

PROFITING FROM CLEANER PRODUCTION

**Saving costs and natural resources
by Environmental Efficiency**



research and consultancy on sustainability

*“Improving the living and working conditions of people
in and around industrial clusters and zones in Indonesia”*
a project funded by the European Union’s Asia Pro Eco II programme





Intro: part I

- Part 0: Video on Cleaner Production
- **Part I: General introduction to Cleaner Production**
 - Sustainable development and environmental strategies
 - The profits of Cleaner Production (why)
 - Cleaner Production examples (what)
 - The approach of Cleaner Production (how)
- **Part II: Cleaner Production step-by-step**
 - Planning and organisation
 - Assessment
 - Feasibility analysis
 - Implementation
 - Sustaining Cleaner Production
- **Part III: Case study distillery (exercise)**



Economical development

- Add country specific data of industrial growth



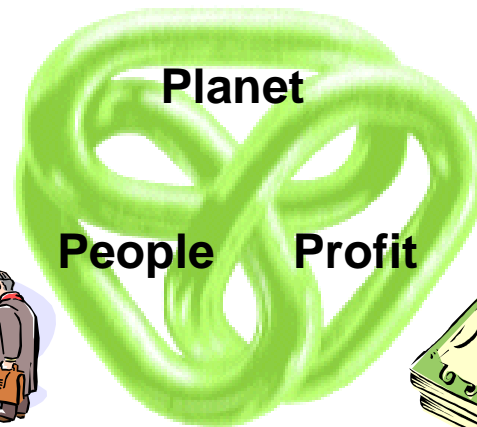
Environmental concerns

- Add country specific data of environmental degradation

Sustainable Development

- Sustainable development meets the needs of the present without compromising the ability of future generations to meet their needs *Brundtland 1996*

Natural resources & energy



Health & Safety



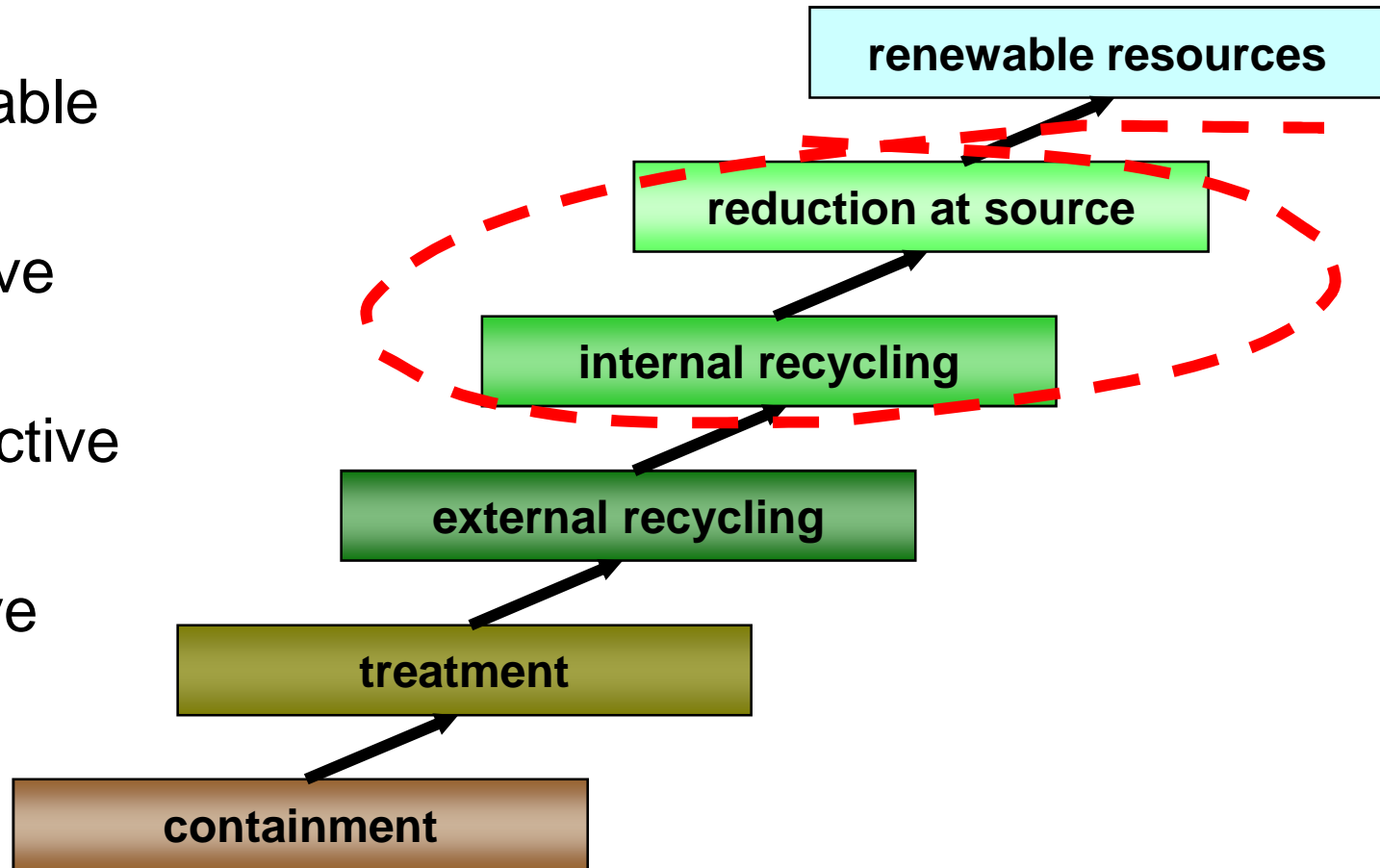
Economic growth



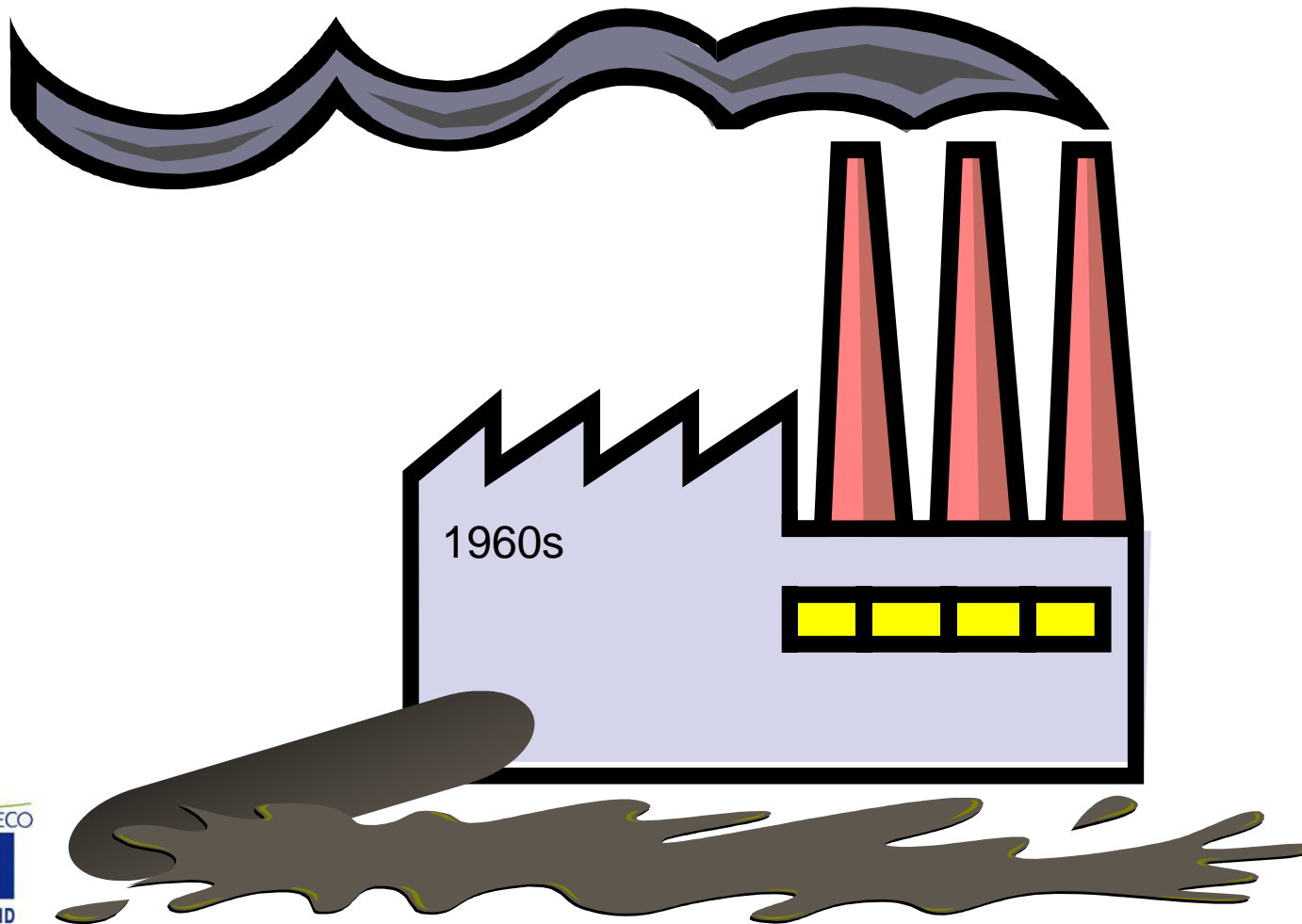
Development in Environmental Strategies



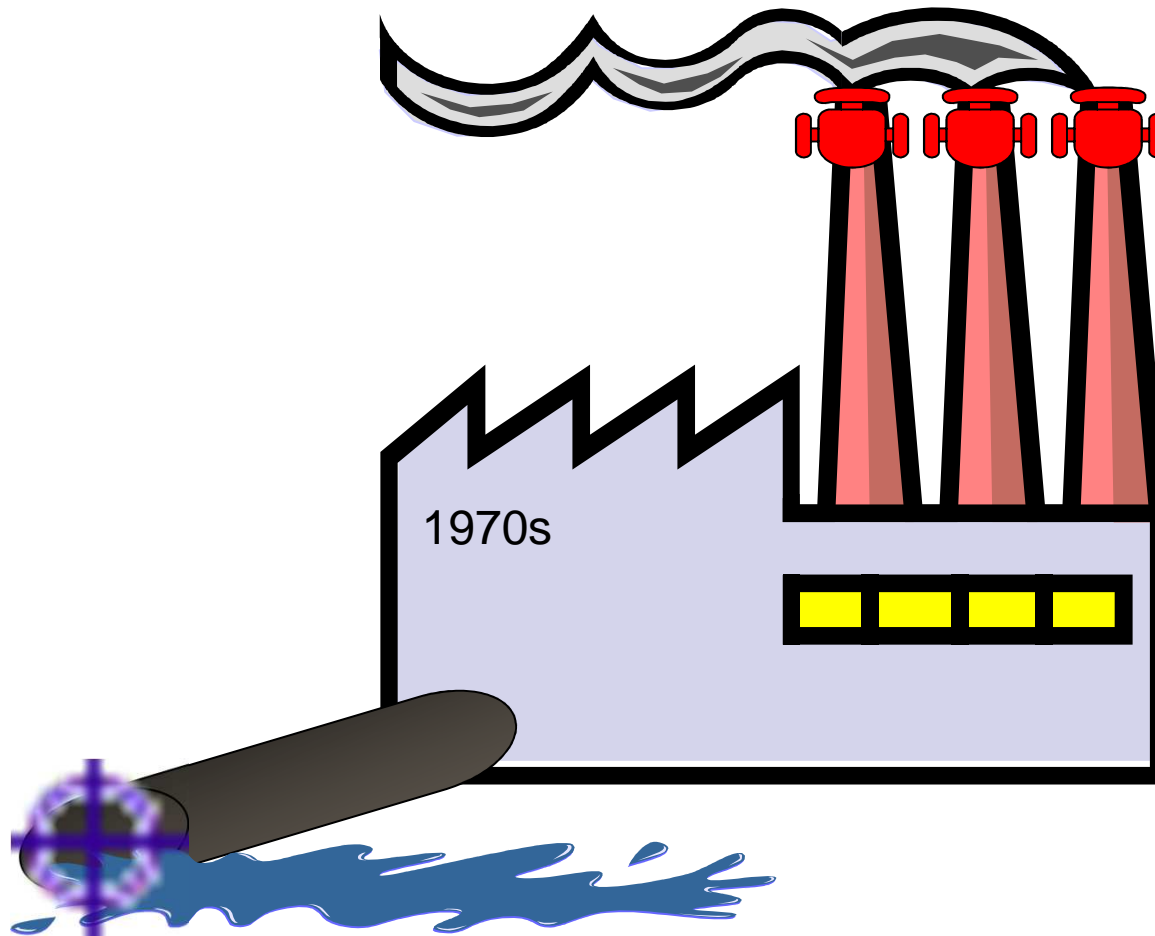
- Sustainable
- Pro-active
- Constructive
- Re-active
- Passive



Passive Environmental Strategy Pollution and Dispersion

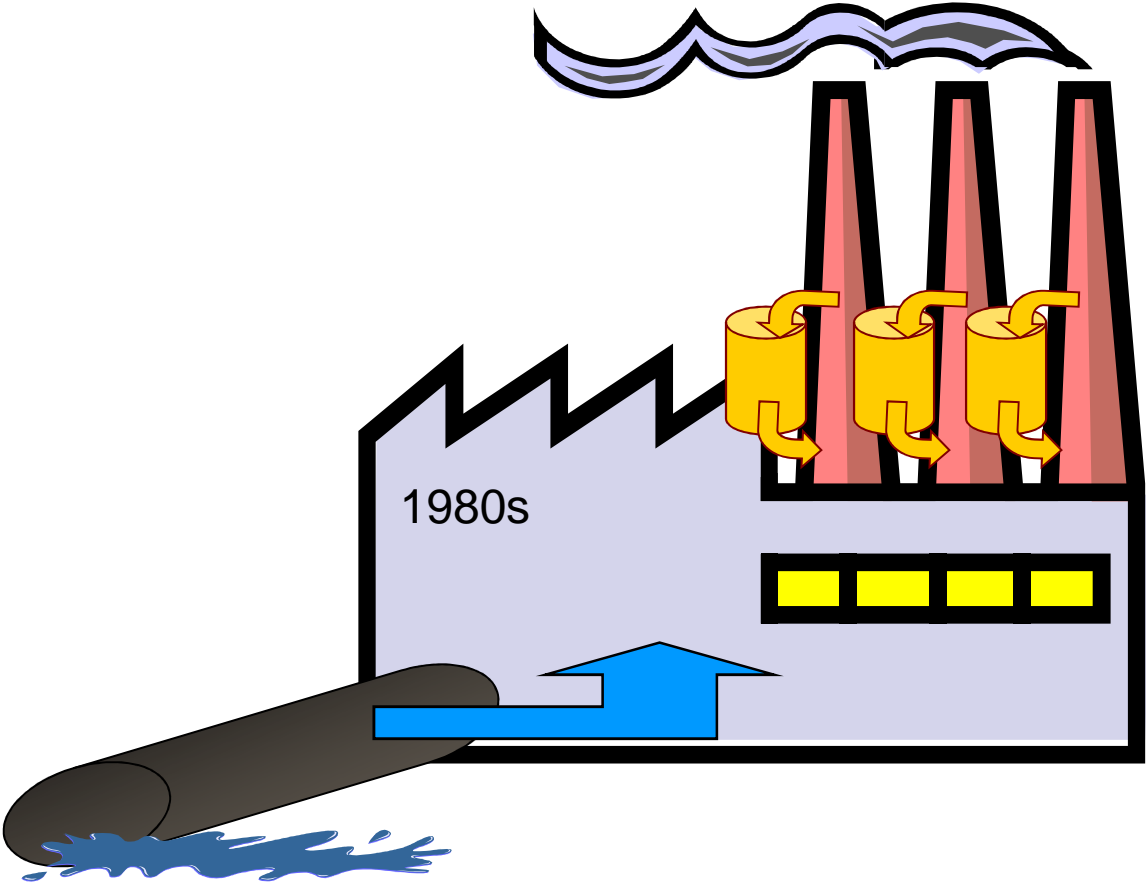


Reactive Environmental Strategy End-of-Pipe Treatment



Constructive Environmental Strategy

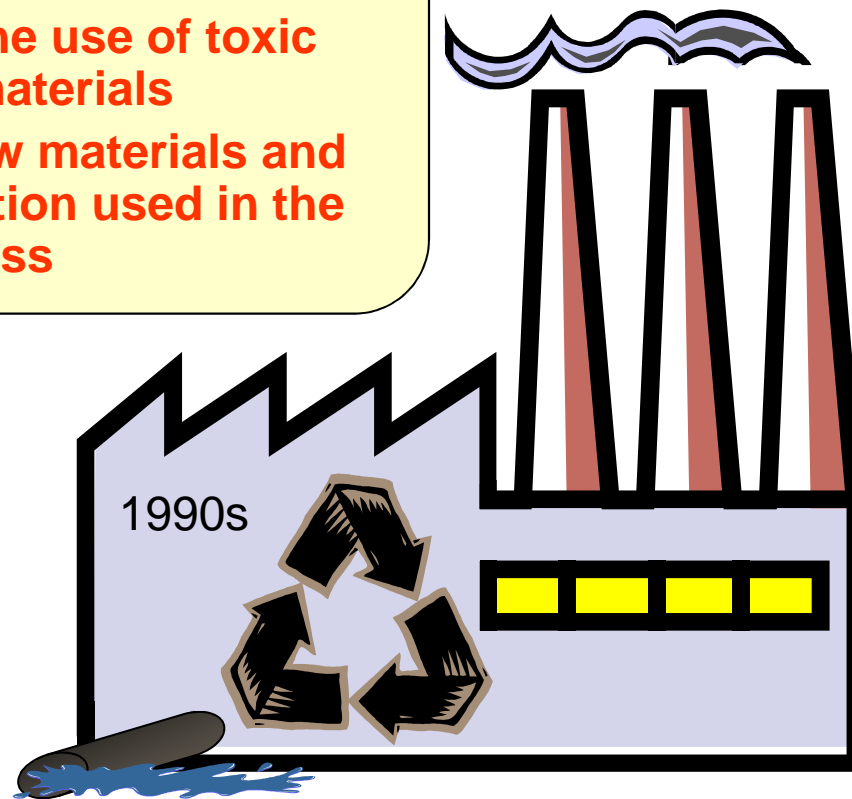
Recycling and Energy recovery



Proactive Environmental Strategy Cleaner Production

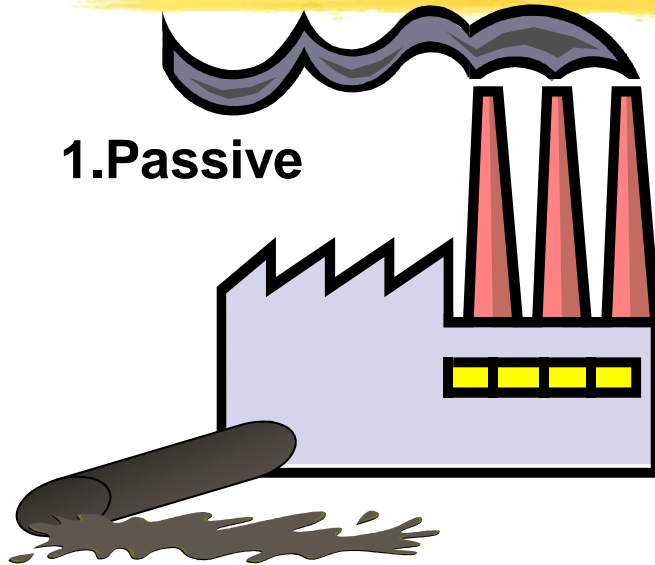


- Reduction at the source of all emissions and wastes
- Elimination of the use of toxic and dangerous materials
- Reduction of raw materials and energy consumption used in the production process

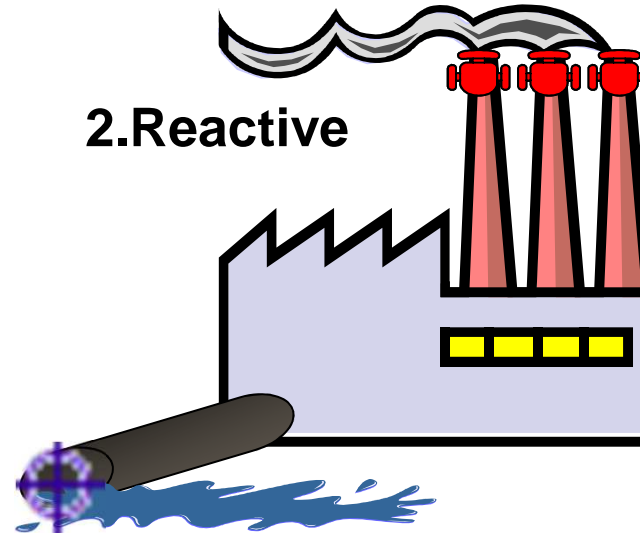


Where are you now?

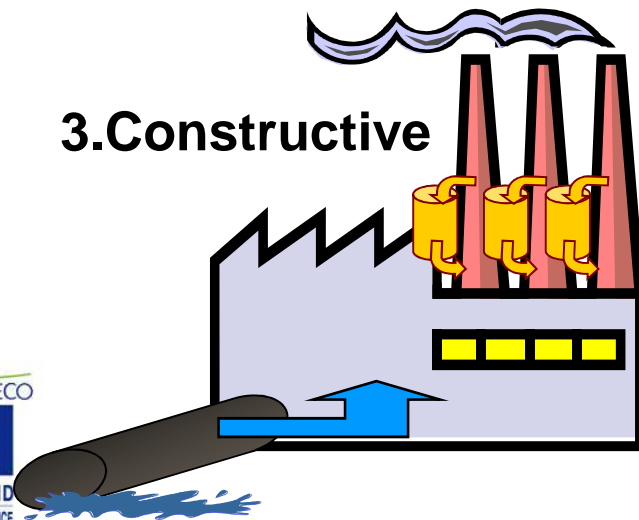
1. Passive



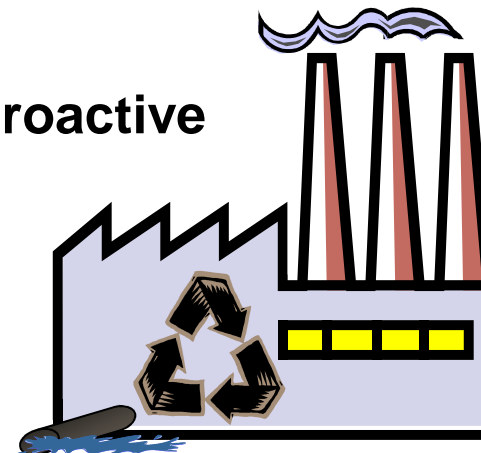
2. Reactive



3. Constructive

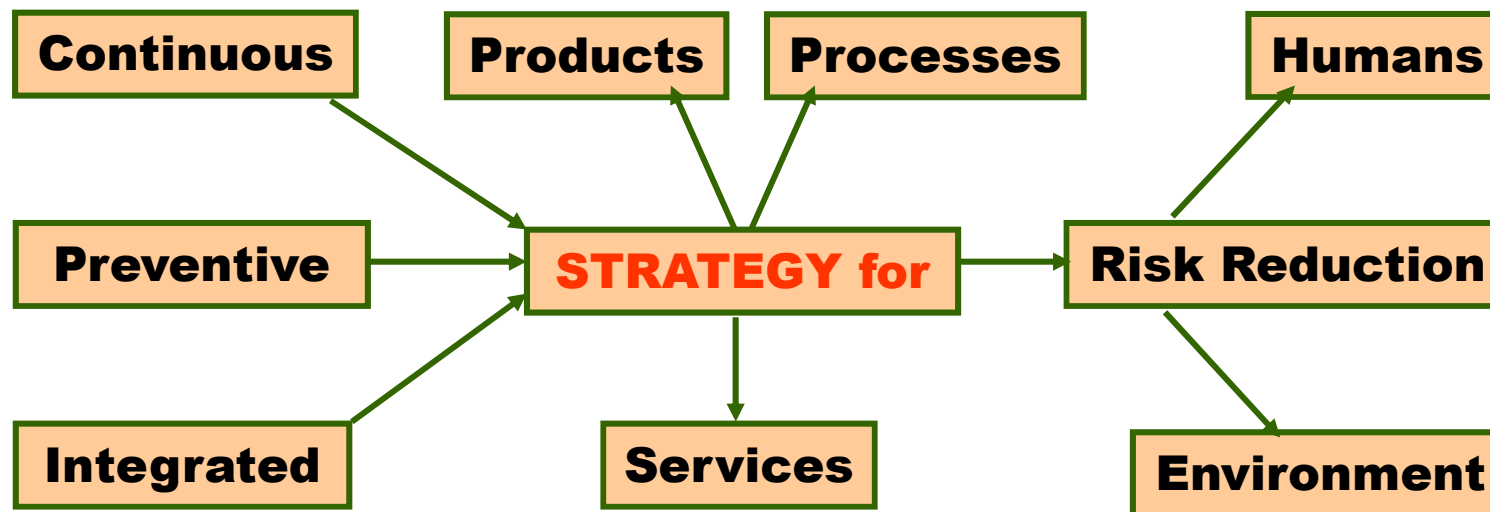


4. Proactive



Cleaner Production Definition

- CP is the **continuous** application of an **integrated**, **preventive** environmental strategy towards **processes**, **products** and **services** in order to increase overall efficiency and **reduce damage & risks** for **humans** and the **environment** *UNEP*








Cleaner Production policy

- Add country specific data

Cleaner Production Profits (1)

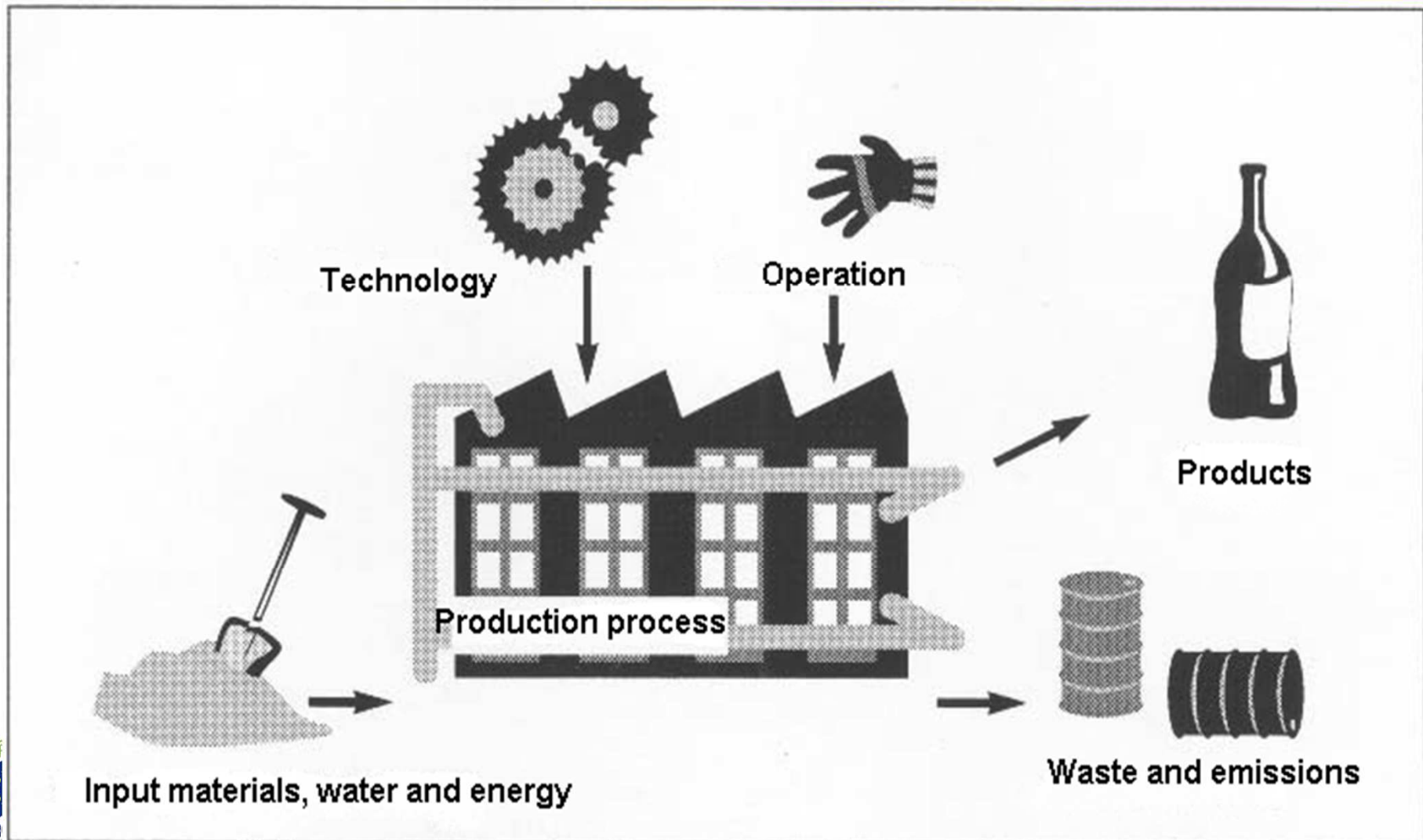
- Human (people) 
 - Better working conditions and increased workers motivation
 - Improved health & safety
 - Improved (company) image
- Environmental (planet) 
 - Reduced raw materials and energy inputs
 - Eliminated toxic materials use
 - Reduced quantity and toxicity of emissions and waste outputs
- Economical (profit) 
 - Reduced costs on input materials
 - Reduced treatment costs
 - Increased production revenues
 - Better product quality



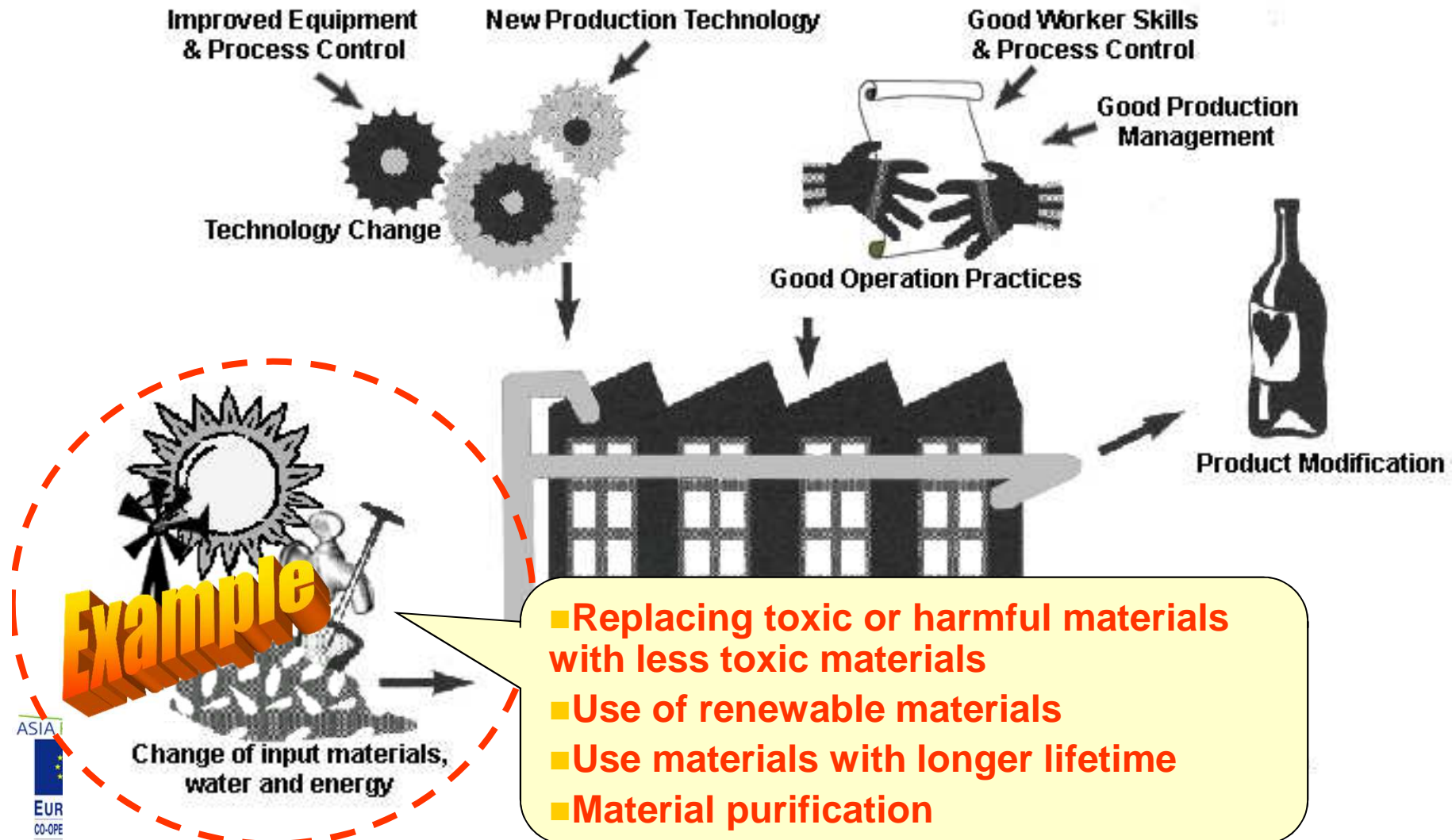
Cleaner Production Profits (2)

- Cleaner Production helps companies to:
 - Increase productivity
 - Reduce production costs
 - Use resources more efficiently
 - Produce safer and better products
 - Reduce levels of pollution and risk
 - Comply with Environmental Management Systems (ISO 14000)
 - Link up with international markets
 - Improve company image

Cleaner Production Categories



CP Options: change of input materials



Change of Input Materials USPS



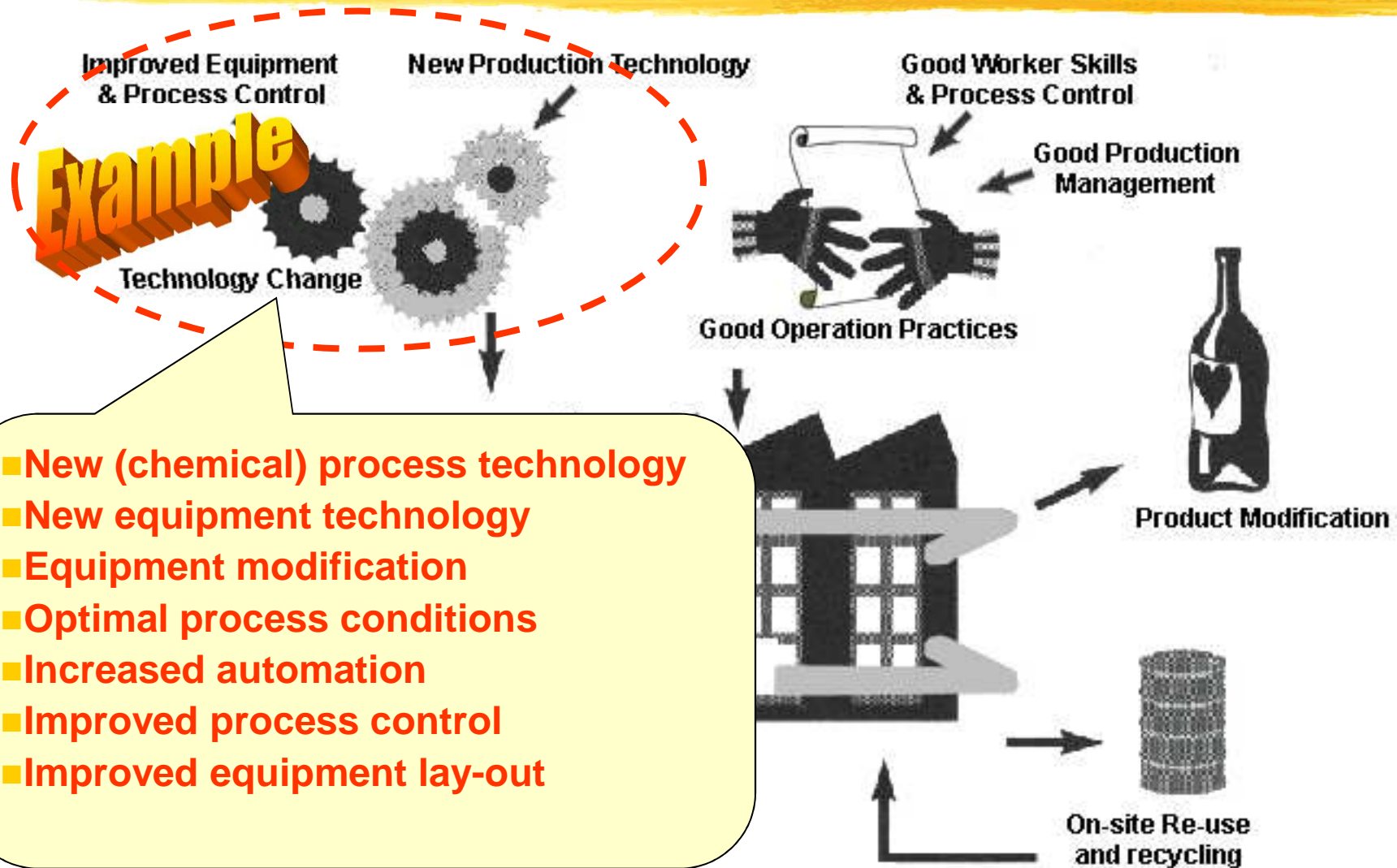
Focus area	Oil consumption and waste
CP option	Change from virgin oil to re-refined oil in 4.500 vehicles
Results	Savings on resources: 18.000 litres Savings: \$1.300/year

Change of Input Materials Nestle



Focus area	International pressure on ozon depleting substances
CP option	Change from halon as refrigerant to a combination of ammonia and CO2
Results	Savings ozon depleting substances: 100%

CP Options: technology change



Technology change Campina



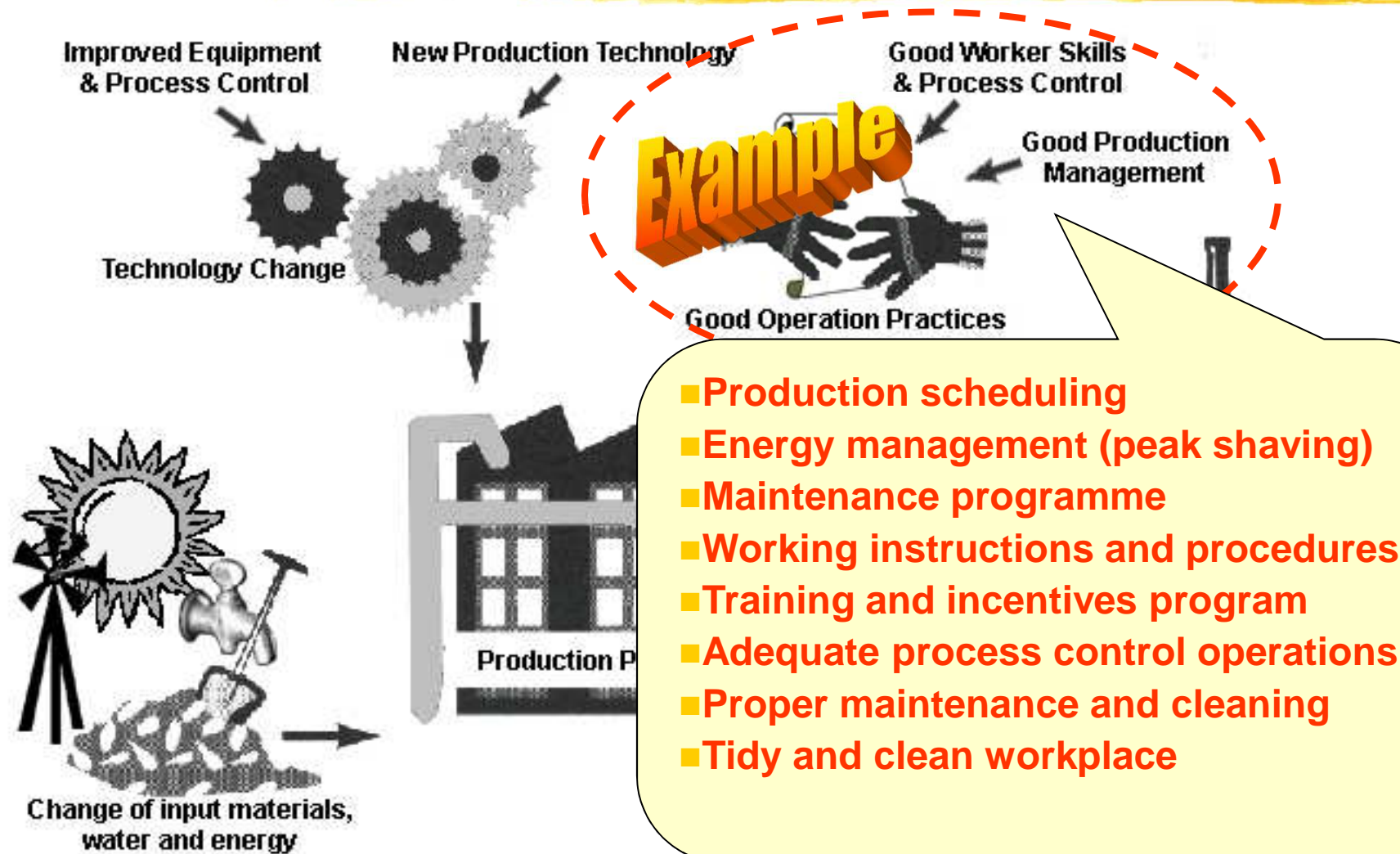
Focus area	Product loss in custard preparation
CP option	Measuring equipment and optimisation of the cleaning process
Results	Savings on cleaning agents: 23% Investment: \$1.000 Savings: \$30.000/year

Technology Change PR labelmakers



Focus area	Waste of ink, plastic film and metal foil
CP option	Camera system for detecting printing errors
Results	Savings on waste and emissions: 40% Investment: \$105.000 Savings: \$38.000/year

CP Options: good operation practises



- Production scheduling
- Energy management (peak shaving)
- Maintenance programme
- Working instructions and procedures
- Training and incentives program
- Adequate process control operations
- Proper maintenance and cleaning
- Tidy and clean workplace

Good Operation Practises B&S



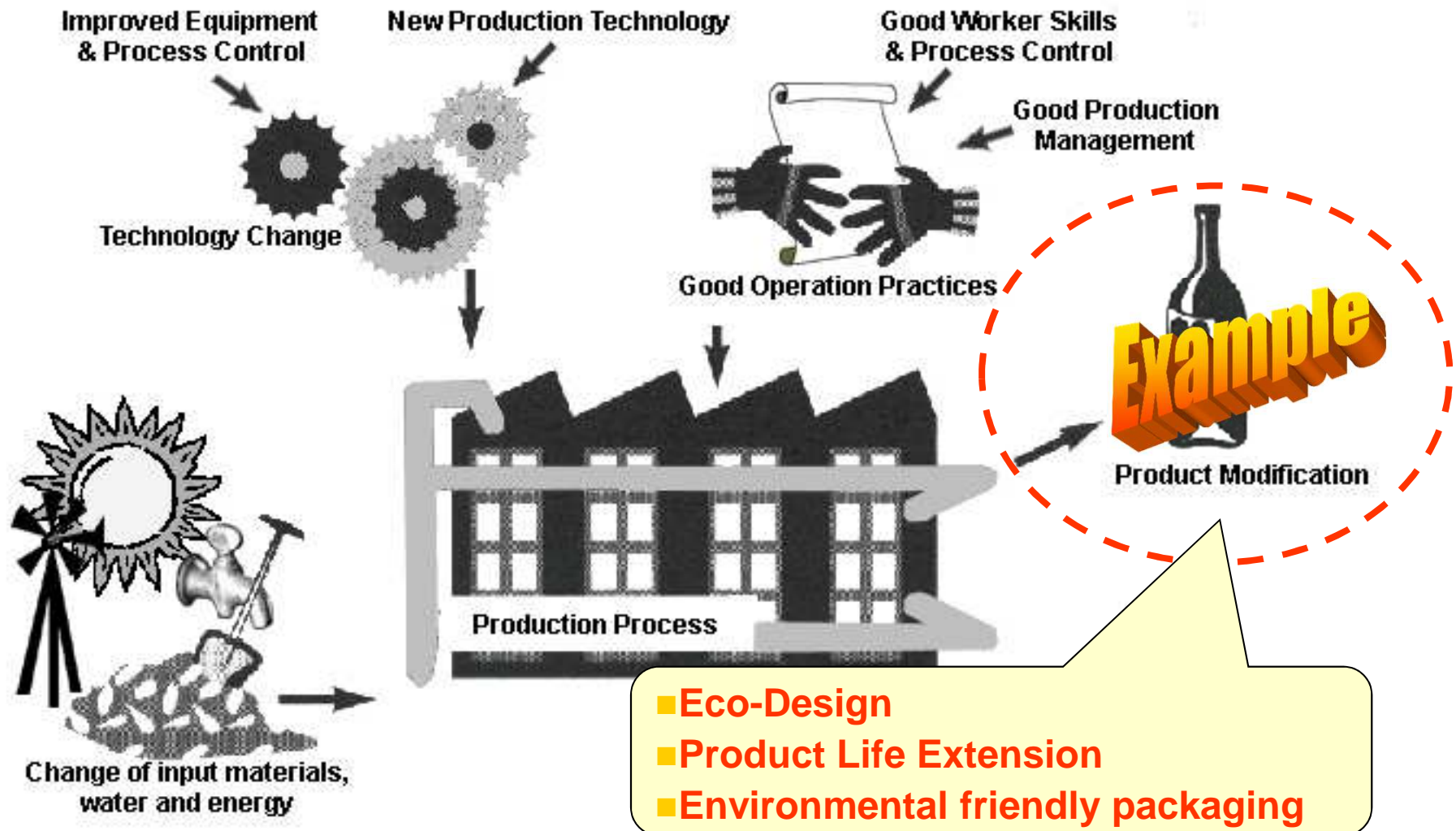
Focus area	Lubricating oil waste
CP option	Recording oil consumption Prolonging periods between oil changes from 240 to 400 hours
Results	Savings on resources: 30% Savings: \$3.000/year

Good Operation Practises Nestle



Focus area	EMS/ISO14001
CP option	Waste and waste water minimisation
Results	Reduction on waste: 41% Reduction on waste water: 8% Savings: \$800.000/year

CP Options: product modification



Product Modification Mona



Focus area	Transport costs
CP option	Replacing round yoghurt packing for cubic packing (spatial efficiency)
Results	Savings on energy: 20% Savings on tray material: 25% (100.000kg/year)

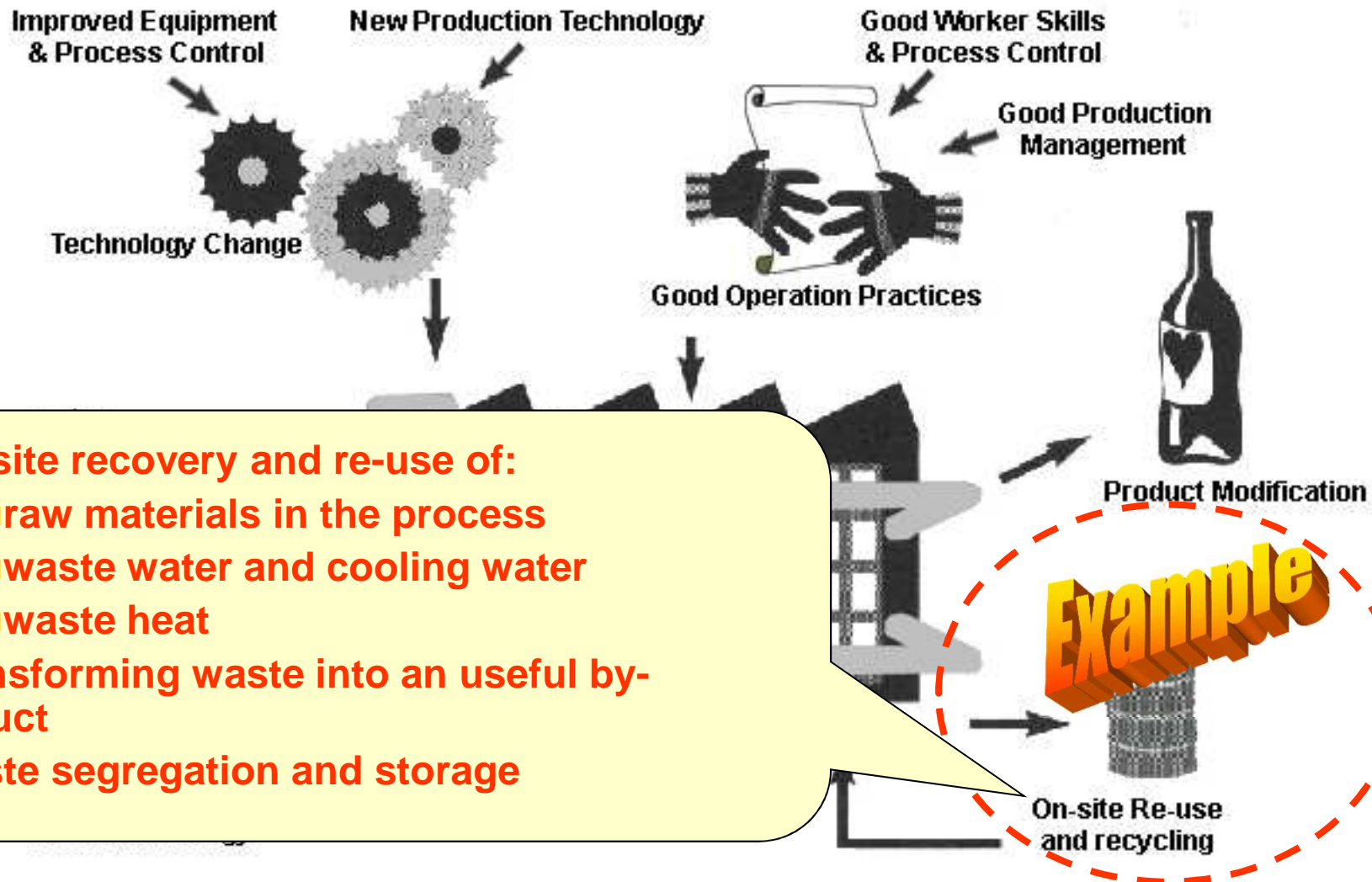
Product Modification

BioTec/De Ster



Focus area	Waste of plastic disposables (tableware)
CP option	Replacement of conventional plastics for potato starch (biopolymer)
Results	Ergonomical high tech product Waste reduction: 100% (biodegradable)

CP Options: re-use and recycling



- On site recovery and re-use of:
 - raw materials in the process
 - waste water and cooling water
 - waste heat
- Transforming waste into an useful by-product
- Waste segregation and storage

Re-use and Recycling Nestle



Focus area	High discharge of wastewater
CP option	Re-use of cooling water from soup plant in flavour plant
Results	Savings on water consumption: 120.000m3 Investment: \$12.000 Savings: \$75.000/year

Re-use and Recycling MET Foundry



Focus area	Sand waste and contamination
CP option	Adding a reclamation process for sand used in moulds
Results	Savings on sand: 80% (reduction: 710 t/y) Investment: \$20.000 Savings: \$20.000/year



Realities

Cleaner Production:

- makes companies more profitable and competitive
- improves products and services
- lowers risk (liability)
- improves company image
- Improves worker's health & safety conditions
- reduces waste treatment and disposal costs
- save costs on raw material, energy and water

Constraints

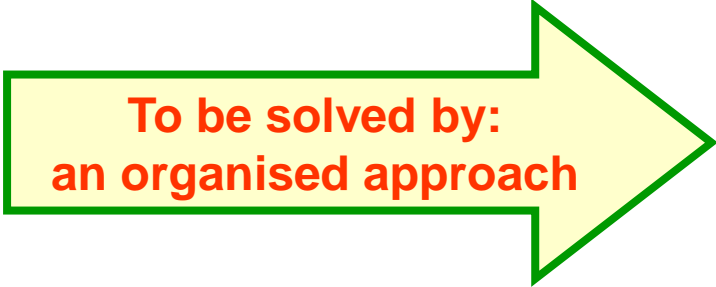
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■ Internal

- Traditional philosophy of CEOs (low awareness)
- Internal organisation and communication (initial constraints)
- Limited information, data and expertise on waste and emissions
- Focus on end of pipe solutions and short term profits
- Inadequate cost/profit calculations CP options
- Missing, outdated or unreliable process instrumentation
- No or limited support of middle management
- No EMS to achieve continual improvement

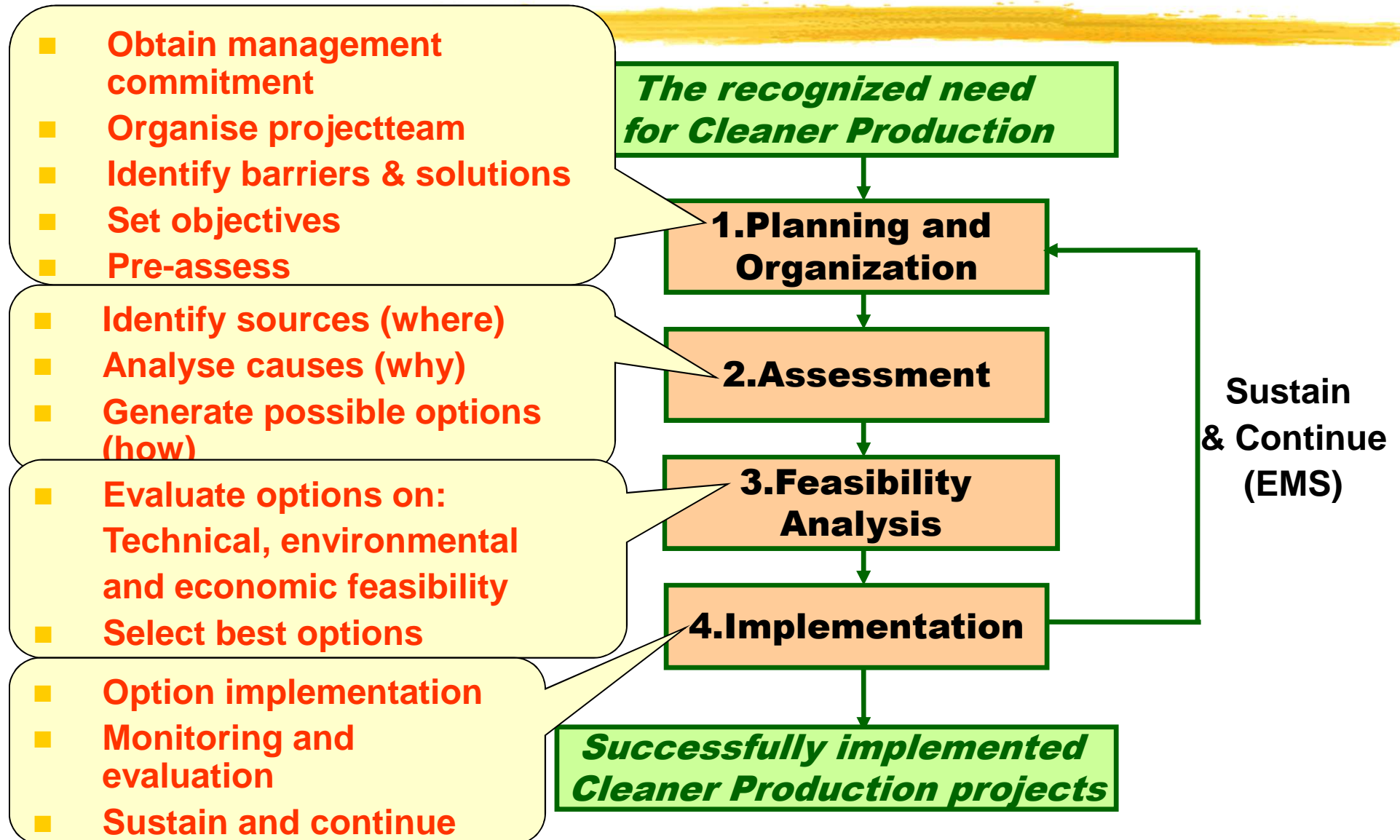
■ External

- Availability of investment capital
- Availability of CP technologies

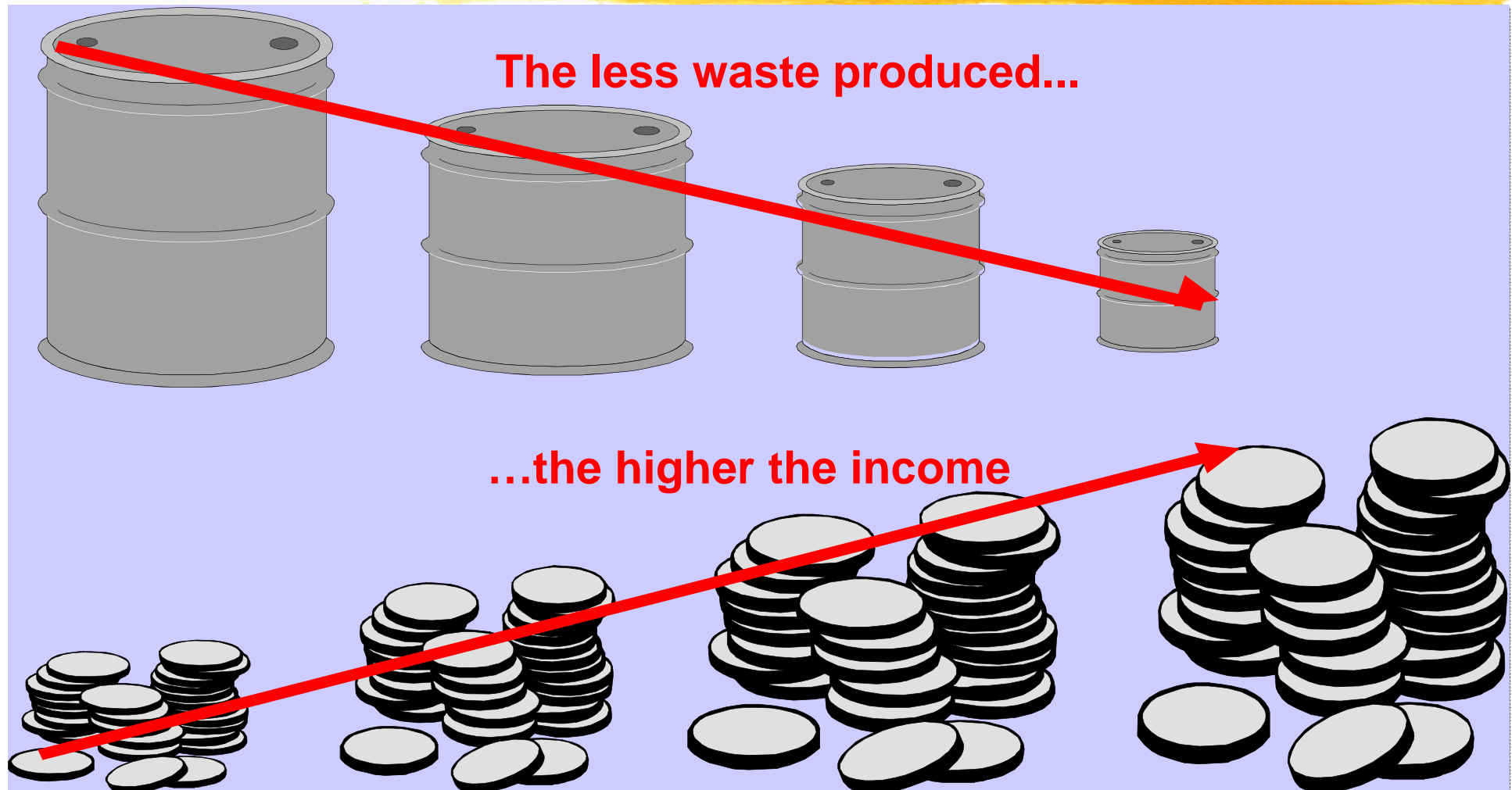
A large, light yellow arrow with a green outline, pointing to the right. Inside the arrow, the text 'To be solved by: an organised approach' is written in red.

**To be solved by:
an organised approach**

Cleaner Production Approach



Less waste, more profits!

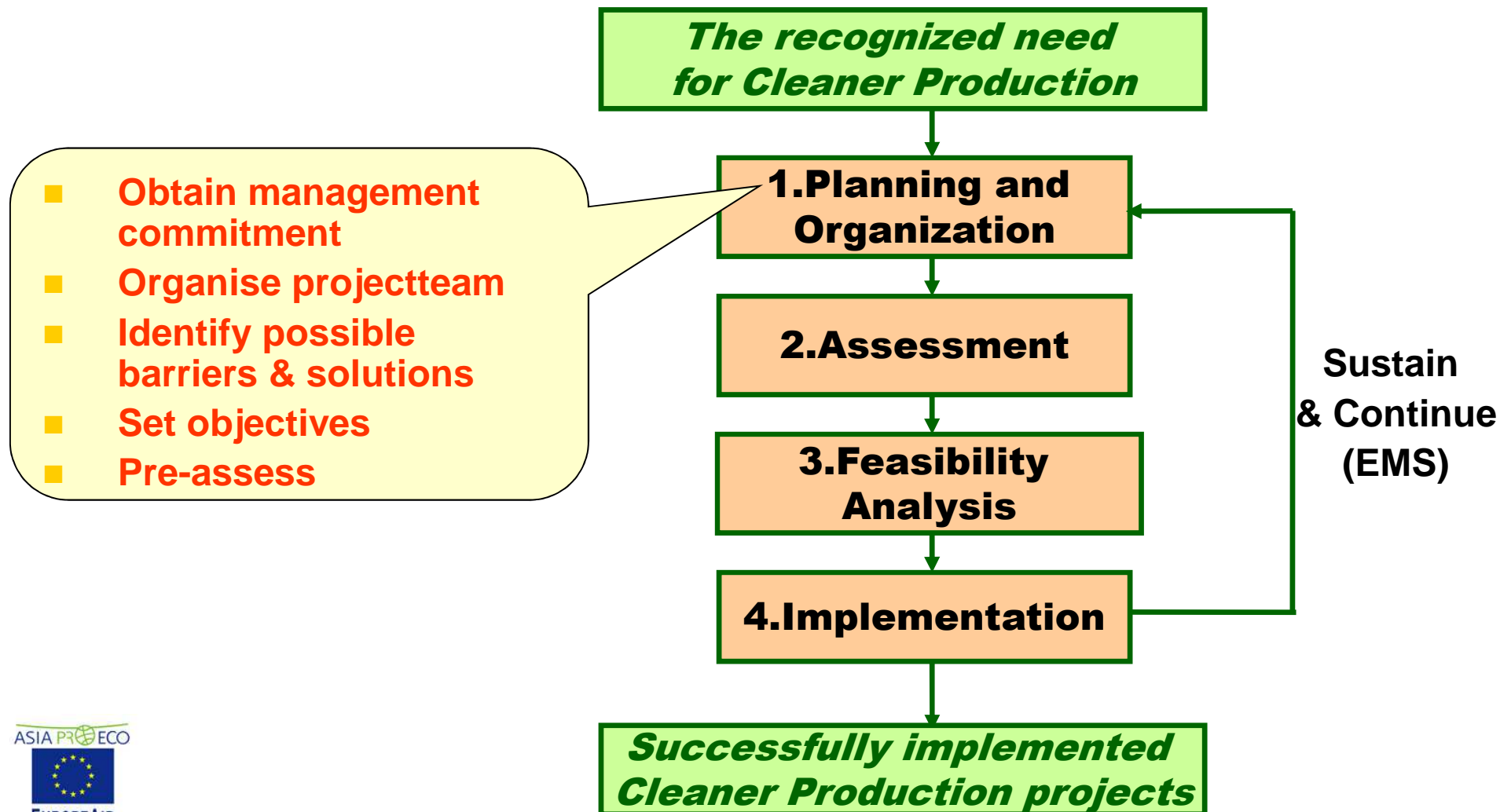




Intro: part II

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Cleaner Production Approach



Phase 1: Planning & Organisation

Obtain management committment



- To give CP importance within the organisation
- To involve all departments needed for CP assessment
- To approve organisational changes needed
- To provide necessary resources
- To encourage a consistent approach of CP throughout the organisation

- **Emphasise economic benefits (cost reduction)**
- **Encourage 'responsible' care**
- **Illustrate environmental benefits**
- **Involve respected informal leaders and employees**





Leading team	Position in company	Possible roles
Team leader	Director of the company	<ul style="list-style-type: none">■ Organise & facilitate assessment team■ Set objectives■ Coordinate CP implementation■ Review the assessment reports
Vice leader	Chief engineer	<ul style="list-style-type: none">■ Support CP assessment plan■ Responsible for CP assessment & implementation
Member	Deputy director	<ul style="list-style-type: none">■ Responsible for CP option generation and implementation

Phase 1: Planning & Organisation

Organise projectteam



- Leading team
- Assessment team





Assessment team	Position in company	Possible roles
Team leader	Chief engineer	<ul style="list-style-type: none"> ■ Organise team and assessment plan ■ Coordinate the assessment activities ■ Review & approve assessment reports ■ Report to leading team
Member	Department leader	<ul style="list-style-type: none"> ■ Collect & analyse information and data ■ Initiate participation and training ■ Identify assessment focus and targets ■ Option generation & implementation
Member	Production unit	<ul style="list-style-type: none"> ■ Idem
Member	Sales unit	<ul style="list-style-type: none"> ■ Idem, incl. financial feasibility
CP expert	External	<ul style="list-style-type: none"> ■ Provide methods and tools

Phase 1: Planning & Organisation

Identify possible barriers/solutions



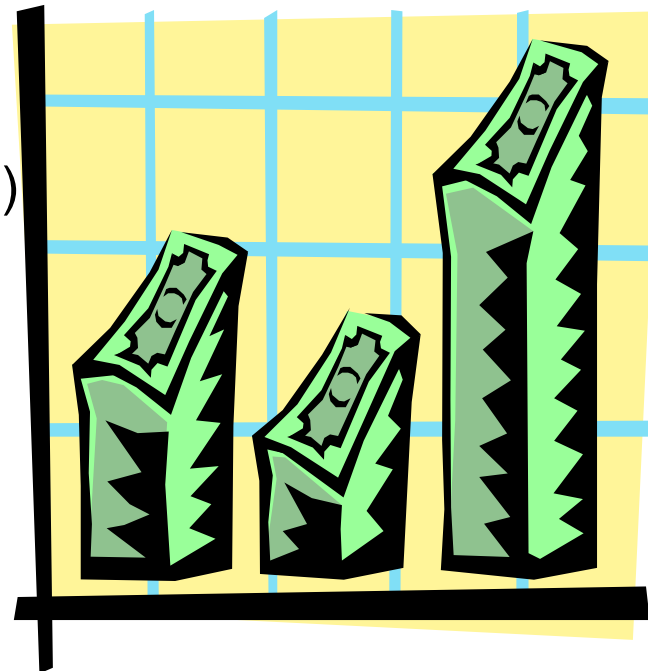
Possible barriers	Possible solutions
Negative attitudes of employees/staff	<ul style="list-style-type: none"> ■ Focus on CP successes and benefits ■ Organise workshops on CP (dissemination) ■ Involve employees (two-way dialogue)
Too complex prod.process	<ul style="list-style-type: none"> ■ Implement CP step-by-step (small steps) ■ Involve an external CP expert
Poor equipment, technology and process control	<ul style="list-style-type: none"> ■ The need for CP is even bigger! ■ Measure flows, emissions and toxics low tech ■ Show the benefits of good control of the process
Shortage of information	<ul style="list-style-type: none"> ■ Use purchase and sales data ■ Collect data elsewhere (other companies) ■ Use information from external CP experts
No money	<ul style="list-style-type: none"> ■ Explain that CP reduce discharge and treatment fees ■ Combine CP with energy and material saving ■ Apply for funding at local authorities

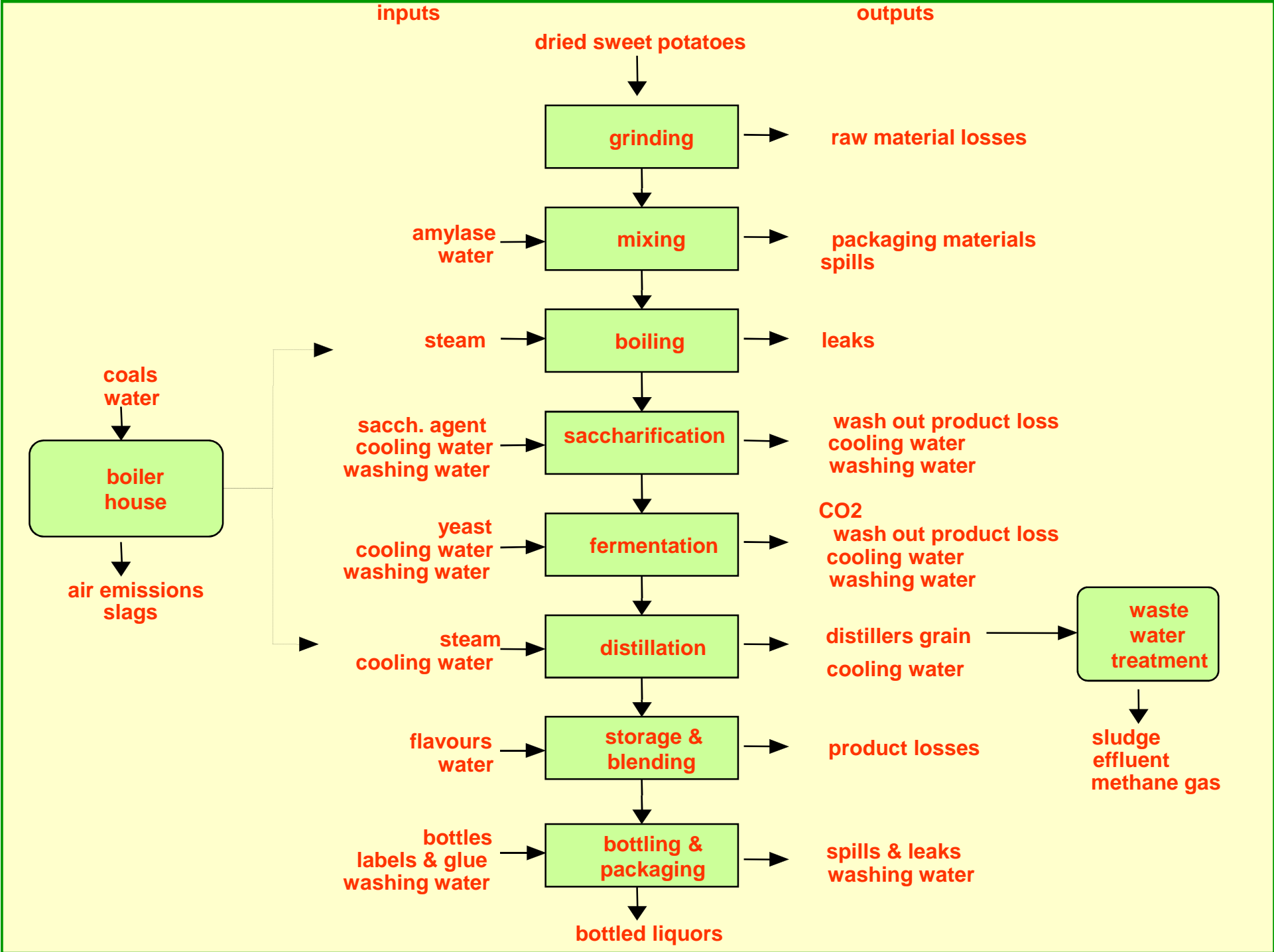
Phase 1: Planning & Organisation

Set objectives



- On strategic level (and related to national policies)
- Formulated in changes (compliance, %, tons, kwh, m3, quality indicators, knowledge, attitude and behaviour)
- SMART:
 - Simple and specific
 - Measurable (what and how much)
 - Achievable (small steps)
 - Realistic
 - Timed (deadline)





Phase 1: Planning & Organisation

Pre-assess



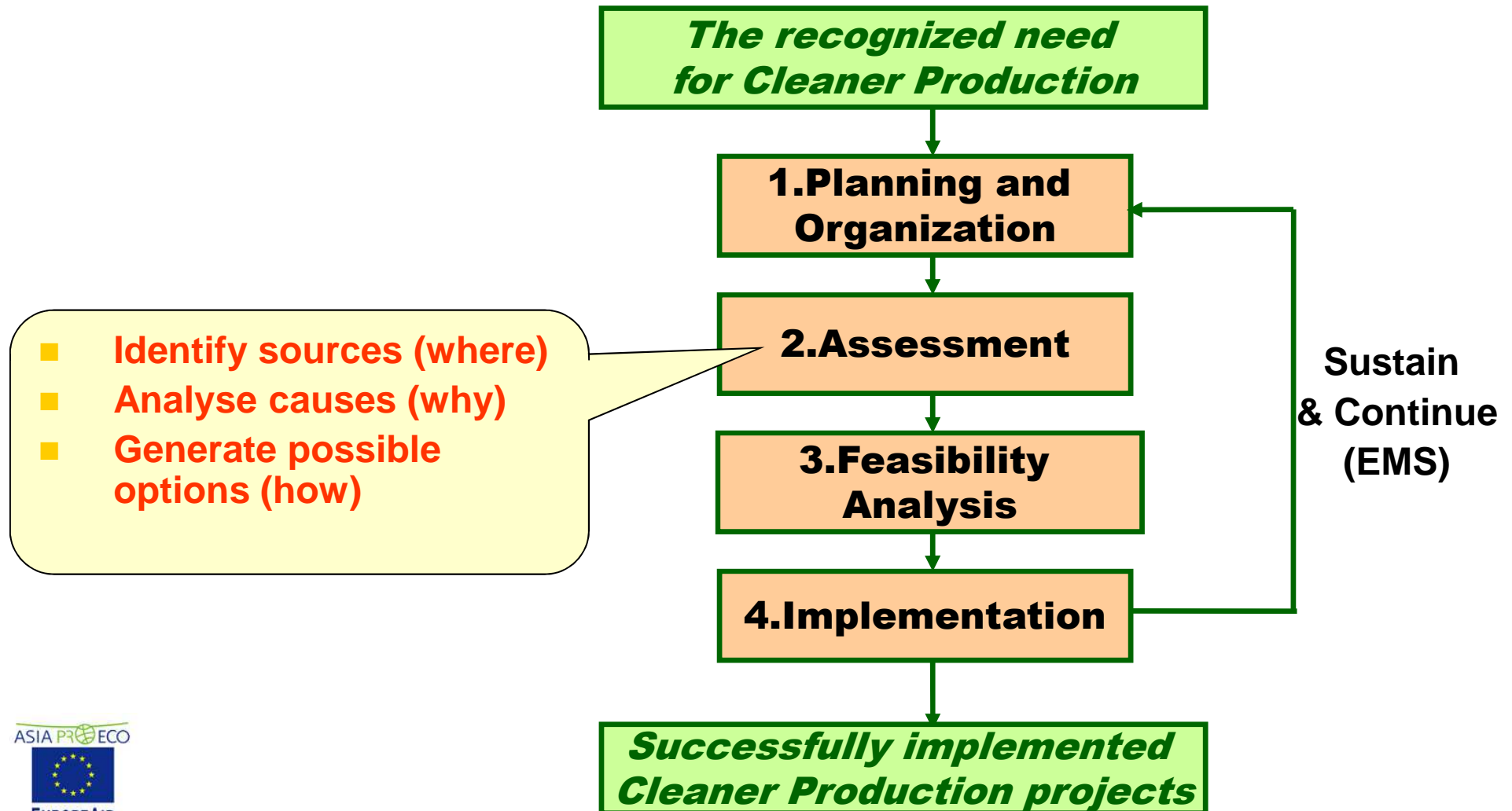
- Collect ready available data
 - Historical data (annual reports)
 - Baseline data (operations manuals)
 - Performance indicators (in sector)
 - Process flow chart ([example](#))
- On-site investigation (workfloor)
- Select the assessment focus
- Set CP targets (smart)
- Implement obvious options
- End up with assessment plan

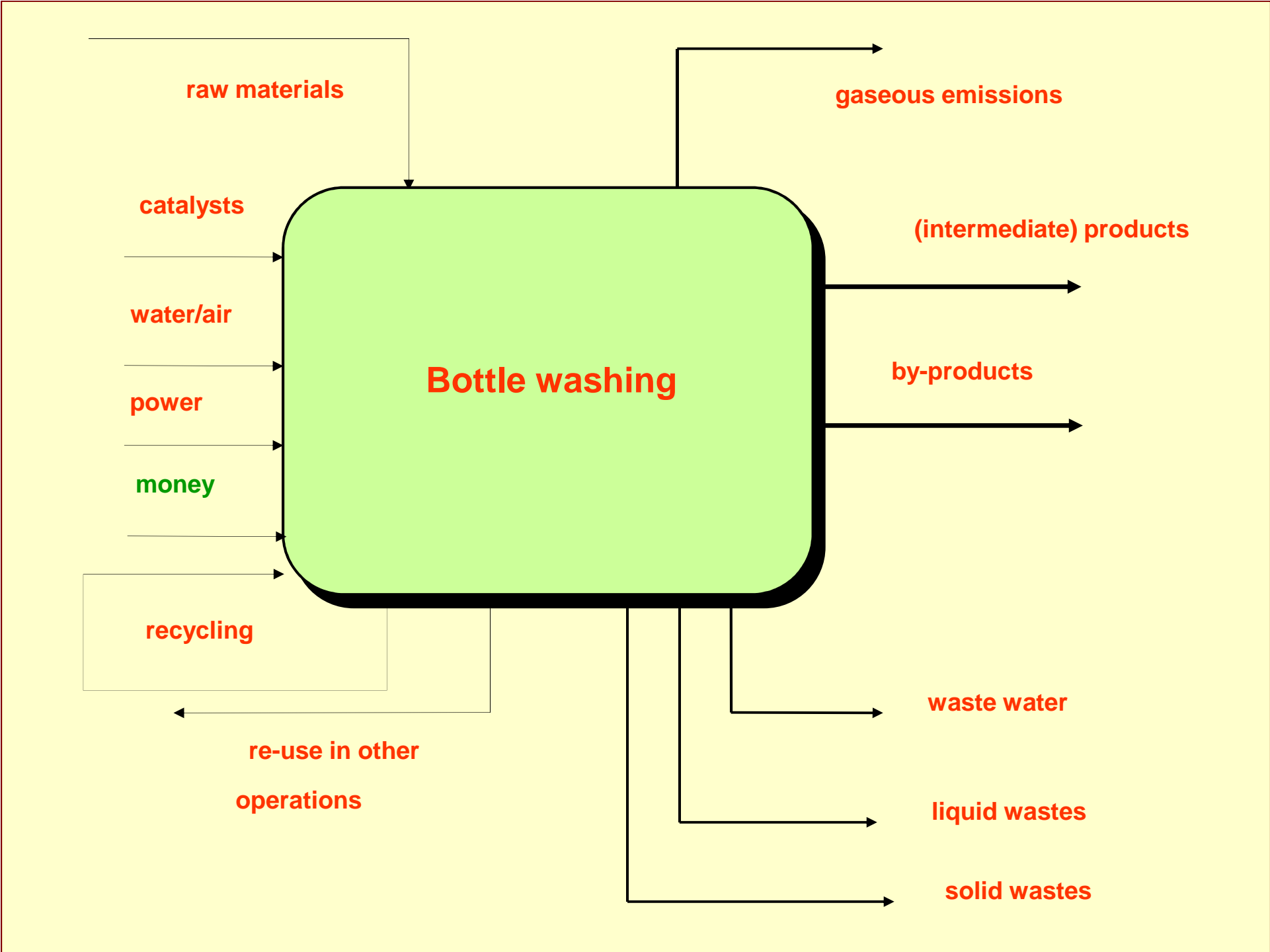
- **Select areas with:**
 - **high economic losses**
 - **high pollution**
 - **high risk for health/safety**
- **Choose low hanging fruits**

- **Better material handling**
- **Repair leaks**
- **Switch off taps, lights, machines etc.**

- **Projectteam**
- **Objectives/CP targets**
- **Monitoring**
- **Major activities**
- **Planning**
- **Expected outputs**

Cleaner Production Approach





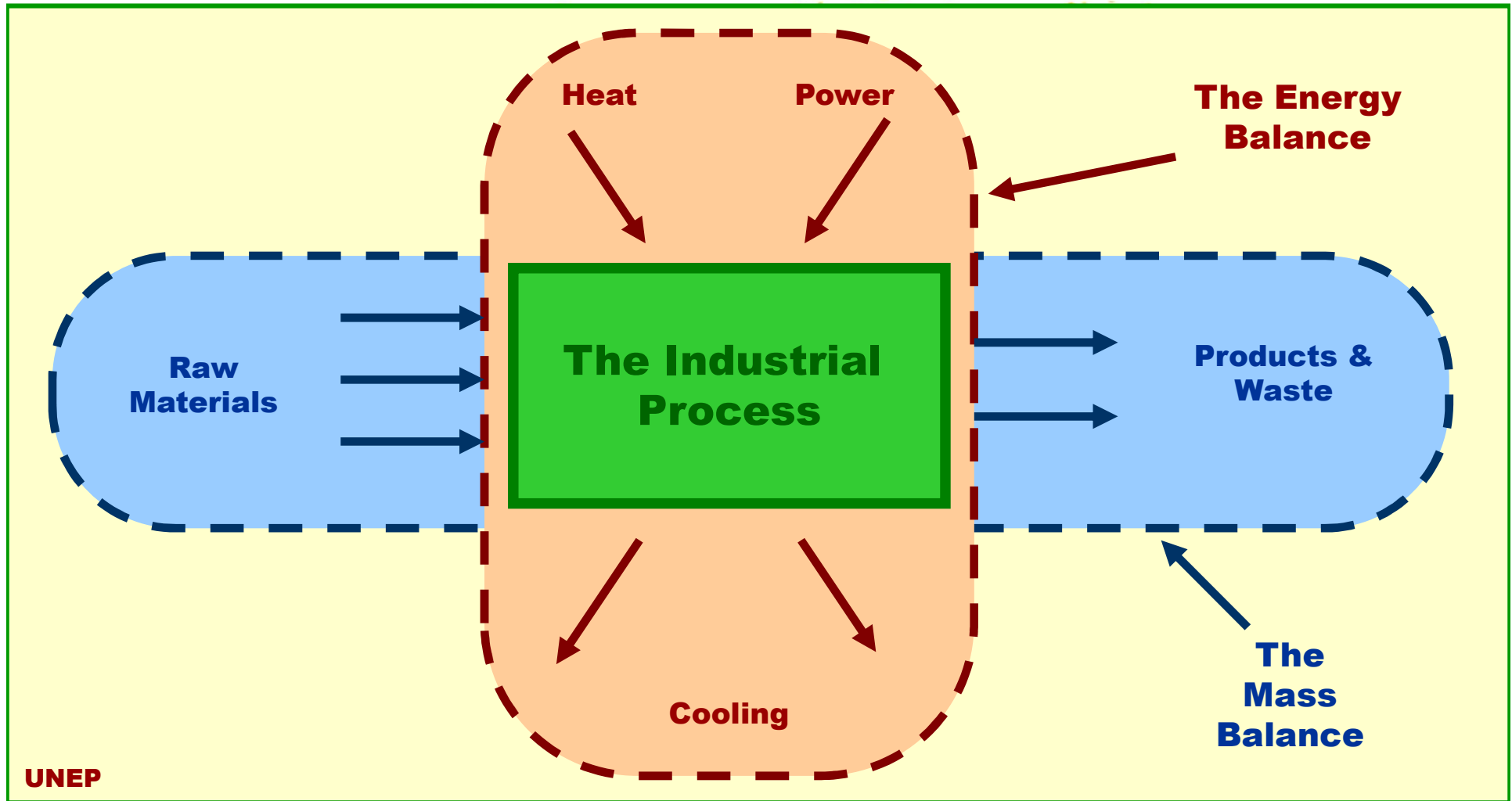
Phase 2: Assessment

Identify sources



- WHERE are waste and emissions generated in the selected focus area?
- Compile process flow chart of the focus area to identify where materials and energy are used and lost!
- Assess process inputs and outputs

- On-site measurements
- Sampling
- Detection
- Analysers
- Calculations
- Costs

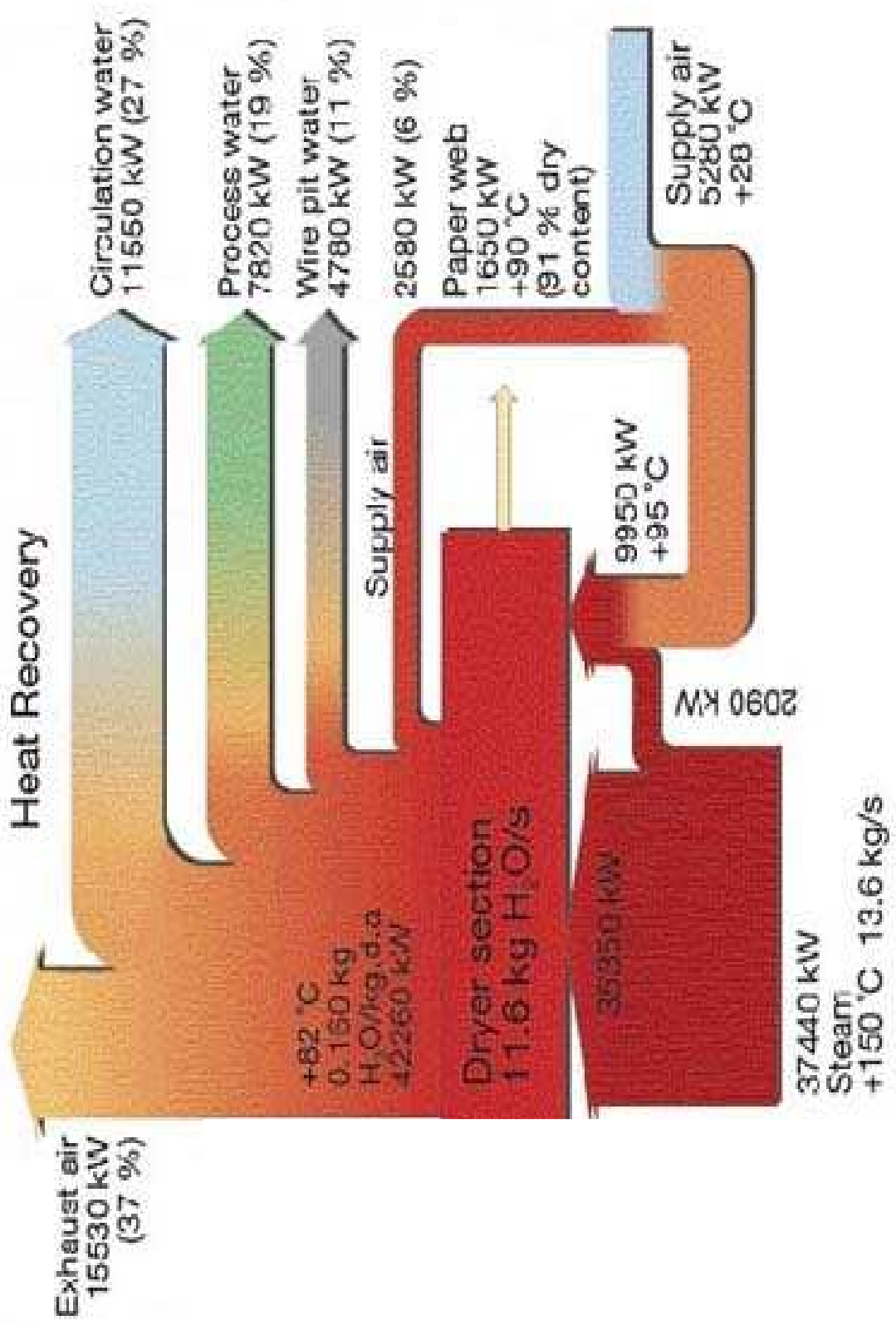


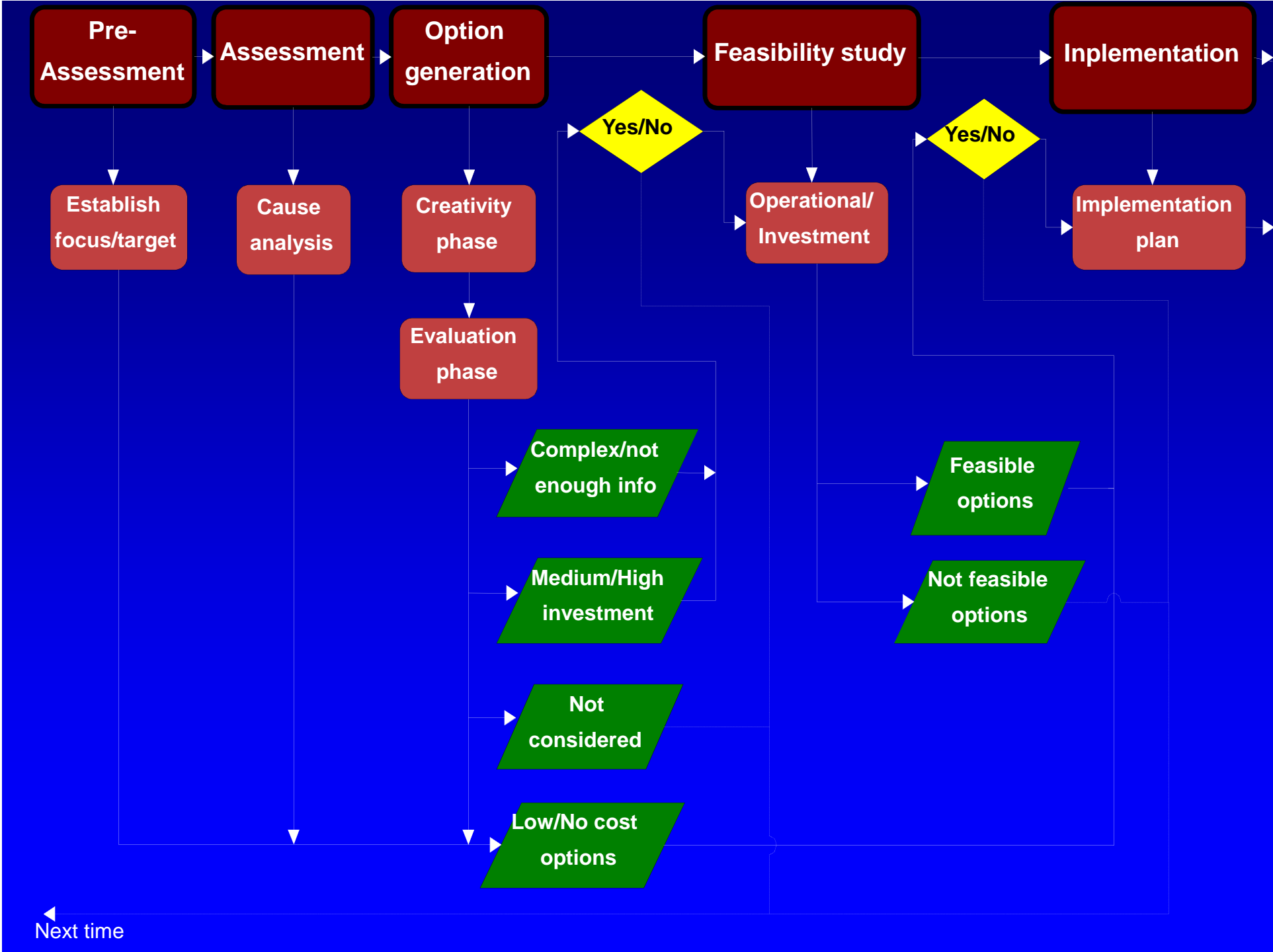
Phase 2: Assessment

Analyse causes



- WHY are waste and emissions generated?
- Make a material and energy balance of the selected focus area (unit)
- Assess waste/energy causes





Phase 2: Assessment

Generate options



- HOW can these causes be eliminated?
- Implement obvious options
- Monitor impact of implemented options
- Generate options
- Screen options
- Mid-term report

- Unnecessary use of lights and machines
- Spills & leaks
- Unmotivated personnel
- Inadequate storage
- Inappropriate tools

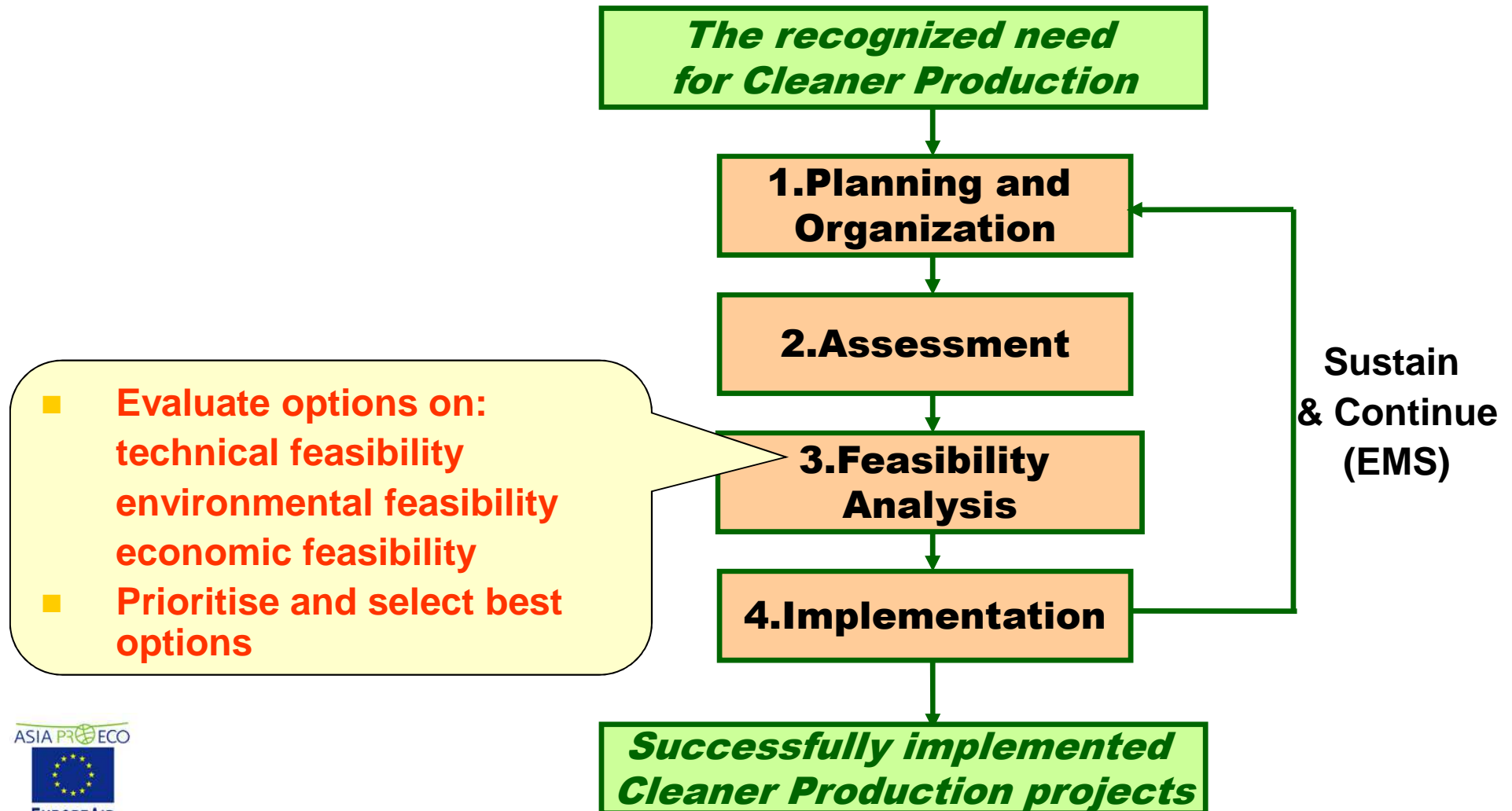
- Brainstorm in project team
- Creative problem solving
- Overcome obstacles
- Use example options, demo's, benchmarks



- Organise options per unit
- Divide options in groups:
 - Implement now
 - Investigate now (seems to be feasible)
 - Put on hold (clearly not (yet) feasible)
- Involve appropriate experts and technicians for engineering analysis

- Progress of the CP assessment
- Results of obvious options
- Pre-selected technology options
- Feasibility planning
- Feedback to project team and employees

Cleaner Production Approach

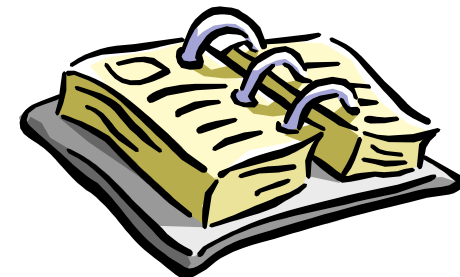


Phase 3: Feasibility analysis

Evaluate options technical



- Evaluate technical consequences
 - Availability and reliability of equipment
 - Requirements for utilities and process control
 - Maintenance requirements
 - Required technical skills (operators, technicians, etc.)
- Evaluate technical performance
 - Consumption rates before/after implementation
 - Inputs: raw materials, labour, energy, water
 - Outputs: products, waste, waste water



Phase 3: Feasibility analysis

Evaluate options environmental



- Evaluate environmental improvements
 - Reduction of pollutants generation
 - Reduction of pollutant toxicity
 - Reduction of energy consumption
 - Reduction of material consumption
 - Reduction of water consumption
 - Reduction of pollutant load in product



Phase 3: Feasibility analysis

Evaluate options economical



- Collect data (from technical evaluation)
 - Investment: equipment, construction, training, start up etc
 - Operational costs and benefits before and after comparison
- Set decision criteria (based on project objectives)
 - If for profit: normal company investment criteria
 - If for compliance: least cost criteria
 - If for green strategy: include benefits as higher market share or added value

■ Calculate economical effects

- Pay back time
- Net Present Value
- Internal Rate of Return (bank interest rate)

$$PBT = \frac{\text{Investment}}{\text{Annual operating cost savings}}$$

$$NPV = \sum_{j=1}^n \frac{\text{Cash flow}}{(1+i)^j} - I$$

n = installation lifetime (years)
i = interest rate (%)
I = total investment

$$IRR = i_2 + \frac{NPV_{(pos)}}{NPV_{(pos)} + NPV_{(neg)}} * (i_2 - i_1) = \%$$

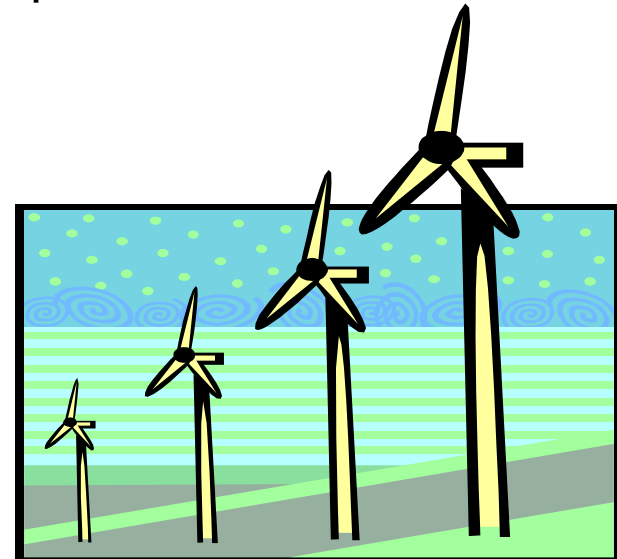
i1 = lower rate of return at NPV_(pos)
i2 = higher rate of return at NPV_(neg)

Phase 3: Feasibility analysis

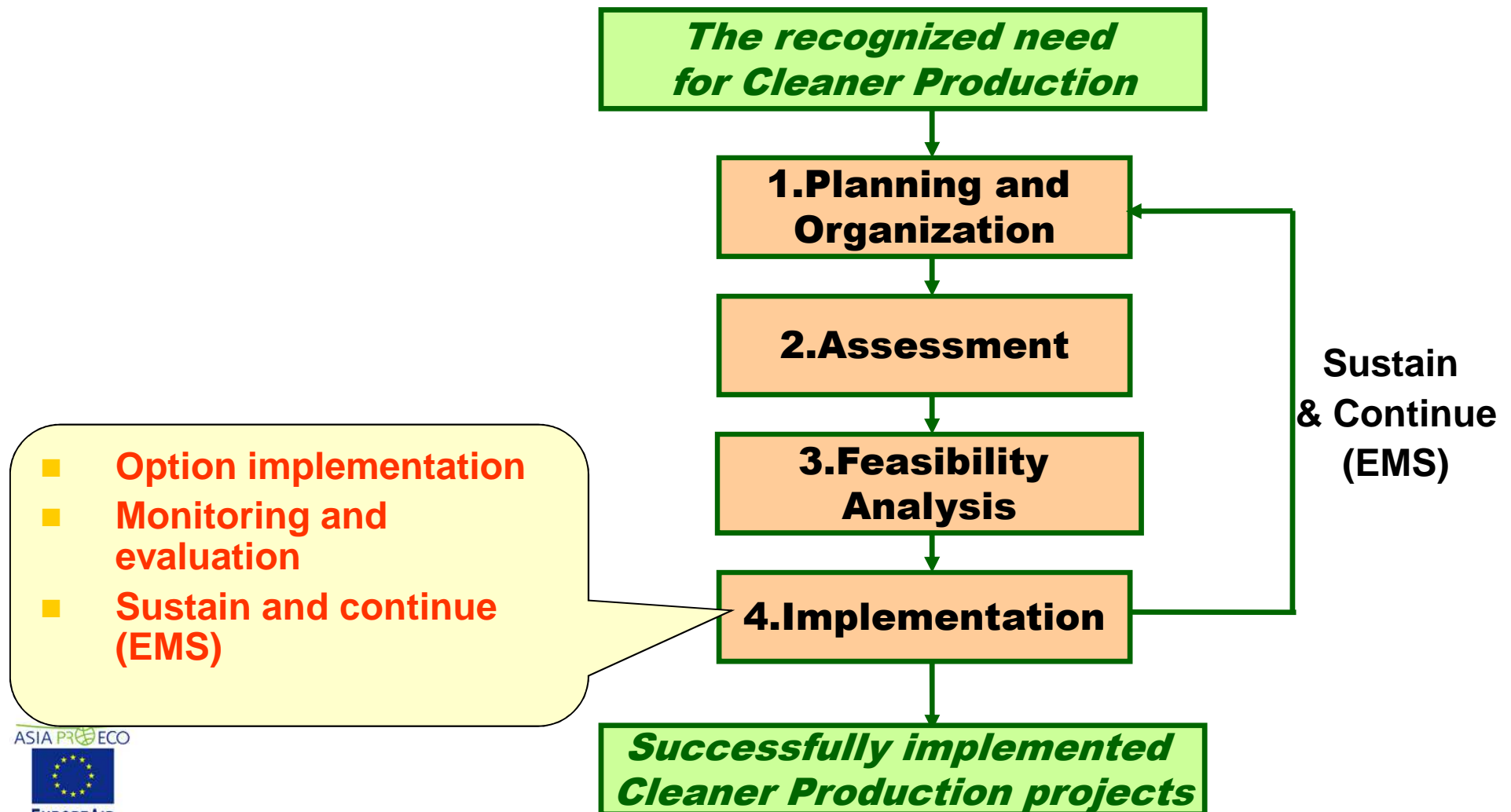
Prioritise and select best options



- Select most feasible (technical innovation) options
- Document expected benefits for each selected option
- Prepare fundraising plan
 - Consider different sources: own funds, domestic/foreign loan
 - Consider financial implications of implementation scenarios



Cleaner Production Approach



Phase 4: Implementation

Option implementation



- Prepare a CP plan: planning of installation
- Implement feasible CP measures
 - Supervise construction and installation
 - Purchase necessary equipment, spare parts, chemicals etc.
 - Train operators in usage and maintenance

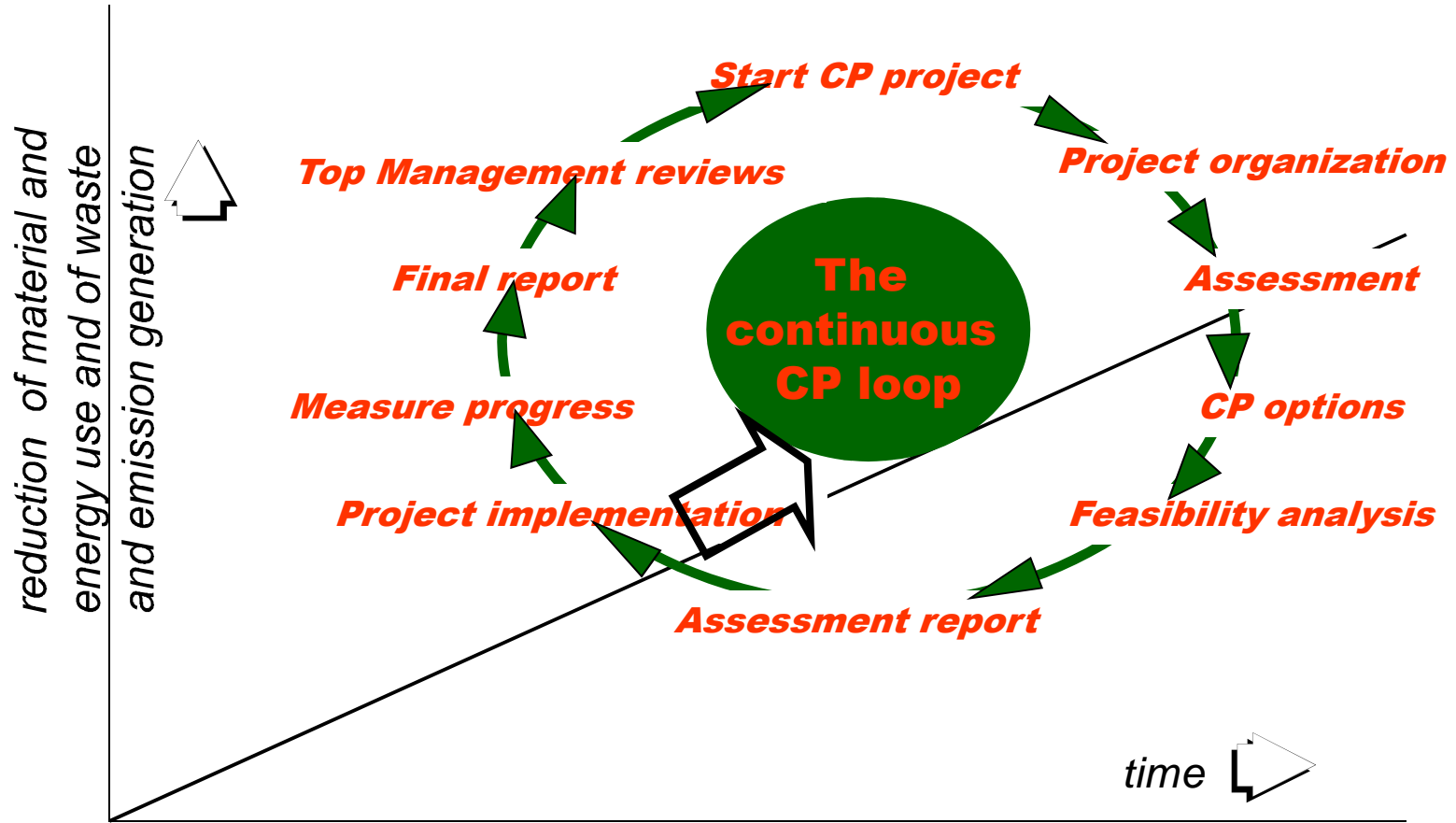


Phase 4: Implementation

Monitoring and evaluation



- Choose a monitoring method based on the objectives (set in phase 1)
- Measure the changes in:
 - waste quantities
 - resource consumption
 - profitability
 - total production output
- Compare measured benefits with expected benefits
 - 0-measurement
 - 1-measurement
- Identify ways to further improve the installations
- Verify installations operation according to specifications



Phase 4: Implementation

Sustain and continue



- CP is an ongoing process (it's a journey, not a destination)
- Continue CP by an organisational structure for:
 - Ongoing option generation and implementation
 - Involvement of production departments
 - Appointing key responsibilities for option implementation
 - Making managers accountable for option implementation
 - Ongoing training & incentives of managers and employees
 - Ongoing feedback and communication on successes
 - Defining long term CP strategies & policies
 - Pro-active thinking in design and new investments
 - Linking up with EMS, TQM, Health and Safety Management



Cleaner Production & EMS/ISO 14001

- CP the focus and EMS the management continuity:
 - CP provides direct benefits, but is often not continued
 - EMS provides a management framework, but focus too often on end-of-pipe treatment

■ Win-Win

- Overlap CP and EMS
- CP can gain from EMS
- EMS can gain from CP

- **Focus identification**
- **Objectives and targets**
- **Environmental program**
- **Structure & responsibility**
- **Training & communication**
- **Verification & preventive action**

- **Value added system and results**
- **Focus identification support**
- **Defining objectives and programs**
- **Real environmental improvement**
- **Credibility with stakeholders**
- **CP can avoid system bureaucracy**

- **Global market demand**
- **Continual improvement**
- **Defined & recognised framework**
- **Top management commitment**
- **ISO can avoid stopping CP**

What we have learned

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- The CP approach reduces pollutant generation at every stage of the production process
- CP can be achieved through:
 - raw material substitution
 - technology changes
 - good operating practices
 - redesign and/or reformulation of product
 - re-use and recycling
- The economic advantages of CP are:
 - cost effectiveness
 - increased process efficiency
 - improved product quality and enterprise competitiveness
 - minimised costs for final treatment and disposal

