ASEM
SMEs
Eco-Innovation
Center

ASEM SMEs Eco-Innovation Consulting Project :

- Eco-Innovation Guideline for TMChain -

2011. 12

ASEM SMEs Eco-Innovation Center (ASEIC)

Contents

Introduction to ASEM Eco-innovation Project

- The green marketplace is worth trillions of dollars and against this backdrop, Asian and European countries under ASEM established ASEIC as a cooperative mechanism with the principal mandate of enhancing eco-innovation of SMEs in both regions.

- The Project aims to facilitate innovation in the corporate strategy of SMEs at any stage of the product or service lifecycle, while developing global green growth opportunities.

- The consulting services provide SMEs with the implementation of a holistic and multifaceted approach to strengthening eco-innovation, from sharing core environmental regulations, innovative techniques and practices, to providing related educational program.

- The main goal of Eco-innovation consulting is to strengthen the “green competitiveness” of SMEs by disseminating and utilizing green management and technology in their various businesses.

Introduction to ASEM Eco-innovation Project

1st ASEM Eco-innovation Project was launched September 2011 and finalized in December 2011. Four countries and a total of 33 companies participated in this Project.

Participating Countries

Malaysia

8 companies

Indonesia

9 companies

Vietnam

8 companies

Thailand

8 companies

1St ASEM Eco-innovation Consulting Services for SMEs (2011)

Consultancy

- Develop environmental management strategies to foster sustainability
- Provide recommendations for greener industrial processes to save production costs and reduce environmental burden
  - Improve energy & resource efficiency
  - Reduce GHG emissions level
  - Monitor and manage environmental data
  - Environmental compliance
- Develop eco-innovation strategy to strengthen green competitiveness

Contents

Eco-innovation Strategy

Eco-innovation is **innovation that results in a reduction of environmental impact,** no matter whether or not that effect is intended.
Eco-innovation can be analyzed along three dimensions:
1)Targets: the focus areas of eco-innovation such as products, processes, marketing methods, organizations and institutions
2)Mechanisms: the ways in which changes are made in the targets (modification, redesign, alternatives and creation)
3)Impacts: effects of eco-innovation on the environment

Sustainable Business Management

Strategy	• Establish EM strategy, objectives and quantitative targets
System	• Establish EM team to oversee organization's environmental activities
Energy & Resources	• Monitor the use of energy & resources and set reduction targets • Practice cleaner production
GHG Emissions / Environmental Compliance	• Calculate GHG emissions & set reduction targets
Environmental CSR	• Disclose organization's environmental activities on website or by publishing a sustainability report

Green Competitiveness

- **Green Process**
- **Green Product &Services**
- **Green Technology**
- **Green Business Development**

Eco-innovation Strategy

Contents

Sustainable Business Management

Sustainable Business Management Recommendations

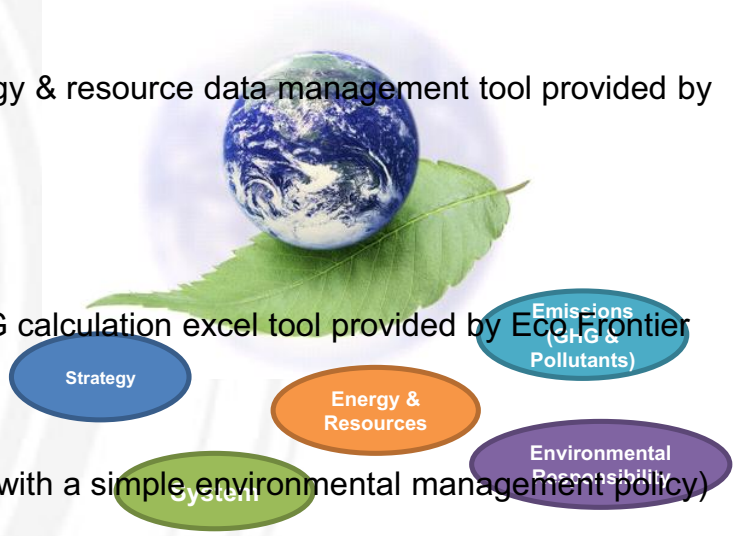
1. Environmental Strategy & Policies
- Establish an environmental management strategy
- Set qualitative objectives and quantitative targets based on the EM strategy
- Increase green procurement such as the purchase of eco-friendly office supplies and recycled packaging materials
- Enhance equipment efficiency

2. Environmental Management System
- Appoint an environmental management representative and establish an environmental management team and committee
- Establish an internal bulletin board to share EM information with employees
- Conduct an internal audit annually
- Attend EM training sessions provided by governmental organizations or global corporations

3. Energy & Resources
- Monitor the use of energy & resources using relative indicators (use energy & resource data management tool provided by Eco Frontier)
- Set quantitative reduction targets
- Compare environmental performance and targets annually

4. GHG Emissions and Environmental Pollution
- Calculate GHG emissions (Scope 1 & 2) from total energy use using GHG calculation excel tool provided by Eco Frontier
- Set GHG emissions reduction target

5. Environmental CSR
- Disclose company's environmental management status on website (start with a simple environmental management policy)
- Publish a sustainability report



Environmental Strategy Establishment

Establishment of Corporate Environmental Strategy (Policy, Objectives, Targets)

Environmental Policy

- Environmental policy is your declaration of commitment to the environment as well as to health & safety of your employees.
- To develop an environmental policy, make a list of general environmental concerns that could be addressed in your company.
- The environmental policy should serve as the framework for setting environmental objectives and targets.

Qualitative Objectives

- Environmental objectives are established based on the company's environmental vision and policy.
- Environmental targets are established for each environmental objective to measure change in improvement.
- Implementation plan should be developed for each environmental objective and relevant targets.

Quantitative Targets

- Environmental objectives and targets should be included in the company's medium and long-term goals as well as a system for monitoring the performance results of the implementation plan.

Environmental Strategy Establishment

SAMPLE Environmental Policy

Company A aims to promote and maintain environmentally responsible practices to benefit our customers, employees, clients and community as a whole. To realize this vision, we will commit to the following:

- Establish and review our environmental objectives and targets.
- Comply with legal regulations and standards pertinent to our industry.
- Minimize emissions to contribute to climate change mitigation.
- Purse efficient use of energy & resources.
- Practice safe treatment and disposal of wastes.
- Strengthen our green competitiveness.
- Cooperate and communicate with all relevant stakeholders including employees, suppliers, government agencies and our client.

As a responsible manufacturer, **Company A** is committed to design, manufacture, handle and distribute our products to ensure that this policy is met at all times.

[Name of President]
[Signature]
[Date]

Environmental Strategy Establishment

SAMPLE Environmental Objective and Targets

Environmental Management Objective	Targets (By Year 2015 with Baseline of Year 2010)
Transparency in environmental management	• Post environmental management policy on the company's website • Set up an internal bulletin board that discloses the company's environmental management status • Publish a sustainability report
Development of eco-friendly products & services	• Increase the use of recyclable & recycled packaging materials by 5% • Adopt Type I eco-labeling for bio-fertilizer
Increase green procurement (purchase of eco-friendly products)	• Increase green procurement by 20% • Don't use paper or plastic cups in the office • Increase purchase of recycled packaging material by 50%
Reduce waste and expand recycling	• Reduce waste generation by 5% • Achieve 100% waste separation and recycling
Reduce energy-use and GHG emission level	• Reduce energy-use by 5% • Reduce GHG emissions (scope 1 & 2) by 5% • Conduct a detailed energy audit every 6 months

Environmental Management System

To successfully implement environmental management, it is important to designate responsible person(s) for developing and promoting your EMS.

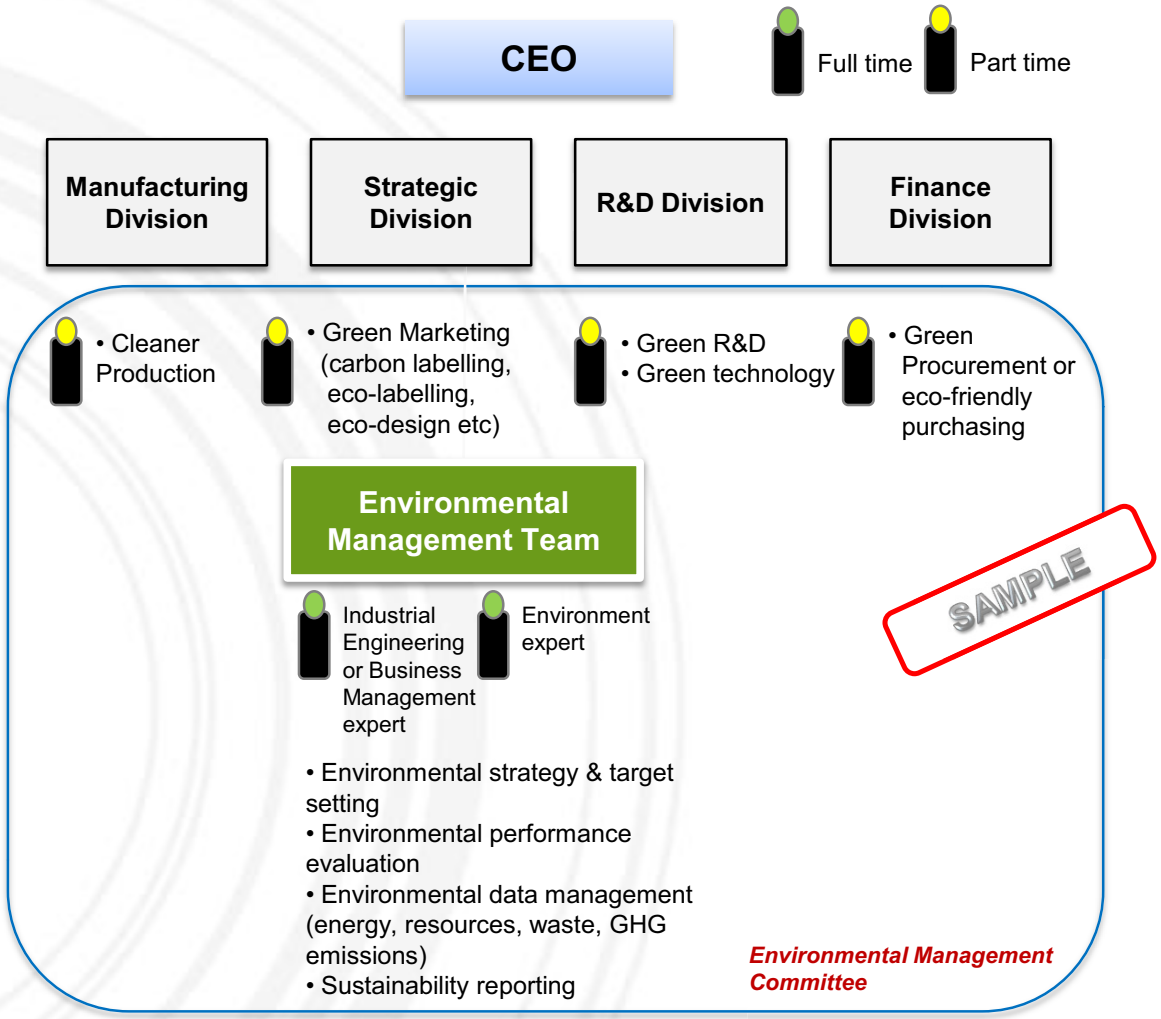
Organizing an EM Team or Committee

Appoint an EM Representative

- Top plant manager
- Responsible for all tasks relating to EM
- Responsible for reporting to MD on the progress and results of the organization's EM

Establish an Environmental Management Team or Committee

- Management of environmental aspects of production
- Management of environmental aspects of energy and resources
- Management in measuring and monitoring environmental performance outcomes
- Management of green procurement
- Management of external communications on environmental management



Environmental Data Management

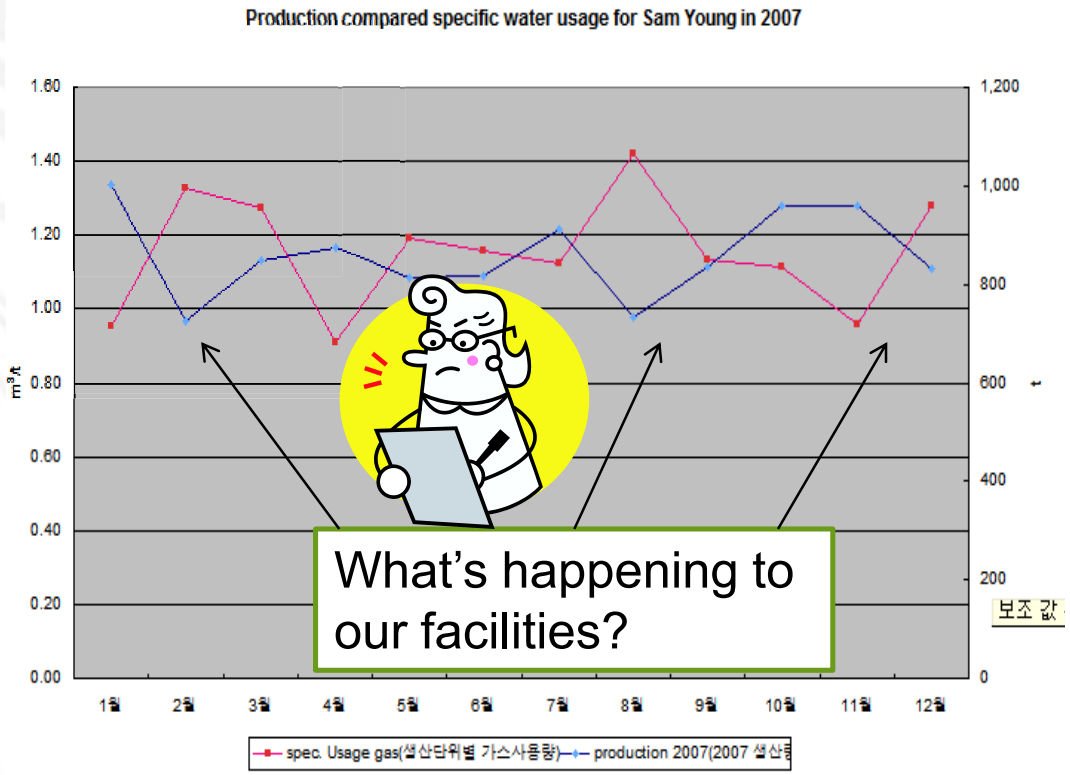
Environmental data should be managed in relative terms to compare your environmental targets (e.g., reduction in energy-use by 5% by year 2012) with your performance outcome (energy use in year 2012).

- **Absolute indicators**
  - Measure basic data in a given time frame, typically one year
  - **e.g.,** tons of CO_2 emitted annually, tons of wastes generated annually

- **Relative indicators (normalized indicators)**
  - Measurement of absolute consumption or emission figures relative to reference data
  - Used to measure productivity and intensity ratios e.g., waste generated per unit of production(kg)

***Relative indicators provide accurate environmental data → better management**

Track, analyze and compare monthly & annual performance



Environmental Data Management

Using the excel tool → Electricity Use (Example)

(Company A) Indicator					
Criteria for Comparison		**Electricity Use Indicator**			
Month(2010)	Sales/1,000RM	Electricity Use (kwh)	Total Price(RM)	Use/Sales (kwh/1,000RM)	Total Price/Sales(%)
1	464	32,642	2,307,390	70.35	0.5
2	291	32,254	2,527,930	110.84	0.9
3	462	29,102	2,203,710	62.99	0.5
4	526	33,902	1,851,810	64.45	0.4
5	447	26,894	1,670,230	60.17	0.4
6	654	23,832	1,806,190	36.44	0.3
7	514	26,076	2,212,550	50.73	0.4
8	348	24,163	2,181,980	69.43	0.6
9	354	24,509	2,047,000	69.23	0.6
10	417	17,549	2,054,190	42.08	0.5
11	426	22,649	2,233,310	53.17	0.5
12	401	25,675	2,468,170	64.03	0.6
yr2010	5,304.00	319,247	25,564,460.00	60.19	0.48

Step 1: Input the amount of your monthly sales volume.

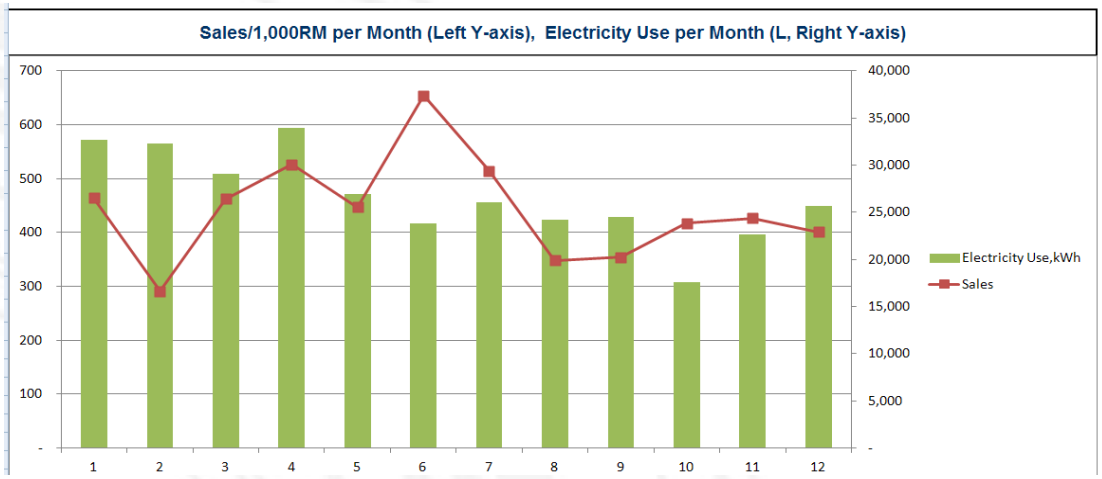
Step 2: Input monthly electricity use in KWh indicated in your energy bill.

Step 3: Input the monthly electricity rate indicated in your energy bill.

Environmental Data Management

Using the excel tool → Electricity Use (Example)

A graph & table automatically constructed based on the inputs from steps 1,2,3



Month (2010)	1	2	3	4	5	6
Use/Sales (kwh/1,000RM)	70.35	110.84	62.99	64.45	60.17	36.44
Unit Price(RM/kwh)	70.69	78.38	75.72	54.62	62.10	75.79
Month (2010)	**7**	**8**	**9**	**10**	**11**	**12**
Use/Sales (kwh/1,000RM)	50.73	69.43	69.23	42.08	53.17	64.03
Unit Price(RM/kwh)	84.85	90.30	83.52	117.05	98.61	96.13

2010 Use/ Sales (kwh/1,000RM)	60.19
2010 Unit Price (RM/kwh)	82.31

Repeat steps 1, 2, 3 for other indicators (waste, materials, harmful substances , water, fuel)

GHG Emissions Management

What are GHG Emissions? Where do they come from?

Types of GHGs	Global Warming Potential
CO_2	1
CH_4	21
N_2O	310
HFCs	140 ~ 11,700
PFCs	6,500 ~ 9,200
SF_6	23,900

- GHG Emissions are gases in Earth's atmosphere that prevent heat from escaping into space. GHGs increase the Earth's surface temperature resulting in climate change and global warming.
- There are 6 types of GHGs.
- The 6 types of GHGs can come from 3 different scopes of emissions.

GHG calculation tool include

Scope 1

- **Definition:** GHG emissions from sources that are owned or controlled by a Federal agency
- **Examples:**
  - Vehicles and equipment
  - Stationary Sources
  - On-site landfills & wastewater treatment
  - Fugitive emissions

Scope 2

- **Definition:** GHG emissions resulting from the generation of electricity, heat, or steam purchased by the company.
- **Examples:**
  - Purchased electricity
  - Purchased Heating / Cooling
  - Purchased Steam

Scope 3

- **Definition:** GHG emissions from sources not owned or directly controlled by the company but related to the company's activities.
- **Examples:**
  - Business travel
  - Employee commuting
  - Contracted solid waste disposal
  - Contracted wastewater treatment
  - Others

*** The GHG emissions data management tool is available on ASEIC's portal site. <http://www.aseic.org/main.do>**

GHG Emissions Management

1. Station Combustion (Scope 1 Emission)

Scope 1- Stationary combustion				Step 1			
				A	B	C	D
Calculation							
Factory Site	Period	Process	Equipments	Fuel Type	Collecting Methods	Fuel Consumption	Ur
	2011			LNG	measured	0	Nr
	2011			Gasoline	measured	0	
	2011			Lamp oil	measured	0	
	2011			Coal	measured	0	k
	2011			Diesel	measured	0	
	2011			Others	measured	0	
	2011			LPG	measured	0	Nr
Scope 1 Stationary Combustion Emission							

Step 1: Indicate year

Step 2: Select fuel type (LNG, Gasoline, Lamp oil, coal, diesel, LPG, Others)

Step 3: Input the total amount of fuel consumption

Step 4: Repeat steps 1, 2 & 3 if the facility uses more than one type of fuel

GHG Emissions Management

2. Mobile Combustion (Scope 1 Emission)

Scope 1- Mobile Combustion						Step 1				
						A	B	C	D	E
Calculation										
Factory Site	Period	Vehicle	Use	Registration number	Manufactured Year Production	Fuel Type	Colleting Methods	Fuel Consumption	Unit	Mile
	2011	Company Vehicle A	Transportation of Confectionery			Diesel	measured	34,796	ℓ	-
	2011					Diesel	measured		ℓ	-
	2011					LPG	measured		Nm3	-
Scope 1- Mobile Combustion Emission										

Step 1: Indicate year

Step 2: Select fuel type (gasoline, diesel, LPG)

Step 3: Input the total amount of fuel consumption

Step 4: Repeat steps 1, 2 & 3 if the facility uses more than 1 vehicle type

GHG Emissions Management

3. Electricity (Scope 2 Emission)

Scope 2 - Electricity			Step 1					
			A	B	C	D	E	
							Emission Factor	
Period	Pocess or Place	Facility	Fuel Type	Collecting Methods	Electricity Consumption	Unit	CO_2 Default emission Factor	D em F
2011				measured	10,950,000	kWh	0.6900	0.0
Scope 2 - Emission by Electricity								

Step 1: Indicate year

Step 2: Input annual electricity consumption in kWh.

Nations have different electricity emission factors; therefore, refer to national government website for accurate electricity emission factor or follow IPCC guideline.

GHG Emissions Management

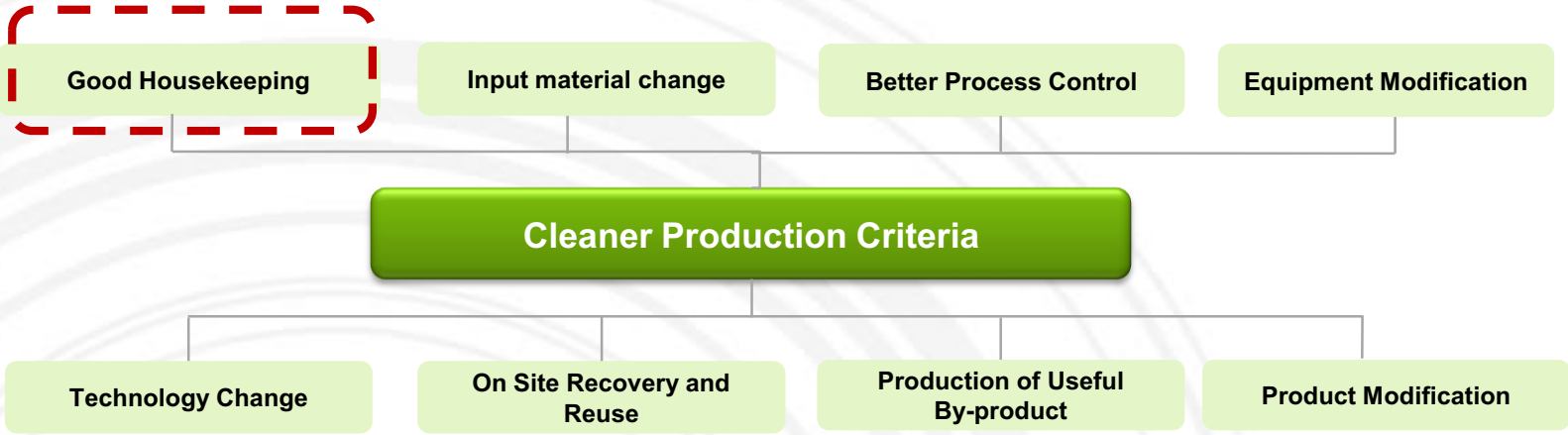
Total GHG Emissions for Scope 1&2

Total GHG emissions automatically calculated – A table is constructed showing accumulated GHG emissions for scopes 1 & 2

Emission Type			Emission total Amount	Emission Subtotal Amount	Types of GHGs					
					CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
SCOPE 1	Stationary combustion	Fuel	0	0.0	0.0	0.0	0.0	-	-	-
	Mobile combustion	Vehicle	93	92.8	91.3	0.1	1.4	-	-	-
	Sub total		93	92.8	91.3	0.1	1.4	0.0	0.0	0.0
SCOPE 2	Electricity	Purchasing Electricity	7,566	7,566.2	7,555.5	1.5	9.1	-	-	-
	Sub total		7,566	7,566.2	7,555.5	1.5	9.1	0.0	0.0	0.0
GHG Total Emission (Scope 1 + 2)			7,659	7,659.0	7,646.8	1.7	10.6	0.0	0.0	0.0

Cleaner Production

"**Cleaner production** is the continuous application of an integrated preventative environmental strategy to processes, products and services to increase inefficiency and reduce risks to humans and the environment" (United Nations Environment Programme, 1991)



- **Good housekeeping:** appropriate provisions to prevent leaks and spills and to achieve proper, standardized operation and maintenance procedures and practices. → **Lowest cost and most basic form of cleaner production**
- **Input material change:** replace hazardous or non-renewable inputs with less hazardous or renewable materials or by materials with a longer service life-time
- **Better process control**: modification of the working procedures, machine instructions and process record keeping for operating processes at higher efficiency and lower rates of waste and emission generation
- **Equipment modification:** modification of the production equipment so as to run the processes at higher efficiency and lower rates of waste and emissions generation
- **Technology change:** replacement of technology processing sequence and/or synthesis pathway in order to minimize the rates of waste and emissions generation during production
- **On-site recovery / reuse:** reuse of wasted materials in the same process or for another useful application within the company
- **Production of useful by-products:** transformation of previously discarded wastes into materials that can be reused or recycled for another application outside the company
- **Product modification:** modification of product characteristics in order to minimize the environmental impacts of the product during or after its use (disposal) or to minimize the environmental impacts of its production (e.g., automatic control)

Cleaner Production - Step(Solve the roots of the problems)

Stage 1

Determine the necessary measures

Decision for environmental protection

Definition of the environmental profile

Identification of the starting point

Acute environmental problem

Stage 2

Plan the environmental project

Environmental problem/description of the starting point/approach

Identification of the causes

Establishment of goals and measures: project plan

Stage 3

Implement the environmental project

Implementation of the project plan

Monitoring of success

Cleaner Production – Material management

1. Material management- Summary

Material management is a scientific technique, concerned with Planning, Organizing &Control of flow of materials, from their initial purchase to destination.

TO ACHIVE

1. Right quality(environment, human health, material use)

2. Conservation of materials (resource)

3. Clean working environment

4. Efficient working environment

PURPOSE OF MATERIAL MANAGEMENT

- **To reduce waste**
- **To implement environmental regulation**
- **To reserve stocks to prevent supply shortage**
- **To avoid environmental risk**
- **To achieve a safe working environment**

RECOMMENDATIONS

Manage materials and products on a life-cycle basis.

1. Select a few materials/products for an integrated life-cycle approach, and launch demonstration projects.
2. Expand the focus of existing environmental programs to encompass life-cycle materials management more fully.
3. Promote specific materials management approaches that can help address climate change.
4. Promote greener products, product stewardship, and product-to-service transformations.
5. Strengthen market signals to reduce waste and other adverse environmental impacts throughout the life cycle of materials.

METHODS

Alternative eco-friendly materials	Introduction of efficient technologies	Efficient production plan and stock management	Use the **proper** amount of material	Chemical management	Green purchase

Cleaner Production – Material management

2-1. Material management - Common issue : Spray process(painting, glue…)

Issue : Efficiency of spraying process(Overuse management)

Needs/Problem : - Dissipation of paint due to open work place without dust collecting facility
- Inefficient working and waste of material

Approach : Find a case study that deals with improving the spray painting process

1. Check the amount of waste → Reduce material and reuse some materials
2. Make **standard operation(Appropriate pressure,** find the best point of distance depending on the concentration of paint and size of work-piece)
3. Use HVLP type gun (high efficiency transfer with low pressure air)
4. Use appropriate tools such as laser targeting device, inside pipe tool, auto gun washer, and washing solvent distiller

•**Benchmark** : Alternative efficient equipment and proper spraying distance can be checked by the eyes.

• Laser pointer gun

•Orbiter: coating equipment inside pipe

Cleaner Production – Material management

2-2. Material management - Common issue : Chemical management

Issue : Management of raw materials (chemical)

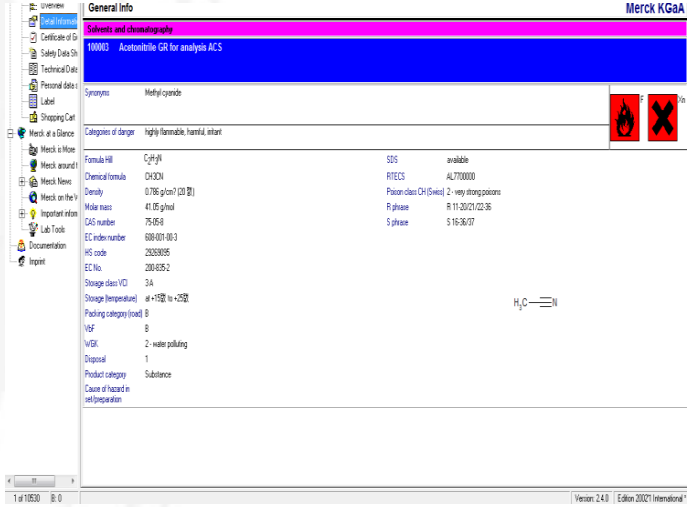
Needs/Problem : - Material waste due to inefficient management
- Environmental regulations and harmful effects on human health

Approach : Managing waste paint

1. Educate employees about toxic substance .
2. Check the amount of chemical waste.
3. Initiate an effective chemical management method.
4. Build a chemical database (testing and analysis).

Benchmark : Individual store, Installation of MSDS

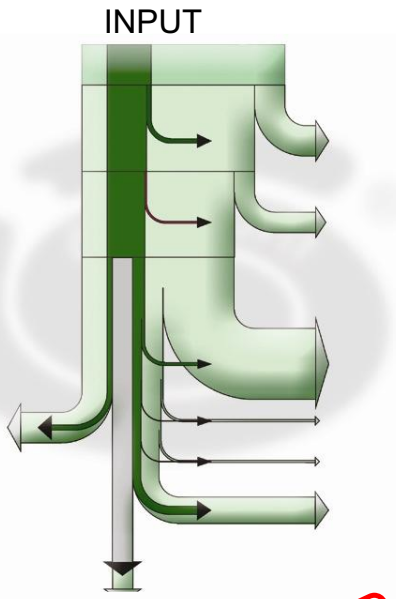
Chemical database management



Cleaner Production – Material management

3. Material management Tool – MFA(Material flow analysis)

Overview on material input and consumption of a company;
Places, amount of and causes for the production of waste and emissions (noise, exhaust air, sewage, etc.);
Assessing and estimating future development;
Actions for improvement.



Purposes

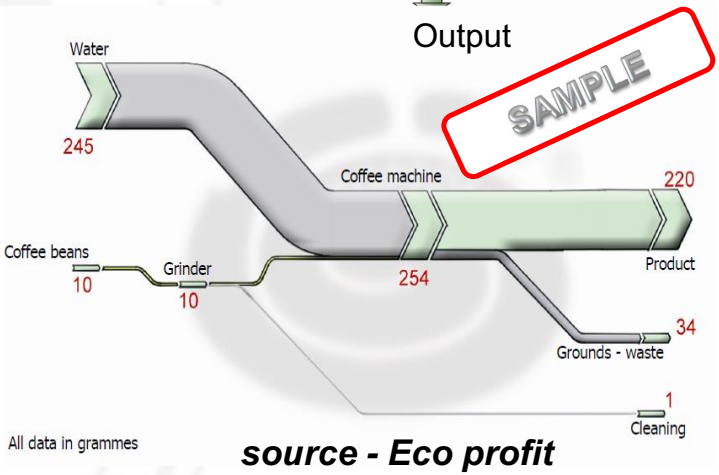
- tracking material flow in the company;
- tracing waste back to where it is produced;
- processing data in a way that enables right decisions;
- detecting and identifying weak points and opportunities for improvement in the process; and
- setting useful priorities for actions to avoid waste and emissions.

Steps

1. defining the objectives, targets and the parameters under consideration;
2. delimiting the balancing area;
3. delimiting the balancing period;
4. acquiring and designating the production steps;
5. drawing up the flow chart: material flows – in qualitative terms;
6. balances: material flows – in quantitative terms;
7. interpretation and conclusions

Useful graph

- **Flow Charts for representing material flows and process flows**
- **X-Y Charts for representing time series**
- **Bar Charts and Histograms for illustrating distributions and compositions**
- **Sankey Charts for visualizing material flows true to scale**



source - Eco profit

Cleaner Production – Material management

4. Material management - Case Study in Korea : Improve material efficiency using material flow analysis

BEFORE

■ Before MFA

• **4kg of PVC residue left in extruder screws after extrusion process**

AFTER

■ After MFA

• **After the material flow analysis (MFA), the company was able to input only the needed amount of PVC**

➢ Improvement result: **Save 8,300 USD/yr**

- Minimize the use of materials & reduce waste

Cleaner Production – Energy management

1. Energy management - Summary

Objectives of corporate energy management

- **Improve security and quality of energy supply**
- **Reduce energy cost (short-term and long-term)**
- **Reduce environmental impacts**
- **Commence or reinforce energy conservation activities**
- **Achieve sustainability and energy efficiency**
- **Mobilize resources and cooperate with partners**
- **Increase the company's environmental image**

Tasks and procedure

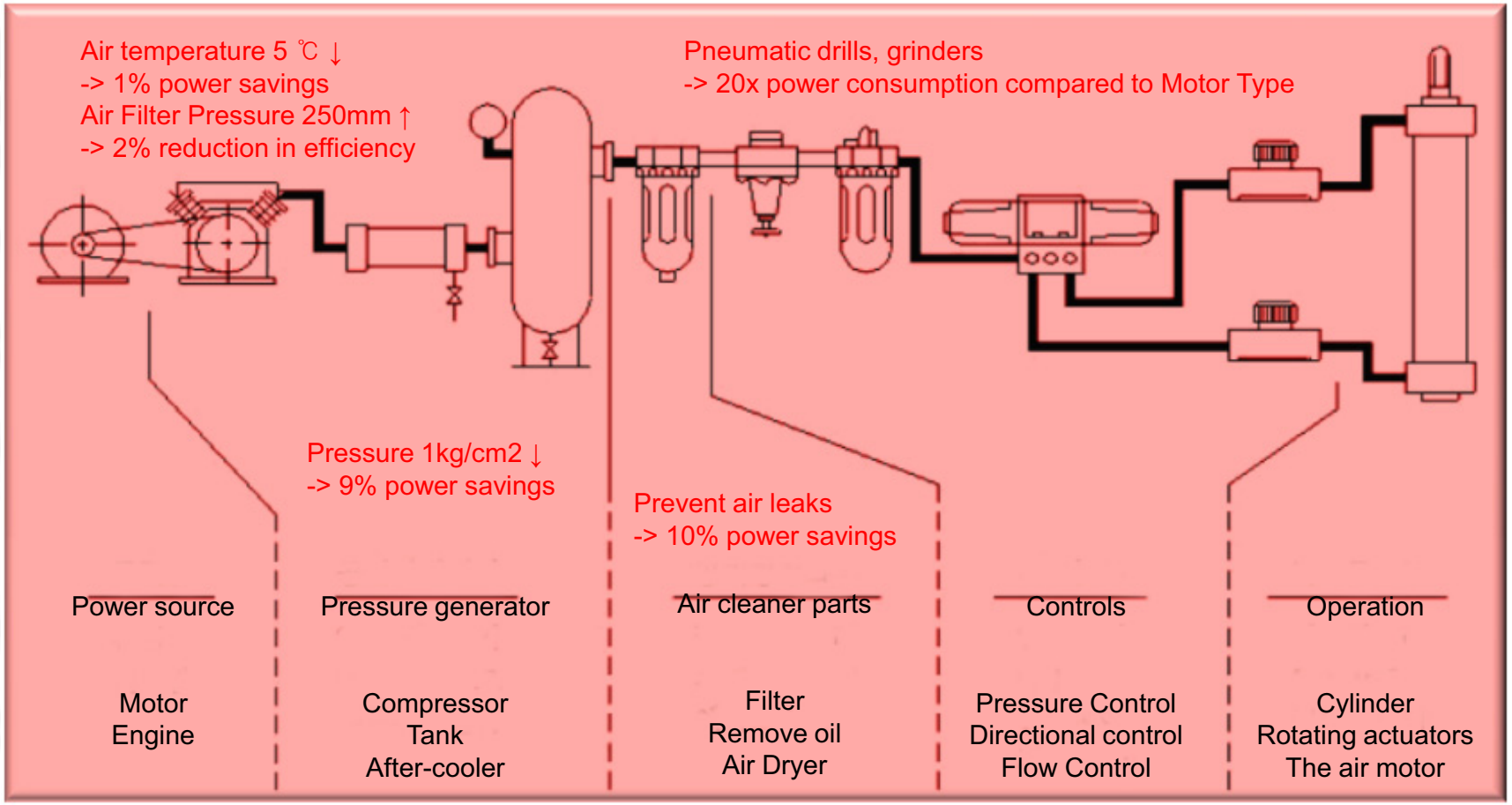
Energy management serves to prepare decisions and give:

- **Advice to managers based on well-targeted data collection** (the fewer the better)
- **Data analyses and evaluation** (efficiency indicators and benchmarking, comparison with previous consumption periods, identifying weak points) – (try rough analyses)
- **Analysis of technical, economic and environmental problems** (e.g. energy concept or detailed analyses)
- **Proposal of concrete measures** (catalogue of measures, including action plan: short-term, mid-term and long-term)
- **Detailed planning and implementation of** (small-scale) **energy efficiency measures**
- **Controlling** (efficiency indicators, comparison with previous consumption, comparison of target and actual values)

Cleaner Production – Energy management

2-1. Electricity - Common Issue : Air compressor

- air compressor



Cleaner Production – Energy management

2-1. Electricity - Common Issue : Air compressor

Issue : Current operation status of air compressor

Needs/Problem : Need for analyzing energy efficiency of air compressor

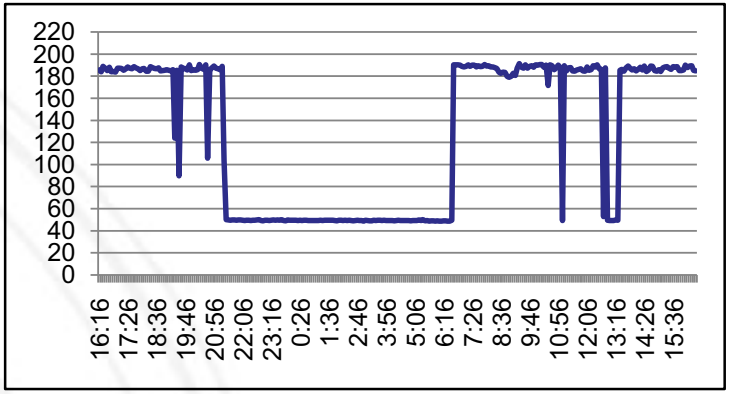
Approach : Check operation condition, then optimize

1. Check operation pressure and leakage point
2. Check power consumption
3. Check intake outdoor air
4. Check operation condition of air dryer
5. Suggest increasing method of loading rate

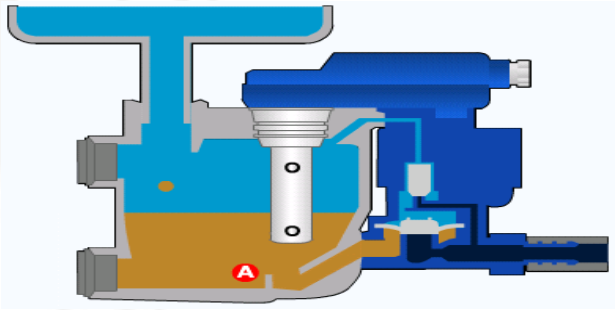
Benchmark : Prevention of material loss by installing condensate trap

Finding efficient operation method by analyzing process patterns

Utilization of cool outdoor air for the intake



(Case study)
Reduction of standby power consumption by changing to *auto on-off control system on unloading time.
(* If unloading time of air compressor is long, air compressor is off automatically)



Cleaner Production – Energy management

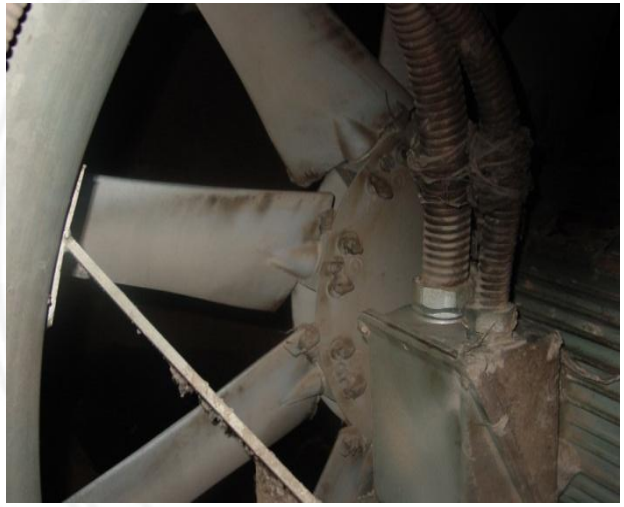
2.2 Electricity - Common Issue : Fan

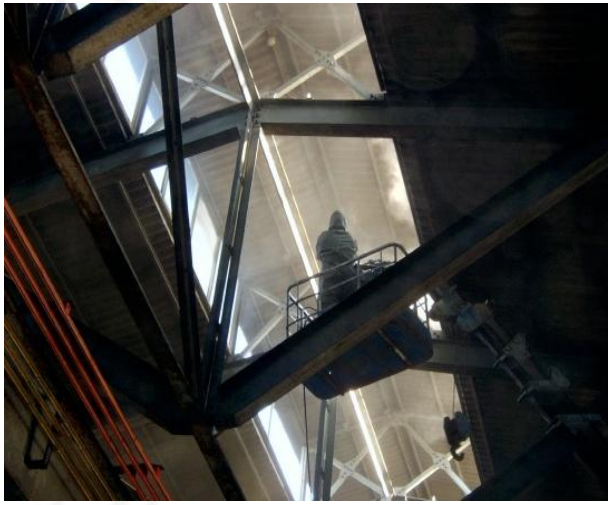
Issue : Efficiency of internal ventilation fan in factory

Needs/Problem : Efficiency analysis of exhaust fan / Decreased usage time of electric fan is necessary

Approach : Evaluate the efficiency of exhaust fan
1. Check power consumption
2. Compare facility capacity with actual power consumption

Benchmark : Using exhaust pipe at the ceiling as a natural source of ventilation method .
Install inverter to fan





Cleaner Production – Energy management

2.3 Electricity - Common Issue : Light

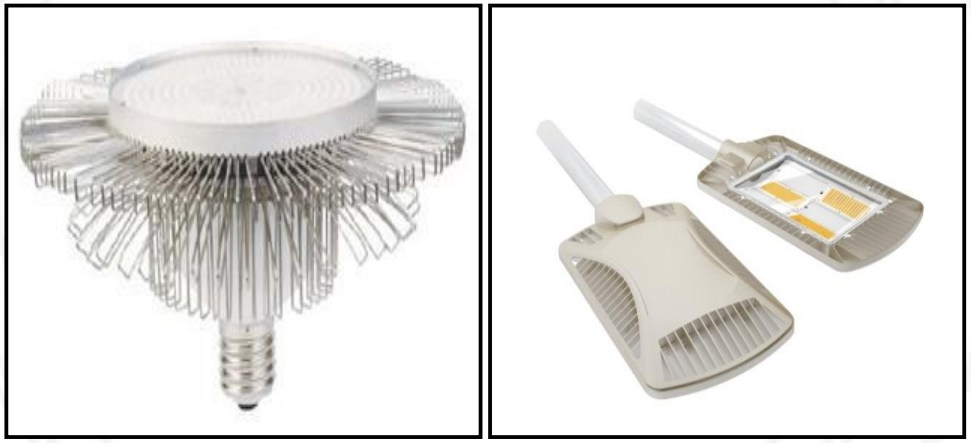
Issue : High Efficiency lighting lamp

Needs/Problem : Energy loss caused by low efficiency lighting lamp

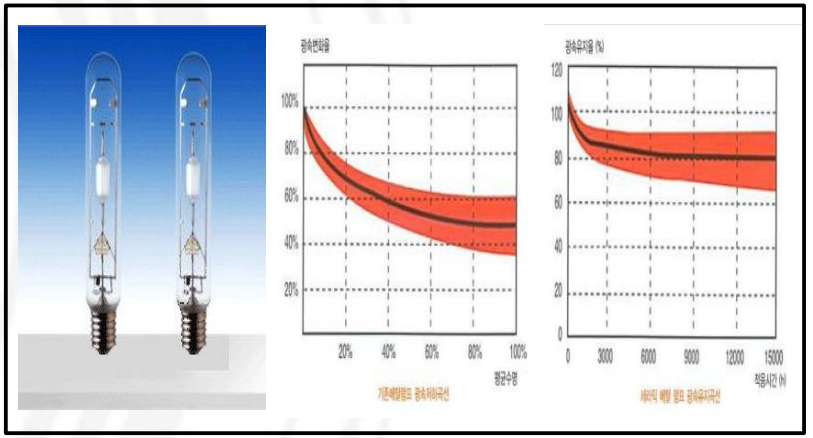
Approach : Check present condition of lighting
Analyze economical effect of changing to high efficiency lighting lamp

Benchmark : Replace low efficiency lighting lamp with high efficient types.
Install auto on-off system by using timer and sensor.

LED Lighting lamp



Lighting lamp for metal halide lamp alternative



Cleaner Production – Energy management

2-4. Electricity - Common Issue : Dust collector

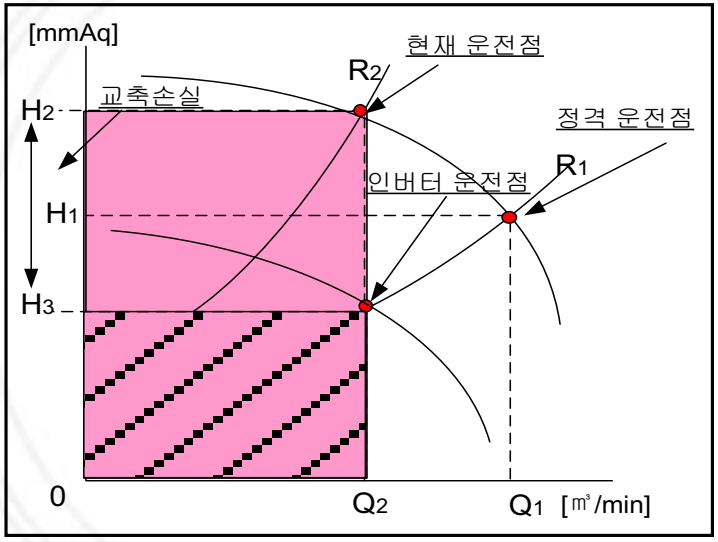
Issue : Energy efficiency measures for dust collector

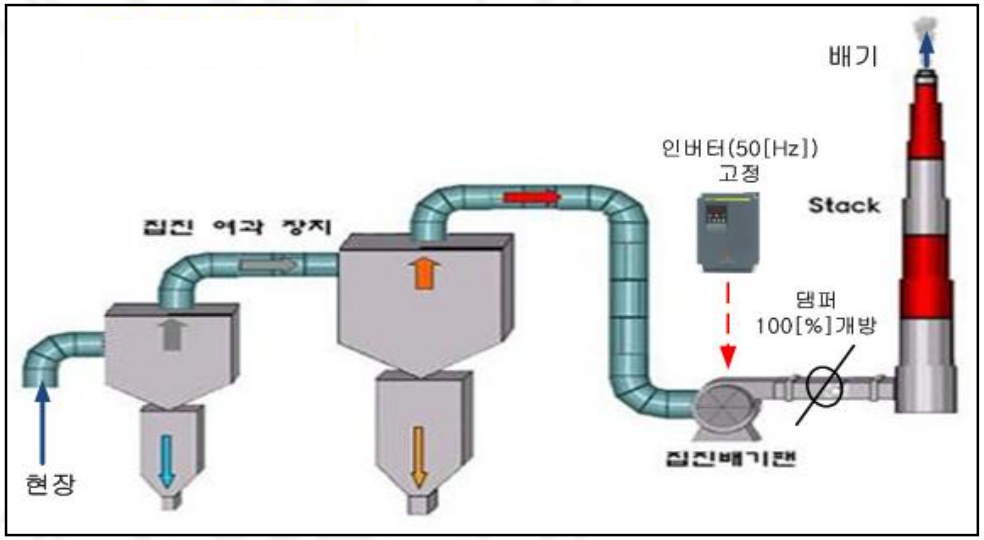
Needs/Problem : Analysis of optimum efficiency and capacity

Approach : Check the condition and capacity of dust collector.

1. Check the power consumption.
2. Check the possibility of a adding to the dust collector.

Benchmark :

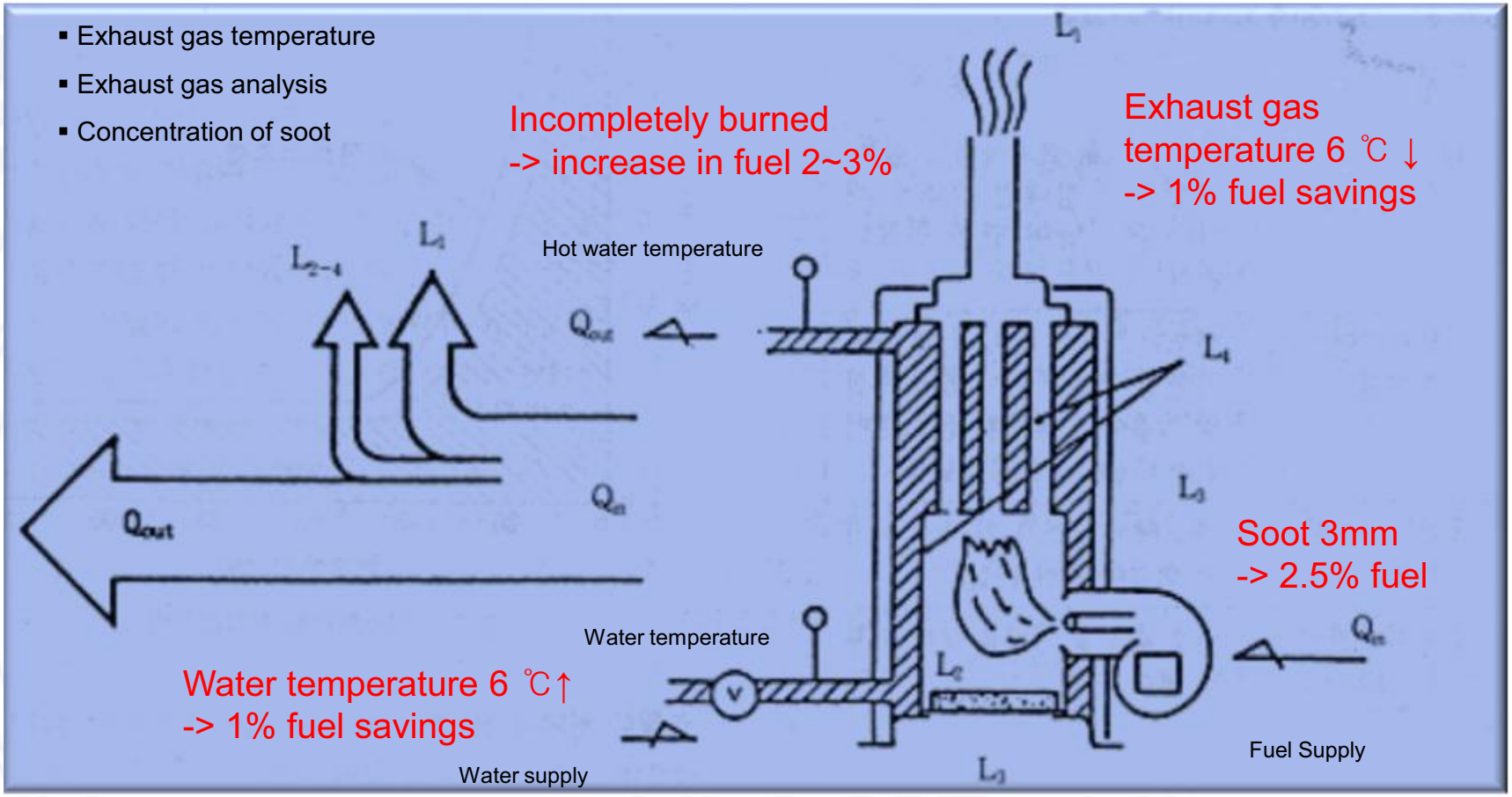




Cleaner Production – Energy management

3-1. Heat energy - common issue : Boiler

boliler



Cleaner Production – Energy management

3-1. Heat energy - common issue : Boiler

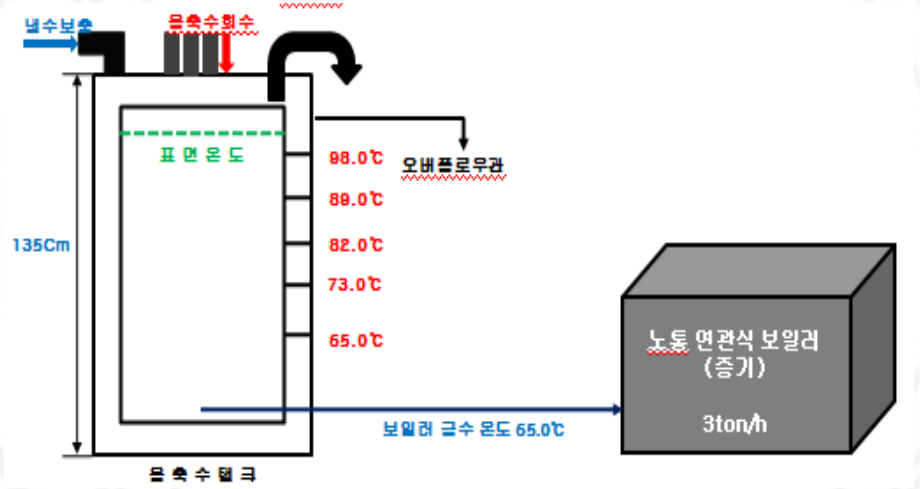
Issue : Recovery of waste steam from coal boiler

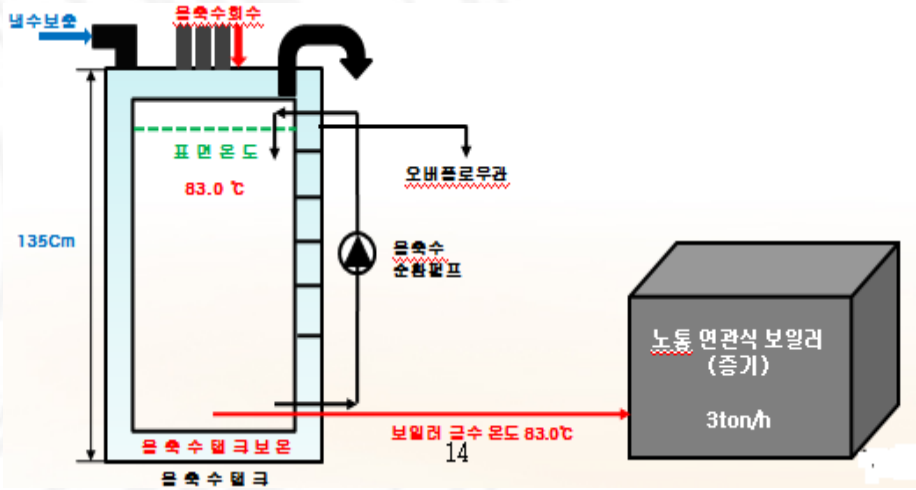
Needs/Problem : Steam loss during the ironing process

Approach : Check the temperature of condensed water and fine recovery method of waste heat

1. Check the insulation of transfer pipeline.
2. Assess the economic feasibility by changing the electric boiler.
3. Check the possibility of recovering water during condensation.

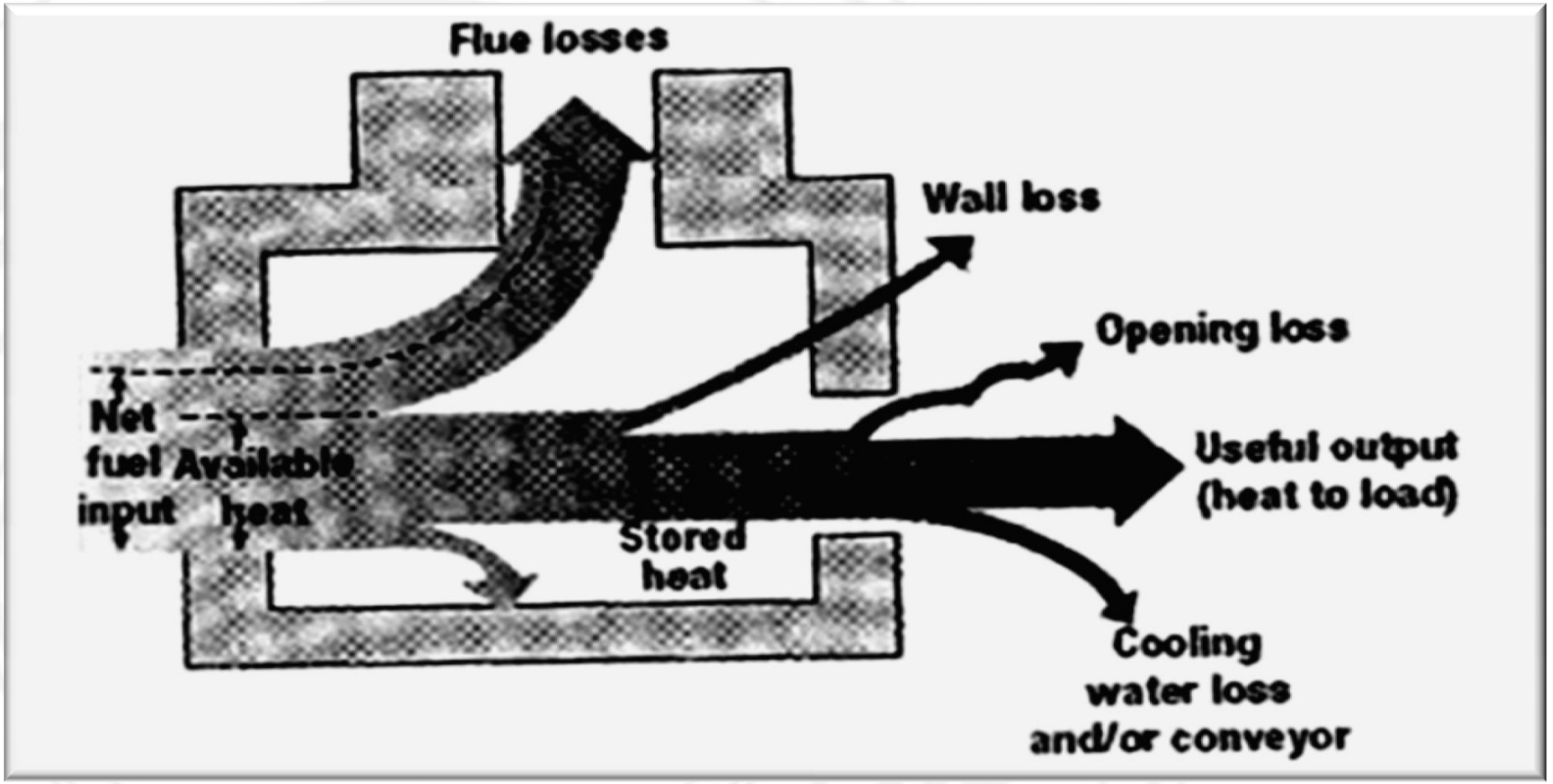
Benchmark :





Cleaner Production – Energy management

3-2. Heat energy - common issue : Heating furnace



Cleaner Production – Energy management

3-2. Heat energy - common issue : Heat treating furnace

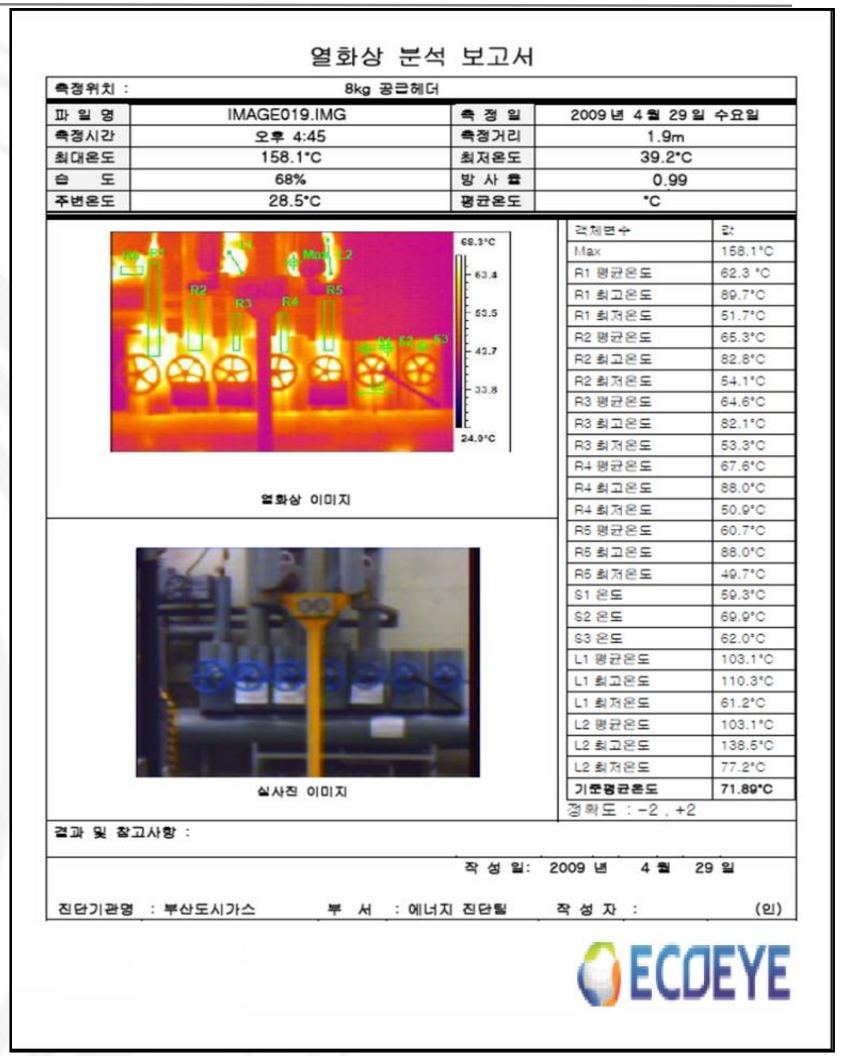
Key Issue : Performance and efficiency of enamel furnace

Needs/Problem : Need for investigating flaws in operation and efficiency

Approach : Energy audit for operation condition

1. Check the availability of waste heat of exhaust gas
2. Check radiant heat linkage.
3. Analyze the condition of exhaust gas.

Benchmark : Recycling heat by heat exchanger
Protecting heat leakage by insulation



열화상 분석 보고서

측정위치 :	8kg 공근헤더		
파 일 명	IMAGE019.IMG	측 정 일	2009 년 4 월 29 일 수요일
측정시간	오후 4:45	측정거리	1.9m
최대온도	158.1°C	최저온도	39.2°C
습 도	68%	방 사 율	0.99
주변온도	28.5°C	평균온도	°C

열화상 이미지

실사진 이미지

측정번수	값
Max	158.1°C
R1 평균온도	62.3 °C
R1 최고온도	89.7°C
R1 최저온도	51.7°C
R2 평균온도	65.3°C
R2 최고온도	82.8°C
R2 최저온도	54.1°C
R3 평균온도	64.6°C
R3 최고온도	82.1°C
R3 최저온도	53.3°C
R4 평균온도	67.6°C
R4 최고온도	88.0°C
R4 최저온도	50.9°C
R5 평균온도	60.7°C
R5 최고온도	88.0°C
R5 최저온도	49.7°C
S1 온도	59.3°C
S2 온도	69.9°C
S3 온도	62.0°C
L1 평균온도	103.1°C
L1 최고온도	110.3°C
L1 최저온도	61.2°C
L2 평균온도	103.1°C
L2 최고온도	138.5°C
L2 최저온도	77.2°C
기준평균온도	71.89°C

정확도 : -2 , +2

결과 및 참고사항 :

작 성 일: 2009 년 4 월 29 일

진단기관명 : 부산도시가스 부 서 : 에너지 진단팀 작 성 자 : (인)

ECOEYE

Cleaner Production – Energy management

3-2. Heat energy - common issue : Heat treating furnace

Issue : Recovering the waste heat from the heat-treating furnace

Needs/Problem : Large energy consumption from the furnace in the galvanizing process for zinc

Approach : Use heat recovery method and prevent the loss of radiant heat.

1. Analyze the exhaust gas.
2. Check if heat recovery is possible.
3. Check the internal pressure of the furnace.
4. Check the consumption of LNG by fuel.
5. Calculate the calories for the heat wasted.

Benchmark :

Increasing the inlet-air temperature using heat exchanger

Generation steam by using tubular waste heat boiler

Cleaner Production – Energy management

3-3. Heat energy - common issue : Dryer

Issue : Efficiency of painting dryer

Needs/Problem : Optimizing the operation of painting dryer is necessary.

Approach : Check the operation and the time involved.

1. Assess energy efficiency
2. Avoid the loss of radiant heat

Benchmark :

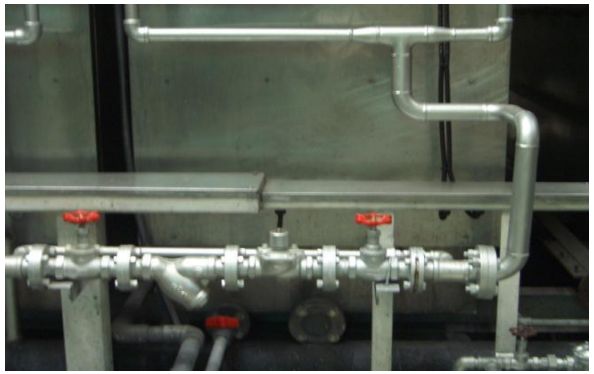
품명	특성특징 상세설명	온도℃ (Max)	밀도 (kg/m³)	두께 (mm)	표준규격 (mm)	용도
Pyro-Log		1316 1430 1430	128~240 160~240 192, 240	150~200	600×900	-대차용 단열 -로내 바닥용 단열 -각종로의 Peep Hole Shapes
Pyro-Bloc Module		1316 1430 1430	128~240 160~240 192~240	100~300	305×305	-가열, 단조, 열처리로등 단열재 -석유화학 히터, 발전설비
Pyro Combi-15		1500	192~240	300	320×305	-단조 가열로 단열재 -각종 고온도용 공업로 등
Fold-Module		1316 1430	128~170	100~300	300×300	-소각로, 소성로 -기타 공업용 로
Veneering Module		1430 1700		50, 75	300×300	-단조로, 가열로, 열처리로 -균열로, 소성로

Cleaner Production – Energy management

4. Cleaner Production - Case Study in Korea : Prevent heat loss

Water is circulated to produce heat → Add protective material to prevent heat loss

BEFORE



AFTER

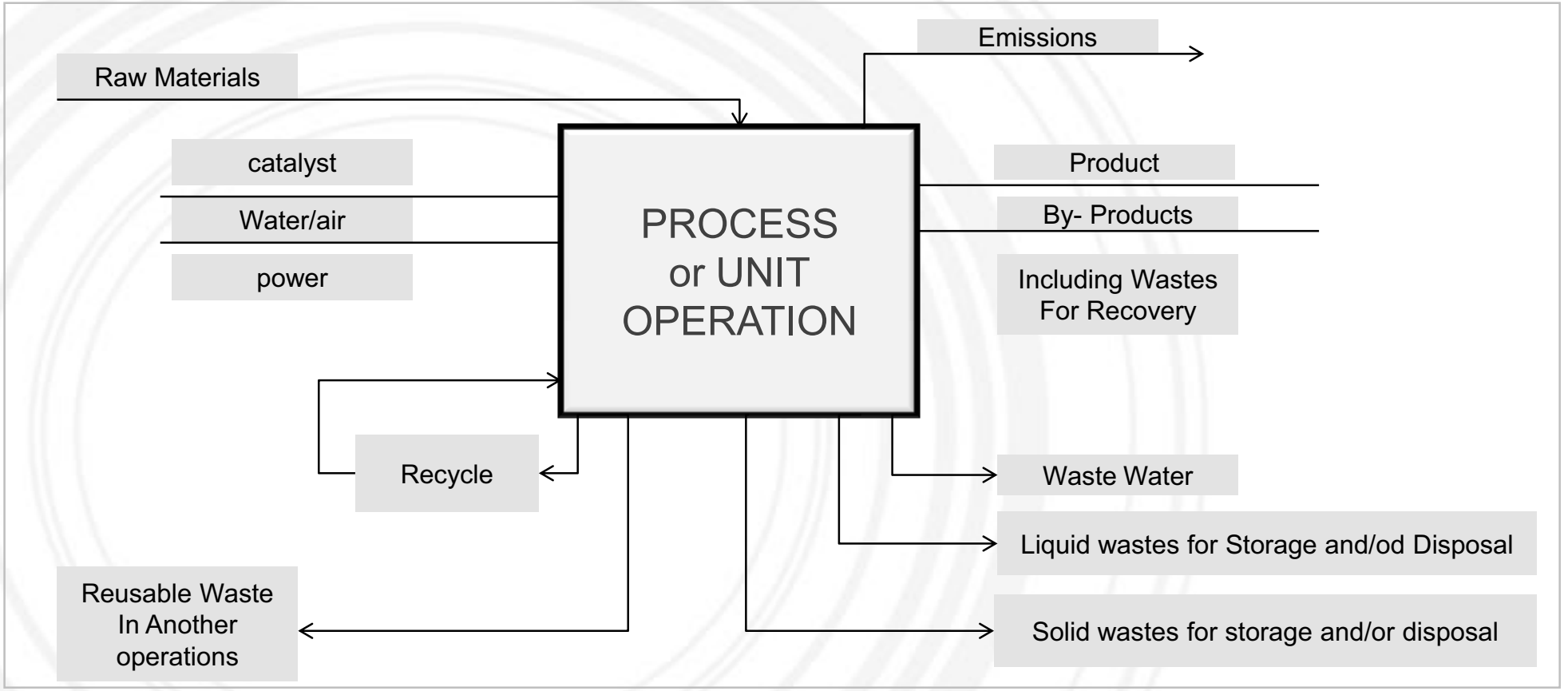
Period	No. of pipe hangers	Hours of labor	Monthly energy costs	Indicator
SEP 2005	735	208	4,255 USD	20.46 USD / hr
SEP 2006	1091	616	6,685 USD	10.68 USD / hr (47% save)

➢ Improvement result: **Saved** (**20.46 USD/hr*616 hr – 10.68 USD/hr*616 hr) * 0.47 = 2,831.51 USD**

Cleaner Production – Waste management

1. Waste Management - Summary

- Starting on the corporate structure: visualizing the waste flows depending on the types, amounts, destination and costs of waste;
- Reviewing waste logistics for weak points and opportunities; and
- Identifying opportunities for waste prevention and reduction as well as cost reduction; and
- Establishing, implementing, and reviewing actions.



Cleaner Production – Waste management

2. Waste Minimization - Methods

Resource optimization

Minimizing the amount of waste produced by organizations or individuals goes hand-in-hand with optimizing their use of raw materials. For example, a dressmaker may arrange pattern pieces on a length of fabric in a particular way to enable the garment to be cut out from the smallest area of fabric

Reuse of scrap material

Scraps can be immediately re-incorporated at the beginning of the manufacturing line so that they do not become a waste product. Many industries routinely do this; for example, paper mills return any damaged rolls to the beginning of the production line, and in the manufacture of plastic items, off-cuts and scrap are re-incorporated into new products.

Improved quality control and process monitoring

Steps can be taken to ensure that the number of rejected batches is kept to a minimum. This is achieved by increasing the frequency of inspection and the number of points of inspection. For example, installing continuous automated monitoring equipment can help identify production problems at an early stage.

Waste exchanges

This is where the waste product of one process becomes the raw material for a second process. Waste exchanges represent another way of reducing waste disposal volumes for waste that cannot be eliminated.

Ship to point of use

This involves making deliveries of incoming raw materials or components direct to the point where they are assembled or used in the manufacturing process to minimize handling and the use of protective wrappings or enclosures.

Cleaner Production – Waste management

3. Waste Management – Tool(source : Eco profit)

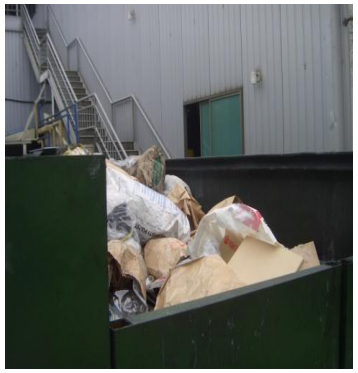
Establishing internal waste logistics

- informing on the correct waste separation;
- suitable container systems;
- optical design of the waste collection points
- involving the employees in the individual areas;
- involving the cleaning personnel;
- motivating all those concerned

Cleaner Production – Waste management

4. Cleaner Production - Case Study in Korea : Improve Waste Management

BEFORE



- Inadequate waste management results in high disposal costs
- No waste separation, no recycling

AFTER

- Establish waste logistics.
- Promote reusable packaging.
- Reduce dead space.
- Place notice sign in front of waste disposal site.

Waste treatment cost/year	**5,517 USD / last year → 3,767 USD / current year (given the same production amount)**
Improvement result	**32% reduction in disposal costs = Save 1,750 USD / yr**

Cleaner Production – Improvement of working environment

1.1. Improvement of working environment - Common Issue : Welding Hume

Issue : Efficiency of welding machine

Needs/Problem : Energy loss caused by low efficiency welding machine

Approach : Check the present condition of welding machine

1. Check the working distance.
2. Check power consumption.
2. Check the economic feasibility.
3. Check the operation efficiency.

Benchmark : http://www.ilhung.co.kr

(High efficiency welding machine equipped with hume for sucking smoke and dust)

OR

(Removeable Hume collector)

OR

(Local exhaust ventilation)

Cleaner Production – Improvement of working environment

1-2. Improvement of working environment - Common Issue : Oil management

Issue : Oil Management (e.g., lubricant oil)

Needs/Problem : Overuse of oil, inappropriate management of iron scrap

Approach :

1. Check type and amount of oil
2. Recycle the used oil
3. Check the cost and toxicity
4. Separate the type of oil

•**Benchmark** : Auto supplier, Separation management, Recycling of used oil

Auto Supplier

Separation management

Collection of used oil

Cleaner Production – Lean Process

1. Lean manufacturing summary

Lean manufacturing, **lean enterprise**, or **lean production**, often simply, "**Lean**," is a production practice that considers the expenditure of resources for any goal other than the creation of value for the end customer to be wasteful, and thus a target for elimination. Working from the perspective of the customer who consumes a product or service, "value" is defined as any action or process that a customer would be willing to pay for.

Lean manufacturing is a variation on the theme of efficiency based on optimizing flow; it is a present-day instance of the recurring theme in human history toward increasing efficiency, decreasing waste, and using empirical methods to decide what matters, rather than uncritically accepting pre-existing ideas. As such, it is a chapter in the larger narrative that also includes such ideas as the folk wisdom of thrift, time and motion study, Taylorism, the Efficiency Movement, and Fordism. Lean manufacturing is often seen as a more refined version of earlier efficiency efforts, building upon the work of earlier leaders such as Taylor or Ford, and learning from their mistakes. However, the modern view takes a more holistic approach where the definition of waste is far more generic. Irregular production with ups and downs in production levels would be considered waste. The goal of Lean then becomes the creation and maintenance of a production system which runs repetitively, day after day, week after week in a manner identical to the previous time period

- **Initiative between 3 EPA offices and US Dept of Commerce**
- **Promotes lean manufacturing to businesses to achieve greater environmental results**
- **Resource: Lean and Environment Toolkit**
- **www.epa.gov/lean**

Cleaner Production – Lean Process

2. Lean manufacturing & environment

Waste Type	Examples	Environmental Impacts
Defects	Scrap, rework, replacement production, inspection	• Raw materials consumed in making defective products • Defective components require recycling or disposal • More space required for rework and repair, increasing energy use for heating, cooling, and lighting
Waiting	Stock-outs, lot processing delays, equipment downtime, capacity bottlenecks	• Potential material spoilage or component damage causing waste • Wasted energy from heating, cooling, and lighting during production downtime
Overproduction	Manufacturing items for which there are no orders	• More raw materials consumed in making the unneeded products • Extra products may spoil or become obsolete requiring disposal
Movement	Human motions that are unnecessary or straining, carrying work in process (WIP) long distances, transport	• More energy use for transport • Emissions from transport • More space required for WIP movement, increasing lighting, heating, and cooling demand and energy consumption • More packaging required to protect components during Movement
Inventory	Excess raw material, WIP, or finished goods	• More packaging to store work-in-process • Waste from deterioration or damage to stored WIP • More materials needed to replace damaged WIP • More energy used to heat, cool, and light inventory space
Complexity	More parts, process steps, or time than necessary to meet customer needs	• More parts and raw materials consumed per unit of production • Unnecessary processing increases wastes, energy use, and emissions
Unused creativity	Lost time, ideas, skills, improvements, and suggestions from employees	• Fewer suggestions of P2 and waste minimization Opportunities

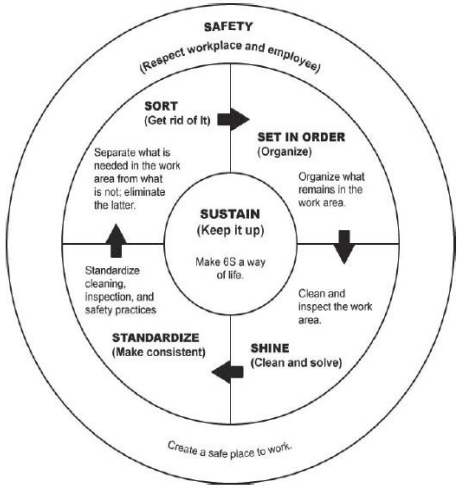
Cleaner Production – Lean Process

3-1. Cleaner Production Lean Process - Tool : 6S

- 6S is a method used to create and maintain a clean, orderly, and safe work environment. 6S is based upon the five pillars (5S) of the visual workplace in the Toyota Production System, plus a separate pillar for safety. 6S is often the first method companies implement in their Lean journey, since it serves as the foundation of future continual improvement efforts.

The Six Pillars of 6S

- **Sort (Get rid of it): Separate what is needed in the work area from what is not; eliminate the latter.**
- **Set in order (Organize): Organize what remains in the work area.**
- **Shine (Clean and solve): Clean and inspect the work area.**
- **Safety (Respect workplace and employee): Create a safe place to work.**
- **Standardize (Make consistent): Standardize cleaning, inspection, and safety practices.**
- **Sustain (Keep it up): Make 6S a way of life.**



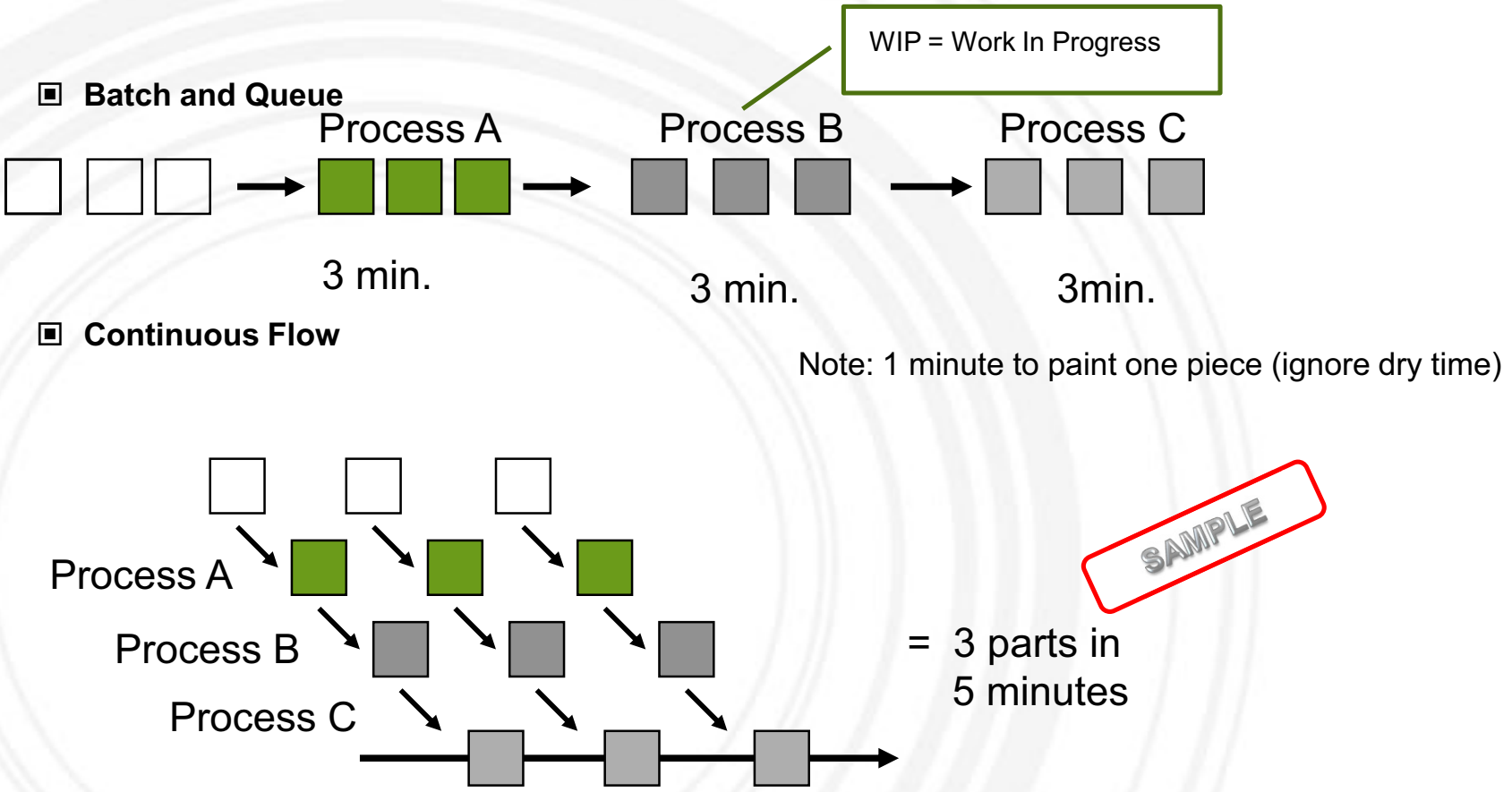
The six pillars work together to support improvement efforts at your company. They help increase productivity, reduce defects, make accidents less likely, and reduce costs. 6S also fosters a culture of continual improvement and employee engagement that is essential for successful implementation of Lean. 6S often makes it easier to implement other Lean methods such as cellular manufacturing, one-piece flow, and just-in-time production.

6S can help your company reduce waste and improve environmental performance leading to increased system productivity. You can also use 6S to minimize risks to the health of workers and the environment. Full implementation of 6S requires looking not only at the quantity, usefulness, and frequency with which an item is used in a work area, but also the risk or toxicity of the item. It also means paying close attention to what ends up in waste streams and how to manage those wastes.

Cleaner Production – Lean Process

3-2. Cleaner Production Lean Process - Tool : Batch Reduction

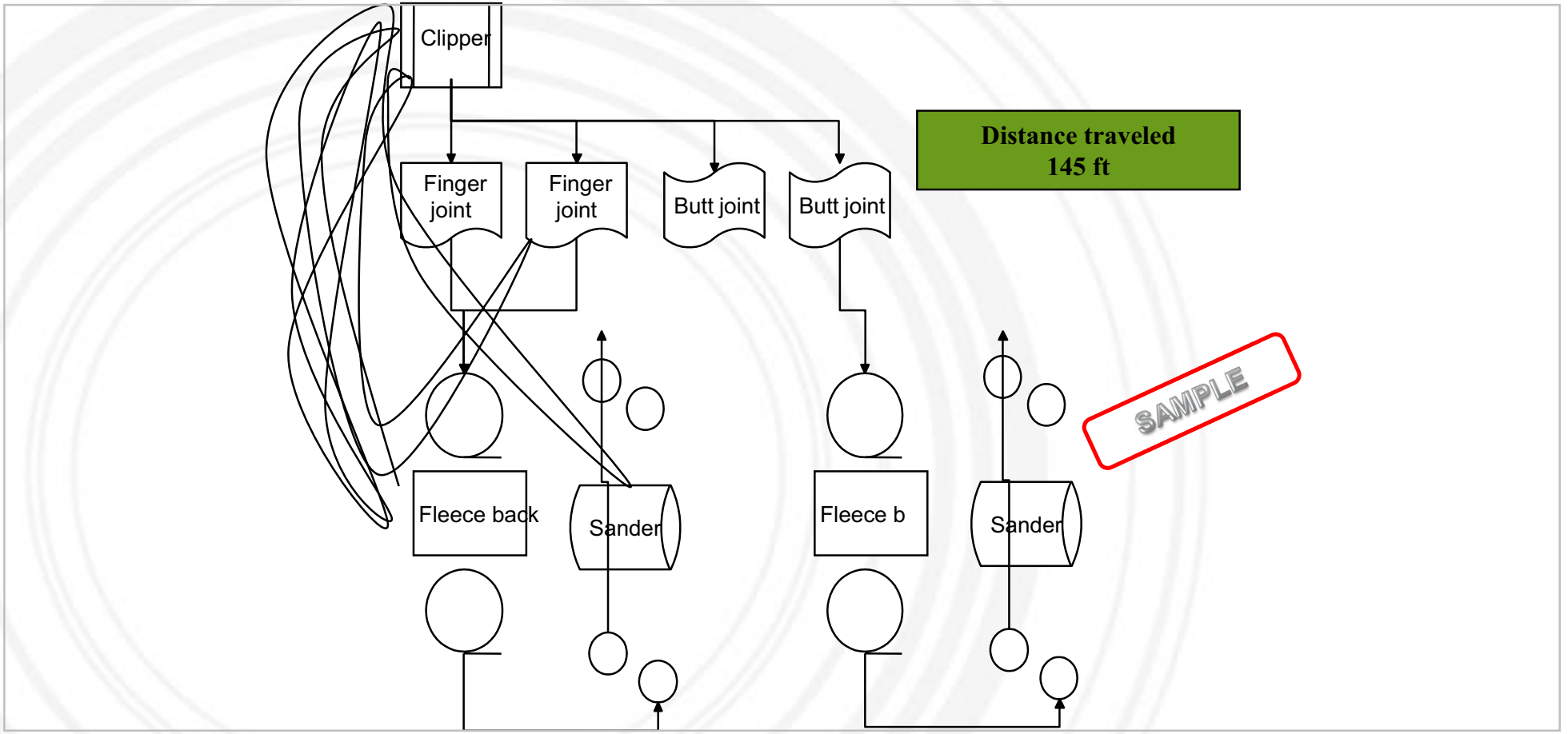
- It is important to improve your setup time so that you can successfully reduce your batch size



Cleaner Production – Lean Process

3-3. Cleaner Production Lean Process - Tool : Noodle(spaghetti) Diagram

- It is a movement path diagram by a more appetizing name. The Noodle diagram is a great waste observation tool even for people taking their very first steps at kaizen and lean management, and also one that serves even the most seasoned lean practitioners faithfully.



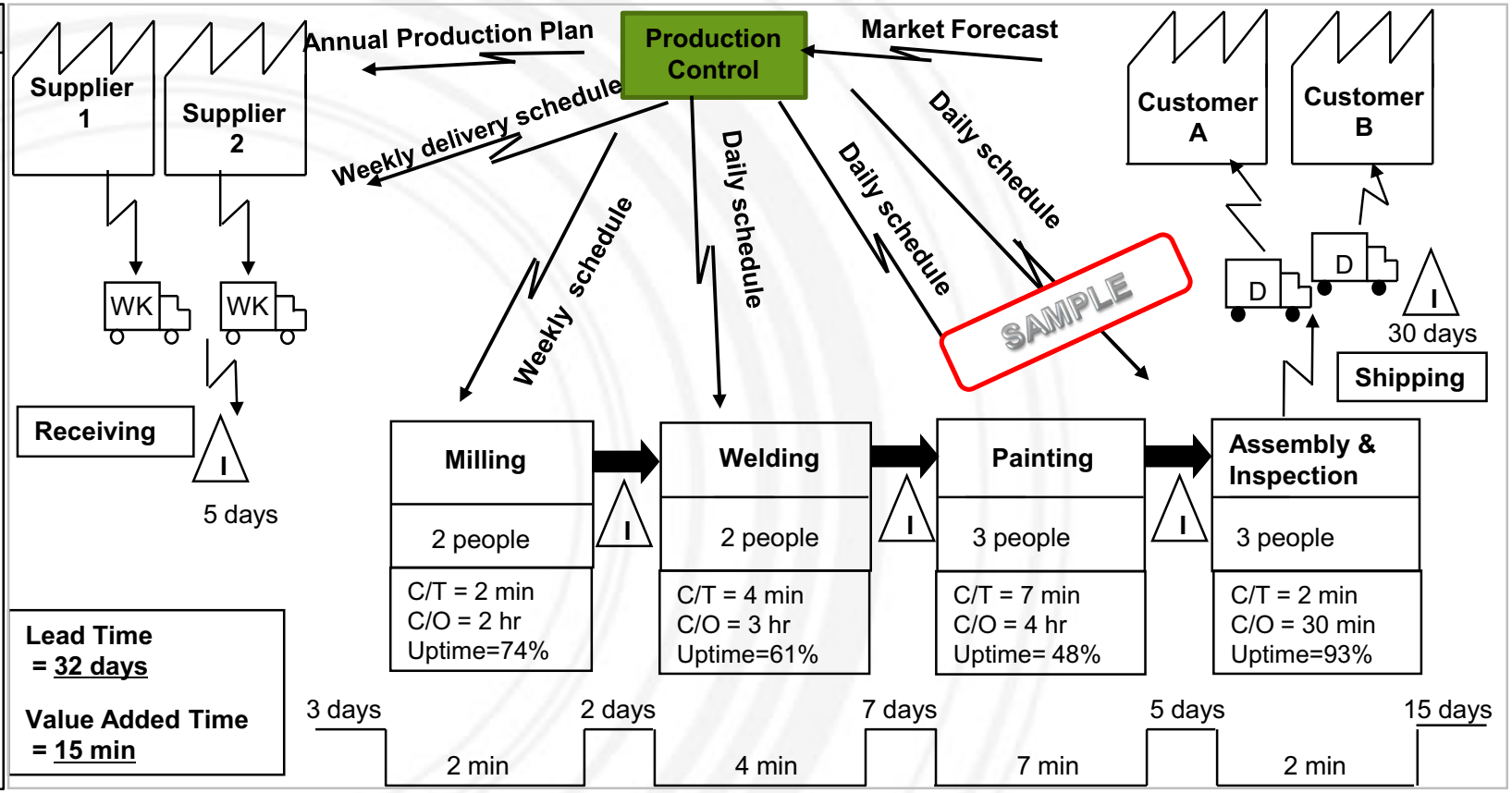
Cleaner Production – Lean Process

3-4. Cleaner Production Lean Process - Tool :Value Stream Map (VSM)

- **(VSM))** is a process mapping method used to document the current and future states of the information and material flows in a value stream from customer to supplier. A value stream is the set of specific actions (value-added and non-value added) required to bring a specific product through three critical management tasks of any business: problem solving, information management, and physical transformation. A tool to reduce muda by distinguishing the process that adds values and that does not add values along with the raw materials and product flows.

When to consider VSM?

- **Difficult to meet the delivery deadline**
- **Some processes are mostly standing-by, while some are being operated 24/7 to consume waiting.**
- **Short storage capacity.**
- **Too much or too little inventory.**
- **Operations are slowed down due to a few bottleneck processes**



Environmental Transparency

Global companies are disclosing their environmental management practices.
⇒ **WHY:** Interested stakeholders (investors, consumers, buyers, suppliers) pressure companies to measure their sustainability.
⇒ **HOW:** **Transparency** is the first step to Environmental Responsibility of companies

What and how to disclose environmental information?

Information Content

- Use of Electricity, Fuel, Materials
- Waste and Toxic Substance Generation
- Carbon footprint
- Environmental Management Strategies & Targets

Methods

- Disclose environmental management information on the company's **website**
- Publish a **sustainability report**
- Use **bulletin boards** to share information on the company's environmental management and sustainability activities to employees & clients

Sample 1

Environmental policy on website

Sample 2

Environmental management bulletin board

Sample 3

Sustainability report

Environmental Transparency

Sustainability reporting is the ultimate form of environmental transparency. The report should include all aspects of the organization's sustainability performance results and targets.

Sustainability Report

Contents

Energy & Resources

Energy-saving activities:
• Schedules adjusted for cooling, heating, and air filtration
• Heat exchangers installed
• Hot water supplied on ground floors
• Floor lamps replaced with high-efficient lights

	Unit	2009	2010
LNG	Nm3	265,626	275,319
Diesel	ℓ	106,947	80,947
Gasoline	ℓ	221,330	242,368
Electricity	kWh	55,314	59,767
Heating System	Gcal	1,059	1,192

Contents

TMChain

1. Basic information of Company

Company name	Thai Motor Chain Co., Ltd		
Repersentative		Company Size	☐Large company ■Medium ☐Small
Address	7/138 M.4 Amata City Industrial Area, Pluek Daeng, Mab Yang Porn , Rayong 21140		
Type of Industry	Metal	Main product	Motorcycle Roller Chain
Sales Volumes	7 Million USD	No of employees	115

2. OVERVIEW

Thai Motor Chain Co., Ltd or TMC is a motorcycle chain manufacturer in Thailand. TMC has fully capitalized and has established an integrated system incorporating every step from design, develop and manufacturing through distribution and merchandising. TMC can offer a high range of manufacturing process in machining, forming, extrusion, assembly, stamping and heat treatment to satisfy customer requirements. It strives to increase eco efficiency in the manufacturing process especially in terms of energy conservation.

- As heat treatment is the key bottleneck, it is important to seek ways to increase productivity. Since the heat treatment process consumes a lot of energy, they need to develop new material or new process to reduce the cost.
- Wash water recycling options
- Oil management

TMChain

2. ITEM

Case 1. Air Compressor

• **State of worksite:**
Air compressor discharge pressure 7.5 (kg / ㎠) high.

Air compressor inlet temperature is too high.

•**Betterment :**
Discharge pressure lowering electricity savings
Improvement of the air compressor inlet temperature

• Air Compressor discharge pressure (7.5 kg / ㎠ → 5.5 kg / ㎠)

• Lower the air compressor inlet temperature

• **Expected Effectiveness :**

•Annual Fuel savings = 19,272(kWh/Yr)
•Annual Amount of savings = 19,272(kWh/Yr × 3.0(BHT/kW)
= 57,816(BHT/Yr)
•Investment = With out nay investment

TMChain

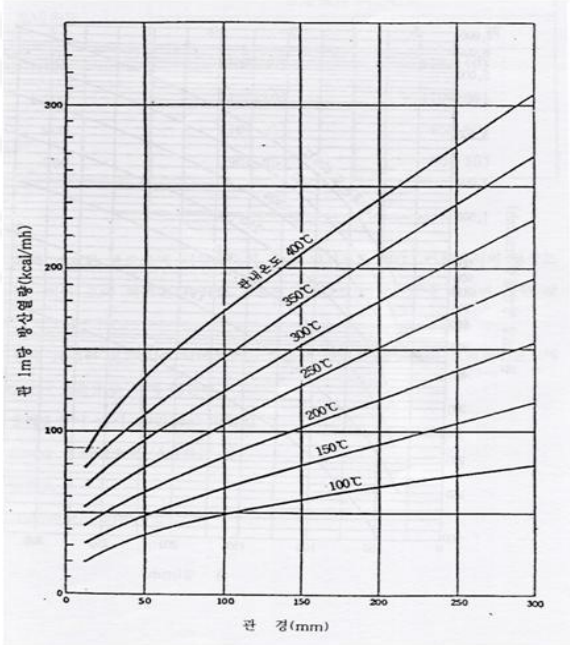
2. ITEM

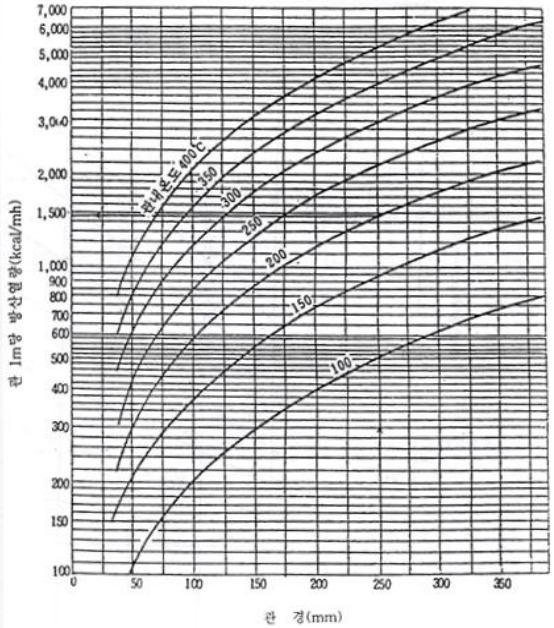
Case 2. Heat Furnace

• **State of worksite:**
Loading and Unloading of Heater frequency
High surface temperature of Heat Furnace
(Heat Furnace warmth reinforced)

•**Betterment :**

Solution : Heat Furnace warmth installation





• **Expected Effectiveness :**

- •Annual Fuel savings = 365,552(kWh/Yr)
- •Annual Amount of savings = 365,552(kWh/yr) × 3.0(BHT/Yr)
  = 1,096,656(BHT/Yr)
- •Investment = 1,000,000(BHT)

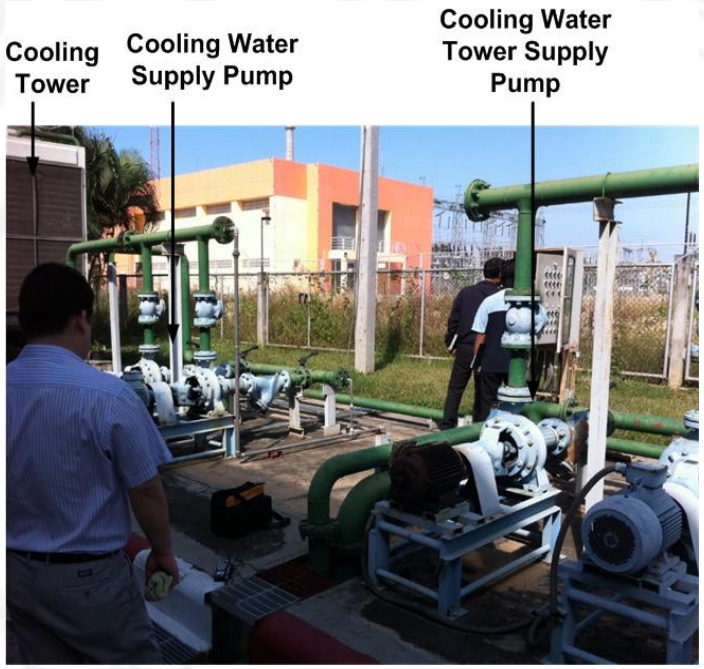
TMChain

2. ITEM

Case 3. Cooling Water Pump

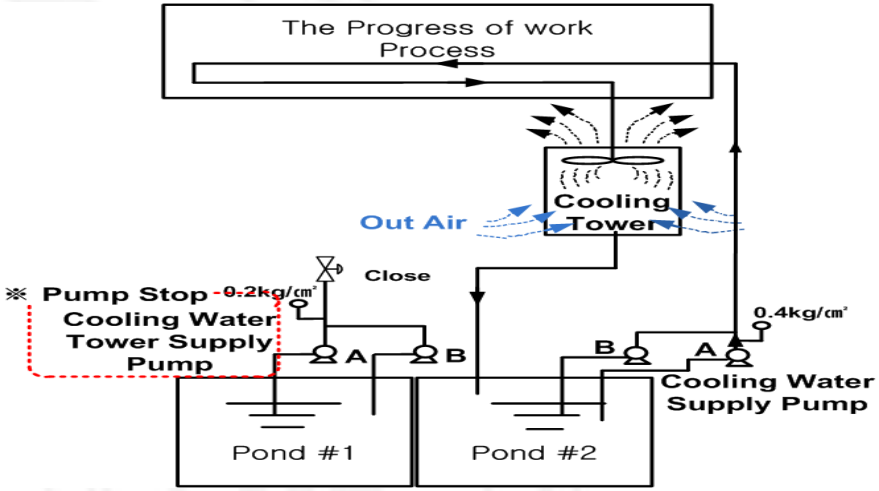
• **State of worksite:**

The coolant temperature is low
Cooling water pump is still operating
Unnecessary power is consumed



• **Betterment : Modify Pipe**

Solution : Directly connected to the return cooling water tower



• **Expected Effectiveness :**

•Annual Fuel savings = 26,280(kWh/Yr)
•Annual Amount of savings = 26,280(kWh/yr) × 3.0(BHT/Yr)
= 78,840(BHT/Yr)
•Investment = 100,000(BHT)

TMChain

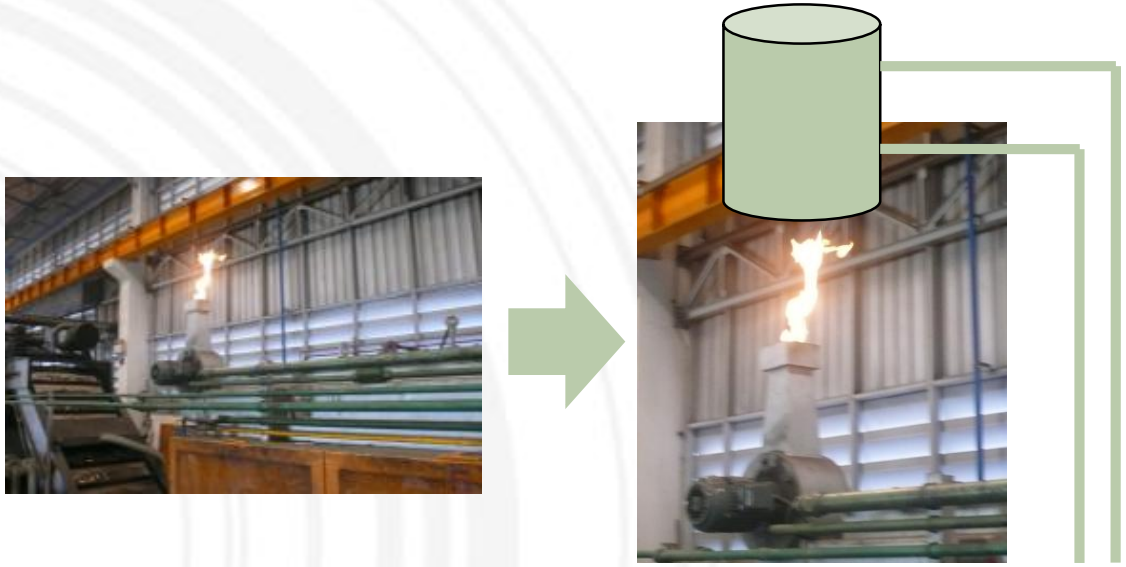
2. ITEM

Case 4. Waste energy recovery

• State of worksite:
Burn the furnace exhausted gas (H2+methane)

•Betterment :

Solution : Install boiler upside in the exhausted flame and recover the waste heat for rinse water.



• Expected Effectiveness :

save 40kw of one rinse water heater.

Tipco Biotech

2. ITEM

Case 5. Container modification

• **State of worksite:** Parts storage case occupies more area inside the factory

•**Betterment :**

Solution : Modify the container leg

• **Expected Effectiveness :**

save space, promote safety, and increase handling efficiency

ASEM
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Center

ASEM SMEs Eco-Innovation Consulting Project :

- Eco-Innovation Guideline for TMChain -

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