- Duration** *Length (years) of the support scheme.*
- Cap** *Maximum amount of energy to be produced.*

Source: EPIA. 2009 "Overview of European PV support schemes."

3. OUR ANSWER IS BIPV

a. What are BIPV?

Building Integrated Photovoltaics (BIPV) combine the best of both worlds: as multifunctional solar products they generate electricity through photovoltaics while serving as construction materials.

BIPV can be parts of a building's envelope, like roof cover, wall facing and glazed surfaces. They can be solar protection devices like sunshadings, additional architectural elements such as canopies, balcony parapets and any other architectural element of a building.

Today's BIPV products come in all shapes, colors and functions. They are affordable, beneficial and highly attractive as the defining element in a building's design. Moreover, they contribute to the ecological image of the building and the people it houses.



La Salle - Barcelona, Spain (Architect : Robert y Esteve Terradas Muntañola)

b. Why choose BIPV?

- Increase energy performance: generate reliable clean and renewable energy
- High tech 'green energy' solution with return on investment
- Cost-efficiency: offset façade, roofing and glazing material costs
- Increase the value of your building, both in design and energy management
- Enhance architectural design with clean and attractive materials, cabling remains hidden
- Elegant, sustainable architecture enhances client's ecological corporate image
- Easy to maintain

c. Types of PV panels

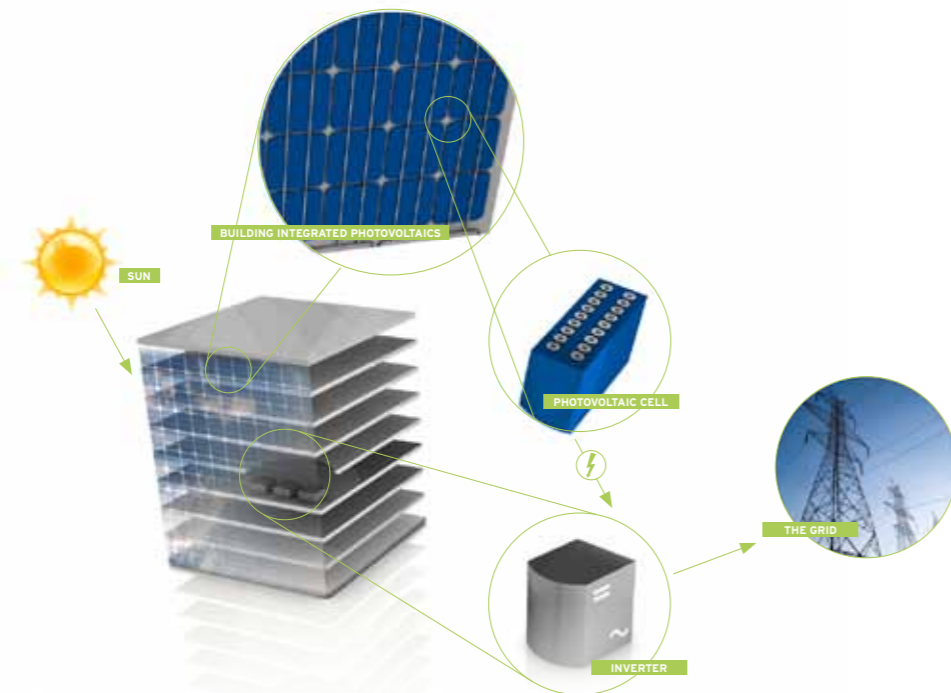
In photovoltaic modules, the absorber converts sunlight into electricity. Mono and poly crystalline cells are the most well-known absorbers.

- **Mono crystalline cells:** yield 18% - 180 Wp/m²
- **Poly crystalline cells:** yield 14% - 140 Wp/m²

Crystalline PV can be applied as non-transparent panels with an average yield of 120 to 180 Wp/m². As semitransparent PV you get an average yield of 50 to 100 Wp/m².

- **Amorphous cells:** yield 8% - 80 Wp/m²
- Amorphous silicon cells may be less efficient than crystalline cells, but they are cheaper and that makes them more suitable for applications where cost is the key. Their efficiency can be optimized by stacking several layers and adjusting each layer to the right frequency of light. Since amorphous silicon cells are much thinner, they are more flexible as building material.

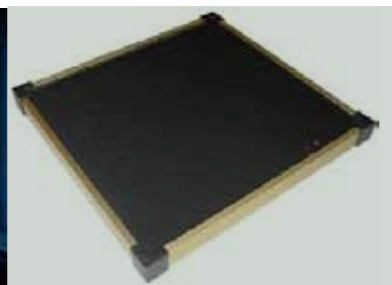
Amorphous PV can be applied as non transparent panels with an average yield of 50 to 80 Wp/m². Translucent amorphous PV produce an average yield of 25 to 60 Wp/m².



Crystalline PV



Semitransparent Crystalline PV



Amorphous PV



Translucent Amorphous PV

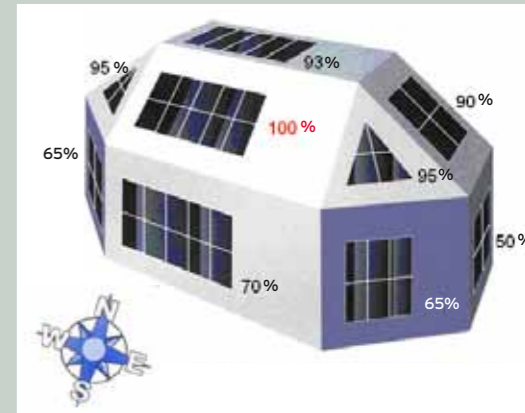
d. Effective design

When designing the integration of PV into a building, it is vital to orientate the panels towards direct sunlight. The balance between the shading capacities of semitransparent systems and providing an office with maximum daylight is crucial for visual comfort.

By calculating the shadow angles of a building's façade you can determine the optimal position of a panel. Depending on your position and the season, shadow angles logically differ for different cities.

As shown in this graph, the orientation of the building as well as the angle of the panels are crucial to determine the output of the panels.

The output is the highest when the panels are oriented between south-east and south-west with an angle of 35 to 45 degrees.



e. Case study

This building in Avignon, France, had RB 10 Solar railings and BS 30 Solar sunblinds installed. The building is south oriented, which is ideal for maximum yield. The railings had an inclination of 75°, the blinds of 30°.

The installation consists of specific glass panels. One panel generates 175 Wp. The total power is 10,15 kWp. Yearly production is 11,1 kWh.

The results are substantial: CO₂ emissions have been reduced by 6.2 tons. The return of investment is expected to be complete in about 9 years.



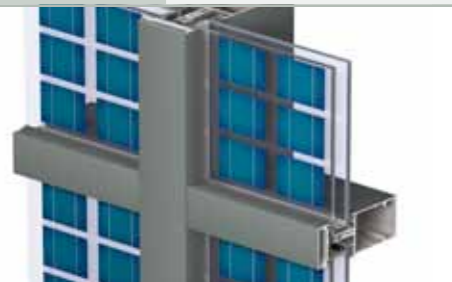
Gaia Maneo, Avignon, France

4. REYNAERS BIPV PRODUCT RANGE

Reynaers is proud to present a full range of BIPV solutions. They are designed to match the different parts and sides of a building and guarantee maximum yield for each panel.

All our products can handle all 3 types of PV panels: mono and poly crystalline and amorphous cells.

CW 60 Solar



- For wall and roof applications
- As a curtain wall or glass roof these panels have been designed to completely avoid shadow on the cells.
- Easy wiring assembly. Totally insulated system.

Filling type	double glass and double glazing
Inclination	15° to 90°

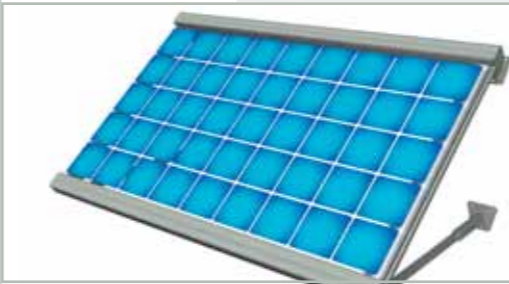
RB 10 Solar



- For balustrade
- Designed for balustrades on balconies that are accessible or not.

Filling type	PVB sheeted double glass (accessible) double glass, glass/Tedlar and standard panels (non-accessible)
Inclination for accessible balcony	90°
Inclination for non-accessible balcony	60° tot 90°

BS 30 Solar



- For sunshading
- This sun blind matches electricity production with protection against blinding and direct sunlight.

Filling type	double glass, glass/Tedlar and standard panels
Inclination	15° tot 45°

BS 100 Solar



- For sunshading
- This type of sun blind consists of a series of different PV panels that are suited for every building, existing or new.
- Both practical and attractive, it protects against sunlight and avoids blinding.

Filling type	double glass, glass/Tedlar
Inclination	0° to 45°

SR 40



- For roof applications
- Non-insulated solution suited for renovation projects or new roofs, for hangars e.g., this is a great alternative for classic roof systems because they generate electricity.

Filling type	double glass, glass/Tedlar and standard panels
Inclination	5° to 45°



Curtain wall with photovoltaic panels - La Salle - Barcelona, Spain (Architect : Robert y Esteve Terradas Muntañola)

5. PROJECTS

CW 50-HL with photovoltaic panels



*Universitat Ramon Llull, La Salle
Barcelona, Spain, 2006*

The La Salle Technological and Business Innovation Park building is located in Barcelona's uptown. The façade structure is a combination of iron and the CW 50 Reynaers Aluminium system that sustains 650 m² of glass surface. The surface includes 195 m² of solar panels that generate 90 mW hours per year, enough energy to illuminate 2,5 km of city streets for one year. The creation of a curtain wall as support on the photovoltaic façade allows the hot air accumulated in the air chamber to be reused in winter. The accumulated hot air is released in summer by an automated trapdoor in the roof.

CW 60 Solar



*Préfecture de Ramonville
France, 2008*

The Town Hall of Ramonville is located in the south-west of France. In the new additional part of this public building a photovoltaic surface of 16 m² is installed in order to produce electricity (700 Wp). This project also demonstrates amorphous cells can be integrated into our CW 60 Solar.

BS 30 Solar and RB 10 Solar



*Gaia Maneo,
Avignon, France, 2009*

The Brise Soleil 30 Solar and RB 10 Solar are specifically designed and developed by Reynaers in collaboration with Urbasolar. It can integrate most of the standard Tedlar glass panels manufactured by world leading companies. The module dimensions, already equipped with anodized aluminium frames are 1575 x 826 mm. The BS 30 solar can be fixed both on the concrete part of the façade and on the aluminium curtain wall thanks to specific anchors. Different angles from 10° to 90° are also possible to get optimised performance. The RB 10 Solar for roof applications offers different angles from 15° to 45°. Both systems have been equipped with specific safety screws for anti-burglary reasons.

6. CHOOSE REYNAERS

Whatever your wishes in terms of design, construction and yield, Reynaers provides the solution.

Expert solutions

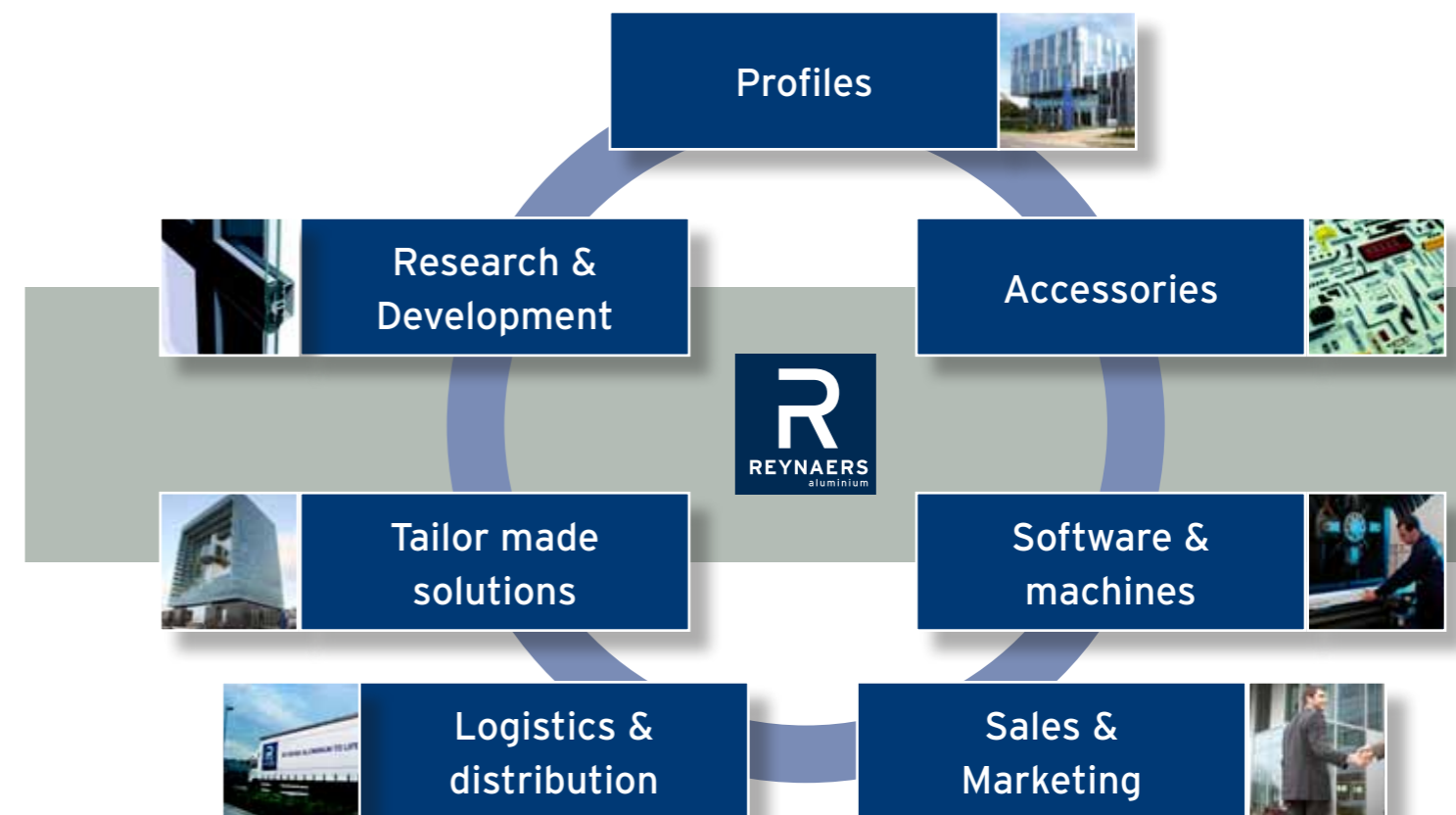
Our full range of BIPV materials guarantees a multitude of applications. But even more than the sheer range of products, it is their flexibility that makes them ideal to work with. We provide every project with open solutions that can be adapted to all materials developed by our partners: cells, inverters, cabling, ...

Expert skills and partners

Our partners include major suppliers of PV panels and green technology in the industry. We team up with the most trusted project integrators and have access to an extensive network of experts in project computation. The installers we work with have been carefully assessed and selected.

Expert experience

As a leading provider of aluminium system solutions, more than 2 million m² of façades are installed every year with Reynaers systems. We have more than 4.000 partners and customers all over the world who trust us when it comes to engineering and providing custom-made solutions. That is experience that will work for you.



ABOUT REYNAERS ALUMINIUM

Reynaers Aluminium is a leading European provider of innovative and sustainable architectural aluminium solutions. These include a wide variety of window and door systems, curtain walling, sliding systems, sun screening, conservatories, skylights, screens and systems to incorporate blinds and ventilation grids. Established in 1965 and headquartered in Duffel (Belgium), Reynaers Aluminium has offices in more than 30 countries worldwide.



WE BRING ALUMINIUM TO LIFE

REYNAERS ALUMINIUM N.V.

Oude Liersebaan 266 - B-2570 Duffel
t +32 (0)15 308 810 - f +32 (0)15 308 880
www.reynaers.be - info@reynaers.be