# Design Guidelines & Pamphlets for Planning and Designing of Zero Energy Buildings(ZEBs) in Japan

November 2018

Sustainable open Innovation Initiative

Nomura Research Institute, Ltd.

# Contents

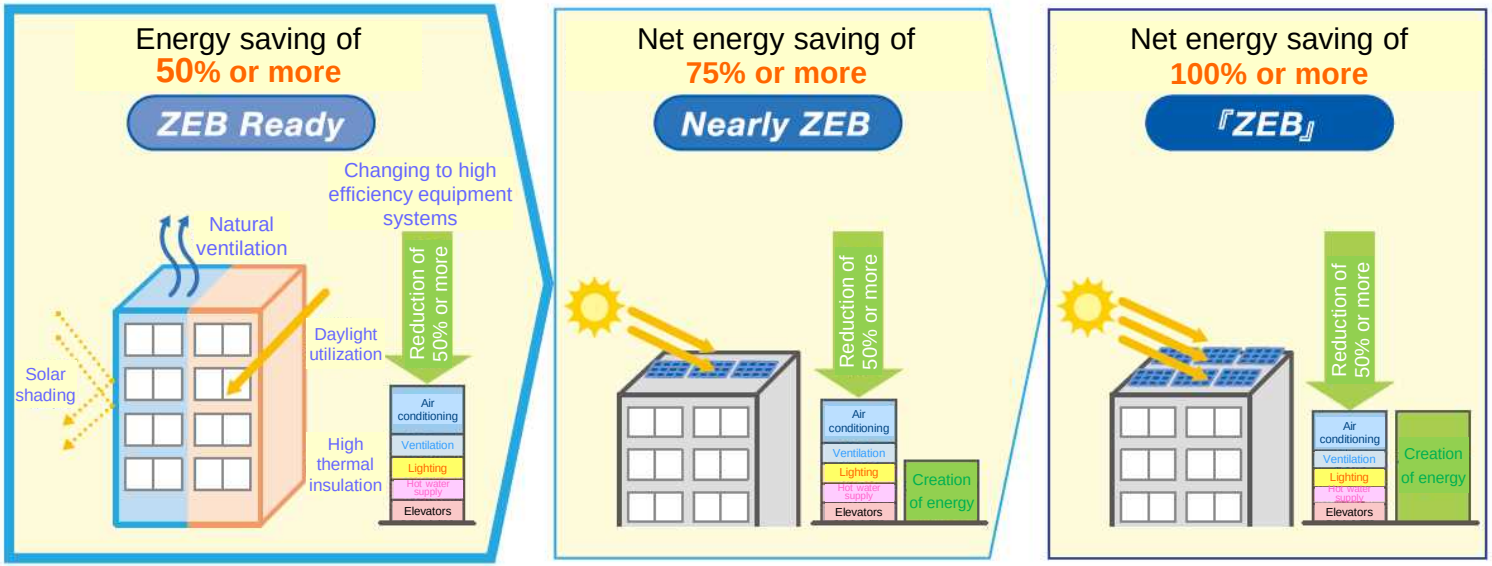


* ZEBs: Net Zero Energy Buildings

(Definition of ZEBs)

# The definition of ZEBs have been established by the ZEB Roadmap Examination Committee*

Comparing with residences, it's a quite difficult to realize 100% energy saving commercial buildings(ZEBs) with the current off-the-shelf technology.
The concept of ZEBs was expanded to enable aiming to realize ZEBs according to the actual situations of buildings.



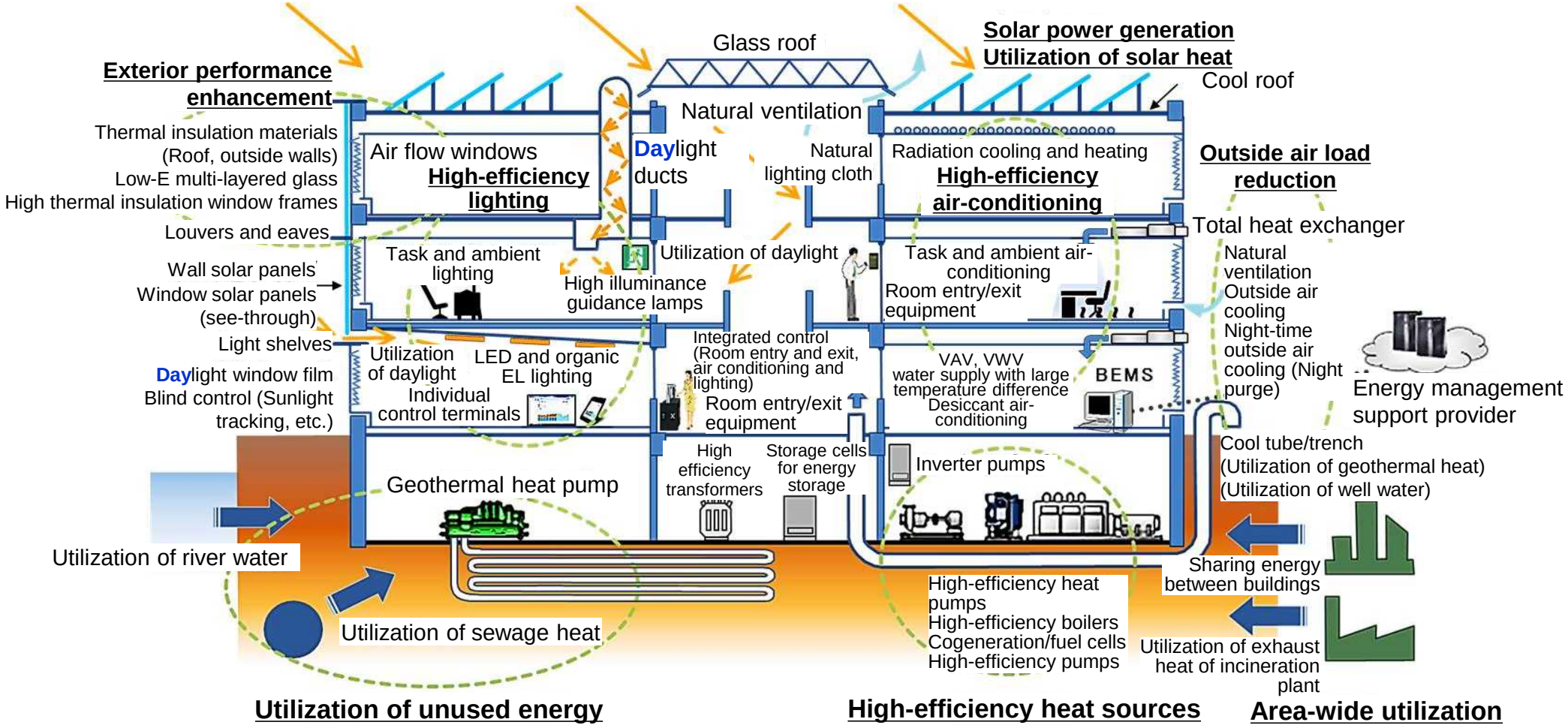

■ What are ZEBs? (Qualitative definition)

ZEBs are defined as buildings using advanced architectural designs that aim to realize substantial energy savings while maintaining the indoor environment by (1) reducing the energy loads, (2) positively utilizing natural energy by applying passive technologies, and (3) introducing high efficiency equipment and systems. They additionally aim to achieve the highest degree of energy independence and reduce the annual primary energy balance to zero by (4) introducing renewable energy.

* In 2015, the Ministry of Economy, Trade and Industry assembled a committee of experts in order to achieve the ZEB policy targets specified in the Basic Energy Plan, and investigated the measures, etc. required for realizing and popularizing ZEBs.

# ZEB concept diagram

- The fossil energy consumption in buildings is reduced by improving the energy-saving performance of the building framework and equipment and utilizing renewable energy generated on the site.



# Contents



* ZEBs: Net Zero Energy Buildings

# Know-how relating to ZEBs has not been sufficiently spread

The following have been indicated as issues impeding the Realization and Dissemination of ZEBs.

(1) Although measures and activities are promoted by the national government and the construction industry to realize and disseminate ZEBs, and developments that are expected to greatly improve the performance of each of the facilities including air conditioning and lighting have been made, the establishment and sharing of the methods of combining these when designing ZEB buildings have not been adequately implemented.

(2) Until now, trial calculations relating to the costs of ZEB buildings have not been implemented, so that it was not possible to evaluate whether ZEBs could be realized at budgets corresponding to the costs.

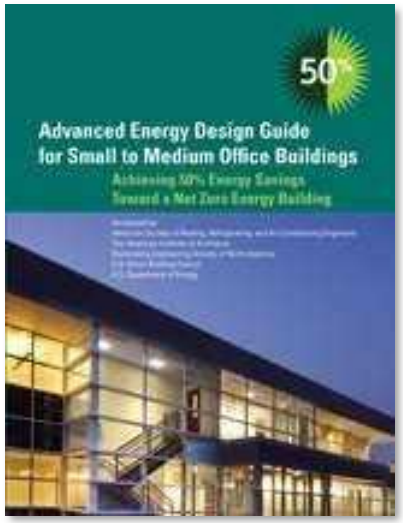
The Realization of ZEBs for buildings is essential for achieving the 2030 review of the energy basic plan.

The number of ZEBs that have been developed by leading business operators through incorporating devices in the designs and combining various **current** technologies is gradually increasing throughout Japan.

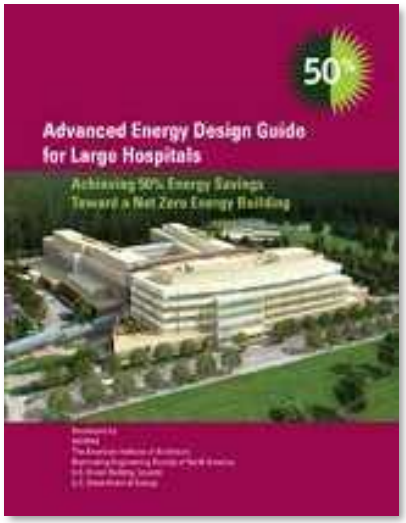
# In the US, it is possible to obtain 50% Advanced Energy Design Guides free download

ASHRAE（American Society of Heating, Refrigerating and Air-Conditioning Engineers）is making the Advanced Energy Design Guides for 50% Savings available for free download (PDF) from the website of the (ASHRAE).

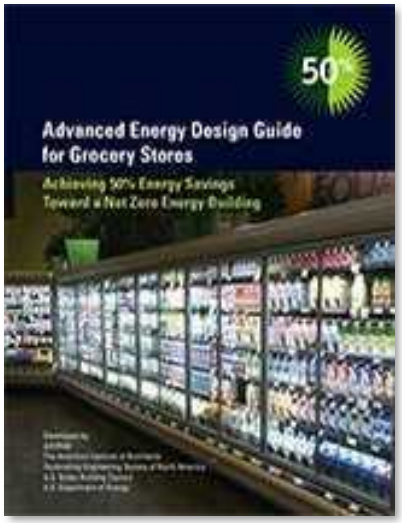
Small to Medium Office Buildings



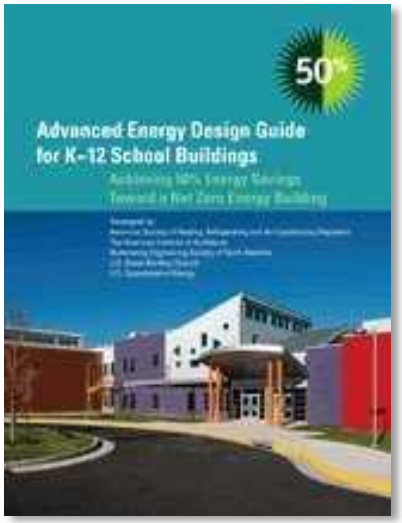

Large Hospitals




Grocery Stores




School Buildings




Source: 50 Percent AEDG (Advanced Energy Design Guide series) free download webpage

# Utilization in energy conservation planning between persons related to building architecture

**design and planning**
Utilizing the ZEB Pamphlets

**Basic designs and working designs**
Utilizing the ZEB Design Guidelines



**Proposals of ZEBs**

**Consultations about ZEBs**

Design offices, general contractors, architects, consultants, etc.

Real estate business operators, building owners

**Communications relating to the architectural plans and equipment designs required for ZEBs**

Architects, architectural designers, etc.

Facility designers

# The ZEB Design Guidelines and ZEB Pamphlets have been made to realize further improvements in awareness of ZEBs and to spread know-how on ZEBs

| | Information media | Purpose | Supplied information |
|---|---|---|---|
| Design offices, general contractors, real estate business operators (Persons in charge of design) | • ZEB Design Guidelines | • To increase awareness and the degree of interest in ZEBs<br>• To share ZEB-related know-how | ✓ Combination of technologies for Realization ZEBs (Design knowhow)<br>✓ Energy conservation effects and added costs<br>✓ Actual design examples<br>✓ Advantages due to Realization ZEBs (Energy- saving advantages, improvement of working environment, etc.)<br>✓ Methods for achieving ZEBs, actual design examples<br>✓ Applicable systems, etc. |
| Building owners, architects, architectural designers, real estate business operators | • ZEB Pamphlets | • To increase awareness and the degree of interest in ZEBs | |

# Made guidelines for each building use based on the subsidy application situations

**Offices edition**

- The energy consumption is the largest among each building use.
- Has the largest number of applications for ZEB verification projects.
- Matching each building size, a medium office edition and small office edition has been created.

**Nursing homes and welfare homes edition**

- Has the second largest number of applications for ZEB verification projects, following office use.
- In consideration of the aging Japanese society, new constructions can be expected in the future.

**Supermarkets and home-improvement centers edition**

- The energy consumption is the second largest among each building use, following office use.
- A certain number of new store openings can be expected each year.

**Hospitals edition**

- The energy consumption is the third largest of each use, following office use and department stores (including supermarkets and home improvement centers).
- By indicating the processes for hospital use which has comparatively high hurdles to overcome for realizing ZEBs, developments will also become possible in medium- to large-sized buildings other than hospitals.

# ZEB Design Guidelines and ZEB Pamphlets series

## ZEB Design Guidelines






## ZEB Pamphlets





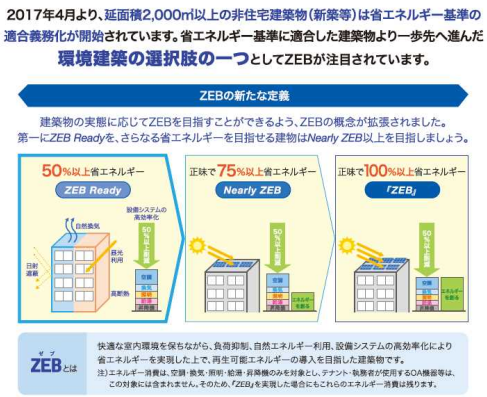
# Disclosure on the website (Can be downloaded free of charge)

The information can be downloaded free of charge from the Sustainable open Innovation Initiative website.

https://sii.or.jp/zeb/zeb_guideline.html


☑ ZEB Design Guidelines

☑ Calculation Program Sheet
(Building Energy Efficiency Act)


☑ ZEB Brochures

# The total number of downloads has reached approximately 43,000 (As of October 2018)

| Contents | | Actual number of downloads | | |
|---|---|---|---|---|
| ZEB Design Guidelines | Medium offices | 6,328 | 16,593 | 43,173 |
| | Small offices | 4,586 | | |
| | Nursing homes and welfare homes | 2,474 | | |
| | Supermarkets/Home improvement centers | 2,253 | | |
| | Hospitals | 952 | | |
| Calculation program sheets | Medium offices | 3,330 | 10,588 | |
| | Small offices | 2,871 | | |
| | Nursing homes and welfare homes | 1,691 | | |
| | Supermarkets/Home improvement centers | 1,608 | | |
| | Large hospitals | 555 | | |
| | Medium hospitals | 533 | | |
| | Schools | 0 | | |
| ZEB Pamphlets | Offices | 7,732 | 15,992 | |
| | Nursing homes and welfare homes | 3,287 | | |
| | Supermarkets/Home improvement centers | 2,943 | | |
| | Hospitals | 1,009 | | |
| | Schools | 1,021 | | |

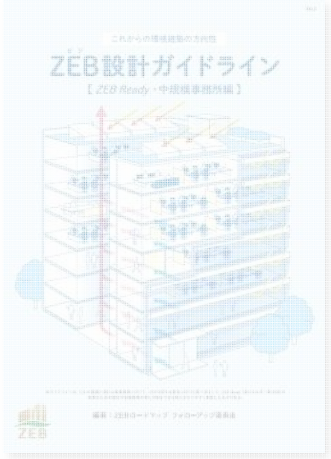
Measures for Realization and Dissemination of ZEBs
About the ZEB Design Guidelines and ZEB Pamphlets

# ZEB PAMPHLETS

# Utilization in the ZEB architectural design and planning stages

**design and planning**
Utilizing the ZEB Pamphlets

**Basic designs and working designs**
Utilizing the ZEB Design Guidelines


**Communications relating to the architectural plans and equipment designs required for ZEBs**

**Proposals of ZEBs**

**Consultations about ZEBs**

Design offices, general contractors, architects, consultants, etc.

Real estate business operators, building owners

Architects, architectural designers, etc.

Facility designers

# One of the directions in the future for environmentally friendly architecture will be ZEBs

## ■ KEY POINT ❶

ZEBs are attracting attention as one of the options for environmental buildings.

## ■ KEY POINT ❷

Situation the actual building conditions and popularization of the concept, the definition of ZEBs has been established.

## ■ KEY POINT ❸

The Realization and dissemination of ZEBs are promoted to achieve national government targets.

# *ZEB Ready* and above have not only energy saving effects, but a variety of other merits

## 1 Reduction in utility costs

It is possible to reduce utility costs while maintaining and improving the quality of the indoor environment.

➡If an office building with a total floor area of around 10,000 m² realizes energy conservation of 50%, it will also be possible to reduce the lighting and heating costs by 40-50% annually.

注）標準ビル、50%省エネルギービルともに、延床面積10,000㎡程度の事務所ビルを想定し、一次エネルギー消費量から光熱費への換算を行いました。電力の換算については、2016年8月現在の東京電力・業務用電力（燃料費調整額・再生可能エネルギー発電促進賦課金含まず）の契約、都市ガスの換算については、東京ガス一般契約の基準単位料金を想定しています。なお、空調・換気・照明・給湯・昇降機のみを対象とし、全体の約3割を占めるOA機器等の消費電力は本試算には含みません。また、実際の光熱費削減量は人員密度や運用条件等によって変化する可能性があります。


## 2 Improvement in real estate value

The numbers of tenants and investors who are seeking buildings that are environmentally friendly are increasing.

➡Among office buildings located in Tokyo's 23 wards, survey results have also been announced that buildings which have acquired environmental certification (buildings which are considerate to the environment) were viewed positively when concluding new rent contracts.

注）分析対象である環境認証には、建物の省エネルギー性能以外の環境全般を評価する認証も含まれています。そのため、不動産価値向上は、省エネルギー性能以外の要素も影響している可能性がある旨をご留意ください。


※新規成約賃料を立地・規模・新しさ・スペック・成約時期・環境認証の有無で説明するヘドニックモデルを構築し、このモデルに標準的なオフィスビルの属性値を代入することで、環境認証の有無別の新規成約賃料を推定している。
出所）ザイマックス不動産総合研究所

## 3 Business continuity when disasters occur

The business continuity when disasters occur will be improved.

➡When asked for the reason why important work was stopped by the Great East Japan Earthquake in 2011, more than half of the people answered, "because of the power outages", and many other people also gave energy infrastructure-related responses.

ZEBを目指した場合、少ないエネルギー消費で運用が可能となるため、建物機能を維持しやすくなります。


出所）内閣府「企業の事業継続の取り組みに関する実態調査 概要」

## 4 Improvement in the intellectual productivity of tenants and office workers

A comfortable indoor environment is realized, so that improvement in peoples' intellectual productivity can be expected.

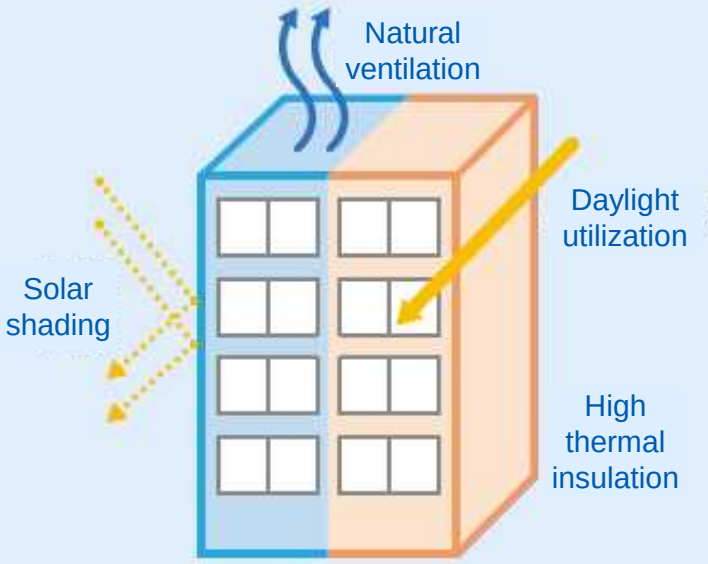
➡When moving to an office in which natural energy utilization technologies had been incorporated, survey results have been announced that the number of users who felt that the indoor environment had become easier to work in after moving to the new office had increased.


出所）知的生産性向上を目指した執務空間における外部の自然環境の導入効果に関する実態調査
竹中工務店・東京大学生産技術研究所

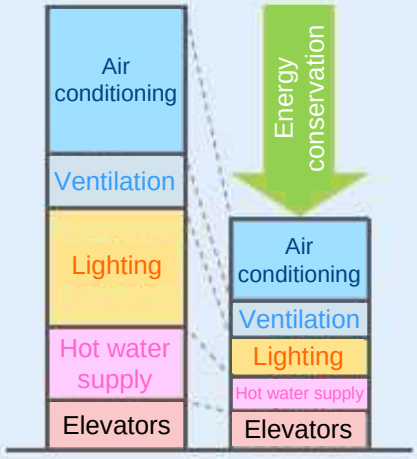
# The key points for realizing ZEBs are “load limiting and natural energy utilization”, the “effective use of energy”, and the “creation of energy”

In addition to limiting the loads and utilizing natural energy, it is important to realize “*ZEB Ready*” status through energy conservation of 50% or more by changing equipment systems to high efficiency types. Further, according to the building’s actual conditions it is important to aim to realize net energy conservation of 75% or more (“*Nearly ZEB*”) and additionally aim to realize net energy conservation of 100% or more (“*ZEB*”) through increased energy conservation and the use of renewable energy such as solar power generation.

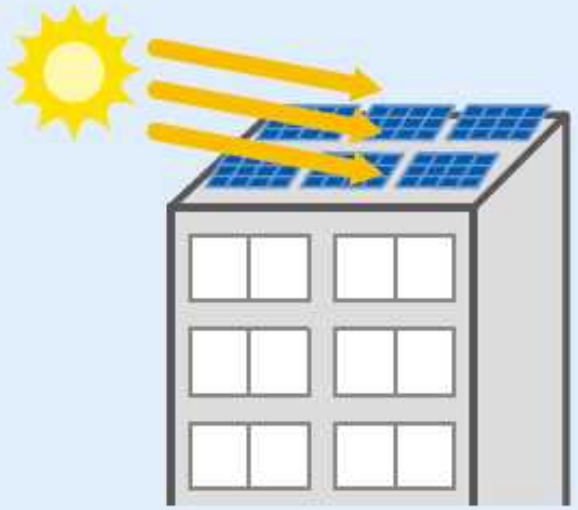
**Limit the loads, and utilize natural energy** + **Effectively utilize energy** + **Create energy**




Change equipment systems to high efficiency types




Note: The energy consumption of office automation equipment used by tenants and users is not included here.



# *ZEB Ready* is an achievable target

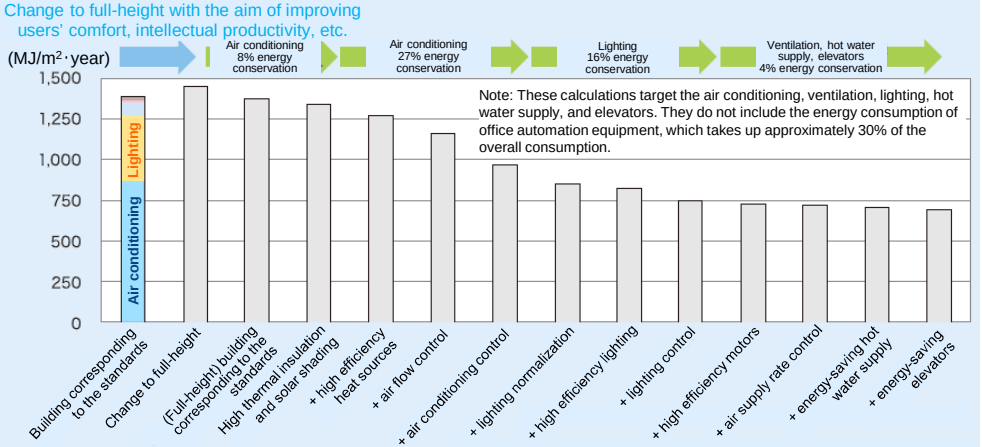
## (50% energy-saving buildings)

- *ZEB Ready* can be realized if the latest general-purpose technologies and controls are effectively combined.

- *ZEB Ready* can be realized through an approximately 12% increase in construction costs. (Trial calculations targeting model buildings)

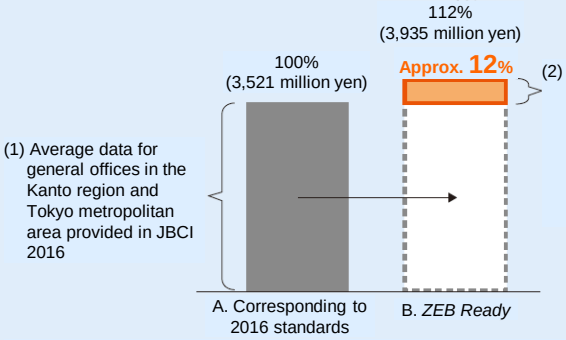
Trial calculation results have been disclosed showing that it is possible to realize "*ZEB Ready*" by combining general-purpose high efficiency energy conservation technologies. In addition, when calculating the necessary equipment and material costs and the construction and administration costs, increased building costs of approximately 12% are incurred compared to buildings corresponding to the Energy Efficiency & Conservation Standards, which indicates that "*ZEB Ready*" is by no means unattainable. Further, when aiming to realize environmental buildings which attain both the design and further energy conservation (*Nearly ZEB* and *ZEB*), it is important to positively utilize passive technologies such as the utilization of natural ventilation and daylight.

◆Energy conservation effects realized by each measure (Rough estimate)




Source: Based on calculation results according to the ZEB Roadmap Follow-up Panel

◆Increased amount rate of construction costs (Rough estimate)




(1) Average data for general offices in the Kanto region and Tokyo metropolitan area provided in JBCI 2016

(2) Individual calculations of increased amount portion including temporary construction, finishing, air conditioning, electricity, sanitation, and various expenses

- In "*B. ZEB Ready*", the increased amount rate of the estimated costs for the overall building is 112%. Considering the increased amount rate of the estimated costs for each separate technology, this is 161% in Air conditioning equipment (air conditioning + ventilation), and it is 117% in Electrical equipment (lighting).
- These building costs are trial calculation results targeting model buildings in a case study, and the estimated costs may vary due to variations in commodity prices according to economic conditions and changes in building specifications. Additionally, when designing buildings which exceed *ZEB Ready* (energy conservation rate of 50%), care will be required when investigating the incorporation of passive technologies (such as the utilization of natural ventilation and daylight by incorporating atriums and voids), which have a high energy conservation effect but also have high initial costs.

| | *ZEB Ready* estimated costs (in millions of yen) | Increased amount rate |
|---|---|---|
| Building construction finishing (High thermal insulation/Solar shading) | 1,160 | 112% |
| Air conditioning equipment (Air conditioning + ventilation) | 423 | 161% |
| Electrical equipment (Lighting) | 393 | 117% |
| Sanitation equipment (Hot water supply) | 191 | 100% |
| Elevators | 69 | 100% |
| Temporary construction | 246 | 111% |
| Earthworks | 111 | 100% |
| Foundation work | 144 | 100% |
| Frame construction | 741 | 100% |
| Various expenses | 457 | 113% |
| **Total** | **3,935** | **112%** |

**Price per unit of area 1,280,000 yen per 3.3 m²**

(* Trial calculation results for an office building with a total floor area of around 10,000 m²)
Source: Based on calculation results according to the ZEB Roadmap Follow-up Panel through the cooperation of the Building Surveyors' Institute of Japan

Measures for Realization and Dissemination of ZEBs
About the ZEB Design Guidelines and ZEB Pamphlets

# ZEB DESIGN GUIDELINES

# Utilization in the ZEB architectural basic designs and working designs

**Planning and concepts**
Utilizing the ZEB Brochures

**Basic designs and working designs**
Utilizing the ZEB Design Guidelines



Proposals of ZEBs

Consultations about ZEBs

Design offices, general contractors, architects, consultants, etc.

Real estate business operators, building owners

**Communications relating to the architectural plans and equipment designs required for ZEBs**

Architects, architectural designers, etc.

Facility designers

# Japan's first ZEB realization manual targeting *ZEB Ready* buildings (50% energy-saving building)

## KEY POINT ❶

Provided with explanations using calculation programs that are compliant with the EE&C standards. (With energy conservation effects and rough cost estimates)

## KEY POINT ❷

Includes renewable energies and points requiring care during operation. (References)

## KEY POINT ❸

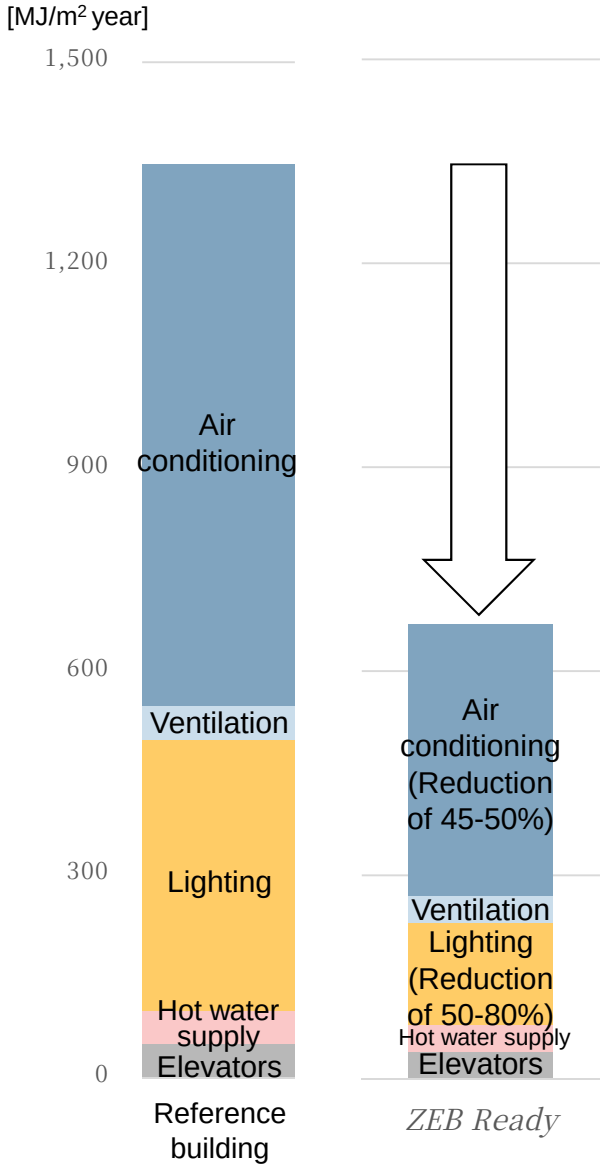
Includes actual design examples.

# First, confirm the energy conservation overall picture (☞Chapter 2)

- Primary energy consumption in reference office buildings (excluding office automation equipment, etc.)
  - Air conditioning is approximately 800 MJ/m$^2$ year.
    (Takes up approximately 60% of the building total)
  - Lighting is approximately 400 MJ/m$^2$ year.
    (Takes up approximately 30% of the building total)

- Trial calculation results using model buildings
  - Energy conservation of 45-50% for air conditioning.
    (= 30% energy conservation for the building overall)
  - Energy conservation of 50-80% for lighting.
    (= 15-20% energy conservation for the building overall)
  - Energy conservation in ventilation, hot water supply, and elevators

* However, with regard to passive methods which are difficult to evaluate in the current calculation program, it is also desirable to plan their effective introduction.



# Additionally, confirm the overall cost picture

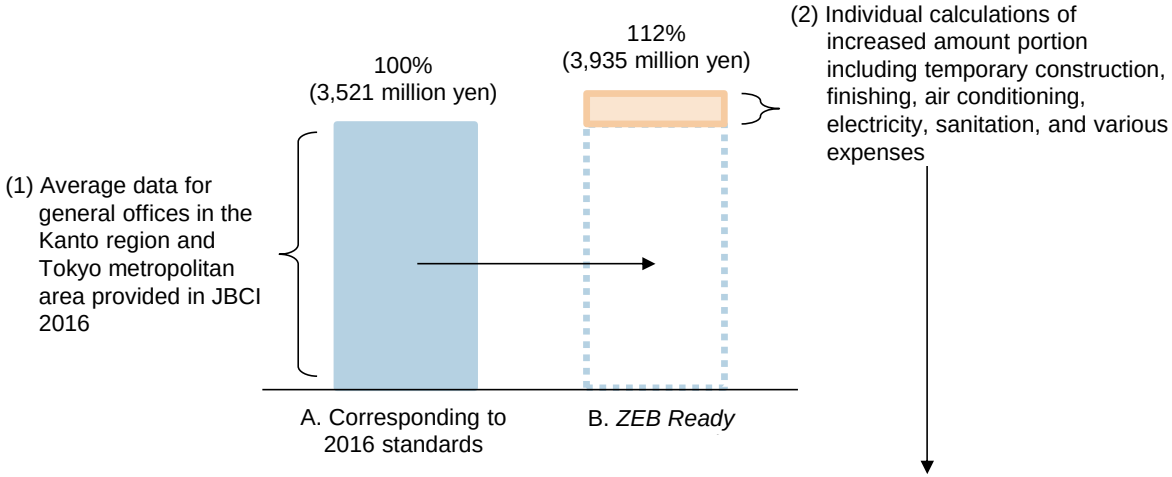
## (☞Chapter 2)

- The increased amount rate of the estimated costs for the overall building is 112%.

Itemization

- This is 161% for air conditioning equipment (air conditioning and ventilation).
- This is 117% for electrical equipment (lighting).

* However, there will be the possibility of changes to the estimated cost results due to variations in commodity prices following the economic conditions and changes in building specifications. In addition, when designing buildings which exceed *ZEB Ready*, it will also be necessary to investigate the introduction of construction methods that have high energy conservation effects, but which also have high initial costs (such as the utilization of natural ventilation and daylight by using atriums or voids).




**2. Individual calculation result of increased amount portion**

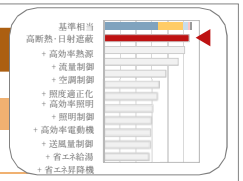
| | Increased amount portion (in millions of yen) | Estimated costs including increased amount B: *ZEB Ready* (in millions of yen) | Increased amount rate |
|---|---|---|---|
| Building construction finishing (High thermal insulation/Solar shading) | 120 | 1,160 | 112% |
| Air conditioning equipment (Air conditioning + ventilation) | 160 | 423 | 161% |
| Electrical equipment (Lighting) | 56 | 393 | 117% |
| Sanitation equipment (Hot water supply) | 1 | 191 | 100% |
| Elevators | 0 | 69 | 100% |
| Temporary construction | 24 | 246 | 111% |
| Earthworks | 0 | 111 | 100% |
| Foundation work | 0 | 144 | 100% |
| Frame construction | 0 | 741 | 100% |
| Various expenses | 53 | 457 | 113% |
| **Total** | 414 | 3,935 | 112% |

Source: Based on calculation results according to the ZEB Roadmap Follow-up Panel through the cooperation of the Building Surveyors' Institute of Japan

# Ways to use the Design Guidelines (3/6)

## Corresponding to the design, confirm the technical points to be noted and the columns (☞Chapters 3-4)

### 3章 建築省エネルギー技術（パッシブ技術）




#### 3.1 外皮断熱

**技術の導入目的**

**空調負荷を抑制する**

- 外皮断熱計画は室内と屋外の境界（外皮）における熱の出入りの抑制を目的としており、無断熱の建物に比べてはるかに少ないエネルギーで室内の温熱環境を快適にすることができる。
- また、太陽からの日射により取得されるエネルギー（日射取得熱）と内部発熱は、断熱がされていなければ短時間のうちに外へ逃げてしまうが、断熱化を図ることで室温を上昇させるための有効なエネルギーとして使うことができる。
- 一方、夏期には断熱化によって熱の侵入を防ぐことがねらいにあるが、日射取得熱や内部発熱が室内にこもってしまう恐れもあるため、自然通風利用の併用についても考慮する必要がある。

**自然室温を維持する**

- 外皮の断熱水準が上がるほど室温は外気温の影響を受けにくくなり、冬期は非暖房室でも暖房室からの熱の流入や日射取得熱・内部発熱により室温が上がり、より高い室温を維持することができる。

**壁や床、窓の表面温度を室温に近づける**

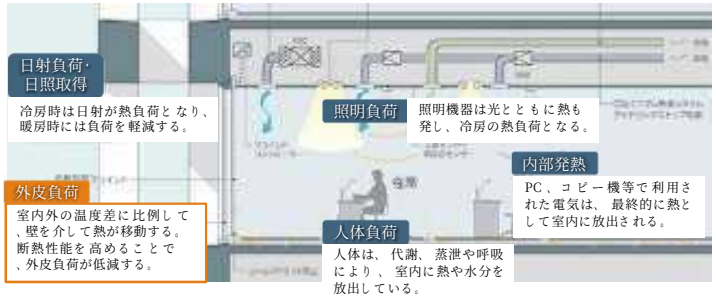
- 一般に、ある空間における体感温度は周囲の窓・壁・床等の表面温度（平均放射温度）と室温の平均とされているが、断熱化によって躯体の表面温度を室温に近づけ、体感温度と室温との温度差を小さくすることで十分な暖かさや涼しさを感じることができる。
- また、床をはじめとした断熱性能の強化（断熱材の設置および漏気の防止）により、床の表面温度を上げることで室内の上下温度差や温度むらを小さくすることができる。

**屋上からの日射熱を遮り、最上階室の暑さを和らげる**

- 夏期の水平面は、多量の日射熱を受ける。そのため、夏期の屋上スラブ面の温度は60～70℃にも達する。屋上スラブ面の断熱を強化することで、屋上が受けた日射熱が室内に入ることを防ぎ、最上階室の暑さを和らげることが可能である。

**外皮断熱技術の高性能化に向けたアプローチ**

- 外皮断熱技術は、建築物に係る熱負荷の抑制に寄与するものである。
- 熱負荷とは、室内温度を一定に保つために処理しなくてはならない熱量を指し、一般的には、外皮負荷、日射負荷・日照取得、外気負荷等の外部の気象条件に応じて時々刻々と変化するものと、照明負荷、機器発熱、人体負荷等、室内側の利用状況に起因するものとに大別される。

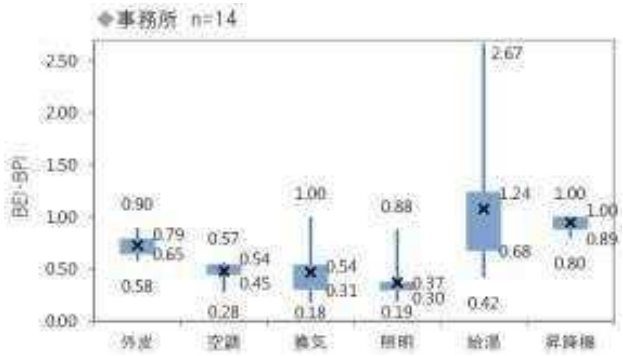



出所）丹羽英治「エネルギー自立型建築」工作舎／2013年

### Column 補助事業（ZEB実証事業）の申請案件における PAL*の削減率の分布

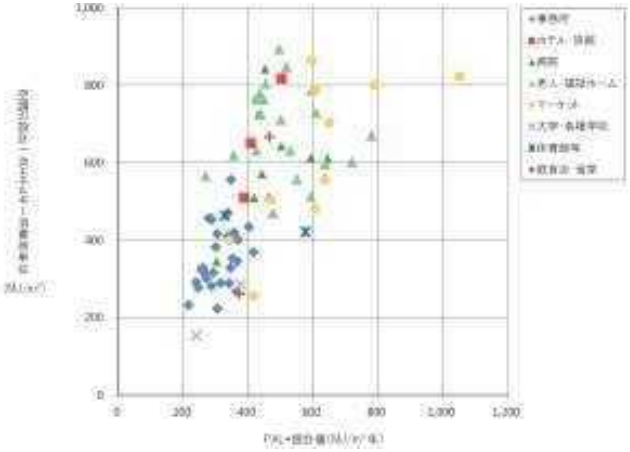
PAL*の削減率の分布

- 事務所の用途別では、PAL*の削減率（外皮BPI）は、0.65（35%減）～0.79（21%減）程度で分布している。




PAL*と空調一次エネルギー消費量の関係

- 補助事業（ZEB実証事業）の申請案件の分布によると、外皮の高断熱化により、PAL*が下がると、空調一次エネルギー消費量原単位も下がる傾向にある。このことは、パッシブ技術とアクティブ技術の組み合わせが重要となることを示している。



出所）「ZEB実証事業 調査研究発表会2017」一般社団法人 環境共創イニシアチブ

# Confirm the methods of applying the actual data to the calculation programs (☞Chapters 3-4)

- Example) Changing the performance and thickness of the thermal insulation materials for the outside wall and roof

## Corresponding to the standards

| ① 外壁名称 (選択) | ② 壁の種類 (選択) | ③ 熱貫流率 [W/m²K] | ④ 建材番号 (選択) | ⑤ 建材名称 (選択) | ⑥ 厚み [mm] | ⑦ 備考 |
|---|---|---|---|---|---|---|
| R1 | 外壁 | | | 室内側 | | |
| | | | 70 | ロックウール化粧吸音板 | 12 | |
| | | | 62 | せっこうボード | 10 | |
| | | | 302 | 非密閉空気層 | | |
| | | | 41 | コンクリート | 150 | 普通コンクリート |
| | | | 47 | セメント・モルタル | 15 | |
| | | | 102 | FRP | 5 | |
| | | | 47 | セメント・モルタル | 15 | |
| | | | 181 | 押出法ポリスチレンフォーム 保温板 1種 | 50 | |
| | | | 41 | コンクリート | 60 | 普通コンクリート |
| | | | | 室外側 | | |
| W1 | 外壁 | | | 室内側 | | |
| | | | 62 | せっこうボード | 8 | |
| | | | 302 | 非密閉空気層 | | |
| | | | 181 | 押出法ポリスチレンフォーム 保温板 1種 | 25 | |
| | | | 41 | コンクリート | 150 | 普通コンクリート |
| | | | 47 | セメント・モルタル | 25 | |
| | | | 67 | タイル | 10 | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | 室外側 | | |
| FG1 | 接地壁 | | | 室内側 | | |
| | | | 101 | ビニル系床材 | 3 | |
| | | | 47 | セメント・モルタル | 27 | |
| | | | 41 | コンクリート | 150 | 普通コンクリート |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | 室外側 | | |

## Corresponding to *ZEB Ready*

| ① 外壁名称 (選択) | ② 壁の種類 (選択) | ③ 熱貫流率 [W/m²K] | ④ 建材番号 (選択) | ⑤ 建材名称 (選択) | ⑥ 厚み [mm] | ⑦ 備考 |
|---|---|---|---|---|---|---|
| R1 | 外壁 | | | 室内側 | | |
| | | | 70 | ロックウール化粧吸音板 | 12 | |
| | | | 62 | せっこうボード | 10 | |
| | | | 302 | 非密閉空気層 | | |
| | | | 41 | コンクリート | 150 | 普通コンクリート |
| | | | 47 | セメント・モルタル | 15 | |
| | | | 102 | FRP | 5 | |
| | | | 47 | セメント・モルタル | 15 | |
| | | | 183 | 押出法ポリスチレンフォーム 保温板 3種 | 100 | |
| | | | 41 | コンクリート | 60 | 普通コンクリート |
| | | | | 室外側 | | |
| W1 | 外壁 | | | 室内側 | | |
| | | | 62 | せっこうボード | 8 | |
| | | | 302 | 非密閉空気層 | | |
| | | | 183 | 押出法ポリスチレンフォーム 保温板 3種 | 50 | |
| | | | 41 | コンクリート | 150 | 普通コンクリート |
| | | | 47 | セメント・モルタル | 25 | |
| | | | 67 | タイル | 10 | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | 室外側 | | |
| FG1 | 接地壁 | | | 室内側 | | |
| | | | 101 | ビニル系床材 | 3 | |
| | | | 47 | セメント・モルタル | 27 | |
| | | | 41 | コンクリート | 150 | 普通コンクリート |
| | | | | | | |
| | | | | | | |
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| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | 室外側 | | |

## Ways to use the Design Guidelines (5/6)

# Apply the calculation programs (in Chapter 7 or in an Excel sheet) to calculate the energy savings

1. 計算条件

| | |
|---|---|
| 計算実施日時 | 2017年1月10日 12時45分 |
| 入力責任者 | |
| プログラムのバージョン | Ver.2.2.3 (2016.10) |
| XML ID | 6c6df5d3-6ecc-431c |
| 再出力コード | TM#R-*AEU-MJBU-#FWE |

2. 建物の概要

| | |
|---|---|
| 建物名称 | 10000m2事務所ビル |
| 建物所在地 | 東京都千代田区○○町○○番地 |
| 地域区分 | 6 地域 |
| 日射地域区分 | 未設定 |
| 「他人から供給された熱」の一次エネルギー換算値 | 指定しない |
| 構造 | 鉄筋鉄骨コンクリート造 |
| 階数 | 地上 7 |
| 敷地面積 | 5000 m2 |
| 建築面積 | 1422.9095 m2 |
| 延床面積 | 10104.51 m2 |

3. PAL＊・一次エネルギー消費量計算結果

| | 設計値 | 基準値 |
|---|---|---|
| PAL＊ | 423 | 470 |

| | | 設計一次エネルギー消費量 | | 基準一次エネルギー消費量 | |
|---|---|---|---|---|---|
| 内訳 | 空調設備 | 4,489.37 GJ/年 | 444.29 MJ/延床m2年 | 8,804.51 GJ/年 | 871.34 MJ/延床m2年 |
| | 換気設備 | 394.06 GJ/年 | 39.00 MJ/延床m2年 | 695.14 GJ/年 | 68.80 MJ/延床m2年 |
| | 照明設備 | 1,722.06 GJ/年 | 170.42 MJ/延床m2年 | 4,209.25 GJ/年 | 416.57 MJ/延床m2年 |
| | 給湯設備 | 209.02 GJ/年 | 20.69 MJ/延床m2年 | 138.80 GJ/年 | 13.74 MJ/延床m2年 |
| | 昇降機 | 204.80 GJ/年 | 20.27 MJ/延床m2年 | 256.00 GJ/年 | 25.34 MJ/延床m2年 |
| | 効率化設備 | 0.00 GJ/年 | 0.00 MJ/延床m2年 | | |
| | その他 | 3,677.42 GJ/年 | 363.94 MJ/延床m2年 | 3,677.42 GJ/年 | 363.94 MJ/延床m2年 |
| 合計 | | 10,696.8 GJ/年 | 1,058.62 MJ/延床m2年 | 17,781.2 GJ/年 | 1,759.73 MJ/延床m2年 |
| 合計（その他抜き） | | 7,019.4 GJ/年 | 694.68 MJ/延床m2年 | 14,103.8 GJ/年 | 1,395.79 MJ/延床m2年 |

本計算結果は、当該建築物が建設される地域区分及び設計内容に、一定の運用スケジュールに基づく設備機器の運転条件等を想定し計算されたもので、実際の運用に伴うエネルギー消費量とは異なります。

4. 判定結果

| | | |
|---|---|---|
| BPI | （PAL＊設計値／PAL*基準値） | 0.90 |
| BEI | （「その他」を除く一次エネ設計値／「その他」を除く一次エネ基準値） | 0.50 |

| | | | 適否 | 基準一次エネルギー消費量 | |
|---|---|---|---|---|---|
| 建築物省エネ法 | エネルギー消費性能基準 | 新築建築物 | 適合 | 17,781.2 GJ/年 | 1,759.73 MJ/延床m2年 |
| | | 既存建築物※ | 適合 | 19,191.5 GJ/年 | 1,899.30 MJ/延床m2年 |
| | 誘導基準 | 新築建築物 | 適合 | 14,960.4 GJ/年 | 1,480.57 MJ/延床m2年 |
| | | 既存建築物※ | 適合 | 17,781.2 GJ/年 | 1,759.73 MJ/延床m2年 |
| 低炭素建築物　新築等計画認定制度 | | | 適合 | 16,370.8 GJ/年 | 1,620.15 MJ/延床m2年 |

※ 既存建築物とは、建築物省エネ法施行時点で現存する建築物のことをいう。


*** Because the descriptions are only examples in model buildings, be sure to change the equipment, numerical values, etc. to match each building, and use the results as an assistive measure when aiming to realize ZEBs.**

# Confirm the use of renewable energy and the points to be noted during operation (☞Chapters 5-6)

Column

## Verification of renewable energy technologies that are integrated into construction materials (Example): Wall surface-mounted solar power generation system

- ZEBの推進には、建物の屋上だけでなく、壁面にも太陽光発電システムを導入し、建築物のエネルギー自給率を高めることが重要である。しかし、建物壁面への設置は、太陽電池モジュールから周囲への太陽光反射による光害等が発生することがあるため、導入においては検討が必要である。これまでNEDOとカネカは、太陽電池モジュール表面の凹凸構造によって光散乱させ正反射を低減させるとともに、太陽電池モジュールの内部に光を閉じ込める技術を用いて発電効率を高めた低反射モジュールを開発し、カネカ ソーラーエネルギー事業部技術センター実証棟において、モジュールの表面構造の最適化等の評価を進めている。
- また、同社は、「太陽光発電多用途化実証プロジェクト」で、防眩機能を有し、意匠性を高めた壁面設置型の低反射環境配慮型太陽光発電システムを大成建設技術センター内に設置し、発電特性等を確認する実証試験を実施している。
- 本システムは、壁面設置型の大きな課題である光害対策のための防眩機能を有し、また多彩な色をつけることで意匠性を高め、フレームレスで設置することが可能となっている。本実証試験では、色の自由度を高めた多彩な低反射モジュールの光を閉じ込める技術により、年間日射の大半が斜入射となる建物壁面設置の太陽光発電システムにおいて、年間発電量の向上を実証する計画である。本取組により、ZEBを実現する光害対策等の設置環境に配慮し、景観に調和した意匠性の高い壁面設置型の太陽光発電システムの実用化を目指している。

壁面に設置したさまざまな色の低反射モジュール

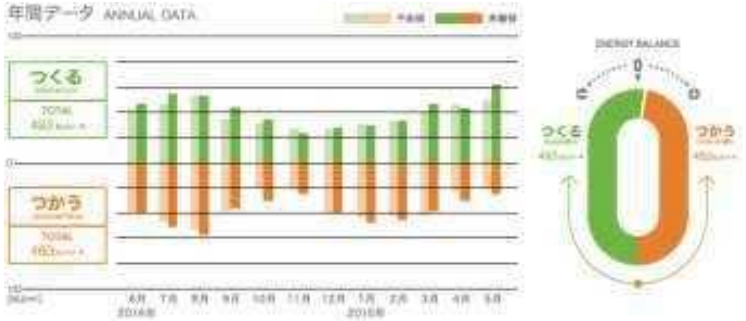
出所）国立研究開発法人新エネルギー・産業技術総合開発機構ニュースリリース（2016年2月25日）

Column

## Example of Realization ZEBs for an office building including the aspect of continuous use

**年間エネルギー収支ゼロを達成**

- 大成建設のZEB実証棟では、2014年6月の運用開始から2015年5月までの1年間で、エネルギー消費量は一般的な建物の1/4程度となる463 MJ/（㎡・年）、創エネルギー量は493 MJ/（㎡・年）となり、建物単体での年間エネルギー収支0（ゼロ）を達成した。ZEBの達成は国内都市部における単体建物として初であり世界的にも希少な先進事例といえる。




**ZEB化採用技術の効果を実証**

- 大成建設独自のセンシング技術と、新たに開発した採光装置、光環境の新しい概念を利用した照明制御技術等により、超省エネルギーと快適性の両立が確認された。また、次世代型高効率燃料電池の排熱を利用したタスクアンドアンビエント空調システムの効果、有機薄膜太陽光発電による創エネルギー効果等、建物に導入した様々な技術の実測データ収集・分析を行い、事前のシミュレーション通りのゼロエネルギーの達成が確認された。


出所）大成建設ウェブサイト

# Contents



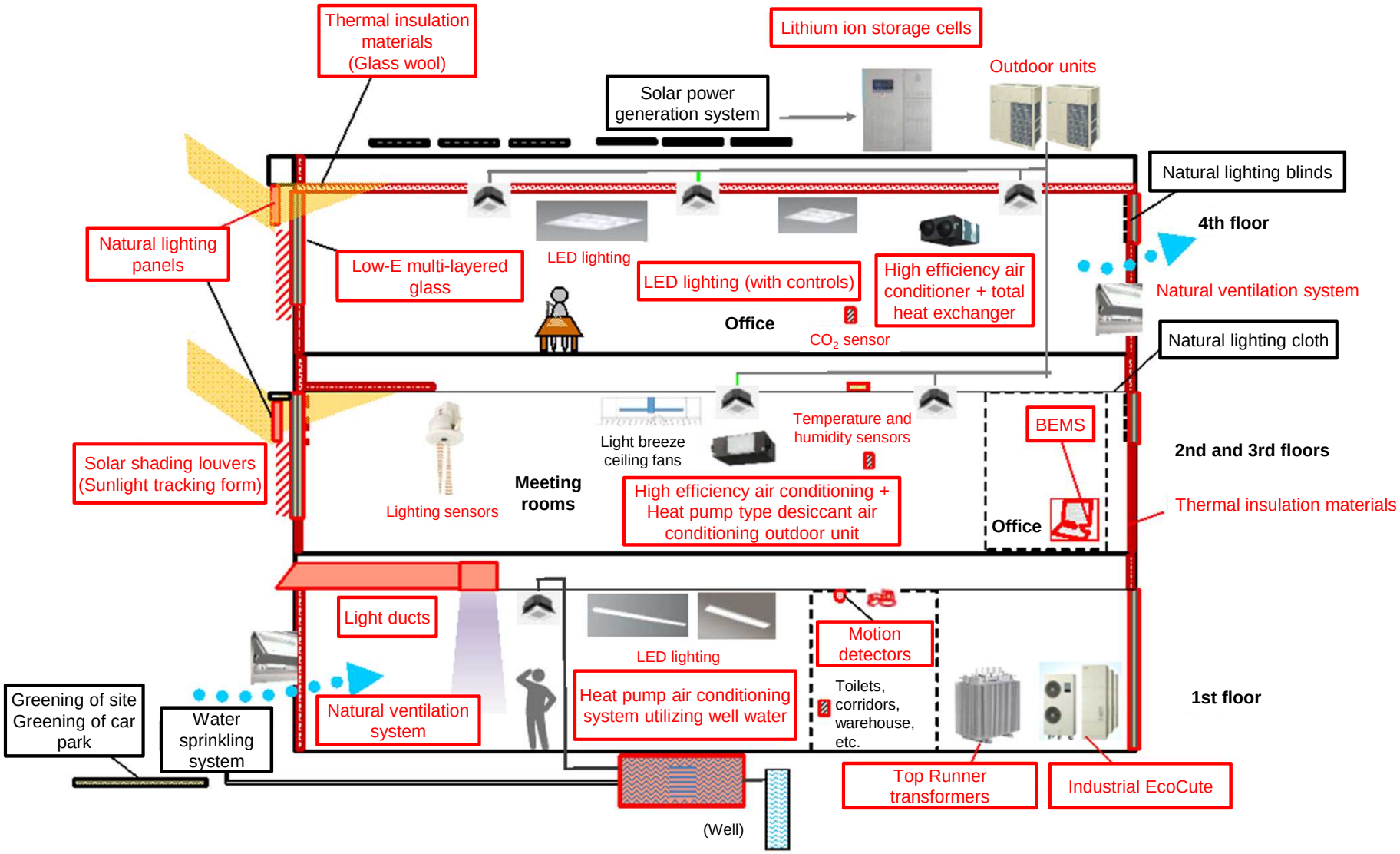
* ZEBs: Net Zero Energy Buildings

# ZEB Example – Office (1)

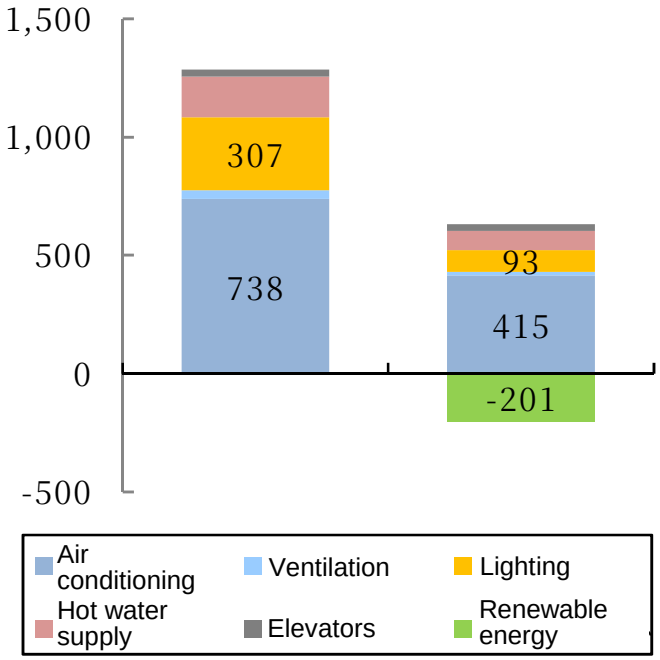
| | |
|---|---|
| Concept for ZEB realization | To realize a ZEB for this headquarters building, it was planned to reduce the building's overall energy load by primarily using a passive building design that enhanced the building envelop insulation performance and utilized daylight and natural ventilation as far as possible. Secondly, regarding the parts of the load that could not be reduced using the above measures, it was planned to implement thorough energy conservation using high efficiency air conditioning, lighting, and hot water supply. Additionally, the introduction of BEMS to understand and evaluate the actual energy consumption was to lead to further reductions in energy consumption with the operations management. |

| | | | |
|---|---|---|---|
| Project location | Hamamatsu, Shizuoka | | Region 6 |
| Building use | Office (Part used as a warehouse) | | Newly constructed |
| Structure | S construction | No. of stories | 4 stories above ground |
| Total floor area | 3,704.10 $m^2$ | | |

# ZEB Example – Office (2)

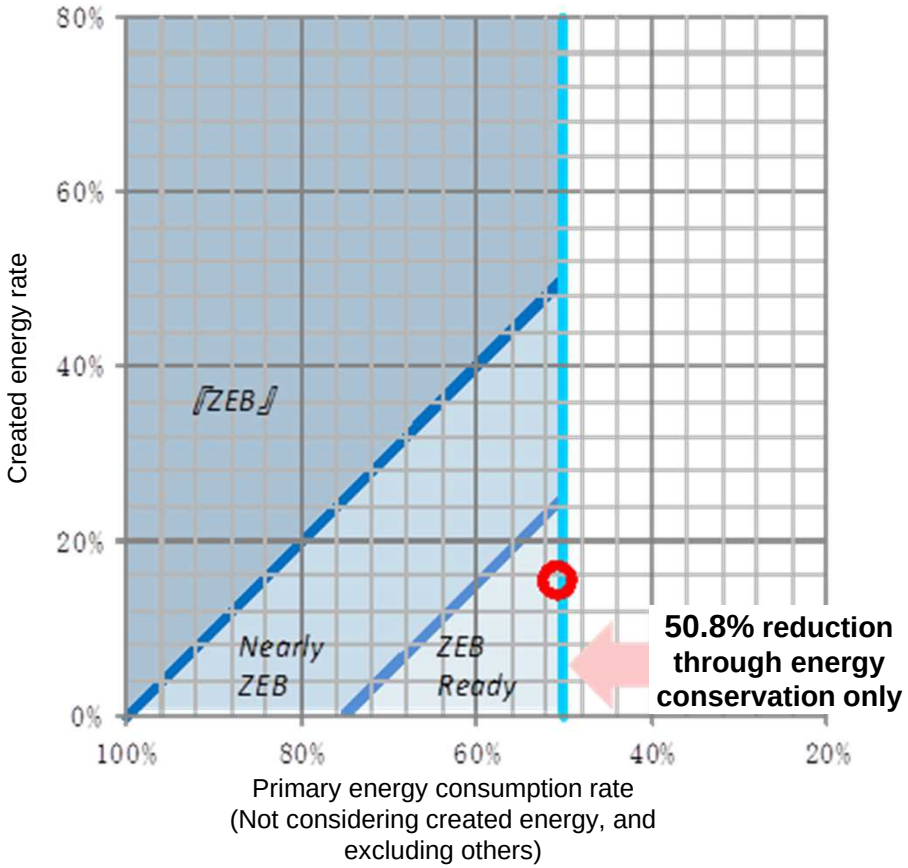


# ZEB Example – Office (3)




Units: MJ/m² year

| | Standards | Design | BPI/ BEI |
|---|---|---|---|
| **Exterior** | 470 | 304 | 0.65 |
| **Air conditioning** | 738 | 415 | 0.56 |
| **Ventilation** | 38 | 14 | 0.38 |
| **Lighting** | 307 | 93 | 0.30 |
| **Hot water supply** | 173 | 81 | 0.47 |
| **Elevators** | 29 | 29 | 1.00 |
| **Total** | 1,286 | 632 | 0.49 |
| **Renewable energy** | 0 | −201 | - |
| **Total** | 1,286 | 431 | 0.34 |




## [Energy performance evaluation]

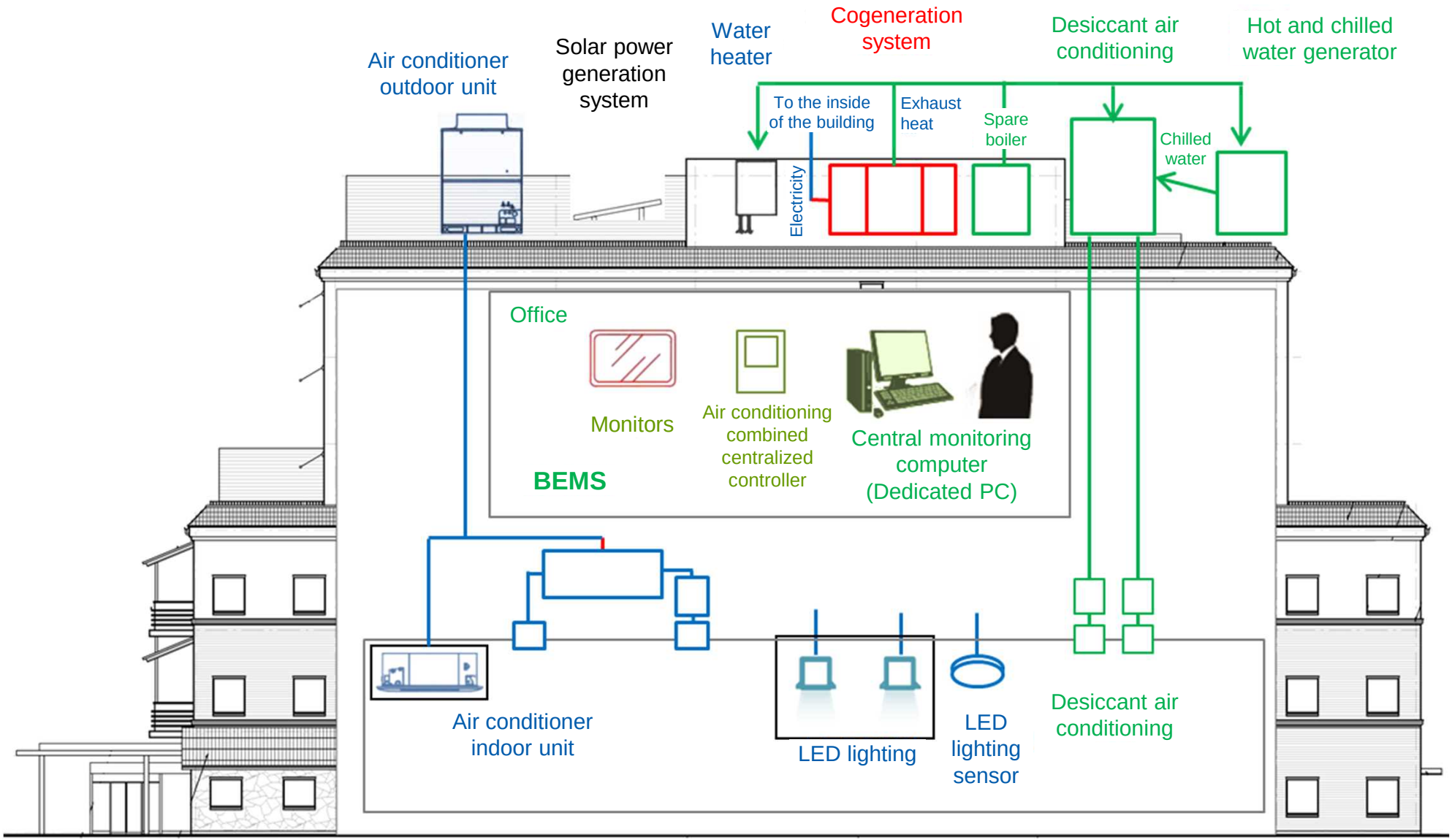
- The design primary energy consumption of this building is 632 MJ/m² year (431 MJ/m² year when including the renewable energy), which realizes energy conservation of approximately 51% compared to the reference .

# ZEB Example – Hospital (1)

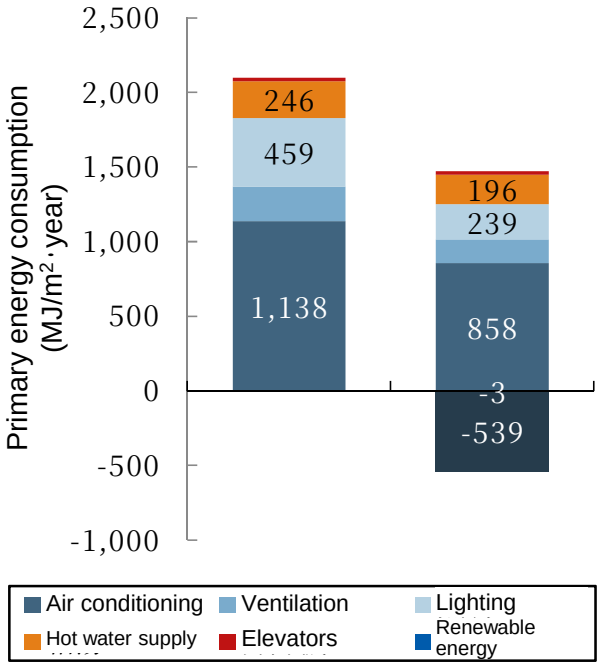
| | |
|---|---|
| Concept for ZEB realization | Planning the hospital construction, an advanced hospital that consumes less energy was to be operated by limiting the air conditioning load as far as possible through the utilization of highly efficient thermal insulation materials and high performance windows, introducing energy-efficient equipment, and implementing energy consumption management using BEMS. |

| | | | |
|---|---|---|---|
| Project location | Fukuchiyama , Kyoto | | Region 5 |
| Building use | Hospital | | Newly constructed |
| Structure | RC construction | No. of stories | 7 stories above ground |
| Total floor area | 10,660.07 $m^2$ | | |

# ZEB Verification Example – Hospital (2)

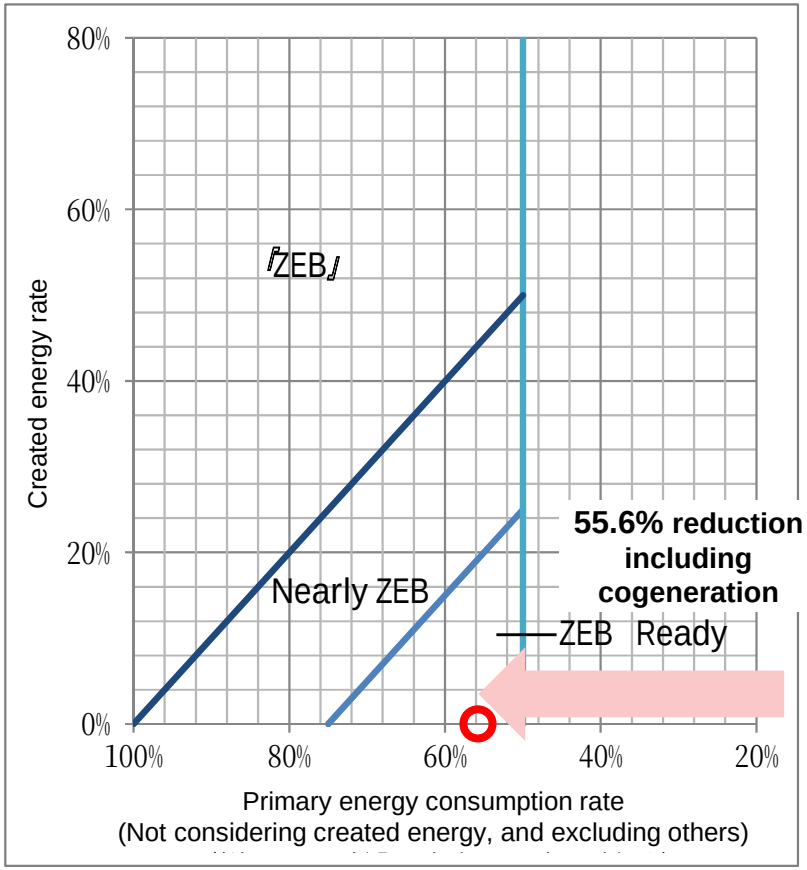


# ZEB Example – Hospital (3)




Units: MJ/m² year

| | Standards | Design | BEI |
|---|---|---|---|
| **Air conditioning** | 1,138 | 858 | 0.75 |
| **Ventilation** | 231 | 156 | 0.68 |
| **Lighting** | 459 | 239 | 0.52 |
| **Hot water supply** | 246 | 196 | 0.80 |
| **Elevators** | 26 | 26 | 1.00 |
| **Total** | 2,100 | 1,474 | 0.70 |
| **Renewable energy** | 0 | –3 | - |
| **High efficiency equipment** | 0 | –539 | - |
| **Total** | 2,100 | 931 | 0.44 |




## [Energy performance evaluation]

- The design primary energy consumption of this building is 1,474 MJ/m² year (931 MJ/m² year when including the renewable energy), which realizes energy conservation of approximately 55.6% (including the renewable energy and cogeneration) compared to the reference.

# Contents



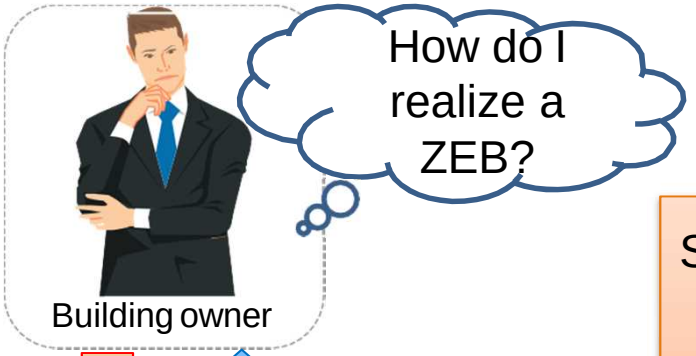
* ZEBs: Net Zero Energy Buildings

# ZEB Planner Registration System

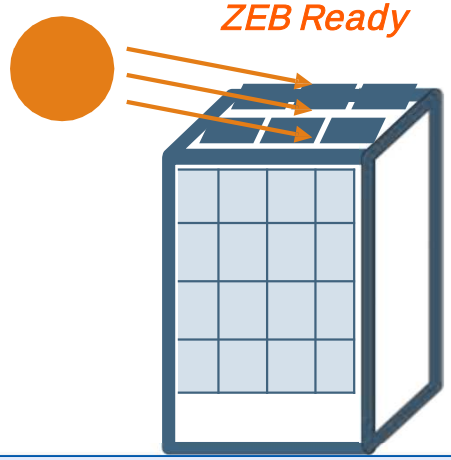
## (Development of ZEB expert engineers, and management of voluntary action plan)

- To promote ZEB building business, design companies, design and construction companies, and consulting companies which have knowledge of energy saving buildings are **registered as ZEB Planners** and **establish consultation service** and **inform the general public them available**.
- **Disclosure of the list of ZEB Planners and their achievements on the website of the subsidy executive body**

Based on the registered information, it is planned to investigate further measures for Realization ZEB popularization.




Subsidies to be given to the ZEB Planner involved projects of various building uses.




**ZEB Planner Consultation Center**


Information disclosure

- ZEB Planner information (Scope of work, supported area and building use, etc.)
- Voluntary activity plans to receive orders for ZEBs
- Actual planning for ZEBs, etc.
- List of ZEB Consultation Centers

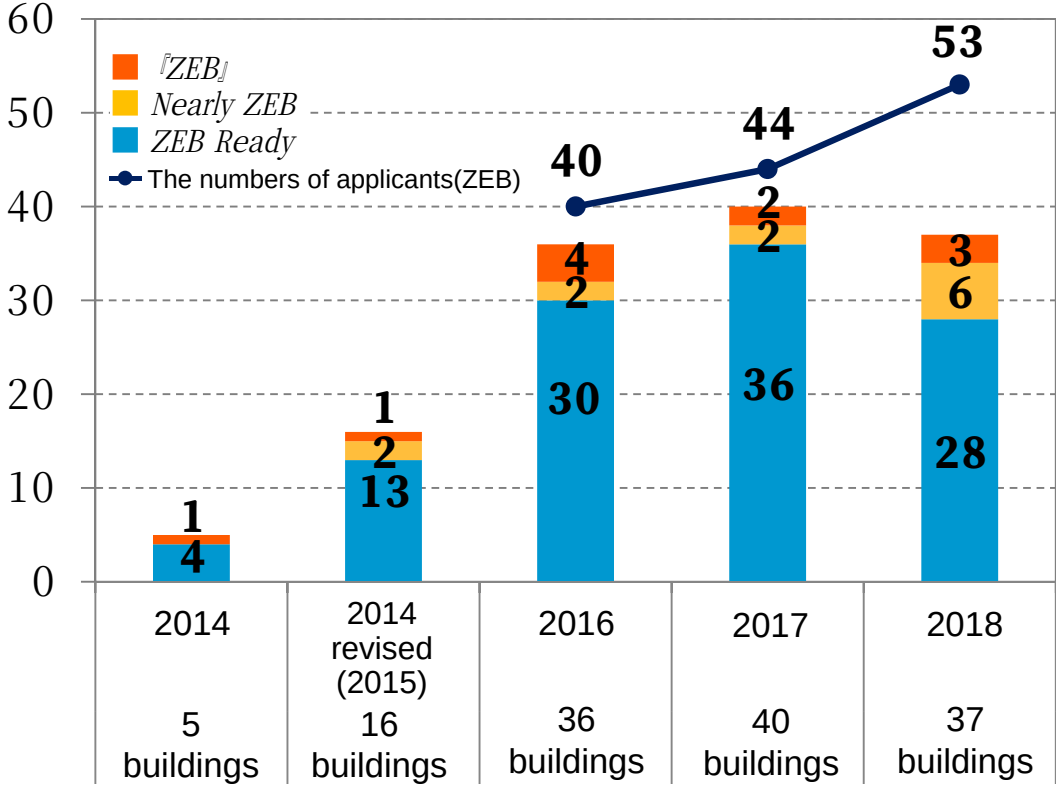
**No. of registered companies as of October 15, 2018: 125**

**(79 design companies, 59 design construction companies, 97 consulting companies * Each company can register multiple categories.)**

# The number of ZEB buildings is increasing each year

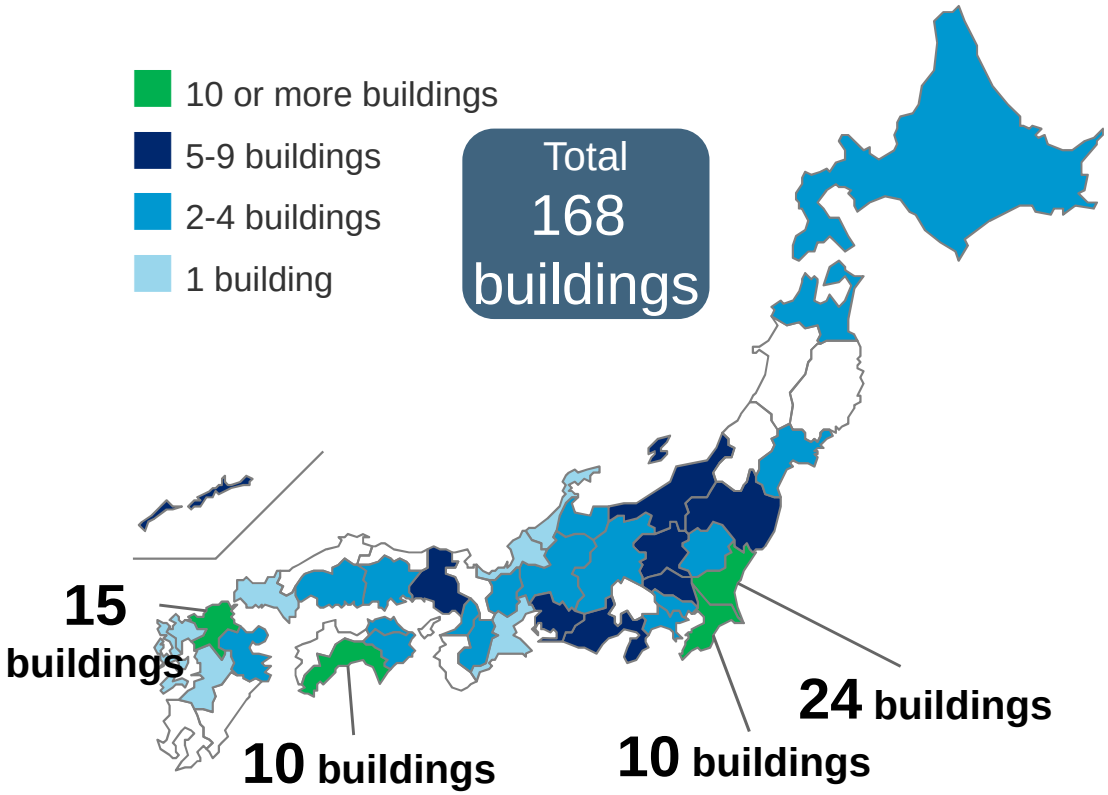
The number of ZEB buildings, comprising not only buildings developed by general contractors and major design offices, but buildings created by a variety of business operators in recent years, is increasing.

No. of subsidized projects



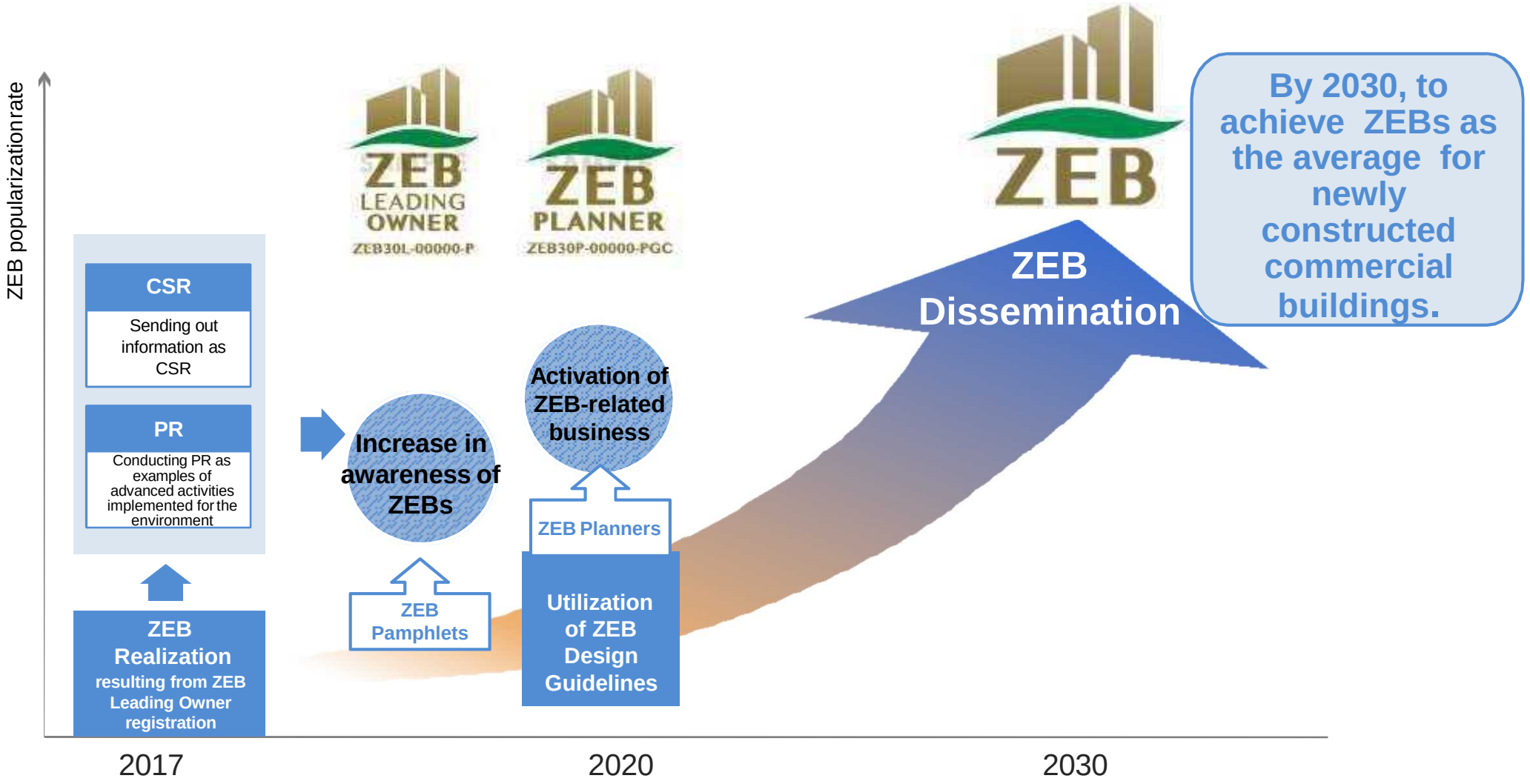

Up until FY2016, the figures indicate the number of confirmed projects, while the figures for FY2017 and FY2018 indicate the number of confirmed grants.
Also includes the number of buildings in projects subsidized by Ministry of the Environment.

Distribution of ZEB Leading Owner registered buildings




(As of October 15)

# Aiming to Realization and Dissemination of ZEBs



# Aiming to Realization and Dissemination of ZEBs

- The interest in ZEBs is rapidly increasing in Japan as well, and the number of ZEB buildings developed by “ZEB Leading Owners” registered on the SII website has increased to 168 buildings nationwide, extending across a variety of building uses and sizes.

- SII continues to investigate to clarify the energy saving effects and advantages of further Realization ZEBs, cooperating with Ministry of Economy, Trade and Industry and Ministry of the Environment.

- We would be happy if our presentation today will be useful for your activities.

Thank you for your attention.