Grenada Capacity Building Programme for Energy Management and Energy Audits

Webinar II : **Save Energy, Save Money**

Target audience: Hotel and Financial Institutions

Date: 12- 13 April 2022
Time: 9:00 am to 12:00 pm Grenada Time

Content

- **Background**
  - *Objective, Methodology, Target audience*
  - *Grenada's Energy Sector*
- **Day-1: Concepts of Energy and How to Conduct Energy Audit**
  - *Fundamentals of Energy, Efficiency and Conservation*
  - *Importance of energy Management*
  - *Step by step Approach in Conducting Energy audit*
  - *Energy Audit Tools and Its Importance*
  - *Q&A*

Content

- **Day-2: Energy Efficiency Measures & Financial Planning**
  - *Review of Energy Use*
  - *Activities to do During Site Assessment*
  - *Identification of Energy Conservation Measures*
  - *Energy Saving Calculations*
  - *Financial Viability of The Project*
  - *Energy Audit Report Format*
  - *Q&A*

Introduction

Background

Government of Grenada recognized that **reducing the energy consumption, managing and increasing the efficiency of energy usage** - is the quickest and cheapest way to have the highest returns on investment for energy transition.

Objective

To strengthen various energy end users' capacity, to undertake energy audits and identify energy cost saving measures which can be implemented practically.

Methodology

Conduct a series of webinars and a face-to-face training program

- ☞ Developing training materials
- ☞ Webinars – for various type of end users (First Webinar : **Homeowners and Youth**)
- ☞ Hotel & Commercial Establishments and Financial Institutions

Partners : SIDS Lighthouses Initiative, IRENA
Ministry of Finance, Planning, Economic Development and Physical Development
Ministry with responsibility for Climate Resilience and the Environment
NDC Partnership

Day - 1

Session II

Introduction to Energy and Electricity Concepts

Introduction - Energy

- What is Energy…???

Energy is the ability to do work

….Reading a book.

….Running around the school.

….Riding a bike.

….Even resting needs energy.

Definition of Energy

- ***Energy*** – It is the ability/capacity to do work
- ***Work*** – It is the transfer of energy. A force of moving a body over a distance is called work.
- ***Power*** – It is rate at which energy is converted to work

Power = Energy / time (Joules per second or Watts, W)

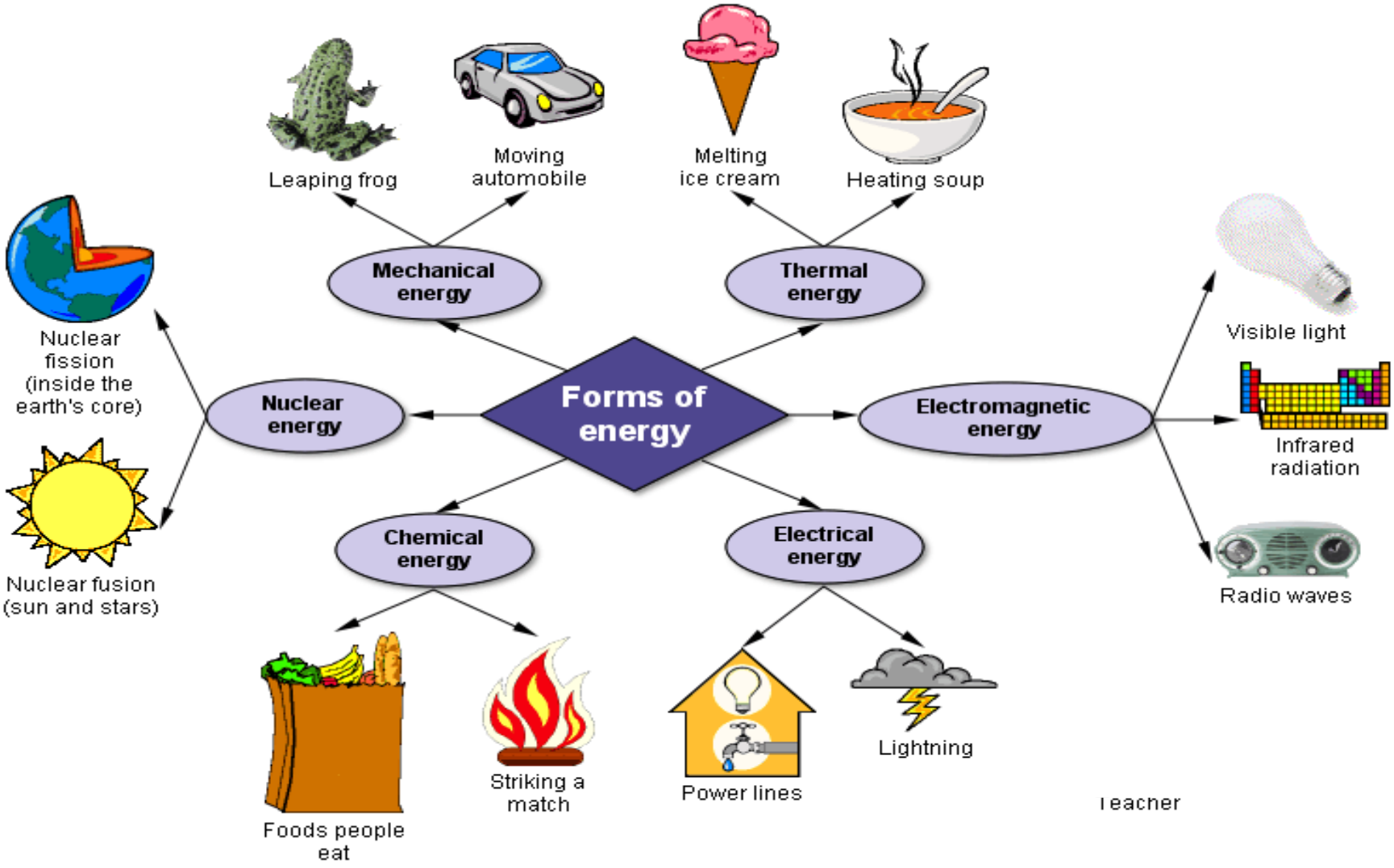
Energy = power x time (kWh)

- ***Kilowatt (kW)*** - A unit of measure of the amount of power needed to operate equipment, equivalent to one thousand (1,000) watts
- ***Kilowatt-Hour (kWh)*** - A measure of electrical energy equivalent to power consumption of 1000 watts for 1 hour. It is the most commonly used unit of measure indicating the amount of electricity consumed over time (*what you get charged*)

1 Joule = Newton x meter

1 Watt = volt x ampere

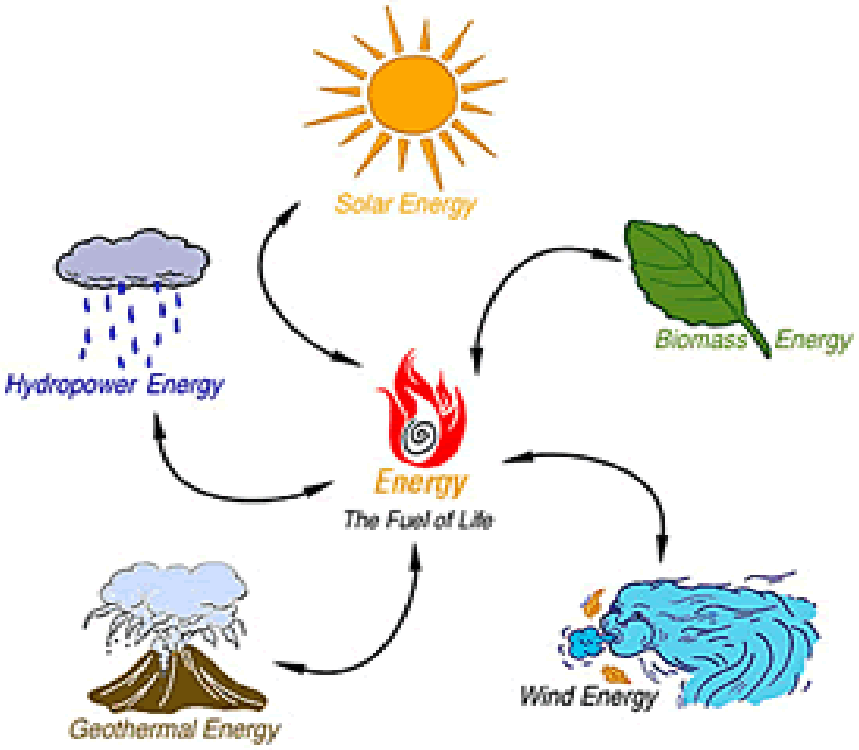
Different forms of energy



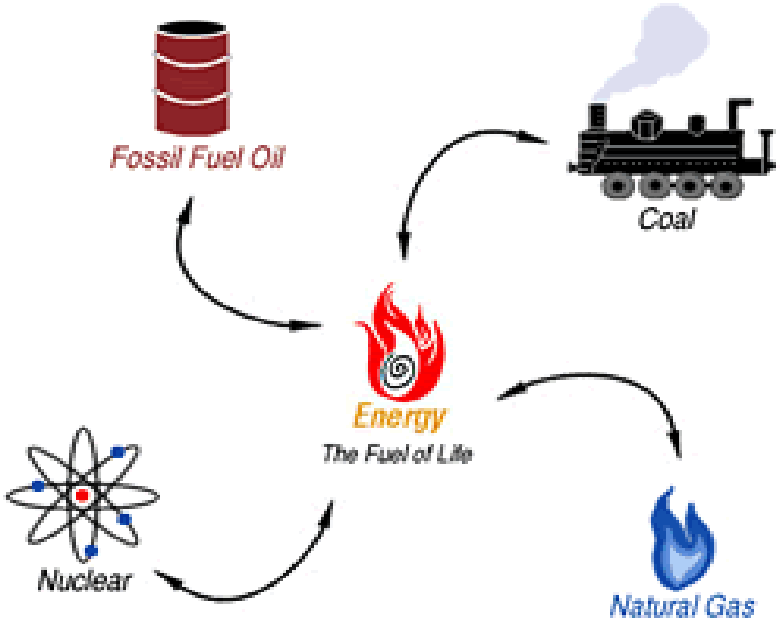
Sources of Energy

Sources of energy refer to - from WHERE energy comes from.

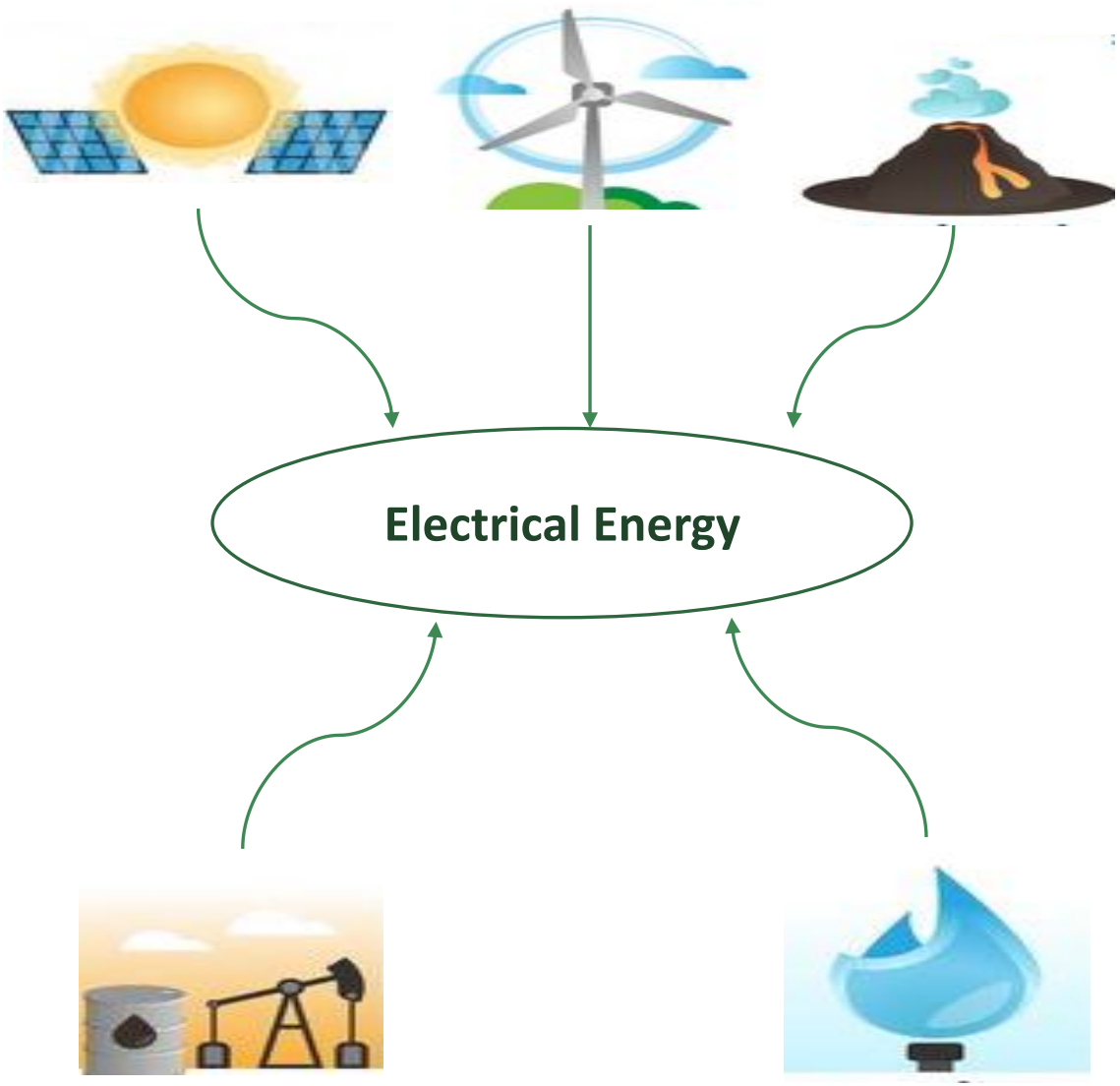
Renewable Energy Sources

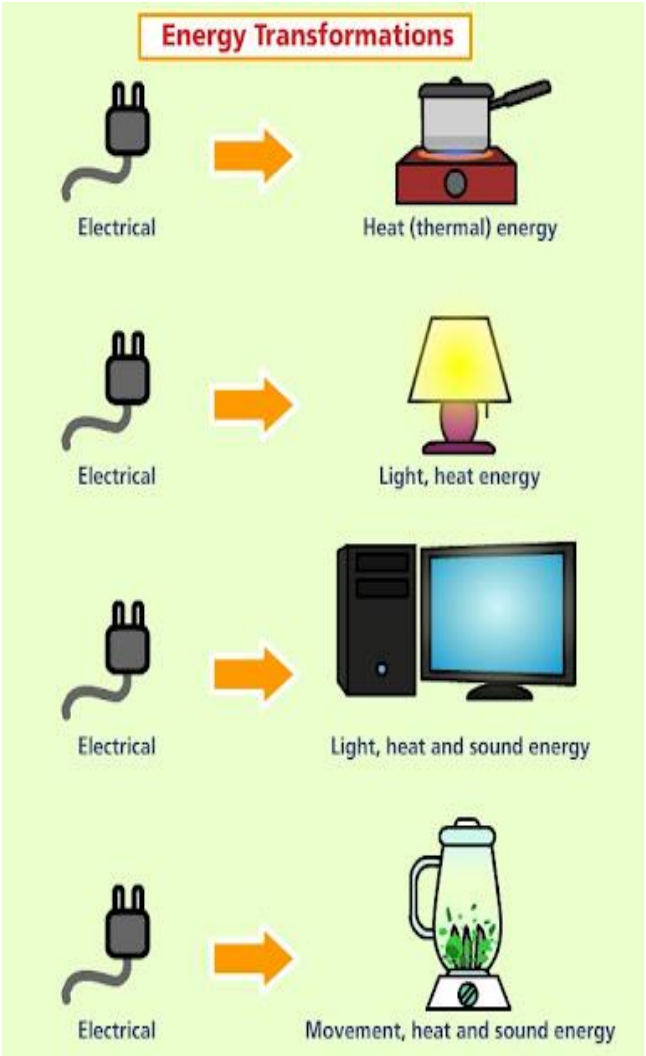


Non-Renewable Energy Sources



Electrical Energy and Transformations

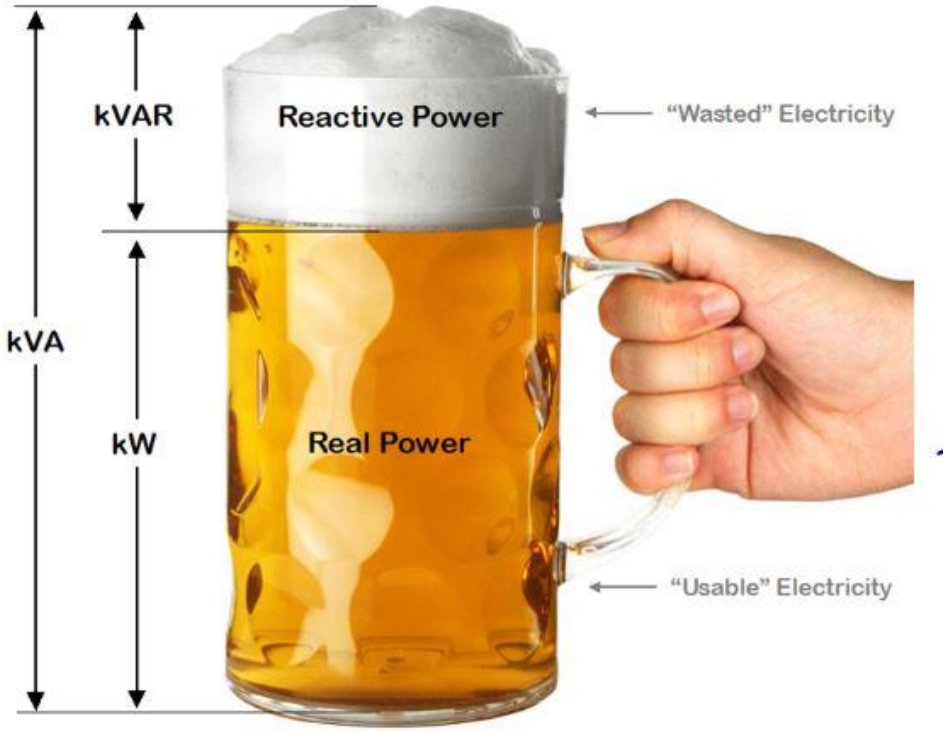




Component of Electric Energy

Electric Energy

- Active Power or True Power (kW)
- Reactive Power (kVAR)
- Apparent Power (KVA)



Electrical Energy : Metering

How To Decide Which Appliance Will Consume More Energy

- Depends on **“INPUT POWER” or “Active Power”** of the appliance.
- Generally written on **“Product Information Tag”** and measured in **Watt (W) or Kilo Watt (kW)**

1000 W = 1KW OR 1W = 1/1000 KW

INPUT POWER (kW)	X	TIME (Hr)	=	ELECTRIC ENERGY (kWh)

1 Unit of Electric Energy Consumed = 1 kWh
It is the amount of active power or true power consumed in one hour

Energy Efficiency v/s Energy Conservation

Energy efficiency is **"using less energy to provide the same service"** either through technology upgradation or through proper utilization of the appliances.

Energy conservation is any **"behavior that results in the use of less energy"** to do same work**.**

- ☞Turning off a light is energy conservation, not energy efficiency
- ☞Replacing conventional incandescent with LED lamps, is energy efficiency
- ☞Setting air conditioner thermostat temperature at 24^{o}C, is energy conservation.
- ☞Replacing non-inverter air conditioner with inverter air conditioner, is energy efficiency.

Energy Efficiency v/s Energy Conservation

Both energy efficiency and energy conservation refer to saving energy through its wise and rational use.

Energy Efficiency looks to employment of different technologies to use less energy while providing the same output or function, for example using front load washing machine instead of top load.

Energy Conservation refers to behavioral practices, which results in using less energy, such as drying cloths outside in SUN.

Energy Conservation Vs Energy Efficiency

Energy Efficiency	Energy Conservation
Energy Efficiency is using technology that requires less energy to perform the same function (or) service -**Technology improvement / advancement**	**Energy conservation** is using less energy by changing our **behavior or habits** (in addition to using energy more efficiently)
Examples	**Examples**
Use of high-efficiency lighting bulbs (LED)	Use of Staircase
Use of high-efficiency ceiling fans (BLDC)	Use of bicycle
Use of inverter-based air conditioner	Use correct size burner based on a cooking vessel
Use of induction technology – cook stove	Citizens interested in saving energy make use of solar or renewable energy sources (like solar battery back-up for mobile charging /recharging battery/ torch light etc.)

Energy Conservation Vs Energy Efficiency

Energy is particularly important to a country's economic growth and development

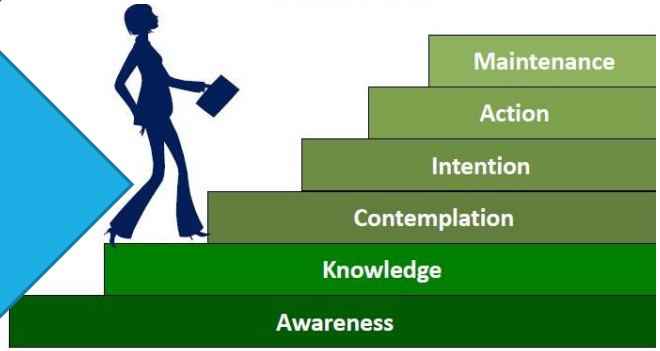
Incandescent Bulb

Energy efficiency is the goal to reduce the amount of energy required to provide products and services.

LED

Energy conservation is the saving of energy by any means including energy efficiency.

Energy Management is defined as the steps taken to minimize usage and wastage of energy.



Energy Conservation Vs Energy Efficiency

Scenario: ***Commuting to 2rd Floor in a building in public place***

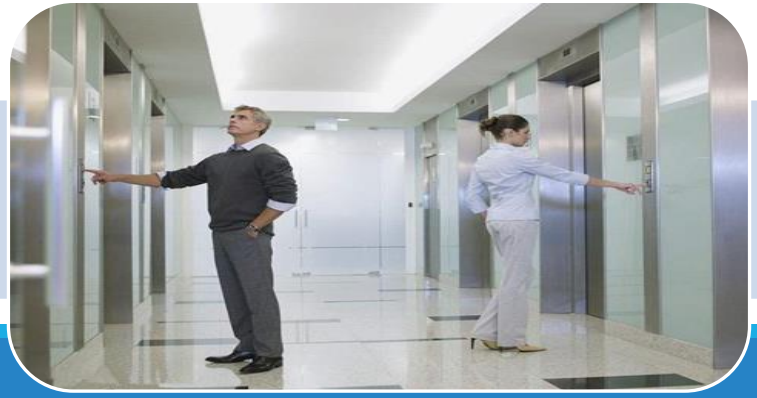
Energy Conservation

Taking the stairs

Efficient Use of Energy

More than 3 people using the lift at the same time

Energy Intensive Process



Single person using the lift

Energy Conservation Vs Energy Efficiency

Scenario: ***Travelling to nearest supermarket***

Energy Conservation

Using a bicycle for shopping

Efficient Use of Energy

Hatchback car for moderate shopping

Energy Intensive Process

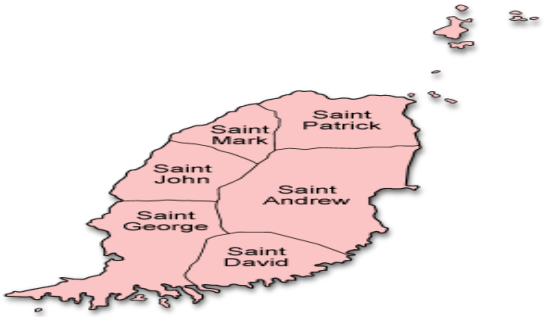
Pick-up SUV car with minimal shopping

Benefits of Energy Conservation

Homes/Buildings/Industry

- Reduced Energy Bills
- Increased comfort levels
- Increased productivity
- Reduced maintenance cost
- Increased profits.

National



- Reduced fuel imports
- Resources to improve infrastructure
- Optimise the additional power demand
- Supports in meeting NDC commitments.

Global

- Reduced Greenhouse gas emissions
- Maintains a sustainable environment.

Importance of Energy Efficiency

Scarcity+ Cost +
Environment

&

Energy
Efficiency
is a must

Economic development
of Grenada

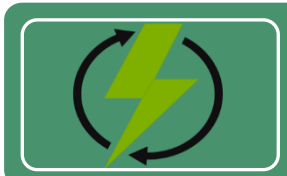
+

Released
capacity
5 MW

Energy Management

Efficient energy use, is using less energy to provide the same level of energy service

Wastage of Energy



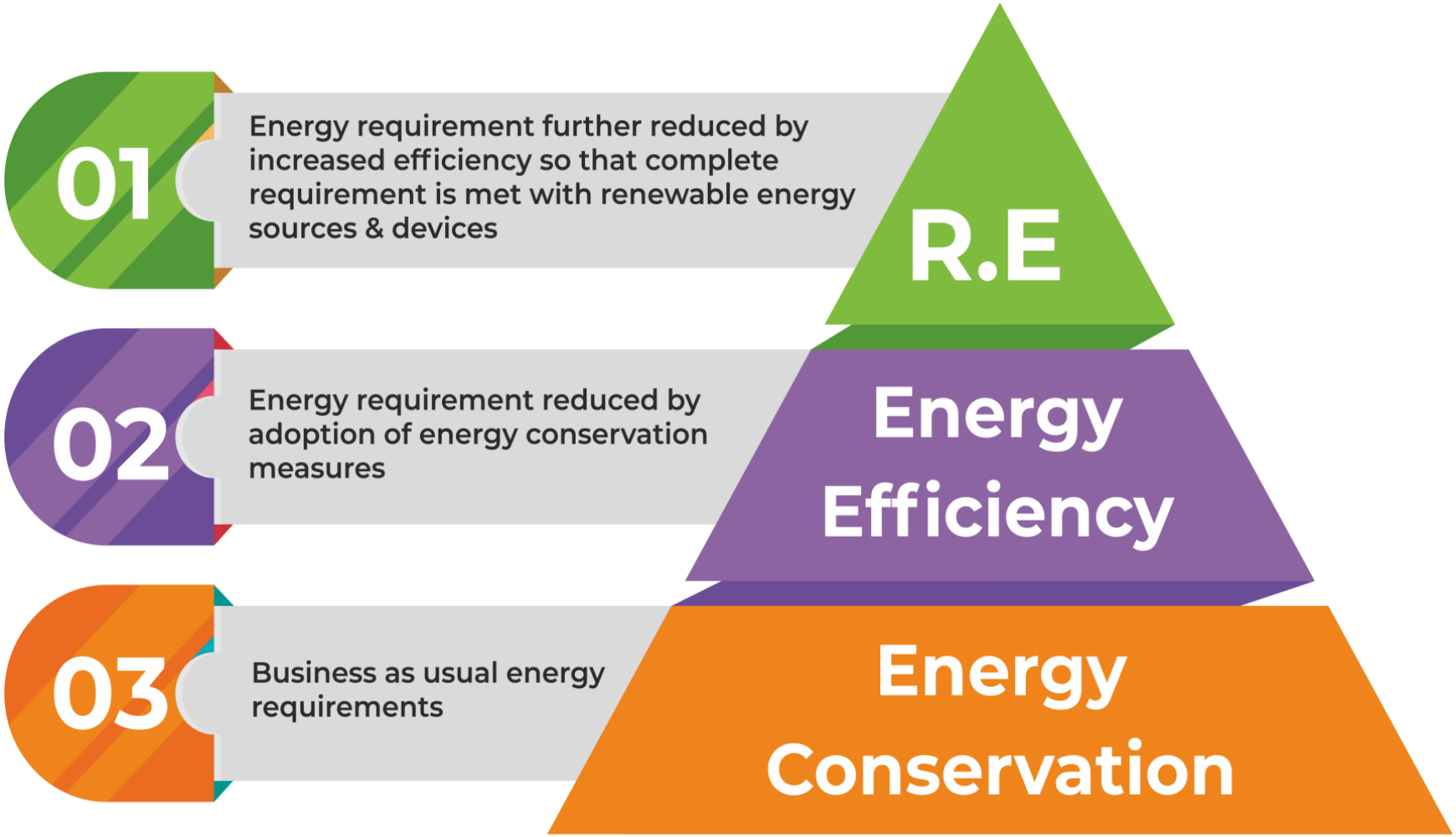
Minimise energy consumption

Energy Intensity

To look over again and again

“Energy Management Involves the utilization of the minimum quantity of energy required for the task at an appropriate quality, neither better nor worse than needed”

Energy Pyramid - Approach



Typical challenges – Energy Efficiency

- Energy is being monitored by electrical departments and they are responsible for power supply up to the equipment's;

- Separate departments for maintaining equipment's and instrumentation;

  - ❖ Difficulty in assessment and advice
  - ❖ Co-ordination problems
  - ❖ Limited focus, expertise in convincing end users and other department
  - ❖ Limited expertise in convincing budget heads to allot budget for Energy Conservation activities

- No procedure of re-looking the SOPs to refine the operating parameters based on todays or future requirements;

- Vendors / Equipment suppliers are not influencing the customer in terms of EE (only low-cost approach)

Energy Efficiency drive to Overcome the Challenge

- Draw out an Energy Vision for Facility (Building, Hotel, School etc.,)
- Compliance to various local Acts / Standards;
- Dedicated and empowered team to initiate, convince all stake holders, create awareness & implement energy efficiency measures;
- Set Target, allocate budget, Monitor, control and verify;
- Holistic approach with external expert intervention;
- Look forward to the ISO EE 50000 standards;
- Draw up a monitoring plan based on metering features of facility

Energy Saving Opportunities in Existing Buildings – Air Conditioner

Most of these buildings are having window and split air conditioners

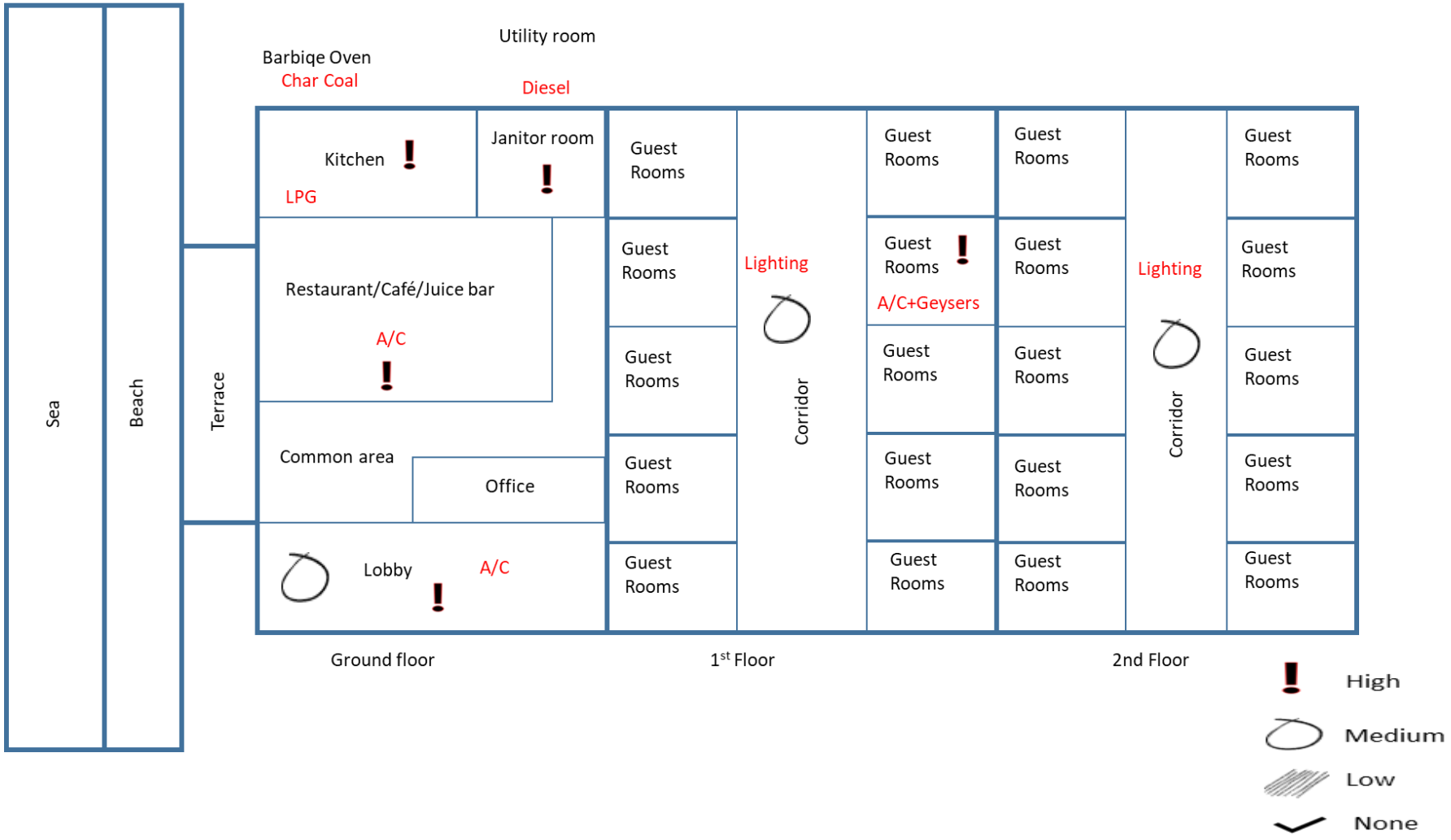
- Absolutely no operational control
- Poor maintenance
- High specific consumption
- Porous envelop

Commercial buildings having fully air-conditioned space like shopping malls (or) Hotels have installed new generation equipment's. We find

- Gaps in operation
- Gaps in maintenance
- No micro level monitoring plan

Energy Profile Map : Hotel

Energy Mapping



Identified Hotspots : Hotel

S No	Priority Symbol	Area	Hotspot Identified	Impact	Indicator Value
1	!	Guest Rooms & common areas	A/C High electricity usage due to split type A/Cs	Energy waste	Electricty consumption
2	!	Kitchen	LPG & Char-Coal used for cooking and Barbiqe oven	Energy waste	Amount of Char-coal or LPG used per month
3	!	Utility room	High diesel consumption for Diesel powered generator	Energy waste	Amount of diesel used per month
4	!	Guest rooms	Energy consumption of water geysers	Energy waste	Electricity bill
5		Common areas/corridors	Lighting	Energy waste	Electricity bill

Action Plan : Hotel

S. No. from priority table	Priority symbol	Improvement actions	Access to finance requirement	Assigned Person/ Responsibility	Timeline
1.	!	Switch to more energy efficient A/Cs. Use natural ventilation and avoid A/Cs in common areas	Yes		
2.	!	Provide training to kitchen workers and reduce the time they are using fuel without utilizing the heat for cooking.	No		
3.	!	Use solar powered water heaters	Yes		
4.		Use motion sensing switches	No		

Example : Optimizing Lighting

Efficient Lighting system and day lighting

- Use of light shelves and Light Louvers
- Design for maximum day lighting without glare
- Provide light shelves to push natural light deep inside the building

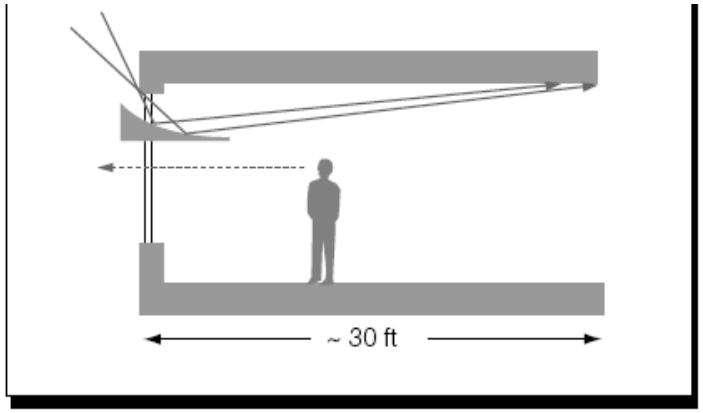
Efficient lamps and luminaries

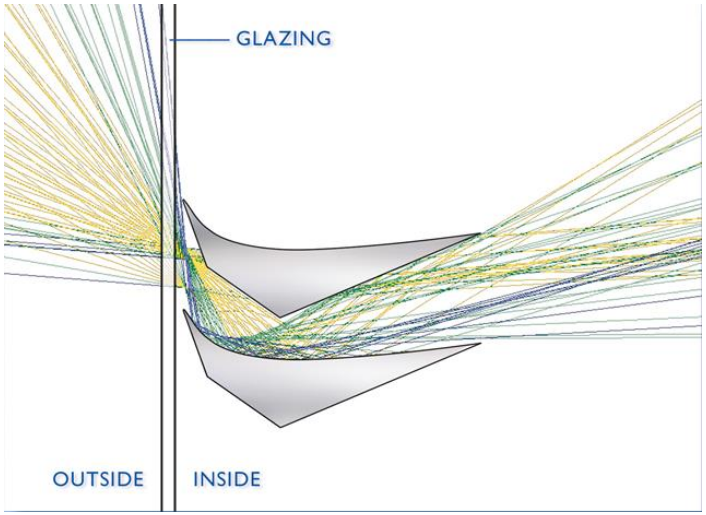
- LED lamps instead of conventional lamps
- Higher efficiency luminaries
- Dimmable electronic Ballasts
- Lighter colored and reflective finishes
- LED for Street lighting and special applications such as building facades

Efficient Controls

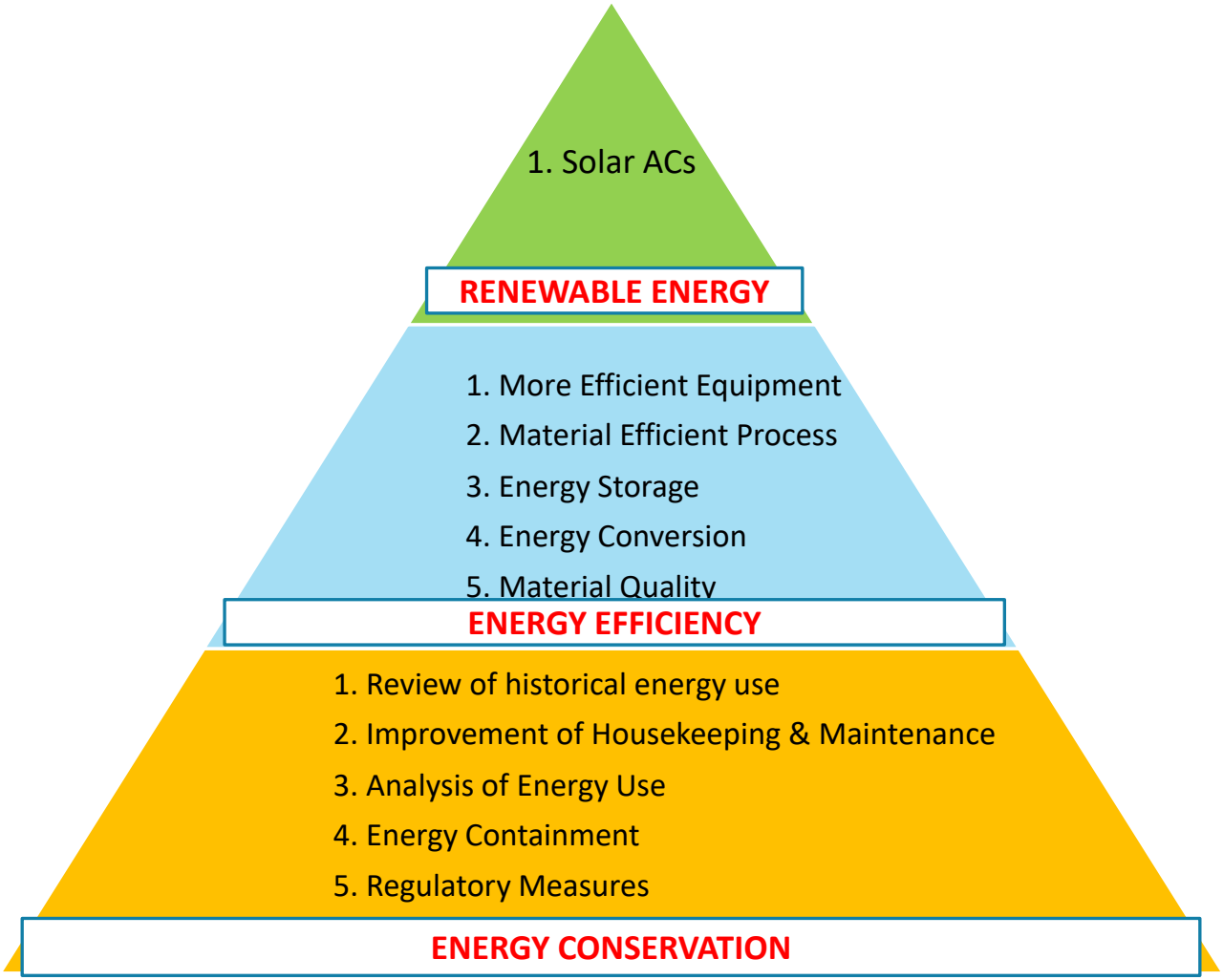
- Occupancy sensors
- Daylight sensors

Task Lighting





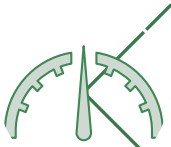
Example : Renewable Energy



Energy Use

Where it is needed

When it is needed

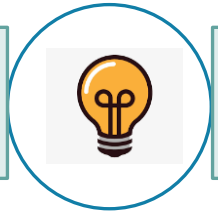


How much is needed

Of what quality is needed

Using most energy and resources efficient system operating on cleanest possible energy

5 T's for Energy Conservation

Turn it **OFF**		Turn OFF/ Unplug the appliances from switchboard after using.
Turn it **DOWN**		Turning down the temperature of heating appliances
Turn it **UP**		Increase the thermostat temperature of cooling appliances
Turn it **AROUND**		Look around and use appliances efficiently.
Turn it **OUT**		Replace old inefficient devices with new energy efficient devices.

Simple Calculation : I

New Staff induction training focus on to realize that conscious effort helps in conserving energy

Practice

- ☞ Make a list of equipment's/ appliances / gadgets used in the Guest Room;
- ☞Find out the wattage of each;
- ☞Find out the electric consumption of each;
- ☞Find out the number of hours each in used per day;
- ☞Find the rate of electricity per unit from the hotel electricity bill;
- ☞Calculate the electricity consumed per day by each type of room and the cost

Appliance / Gadget	Number	Energy used per hour	Number of hours	Total energy per day	Total energy per month	Cost, ECD per kWh
Tube Light (28W)						
TV (150W)						
kettle (120W)						
Ceiling Fan (75W)						

Simple Calculation : II

A fuel-efficient vehicle will cover more distance and hence not only conserve energy but also helps in reducing air pollution (for Hotels & Resorts)

Practice

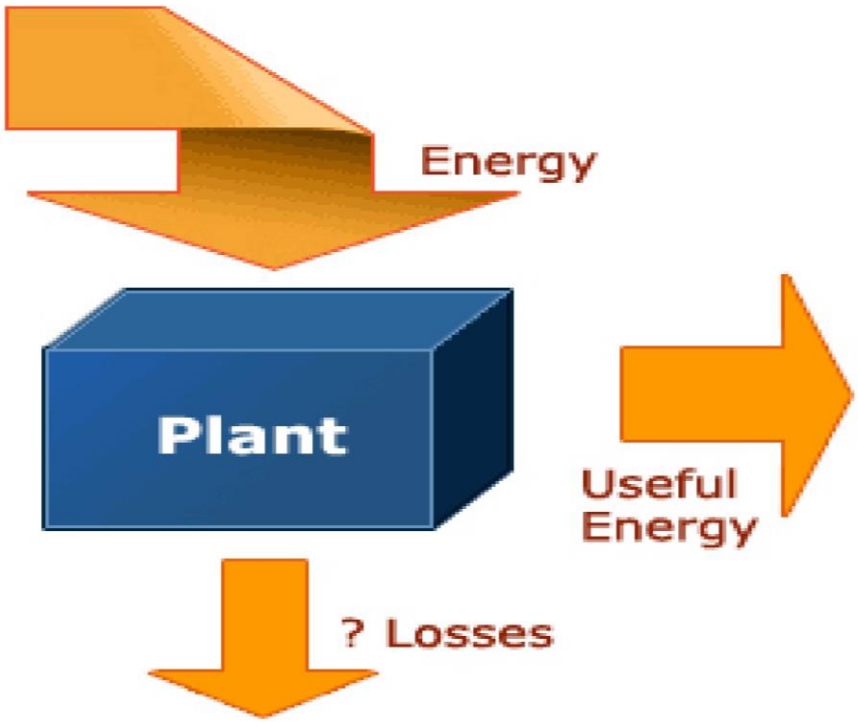
- ☞ Observe the odometer reading of 2-3 common cars/Pick-ups in use under Ministry;
- ☞ Note the odometer reading when the fuel tank is filled up;
- ☞ Note the reading again when the tank needs to be filled up again;
- ☞ Note the quantity of fuel required to fill the tank;

Vehicle	Odometer reading when tank is being filled (a)	Odometer reading when tank needs to be filled (b)	Distance covered C = b - a	Quantity of fuel required to fill tank (fuel required to cover distance) (d)	Fuel Efficiency E = c/d
Car : Model 1					
Car : Model 2					
Pick-up : Model 1					
Pick-up : Model 2					

Session III

Conduct of an Energy Audit

What is Energy Audit



Energy audit is defined as " The verification, monitoring & analysis of energy use, including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption.

Energy audit is an activity or process to reduce the **losses** along with **energy consumption** without effecting the overall output.

Need of Energy Audit

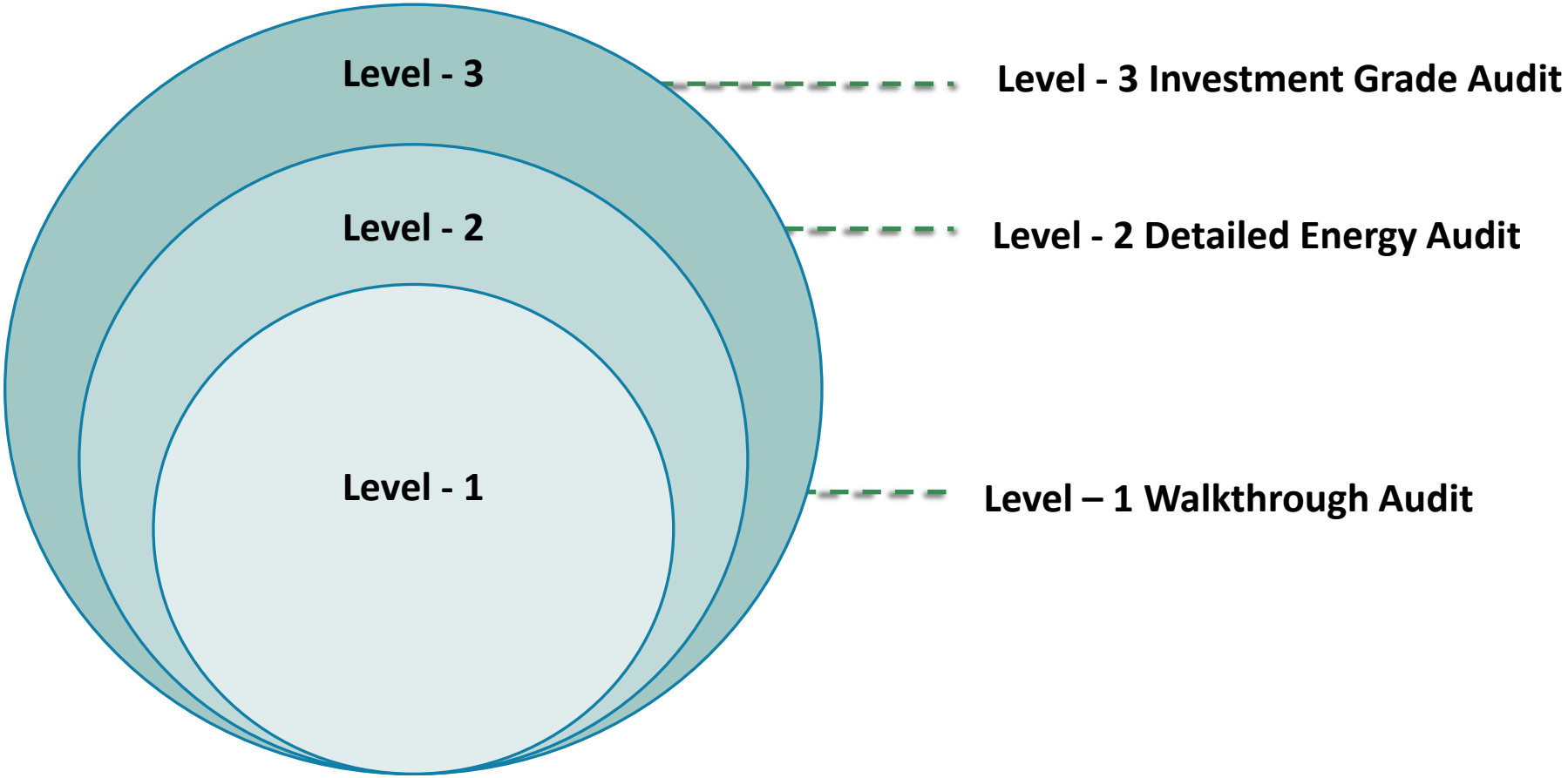
An energy audit will

- Help to understand how energy and fuel are used
- Identify where waste occurs and where there is a scope of improvement
- Give a positive orientation to energy cost reduction
- Translate conservation ideas into reality

Stages of Energy Audit

Types of Energy Audit

Based on the methodology, Energy Audit can be categorized into three types



Level – 1 Walkthrough Audit

- Also called simple audit or walk-through audit.
- It involves:
  - **One** day or **half**-day visit to a plant.
  - Provides quick overview of **energy use patterns -** *Based on observation and historical data collected.*
  - Identify **energy – intensive** processes and equipment.
  - Identify **energy inefficiency**, if any
  - Estimate the **scope for saving** - *Findings will be a general comment based on **energy best practices***.
  - Identify the most likely **areas for attention**
  - Identify **immediate** (no-/low-cost) **improvements**
  - Identify areas for more **detailed study/ measurements**.

Level -2 Detailed Energy Audit

Detailed Energy Audit evaluates all systems and equipment which consume energy and the audit comprises a detailed study on energy savings and costs.

Detailed Energy Audit is carried out in **THREE** phases

Pre-Audit Phase

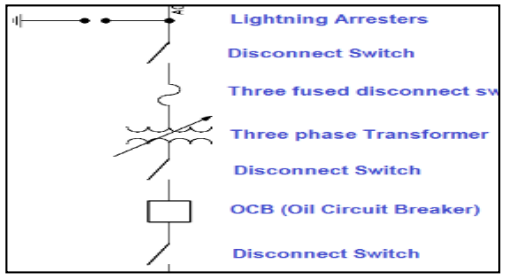
A pre-audit phase is the first phase or first step of a detailed energy audit.

During this phase, the energy auditor intends to take the following measure:

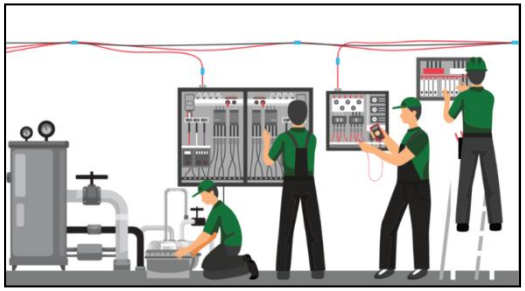
Discussion with the site manager about the energy audit

Explains the meaning of the energy audit and data needed

Analyzes the major area of energy consumption



Obtains the site drawings such as a single line diagram of the electrical circuit, building layout, HVAC system



Energy audit team is finalized

Audit Phase

Collect historical energy consumption details & equipment's installed

Preparing process flow diagram and do energy balance

Identification of Energy Conservation (ENCON) opportunities

Energy-saving and payback period

Technical and feasibility report

Implementation plan for energy-saving measures

Post-Audit Phase

Assist and implement **E**nergy **C**onservation **M**easures and monitor the performance

IMPLEMENTATION

MONITORING

Level – 3 Investment Grade Audit

- It includes steps of both **Level-1 & Level-2** energy audit.
- It provide, in-depth financial analysis such as Net Present Value (NPV) and Internal Rate of Return method (IRR) for the major capital investments.

This type of audit recommends **Guarantied Saving Verification Plan** – Which includes energy saving measures along with financial analysis such as NPV & IRR

Energy Audit Instruments

- To conserve energy, it is necessary to know how & how much energy is being consumed.
- Hence, Instruments Play a vital role in energy audit to characterize and quantify energy.
- Instruments also provide a means to monitor equipment performance and check condition
- Various categories of portable energy audit instruments are

Thermal | **Mechanical** | **Chemical**

Electrical | **Lighting**

Electrical Instruments

Power quality analysers/Load analysers

To measure instantaneously and also to record various electrical power parameters such as

- The fundamental value of Voltage and Current,
- Voltage and Current total harmonic distortion,
- Individual Voltage and Current harmonics
- Active, Reactive and Apparent Power (P, Q, S);
- Power factor
- Frequency
- Voltage and Current Unbalance assessment
- Demand analysis
- Other power quality parameters such as surge/dip and transient analysis

It is possible to download the recorded data to MS Excel for further analysis.

Three Phase Load Analyzer

Usage: Feeders where data need to be logged for three phase (3Ø) loads which are not balanced.
Example: Main incomers of the facilities lighting feeders etc

Single Phase or
Three Phase Balanced Load Analyzer

Usage: Feeders where data need to be logged for single phase (1Ø) and three phase (3Ø) balanced loads

Example: Single phase feeders like household incomers, three phase balanced loads like large motors and air conditioning units.

Instantaneous Power Analyzer

Usage: Can be used to measure instantaneous power of any kind of loads (1Ø or 3Ø). No provision for data recording.

Mechanical Instruments

Tachometer/ Stroboscope

- Speed measurement of rotating equipment such as electric motors, pumps and blowers, conveyors etc.
- Available in contact and non-contact types.

Ultrasonic flow meter

- Measurement of the flow of liquids (Water) through pipelines of various sizes using ultrasonic sensors mounted on the surface of the pipelines.
- Flow can be recorded for the required period and downloaded for analysis

Mechanical Instruments

Anemometer

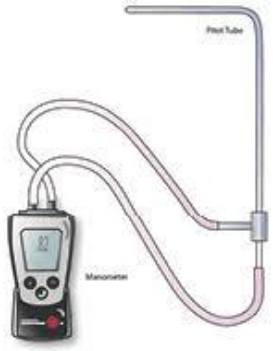
- Used to measure air velocity for estimating air flow rate
- Range: 0 – 30 m/s

Hot wire Anemometer

- Used to measure air velocity in duct to estimate air flow rate as well as air temperature
- Range: 0.25 to 30 m/s and 0 – 80 ^{o}C

Thermal Instruments

Digital manometer



- Used for measurement of differential pressure using pitot tubes
- Used to estimate efficiency of fan

Analog/Digital pressure gauge

- To measure the fluid or air pressure
- Suction and delivery side of pumps and fans

Analog/Digital hygrometer

- Measure temperature & humidity

Thermal Instruments

Infrared Thermometers

- Measurement of Surface Temperatures

Thermography Camera

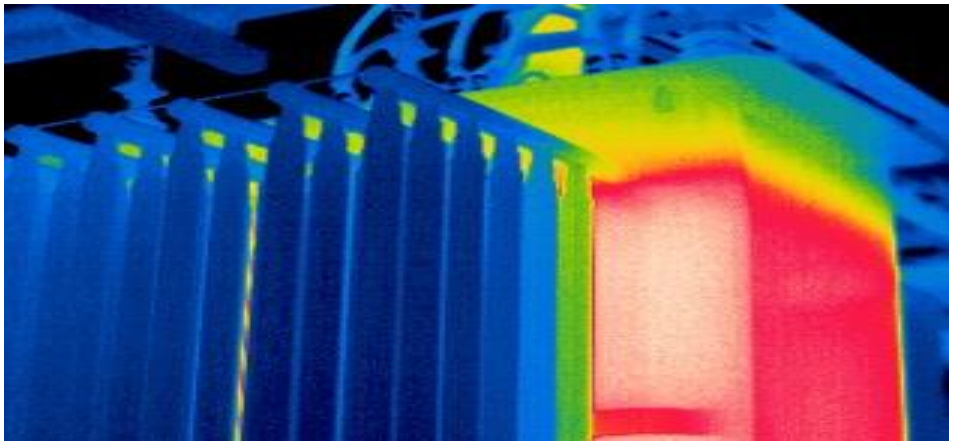
- Capture surface temperature and record it into memory card.
- Temperature variation over a given area.

Thermocouples & Temperature Indicator

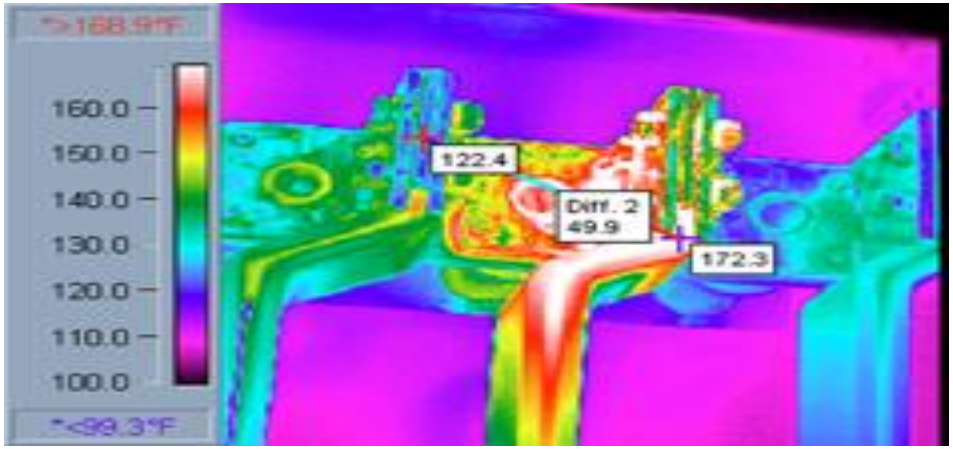
- Measurement of temperature
- Range : -50 to +400°C

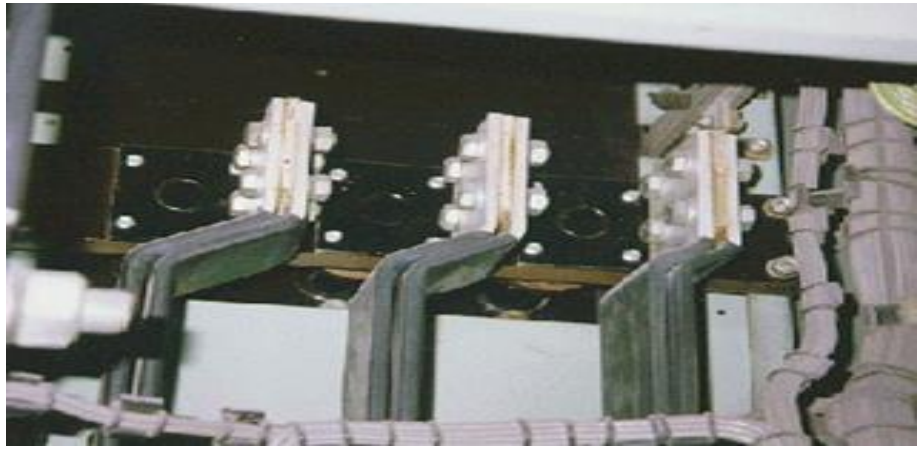
Example of Thermography Images

Cold cooling fins due to low oil level in a transformer



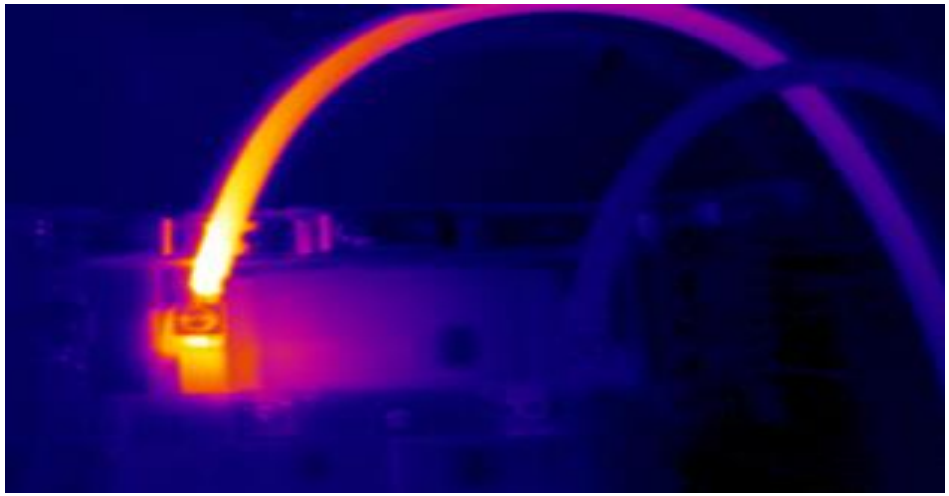
Hot bolted bus bar connection



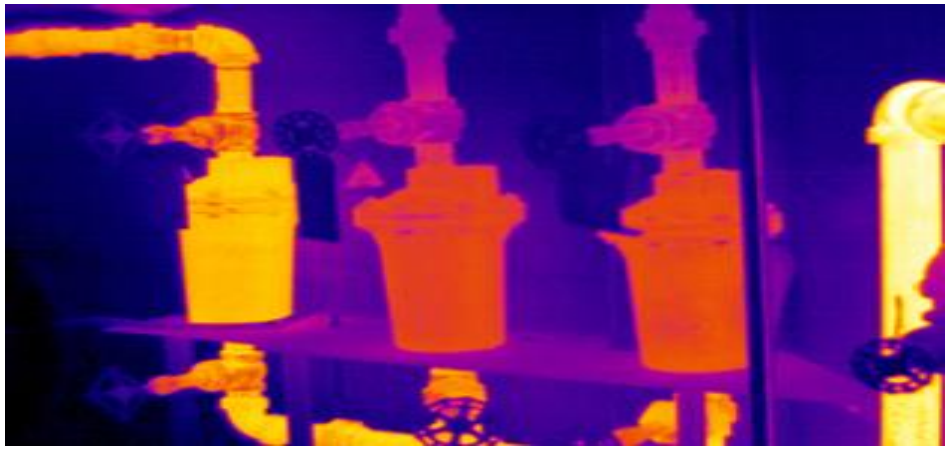


Example of Thermography Images

Hot lug connection



Leakage in Steam Trap



Thermal Instruments

Digital temperature & humidity data logger

- Dry bulb temperature & humidity
- Range: -15 to 150oC and 0 to 99 % RH

Lighting Instruments

Lux meter

- Used for illumination level measurement.
- Can be used to measure the instantaneous value or record the variation in lux level over a period.

Chemical Instruments

Conductivity and PH meter

- To analyse water quality

Flue gas analyser

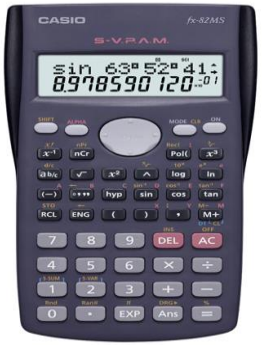
- Measure Oxygen (O2) and Carbon dioxide (CO2) levels in the flue gas
- Other flue gas parameters such as Carbon monoxide (CO), Nitrogen Dioxide (NO2), Temperature and Humidity can also be measured

Other Accessories

Notepad or Tablet

- To quickly record data and observations on site

Calculator



- To do calculation

Measuring Tape

- To measure diameter or length of duct

Thank You