2017 Philippine Golf Course Management Conference

How to Reduce Energy and Resource Consumption using 3R Methodologies by the Zero Carbon Resorts (ZCR) Project

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GrAT – Center for Appropriate Technology

Zero Carbon Resorts For Sustainable Tourism

GrAT Center for Appropriate Technology

European Union's Switch-Asia Program

GrAT Center for Appropriate Technology

- Independent non-profit association since 1986
- Based at Vienna University of Technology
- International R&D for sustainable development
- Project implementation and demonstration
- Consultancy for companies and governments

Boeheimkirchen branch

Headquarters at TU Vienna

Zero Carbon Resorts For Sustainable Tourism

Zero Carbon Resorts Project!

ZCR Towards Sustainable Development of Tourism Sector in the Philippines and Thailand

Duration and Funding

4 Years: May 2014 to May 2018

switchasia

European Union's Switch-Asia Program

Austrian Development Cooperation

Acknowledgement

The ZCR Project is funded by the European Union, through the SWITCH Asia programme, which focuses on sustainable development in Asian countries.

Project Objectives



Overall Objective

To contribute to the sustainable development of the tourism sector and its value chain in the Philippines and Thailand with a focus on reduction of resource consumption and CO_2 emissions

Specific Objective

In the Philippines and Thailand, a critical mass of SMEs demonstrate the value of green tourism by increasing resource efficiency and using renewable resources.

Project Implementation Team

Project Lead

GrAT – Gruppe Angepasste Technologie (Center for Appropriate Technology), Austria

Project Partners

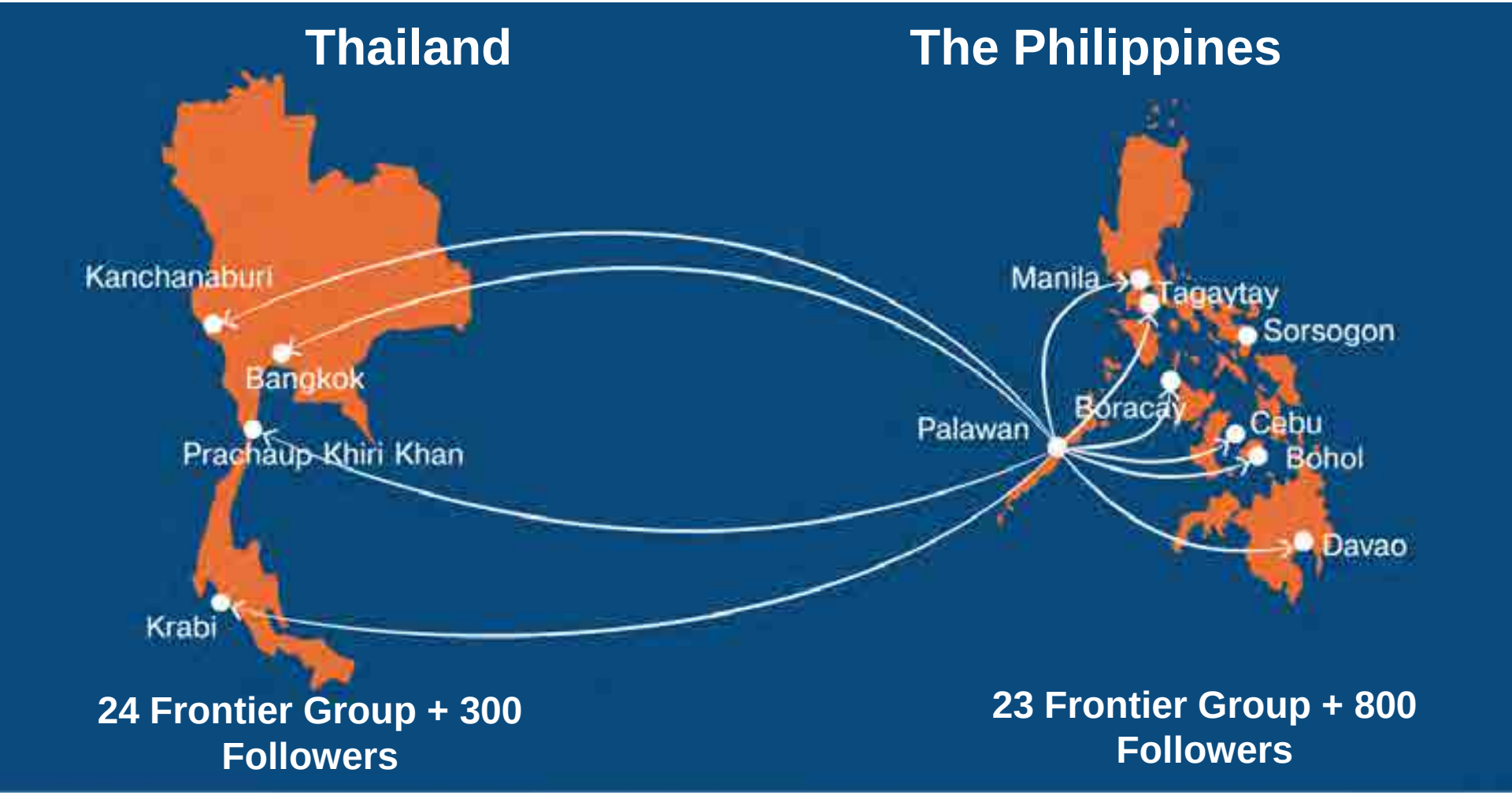
PCSD – Palawan Council for Sustainable Development (PCSD), Philippines

CIEMAT-PSA – Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas - Plataforma Solar de Almería, Spain

GLF – Green Leaf Foundation, Thailand

HPPF – Healthy Public Policy Foundation, Thailand

2 Countries and Bilateral Exchange



ZCR Project Achievement

in Resource Efficiency and Emission Reduction

2010 to 2017

223 ZCR Project Members Annual Savings (Philippines)

Energy Savings per year = **33,324,666.45 kWh**

≈ 3,930 homes

= Equivalent Consumption of 78,780 homes

as per Approtech Asia (2005), one home consumes 423 kWh/yr

Water Savings per year = **663,472,840.48 L**

≈ 220 homes

= Equivalent Consumption of 5,420 homes

as per LWUA Philippines (2005), one low income home consisting of 5 people consumes 122,275 L/yr

Fuel Savings per year = **2,157,180.10 L**

≈ 130 cars

= Equivalent Fuel Consumption of 2,630 cars

as per EPA (2008), one car with a fuel economy of 8.2 L per 100 km and driving range of 10,000 km consumes 820 L/yr

Avoided Emissions per year = **21,157,897.48 kg CO_2**

≈ 710 cars

= Equivalent Emissions of 10,070 cars

as per EPA (2008), one passenger vehicle emits 2,100 kg CO_2/yr

TOTAL ECONOMIC SAVINGS OF 202 COMPANIES PER YEAR!

PHP 414,911,516.33

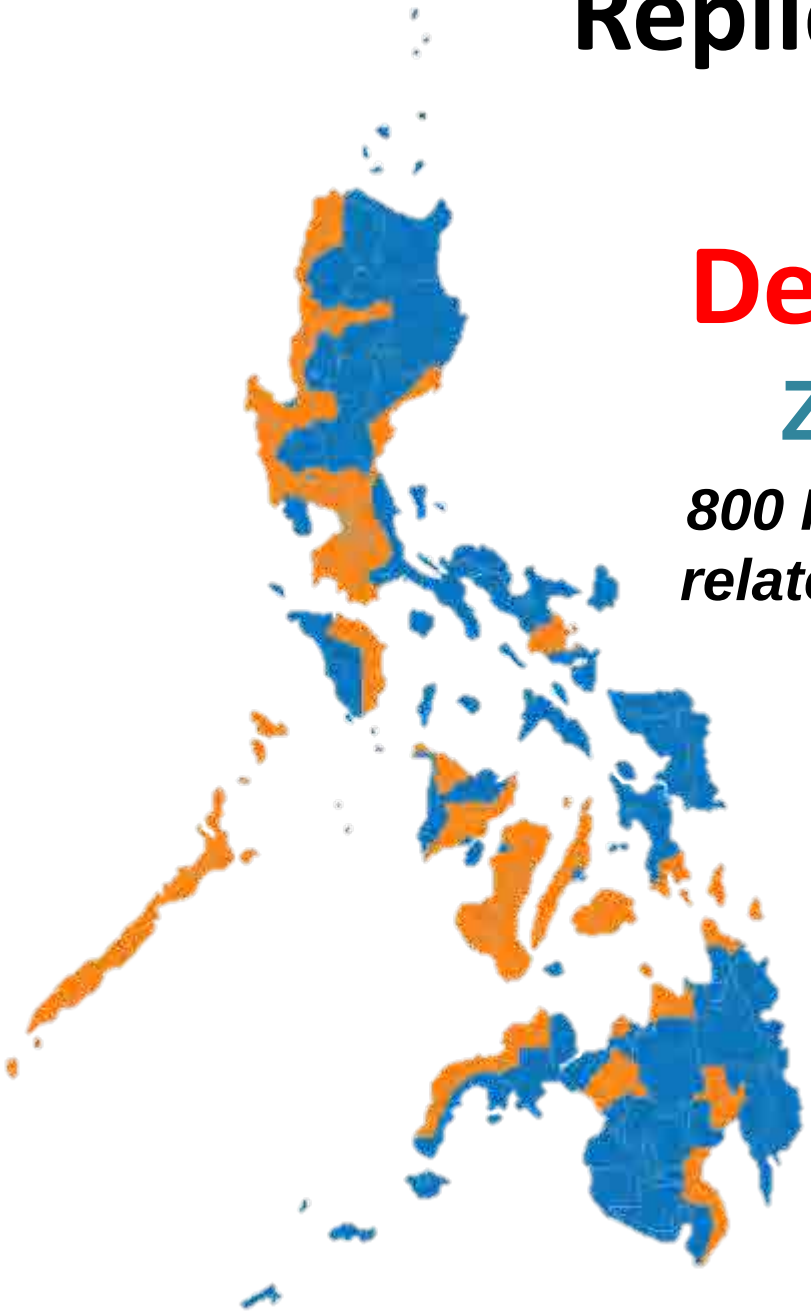
And for 800 more participating hotels? For 1,000 hotels?

Replication via Outreach in Cooperation with the

Department of Tourism

ZCR Registered Members

800 Registered hotels, resorts and other related tourism establishments covering 50,000+ Hotel rooms in 35 Provinces of the Philippines



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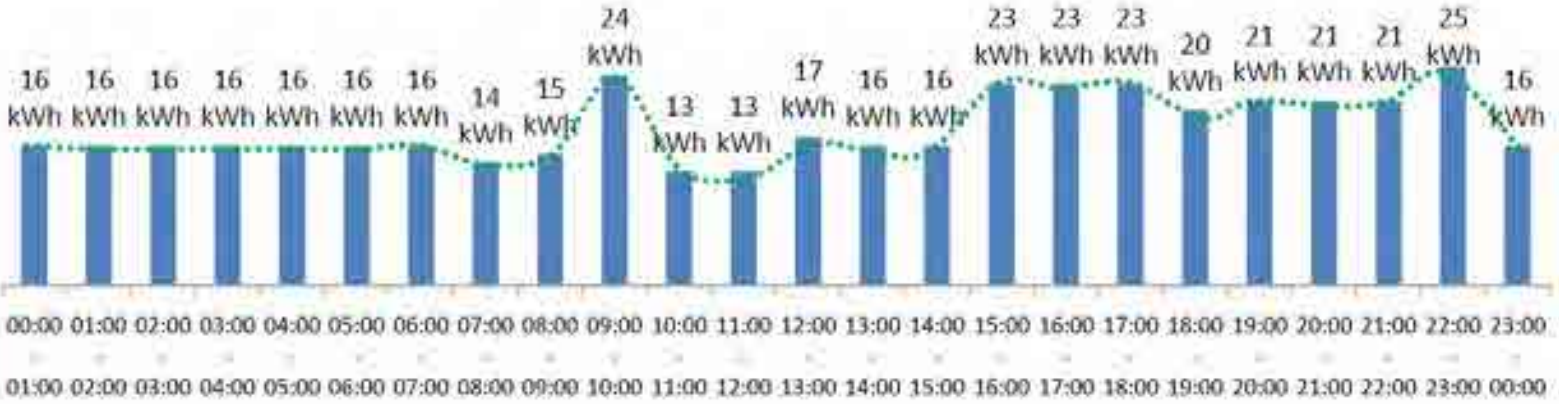
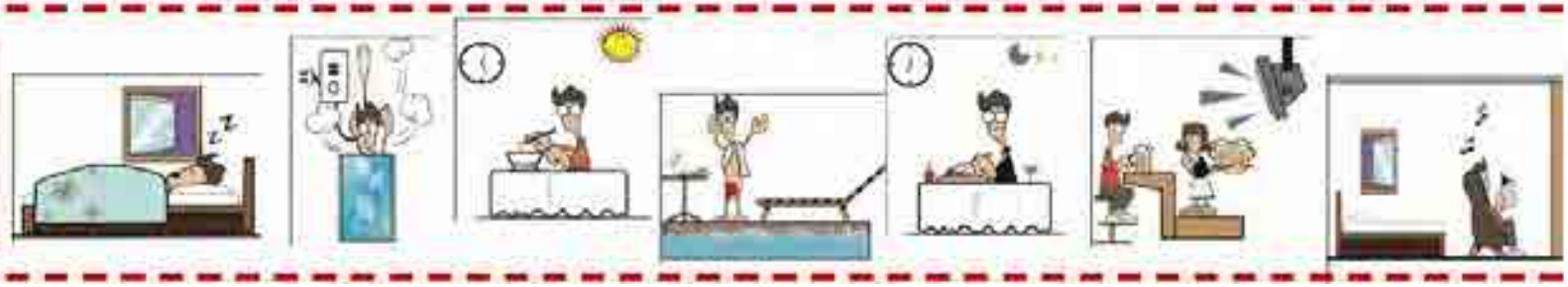
Energy bill's going up…Know why? Low number of guests…Energy bill didn't go down?

Logging of Energy Consumption and Specifying where Energy is Used

Daily energy consump-tion



Guest behavior **Guest survey**



Why be Concerned with Monitoring Energy Usage?

An important aspect to determine and understand:

- Energy consumption,
- Energy consumer behavior, and
- Efficiency of equipment of a resort or hotel.

Measurements → Baseline → Reduce Consumption

You cannot manage what you cannot measure!

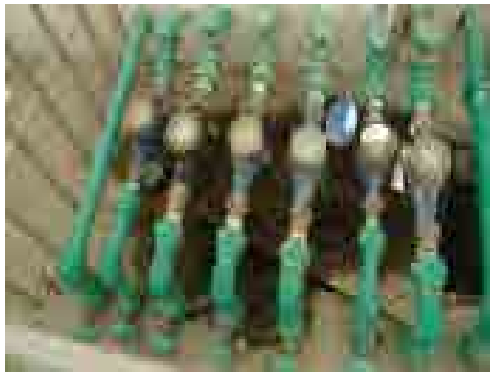
Basic Energy Meters

An analog (or digital) kilowatt-hour meter provided by the utility is basic and free.

☑ Shows energy consumed

☒ No history, carbon emissions, real-time use

Basic Water Meters



Fuel Meters

Professional Energy Usage Monitoring

This kind of systems are more complex, suitable for bigger facilities, and are usually provided by an energy consulting company.

- Real-time energy use
- Historical data
- Cost control
- Carbon emissions

Energy Users in a Tourism Establishment

☑ Guests

☑ Hotel Staff

☑ Silent Consumers

Zero Carbon Resorts

How to Influence Guests?

GUESTS

- Communication and information
- Signage should be attractive, with specific and clear visuals
- Education
- Voluntary involvement
- Encourage use of stairways instead of elevators

Zero Carbon Resorts
For Sustainable Tourism

Dear Guest

We will show you how you can easily contribute to saving energy and resources and reduce your carbon footprint without sacrificing your comfort.

What you can do to contribute ?

Most energy can be saved by avoiding air conditioner (A/C) usage. Set the (A/C) at a healthy temperature of 24°C - 25°C. Be aware that a large difference between outdoor and indoor temperature is the main reason to catch a cold.

Very important:

Close all doors and windows when the A/C is on, otherwise the cool air will escape.

You don't need to keep the A/C on all day long in order to have a chilled room in the evening – modern air conditioning facilities guarantee an appropriate room climate within minutes.

Save energy

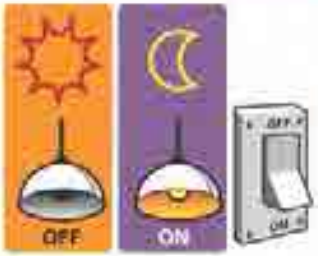
Turn off the A/C when you leave your room or when it is not necessary.

Try to sleep with an A/C running on timer. You won't be disturbed by the noise and you will be less likely to catch a cold.

A quick shower will save a lot of water. Closing the tap during shawing and brushing teeth helps saving valuable resources!

Thank you!

You can help us reduce the amount of laundry. Place the towels which you want to use again on the towel rack. The towels you put on the floor will be replaced with new ones.



You can save electricity if you turn off lights in hotel rooms and other area during the day time and whenever not needed.

For more information, please visit the website

www.zerocarbonresorts.eu.

The Zero Carbon Resorts project aims at greening the tourism industry in Philippines and Thailand through the usage of appropriate technology and engaging all involved people (hotel staffs and owners, travel agencies and guests) into the action. Every party can (and needs to) help conserve the environment, including you!

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Austrian Development Cooperation
European Union's SwitchAsia Program

This document has been produced with the financial assistance of the European Union. The contents of this publication are the sole responsibility of the ZCR for Sustainable Tourism project team headed by GrAT-Center for Appropriate Technology and can under no circumstances be regarded as reflecting the position of the European Union.

This project implemented by:

GrAT

Glue here

How to Influence Staff and Silent Consumers?

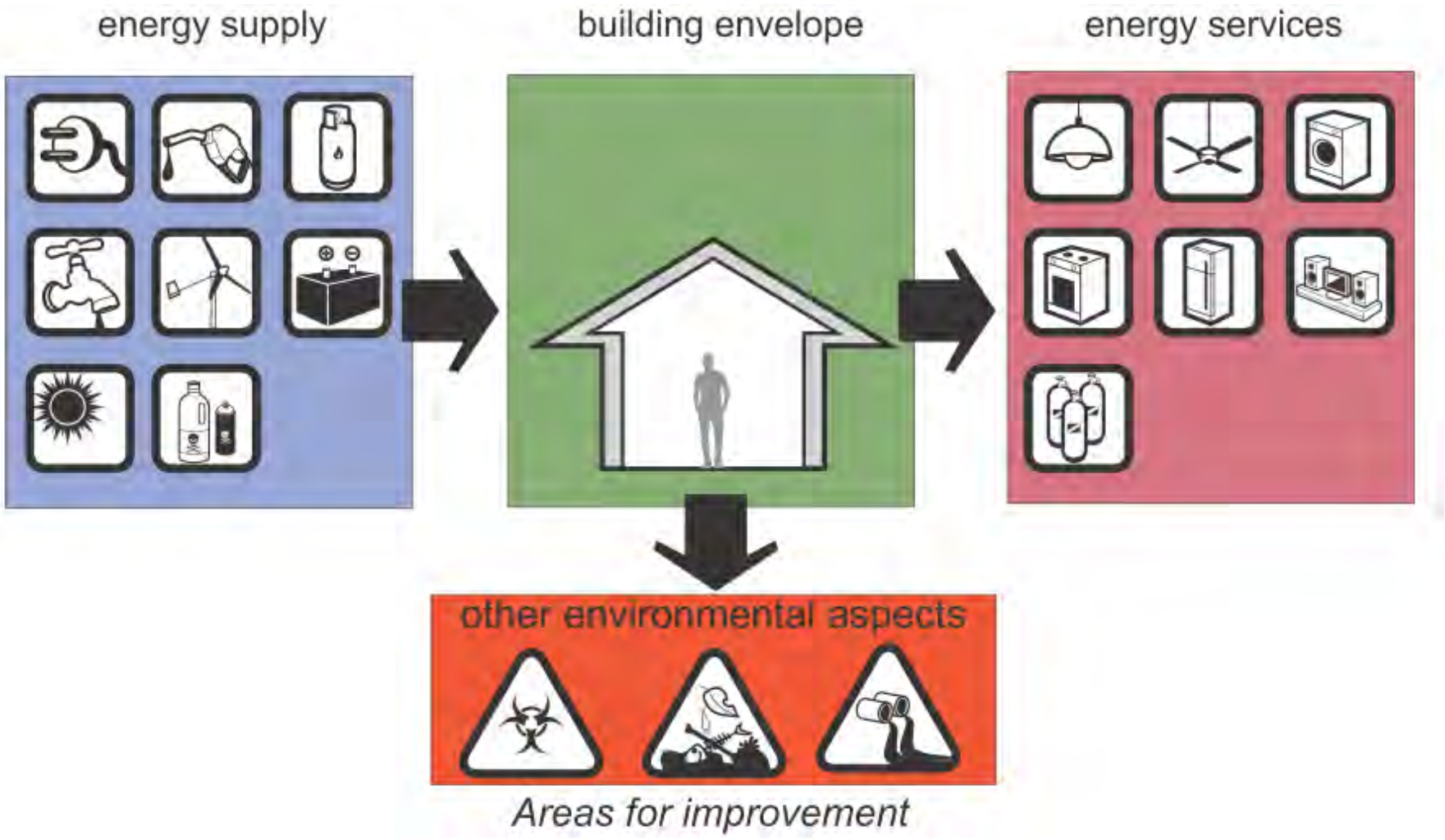
STAFF AND OPERATIONS

- Instructions and briefings
- Trainings
- Standards
- Motivation
- Involvement in projects
- Incentives help!

SILENT CONSUMERS

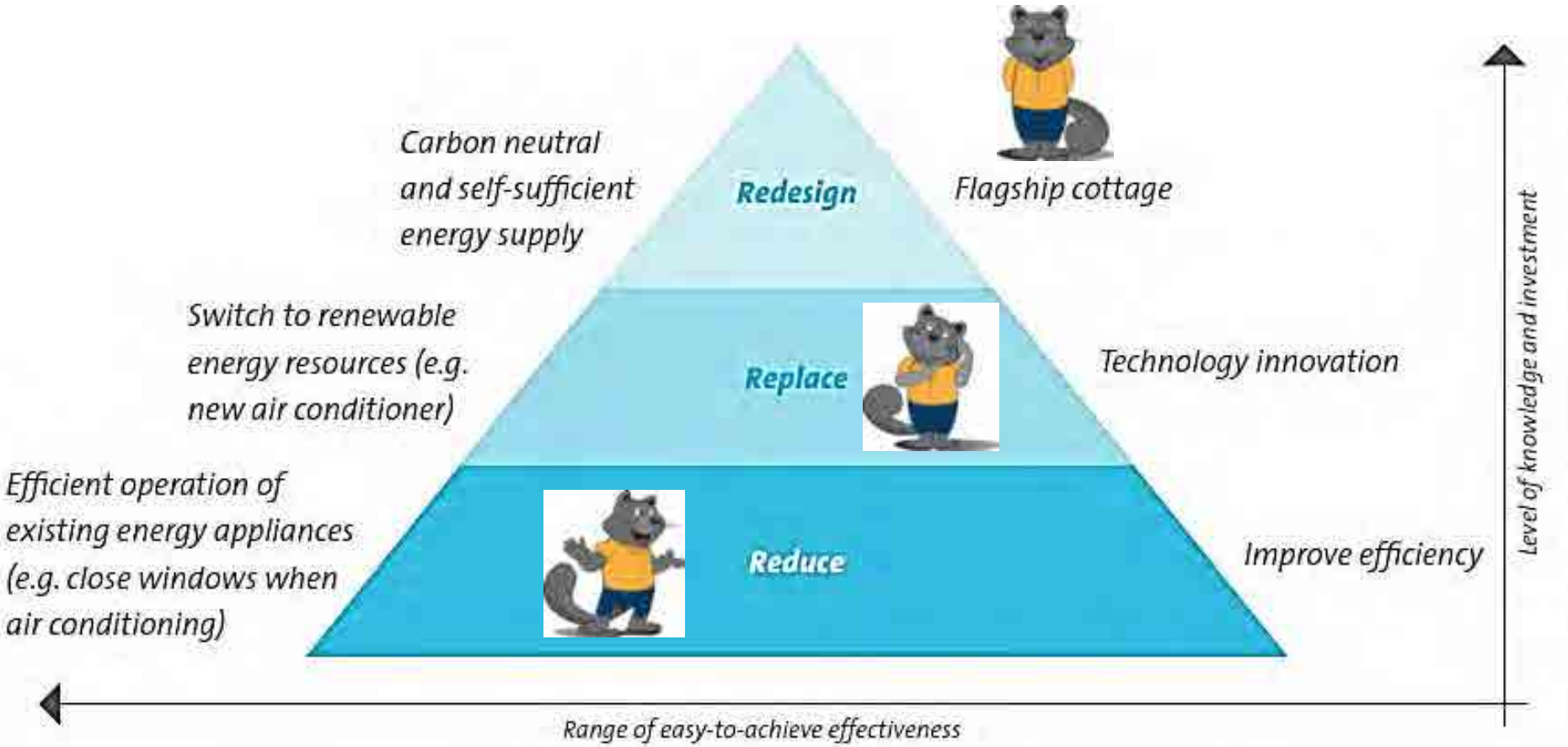
- Technical measures such as key cards, switches, timers, sensors, etc.

Different Areas for Improvement



Energy Services in the Tourism Industry

The ZCR 3R Methodology



Reduce

Implementations with zero or low investment costs

Low-hanging fruits

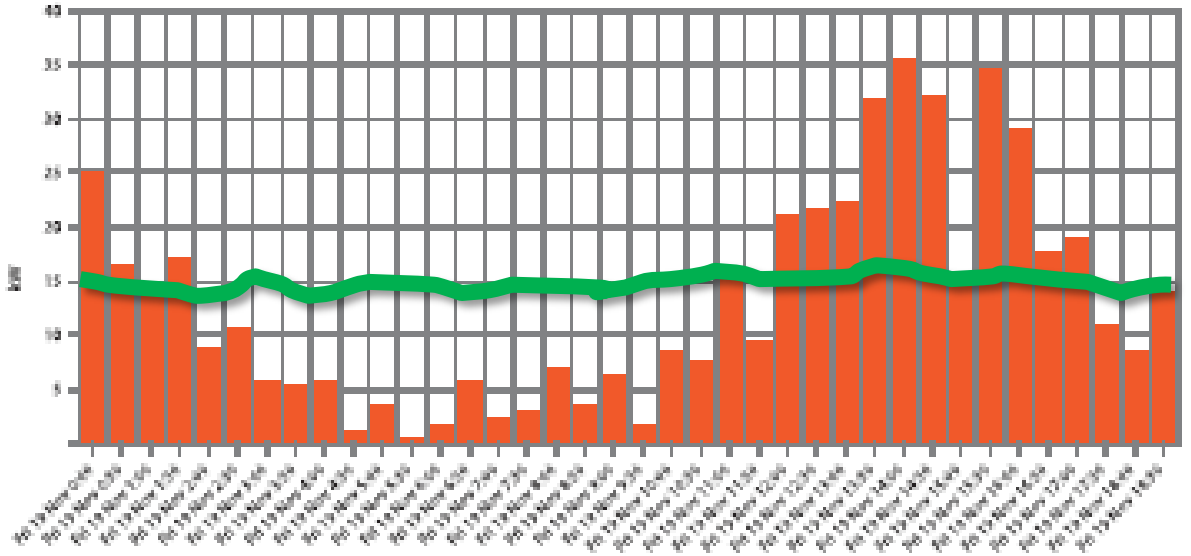
Easy to achieve measures yet remarkable improvement in resource efficiency

Affecting change in guest and staff behavior in resource consumption

Zero Carbon Resorts
For Sustainable Tourism

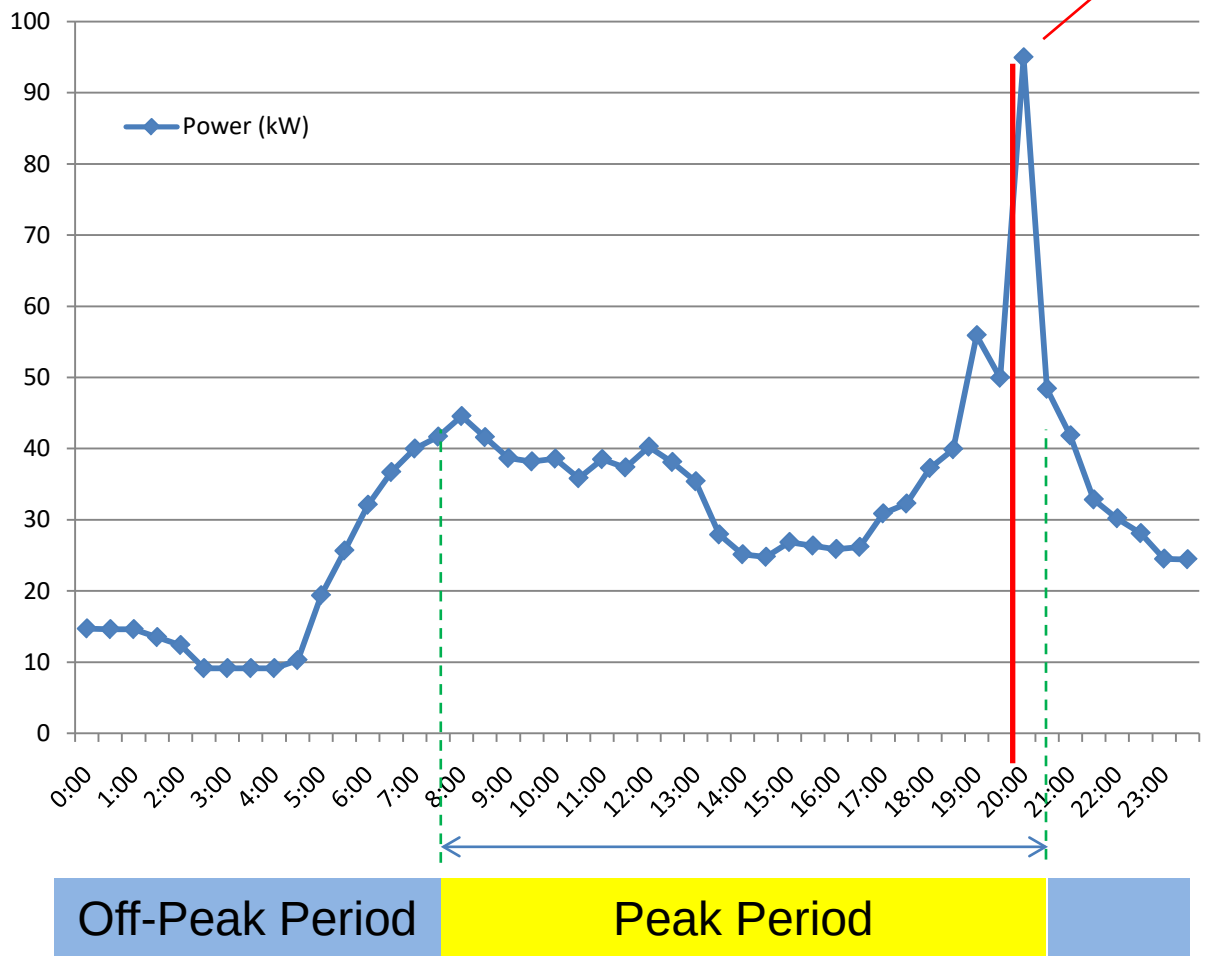
Peak Load Management

- Shifting of electrical loads to low use periods
- Denotes when is the best time to use specific appliances and equipment



SCENARIO A: Philippine Hotel with Restaurant

Daily Consumption: 746.85 kWh



Peak Demand = 94.95 kW
Average Demand = 31.12 kW

A very much PRONOUNCED PEAK LOAD greatly INCREASES generation and transmission charges!

Monthly Electricity Cost
= Generation Charge + Transmission Charge + Distribution Charge + System Loss + Subsidies + Government Taxes + Universal Charges + Feed-in-Tariff Allowance

Monthly Electricity Cost
= **PHP 175,788.48**

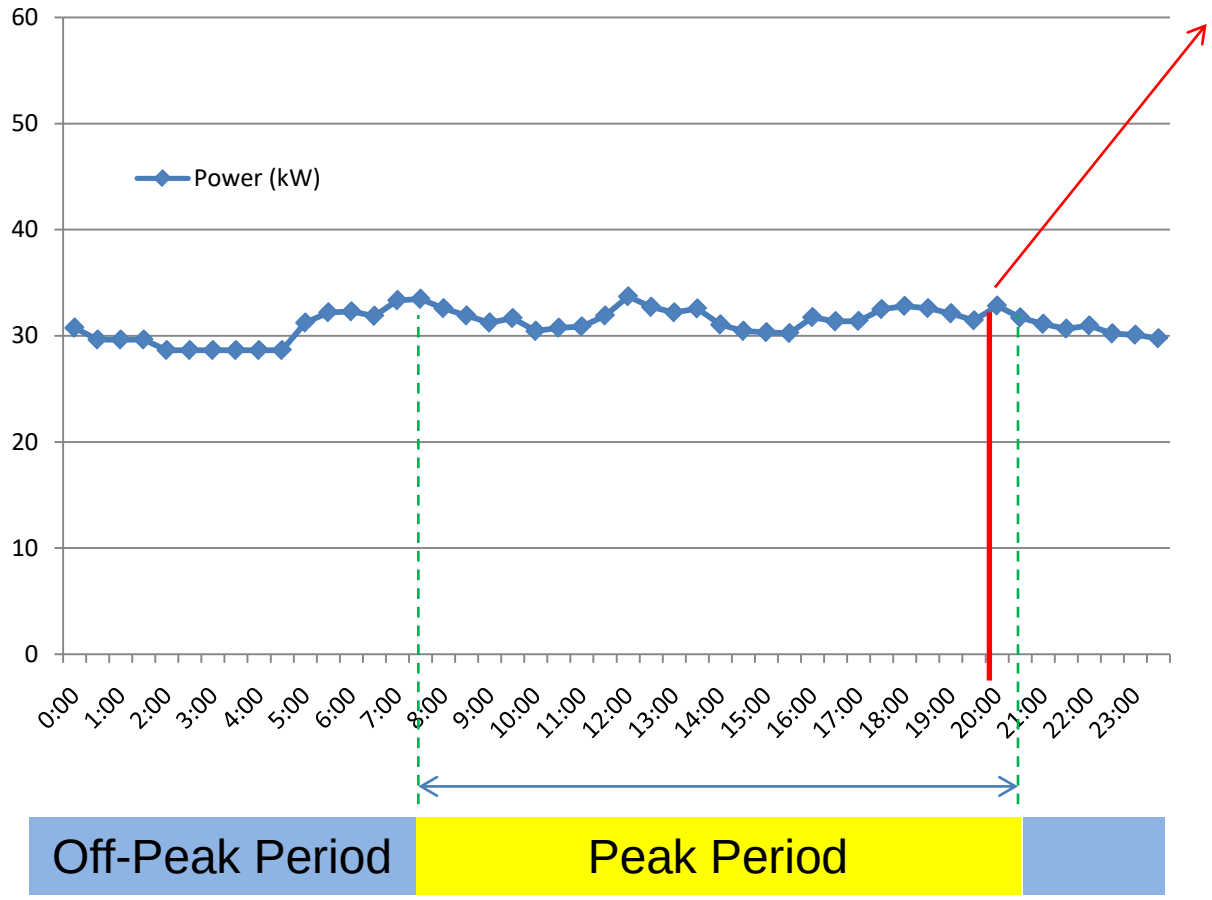
Equivalent cost = PHP 3.55/kWh × 290.13 kWh = PHP 1,029.96

Equivalent cost = PHP 7.48/kWh × 456.72 kWh = PHP 3,416.27

Zero Carbon Resorts

SCENARIO B: **Philippine Hotel with Restaurant**

Daily Consumption: 746.85 kWh



Peak Demand = 32.83 kW
Average Demand = 31.12 kW

Monthly Electricity Cost
= Generation Charge + Transmission Charge + Distribution Charge + System Loss + Subsidies + Government Taxes + Universal Charges + Feed-in-Tariff Allowance

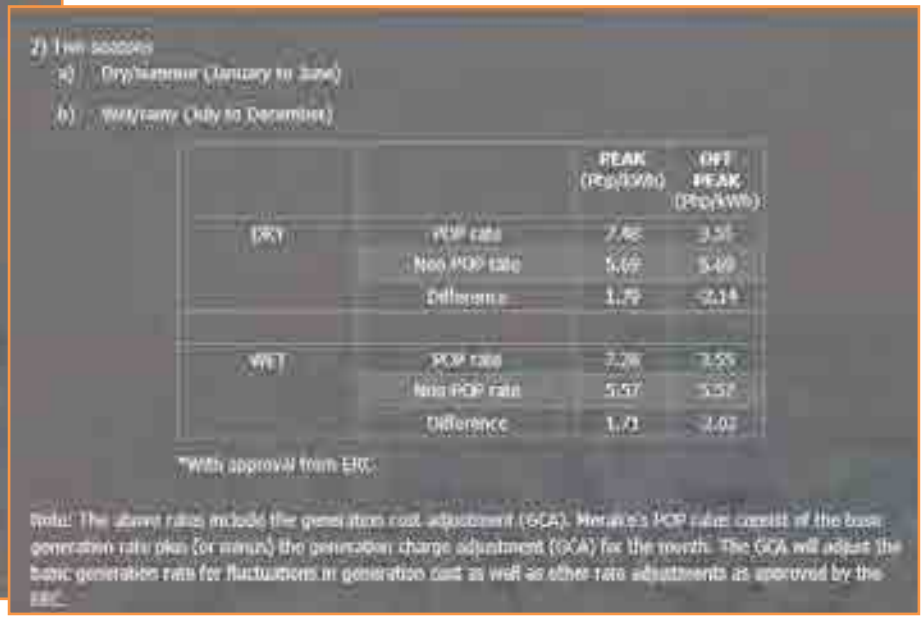
Monthly Electricity Cost
= **PHP 151,953.99**

14% SAVINGS!

Equivalent cost =
PHP 3.55/kWh × 334.34 kWh = PHP 1,186.91

Equivalent cost =
PHP 7.48/kWh × 412.51 kWh = PHP 3,085.57

- **Peak Load Management Savings** = 5% to 30% of total electricity consumption
- Always check with Local Power Distributor* for availability of the Peak / Off-Peak Program



**Meralco requires applicants to have an average power demand of 5 kW to 499 kW for SMEs and at least 500 kW for corporates. For residential applicants, the 12-month average energy consumption must be at least 500 kWh.*

Useless Consumption and Standby

PROBLEMS

- Some guests leave A/C, lights, and electric devices on when they leave the room.
- Outside lights are still on during the day.

SOLUTIONS

- Instructional reminders inside guest rooms
- Centralized switch controls or key cards
- Automatic night lights or motion detectors

Providing a <u>simple switch to easily turn off stand-by loads</u> such as TVs and related appliances can effectively save around **600 kWh (or PHP 6,000)** per year for a 100-room hotel.

Use of Sensors: Motion, Occupancy, Light Detection

Labeling of Switches

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Some Simple Daylighting Techniques







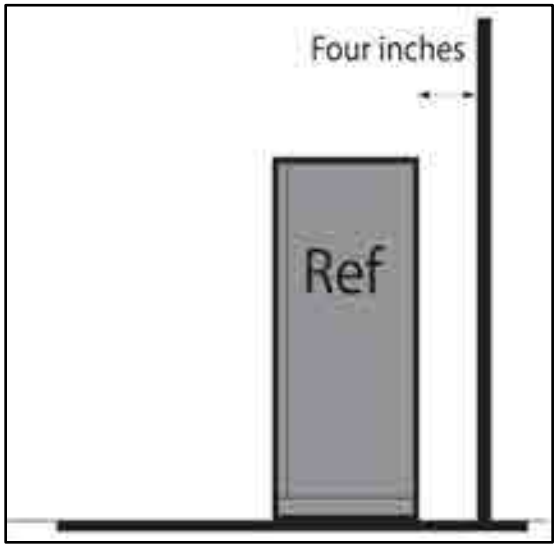



Insulation

☑ Ice buckets should be properly insulated to minimize ice melts.

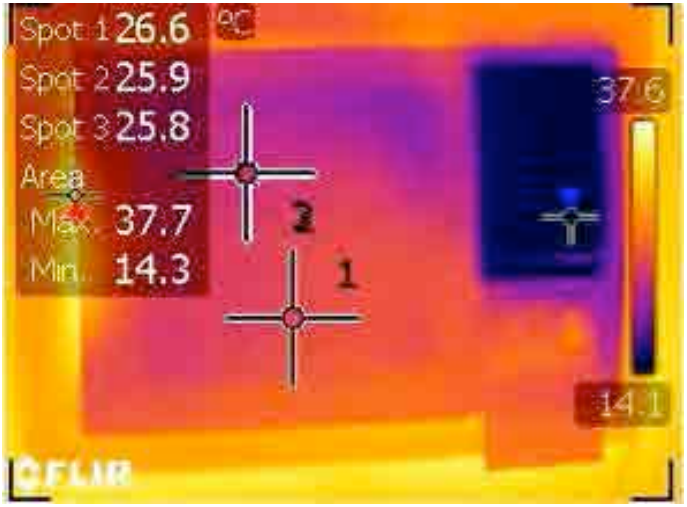
☑ Un-insulated cold drinks served in restaurants gets warm after a few minutes, and makes guest/s request for ice.

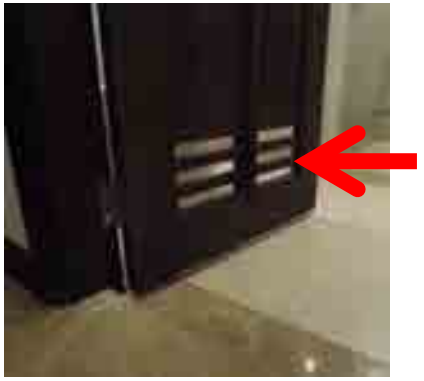
Problem:
Placing refrigerators close to the wall increases the power consumption



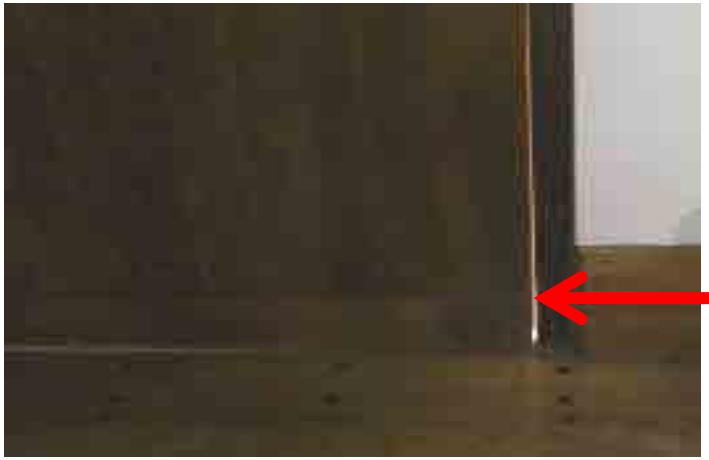
Solution:
Observe proper clearance of refrigerators and freezers to walls.

Sealing of Gaps





Louvered toilet doors



Gaps in doors

PROBLEM

Gaps and insufficient sealing of A/C units

SOLUTIONS!

- ☑ Seal all air gaps
- ☑ Lock all thermostats in public areas

Problem:

- Windows are open while air-conditioning unit is on.

Solution:

- Ensure staff closes all windows after cleaning.

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European Union's Switch-Asia Program

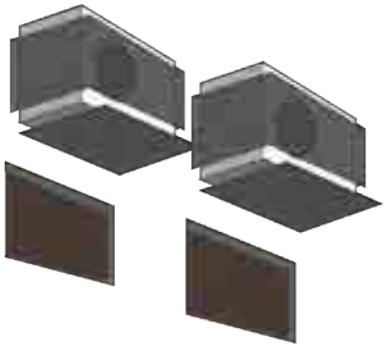
Austrian Development Cooperation

Project Implemented by

GrAT

Use of Fillers, Foams, and Weather Stripping Materials

- ☑ Thermostat: 25°C
- ☑ Awnings, Shading
- ☑ Maintenance
- ☑ Paper test to check filter
- ☑ Short-Circuited Air Conditioners




Bahama shutters


Exterior roll blind


Sarasota shutters


Sun screen


Slatted aluminum


Venetian awning (east or west exposure)


Porch


Trellis & vines


Hood awning

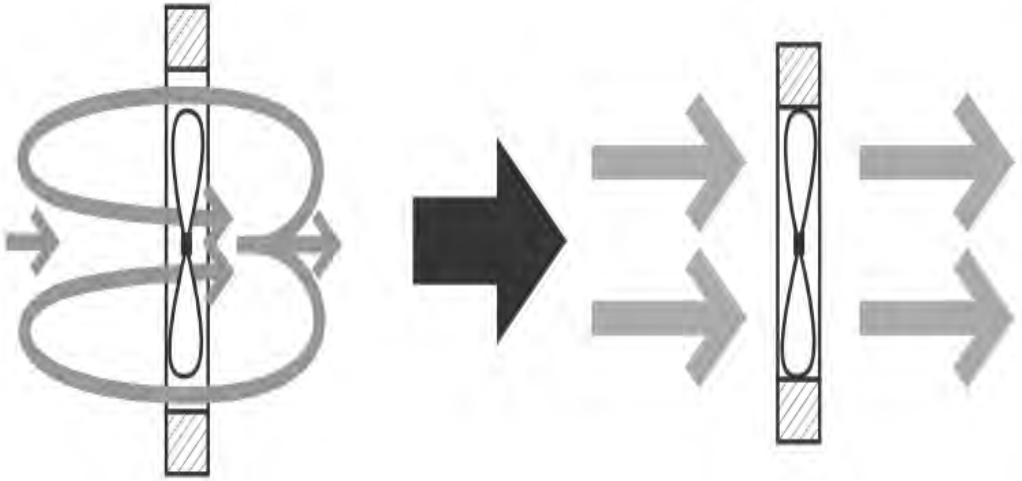

Gambrel awning (for casement windows)


Trees


Solid aluminum awning


Roller awning (self-storing)

Short Circuit in Exhaust Fans or Ventilation Systems



Ensure proper ducting

Problem: No separation of cooled area and ventilated area

Solution: Comfort room with door spring or automatic door closer

Aesthetic vs. Thermal Comfort

Existing dark colored roof temperature = **63 degrees Celsius!**

High Albedo Coefficient Color Retrofit: Use White Paint

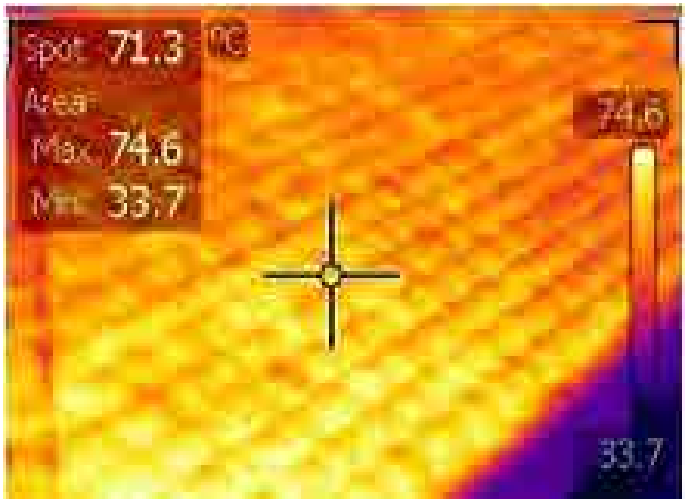
☑ Brown Roof = 63°C

☑ White paint on top of existing brown roof = 37°C

☑ Difference of 26°C

Thermal Image of Asphalt Shingle Roof

- Intensity of the impinging solar radiation, up to 74.6 °C! on a cloudy day
- Heat transfer to the inside of the building



Philippine Green Building Code:

- *The building metal roof shall either be colored white or have min. Solar Reflectance Index (SRI): 70*
- *All exterior wall and surfaces, including pavements shall have SRI of 30.*

Source: The National Green Building Code

Dark colored roofs should be replaced with light colored ones.

Dark colors absorb the sun's heat.

Reduction in the Operation of Moving Equipment

- Reduction in the operating hours of elevators and escalators
- Effective dispatch system: schedule elevator trips of staff; use stairs
- Elevators of the machine-room-less (MRL) type are energy-efficient

Hot Water Pipelines

Hot water lines should be properly insulated!

The temperature readings on the hot water pipeline without insulation are as follows: 115.9 and 52.5 degrees Celsius.

“Locavore”

“Locavore” - growing, using and serving, eating locally grown vegetables, fruits, poultry, fish, seafood and meat






The Philippine Seasonal Fruits Chart

January

Banana
Papaya
Strawberry
Yellow Passion Fruit
Star Apple (Kainito)
Sapodilla (Chico)
Pomelo (Suha)
Citrus Fruit (Dalandan

February

Avocado
Banana
Papaya
Strawberry
Yellow Passion Fruit
Sugar Palm Fruit (Kaong)
Star Apple (Kainito)
Sapodilla (Chico)
Pomelo (Suha)
Citrus Fruit (Dalandan)

March

Avocado
Banana
Papaya
Strawberry
Sugar Palm Fruit (Kaong)
Star Apple (Kainito)
Java Plum (Duhat)
Jackfruit (Langka)

April

Avocado Banana
Papaya Watermelon
Rambutan Strawberry
Cashew Fruit (Kasoy)
Star Fruit (Balimbing)
Spanish Plum (Sineguelas)
Java Plum (Duhat)
Jackfruit (Langka)
Soursop (Guyabano)

May

Avocado Banana
Papaya Watermelon
Mango Pineapple
Cashew Fruit (Kasoy)
Bell Apple (Makopa/ Tambis)
Star Fruit (Balimbing)
Spanish Plum (Sineguelas)
Java Plum (Duhat/ Lumbay)
Jackfruit (Langka)

June

Avocado Banana
Coconut Papaya
Watermelo Mango
Pineapple Rambutan
Star Fruit (Balimbing)
Bell Apple (Makopa/ Tambis)
Spanish Plum (Sineguelas)
Java Plum (Duhat/ Lumbay)
Guava (Bayabas)

July

Banana Durian
Papaya Watermelon
Pineapple Buko
Rambutan Dragon Fruit
Passion Fruit Mangosteen
Rattan Fruit Guava (Bayabas)
Pomegranate (Granada)
Star Fruit (Balimbing)
Bell Apple (Macopa/ Tambis)
Java Plum (Duhat/ Lumbay)
Wild Mangosteen (Santol

August

Banana Durian
Lanzones Calamansi
Passion Fruit Dragon Fruit
Coconut (Buko)
Bilimbi Fruit (Kamias)
Rattan Fruit (Tuntok)
Pomegranate (Granada)
Guava (Bayabas)
Velvet Apple (Mabolo)
Wild Mangosteen (Santol)
Soursop (Guyabano)

September

Banana Durian
Dragon Fruit Papaya
Lanzones Calamansi
Passion Fruit Mangosteen
Bilimbi(Kamias) Guava (Bayabas)
Sugar Apple(Atis) Soursop (Guyabano)
Wild Mangosteen (Santol)
Rattan Fruit (Tuntok)
Pomegranate (Granada)
Velvet Apple (Mabolo)
Breadfruit (Marang)

October

Banana Durian
Lanzones Dalanghita
Papaya Rambutan
Calamansi Mandarin
Sugar Apple (Atis) Guava (Bayabas)
Pomegranate (Granada)
Tamarind (Sampaloc)
Rattan Fruit (Tuntok)
Lucuma (Tiesa/ Tessa)
Velvet Apple (Mabolo)
Soursop (Guyabano)

November

Banana Lanzones
Dalanghita Papaya
Strawberry
Tamarind (Sampaloc)
Pomegranate (Granada)
Lucuma (Tiesa/ Tessa)
Guava (Bayabas)
Soursop (Guyabano)
Sugar Apple (Atis)

December

Banana
Papaya
Dalanghita
Strawberry
Sugar Palm Fruit (Kaong)
Tamarind (Sampaloc)
Sugar Apple (Atis)

switchasia PROGRAMME

Austrian Development Cooperation

GrAT Center for Appropriate Technology

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Waste Segregation

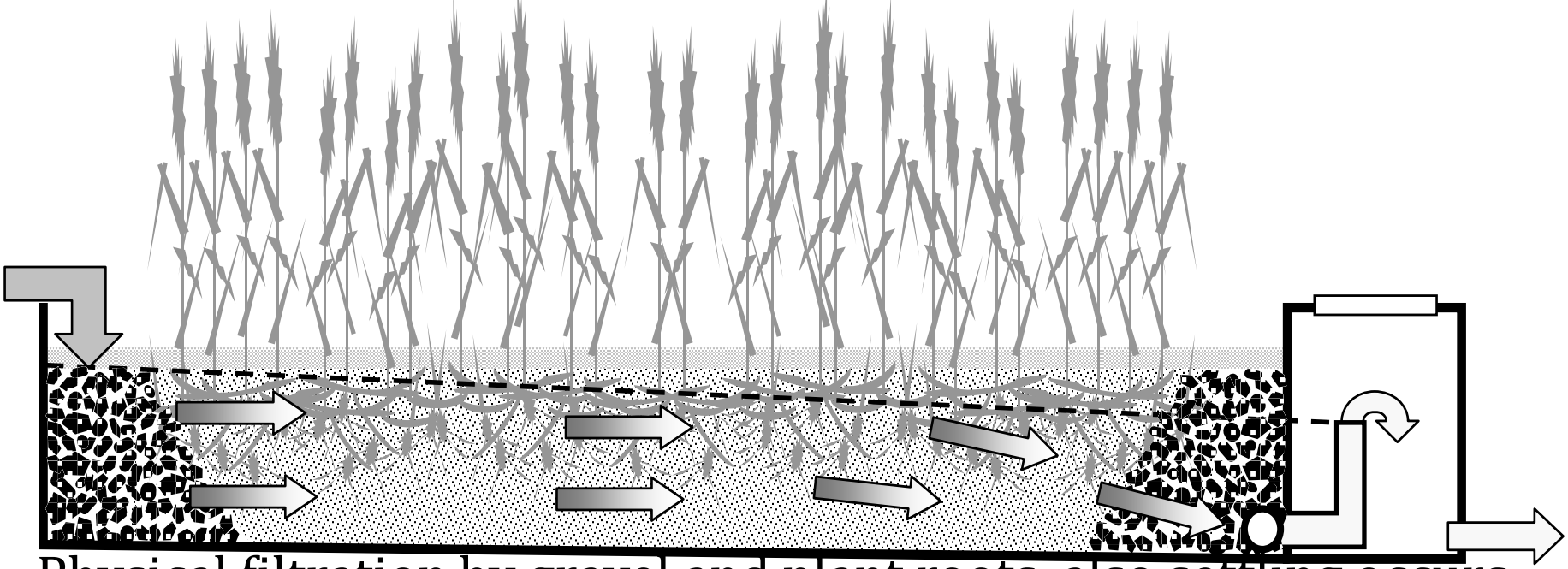
Vastewater problems

Alternative Options:
Natural wastewater treatment:
Reed bed technology

Zen – inspired
Engineered Reed Bed System

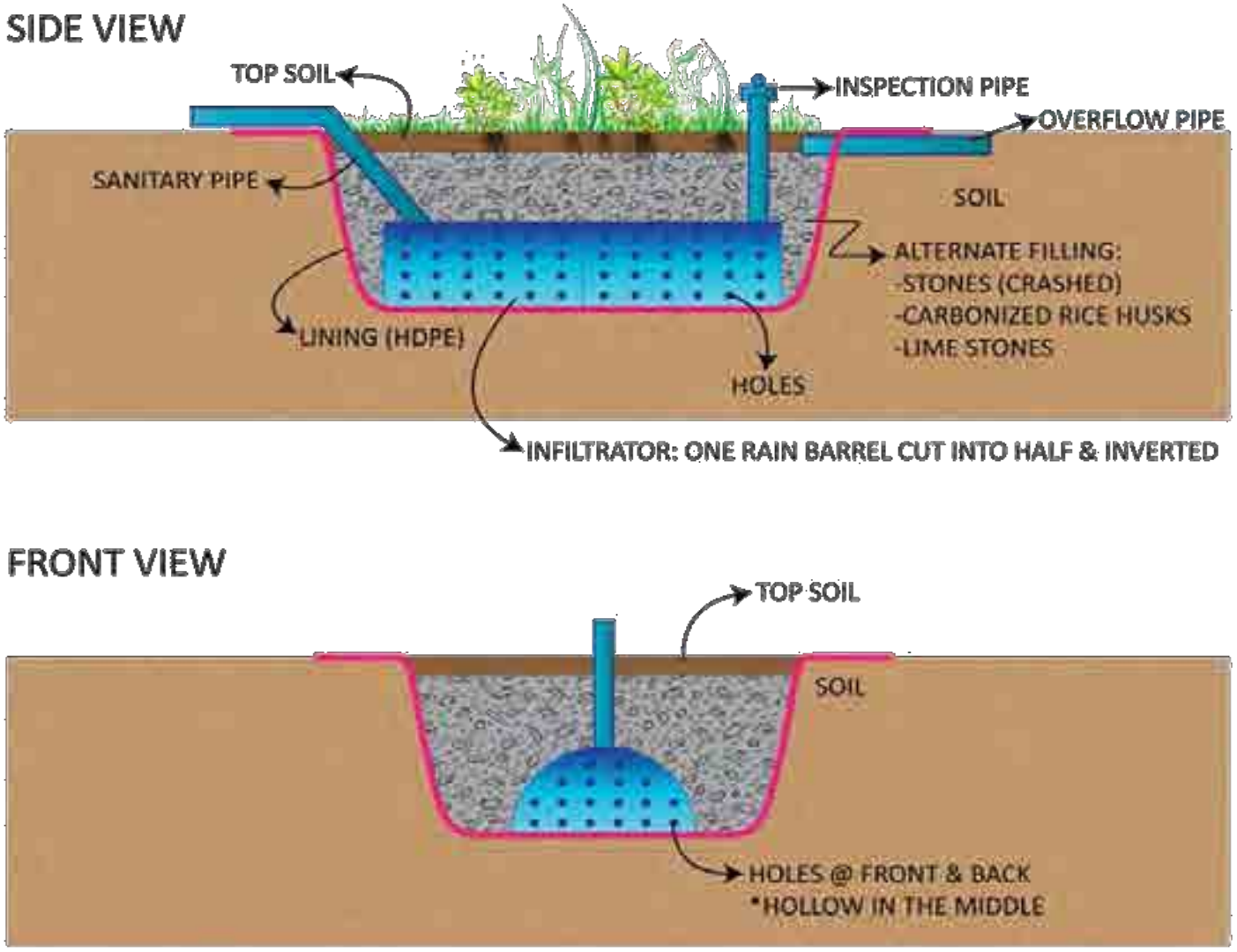
Buri Resort, Puerto Galera

Dive Solana, Anilao, Batangas



- Physical filtration by gravel and plant roots, also settling occurs.
- Biological filtration by microbes and algae (aerobic and anaerobic bacteria).
- Nutrient reduction. Plants are basically grown hydroponically in gravel (feeding on nutrients in water).
- Nutrients are converted to usable and manageable forms.
- Naturally occurring organisms feed in system, (including worms that live in top section of reed bed).
- Worms also help reduce any sludge build-up in the system (self cleaning).

Wastewater Treatment / Watson Wick Method



Grease from kitchen causes

- a high cost of water treatment and
- a high energy use of water treatment
- a high maintenance cost of drain wall and floor

Grease Trap

- Natural fertilizer
- For odor removal in septic tanks
- Some types of EM can reduce fats, oils, and grease in grease traps

Zer
Carb
Res
rts

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Common use of candles

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Waste to value – *used cooking oil*

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For Sustainable Tourism

Used cooking oil recycling

RECYCLED WOOD UTILIZATION

Sala cum library

Art gallery

Amarela Resort, Bohol

New accounting building

Packaging Materials

- ☑ Indigenous Materials
- ☑ Banana Leaves
- ☑ Use of “Bilao” (Woven Tray)
- ☑ Wooden Scoops

Fruit and Vegetable Decoration

Green Decoration

Banana Decoration

No cut flowers

No Throwaway Items

Use of Potted Plants and Flowers

Green Meeting and Function

Encourage outdoor meetings! – **Green Meetings** (less demand for electricity)

Solution for removing odor from smoking room: ONIONS!

Zer Carb On Res rts

Replace

Switch to renewable energy resources or materials

Substituting outdated and inefficient technologies with more efficient ones

Implementations with medium to high investment costs

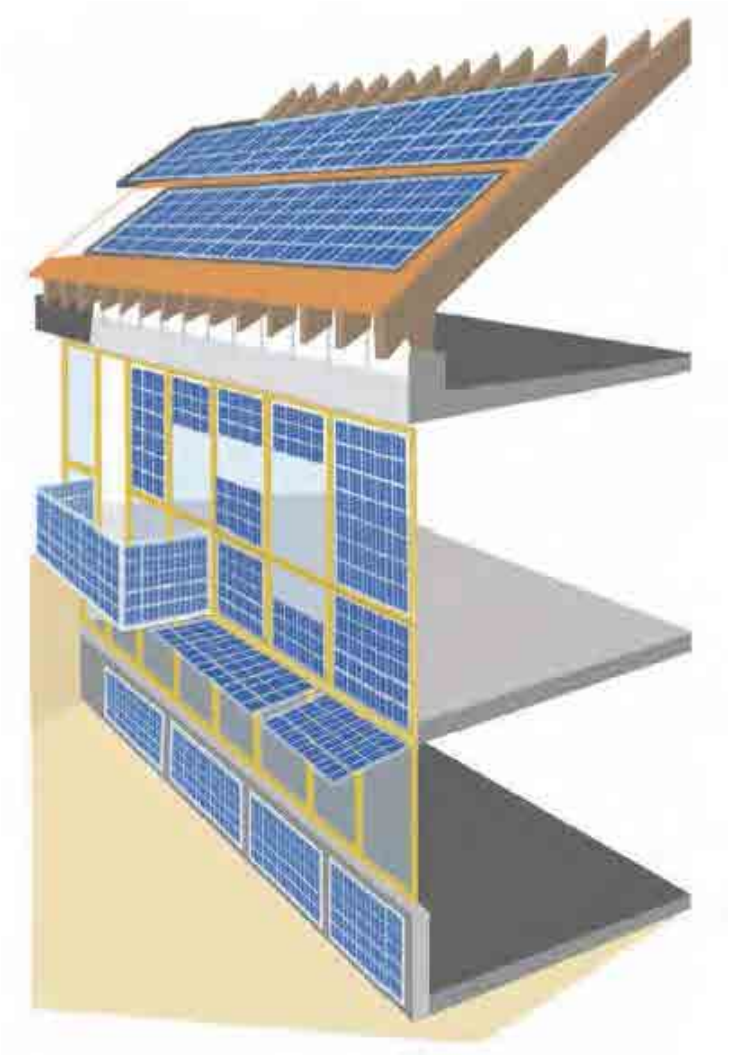
Zero Carbon Resorts
For Sustainable Tourism

Use of PV Panels

- ✓ Opportunity for “Net Metering” scheme
- ✓ Ensure that trees or other obstacles to the sun’s rays do not shade PV panels.
- ✓ Always maintain panel cleanliness, e.g. free from dirt, dust, bird droppings, etc.
- ✓ Conduct renewable energy education to users so as to have a long-term proper utilization of the technology.

Photovoltaic Integration

PV integration can be made using different visual effects that can suppose significant improvements in the aesthetic appreciation of the building

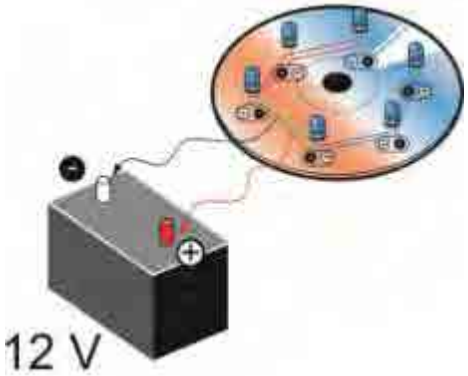


Solar-Rechargeable Lights

Disposal problem of regular batteries

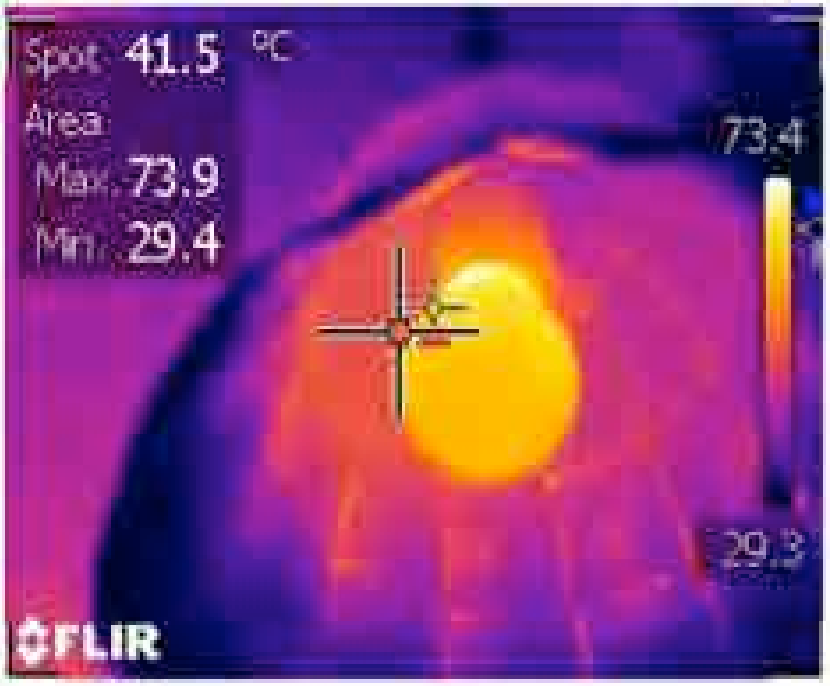
☑ LED lights

☑ DIY LED lights

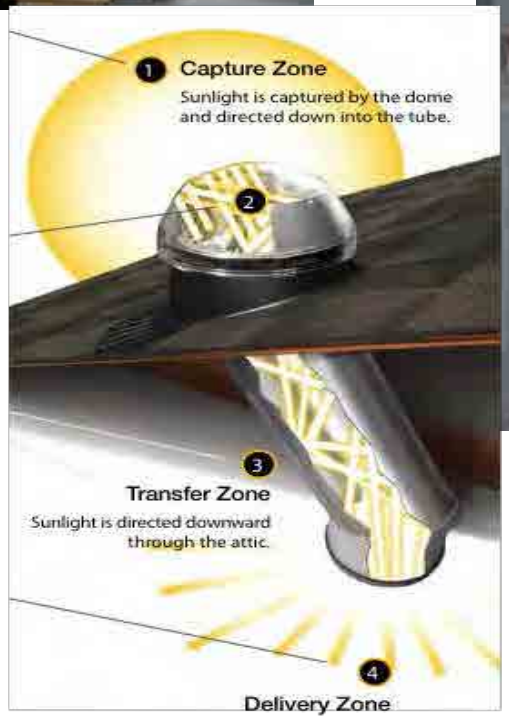


Zer Carb n Res rts

Incandescent and CFL bulbs are still being utilized. They are cheap but consume a lot of energy that is transformed into heat.



Solar Tubes


1 Capture Zone
Sunlight is captured by the dome and directed down into the tube.
2
3 Transfer Zone
Sunlight is directed downward through the attic.
4 Delivery Zone
Sunlight is distributed throughout the room.


DALTON

Replacement of Appliances with More Energy Efficient Ones

Low Wattage, High Volume Fan

This fan uses only 5 to 18 W of power and effectively helps cool the area.

Conventional Menu and Order Slip

Paperless Technology at Restaurant

TABLET MENU and HANDHELD POS

☑ High EER

☑ Inverter type A/C (40% to 60% electricity savings)

- High EEF
- Double glass window refs
- Defrost fridges, mini-bars and freezers when necessary.

- Efficient washing machines
- Clotheslines

What color of linens is the least environmentally friendly?


Zer
Carb
Res
rts

High Energy Consumption of Electric Water Heaters

=

1 CFL light bulb (7W)
can light for 370 hours

2.6 kWh of electricity from 0.86 L diesel

1 refrigerator (5 ft³)
can run 5 days

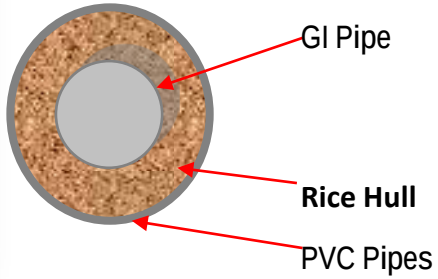
An Air-Condition
can run 3-4 hours

1 notebook (30W)
can run for 86 hours or 2 working weeks

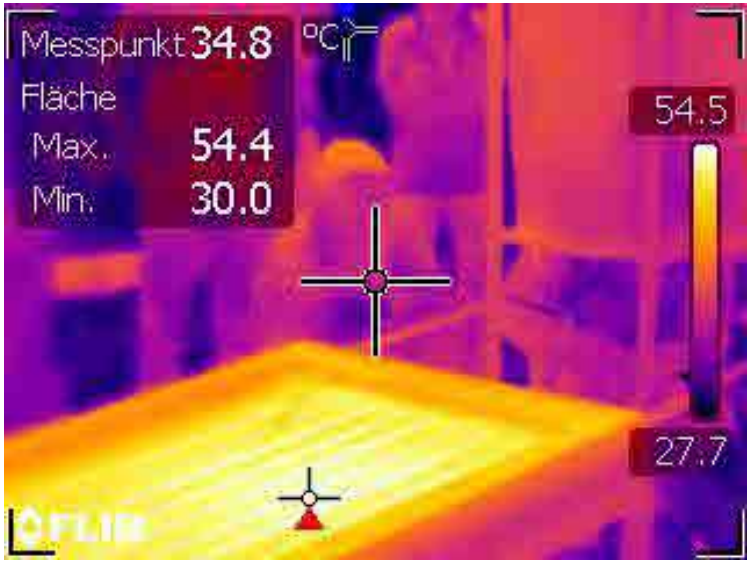
Zer Carb n Res rts

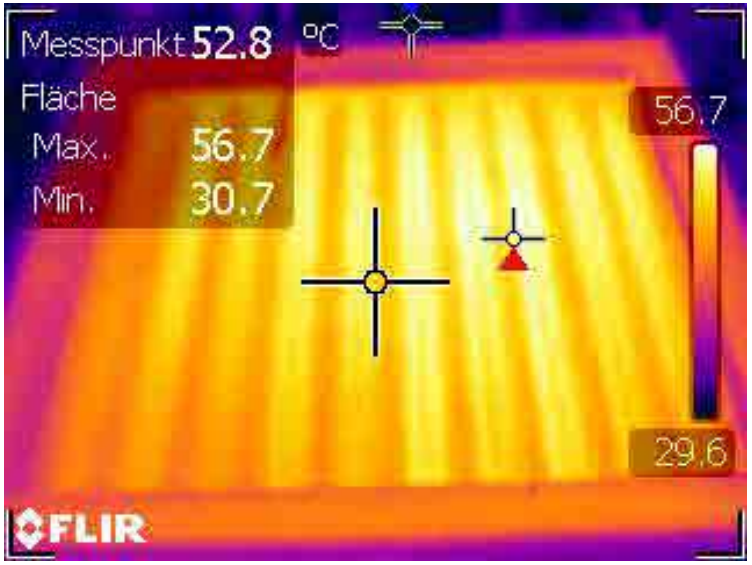
Commercial Solar Water Heaters

Front view of a Rice Hull Insulated SWH showing the main components: reservoir and FPC



Rice hull as insulation

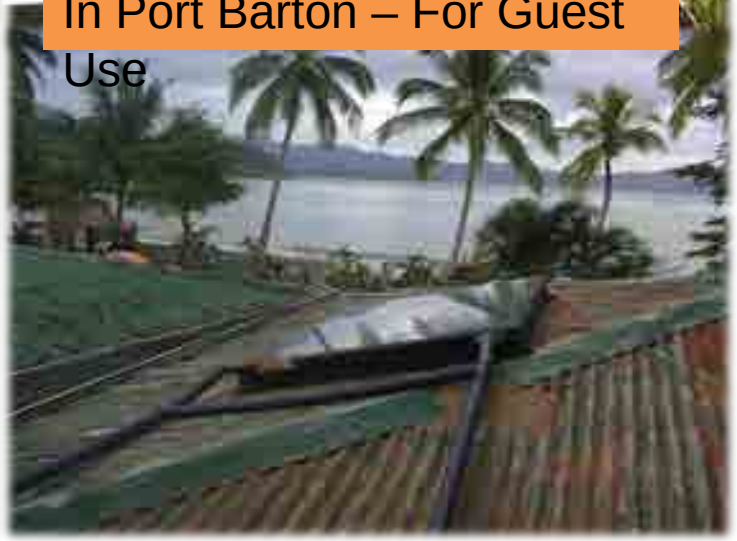

Messpunkt 34.8 °C
Fläche
Max. 54.4
Min. 30.0
54.5
27.7
FLIR


Messpunkt 52.8 °C
Fläche
Max. 56.7
Min. 30.7
56.7
29.6
FLIR

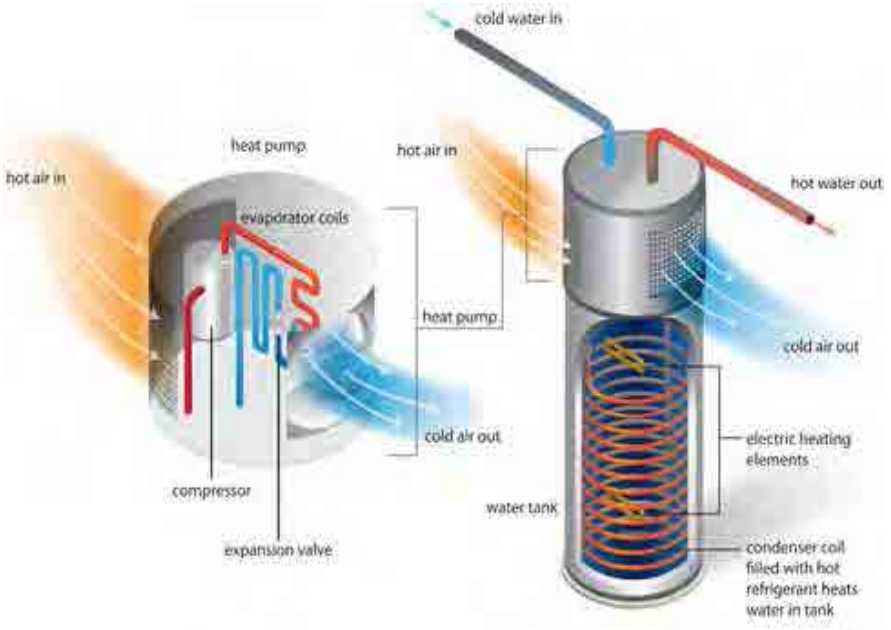
Applications of ZCR Members

In Sabang – For staff Use

In Port Barton – For Guest Use

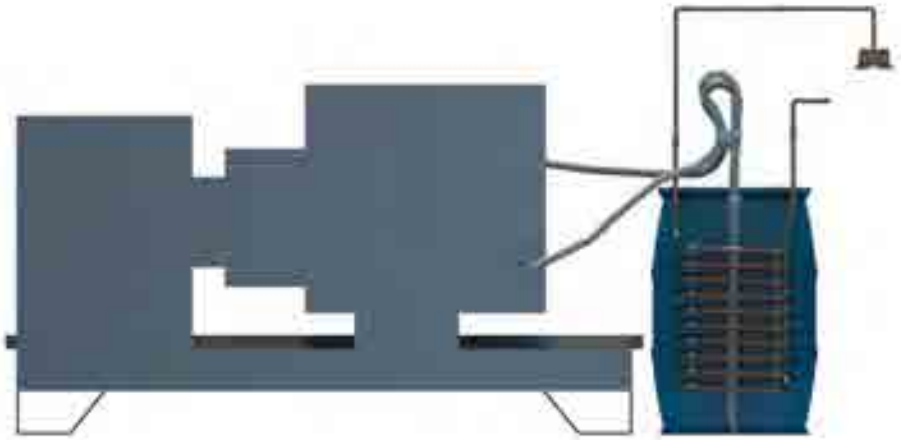


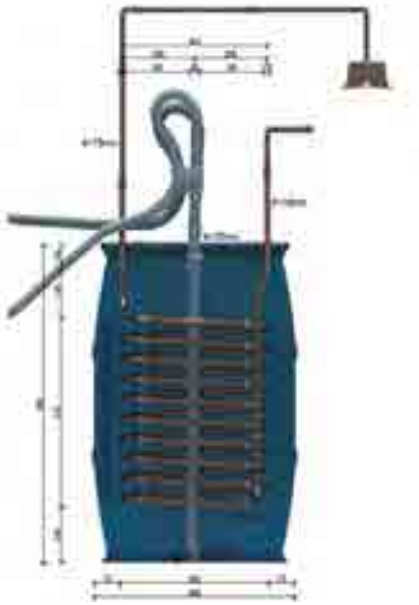
Heat Pump Water Heater

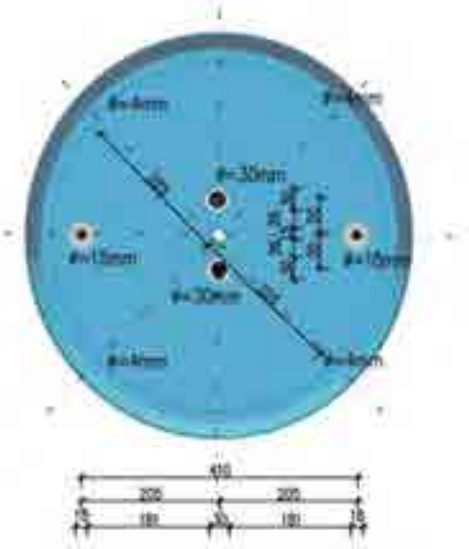


Gas absorption heat pump water heaters are an ideal low carbon solution than electricity-based heat pumps

Heat Recovery from Generator

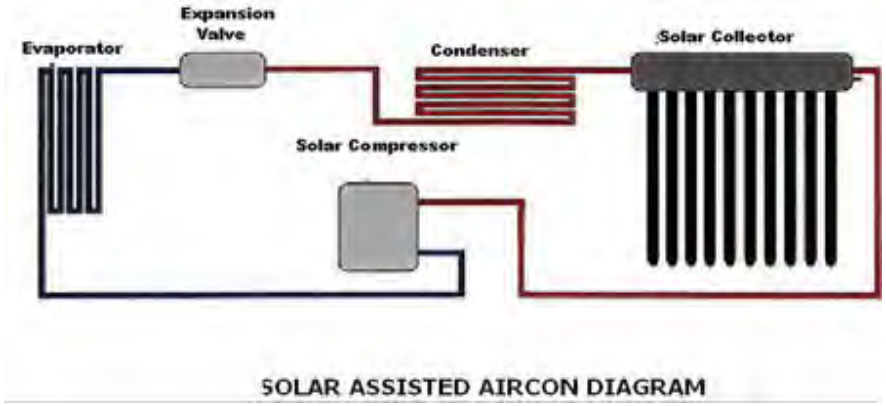






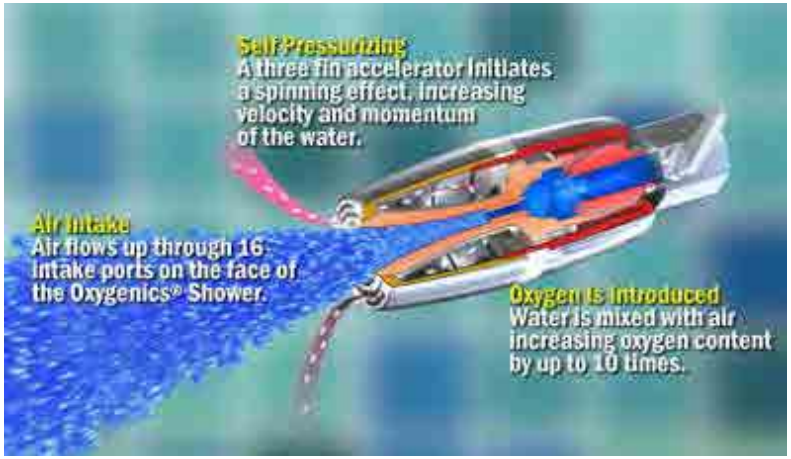
Heat Recovery from Air-Conditioner Condensing Units for Generation of Hot Water

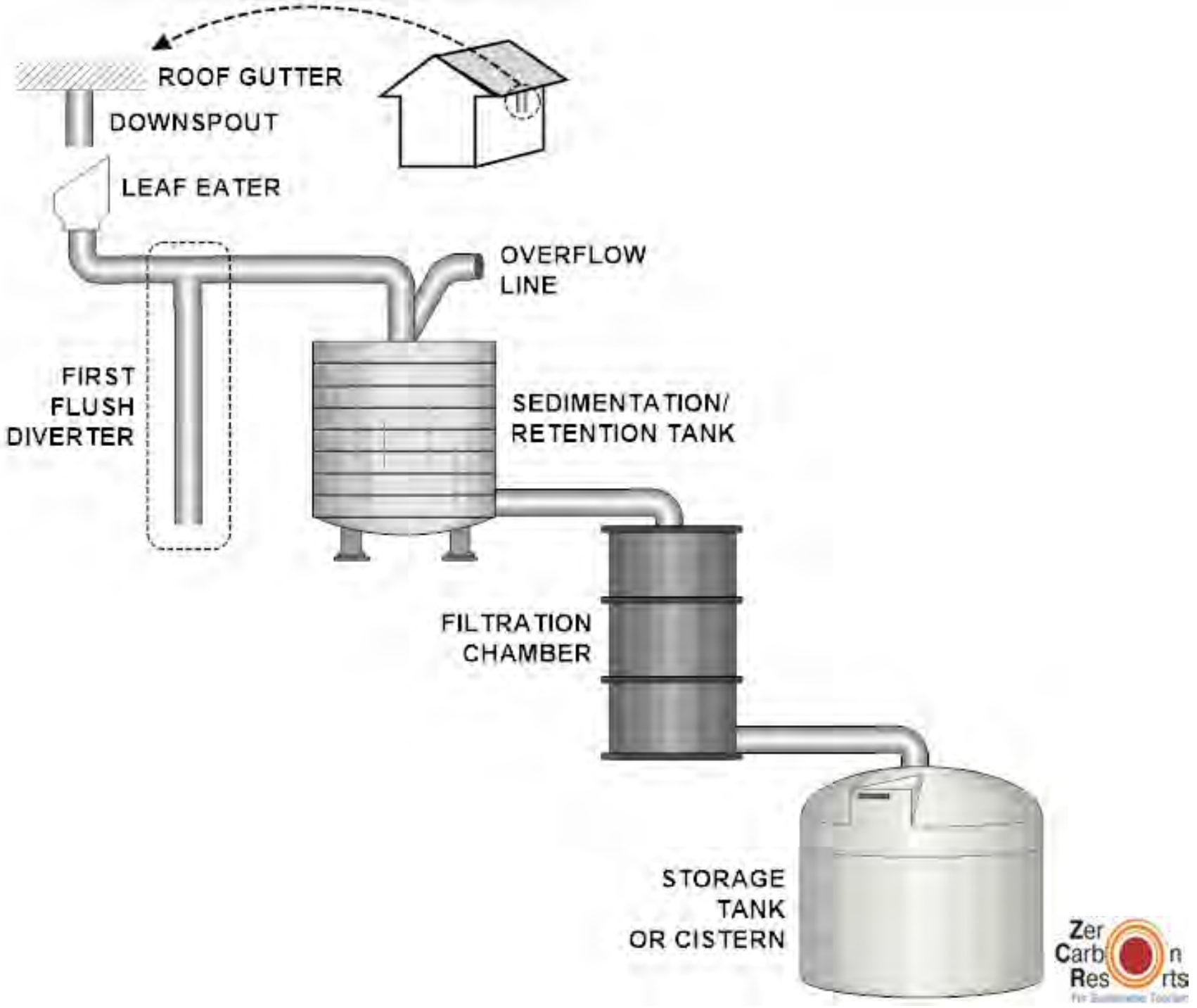
Solar Assisted Air Conditioner



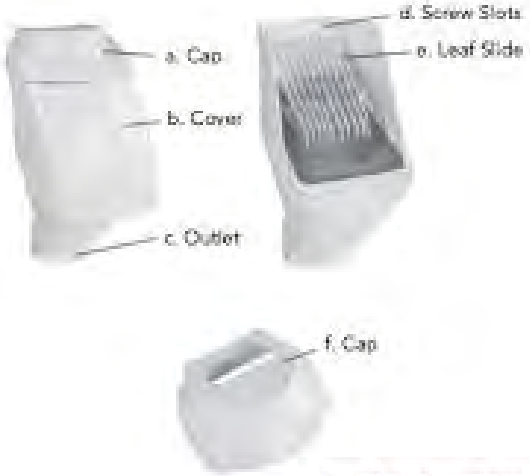
SOLAR ASSISTED AIRCON DIAGRAM

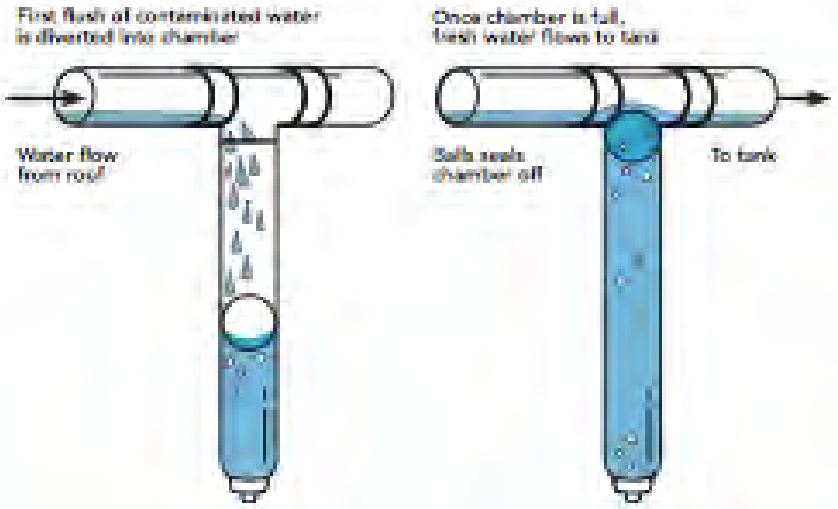
Faucet and Shower Aerators

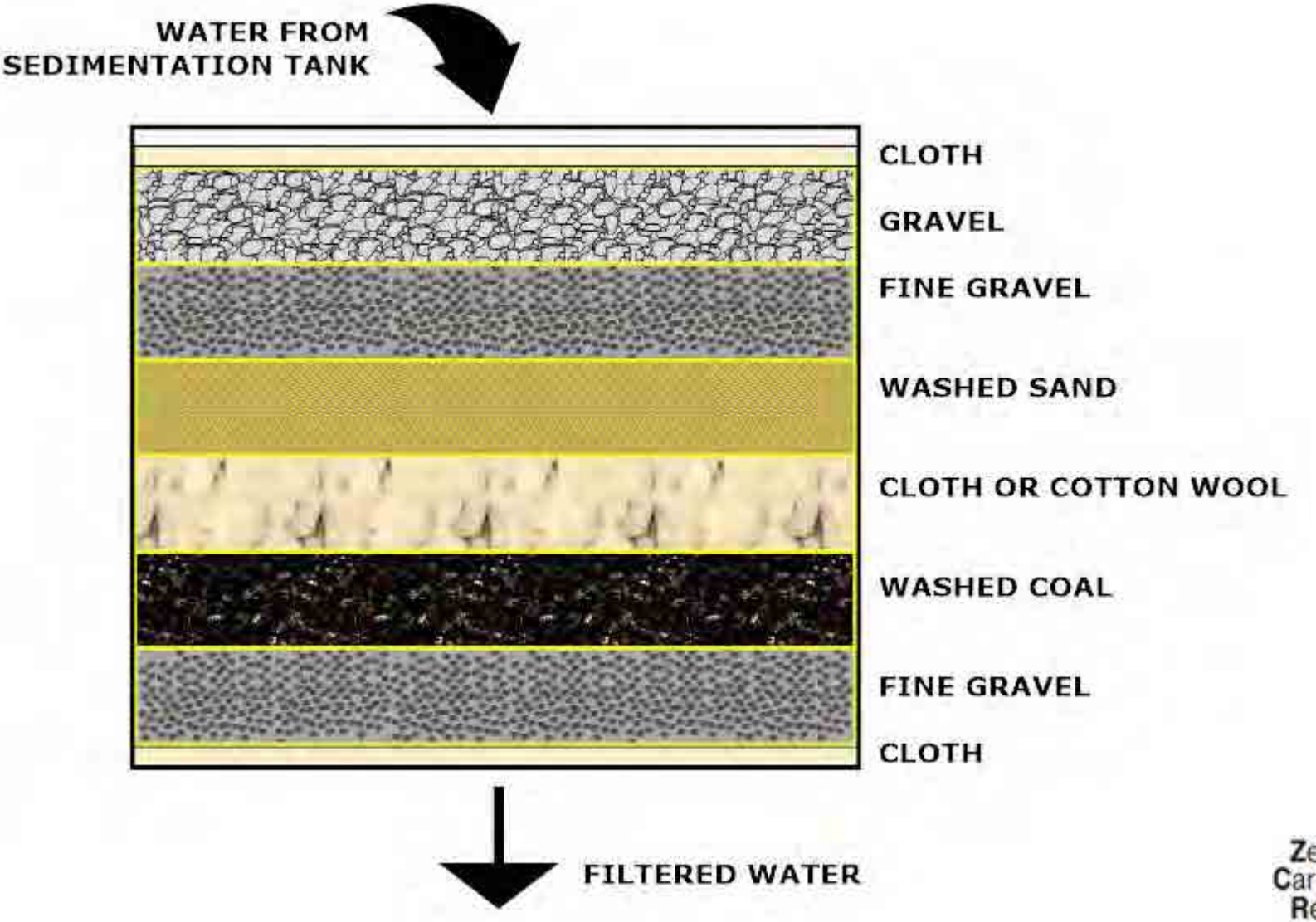



ROOF GUTTER
DOWNSPOUT
LEAF EATER
OVERFLOW LINE
FIRST FLUSH DIVERTER
SEDIMENTATION/ RETENTION TANK
FILTRATION CHAMBER
STORAGE TANK OR CISTERN

First flush diverters. filtration system






WATER FROM
SEDIMENTATION TANK
CLOTH
GRAVEL
FINE GRAVEL
WASHED SAND
CLOTH OR COTTON WOOL
WASHED COAL
FINE GRAVEL
CLOTH
FILTERED WATER

Porous Pavement


ถังผลิตก๊าซชีวภาพ
BIOGAS PRODUCTION
ถังพัก
ถังผลิต
ถังผลิต
3


PORTABLE
DIGESTER

Chemicals

☑ Salt Chlorinator

☑ Eco-Friendly Cleaning Products

- Involve the surrounding local community for sourcing:
  - Products and supplies
  - Food
  - Labor

Local Product Sourcing

Redesign

Development of energy and water autonomous establishments

Adoption of knowledge from ZCR learning centers

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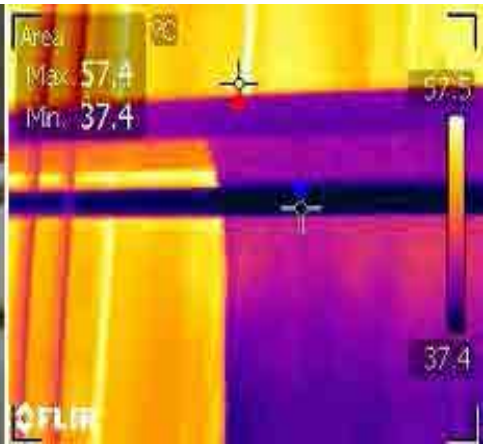
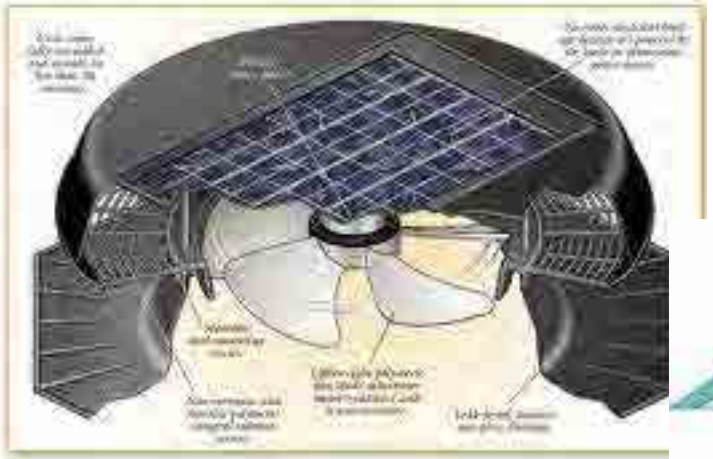
Day lighting through skylight in lobby area

Roof Ventilation and Insulation



Solar Roof Ventilator



Project Funded by

switchasia
European Union's Switch Asia Program

Austrian Development Cooperation

Project Implemented by

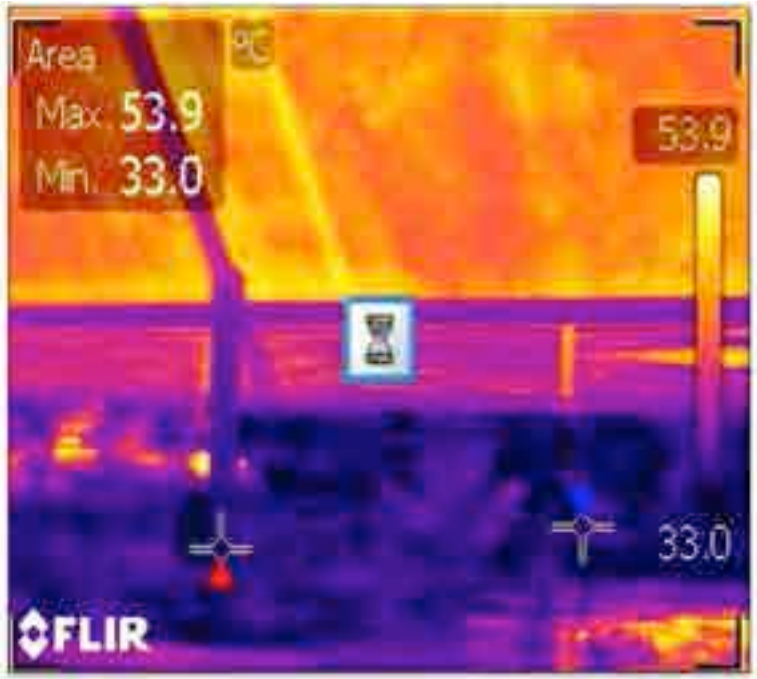
GrAT

Skylight with Ventilation

Sun Screens

Living Roofs

Daluyon Beach & Mountain Resort, Palawan



Improved pavilion with installed water sprinkler, insulation at the roof, wooden ceiling, and rattan chandelier for better aesthetic effect and as an added insulation

Option of Guest to use Air-conditioner or Natural Ventilation

Natural Ventilation - to let natural fresh air to circulate in the room.

Windows

Air-con mode

ZCR Bamboo Showcase Cottage Prototype
Palawan, Philippines

The ZCR Bamboo Showcase Cottage:

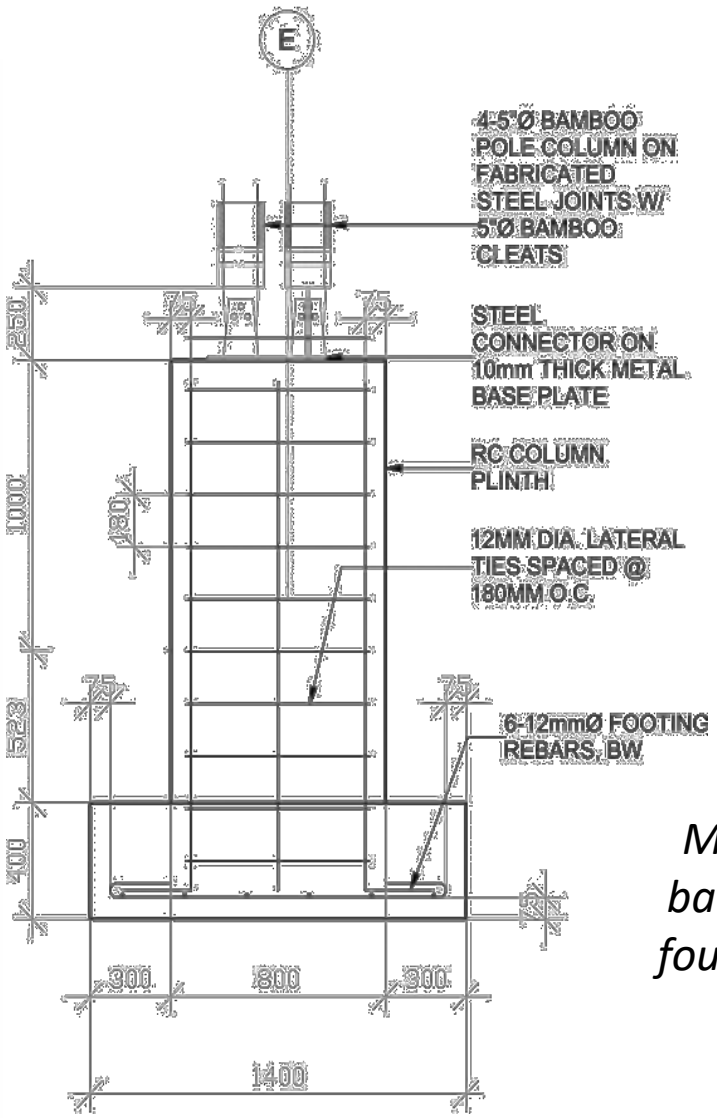
DEVELOPMENT OF A LEARNING CENTER

Anahaw Leaves

Anahaw Leaves Treatment:

Soak leaves by <u>a depth of one meter for three days</u> and sun-dry afterwards

Reinforced Concrete Foundation



Mounting the bamboo on the foundation steel anchors

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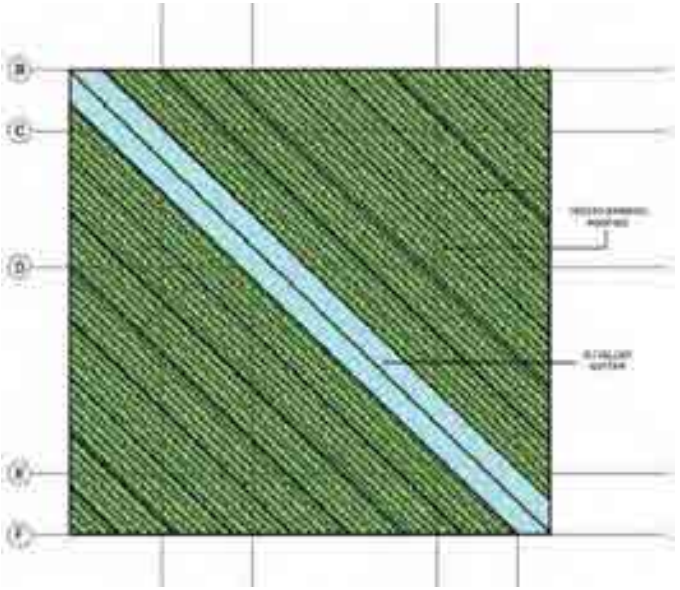
Heat Barrier Roofing



Rammed Earth Wall: Sand + Clay + Water

Solar Photovoltaic Panels

Mainly, solar panels supply electric power for the entire cottage.

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Solar Cooker

This uses energy of direct sunlight and converts it into heat of up to 200°C.

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For Sustainable Tourism

Solar Water Heater

Tubular Solar Lighting

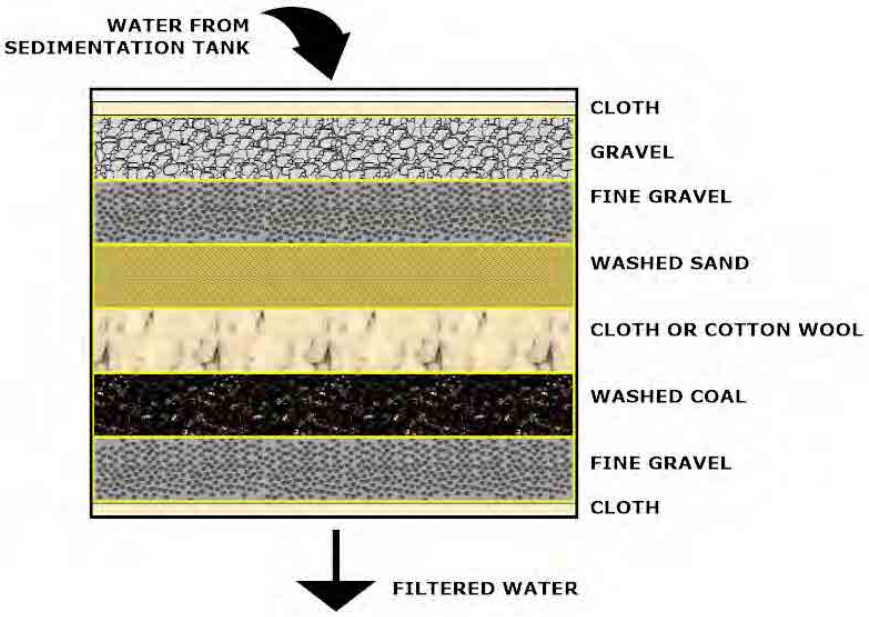
Efficient Technologies

- **Low wattage, high volume ceiling fan** (5-18 watts): active cooling component
- **Efficient lighting** (3-5 watts)
- **Efficient refrigerator**
- **Efficient television**

Building Monitoring System

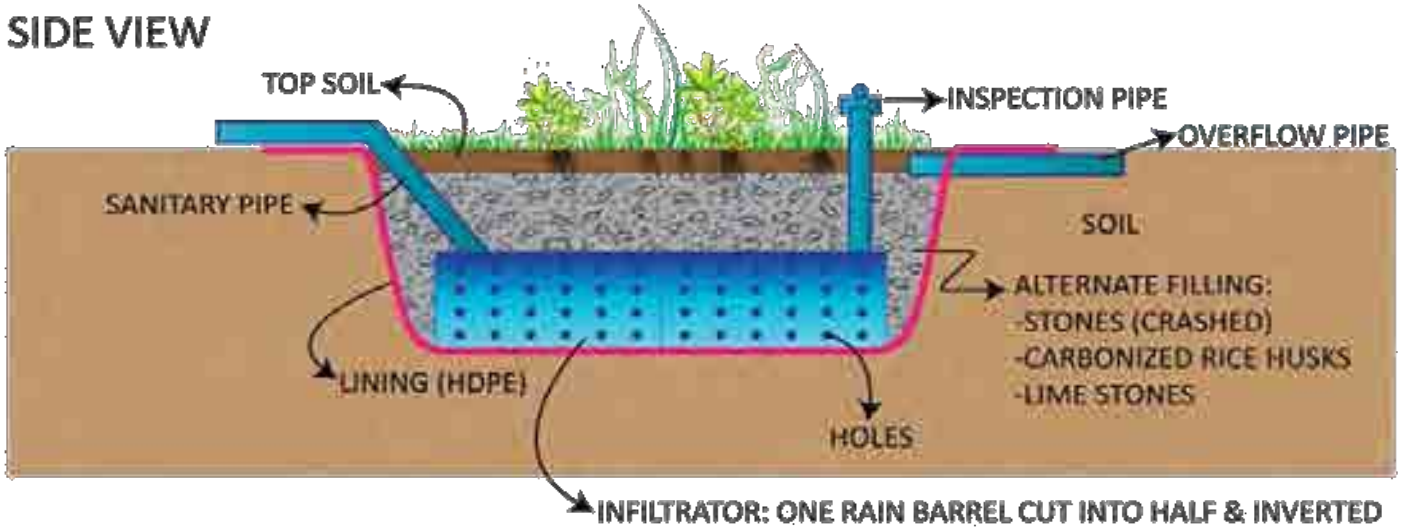
The whole building performance is monitored and analyzed for knowledge transfer and dissemination.

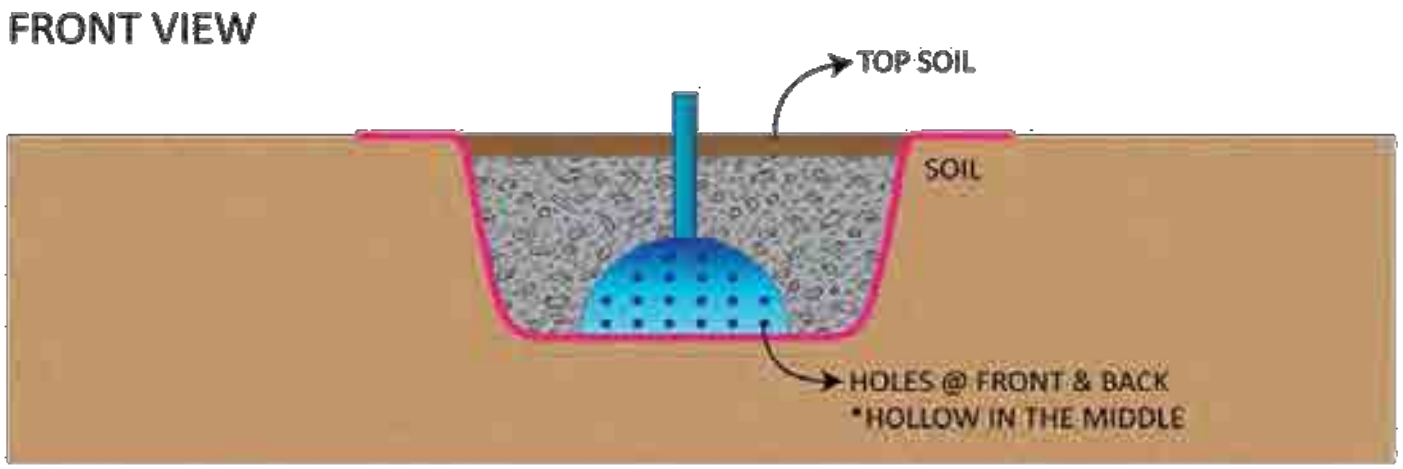
Rainwater Harvesting System



Purification of the water before going to the cistern

Wastewater Treatment / Watson Wick Method





Supply Chain: LOCAVORE



"Locavore" a concept of consuming locally and organically grown food.

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For Sustainable Tourism

Consumption Comparison!

Conventional Resort Cottage

Appliance or Equipment	Power Rating (W)	Time of use (h/day)	Time of use (specific)	Annual Energy Consumption (kWh/year)
Lighting	300	11	0600 – 0800 1100 – 1400	1,204.50
Air conditioner (living room, 2.5 hp)	1,865	8	1000 – 1400 1800 – 2200	5,445.80
Air conditioner (bedroom, 1.5 hp)	1,119	12	0000 – 1000 2200 – 2400	4,901.22
Computer	40	4	0700 – 0800 1300 – 1400 1900 – 2100	58.40
Cooking	1,500	3	0600 – 0700 1100 – 1200 1700 – 1800	1,642.50
Refrigerator	100	12	0000 – 2400	438.00
Water heater	5,000	3	0600 – 0730 1900 – 2030	5,475.00
Television	100	2	0600 – 0700 1900 – 2000	73.00
Auxiliaries	3	24	0000 – 2400	26.28
Total				19,264.70

ZCR Cottage

Appliance or Equipment	Power Rating (W)	Time of use (h/day)	Time of use (specific)	Annual Energy Consumption (kWh/year)
Lighting	80	6	0600 – 0700 1700 – 2200	175.20
Fan (living room and bedroom)	10	15	0000 – 0800 1300 – 1400 1700 – 1800 1900 – 2400	54.70
Computer	40	4	0700 – 0800 1300 – 1400 1900 – 2100	58.40
Cooking	0	3	0600 – 0700 1100 – 1200 1700 – 1800	0.00
Refrigerator	45	24	0000 – 2400	394.20
Water heater	0	3	0600 – 0730 1900 – 2030	0.00
Television	25	2	0600 – 0700 1900 – 2000	18.25
Auxiliaries	3	24	0000 – 2400	26.28
Total				727.08

*In comparison to a standard conventional resort cottage which may consume 19,264.70 kWh per year, the **cottage consumes only 4%** of that or 727.08 kWh per year.*

www.ZeroCarbonResorts.eu

Thank you

Zero Carbon Resorts

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