“BUILDING INTEGRATED PHOTOVOLTAICS – FROM BEST PRACTICE EXAMPLES TO LARGE-SCALE MARKET PENETRATION”

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Solar architecture is not a fashion, it is survival. – Sir Norman Foster
1. ONYX SOLAR: ABOUT

- Year of Incorporation: 2009
- Ownership: Privately held. VC on board
- Headquarters: Avila, Spain
- Offices: New York & Beijing
- Fabrication Plant: Avila, Spain
- Annual Production Capacity: 250,000 Sqm
- Tech. Manufactured: Amorphous (a-Si) and Crystalline Silicone (c-Si)
- Projects completed: +250 worldwide.

https://www.onyxsolar.com/all-you-need
AMORPHOUS

Coating over a layer of flat glass (CVD)

Visual Light Tr: Dark, 10, 20, 30%

Efficiency 5% - 10%

Greater energy production (kWh) at the same installed power (kWp)

Better behavior under the presence of shadows / overcast (tilt, orientation)

Low temperature coefficient – performs well under high temperature

Unobstructed views
By add-ons we refer to other configurations for the photovoltaic glass that, depending on the performance desired for the project, may be required.

Spacers are a typical add-on to improve the U-value of the PV glass unit; counting on an double pane unit and considering the coatings applied, the photovoltaic glass can reach U-values as low as 0.13 BTU/h*Ft²*F°.

Typical spacer thicknesses are ¼”, ½” and 10/16”, depending on the insulation required. Air and Argon gas fills are commonly requested.

Picture on the left shows a typical amorphous Silicon double glazing configuration, as a reference.
2. ONYX SOLAR APPROACH FOR BIPV

Architectural glass which besides providing the building with the same passive properties as a conventional glazing, it also generates free electricity from the sun. It is therefore, the only building material available in the market that provides your building a return on the investment.

ARCHITECTURAL GLASS THAT GENERATES ELECTRICITY

- MATCHES THE ARCHITECTURAL GLASS SPECIFICATIONS
- ENVIROMENTAL BENEFITS: AVOIDING CO2 EMISSIONS
- ECONOMICAL BENEFITS: ENERGY GENERATION
Onyx Solar
BIPV Consultancy Services at
design phases:

• Architectural drawing and project requirement study to provide best BIPV option for the construction project

• Close collaboration with design team.
3. CASE STUDY: EDMONTON CONVENTION CENTER, CANADA

**Project Data:**

- Atrium Skylight replacement with IGU PV GLASS
- Area of integration: 1,600 sqm
- Technology: mono-crystalline silicon
- Installed power: 160 kWp
- Estimated Energy Generation: 227,000 kWh/year
- Owner: ECC, City of Edmonton
- Architecture: DIALOG
- General Contractor: Bird Construction Company
- Glazing Contractor: Flynn Canada Ltd.
- PV Consultant: Howell Mayhew Engineering, Inc.
3. CASE STUDY: EDMONTON CONVENTION
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**BIPV Project Schedule:**
- Consultancy to the architectural design (DIALOG Architects and PV Consultant) during conceptual and developed design: **2015 - 2016**
- PV glass and PV system details during tendering phase and technical design (Glazing Contractor and PV Consultant): **2018**
- PV glass shop drawings and supply: **2019**

**Main Challenges:**
1. Coordination in detail design with all stakeholders: Consultant, Glazing Contractor and Electrical Contractor
2. Shop drawings, manufacturing and project management with 126 different types of units for 700 total PV glass units.
**TYPICAL PV GLASS DATA SHEET**

**PHOTOVOLTAIC GLASS**  
2377 x 1130

<table>
<thead>
<tr>
<th>Type/</th>
<th>6&quot; Mono</th>
<th>Crystalline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal peak power</td>
<td>286</td>
<td>P_{mpp} (Wp)</td>
</tr>
<tr>
<td>Open-circuit voltage</td>
<td>40</td>
<td>V_{oc} (V)</td>
</tr>
<tr>
<td>Short-circuit current</td>
<td>9.09</td>
<td>I_{sc} (A)</td>
</tr>
<tr>
<td>Voltage at nominal power</td>
<td>33</td>
<td>V_{mp} (V)</td>
</tr>
<tr>
<td>Current at nominal power</td>
<td>8.54</td>
<td>I_{mpp} (A)</td>
</tr>
<tr>
<td>Power tolerance not to exceed</td>
<td>±10</td>
<td>%</td>
</tr>
</tbody>
</table>

**Mechanical description**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>2377 mm</td>
</tr>
<tr>
<td>Width</td>
<td>1130 mm</td>
</tr>
<tr>
<td>Thickness</td>
<td>3.25 mm</td>
</tr>
<tr>
<td>Surface area</td>
<td>2.98 sqm</td>
</tr>
</tbody>
</table>

**Electrical data test conditions (STC)**

- STC: 1000 W/m², AM 1.5 and a cell temperature of 25°C, stabilized module state.

**Junction Box**

<table>
<thead>
<tr>
<th>Protection</th>
<th>IP65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wiring Section</td>
<td>2,5 mm² or 4,0 mm²</td>
</tr>
</tbody>
</table>

**Limits**

- Maximum system voltage: 1000 V_{sys} (V)
- Operating module temperature: -40°C...+85°C

**Temperature Coefficients**

- Temperature Coefficient of P_{mpp}: -0.451 \%/°C
- Temperature Coefficient of V_{oc}: -0.361 \%/°C
- Temperature Coefficient of I_{sc}: +0.08 \%/°C

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*All technical specifications are subject to change without notice by Onyx Solar*

*Dimensions as per inner glass dimensions in shop-drawings*
WIRING ROUTE – STRING INTERCONNECTION

- Rafter Cover Cap
- Pressure Plate Cap
- Intermittent Cable Strap
- Cut-out Space in Pressure Plate for Insulated Conduit as Required
- EPDM Gasket
- Silicone Sealant
- PV You
- Spacer

Dashed line indicates pull in drainage into rainscreen cavity. Rafter beyond.

EPDM gaskets
Rafter
Furling beyond

0.8mm Aluminium Brake Shave, 200mm long as cable retainer. [1] / Row / Rafter

200mm long for internal sleeve at face cap sheet.

813-343 Deep Cap to accommodate solar panel wiring.

Top line of sealed unit offset 10mm on busbar side to allow clearance (other edges remain standard).

- 59.5-443 Cap
- 512-041
- 027-920

- 05-001 = Custom Length = 1 1/3

- 4mm to 8mm T
- 4mm H5

2. #12 x 11/2 (3/4) F.M. Self-Tapping Screws to secure pull in rafter. -Typical-

Rafter Anchor constructed of 4mm plate and D.R. Shop Welded, Primed Painted and Final Painted to Match Aluminium

1001 Grade B Bolt w/ Washer and Nylock Nut to Secure Rafter to Anchor

High Impact Plastic Shims to isolate aluminium from anchor

Anchor secured to existing structure with (4) #14 Tek Screws.

Existing Steel Structure

Anchor A or B
126 DIFFERENT TYPES OF UNITS FROM A TOTAL OF 700 UNITS
CENTRAL OCULUS

The pattern of the cells opens up to a circular oculus with lines of Morse code that spell out a poem. It is an excerpt of Gifts of a River by E.D. Blodgett, a former Edmonton Poet Laureate.
Information Note: Architectural details, drawings and electrical schemes shown on this presentations thanks to Flyn Canada, Ltd. and Howell Mayhew Engineering, Inc.