EN 410
Energy Management

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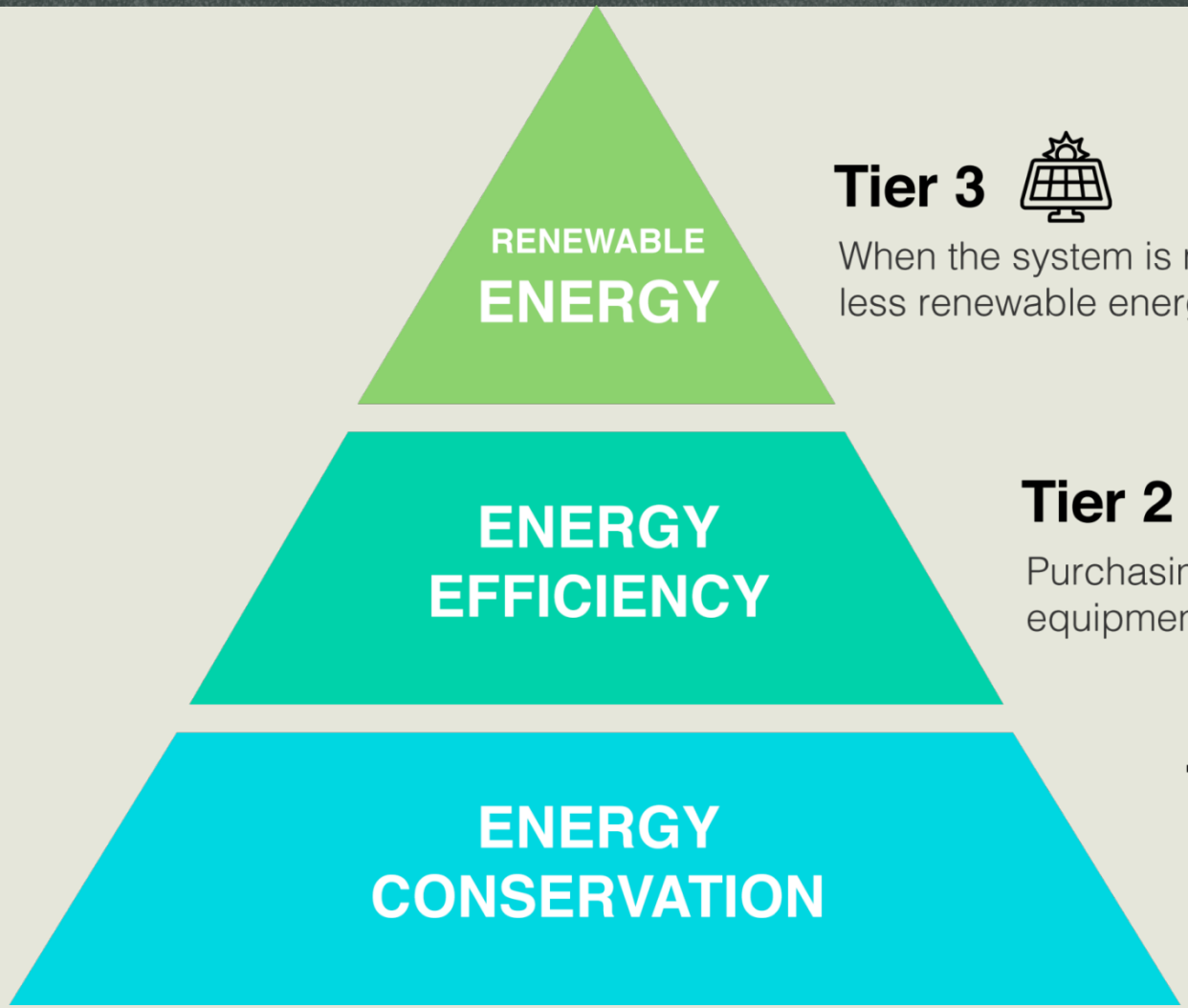
Recap

- Global and Indian energy scenario
- Energy security
- Necessity of energy management

Energy Pyramid



Tier 3

When the system is modified to use efficiency, less renewable energy is needed

Tier 2

Purchasing and installing efficient equipment and processes

Tier 1

Largely based on behavioural & operational practices.
Best return on investment.

Energy Management

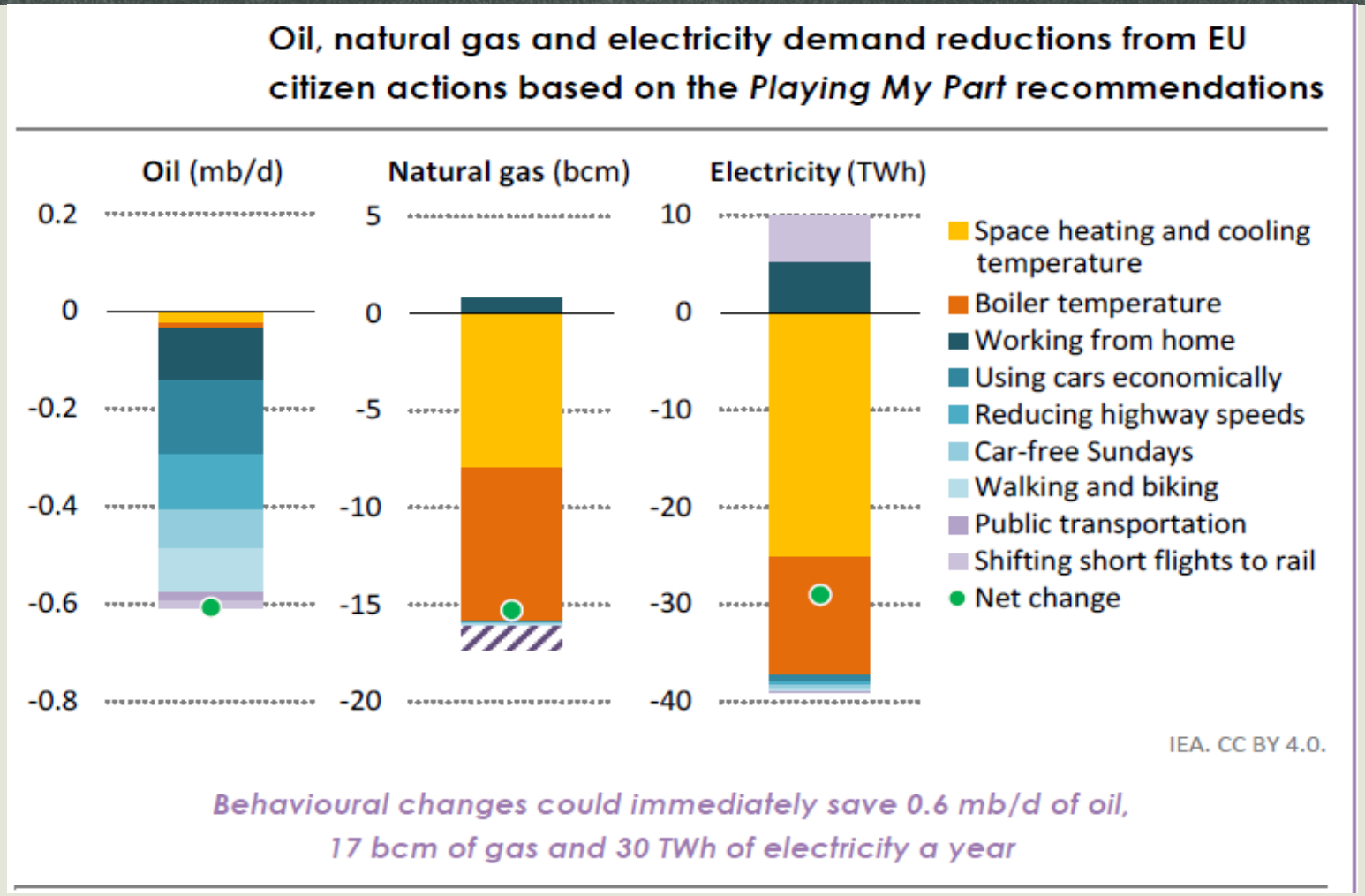
Objective

The judicious and effective use of energy to maximize profits (minimize costs) and enhance competitive positions

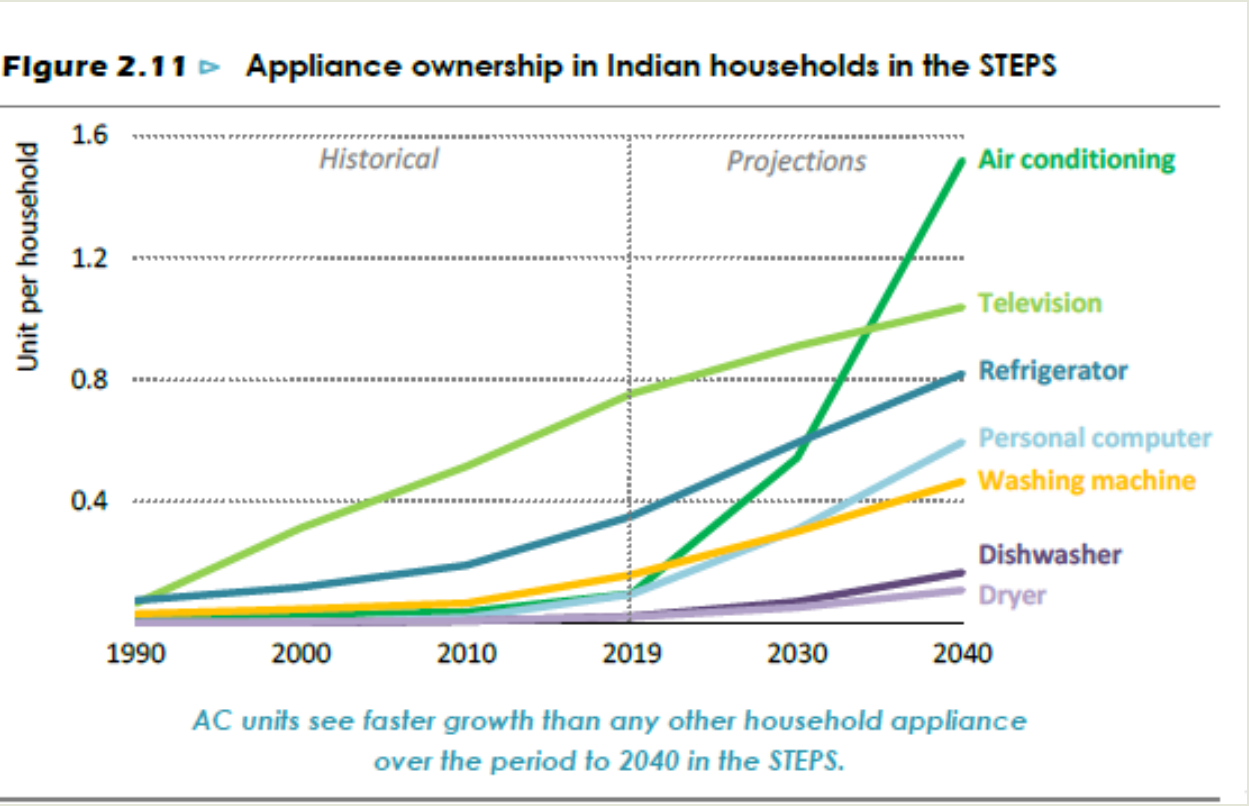
Benefits

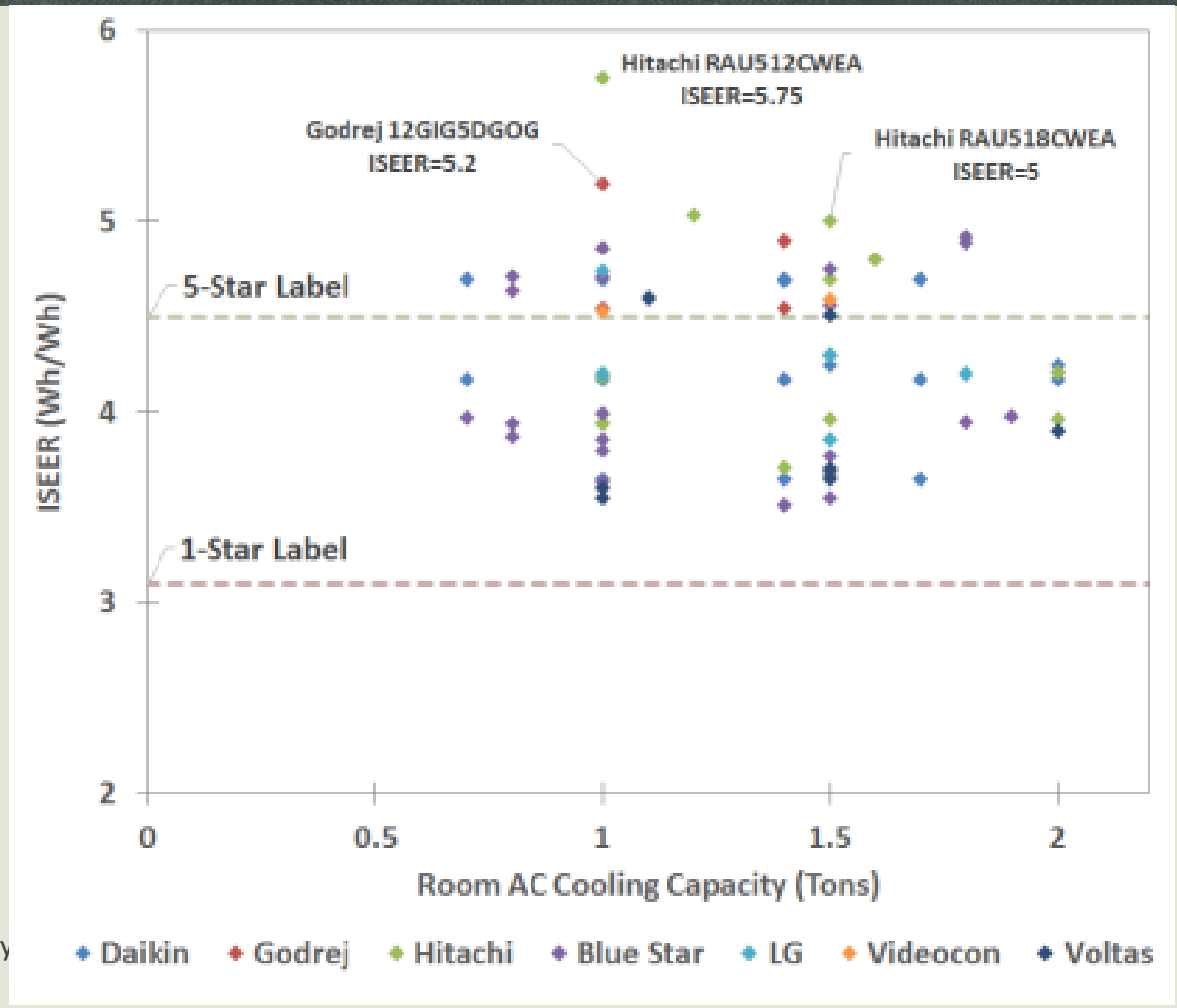
- Reduce the greenhouse gases and improving air quality
- Improving the national energy security index
- Reduce the impact of brownouts or interruption in supplies

Energy Conservation



Energy Efficiency - Often considered as an alternative fuel

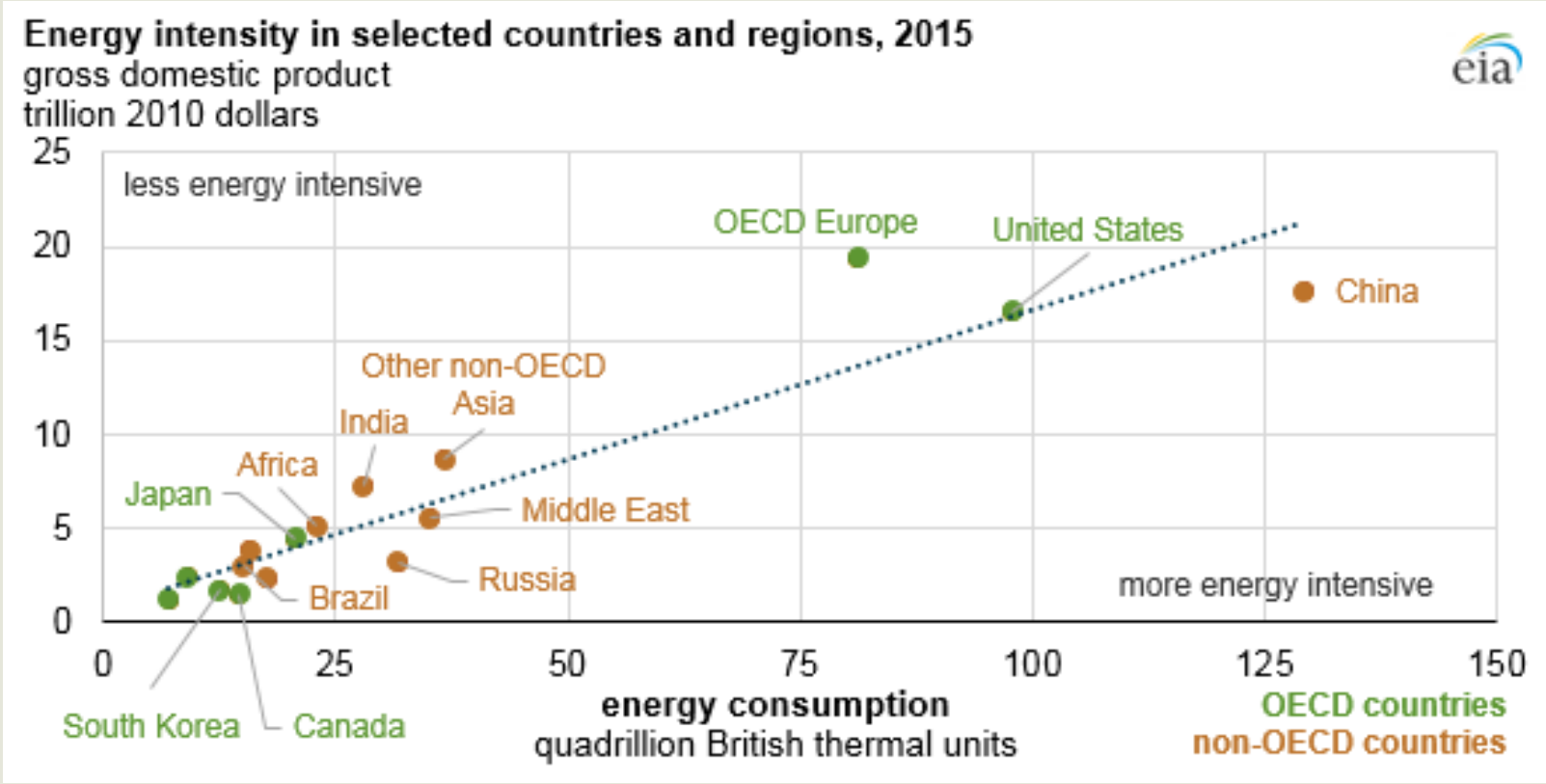




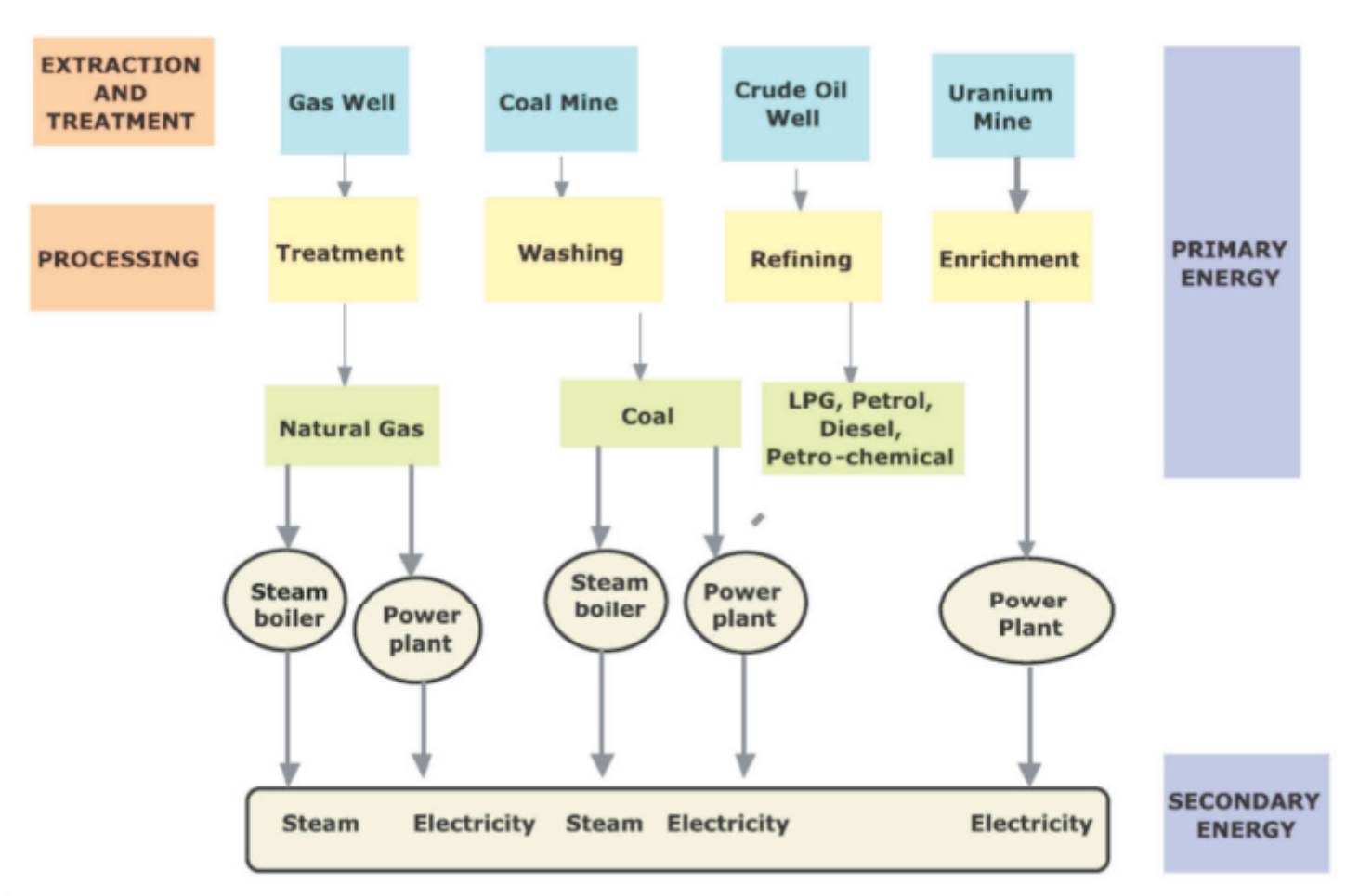
Energy Intensity

- Energy intensity is a measure that is often used to assess the energy efficiency of a particular economy
- Ratio of energy use to gross domestic product
- Low energy intensity is the desired goal
- Trying to decouple energy use and economic output to enhance that quality

How will affect our life?

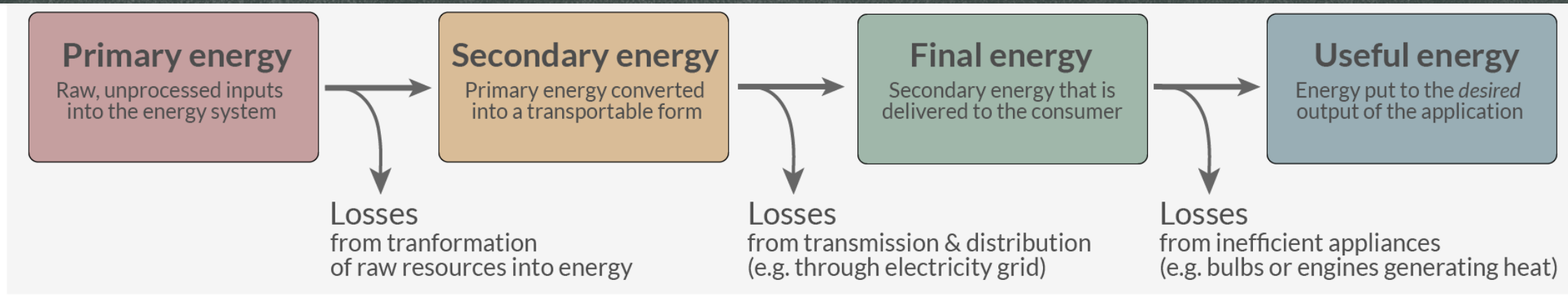


Flow of Energy



- Treatment – Sulfur
- Washing – Sulfur, Ash and Slag
- Refining – Extract different types of oil
- Enrichment - Increasing the percentage of Uranium-235

Flow of Energy



Example: Coal to power a lightbulb

Example: Wood to provide heat

Example: Oil to drive a car

Energy Audit

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

Energy Conservation Act 2001

- ✓ A study of a plant or facility to determine how and where energy is used and identify methods for energy savings
- ✓ The key to a systematic approach for decision-making in the area of energy management
- ✓ Translation of energy conservation ideas into realities
- ✓ Energy, Material and Labor – highest potential for cost reduction and thereby increasing the profit

Types of Energy Audit

- Energy audit type depends on
  - Function and type of industry
  - Depth to which final audit is needed
  - Potential and magnitude of cost reduction desired

- Energy audit can be classified into
  - Preliminary audit
  - Targeted audit
  - Detailed audit

Preliminary Energy Audit

- Set up a baseline / reference for the energy consumption from past data and identify the scope for energy savings
- Identify immediate (especially no-/low-cost) improvements/ savings
- Identify areas for more detailed study/ measurement

Preliminary Energy Audit Outcomes

No cost

- Arresting leaks (steam, compressed air)
- Controlling excess air by adjusting fan damper

Low cost

- Shutting equipment when not needed
- Replacement with appropriate items/ retrofit like lamps, motion sensors

Areas for detailed audit

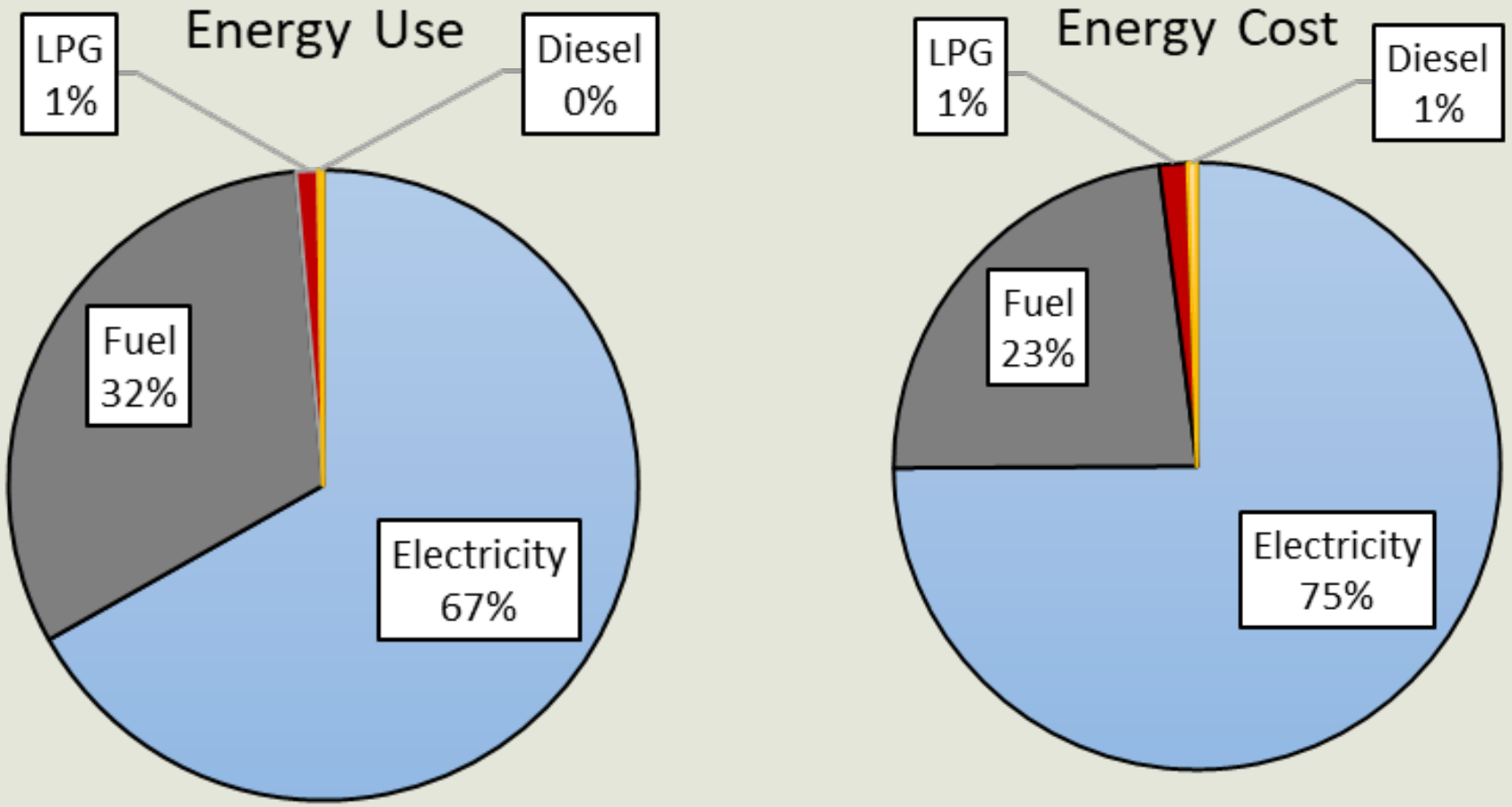
- Upgrading or installing new insulation or equipment (e.g., heat pump based heating, High eff. heat exchanger)
- Modifying the process
- Scheduling of operation
- Waste heat recovery

Energy use analysis

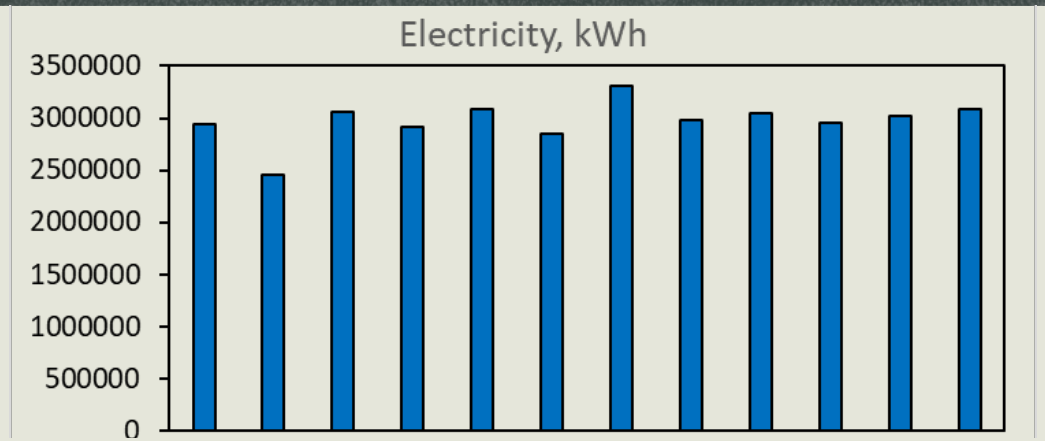
	Electricity, kWh	Fuel, kg	LPG, kg	Diesel, kg	Total, MWh
January	2943374	93919	2498	1650	4070.888
February	2453916	109077	2703	1650	3757.738
March	3054064	129540	3700	1650	4605.024
April	2914539	117146	4064	1100	4321.558
May	3082023	122894	4139	0	4542.829
June	2852936	130902	4446	0	4409.404
July	3313587	128429	4120	880	4848.012
August	2985654	117961	3747	0	4384.962
September	3047247	123566	4707	0	4522.951
August	2958361	128500	5024	770	4503.75
November	3024284	129301	4996	1650	4588.925
December	3079456	148502	4642	1650	4859.656
Total	35709441	1479737	48786	11000	53415.7

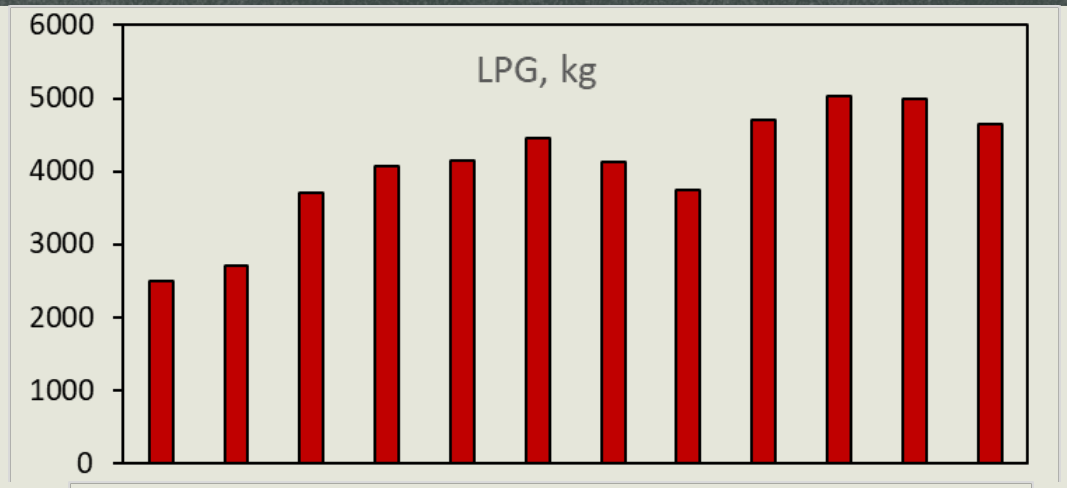
Energy use in a manufacturing plant

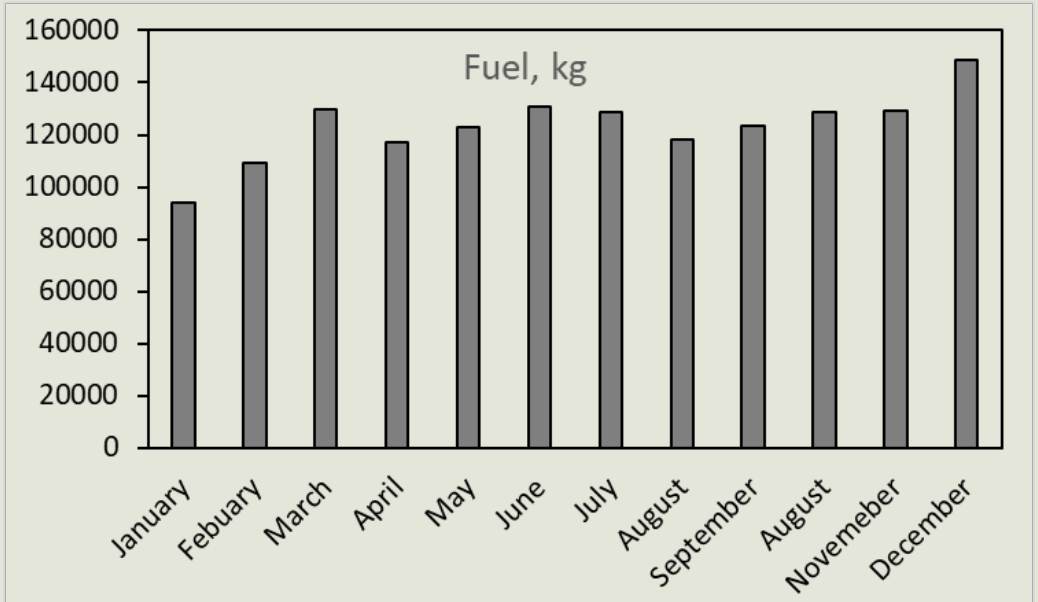
Energy or Cost or Emission?

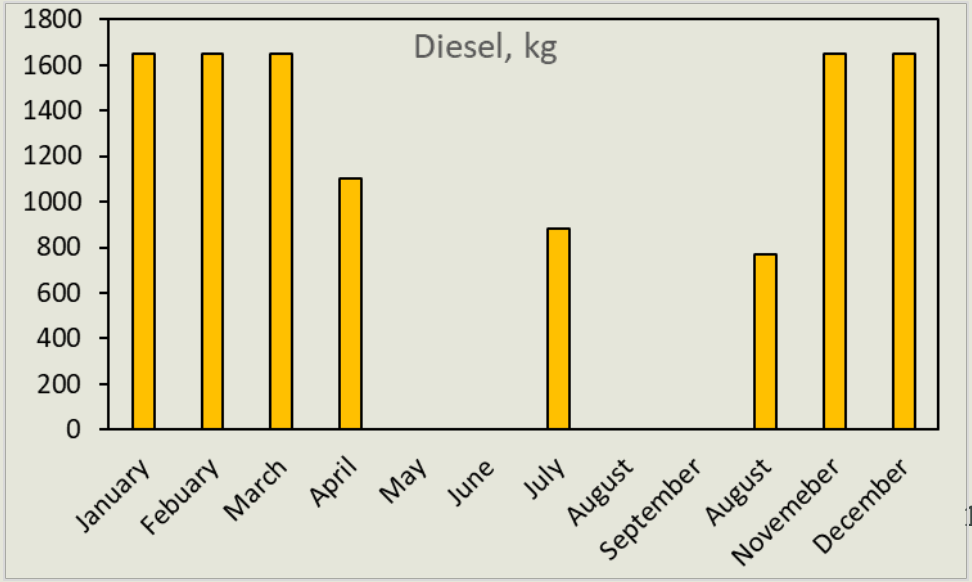


Energy Use and Distribution









Targeted Energy Audit

- Often results from preliminary results
- Detail survey on the area of changes or modifications (e.g. lighting)
- Recommendations reading the outcome in savings (how much savings in energy and cost for the given number and type)

Detailed Energy Audit

- A comprehensive audit provides a detailed energy project implementation plan
- Offers the most accurate estimate of energy savings and cost
- Considers the interactive effects of all projects, accounts for the energy use of all major equipment
- Includes detailed energy cost saving calculations and project cost
- Steps for conducting detailed audit
  - Phase I – pre audit phase
  - Phase II – audit phase
  - Phase III – post audit phase

Pre Audit Phase

Step 1	• **Plan and Organise** • **Walk through Audit** • **Informal Interview** with Energy Manager, Production / Plant Manager	• Establish/organize a **Energy audit team** • Organize Instruments and time frame • Macro data collection (suitable to type of industry.) • Familiarization with process / plant activities • First hand observation and Assessment of current level of operation and practices
Step 2	• **Introductory Meeting** with all divisional heads and persons concerned with energy management (1-2 hrs.)	• To built up cooperation and rapport • Orientation, awareness creation • Issue questionnaire tailored for each department

Audit Phase

Step 3	• **Primary data gathering, Process Flow Diagram and Energy Utility Diagram**	• Historic data collection and analysis for setting up **Baseline energy consumption** • All service **utilities system diagram** (e.g. Single line power distribution diagram, water, and compressed air and steam distribution). • Prepare **process flow charts** • Design, operating data and schedule of operation • Annual Energy Bill and **energy consumption pattern** (Refer manual, logbook, name plate etc.)
Step 4	• **Conduct survey and monitoring**	• **Measurements** : Motor survey, Insulation, lighting survey etc. with portable instruments for operating data. Confirm and compare operating data with design data.
Step 5	• **Conduct of detailed trials** / tests for selected major energy equipment	• **Trials / Tests** - 24 hours power monitoring (MD, PF, kWH etc.). - Load variations trends in pumps, fan compressors etc. - Boiler Efficiency trials for (4-8 hours) - Furnace Efficiency trials - Equipments Performance tests etc

Audit Phase

Step 6	• **Analysis of energy use**	• **Energy and Material balance** • **Energy loss/waste analysis**
Step 7	• **Identification and development of Energy Conservation (ENCON) opportunities**	• Conceive, develop and refine ideas • Review ideas suggested by unit personnel • Review ideas suggested in previous energy audit report if any • Use brainstorming and value analysis techniques • Contact vendors for new / efficient technology
Step 8	• **Cost benefit analysis**	• Assess technical feasibility, economic viability and prioritization of ENCON options for implementation • Select the most promising projects • Prioritise by low, medium, long term measures
Step 9	• **Reporting and Presentation** to the Top Management	• Documentation, draft Report Presentation to the top Management. • Final report preparation on feedback from unit

Post Audit Phase

Step 10	• **Implementation and Follow-up**	**Implementation of ENCON recommendation measures** and Monitor the performance • Action plan, schedule for implementation • Monitoring and periodic review

Energy Audit Report

DETAILED ENERGY AUDIT

TABLE OF CONTENTS

Energy conservation opportunities

Short-term Schemes

Usually involves changes in operating practices with little or no investments

- Tightening operation, control and improved house keeping
- Use of steam (check for leaks)
- Electrical power (avoid the waste)

Medium-term Schemes

Low cost modifications and improvements

- Insulation
- Power factor
- Equipment operational modifications and improvements

Long-term Schemes

Modifications involving high capital investments

- Equipment upgradation
- Heat recovery
- Process modifications

Selection of Long-term Measures

Priority	Economical Feasibility	Technical Feasibility	Risk / Feasibility
A - Good	Well defined and attractive	Existing technology adequate	No Risk/ Highly feasible
B -May be	Well defined and only marginally acceptable	Existing technology may be updated, lack of confirmation	Minor operating risk/May be feasible
C -Held	Poorly defined and marginally unacceptable	Existing technology is inadequate	Doubtful
D -No	Clearly not attractive	Need major breakthrough	Not feasible

- A - Attractive
- B and C – For fixed target

Equipment Data Collection

- Consumption of fuel, steam, electricity, compressed air, cooling water, chilled water…..
- Energy costs
- Quantity of raw materials, intermediate and final products as well as waste products
- Capacity utilization
- Efficiency trends of process, equipment
- It is important to plan additional data gathering carefully (at least for 3 years)

……Many more……

Utility Data Collection – E.g. Steam

At each process / stage of operation

- Boiler capacities
- Steam conditions
- Normal operating load (T/h)
- Maximum load (T/h)
- Steam requirements at different pressures
- Captive generation – Yes/No (if yes provide ratings, fuel, average output)
- Cogeneration – Yes/No (if yes provide ratings, fuel, average output)

References

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