Challenges to Overcome before Spreading BIPV System

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Solar Energy Division, Kaneka Corporation
OUTLINE

1. Incentive, Regulation
2. BIPV system cost
3. Power generation
4. Reliability issues
5. Standardization
Overview of the Act on the Improvement of Energy Consumption Performance of Buildings

The incentive measures are implemented from April 1, 2016, and the regulatory measures shall be implemented within two years (scheduled for April 2017) of the promulgation of the Act.

1. Regulatory Measures (Mandatory)

   - Mandatory compliance with energy efficiency standards
   - Mandatory certification

   - Non-residential buildings over 2,000m² or more (planned)
     Mandatory compliance/evaluation for compliance of newly-constructed building energy efficiency performance standards (energy efficiency standards)

   - Notifications
     Buildings 300m² or more (planned)
     Mandatory notification to administrative agencies with jurisdiction of plan for new construction/extension/renovations

   - Residential
   - Non-residential

   Instructions/orders issued when deemed necessary without compliance with standards.

   - Housing Top-Runner Program

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Primary energy consumption amount

- air-conditioning system primary energy consumption amount
- ventilation system primary energy consumption amount
- lighting system primary energy consumption amount
- hot water supply primary energy consumption amount
- elevator primary energy consumption amount
- other (OA apparatus) primary energy consumption amount
- reduction amount of primary energy consumption through PV and cogeneration system

= primary energy consumption amount
経済産業省 H29年度省エネ事業概算要求

1. 省エネルギー投資促進に向けた支援補助金
1,140.0十億円（515.0十億円）、[補正予算 100.0十億円]
工場・事業場、住宅、ビルにおける省エネルギー関連投資を促進することで、エネルギー消費効率の改善を促し、徹底した省エネを推進する。

2020 50% of newly-built Zero Energy House
2030 50% of newly-built Zero Energy Buliding
Toward a Grid Parity

- **Construction**
- **Maintain**
- **BOS**
- **Wall, Window**
- **Building**

- **net PV cost**

<table>
<thead>
<tr>
<th>Power Gen. Cost</th>
<th>Cost Reduction by BIPV</th>
<th>Capacity Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 YEN/kWh</td>
<td>-23%</td>
<td>10.8%</td>
</tr>
</tbody>
</table>

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Improvement of Performance for BIPV module

Calendar of Year in 2015

PR

March April May June July August

Low refl. Type

Ordinary Type

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Photovoltaic Module and Array Performance Characterization Methods for All System Operating Conditions
David L. King
Sandia National Laboratories
Photovoltaic Systems Department, MS0752, Albuquerque, NM 87185

FIGURE 3. "AOI Functions" showing influence of solar angle-of-incidence on $I_{sc}$ for an ASE Americas (ASE-300-DG/50) module.
Optimization of reflection properties

WL = 550nm

Ordinary Type

Low refl. Type
Improvement of Incidence Angle Properties

Isc of Low Refl. Module / Isc of Ordinary Module

Angle of Incident Sun Light on solar module surface plane
Optimization of BIPV system on Building Wall

Calculation results of annual insolation

Location: Toyooka
Direction: South

Tilt Angle

Interval between each solar panels

Annual insolation for solar panels attached on vertical wall (MJ/m²)
BIPV modules for ZEB

Wall
Low ref. type Thin film Si

Roof
High efficiency c-Si

Window
See-through type Thin film Si

Light-through type c-Si
エム・エス・ケイ様長野工場新社屋

場所: 長野県 佐久市
規模: 3.3kW
種類: KN38
竣工: 2003年
設計: 市川測量設計
施工: 大和ハウス工業

5% transparency
10% transparency
● 山梨県立中央病院様

場所：山梨県 甲府市
規模：1kW
種類：KN38
竣工：2004年
設計：日建設計
施工：大成・早野組・長田組土木JV
JR Kanazawa station
Reduction of Energy Consumption by PV Panels

Thin film Si cell

Back glass

Front glass

Low-E

Back glass

Front glass
Heat Insulation Performance of PV Panels

- Ir-cut double glazing
- See-Through Type
- Thin film Si
- BIPV
Partial shadow takes place partial heating periodically, which affects the structure and the components.

Partial Shadow
↓
① Partial heating on shadowed cell
↓
② Changing electrical and material properties
↓
③ Deterioration of insulation and mechanical properties
Lack of insulation and outlook on facade

1. UV, Humidity, Temperature
2. Changing chemical properties of polymeric materials
3. Deterioration of adhesion between glass and cells
4. Damage of insulation structure
5. Lack of electrical safety
Development of accelerated TC test

Graph showing the relationship between cycle numbers and Pmax, indicating different performance levels for ATC and TC conditions.
Glass in building — Laminated solar photovoltaic glass for use in buildings (DIS18178)

Figure 1 — Example configurations of laminated solar PV glass in building
Photovoltaic modules for building curtain wall applications (IEC62980)

<table>
<thead>
<tr>
<th>Capture System</th>
<th>S.S.G system</th>
<th>D.P.G system</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 side S.S.G supporting</td>
<td>4 side S.S.G supporting</td>
</tr>
</tbody>
</table>

Fig. 2. The types of the PV on curtain wall system
<table>
<thead>
<tr>
<th>Subject</th>
<th>Standards, Requirement</th>
<th>Application Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical</td>
<td>IEC61215/IEC61646</td>
<td>BAPV</td>
</tr>
<tr>
<td></td>
<td>IEC61730</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Retest guide line for type approval</td>
<td>BIPV</td>
</tr>
<tr>
<td></td>
<td>Performance under LTC and partial shadow</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Safety under partial shadow</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Long term reliability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maintenance guideline</td>
<td></td>
</tr>
<tr>
<td>Building-related</td>
<td>Energy economy and heat retention</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mechanical resistance and stability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Safety in case of fire</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hygiene, health and the environment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Safety in use</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Protection against noise</td>
<td></td>
</tr>
<tr>
<td>Building-related</td>
<td>DIS18178</td>
<td></td>
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<tr>
<td>Building-related</td>
<td>EN50583</td>
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</tbody>
</table>

Japanese BIPV international Standardization

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Issues of BIPV Standardization

- Categorization and appropriate requirements
  BIPV or BAPV
  Electrical or Building-rated

- Performance test
  measurement method under partial shadow
  under LTC or diffusive light
  dependence on incidence of light

- Low energy consumption
  comply with primary energy consumption reference
  comply with low carbon reference
  power estimation of BIPV
  ZEH and ZEB
Issues of BIPV Standardization

- Long term reliability
  - Electrical Safety
  - Electrical maintenance guideline
  - Durability Acceleration test for estimation of EOL
  - PV power estimation in a lifetime

- Retest guideline
  - harmonized with design qualification and type-approval
  - size of testing coupons and requirements

- Deregulation and regulation
  - design, size, color, etc.
  - Safety in case of fire, noise, etc.
Thank you for your attention.

Acknowledgement
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