Challenge to Environmental Issues

# Implementation of Green Features in Japan

## Plan, Design, Construct, Audit

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Japan Green Building Council
Founder

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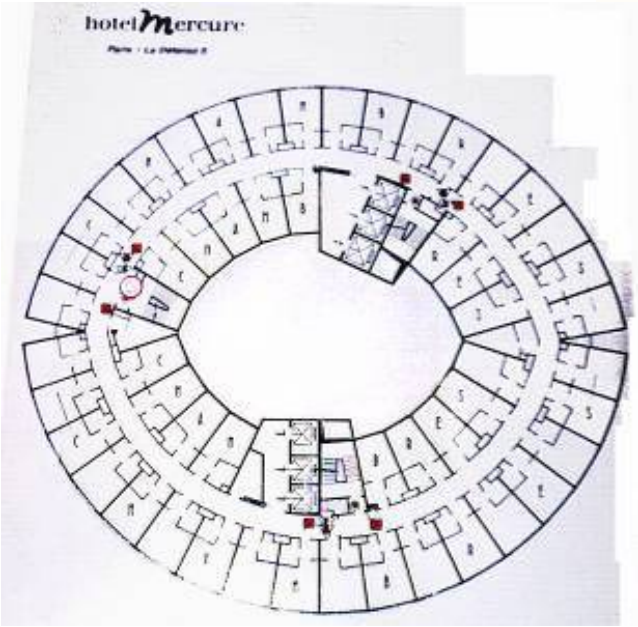





**Hotel Mercure in Paris**

**1995**

1995

1996


1997

1997


1996

1997

# Environmental Current Issues

in France 

**Air pollution**

↓ from industrial & vehicle emissions

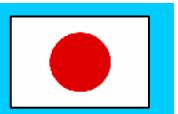
Acid Rain

↓

Forest damage

**Water pollution**

from urban waste & agricultural run off

in Japan 

**Air pollution**

↓ from power plant emissions

Acid Rain

↓

Acidification

degrading water quality & threatening aquatic life

**Resources Depletion**

one of the largest consumer of fish and tropical timber

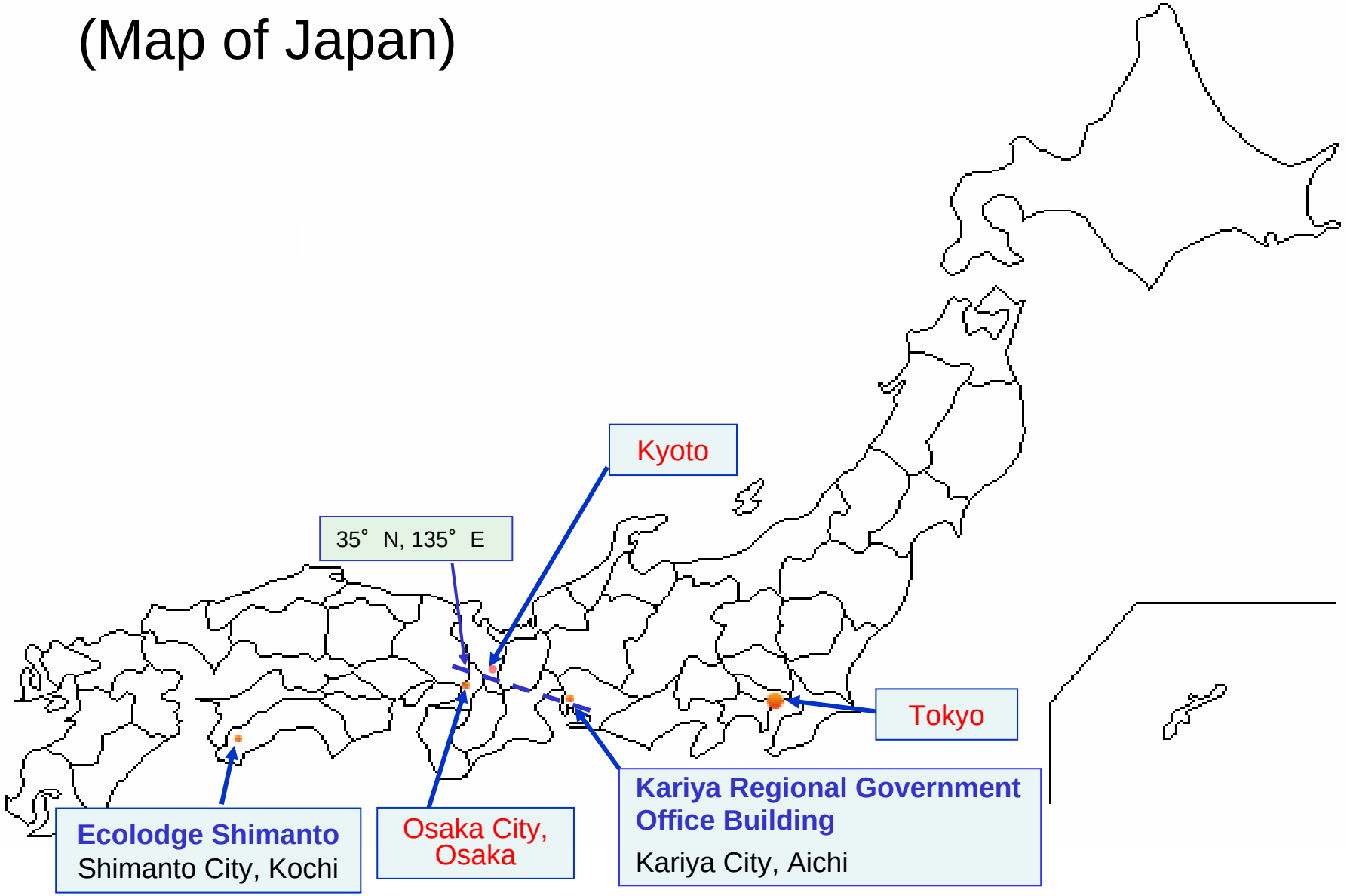
"CIA" the world Fact book 2008

# Environmental Impact Comparison

| | | France | Japan |
|---|---|---|---|
| Green House Gas Emission ( x10 $^{6}$ TON) Gross | $CO_2$ | 406 x10 $^{6}$ TON | 1,247 x10 $^{6}$ TON |
| | Methane | 62 x10 $^{6}$ TON | 20 x10 $^{6}$ TON |
| | $NO_2$ | 73 x10 $^{6}$ TON | 35 x10 $^{6}$ TON |
| | 1990～2002 | -2 % | +12 % |
| Electrical Power Generate ( x10 $^{6}$ kWh) 2003 Gross | Coal | 60,605 | 698,735 |
| | Hydraulic | 64,338 | 104,131 |
| | Nuclear | 441,070 | 240,013 |
| | Total | 566,902 | 1,047,198 |
| 2003 Energy & Resource Consumption per Capita | Coal | 345 kg | 1,320 kg |
| | Oil | 1,419 kg | 1,611 kg |
| | Natural Gas | 30,426 x10$^{6}$Joul | 25,891 x10$^{6}$Joul |
| | Electricity | 8,319 kWh | 8,212 kWh |
| 2002 Air Pollutant Emission per Capita | SOx | 9.0 kg | 6.7 kg |
| | NOx | 22.7 kg | 15.8 kg |
| | CO | 98.9 kg | 27.1 kg |
| | Non Hydrocarbon | 23.7 kg | 13.8 kg |

2007 statistic data by Japanese Government

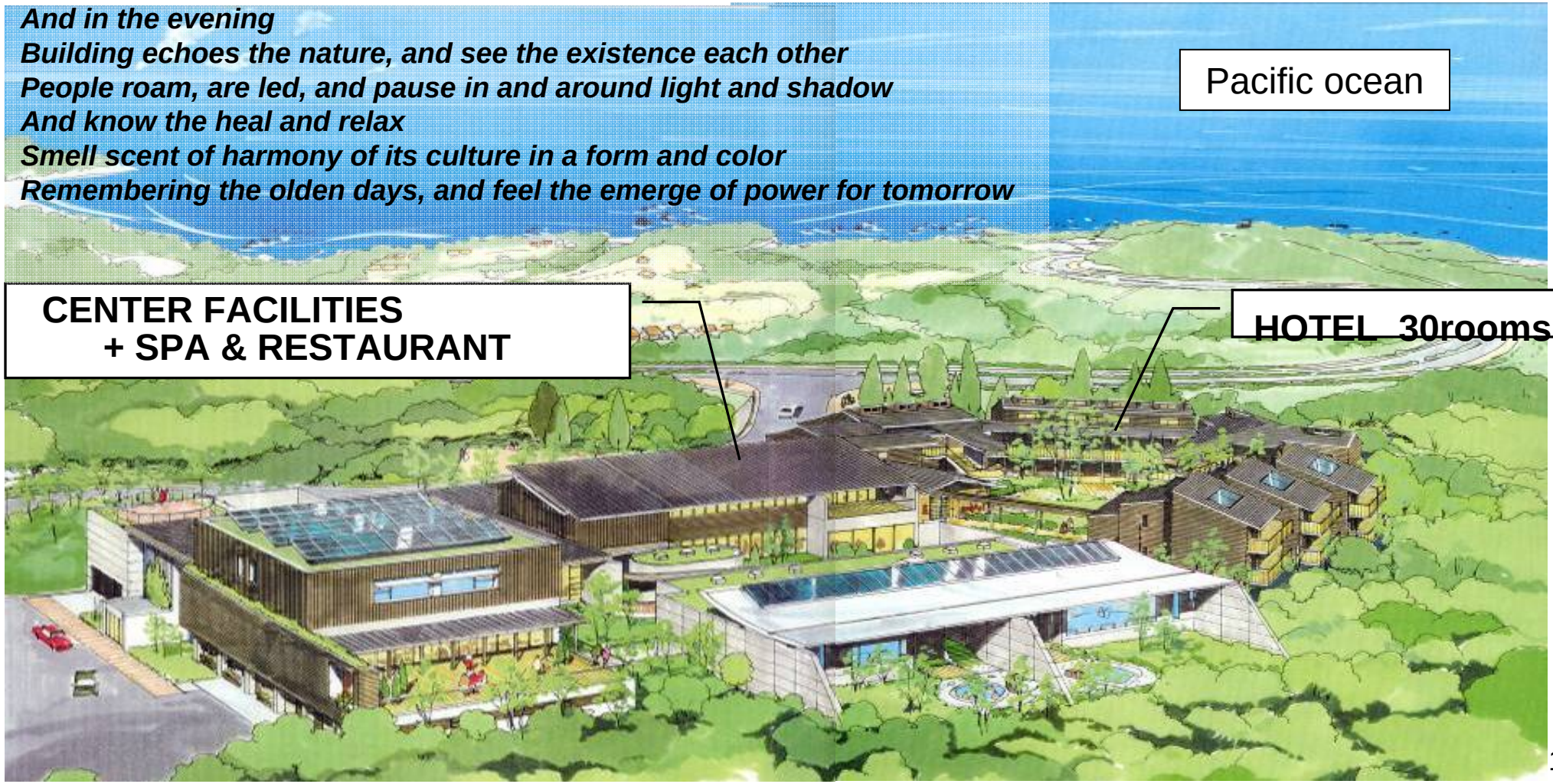
# (Map of Japan)


Kyoto
35° N, 135° E
Tokyo
Ecolodge Shimanto
Shimanto City, Kochi
Osaka City,
Osaka
Kariya Regional Government
Office Building
Kariya City, Aichi

# Example 1 : **Ecolodge Shimanto**

# Concept of Green Development

*In the woods, Building smiles with Spirit of trees talk to*
*River of Shimanto tender to our eyes*
*Sound of Ocean please our ears*
*Nature pore life in Sunlight and heat into the building*
*Soil ease the building by its charm*
*Wind delight people in their stream*
*Rain give moisture living thing in the morning,*
*And in the evening*
*Building echoes the nature, and see the existence each other*
*People roam, are led, and pause in and around light and shadow*
*And know the heal and relax*
*Smell scent of harmony of its culture in a form and color*
*Remembering the olden days, and feel the emerge of power for tomorrow*



# Project Outlines

| | CENTER FACILITIES | HOTEL |
|---|---|---|
| Owner | Nakamura City<br>（Shimanto City） | Japan Railroad -Shikoku Company |
| Structure | reinforced concrete and<br>steel frame; 3 Stories | reinforced concrete and<br>steel frame; 2 Stories |
| Main Use | Hotel Front<br>Spa , Restaurant,<br>Conference Rooms | Hotel Guest Room（30 rooms）<br>（All different types of Interiors）<br>Cafe/ Bar |
| Site Area | 6,348.65㎡ | 2,159.86㎡ |
| Building Area | 1,540.19㎡ | 554.93㎡ |
| Total Floor Area | 2,069.93㎡ | 1,131.03㎡ |
| Location | Shimanto City, Kochi Prefecture, Japan | |
| Completion Date | July 2, 2002 | |

Planner, Architect : PES Kenchiku Kankyo Sekkei/ Takatoshi Ishiguro
General Contractors : Takenaka Constraction Co.&Joint Venture Companies／Shikoku Kaihatsu Kensetsu Co. (Hotel)

# Design Phase

1.Site Selection

↓

2.Vision

↓

3. Charrette

↓

4. Design Concept

↓

5.Pay Back Period Calculation

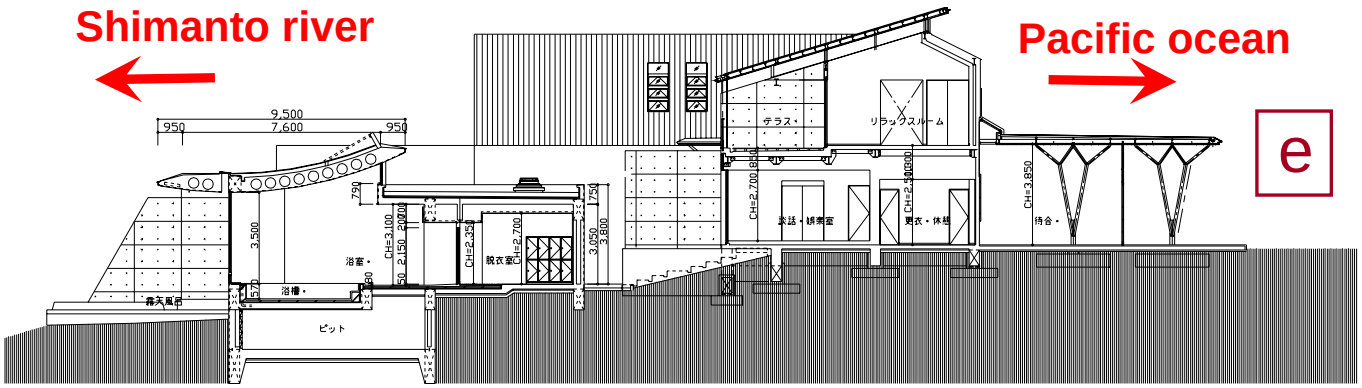
↓

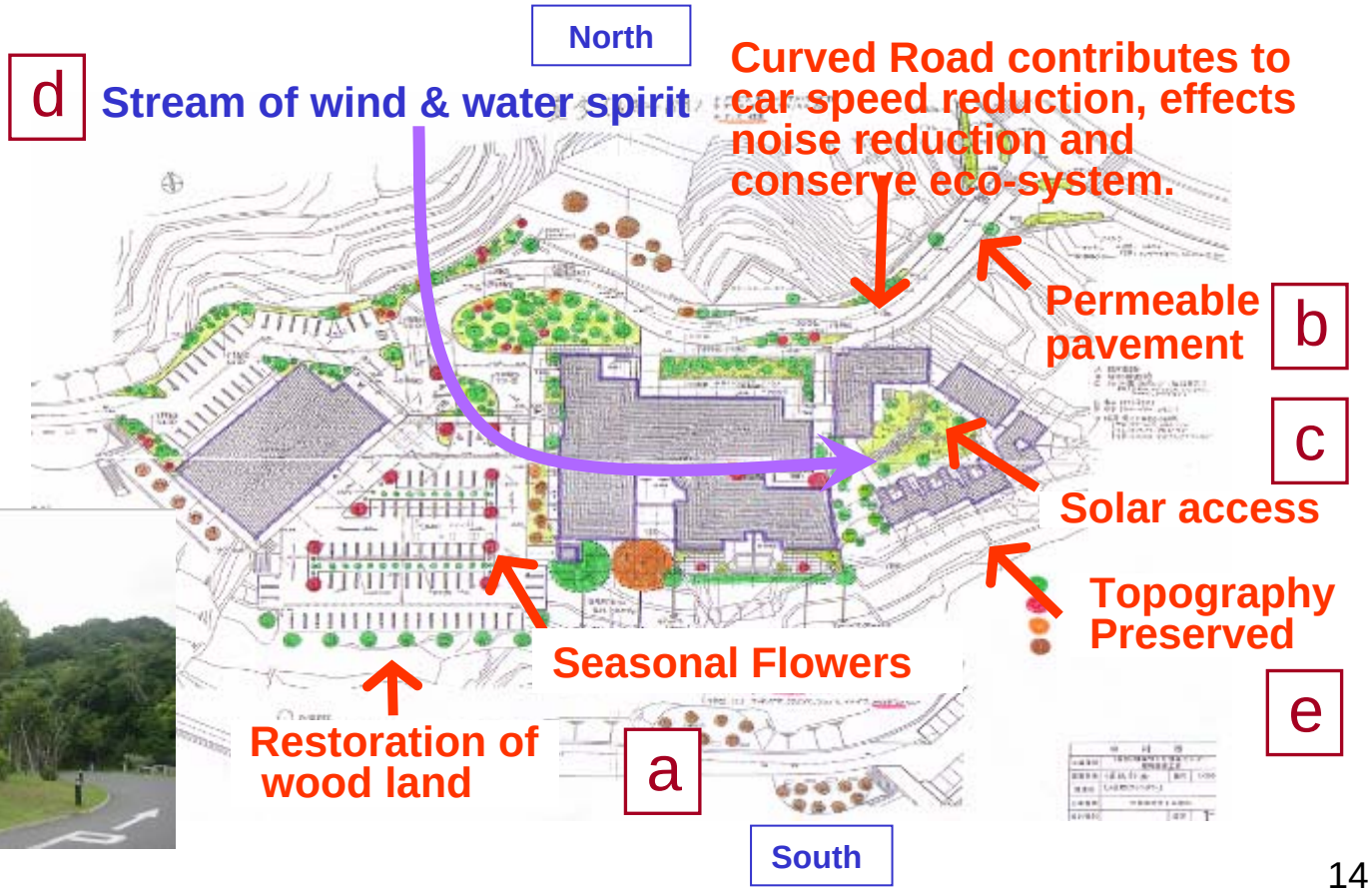
6.Designing & Utilizing Green Features

# 1.Site Selection

## ●Site Planning Issues

a. Tree Protection
b. Erosion Control
c. Solar Access
d. Feng Shui
e. Topography




a

# 2.Vision



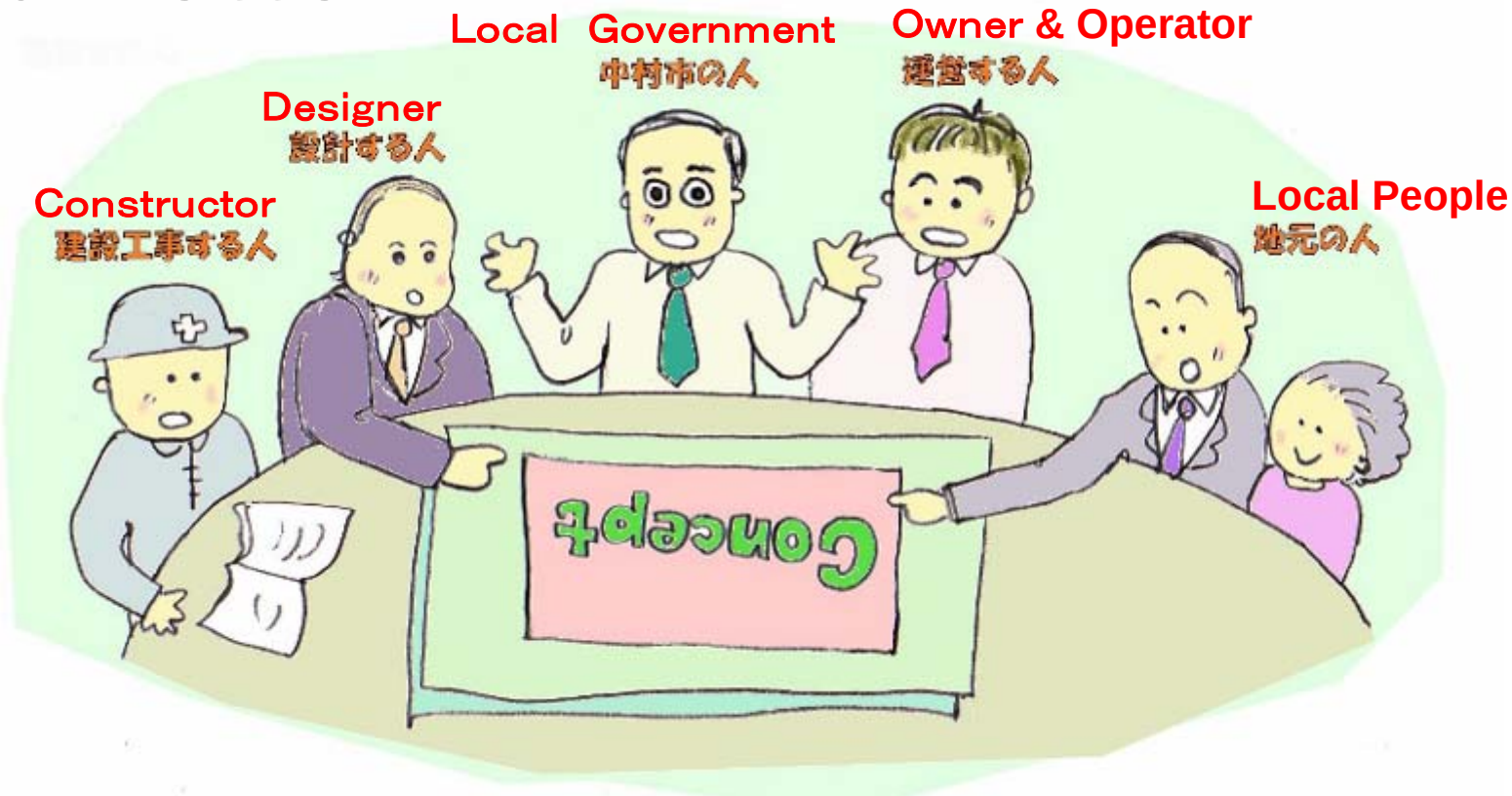
## ●Healing Resort with Nature

- Shimanto River（View）
- Pacific Ocean（Sound , Smell , Taste）
- Landscape（Seasonal Flowers ）
- Hot Springs（Natural, Chinese Medicine,Salt ）
- Observation of Stars（No light pollution ）
- Local Food

**Local food**

**river shellfish & eel** **river shrimp & local sake** **ayu** **river weed** **local rice** **bonito** **today's menu**

# 3.Charrette




**At the beginning of the project, collaboration of all stake holders joined the discussion about how to develop environment-friendly project.**

# 4.Design Concept

- Pause
- Slow & Lazy
- Vernacular
- Green

**Pause In Nature**

There is a pause in nature
Human cannot add anything to Nature
Waiting Spring Sun, heating haze up the hill and field
In early summer, a pause while waiting breeze over the field
Long night autumn, a pause while waiting late full moon
A pause longing for warm sunlight,  is a winter afternoon.
All hope and excitement is in a pause
Waiting rain, in a pause
Waiting sun, in a pause
Promise more satisfactory mind and peace
Nature, its swelling and shaking connect a pause,
And a pause revitalizes heritage and culture,
Nature is passive to any severe weather
And bear fertile fruit
Abandoned materials wake up from long sleep
By compassionate users
And direct new era proudly with blessing in the land
Spirit of pause is a warm heart
Sincere hospitality heals busily tired people
In Nature peace of mind is given healthily
Makes recapture lost sensibility
Eyes see endless view of scenery,
And soak in a natural scent
Ears are enjoyed with pleasant sound
Tongue is thrilled and surprised at rich harvest
When sense of touch run through the body,
Resonant the strings of soul

# Green Features in the project : “Eco Lodge Shimanto” -1/3

1. Use as much natural energy as possible.
   Use natural resources efficiently. (passive way)
   - **Sun**: daylighting ,
   - **Wind**: natural ventilation
   - **Soil**: earth tubes
   - **Rainwater/gray water**: toilet water
2. Use renewable energy.(active way)
   - **Sun**: photovoltaic (electricity); solar panel (hot water)
   - **Soil**: geothermal energy
3. Reduce total energy. (conserve energy)
   - Exterior walls and glass windows; thermally well-insulated
   - Energy efficient machines and equipments (**high COP**)
   - Daylighting with sensor and occupant sensor
   - Water conservation: rainwater/gray water and low-flow fixture

# Green Features in the project : “Eco Lodge Shimanto” -2/3

4. Use harmless and local building materials.
   (Health and Local Business Promotion)
   - Natural materials
   - Non-toxic chemical materials: good for indoor air quality
   - Non-CFC, non-HCFC materials (non-ozone layer depleting materials)

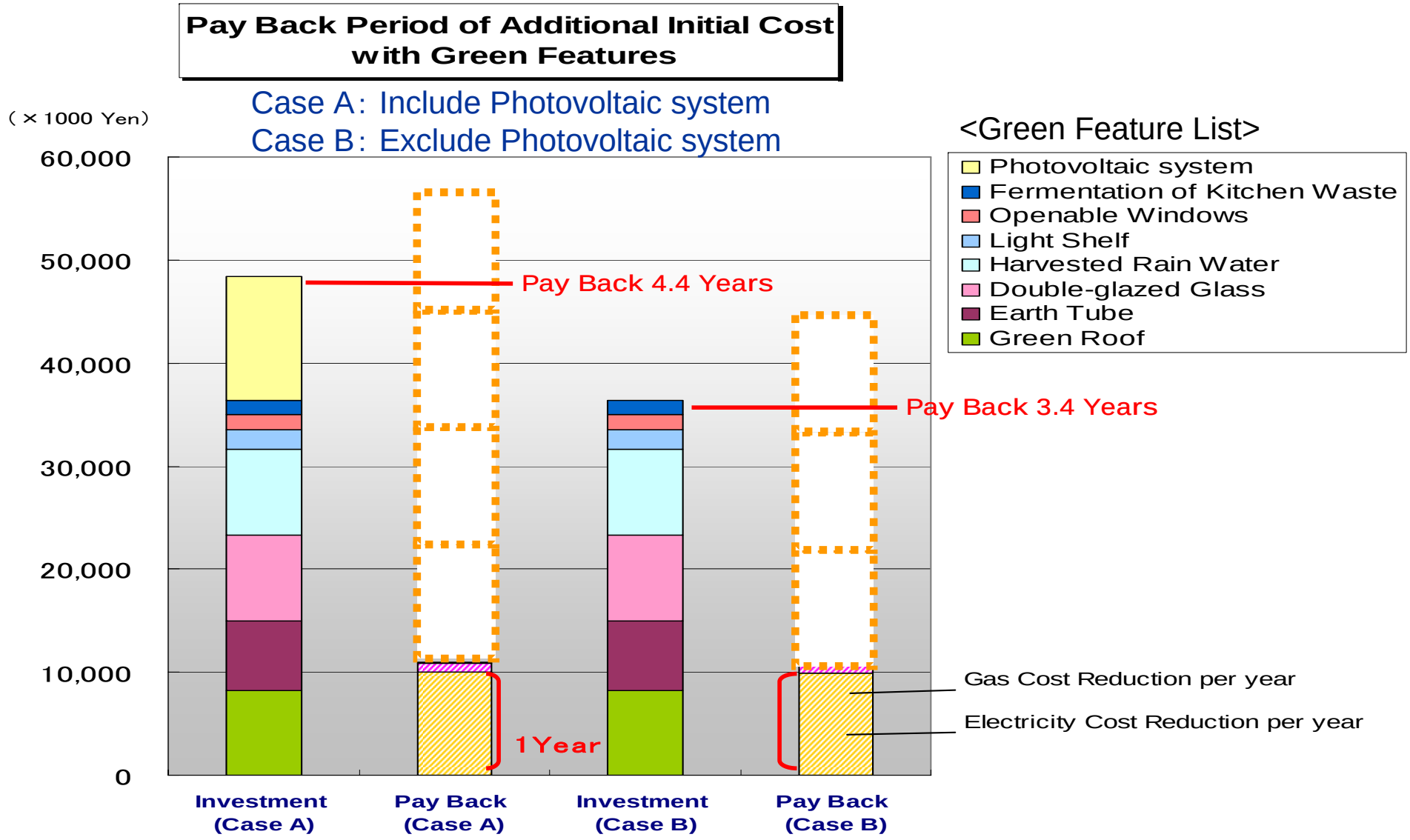
5. Use recycled and easy-to-recycle materials.
   - Low embodied energy: review production, transportation and construction processes
   - Waste reduction: Modularized and factory-fabricated products

6. Conduct appropriate site selection. (conserve ecosystem )
   - Minimize impact to the environment
   - Maximize the use of solar energy and landscape benefit (**orientation**)

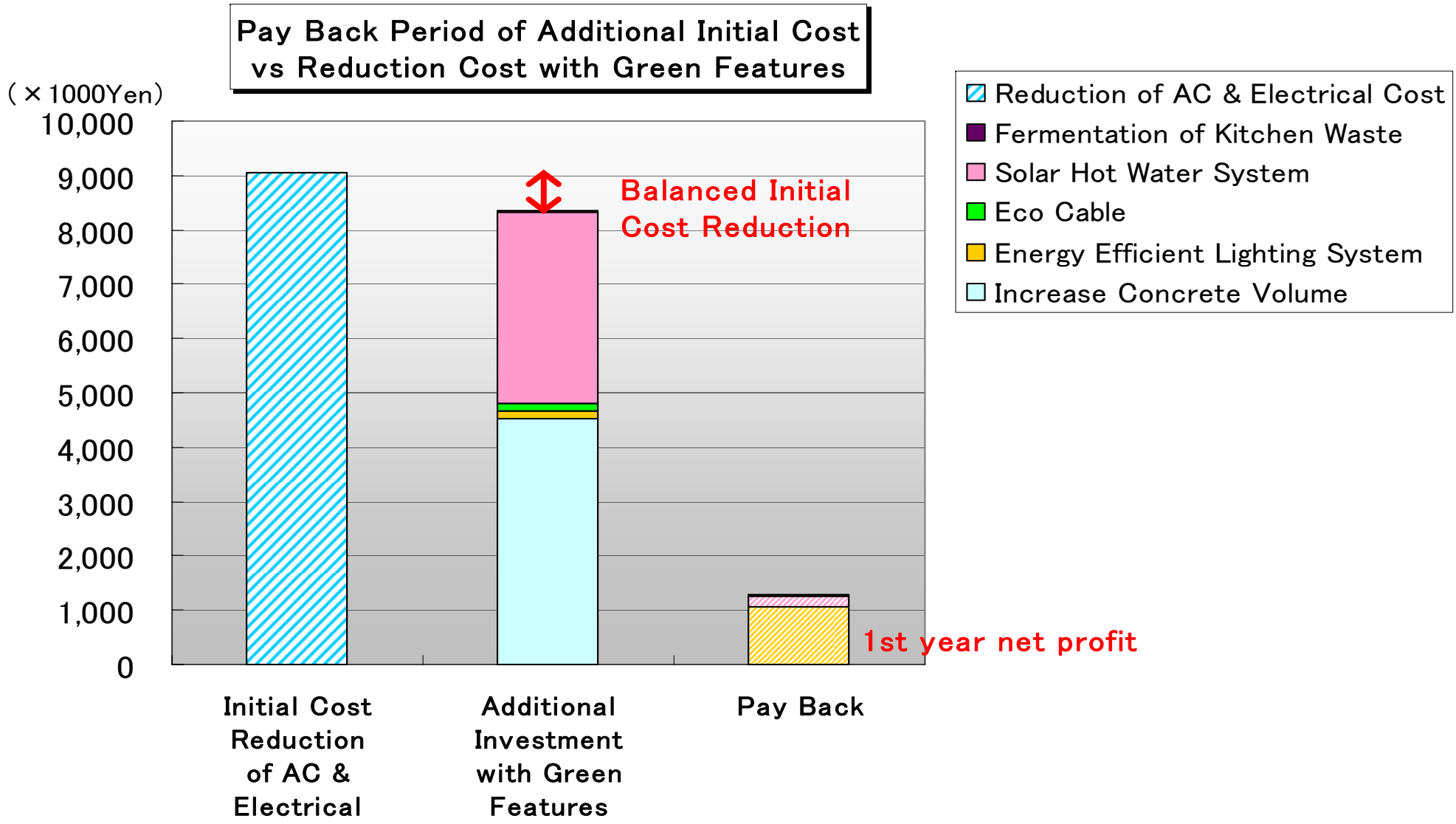
# Green Features in the project : “Eco Lodge Shimanto” -3/3

7. Enhance productivity through greater comfort.
   （Local Labor Benefit)
   (thermal, visual, acoustic)
   ・Guest Satisfaction
   ・Less Sick days leave
8. Promote positive economic effect from construction and operation.
   ・Local labor and local products promotion
9. Reduce waste disposal
   ・Garbage compost and construction waste material
10. Be aesthetic and of high quality in design.（Tourism Marketing）
    ・Vernacular

# 6.Pay Back Period Calculation (feasibility) (Center Facilities)

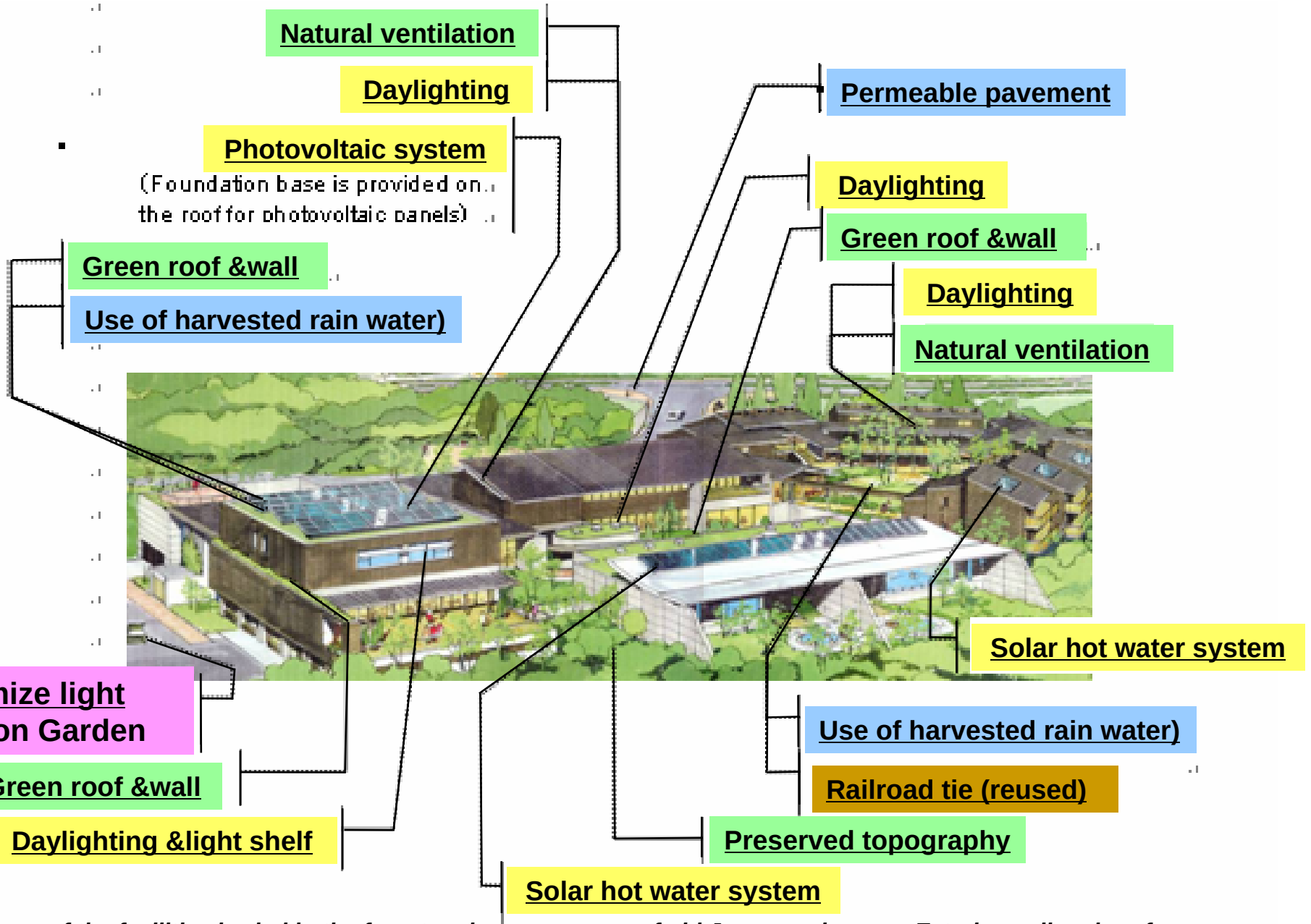


# 6.Pay Back Period Calculation (feasibility) (Hotel)



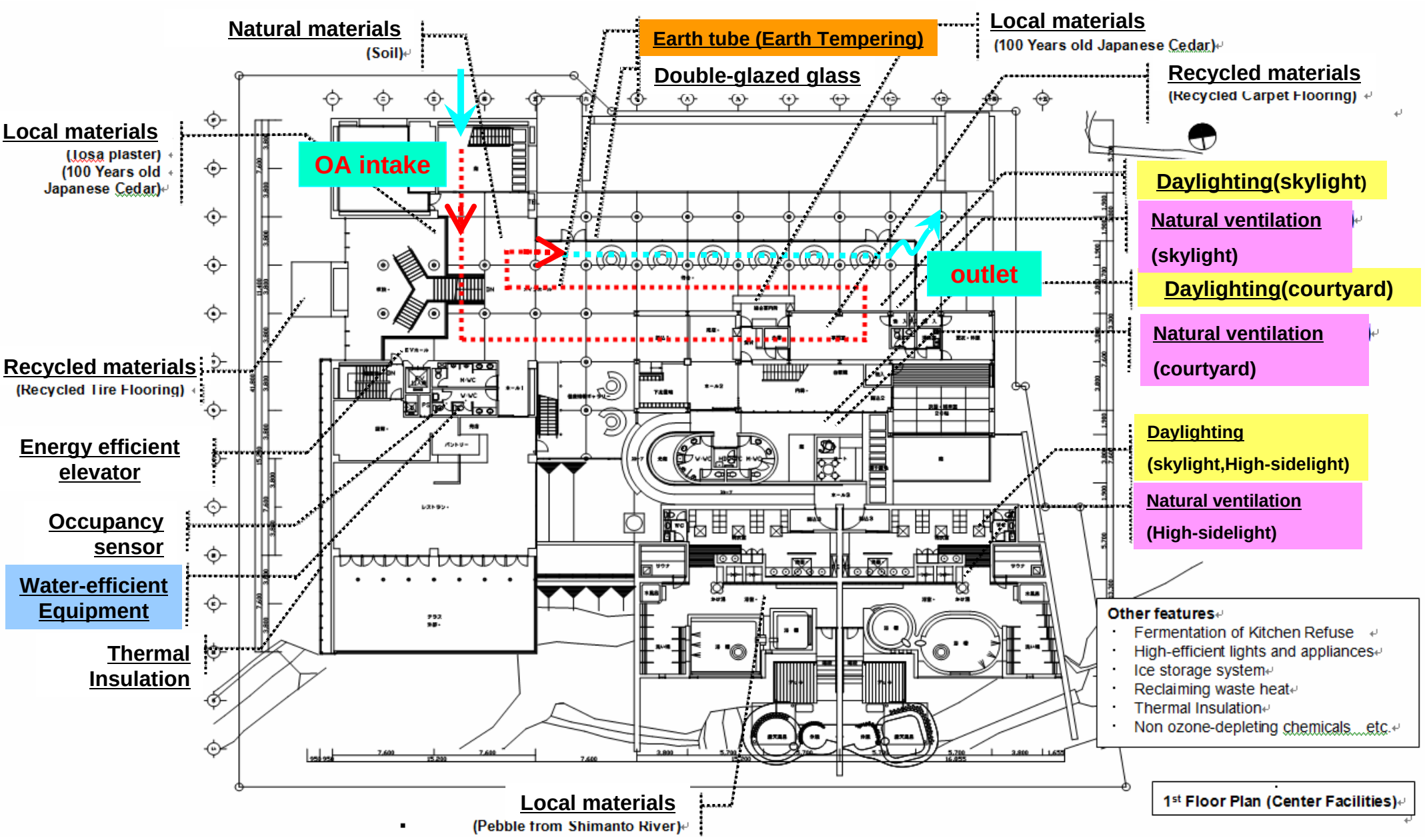
# 6.Designing & Utilizing Green Features

1. Co-existence with surrounding nature
2. Use of Solar Heat and Light
3. Soil (Earth)
4. Wind
5. Water
6. Other Features



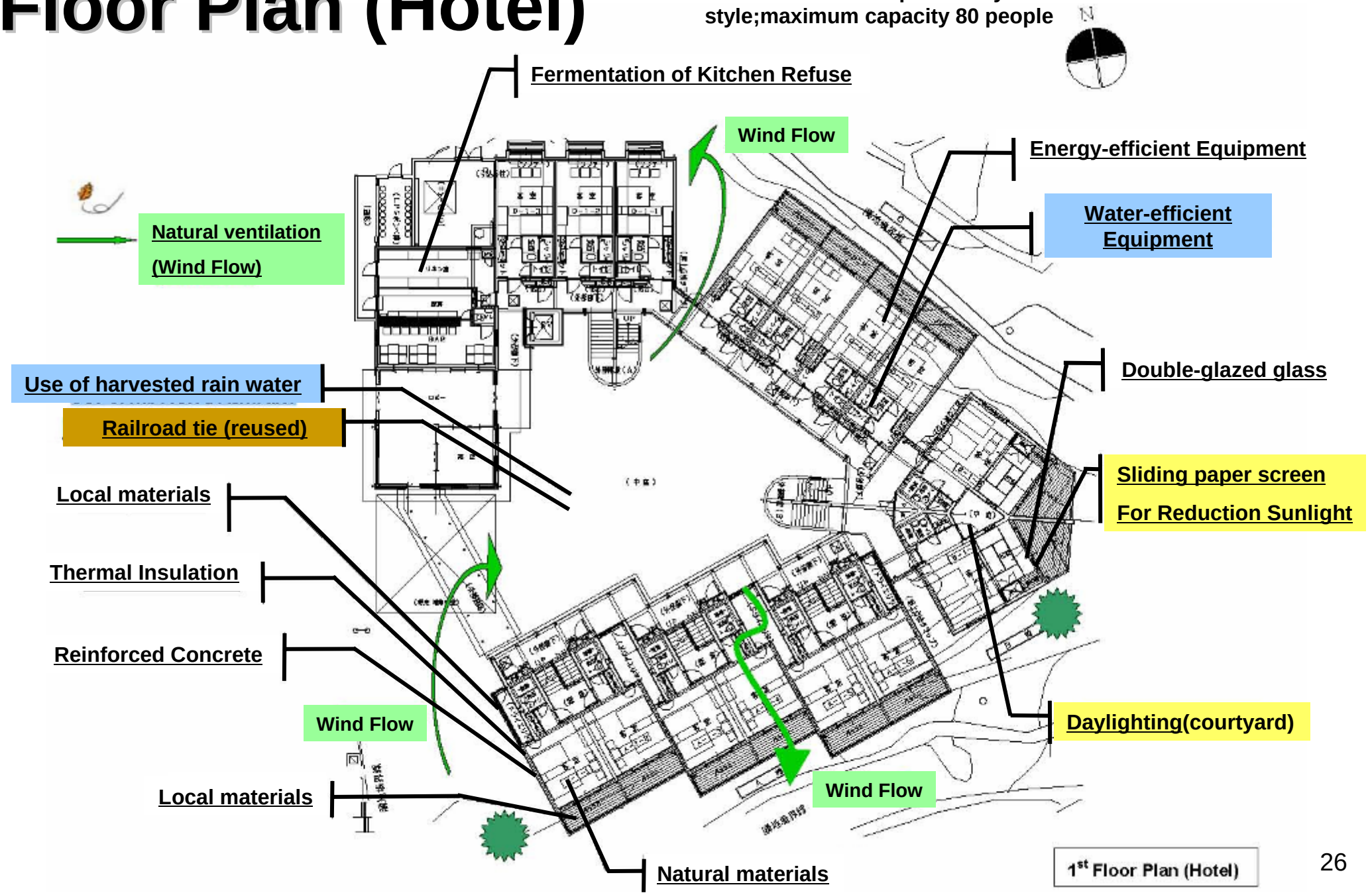

*Outside image of the facilities buried in the forest and reappearance of old Japanese houses. Exterior wall and roof finishing is cedar painted with persimmon varnish. Because in the 15th century, at the collapse of aristocracy in Kyoto, people of imperial court ran away from Kyoto and stayed here more than 100 years. They remembered their culture in Kyoto and kept it at this place.*

# Floor Plan (Center Facilities)



# Floor Plan (Hotel)

30 rooms like as Japanese Ryokan style;maximum capacity 80 people



# Preserved topography

South

Shimanto river view

North

Daylighting

Galvanized Steel (Ceiling)

Vernacular design

Daylighting

Double-glazed glass

Natural ventilation

Natural materials (soil)

Natural ventilation

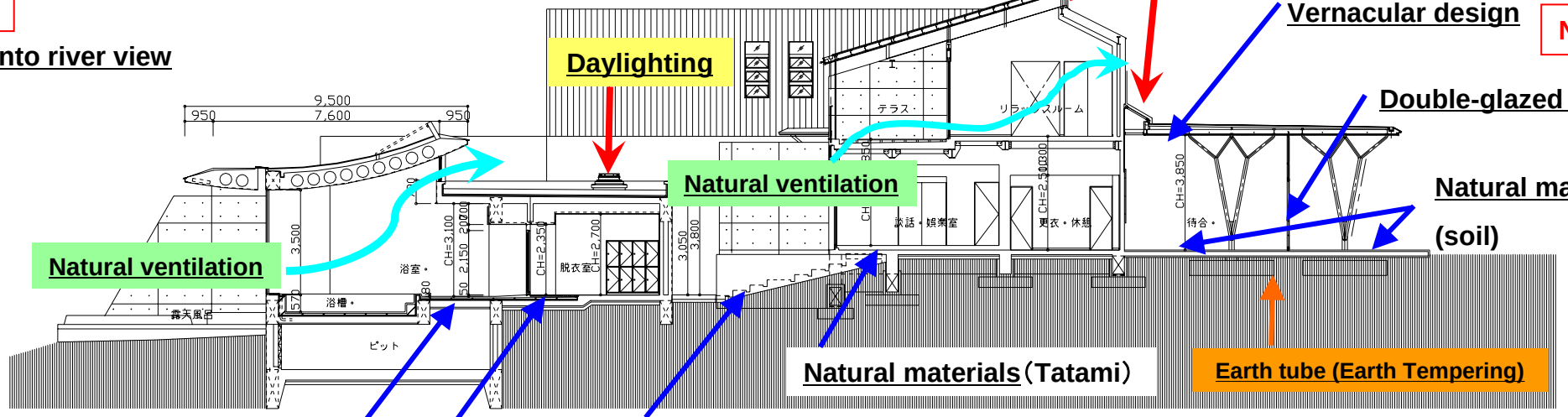
Natural materials（Tatami）

Earth tube (Earth Tempering)

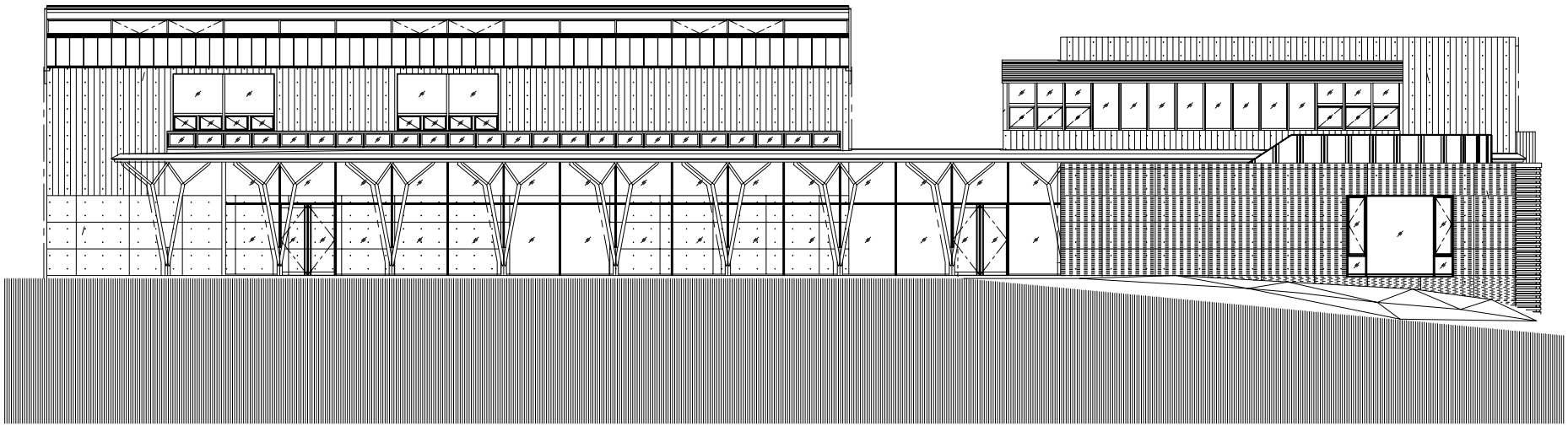
Local materials（ Shimanto river pebble）

Natural materials（palm）

Natural materials（rattan）




NORTH - SOUTH SECTION



NORTH ELEVATION

# Construction Phase

# Construction Phase (1/2)

Bicycles are used within the construction site


Micro climate data collection such as earth temperature, rainfall, ……

Harvested rainwater for cleaning, washing cars and flushing toilet.

# Construction Phase (2/2)

## Workers Education

## Steel Deck instead of Rain Forest Wood

## Construction Waste Sorting to Recycle


## Spreading Excavated Soil

## Minimum Packing

# **Utilized Green Features** (in Detail)

1. Co-existence with surrounding nature
2. Use of Solar Heat and Light
3. Soil (Earth)
4. Wind
5. Water
6. Other Features

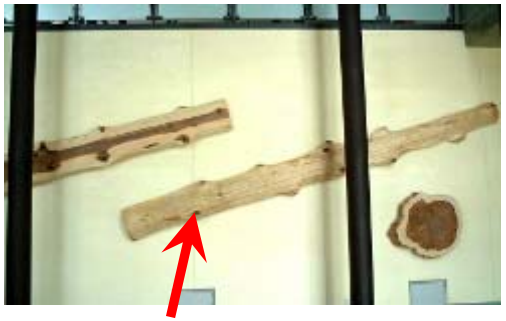
# 1. Co-existence with surrounding nature

a. Preserved topography
b. Restoration of Woodland
c. Green roof and wall
d. Landscape
e. Effective use of local materials



a

e



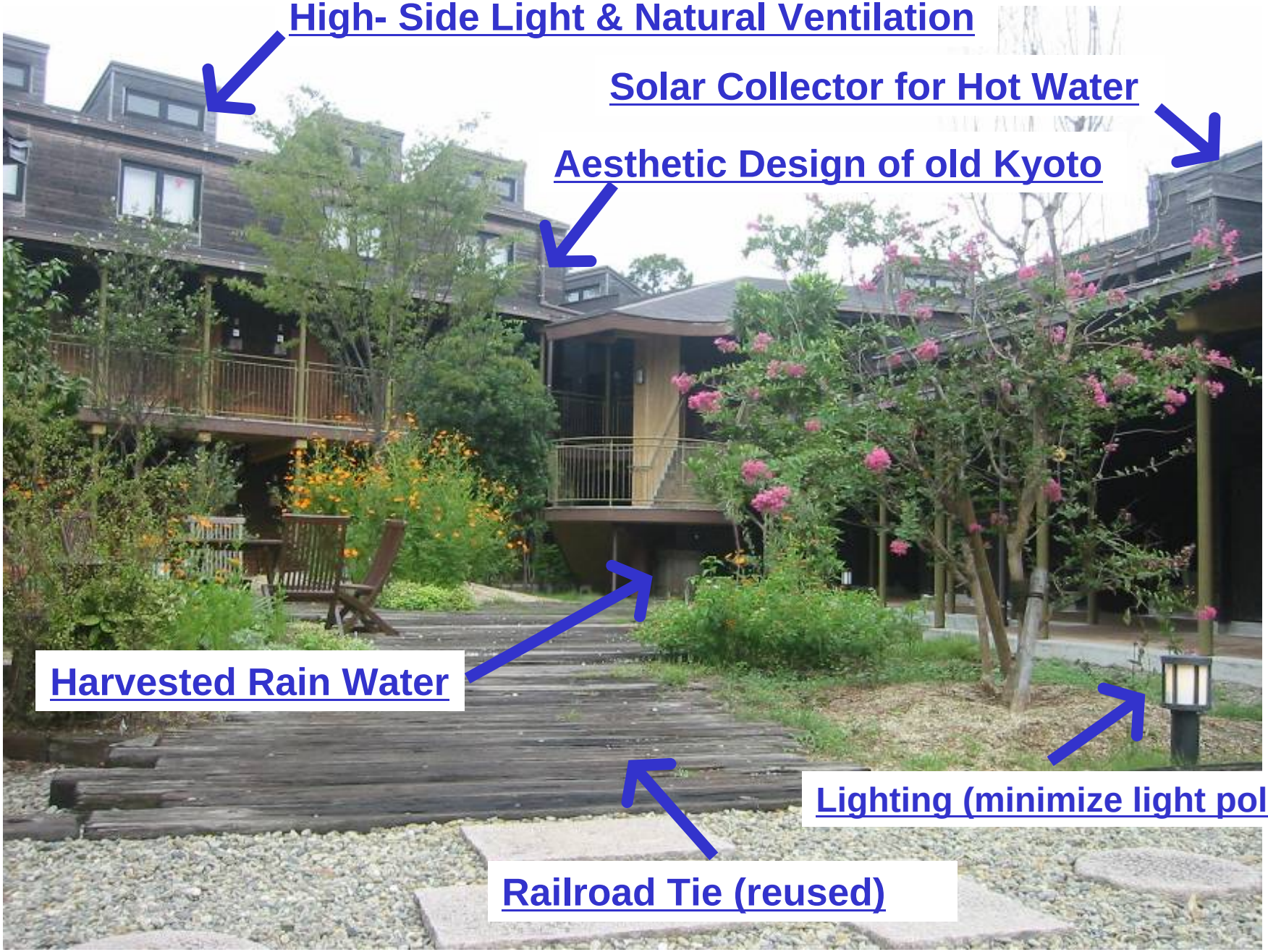
100 Years local Cedar

pebbles from Shimanto River

Local cypress

c

b


High- Side Light & Natural Ventilation
Solar Collector for Hot Water
Aesthetic Design of old Kyoto
Harvested Rain Water
Lighting (minimize light pollution)
Railroad Tie (reused)

# 2. Use of Solar Heat and Light

a. Day lighting & Heat exhaust
b. Light shelf
c. Solar hot water system
d. Photovoltaic system（Future）

a


b

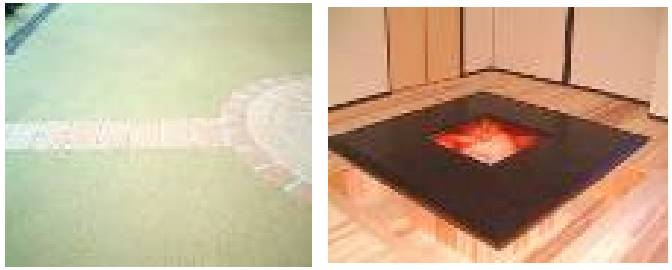
c **Solar heat collectors**

d

# 3. Soil (Earth)

a. Earth tube (Earth Tempering)
b. Use of Natural Materials
(Soil, Tosa plaster, Tatami, Shoji Screen‥)
c. Fermentation of Kitchen Waste

b



a

Trench under the floor (view during the construction)


Outdoor Air Intake

(1 meter below floor)

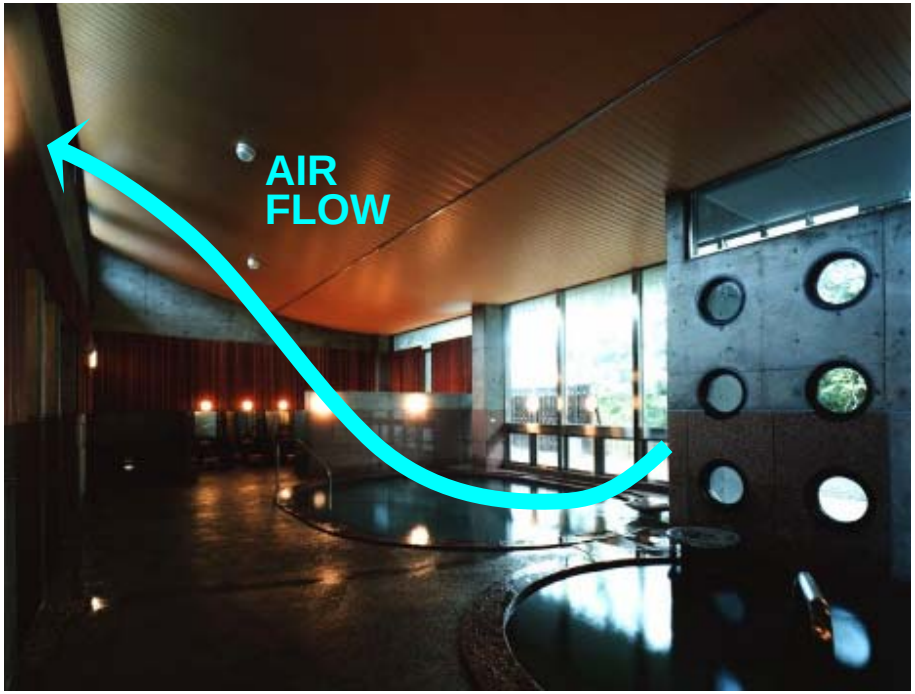

Air Outlet of Earth Tube

c

# 4. Wind

- Natural ventilation

Upper windows for air exhaust (Bathhouse)




Lower windows for air supply (Bathhouse)

**The vertical distance between the inlets and outlets causes the air movement without electricity.**

Natural air stream by air specific weight of temperature difference

# 5. Water

a. Use of harvested rain water
b. Water-efficient equipment
c. Permeable pavement
d. Recycling System of Gray Water

a

Reused
SAKE cask

b

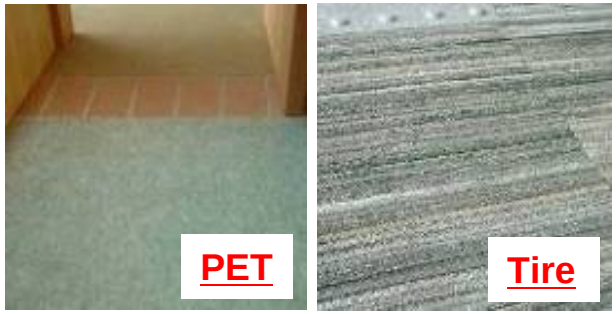
c

d

# 6. Other Features 1/2

a. High-efficient lighting fixtures
b. Minimize light pollution
c. Double-glazed glass
d. Recycled & Reused materials

a




d

c

b

# 6. Other Features 2/2

a. Ice storage system
b. High COP air conditioner
c. Reclaiming waste heat
d. Non ozone depleting chemicals
e. Energy- efficient elevator
f. Thermal insulated panel wall

a

b

b

c

e

f


d

# Hotel Guest Room Finish Materials

## Guest room A

**Western Style**

**FINISH SCHEDULE [A Type ]**

| | |
|---|---|
| Floor | Soil Ceramic Tile (Waste heat used) |
| Wall | Rice Paper |
| | Cedar / Cypress Board |
| | Diatom Soil Plaster |
| | Soil Ceramic Tile ( Moisture Control ) |
| Ceiling | Rice Paper, Cedar |

**FINISH SCHEDULE [B Type]**

| | |
|---|---|
| **Floor** | **Tatami Mat** |
| | **Soil Ceramic Tile ( Waste heat used )** |
| **Wall** | **Diatom Soil Plaster** |
| | **Cedar / Cypress Board** |
| **Ceiling** | **Rice Paper ,Cedar** |

## Guest room B

**With Indoor Unit Bath & Outdoor Bathtub**

## Guest room B

## Outdoor Bathtub

## Traditional Japanese-style

**FINISH SCHEDULE [C Type]**

| | |
|---|---|
| **Floor** | **Hemp Mat** |
| **Wall** | **Rice Paper** |
| | **Cedar / Cypress Board** |
| **Ceiling** | **Rice Paper,Cedar** |

## Guest room C

**Loft-type**

**Lower: Japanese Style**

**Upper: Western Style**

**FINISH SCHEDULE [D Type]**

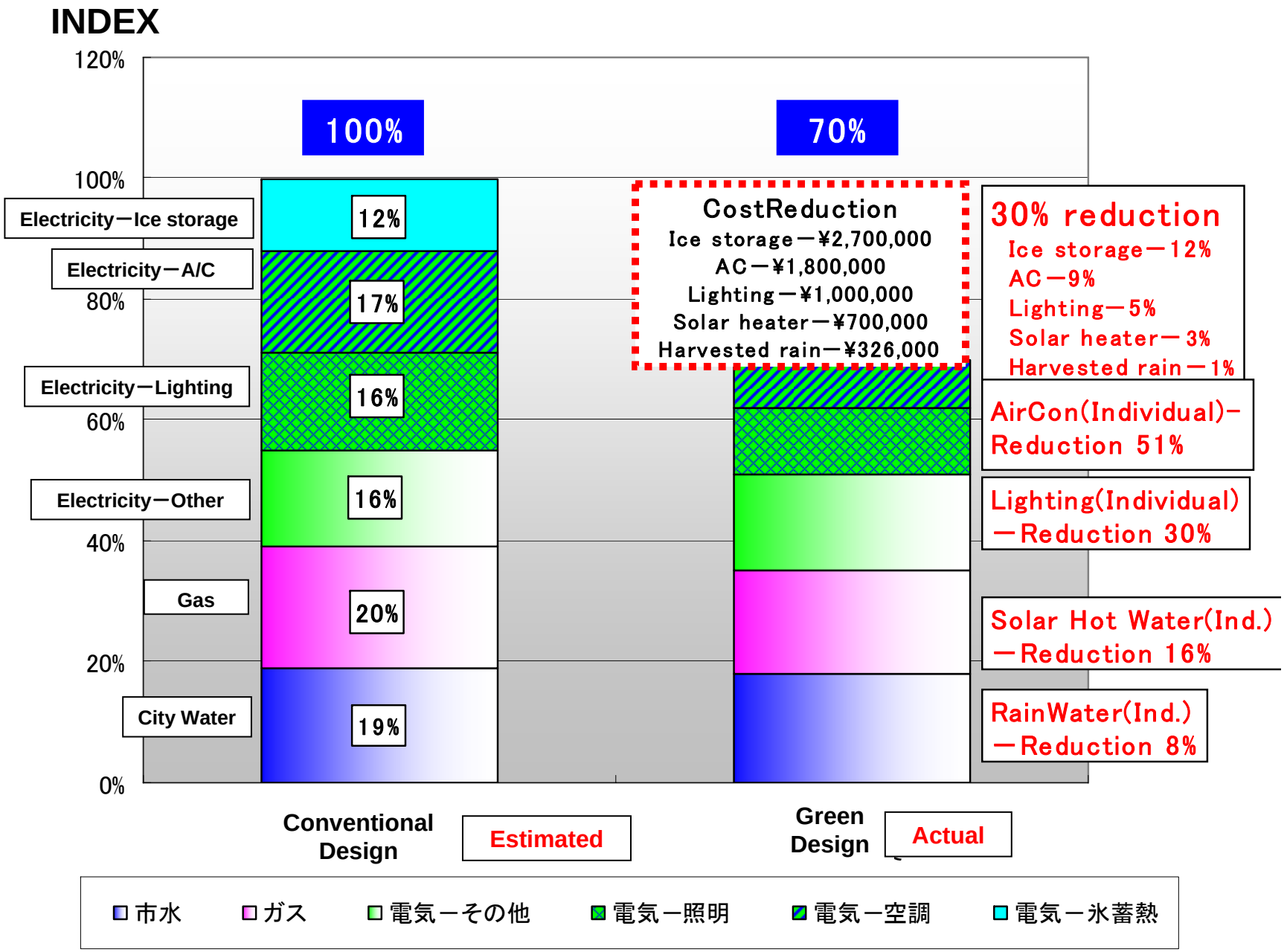
| | |
|---|---|
| Floor | Cedar / Cypress Flooring |
| Wall | Diatom Soil Plaster |
| Ceiling | Cedar Board, Cedar |

## Guest room D

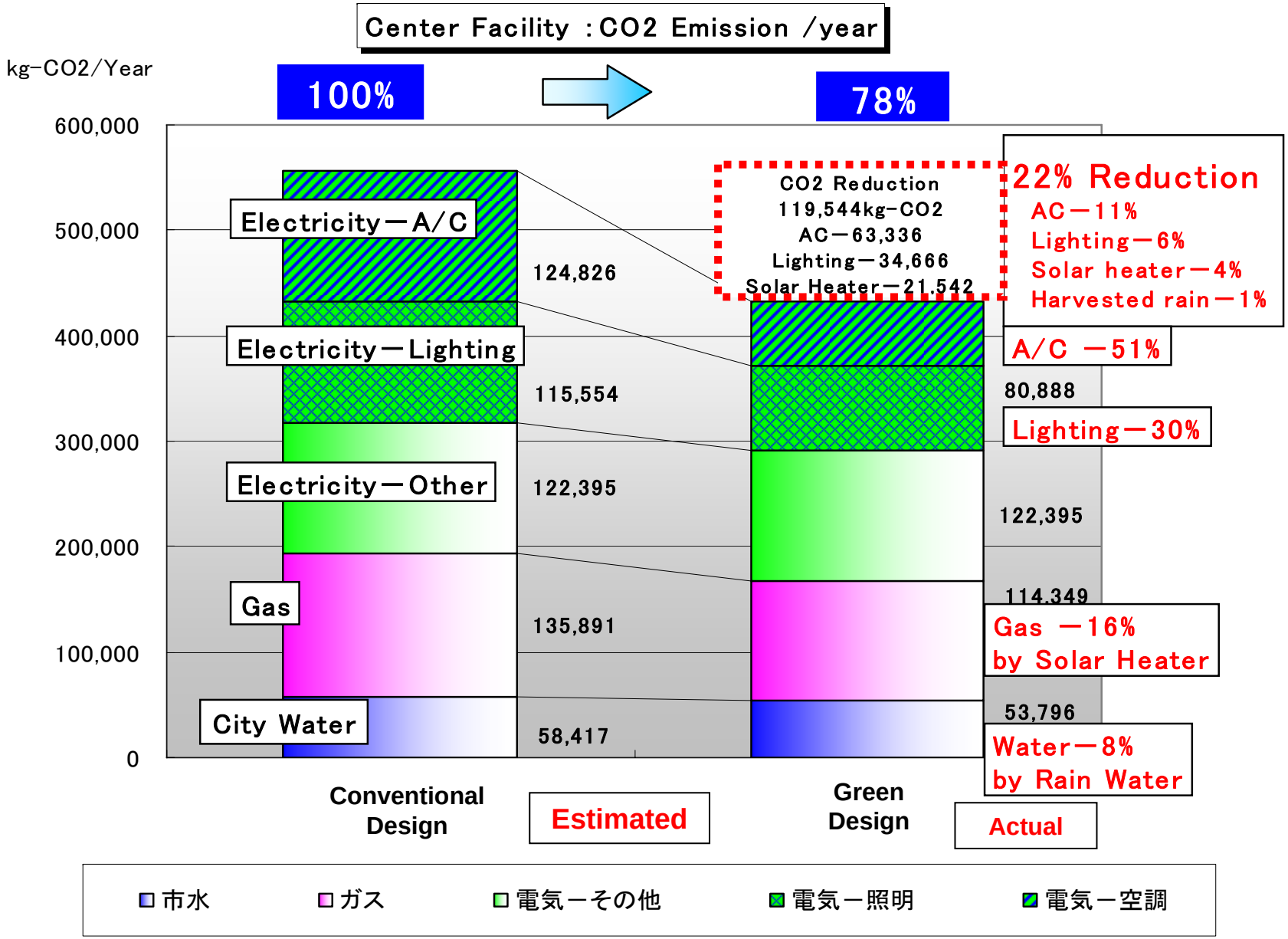
**Western Style with couch**

# Result

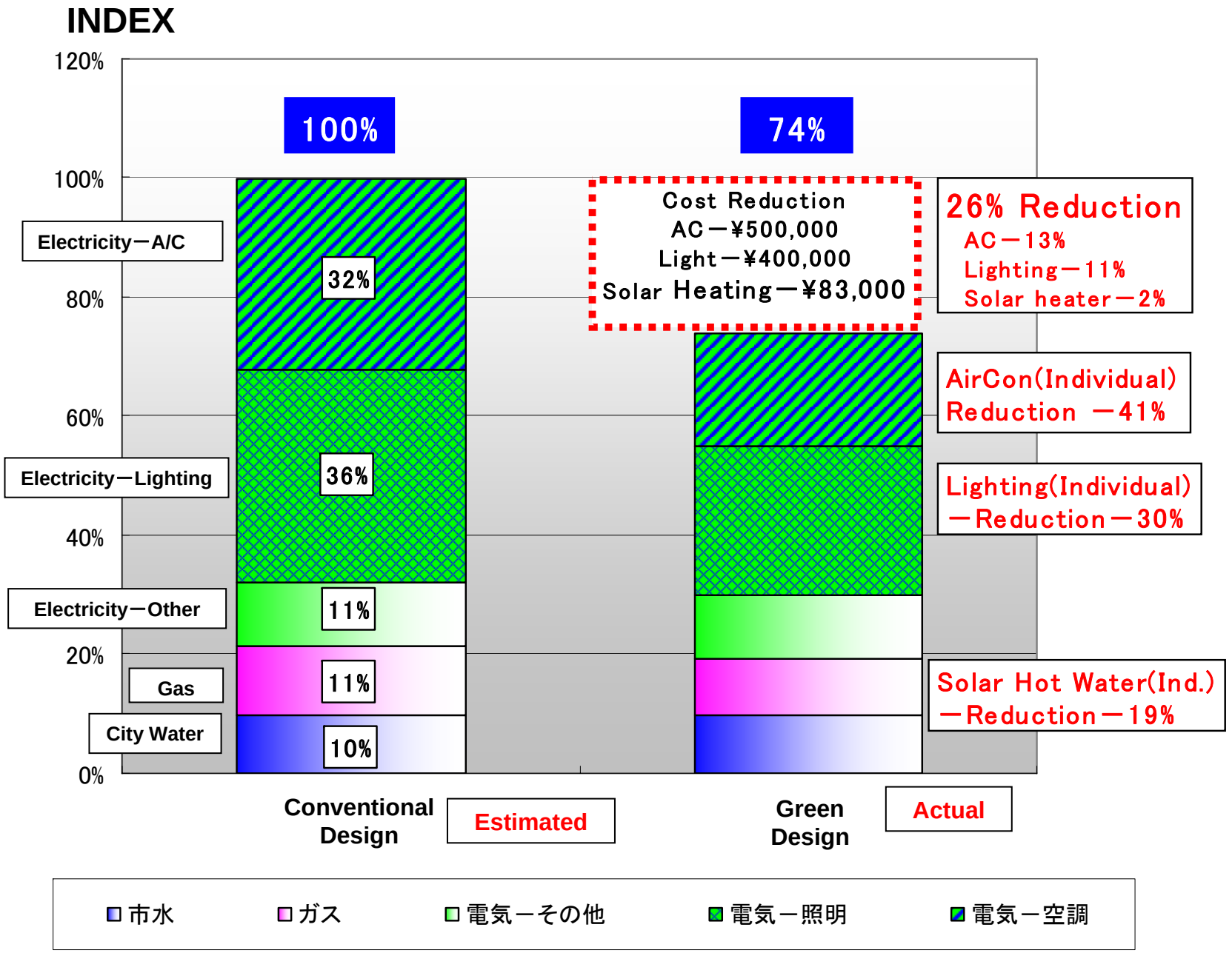
# Energy Consumption Cost (Center)



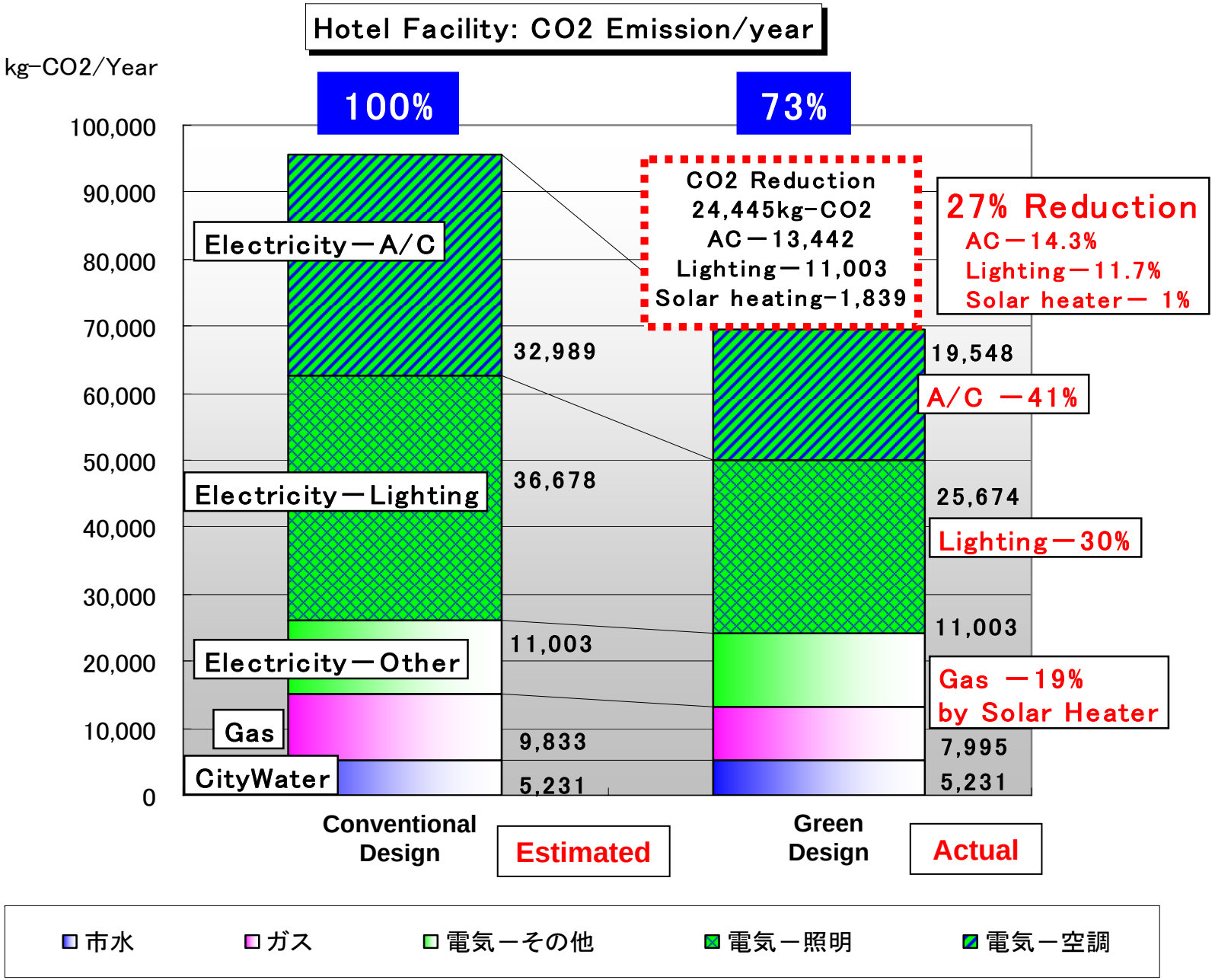
# CO2 Emission （Center） (Energy consumption converted to CO2 )



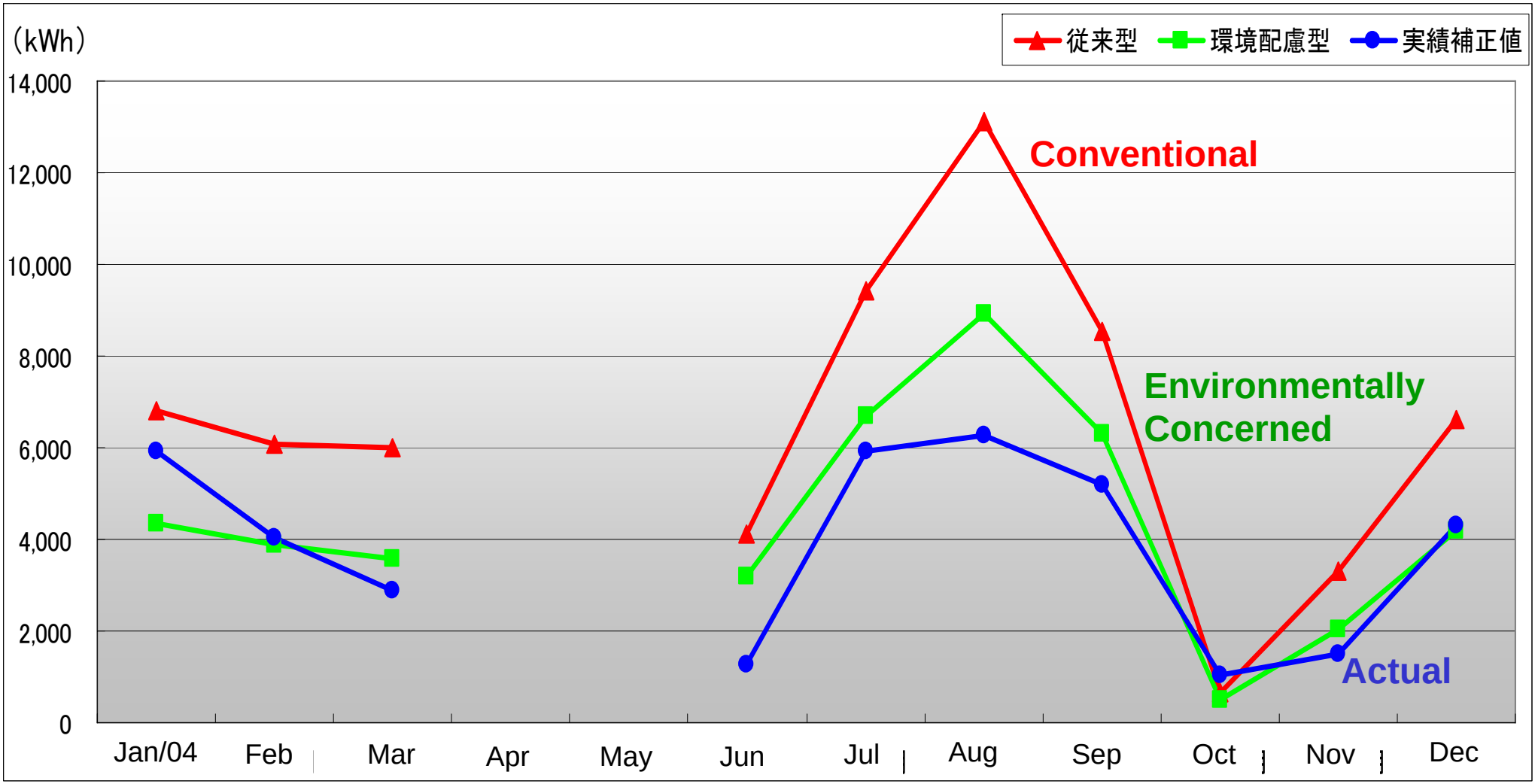
# Energy Consumption Cost (Hotel)



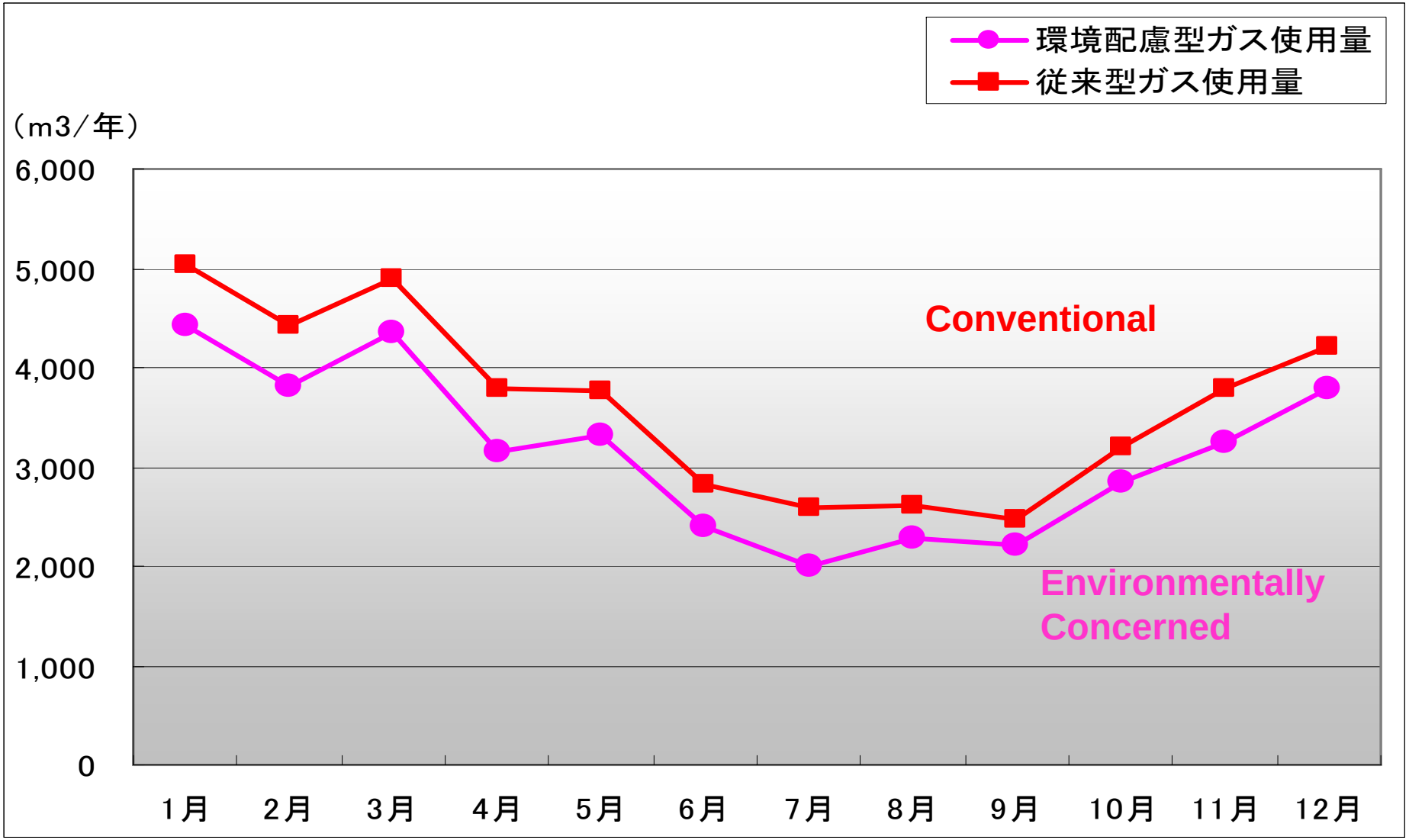
# CO2 Emission （Hotel） (Energy consumption converted to CO2 )



# Eco lodge Shimanto－AC Load Reduction　Monthly Energy Consumption

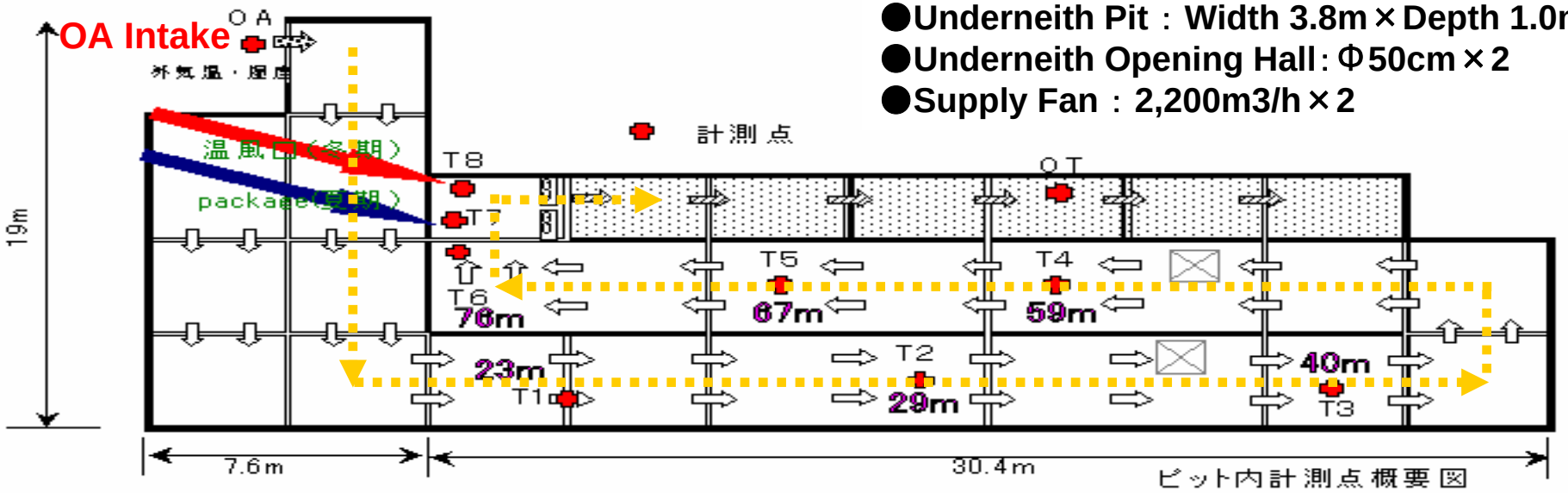


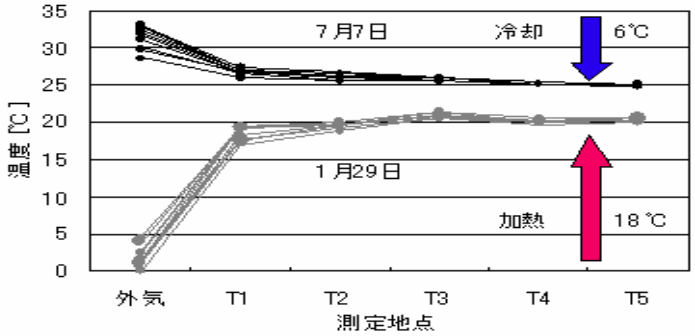
# Eco lodge Shimanto－GAS Consumption Environmentally Concerned Solar Hot Water System



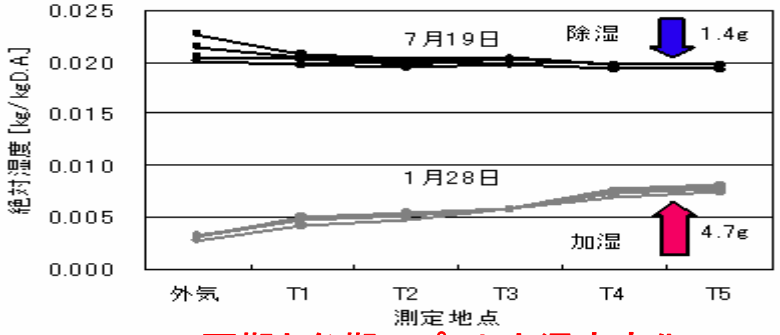
# Earth Tube

●Length：About 80m（外気取入口～吹出手前）
●Underneith Pit：Width 3.8m×Depth 1.0m
●Underneith Opening Hall：Φ50cm×2
●Supply Fan：2,200m3/h×2




夏期と冬期のピット内温度変化




夏期と冬期のピット内湿度変化

**Length of tunnel (Earth tube) is co-efficient of heat exchange efficiency. The air passing distance from OA intake at 40m, the temperature saturated. Winter and Summer is the same phenomena. The another diagram of moisture content shows the different phenomena. Summer time dehumidification related cooling air temperature, so saturated soon because of not so low the soil temperature. Winter time humidification related to moisture content of the soil.**

# Example2: Kariya Regional Government Office Building

**Facility Overview**

Facility Name: Kariya Godo Chosha
Address: 1-46-1 Wakamatsu-cho, Kariya-shi
Completion Date: August, 2004

**Facility Size**

Site Area: 4,414㎡ Building Area: 1,735㎡
Total Floor Area 6,912㎡
Structure: RC + Steel
Number of Floors: 6 Stories above the ground

**Purpose and Composition**

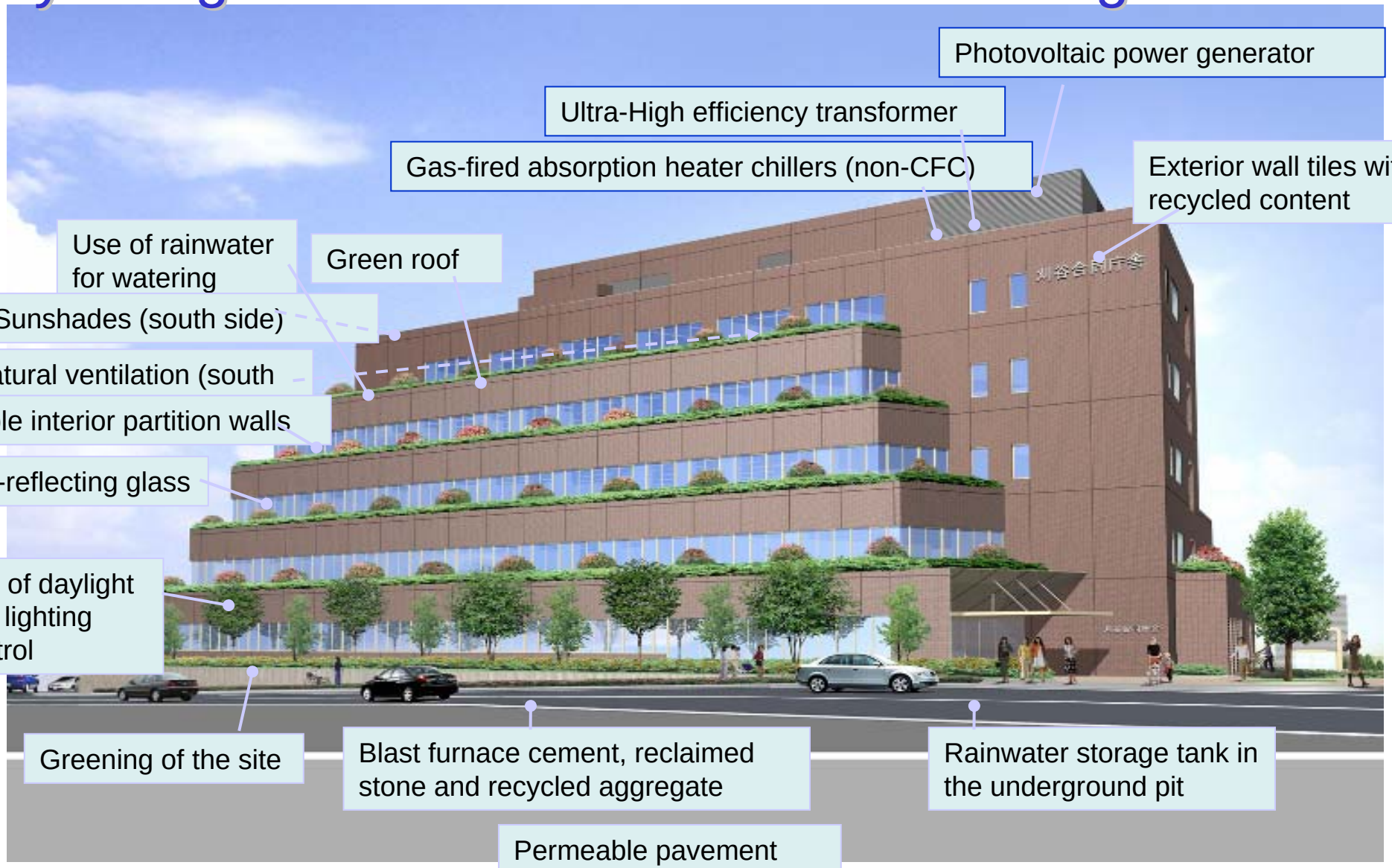
Purpose: Administrative duties
Composition:
- ▢Taxation Bureau
- ▢Legal Affairs Bureau
- ▢Labor Standards Supervision Office

**Energy Used**

▢Electricity ▢Gas ▢City Water

Planner, Architect : Daiken Sekkei Mechanical & Electrical : PES Kenchiku Kankyo Sekkei
General Contractors : Magara Kensetsu Co.

# Kariya Regional Government Office Building




North face of the building

# Major Green Technologies

## (Categorized by the Japanese government)

### Local Environment Conservation

- Greening of the site/green roof
- Countermeasures for Light Pollution/Air Pollution

### Conservation of Energy and Resources

- Sun shade eave
- Natural lighting
- Photovoltaic power generation equipment
- Rainwater harvesting equipment (watering)
- Heat reflecting glass
- High-efficiency lighting fixture + lighting control
- Hybrid (solar & wind) outdoor light
- VAV & VWV
- Ultra high efficiency transformer
- Low-flow plumbing fixtures

### Long Life

- Compact air-handling unit
- Elevators without machine rooms
- Extra space to appropriately meet future changes
- Access floors
- Variability of interior partitions

### Eco Materials

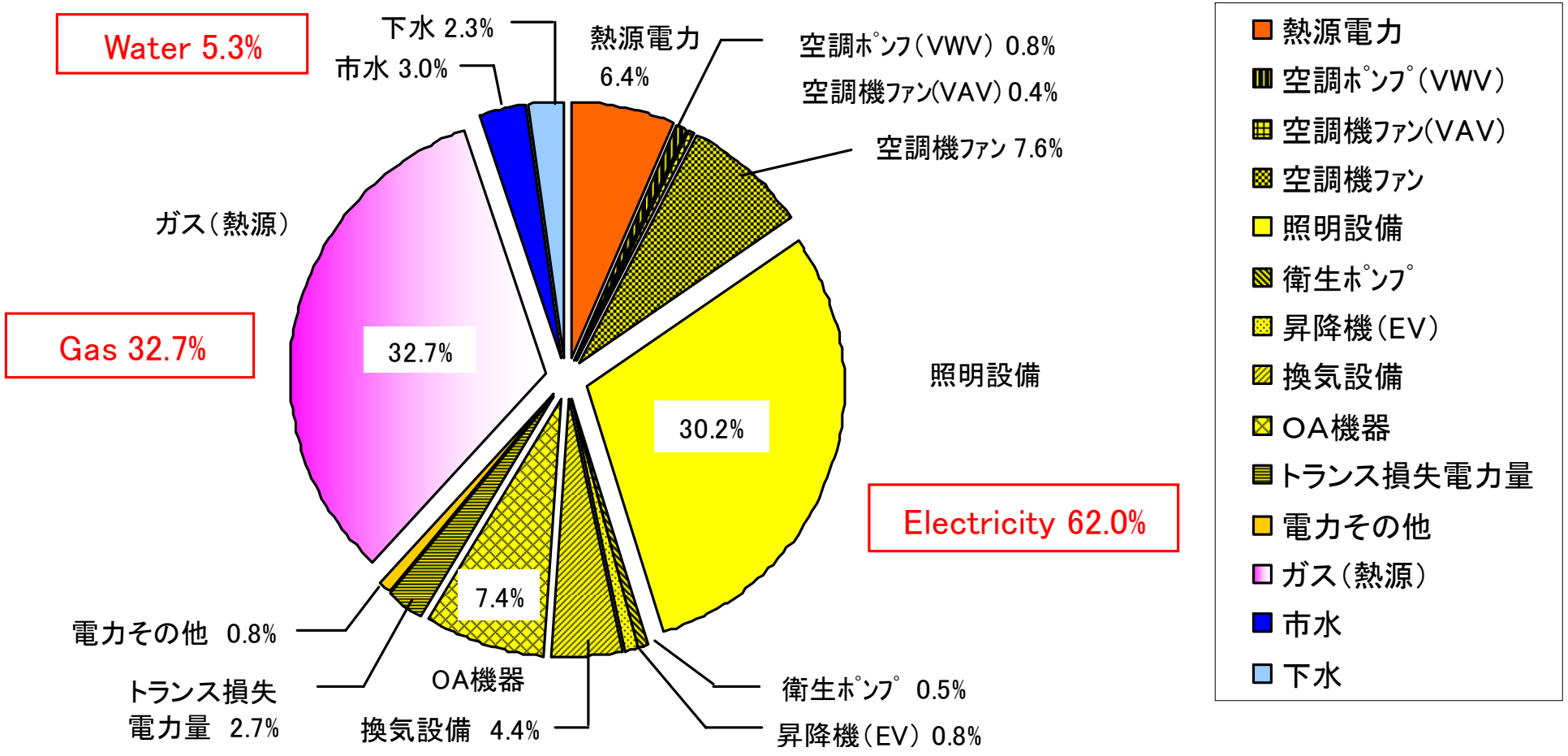
- Exterior wall tiles with recycled content
- EM cables
- Stainless steel pipes and tanks

### Appropriate Use and Disposal

- HCFCs
- Non-CFC heat source (Absorption heater chillers)

## Kariya Regional Government Office Building

# Break Down CO2 Emissions （Conventional）



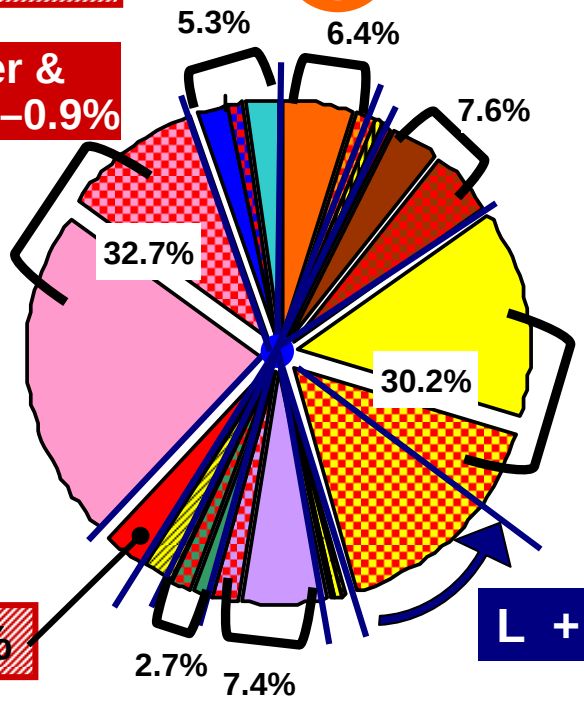
## Kariya Regional Government Office Building

**Overall Green Features Auditing**

# Break Down CO2 Emissions (Conventional vs Green Office)

**Calculated CO2 reduction 39%**
**(include existing CO2 emission 9%)**

**Actual;CO2 reduction 30%**




D – 0.2%

H – 1.4%

F – 0.3%

E – 0.1%

K City water & Drainage –0.9%

K Fan system – 4.3%

G – 9.7%

B – 15.6%

A – 3.2%

L + 9.0%

I – 0.3%

C – 1.3%

J – 1.7%

## Green Features

- A Photovoltaic Power Generator
- B High Efficient Lighting & Control
- C Ultra-High Efficiency Transformers
- D Harvested Rainwater
- E VAV Control
- F VWV Control
- G High Efficiency Absorption Chiller Heater (Gas Reduction)
- H High Efficiency Absorption Chiller Heater System (Electricity Reduction)
- I High Efficiency Elevator (VVVF)
- J Office Equipment
- K K Benefit of Green systems

L Not applicable as Green features (existing load as receptacle, etc.)

**Total: – 30%**

# CASBEE

## (**C**omprehensive **A**ssessment **S**ystem for **B**uilding **E**nvironmental **E**fficiency)

(Japan Sustainable Building Consortium)

### Assessment Items

**Q1: Indoor Environment**
**Q2: Quality of Services**
**Q3: Outdoor Environment on Site**

→ **Q**

**L1: Energy**
**L2: Resources & Materials**
**L3: Off-site Environment**

→ **L**

$$\textbf{BEE} = \frac{\textbf{Q}}{\textbf{L}}$$

**Q** (Building Environmental Quality & Performance))

**L** (Building Environmental Loadings)

(BuildingEnvironmental Efficiency)