Your Dreams, Our Challenge

SEMINAR ON AWARENESS TOWARD ZERO ENERGY BUILDING (ZEB)

AGC products for ZEB family

AGC Asia Pacific Pte Ltd
Yusuke Mori, Ph. D.

Definition of ZEB (Zero Energy Building)

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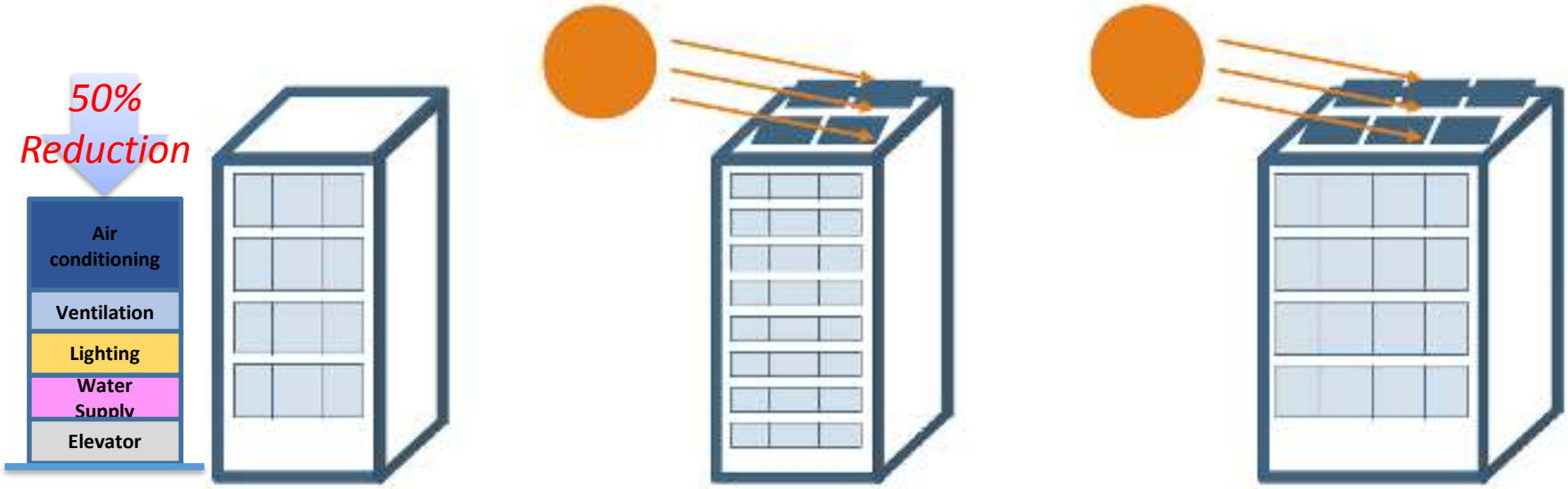
ZEB Ready
(Energy Saving: 50% or More)

Nearly ZEB
(Energy Saving: 75% or More)

ZEB
(Energy Saving: 100% or More)



Achievement of ZEB ready by Energy Saving: 50% or More

Energy generation by renewable energy source

Nearly ZEB, ZEB (Net Zero)

Definition of ZEB (Zero Energy Building)

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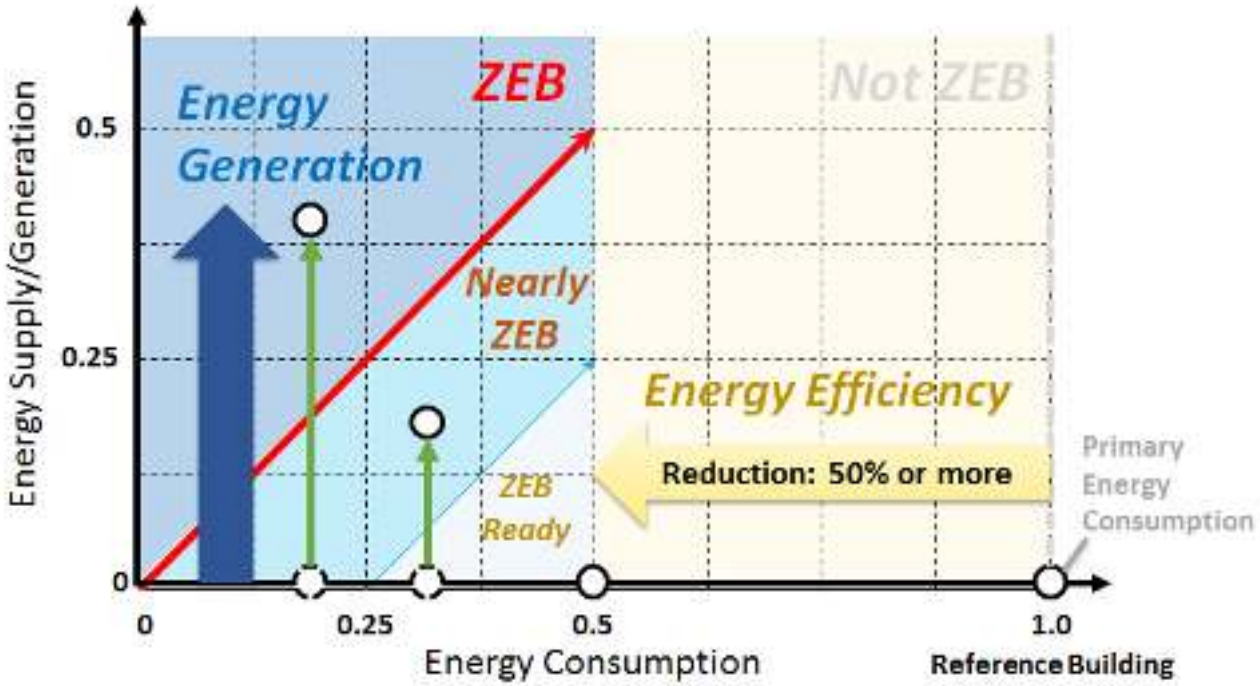


Energy Efficiency

1. **Load reduction (Improvement of thermal insulation and solar shielding)**
2. Use of natural energy (except for renewable energy)
3. Improved equipment and systems

Energy Generation

4. **Introduction of renewable energy**

Introduction of AGC

AGC
Your Dreams, Our Challenge

AGC Group (Net sales JPY 1,463.5 billion (FY2017))

Glass

Flat Glass

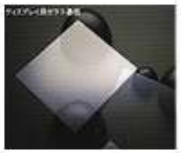
- Float Flat Glass
- Low-E glass
- Fabricated glass for architectural (Heat Insulating/shielding glass, Disaster-resistant /Security glass, Fire-resistant glass)
- Polished wired glass
- Interior / Decorative glass

Automotive Glass

- Tempered glass
- Laminated glass

Electronics

Display



- Glass substrate for display devices
- Specialty glass for display applications
- Glass for Solar Power System

Electronic Materials

- Semiconductor process materials
- Optoelectronics materials
- Lighting glass products
- Laboratory glass

Chemicals

Chlor-alkali & Urethane

- Raw materials for vinyl chloride polymer
- Caustic soda
- Urethane

Fluoro-chemicals & specialty chemicals

- Fluorinated resins
- Water and oil repellents
- Pharmaceutical and agrochemical intermediates
- Iodine-relatd materials

Ceramics/Other

- Ceramic products
- Furnace Engineering

Introduction of AGC Asia Pacific

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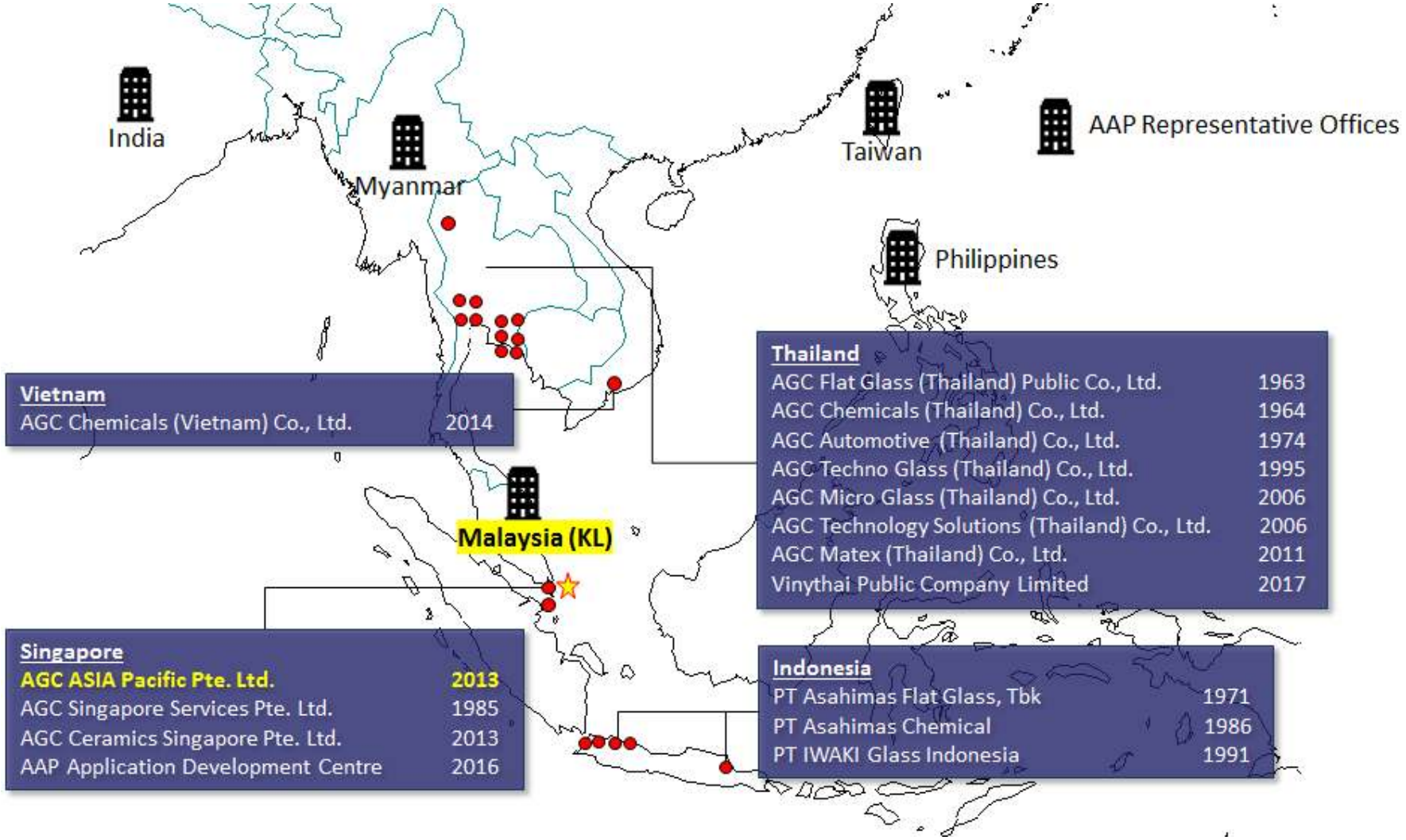

Vietnam

AGC Chemicals (Vietnam) Co., Ltd.	2014

Thailand

AGC Flat Glass (Thailand) Public Co., Ltd.	1963
AGC Chemicals (Thailand) Co., Ltd.	1964
AGC Automotive (Thailand) Co., Ltd.	1974
AGC Techno Glass (Thailand) Co., Ltd.	1995
AGC Micro Glass (Thailand) Co., Ltd.	2006
AGC Technology Solutions (Thailand) Co., Ltd.	2006
AGC Matex (Thailand) Co., Ltd.	2011
Vinythai Public Company Limited	2017

Singapore

AGC ASIA Pacific Pte. Ltd.	**2013**
AGC Singapore Services Pte. Ltd.	1985
AGC Ceramics Singapore Pte. Ltd.	2013
AAP Application Development Centre	2016

Indonesia

PT Asahimas Flat Glass, Tbk	1971
PT Asahimas Chemical	1986
PT IWAKI Glass Indonesia	1991

AGC Solutions for ZEB family

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Eco Glass

The products with various functions such as thermal insulation, energy saving, disaster prevention, and sound insulation.

Lightweight solar cell module (Leoflex)

AGC has considerably reduced the weight of solar cell modules, which enhances flexibility in the installation area and sizes of the solar cells.

GIPV (Glass Integrated PV) 〈SUNJOULE〉

Solar cell module for receiving sunlight on its single or both surfaces. It can be also used not only a PV cell module, also a fence and a sound barrier.

Light weight Mounting System for Solar Module (Plalloy™)

AGC's original FRP Plalloy is used as the light weight, highly durable frame of a solar module. Its specific gravity is 72% of that of aluminum, and 24% of that of iron. [

High durable Fluoropolymer Film

ETFE is a thermo plastic fluororesins. While maintaining chemical resistance, electrical / mechanical characteristics and high moldability, ETFE as film material that is lightweight and has high design-flexibility and light transmittance.

Glass ceramic substrates for LEDs (GCHP™)

AGC's LED substrates a newly developed substrate combining glass technology and ceramic technology. It has high luminance and durability.

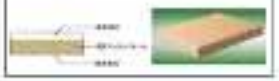
Fluoropolymer for Coatings 〈Lumiflon〉

This material protects buildings and bridges without fading for a long time. Repainting is unnecessary for more than 20 years. This material is used for a landmark construction all over the world.

Thermal Simulation

AGC can offer solutions with our own thermo simulation technology for living spaces.

Polyurethane Raw Materials for Insulation (Polyether Polyol: PPG)



PPGs are used for various insulation products as a raw materials. It contribute for high insulation and light weight.

Fastest & Flexible Plastic FONTEX Optical Fiber

Fontex is developed by fluorinated chemistry. Fontex combines low power consumption of 1/20 that of copper cable and high-speed transmission of 10 Gbps or more. It is the fastest communication cable.

Polycarbonate Sheet and Films (CARBOGLASS™)

AGC's polycarbonate is a highly shock-resistant and transparent resin.

Eco Glass for EV (Electric Vehicle)

Saving energy consumption by high thermal insulation glass. Chemically strengthened glass, and anti fog glass.

AGC Solutions for ZEB family

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Energy Efficiency

Load reduction (Improvement of thermal insulation and solar shielding)

Stopsol Sunergy
Stopray T-Sunlux

ATTOCH™

HALIO™

BONNFLON

Energy Generation

Renewable energy

SUNJOULE
Glass Integrated PV Solution

Eco Glass: Coated Glass

Energy Efficiency

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- Coated Products
  - Pyrolythic Coating (Hard/Online Coating)
    - Solar Control Reflective
      - Stopsol Classic
      - Stopsol Supersilver
    - Solar Control Low E
      - Sunergy Clear, Cool, Tinted
      - Sunergy Sigma
      - Planibel G (Low E only)
  - Magnetron Sputtering Coating (Soft/Offline Coating)
    - Solar Control Reflective
      - T-Sunlux
    - Solar Control Low E
      - Stopray Ace
      - Stopray Vision
      - Stopray Smart

DGU

Eco Glass: Coated Glass

Energy Efficiency

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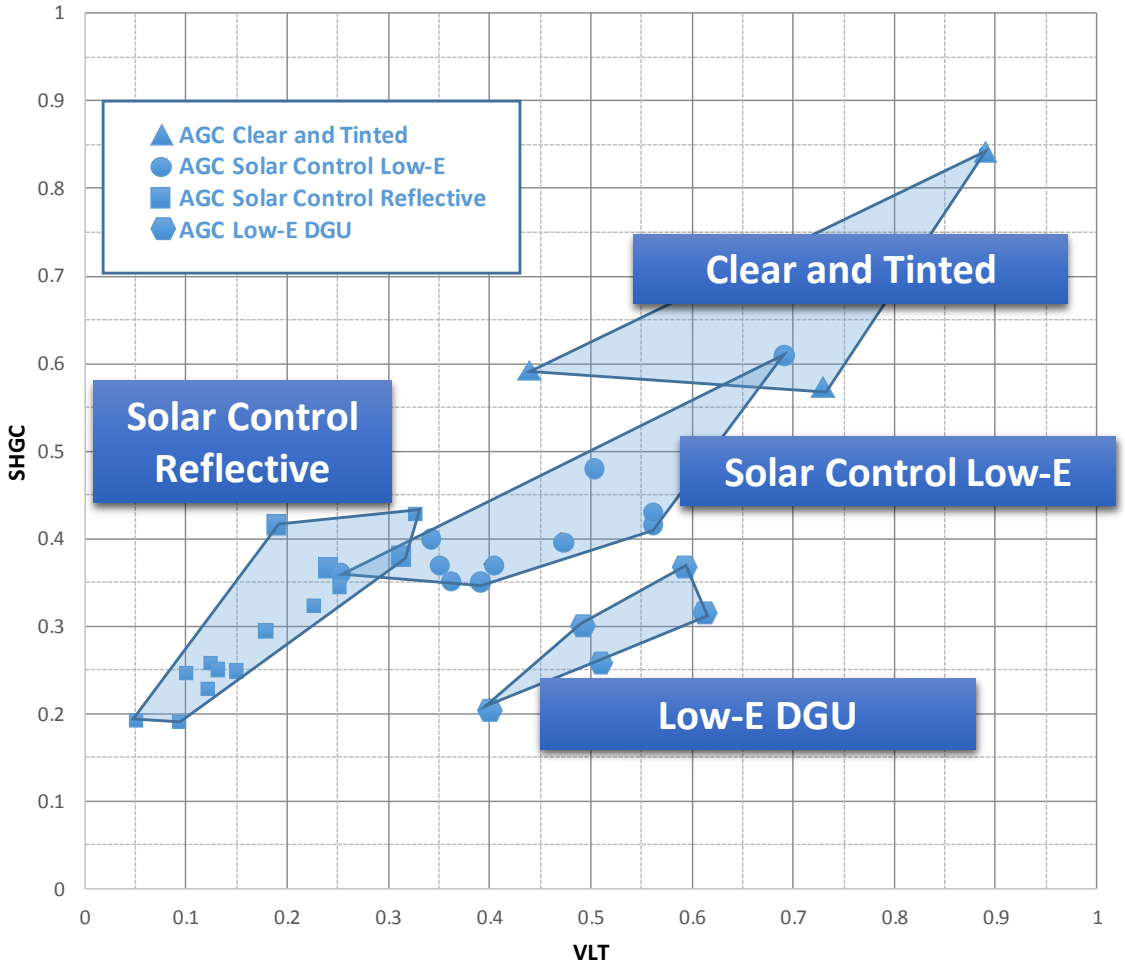

Wide range products for various requests

Eco Glass: Coated Glass

Energy Efficiency

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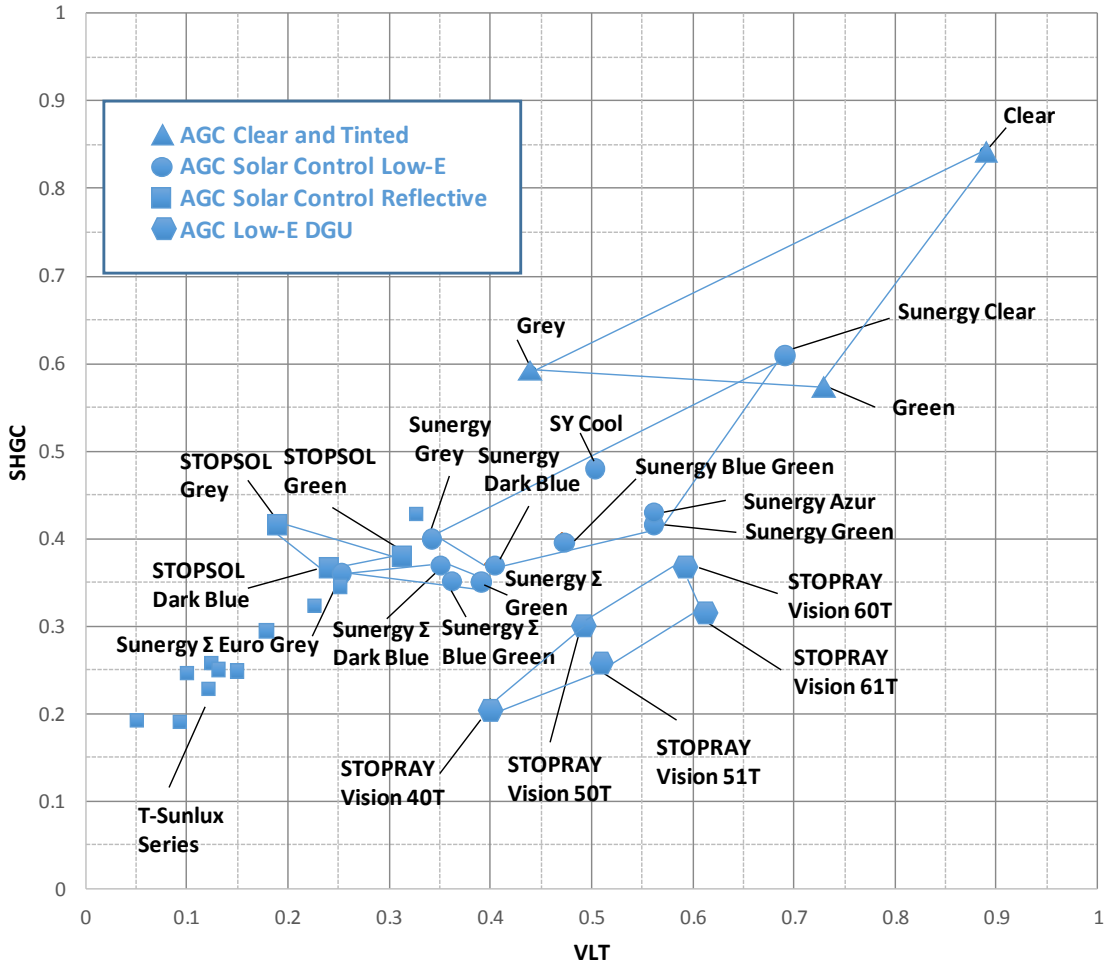

Wide range products for various requests

Eco Glass: Coated Glass

Energy Efficiency

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Combining comfort and privacy

STOPSOL

Stopsol is a reflective pyrolytic coated glass that stands out for its performance durability coupled with good solar control and unique reflective aesthetics. It can be easily used for a large variety of processing options including tempering, laminating, bending and silkscreen printing, offering architects unlimited creativity for its applications.

It is available in 3 types of coatings – namely Stopsol Classic (slightly amber reflection), Stopsol Supersilver (silver reflection) and SilverLight (lower degree of reflection with a bluish hue). The final appearance of Stopsol will depend on the colour of the substrate glass, the coating, the thickness and the position of the coating.

What's so special about it?	What does it mean for you?
Wide variety of visual appearances	- Provides architects with an array of aesthetic choices through its reflective appearance.
Enhanced Solar Control	- Keeps the heat out thereby maintaining comfortable temperatures indoor. - Reduces energy cost needed for air-conditioning.
Durable Online Coating	- Withstands harsh environmental conditions such as extreme temperature changes, pollution and corrosion. - Allows for long term storage due to infinite shelf life. - Provides easy handling and multiple processing options.

Reflective and Temperable

T-SUNLUX

T-Sunlux, a temperable magnetron coated glass, has a strong and durable coating that is able to go through tempering without compromising its appearance.

This high performance solar control coated glass specializes in blocking heat and is a great fit for architectural glass applications where heavy sun makes excessive solar heat gain. In addition to its excellent performance, T-Sunlux is available in various colour substrates and has a wide selection of coatings.

What's so special about it?	What does it mean for you?
Variety of coatings on three colour substrates	- Offers multiple options to provide the right solution for all glass needs.
Excellent Solar Control	- Keeps the heat out thereby maintaining comfortable temperatures indoor. - Reduces energy cost needed for air-conditioning.
Durable Coating	- Durability exceeds traditional magnetron coated products. - Allows for long term storage due to long shelf life. - Provides easy handling and multiple processing options.

Eco Glass: Coated Glass

Energy Efficiency

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Versatile with neutral aesthetics

SUNERGY

Sunergy is a pyrolytic coated glass that is highly scratch-resistant and can be bent, tempered and laminated, making it one of the favourite choices for complex constructions. Together with its excellent solar control properties, low reflection and neutral appearance, Sunergy is definitely an ideal product in today's architectural world.

What's so special about it?	What does it mean for you?
Excellent Solar Control	- Keeps the heat out thereby maintaining comfortable temperatures indoor. - Reduces energy cost needed for air-conditioning.
Low Emissivity	- Delivers thermal insulation properties to keep comfortable temperatures within the building.
Wide variety of visual appearances	- Provides architects with an array of aesthetic choices.
Durable Online Coating	- Withstands harsh environmental conditions such as extreme temperature changes, pollution and corrosion. - Allows for long term storage due to infinite shelf life. - Provides easy handling and multiple processing options.

Energy-efficient glazing

STOPRAY

Stopray, a high performance magnetron coated glass, gives excellent selectivity while retaining a neutral appearance. It offers improved balance between visible light transmittance, solar control and enhanced U-values thereby delivering maximum energy savings that meet or exceed energy code requirements.

Always used as double or triple glazing, it is suitable for use in all climates as it controls heat entering in the summer and keeps heat from escaping during the winter. Stopray is also available in temperable versions (Stopray T range), this brand offers architects more design freedom and flexibility in their projects.

Each product...	...has its benefits
Stopray Smart	- No edge deletion required. - Low internal reflection, making it ideal for residential projects. - Longer shelf life compared to other magnetron coating. - Can be used in both tempered and non-tempered versions.
Stopray ACT	- Low internal reflection, making it ideal for residential projects. - Good selectivity ratio (LT/SF). - Specially developed for Asia tropical climates, with its excellent solar control below 3.0.
Stopray Vision	- Offers a wide range of light transmission from 36% to 72%. - Provides good thermal insulation. - Good selectivity ratio (LT/SF).
Stopray Ultra	- Delivers a high level of natural light throughout thanks to its high light transmission. - Low solar factor, resulting in significantly lower air conditioning costs. - Excellent selectivity ratio above 2.0.

Eco Glass: Coated Glass

Energy Efficiency

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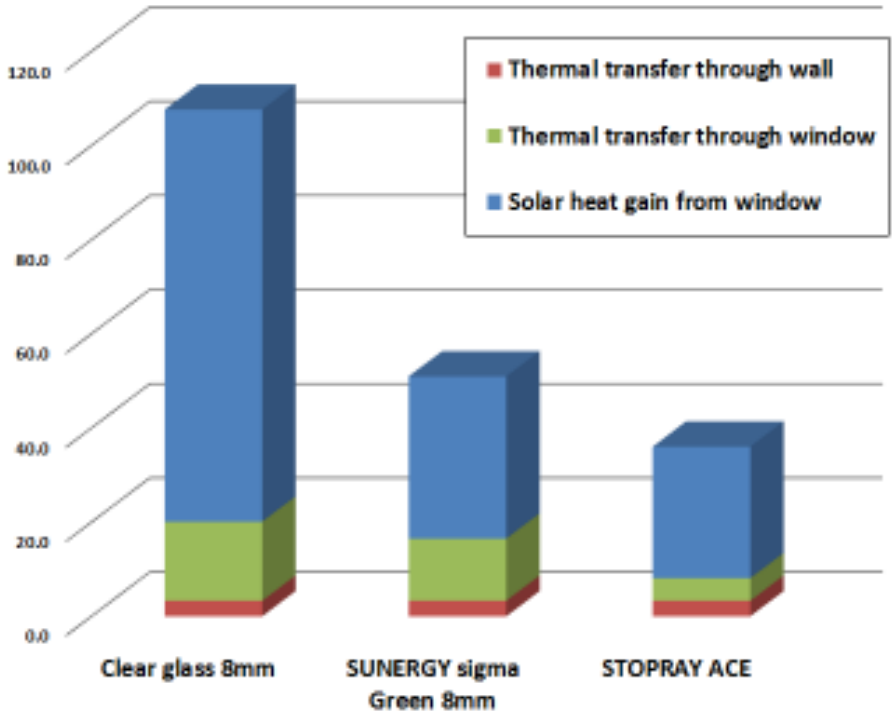

Wall type: Autoclave Aerated Concrete

Glazing type: 3 types

Clear glass 8mm

Sunergy Sigma Green 8mm (Solar control Low-E)

STOPRAY ACE (Low-E DGU)

WWR = 0.5

N:E:S:W = 2.5:1:2.5:1

Item	Uf	SC	Thermal transfer through wall	Thermal transfer through window	Solar heat gain from window	OTTV
Clear glass 8mm	5.6	0.94	3.3	16.8	87.5	107.6
SUNERGY sigma Green 8mm	4.4	0.37	3.3	13.2	34.5	51.0
STOPRAY ACE	1.6	0.3	3.3	4.8	27.9	36.0

Eco Glass: Coated Glass

Energy Efficiency

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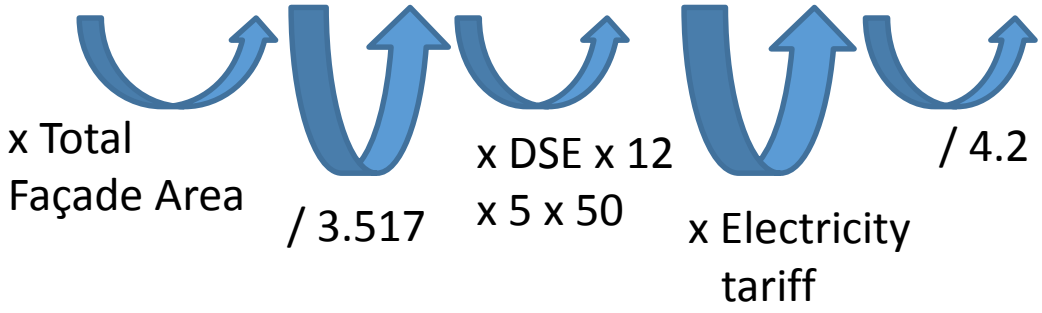
	Uf	SC	OTTV	Building cooling load		Annual operating electricity		
	W/m2/K	-	W/m2	kW	RT	kWh	MYR	USD
Clear glass 8mm	5.6	0.97	107.6	754	214	514,198	190,253	45,298
SUNERGY sigma Green 8mm	4.4	0.37	51.0	357	101	243,456	90,078	21,447
STOPRAY ACE	1.6	0.30	36.0	252	72	172,194	63,711	15,169



DSE(Design System Efficiency) of chiller plant system : **0.8 kW/RT**
Total Façade Area: **7,000 m2**
Electricity tariff: **0.37MYR/kWh**
RT (Refrigerating ton) = 3.517 kW

Eco Glass: Coated Glass

Energy Efficiency

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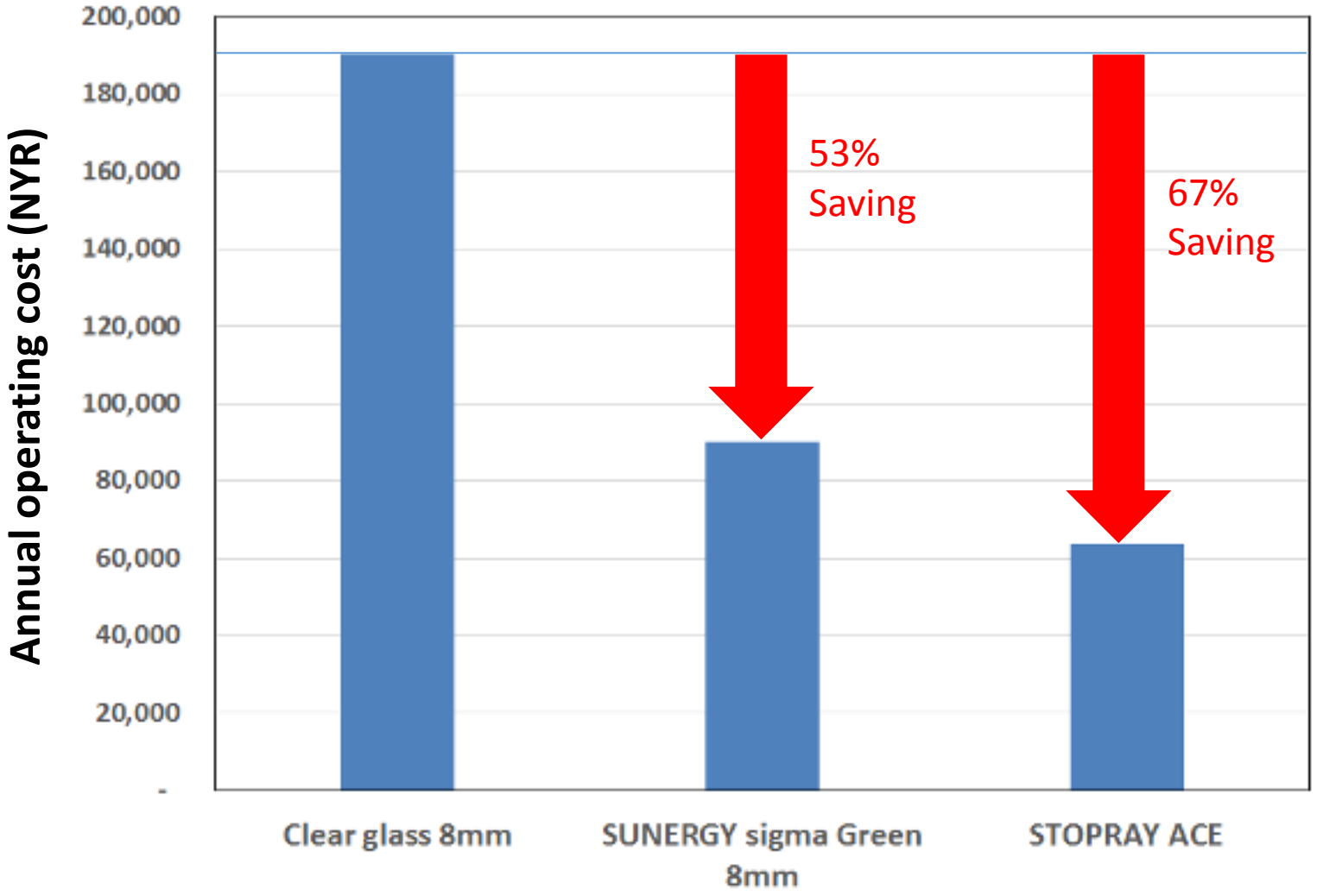

Attoch

Energy Efficiency

ATTOCH™

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Your Dreams, Our Challenge

Energy conservation and improvement of the indoor environment by renovating the operational building. It provides new life to the existing building.

Improved Comfort	Energy Saving	Reduction in dew condensation	Noise Reduction
Easy Installation	Good Aesthetics	Increases Property Value	Less Maintenance

Basic Specifications

Glass type and thickness	: Heat Strengthened Glass, thickness of ATTOCH™ glass depends on the size of the existing glass.
Colour Variations*	: Clear, Blue, Green, Blue Green, Grey or as requested by the customers.
Thickness of the Air Layer	: 12mm
Standard Weight	: 20kg/m² for 8mm thick glass, the weight varies for different glass thickness.

*The colour of the glass

Attoch

Energy Efficiency

ATTOCH™

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Your Dreams, Our Challenge

Existing Glass	ATTOCH™ Glass	LVT(%)	ER(%)	ET(%)	EA(%)	SC	U-Value	ETTV (w/m²) (SW)	ETTV (w/m²) (N:W:S:E =2.5:1:2.5:1)
6mm Green Tinted Glass (Panasap Green)	–	69	5	41	54	0.63	5.7	86	76
	6mm Clear Float Glass	61	7	34	59	0.50	2.8	66	59
	6mm Sunergy Cool (#3)	35	8	18	75	0.42	2.3	56	50
	6mm Sunergy SIGMA Green (#3)	27	11	12	77	0.36	2.3	50	44

Yearly Saving Cost (SGD/m²)

Glass	AC* setting 22°C, 60% RH	AC* setting 22°C vs 24°C, 60% RH	Electricity Saving Ratio (%)
6mm Green Tinted Glass <Existing Window>		(22°C)	100
+ 6mm Clear Float Glass	4.0	7.2 (24°C)	85.5
+ 6mm Sunergy Cool (#3)	5.9	8.9 (24°C)	82.2
+ 6mm Sunergy SIGMA Green (#3)	8.0	10.9 (24°C)	78.0

* AC– Air Conditioning
* COP = 2.5
* AC operation time is 9:00 – 18:00, weekday

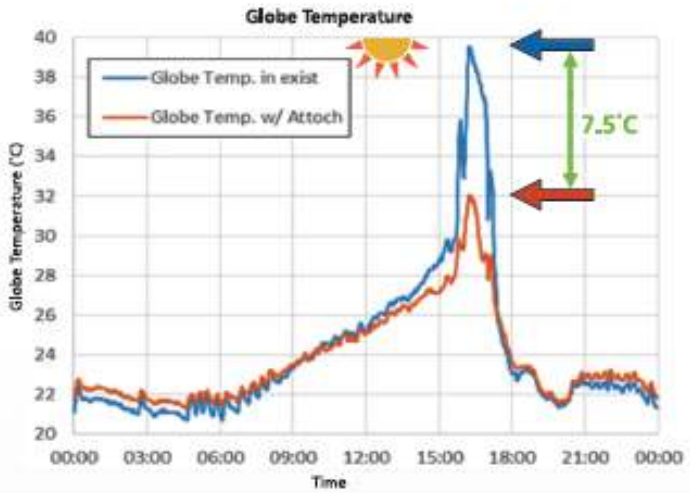
ENERGY SIMULATION
(Associate Professor Dr.-Ing. Mr Ichinose Tokyo Metropolitan University)

- Location: Singapore (Lat:1.4, Long:103.9)
- Weather Data: EPW Singapore 1999
- Window Orientation: South-West
- AC Setting: 22°C, 60% RH (24°C, 60%RH)

Installation on normal clear glass can leads to more energy saving.

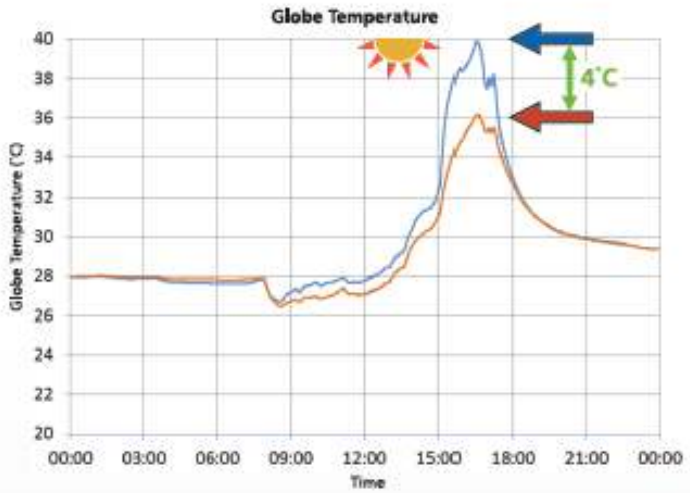
Effect of ATTOCH™ in reduction in the Globe Temperature

Case(1): Shop in Thailand
(Facade Facing West)



ATTOCH™ helps in reducing the globe temperature by 7.5˚C

Case(2): Office in Malaysia
(Facade Facing West)



ATTOCH™ helps in reducing the globe temperature by 4˚C

After Attoch installation, human comfortability is improved.
(PMV and PPD are also improved.)

Smart Glass

Energy Efficiency

HALIO

NEW!! AGC

Your Dreams, Our Challenge

HALIO SMART-TINTING GLASS SYSTEM: BREAKTHROUGH TECHNOLOGY

From Clear	To Dark	And In-Between	Seamlessly
			
Natural clear state allows over 66% light transmission	Blocks up to 99.9% total transmitted light with a dark neutral grey state	Uniform switching makes intermediate tints useable and offer a high Color Rendering Index > 90	Full switching under 3 minutes provides energy efficiency and near-privacy. Visible transitioning within 20 seconds

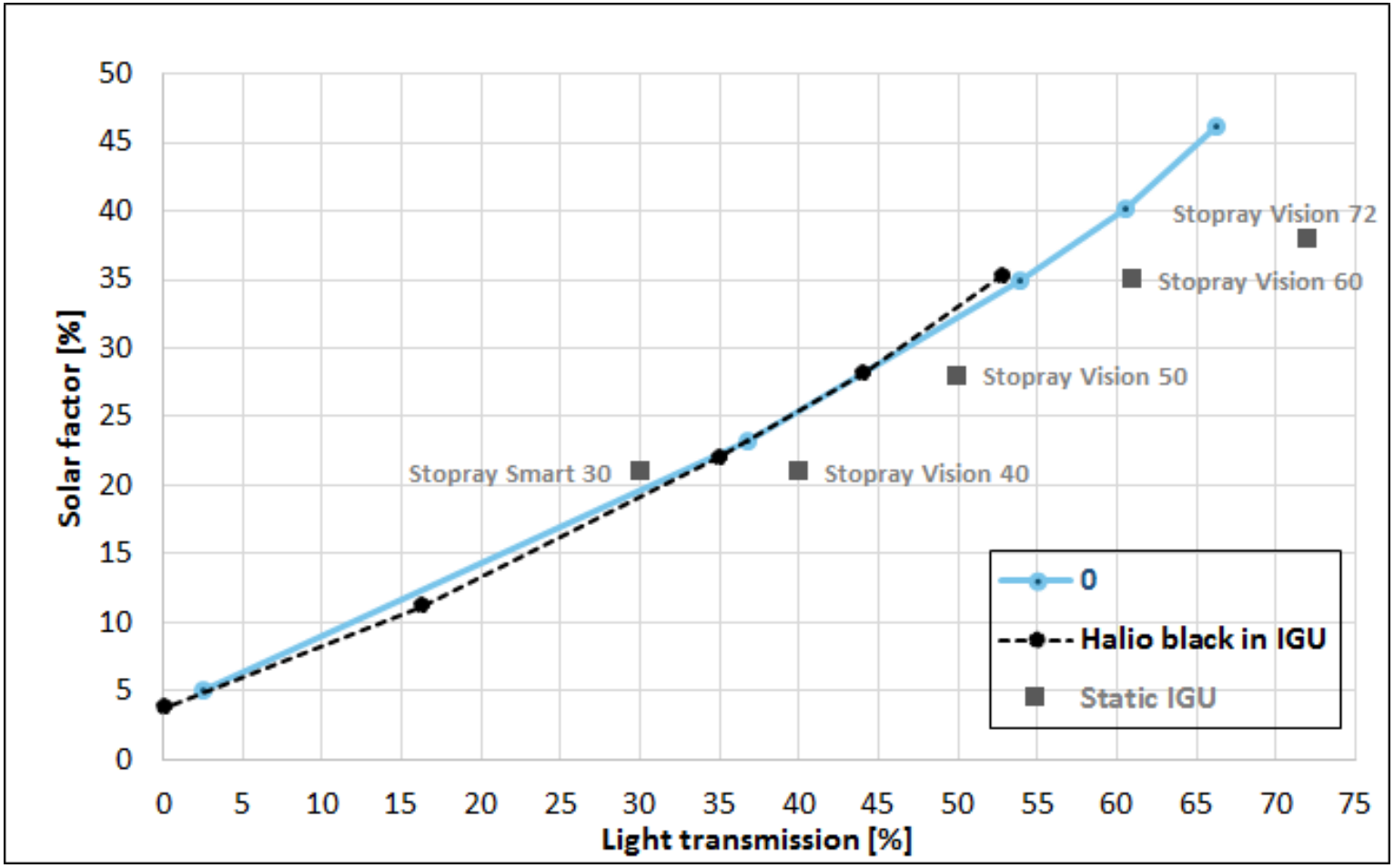
Smart Glass

Energy Efficiency

HALIO

NEW!! AGC

Your Dreams, Our Challenge



Example:

Smart tinting glass laminated between two Clearvision 4mm Tempered – 15mm 90% Argon – Clearvision 4mm with Iplus Top 1.1

Smart Glass

Energy Efficiency

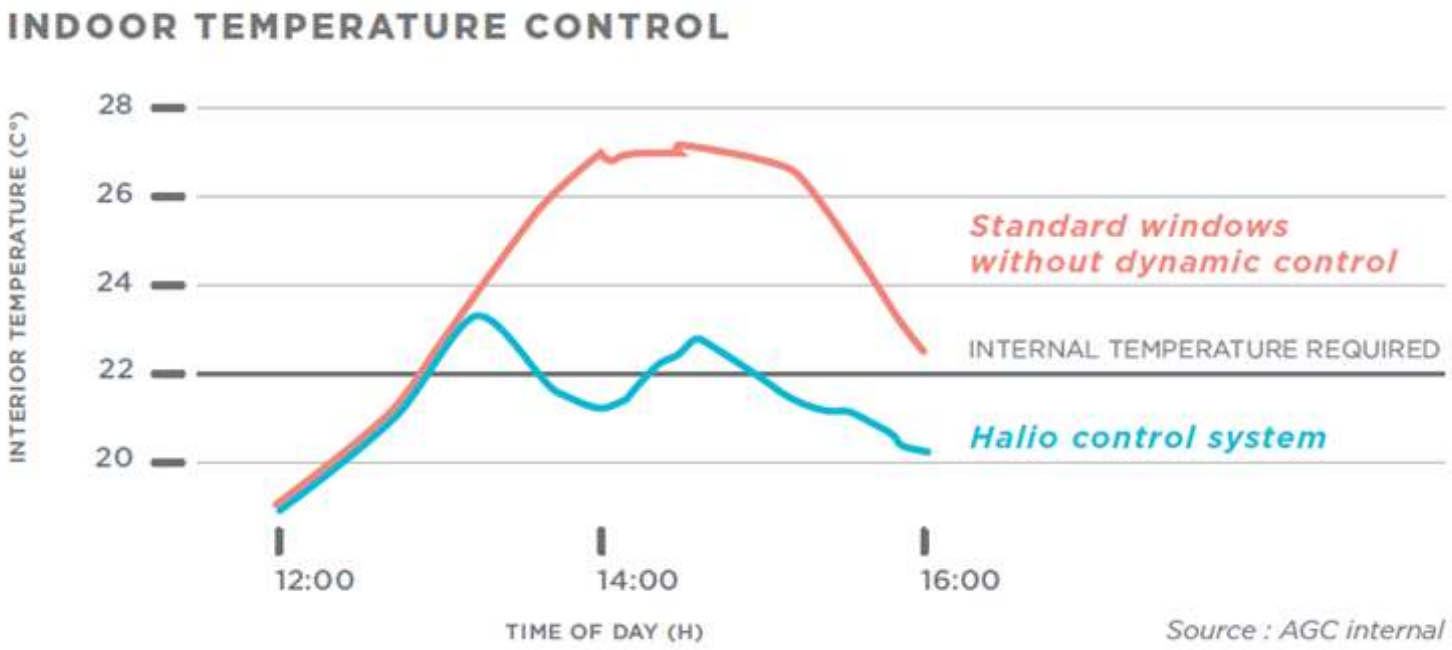
HALIO

NEW!! AGC

Your Dreams, Our Challenge

HALIO SYSTEM ENABLES TO CONTROL NATURAL LIGHT REMOTELY

ENERGY EFFICIENCY



Bonnflon Sunbarrier

Energy Efficiency

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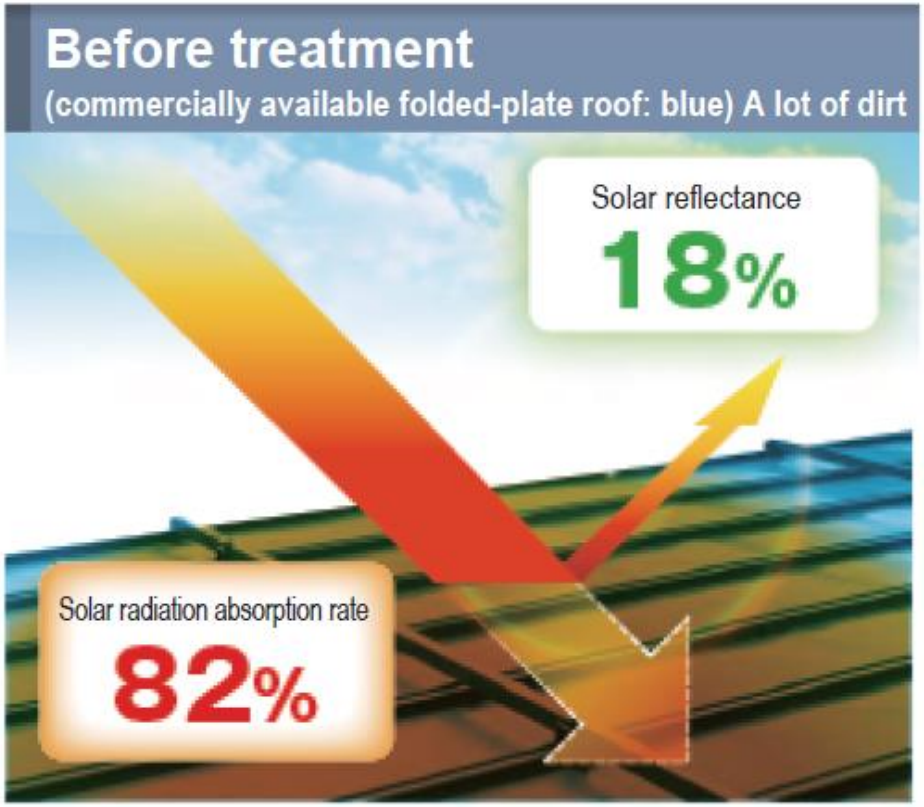
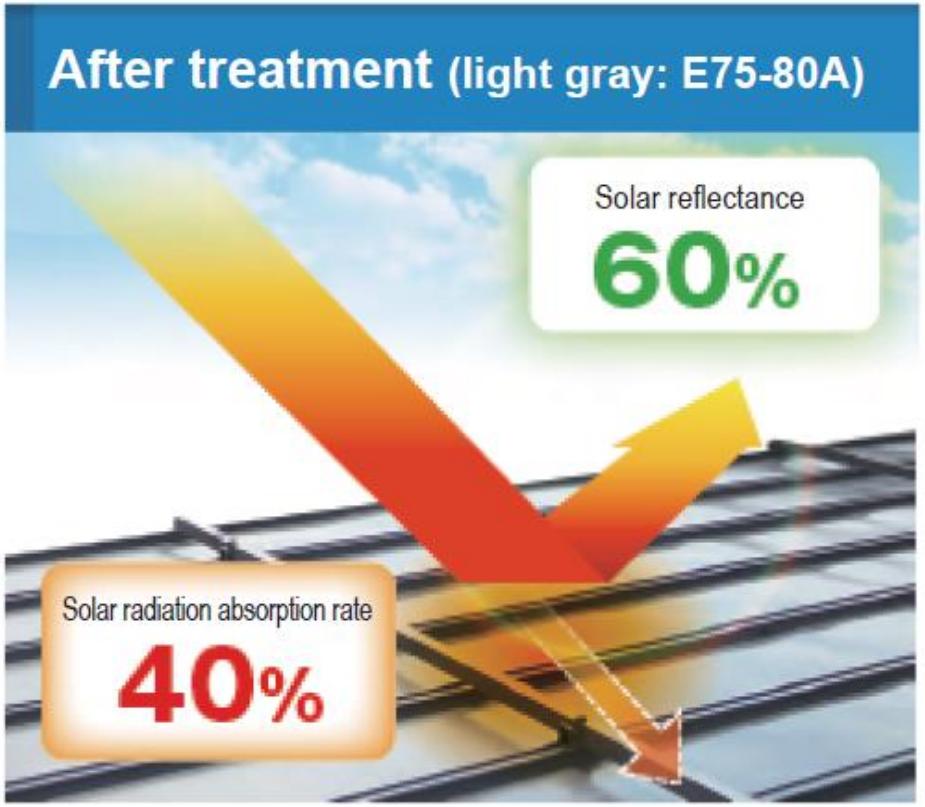
Low-Contamination High Thermal Energy Reflectance Fluoropolymer Coating
(High Solar Reflectance Paint)





Bonnflon Sunbarrier

Energy Efficiency

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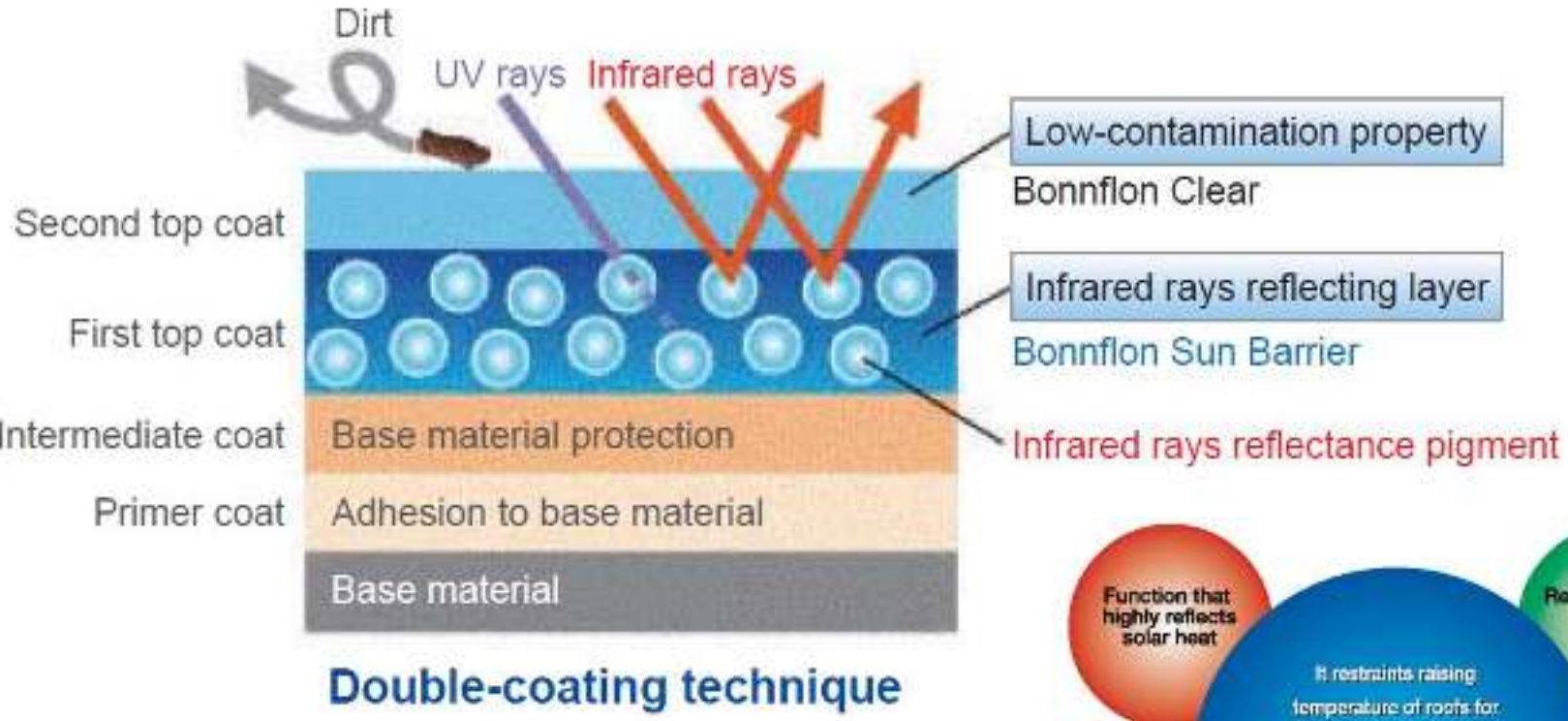
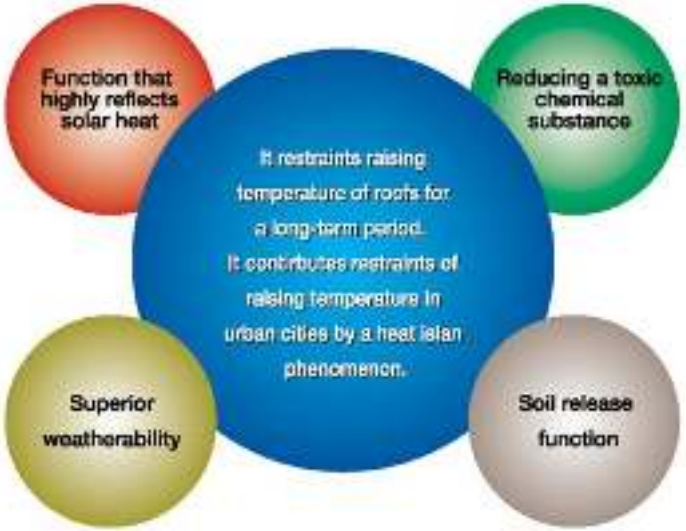


Double-coating technique



Bonnflon Sunbarrier

Energy Efficiency

AGC
Your Dreams, Our Challenge

Verification test on the rooftop of a RC condominium

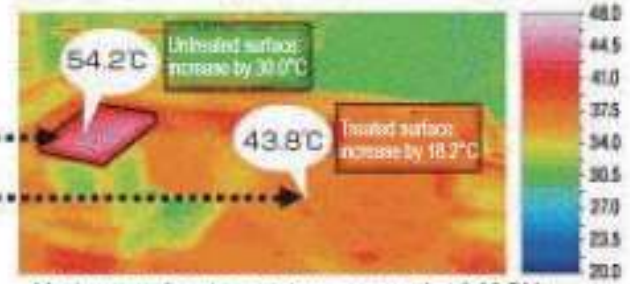
We applied Bonnflon Sun Barrier to the rooftop of a condominium with actual residents to verify the following effects.

Temperature measurement on the rooftop surface treated/not treated with the coating

- Applied Bonnflon Sun Barrier on the rooftop of a condo (RC construction structure with seven floors)
  Color: N-7 Gray

Bonnflon Sun Barrier untreated area

Minimum surface temperature measured at 6:00 AM



Maximum surface temperature measured at 2:00 PM

Results

	AM6:00	PM2:00	Rising temperature difference
Untreated surface	24.2℃	54.2℃	30.0℃
Treated surface	25.6℃	43.8℃	18.2℃

Reduction by ~12℃

Bonnflon Sunbarrier

Energy Efficiency

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●Result of CO_2 emission reduction rate simulation

	AC and heating loads (Mcal / year)	Power consumption (kwh / year)	Electricity cost (yen / year)	CO_2 emission amount (kg / year)
Bonnflon Sun Barrier	31.401	10.467	136.073	4.449
General paint	39.528	13.176	171.289	5.600
Reduction amount	8.127	2.709	35.216	1.151
Reduction rate	21%	-	-	21%

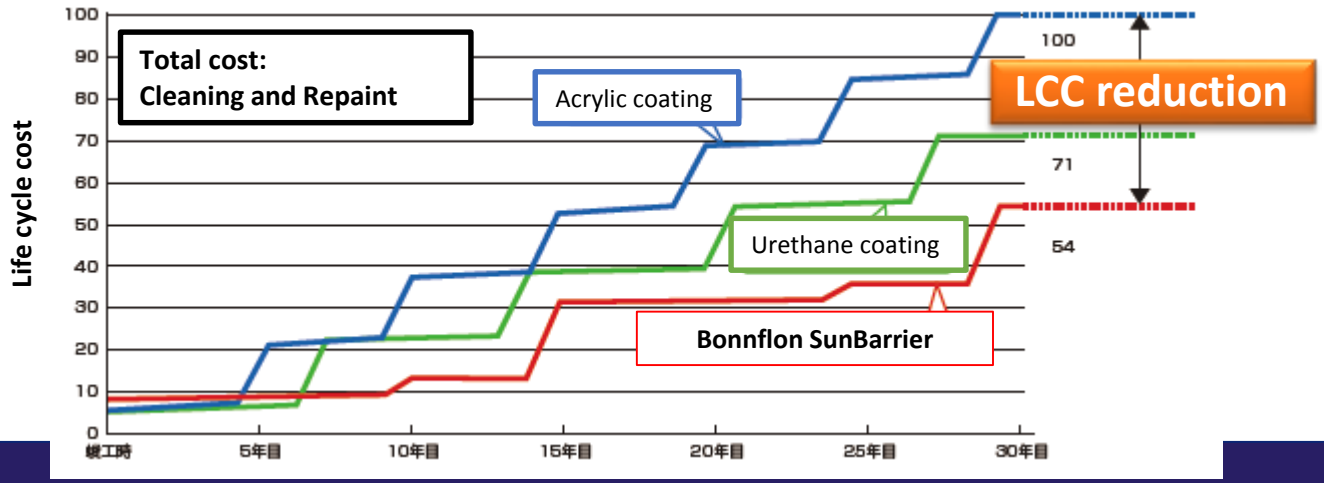
*The above numerical values are simulation results and not guaranteed values.

Calculation conditions:
- the unit price of electricity consumption is 13 yen per 1 KWh, and only the price of electricity is considered in calculation (excluding basic charge/service fee).
*The unit price of electricity varies depending on the condition of how the customer receives electricity
Power consumption is calculated assuming energy consumption efficiency (COP) as 3.
- CO_2 emission amount is 0.425 kg / kwh
1 kwh will be 3.6 megajoules

Items	Conditions			
Region / weather conditions	Calculated based on the weather data for Tokyo.			
Comparison conditions	The roof surface treated with Bonnflon Sun Barrier and the one treated with a general paint are compared. The roof is gray (N 4) * The exterior walls are light-colored and painted with a general paint.			
Air conditioner operating conditions	Period of use	June - October		
	Preset temperature	26 °C	Usage time	9: 00 - 20: 00

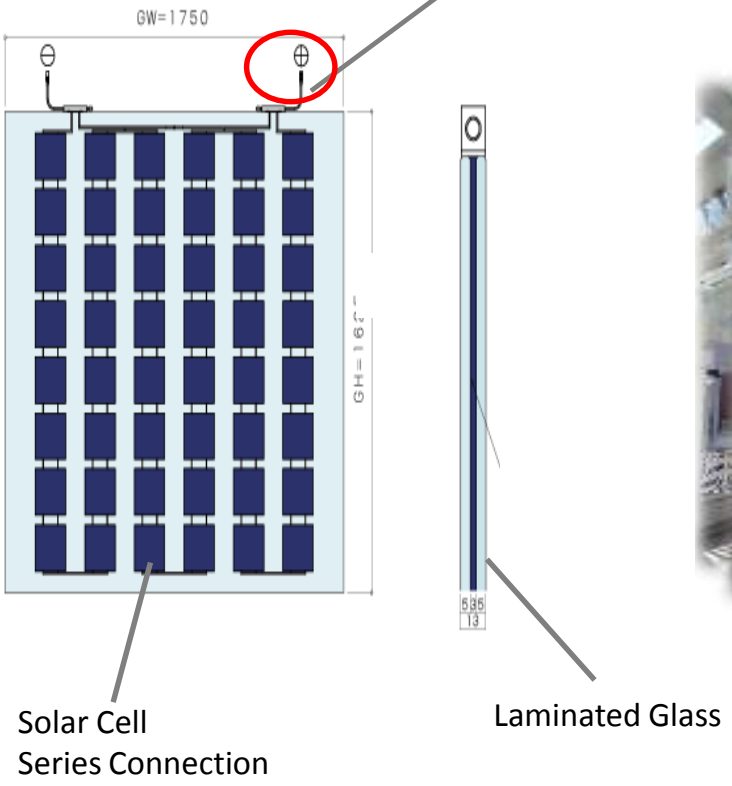
- Roof: stainless steel / plate thickness 3 mm / area 300 m²
- Exterior wall: flexible board / plate thickness 4 mm / area 52 m² × 4
- Floor: regular concrete / thickness 150 mm / area 300 m²

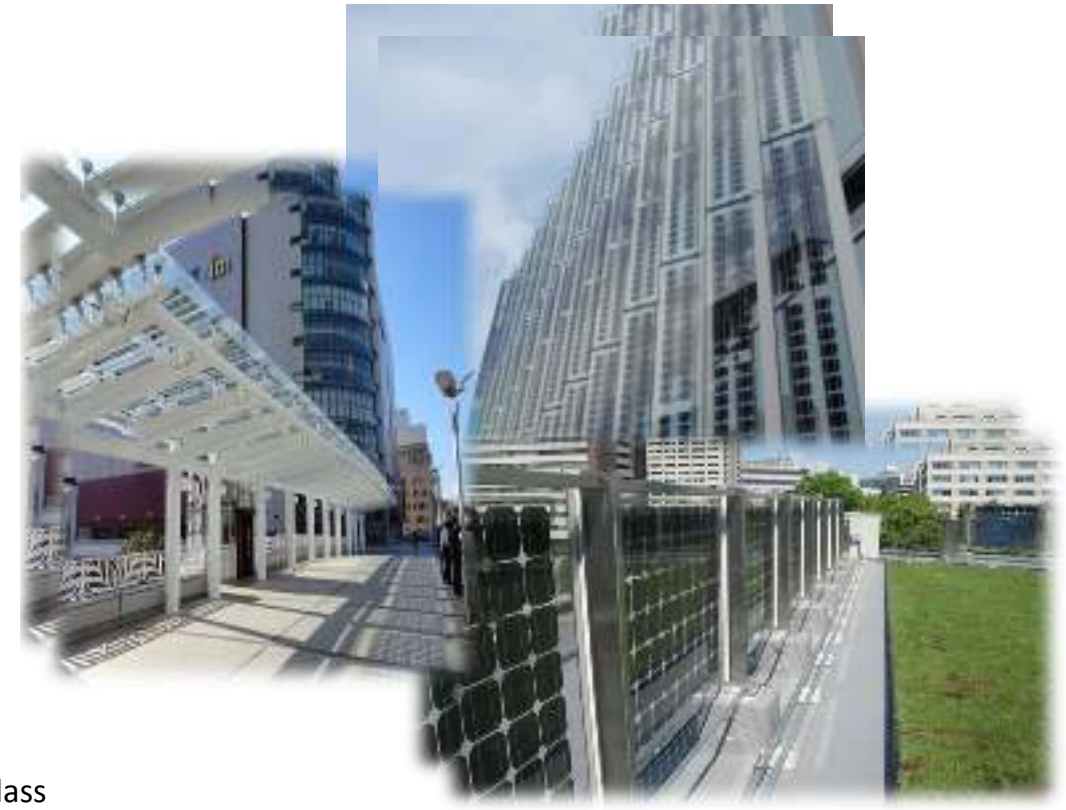
*This simulation was calculated using standard weather data and thermal load calculation program LESCOM (author: Jin Takeda, published by Inoue Shoin).



Combine Laminated glass and Photovoltaic module

Module Structure

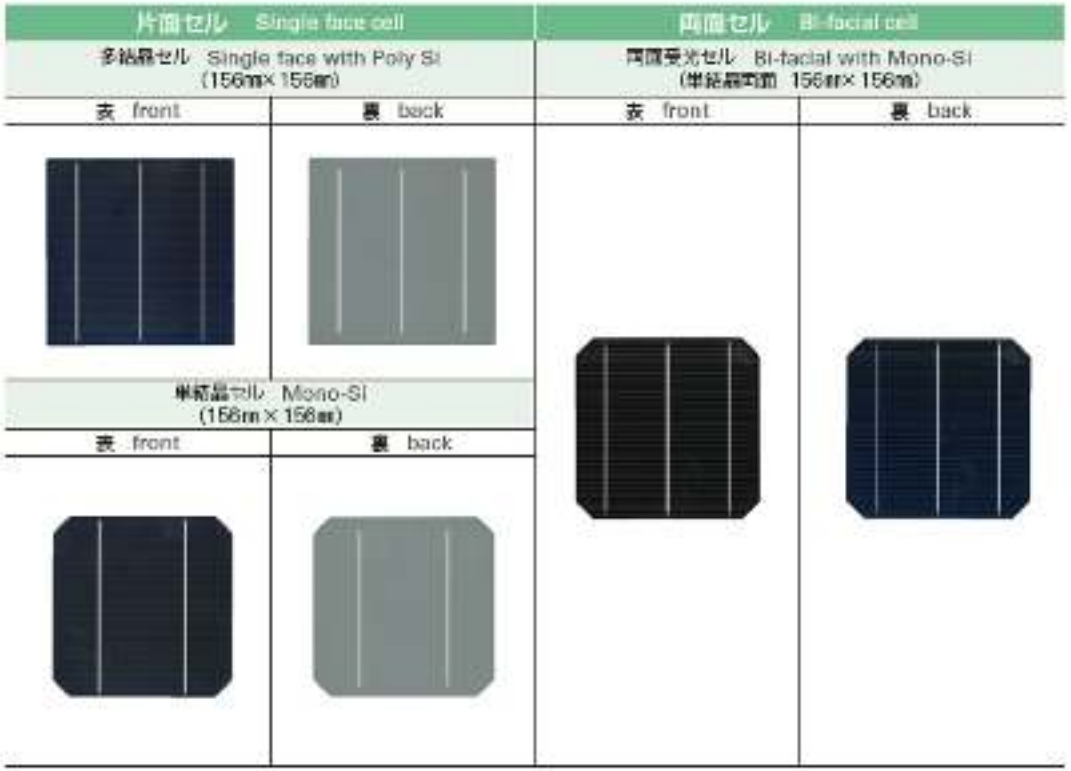




セル | Solar Cell

モジュールに組込まれるセルは、大きく分けて2種類から選べます。カーテンウォールや、トップライトなど片側の面から太陽光を受光し発電する片面セル（一般的なセル）とフェンスや手すりなど両面から受光し発電する両面セルがあり、使用用途や発電性能・デザインから選べます。

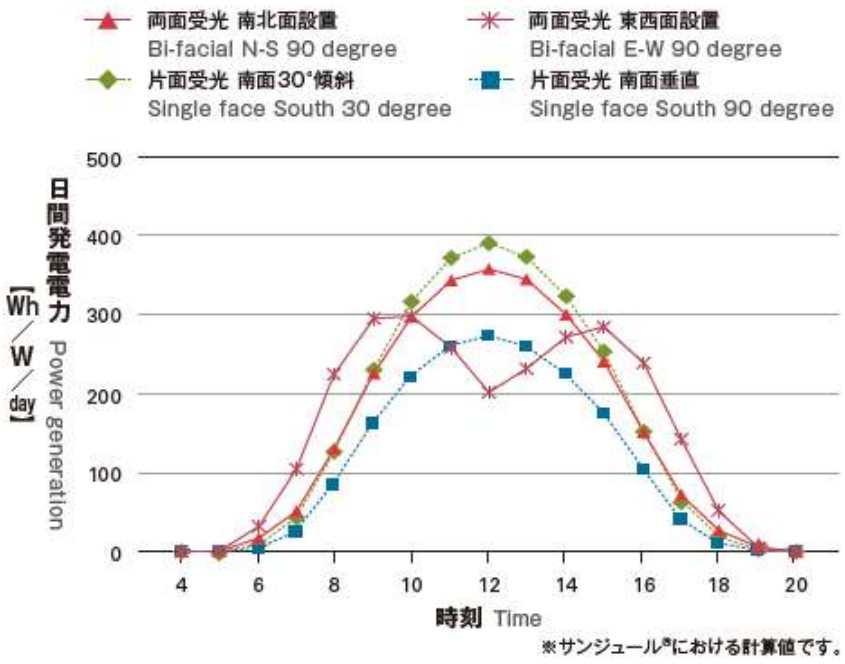
SUNJOULE® offers 2 types of crystalline cells embedded. One is Single face either mono or poly crystalline. Another is Bi-facial with mono crystalline.



Cell Efficiency : 18%-20%

■ 両面受光型垂直設置の年間平均日間発電出力の平均的分布(計算値)

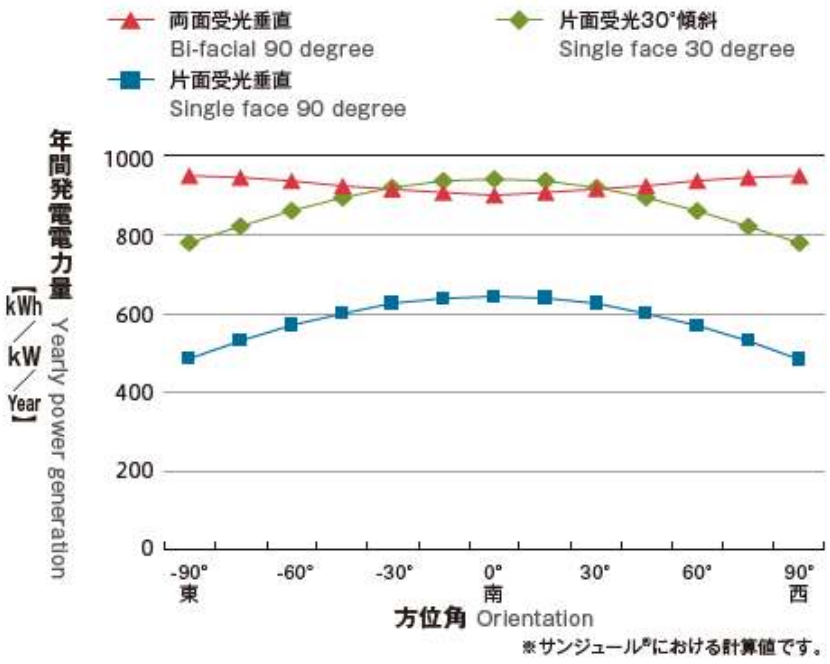
Comparison of estimated power generation per day between Bi-facial and Single face solar cell in case of Japan



In case of Japan, using Bi-facial cells, even if the module is settled vertically, you can obtain above 95% power generation compared with south-faced 30 degrees slanted regardless of setting direction.

■ 両面受光型設置の方位角依存性(計算値)

Comparison of angle dependence between Bi-facial and Single face solar cell in case of Japan



In case of Japan, using Bi-facial cells, when the module is settled vertically, you can evenly obtain the good power generation regardless of setting direction.

サンジュール® シースルー | SUNJOULE® See-Through

※施工例: SUNJOULE® See-Through

適度に光を取り込みつつ、日射を効果的に遮蔽
See-Through PV Glass

サンジュール®シースルーは、アモルファスシリコンセルをレーザーカットし、微細な隙間を実現したシースルータイプの太陽光発電モジュールです。モジュールサイズは1,400㎜×1,100㎜がスタンダードサイズとなります。適度な透過・遮蔽性により快適な空間を演出します。

SUNJOULE® See-Through is an amorphous silicon type solar module. Standard size is 1,400mm × 1,100mm.

特長 Features of See-Through PV Glass

① 1ユニットのスタンダードサイズ: 1,400㎜ × 1,100㎜(最大)
※特別寸法についてはご相談ください。

② ・ガラス構成: 高透過熱処理4ミリ+熱処理4ミリ
・開口率: 10%, 20%
・複層ガラスにも対応。

① Standard size of unit : 1,400mm × 1,100mm (max)
② Composition: Front Glass 4mm+ Back Glass 4mm
Glass shall be annealed or Heat Treated
Opening ratio: 10%, 20% are available.
Remarks: Double Glazing is available.

開口率 Opening ratio	10%	20%
Pm (W)	125	110
Voc (V)	167.0	167.0
Isc (A)	1.12	1.01
Vpm (V)	122.6	120.9
Ipm (A)	1.02	0.91

表 front　裏 back

Summary

AGC
Your Dreams, Our Challenge

AGC products can contribute to ZEB family

Energy Efficiency

Load reduction (Improvement of thermal insulation and solar shielding)

Stopsol Sunergy
Stopray T-Sunlux

ATTOCH™

HALIO

BONNFLON

Energy Generation

Renewable energy

SUNJOULE

Thank you very much for your attention.

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