ज्ञानेन प्रकाशते जगत्

INDUS UNIVERSITY

WHERE PRACTICE MEETS THEORY

- **Subject:** Energy Management (OE V)
- Subject Code: ME0437
- Unit No. 4

Topics :

- Energy Monitoring & Targeting
- Energy, Environment and Climate Change

Energy Monitoring and Targeting

Monitoring & Targeting

- It is a management techniquewhich helps to
  - Control energy consumption
  - Control any resource
  - Continuous monitoring
  - Gather continuous information
  - Indicate the continuous varying pattern
- “Without Compass and Map we are dead men in the Desert”.

  "you can't manage what you don't measure"

Elements Of Monitoring and Targeting System

Recording -Measuring and recording energy consumption

- **Analysing** -Correlating energy consumption to a measured output, such as production quantity
- **Comparing** -Comparing energy consumption to an appropriate standard or benchmark
- **Setting Targets** -Setting targets to reduce or control energy consumption
- **Monitoring** -Comparing energy consumption to the set target on a regular basis
- **Reporting** -Reporting the results including any variances from the targets which have been set
- **Controlling** -Implementing management measures to correct any variances, which may have occurred.

Particularly M&T system will involve the following:

- **Checking** the accuracy of energy invoices
- **Allocating** energy costs to specific departments (Energy Accounting Centres)
- **Determining** energy performance/efficiency
- **Recording** energy use, so that projects intended to improve energy efficiency can be checked
- **Highlighting** performance problems in equipment or systems

Advantages of Monitoring and Targeting

- Expected Benefits
  - Guidance to reduce excess energyconsumption
  - Identify the defaultequipments
  - Power factor improvement
  - Current reduction and reduction in linelosses
  - Load balancing and minimizing of neutral current
  - Maintaining SEC and creating bench marks
  - Determining the future energy use when planning changes
  - Diagnose specific areas of wastedenergy

A Rationale for Monitoring, Targeting and Reporting

The relationship of energy use to key performance indicators will allow you to determine:

Whether your current energy is better or worse than before

- Trends in energy consumption that reflects seasonal, weekly, and other operational parameters
- How much your future energy use is likely to vary if you change aspects of your business
- Specific areas of wasted energy
- Comparison with other business with similar characteristics - This "benchmarking"

process will provide valuable indications of effectiveness of your operations as well as

energy use

- How much your business has reacted to changes in the past
- How to develop performance targets for an energy management program

Information related to energy from following sources:

- Plant level information from financial accounting systems-utilities cost centre
- Plant department level found in comparative energy consumption data for a group of similar facilities, service entrance meter readings etc.
- System level (for example, boiler plant) performance data from submetering data
- Equipment level information from nameplate data, run-time and schedule information, sub-metered data on specific energy consuming equipment.

Data and Information Analysis

Electricity bills and other fuel bills should be collected periodically and analysed as below

TABLE 8.1 ANNUAL ENERGY COST SHEET

	Thermal Energy Bill				Electricity Bill				Total Energy Bill
Month	Fuel 1	Fuel 2	Fuel 3	Total Rs. Lakh	Day kWh	Night kWh	Maximum Demand	Total Rs. Lakh	Rs.Lakh
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
Sub-Total									
%									

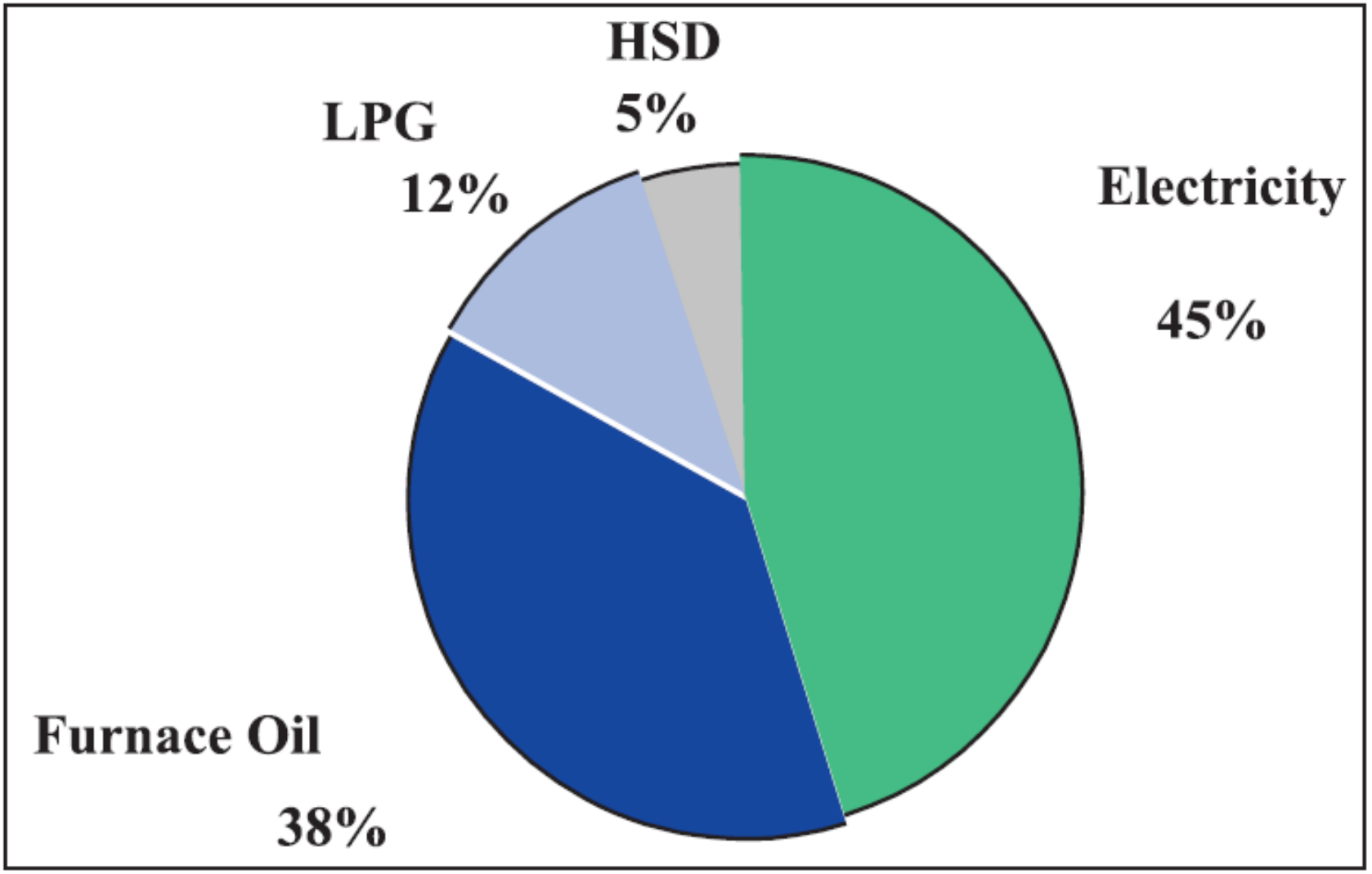


Figure 8.1 % Share of Fuels Based on Energy Bill

TABLE 8.2 FUEL CONVERSION DATA

Energy source	Supply unit	Conversion Factor to Kcal
Electricity	kWh	860
HSD	kg	10,500
Furnace Oil	kg	10,200
LPG	kg	12,000

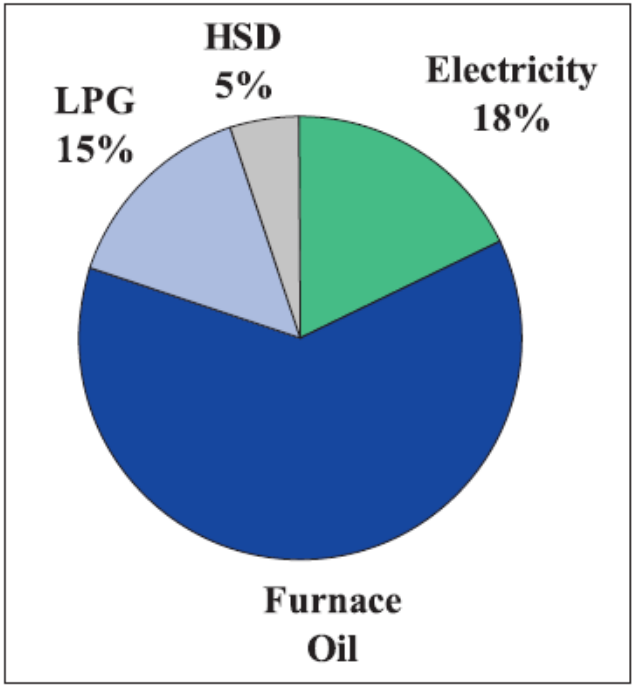


Figure 8.2 %Share of Fuels Based on Consumption in kCals

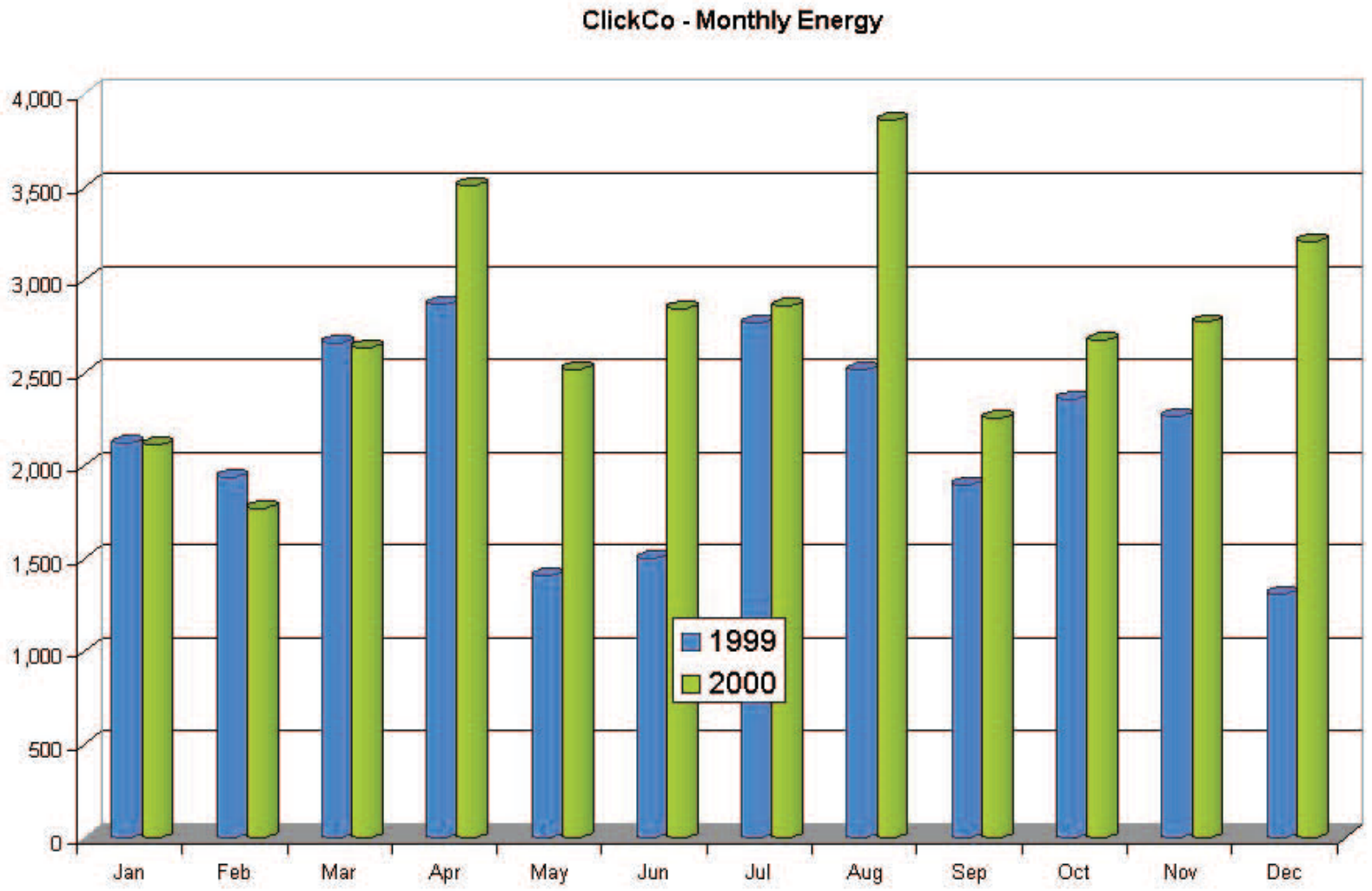
Relating Energy Consumption and Production.

Graphing the Data

Data be presented graphically. A better appreciation of variations is almost always obtained from a visual presentation, rather than from a table of numbers. Graphs generally provide an effective means of developing the energy-production relationships, which explain what is going on in the plant.

Use of Bar Chart

The starting point is to collect and collate 24/12 months of energy bills. The most common bar chart application used in energy management is one showing the energy per month for this year and last year however, it does not tell us the full story about what is happening. We will also need production data for the same 24/12-month period.



Energy Consumption :Current Year(2000) Vs. Previous year(1999)

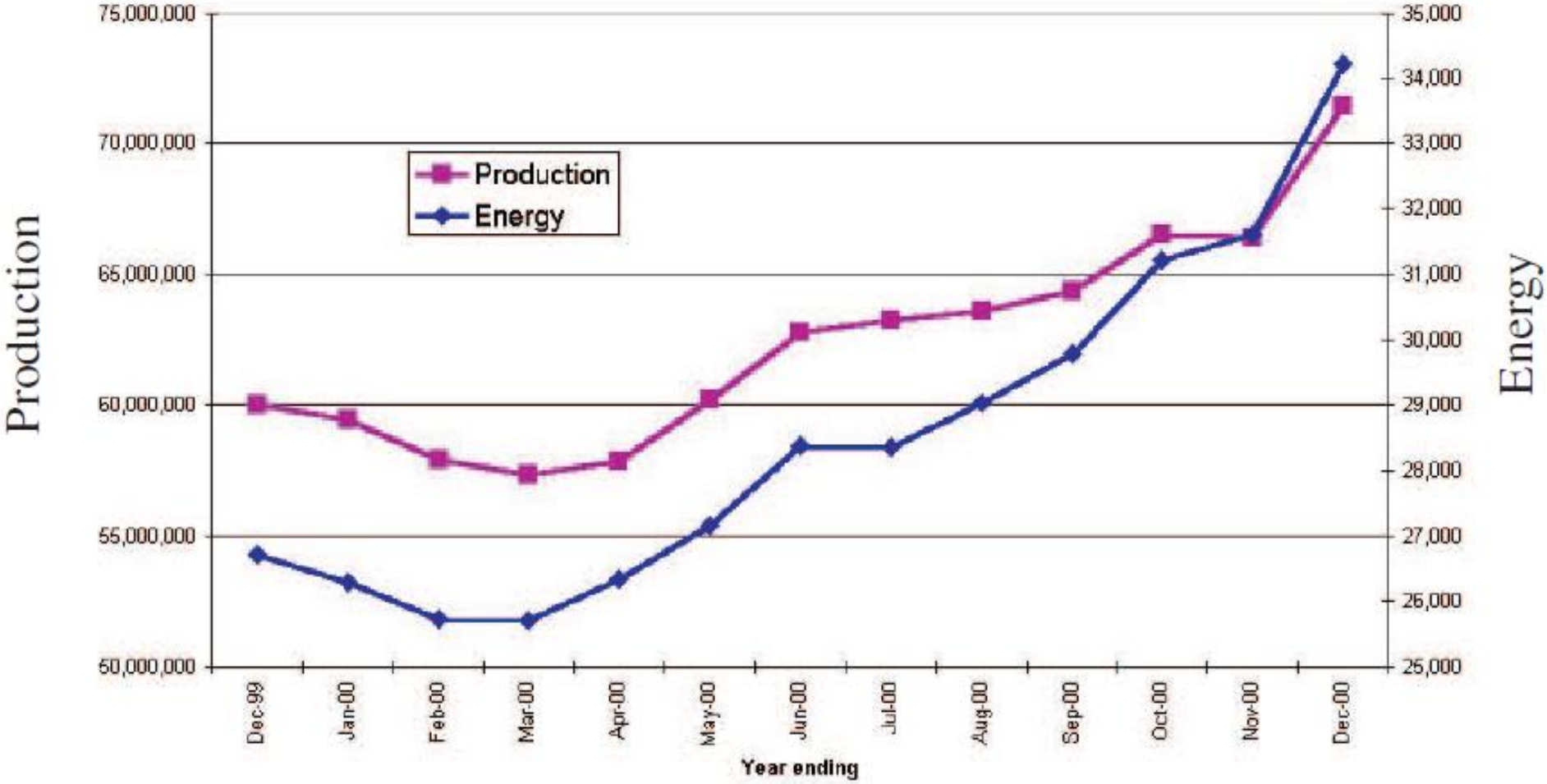


Figure 8.4 Moving Annual Total - Energy and Production

Specific Energy Consumption (SEC), which is energy consumption per unit of production. So we now plot a chart of SEC

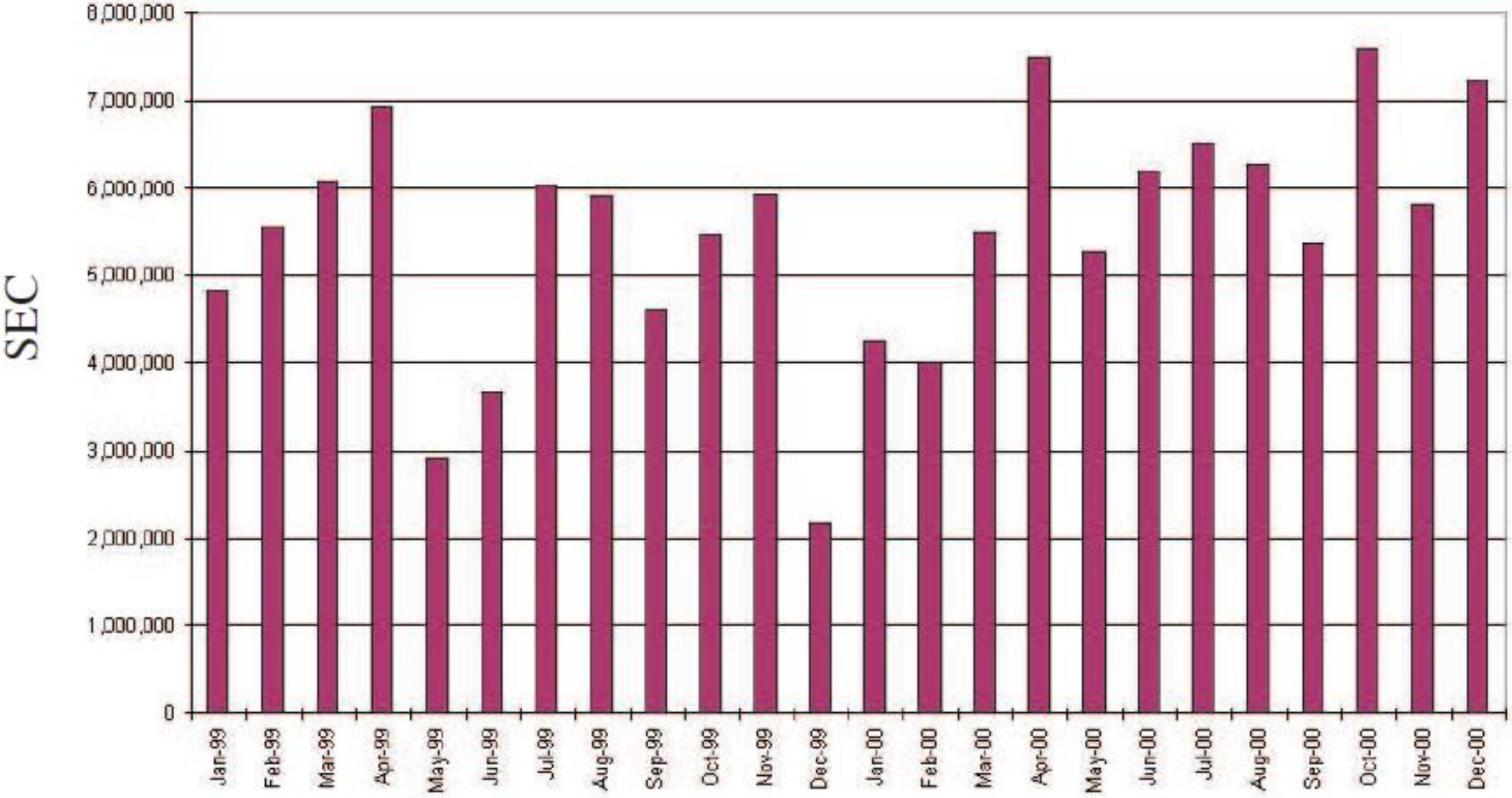
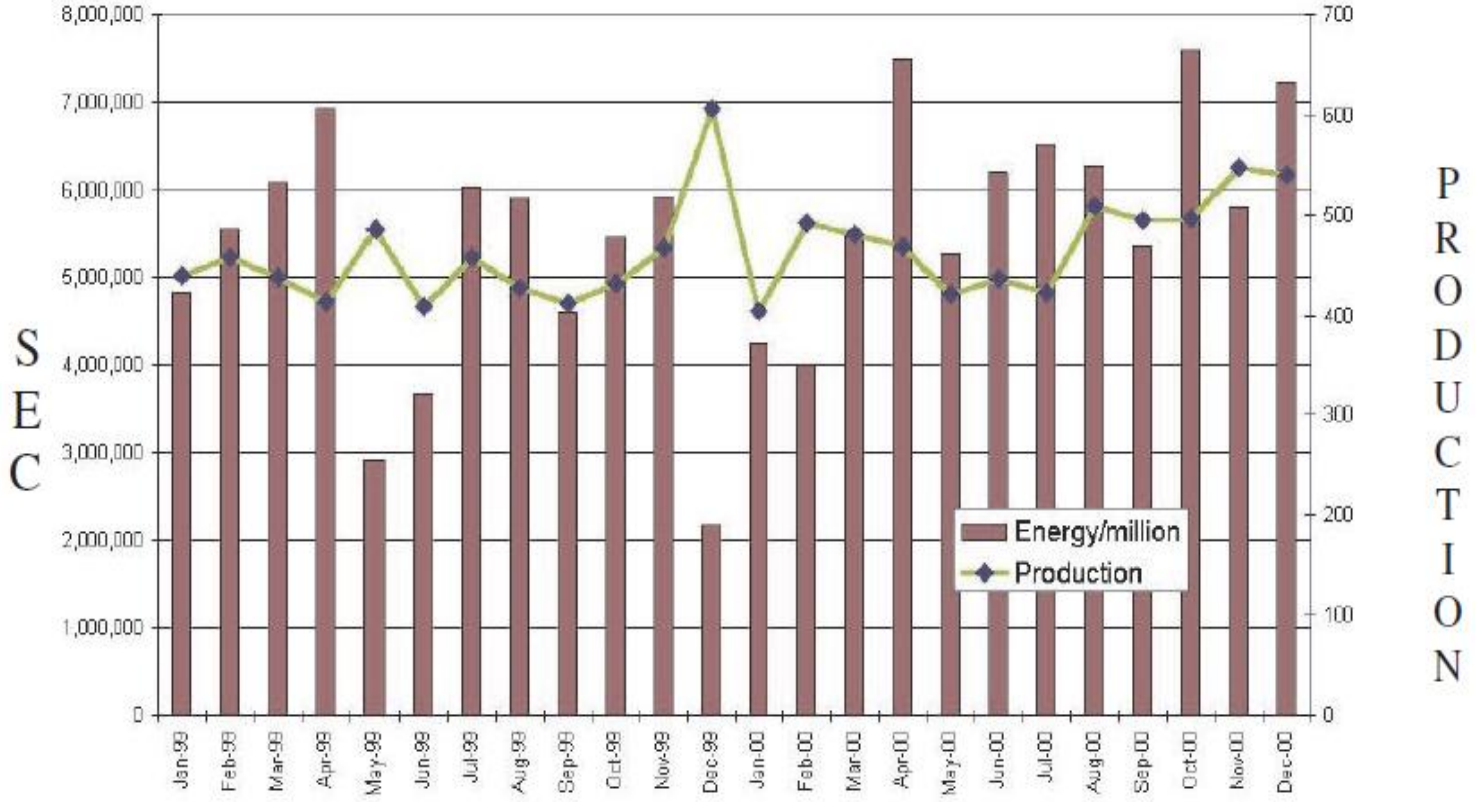


Figure 8.5: Monthly Specific Energy Consumption

We also know that the level of production may have an effect on the specific consumption. If we add the production data to the SEC chart, it helps to explain some of the features. For example, the very low SEC occurred when there was a record level of production. This indicates that there might be fixed energy consumption - i.e. consumption that occurs regardless of production levels. Refer Figure 8.6.



The next step is to gain more understanding of the relationship of energy and production, and to provide us with some basis for performance measurement. To do this we plot energy against production - In Microsoft Excel Worksheet, this is an XY chart option. We then add a trend line to the data set on the chart. (In practice what we have done is carried out a single variable regression analysis!). The Figure 8.7 shown is based on the data for 1999.

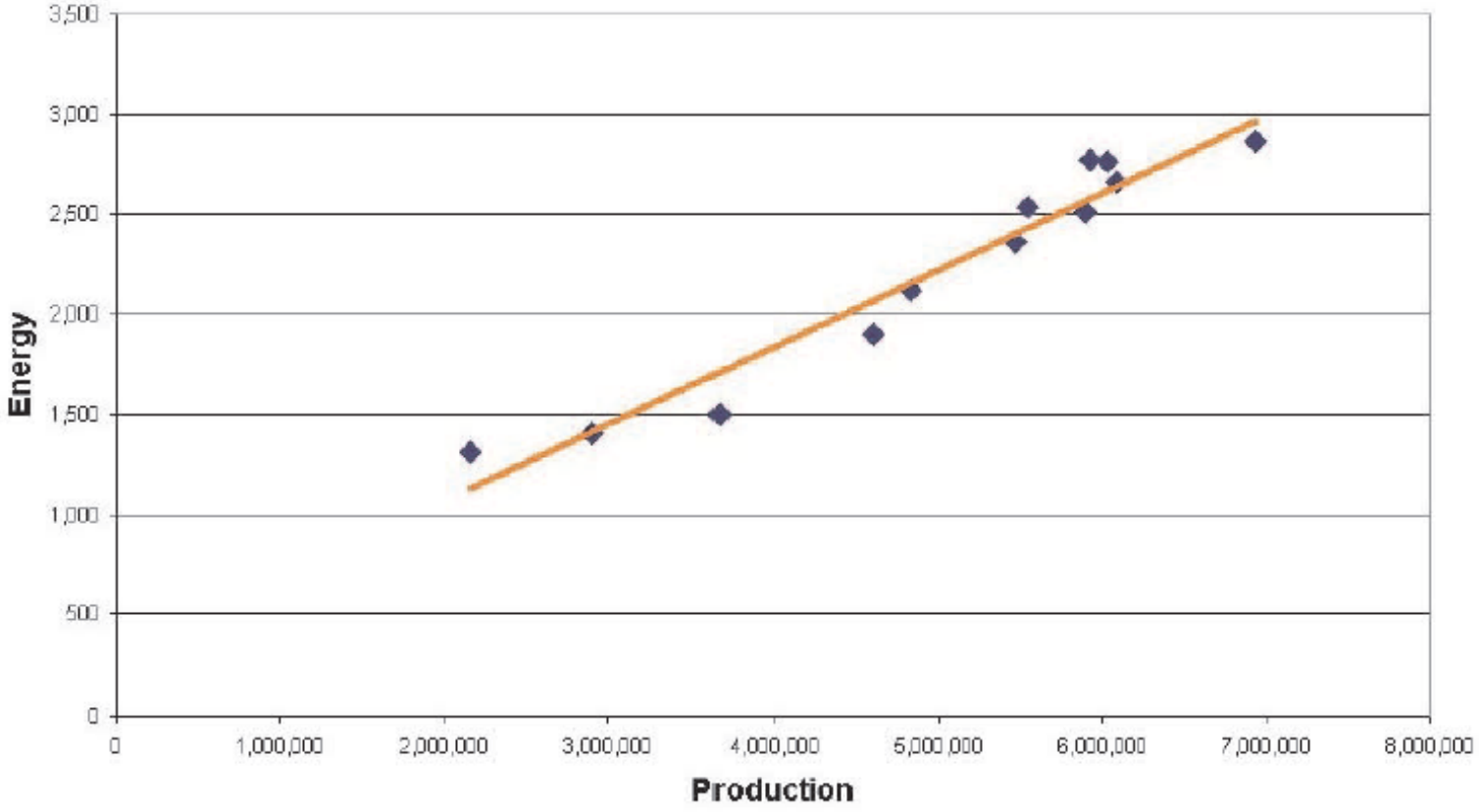


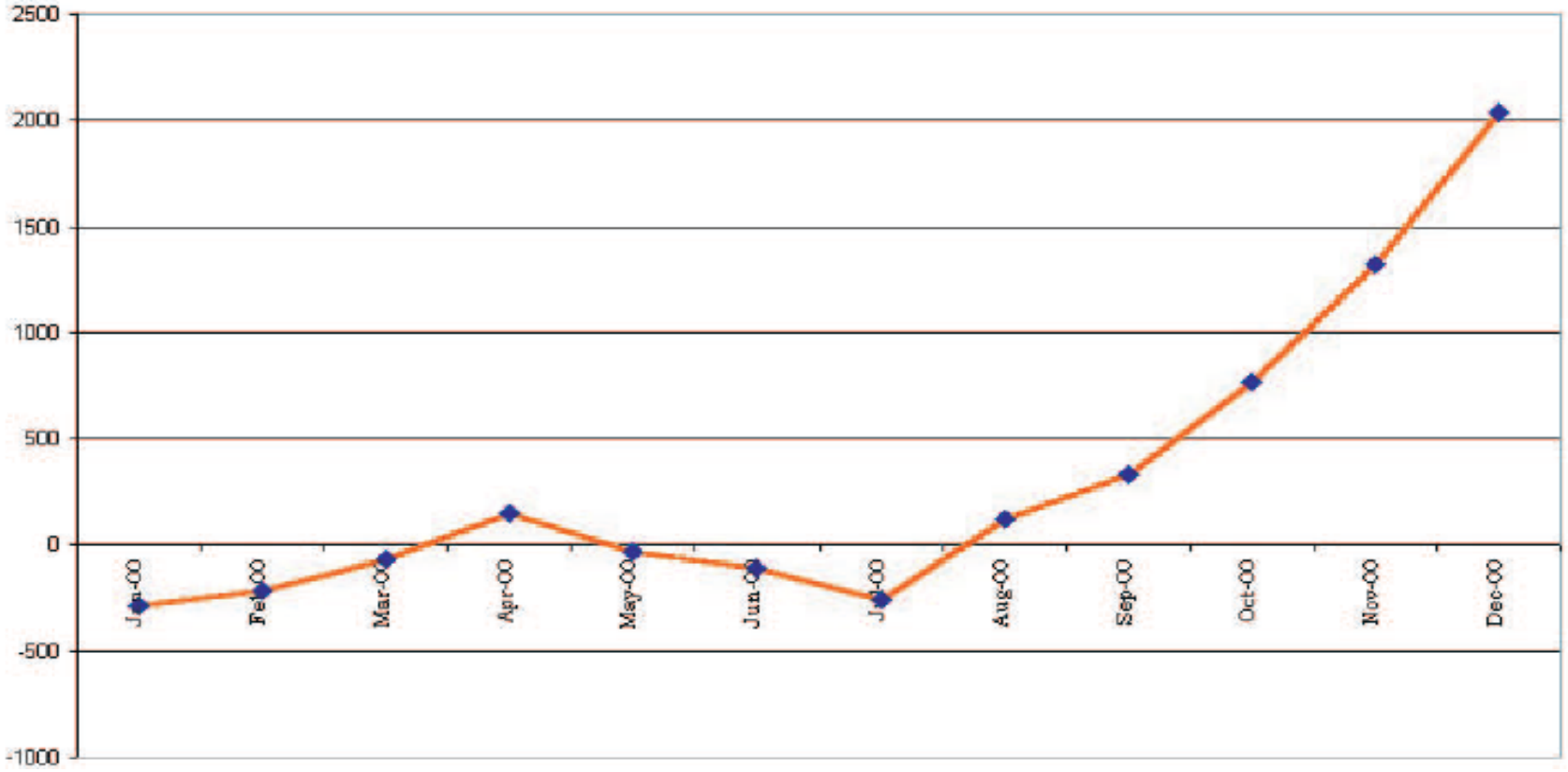
Figure 8.7: Energy vs Production

- **Energy consumed for the period = C + M x Production for same period**

- **M =** The energy consumption directly related to production (variable)
- **C** = *"fixed" energy consumption* (i.e. energy consumed for lighting, heating/cooling and general ancillary services that are not affected by production levels).
- Predict standard consumption, and also set targets - for example, standard less 5%.
- Above the line is the regime of poor energy efficiency, and below the line is the
- regime of an improved one.

Cumulative Sum (CUSUM)

- The difference between the base line (expected or standard
- consumption) and the actual consumption points over the base line period of time.
- Calculates savings/losses to date and shows when the performance changes.
- CUSUM graph follows a trend and shows the random fluctuation of energy consumption and should oscillate around zero (standard or expected consumption).
- This trend will continue until something happens to alter the pattern of consumption such as the effect of an energy saving measure or, conversely, a worsening in energy efficiency (poor control, housekeeping or maintenance).



- Starting from year 2000, performance is better than standard.
- Performance then declined (line going up) until April, and then it started to improve until July, from July onwards, there is a marked, ongoing decline in performance - line going up.
- Changes in direction of the line indicate events that have relevance to the energy consumption pattern.
- No planned changes in the energy system, the change in performance can be attributed to poor control, housekeeping or maintenance.

- Case Study
- Energy consumption and production data were collected for a plant over a period of 18 months. During month 9, a heat recovery system was installed. Using the plant monthly data, estimate the savings made with the heat recovery system.

TABLE 8.3 MONTH WISE PRODUCTION WITH ENERGY CONSUMPTION

Month	E_{act} - Monthly Energy Use (toe * / month)	P - Monthly Production (tonnes / month)
1	340	380
2	340	440
3	380	460
4	380	520
5	300	320
6	400	520
7	280	240
8	424	620
9	420	600
10	400	560
11	360	440
12	320	360
13	340	420
14	372	480
15	380	540
16	280	280
17	280	260
18	380	500

* toe = tonnes of oil equivalent.

Steps For CUSUM analysis

- 1. Plot the Energy - Production graph for the first 9 months
- 2. Draw the best fit straight line
- 3. Derive the equation of the line
- The above steps are completed in Figure 8.9, the equation derived is E = 0.4 P + 180

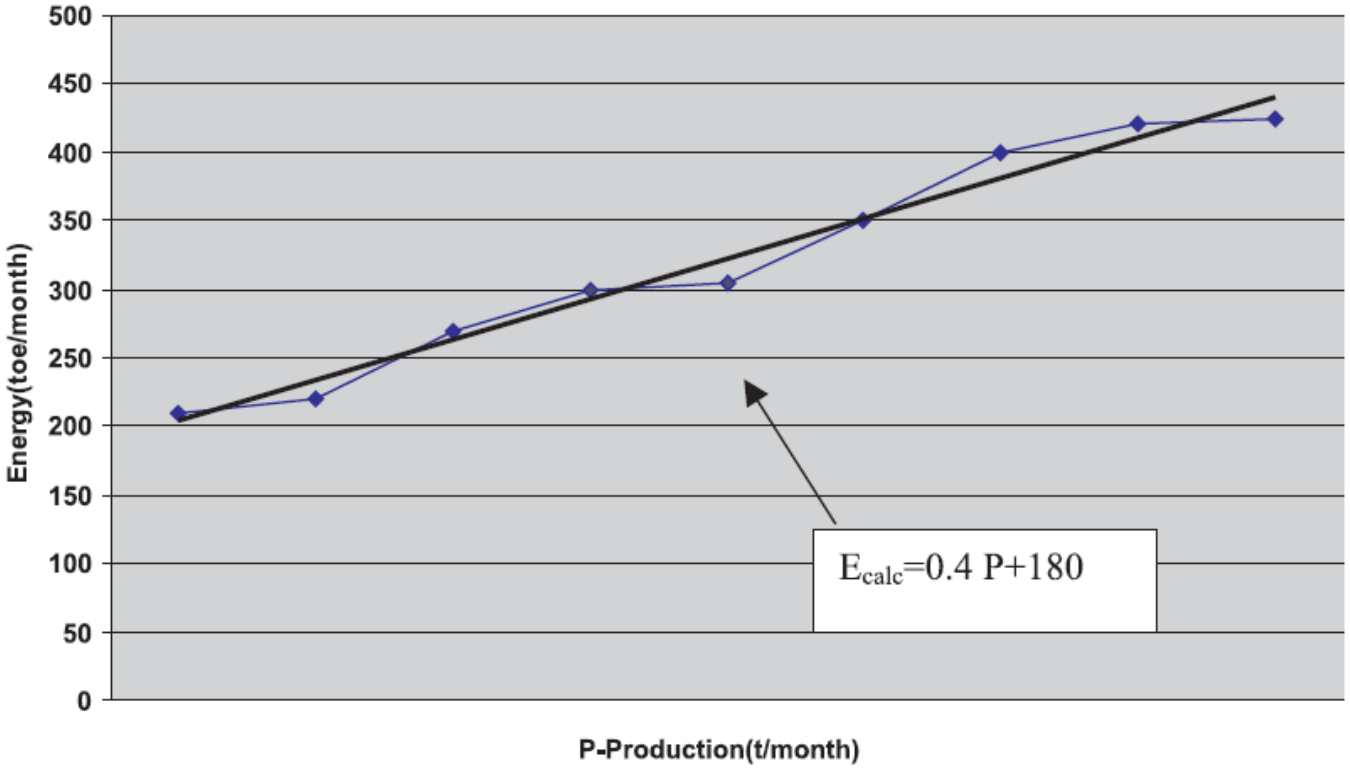


Figure 8.9 Energy Production Graph

- 4. Calculate the expected energy consumption based on the equation
- 5. Calculate the difference between actual and calculated energy use
- 6. Compute CUSUM

TABLE 8.4 CUSUM

Month	E_{act}	P	E_{calc} (0.4 P + 180)	$E_{act} - E_{calc}$	CUSUM (Cumulative Sum)
1	340	380	332	+8	+8
2	340	440	356	-16	-8
3	380	460	364	+16	+8
4	380	520	388	-8	0
5	300	320	308	-8	-8
6	400	520	388	+2	-6
7	280	240	276	+4	-2
8	424	620	428	-4	-6
9	420	600	420	0	-6
10	400	560	404	4	-10
11	360	440	356	+4	-6
12	320	360	324	-4	-10
13	340	420	348	-8	-18
14	372	480	372	0	-18
15	380	540	396	-16	-34
16	280	280	292	-12	-46
17	280	260	284	-4	-50
18	380	500	380	0	-50

E_{act}- Actual Energy consumption E_{calc} - Calculated energy consumption

#E_{act} for the last 7 months (from month 12 to month 18 in Table 8.4)

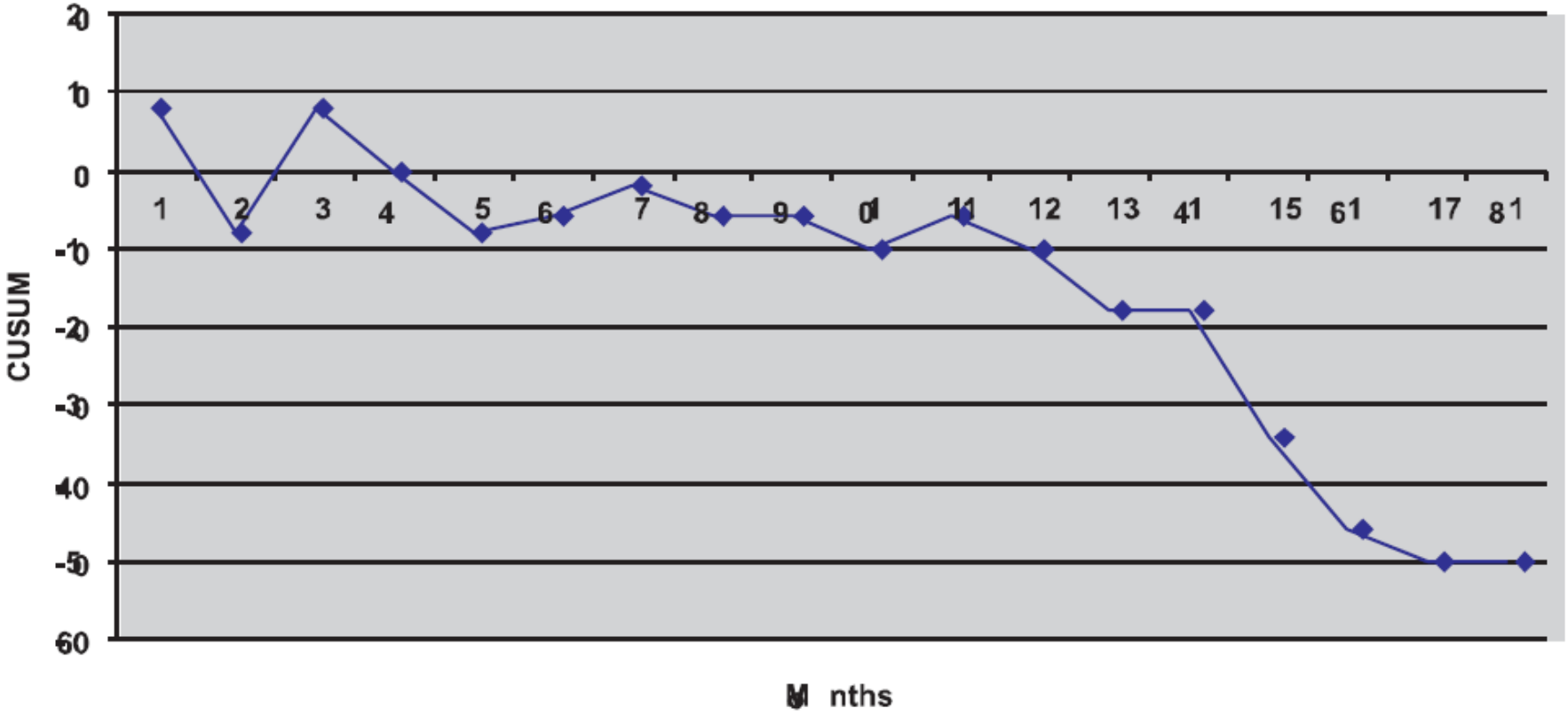


Figure 8.10 Example CUSUM Graph

- 7. Plot the CUSUM graph
- 8. Estimate the savings accumulated from use of the heat recovery system.

- oscillates around the zero line for several months and then drops sharply after month.
- Savings of 44 toe (50-6) have been accumulated in the last 7 months. This represents savings of almost 2% of energy consumption.
- Last six month total oil consumption = 2352 ton

- (44/2352)*100 = 1.8% saving during last 6 months

- The CUSUM technique is a simple but remarkably powerful statistical method, which highlights small differences in energy efficiency performances. Regular use of the procedure allows the Energy Manager to follow plant performance and spot any trends early.

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QUESTIONS

- 1. What is the difference between monitoring and targeting?
- 2. Explain briefly the essential elements of a monitoring and targeting system.
- 3. What are the benefits of a monitoring and targeting system?
- 4. What do you understand by the term "benchmarking" and list few benefits?
- 5. Explain the difference between internal and external benchmarking.
- 6. Explain how a CUSUM chart is drawn with an example.
- 7. Narrate the type of energy monitoring and targeting systems in your industry.

Topic
Energy, Environment, Air Pollution and Climate Change

-

Climate Changes in India

- Increase in surface temperature by **0.4 degree C** over the past century.
- Warming trend along the **west coast**, in **central India**, the **interior peninsula**, and **northeastern India.**

Climate Changes in India

- Cooling trend in **northwest** India and parts of **South India.**
- Regional monsoon variations: increased monsoon seasonal rainfall along the **west coast, northern Andhra Pradesh and North-western India**, decreased monsoon seasonal rainfall over eastern **Madhya Pradesh, North-eastern India, and parts of Gujarat and Kerala**.

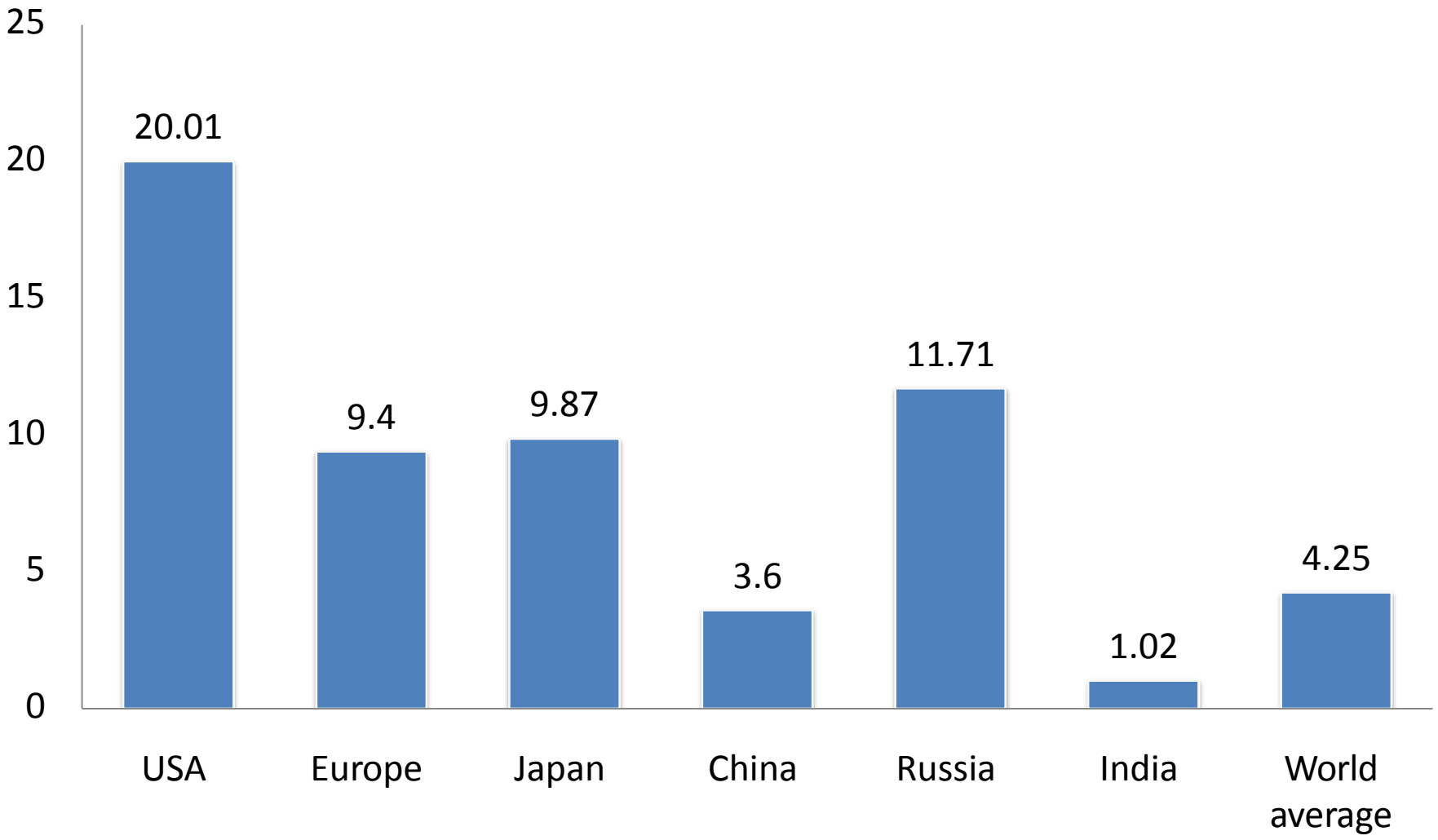
Climate Changes in India

- Observed trends of multi-decadal periods of more **frequent droughts**, followed by less severe droughts.
- Studies have shown a rising trend in the frequency of **heavy rain events** and decrease in frequency of moderate events over central India from 1951 to 2000.

Climate Changes in India

- Records of coastal tide gauges in the north Indian ocean for the last 40 years has revealed an estimated **sea level rise between 1.06-1.75 mm per year.**
- The available monitoring data on **Himalayan glaciers indicates recession of some glaciers**.

Per-capita Carbon –dioxide emission (Metric Tons)



Impacts of Climate Changes

- Water resources
- Agriculture and food production
- Health
- Forests
- Coastal areas
- Vulnerability to extreme events
- Bioenergy
- Livelihoods
- Environment
- Economy
- Ecology

National Action Plan for Climate Change (NAPCC)

- Protecting the poor and vulnerable sections of society through sustainable development sensitive to climate change
- Achieving national growth objectives through a qualitative change in direction, ecological sustainability, mitigation of greenhouse gas emissions.

National Action Plan for Climate Change (NAPCC)

- Efficient and cost effective strategies for end use Demand side Management.
- Technologies for adaptation and mitigation of greenhouse gases emissions.
- Promote sustainable development - Regulatory and voluntary mechanisms

Core of NAPCC - National Missions

- National Solar Mission:The NAPCC aims to promote the development and use of solar energy for power generation and other uses with the ultimate objective of making solar competitive with fossil-based energy options.

- National Mission for Enhanced Energy Efficiency: Current initiatives are expected to yield savings of 10,000 MW by 2012.

These National Missions are being institutionalized by the respective Ministries/ Departments.

Core of NAPCC - National Missions

- National Mission on Sustainable Habitat: To promote energy efficiency as a core component of urban planning.
- National Water Mission: With water scarcity projected to worsen as a result of climate change, the plan sets a goal of a 20% improvement in water use efficiency through pricing and other measures.

Core of NAPCC - National Missions

- National Mission for Sustaining the Himalayan Ecosystem: The plan aims to conserve biodiversity, forest cover, and other ecological values in the Himalayan region, where glaciers that are a major source of India's water supply are projected to recede as a result of global warming.
- National Mission for a "Green India": Goals include the afforestation of 6 million hectares of degraded forest lands and expanding forest cover from 23% to 33% of India's territory.

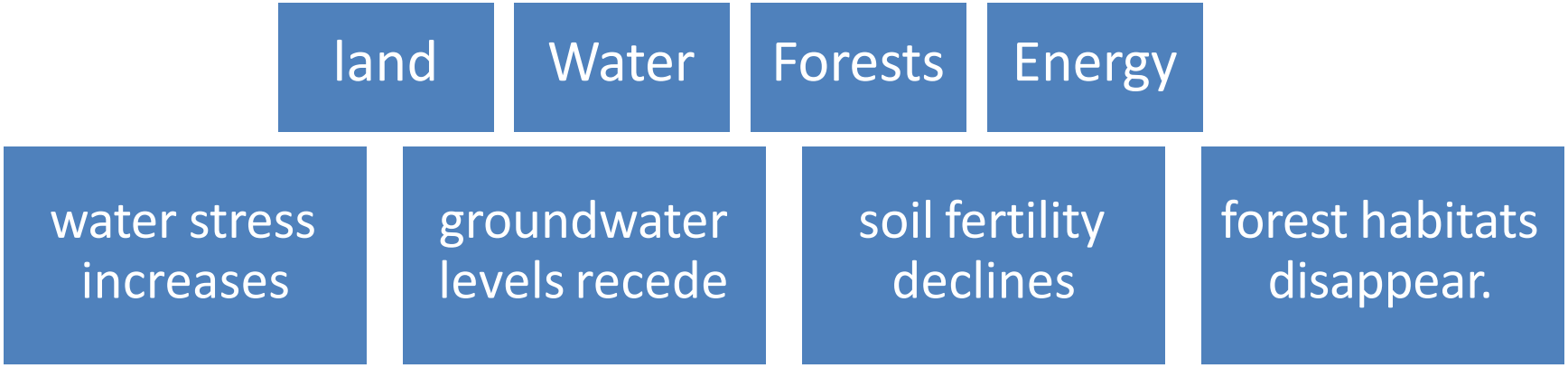
Core of NAPCC - National Missions

- National Mission for Sustainable Agriculture: The plan aims to support climate adaptation in agriculture through the development of climate-resilient crops, expansion of weather insurance mechanisms, and agricultural practices.
- National Mission on Strategic Knowledge for Climate Change: To gain a better understanding of climate science, impacts and challenges, the plan envisions a new Climate Science Research Fund, improved climate modeling, and increased international collaboration. It also encourage private sector initiatives to develop adaptation and mitigation technologies through venture capital funds.

Climate Change will put additional stress in rural areas

Rural Livlihoods - Resources

The livelihoods of the rural poor are directly dependent on environmental resources.



Are vulnerable to weather and climate variability

Rural Poor Paying the most

Climate change will only exacerbate the vulnerabilities of the rural poor. As climate-sensitive, natural ecosystems deteriorate, subsist ence will slip further out of reach.

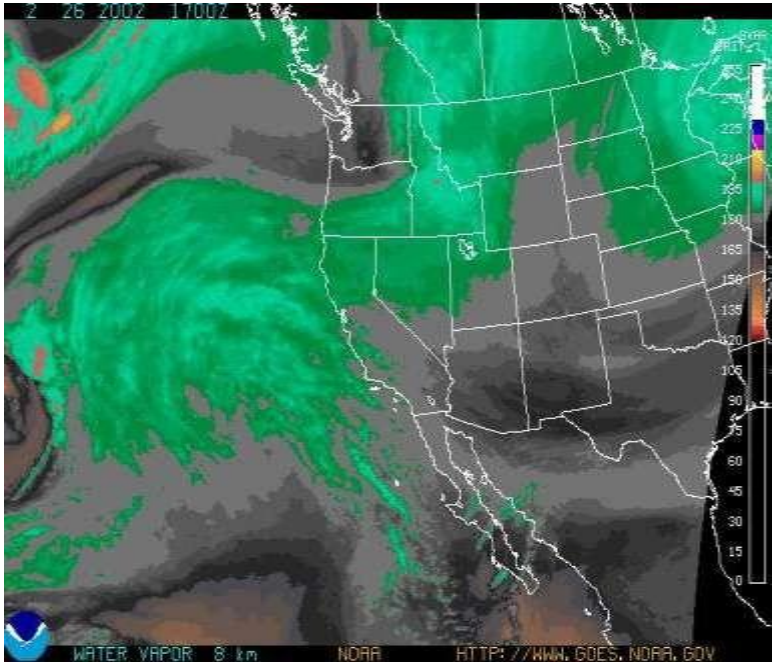
India’s rural poor, who have least contributed to Climate Change, will pay some of the problem’s heaviest tolls.

Climate Change vulnerability

- Vulnerability to climate change is the risk of adverse things happening
- Vulnerability is a function of three factors:
  - Exposure
  - Sensitivity
  - Adaptive capacity

Exposure

- Exposure is what is at risk from climate change, e.g.,
  - Population
  - Resources
  - Property
- It is also the climate change that an affected system will face, e.g.,
  - Sea level
  - Temperature
  - Precipitation
  - Extreme events



Sensitivity

- Biophysical effect of climate change
  - Change in crop yield, runoff, energy demand
- It considers the socioeconomic context, e.g., the agriculture system
- Grain crops typically are sensitive
- Manufacturing typically is much less sensitive

Adaptive Capability

- Capability to adapt
- Function of:
  - Wealth
  - Technology
  - Education
  - Institutions
  - Information
  - Infrastructure
  - “Social capital”
- *Having* adaptive capacity does not mean it is *used* effectively

Vulnerability is a Function of …

- More exposure and sensitivity increase vulnerability
- More adaptive capacity decreases vulnerability
- An assessment of vulnerability should consider all three factors

Adaptation

"adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm of exploits beneficial opportunities"

(Third Assessment Report, Working Group II)

Includes "actual" (realized) or "expected" (future) changes in climate

Adaptation (continued)

Two types of adaptation

Autonomous adaptation or reactive adaptation tends to be what people and systems do as impacts of climate change become apparent

Anticipatory or proactive adaptation are measures taken to reduce potential risks of future climate change

Introduction to UNFCCC

UNFCCC

Overview of UNFCCC

- United Nations Framework Convention on Climate Change

- A global legal instrument (international agreement) on the control and management of greenhouse gases (GHG).
- Adopted in 1992, entered into force in 1994.
- Status of participation: 189 Parties.

  Contains 2 annexes:
  - Annex 1: countries with obligations to take measures to mitigate the
  - effects of climate change
  - Annex 2: countries with obligations to provide financing to developing countries for their obligations under UNFCC
- Affiliated instruments: Kyoto Protocol.

UNFCCC

Overall goal and objectives

What is the overall goal?

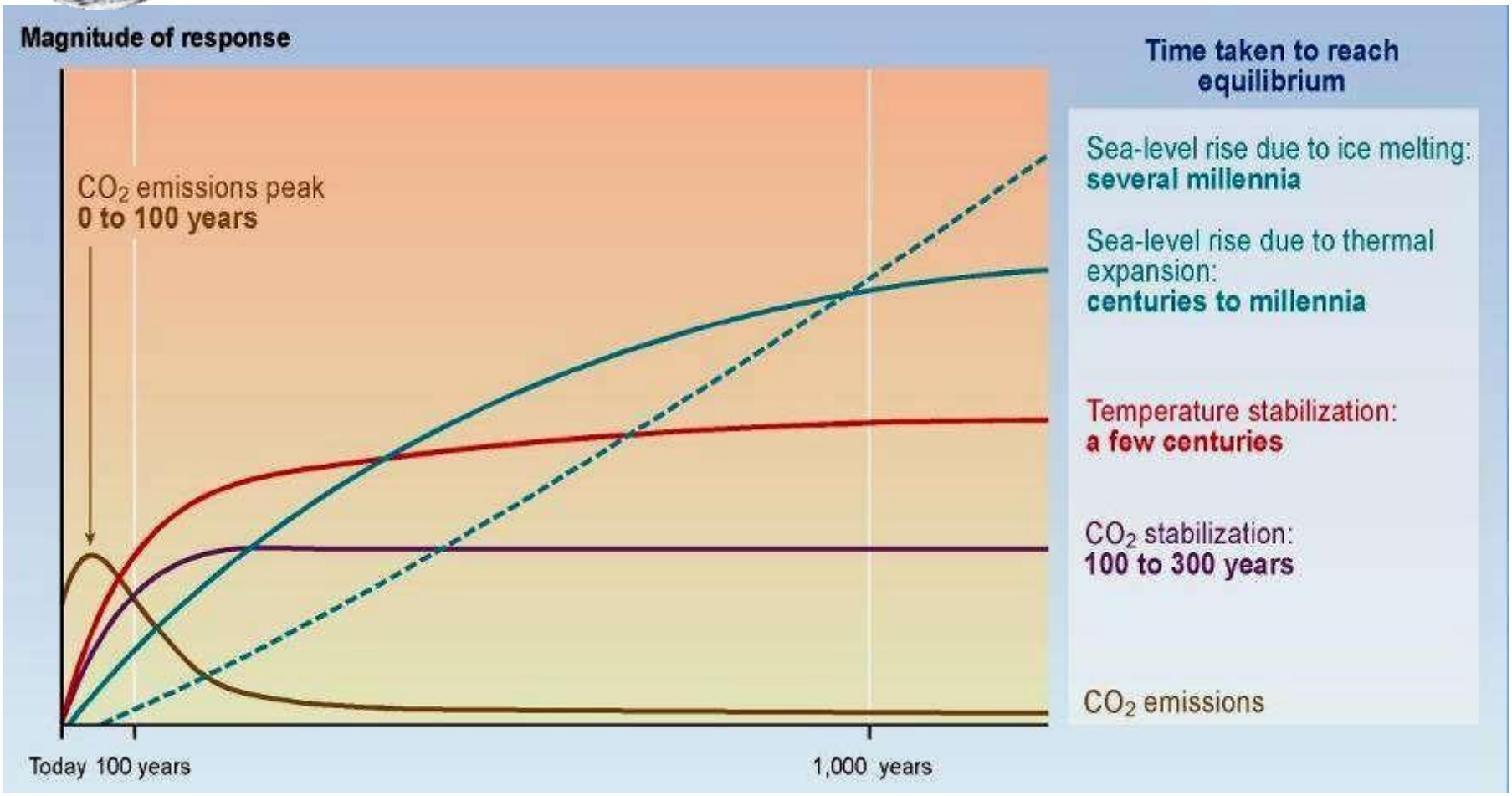
*“ to **protect the climate system** for the benefit of present and future generations of mankind. ”*

What are the further objectives?

*“ to **achieve stabilisation of greenhouse gas** concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. ”*

UNFCCC

Time taken to reach equilibrium



CO2 concentration, temperature, and sea level continue to rise long after emissions are reduced !

UNFCCC

Means to achieve the objectives

What can be done to **protect the climate system**?

>Enhancement of energy efficiency in relevant sectors and development of new and renewable energy forms/sources.

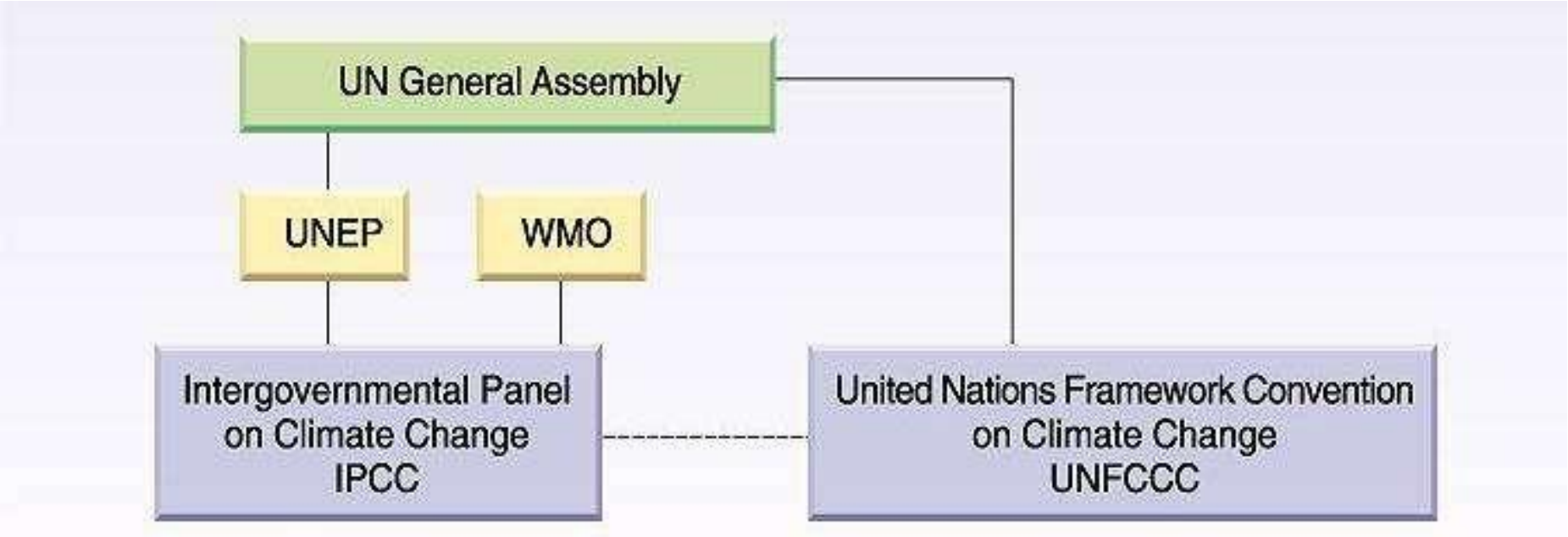
> Protection of sinks and reservoirs of GHGs.

>Limitation and reduction of transport and waste management-related emissions.

>Policy changes toward elimination of market imperfections and implementation of market-based instruments, and policy reform to support GHG limits and reductions.

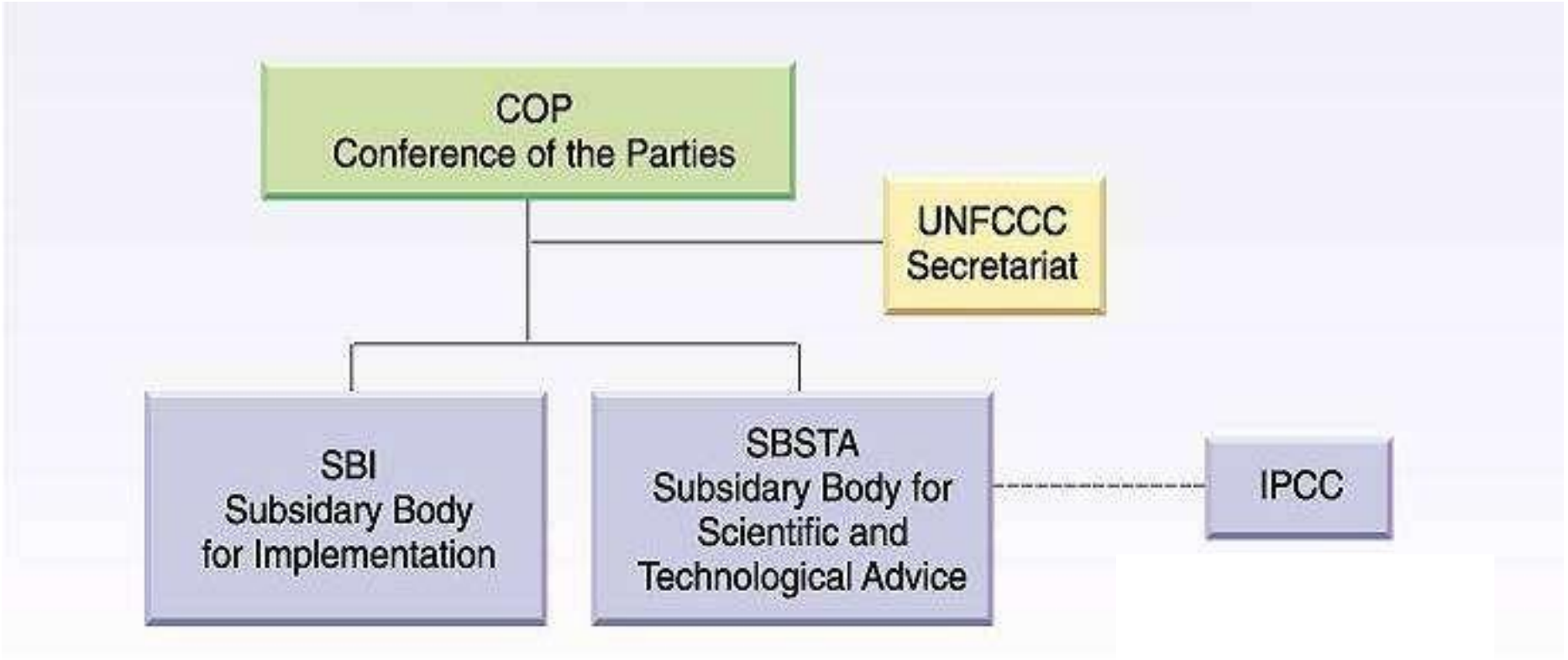
UNFCCC

Institutional framework



UNFCCC

Organisation of the Convention



UNFCCC

National level actors

National UNFCCC focal points

>Responsible for the Government's interaction and communication with UNFCCC.

> Usually a specific ministry / department.

>Usually interacting with a wide range of other organizations / stakeholders at the national level.

National CDM or JI organizations (DNA)

>Specific organization (authority) that is responsible for approving CDM and JI activities at the national level.

>Often, but not always, the same as the National Focal Point.

KYOTO PROTOCOL

Bringing UNFCCC into action

The Kyoto Protocol

>An addition to UNFCCC that requires developed countries to limit their GHG emissions in 2012, as compared to their emissions in 1990.

>Provides detailed methods and mechanisms for how the emission reductions can be achieved, measured and verified.

> All members in UNFCCC have not agreed to sign the Kyoto Protocol!

A long process of ratification

>Adopted in 1997, but required the ratification of more than 55 countries representing more than 55% of GHG emissions.

>Entered into force on February 16th, 2005 after ratification of the Russian Federation (now 163 countries covering 61.6% of global emissions have ratified the protocol).

KYOTO PROTOCOL

A market-based instrument

Kyoto Protocol **characteristics**

>Commits Annex 1 countries to reduce GHG emissions by 5.2% by 2012 compared to 1990.

> Actual commitment period: 2008 - 2012.

> Individual goals for each country.

3 mechanisms to help countries to reach their commitments

> ETS - Emissions Trading System

> CDM - Clean Development Mechanism *(session 5)*

> JI - Join Implementation *(session 6)*

6 greenhouse gases: CO_2, CH_4, N_2O, PFCs, HFCs, SF_6.

Kyoto Protocol

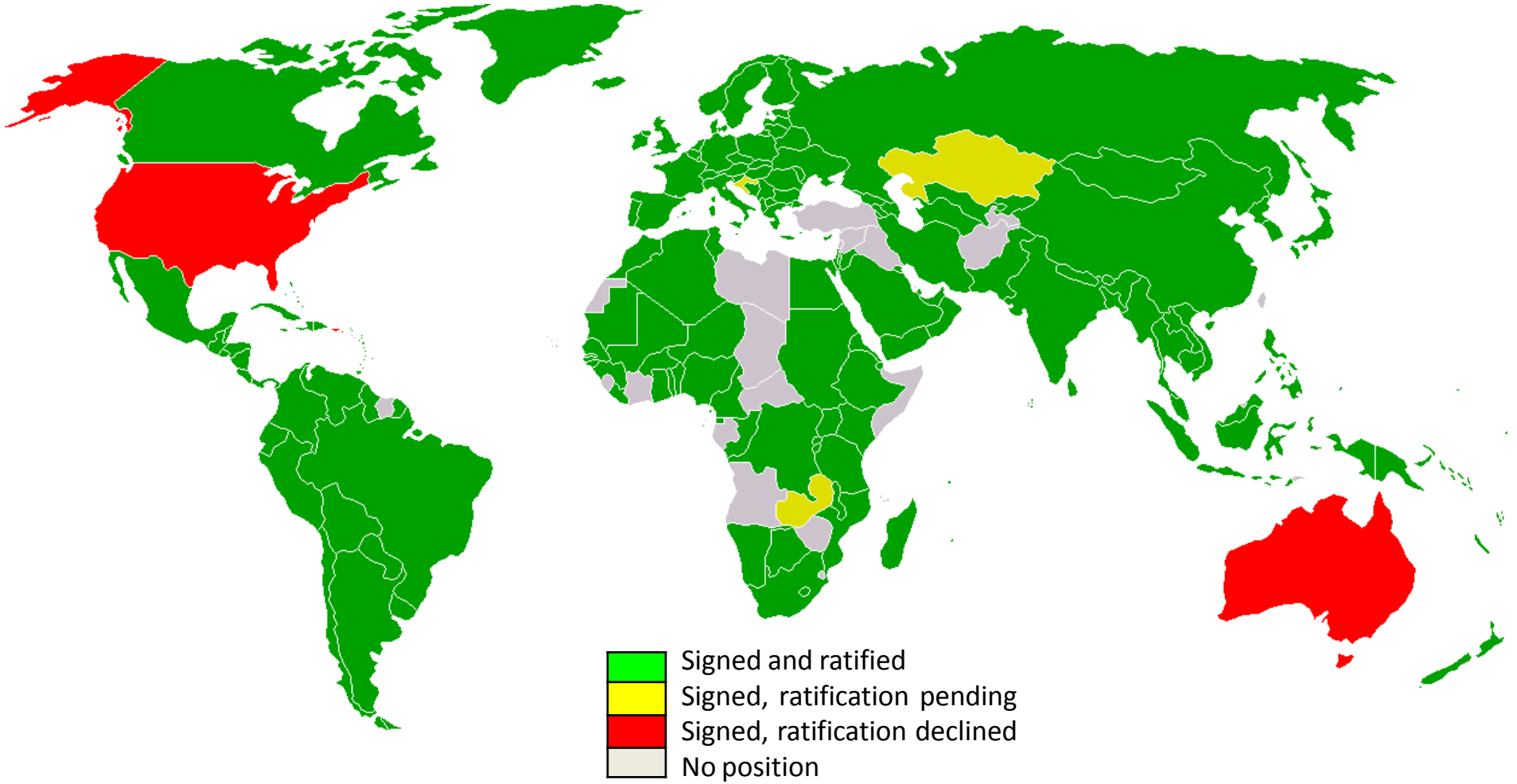
- Developed Countries Signed:
  - Greenhouse Gases ↓ by 5% by 2012
  - Reduce or Offset
  - National Targets, Government's responsible
- Mechanisms:
  - Clean Development Mechanism
  - Emissions Trading
- Runs out in 2012 – new agreement needed

Policies to mitigate impact of climate change

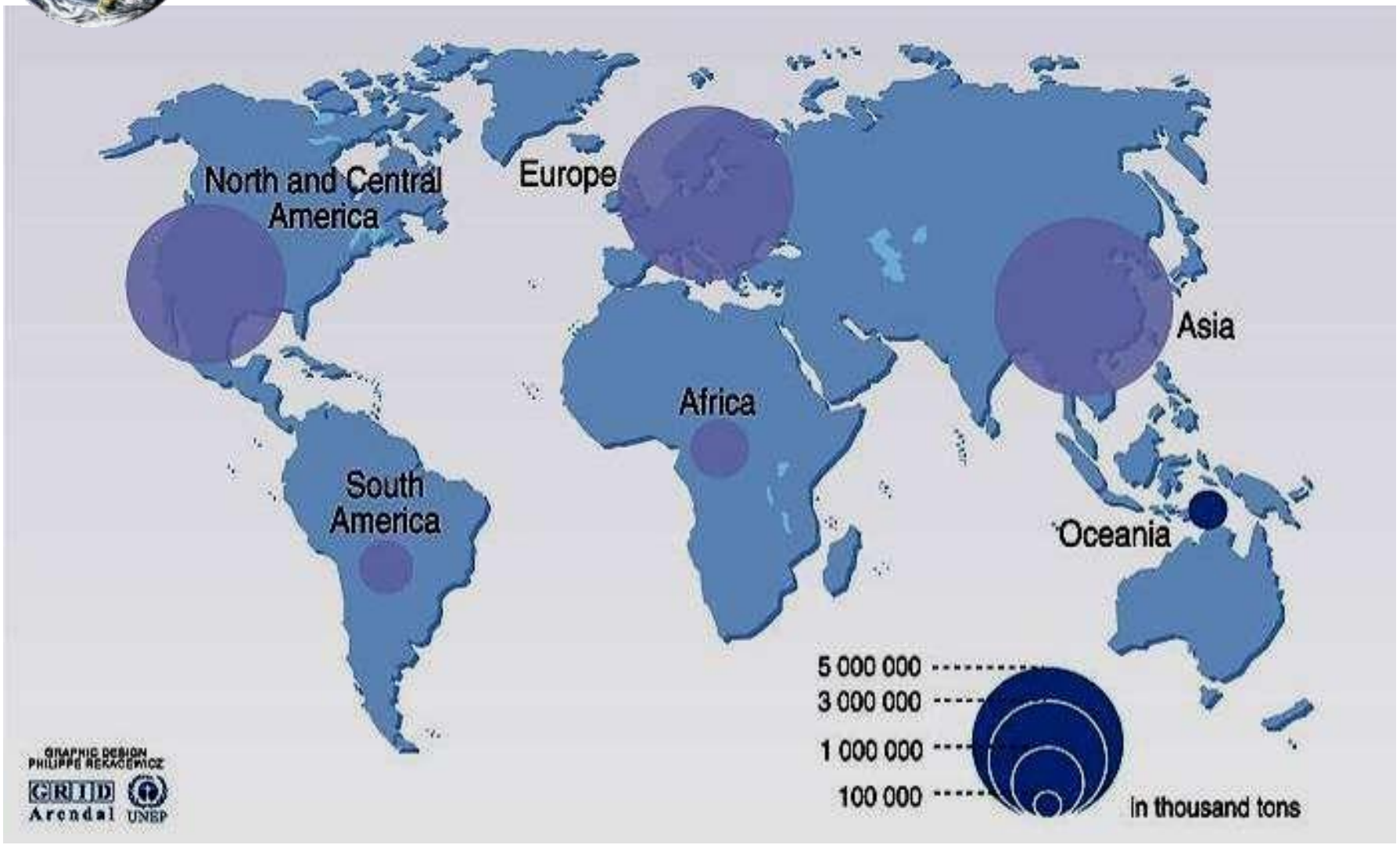
- Pricing the externality:
  - Carbon tax
  - Carbon trading
  - Implicit pricing through regulation / legislation
- Bringing forward lower carbon technology- research, development and deployment
  - Which policies provide the best incentive for this?
- Income payments for environmental husbandry e.g. to combat deforestation
- Overcoming information barriers
- Promoting a shared understanding of responsible behaviour across all societies

UNFCCC

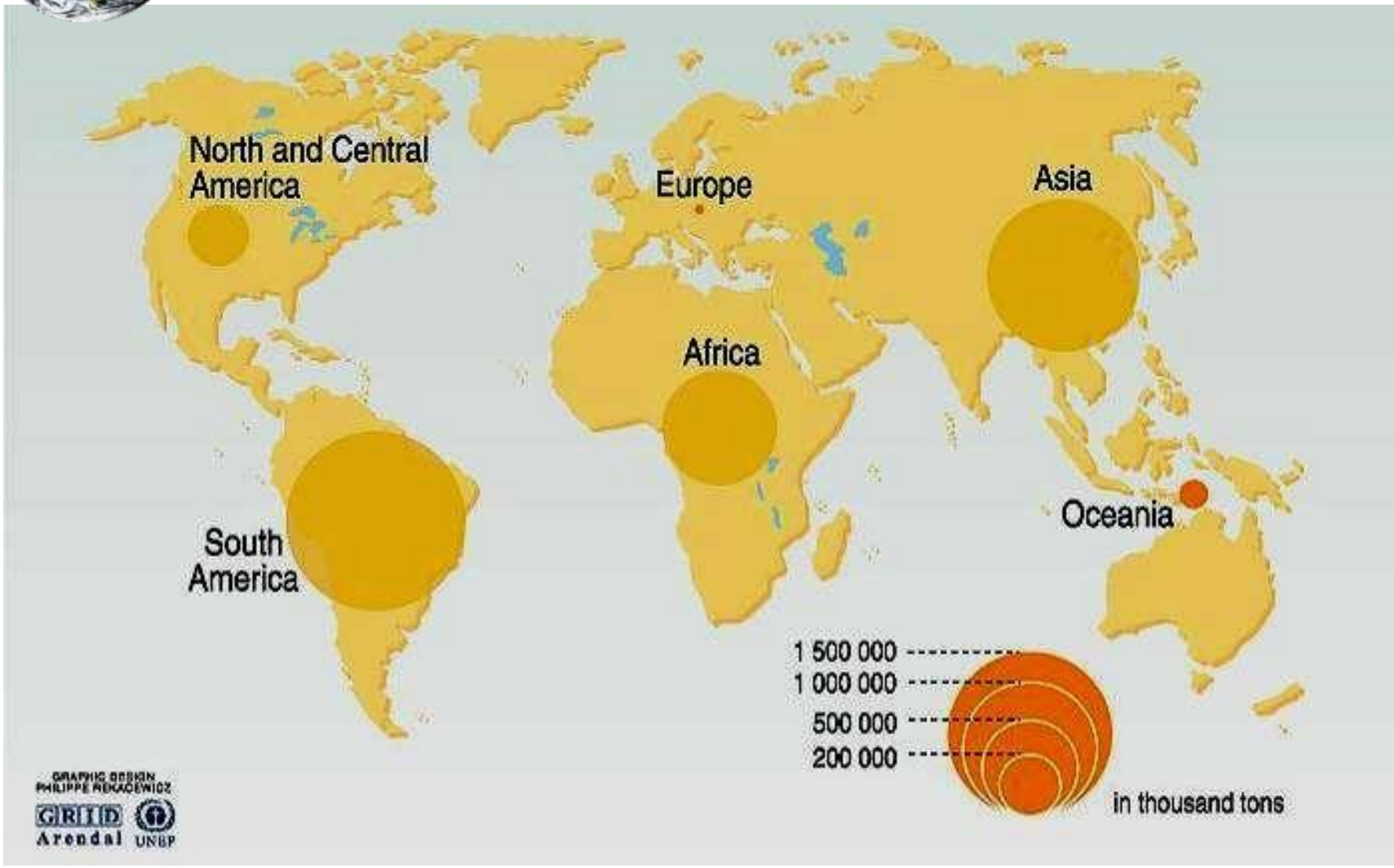
Ratification of the Kyoto protocol



CO_2 emissions from industrial process



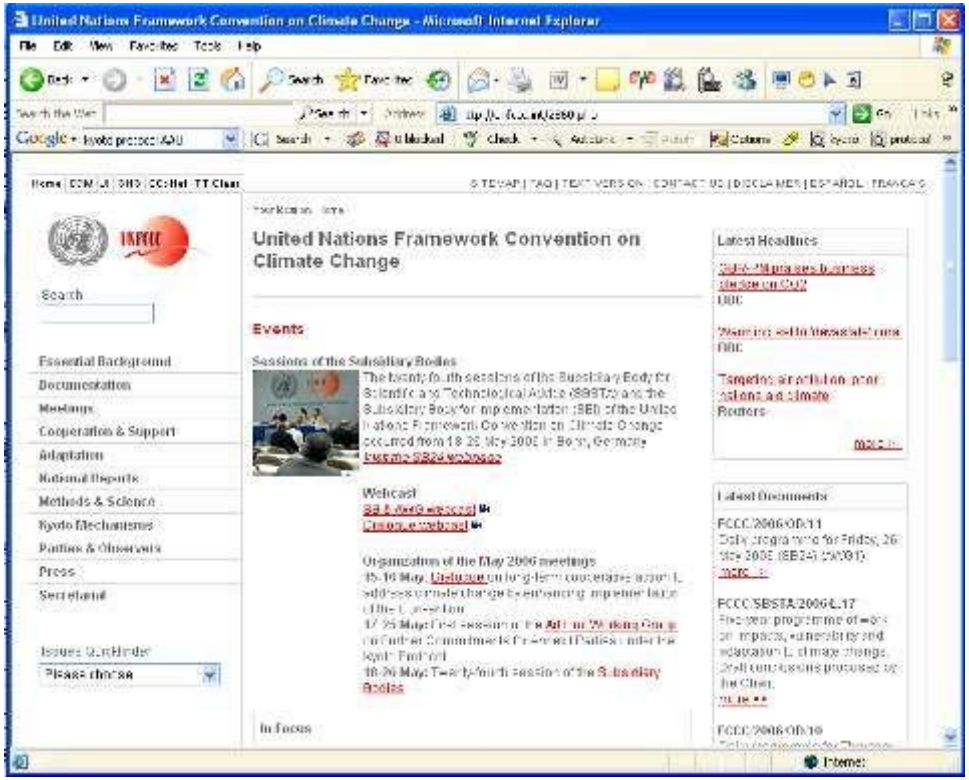
CO_2 emissions from land use change

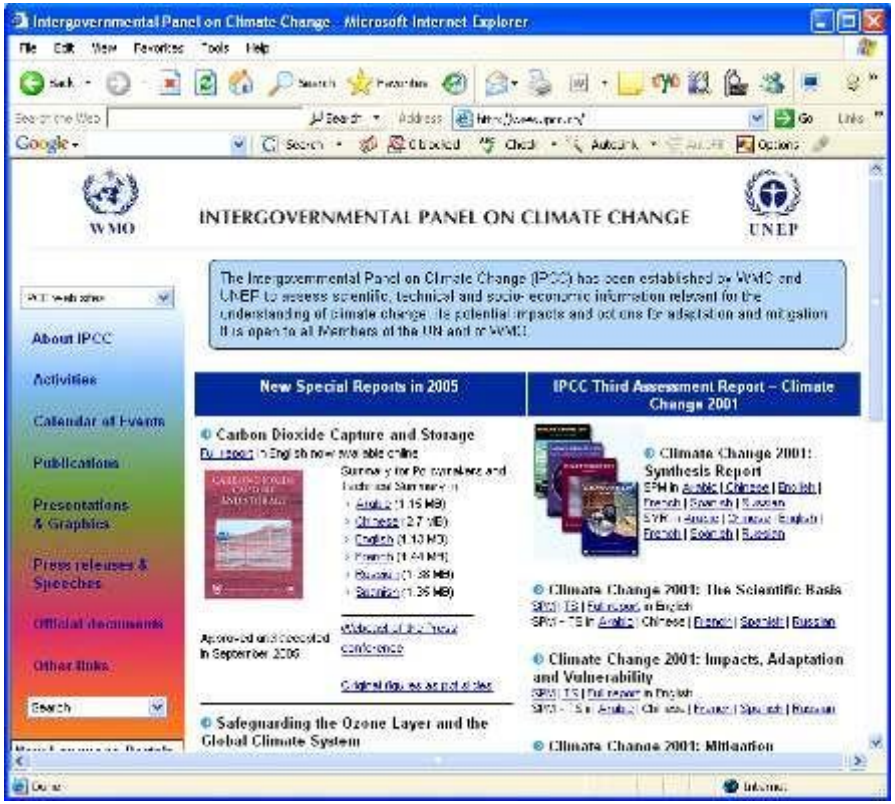


INFORMATIONS & TOOLS

Official websites

UNFCCC, site of the Convention
http://unfccc.int





IPCC, Intergovernmental Panel on Climate Change
http://www.ipcc.ch

UNDP – GEF Project

- Government of India, with UNDP as the lead agency, is implementing a Global Environment Facility (GEF) supported project - "**Mainstreaming Coastal and Marine Biodiversity Conservation into Production Sectors in the Godavari River Estuarine Ecosystem, Andhra Pradesh**".

COUNTRY: India

PROJECT TITLE: Mainstreaming Coastal and Marine Biodiversity Conservation into Production Sectors in the East Godavari River Estuarine Ecosystem (EGREE)

GEF AGENCY: UNDP

OTHER EXECUTING PARTNER: Ministry of Environment & Forests (MoEF), Government of India / Wildlife Wing, Environment, Forests, Science & Technology Department, State Government of Andhra Pradesh

GEF FOCAL AREA: Biodiversity

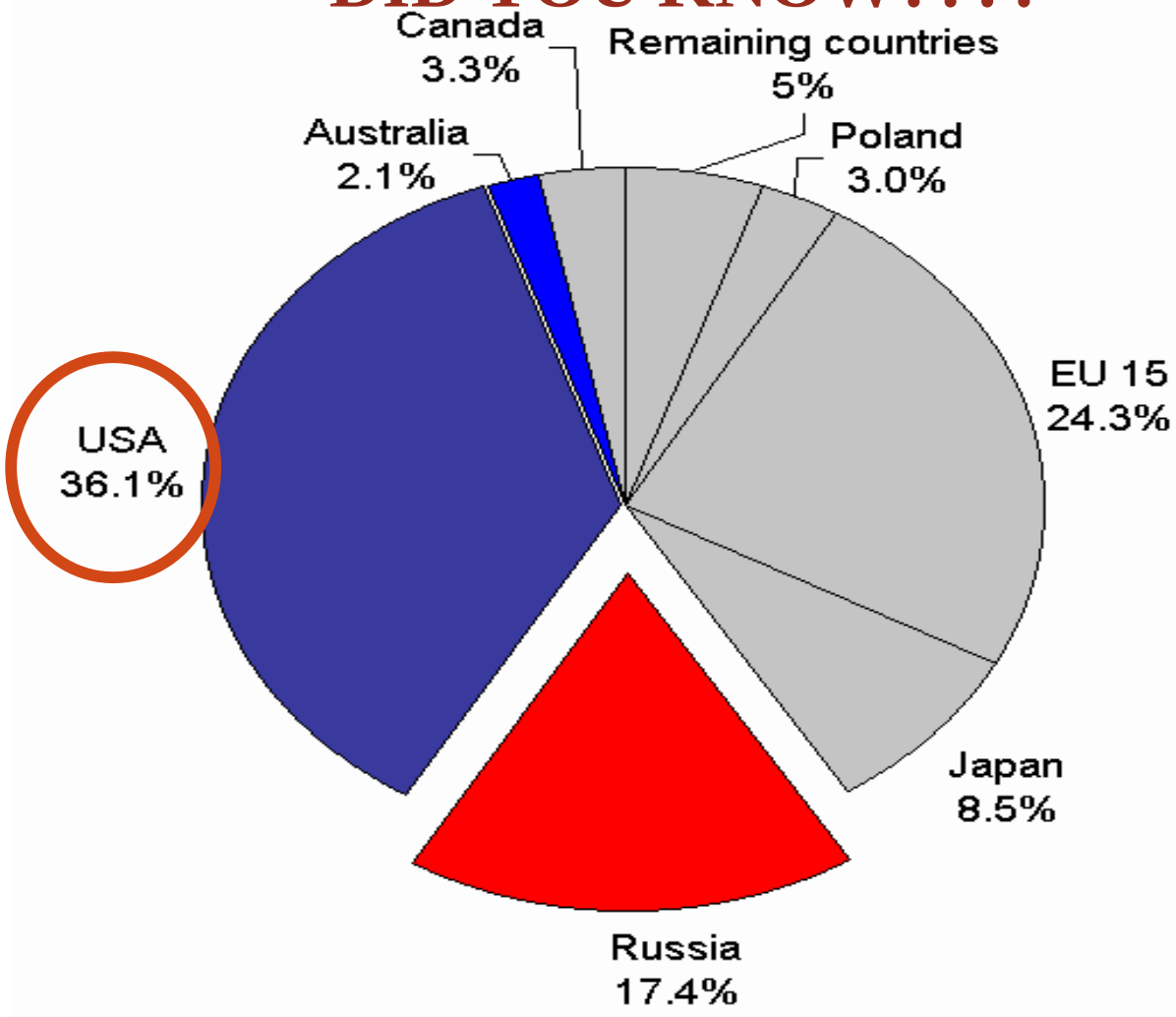
The project will focus specifically on removing the key barriers to **mainstreaming environmental management** considerations into major production activities that are impacting the Godavari region, with special focus on **Coringa Wildlife Sanctuary**.

The main components of the project include

a) Sectoral mainstreaming including knowledge management for coastal and marine biodiversity conservation;
b) Institutional Capacity Development; and
c) Sustainable Community Livelihoods and Natural Resource Use in the Godavari River Estuary.

Carbon Credit

DID YOU KNOW????



WHY

Concept of Carbon Credit

Birth of Carbon Credit

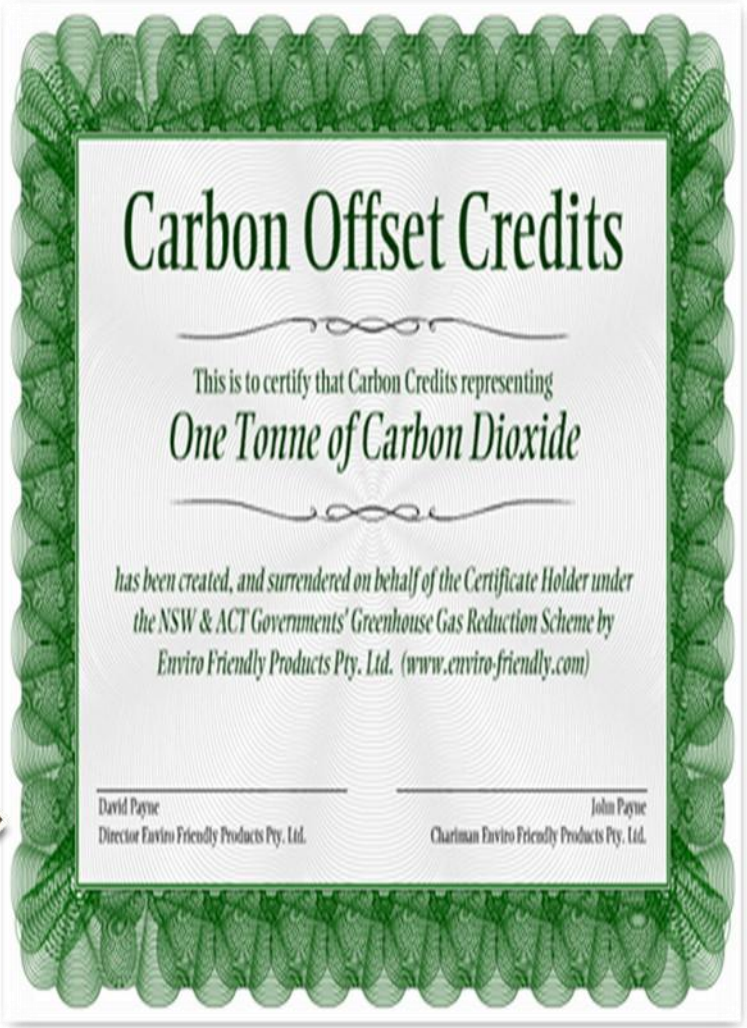
Growth of Carbon Credit & India's Position

Concern for Chartered Accountants

What is Carbon Credit under the KYOTO Protocol…

A credit for reducing 1 ton of CO_2 (Green House Gases) from the atmosphere

Allowance to generate 1 tonne of CO_2 (GHG's)



How to generate Carbon Credits???

CARBON CREDITS

METHANE

CO_2

METHANE

EARN CARBON CREDIT

METHANE

CO_2

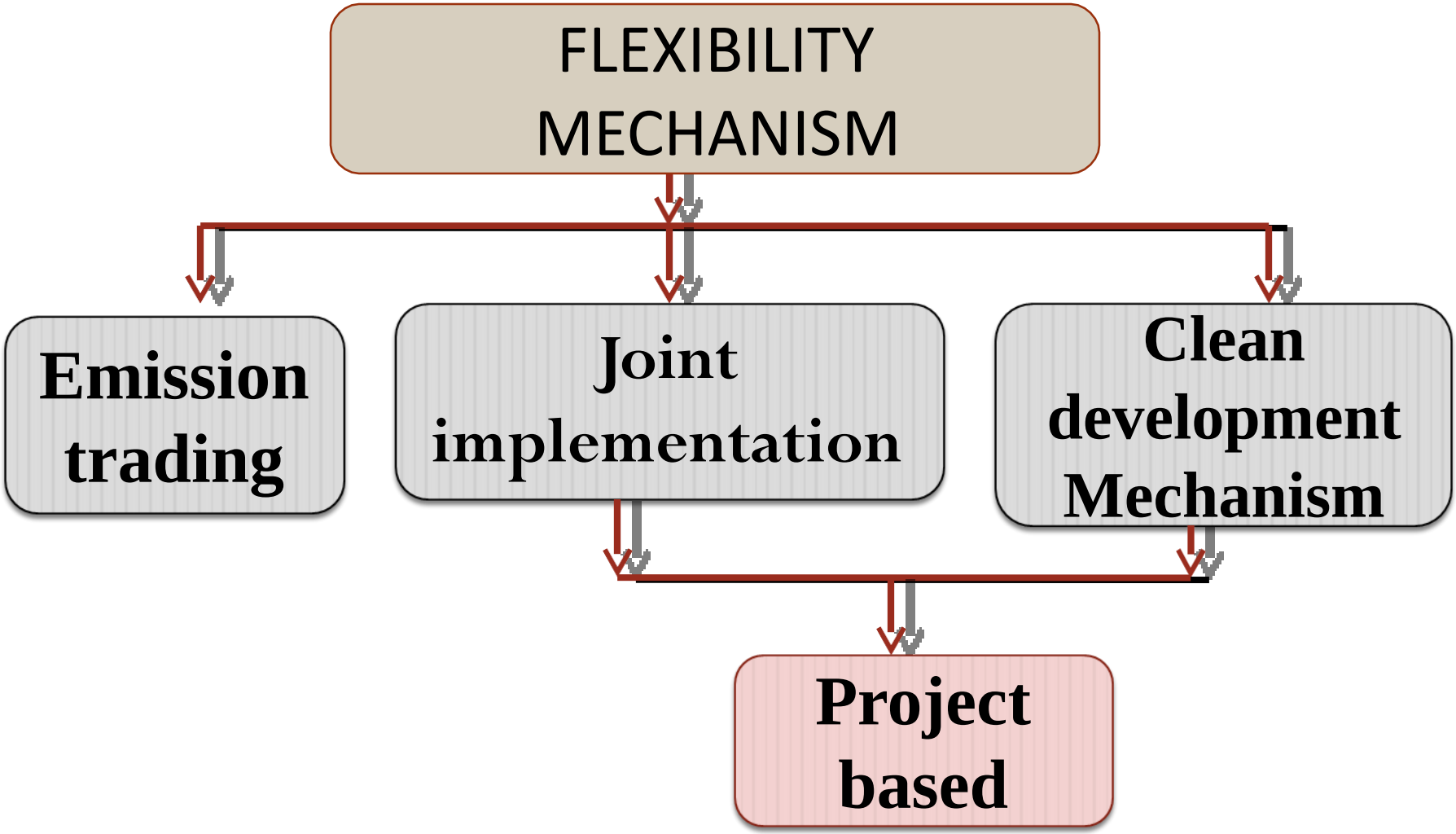

USE OF CARBON
CREDITS IN
EMISSION REDUCTION

REDUCTION

NATIONAL MEASURES

ADDITIONAL MEASURES

THE FLEXIBILITY MECHANISM


FLEXIBILITY MECHANISM
Emission trading
Joint implementation
Clean development Mechanism
Project based

Emission Trading

Payment for CC

Developed country A (needs CC)

Developed country B

Earns carbon credits called Assigned Amount Units

Sell these carbon credits

Joint Implementation

Sets a project

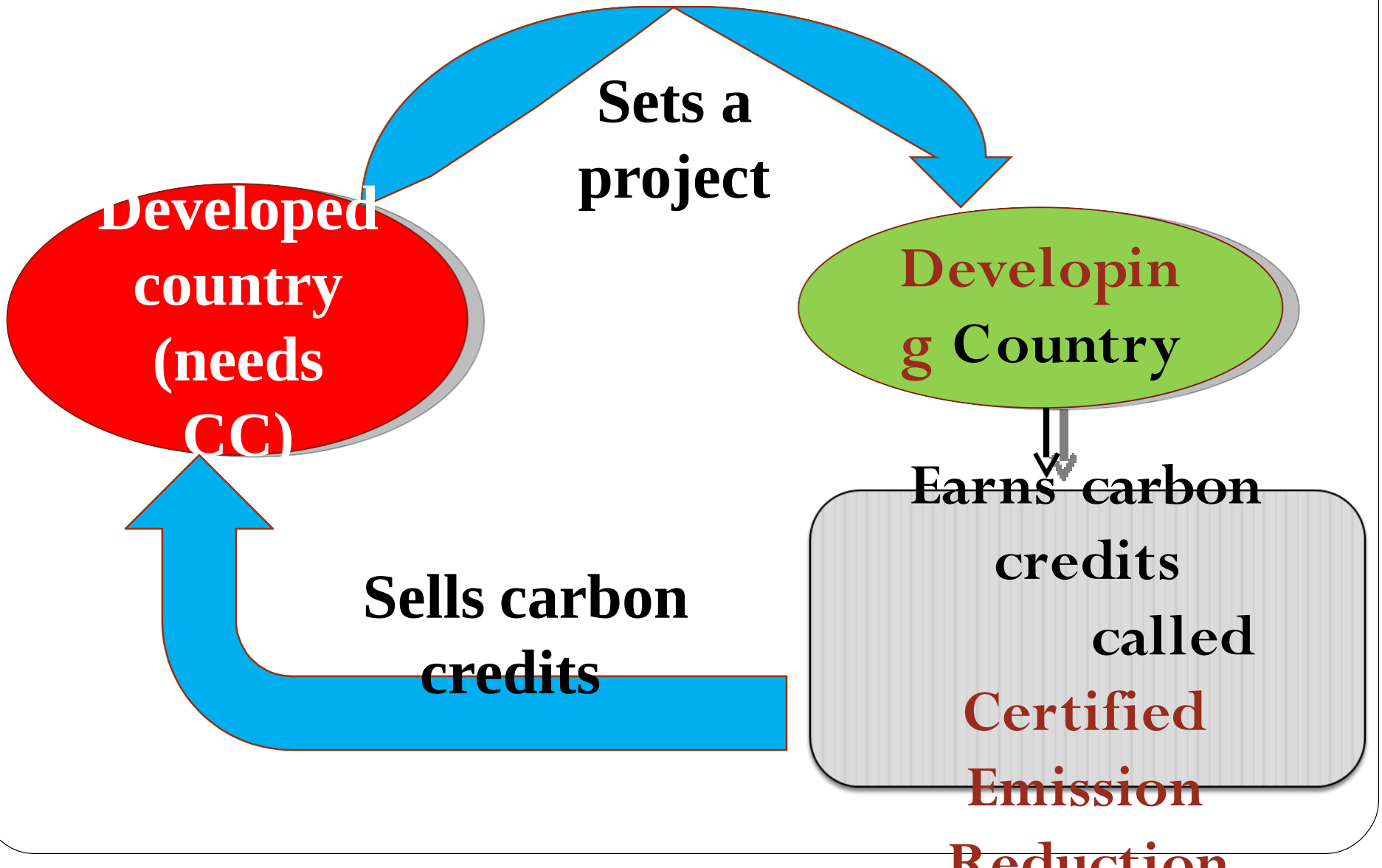
Developed country A (needs CC)

Developed country B

Earns carbon credits called Emission Reduction Units

Sell carbon credits

Clean Development Mechanism (CDM)

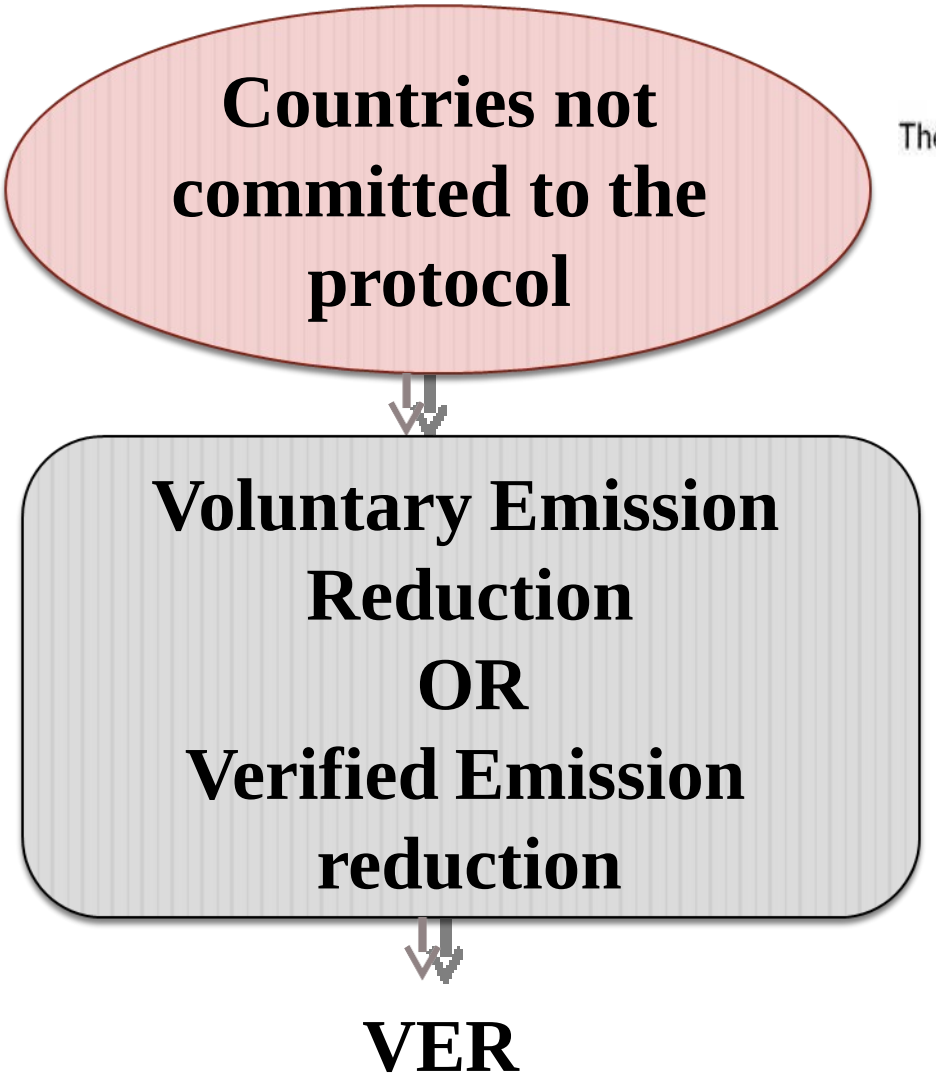


Concept of VER's

VER+

Robust. Reliable. Verified.

The Standard for Verified Emission Reductions



What should be the price of carbon????

At present, price of 1 carbon credit is 10 Euro to 15 Euro

Concept of Carbon Credit

Birth of Carbon Credit

Growth of Carbon Credit & India's Position

Concern for Chartered Accountants

Market for Carbon Trading……

Currently there are 5 Environmental Exchanges, trading in Carbon Credits

CCX

Chicago Climate Exchange

NORD POOL

THE NORDIC POWER EXCHANGE

ECX

EUROPEAN CLIMATE EXCHANGE

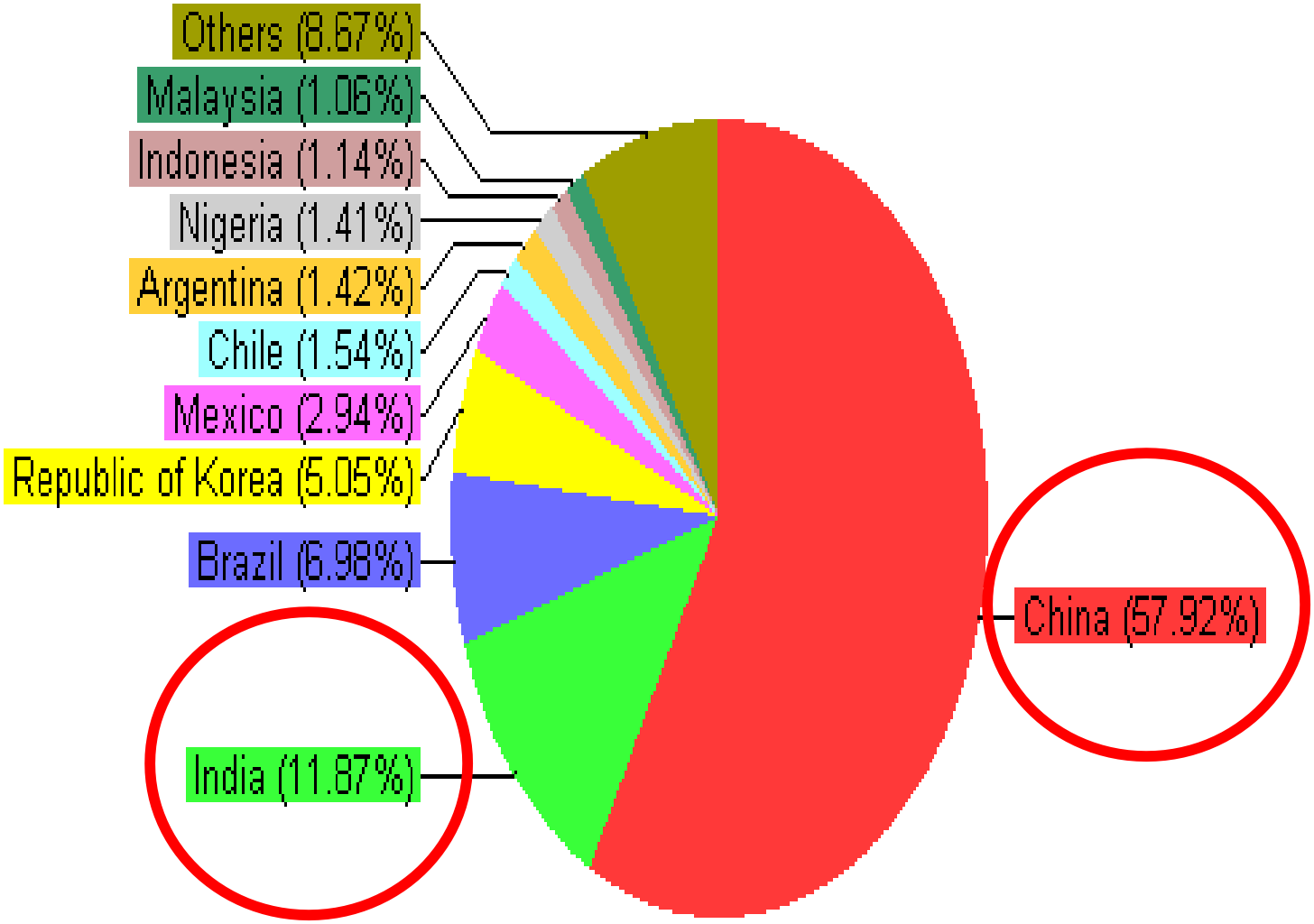
EEX

EUROPEAN ENERGY EXCHANGE

POWER NEXT

India’s Stance in Carbon Credits

India along with China, lead countries in earning Carbon Credit



India pocketed Rs 1,500 crores in the year 2005 just by selling carbon credits to developed-country clients.

India has generated 30 million Carbon credits & 140 million are in pipeline

Some of the Leading companies of India using & selling Carbon Credits…

SRF

Making our nation proud.

एनटीपीसी NTPC

ओएनजीसी ONGC

GUJARAT FLOUROCARBONS Ltd

SRF….

- The major beneficiary of reducing GHG gases

Concept of Carbon Credit

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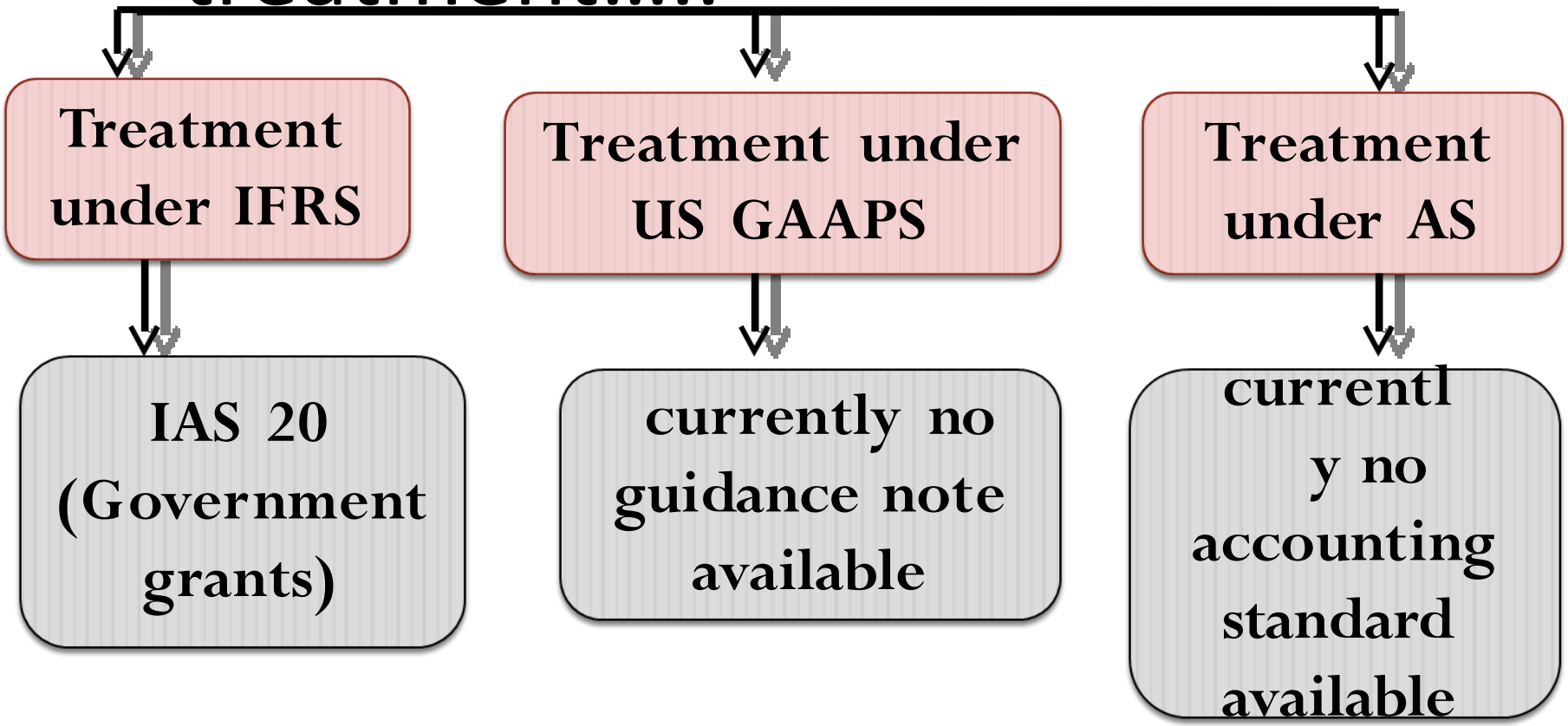
Concern for Chartered Accountants

Concern for

The Chartered Accountants

ACCOUNTING TREATMENT

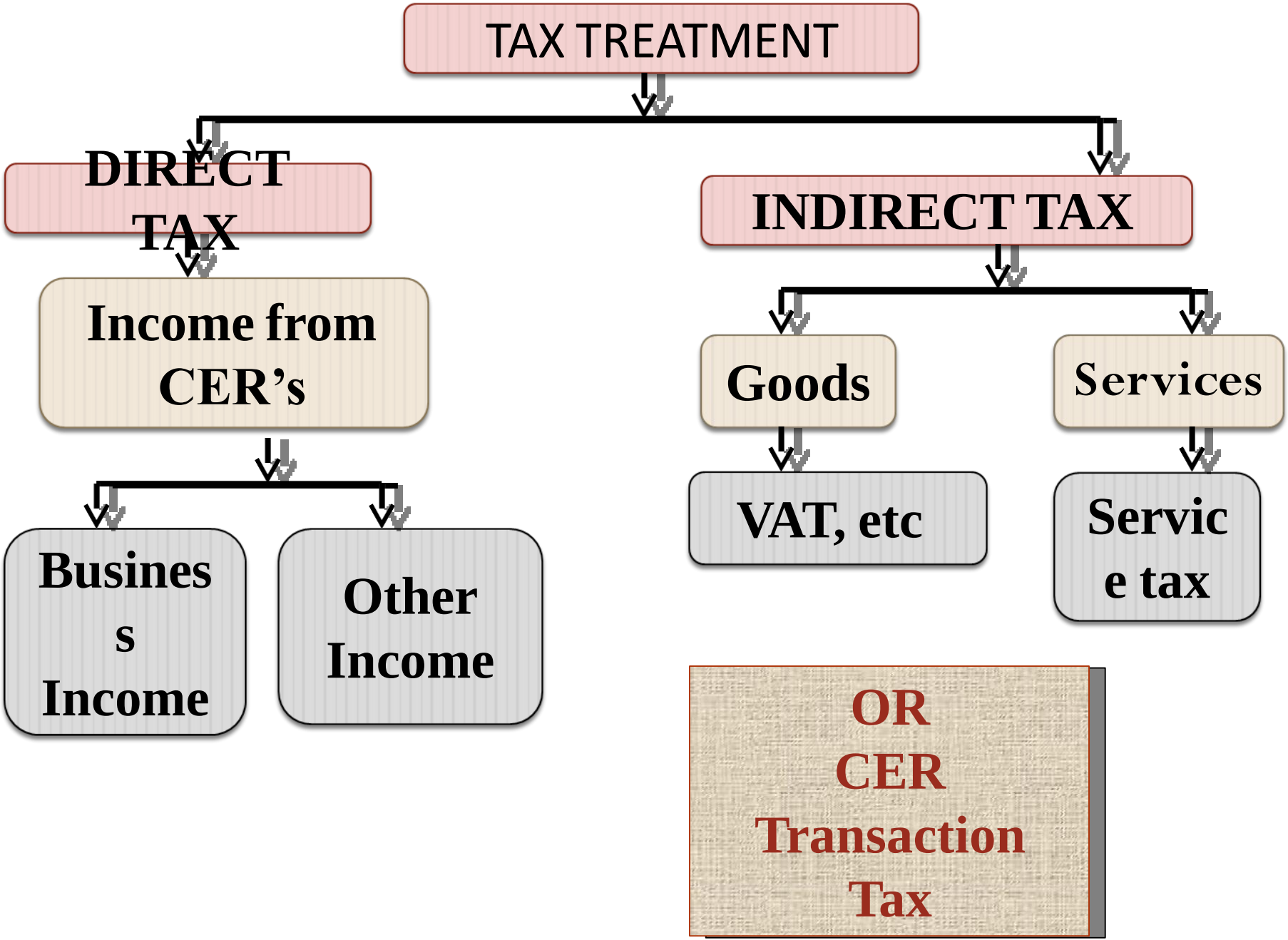
Present Accounting treatment.....



Tax Treatments

Will there be any tax on Carbon Credits ??????

If there is income there will be tax…


TAX TREATMENT
DIRECT TAX
INDIRECT TAX
Income from CER's
Goods
Services
Busines s Income
Other Income
VAT, etc
Servic e tax
OR
CER
Transaction
Tax

However, NO set Accounting or Tax Treatment has yet been

Scope for Chartered Accountants

Other opportunities…..

As an auditor….
In audit of Carbon Trading

As a Carbon Trading Consultant

Carbon Trading Broker

Question Bank

1. Explain effect of climate change due to conventional energy utilization.
2. Role of United Nations Framework Convention on Climate change (UNFCC) in climate change policy forming.
3. Explain in detail Kyoto Protocol.
4. Explain concept of carbon credit in detail.
5. Explain following terms in detail.
   (a) Conference of Parties (COP), (b) Clean Development Mechanism (c) Prototype Carbon Fund
6. What are the national action plans for climate change?
7. Write procedures case of CDM.
8. Write short note on ECBC code for Building construction

Thanks