Promotion of ZEB Renovation Projects in Existing Buildings
Current State of ZEB
Renovations in Existing Buildings
<table>
<thead>
<tr>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ZEB has not penetrated to the owners and top management of existing buildings</td>
</tr>
<tr>
<td>2. Many people believe that a reduction rate of 50% or more on existing building renovations is difficult</td>
</tr>
<tr>
<td>3. There are not enough building drawings and equipment drawings etc. required for web performance calculations</td>
</tr>
<tr>
<td>4. There is a worry that large-scale renovations will interfere with business</td>
</tr>
<tr>
<td>5. The capital investment will increase with a large-scale renovation</td>
</tr>
<tr>
<td>6. The partial renovation of existing facilities has been completed, making it difficult to convert to ZEB</td>
</tr>
<tr>
<td>7. For large-scale renovations, it is difficult to choose partial renovation</td>
</tr>
<tr>
<td>8. Removal work ⇒ Removal and loading work adjusted to renovation times (high cost)</td>
</tr>
</tbody>
</table>
Considerations

1. A reduction rate of more than 50% on ZEB criteria for existing renovations is not difficult to achieve

2. Old style air conditioners and lighting ⇒ Power consumption of 50% or less with latest energy-saving models

   Buildings built more than 15 years ago should be updated as soon as possible

3. Maintenance costs due to faults and repairs will soar

   Life cycle costs (lifetime costs) are higher with partial repairs

4. It is time to update the facilities in buildings that were built more than 15 years ago

   Should consider ZEB renovation
### Outline of ZEB renovation projects handled by our company for existing buildings

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of Building</th>
<th>Year</th>
<th>Floor Area (㎡)</th>
<th>Use</th>
<th>Age (years)</th>
<th>Region Class</th>
<th>Reduction Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Home Center Brico Kera Store</td>
<td>2014</td>
<td>2,481</td>
<td>Market</td>
<td>19</td>
<td>7</td>
<td>51.4, 52.9</td>
</tr>
<tr>
<td>2</td>
<td>Onomiso Special Elderly Nursing Home</td>
<td>&quot;</td>
<td>2,765</td>
<td>Nursing Home</td>
<td>22</td>
<td>6</td>
<td>51.4, 54.7</td>
</tr>
<tr>
<td>3</td>
<td>Aonoyama Special Elderly Nursing Home</td>
<td>2016</td>
<td>3,601</td>
<td>Nursing Home</td>
<td>23</td>
<td>6</td>
<td>57.1, 62.2</td>
</tr>
<tr>
<td>4</td>
<td>Home Center Brico Sanbashi Store</td>
<td>&quot;</td>
<td>3,753</td>
<td>Market</td>
<td>19</td>
<td>7</td>
<td>57.2, 62.5</td>
</tr>
<tr>
<td>5</td>
<td>Yamasaki Orthopedic Hospital</td>
<td>2016-2017</td>
<td>4,193</td>
<td>Hospital</td>
<td>44</td>
<td>5</td>
<td>51.6, 52.8</td>
</tr>
<tr>
<td>6</td>
<td>Sawarabi Long-term Care Welfare Center</td>
<td>2017</td>
<td>3,927</td>
<td>Nursing Home</td>
<td>23</td>
<td>7</td>
<td>52.3, 54.3</td>
</tr>
<tr>
<td>7</td>
<td>Tosa Seifuen Special Elderly Nursing Home</td>
<td>&quot;</td>
<td>4,046</td>
<td>Nursing Home</td>
<td>17</td>
<td>7</td>
<td>53.9, 56.8</td>
</tr>
<tr>
<td>8</td>
<td>Kochi Joto Hospital</td>
<td>2017-2018</td>
<td>10,716</td>
<td>Hospital</td>
<td>36</td>
<td>7</td>
<td>51.5, 52.2</td>
</tr>
<tr>
<td>9</td>
<td>Joseikan</td>
<td>2018</td>
<td>11,944</td>
<td>Hotel</td>
<td>24</td>
<td>7</td>
<td>55.5, 56.0</td>
</tr>
</tbody>
</table>

* Of the 19 ZEB cases from the 2014 supplementary budget to 2018, 9, or about 50% were ZEB renovations of existing buildings
* ZEB renovations are possible on existing buildings, regardless of the building use
* There are many existing buildings whose statutory useful life has passed more than 15 years, and are ready for renovation
3 Requirements and Reasons for ZEB Renovations

1. Architectural drawings are available
   (confirmation certificate, completion drawings, record drawings) etc.
   Outer wall web performance (PAL*) can be calculated

2. Facility drawings are available
   (electrical work, machinery and equipment construction, record drawings)
   ZEB conversion plans are simple to set up

3. Understand overview of renovated facilities
   Determine whether energy-saving equipment can be reused (update if not energy-saving)

4. Owner cooperation system
   ZEB renovation construction will take place while maintaining facility sales
   It is essential that construction take place with response to residents and a cooperation system for the construction period
5. **Cooperation on site surveys**
   - Many inconsistencies between completion drawings and actual finished work (changes after completion)
   - ⇒ Need to understand actual condition before a renovation

6. **Organization of ZEB Promotion Committee**
   - Organization of a project promotion system is essential (owners, managers, planners, persons in charge of design etc.)

7. **Time availability**
   - Site survey and implementation design take a long time
   - ⇒ Not compatible with the assistance application schedule in the case of Japan

8. **Other structural or aesthetic limitations of the existing building**
   - Confirmed issues with the installation of solar power generation and solar heat use equipment etc.
Approach of ZEB
Proposals to Building Owners
ZEB Renovation of Existing Buildings – Process Flow

1. Deepen understand of owners of ZEB projects
   Understand important matters necessary for ZEB conversion

2. Organize ZEB Promotion Committee
   Consultation on work sharing and schedule etc.

3. Construction drawing confirmation
   (Confirmation Certificate, Completion Drawings, Record Drawings)
   Obtain CAD data

4. Facility drawings confirmation
   (Electrical work, machinery and equipment construction, record drawings)

5. Site survey
   Check the difference between state before renovation and record drawings (architectural drawings and equipment drawings), and prepare drawings of state before renovation

6. Review outline of renovation plan for ZEB conversion
   Outer wall performance, air conditioning, ventilation, lighting, hot water supply, elevators, BEMS, energy-saving

7. Determine building outer wall performance
   PAL *values below standard value of Energy Conservation Act
   Consider measures to strengthen insulation

8. Prepare design drawings by usage category
   Calculation of energy consumption by application
   (reference value, design value, BEI value)

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Many haven't achieved ZEB
9. Prepare additional and modified design drawings

Recalculate energy consumption by application
(reference value, design value, BEI value)

Achieved

10. Prepare ZEB Project Plan

Report to Officers → Project Approval

11. Grant application submission

Adoption → Construction

12. Process Meeting

Meeting on practical measures such as construction plan, implementation process, cooperation requests etc.
Need to consult on safe and detailed construction management

Very different from new construction

13. Check Energy-Saving Performance from Changes

Prepare Construction record

Minor Changes

14. BELS certification

ZEB reading, owner registration

15. Construction Completion

Performance Report Submission → Project Completion → Subsidy Payment

16. Implementation Report Submission

Improve through PDCA Cycle
Issues in ZEB Renovations of Existing Buildings
Issues for the ZEB renovation of existing buildings

1. Difficult to improve outer wall performance
   - Difficult to renovate insulation in outer walls
   - Reinforce roof (ceiling) insulation and use multi-layer window glass

2. Reuse existing equipment
   - Update to energy-saving equipment?
   - Consider residual book value, durability and frequency of use
   - If not energy saving, update

3. Reuse existing pipe and wiring construction
   - Determine whether piping and wiring duct materials can be reused
     ⇒ If durable, reuse and partially renovate

4. Air Conditioning: Air conditioning improvement is a key point as the greatest consumer of energy
   - Often the capacity of existing equipment is too large
     ⇒ Appropriate equipment capacity
   - Recover heat dissipation loss through ventilation
     ⇒ Introduce complete heat exchange ventilation
5. **Hot Water Supply:** Difficult to reduce hot water supply energy
   - Use eco hot water supply and solar heat (particularly for nursing homes, hospitals and hotels etc.)

6. **Lighting:** Update to LED lighting
   - Automatic controls such as brightness sensors, human sensors and scheduled timer controls etc.

7. **BEMS:** Measure potential of existing boards and wiring systems etc. by application
   - Boards for renovation or new construction ⇒ Measure by application
   - Very different from new construction

8. **Request presentation of running cost reduction**
   - Calculate running cost reduction against previous year actual performance by type of energy
   - Very different from new construction
Verification of the Effectiveness of ZEB Renovations of Existing Buildings
<table>
<thead>
<tr>
<th></th>
<th>Relationship between the Web calculated primary energy reduction rate and running cost reduction rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In the case of a reduction rate of 50%, the running cost reduction is not 50%</td>
</tr>
<tr>
<td></td>
<td>Request presentation of reduction of running costs</td>
</tr>
<tr>
<td>2</td>
<td>Running cost reduction calculation (calculation is not necessary for ZEB project application)</td>
</tr>
<tr>
<td></td>
<td>Calculate running costs by type or energy (electricity, oil, gas) by application category</td>
</tr>
<tr>
<td>3</td>
<td>Ventilation facility and other (OA equipment) energy consumption can be difficult to measure</td>
</tr>
<tr>
<td></td>
<td>Most existing buildings have power supplied from electric socket outlets (shared wiring with other equipment)</td>
</tr>
<tr>
<td>4</td>
<td>Actual Evaluation Method: Manage measurements on the computer by month for each application category (reference value, design value, actual value, achieved rate etc.)</td>
</tr>
<tr>
<td></td>
<td>ZEB Promotion Committee in Japan analyzes monthly and annual reports and makes improvements through the PDCA cycle.</td>
</tr>
</tbody>
</table>
Approach Utilizing Local Government Policies
Important to broadly spread awareness through cooperation with local governments etc.

Kochi Prefecture New Energy Promotion Division

- Holding various meetings, training sessions and presentations to promote the spread of new energy
- Subsidies to welfare facilities (evacuation centers), hospitals and clinics (rescue hospitals, medical aid centers)
  
  Solare power generation and storage battery assistance (1/3, up to 5 million yen)

Kochi City New Energy Promotion Division

- Holding various meetings, training sessions and presentations to promote the spread of new energy
- Subsidies to ZEB selected sites
  
  Solare power generation and storage battery assistance (planned from 2019, Subsidy rate of 1/6)
Value of ZEB in Planning
1. Emphasis on a building’s life cycle cost (LCC: lifetime cost)

   \[ \text{LCC} = (\text{Initial Cost}) + (\text{Running Cost}) + (\text{Repair Cost etc.}) + (\text{Disposal Cost etc.}) \]

2. LCC is more than 4 times the initial cost ⇒ Reducing running costs reduces the LCC

   ZEB is the most effective way to lower LCC ⇒ Cost-effectiveness is high ⇒ Value of introduction is high

3. Energy resources are scarce in Japan ⇒ Future energy prices will inevitably rise

   Primary energy reduction ⇒ Reduction in rise range of water and utility costs ⇒ Safer, and insurance for the future

4. ZEB ⇒ Reduce ordinary expenses ⇒ Use surplus money for new services and improvements

5. ZEB ⇒ Contribute to the global environment ⇒ Improved employee consciousness and great social contribution

6. ZEB ⇒ Running cost reductions you can see ⇒ Repeat and introduce other facilities etc.
Example of a Case Study
(Yamazaki Surgical and Orthopedic Hospital)
Project outline

Fiscal 2017  Subsidy for expenses for promotion of introduction of innovative energy-saving technology for houses and buildings (Verification project of Net-Zero Energy Building)

Name of the subsidized project
Yamazaki Surgical and Orthopedic Hospital
ZEB development project

Name of the subsidized business operator
Medical Corporation Sanshukai

[Hot water supply equipment]
- Heat pump water heater (15 kW)
- Hot water storage unit for the above (560 L)
* Eco-friendly hot water supply system for business use comprised of a heat pump and a hot water storage tank unit
* Leveling of peak load by heat storage, utilization of midnight electric power and high-load high-efficiency operation
* The existing and renewed latent heat recovery type gas water heater shall be reused.

[Air conditioning equipment]
- Multi air conditioner outdoor unit (high efficiency type)
- Package air conditioner outdoor unit (energy-saving type)
- Individual air conditioner outdoor unit (energy-saving type)
- Indoor unit
* Energy-saving air-conditioning system by combination of a high-efficiency multi air conditioner for buildings and an energy-saving type individual air conditioner
* Air conditioning control by centralized remote control

[Lighting equipment]
- LED base light
- LED down light, etc.
- LED guide light
- Light control switch
* Overall adoption of LED lighting equipment
* Adoption of LED guide lights
* Prevention of forgotten light-out by motion sensors

[Photovoltaic power generation]
- Photovoltaic power generation (10.8 kW)
- Power conditioner (10 kW)
- Actinometer
- Outside-air temperature gauge
* Installation of photovoltaic power generation device on the roof surface (10 kW)
* The generated power is interconnected to the grid system of the Shikoku Electric Power Co., Inc. as well as self-consumed.
* Subsidy is applied to the Japan Environment Association.

[Performance improvement of outer surface]
* Construction of externally heat insulation on the flat roof of the top floor (rigid urethane foam 50 mm)

[BEMS]
- Central monitoring personal computer
- Control software
- Communication adapter
- Measuring equipment
◆ System Concept Diagram
(Comparison of Before and After ZEB Renovation)

**Outer surface**

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**Before**

*最上階の陸屋根部をセーモコントロール断熱防水工法により外皮性能の向上（硬質ウレタンフォーム系断熱材50mm）*

**After**

*高効率型ビル用マルチエアコンと省エネ型個別エアコンの組合せによる省エネ空調システム*

+集中リモコンによる空調管理*

- 冷房出力合計 = 429.5kW (COP = 3.04)
- 暖房出力合計 = 485.0kW (COP = 4.30)
[Lighting equipment]

Before

After

*全面的にLED照明器具の採用
*LED誘導灯の採用
*トイレ等の温熱センサーによる省エネルギー

[Hot water supply equipment]

Before

After

*ヒートポンプと貯熱槽ユニットによる業務用エコ給湯システム
*温熱によるヒートパイクの活用化、深夜電力の活用と高効率電熱
*既設の更新を含む給湯設備は既設再利用する。

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Before

After

* 屋根面に太陽光発電装置を設置（10.485kW）
* 発電は自家消費すると共に四国電力と系統連系する。
* 公益財団法人日本環境協会へ補助申請

P H F
4 F
3 F
2 F
1 F
B F

太陽光発電（10.485kW）
パワーコンディショナー（10kW）
日時計
外気温度計

株式会社オフィス省エネプラン。
Comparison of Energy Consumption per Month (Jan–Dec 2018)

- **Air Conditioning**
- **Ventilation**
- **Lighting**
- **Water Heating**
- **Elevators**
- **PV**
- **Other (OA)**

**Projected Values**

**Actual Values**

![Graph showing energy consumption by month for Jan–Dec 2018 with projected and actual values broken down by category.](image-url)
### Effects of Introduction

<table>
<thead>
<tr>
<th>Usage Category</th>
<th>Reference Values</th>
<th>Design Values</th>
<th>Actual Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MJ/Year</td>
<td>Consumption (MJ/Year)</td>
<td>Decrease (MJ/Year)</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>3,975,579</td>
<td>2,392,103</td>
<td>1,583,476</td>
</tr>
<tr>
<td>Ventilation</td>
<td>933,570</td>
<td>372,741</td>
<td>560,829</td>
</tr>
<tr>
<td>Lighting</td>
<td>1,916,324</td>
<td>443,488</td>
<td>1,472,836</td>
</tr>
<tr>
<td>Water Heating</td>
<td>1,524,001</td>
<td>787,223</td>
<td>736,778</td>
</tr>
<tr>
<td>Elevators</td>
<td>83,882</td>
<td>83,882</td>
<td>0</td>
</tr>
<tr>
<td>Photovoltaic Power Generation (Self-consumption)</td>
<td>0</td>
<td>-103,304</td>
<td>103,304</td>
</tr>
<tr>
<td>Other</td>
<td>580,780</td>
<td>580,780</td>
<td>0</td>
</tr>
<tr>
<td>Including PV / Including Other</td>
<td>9,014,136</td>
<td>4,556,913</td>
<td>4,457,223</td>
</tr>
<tr>
<td>Including PV / Excluding Other</td>
<td>8,433,356</td>
<td>3,976,133</td>
<td>4,457,223</td>
</tr>
<tr>
<td>Not considering PV / Excluding Other</td>
<td>8,433,356</td>
<td>4,079,437</td>
<td>4,353,919</td>
</tr>
</tbody>
</table>

#### ZEB Rank (Including PV / Excluding Other)

<table>
<thead>
<tr>
<th></th>
<th>Design Values</th>
<th>Actual Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption (MJ/Year)</td>
<td>3,976,133</td>
<td>1,474,242</td>
</tr>
<tr>
<td>Decrease (MJ/Year)</td>
<td>4,457,223</td>
<td>6,959,114</td>
</tr>
<tr>
<td>Decrease Rate (%)</td>
<td>52.8</td>
<td>82.5</td>
</tr>
<tr>
<td>ZEB Rank</td>
<td>ZEB Ready</td>
<td>Nearly ZEB</td>
</tr>
</tbody>
</table>

#### Primary Energy Consumption per Usage (Including PV / Including Other)

![Primary Energy Consumption per Usage](image-url)