PROMEEC (Energy Management) Project

ENERGY MANAGEMENT HANDBOOK for ASEAN (Final Version at the Stage of Common Handbook)

New Approach to Energy Conservation in ASEAN countries

January 2009 Rev. 3

The Energy Conservation Center, Japan

Preface

This handbook was developed based on the TEM (Total Energy Management) Handbook which was successfully prepared first in Thailand through the policy dialog between Thai government and Japanese government to support and supplement Energy Conservation projects carried out by Thai government.

The TEM Handbook, after the completion, was actually subjected to introductory use in 10 factories in Thailand in 2005, and proved its usefulness by the excellent results of energy saving corresponding to about 45.6 million Thai Bahts (about US$ 1.2 Million) only in about 7 months. The results are summarized in the Table at Appendix-1 as one of the successful examples of Energy Conservation.

This TEM Handbook was then applied to the need of other ASEAN countries. In other words, the ASEAN TEM Handbook was developed by modifying the said Thai Handbook to meet the requirements of Energy Conservation in those countries.

This Handbook has been provided to be utilized by all people concerned with energy conservation in all the industries in ASEAN countries “from Top to Bottom”. In addition, the concept of Total Productivity Management (TPM), Total Quality Management (TQM) and Small Group Activities are incorporated into the TEM Handbook to facilitate to enhance energy efficiency.

This Handbook was improved through the studies and discussions of PROMEEC (Promotion of Energy Efficiency and Conservation) activities based on the ASEAN-Japan cooperation program, as one of the most useful tool of “the ASEAN Energy Management System”. In such countries as Lao PDR, Vietnam and Indonesia, some pioneer companies shown later used the Handbook in a trial manner. Their comments after the said introductory use were then utilized for further improvements in the Handbook. We are accordingly at the stage of finalizing the Handbook as a common book, as shown in this “final version”. From now on each ASEAN country is supposed to develop the Energy Management Handbook to meet respective situations and requirements. At the same time, the Handbook should be translated to its own language so that all the parties in the country could fully utilize the book without any difficulties. Especially the Appendix sections should be customized to the needs and situations of individual countries, with successful examples of Energy Conservation from ASEAN countries, and favorably, from the individual countries.

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ABREVIATION

ACE	ASEAN Centre for Energy
CP	Counterpart
EC	Energy Conservation
ECCJ	The Energy Conservation Center, Japan
JICA	Japan International Cooperation Agency
METI	Ministry of Economy, Trade and Industry
PEMTC	Practical Energy Management Training Center
PR	Public Relations
PRE	Person Responsible for Energy
PROMEEC	Promotion of Energy Efficiency and Conservation
TEM	Total Energy Management
TPM	Total Productive Maintenance/Management
TQC	Total Quality Control
TQM	Total Quality Management
W/G	Working Group

Experience in Thailand by Using Total Energy Management (TEM) Handbook

Summary of Results of Introductory Use of TEM Handbook in Pioneer Factories in Thailand

(Effects of Activities for Approximately 7 Months, in 2005)

Company	No. of Small Groups Established	No. of Suggestions	No. of EC Projects Implemented	Energy Saving		Total Savings (Baht)
				Electricity (kWh)	Heat	
A – Company Building Management	13	196	26	300,000	-	825,000
B – Company Food Processing	29	25	25	25,350	-	68,193
C – Company Electrical Appliance	5	30	12	117,696	-	318,954
D – Company Plastic	60 (TPM)	5 (TEM)	4	TOD-TOU + 76,000	-	1,900,000
E – Company Ink Fabrication	5	5	5	7,287	-	18,217
F – Company Ceramic	182 (QCC/TPM) 1 (TEM)	19 (TEM)	18	543,562	1,224,264* (Baht)	2,590,548
G – Company Cement	1	5	2	35,880	-	79,530
H - Company Pulp & Paper	63 (TPM) 7 (TEM)	28 (TEM)	11	9,203,000	28,050 ton (Steam)	35,339,600
I - Company Manufacturing Vehicle Engine	7	11	10	114,278	-	314,266
J – Company Textile	76	32	9	27,061	19,676 GJ (HFO, Coal)	4,147,652
Total				10,450,114		45,601,960

* Demand charge savings for natural gas purchased

TOD : Time of Day

TOU : Time of Use

TPM : Total Productive Maintenance/Management

QCC : QC (Quality Control) Circle

Part I

Purposes and Usage of Energy Management Handbook

Chapter 1 Introduction

Energy is one of the most important resources to sustain our lives. At present we still depend a lot on fossil fuels and other kinds of non-renewable energy. The extensive use of renewable energy including solar energy needs more time for technology development. In this situation Energy Conservation (EC) is the critical needs in any countries in the world.

Of special importance of Energy Conservation are the following two aspects:

(1) Economic factors
(2) Environmental impacts

1.1 Economic factors of Energy Conservation

Energy saving is important and effective at all levels of human organizations – in the whole world, as a nation, as companies or individuals. Energy Conservation reduces the energy costs and improves the profitability.

In ASEAN countries, though the situation is a little different from nation to nation, the efforts of Energy Conservation have been continued in every nation for decades. Some countries already have legal enforcement like the Energy Conservation Promotion Act. Some others are planning that or preparing for that. For both the oil-exporting countries and the oil-importing countries, the nation-wide Energy Conservation efforts will contribute to lessening dependence on scarce resources such as crude oils and establishing the more favorable budget balance of the country. The significance and importance of Energy Conservation are growing bigger day by day, in the recent situations of skyrocketing crude oil prices.

Private companies are also sensitive to energy costs, which directly affects their profitability and even their viability in many cases. Especially factories in the industrial sectors are of much concern, because reduced costs by Energy Conservation mean the more competitive product prices in the world markets.

1.2 Environmental impacts of Energy Conservation

Energy Conservation is closely related also to the environmental issues. The problem of global warming or climate change is caused by emission of carbon dioxide and other Green House Gases (GHG). Energy Conservation, especially saving use of fossil fuels, shall be the first among the various countermeasures of the problem, with due considerations of the aforementioned economic factors.

To cope with the said problem, there have been many global or international cooperation activities. One of those is IPCC (Intergovernmental Panel on Climate Change), started in November 1988.

There have been also the efforts in the shape of UNFCCC Kyoto Protocol, where a lot of countries in the world are working together in the same direction of reducing GHG emission. Moreover, encouraged by introduction of “flexible mechanism” many international cooperation projects are developed between private sector entities of Annex 1 countries (Japan) and non-Annex countries (developing countries or those in transition) in the Asia-Pacific region. (Related articles in the Kyoto Protocol refer to “Activities Implemented Jointly”, “Emissions Trading among Annex 1 Parties” and “Clean Development Mechanism”.) Moreover, the G8 Hokkaido Toyako Summit held in July 2008 ushered in the new era of increasingly important environmental protection.

Chapter 2 Purposes of Energy Management Handbook

The current Energy Management Handbook was originally a product of a project initiated by the GAP (Green Aid Plan) policy dialog between Thai government and Japanese government, and now that is expanded to application to all ASEAN countries. The project was meant to support and supplement many projects for EC promotion carried out by the governments of ASEAN countries. More specifically, the Handbook is characterized by the following purposes:

(1) Main Users
The main users of the Handbook would be the energy managers or the key persons in similar positions who plan to promote EC inside the factories. Additionally all the people within factories from top management to workers/operators could be proper users to realize Energy Conservation by all members' contribution.

(2) EC by PARTICIPATION
The Handbook will be a very effective tool to be utilized in industrial factories based on the sprit of the teamwork, or "EC by Participation".

(3) Special and Unique Features
The Handbook was planned and designed in such a special way as is described later, and so it has very special and unique features. Those features are explained in the two categories – Comprehensive and Specific. The latter means utilization of SGA (Small Group Activities) in a broad sense – ESGA (Effective Small Group Activities).

2.1 Comprehensive Features

To achieve the above-said purposes, there was close cooperation among ACE, the representatives of ASEAN countries and Japanese experts from ECCJ. As a result, the Handbook has the following features:

(1) First book in the world
This kind of "Handbook for Energy Conservation" does not exist yet either in Japan or in any other countries in the world. It was first prepared in Thailand and followed by ASEAN countries under the cooperation by Japan through ECCJ.

(2) Management issues – not technical issues
The Handbook is different from the existing or planned manuals in ASEAN countries. The manuals in most cases deal with technical issues related to machinery and facilities, while the Handbook deals with management issues related to people. In other words, the Handbook shows how to use manuals and motivate people to work together for Energy Conservation.

(3) How to motivate people

Accordingly the Handbook puts stress on such items as Motivation Techniques, EC Attitudes and SGA (Small Group Activities) including TQM/TPM, all contributing to "EC by PARTICIPATION (of all the people working together)".

Of these elements, utilization of SGA (including TQM/TPM) forms the very special features of the Handbook, and it is explained in more details in 1.2.2.

(4) User-friendly

The Handbook is so designed that the users read it and learn how to work on Energy Conservation program for industrial factories. Namely the book shows the way to carry on Energy Conservation activities. The book is very unique in that it is made in the "user-friendly" way. It was planned and designed, originally in Thailand, by the users, including not only engineers in industrial factories but also management level people, involved in the project from the very beginning stage. Thus the contents of the book were carefully arranged to assure convenience of the users.

(5) Comprehensive

At the same time, the Handbook is a very comprehensive one, with a lot of related useful information put into the Appendix part, so that the users would easily find what they want somewhere in the book.

(6) Expandable

The Handbook is made in an "expandable" manner for refinement and addition in the future. After actual use of the book in many factories in ASEAN countries from now, the feedback would be utilized to revise, update and expand the book. Especially putting successful examples of using the book into some part of the Handbook with a category by industry would make the book much more useful in the future.

(7) Provides the self-sustainable way

Accordingly the Handbook will be utilized within industrial factories in a self-sustainable way so that private sector people probably would be able to continue EC activities even without the help of outside consultants.

2.2 Specific Features – Full utilization of SGA (Small Group Activities)

As mentioned previously, utilization of Small Group Activities (SGA) is one of the special features of the Handbook. Japanese industrial sector has developed and improved a lot of techniques and methodology in the field of SGA, including TQM and TPM, in the past few decades with successful results. In the original project of

preparing the TEM Handbook in Thailand, two Japanese TQM/TPM experts took part and had long discussion with other committee members on how to utilize the essence of those SGA in Energy Conservation promotion.
The conclusion is, as explained below, introduction of the consolidated concept of SGA(Small Group Activities). Now the special feature of the TEM Handbook is "full utilization of SGA for Energy Conservation".

(1) SGA in a broad sense and in a narrow sense

There are many tools, methods and techniques in the field of SGA in a broad sense. TQM and TPM would be the two famous examples. SGA in a narrow sense might include such methods as Employee Suggestion System, ZD (Zero Defects) movement, 5S (**S**eiri: Order, **S**eiton: Arrangement, **S**eisou: Cleaning, **S**eiketsu: Cleanliness and **S**hitsuke: Discipline) activities, KAIZEN (Improvement) activities, and so on. All the good points of the SGA in a broad sense (i.e. TQM, TPM and the SGA in a narrow sense) were intended to be utilized in the TEM Handbook for the purpose of Energy Conservation promotion.

(2) Essence of SGA

It would not be useful to put all these methods and techniques, as they are, into the Handbook, because it requires a voluminous part of the book and also it confuses the users who would ask themselves which method to adopt for Energy Conservation promotion activities. It was therefore desired for the Japanese experts to digest all the good points of the said SGA in a broad sense and put only the essence (core nutrition) into the Handbook for the ready use in Energy Conservation activities.

(3) TQM and TPM

TQM and TPM have a separate long history each, starting from the different field, respectively the quality and maintenance. However the both methods continued development to cover wider fields and now deal with the extensive fields of organizational activities, with a lot of overlapping each other. At present both TQM and TPM aim at solving management issues, and can be used and applied in the various fields of company activities – manufacturing, maintenance, sales, administration, etc.

(4) Consolidated concept of SGA

The essence of TQM, TPM and SGA (in a narrow sense) is expressed by a new consolidated concept of SGA (Small Group Activities). It contains the excellent and substantial points extracted from all these methods/techniques and can be applied effectively to Energy Conservation activities as well as many other fields of business activities. It is based on integration of the power of all the members of organizations through their PARTICIPATION for a project or the common goal (such as Energy Conservation).

Chapter 3 Usage of Energy Management Handbook

3.1 Users of Energy Management Handbook

The Handbook is meant for use in factories in the industrial sector in ASEAN countries. The following class (category) of people may be considered as users of the Handbook:

(1) Factory Manager (Senior Management)
(2) Middle managers
(3) Energy Manager, or equivalent engineers to promote EC
(4) Other staff/engineers
(5) Workers/operators

Of these, the Handbook is primarily supposed to be used by Energy Managers or equivalent. For readers' information, new types of PRE(Person Responsible for Energy)s appeared in Thailand after completion of the new training center in the suburbs of Bangkok through PEMTC (Practical Energy Management Training Center) project jointly implemented by Japanese and Thai governments, with the new qualification system and the training with the mini-plants and new textbooks. Then they found the TEM Handbook a very useful tool to actually promote EC activities within the factories.

The Handbook is also useful for other class of people. They get deeper understanding of the issue of EC and how to promote it within factories so that all the people from the senior management down to workers/operators, including PREs, can work together in the same direction – EC promotion. The same thing goes in other ASEAN countries, too.

3.2 Contents of Energy Management Handbook

The contents of the Handbook are designed for convenient use. After Part I, Purposes and background of Total Energy Management Handbook, comes Part II, which shows Total Energy Management "by Participation" with Key Step Approach. Then Part III contains the way of Implementation of Energy Conservation Project. Appendix-1 and -2, respectively, show Successful Examples and useful related information.

3.3 Future Shape after Expansion

Since the Handbook is designed to be expandable, addition of many successful examples, to be gathered from all over ASEAN countries, will accumulate in the book in future. Those examples will be arranged by category of industry, such as iron & foundry, chemical, food, textile, etc. Then future users would first look for reference examples in the industry to which they belong, and have good chances to find ones.

Part II

Total Energy Management "by Participation" with Key Step Approach

As said in the previous Part, strategic planning of the Energy Management is very important for the management of factories/companies, and Energy Conservation is one of its major topics. In the Handbook, stress is put on introduction of the way of promoting Energy Conservation by participation of all the members within factories, i.e. “Energy Conservation by Participation”. That is explained in more details in Part II, with the “Key Step Approach, which is meant for easy and convenient access by the users.

Chapter 1 Key Step Approach for Energy Management

1.1 Energy Management Principles

Energy Conservation is an important issue for the corporate management, and is considered to form a part of Energy Management.

(1) Definition of Energy Management

Energy is one of the management resources of a company, and shall be managed and controlled by a systematic method in harmony with the management of other resources. Energy Management is managing all kinds of energy used in the company by making out an optimum program of purchasing, generating and consuming various types of energy based on the company's overall short-term and long-term management program, with due consideration of costs, availability, economic factors, and so on.

(2) Necessity of Energy Management

Energy Management is necessarily required because it influences a number of aspects of company operation and activities including the following:

- energy costs which affect the company profitability
- energy costs which affect the competitiveness in the world market
- national energy supply/demand balance
- national trade and financial balance
- local and global environments
- occupational safety and health
- loss prevention and waste disposal reduction
- productivity
- quality

1.2 Strategic Approach for Energy Management (Key Step Approach)

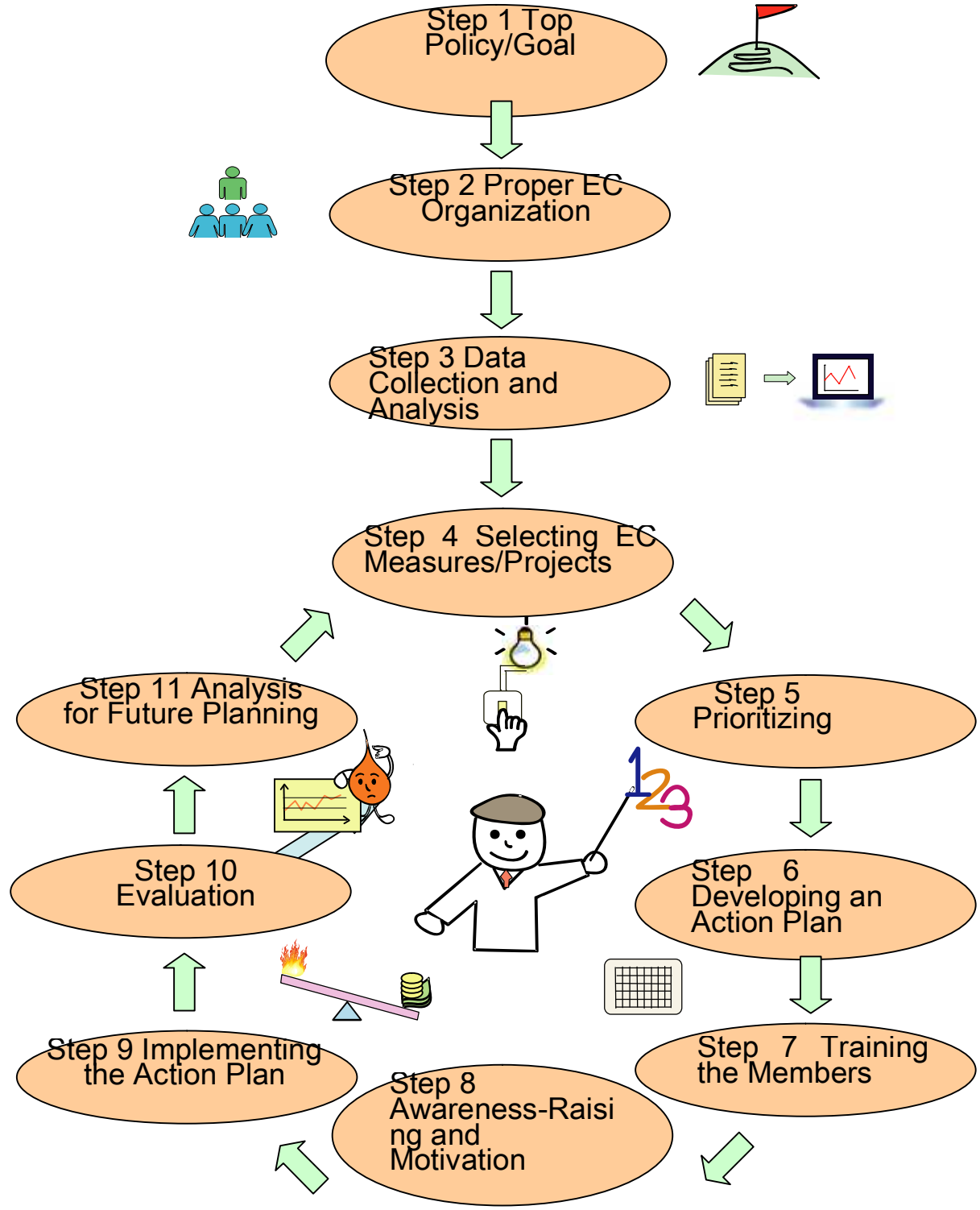
Nowadays all the corporate decision making and action taking shall be carried out on the basis of Strategic Approach. Otherwise the decision or action may not be effective enough from the overall viewpoints or under the rapidly changing circumstances, and soon the company would find itself in an uncertain situation of its viability. Energy Management is no exception.

In this section, Strategic Energy Management is explained in the form of "the Key Step Approach" to serve as a quick reference for the users to grasp its essence and take actions without delay. More detailed explanation of the Key Step Approach is given in Part III. It consists of the following key steps:

(1) Top management policy/Goal
   - Develop a policy statement
   - Set targets
(2) Proper EC Organization including Assignment of Energy Manager
   - Establish proper EC organization (utilizing SGA)
   - Assignment of Energy Manager
(3) Data collection and Analysis
   - Collect data on current energy use
   - Analyze the collected data
   - Identify management strength and weakness
   - Analyze stakeholder needs
   - Anticipate barriers to implement
   - Estimate the future trend
(4) Selecting EC Measures/Projects
   - Selecting EC Measures
   - Selecting EC Projects
   - Make out a plan/program
(5) Prioritizing
(6) Developing an Action Plan
(7) Training the related members
(8) Awareness raising and Motivation
(9) Implementing the Action Plan (including controlling and monitoring)
(10) Evaluation (Management review)
(11) Analysis for future planning (Standardization and Dissemination)

These Key Steps are illustrated in the following figure:

Steps of the Key Step Approach.



Each step will be explained in this order as below:

(1) Top Management policy/Goal

It is the most important for the success of Energy Conservation activities within companies or factories to have clear and official commitment of top management – either the corporate top (senior) management or factory managers. The top (senior) management shall announce explicit commitment to the Energy Management (or Energy Conservation) and behave along this line – for example, participate in EC (Energy Conservation) events and encourage the people there for EC promotion. This Handbook is primarily meant for Energy Managers for the use of EC promotion within factories, on the assumption that top management has already committed to that. However, there may be cases where top management would learn about Energy Management (or Energy Conservation) by this Handbook, or Energy Managers would make efforts to persuade top management to support or commit to Energy Management (or Energy Conservation) with the help of this Handbook.

① Develop a policy statement

It is desired that the top (senior) management announces the "Energy Policy Statement". This is very effective to let people inside and outside the company clearly know the management's commitment to Energy Management (or Energy Conservation). The format of the energy policy statement is various, but it usually includes the goal or objective of the company and the more concrete targets in the field of Energy Management (or Energy Conservation). It often shows the major measures and timetables. The statement shall match the company's mission statement or overall management strategy plan.

② Set targets

The targets shall be concrete and specific so that everyone can understand it.

(2) Proper EC Organization including Assignment of PRE (or Energy Manager)

In some countries, where the EC Promotion Act is in force, the designated factories have obligation of assigning PREs. For example, in case of Thailand, a new training center was constructed to support the new system of assigning and training Energy Managers under the law.

In relation to Energy Management, however, the word "Energy Managers" is here used as a Manager or a Coordinator, separate from the above-said legal obligation, who works exclusively for Energy Management (or Energy Conservation) purposes, ranging from gathering energy-related information to drafting EC plans/programs and promoting or coordinating during implementation. To the proper Energy Management, this type of PRE is indispensable. How to position this PRE within

the company organization is also an important issue and needs careful decision. In some cases, Energy Committee, with members from the major departments, may be formed to assure the company-wide or factory-wide cooperation. This issue will be explained in Part II, Chapter 3, Organization and Structure.

(3) Data collection and Analysis

Before trying to make out any future programs or action plans, it is essential for the company or factory management to understand the current situation in a proper and accurate manner. This includes not only the status of their own operation but also other relevant information such as competitors' operation, circumstances around the company and their trend in future, positioning the company itself in the local and global markets, and so on.

The key steps for this purpose are shown below:

① Collect data on current energy use and analyze them

The current data of energy consumption shall be obtained by measurement, calculation or estimation for the individual operation units (energy cost centers) with classification of kinds of energy (fuels types, utility types, etc.). The data shall be gathered regularly and arranged/summarized daily, weekly, monthly, by seasons or annually. Then the data shall be checked for the past historical trend and interpreted with relation to operational modes and production scales. That shall also be utilized for the forecast of future trends. More details of the data gathering are explained in Part III, Implementation of Energy Conservation Projects .

② Identify Management Strength and Weakness

Then the data shall be compared with the best practice data or benchmarks in the industry. If such reference data are hardly available, the historical data of their own operation and estimated data for the competitors would be utilized for this purpose. At the same time, the strength and the weakness of the company shall be evaluated considering the competitors' situations in the local and global markets. This would serve the purpose of making out a realistic Energy Management plan later.

③ Analyze stakeholder needs

Stakeholders are top (and senior) management, middle managers, staff/engineers and workers/operators. Other stakeholders in the normal sense, such as the shareholders and lenders, need not be included here. The needs and intention of those stakeholders shall be summarized and taken into consideration.

④ Anticipate barriers to implement

Making out a realistic and practical program also needs consideration of

anticipated barriers for the implementation of Energy Management program or action plan. Some possible examples of such barriers are:

- Insufficient understanding and support by top management
- Insufficient understanding and cooperation of managers within factories
- Insufficient awareness of people to get successful results
- Insufficient capability of people due to lack of training
- Insufficient available technology due to lack of information
- Insufficient availability of manpower for EC activities within factories
- Insufficient budget for EC activities due to the company's financial status

⑤ Estimate the future trend

The future trend of energy supply-demand balance is estimated based on checking and analysis of the historical data. That data of future trend would also be a basis of the program of good Energy Management.

(4) Selecting EC Measures/Projects

Based on the aforesaid understanding of the current status and position of the company(factory), various EC measures are studied and many EC Projects are proposed. Comparison among these measures and projects are compared with a lot of factors considered.

Then a plan/program is developed based on the these study results. To do this, it is very important to consider the following issues:

The plan/program shall be realistic, practical and attainable with due consideration of many related elements and management resources of the company or factory. It also shall be expressed in terms of the measurable or quantifiable parameters. It usually include a lot of managerial measures of Energy Management (or Energy Conservation) promotion activities such as motivation techniques, means to improve awareness, training, and so on.

(5) Prioritizing

Many EC measures and projects are prioritized based on the internal studies including comparison among the alternatives.

(6) Developing an Action Plan

The priority consideration then gives birth to the Action Plan. The plan shall be clear, practical and comprehensive with proper schedule and budgeting.

(7) Training the related members

This issue is very important to secure the success of project implementation.

(8) Awareness raising and Motivation

To have the total power of “all members’ participation” combined together, it is also very crucial how to raise awareness and motivation of related people within the company (or factory).

(9) Implementing the Action Plan (including controlling and monitoring)

The organizational force established in the said planning step shall be utilized fully to ensure smooth implementation of the program. Energy manager and/or the committee shall continue working to promote the activities and report to top management on the status quo. This issue is explained in more details in Part III, Implementation of Energy Conservation Project.

The actual records of implementation shall be closely watched and monitored. If some problems arise, or some variance between the planned figure and the actual record is observed, then necessary actions shall be taken immediately.

(10) Evaluation (Management Review)

After the program is completed, the report shall be submitted to the top (senior) management. The results shall be assessed and analyzed for any good and bad points. The lesson shall be utilized as a feedback in the subsequent plan/program. Thus the activities are repeated to form a cyclic movement.

(11) Analysis for future planning (Standardization and Dissemination)

The successful results and the lessons learned are to be analyzed and arranged into the standard form which can be easily utilized by anyone in the factory. The standardized documents or information are to be disseminated all over the company.

As mentioned earlier, more details of how to implement each step are explained in the following chapters.

Chapter 2 Policy and Planning

2.1 Energy Policy

As already mentioned previously, everything starts from the clear top management's policy. Without it, nothing could happen.
There are five attributes of a successful energy policy as shown below:

(1) Commitment;
Personal message from top management with a commitment with a regular policy review.

(2) Thrust;
A new and challenging dimension to energy and environment.

(3) Applicability;
Directive on which parts of the organization are covered by the policy.

(4) Implementation;
Guidance on how the policy objectives are to be met.

(5) Review;
How an organization knows goals have been achieved.

To make out a good energy policy, the top (or senior) management shall convey his/her commitment clearly to others and the expected performance standards shall be set out.

2.2 Planning

It is then essential that the top management has good planning of how to do it.
Good Planning is a basis and starting point of the "Energy Conservation by Participation".
The essential elements for the purpose are as follows:

- Strategic goals only achieved if driven by day-to-day actions.
- Focusing on action plans starts with developing an energy policy.
- Setting objectives and targets.
- Preparing detailed action plans.
- Allocating management resources.
- Utilizing SGA (Small Group Activities)

2.3 Developing an Effective Energy Policy

An effective Energy Policy is developed using the following documents:

(1) Published policy document
- Statement policy document
- Corporate policy, endorsed by board, specifying goals and objectives.

(2) In- house management documents
- Strategic plan outlining what has to be done.
- Management system specifying.
  / Who is responsible for managing energy.
  / Reporting and reviewing mechanism.
  / Who is responsible for implementation.
  / Milestones and targets.

2.4 Formulating Policy

The policy can be formulated in the following manner:

(1) Can be a long and detailed process.
(2) Remember the five key attributes explained in 2.1.
(3) Syndicate session 1.
- Draft a policy document containing a CEO statement and company goals and objectives.
- Use the handouts to pick some long-term goals and medium-term objectives to put into your policy document.
- Be prepared to present your results to the group and explain why you picked the message, goals and objectives that you did.

2.5 Objectives and Targets

The important factors of the objectives and targets are as follows:

(1) Setting objectives and targets
- Objectives can be almost the same as the policy or may have to be set locally
- they express desired outcomes of specific policy commitment.
- Targets detail performance required to meet objectives, often quantitative
- must be realistic, meaningful and achievable.
- Benchmarking may be considered at this stage. This issue is explained in Part III, Chapter 4.

(2) For each part of the organization.
(3) Information from the “Understanding” stage.
- Assess waste reduction targets, costs and returns.
- Build on management strengths, Identify gaps.
- Provide incentives for people at all levels.

2.6 Example: Long-Term Goals

(1) Commit to responsible energy management.
(2) Give priority to energy efficiency in investments.
(3) Promote energy efficiency throughout operations.
(4) Do every thing economically feasible to reduce consumption.
(5) Minimize CO_2 emissions.
(6) Minimize environmental impact.
(7) Promote the use of sustainable energy resources.
(8) Use renewable energy wherever possible.

2.7 Example: Medium-Term Objectives

(1) Create & maintain high profile for energy management.
(2) Publish corporate energy policy.
(3) Reduce cost of energy consumption by X% over Y years.
(4) Monitor and evaluate performance levels.
(5) Set and publish improvement targets.
(6) Report performance (improvements) annually.
(7) Increase staff awareness.
(8) Motivate staff to save energy.
(9) Use maximum payback period of 3 – 8 years.
(10) Nominate employees as departmental energy officers.
(11) Provide practical advice on energy saving to staff.
(12) Adopt effective energy procurement policy.
(13) Establish energy management structure.
(14) Establish a monitoring & target setting system.
(15) Provide regular reports on costs and consumption.
(16) Establish an energy saving budget.
(17) Invest 1 – 10% of energy spend on efficiency measures.

2.8 Action Plans

Based on the energy policy and the objectives/targets, actions plans shall be made out, consisting of the following:

(1) Keep the program on track.
(2) Operate at different levels, but all should
    - Be agreed at appropriate level and “roll up” to the senior manager with overall responsibility for energy.
    - Relate actions to individual objectives and targets.
    - Assign actions to specific individuals, with clear deadlines for reporting & completion.

- Indicate who is responsible for signing off.
- Describe the resources available.
- Facilitate budget negotiations and confirm adequate budget provisions have been made.

2.9 Action Plans/Major Points

The major points explained in the above are summarized as below:

(1) Draft a policy statement about the 5 key attributes mentioned in 2.1 and have it signed by the head of the organization.
(2) Draft objectives and targets and have these accepted and approved by senior management.
(3) Develop action plans and complete a roles and responsibilities matrix.
(4) Have key people develop individual action plans to guide their day-to-day activities.
(5) Utilize SGA (Small Group Activities) as much as possible.
(6) Establish monitoring procedures.

2.10 Detailed Action Plans/Major Points

For the detailed action plans, major points are as follows:

(1) Break down the policy statement into specific objectives. Identify realistic targets for measuring progress.
(2) Draw a roles and responsibilities matrix for the organization, including key functions and names of individuals.
(3) Ensure all key players create their own action plants to guide day-to-day activities.
(4) Have all action plans agreed and approved through line management.
(5) In the plans SGA (Small Group Activities) can be utilized to a full extent. This topic is explained in more detail in Part II, Chapter 4, Principles and Methods of small Group Activities (SGA) for Energy Management.

Chapter 3 Organization and Structure

To effectively promote Energy Conservation by utilizing ESGA (Effective Small Group Activities), it is very important to design and make out the organization carefully to meet the purpose. In practical sense to do that, there may be the following six widely applicable ways of establishing the organization.

(1) Utilize Line (Formal) Job-related Organization for TEM purpose
(2) Use TPM Organization for TEM purpose
(3) Use TQM Organization for TEM purpose
(4) Use both TQM and Employee Suggestion System for TEM purpose
(5) Energy Conservation Organization and Suggestion System for TEM purpose
(6) Utilize another organization for TEM purpose

Each way listed above is explained briefly below, with some examples actually adopted in some Thai companies

3.1 Utilize Line (Formal) Job-related Organization for TEM purpose - Roles & Responsibilities Matrix

In case the company (factory) makes full use of the existing line (formal, or job-related) organization, then the rolls and responsibilities of each member in the line organization could be expressed in the form of matrix as shown bellow:

	Positions in line (formal) company (factory) organization				
Key Function Responsible Person	Director	Mgr A	Mgr B	Asst C	Asst D
Measure consumption	(3)	(2)	(1)		
Identify energy cost centers		(3)	(4)		
Track Performance					
Set target for energy use					
Develop energy saving programmer	(3)	(2)	(1)		
Inspect equipment					
Select improvement projects					
Allocate budget/resources					
Prepare documentation					
Provide training					
Review new project for EE					
Carry out EE audits					

Key: (1): Perform work
(2): Responsible for work
(3): Approval authority
(4): Provide advice (technical support)

3.2 TPM Organization for TEM purpose

Forming SGA in the framework of TPM is more closely related with the line (or formal) factory organization than the case of TQM. There are opinions that the TPM organization might be the best form of utilizing SGA for the Energy Conservation purpose, because the issue of Energy Conservation could be handled as one of the several “pillars” in the TPM system. However, adopting TPM into a factory means actually putting appreciable amount of manhours into the various work items, and there may be some factories where they find it difficult to introduce TPM method due to lack of manpower. Such factories may be better to look for another way.
An example of such a “TPM Organization for ENERGY MANAGEMENT purpose” is shown in the following figure and explanation. In this case, “TPM Organization for

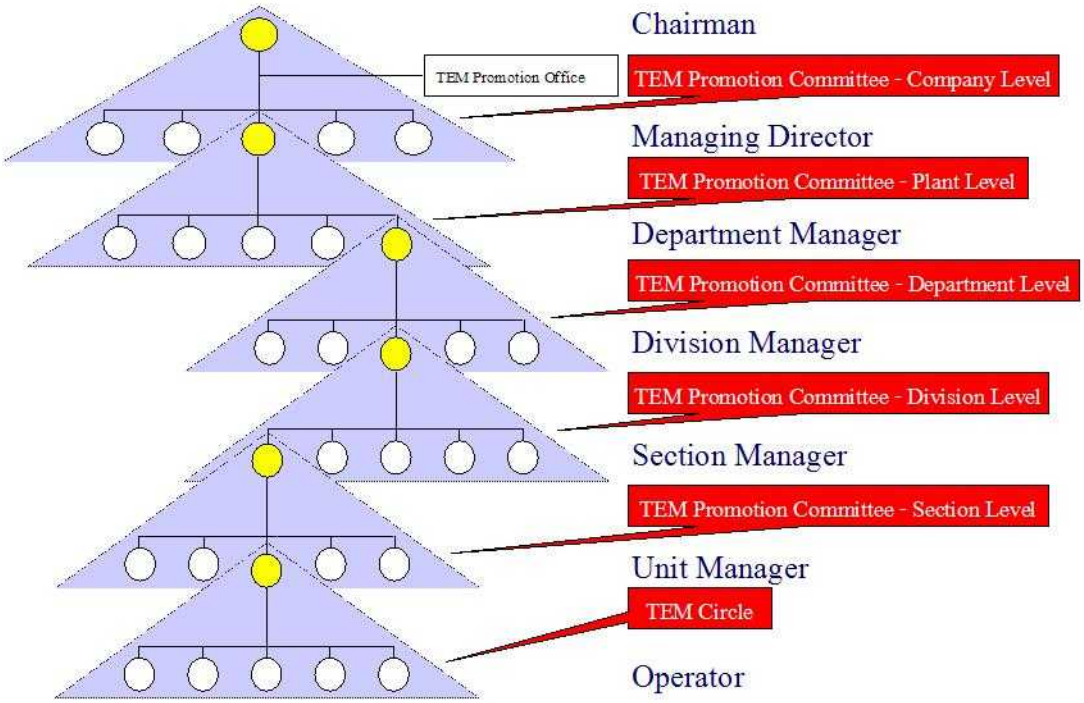
ENERGY MANAGEMENT purpose" is expressed as "ENERGY MANAGEMENT Organization", and actually "TPM Organization" is adopted and utilized to solve the Energy Conservation problems as one pillar of several ones.

Example – ENERGY MANAGEMENT Organization (with overlapping small group)

(1) Organization Structure

The Organization Structure of ENERGY MANAGEMENT activities should have overlapping small groups. And ENERGY MANAGEMENT promotion committees should be established in all organization levels company wide, that is in the level of company, plant, department, division and section level, including promotion offices of each committee called ENERGY MANAGEMENT promotion office or ENERGY MANAGEMENT office. In each ENERGY MANAGEMENT office will have permanent responsible persons.

The organization structure with overlapping small group (ENERGY MANAGEMENT Circle) will provide efficiency and effectiveness for internal communication and administration of activities.



Example of Overlapping Small Group Organization Structure
(ENERGY MANAGEMENT Circle)

(2) Role and responsibility of small group in each organization level

① Role and responsibility of ENERGY MANAGEMENT promotion office

a. Ensure the overall ENERGY MANAGEMENT activities of each level are in the same right directions and not delayed.
b. Promote ENERGY MANAGEMENT activities and make them run smoother.
c. Provide appropriate guidance and methods to continually promote ENERGY MANAGEMENT activities with non-stop.
d. Listen for ideas and suggestions from small groups, consider for improvement of ENERGY MANAGEMENT promotion.
e. Provide appropriate advises in running ENERGY MANAGEMENT activities for small groups.
f. Maintain good human relation, friendly reaction and service mind.

② Role and responsibility of top management

a. Establish company policy and target for ENERGY MANAGEMENT activities.

b. Follow up and ensure ENERGY MANAGEMENT activities are in line with policy.
c. Consider ideas and suggestions from ENERGY MANAGEMENT promotion offices.
d. Consider reports from ENERGY MANAGEMENT promotion committees.

③ Role and responsibility of middle management

a. Establish ENERGY MANAGEMENT policy and target for responsible department, division or section in line with the company policy.
b. Establish numerical targets for each ENERGY MANAGEMENT circle by braking down from company target.
c. Establish topics to be improved and set appropriate members responsible for each topic.
d. Follow up, advice, recommend and provide help for ENERGY MANAGEMENT circle activities.
e. Periodically report to upper committee the progress, comments and suggestions of ENERGY MANAGEMENT circle activities.

④ Role and responsibility of ENERGY MANAGEMENT circle

a. Run ENERGY MANAGEMENT circle activities in the assigned topic successfully.
b. Periodically report to upper committee the progress and problems occurred.
c. Ask upper committee for help and provide suggestions and ideas in promotion of ENERGY MANAGEMENT activities.

⑤ Role and responsibility of small group leader/ ENERGY MANAGEMENT circle leader

a. Provide each member opportunity to fully express their unlimited potentials.
b. Create system that promotes cooperation among members.
c. Provide each member necessary appropriate training.
d. Promote “want to work” feeling of each member.
e. Provide appropriate atmosphere, environment and work place suitable for working.
f. Continually check and promote working ability, “want to work” feeling and appropriate working environment.
g. Discuss with managers/ group leaders or other units for making success small group activities.

Group Success

= Potential X Human Relation X Enthusiasm

= Working Ability X “Want to Work” Feeling X Appropriate Working atmosphere

3.3 TQM Organization for TEM purpose

This may also be a popular way of utilizing SGA for the Energy Conservation purpose, for there are a growing number of factories who carry out TQM (or QCC activities). TQM utilizes SG called "QC circles" (QCC), and the system can tackle problems in various fields and Energy Conservation can be one of them. Furthermore, TQM may be easier to introduce than TPM. The basic method can be covered by the subsequent section which deals with the third way of using the both TQM and Suggestion System, so please refer to the Section 3.4 for further details.

3.4 Both TQM and Suggestion System for TEM purpose

A good example of a Thai company factory utilizes both TQM method and Employee Suggestion System at the same time to solve the Energy Conservation problems. The both systems have the management policy, the committee, rules for operation/ management, and so on.

3.5 Energy Conservation Organization and Suggestion System for TEM purpose

There have been many factories in Japan where the both (special) Energy Conservation Organization and Employee Suggestion System are used in parallel. The Energy Conservation Organization has the following features:

(1) Factory Manager clearly announces the Energy Management Policy and commit himself to Energy Conservation activities.

(2) An Energy Conservation Committee is formed. Chairman of the committee is Factory Manager. Other members are department managers, and some section managers such as utility section manager, operation control manager, etc.

(3) Secretary of the committee is assigned. In many cases this person is a Energy Manager (Energy Manager in the Japanese system, enforced by law, is a bit different from other countries).

(4) Under the direction of chairman, the secretary (called EM hereinafter) makes out a draft of a one-year program including routine and special events.

(5) In February every year in Japan, METI (Ministry of Economics, Trade and Industry of Japan) encourages many factories to hold an event including seminars, commendation ceremonies, etc. The committee plays an important role on that occasion.

Employee Suggestion System is carried out at the same time.

3.5 Utilize other organization for the TEM purpose

There may be another way, which utilizes an already existing organization for promoting the Energy Conservation, instead of forming a new organization. An example of such an organization is Safety Committee, which is obligated by law to form in factories in Japan.

Chapter 4 Principles and Methods of Small Group Activities (SGA) for Energy Management

4.1 Principles of Small Group Activities (SGA) for Energy Management

One of the features of this Handbook is utilization of SGA (Small Group Activities) for the purpose of Energy Conservation. This chapter deals with the topic of "Energy Conservation by Participation of all the members", or how to utilize SGA (or ESGA as already explained previously) for the purpose of Energy Conservation.
There have been many management tools proposed and carried out on how to utilize the capability of all the members within organizations, because the fruits of all the members working together toward one and the same objective are much bigger than the sum of the individual fruits of members working separately.
The typical successful methods or techniques in that category of management tools are TQM and TPM. Other methods or techniques in the category include Employee Suggestion System, ZD (Zero Defect) movement, KAIZEN, and so on.
As explained in Chapter 3 (Organization and Structure), there are many ways of using these tools, separately or in combination, to promote Energy Conservation.
In this chapter, principles of forming and utilizing SG (Small Group) are explained mainly based on the TQM techniques. The purpose of SG activities is expressed in a general terms, because the technique can be used for various management purposes including Energy Conservation.

4.1.1 Principles of Energy Conservation promotion by participation by everyone

(1) Management cycle

As shown in below, the management cycle consists of four steps.

- Plan
- Do
- Check
- Act

Until the process achieves its objectives, the cycle is repeatedly rotated while each step is observed attentively. Commonly, people say "rotate the management cycle" or "the PDCA cycle" using its acronym.

The following explains the management cycle in more detail:

- Establish the objectives and targets for improvement.
- Determine the process and methods for achieving the objectives.

Plan	(Standardization: technical standards, operational standards, Procedures, guidelines, manuals, etc.) - Predict and prevent troubles beforehand.
Do	- Educate and train employees. - Implement the plans.
Check	- Compare the results against the targets. - When the results fall short, examine the causes. - Take immediate measures. - Analyze the process and identify the root causes and develop
Act	- Permanent measures (prevention of recurrence, prevention by prediction) - Revise the standards.

"Process control" is the name used for the quality control activity that is carried out by rotating the management cycle. Process control strives for controlling and improving work processes and procedures so as to obtain desirable results.

"Prevention of recurrence" refers to activities that prevent problems from recurring by analyzing the probable causes of the problems, identifying the root causes, and removing them. "Prevention by prediction" are activities that predict and prevent problems before they occur.
A key to both prevention of recurrence and prevention by prediction is to nail down the root causes of the problems so as to improve the work processes and procedures.

(2) Management by Fact

Small Group activity encourage their members to discuss, think, and judge necessary matters based on the facts and data. Data refers to the results obtained by measuring or observing a fact and comes in various forms such as numerical values, language data, drawings, and pictures.
Without confirming the facts and collecting data, people often make judgments based solely on their experience, intuition, and gut feeling. On the other hand, the scientific way of thinking relies on the facts and data. Main points include the following:

- Observe actual items and symptoms on the spot.
- Show the observed results in data.
- Think about causes and effects while separating the two.
- Prioritize.
- Pay attention to variability when assessing the situation.
- Stratify and analyze data completely.

4.1.2 Planning and implementation of SGA (Small Group Activities)

(1) Administration of Small Groups and solving Energy Conservation problems
(2) Formation of Small Groups (belonging to the same section, having the same functional skill, depending on the individual problems, acting by fixed members, and so on)
(3) Definition of functions of each group member
(4) Setting the target and the annual program
(5) Preparation for Small Group meetings
(6) Administration of Small Group meetings
(7) Follow-up of Small Group meetings
(8) Summarizing lessons from problems tackled by Small Groups
(9) Reporting and presentation of the problems solved

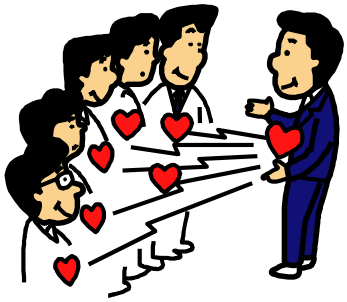
4.1.3 Activation of SGA (Attractive Small Group Activity)

Recognition of “Attractive” depends on where he/she stands.
For Leader/member, where they extend their ability is attractive.
On the other hand, Management expect to develop human recourses.
Manager must improve their workplace and make results.
Small Group Activity means the activity that is attractive for all interested party.

(1) SGA attractive for leaders and members

For Small Group leader/member, attractive Small Group Activity start from sense of accomplishment in what way it is. For instance, Some improvement “kaizen” that prove themselves and get recognition of superior, they will have incentive to challenge next.
For this, they start to master new Energy Conservation technology and skill.
Attractive Small Group Activity brings out their newly acquired skill, and it brings glad.

Key word
1, exertion of ability
2, achieve recognition
3, skill up



(2) SGA attractive for managers

Mission of Manager is achieving Energy Conservation Objectives and Targets that is deployed from Organization Policy.
For this, they need to continue improvement and management of their site.
In former years, Managing is the manager's job, and that employees are expected to follow the manager's instructions.
To achieve Energy Conservation mission, the participation of all people concerned -not only managers but also first-line workers- required.
The managers do not have a monopoly on managing; it is, rather, the job of all employees
Then What happens to the manager's roles?

Key word
1, mutual understanding of all members
2, enjoy accomplishments
3, Improvement and Management on an autonomous basis

(3) Small Group's sense of achievements

① Challenge
② Efforts
③ Reflection
④ Sense of achievements

(4) Function of managers to assure sense of achievements

① Motivation
② Guidance and support
③ Evaluation
④ Praising

(5) Importance of setting the target and the program

(6) Some problems observed in administration of SGA - Japanese top management

Function of management and managers

Difference between success company and troubled company expressed widely in Japan.

On the other hand, we know a company has made steady efforts and achieved V-shaped recovery.

What is the crisis between success case and troubled case?

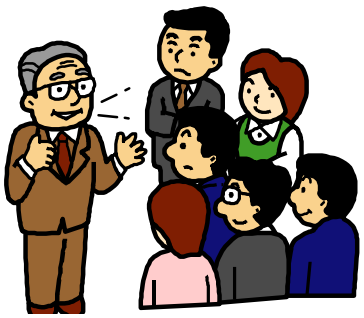
Top Managements from Some of Japanese Excellent Companies (eg: TOYOTA, HONDA, NISSAN, NEC, DENSO and so on) sometimes gather to discuss the topics about TQM.

After 2-days Discussion one of Group had presentation about the solution to Mannerism in QCC (Small Group Activity) in Japan.

Here are some of answers from experience in Japanese Companies.

<u>– Key factor for Effective Small Group Activity –</u>

(1) Top Management's leadership



*The more earnest to develop human resource, the more significant result Small Group Activity achieve.

*Top Management should ensure that Small Group Activity is introduced all division.

*Top Management should make clear target of Small Group Activity eg, human resource development, vitalization in workplace, contribution to an Organization's health.

*For Top Management, Participation to Presentation meeting is indispensable.

*Communication should carry out to communicate in workplace.

(2) Connection between Organization's Policy and Small Group Activity

*Theme deployment to have sense of urgency in Organization

*Positioning Small Group Activities in an Organization

*Results of Small Group Activities should be reflected to employee evaluation or career path program.

(3) Manager's positive measure

*Manager should regard seriously to develop Human resource.

*Not only "Presentation Meeting" but also "Counseling and Training Meeting" should be implemented.

*Manager should trust Small Group. Delegation of authority

(4) Continual and steady Education, Training

*Performance-based wage system without education and support needless pressure. It makes workplace dissatisfied

*Education of Problem solving procedure and Task achieving procedure is indispensable for all employees.

*Manager should make clear the competence of Small Group leader

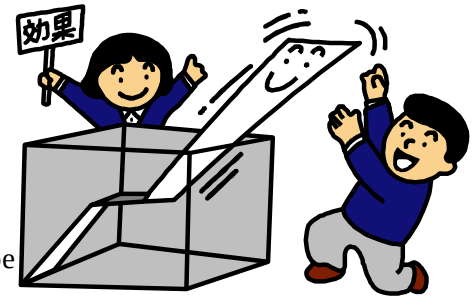
*Education to Small Group leaders to manage Small Groups (It includes bringing up next generation leaders)

*Framework of ISO9001 Quality Management system should be made use of evaluation for employees

(5) Sharing system of technical know-how

*Presentation is not Goal of activity. After presentation, Exchanging comments between Small Group and superior should be held.

*Small group's Improvement cases should be deployed to other workplace by Staffs and superior.



(6) Evaluation to Results

*Manager should feature the Evaluation that meets purpose of Small Group Activity

*Recognition should be decided with not only presentation but daily activity in workplace.

4.2 Method of Implementing Small Group Activities

In order to develop the Small Group Activities (SGA), the following basic method should be established in a company based on the philosophy of "Participation of All Employees" from top management through worker level.

1. Establishment of Infrastructure / Environment for SGA by management
   The employer or top management should provide the following with employees.
   (1) Announcement of policy to support SGA
   (2) Organization of a task force or a team to motivate and assist SGA
   (3) Establishment of management system of SGA in a company
   (4) Establishment of annual plan of action to proceed SGA in the company
   (5) Establishment of places and opportunities for guidance, presentation of activity results
   (6) Establishment of the award system for employees' contribution
   (7) Establishment of a reporting system from registration of a theme through results of activities
   (8) Establishment of a fair evaluation system
   (9) Establishment of technical supporting system including educational system for workers

2. Establishment of groups
   Consulting with a manager, workers should form groups for SGA. The size of a group depends upon the size of section or group and subject etc. It is very important that each group member shall have rolls to proceed activities under a group leader.

3. Setup of subject for activities
   Based on findings of problems / barrier to be improved, under consulting with a manager, each group will setup a subject for their activities. Basically, subjects as follows are not suitable for SGA.
   - Subject technically too difficult
   - Subject expected a long term for activities or manpower beyond a group size

4. Setup of basic duration of group activities for SGA
   Managers shall set up a basic period for SGA from setting up a subject through completing the report, in accordance with a basic business plan.
   Usually, one year or 6 months would be appropriate.

5. Setup of plan of action for each subject by an individual group
   Each group should setup a plan of action for activities.

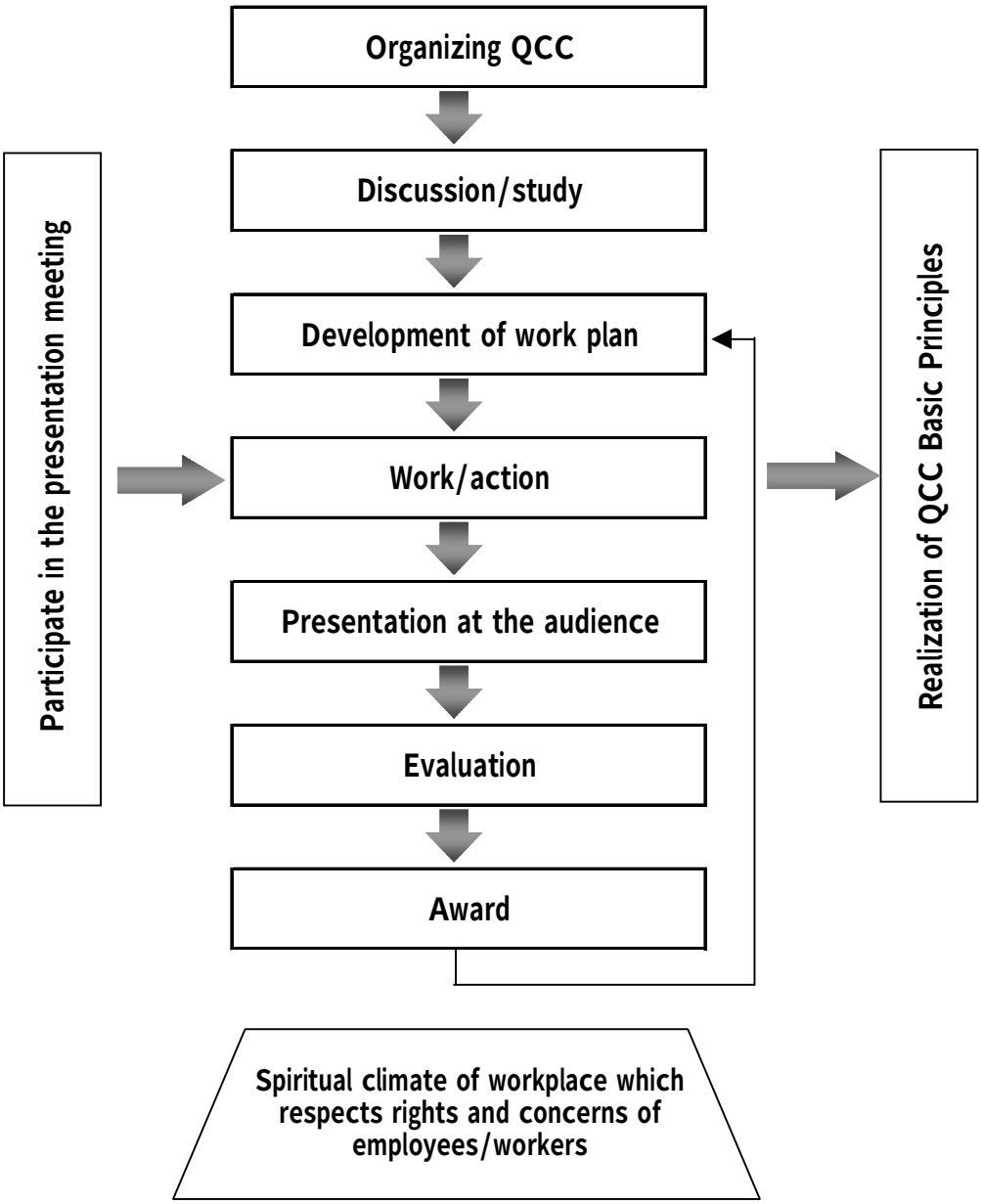


Fig II-4-1 : Circle Activities

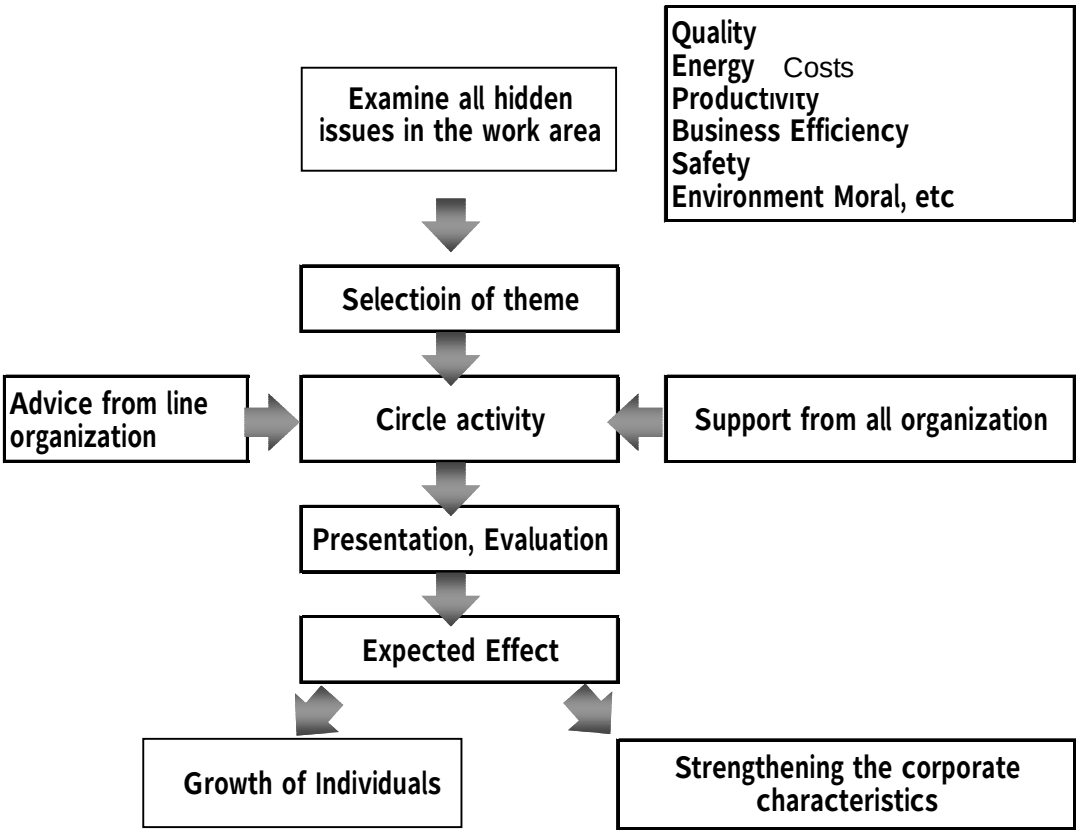


Fig II-4-2 : Outline of QCC (Quality Control Circle) Activities

6. Actual implementation of activities in accordance to the action plan

The actual activities by each group will be implemented in accordance with the basic sequence shown the following figures.

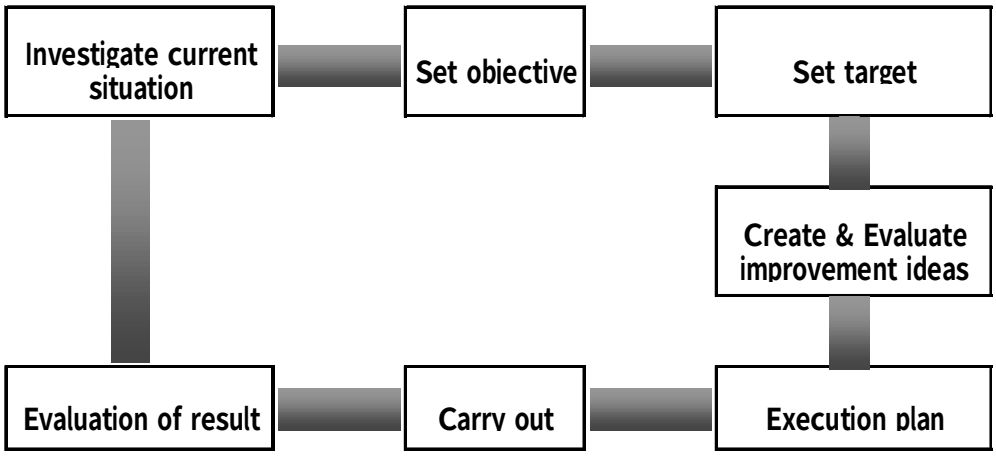


Fig. II-4-3 Basic procedure to Promote Energy Conservation Activities

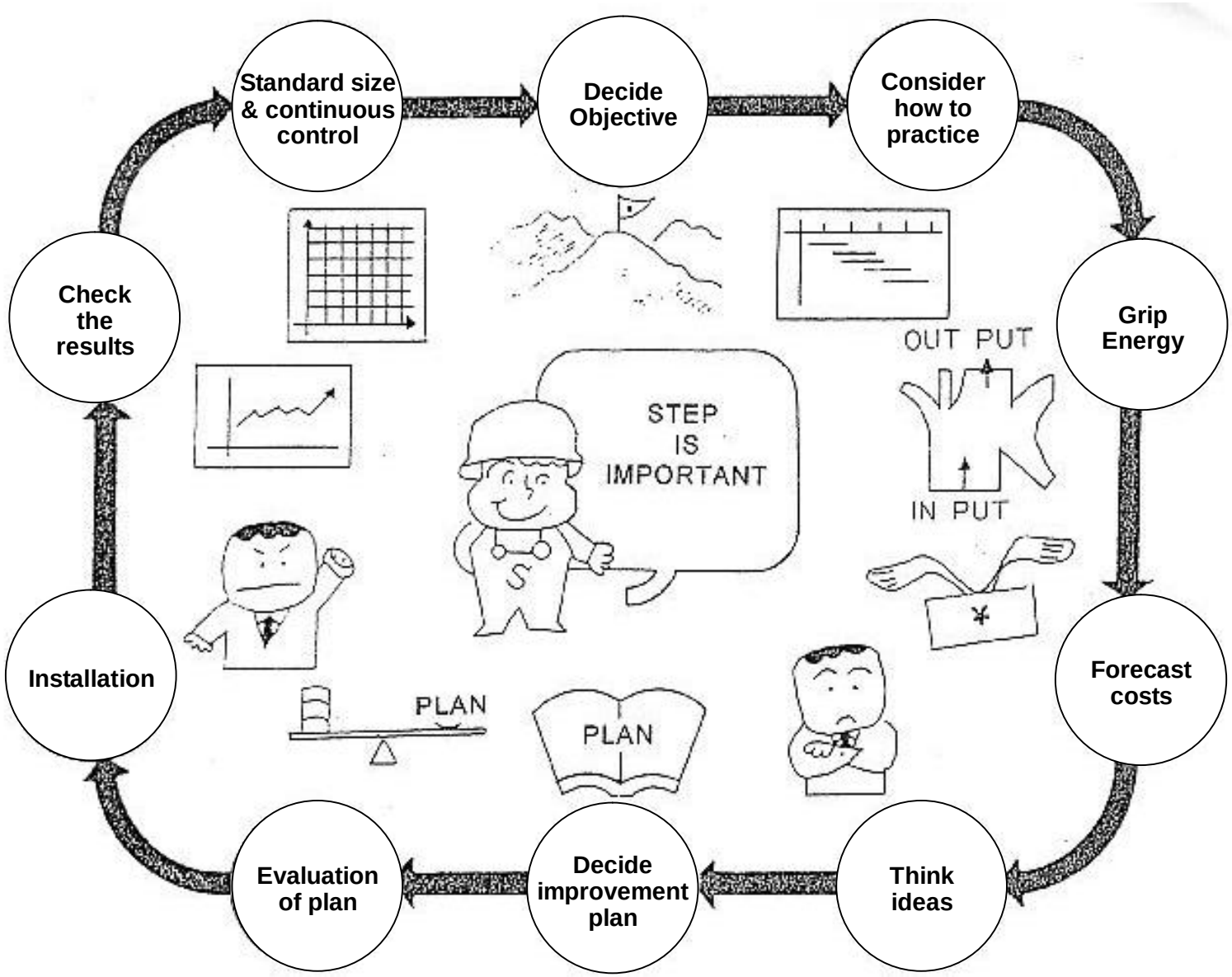


Fig II-4-4. Basic Procedure of Energy Conservation Activities

4.3 Examples of management tools

In this section some techniques or tools that might be useful to the Total Energy Management are summarized as follows :

(1) **5s** is a five basic activities required for increasing productivities i.e. **S**EIRI, **S**EITON, **S**EISO, **S**EIKETSU, and **S**HITSUKE

SEIRI Keeping the workplace in well-arranged conditions so that necessary items could be taken out easily when needed. This includes:
- Separate utilizing items from unused items
- - Eliminate the unused items and keep the utilizing ones

SEITON - Keeping the workplace in order so that it is also good to see and encourage people working there

SEISO - Cleaning the workplace to keep the comfortable conditions

SEIKETSU Maintaining the workplace to be clean and sanitary

SHITSUKE Building good habits and discipline of employees

(2) **7 Wastes of Lean** is a waste analysis process to minimize 7 wastes that would not make a profit to the company.

Deflects – Losses due to deflects of products
Overproduction – Losses due to over production
Transportation – Losses due to transportation system
Waiting – Losses due to waste of time in waiting
Inventory – Losses due to stocks of unnecessary materials
Motion – Losses due to movement
Processing – Losses due to inefficient processing

(3) **Activity – Based Costing (ABC)** is a technique to determine actual costs by activity focusing on competitive and profit making ability. The cost estimate would take into account all the costs incurred in the process including waiting cost, delivery waiting cost, reproducing cost, value engineering cost, quality management cost, etc.

(4) Checklist is a tool for inspection to ensure major steps or activities have been implemented and not forget.

(5) Control chart is one of the 7 QC tools used to control the items to be inspected to be under the area of acceptable range.

(6) 5 W and 1 H is a guideline for workers to follow the working procedure.

Who - Who is responsible
What - What is needed to do
Where - Where is the place to do

When - When is needed to do
Why - Why is needed to do
How - How to do

(7) Employee Suggestion System

This is a Japanese suggestion system that encourages the employees to participate in giving suggestion and getting rewards in return. The rewards are focused on quantity not valuable so that the chances to get rewards are high, resulting in getting many more people to participate.

(8) Lean Production System (LPS)

This system is to eliminate all kinds of wastes in the process but to focuses on value added to the process. This is a normal practice in the U.S. automobile industry which is comparable to the Toyota Production System in Japan.

(9) Pareto Chart (Please see "Seven QC Tools" below)

This is one of the 7 QC tools where main causes and miner causes of a problem are sequentially identified in graph from called Pareto Chart. This technique was developed by J.M. Juran in 1950 using a principle of Vilfredo Pareto, on economist in nineteen century.

(10) Plan – Do – Check – Act Cycle

This is a quality improvement cycle consisting of the following steps

① Plan properly
② Do according to the plan
③ Check what have done so far is corresponded with the plan
④ Act due to the evaluation of results

(11) Seven QC Tools

This a 7 basic QC tools used for analyzing work problems based on the data collected and to determine causes or roots of problems that would lead to the solutions for improvement. The tools include.

① Pareto chart
② Cause and effect diagram (Fishbone chart or Ishikawa diagram)
③ Check sheet
④ Histogram
⑤ Control chart
⑥ Scatter diagram
⑦ Graph

(12) Preventive Maintenance (PM)

This is a maintenance system to prevent a sudden interruption or shutdown of the machine during the operation, including installation of machines in right places and maintaining them in good conditions.

(13) Productive Maintenance

This is a set of maintenance systems used to prevent a sudden interruption or shutdown of machines during their operation taking into account efficiency and economic factors. The systems were developed to include.

- Breakdown maintenance
- Preventive maintenance
- Predictive maintenance

This methodology was developed to finally reach the stage of TPM. Please see (17) TPM.

(14) Six big losses

Six most important losses resulting from inefficiency of machines and process are investigated. These include

- Breakdown loss
- Setup and adjustment loss
- Minor stoppage loss
- Speed loss
- Quality defect and rework loss
- Yield loss

(15)Kaizen activities

This was originally developed at Toyota Motors Company in Japan, characterized by continuous improvements in many fields with full utilization of all the employees working at the company or factories. The method was adopted in many Japanese companies and gave very successful results. Also see (20)Toyota Production System.

(16)Six Sigma

This was originally developed at Motorola Company in USA, also characterized by continuous improvements in many fields with full utilization of all the employees working at the company or factories. The method was adopted later in GE and many other US companies and gave very successful results. In the development stage, many good points of Japanese way of improvements were introduced and utilized.

(17) Total Productive Management (TPM)

This is a small group activities (SGA)- based management system that encourage teams set up in all level of the organization working together to find out problems and solutions for work improvement.

(18)Total Quality Control (TQC)

This means the Company-wide QC, namely QC activities conducted all over the company.

(19) Total Quality Management (TQM)

This is a total quality management conducted by a group of QC experts in an organization.

(20) Toyota Production System (TPS)

This is a production system developed by Toyota Motors Company in Japan. The system would focus on eliminating losses that affect to the production cost and quality of products would be guarantied for each processing step.

(21) Why – Why analysis

This is a problem analysis based on why question until ending with no why question.

4.4 Staff Training

4.4.1 Introduction

Training is the key to staying on track for energy conservation. It is management responsibility to ensure that technical and operating personnel are trained to operate the equipment safely and in a proper manner. Effective training is not accomplished in a single whirlwind session that once completed, may be quickly forgotten. Training must be through and continuous to help not only to inform but also to change attitudes.
Top management must give proper support to its Energy Committee, and to the Energy Manager in the form of training. Training allows the staff to explore new ideas, interchange them with experts and with other trainee participants, and feel more comfortable with the role they must fulfill. In turn, trained technical and management staff should be encouraged to provide in-house training to operating and lower level technical staff.

Staff training is the primary tool by which awareness is generated and knowledge is transmitted. As part of the Total Energy Management program, management needs to address two major areas for employee training:

(1) Training to develop new skills in technologies
- In-house Training
- Outside Training and study Tour
- Overseas Training

(2) Training to adopt new attitudes towards energy wastage and reduction of waste.

The introduction of new technologies, process equipment, operating and maintenance procedures and energy documentation methods requires training at many levels. There is a need to train new as well as experienced personnel in energy efficient operation of company facilities. The need for training in each should be reviewed periodically to assure that all new personnel are properly trained and to refresh the skills of existing personnel. The Staff training is typically at three levels:

- Management
- Engineering/Technical/Supervisory

- Operators.

And following topics are some guidelines to train all energy conservation staffs;

- Awareness on Energy conservation
- TPM and TQM concept
- Electric System
- Thermal System
- Production Process
- Reduction of Loss
- Maintenance
- Data Recording & Summary
- Report
- Evaluation
- etc.

Finally, the ultimate target of the energy conservation training are;

- We can never stop learning or training unless we stop working
- Creativity is not just a natural talent, it is also a skill that everyone can develop and learn more.

4.4.2 Developing steps of the training program, there are 6 steps as the following;

(1) Analysis for the training needs
(2) Develop the objective of the training
(3) Specify the matrix of the training
(4) Select the suitable training method
(5) Implementing the training
(6) Evaluate the training

(1) Analysis for the Training Needs
   - Concept
   - Objective
   - Target group
   - Contents
   - Trainer
   - Plan
   - Venue and equipment

(2) Develop the objective of the training
   - The right and concise objective of the training is an important for the training on energy conservation.
   - The good objective will be a good guideline for the trainers on developing the

matrix and a training method.

- The objective of the training will guide to the trainees what they should learn and acknowledge after the training.

(3) Specify the matrix of the training

- Matrix of the training must cover and reflect everything that the trainees have to know.
- A clear matrix will help specifying duration for the training.

(4) Select the suitable training method

- Presentation
- Case Studies
- Practice Cases
- Workshop
- Discussion
- Demonstration
- Coaching
- On the job training

(5) Implementing the training

- Prepare venue (classroom, theater, U – shape, I – shape, etc.)
- Prepare training documents (copies, bags, files, etc.)
- Prepare coffee breaks and meals
- Confirm participants, (Top management, trainers, trainees, etc.)
- Prepare evaluation forms
- Prepare training equipments (computers, notebooks, calculators, whiteboard, flipchart, pen, etc.)
- Prepare certificates

(6) Evaluate the training

- For the content and matrix (relevant or none)
- For the method of the training
- For the objective (support to the requirement or not)
- For the trainers
- For the acknowledge or benefit (progress or none)
- For the venue and facilities of the training
- For the Outcome (After Training in some duration to follow up)

4.4.3 Management Training

Sufficient awareness should exist in management to treat energy as a resource that needs to be managed. All too often, managers looking to increase company profits concentrate on increasing production and not on reducing costs. Through training and information

management can not only acquire the insight into efficient energy utilization but also provide guidance, motivation and encouragement to the company staff. In this manual an outline for a comprehensive energy management strategy has been presented. A number of courses are now being offered by public and private sector companies to train people in energy management.

4.4.4 Engineers and Supervisors Training

In most industries and building facilities, engineers, higher-level technicians and supervisors are the on-line decision-makers, accountable to the senior level managers. They are usually the most interested and willing, as well as the most capable of understanding the technical (as well as the managerial) concepts of energy conservation.

It is important to consider broader training for technical personnel, even across disciplines. For example, a mechanical engineer could well be sent to participate in an electrical energy seminar, since much of the mechanical equipment he operates and maintains uses electricity. Similarly, a boiler operator may be sent to a course in steam systems efficiency: boiler room steam may be used for fuel preheating, condensate returns to the boiler, steam may be used for feed water preheating, and so on.

Technical staffs have the major role to play in operator training, and therefore need to be trained first.

Training technical-level staff will not only help ensure training of the operators and workers, but also encourage this staff to prepare and present interesting and cost-effective energy conservation proposals to the senior management.
It is important to note that from a personnel development policy, training is an extremely significant activity. Most companies know that the best future managers are those with the widest experience and broadest perspectives. At the same time, the technical staffs themselves know that training is important, they desire to learn more, and also see training as a strong motivational factor in their work.

4.4.5 Operator Training

The operator generally decides how he will operate the facility to accomplish the ends set by or for him. His decisions or ability have a most direct influence on savings or costs. Depending on the operators' skill, an investment in education and training can produce the greatest benefit rate of all. Poorly skilled, careless, or incompetent operators will degrade benefits. Competency is needed and must be produced by training and retraining.

They have learnt their skills by on-the-job training over several years. Short seminars or workshops in operating specific equipment more efficiently need to be reinforced by

supervisors to ensure that training given during the short courses or workshops is fully absorbed by the operating personnel.

The operator must also be made aware of the reasons for operating the equipment in a particular (energy efficient) manner. They must know the importance and use of the data they are required to collect. Energy conservation programs may not be successful if operators are not educated, kept informed, motivated and properly trained. They more than anyone, may determine success or failure.

4.4.6 Internal Training

For in-house courses or training programs, the same comments made in the preceding section apply. In these courses, company management has additional control that should be exercised. The course instructors are usually from within the company. Management should be careful in selecting these persons, for not everyone is good at training or teaching. In this case, evaluation of the courses, even if informal, is very important. While some persons may be better at classroom training and teaching, others may be much more effective at on-the-job or hands-on training programs. Management should be aware of the different capabilities of their staff, and assign them tasks accordingly. Following Table can be used for training record for each trainee.

No.	Training Topics	Trainee	Year 2008											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Awareness		Δ											
2				Δ										
3					Δ									

Chapter 5 Building Employee Awareness and Motivation

Why do people waste energy in their organization without cares? Listed below are some reasons.

- No concerns in energy cost
- No problems in energy supply and consumption
- Not their duties to save energy
- Daily work load make no time to think about energy savings
- No energy saving policy from top management

Top management or energy manager have to find out how to motivate their people to and owner give cooperation in energy savings, taking into consideration environmental and ecological impact, decreasing in energy reserves, and rising in energy price.

Motivation of people to save energy is a challenge job of an energy manager. And, it is his opportunity to be accepted by the top management if successful.

Principle of motivation

- Allow participation in decisions making
- Let they know problems and reasons
- Admire their work results
- Believe in their responsibilities
- Rewarding when success

Characteristics of energy manager to support motivation of people

- Affable
- Admirable
- Amusing
- Ambitions
- Alert
- Active
- Accessible
- Articulate
- Appreciative
- Accepted

Strategies of motivation

- Understanding in objective and requirement of employee
- To be a good example on energy savings
- Set up a challenge and possible target in energy savings
- Opened mind to listen to anyone's opinion and ready to give them an advice
- Give simple, clear and interesting explanation

- Admire people in any chances

How to get cooperation from the 1st meeting

- Show strong self and team's confidence in success on energy savings
- Make relax meeting atmosphere and allow every one to participate
- Give comprehensive information and gook plan
- Find out what key factors that influence their decision in giving cooperation and try to response to their requirements
- If raising a question and nobody respond, wait until getting an answer, do not self answer

Two ways Communication

- Two ways Communication make understanding and cooperation
- Two ways communications is made for not only motivation but also request
- Two ways communication leads to common understanding and target
- Two ways communication is made for not only data monitoring but also return comments and suggestion

To be successful energy manager should demand not only for data but also for comments of participations. His task is not only to set up a target and plan, announce and request others to follow. Instead, he should persuade all the people concerned to participate in making action plan, make comments and implement according to the plan.

Building morale and encouragement

- Ask what they think or know about energy losses and how to improve
- Agree on objective, target and results of energy audit
- Give incentives, rewards to any responses

Good practices for building awareness and motivation

- Top management paid strong attention to energy conservation, set up and announce energy conservation policy
- Top management support energy conservation team and activities
- Top management gives incentives, rewards or admire to individual or team who succeed in energy conservation projects
- Continuation of energy conservation activities
- Follow up the projects and announce results of energy conservation to all employee
- Make good understanding and coordination among the people concerned
- Try to get participation from all the people concerned in every steps i.e. suggestion, making decision, implementation, follow up and evaluation
- Inform all the key staff of the organization about energy losses and convince them the benefit of energy saving policy. This would draw attention of the remaining staff to participate

- Working group consisting of representatives from each division should encourage and support their staff to implement energy saving measures
- At the end of every mouth there would be an evaluation energy consumption and energy saved in comparison with that of the past
- Maintain common understandings and prevent from watching mistakes to each other. Instead, follow up of results of implementation should be conducted
- The former employee should be a good example of energy saver for the new comer
- In order to get strong support working group should collect energy saving results and report to the management
- Organize in house training by utilizing inside and outside qualified speakers
- Campaign or connect use of electrical equipment
- PR of energy consumption data and energy savings by posting on a board or through local boast casting
- Organize and energy conservation week with various activities e-g, seminars, exhibitions, contest etc.

Chapter 6 Evaluation of Total Energy Management

6.1 General

After SGA and other methods such as TQM or TPM are applied in the Total Energy Management (TEM), evaluation of TEM implementation is essential and needed. In the evaluation the following aspects should be taken into consideration:

(1) Policy of TEM
(2) Results of implementation
(3) Comparison of the results with KPI (Key Performance Index)

6.2 Preparation of evaluation form

In order to achieve the objectives given in the policy it is essential to evaluate the results of TEM implementation. An evaluation tool capable of monitoring the results is thus designed as given in Table 5.1. There should be three levels of evaluation as follows:

(1) Self evaluation – This is an internal evaluation conducted by staff within a section or work unit in every month.

(2) Section Manager Evaluation – This is an evaluation conducted by a section manager or a division manager who takes care of that section in every three months in order to intensity the evaluation.

(3) Top Management Evaluation – This is an evaluation conductial by a top management. The evaluation results obtained will be used for personnel evaluation i.e. for annual increment of staff salary or giving bonus.

Table 6.1 Example of evaluation form

TEM Evaluation Form

Level of Evaluation	Self	Section	Top management

Section :	
Unit :	
Due Date :	
Evaluation Date :	

Name of Evaluater :			
Total rating		Pass	Fail
Passing Criteria			
Self		Section mgr	Top Management
90%		85%	80%

Topics / Place	Items to be evaluated	Rating 4	3	2	1	Suggestion
1. Policy and Plan	1.1 Is there any PR activities?					
Objective	- Posting policy on PR boards and explain to all employees					
	1.2 Is there any action plan according to the policy?					
	- Action plan is made acoording to the policy					
	1.3 Is there any inspections and reviews of improvement measures?					
	- Follow up of the measures implemented					
2. Implementation	2.1 Record of gasoline filled in cars					
	2.2 Record of destination and milages					
	2.3 Record of A/C operation in working area					
	2.4 Setup room temperature between 25 - 28 °C					
	2.5 Reduce number of heat sources in the room					
	2.6 Prevent outside air flowing into the room					
	2.7 Turn off A/C in the unoccupied rooms					
	2.8 Prevent direct sun light penatrating the rooms					
	2.9 Install individual switchs for lighting in specific areas					
	2.10 Cleaning light bulbs every month					
3. Report of results	3.1 Display of energy consumption data					
Target & KPI	3.2 Reduce electricity consumption by 10 %					
	3.3 Reduce oil consumption by 10 %					
Definition of Rating	4 = Able to reduce energy consumption by 10 % or more					
	3 = Able to reduce energy consumption by 7.5 % but < 10 %					
	2 = Able to reduce energy consumption by 5 % but < 7.5 %					
	1 = Able to reduce energy consumption by 2.5 % but < 5 %					
Total rating						

Other suggestions :

6.3 Key Performance Index for Personnel Evaluation

In evaluating the TEM activities or other activities of the company, Key Performance Index (KPI), which may differ depending on the company/factory, is a very excellent indication. To motivate people and get good participation or cooperation, it may be a good way to use the results of evaluation to apply to Human Resources Management. In other words, personnel evaluation at the activities can be used for annual increment of salary or giving bonus in all staff level e.g., factory manager, department manager, section manager, supervisor and operating staff.

Weighting in each KPI would depend on the company policy and/or agreement in each organization.

Part III

Implementation of Energy Conservation Projects

Chapter 1 Procedures of Energy Audit

1.1 Introduction

In order to effectively promote energy conservation activities key steps approach is needed to apply. This is presented in more details in this Chapter.

In implementation of any energy conservation projects energy audit should be firstly conducted in order to determine the present energy situation and problems which would lead to the identification of improvement measures. And the data collected can be used as a reference throughout the project duration.

Energy audit could be conducted by using outside consultant or internal technical staff. One of the main objectives of this handbook is to guide the user how to conduct self energy audit without relying on outside consultants.

1.2 Purposes of Energy Audit

Energy audit is implemented for following purposes;

- Find realistic energy savings
- Create important information, new ideas
- Define cost effective project
- Prepare action plans
- Develop staff training programs

1.3 Main Stages of Energy Audit

Energy audit includes seven important stages which are seen below;

- Data collection and analysis
- Site investigations
- Conduct cost/benefit analysis
- Prepare a concise report
- Present the result to management
- Action plan for project implementation
- Follow up monitoring to prove results

(1) Data collection and Analysis

Following data below are collected and analyzed;

- Historical information on utilities unit consumption. (Energy intensity)

(toe/ton-product)
- Comparison with standard/Industrial best, average.
- Production data for industrial plants to find out operation improvement opportunities.
- Cost (tariff) analysis.

The data can be collected in an efficient way with the comprehensive form of questionnaire or information format. This kind of form can be used both in the case of internal energy audit and outside consultants' audit.

Actual energy consumption in terms of fuel, electricity and water, etc. can be obtained either through:
- Measurement
- Calculation; or
- Heat and material balances.

The best way is through measurement. This may not always be possible due to poor metering or the measuring point may not be inaccessible.
Detailed explanation is made in latter part.

(2) Site Investigations

Procedures of Site Investigation normally includes following stages;
- Find major energy users.
- Conduct site tests.
  (Conducting measurement and test works in the factory in order to collect all data on energy consumption and energy efficiency.)
- Install energy monitoring where required to assess opportunities and to identify energy waste.
- Discuss operations with site personnel, often they will know the energy use problems.

In order to conduct site investigations and site tests, the measuring instruments as shown below are necessary.
- Portable data logger to monitor energy use with analog and digital signals input capability.
- Digital thermometer, Infrared thermometer, Thermo-Hygrometer.
- Clip-on power meter, current meter, power factor meter, Demand profile meter.
- Combustion analyzer, O_2 analyzer.
- Ultrasonic flow meter, Ultrasonic leak checker etc.

In order to facilitate determining energy saving potentials, two major opportunities, Fuel saving and Electricity saving are considered;

Fuel Saving;

- Enhancement of heat insulation
- Combustion improvement.
- Waste heat recovery.
- Reduction of waste heat.
- Efficiency increase in energy use.

Electricity Saving;

- Electricity demand control to reduce electricity costs.
- Power factor correction to reduce electrical demand and improve electrical distribution capacity.
- Reduce compressed air waste by minimizing air leaks, and isolation valves.
- Variable speed drives for fans and pumps to reduce energy loss due to valve throttling.
- Pump impeller trimming.
- Lighting replacement for more efficient lamps.
- Lighting control.

By well-prepared consideration of the operation and schedule management, energy saving becomes possible.

- **Good Housekeeping (As first priority).**
- Re-scheduling operations to occur during low cost energy period.
- Reducing rework or production wastes.
- Maintaining equipment correctly and promptly.
- Reducing delay times between processes particularly those involving heating/cooling.
- Improving control systems to ensure production quality targets are maintained.
- Improving the process; and
- Installing new technology.

The management would consider the simple low cost improvements first and only think about new equipment after all other improvements have been undertaken. Cheapest and easiest measures to implement should be first implemented.

(3) Cost and Benefits Analysis when conducting Feasibility study on energy saving projects, cost and benefits analysis are essential;

- Assess both technical and economical feasibility.
- Obtain supplier information and budget pricing as required.
- Process monitoring to assess saving potential.

- Use company financial evaluation criteria.
- Calculate return on investment, payback.

As next step, it is necessary to prepare the Strategy for implementation. In general, **no-cost or low-cost measures should be, of course, implemented first.**

To consider Priority of the energy conservation projects, one can grade the potential projects under the following headings:

Title	Cost	Expected annual saving	Payback (years)	Effort required (man days)	Proposed start date	Outside help needed (Y/N)

Detailed Analysis of Energy Conservation Potentialities or Measures:

A typical energy study report has to include all energy conservation opportunities, potential energy saving measures which could be obtained from opportunities, and an efficient summary table which shows an analysis of investment costs of these opportunities. A good report also has to include an analysis and detailed description of every measures in order to make the best possible information available for the management and thus to allow the management of the company to make appropriate decisions on the implementation. In addition to the possible risks analysis which is importance in the project implementation, the equipment expenditures has to be estimated with high accuracy as well.

(4) Preparation of concise report

After following works,

- Collection of basic energy consumption and production data, and determination of specific energy consumption where available,
- Conducting measurement and test works in the factory in order to collect all data on energy consumption and energy efficiency
- Calculation of energy balance and energy efficiency for the important equipment and processes in the factory;

a concise feasibility report must be prepared to express outline of project and feasibility and to convince their management.

Report must generally include following item;

- List of areas in need of improvement with priority Background information on the Plant
- Energy usage, details of energy consumption in machinery and equipment

(including Evaluation of problems in gathering data and Necessity of installation of meters and proper maintenance)
- Concrete measures to address the improvement plan (Assessment of energy saving potentials of various measures)
- Proposal with expected benefit and investment and Evaluation of past energy conservation investments.
- Action plan for implementation.
- Evaluation of staff involved in energy production and use, and Staff training plan.
- Developing implementation plan, providing necessary guidance on project implementation.
- Conclusions and recommendations

Appendices shall include
- Details of the energy analysis.
- List of members.

As shown on the above, a good report also should present recommendations on energy conservation and, besides it should also specify the implementation order of these recommendations at the same time. In addition, the report should include some information about how the implementation will be conducted, who will be responsible for implementation and how long will the implementation take.

(5) Staff Training.

Staff training in Energy audit is important object. Through Energy audit, staffs are educated and trained. Training of staffs is conducted in various stages:
- On-going training while doing the audit.
- Energy awareness training through presentations and meetings
- Energy conservation training for staff.
- Technology updates for engineers.

Detailed explanation on staff training is stated in the latter parts.

(6) Presentation of the results to management

To persuade a company management, several considerations may be taken as follows;
- Persuasive Information to management.
- Pilot or demonstration projects to prove concept.
- Outside assistance
- Examples of energy savings achieved by similar industries.

As the management and managers who are the decision-makers, you must convince them that the projects are viable.

(7) Action Plan for Project Implementation

Determination of the energy conservation potentialities that require capital investment specification of the equipment which are subject to replacement, quality improvement and the additional equipment to be provided; and recommendation regarding those equipment. In addition, calculation of the cash equivalent of the energy to be saved and the cost of investment. New equipment to be provided should be taken into account in following points:

- Equipment specifications.
- Specific instructions.
- Financial assistance available.
- Budget requirement.
- Seek examples of similar projects as a reference.

(8) Follow up monitoring to prove results

Implemented projects are evaluated in following viewpoints;

- Typical annual savings from projects with paybacks between 0 to 3 years.
- Staff energy awareness is improved.
- Improved knowledge of process operations leads to reduce energy wastes.
- Specific actions are defined to improve energy use.
- Increased awareness of energy costs leads to more management focus on energy use and improved energy conservation.

Chapter 2 Measurement Procedures

2.1 Introduction

Usually, the most important part of an energy audit study is the achieving of the accurate mass and energy balances for the whole factory (or plant) and / or for the equipments which are operated in different sections of the plant. Without these data, it is almost impossible to conduct the quantitative analysis which determines the value and the volume of the energy conservation potential.

Based on the experiences, in most cases, the necessary instrumentation which are to be used in order to calculate mass and energy balance is not sufficient sometimes in the plants. In addition to this situation, even if some instruments are existing, the accuracy levels of them are often not clear. In this situation, usage of the portable instruments is the most useful in the energy audit study. Thus, the basic data can be obtained and the accuracy of the fixed instruments can be confirmed.

The measurements which should be made the most frequently in the plant are as follows:

- Temperatures (ambient, different flows, surfaces, etc.)
- Volume or flow speed of the gas, liquid and solid substances.
- Pressures (including the vacuum and draft in the furnaces)
- Temperature and component in the flue gases (oxygen, carbon-monoxide, etc.)
- Relative humidity (in order to determine the quantity of water steam which is contained in the air that enters and exit the dryers)
- Electrical energy (Voltage, Current, Power factor)
- Luminous intensity
- Linear speed and revolution speed on the motors and connected rotating equipments.
- Conductivity of different waters (boiler feed water, blow-down, condensate, fresh water, etc.)

The portable instruments should not be considered as a replacement for the fixed instruments which are periodically checked and calibrated and used in order for the plant to be operated under control and at optimum capacity. However, when the fixed instruments are not available, the majority of the data which is mentioned above can be collected by using portable instruments.

The physical data that is related to the steam, thermal fluids and fuels and material which is processed or produced, are also necessary in order to achieve energy and material balances. The data which is frequently used in the audit calculations are; the specific heat, enthalpies, calorific value of fuel, densities and the heat transfer coefficients. In most cases, the data can be obtained from the reference books (for example from steam

tables) and usually it is not necessary to obtain the data by trial method.

2.2 Energy metering

Energy metering can lead to improved equipment management & greater industrial competition.

(1) Measurement of different parameters and control of process flow for:
- determining breakdown of energy use,
- calculating equipment efficiencies, and
- tracking the evolution of production ratios.

(2) Energy management for:
- identifying the cause of increased energy use,
- optimizing the control of production process,
- choosing the energy with least cost at all times,
- assuring quality of production.

(3) Continuous follow-up leading to:
- greater reliability and safety of equipment,
- increased life of equipment
- improved working conditions,
- reduction in pollution emission

(4) Better knowledge of the above data helps:
- to justify investments related to energy management and calculate the benefits,
- to motivate the personnel by introducing means for measuring the efficiency of his/her activities.

Win Through Energy Monitoring

Know	Manage
→ Breakdown of energy use → Efficiencies of equipment → Production ratios	→ Share of energy cost in production → Equipment performance evolution → Choice of appropriate energy → Improvement in product quality
Train	**Win**
→ Personnel involvement → Optimize all options for equipment → Contribute to equipment reliability and safety → Improvement of maintenance and fine tuning of equipment/process	→ Reduce energy consumption → Improve productivity & quality → Greater competition

2.3 Energy Management Implications

Energy monitoring and follow-up help to measure the performance of production activities and introduce analytical elements for enterprise management, through:

- Reduction of energy and raw materials.
- Important role of energy in the management of enterprise.
- Provision of reliable and useful data for decision making.
- Improvement in the product quality.
- Sensitization of personnel to the energy problem.
- Preparation towards automatic facility in factories.

2.4 Approach to Energy Monitoring

Steps prior to the establishment of energy monitoring and management system:

- Assess status of existing measuring instrumentation.
- Specify the need for new measuring devices and define the points of their installation.
- Select well adapted data collection and processing equipment.
- Consult competent enterprises to assure satisfactory installation, maintenance and after-sale support.
- Propose a well designed training program for operators.

Chapter 3 Data Collection and Analysis (Data Collection Standard Form)

After the information in the questionnaire form (A sample form is attached here) which has been sent by the factory after being completed, is evaluated and after that, if necessary, a member of the team which is to conduct energy conservation survey, pays a visit to the factory in order to determine the size of the factory to have a visual understanding of the departments of the factory and to determine the necessary portable test devices which are to be used in survey areas. In addition, the locations in which the test devices are to be installed during the energy conservation survey, and the factory staff is asked to establish connection parts (Flue gas measuring hole, suitable connection parts for electrical connection). Furthermore, more detailed information regarding the parts which are not clear in the questionnaire form is demanded and preparation of information about the process is required.

The most convenient date is decided by examining the work schedule of the factory in cooperation with the factory staff. Duration of the factory survey, which is to be conducted, are determined by such factors as results of diagnosis, the need for devices and the departments of the factory to be examined.
The collected data and information shall be properly compiled in a standardized database. The database is for in-house use for analyses and monitoring so as to maintain or improve energy efficiency.

In order to systematically manage and control all the data and information required for analyses and monitoring, it is necessary to prepare the database for in-house use, or "In-house Database".

ATTACHMENT 1

Form 1/13

ENERGY AUDIT PRELIMINARY INFORMATION FORM	
A. INFORMATION REGARDING FACILITY:	
Date:	
Name of the factory:	Industrial sector:
Address:	Telephone: Fax:
Person who completes the form:	Title:
Operation starting date of the factory:	
No. of employees:	No. of Shifts:
B. AREA OF ACTIVITY:	
Please list main production activities and equipments which consume big amount of energy and the important auxiliary systems. Please specify the energy production and consumption amounts on the basis of units.	

C. ENERGY USAGE

Please complete the following table with the previous year's values.
Please attach photocopies of all electric and fuel bills.

Year: .....

Energy Type	Amount of consumption	Unit	Unit cost	Annual cost
Electric				
Natural gas				
LPG				
Gas oil				
Light Fuel oil				
Heavy Fuel oil				
Petrol coke				
Hard coal				
Lignite				
Other				
Other				

The monthly consumption values and monthly average unit prices of the fuels of which the types and annual consumption values are given in this table are to be printed in the tables in the following pages based on the same year.
Please print the fuel types and their consumption units (ton / month, kg / month, kWh / month, etc.) in the given blanks.

A. PRODUCTION DATA

Complete the following table with the previous year's values.

Year: .....

Type of product	Amount of production	Unit

The monthly production values of the products of which the types and annual production values are given in this table are to be printed in the tables in the following pages based on the same year.

C-1	..... YEAR CONSUMPTION VALUES			
	CONSUMPTIONS			
	ELECTRICITY		.....	
MONTHS	Consumption unit ..... / month	Unit price $ /.....	Consumption unit ..... / month	Unit price $ / .....
JANUARY				
FEBRUARY				
MARCH				
APRIL				
MAY				
JUNE				
JULY				
AUGUST				
SEPTEMBER				
OCTOBER				
NOVEMBER				
DECEMBER				
TOTAL				
Calorific value		Kcal/kWh	Calorific value	

Note : Please print the type, consumption unit (ton / month, kg / month, kWh / month etc.), monthly average unit price ($ / ton, $ / kg) of fuel which is consumed and then fill out the related columns according to this data.

: Please print the calorific value of the consumed fuel including its unit (kcal/kg, kcal / Nm^3, kcal / ton etc.) if known.

C-2	..... YEAR CONSUMPTION VALUES			
	CONSUMPTIONS			
	..FUEL.....		.....	
MONTHS	Consumption unit ..... / month	Unit price $ /.....	Consumption unit ..... / month	Unit price $ / .....
JANUARY				
FEBRUARY				
MARCH				
APRIL				
MAY				
JUNE				
JULY				
AUGUST				
SEPTEMBER				
OCTOBER				
NOVEMBER				
DECEMBER				
TOTAL				
Calorific value			Calorific value	

Note : Please print the type, consumption unit (ton / month, kg / month, kWh / month etc.), monthly average unit price ($ / ton, $ / kg) of fuel which is consumed and then fill out the related columns according to this data.

: Please print the calorific value of the consumed fuel including its unit (kcal / kg, kcal / Nm^3, kcal / ton etc.) if known.

: In case this table is not sufficient please copy it.

D-1	..... YEAR CONSUMPTION VALUES		
	PRODUCTIONS		
	Name of product	Name of product	Name of product .....
MONTHS	Production unit	Production unit	Production unit .....
JANUARY			
FEBRUARY			
MARCH			
APRIL			
MAY			
JUNE			
JULY			
AUGUST			
SEPTEMBER			
OCTOBER			
NOVEMBER			
DECEMBER			
TOTAL			

Design Capacity			

Note : Please print the type of product, and then print the related production value and production unit in the corresponding column.

: If it is possible to use different production units for the same type of product, please specify the correlation between these units (For example, it is possible to use m^2 and ton as units in square flagstone production.
In that case, specify the correlation as;

1 m^2 (flagstone) = 1 ton (flagstone)

: In case this table is not sufficient please copy it.

: Print the annual or monthly planned production capacity in the related column by specifying the unit (ton / month, ton / year)

E. MISCELLANEOUS SUBJECTS

Please express your comments on the following subjects.

Problems related to the control of environmental pollution:

Possible process changes:

Maximum grace periods which can be accepted for the investments:

F. ENERGY MANAGEMENT

Is there an energy management program in your factory ?:

If yes, since when ?:

Is an energy manager assigned ?:

If yes, how long has he been working ?:

Is there any effort in order to Increase the Energy Efficiency, and to Decrease the Energy Consumption ?:

Are energy consumption and production values examined in terms of energy efficiency ?:

Are specific energy values etc., calculated ?:

Are these results checked in terms of problems and causes ?:

What are your other comments ?:

G. BOILERS

No. of boilers in the facility

Boiler No.	Capacity	Unit [1]	Production [2]	Pressure	Temperature
1					
2					
3					
4					
5					
6					

[1] Ton / h, Kcal / h, m^2, please specify the type of heating surface
[2] Specify as steam, hot oil etc.
Is flue gas analysis made in the boilers? :
If yes, how often? :
Are the necessary regulations made in the boilers? :
Is the analyzer fixed type or portable? :
Type of the flue gas analyzer (Electronic etc.) :
Results of the flue gas analysis: Fill out following table

	Date	Date	Date	Date
Unit				
T_{gas}				
$T_{atmosphere}$				
O_2				
CO				
(*)				
Fuel characteristics				
Type				
H_{high}				
H_{low}				
C				
H_2				
H_2O				
O_2				
N_2				
S				
Ash				
Results of Slag Analysis (**), if necessary.				
Grate discharge temperature °C				
Un-burnt carbon rate %				

(*) : The other parameters (SO_2, NOX, etc.) that the device is capable of measuring may be written.
(**) : Please fill out only in case solid fuel is used
Note : Please attach the unit prices of the fuels which have been purchased lately and send the form.

H. ELECTRIC ENERGY USAGE		
Of the existing power transformers:		
Operation voltage (KV)	Installed power (KVA)	Power usage rate (Derived power / installed power)
..... /		
..... /		
..... /		
..... /		
Please print the amount of electric energy consumption according to the area of consumption.		
Manufacturing		
Lighting		
Heating and Ventilation		
Other (specify)		
Purchased electric energy		

☐ Electric tariff

What is the contracted electric power? :

The peak power range of electric energy: ..... kW (min. power) - .....kW (max. power)

Is charge management implemented in your factory? : ☐ Yes ☐ No

Is there a charge management system in your factory? : ☐ Yes ☐ No

Power factor value (Cos φ) :

Type of compensation :

☐ Single compensation unit ☐ Independent compensation unit

Are the static patching circuits applied to electric motors?

☐ Yes ☐ No

Are variable speed control units applied to the pumps and fans?

☐ Yes ☐ No

Please specify the usage percentages of the lighting armatures in the factory		
Type of armature	Usage percentage	Place of usage
Glow filament armatures		
Fluorescent armatures		
Compact fluorescent armatures		
Low pressure- High pressure Sodium vapor armatures		
Mercury vapor armatures		
Other (specify)		
Other (specify)		

How is the lighting control done in the factory?

.....% Armature manual control

.....% Armature automatic control

Is electric energy produced in the factory? ☐ Yes ☐ No

Please specify the type of facility that you use for electricity production

☐ Steam turbine ☐ Piston

☐ Gas turbine ☐ Other (specify)

☐ Combination of gas turbine and steam turbine

What is the total amount / installed power of the electric energy that is produced?

.....KVA / ..... KWh / year

I. FIXED MEASUREMENT DEVICES IN THE FACTORY

Water Meters:

Places of usage

a) Factory ..... pieces

b) other building (specify)..... pieces

Electricity Meters

Places of usage

a) Factory ..... pieces

b) other (specify)..... pieces

Steam Meters

Places of usage

a) Boiler house..... pieces b) other (specify).....Pieces

J. PORTABLE MEASUREMENT DEVICES IN THE FACTORY
☐ Flue gas analyzer ☐ Thermometer and its props (including infrared demometer) ☐ Conduct meter ☐ Watt meter ☐ Ammeter ☐ Lux meter (Light) ☐ Hygrometer (Humidity) ☐ Tachometer (Rotating speed) ☐ Recorder ☐ Thermographic camera (Temperature Indicator) ☐ Ultrasonic liquid flow meter ☐ Manometer (Pressure drop) ☐ Steam trap test device ☐ Dissolved oxygen meter ☐ Sound analyzer ☐ Other (specify)

K. Compressor Types and Compressed Air Systems

Type of Compressor:

Brand of Compressor:

Capacity of Compressor:.....(m^3/minute)

Annual operation period of the compressor: .....(hour / year)

Compressor outlet pressure: .....(bar)

Air pressure needed in at the final usage point:.....(bar)

Pressure loss along the line: .....(bar)

No. of similar compressors:.....

How is the cooling done: ☐ With air ☐ With water ☐ With oil

Cooling (water, air, oil) inlet temperature: .....°C

Cooling (water, air, oil) outlet temperature: .....°C

Power which is used by the compressor at full load: .....kW, ...hour / month

Power which is used by the compressor at No - load: .....kW, ...hour / month

Is there any compressed air dryer:

Type of the dryer: ☐ Cooling ☐ Adsorption

Compressor control system: ☐ Modulating ☐ On /off load ☐ Start / stop

Is the compressor working connected to a successive (sequential) system? :

From which direction does the compressor get inlet air (suction air) ?:

Where does the compressor get inlet air? :

What is the type of compressed air line? : ☐ Single line ☐ Ring line ☐ Other

Is there any test for air leakage? : ☐ Yes ☐ No

If yes, how often? : ☐ Weekly ☐ Monthly ☐ Other

Is there any waste heat recovery system? : .....

Where is the energy recovered from waste heat, used? :

☐ Boiler feed water pre - heating ☐ Field heating ☐ Bathroom, kitchen

☐ Other (specify) .....

Note: Please copy this form and fill the copies out for each of the existing compressors.

L. OTHER INFORMATION

Please attach the following information to this form if possible;

1. Factory settlement plan
2. Brief description of process
3. Basic flow chart
4. Detailed information regarding auxiliary facilities (boilers, turbines, air compressors, waste cleaning, cooling towers, water supply, cooling units)
5. Distribution lines chart (steam, water, gas, air)
6. Electric energy single line and distribution charts

Total area of the factory	m^2	Heating time
Total heating area *	m^2	Month / year
Total heating volume *	m^3	Month / year
Total air conditioning area	m^2	Month / year
Total air conditioning volume	m^3	Month / year

* Excluding the air conditioning area

J. WORKING PERIODS OF THE MAIN SECTIONS

	Working Periods	
NAME OF THE SECTION	hour / day	day / year
Boiler House		

Hour / day : Working period of the section per day (in hours)

Day / year : Working period of the section per year (in days)

M. AREA OF WORK

Please specify the units of the factory to be worked in

How long should the working period be? :

Convenient dates for work :

B. EXAMPLE OF THE AREA OF ACTIVITY

Raw material preparation	4500 kg / hour steam	10 hour / day
	325 kW electricity	10 hour / day
Chemical reactors	3200 kg / hour steam	16 hour / day
Product separation	2500 kg / hour steam	24 hour / day
Boilers with 3 - 8 bars	10800 kg / hour steam	24 hour / day
	815 kg / hour Fuel oil	24 hour / day
Air compressors	225 kW	24 hour / day
Office heating	4500 kg / hour steam	10 hour / day during winter

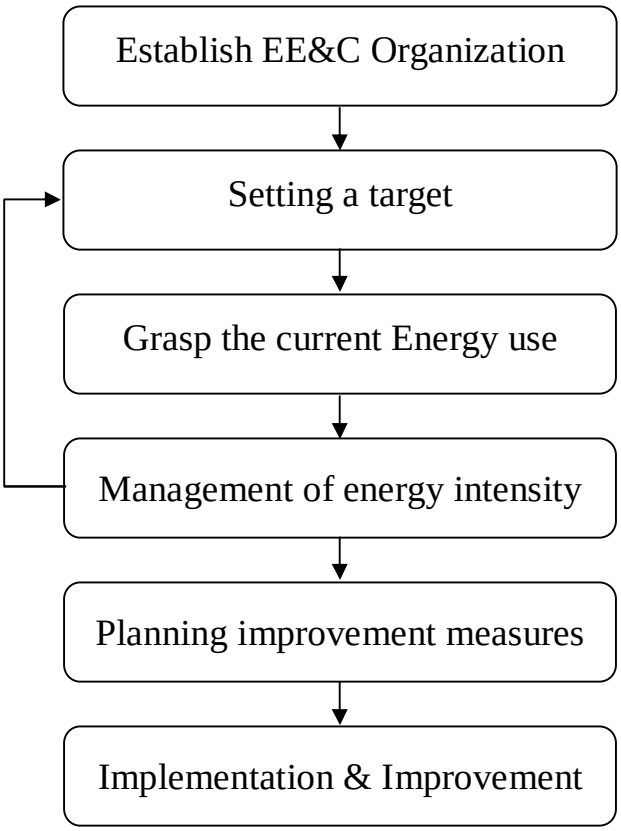
(In case the first page is not sufficient for the information regarding the area of activity, please use this page)

Chapter 4 Planning, Targeting and Benchmarking for Energy Conservation Projects

4.1 Promotion Procedures for Energy Saving Projects

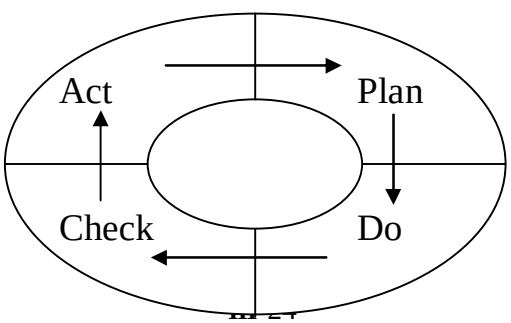
Through Energy Audit, the identification and evaluation of energy saving projects are implemented. Chapter 5 and 6, devoted to explanation of project planning and implementation, deal with key issues common to all kinds of projects. Accordingly, the contents of these chapters can be utilized not only in Energy Conservation projects but also in projects in other fields.

Following steps are taken for the promotion of energy conservation projects;



Grasp of the current Energy use and Management of energy intensity is a very important action. This action is followed by the goal setting/targeting.

In order to promote energy conservation in factories, “Plan - Do - Check - Action” cycle usually adopted which is in detail described in the previous part.



4.2 Setting Energy Conservation Goals and Targets

(1) Purposes of Setting Energy Saving Goals and Targets

Goals and targets are an important part of an energy conservation activity in factories. For an energy management program, this is of crucial importance. Performance improvement or energy savings targets are also a logical outcome of the energy accounting, monitoring, and analysis.

Targets are set for implementing changes and achieving the predicted energy cost savings. The targets can relate to the whole firm, to one site, to a production process, or even to a particular machine. A company may set a range of targets for different departments, taking into account the scope for improvement.
A goals program has a number of obvious and significant benefits:

- people are forced to plan ahead, and think concretely, because goals can only be achieved by implementation of specific projects.

- goals assign specific accountability to everyone, from the individual Energy Manager, right up to the top management, all of whose credibilities depend on achieving the goals

- goals serve as a standard against which progress can be measured.

- setting and evaluating goals elevates the energy issue to a higher level of awareness within the company.

Setting goals will not automatically produce results. A continuous process of monitoring, reviewing and evaluation is necessary to keep the goals visible and reachable.

In addition, some baseline data must be available in order to properly set reasonable goals. This must be data on energy consumption and production; it should be available for at least one, but preferably two or three years. Based on the variations in this data, energy consumption can be evaluated, and reasonable targets for reducing consumption can be set.

For the purpose of setting the targets, the most excellent and systematic way is to establish so-called “In-house database”. In ASEAN PROMEEC (Promotion of Energy Efficiency & Conservation) projects, it has been recommended for years to develop that database. By downloading and utilizing a prototype of standardized

database, a factory can internally accumulate and analyze the energy data, as explained in the above, for some years until they can establish their own "In-house database", which can be utilized to set the targets for the future. After the In-house database is established and utilized, then that can be shown to outside people, in a way of exchanging standardized data and information.

(2) Approach to Setting Goals or Targets

There are two principal methods of goal or target setting. First is the so-called 'top down' approach, a broadly based generalized technique that does not usually draw on a detailed analysis of the company's circumstances. Second is the 'bottom up' method, which is based on a close knowledge of the energy requirements of different parts of the firm's activities. Both systems have their merits and the method to be selected depends on circumstances and cost-effectiveness. The most firms are likely to prefer the 'bottom up' approach since it is, by its very nature, more closely tailored to company needs and hence more effective in providing motivation.

Even if the 'bottom up' approach is adopted, there can still be advantages for senior management to gather information on competitors' performance as reference for goal setting/targeting. This issue is related to the topic of "4.3 Benchmarking" discussed later.

(3) How to Set Targets in Factories

The questions for the Energy Committee and for the Energy Manager are how to set up goals and targets, and what is a logical numerical goal or target for a given Company? Goals should be attainable, yet still challenging. A number of possibilities or examples of the form targets can take are given below.

Absolute energy savings basis: Some companies may set the goal of providing an absolute reduction in the energy consumption. Common energy units, such as kWh, GJ, or Btu can be used for all the energy consumption; the goal is a percent reduction of the total energy consumption.

Monetary savings basis: In other companies, the goal may be simply the reduction of energy costs. For example, the goal would be to save a certain percentage of last year's energy bill. If the total energy cost the previous year were US$ 50,000 the company (the Energy Manager) would be expected, for example, to come up with projects that saved US$ 5,000:

Unit energy efficiency basis: A more common basis for setting an energy-saving goal is improvement in unit energy efficiency, or specific energy consumption. In this case, the company sets a goal of a certain percent reduction in the energy

required to manufacture a particular product; or in the amount of energy consumed at each processing or production unit within the factory. For example, if the unit consumption of a paper mill were 20.7 GJ/ton paper produced, a 5% improvement would set a goal of 19.7 GJ/ton. This presupposes that a good baseline measure of specific energy consumption is already available.

A good rule for setting goals is: start small. First year goals of 3 to 6% of energy consumption or specific energy consumption are quite adequate for most companies. In facilities where no attention has been paid to energy, or to maintenance, these savings will be extremely easy to achieve. In other cases, it may be more difficult. Another way may be to develop a target over several years; for example, set up a goal of 15% energy savings over 3 years. The yearly goals are usually better, however, as the reward can be seen sooner, success celebrated more often, and adjustments and corrections to goals can be made more frequently (especially if plant production changes).

4.3 Benchmarking

"Benchmarking" is a general term in the field of business administration or corporate management, meaning "gathering information on performance of others and compare" or "learn from others". By benchmarking themselves against others who are best in the field, companies can learn more efficient ways of operating. You can learn from the international players as well as the competitors in the Southeast Asia.
This concept was already referred to in "Part II, 2.5 Objectives and Targets". If you could get good Benchmarking figures, they might be utilized as reference for goal setting or targeting.

Though Benchmarking is an effective tool for performance comparison and improvement, it should be used in a very careful manner, because it requires all the detailed data and information on not only energy type and consumption but also on manufacturing or production processes. The latter includes information on raw materials, products (types and grades), processes and other related conditions. Inaccurate comparison not standing on the same basis would give the misleading results.

Accordingly, if you want to do the Benchmarking, that means you should get very detailed information from others, and you have to think about the issue of confidentiality. There would be cases of gathering detailed information from others as shown below:
- Industrial Association who gathers data from members by questionnaires
- Close relationship of top executives of companies in the same industry
- Seminars and/or conferences (not so detailed generally)
- Consultants who gather and disclose information based on multi-client contracts

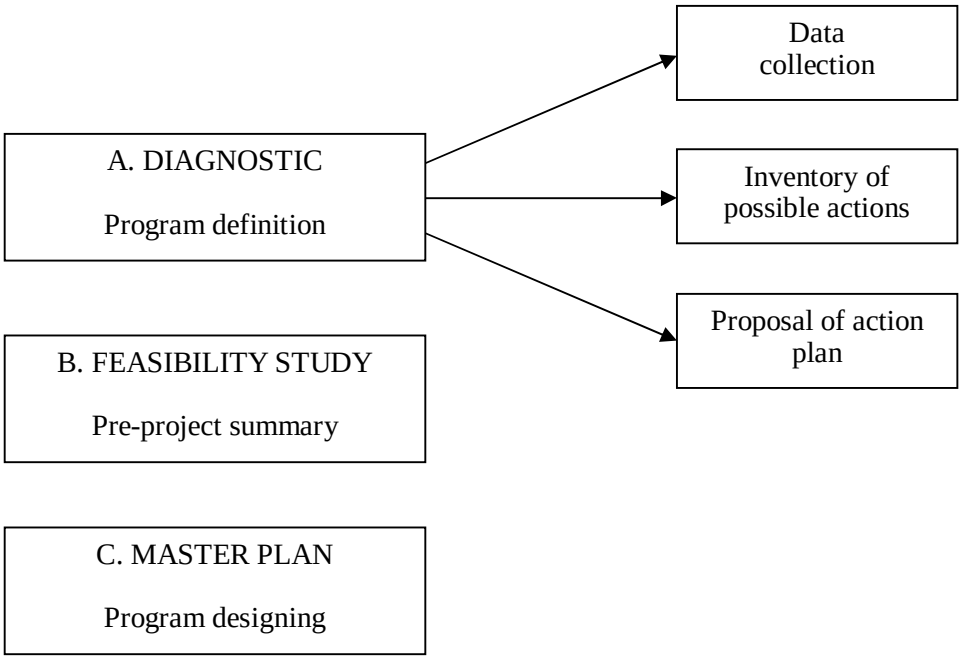
(Process licensors could sometimes be in this kind of position)
In any case, you will not disclose information unless you see the bigger merits in getting others' information. So it is important that the information is kept confidential only to be shared by the specific group members. In this relation, "Establishing Database" may be an excellent approach to serve the purpose. As stated in the previous item 4.2, the first step would be "In-house database". Then the database could be expanded and improved by information exchange with other companies, possibly including competitors depending upon the purpose, to establish the "Industry database" at a level of industrial association.

This Energy Management Handbook does not contain concrete Benchmarking figures for various kinds of industry for the above-mentioned reasons. As said in "Part I, 3.3 Future Shape after Expansion", it is expected that actual successful examples of applying the Handbook are put into the book in the future. Then the concrete figures will be accumulated in the Handbook covering various fields of industry, which will ultimately form the Benchmarking figures. Anyway that shall be also linked with the Database issue mentioned here.

Chapter 5 Project Implementation of Energy Conservation

5.1 Project Implementing Steps

(1) Energy Study

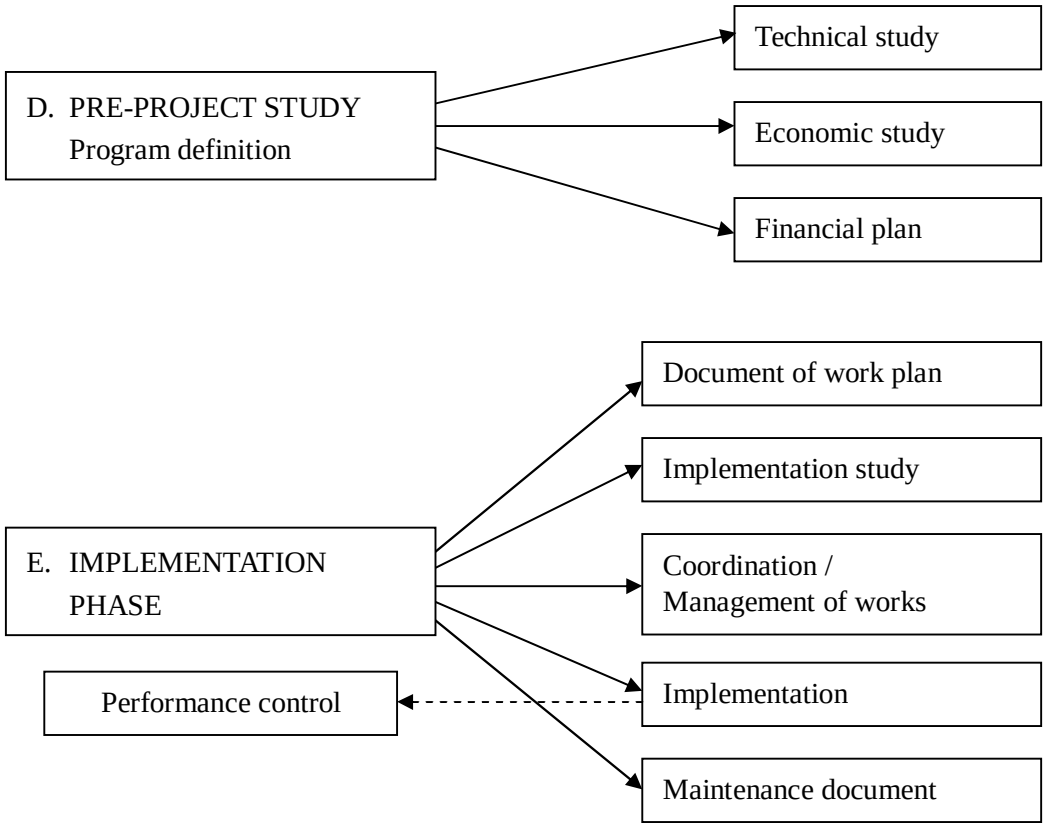


- Improved operation and greater competition are the main objectives of energy efficiency action.
- Industry should invest not only in efficient equipment and processes, but also on monitoring & management, maintenance, information & training as well.
- Investments should be defined and made according to a global energy policy, accounting for all parameters, existing and future, which influence decision making.

(2) Implementing Steps

Implementation of the energy survey recommendations is normally the responsibility of the energy manager, who, ideally, has participated in the energy survey and helped draw up the action plan. The low-cost maintenance and housekeeping measures should be implemented first, to begin capturing energy cost savings and improving efficiency. Higher capital cost measures may require more detailed feasibility studies to determine exact equipment specification and to detail the financial attractiveness. “Technical Directory”, now under development in the PROMEEC Projects, will greatly serve for the purpose of Technical Study. The energy manager’s role is to coordinate these projects, working with outside consultants, evaluating the

projects, and communicating to top management to ensure their continued commitment.

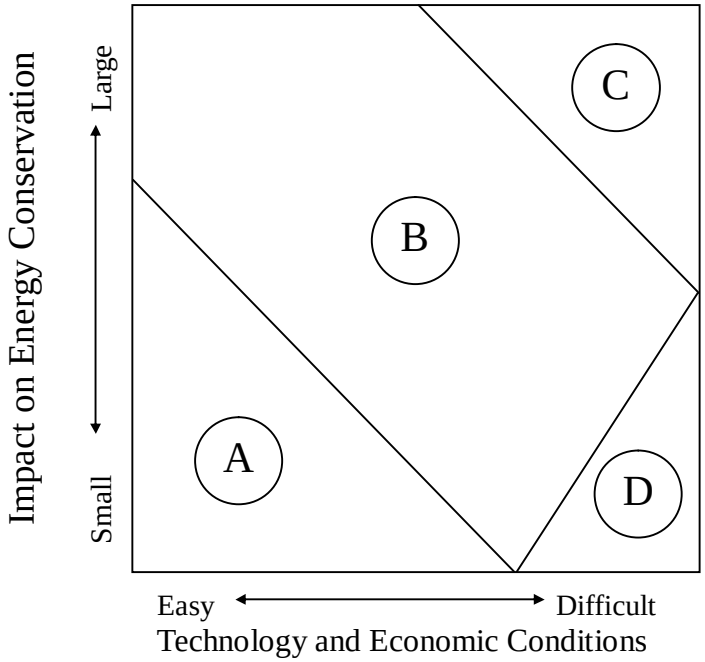


5.2 Project Implementation Scheduling

A realistic schedule should be drawn up for the various stages of the project implementation. This is an essential part of the feasibility study as the implementation of every project must be related to a time-scale. Such a schedule should initially define the various implementation stages, such as negotiation and contracting, project formulation, and actual construction and running-in, in terms of time required for each stage. The schedule should then lay down a time-programme that combines the various stages into a consistent pattern of activities that connect to one another. This comprehensive schedule should cover the entire phase, including the period between the investment decision and the end of the start-up stage of which the actual construction period is only one, although the most important, part.

5.3 Project Implementation Management

(1)Category of Candidate Projects



A: Little Investment, Technically Easy, and Small Return

B: Small Investment, Fair Return

C: Large Investment, Technically Difficult, and Large Return

D: Technically Difficult, but Small Return

(2)Priority by Small Groups, Managers and Project Teams

	Small-group Circle	Manager Group	Director Project Team
A	++	+	
B	+	++	+
C		+	++
D	x		

++ : First Priority

+ : Second Priority

x : Not Consider

When implementing a project, the company should first set up his own project implementation management team depending on its project largeness, technological difficulty, etc. shown previously. The efficient implementation of a project may depend considerably on the support services the counterpart team is able to furnish. This team should not only remain active during the implementation period, but should ideally form the nucleus of the managerial, technical and operational staff that is to be put in charge of operating the plant.

While the construction of civil works and infrastructure facilities is proceeding at the site, machinery and equipment may need to be inspected at various locations and to be dispatched.
The main critical stages during the implementation phase are the testing of equipment, trial production and commissioning of the plant. The trial production period is particularly crucial since it can only be initiated once the entire plant has been erected (if one disregards partial tests and trial runs performed during the stages of construction). There are several project implementation techniques and schedules available to facilitate this task.

Chapter 6 Evaluation of Energy Conservation Projects

6.1 Measurement and Verification of Results

(1) General

From a financial viewpoint, energy conservation can be achieved by two different approaches:

① Implementation of housekeeping and maintenance measures that improve efficiency of existing plant and equipment. Most can be done at low cost out of operating expenses.

② Investment in new plant and equipment.

All investment, whether for energy conservation or not, should be subject to a systematic process of capital appraisal with two goals in mind:

① to provide a basis for selection or rejection of projects by ranking them in order of profitability

② to ensure that investments are not made in projects that earn less than the cost of capital, which is frequently expressed as a minimum rate of return.

After implementation of the energy saving project, following item should be checked;

- Typical annual savings from projects with paybacks between 0 to 3 years.
- Staff energy awareness is improved.
- Improved knowledge of process operations leads to reduce energy wastes.
- Specific actions are defined to improve energy use.
- Increased awareness of energy costs leads to more management focus on energy use and improved energy conservation.

(2) Preparation of Project Evaluation Report

When carrying out the evaluation of capital investment in energy efficiency projects, the Energy Manager or consultant should keep the audience in mind. The evaluation report, or feasibility study should be addressed to the decision makers, who are general top managers in the facility. Investment appraisal by management should focus on discerning, from the many claims that will be made on scarce resources, those projects that will best meet the company's goals.

The Energy Manager should recognize three important considerations:

① The decision maker should be identified so that his needs can be satisfied.

② The form of the project evaluation report should also satisfy the decision maker. Company policy may dictate the use of a particular format, or the decision maker may prefer a one-page summary.

③ The report should state clearly and explicitly the following:
- why the project is being considered
- what the project is intended to achieve
- what the financial and other benefits should be.

6.2 Post Implementation Monitoring

It is vital to ensure the savings predicted are confirmed through adequate monitoring. Monitoring can be provided through a number of ways:
(1) Using in-built metering equipment supplied with any new technology.
(2) Purchasing additional meters and installing these during the project.
(3) Using portable meters to monitor the performance of the new system.
(4) Salvaging existing meters from the equipment to be replaced.

Evaluation of performance is done by regularly comparing actual levels of energy consumption with the expected energy use, as defined by a set of internally based standards that draw on past performance and reflect the particular and varying circumstances of individual energy-accountable centers. Differences between actual consumption and the standards will reveal either improvements in energy efficiency or a fall-off in performance levels.
In this way, the information produced by monitoring forms a basis for continuing performance evaluation and control. First, it will provide quantified evidence of exactly how successful measures to improve performance have been. Second, it will indicate if and where failures have occurred and trigger the necessary remedial action.

Allowance has to be made for the influence on energy consumption of “independent variables” such as output levels, product mix, raw material variations, rejection rates and weather conditions. Approximations both for standards and the corrections due to the relevant “independent variables” can be derived from a company’s own past records. The information can be refined as better records are collected.

Analysis should be a continuing process so that action can be taken speedily if energy efficiency deteriorates. To ensure effective performance evaluation and control, each line manager or plant operator must receive the energy, throughput, and other figures regularly (monthly in most plants, but on a weekly or a daily basis in large plants) and

promptly, so that departures from the standards can be quickly diagnosed and corrected. In turn, line managers themselves must ensure a rapid response to the information they receive. In this respect, well-designed reporting forms, expressed in readily understood energy cost terms, will be of great assistance.

6.3 Technology Assessment

After completion of energy saving projects, outcomes of projects should be reflected into manuals, standards or guidelines, for engineering, operation and maintenance.

(1) Engineering Design Standards

When designing new systems or retrofitting old systems, standard engineering design practices should be followed. Certainly, boilers are designed and installed according to the country's boiler code; pressure vessels are built to certain code specifications.

However, where codes do not apply, design standards are lax, and often cause energy waste. A few examples of poor design practices commonly evident are noted below:

① Steam and condensate Piping is a common example where engineering standards are not followed. Steam piping should be supported at regular intervals depending on its size; piping should be inclined to allow condensed steam to drain toward drip legs; drip legs and traps should be installed at regular intervals; piping should be properly sized for the steam flow. If these standards are not followed, steam will still be supplied to the process; however, piping will sag, causing steam leaks at flanges and connections, accumulations of condensate will cause water hammer, slowly destroying valves and even equipment.

② Condensate piping should be laid in trenches, not on the ground. It is simply not worth insulating piping that is laid on the ground. If laid in trenches, however, wastewater should not be allowed to flow in the same trenches.

③ Additional electrical connections to existing panels should be limited; heavy loads on existing wires cause both energy losses and deterioration of cable, as well as increased voltage drops to end use equipment.

④ Electric motors should be protected from dust, moisture, and dirt. If a motor burns out, and must be rewound, the consequent drop in efficiency is an additional energy cost to the company, not to mention lost production time due to motor burn-out.

A number of engineering standard practices which can also result in energy savings, directly or indirectly, are available to companies through their Energy Manager or engineering department.

(2) Operation and Maintenance Guidelines

Deterioration of equipment due to lack of maintenance, improper spares, or harsh environmental conditions are common sources of energy inefficiency.

Proper maintenance of equipment will extend equipment life and save energy. The energy manager, especially if he is from the maintenance department should help implement a proper preventive maintenance program throughout the plant. Equipment manufacturers' guidelines should be consulted, and used as the basis for the checking and maintenance of each piece of equipment.

(3) Energy Efficiency Standards

The highest level of engineering standards that a company can adopt relate to energy efficiency. Implementing these standards will also reap benefits such as extended equipment life and reduced maintenance costs. The Energy Manager can help organize and implement these standards. Examples of such standards are the following:

① **Operation and maintenance standards.**: consistent procedures are developed to ensure rapid maintenance when energy waste is involved; one example is to physically tag steam leaks, compressed air leaks, failed steam traps, or even un-insulated pipes until they are repaired.

② **Standard for monitoring:** a company can institute regular measurements and logging of these measurements for all parameters related to equipment energy consumption, or which can be signs of increased equipment energy use; examples include motor currents (amps) at given load, boiler or furnace stack temperatures, chilled water supply and return temperatures.

③ **Purchasing of similar equipment:** equipment is bought consistently from the same manufacturer, especially once that equipment has proven itself in plant operation; this allows better familiarity of operators and maintenance staff with the equipment, and results in better maintenance; also the stocking of spares is reduced; this applies especially to small and numerous equipment such as steam traps, steam valves and other steam accessories, electric motors, electric accessories, but can also be used to for larger equipment such as burners, boilers, compressors. Always, when buying new equipment, efficiencies and operating costs should be checked to ensure that the best equipment is purchased.

④ **Energy efficient design standards:** minimum level efficiency standards can be incorporated for light levels, insulation type and thickness.

⑤ **Equipment efficiency standards:** the company will purchase only equipment that meets certain minimum standards of efficiency; this can apply especially to electric motors, lamps and bulbs, burners, and even large equipment such as boilers.

While implementing all of these standards simultaneously is almost impossible, some or others may be easier for different companies, depending on their business or their energy consumption. As time goes on, and energy costs rise, all of these will become more important. Certainly, each company should be aware of the many tools and approaches at their disposition to improve energy efficiency throughout their operations.

6.4 Financial Evaluation

Smaller projects will normally be funded from internal sources. Larger projects may need external funding which may require consideration of several criteria such as:

- Amount of investment.
- Amount and period of loan.
- Current and expected future inflation rates.
- Asset of borrower.
- Lender's judgment of the risk involved, etc.

Criteria used for evaluating project feasibility:

- Simple payback period for low cost projects.
- Rate of return considers the benefits after the project has paid back.
- Net present value gives the real cost benefits of a project.
- Internal rate of return offers the most comprehensive comparator.

These methodologies are shown in many published books which are available in ASEAN countries.

Appendix – 1

1. Successful Examples of Energy Conservation by Small Group Activities in ASEAN countries
(Excellent Cases of Winners for ASEAN Award System of Best Practices in Energy Management for Industries and Buildings)

Refer to Website of ASEAN Centre for Energy (ACE)
http://www.aseanenergy.org/aeawards/energy_management/

The award system started in FY 2007. ACE has already coordinated the ASEAN Competitions of Best Practices of Energy Management from 2007 to 2010 covering both the industrial sector and buildings. The awarded cases are uploaded in the ACE Website.

2. Summary of Results of Introductory Use of TEM Handbook in Pioneer Factories in Thailand

3. Successful Example of Energy Conservation in a Japanese Factory (Utilization of QC Tools)

2. Summary of Results of Introductory Use of TEM Handbook in Pioneer Factories in Thailand
(Effects of Activities for Approximately 7 Months, in 2005)

Company	No. of Small Groups Established	No. of Suggestions	No. of EC Projects Implemented	Energy Saving		Total Savings (Baht)
				Electricity (kWh)	Heat	
A – Company Building Management	13	196	26	300,000	-	825,000
B – Company Food Processing	29	25	25	25,350	-	68,193
C – Company Electrical Appliance	5	30	12	117,696	-	318,954
D – Company Plastic	60 (TPM)	5 (TEM)	4	TOD-TOU + 76,000	-	1,900,000
E – Company Ink Fabrication	5	5	5	7,287	-	18,217
F – Company Ceramic	182 (QCC/TPM) 1 (TEM)	19 (TEM)	18	543,562	1,224,264* (Baht)	2,590,548
G – Company Cement	1	5	2	35,880	-	79,530
H - Company Pulp & Paper	63 (TPM) 7 (TEM)	28 (TEM)	11	9,203,000	28,050 ton (Steam)	35,339,600
I - Company Manufacturing Vehicle Engine	7	11	10	114,278	-	314,266
J – Company Textile	76	32	9	27,061	19,676 GJ (HFO, Coal)	4,147,652
Total				10,450,114		45,601,960

* Demand charge savings for natural gas purchased

TOD : Time of Day

TOU : Time of Use

TPM : Total Productivity Maintenance

QCC : QC (Quality Control) Circle

3. Successful Example of Energy Conservation in a Japanese Factory (Utilization of QC tools)

Application of Small Group Activities for the Management of Energy in Japan

Factory A made an inspection of their usage of energy. As a result, it was found that a lot of electric energy was consumed there, which led to a large emission of Carbon Dioxide (CO_2). The factory, therefore, implemented measures for the energy conservation based on the following policy.

1. Decrease the emission of CO_2
2. Reduce energy-related cost

For the efficient operation, the factory decided to implement small group activities as follows.

1. Setting up of Energy Conservation Committee

Energy Conservation Committee was set up in the factory. Improvement activity was divided into 2 parts as follows.

(1) Major section in improvement (New equipment): Parts production technology section (Die production or Temperature maintenance section) and secondary production technology section (parts assembly section). They have main roles in information analysis, planning for the measurement, improvement and implementation according to the plan.

(2) Minor improvement (Equipment that already exists): Technology section in the factory has the major role in information analysis, planning for the measurement, improvement and implementation according to the plan.

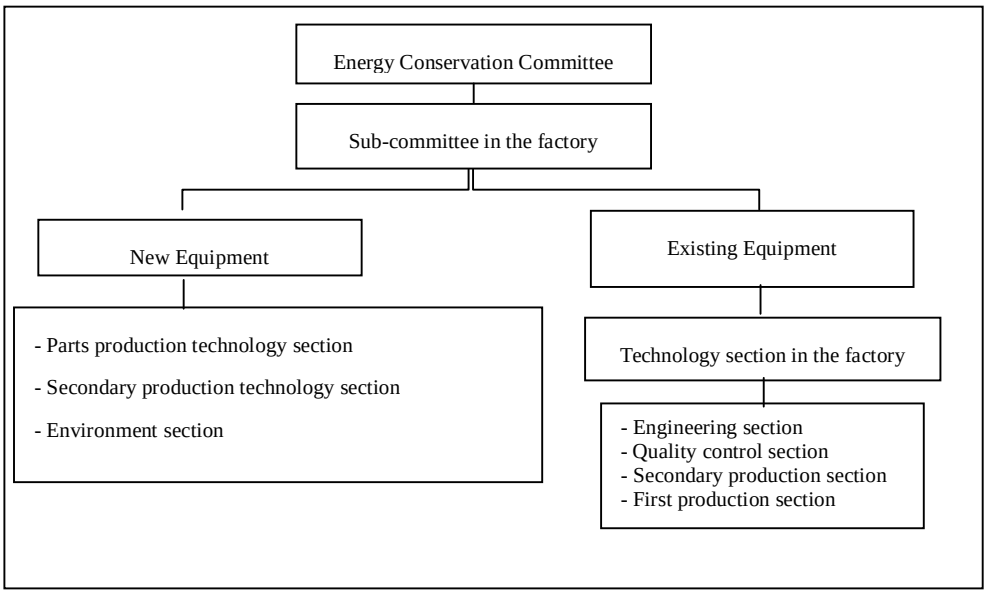


Figure A-1: Setting up of energy conservation committee

2. Meeting for the consultation or survey of problems and improvement measures

After setting up Energy Conservation Committee and assigning what should be implemented, a meeting was held for the consultation or examination of problems and improvement measures, in which information was gathered and analyzed on the energy usage in the factory and analysis was made on the energy usage in various equipment.

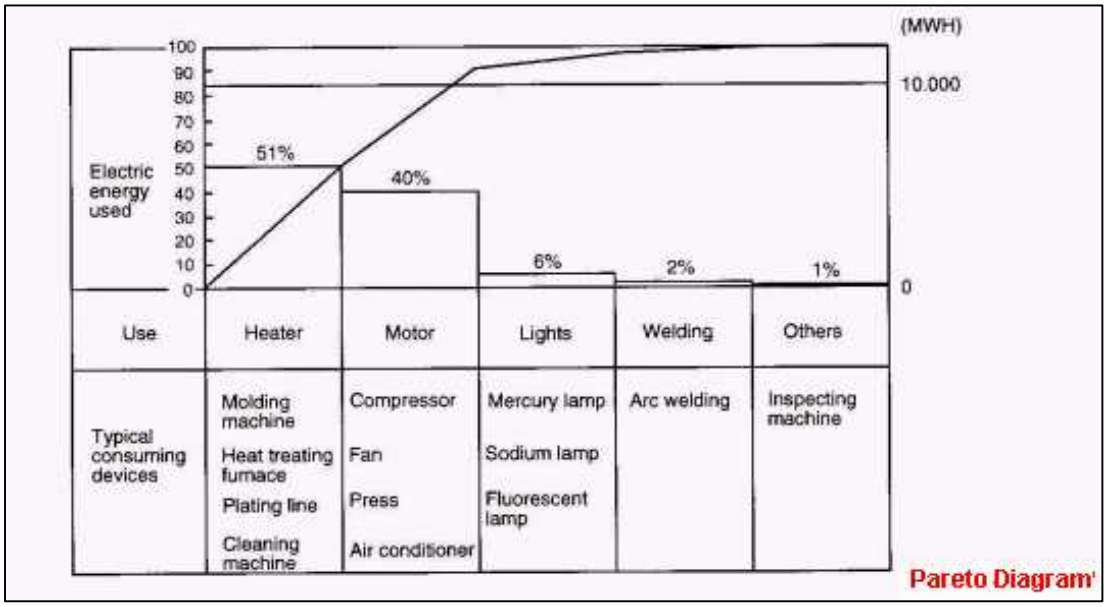


Figure A-2: Analysis of usage of electric energy in various equipment

As a result, it was found that equipment that is related to heat consumes energy that equals to 51% of all the energy consumption. From that we have checked various equipment related to heat (Table A-1) and found that heat treating furnace and plating equipment have high heater power capacity ratio. Especially, heat treating furnace had the highest heater power capacity ratio to electric power. This is why we have picked up heat treating furnace as the first equipment to make improvement.

Table A-1: Heater power capacity ratio in various equipment

Equipment	Types of Electricity Power*	Heater power capacity ratio	Order in Energy Conservation implementation
Furnace	A	32	**1**
Plating line	A	18	**2**
Cleaning machine	C	14	**3**
Molding machine	C	3.6	**4**

Remark*: A: Over 100 kW, B: 40~100 kW, C: 20~40 kW, D: Less than 20 kW (Per unit)

Therefore, the factory made a survey on the emission of CO_2 per mega calorie (Figure A-3) and the costs of various energy per mega calorie (Figure A-4).

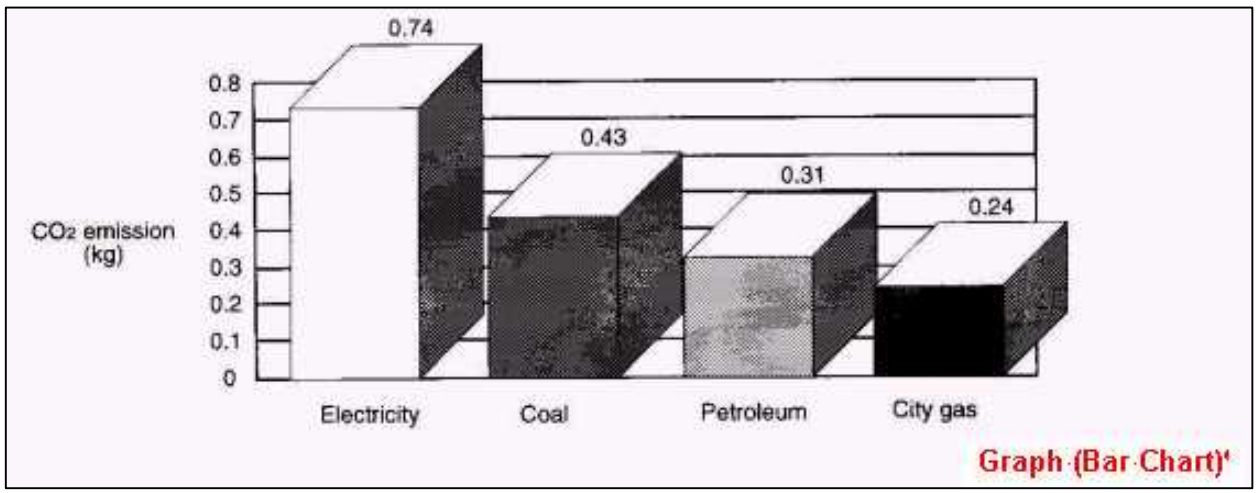


Figure A-3: Emission of CO_2 per mega calorie

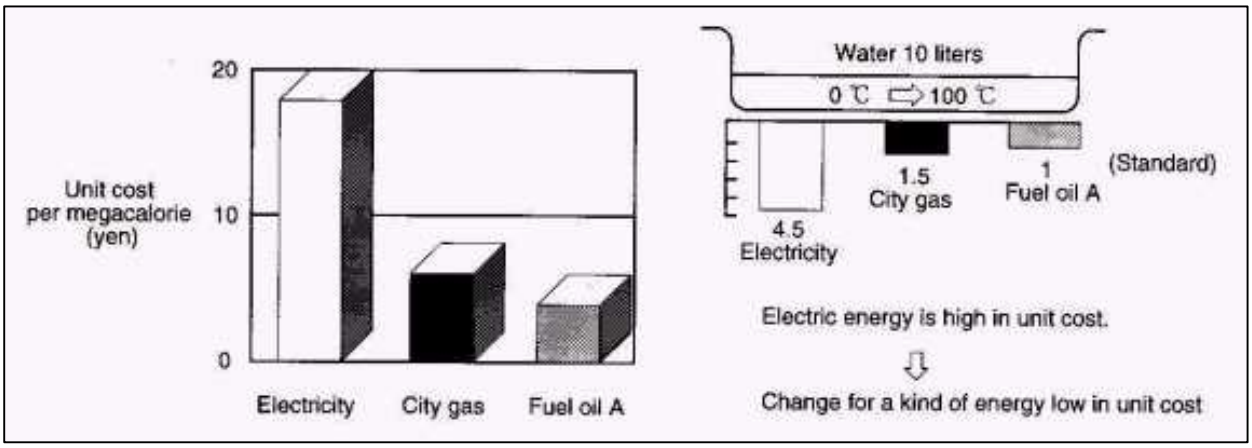


Figure A-4: Survey of costs per mega calorie for various types of energy

In considering changing the energy source, there are factors other than the emission of CO_2 per mega calorie and the costs of various energy per mega calorie that need to be considered such as; safety, operability, reliability and initial cost (Figure A-5).

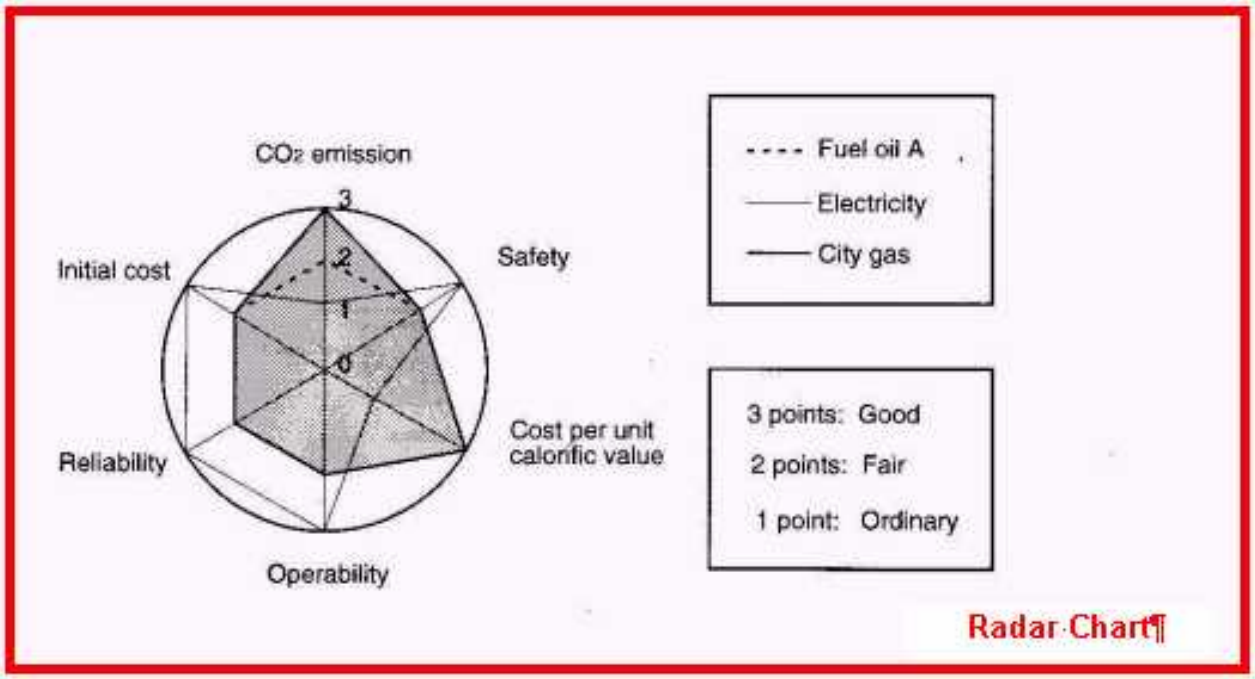


Figure A-5: Factors that need to be considered in choosing energy source

3. Planning

From considering factors that need to be taken into consideration in changing energy source, we came to the conclusion that we should change the energy source from electricity to gas in Furnace No. 1 and make an experiment in Furnace No. 2. From implementing these measures we found the following problems.

Problem 1: Gas furnace has higher rate of losing gas from the burning of gas and has lower efficiency than electric furnace.

Problem 2: Gas furnace has higher rate of heat radiation from walls and walls have higher temperature.

From the problems above, factory A made a plan to improve energy consumption efficiency from 48% to 59% (from 49,000 kilo calorie to 60,000 kilo calorie). Details are described as follows.

Objective 1: Reduce loss of gas from burning from 37% to 26% (from 38,000 kilo calorie to 27,000 kilo calorie)

Objective 2: Lower the wall temperature (from 90°C to 80°C)

4. Implementation of the plan

Problem 1: Gas furnace has higher rate of losing gas from the burning of gas and has lower efficiency than electric furnace.

This furnace uses gas and air as fuel and produces exhaust fume at a temperature of above 900°C. This gas is exhausted at about 500°C by transferring heat from the empty space inside cylinder pipes inside or outside of the furnace to the heat exchanger. By analyzing the cause, we found the following problems and the solution.

Problem: Hot area is small and the re-use of heat is limited.

Plan: Use a new burning head to change furnace to gas furnace
Implementation according to the plan: Furnace No. 1 was changed from electric furnace to gas furnace

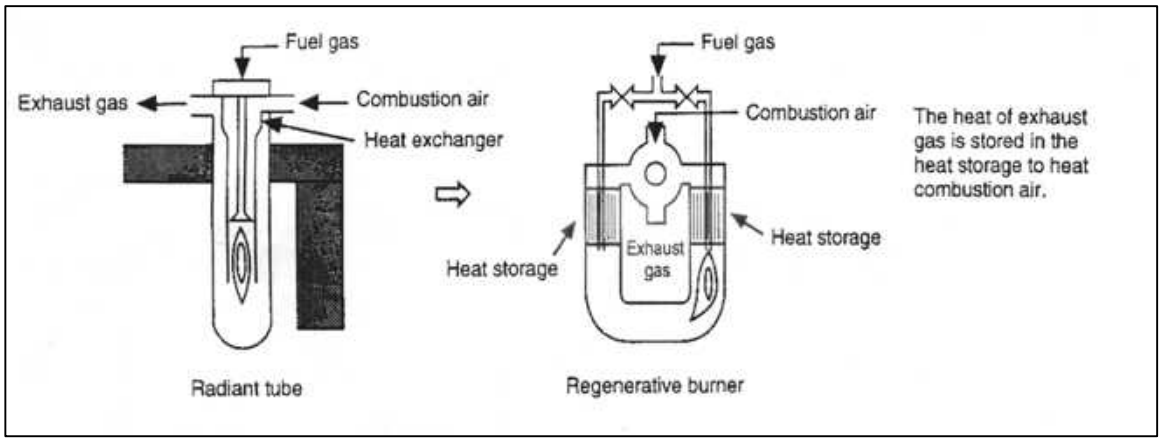
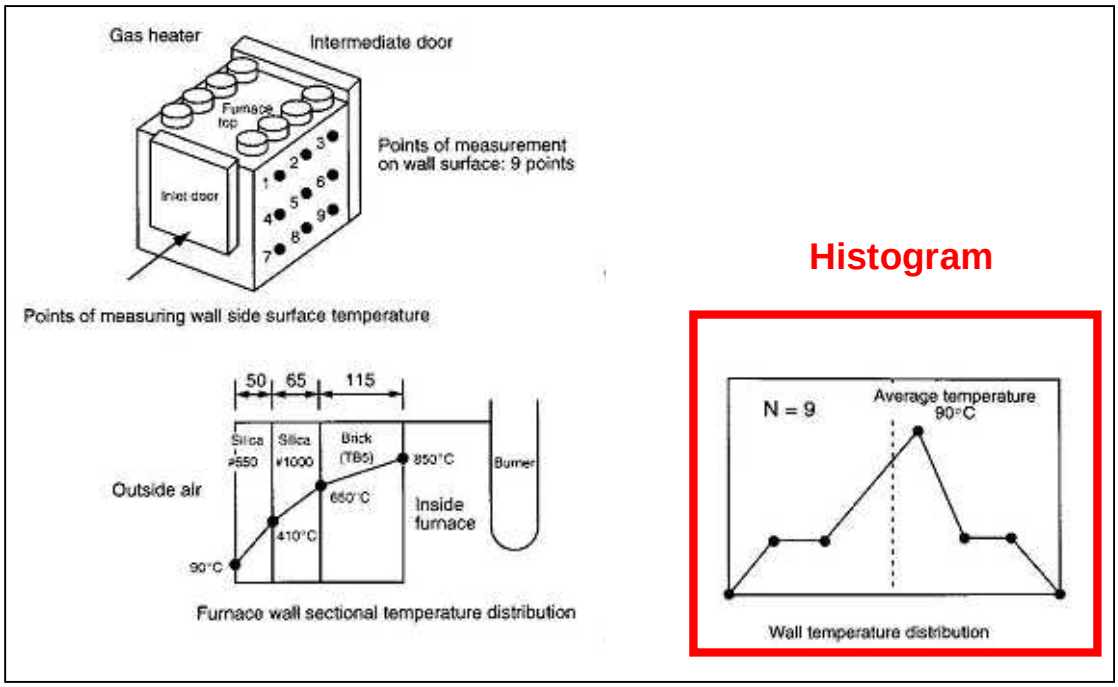


Figure A-6: Changing burning head from radiant tube to regenerative burner

Problem 2: Gas furnace has higher rate of heat radiation from walls and walls have higher temperature.

We measured the temperatures of Furnace No. 2 and made assumption about the distribution of heat in various points. As a result, we had the following findings.

- Average temperature of the wall was 90°C.
- Distribution of temperature in various points on the wall can be calculated by coefficient of heat resistance.



FigureA-7: Survey on the temperature of furnace wall

From the analysis of causes, we found out following problems and solutions.

Problem 2.1: Heat radiation causes cracks in bricks
Plan: Research the heat-resistant material and its thermal expansion and shrinkage according to temperature.
Implementation according to the plan: Uses the selected material for making bricks in furnace 1

	Material	Coefficient of heat resistance kcal/m,h,c	Cost	Workability	Heat resistance	Elasticity
Before	TB5	1．5	○	○	○	○
After	FLB	1．5	△	○	◎	◎

◎ Good
○ Fair
△ Ordinary

Evaluation Table

Figure A-8: Research on the materials that are heat resistance or that shrink according to temperature

Problem 2.2: Heat resistant board has low resistance to heat
Plan: Research the material that is highly resistant to heat

Implementation according to the plan: Used the selected material as a heat-resistant board in furnace 1

	Material	Coefficient of heat resistance kcal/m,h,c	Cost	Workability	Heat resistance	Elasticity
Before	Silica #650	5 . 7	○	○	○	○
After	Microtherm	17	△	◎	◎	○

◎ Very good ○ Fair △ Ordinary

Evaluation Table

Figure A-9: Research on materials with high coefficient of heat resistance

5. Presentation of the plan

Result of the implementation of the plan

1) Distribution of temperature in the furnace

Distribution of temperature in the furnace after changing from electric furnace to gas furnace was within the specification.

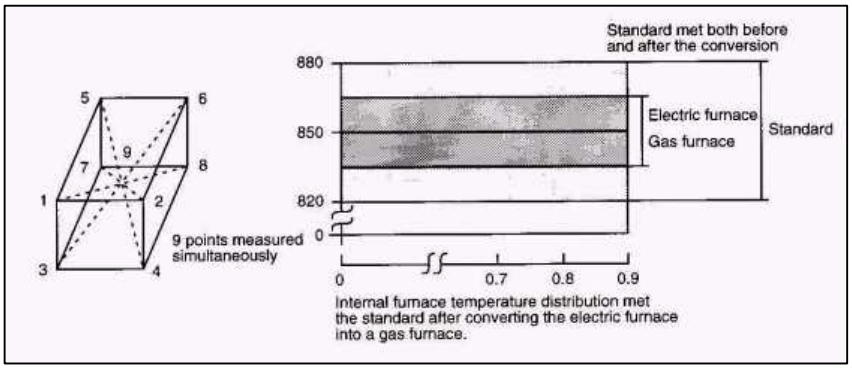
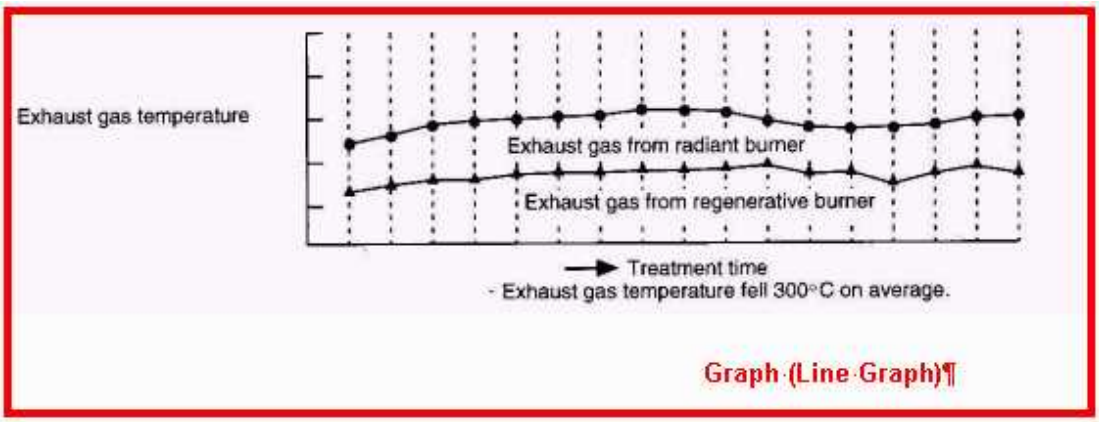


Figure A-10: Distribution of temperature in the furnace

2) Gas temperature

Average temperature of gas after burning was 300°C.



FigureA-11: Temperature of gas from the burning head of radiant tube and regenerative burner

Result of implementing the plan

1) Temperature of furnace

After improvement, the furnace temperature was reduced from 90°C to 76°C.

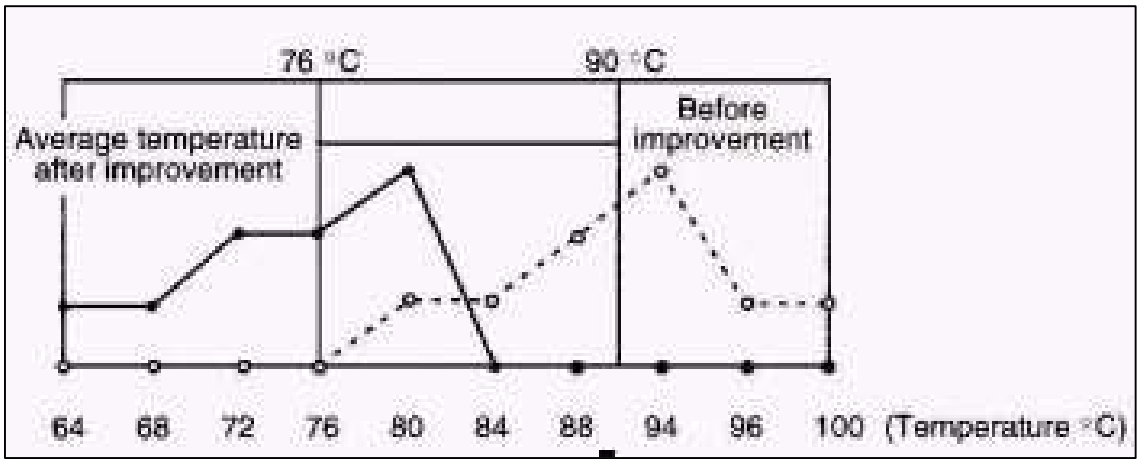


Figure A-12: Temperature of furnace

2) Distribution of temperature in various parts of the wall of furnace

After changing the material used for heat-resistant board to microtherm, the temperature of the outside wall was reduced from 90°C to 80°C.

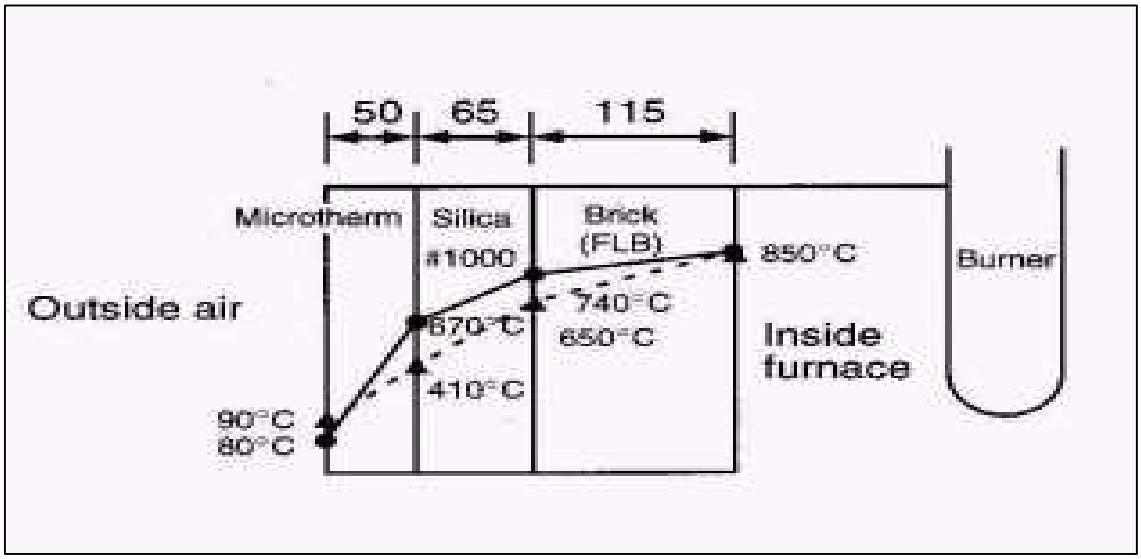


Figure A-13: Distribution of temperature in points in furnace

6. Evaluation of the results

1) Heat efficiency

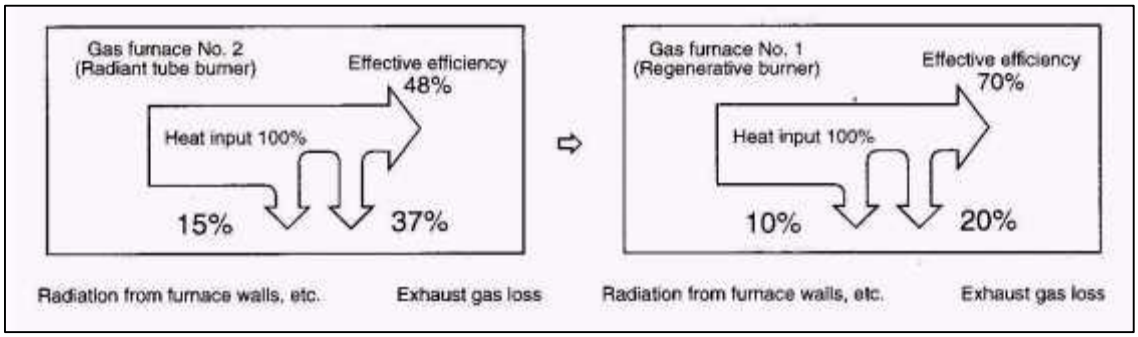


Figure A-14: Heat efficiency

The objective of improving the efficiency to 59% was more than achieved. The efficiency was increased from 48% to 70%. Heat radiation from the furnace wall was reduced from 15% to 10%. The loss of gas from burning was reduced from 37% to 20%.

2) Fuel/Production costs

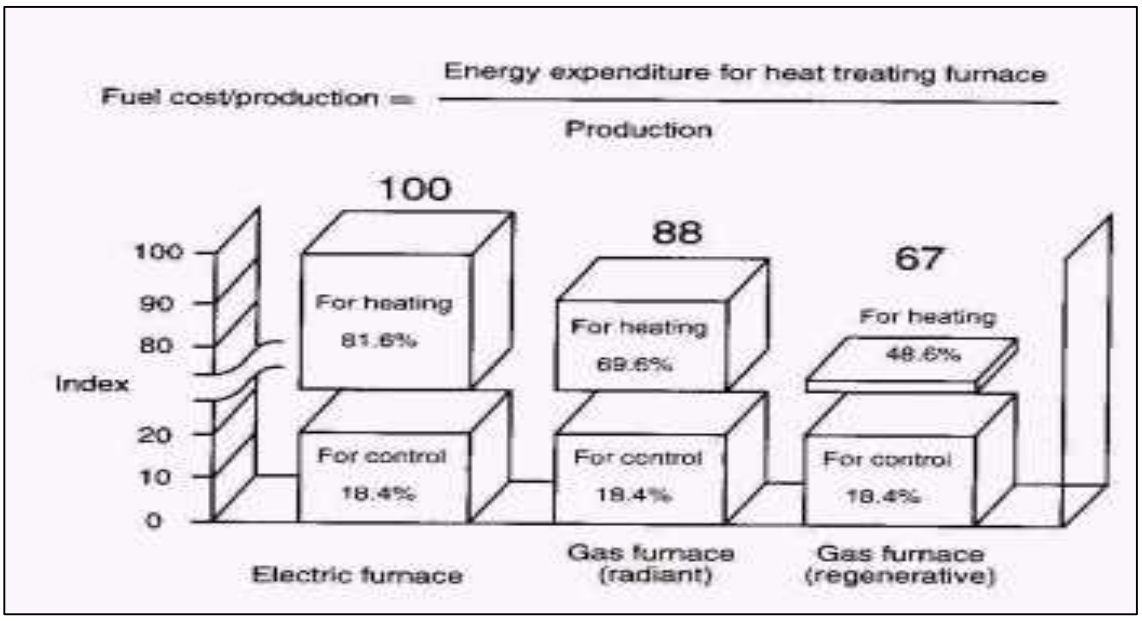


Figure A-15: Fuel cost needed for production

If we set the strength of energy from using electricity as 100%, then strength from gas Furnace No. 2 (radiant tube) is 88% and the strength from gas Furnace No. 1 (regenerative burner) is 67%.

We compared the usage of various forms of energy for the production in the furnace in the point of view of petroleum consumption and CO_2 emission in each month. As a result we found out the following facts.

(1) Furnace No. 1 required the least amount of energy (in the form of petroleum) per 1kg of production.

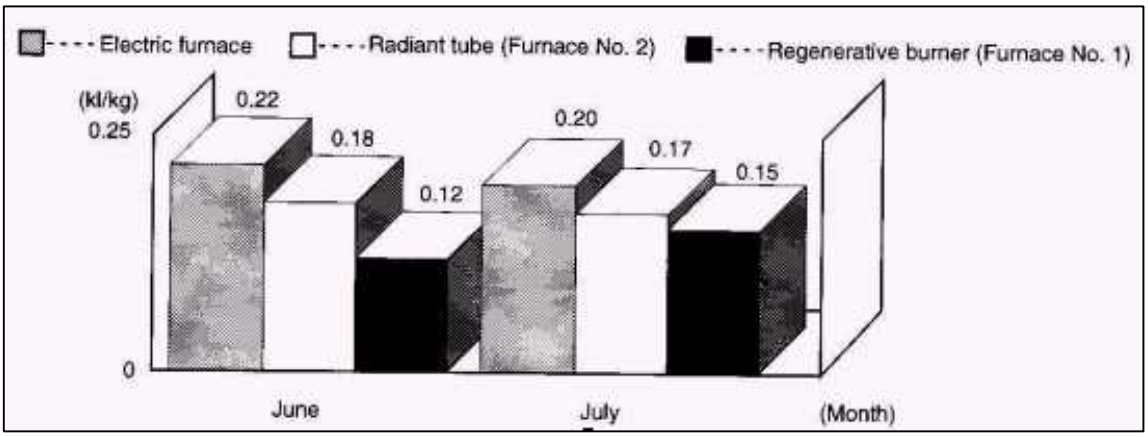


Figure A-16: Energy demand

(2) Furnace No. 1 caused the least amount of CO_2 emission per 1kg of production.

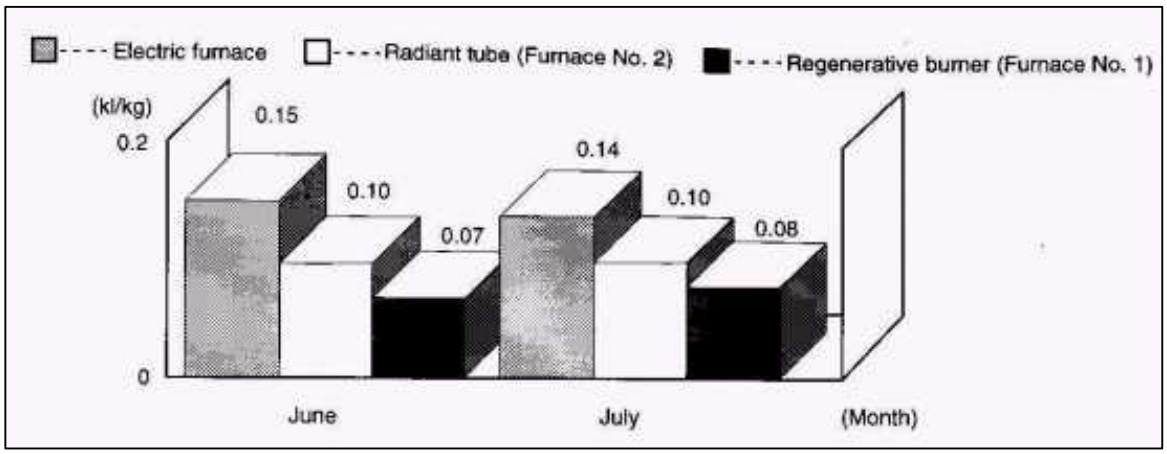


Figure A-17: Emission of CO_2 per 1kg of production

Summary (Result of changing the Furnace No.1 to gas furnace)

- Consumption of electricity per 1kg of production was reduced by 36%.
- Emission of CO_2 per 1kg of production was reduced by 48%.
- Energy-related costs was reduced by 33% (Reduction of 11,000,000 Yen per year)
- We achieved more than the objectives because of cooperation from the gas company and the construction company.

7. Prize giving

Factory A more than achieved the objectives and as a result gave prizes to employees. This was intended to raise the spirits of employees and to motivate them for the continuous conservation of energy.

Appendix – 2

1. In-house Database / Technical Directory

Refer to the website of ASEAN Centre for Energy as follows :

(In-house Database)

http://www.aseanenergy.org/projects/promeec/ihd.php?link=ihd&page=industry

http://www.aseanenergy.org/projects/promeec/ihd.php?link=ihd&page=building

(Technical Directory)

http://www.aseanenergy.org/projects/promeec/td.php?link=td&page=industry

http://www.aseanenergy.org/projects/promeec/td.php?link=td&page=building

As for the following, it is recommended to use the existing information and books etc. written in a national language available in each country.

2. Statistics Data on Energy, etc.
3. Web sites of related energy and industrial organizations
4. List of Available Training Courses
5. List of Available Technical Manuals
6. Manuals and Tools for TQM and TPM