P 1.8 – Feasibility analysis

Which criteria can be used to analyse the feasibility of improvement measures?

SWITCH-Med Programme
is funded by the
European Union

Regional Activity Centre
for Sustainable Consumption
and Production

UNEP

switchmed Programme

Table of content

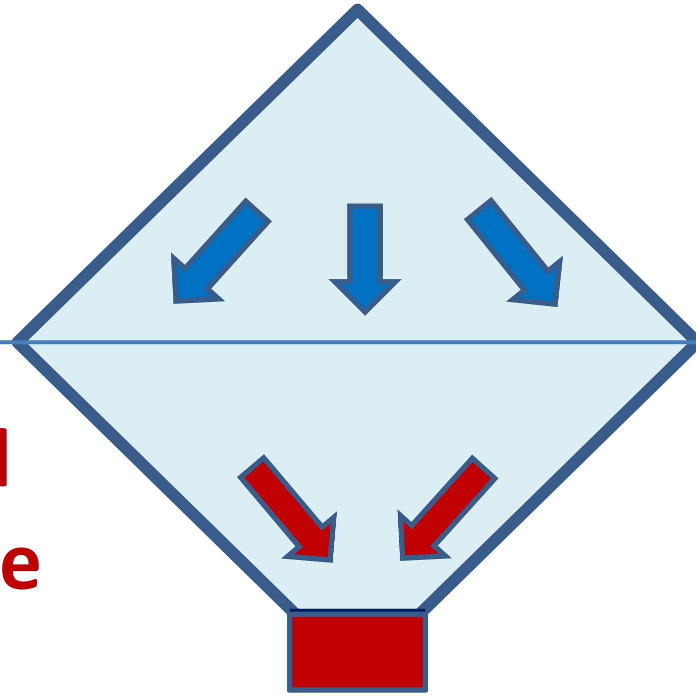
- Introduction
- Evaluation process
- Case studies
- Advanced economic analysis

Goal

To open the scope of potential solutions

in order to get

an optimised set of feasible measures



1.7 OPTION GENERATION

1.8 FEASIBILITY STUDY

Overview of Step 1.8

Inputs	Activities	Outputs
Technology and process operational parameters (baseline) Technology suppliers' information and technical requirements Knowledge	Evaluate each option using technical, environmental and economic criteria Shortlist a set of priority solutions with highest benefits and prepare summary report for decision of top management	Savings catalogue (set of project fiches of feasible measures) Terms of reference for detailed technical and financial appraisal of high investment needing measures

EVALUATION PROCESS

Multicriteria analysis

Each functional units in a company have different priorities:

- **Production manager:** increase productivity, product quality, minimize maintenance requirements
- **Environmental manager:** compliance with legislation, minimize pollution generation
- **Financial manager:** minimize NPV of investment

Start with Technical evaluation

- ✓ Possible changes in product quality
- ✓ Technical requirements for energy and material inputs and labour workforce
- ✓ Impact on productivity, production bottlenecks and capacity
- ✓ Need for additional resources (compressed air, water, etc.)
- ✓ Additional need for maintenance, spare parts, control

<u>Objective:</u> exclude options that might have an adverse impact on product quality, productivity or which would be technically not acceptable

Continue with Environmental criteria

- ✓ Reduction of waste streams, pollution, emissions
- ✓ Internal and external environmental management procedures
- ✓ Legal environmental requirements
- ✓ Impact on health and safety of employees
- ✓ Potential need for additional permits
- ✓ Additional need for operator training

<u>Objective:</u> *exclude options that might cause cross-media environmental side effects that could potentially offset the expected benefits*

Financial evaluation

- Simple cost-benefit analysis: economic savings, preliminary estimates of capital and operating costs, Pay-Back-Period (PBP).

- Advanced financial evaluation: ROI, NPV,

TOOL: Financial metrics

Source of data for feasibility analysis

- Data from previous steps (MFCA, I-O analysis, balances)
- Technology suppliers and technical specifications sheets
- Production, process and utilities parameters
- Water, energy, raw materials and labour costs
- CO_2 emission factors for energy sources
- Pollution intensity benchmarks (e.g. 1 l of milk in wastewater generates 90-120 g of BOD - source EU BREFs)
- Expert knowledge

Costs of utilities (2013)

Utility	TUNISIA Unit Cost [USD]	MOROCCO Unit Cost [USD]	EGYPT Unit Cost [USD]	Italy Unit Cost [USD]
Water (pipe) (m3)	0.64	1.063	0.24-0.34	0.7-2.1
Wastewater discharge (m3)	0.57	-	-	0.7-1.4
Electricity (kwh)	0.12	0.13	0.08 *(grid)*	0.25
Gas (Th – 10□ kcal)	0.017	0.10-0.13	0.007	0.07

1 m3 gas= 38MJ = 9 Th
1kg propane/butane = 50/49 MJ

Classification of measures

3 Types of measures:

a) **Good housekeeping measures**, requiring no/low cost

b) **Low-medium cost measures** can be implemented using a company’s technical and economic resources

c) **High investment needing solutions** complex technical and financial appraisal, possible external financing

OUTPUT: the saving catalogues

The saving catalogue is for top management decision-making process, including for specific feasible measures :

- technical description
- environmental benefits
- economic savings and PBP

Tool - Template

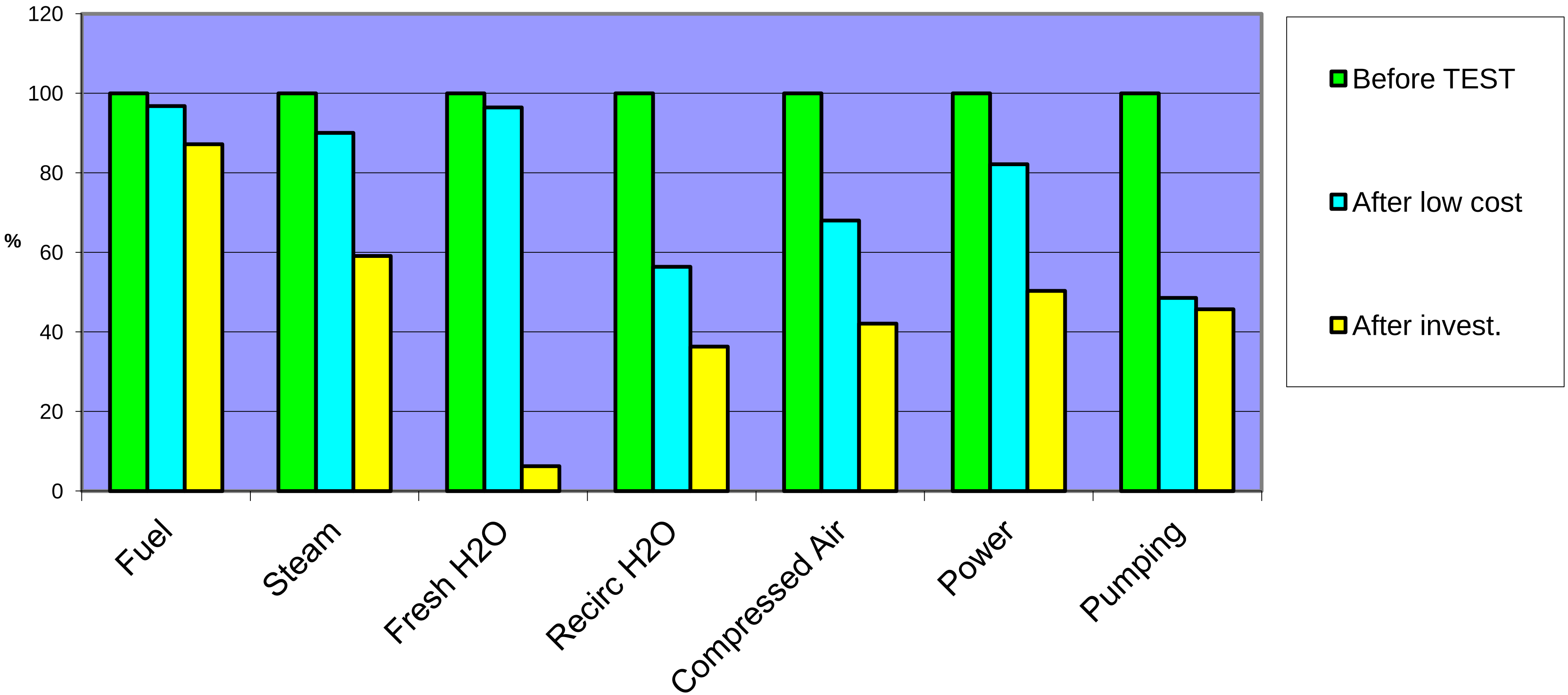
Summary saving catalogue indicators

ID	Measure	Cost savings [USD/y]	Investment [USD]	PBP [y]	Reduced CO2 em. [t/y]	Reduced water cons. [m³/y]	Reduced BOD5 [kg/y]	Reduced COD [kg/y]	Reduced solid waste
1	Reduction of BOD / COD loads and water consumption from cream separator and centrifuges	18,833	3,300	<1	92	3,709	57,456	92,232	-
2	Recovery of milk and fermented products sent to WWTP	31,467	-	<1	165	-	104,241	167,334	-
3	Reduced product losses from product transfer	362,635	56,700	<1	151	-	94,392	151,524	-

Consider changing parameters

- Results of TEST is a set of feasible measures which can be interrelated:
  - The implementation of specific measures may change the process parameters and therefore the baselines for calculating the feasibility of other measures
  - Particularly, technical specifications of investment needing measures changes after implementation of no and low cost measures

Good housekeeping and investments



Example: Reduction in consumption of specific process inputs in a chemical company after implementation of no cost and low cost measures and aggregated result after implementation of investment needing measures *(in % related to unit of production).*

CASE STUDIES

1. CHANGING PARAMETERS OF INDIVIDUAL MEASURES
2. RESOURCE EFFICIENCY MEASURES MODIFY PARAMETERS OF WWTP

Case study 1: overview

Dairy company (milk products)

Two priority flows: water and raw material

Water priority flow, two major sources:

- Cleaning in place
- Direct cooling (after homogenization stage) = 22% of total water use

Focus – Eliminate direct cooling to reduce costs and volumetric load to the WWTP

Case study 1: measures

- **Two measures:**
  1. Closing the loop with the chilled water circuit, new investments required for additional chiller capacity
  2. Partial milk homogenization (reducing the cooling demand of the process)

How does the feasibility of option 1 change when partial milk homogenization is first implemented?

Case study 1: feasibility analysis

Process needs (homogenizer)	Elimination of direct cooling (closing the cooling water loop at homogenizer with chilled water circuit)
	Without partial milk homogenization
Water for direct cooling:	
Volume (m3/y)	120,299
Cost (USD/y)	100,569
Cooling demand (chilled water):	
kWh/y	1,117,440
cost (USD/y)	24,583
Payback period (PBP)	**> 5 y**

Process water (η=90%)	0.836	USD/m³
Chilled water 3°C (R717, COP = 3,2)	0.022	USD/kWh
Cooling tower water	0.002	USD/kWh

Case study 2: Overview

Company	KOH-I-NOOR Prague, 300 employees
Products	tiny fancy articles made of metal and plastics (pins, zips, clipping and rivet buttons)
Key Processes	Nickel plating (about 80% of all production is galvanised)
Stakeholder concern	local authorities request WWTP
Objective of RECP assessment	To reduce water consumption To reduce use of chemicals To verify correctness of parameters of WWTP which was already designed (however too expensive for company to afford it)

Workflow

Phase I

Good Housekeeping

- **OUTPUTS**
- Reduced water consumption
- Reduced use of galvanising chemicals
- Reduced nickel consumption
- Reduced electricity consumption

- **Additional effects:**
- reduced health and safety risks
- lower number of rejects (for some articles up to 50% lower)

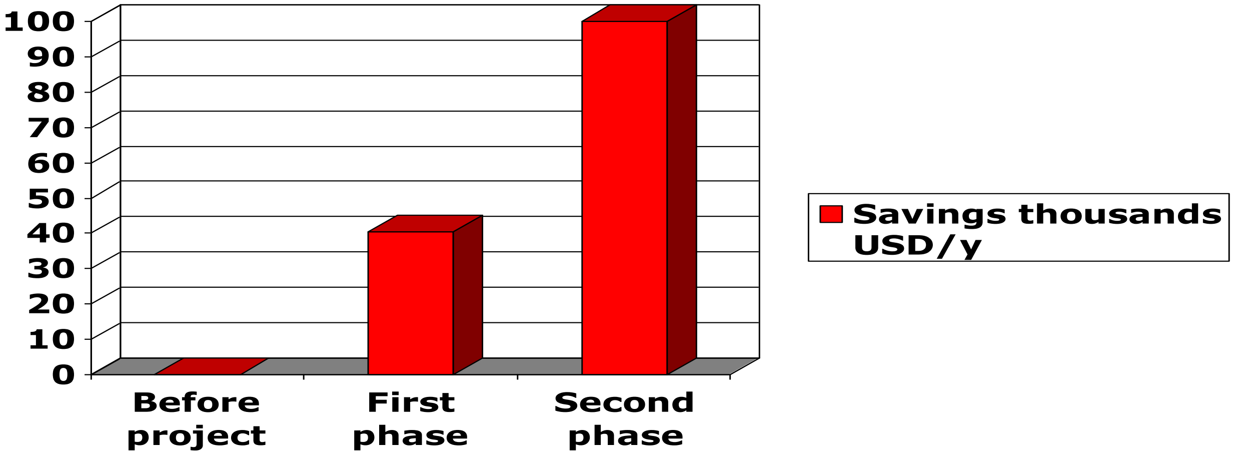
Phase II

Investments

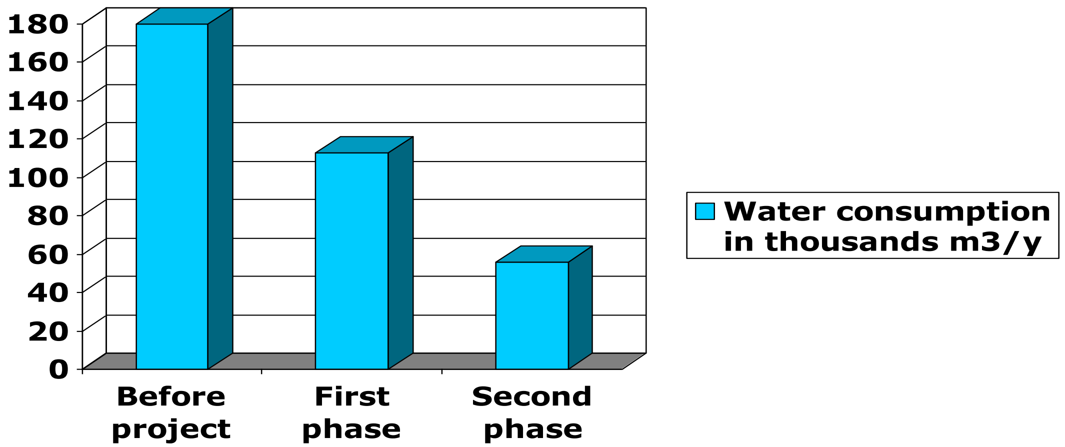
- Reconstruction of water and sewerage system (to prevent losses of clean water and improve logistics in collection of waste water) - total investment of USD 9,000

- Installation of nickel recovery unit used for waste water from surface finishing plant (on-site recycling of nickel) - total investment of USD 36,000

Savings

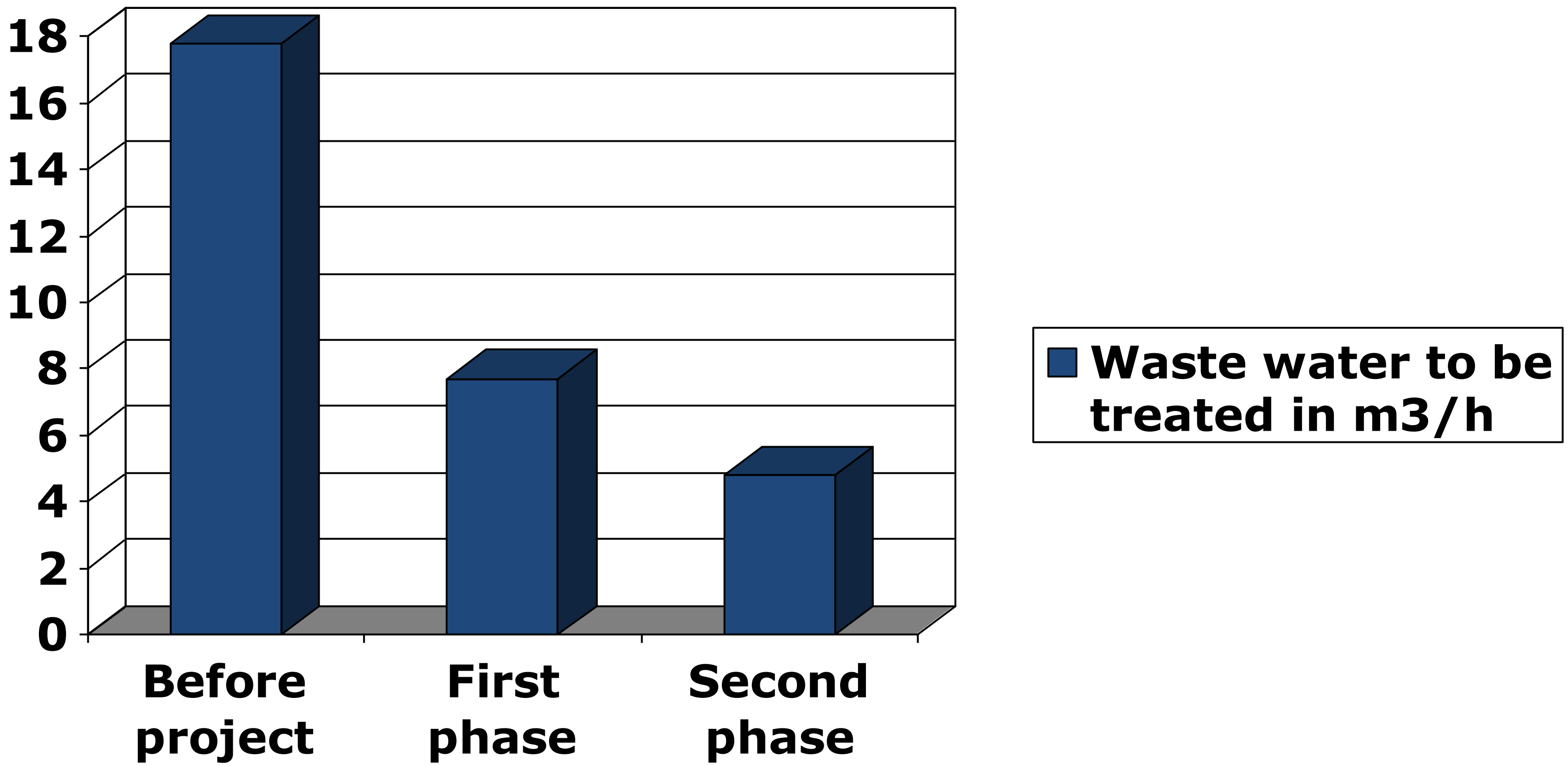


100
90
80
70
60
50
40
30
20
10
0
Before project
First phase
Second phase
Savings thousands USD/y

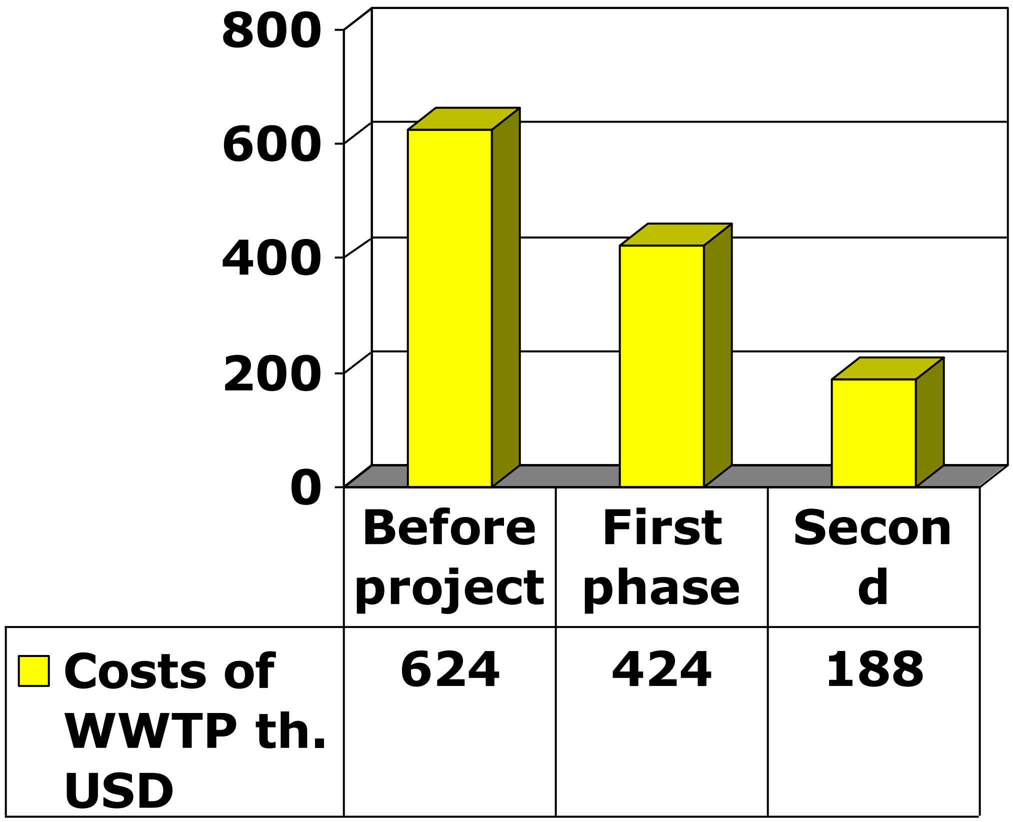


180
160
140
120
100
80
60
40
20
0
Before project
First phase
Second phase
Water consumption in thousands m3/y

Impact on WWTP: volumetric flow



Impact on WWTP: COSTS



In addition

KOH-I-NOOR is annualy saving

USD 40,000 on operational costs of WWTP

ADVANCED ECONOMIC ANALYSIS

FOR INVESTMENT NEEDING SOLUTIONS

Investment needing solutions

- The TEST approach can assist companies in optimizing basic technological parameters
- For evaluation of specific high investment needing solutions utilise established company procedures
- Payback period utilised for economic evaluation of low investment measures is not sufficient here, consider indicators reflecting changing price of money such as return on investment (ROI) or internal rate of return (IRR).

Simple Pay Back Period

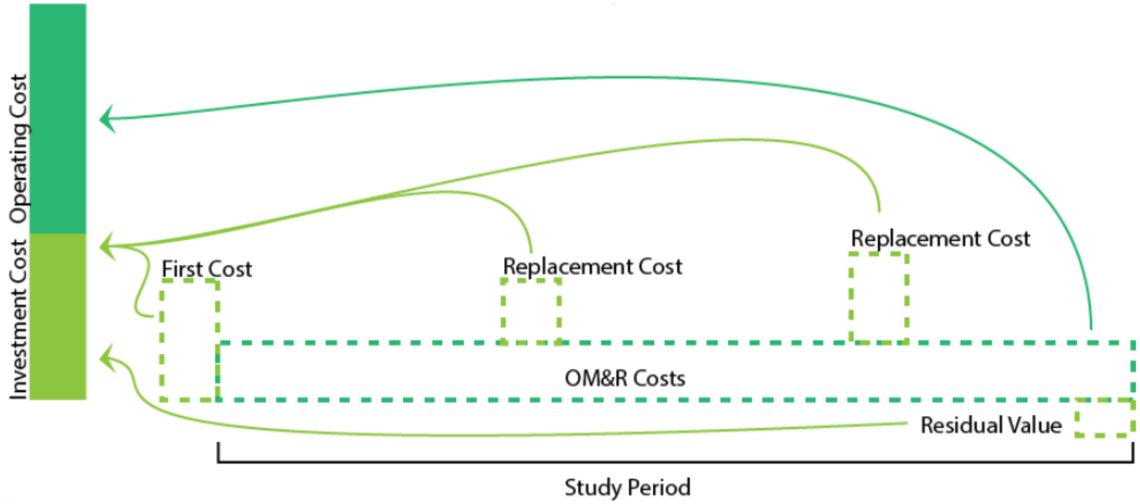
- SPB = Cost in $ / Savings in $ p.a.
- Usually organisations have a limit e.g. only opportunities with a payback of less than 2 years will be considered

- **Advantages**
  - Simple
  - Quick
  - Good rule of thumb
  - Useful as a quick estimate
  - Useful for low cost opportunities

- **Disadvantages**
  - Too simple
  - What is the effect of the life of the item?
  - Should not be used for major decisions, either high cost or organisationally critical

Life Cycle Cost Analysis (LCCA)

- Total cost of ownership of a product over its life cycle, including: installation, operation, maintenance, decommissioning/disposal.
- It enables comparison of alternative project's solutions based on the present value of the future investment using a discount rate % that is specific to the investor's requirements.
- It consider residual value at the end of the life cycle (resale value, salvage value)



Life Cycle Cost Analysis

The EMA-MFCA tool can be used as a supporting tool to identify all the relevant environmental costs. Some "cheap investments" can turn out to be very expensive at the end of the technology life cycle when all operational costs are considered, compared with more resource efficient equipment!

$$LCC = IC + \sum_{t=1}^{N} OC_t / (1+r)^t$$

where:

LCC = life-cycle cost ($),
IC = total installed cost ($),
$\sum$ = sum over the lifetime, from year 1 to year N,
where N = lifetime of equipment (years),
OC = operating cost ($),
r = discount rate, and
t = year for which operating cost is being determined.

Procurement of goods: EXAMPLE

- Two options for equipment (Chiller)
  - One cost 50,000 USD and total running costs 8,000 USD/yr
  - Another one cost 75,000 USD and total running costs 4,000 USD/yr

Which one do I buy?

Procurement of goods: EXAMPLE

G	H	I	J	K	L
	Option 1	Option 2			
Cost	- 50,000.00	- 75,000.00		Discount Rate	10%
Year 1	- 8,000.00	- 4,000.00		Savings Inflation	3%
Year 2	- 8,240.00	- 4,120.00			
Year 3	- 8,487.20	- 4,243.60			
Year 4	- 8,741.82	- 4,370.91			
Year 5	- 9,004.07	- 4,502.04			
Year 6	- 9,274.19	- 4,637.10			
Year 7	- 9,552.42	- 4,776.21			
Year 8	- 9,838.99	- 4,919.50			
Year 9	- 10,134.16	- 5,067.08			
Year 10	- 10,438.19	- 5,219.09			
LCC	-€95,518.14	-€93,213.61			

Sustainable design

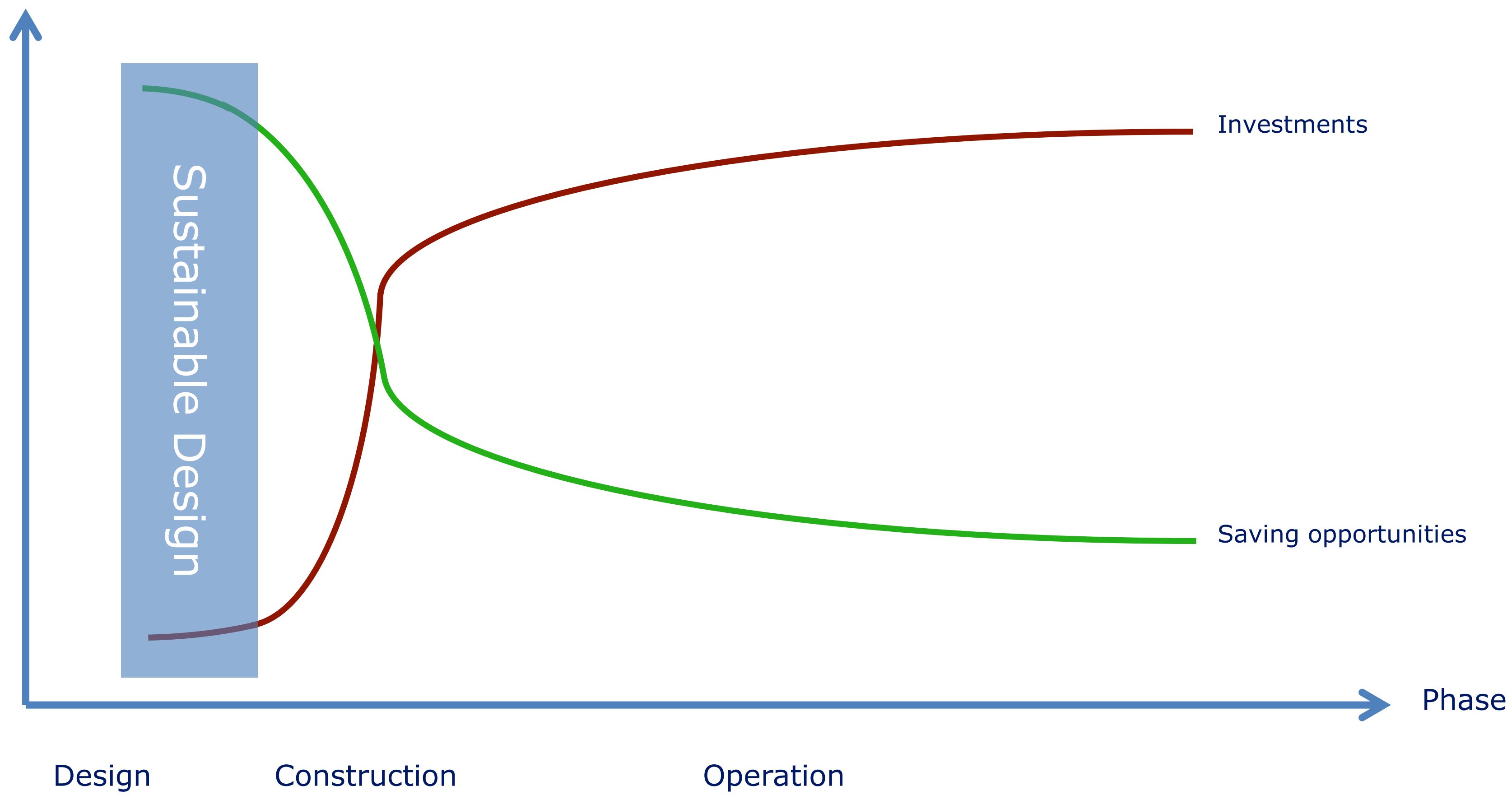
Can be employed for analysing large investments in new production lines and green-field projects.

This technique is:

- Carried out in parallel to the traditional engineering design process
- systemically applies resource efficiency to virtual material and energy flows (through calculated baselines)
- a detailed analysis of the initial engineering design parameters is conducted to generate optimized solutions in terms of selected technology, operating set points, and plant layout
- the engineering company then revises the design of the new investment accordingly
- 2% investment cost

Implementing resource efficiency at the design stage is more cost effective than retrofitting or modifying existing processes after the initial investment has been made.

A Lifetime of Opportunities



Example: new cold storage room

Scope: revision of the design of new cold storage room (sustainable design)

Output:

- Layout modification for more effective positioning of the evaporators to facilitate homogeneous circulation of cold air (5% savings on annual energy bill)
- Revised procurement specifications for energy efficient equipment

Savings USD/yr	Investment USD	PBP	Energy savings
7,000	14,000	2 years	100 Mwh/yr

Linkages with EMS

EMS
Not in place

- The output of this TEST step provides a sound basis for developing a company's Environmental/Energy Management Programs (EMPs).

EMS
In place

- Existing EMPs can be reviewed and updated to include newly identified feasible resource efficiency measures.

Thank YOU for your Attention