Chapter 11 Financial Mechanism

11.1 Current Situation

11.1.1 Existing Financial Support Scheme

(1) Common Scheme and Characteristic

One example of the role of financial support schemes in EE&C activities is to promote the usage of high efficiency equipment by reducing the initial cost of such equipment. The expected benefits of implementing financial support are the reduction of fossil fuel imports by reducing energy consumption and reducing investment costs for the construction of the installation of electric utilities by lowering the peak demand of electricity and so on. The common scheme and characteristic are as described in the following table.

Table 11-1 Common Scheme and Characteristics of Financial Support Scheme

	target sector	user's advantage	application process	necessity of fund
Low Interest Rate Loan	industrial commercial transportation	reduction of repayment	examination by financial institution	necessary
Tax Benefits	industrial commercial transportation	recovery of equipment cost by tax reduction	proof of installation	unnecessary
Subsidies	industrial commercial transportation residential	reduction of initial investment cost	proof of installation/ proof of effect	necessary

There are other financial support schemes in addition to the above schemes, namely low interest loans or subsidies for R&D costs and duty-free importations etc.

(2) Process of Fund Raising and Utilization

It is necessary to collect funds to carry out low rate loans and subsidies schemes. The fund is collected from special purpose taxes or bonds usually issued by the government. Those funds are at once pooled in a special or general account and then utilized according to the budget by a government-managed financial institution or semi-governmental corporation. (refer Figure11-1)

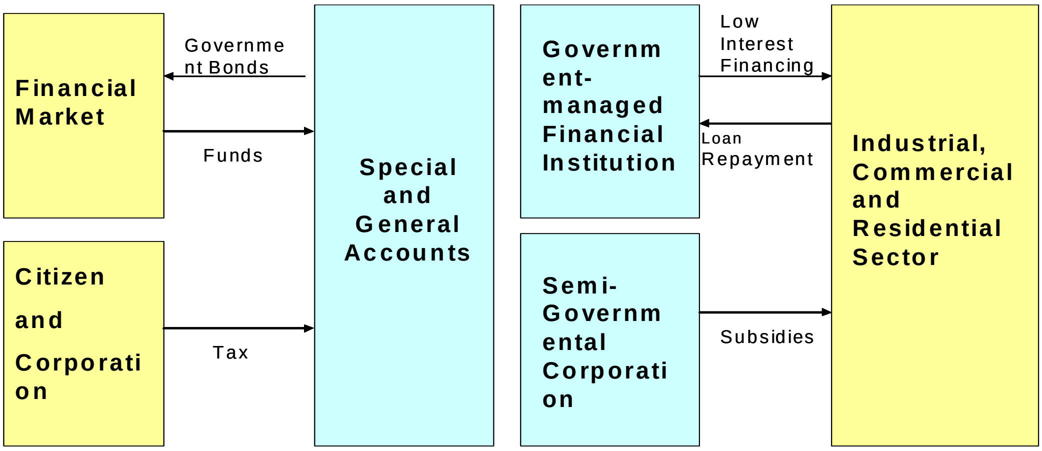


Figure 11-1 Process of Fund Raising and Utilization

(3) Outline of Existing Financial Support Scheme

For the time being, there is a low rate loan scheme for EE&C activity supported by KfW[1] in the Philippines. However the number of users is small because its interest rate is not competitive compared to the other loans in the market (according interviews with the NEDA and DTI-BOI which are responsible organizations for financial support scheme) .

Except for this scheme, their might be no financial support schemes for EE&C activity . No other such scheme is found in the "Investment Priority Plan" issued by DTI-BOI which shows the projects supported by the government

(For reference) The existing low rate loan for EE&C activity

Name of loan: CREDIT Line for Energy Efficiency and Climate Protection (CLEECP)

Objective: To significantly reduce the direct consumption of primary energy and direct greenhouse gas emissions

Eligible borrowers: Private sector and entities at least 70% Filipino-owned and governmental units, agencies, corporations

Eligible equipment and project:

- CFC, HFC and HCFC chillers
- Biomass cogeneration facility
- Replacement or energy efficient modernization of public transport systems and cars or truck fleets
- Solar panels, mini-hydros

Loan amount: Up to a maximum loan of PHP 200 million

Interest rate: fixed interest rate

Project cost sharing: KfW funds (maximum 80%)

[1] KfW（Kreditanstalt für Wiederaufbau）: A German government-owned development bank. It's major businesses are to assist developing countries and low-rate loan for the overseas investment.

Implementing facility: Land Bank of the Philippines etc.

11.1.2 Adaptability of Financial Support Scheme on EE&C Law in the Philippines

(1) Statement in Other Similar Bills

①Senate Bill No.2027

In the existing Enercon Bill namely Senate Bill No.2027 which has already been submitted to the Senate on July 2010 and awaiting deliberation. The main targets are the Power and Transportation Sector and stated for the fund resources and utilization of financial support schemes as follows.

<For reference> An excerpt of the statement from the financial support scheme in the Senate Bill No.2027

- Establishment of the EE&C Fund
  (Fund Resource)
  Funded out of the contributions from distribution utilities, generation utilities and transport entities. These contributions pertain to a percentage of said entities' gross revenue, with the reasonable percentage to be set and reinforced by the ERC and the DOTC.
  (Utilization)
  ・The R&D cost of Power and Transportation sector (utilize 10 % of the Fund)
  ・The respective entities' programs towards EE&C and upgrading, repairs, maintenance, expansion of existing facilities or such other programs that shall enhance the performance and efficiency of existing infrastructures. (utilize 90 % of the Fund)
- Incentives for EE&C activities
  ・Tax and Duty-free importation of capital equipment for EE&C project
  ・Tax credit on domestic capital equipment

②Renewable Energy Act

The Renewable Energy Act (Act No.9513) established in December 2008 mentions financial support schemes such as tax benefits and low interest loans. However, it does not contain a subsidy scheme. There might be two reasons for this.

One of the reasons is that after the establishment of EPIRA, basically, the energy sector is under the control of market mechanisms. Hence, it is feared that the use of the subsidy hinders the privatization and deregulation of the sector. Another reason is that the government budget is insufficient and the idea that governments are responsible for providing tangible services as opposed to cash financing is prevalent.

<For reference> Financial support scheme in the Renewable Energy Act of 2008

- Tax and duty-free importation
- Income tax holiday and exemption
- Zero-rated value added tax transactions
- Tax rebate
- Financial support from government-managed financial institutions

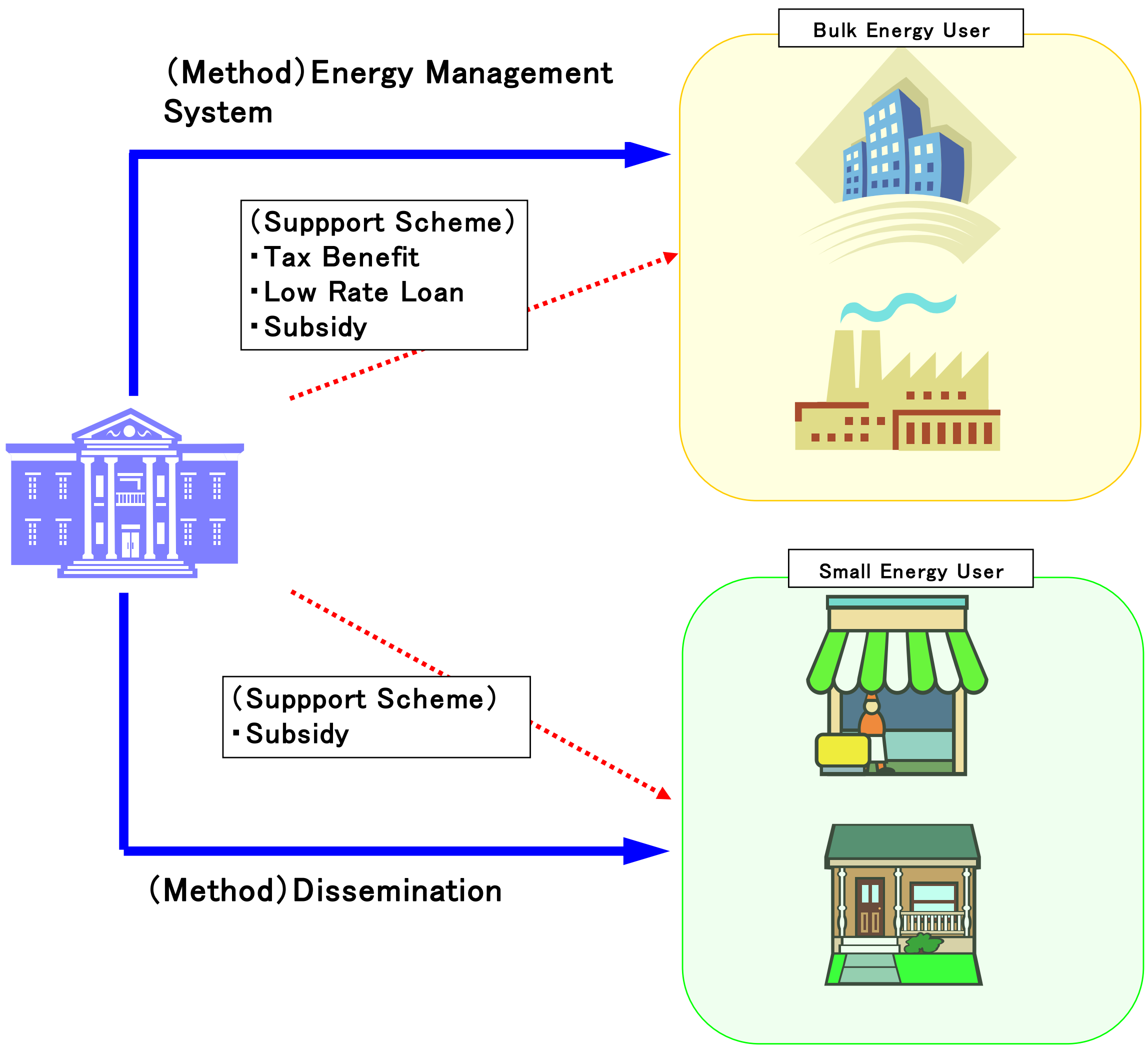
11.2 Issues

(1) Theme of financial support scheme for EE&C Activity

In the Philippines, tax benefits tend to be chosen as financial support schemes due to the lack of funding resources. The reduction of income tax and duty-free importation is effective for the industrial and commercial sector. However, for the residential sector, complicated procedures to apply tax reductions might be a barrier to use it except for VAT.

On the other hand, individual energy management for bulk customers from the industrial and commercial sector will be effective for EE&C. But for small-sized companies and households, individual guidance is not practical. So it is necessary to provide simple incentives like subsidies in addition to the dissemination program.

To regulate and provide incentives to manufacturers and importers is another scheme to improve the energy efficiency of equipment.



Fund resources are necessary to utilize subsidies. Resource candidates are usually special purpose taxes like energy taxes. The Energy tax is commonly imposed on energy charges like electricity charges and oil products. However, electricity charges in the Philippines already contain a universal charge whose purpose is the recovery of past NPC debt and rural area electrification. Oil products in the Philippines are imported mainly from middle-east countries and its prices are in proportion to international prices and unstable. Both energy prices are rather high in consideration of the Philippines GDP level. So it might be difficult to get nations to agree to impose an additional tax or charge on energy charges.

Most of the high efficiency equipment, which are the targets of financial support, are made by foreign manufacturers because the manufacturers in the Philippines are not developed enough. So this raises the government concern that the invested funds to promote sales of high efficiency equipment will only contribute to the profit increase of foreign companies with little return to the domestic economy. In other words, the outflow of national wealth may turn out to be the result.

11.3 Proposal

11.3.1 Mention in the DOE's Draft Bill

It is mentioned in the DOE's draft Bill that the DOE shall endorse pioneering energy efficient technologies to the Board of Investment (BOI) as incentive targets. However, there is not any mention of the contents of the incentives.

The DOE wants to make appropriate use of the incentives as the occasion demands, so they intend to mention it in the IRR, which is easier to amend than the Law.

In the Philippines, regarding targets and schemes of incentives it is necessary to have it recorded in the Investment Priority Plan issued by the DTI-BOI as the process to carry out Government financial support.

11.3.2 Incentive Schemes

(1) Choices of Incentive Schemes

The followings are the choices of inventive schemes which the Study Team presented based on the examples of the schemes in Japan and the Philippines. However, the DOE's reaction concerning their introduction was less than positive.

On the other hand, the result of the questionnaire collected at the workshop to introduce the DOE's Draft Bill held on August, 2011 received many requests to set incentives for EE&C activities. So, it is desirable to consider having the DOE set them continuously. Particularly there were many requests for financial support for R&D and the implementation of low-rate loans. Hence, Study team recommended to implement following incentive schemes namely, low rate loan for initial cost of energy conservation projects and high-efficient equipment for enterprises and subsidies for purchase of high efficient equipment which are easy to understand the systems for residential users.

① Incentives for Energy Efficiency and Conservation Projects

a. Tax and duty-free importation of capital equipment

b. Tax credit on domestic capital equipment

c. Subsidies for the initial cost of projects

d. Low rate loans for the initial cost of projects

② Incentives for High Efficient Equipment

a. Tax credit for the purchase of high efficient equipment
b. Subsidies for the purchase of high efficient equipment
c. Low rate loan for the purchase of high efficient equipment
d. Accelerated depreciation for high efficient equipment

③ Incentives for R&D programs

a. Subsidies for R&D programs
b. Low rate loan for R&D programs

(2) Cases in the Neighboring Countries

The Study Team provided examples of the incentives being implemented in the neighboring countries for reference and requested to consider the implementation of the suitable incentives for each target which were mentioned in the previous page. The outline of the financial schemes of each country are shown below. Each country provides several supports for the target. In Japan it is characteristic that support for small and medium-sized enterprises are substantial to develop such enterprises having less capital strength.

① Thailand

	Thailand	
Kind of measure	**Low-interest loan**	Tax benefit
Name of measure	Energy Efficiency Revolving Fund (3 Phases)	Tax Incentive Program for Energy Efficiency
Purpose of measure	1. To stimulate and leverage commercial investment for EE Improvement. 2. To familiarize commercial banks with EE lending market and opportunities.	1. To be the incentives for targeted groups to implement energy efficiency projects 2. To stimulate more participation in promoting energy efficiency
Target sector	Commercial buildings, manufacturing and ESCO. - Eligible Borrowers: Facilities' owners, ESCOs and Project developers - Eligible Projects: EE improvement or RE development and Utilization Loan Period : 7 years (maximum) Loan Size : Up to 1.56 million USD / project Interests charge to customers : Not more than 4%	Two schemes of Tax Incentive Program have been implemented for Building and Industry Sector 1. Cost-Based : 25% of Tax Break on Corporate Tax for the investment not more than 1.25 million USD in EE Projects 2. Performance-Based : 100% of achieved energy saving from EE projects will become tax deduction with the maximum incentive of 60,606 USD
Funds and budget for the measure	Energy Conservation Promotion Fund, Phase 1&2: 2 billion Baht(62.5million USD) for each phaze Phase 3 : 4 billion Baht (125million USD)	Energy Conservation Promotion Fund Budget allocation for both programs is up to 2.5 million USD
Method for measuring the effect of the measure	-	-
Result of the measure	Overall Achievement: Reduce oil imports of over 184 million liter/yr. Reduce power demand over 98 MW for 207 Projects	-Cost Based: 108 applications in EE investment has been approved -Total Energy saving is up to 8 million USD/year -Performances-Based: 210 applications have been approved -Total Energy saving is up to 10 million USD/year
Future tasks	-All financial loan come from banks. -Only technical assistance from DEDE(*) including project development. -Emphasize more on renewable energy projects. -Expand target group to SMEs. (*) Department of Alternative Energy Development and Efficiency	Extending this program to other target groups with appropriate approach

source: ECCJ website

② Malaysia

	Malaysia			
Kind of measure	Tax benefit		Low-interest loan	Subsidies and budgetary measures
Name of measure	Incentives for Investment (1) a) Pioneer Status b) Investment Tax Allowance, Sales Tax and Import duty exemption. (Started in 2001)	Incentives for Investment (2) a) Sales tax exemption for locally produced equipment/machinery b) Import duty and sales tax exemption on imported equipment/machinery (Started in 2001)	Malaysian Industrial Energy Efficiency Improvement Project (Started in 2000 and ended in 2007)	Malaysia Electricity Supply Industry Trust Account (MESITA) (Started in 1997)
Purpose of measure	To disseminate and promote energy conservation and renewable energy. (as incentive measures applicable to introduction of energy efficiency and conservation technology)	To disseminate and promote energy conservation. (as incentive measures applicable to introduction of energy efficiency and conservation technology)	To financially support energy efficiency projects. The objectives of the MIEEIP were embodied in the eight (8) components or programmes below. a) Energy-use Benchmarking Programm b) Energy Audit c) Energy Rating d) Energy Efficiency Promotion e) ESCO Support f) Energy Efficient Technology Demonstration g) Local Energy Efficient Equipment Manufacturing Support h) Financial Institution Participation	MESITA is used in the following areas: a) Rural Electrification Programme; b) R&D Programmes and New Renewable sources of energy projects; c) Human resource development programmes for the industry; d) Energy efficiency projects; e) Development and promotion of the electricity supply industry; f) Advance For Projects Approved by Trustee of Electricity Trust Fund.
Target sector	Manufacturing sector Scope of the incentives for investment : Investment for energy conservation ・Companies providing energy conservation services ・Companies which undertake conservation of energy for own consumption and export electricity to the grid.	Companies and manufacturing facilities investing conservation of energy for own consumption	・Parties audit in MIEEIP Energy Audit Program ・ESCO companies registered in MIEEIP	Electricity supply
Funds and budget for the measure	-	-	RM 8.0 Million (UNDP-GEF)	The contributors to the fund are the power generating companies. Their contribution is voluntary and they contribute one percent (1%) of their electricity sale (their total annual audited turnover) to the Peninsular Grid or the transmission network to the Peninsular Grid or the transmission network to the fund. Total:1997-Jun 2008: RM737million
Method for measuring the effect of the measure	Special Committee on Renewable Energy and Energy Efficiency Incentives	Special Committee on Renewable Energy and Energy Efficiency Incentives	A national steering committee was setup to measure the deliverables of the programme.	Technical Committee of MESITA to evaluate project progress and impact

Source: ECCJ website

③ Singapore-1

	Singapore	
Kind of measure	Tax benefit	
Name of measure	Investment Allowance Scheme	Green Vehicle Rebate (started 2001, enhanced in 2006)
Purpose of measure	To encourage companies to invest in energy efficient equipment, there is an investment allowance (IA) scheme that is a capital allowance on qualifying equipment cost that allows a deduction against all chargeable income. The IA may be awarded if the capital expenditure results in, among others, more efficient energy utilisation.	To raise promote the uptake of Green vehicles such as hybrid vehicles, etc.
Target sector	Industry Sector	Transport Sector
Funds and budget for the measure	-	-
Method for measuring the effect of the measure	-	Number of Green vehicles had increased from about 200 in 2005 to about 1000 in 2007.
Result of the measure	-	-
Future tasks	-	-

source: ECCJ website

④ Singapore-2

	Singapore			
Kind of measure	Subsidies and budgetary measures			
Name of measure	Innovation for Environmental Sustainability Fund : IES (Started in 2001)	Energy Efficiency Improvement Assistance Scheme : EASe (Started in April, 2005)	Design for Efficiency Scheme (started in 2008)	BCA GMIS : BCA Green Mark Incentive Scheme (The rating started in January, 2005. The cash incentive started in December, 2006)
Purpose of measure	To encourage and assist Singapore-registered companies to undertake innovative environmental projects that could help to meet the government's goal of environmental sustainability.	Financial support to companies in the manufacturing and building sectors to carry out detailed studies on their energy consumption and identify potential areas for energy efficiency improvement conducted by experts or Energy Service Company (ESCO).	To encourage investors in new facilities in Singapore to integrate energy and resource efficiency improvements into manufacturing development plans early in the design stage. The scheme co-funds the cost of design workshops.	It is intended to promote sustainability in the built environment and raise environmental awareness among developers, designers and builders when they start project conceptualization and design, as well as during construction.
Target sector	All Singapore-registered companies	Manufacturing sector Building sector	New industrial facilities/buildings	Developers, Building owners
Funds and budget for the measure	S$20 million	S$10 million	-	S$20 million
Method for measuring the effect of the measure	-	-	-	-
Result of the measure	-	More than 100 energy audits were conducted. As of 15 Jul 08, total potential energy savings if measures are implemented: over 330,000MWh with potential reduction in CO2 emissions of more than 167 kilotonnes per year.	-	-
Future tasks	-	-	-	-

source: ECCJ website

④ Japan

1. Low Interest Rate Loan

- Target: EE&C project
- Provide preferential interest rate loans for installing EE equipment
- Only for small and medium-sized enterprises
- Implementing Agency:
  - Japan Finance Corporation (owned by gov.)
- Applicable equipment is defined in a list
- Energy efficiency criteria
  - EE&C effect should be 25% more than that of averaged equipment
  - In the case of retrofitting, the EE&C effect should exceed 40% more than that of the equipment before retrofitting

2. Tax Benefits

- Applicants can choose one of the below
  - Corporate tax deduction (up to 7% of equipment cost)
    - Only for small and medium-sized enterprises
    - Up to 20% of corporate tax
  - Special depreciation, up to 30% of equipment cost, in addition to standard depreciation
- Applicable equipment is defined in a list.
- Not applicable to leased equipment

3. Subsidies

- Major Projects
  - Support project for operators for promoting the rational use of energy
  - Projects for promoting the introduction of high-efficiency energy systems into homes and buildings
  - Support project for the introduction of high-efficiency water heaters
  - Support project for the introduction of highly -efficient air conditioning equipment
- Subsidy Providers
  - NEDO (governmental) : New Energy and Industrial Technology Development Organization
    - ・EE&C projects, equipment, surveys, promotion activities etc.
  - JEHC: Japan Electro-Heat Center (power utilities and manufacturers)
    - ・Eco-cute (HP water heater with CO2 refrigerant)
    - ・AC system (not for the industrial sector)
  - Toshi (City)-gas Shinko Center
    - ・Combustion equipment
    - ・Change source to natural gas (city gas)
    - ・Gas water heater
    - ・District heating/cooling by natural gas cogeneration
  - The Conference of LP Gas Associated Organizations
    - ・Water heater by LP gas
  - Petroleum Association of Japan
    - ・boilers

An example: A Subsidy Scheme of NEDO

	Category1:	Category2:
Project name	Support Project for operators promoting the rational use of energy	Projects for promoting the introduction of high-efficiency energy systems into homes and buildings
Subsidy	Up to 1/3 of total project cost: Max JPY 500 million/fy	Up to 1/3 of total project cost: Max JPY 100 m(As for BEMS)
Budget (FY2010)	JPY 24,000 million	JPY 3,700 m
Number of approved application (FY2007)	Industrial: 94 Transport:176 Agriculture & Fisheries:61	Building related projects:34 Homes related projects:2,497 Introduction of BEMS: 39

11.4 Economic Effects via Diffusion of High-efficient Air-conditioners

11.4.1 Purpose

To confirm the advantages in providing incentives to promote the diffusion of high-efficient equipment, calculate the economic effects in the case of air-conditioner.

It can be estimated that there are a small number of users of air-conditioners with inverters in the Philippines based on a market survey, which shows only one household among two hundred and thirty eight (238) households using an air-conditioner with an inverter.

11.4.2 Calculation Method

First, calculate the reduction of electricity consumption by using a high-efficient air-conditioner. Then, compare the energy cost reduction with the installation cost of equipment.

The calculation order is as follows.

(1) Grasp the standard cooling load of a household

(2) Calculate the difference of electricity consumption between an inverter- type air-conditioner and a non-inverter type one

(3) Calculate the reduction of the electricity charge by using a high-efficient air-conditioner

(4) Grasp the price of both types of air-conditioners

(5) Compare the reduction of the electricity charge and price difference of a high-efficient air-conditioner

(6) Confirm the advantage and necessity of incentives

11.4.3 Results of the Calculation

(1) Grasp the Standard Cooling Load of a Household

Cooling load (MJ)=Floor area(m^2) × Max. load (kW/m^2) × Annual operation hour (h/y) × Load factor × 3.6(MJ/kWh)

= 16,462MJ/y

Data for calculation

Floor area(*1) : 20 m^2

Maximum heat load(*1) : 0.174 (kW/m^2)

Annual operation hour(*2) : 6h × 365d=2,190(h/y)

Load factor(*3) : 0.6 (including insolation ratio)

(*1) source: Air-conditioning and plumbing handbook (Substitute standard floor area with an AC in Japan for that of the Philippines which was not available)

(*2) Grasped by market survey

(*3) Assumption by insolation data etc.

(2) Calculate the Difference of Electricity Consumption between Inverter-type air-conditioner and Non-inverter type one

Electricity consumption (kWh/y) = Cooling load (MJ/y) ／ EER (kJ/Wh) (*1)

(*1) Energy Efficiency Ratio(Heat value output / Electricity consumption)

Table 11-2 Comparison of Specifications of AC by Type

	EER(kJ/Wh) (by questionnaire survey)	Electricity consumption (kWh/Y･household)
Inverter-type	13.3	1,238
Non Inverter-type	10.2	1,614
Difference	3.1	**-376**

(*per questionnaire and certified air-conditioner data)

Each EER is average in the major cooling capacity band in the Philippines which is from nine thousands (9,000) to ten thousands (10,000) kJ/h based on the market survey.

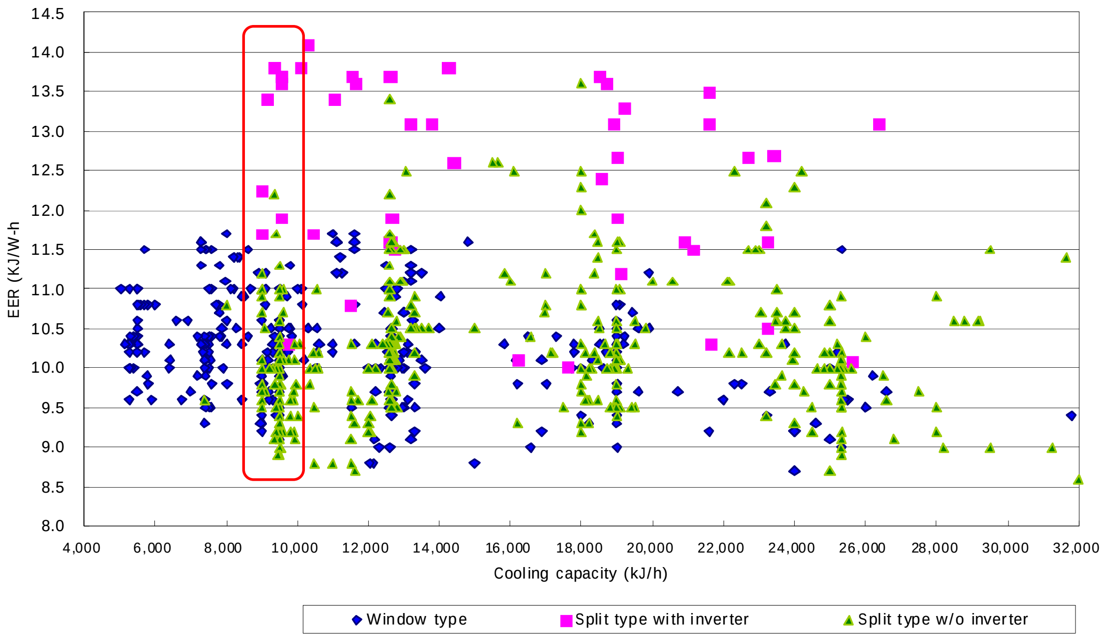


Figure 11-2 Distribution of EER of AC by Type

(3) Calculate the Reduction of Electricity Charge by Using a High-efficient air-conditioner

Reduction of electricity charge (PHP) = Reduction of electricity consumption (kWh) × Electricity rate

=**3,384**(PHP/y)

Data for calculation

Electricity rate for the residential user: 9(PHP/kWh)

(Based on the rate of MERALCO and ECs)

(4) Grasp the Price of Both Types of Air-conditioners

The average price of each type is calculated in the following order. The data in the major cooling capacity band in the Philippines which is from nine thousands (9,000) to ten thousands (10,000) kJ/h are used in the calculation.

①Average price /cooling capacity of air-conditioner

Inverter-type : **3.2** (PHP/kJ･h)

Non Inverter-type : **1.6** (PHP/kJ･h)

②The most popular cooling capacity of the air-conditioner

The average of the cooling capacity in the major cooling capacity band in the Philippines

9,400 (kJ/h)

③ Equipment Price Differences

Inverter-type : **3.2** （PHP/kJ･h）× **9,400** (kJ/h) =**30,080** （PHP/unit)

Non Inverter-type : **1.6** （PHP/kJ･h）× **9,400** (kJ/h) =**15,040** （PHP/unit)

(Difference) **15,040** （PHP/unit)

(5) Compare the Reduction of the Electricity Charge and the Price Difference of a High-efficient air-conditioner

It takes 4.4 years to recover the difference of the equipment price per the reduction of the electricity charge.

Price difference／reduction of electricity charge

15,040 （PHP/unit)／3,384(PHP/y) = **4.4**y

On the assumption that the life of the air-conditioner is six (6) years like in Japan, the price difference of equipment can be recovered over the lifespan.

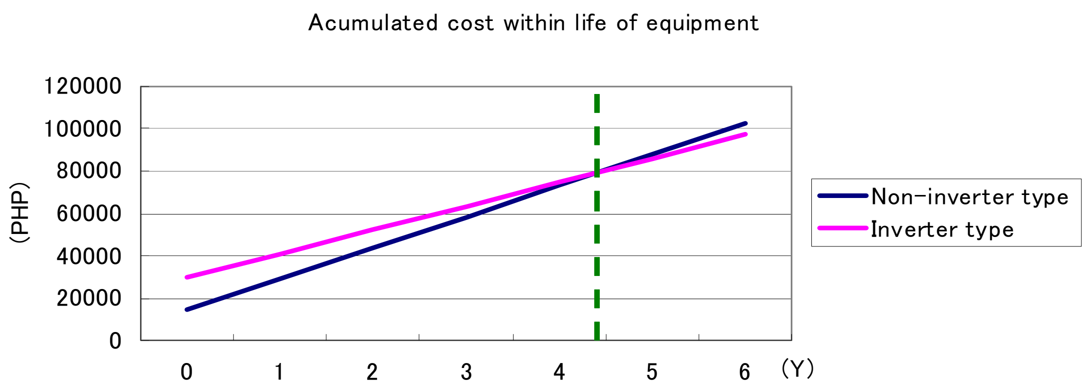


Figure 11-3 Cumulative Cost by Type of AC

(6) Confirm the Advantage and Necessity of Incentives

1) Estimation of the amount of incentives

Expected recovery period in the Philippines is between two(2) and three(3) years according to the market survey. It is ideal that additional investment costs are recovered within 2.5 years in order to disseminate high-efficient air-conditioners in the Philippines and the necessary amount of incentives to realize that is calculated as follows.

15,040 (PHP/unit) – (3,384(PHP/y) × 2.5y) = **6,580(PHP/unit)**

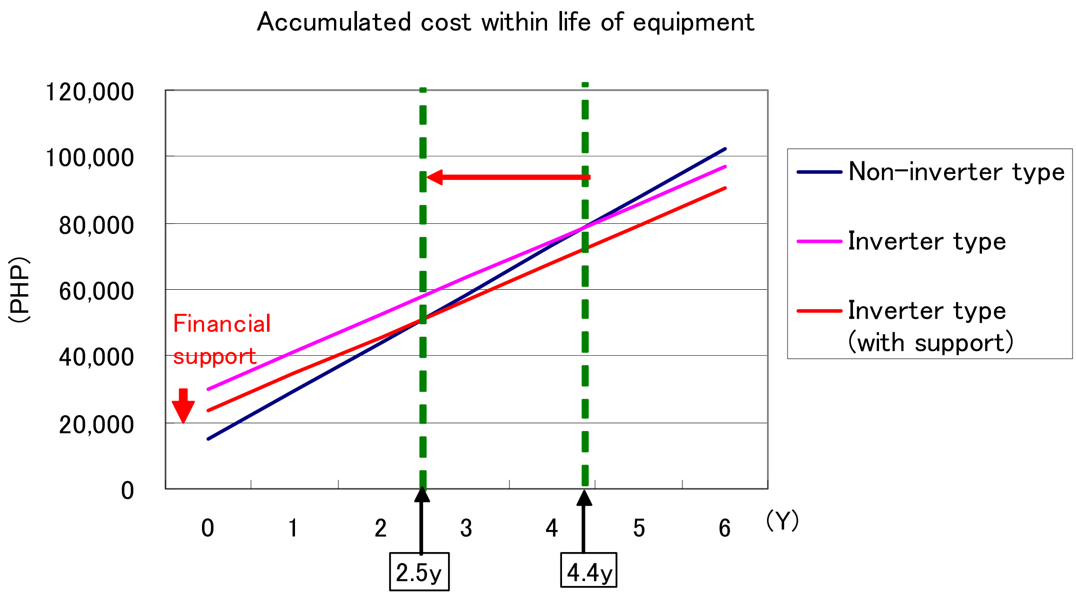


Figure 11-4 Change of Payback Period by Financial Support

Incentive/unit × Number of households ×AC possession rate (%)

6,580(PHP/unit) ×18,452(thousand household) × 37.8% ＝ 45,895(million PHP)

<u>Data for calculation</u>

Number of households: Record of 2009

AC possession rate: per the market survey

2) National benefit via the dissemination of high-efficient air-conditioners

The national benefit per the dissemination of high-efficient air-conditioners is reduction of fuel consumption brought about via the reduction of electricity consumption. The reduction of fuel consumption for generation on the assumption that all air-conditioners in the Philippines are changed to inverter types is calculated in the following order. The reduction of fuel consumption should occur as the reduction of oil consumption, which is used for the generation of peak demand of electricity.

① Reduction of Power consumption (kWh) = Reduction of Power consumption / household × Number of household ×AC possession rate(%)

376(kWh/household) × 18,452,000 (household) × 37.8% = 2,623 (million kWh)

② Reduction of Power generation (kWh) = Reduction of Power consumption (kWh) ×Power generation/consumption ratio(%)

2,609(million kWh) × 122.6% = 3,216 (million kWh)

<u>Data for calculation</u>

Power generation/consumption ratio(%) : record of 2010

③ Reduction of fuel consumption (toe) = Reduction of electricity generation (kWh)/ Thermal efficiency(%) × Conversion factor

3,198 (million kWh) / 40.7% × 0.086 = 679,547.9(toe)

Data for calculation

Thermal efficiency (%): Average of the thermal efficiency of the oil thermal power plant from 2008 to 2010

④Reduction of fuel costs (PHP) = Reduction of fuel consumption (toe) ×Price (PHP) × Life of AC

679,547.9(toe) /0.147(bbl/toe) ×97 ($/bbl) ×43(PHP/$) ×6 (y) = 115,690(million PHP)

Data for calculation

Oil price: WTI price (Average from January to August 2011)

Exchange rate: Average from April to September 2011)

According to the above estimation, it is expected that a grant of forty-six (46) billion of financial support for purchasing a high-efficient air-conditioner with an inverter can generate a hundred and sixteen (116) of national benefit.

Subsidies will be the most effective measures to disseminate home appliances like air-conditioners for a large number of small targets. The eco-point system in Japan is a good example.

11.5 Summary

In this chapter the Study team investigated the existing financial support schemes and considered the possibility to apply various types of the schemes namely tax benefit, subsidy and low rate loan in the Philippines. Then the Study team discussed the suitable schemes with DOE introducing the similar cases of the neighboring countries of the Philippines but could not reached the determination of priority of the schemes.

DOE mentioned the low possibility of application of subsidy scheme which needs fund, but the Study team explained the effectiveness of the subsidy scheme for dissemination of high-efficient equipment showing the estimation of effects on energy conservation and national benefit by dissemination of high-efficient air-conditioner on the assumption that subsidy scheme is applied.

The annual electricity consumption per an home air-conditioner could be saved twenty-three (23) %, if users changed it to inverter type one from non-inverter type one. The difference of initial cost can be recovered by the reduction of electricity charge within approximately 4.4 years. The required amount of subsidy is 20% of the equipment cost to shorten the recovery period to two (2) or three (3) years. The investment of approximately 45 billion PHP as subsidy for high-efficient air-conditioner will generate approximately PHP 115 billion as national benefit on our estimation.

Chapter 12 ESCO (Energy Service Company)

The formulation of efficiency equipment and facilities is absolutely necessary to promote energy efficiency. The dissemination of such technologies, however, requires advanced techniques, to estimate energy saving potential, select optimum systems, implement renovation, operations and management, and meeting financing needs. Against this background, ESCO's efforts in performing an in-depth analysis of the property, designing an energy efficient solution, installing the required elements, and maintaining the system to ensure energy saving during the payback period, has attracted attention recently. Therefore, the levers for promoting ESCOs, an important matter to expand energy efficiency, is explored in this chapter.

12.1 Current Situation

12.1.1 Overview of ESCO Business

(1) Distinctions of ESCO

The Energy Service Company (acronym; ESCO) is a commercial business model that provides from customer's energy savings cost, to financing for renovation, customer's profits, interest rates, and other fares including ESCO service fees. At the same time of signing the contract, ESCO shall conduct client's energy saving, and all of the energy efficiency services including identifying and evaluating energy-saving opportunities, developing engineering designs and specifications, managing the project, arranging for financing, measurements and verification. The features of the ESCO business are as follows;

1) Guarantee that savings costs will cover all project expenses

The savings in energy costs is used to pay back all of the capital investment of the energy efficiency project; initial investment, interest, improvement service fees and so on. In addition, the savings after the ESCO service agreement will become a customer advantage. (Figure 12-1)

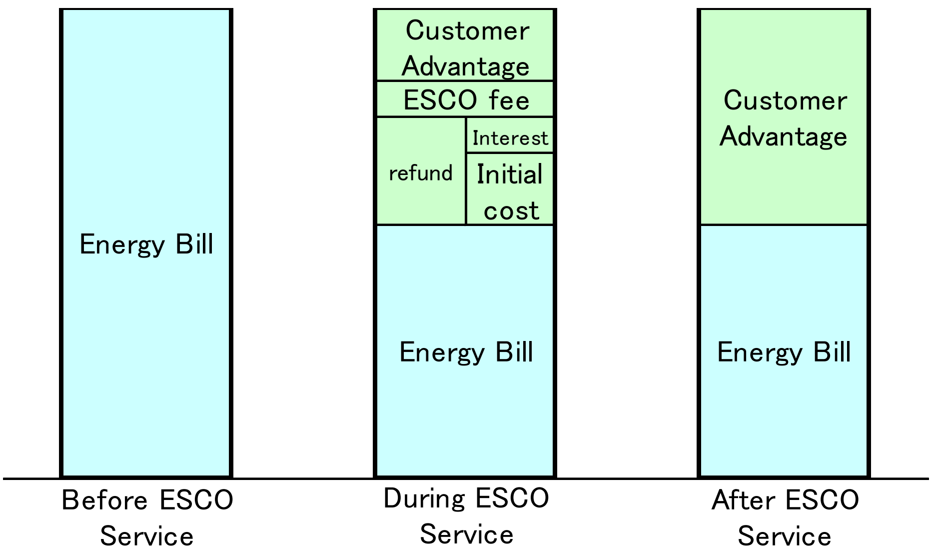


Figure 12-1 Expenditure for Before and After ESCO Service

2) ESCO performs energy savings

ESCO guarantees the reduction in utility costs by introducing the ESCO service, if the project does not provide returns via the performed reduction, ESCO is responsible to pay the difference. This contract method includes a performance guarantee called Energy Performance Contracting (EPC). EPC needs to ensure savings, especially the training of the Measurement and Verification (M&V) on energy efficiency for ESCO staff and the development of trusting relationships between customers and ESCO. The relationships, for instance, includes whether the customer will operate under ESCO supervision and to re-evaluate the health of customers.

3) ESCO manages the entire project

ESCO not only provides the implementation of energy efficiency renovation; energy audits, retrofit planning, designing and execution management, but guarantees operations and maintenance (O&M) and financing. If the customers have anxiety concerning a shortage of know-how, skills, and talented staff for energy efficiency, ESCO assists on all of these matters that will eventually result in energy savings.

4) Measurement and Verification of the effect on the energy efficiency project

ESCO periodically reports to their customers the results of monitoring and maintenance during the EPC. In the case of customers who could not obtain the savings guaranteed on the EPC, ESCO reviews and adds their projects. If customers might not achieve, ESCO makes up balance by the EPC.

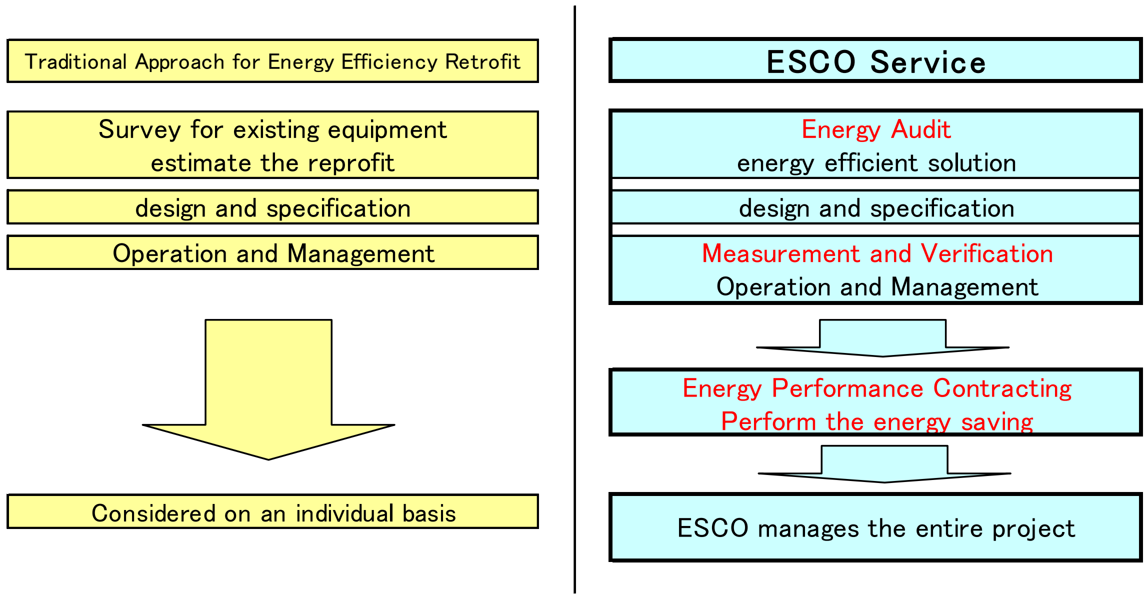


Figure 12-2 Main Aspect of ESCO

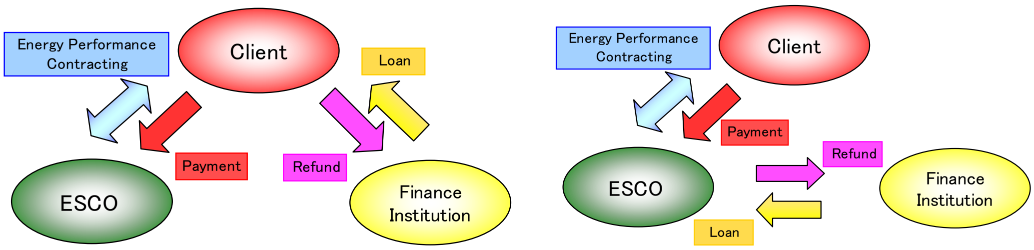
5) Non-resources loans, which are without general assets or creditworthiness (Project financing)

Project financing, based upon the projected cash flows of the project rather than the balance sheets of the project sponsors, is sometimes a part of the service that ESCO provides.

In the United States, one of the advanced ESCO countries, there are numerous types of ESCO financing. Not only bank financing but also capital-leases, operation-leases or claims.

(2) Contracting types

Generally, there are two contract types of ESCO service, one is Guaranteed Savings that the customer shall land financing, and the other is Shared Savings that ESCO shall raise capital.



Guaranteed Savings Shared Savings

Figure 12-3 ESCO Contract Types

From a financing perspective, customers under the guaranteed savings obtain capital to implement retrofitting. ESCOs under the shared savings, on the other hand, raises funds for renovation equipment and facilities. The characteristics of the two types of ESCO contracts are shown in Table 12-1:

Table 12-1 Characteristics of ESCO Contracting

	Guaranteed Savings	Shared Savings
Financing	Customer	ESCOs
Ownership	Customer	ESCOs
Service fee	Operation and Maintenance Cost	
	No need others than above	Installment payment initial cost and interest
Initial cost	Necessary	Unnecessary
Customer's benefits	Performing the savings of energy	
	Ownership	Asset off
	Cheaper service fee	No financial risk

12.1.2 Current Situation of ESCO in the Philippines

The business situation of ESCO in the Philippines is as follows.

(1) DOE ESCO Certificate of Accreditation

In 2008, the DOE issued Department Circular (DC2008-09-0004) which compels any ESCO to apply for a certificate of accreditation. The objectives of the Circular are as follows;

(a) To promote and expand ESCO business as a new emerging business industry in the local market

(b) To classify ESCOs in the market according to their area of expertise and financial capability

(c) To help inefficient companies avail of ESCO services with least to no-cost investment in energy efficiency projects

(d) To be able to create more jobs and stabilize the ESCO business sector to help contribute to the country's economic development and poverty alleviation program of the government

(e) To promote and build-up networks of the DOE accredited ESCOs in the local market as well as in the ASEAN region market

(f) To be able to accelerate implementation of energy efficiency projects and programs within the context of the government thrust on energy security, soaring energy prices and climate change mitigation

By July 2011, the DOE accredited the following eight ESCOs:

(1) Thermal Solution, Inc

(2) PhilCarbon Inc.

(3) Electro-System Industries Corp

(4) Design Science Inc.

(5) Renaissance Pacific Energy Solutions Asia (REPESA)

(6) Schneider Electric Philippines, Inc

(7) Cofely Philippines

(8) Filairco, Inc./ Trane Philippines

DOE EUMB is responsible for the administrative procedures of accreditation, and accepts the applications. ESCOs shall apply for accreditation with a full Application Form in the DOE Accreditation Guidelines. Applicants for ESCO Accreditation shall pay the Schedule of Fees; a Proceeding Fee of 5,000 Pesos and an Accreditation Fee of 10,000 Pesos. ESCOs are assessed on the following items, and are classified as "A", "B", "C" and "D".

<Classification Criteria>

a) Number of implemented energy efficiency projects

b) Financial capability and status

c) Commitment to energy efficiency projects

d) Company stability

e) Technical capability of ESCO on energy efficiency projects

Although, the technical capability of ESCO on energy efficiency projects is judged by both the Application Forms and Interviews, the evaluation criteria has not been publicly released.
Actually, many non-accredited ESCOs exist and have activities. The improvement of the quality of ESCO services need to boost the number of accredited ESCOs. The Study Team grasps the 27 ESCO companies, but most ESCOs have a low ESCO service fare percentage of their total sales.

(2) Association of ESCO in Philippines

The Association of ESCO in the Philippines, named ESCOPHIL, was established with about 15 member companies in 2008, but now has been practically stopped.

(3) Super ESCO

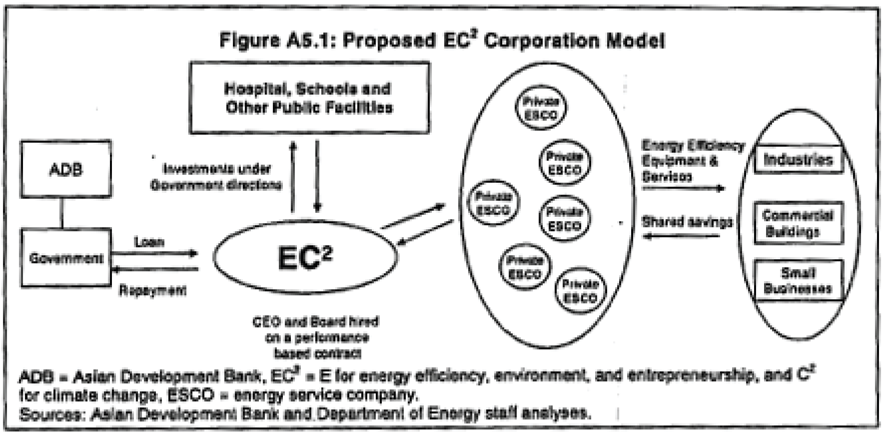
Briefly describing PEEP supported by ADB in chapter 3, the government is establishing the Super-ESCO, the main objective is to expand the private ESCO market. Super-ESCO defines their target as 80 % being the public sector such as hospitals and schools and the other 20 % being the private sector. Designed Super ESCO is shown in Table 12-2, to easier understand the barriers that need to be overcome to promote ESCO in Philippines.

The designed concept of Super ESCO is shown in Figure 12-4, that Super ESCO with governmental loan delegates actual ESCO service to other private ESCOs. The government also discusses the introduction of the Administrative Order that governmental organizations have to adapt ESCO services through the Super ESCO.

Table 12-2 Designation of Super-ESCO

Barriers to Promote ESCO Market	Designation of Super ESCO
・ Small number of ESCOs	・ Super ESCO and ADB will support to expanding private ESCO market size
・ Private ESCOs can not develop energy efficiency project for public sector ・ The public agencies ordered to reduce energy, do not used to introduce ESCO, and have no budget.	・ ESCO service in public sector will be provided by Super ESCO operation ・ First-year budget of 6.5 million US$ for public sector projects, as a first step to promote public ESCO business model
・ Difficult financing in private sector －Financing of private companies －Financing of private ESCOs －Project financing	・ First-year budget of 1.5 million US$ for private ESCO projects as a first step to develop private ESCO market ・ Encouragement for lease companies to take part in energy efficiency projects ・ Financing can be provided by Super ESCO ・ Development of project financing ・ In the future, energy efficiency fund will be established
・ Limited techniques of ESCOs ・ Lack of regulations and standards such as ESCOs guarantee energy savings of client for EPC	・ Technical training for private ESCOs ・ Standardization of EPC
・ Low awareness of the ESCO	・ Support to IEC campaign for promoting ESCOs ・ Supply best practices ・ Implementation of demonstration project

Source: Scaling-Up Energy Efficiency: The Case for a Super-ESCO, Asia ESCO Conference 2010



(Source: Proposed Loan and Administration of Grant Republic of the Philippines, ADB)

Figure 12-4 Concept of Super ESCO

(4) Activities of ESCO

a. Case Example of ESCO

As an example, the business summary of some ESCOs accredited by DOE is shown in Table 12-3. The ESCO business has achieved satisfactory results (especially commercial), and focused on all cost centers including lighting and elevator, but the strength is the air-conditioning system for commercial use. The ESCO has an annual number of 10 energy audits, the EPC for five to ten years, average energy consumption reduction rate is 20 to 30 % on air-conditioners.

Table 12-3 An Example of Accredited ESCO

Item	Situation
Energy Audit / Energy Efficient Solution	・ Started energy audit from 2007, Average 10 sites per annum ・ Scale of object: 3 levels Level 1 Walk-through (fee-free) a1. New ideas for low cost/co cost changes a2. Ideas for capital change a3. Primary energy use breakdown Level 2 Energy Service and Analysis b1 All practical changes to procedures and settings (O&M) b2 Energy breakdown b3 List of capital projects, estimate cost and benefits Level 3 Detailed Analysis of Capital Projects c1Detailed economic and engineering basis for capital projects including modeling and simulation
designing and execution / Operation and Management	The ESCO has not only ESCO service but also Retrofit and Maintenance. The ESCO service accounts for the greatest proportion of the business, about 60 %. Retrofitting is about 20 %, and Maintenance is about 20 %.
Contracting Types	・ Shared Savings －comprise 80 % of ESCO service －targets large energy consumers －EPC within 5 to 10 years －Financing is either in-house or seeking a partner-financing institution ・ Guaranteed Performance －Comprises 20 % of ESCO service －Client will finance the investment －Period of EPC is one year －ESCO will be paid after the demonstration of the projective savings on the professional services rendered in the study －If the project does not achieve its targets, the contractor takes the necessary steps to rectify the situation
Energy Reduction	・ Mainly commercial building, average energy efficiency is: Air-conditioning system: 20 to 30 ％ Lighting: 25 to30 ％ Elevator: 3 to 5 ％
Main Financing Bank	・ Banco De Oro Unibank (BDO) ・ Bank of the Philippines Island (BPI)

b. Issues in promoting ESCO

The ESCOs interviewed point out the problems of ESCO business promotion in the Philippines as follows:

- Lack of ESCO awareness
- ESCO staff’s substandard skill level
- Financing and Incentives for ESCO

(i) ESCO Awareness

An important business change in the Philippines is to save energy costs more than other countries. When ESCO is introduced, it is responsible for financing including initial costs. Therefore, the introduction of ESCO is one effective way to save costs. However, the lack of awareness for ESCO leads to a few inquires about ESCO service.

(ii) ESCO Techniques of ESCO

Generally, the ESCO business model was imported around 2007. Therefore, the span of Philipino ESCO history is relatively short. Various professionals became ESCOs, but in many cases it was not the primary job. As a result, ESCOs from design and construction corporations, for instance, have great depth of knowledge and experience about their core business, most of them have lack of experience, in the case, operations and management, and/or financing.

(iii) Financing and incentives for ESCOs

Concerning financing, some of ESCOs employ project finance, the long-term financing based upon the projected cash flows of the project. General, however, the ESCO business model still looks to their own or the customer's credit. There are lease companies, but the Study Team could not yet find companies working on ESCO business.

The support schemes such as low-interest, subsidies and tax-holidays are non-existent, therefore the business environment for ESCO is not good.

(5) Activities of Financial Institutes

a. Examples of Investment for ESCO business

Two banks in the Philippines are providing ESCO loans. One is the Bank of the Philippine Islands (BPI), its energy efficiency loan is described in Table 12-4. The BPI and IFC have been jointly established and are operating the fund "Sustainable Energy Finance Program", and the ESCO loan is part of the Program.

Table 12-4 Loan Program for Energy Efficiency Projects of BPI

Item	Situation
Partnership	BPI and IFC are implementing the loan program Loan ratio of BPI and IFC is 50 : 50
Target	Throughout energy efficiency projects - As far as ESCO is concerned, five ESCOs now are accredited by BPI
Examination of loans	Loan standard that cash-flows of projects are kept as collateral The loans should be decided per technical and financial review conducted jointly with IFC
Loan amount	Past record: Max 300 million Peso, Min 5 million Peso

b. Exploring the possibility of a lease agreement

The Study Team had interviews with banks to identify the challenges in promoting ESCO Leases.

- Each bank has their own lease companies
- There are no lease regulations, and all equipment can be leased
- The Lease companies will finance with bank borrowing, and purchase the equipment on behalf of the leasing, it is called a Finance Lease. The finance lease expenses are allocated between the interest expense and principal values. The International Accounting Standards Board is classifying the finance lease as financial expenses, not operating, so ESCO projects per the lease agreements cannot make a profit. In the Philippines, on the other hand, the operating lease, which can be disbursed as operating expenses, is not applicable to ESCO projects.

c. Issues

The financial institutes interviewed are noting that the promotion of ESCO projects need require the following.

- Capacity Building for EPC
- IEC of ESCO business for the market
- IEC of ESCO business for financial institutes

(i) Capacity Building for EPC

The standardization of EPC will create various benefits because clients and financial institutes typically might be concerned about ESCO business. Some examples of the benefits are cutting times for negotiations, comparison of ESCOs will be easier, etc. The important issues as follows are shown in the study report for Sri Lanka supported by USAID.

- Business Plan
- Payment Terms
- Responsibilities between the Client and ESCO
- In case of an energy saving failure

(ii) ESCO awareness in the market

Per the same results of the ESCO interview, the introduction of ESCO is one effective way to save costs. However, the lack of awareness for ESCO leads to a few inquires about ESCO service.

(iii) ESCO awareness in financial institutes

There is a lack of ESCO awareness for ESCO among financial institutes as is the same in the market. Although the institute is implementing the financing for energy efficiency projects, the institute does not have any information regarding ESCO.

(6) ESCO Market Potential

The Philippines' ESCO market potential is 793 million US$ of projects, 214 million US$ of energy savings on ESCO projects, and 3.7 years for payout time.[1]

(7) Regarding the ESCO business in the Enecon Bill by DOE

As of December 2011, the ESCO business is described in the Enecon Bill. According to the Bill, the DOE shall implement the accreditation of ESCO and promote ESCO business.

Regarding ESCO accreditation, the Energy Efficiency Service Provider (EESP), whose service is just a single energy efficiency system such as lighting, air-conditioning etc., will be distinguished from ESCO, whose service is a comprehensive energy efficiency system.

Regarding ESCO promotion, on the other hand, there is no specific plan.

12.1.3 Current Situation of ESCO in Japan

For an abstraction of several good points from Japan, we introduce the current situation of Japanese ESCO business.

(1) ESCO Business and Market Size

The first ESCO in Japan was established in May 1997. In 1999, the Japan Association of Energy Service Company (JAESCO) was established. The number of operative ESCOs in Japan is generally estimated to

[1] Market Feasibility Report for Assessing the need for an Energy Efficiency Fund in South-East Asia, Re Ex Capital Asia

be about 10-20. The market size of ESCO in Japan is shown in Table 12-5.

Table 12-5 The Market Size of ESCO in Japan

Unit: Million Yen

Year	2009	2010	2011	2012	2013	2014	2015
Market Size	24,000	21,000	23,000	26,000	28,000	29,000	30,000

*2009; result, 2010; contemplation, from 2011; forecast

Source: ICT Realizes Energy Solutions whose Current Situation and Future Perspective, Fuji Chimera Research Institute

(2) Issues in Promoting ESCO in Japan

The development of ESCO business needs, to promote ESCO business with EPC, information, education and campaigns, to solve issues to project implementation in the public sector, R&D for energy efficiency techniques, project financing, development of institutions to support ESCO business. These matters are too difficult for one private company to do all alone, therefore JAESCO was established with its objective of the sound development of ESCO business. The following are JAESCO activities:

- ESCO PR and marketing
- Information exchange between members
- Support R&D towards efficient equipment and facilities
- White list of ESCO
- Extra-judicial conflict resolution procedures for ESCO businesses

12.1.4 ESCO Business in ASEAN Countries

For an abstraction of several good points from other ASEAN countries, their current situations as related to ESCO business are described here (see Table 12-6). Singapore and Thai have a larger number of ESCOs, and there are various incentives in Thailand.

Table 12-6 Overview of ESCO Business in ASEAN Countries

Country	The number of ESCO*	ESCO Associate	Incentives for ESCO	Energy Efficiency Fund	Energy Performance Contracting	Accreditation Scheme
Indonesia	9			—	—	—
Malaysia	12	Exist	low-interest	—	Some Existing	—
Singapore	34	Exist	Subsidy	—	Existing	Existing
Thailand	37		tax-incentive, low-interest, subsidy	Existing	Existing	—
Vietnam	20		low-interest	—	—	—

*The number of ESCOs listed in each country is based on the desk research of the companies listed itself as an energy service company

Source: Market Feasibility Report for Assessing the need for an Energy Efficiency Fund in South-East Asia, Re Ex Capital Asia

A country-by-country ESCO Overview is as follows:

(1) Thailand

The Thai ESCOs have the longest and largest exposure to EPC, as it is the only country among the six with a commercial managed energy efficiency fund, the Thai Energy Efficiency Revolving Fund, whose objective is to promote loans from financial institutes. The fund developed the evaluation capacity of the financiers, increased investment in energy efficiency projects, and grew the Thai ESCO market size. The total investment for energy efficiency projects with EPC increased from 6.5 million US$ in 2000 to 86.9 million US$ in 2006.

Various different types of business professionals in equipment and technology in Thailand became ESCOs, classified under the broader grouping. Based on data collected in 2009 on 24 ESCOs, ESCO was classified as follows.

1. A large company that can provide both equipment and technology
   These companies have talented staff, equipment and technologies
2. A company that serves as an equipment agent
   These companies do not have equipment and technology but act like distributors of certain equipment and technologies
3. A company that developed from an energy consultancy
   These companies have well-rounded knowledge and competency that includes performing an energy consumption investigation, project design, administrative management, operations and maintenance facility
4. A company that developed from the energy generator business
   These are large scale companies that provide a range of service including the investigation of energy consumption, installation of equipment, operations and maintenance.

(2) Singapore

ESCOs in Singapore have enough capacity to implement energy efficiency retrofitting. There are a large number of ESCO, including 14 ESCOs accredited under the Energy Services Companies Accreditation Scheme in Singapore. There are also a significant number of other firms of varying sizes offering various levels and types of energy efficiency projects. ESCOs in Singapore can provide the EPC, but are limited by the lack of financing for ESCO service. Another point to be noted is that most of the ESCOs in Singapore only offer energy efficiency retrofits for the commercial sector.

(3) Malaysia

Before the implementation of the Malaysia Industrial Energy Efficiency Improvement Project (MIEEIP) in 2002, some firms or equipment distributors provided some energy efficiency advisory service, but not in a way corresponding to the ESCO service and EPC.

Now, most ESCOs registered in Malaysia have the capacity to conduct energy audits and provide specific energy efficiency overhauls such as heating, ventilation and air-conditioning (HVAC), only a few of them are ready to move away from energy audits and a fee-for-service to EPC. From the interviews with local ESCOs, the main barrier preventing ESCOs from offering EPC is the lack of financing for such projects.[2]

(4) Indonesia

It has to be noted that ESCOs in Indonesia are subpar in comparison with the other five countries. In Indonesia, while energy audits without fares are provided to at least 250 buildings and factories, the number of energy efficiency projects implemented has not increased with the number of energy audits conducted. Overall, most ESCOs do not possess enough technical capability and financing.

(5) Vietnam

Until 2004, there were financing sources supported by international funding facilities or developed governments. While there are some local companies that promote energy efficiency in Vietnam, there are few ESCOs that provide-large scale commercial and industrial energy efficiency retrofits.[1]

(6) Summary of ESCOs

In ASEAN countries, the business environment for ESCO in Thailand is good in ASEAN countries because Thailand is supporting ESCO business with incentives and financing. Therefore, Thai ESCOs have developed various businesses specialists. It seems that most Thai ESCOs also have higher technical capability and skill amongst the ASEAN countries, and they can provide EPC.

Generally, examples of need for ESCOs in Developing Countries are:

- ✓ A range of DSM and EE programs by governments
- ✓ Program types include energy audits and so on
- ✓ Incentives for energy efficiency projects
- ✓ Create investors for energy efficiency projects

12.2 Issues in the Philippines

There are three important players, “Clients”, “ESCOs” and “Financial Institutes”. In order to promote ESCO, it is necessary that the Clients recognize ESCO business as an energy saving enterprise, fully understand its contents of agreement, and commission definitive ESCOs to conduct an energy efficiency project. The ESCOs also conclude good project agreements, and implement through technical and financial matters, the Financial Institutes recognize the ESCO project as a prospective business, strictly examine and lend to ESCO projects.

The following outlines the challenges to ESCO promotion in the Philippines.

1) ESCO Awareness

One of the issues is the lack of ESCO awareness in the market. DOE is implementing ESCO accreditation, but the campaign for ESCO promotion, introduction case studies and the demonstration projects have not yet been conducted. First, it is necessary to increase the number of access routes to ESCOs from the market.

2) Reliability of ESCO

ESCO projects differ from simply the buying and selling of goods and thus need to conclude long term agreements. To achieve energy saving, the Clients shall maintain the energy efficiency facilities and use its best efforts to protect and preserve EPC. In the case of a failure whereby the savings contemplated to be achieved per the EPC are negatively affected (although the risk can be reduced through the operation by ESCOs per its agreement). It is therefore important for the Clients and the ESCOs to implement optimized maintenance and operation, and to maintain healthy financial statements in order to conclude a long-term agreement. The Clients will be required to have solid financial statements, good credibility and good governance for energy management, on the other hand the ESCOs will be required to have solid financial statements, good credibility and higher technical skills.

3) Technical level of ESCOs

Although the DOE is implementing ESCO accreditation, the number of accredited ESCOs is only eight, and generally the criteria of ESCO accreditation includes only the financial statements of ESCOs, the number of energy audits etc, not verify the level of business skill of the ESCOs. Therefore, ESCOs can be accredited without the knowledge of EPC and related matters.

4) Incentives

The Philippines does not seem to support schemes, low-interest, subsidies and tax-holidays in comparison with other ASEAN countries.

5) Financing

Most ESCOs are facing financing limitations but certain ESCOs use project financing, so ESCO service for the private sector has not increased. The Study Team must research the situations of financing for ESCO projects in order to assess the situation properly.

Although some financial institutes are lending to energy efficiency projects, the study team has realized that only two institutes (BDO and BPI) are lending to ESCO projects. The study team is considering the reason that many financial institutes do not understand the ESCO business as such, or why they could not provide financing because of their lack of know-how to lend, etc.

6) Accounting entry for the public

ESCO projects and demonstration for the public sector affect ESCO promotion in the private sector. However, the ESCO service fare cannot be paid from the cost savings by conducting the ESCO project, and now there are no government agencies engaged in a ESCO project.

12.3 Proposal

As for the results, the study team has classified the following three challenges to ESCO promotion:

- Raising Awareness for “Clients” and “Financial Institutes”
- Capacity Building for “Clients”, “ESCOs” and “Financial Institutes”
- Support for project financing

These challenges and countermeasures are described as follows.

12.3.1 Raising Awareness for “Clients” and “Financial Institutes”

Regarding the enhancement of ESCO awareness, the study team suggests the following.

(1) ESCO business Introduction Activities

(2) Workshops or seminars on ESCO for financial institutes

(3) Demonstration project for government agencies

(1) ESCO Business Introduction Activities

DOE is implementing ESCO promotion on its website, but there are a few case studies and visitors could not understand the ESCO business model such as EPC. To enhance ESCO reliability of the Clients and the Financial Institutes, the outlines will be explained clearly with its case study so that they will be able to recognize the exact benefits to be had from an ESCO business.

One example from other countries is the government agency implementing the introductions of case studies, concerning only the public, including the energy efficiency system, service amount and the energy savings. Many other countries are also implementing activities to enhance ESCO awareness in the market.

(2) Workshops or Seminars on ESCO for Financial Institutes

Workshops and seminars on the ESCO business to enhance ESCO awareness will increase the number of financial institutes lending to ESCO projects in the Philippines, because there are some financial institutes lending to energy efficiency projects excluding ESCO.

The capacity building of project financing for the financial institutes will also activate lending for ESCO projects without asset collateral and promote energy efficiency, because some financial institutes do not treat the project cash flow as collateral for the project loan.

(3) Demonstration Project for Government Agencies

The implementation of a demonstration project for government agencies will affect the clients and the financial institutes when it comes to enhancing the awareness and reliability of ESCO business. To improve the awareness of EPC for the private sector, the case study of the ESCO project per EPC for the public sector is also effective.

As described in 12.2(7), the accounting entry for the public, one of the issues is government agencies cannot implement ESCO business per the current accounting. To implement the ESCO project, the government should improve the accounting entry, or carry out special measures for the ESCO project in the public.

12.3.2 Capacity Building for "Clients", "ESCOs" and "Financial Institutes"

The study team is suggesting the following as capacity building.

(1) Standardization of EPC
(2) Improvement of DOE ESCO website
(3) Workshops or seminars on ESCO financing
(4) Tightening of ESCO accreditation

(1) Standardization of EPC

Standardization of EPC created by the government or concerned parties will improve the ESCO business reliability, and create various benefits including the cutting times for negotiations between clients and ESCOs, and the review of financial institutes.

Many countries are implementing EPC standardization and achieving benefits. In Japan, the ECCJ created an ESCO guideline for the public sector, which includes ESCO business case studies of and the ESCO business standard agreement.

(2) Improvement of DOE ESCO Website

As described in 12.3.1(1) activities of the Introduction of ESCO business, the DOE does not introduce the case studies including the type of ESCO agreement, installation equipment and the amount of energy savings on its website. Furthermore, there are not a few ESCOs without the necessary knowledge of ESCO business such as EPC.

The case studies of ESCO business for the public can improve awareness in the energy saving potential sector, and be capacity building for "Clients", "ESCOs" and "Financial Institutes".

(3) Workshops or Seminars on ESCO Financing

To improve the awareness and exact knowledge of ESCO business for financial institutes is necessary to promote financing for ESCO projects. Now there are some institutes lending to energy efficiency projects that have no awareness of ESCO. These institutes therefore might not understand the issues for lending and the benefits of ESCO business. Workshops and seminars on ESCO for financial institutes will do their capacity building.

(4) Improvement of ESCO Accreditation

When the criteria of accreditation include the EPC levels of ESCOs, ESCOs who would like to achieve accreditation will be expected to improve their EPC level. The accreditation needs to implement EPC between Clients and ESCOs, and the implementation status of EPC will be affirmed by conducting interviews for Clients. With regards to presently accredited ESCOs, EPC workshops etc. will be conducted, as it would be best to have all accredited ESCOs become enterprises knowledgeable in the workings of performance-based contracts.

To tighten ESCO accreditation will create criteria that will be referred to when the clients seek ESCOs. The financial institutes also can refer to the criteria when some of the accredited ESCOs apply for the institutes to lend to energy efficiency projects.

12.3.3 Support for Project Financing

The study team is suggesting the following as support for project financing. The report removes the contents that overlap between the project financing and enhancing awareness or capacity building.

(1) Project bundling for government buildings
(2) National financial support

(1) Project Bundling for Government Buildings

The bundling project, several buildings into one project could be a solution to promote ESCO business for small buildings, if the government buildings could improve ESCO business. Therefore, the study team suggests that the DOE bundle these small buildings into one ESCO project as a demonstration project. The ADB also considered the same scheme in the Super ESCO project. Given that the portion of transaction costs in small projects is bigger than in large projects, financial institutes are likely to refuse lending for small projects.

To solve this problem, the public sectors in Japan will bundle together their small buildings such as primary schools and increase the scale of ESCO project lending.

These activities will affect the private sector to the standardization of the same structure. The challenge to commission ESCOs for minor enterprises is its small scale of operation. It is difficult for a sole enterprise to commission ESCOs, but some enterprises can jointly commission ESCOs because of their large project scale. Therefore, minor enterprises can lend the amount equivalent to the cost of the energy efficient project, ESCOs can negotiate with representative enterprises and cut the times of negotiations with their clients, and financial institutes can put aside enough lending costs for the bundling agreement.

(2) National Financial Support

The financial support from EECCP under consideration as a government institute can be of help for the financing of an ESCO project. The study team would like to suggest two matters in consideration of the government financial statement.

a. Joint financing with financial institutes
b. Credit guarantee for ESCO projects

The details are described as follows.

a. Joint financing with financial institutes

Joint financing can be the diversification of the lending risks of large ESCO projects for financial institutes. The lead manager can achieve not only the loan rate but also the arrangement fee and agent fee.

There appeared one example whereby IFC and BPI are implementing joint financing for an energy efficient project in the Philippines.

b. Credit guarantee for ESCO projects

Given that ESCOs in the Philippines are often not set up by utilities or other large companies, the ESCOs might not get good financing minus any established credibility. The same scheme might be applied for because the credit guarantee that the government shall cover the project cost in the case of a failure on behalf of financial institutes will encourage lending for ESCO projects. However, it is necessary that the DOE implement the ESCO accreditation strictly and that the government understands the reliability of ESCOs.

In Brazil, the government created a guarantee facility for energy efficiency projects, shares up to 80% of the credit risk. International financing institutes such as the World Bank implemented the same scheme of credit guarantee in each country.

12.4 Summary

This report has shown that the current situation of ESCO business, issues and challenges in the Philippines with the introduction of the business situation in each ASEAN country including Japan. The ESCO business in the Philippines is recent, and has many issues such as ESCO awareness, their capability and financing, etc. However, it is not impossible to improve their business situation. The study team suggests challenges to encourage the ESCO business and show the effect of such activities.

Table 12-7 Challenges and Effectives for Promoting ESCO

Challenge	Effective		
	Awareness	Capacity Building	Financing
(1)Introduction of ESCO business through the DOE website and so on	Enhancement of ESCO awareness for clients and financial institutes	For clients, ESCOs and financial institutes	Increasing the number of financial institutes lending for ESCO projects
(2) Standardization of EPC conducted by DOE	Enhancement of EPC awareness for clients, ESCOs and financial institutes	Improvement of negotiation between clients and ESCOs, and screening skills for financial institutes	Increasing the number of financial institutes lending for ESCO projects
(3) Workshops or seminars on ESCO financing for financial institutes	Enhancement of ESCO awareness for financial institutes	Improvement of financing capability for financial institutes	Increasing the number of financial institutes lending for ESCO projects
(4) Tightening the DOE ESCO accreditation		Improvement of business skills of ESCOs, Establishment of the ESCOs judgment standard for clients and financial institutes	Creation of the lending standard for financial institutes, and increasing the number of financial institutes lending for ESCO projects
(5) Review the current accounting regulation for government agencies			Creation of the ESCO project cost for government buildings
(6) Demonstration projects for government agencies	Enhancement of ESCO awareness for clients and financial institutes		Increasing the number of financial institutes lending for ESCO projects
(7) Bundling of ESCO projects for government buildings			Improvement of the ESCO financing of small buildings
(8) Joint financing between government and financial institutes			Diversification of lending risks, creation of fees excluding loan rate, and increasing the number of financial institutes lending for ESCO projects
(9) Credit guarantee for ESCOs by government			Diversification of lending risks, and increasing the number of financial institutes lending for ESCO projects

Chapter 13 EE&C Standards for Buildings

13.1 Current Situation

EE&C standards for buildings are out of the scope of the Study, but the current situation grasped and considerations are shown herewith.

13.1.1 Current Situation in Other Countries

(1) Japan

More than 30 years have passed since building energy conservation codes, which They are legislated in the act 'The Act on the Rational Use of Energy (so-called 'The Energy Conservation Act')' was into effect in 1960) were applied.

1) Obligation

Submission of energy conservation measures for the newly building under construction or for renovation.

Regular reporting (every 3 years)

2) Object

Buildings of 300m^2 and more (total floor area) (new building, extension and renovation of building)

3) Evaluation items

① Protection of Heat gain through wall and window
② Efficient energy utilization of air-conditioning system
③ Efficient energy utilization of ventilation system
④ Efficient energy utilization of hot water system
⑤ Efficient energy utilization of lighting system
⑥ Efficient energy utilization of transporting system

4） Standards

- Performance standards

It is composed of PAL and CEC and applicable for all kinds of buildings.

PAL: Perimeter Annual Load (MJ/m^{2}year)

PAL＝Annual heating load / all floor area of perimeter zone

To evaluate thermal performance of building envelope (wall and windows)

CEC: Coefficient of Energy Consumption for Air Conditioning (MJ/m^{2}year)

Air-conditioning and Hot water supply systems:

CEC＝Annual energy consumption / Annual estimated load

Mechanical ventilation・Lighting・Elevator systems:

CEC＝Annual energy consumption / Annual estimated energy consumption

To evaluate efficiency of equipment or system

Standard values for PAL and CEC are shown in the next table. They are set according to building types and the values calculated should be below the standard values.

Table 13-1 Energy Performance Standards by PAL/CEC and Point Method

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Types	**Hotel**	**Hospital**	**Retailer**	**Office**	**School**	**Restaurant**	**Assembly Hall**	**Factory**
①PAL	**420**	**340**	**380**	**300**	**320**	**550**	**550**	**?**
②CEC/AC	**2.5**	**2.5**	**1.7**	**1.5**	**1.5**	**2.2**	**2.2**	**?**
③CEC/V	**1.0**	**1.0**	**0.9**	**1.0**	**0.8**	**1.5**	**1.0**	**?**
④CEC/L	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
⑤CEC/HW	**0＜Ix≦7 1.5 7＜Ix≦12 1.6 12＜Ix≦17 1.7 17＜Ix≦22 1.8 22＜Ix 1.9**							
⑥CEC/EL	**1.0**	**?**	**?**	**1.0**	**?**	**?**	**?**	**?**

- Specification standards －Point method, Simple Point method

Applicable for buildings of 300～5,000m^2

Total points for every energy conservation measures should reach 100 and more.

The accuracy of this method is inferior to that of PAL/CEC, but an easy method to evaluate.

Simple Point method was added by the revision of 2008 for buildings of 300～2,000m^2 floor area.

(2) Movement of ASEAN Countries

EE&C standards have been already applied in Singapore, Malaysia and Thailand. The fundamental structures of them are very similar and based on ASHRAE[1] Standards of the United States. Evaluation items are as follows:

1) Thermal evaluation of building envelope by OTTV (Overall Thermal Transfer Value)
2) Performance standards on air-conditioning and ventilation system, lighting system, electrical system and hot water supply system

Buildings in Singapore are mandated to be designed based on their EE&C standards in the energy conservation act (from 1979). The Building & Construction Authority of Singapore is in charge of this affair.

There are building guidelines made in Malaysia, which will be mandatory if its energy conservation law is established.

In Thailand, the energy conservation act was established in 1995 and at the same time, the building EE&C standards became mandatory for large size buildings beyond the certain level of newly built or being renovated under its regulations.

1 American Society of Heating, Refrigerating and Air-Conditioning Engineers

13.1.2 Current Situation regarding EE&C Standards in the Philippines

In the Philippines the submission of energy conservation planning based on the energy standards is not required when a building permit is applied. This kind of submission is very important theme to promote EE&C and can be said as one of the most important items of EE&C law in the future.

At present, there is already an existing guideline for EE&C which is at the level of practical use for EE&C standards.

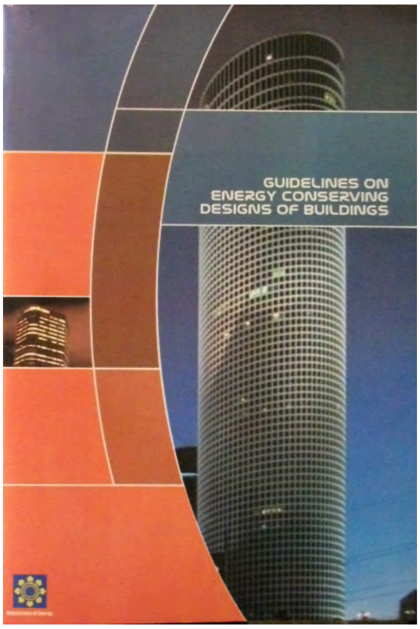


Figure 13-1 Guidelines on Energy Conserving Designs of Buildings

This guideline is aimed for EE&C designing for buildings and was made by the leadership of DOE with the cooperation of the organizations concerning building codes in the following table.

Table 13-2 Relevant Organization for Guidelines on Energy Conserving Designs of Buildings

DOE（LATL 含む）: Department Of Energy
IIEE: The Institute of Integrated Electrical Engineers of the Phils.
PLIA: Philippine Lighting Industry Association
ENPAP: The Energy Efficiency Practitioners Association of the Philippines
BPS: Bureau of Product Standards
DPWH: Department of Public Works and Highways
MERALCO: Manila Electric Railroad And Light Company
PSME: Philippine Society of Mechanical Engineers
PSVARE: Philippine Society of Ventilation, Air Conditioning and Refrigeration
UAP: United Architects of the Philippines

The guideline is composed of the following items. Similar to the cases of ASEAN countries, it is based on the ASHRAE Fundamentals and the structure and the contents are similar to them.

1) Lighting system

It regulates necessary conditions from the standpoints of energy conservation on luminance, lighting efficiency and lighting density. It refers to luminance levels according to room functions.

・To use of energy efficient lighting
・To use of task and ambient lighting system
・EE&C by integrating lighting and air-conditioning
・To design lighting fixtures according to activity

Table 13-3 Recommended Design Luminance Levels

Task	Min. & Max. (Lux)	Applications
Lighting for infrequently used areas	50 – 150	Circulation areas and corridors
	100 – 200	Stairs
	100 – 200	Hotel, escalators
Lighting for working interiors	200 – 300	Infrequent reading and writing
	300 – 750	General offices, typing and computing
	300 – 750	Conference rooms
	500 – 1000	Deep-plan general offices
	500 – 1000	Drawing offices
Localized lighting for exacting tasks	500 – 1000	Proofreading
	750 – 1500	Designing, architecture and machine engineering
	1000 – 2000	Detailed and precise work

In addition, there are maximum limits according to luminance intensity and room types.

2) Electric power and distribution system

・Power receiving system and transformers
- ✓ Transformer efficiency: 98％ and more
- ✓ Power factor: 85％ and more
- ✓ Load factor of transformer: 75％ and more

・Energy metering facility
- ✓ To install metering facilities of current, voltage, power factor, peak demand and electricity consumption of buildings with the capacity of 20KVA and more.
- ✓ To install feeders divided to make it possible to meter energy consumption of particular groups such as lighting, air-conditioning and ventilation systems.

3) OTTV（Overall Thermal Transfer Value）

OTTV values and permissible infiltration values are defined for buildings with their air-conditioning load of 175 kW and more.

・Objects for calculation of OTTV

① Heat penetration through wall and roof

② Heat penetration through fenestration

③ Solar radiation through window glasses

・Equation of OTTV for wall and roof

$$OTTV = \frac{A_W \times U_W \times TDeq + Af \times Uf \times \Delta T + Af \times SF \times SC}{A_0} \quad \text{----------------} \quad (1)$$

Where:

OTTV : overall thermal transfer (W/m^2)

Aw : opaque wall area (m^2)

Uw : thermal transmittance of opaque wall (W/m^2 °K)

TDeq : equivalent temperature difference (°K), see sub paragraph 5.2.4.1.1

Af : fenestration area (m^2)

Uf : thermal transmittance of fenestration (W/m^2)

ΔT : temperature difference between exterior and interior

SC : shading coefficient of fenestration

SF : solar factor (W/m^2), see sub paragraph 5.2.5.1.2

Ao : gross area of exterior wall (m^2)

= Avs + Af

・OTTV for wall： 45W/m^2 and more

OTTV for roof： 45W/$m^2$and more

・Infiltration

✓ Infiltration through fenestration

2.77 m^3/h・m（clearance leakage） and less

✓ Infiltration through door

61.2 m^3/h・m （door perimeter length） and less

4) Air-conditioning and ventilation system

Air-conditioning load calculation is based on A SHRAE Handbook of Fundamentals.

✓ Designing indoor conditions : 25℃（23～27□）、55%（50～60%, relative humidity）

✓ Designing outdoor conditions : 27℃（wet bulb temperature）、35℃（dry bulb temperature）

✓ Necessary ventilation

Table 13-4 Outdoor Air Requirements for various Rooms

Facility/Area	Outdoor Air Requirements (L/s)	
	Smoking	Non-Smoking
Commercial Stores		
Sales floors & showrooms	3.5	5 – 7
Stockrooms	2.5	3.5 – 4.5
Dressing rooms	3.5	5 – 7
Malls & arcades	3.5	5 – 7
Shipping & receiving areas	7	7 – 9.5
Warehouses	3.5	3.5 – 4.5
Elevators	3.5	3.5 – 4.5
Smoking areas	14	18 – 23.5
Sports & Amusement Facilities		
Ballrooms	7	9.5 – 11.5
Bowling alleys (seats)	7	9.5 – 11.5
Gymnasiums	9.5	11.5 – 14
Spectator areas	9.5	11.5 – 14
Game rooms	9.5	11.5 – 14
Hotels & Other Lodging Facilities		
Bedrooms (S/D)	3.5(b)	5 – 7(b)
Living rooms (suite)	4.5(b)	7 – 9.5(b)
Baths, toilets	9.5(b)	14 – 23.5(b)
Lobbies	3.5	5 – 7
Conference rooms (small)	9.5	11.5 – 14
Large assembly rooms	7	9.5 – 11.5
Offices		
Work areas	7	7 – 11.5
Facility/Area	Outdoor Air Requirements (L/s)	
	Smoking	Non-Smoking
Hospitals		
Patient rooms	-	3.5 (c)
Medical procedure areas	-	3.5
Operating rooms	-	10.0
Recovery & ICU rooms	-	7.5
Autopsy rooms	-	30.0
Physical therapy areas	-	7.5
Educational Facilities		
Classrooms	-	2.5
Laboratories	-	5.0
Training shops	-	3.5
Libraries	-	2.5
Auditoriums	-	3.5

Notes:

(a) All figures are in liters per second (L/s).
(b) Unit is on per room basis.
(c) Unit is on a per bed basis.

・Minimum performance ratings of various air conditioning systems is shown in the following table.

Table 13-5 Minimum Chiller's Performance

Air Conditioning Equipment	EER	kWe/TR
Unitary A/C units		
Up to 20 kWr capacity	0.56	-
21 to 60 kWr capacity	0.53	-
61 to 120 kWr capacity	0.50	-
Over 120 kWr capacity	0.48	-
Reciprocating chillers (up to 120 kWr)		
Air cooled	-	1.37
Water cooled	-	0.99
Reciprocating chillers (above120 kWr)		
Air cooled	-	1.27
Water cooled	-	0.92
Centrifugal chillers		
Air cooled	-	-
Water cooled	-	0.60

Notes:
EER = kJ/kWh
See Equation 6.10.4
kWe/TR = kilowatt electricity per ton of refrigeration
1TR = 3.51685 kWr

5) Steam and hot water supply system

Conditions for steam boiler and hot water supply system are shown in the next table.

Table 13-6 Minimum Efficiency for Steam Boilers and Storage Tanks

Equipment	Minimum Criteria
Shell Boiler (light oil fired)	
@ Rated capacity	85% boiler efficiency
@ Part load capacity	80% boiler efficiency
Shell Boiler (heavy oil fired)	
@ Rated capacity	85% boiler efficiency
@ Part load capacity	80% boiler efficiency
Unfired Storage Tanks (all volumes)	
Surface heat loss (maximum)	43 W/m^2

13.2 Proposal

Guidelines on Energy Conserving Designs of Buildings made by DOE is at the same level of those used in ASEAN countries. Therefore, there will be no problems to apply them as EE&C standards for a newly built or renovated buildings when EE&C law is enforced.

The following items are considered in terms of the introduction of the standards.

- Concretization of guidelines
- Size of buildings to apply energy conservation standards
- Work flow
- Structure
- Schedule for execution

(1) Concretization of Guidelines

It is necessary to examine in detail whether the guidelines can be practically used. The main items are as follows,

- ✓ Applicability of every regulation clause for the current situations
- ✓ Development of calculation software of the standards by personal computer
- ✓ Buildup of calculation methods of every item of the standards
- ✓ Formats of submission document（refer to an example by Hong Kong government in Table 13-8 at the end of this chapter）

(2) Size of Buildings to Apply EE&C Standards

The items to be considered are as follows,

- ✓ Building size shall be decided by floor area or energy consumption. （In Japan it is decided by floor area.）
- ✓ Building size of 10,000 m^2 of floor area or more is acceptable for the capability of DOE to handle submitted documents.
- ✓ Consideration of necessity to change the size of the building according to the building type
- ✓ Determination on conditions to submit EE&C Plan for the renovation of facilities such as air-conditioning, ventilation, hot water supply and lighting system in buildings.

(3) Work Flow

Flow chart of submission of Energy Efficiency Plan is shown in Fig.11.2.1. At the process of applying building permits, EE&C Plan should be attached with the design materials to report the calculation results for EE&C according to the EE&C standards.

It is difficult for the officers of DPWH (Department of Public Works and Highways) to deal with these documents and DOE may examine and approve the documents (Receiving the documents is possible by DPWH together with other building permit materials).

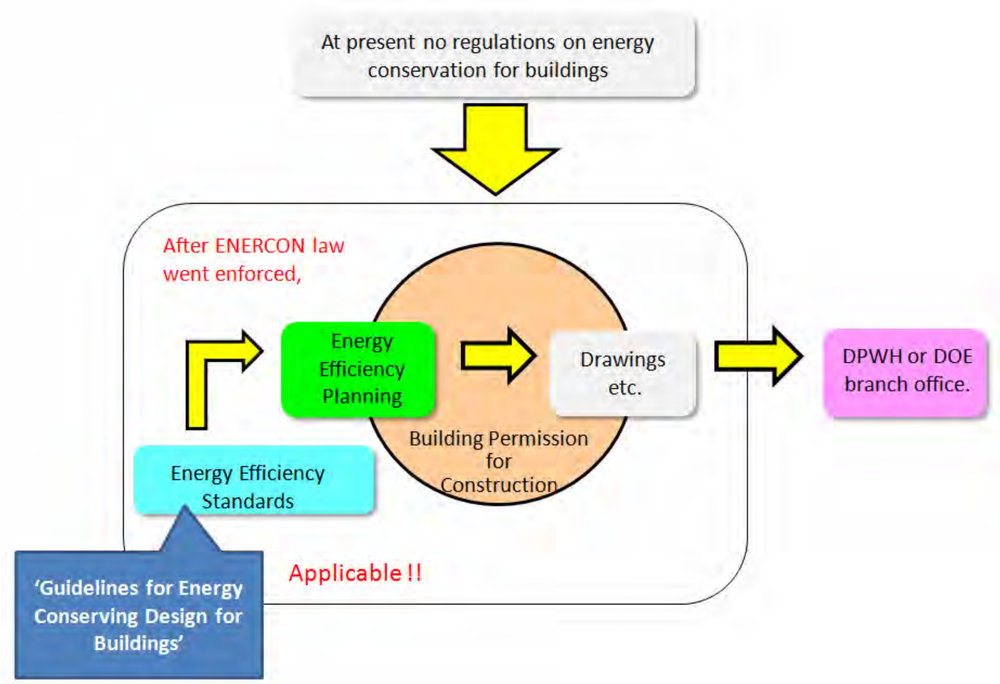


Figure 13-2 Flow Chart of Submission of Energy Efficiency Plan

(4) Structure

The items to be considered are as follows,

- ✓ Structure of DOE for treating submitted documents and the cooperation system with DPWH and LGUs.
- ✓ Role allocation of works of branches of DPWH, LGUs and DOE.
- ✓ Concrete process for admission of submitted document of Energy Efficiency Plan

(5) Schedule for Implementation

It is needed to make a concrete schedule in detail for implementing EE&C standards system before establishment of EE&C law, especially concerning building up the cooperation system between DOE and DPWH and LGUs.

13.3 Summary

The Philippines has a guideline for EE&C standards for buildings. It also is stipulated in the draft EE&C bill. After introducing Japanese cases, the items to be considered in the case of introduction in the Philippines were analyzed and presented below.

Table 13-7 Outline of Consideration Items in case of Introduction

Items	Contents	Japanese Case (reference)
Concretization of guidelines	- Applicability of the guideline - Format reports to be submitted etc.	- Indicators easy to be judged (PAL,CEC)
Size of buildings to apply energy conservation standards	- Construction only or inclusion of retrofitting - Target by floor area or energy consumption etc.	- Inclusion of construction and large retrofitting - Floor area standards
Work flow	- Work flow of the procedures	- Submission in applying construction permission
Structure	- Implementing agency (DOE) - Agency who receives reports	- Implementing agency（Ministry of Land, Infrastructure, Transport and Tourism）
Schedule for execution	- Necessity of establishment	

Table 13-8 OTTV Summary Sheet（Hong Kong）

OTTV Summary Sheet

Address :			BD Ref. No.
Building Type		☐ 1. Hotel ☐ 2. Office (including industrial/office) ☐ 3. Shops ☐ 4. Others*, please specify :	
OTTV calculated by		☐ 1. Registered Professional Engineers (Building Services/Mechanical) ☐ 2. Architect ☐ 3. Others, please specify :	
Classification		Podium	Tower
Designated Use		☐ 1. Shops ☐ 4. Cinema ☐ 2. Offices ☐ 5. Plant Rooms ☐ 3. Restaurants ☐ 6. Others	☐ 1. Office ☐ 2. Hotel Rooms ☐ 3. Others
No. of Storeys (excluding ground floor)			
Gross Floor Area		m²	m²
Usable Floor Area		m²	m²
Total External Wall Area (including windows)		m² window to wall ratio	m² window to wall ratio
Total Window Area		m² = :	m² = :
Total Skylight Area		m²	m²
*Weighted Average U-value (W/m² K)	Opaque Wall	W/m² K	W/m² K
	Window	W/m² K	W/m² K
	Opaque Roof	W/m² K	W/m² K
	Skylight	W/m² K	W/m² K
Window	Glass Type	☐Reflective, Area = m², SC = VLT =	☐Reflective, Area = m², SC = VLT =
		☐Tinted, Area = m², SC= VLT =	☐Tinted Area = m², SC= VLT =
		☐Clear, Area = m², SC= VLT =	☐Clear, Area = m², SC= VLT =
	Double Glazing	☐ Yes ☐ No	☐ Yes ☐ No
	External Shading	Overhang ☐ Yes ☐ No	Overhang ☐ Yes ☐ No
		Sidefin ☐ Yes ☐ No	Sidefin ☐ Yes ☐ No
Skylight	Glass Type	☐ Reflective, Area = m², SC = VLT =	☐Reflective, Area = m², SC = VLT =
		☐ Tinted, Area = m², SC= VLT =	☐Tinted, Area = m², SC= VLT =
		☐ Clear, Area = m², SC= VLT =	☐Clear, Area = m², SC= VLT =
	Doubling Glazing	☐ Yes ☐ No	☐ Yes ☐ No
	External Shading	☐ Yes ☐ No	☐ Yes ☐ No
**Weighted Average Absorptivity	Wall		
	Roof		
**Weighted Average Density	Wall	kg/m²	kg/m²
	Roof	kg/m²	kg/m²
OTTV	Wall	W/m²	W/m²
	Roof	W/m²	W/m²
	Overall average	W/m²	W/m²
Additional information/views on energy efficiency control :			

Address :			BD Ref. No.
Building Type		☐ 1. Hotel ☐ 2. Office (including industrial/office) ☐ 3. Shops ☐ 4. Others*, please specify :	
OTTV calculated by		☐ 1. Registered Professional Engineers (Building Services/Mechanical) ☐ 2. Architect ☐ 3. Others, please specify :	
Classification		Podium	Tower
Designated Use		☐ 1. Shops ☐ 4. Cinema ☐ 2. Offices ☐ 5. Plant Rooms ☐ 3. Restaurants ☐ 6. Others	☐ 1. Office ☐ 2. Hotel Rooms ☐ 3. Others
No. of Storeys (excluding ground floor)			
Gross Floor Area		m²	m²
Usable Floor Area		m²	m²
Total External Wall Area (including windows)		m² | window to wall ratio	m² | window to wall ratio
Total Window Area		m² | = :	m² | = :
Total Skylight Area		m²	m²
*Weighted Average U-value (W/m² K)	Opaque Wall	W/m² K	W/m² K
	Window	W/m² K	W/m² K
	Opaque Roof	W/m² K	W/m² K
	Skylight	W/m² K	W/m² K
Window	Glass Type	☐Reflective, Area = m², SC = VLT = ☐Tinted, Area = m², SC= VLT = ☐Clear, Area = m², SC= VLT =	☐Reflective, Area = m², SC = VLT = ☐Tinted Area = m², SC= VLT = ☐Clear, Area = m², SC= VLT =
	Double Glazing	☐ Yes ☐ No	☐ Yes ☐ No
	External Shading	Overhang ☐ Yes ☐ No Sidefin ☐ Yes ☐ No	Overhang ☐ Yes ☐ No Sidefin ☐ Yes ☐ No
Skylight	Glass Type	☐ Reflective, Area = m², SC = VLT = ☐ Tinted, Area = m², SC= VLT = ☐ Clear, Area = m², SC= VLT =	☐Reflective, Area = m², SC = VLT = ☐Tinted, Area = m², SC= VLT = ☐Clear, Area = m², SC= VLT =
	Doubling Glazing	☐ Yes ☐ No	☐ Yes ☐ No
	External Shading	☐ Yes ☐ No	☐ Yes ☐ No
**Weighted Average Absorptivity	Wall		
	Roof		
**Weighted Average Density	Wall	kg/m²	kg/m²
	Roof	kg/m²	kg/m²
OTTV	Wall	W/m²	W/m²
	Roof	W/m²	W/m²
	Overall average	W/m²	W/m²
Additional information/views on energy efficiency control :			

SC = Shading Coefficient VLT = Visible Light Transmittance

*Other commercial buildings may include : department stores, places of public entertainment, places of public assembly, restaurants etc.

**Weighted by area

Note :

1. Please tick in the box as appropriate
2. Window and skylight data should represent the major proportion of its use in the development.

Source: Building energy code of Hong Kong, Overall thermal transfer value in buildings (1995), Building code on energy services.

Chapter 14 Economic Evaluation of Introduction of EE&C Law and Measures

14.1 Purpose and Calculation Method

14.1.1 Purpose

In this chapter the Study team forecasted the energy conservation amount in two cases. The first case was the evaluation of the implementation of Energy Management System(hereinafter EMS) and the second case is the assumption brought by achieving the national target. Then, the reduction of energy cost in both cases as a national benefit was calculated, which can be the capital of EE&C activities.

14.1.2 Calculation Method

The calculation was done in two reference cases those are the implementation of EMS case (case A) and achieving the national target case (case B). The reduction of energy consumption and cost were deduced from difference between each reference case and base case which is forecasted by the Study team based on the current situation.

(1) Forecast energy consumption of whole country until 2030 (case A)

(2) Forecast energy consumption of whole country until 2030 (case B)

(3) Calculate the reduction of energy consumption and cost by comparison between the base case with the Reference case A,B

The final energy consumption per sector is estimated using the energy intensity of the population and GDP. Then, the final energy consumption per energy type is estimated based on "Philippine Energy Plan" and "Power Development Plan".

Primary energy used for power generation is estimated by each energy type and then add to the energy other than power generation to calculate the total primary energy.

The following plans adopted in the Philippine's energy policies are also reflected in the estimation.

- Accelerated use of renewable energies (wind, solar, biomass)
- Development of Geothermal power plant
- Accelerated use of Bio fuel for automobiles

Regarding the case of assumption brought by achieving the national target, the Study team changed some of the conditions for calculation for reasons to be given later.

14.1.3 Preconditions of Calculation

The economic indicators used for the calculation are as follows. The data from 2011 to 2030 are estimated based on the actual data from 2000 to 2010. The data of every five years are shown in the following table as representative.

Table 14-1 Economical Indicators

	2010	2015	2020	2025	2030
Population (million person)	94.0	103.3 (1.9%/year)	113.4 (1.9%/year)	124.4 (1.9%/year)	136.3 (1.8%/year)
GDP (real billion peso)	6,906.6	8,966.9 (5.5%/year)	11,719.3 (5.5%/year)	14,957.2 (5.0%%/year)	19,089.6 (5.0%/year)
Exchange rate (Peso/US$)	45.1	44.7 (1.3%/year)	47.7 (1.3%/year)	49.6 (0.8%/year)	49.6 (0.8%/year)
Crude oil price (US$/bbl)	79.5	101.3 (1.2%/year)	107.5 (1.2%/year)	114.0 (1.2%/year)	120.9 (1.2%/year)
Coal price (US$/t)	105.2	118.8 (1.2%/year)	126.0 (1.2%/year)	133.6 (1.2%/year)	141.7 (1.2%/year)
Natural gas price (US$/MMBtu)	9.6	10.9 (0.9%/year)	11.4 (0.9%/year)	11.9 (0.9%/year)	12.5 (0.9%/year)

[Source of actual data(2000～2010)]

Population : ADB statistics

GDP : ADB statistics

Exchange rate : ADB statistics

Crude oil price : BP statistics

Coal price : BP statistics

Natural gas price : collected from Natural Gas office of DOE

[Measures of estimation (2011～2030)]

Population : Regression analysis

GDP : Based on the trend of recent years and the estimation of IMF and ADB

Exchange rate : Estimated by the difference of the USA and the Philippines' inflation rate

Crude oil price : Refer to the analysis of the research institution

Coal price : Regression analysis with the crude oil price

Natural gas price : Regression analysis with the crude oil price

14.2 Economic Evaluation of Introduction of EMS

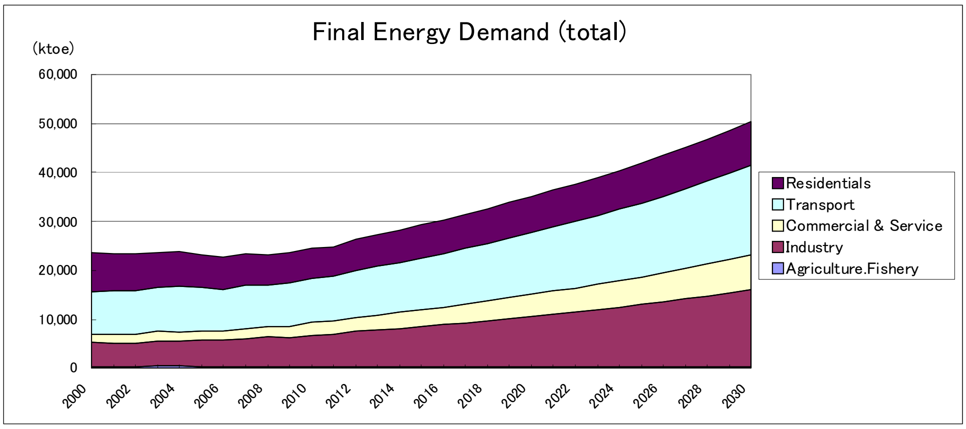
The energy consumption amount of the base case is forecasted in the order of final energy consumption and primary energy consumption at the first. The same consumption data of the reference case are also forecasted in the next. Then, the energy conservation amount is calculated by difference of energy consumption data of the both cases. Finally, the national benefit is calculated as the reduction of energy cost.

14.2.1 Estimation of Energy Consumption Amount (Base case)

(1) Final Energy Consumption

1) Final energy consumption by sector(Base case)

The growth rate per year of final energy consumption from 2010 to 2030 is estimated to be three point seven per cent (3.7%) in proportion to economic growth. The growth rate of the commercial sector, industrial sector and transportation sector are relatively high.



(Source: EPPB, EPIMB etc.)

Figure 14-1 Chronological Data of Estimation of Final Energy Consumption by Sector

Table 14-2 Chronological Data of Estimation of Final Energy Consumption by Sector

(ktoe)

	2000	2005	2010	2015	2020	2025	2030	2030/10* (%/year)
Residential	7,904	6,694	6,125	6,754	7,409	8,120	8,894	1.9
Transportation	8,748	8,989	9,023	10,580	12,678	15,116	18,224	3.6
Commercial	1,685	1,853	2,664	3,455	4,483	5,673	7,181	5.1
Industrial	4,830	5,302	6,364	8,159	10,243	12,656	15,691	4.6
Agriculture	364	381	347	333	337	352	376	0.4
Total	23,532	23,219	24,552	29,281	35,150	41,917	50,366	3.7

*2030/2010: Average growth rate per year from 2010 to 2030

(Source: EPPB, EPIMB, etc.)

2) Final Energy Consumption by Energy Type (Base case)

The growth rate of Power (5.0%) and coal (4.5%) are high. The growth rate of natural gas (4.5%) and biomass (13.8%) are also high though the consumption amount is not so much. Regarding oil products, the growth rate is below the average rate though consumption amount is still high.

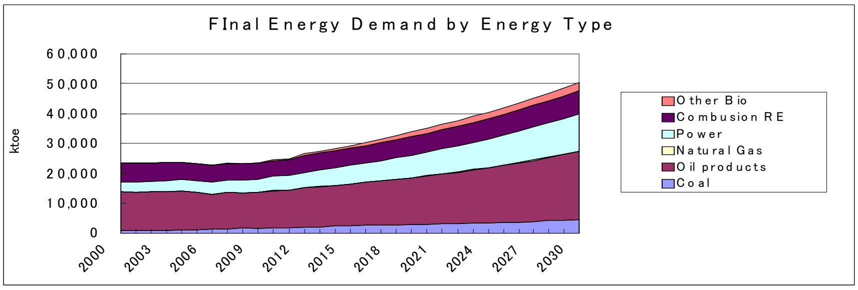


Figure 14-2 Chronological Data of Estimation of Final Energy Consumption by Energy Type

Table 14-3 Chronological Data of Estimation of Final Energy Consumption by Energy Type

(ktoe)

	2000	2005	2010	2015	2020	2025	2030	2030/10 (%/y) *1
Coal	701	1,056	1,831	2,344	2,910	3,566	4,391	4.5
Oil products	13,018	12,499	12,320	13,975	16,219	19,035	22,906	3.1
Natural gas	0	52	70	89	111	136	167	4.5
Power	3,144	3,884	4,753	6,146	7,943	10,014	12,541	5.0
Combustion RE *2	6,670	5,766	5,341	5,823	6,316	6,884	7,609	1.8
Other BIO *3	0	2	208	904	1,652	2,282	2,752	13.8
Total	23,532	23,219	24,522	29,281	35,150	41,917	50,366	3.7

*1 2030/2010: Average growth rate per year from 2010 to 2030

*2 Combustion RE: Mainly firewood

*3 Other BIO: Biomass energy other than combustion RE -e.g. ethanol

(2) Primary Energy Consumption (Base case)

1) Primary energy consumption by energy type (Base case)

After the conversion of power into fuel consumption, the growth rate of coal (6.8%) and natural gas (6.5%) became higher. On the other hand, the growth rate of oil became lower. The growth rates of renewable energy such as wind and solar are also high though the consumption amount are not so much.

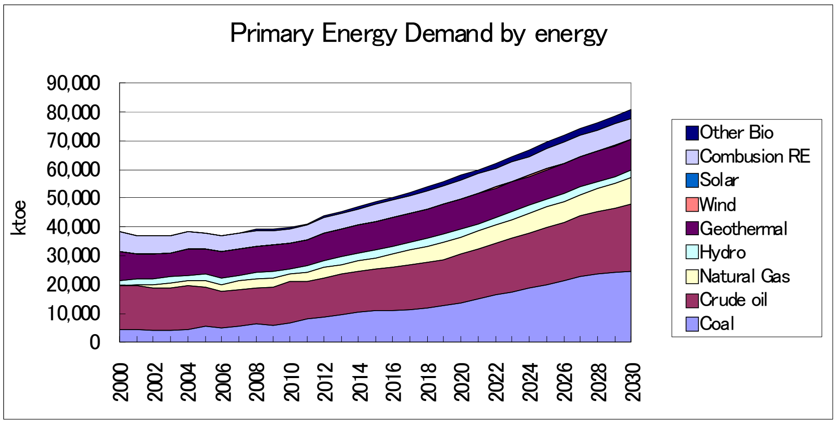


Figure 14-3 Chronological Data of Estimation of Primary Energy Consumption by Energy Type

Table 14-4 Chronological Data of Estimation of Primary Energy Consumption by Energy Type

(ktoe)

	2000	2005	2010	2015	2020	2025	2030	2030/10 (%/y) *
Coal	4,485	5,190	6,920	10,715	13,698	19,993	25,734	6.8
Crude oil	15,123	13,899	13,801	14,633	16,859	19,657	23,480	2.7
Natural gas	9	2,473	2,802	3,997	6,079	7,275	9,848	6.5
Hydro	1,942	2,088	1,943	2,712	2,712	2,712	2,712	1.7
Geothermal	9,998	8,516	8,539	9,910	10,359	10,359	10,359	1.0
Wind	0	2	5	30	136	154	165	18.7
Solar	0	0	0	1	4	6	9	24.9
Combustion RE	6,670	5,766	5,341	5,823	6,316	6,884	7,609	1.8
Other BIO	0	2	217	929	1,685	2,320	2,796	13.6
Total	38,227	37,935	39,568	48,750	57,846	69,301	82,713	3.8

* 2030/2010: Average growth rate per year from 2010 to 2030

14.2.2 Estimation of Energy Consumption Amount (EMS installed case)

(1) Case settings of the Introduction of EMS

Estimation has been done under the following conditions. Some unavailable data are assumed.

Introduction year of EMS : 2012

Effective period : 2015～2030

(Effect of EMS will emerge after three years of the introduction)

Energy conservation effect: Final energy intensity per GDP shall decrease 1% per every year (assumption)

Target sector : Industrial, Commercial, Transportation

overage of EMS on the target sector : 50% of final energy consumption in 2012 (assumption)

(Coverage will increase in proportion to economic growth to 80% in 2030)

(2) Energy Conservation Effectiveness by Introduction of EMS

1) Comparison of final energy consumption by sector

Per the comparison between the base case and the EMS installed case, the energy consumption of the target sector comprised of the Industrial, Commercial and Transportation sectors will be reduced. The reduction of energy consumption is four thousand and three hundred and twenty four (4,324) ktoe which is an 8.6% reduction from the base case per the installation of EMS in 2030. The average growth rate per year from 2010 to 2030 will decrease 0.5 points from 3.6% to 3.1%.

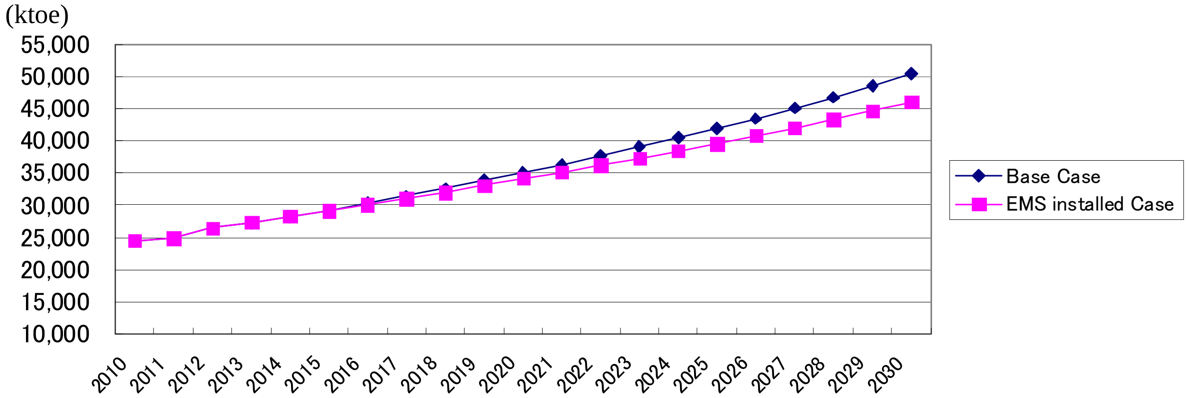


Figure 14-4 Comparison of Final Energy Consumption

Table 14-5 Comparison of Final Energy Consumption by Sector

		2010	2015	2020	2025	2030 (ktoe)	Total (2015～2030)	GR/Y 2030/2010 (%) *
Base case	Agriculture	347	333	337	352	376	5,560	0.4
	Industrial	6,364	8,159	10,243	12,656	15,691	185,332	4.6
	Commercial	2,664	3,455	4,483	5,673	7,181	82,329	4.8
	Transport	9,023	10,580	12,678	15,116	18,224	224,574	3.6
	Residential	6,125	6,754	7,409	8,120	8,894	124,521	1.7
	Total	24,522	29,281	35,150	41,917	50,366	622,315	3.6
EMS installed case	Agriculture	347	333	337	352	376	5,560	0.4
	Industrial	6,364	8,120	9,911	11,847	14,151	175,166	4.1
	Commercial	2,664	3,436	4,324	5,283	6,438	77,427	4.2
	Transport	9,023	10,517	12,188	13,988	16,183	210,477	3.0
	Residential	6,125	6,754	7,409	8,120	8,894	124,521	1.7
	Total	24,522	29,160	34,169	39,592	46,042	593,150	3.1
Difference	Agriculture	0	0	0	0	0	0	0.0
	Industrial	0	-39	-331	-809	-1,540	-10,166	-0.5
	Commercial	0	-19	-160	-390	-743	-4,902	-0.6
	Transport	0	-63	-490	-1,127	-2,041	-14,097	-0.6
	Residential	0	0	0	0	0	0	0.0
	Total	0	-122	-982	-2,326	-4,324	-29,165	-0.5

*GR/Y 2030/2010: Average growth rate per year from 2010 to 2030

2) Comparison of primary energy consumption by energy type

The consumption of fossil fuels will decrease. The reduction of energy consumption is six thousand and twenty nine (6,029) ktoe which is a 7.3% reduction from the base case per the installation of EMS in 2030.

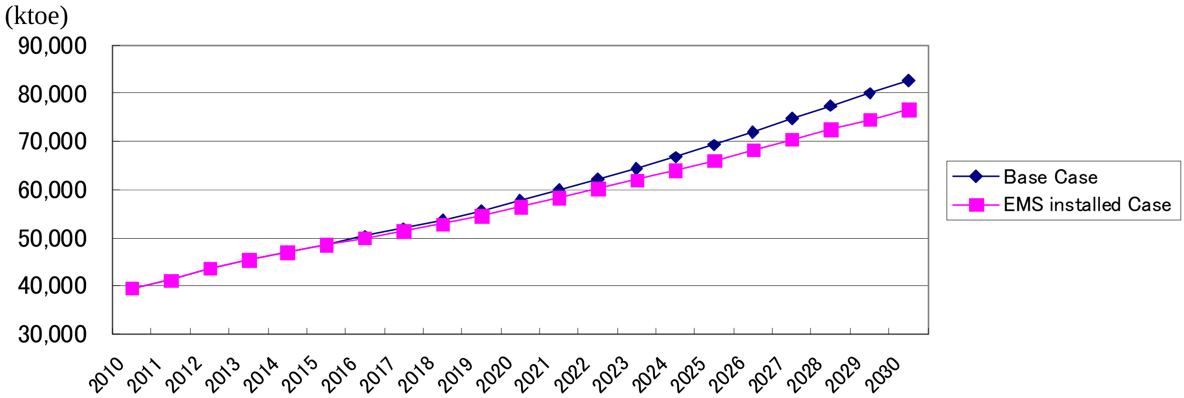


Figure 14-5 Comparison of Primary Energy Consumption

Table 14-6 Comparison of Primary Energy Consumption by Energy Type

(ktoe) (%)

		2010	2015	2020	2025	2030	Total (2015～2030)	GR/Y 2030/2010 *
Base case	Oil products	13,801	14,633	16,859	19,657	23,480	296,058	2.7
	Coal	6,920	10,715	13,698	19,933	25,734	277,618	6.8
	Natural gas	2,802	3,997	6,079	7,275	9,848	106,817	6.5
	Others	16,045	19,405	21,211	22,437	23,651	347,202	2.0
	Total	39,568	48,750	57,846	69,301	82,713	1,027,695	3.8
EMS installed case	Oil products	13,801	14,557	16,290	18,368	21,139	279,848	2.2
	Coal	6,920	10,663	13,283	18,804	23,571	263,482	6.3
	Natural gas	2,802	3,977	5,897	6,870	9,041	101,666	6.0
	Others	16,045	19,389	21,058	22,051	22,933	342,444	1.8
	Total	39,568	48,587	56,528	66,093	76,683	987,440	3.4
Difference	Oil products	0	-76	-569	-1,289	-2,341	-16,210	-0.5
	Coal	0	-52	-414	-1,129	-2,163	-14,136	-0.5
	Natural gas	0	-20	-183	-405	-807	-5,151	-0.5
	Others	0	-16	-153	-386	-718	-4,758	-0.2
	Total	0	-163	-1,319	-3,209	-6,029	-40,255	-0.4

*GR/Y 2030/2010: Average growth rate per year from 2010 to 2030

(3) Reduction of Energy Cost

The energy cost reduction mainly brought about by the reduction of fossil fuel consumption which depends on overseas imports will be one hundred and forty (140) billion pesos which will result in a 9.3% reduction in 2030.

Table 14-7 Estimation of Reduction of Energy Cost

		2010	2015	2020	2025	2030	Total (2015～2030)	GR/Y 2030/2010 *
					(Billion peso)			(%)
Base case	Oil products	336	451	587	755	957	10,903	5.4
	Coal	55	95	137	220	301	2,974	8.9
	Natural gas	48	77	130	170	241	2,412	8.4
	Total (fossil fuel)	439	622	855	1,145	1,499	16,289	6.3
EMS installed case	Oil products	336	448	568	706	862	10,280	4.8
	Coal	55	94	133	208	276	2,817	8.4
	Natural gas	48	77	127	160	221	2,292	7.9
	Total (fossil fuel)	439	619	827	1,074	1,359	15,389	5.8
Difference	Oil products	0	-2	-20	-50	-95	-623	-0.6
	Coal	0	0	-4	-12	-25	-157	-0.5
	Natural gas	0	0	-4	-9	-20	-120	-0.5
	Total (fossil fuel)	0	-3	-28	-71	-140	-900	-0.5

*GR/Y 2030/2010: Average growth rate per year from 2010 to 2030

Total reduction of energy cost will be nine hundred (900) billion pesos from 2015 to 2030. That amount of money is converted into three hundred and eighty seven (387) billion pesos at the 2011 price using a six (6) % interest rate which is the recent interest rate of the long term (10 years) national bond in the Philippines.

14.3 Economic Evaluation Assuming that National Energy Conservation Target is Achieved

The Philippines has a national target of energy conservation which is to reduce ten percent (10%) of final energy consumption every year from the outlook for 2009 to 2030. Each year's figure of the outlook was not available but the cumulative reduction amount over twenty-two (22) years is 76,002ktoe (Refer figure 3-36). To grasp the rough national effect of investment for energy conservation, estimate the energy conservation amount and its economic impact to the whole country on the assumption that the national energy conservation target was achieved.

14.3.1 Preconditions of Calculation

Each year's figure of the outlook was not available and there is an apparent gap between the actual energy consumption data and the outlook. So the Study team interpreted and estimated the achievement of the national energy conservation target as follows

The estimation is calculated on the assumption that the energy intensity will be improved year by year instead of the achievement of a uniform ten percent (10%) reduction from the starting year. On this assumption, set the target years from 2015 to 2030, the same as the EMS introduction case and counted backward the necessary reduction ratio of energy intensity per year to achieve a cumulative ten percent (10%) reduction of final energy consumption compared with accumulated one wihin the same period on the base case which was estimated by the Study team this time. The image of the energy consumption of the three cases which are the base case, the cumulative 10% reduction case and the yearly 10%reduction case and is shown in the following figure.

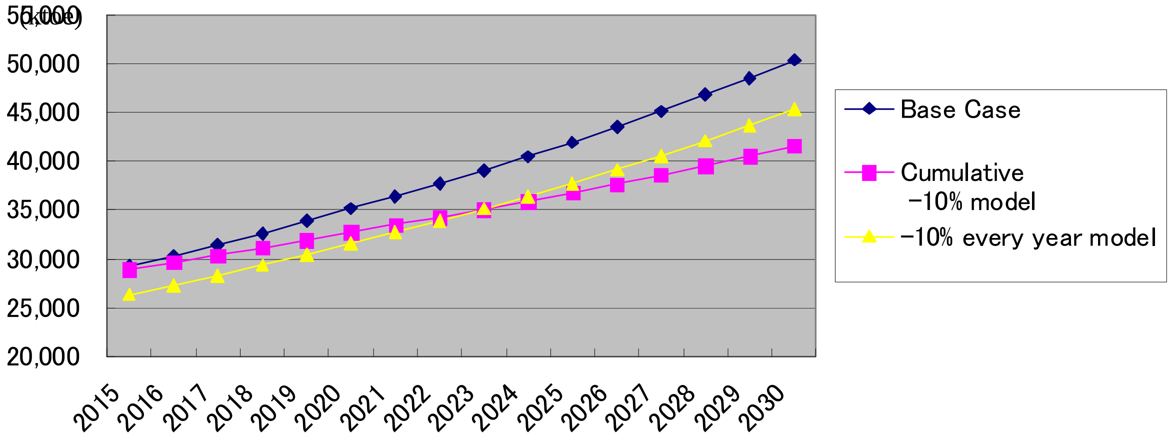


Figure 14-6 Image of Final Energy Consumption of Each Case

It is assumed that energy intensity will be reduced in every sector uniformly, because the 10% reduction can be achieved not only by the EMS but also by all of the EE&C activities in the Philippines.

14.3.2 Energy Conservation Effectiveness and National Benefits per the Achievement of the National Target

As a result, it is confirmed that a cumulative 10% reduction of final energy consumption can be achieved by a 1.23% reduction per year of energy intensity in every sector (The total reduction ratio is 10.3% on this calculation, but this degree (0.3%) of difference is within the error range and is not significant). In this case, the sum of the reduction amount is 64,325 ktoe which is less than the national target of 76,002ktoe mainly because the target year is short (reduced from 22 years to 16 years). The reduction amount is more than twice as large as the EMS installation case because the improvement ratio of energy intensity per year is 1.23% which is bigger than 1% of the EMS installation case in addition to the target expansion to every user of every sector. The cumulative effectiveness of the improvement of energy intensity is very big. The estimation of final energy consumption for each case are shown in the following chart.

Table 14-8 Estimation of Final Energy Consumption in Each Case

Final energy consumption (ktoe)

		2015	2020	2025	2030	Total
Estimation by Study Team	Base Case	29,281	35,150	41,917	50,366	622,315
	Cumulative -10% model	28,939	32,735	36,758	41,564	557,990
	Reduction ratio	-1.2%	-6.9%	-12.3%	-17.5%	-10.3%
National target (simulation)	-10% every year model	26,353	31,635	37,726	45,329	560,084
	Reduction ratio	-10.0%	-10.0%	-10.0%	-10.0%	-10.0%

9% reduction of primary energy consumption from the base case is estimated at the same time.

Table 14-9 Estimation of Primary Energy Consumption

Primary energy consumption (ktoe)

		2015	2020	2025	2030	Total
Estimation by Study Team	Base Case	48,750	57,846	69,301	82,713	1,027,695
	Cumulative −10% model	48,267	54,410	61,699	69,561	933,014
	Reduction ratio	−1.0%	−5.9%	−11.0%	−15.9%	−9.2%

The total reduction of the energy cost will be 1,909 billion pesos from 2015 to 2030. That amount of money is converted into 831 billion pesos at the 2011 price using a six (6) % interest rate which is the recent interest rate of the long term (10 years) national bond in the Philippines.

Table 14-10 Estimation of Energy Cost

(Billion Peso)

		2015	2020	2025	2030	Total
Estimation by Study Team	Base Case	622	855	1,145	1,499	16,289
	Cumulative −10% model	614	790	992	1,219	14,380
	difference	−8	−65	−153	−280	−1,909

14.3.3 Utilization of Benefits from Energy Conservation

This energy cost reduction amount means the national benefit which can be considered as the national fund to be used to promote EE&C activities.

The following issues are considered as the EE&C activities to be supported.

1) EMS management Costs

- Operational costs of managing EMS organizations such as the DOE
- Operational cost of Energy Efficiency and Conservation Center
- Support for energy audits
- Promotion of energy efficiency and conservation

2) Investment

- Investment for high energy efficient equipment of enterprises
- Financial support for purchases of high efficient home appliances

14.4 Summary

In this chapter, the Study team forecasted the energy conservation amount and its national benefit in two cases which are the EMS installation case and the national target achievement case. An estimate of the energy conservation amount and economic benefits is shown in the following table.

Table 14-11 Summary of Economic Evaluation

		EMS installation case	Achievement of national target case
Energy conservation amount (Accumulation)	(Final energy consumption)	29,165 ktoe 4.7%	64,325 ktoe 10.3%
	(Primary energy consumption)	40,255 ktoe 3.9%	94,681 ktoe 9.2%
Reduction of energy cost	(Accumulation of 16years)	PHP 900 billion	PHP 1,909 billion
	(Present value)	PHP 387 billion	PHP 831 billion

These estimates show a very large national economic benefit. In the EMS installation case, the targets are designated and estimates were made on the specific assumption that they will reduce 1% of their energy intensity year by year as regulated by EE&C Law, but in the achievement of the national target case, an estimate was made on the ambiguous assumption of achieving the national target by all of the energy users of the country that require attention. That is, it is difficult to estimate the effects of schemes other than EMS, so the estimated figures above do not mean that the introduction of EE&C Law will automatically bring about the achievement of the national target.

However, the estimates were conducted based on the belief that they will be an aid to considering the economic effects of the introduction of EE&C Law and accompanying schemes.

Chapter 15 Summary

15.1 Outline of the Study

This Study whose objective is to support the DOE to in creating a draft of the EE&C bill, surveyed the current EE&C situation in the Philippines, and identified issues. Then, it studied the design concepts governing EE&C measures and the way these measures will be reflected in the EE&C bill. The targets covered are shown below. Although not targeted at the beginning, ESCO has also been studied and an economic evaluation (evaluation of national benefits by EE&C) done. Regarding the energy performance standards of the building, reference information and/or an analysis has also been provided. Japanese measures were mainly introduced for the transport sector.

- EE&C Bill
- Organizational Structure
- Energy Management System
- Information, Education and Communication Activities and EE&C Education
- Energy Efficient Equipment Promotion and Labeling Scheme
- Energy Audit
- Database for EE&C
- Promotion of ESCO (Energy Service Company)
- Subsidies and Financial Mechanisms to promote EE&C
- Energy Performance Standards of Building
- Economic Evaluation

The Study Team and the DOE had a great number of discussions based on the Philippine's current situation and the reference cases of other neighboring countries including Japan. The discussion flow was as follows: first, each member of the Study Team had discussions with their corresponding counterpart from the DOE and confirmed directions and had discussions with the main members including an assistant secretary, trying to match the intentions of the DOE and the recommendations from the Study Team. In addition, we tried to create a reasonable bill that matches the situation in the Philippines by collecting opinions from other governmental agencies, private companies and associations at SWGM (Stakeholders Working Group Meeting).

As a result, although there are matters requiring further studies, the draft bill received an evaluation as a comprehensive bill from the Philippine stakeholders.

In addition, one of the objectives of this Study, the capacity building of the DOE must be achieved via a great number of these discussions and opinion collection.

15.2 Considerations

In the beginning, in order to achieve the objective to support the DOE in the creation of a draft EE&C bill, the Study had planned to provide materials such as the design concepts of measures or the way they will be reflected into the bill after the Study period or around the completion of the Study when the DOE would create a draft of the EE&C bill. However, the request for the creation of a draft bill intensified resulting in the creation of a draft bill in August, 2011, the middle of the Study period. It affected greatly the way of proceeding the study. As a result, a draft bill was made before the completion of concept design of measures and the measures for the sectors, which are not supervised by the DOE, e.g. measures for the transport sector and energy performance standards of buildings etc, were not surveyed and discussed in detail during the period of this Study. The survey and discussion may be implemented after the DOE's finalization or the filing of the bill.

When the draft bill was presented to the stakeholders, participants from other governmental agencies were proactive. We look forward to future discussions among governmental agencies.

There are some matters where the DOE has its own strong concepts. In such cases, there appeared to be differences between the contents stipulated in the current DOE bill, Appendix-1, and the recommendations of the Study Team. The recommendation with accompanying reasons is described in the report.

15.3 Summary of Proposal and Consideration

The following is a summary of the proposals, discussion results and consideration points for each theme (There are conclusions/summary at the end of each chapter after Chapter 4 and there are some cases that are the same as those.)

(1) EE&C Bill

Concerning the interview with the DOE and other government stakeholders, we broke down several potentially obstructive factors to EE&C law enactments as follows

- Delayed discussions at the Congress
- Limited time for ordering issues
- Factors preventing cooperation among related government agencies and other groups
- Financial weakness

The structure of the current version of the draft EE&C Bill is described in Table 4-5. The main contents listed based on the measures to be introduced are as follows.

Table 15-1 Overview of the Contents of the Draft EE&C Bill

Measures	Overview	Targets
Energy management program for the government	Mandatory measures requiring the government organizations to reduce a certain amount of energy consumption amount (GEMP program is currently being implemented)	Government sector
Energy management system	Mandatory measure requiring large energy consumers to submit energy consumption reports and energy conservation program reports, appointment of CECO and /or CEM.	Industrial/Commercial sector Power sector Transportation Sector
Energy audit system	Mandatory measures requiring designated energy consumers to submit energy audit reports once in 3 years	Industrial/Commercial sector Power sector Transportation Sector
Accreditation system (CECO, ECO, CEM, ESCO)	Establishment of CECO and CEM as qualified professionals Accreditation of ESCOs	Industrial/Commercial sector
Establishment of the EECCP	Establishment of the EECCP	All sectors
Promotion of High energy-efficient equipment and labeling program	Mandatory measures setting minimum energy efficiency standards (MEPS) and require insufficient equipment to be shut out of the market, and providing information of energy efficiency performance level of equipment by labeling	Manufacturers/dealers/importers /retailers of household appliances and vehicles
Information, Education and Communication (IEC)	Implementing IEC activities including awards	All sectors
EE&C standard for building	Introduction of EE&C guidelines for buildings to the National building code and requiring compliance	All sectors
Mass transport system	Establishment of a mass transport system	Transportation sector
Incentives	Incentives for EE&C technologies	All sectors
EE&C fund	Establishment of EE&C Fund (initial funding: PHP 10 billion) for promotion of EE&C activities, technologies, and dissemination of EE&C.	All sectors

Recommendation to the draft EE&C Bill is described in 4.3.3. The main points are as follows.

- Deleting specific numbers (as the thresholds for the designations)
- Setting clear intentions and targets for each measure
- Clearer definition of terms and/or explanations for some terms
- Dealing with the missing items in the flow of measures , and contradictions
- Considering a balance between mandatory and voluntary measures
- Evaluation of a reasonable scale of measures in consideration of cost-benefits and manpower
- For the transportation sector and power sectors, considering more effective options other than the energy management system
- For the power sector, setting measures that do not contradict current ERC regulations
- Considering the balance between incentives and mandatory measures, especially, the fulfillment of supporting measures
- In order to strengthen the law abiding nature of the system, consider the expansion of the number of acts to be prohibited,

(2) Organizational Structure

There are various organizations acting for EE&C in the Philippines. They hope to have a cooperation-based platform. After discussion with the DOE, two organizations have been proposed; the Energy Efficiency and Conservation Center of the Philippines and an advisory committee. The role allocation concept between them is as follows; the DOE is in the principal position in charge of establishing policy, EECCP is an implementing agency and committees are in the position of providing advice and recommendations and conducting policy evaluations.

Regarding EECCP, the following items were discussed: the organizational structure, role allocation of the work, the size and the internal organization, and the amount of necessary costs. The cost estimation is quite rough, since many details of the measures have not yet been decided, and the basis of the unit price is not so strong. The necessary costs are estimated to be approximately 90 million pesos. The processes and items of calculation are described for the future revision by the DOE. In addition, the cost (approx. 4 million pesos) for the DOE is also estimated herewith.

Regarding committees, three choices were proposed and discussed: a committee similar to NREB, which covers all the governmental agencies and all the stakeholders, a committee similar to the Advisory Committee for Natural Resources and Energy, Japan, and committees per theme. Although we could not reach one conclusion, the recommendation of the Study Team is similar to Japan’s committee. They are described here for reference, since it is not necessary to have the committees stipulated in the law.

(3) Energy Management System

1) Current situation

- The current energy management system in the Philippines is comprised of two different systems for the private and public sectors, and the one for the private sector lacks legal binding with only the submission of an energy consumption report required. The system aimed at the public sector is comprised of a report, an on site check by the DOE, a scored evaluation of energy management situations, and a publication of the evaluation results.
- In the private sector, for the those who submit a quarterly energy consumption report there is the incentive of being selected as a candidate for the Don Emilio prize, and these are in the main large scale enterprises however, as it is a voluntary based system, many targeted establishments do not submit reports so they are not checked by the DOE.
- The transport sector is outside of the scope of this report, so no study has been carried out however, there is currently no policy being implemented to strengthen the system and it lags behind the reporting system in the private sector.

2) Proposals

- The currently established energy management system for the government sector works well so proposals are mainly aimed at the private sector.
- This shall not be voluntary, but a compulsory system.
- Establishments whose energy consumption exceeds the threshold will be classified as designated establishments and will have to submit the Energy Consumption Report (Type 1 & 2) and Energy Conservation plan (Type 2 only) to the DOE.
- Regarding the range of targets for the system, the current system covers one standard type of premises, while under the new system they are now divided into Type 1 at between 500,000 and 2,000,000 (loe) crude oil equivalent, and Type 2 at over 2,000,000 (loe).

- With the aim of making the system for the private sector compulsory, in consideration of the DOE workload mainly with regard to the energy consumption reports and after much discussion, it was decided to change the frequency of report submission from the current 4 times to twice a year
- Mention of the specific energy consumption is required in the report, and legal penalties were proposed for non-submission, or falsification of information in the reports.
- There is an obligation to appoint a Certified Energy Conservation Officer (CECO) for Type 1, and to appoint a Certified Energy Manager (CEM) for Type 2, which requires a higher level of management-like-preparation of the energy conservation plan report.
- Discussions were held regarding the DOE approval procedure in relation to situations where candidates who have been approved as both CECO and CEM are required, and additional proposals were concluded for the future IRR plan.

3) Other items for attention

- As this is a system where targeted establishments are to come forward on a voluntary basis for designation, doubts remain as to whether enterprises can be enrolled as in Japan.
- The number of targets for each of the Type 1 and Type 2 establishments is unclear, and the volume of work on the administrative side is unclear if the system is implemented as proposed. There is the possibility that a threshold of 500,000 loe will create a seriously large amount of work for the DOE.
- In the case of Japan, there are no checks without the public announcement of the evaluation criteria and the responsibility for the setting of management standards for EMS, so it is not clear whether the PDCA of the energy consumer is in line with the original systems intent, so this will be subject to further scrutiny.
- Reductions in specific energy consumption are not non-binding targets but are mandated, and it is possible that compliance will be difficult.
- As completion of DOE approved training is required for the approval of energy managers, not all target facilities will be able to appoint a CECO or CEM, and the expectation is that there will be cases where the report cannot be submitted. An option has been proposed to cover such situations.
- With government institutions (GEMP) the system the evaluation criteria is comprised of is 20 items which are evaluated by the DOE site check, and are part of the continuous system of energy management activities at target establishments.
- An example check of compliance under the evaluation criteria and items covered in the energy consumption report under the Japanese Law (concerning the Rational Use of Energy) was presented, and although the evaluation criteria are not at the same level, a policy suited to the actual conditions in the Philippines was proposed to the DOE to make a continuous system for private establishments.
- Regarding the transport sector, there is only an introduction to the situation in Japan, and a report format is submitted that we think requires studying by the DOE.

(4) Energy Audit

As for the Energy Audit, one of the tools to promote EE&C, the current situation of the Philippines was surveyed, factors to promote energy audits were analyzed and advantages & disadvantages and possible choices were presented.

In the Philippines, there is a momentum towards a mandatory energy audit system and certification of energy auditors and energy audits are described as mandatory in the draft EE&C bill of DOE. The outline in the draft bill is as follows:

- Designated establishments are obliged to submit energy audit reports once every three years.
- Persons who conduct energy audits shall be competent energy auditors, accredited ESCOs etc.

Despite a great number of discussions, the detailed framework of energy audits did not reach the conclusions. The mandatory energy audit scheme and the certification of energy managers mean that the DOE needs to accept responsibilities. Thus, further consideration including cost-benefit analysis is required.

As for the mandatory energy audit scheme, the proposed consideration items are 15 including the target, way of obligation, energy audit frequency, energy auditor characteristics (outside/ inside), certifications etc. The flow in the case of a mandatory scheme was also proposed. As for the certification of energy auditors, 7 items were proposed including the way of providing certification, pre-conditions of applicants etc.

(5) High Energy-Efficient Equipment and the Labeling Program

As a program to promote high energy-efficient equipment, there has been a scheme of MEPS and a labeling program in the Philippines. The Study team discussed and analyzed with the DOE on improvement measures. However, EES&L for lighting became voluntary from the mandatory program last year. The situation is in reverse progress. Based on the issues, the proposed contents are as follows;

Table 15-2 Summary of Proposed Items

Framework to promote EES&C		
	Accreditation procedure flow based on DOE orders	Procedural flow will be changed to managed primarily by DOE not DTI.
	Duties to report product sales quantity to manufacturers	Putting duties on manufacturers to report sales quantity data to DOE to revise and improve standards of MEPS.
	Duties of efforts by retailers to provide information	Putting duties on retailers, a key influencer to consumers, to provide information on EE&C.
Implementation structure etc.		
	Responsible organization and laws/regulations	The primary agency is DOE and laws/regulations will be the EE&C bill or DOE orders.
	Consultation with stakeholders	Asking DTI for cooperation, coordination or discussion will be made in TC.
	Energy performance test procedures	It should be stipulated in PNS (DTI-BPS).
	Database	DOE will make and manage a database with quantified data etc.
Improvement of standard values of MEPS and expanding designated appliances		
	Periodical improvement of standard values	The current standard values stay low compared to other countries. Thus, it is necessary to collect data and improve the standard values. In addition, they should be evaluated periodically (3 to 5 year interval) and revised.
	Expansion of designated appliances	It is necessary to take back lighting equipment to the mandatory program. In addition, the designated appliances are limited. They should be expanded step by step.
Enhancement of label contents		
	Improvement by introducing a ranking system (star rating system)	This is under consideration by the DOE.
	Estimated annual electricity cost introduction	This is very comprehensible information for the consumers. However, it requires some conditions such as the standard use of appliances, the unit price of electricity, which needs further research/ study.
Award program for retailers		
	Providing awards for retailers who display labeling appropriately and provide EE&C information (accreditation of logo use)	Retailers who communicated to consumers directly apply for the excellent EE&C retailers and can use logos when accredited.

(6) Information, Education and Communication

Most of the current EE&C activities by DOE are of IEC, promotion of EE&C. The current DOE's bill stipulates roles of the DOE and other organizations in the private sector. As for the implementation process, setting priorities and setting goals were recommended with concrete ideas. Main recommendations for each IEC activity are shown in the next table.

Table 15-3 Outline of Proposed IEC Activities

Items	Outline
Improvement of Don Emilio EE&C Award	1) Expansion of the target sector and target population: Creation of awards for academe, communities and retailers etc. 2) New evaluation committee setting according to 1).
Improvement of EE&C training-workshop	1) Cooperation with LGU/NGO and DENR. 2) Expansion of workshop theme: Integration of "EE&C" and "Environment" and cooperation with DENR.
Introduction of periodical IEC effect survey	Questionnaire survey for training/workshop participants and survey of the effects (awareness and understanding) when providing training/workshops
Introduction of EE&C school curriculum	Introduction of "EE&C" in environmental education in cooperation with DepEd
Introduction of EE&C character	Currently, no unified characters are used. Thus, the creation of a new EE&C character through e.g. poster contests.
Introduction of an EE&C event	Introduction of an EE&C event like a Japanese ENEX

(7) Database

At present, whereas NECD held by EECD is the only energy conservation database, as a future plan, as shown in Figure 10-1, the practical use of a variety of energy data from various sectors to energy policy deployment, and the feedback of analysis results of the data to energy consumers through the database was considered and shown as a proposal.

Furthermore, reconstruction of NECD was carried out since the present NECD has a shortage of capacities and are not very convenient. The new NECD was built implementing the evolution of the ongoing energy consumption reporting system (web submission) and taking future expansion of the system into account. In more details, in the newly established database, imputing data, which had been by done manually by hand will be semi-automatically processed. As for the analysis of specific energy etc., the creation of tables and graphs will be conducted automatically just by choosing the necessary items. Thus, DOE's work load will be reduced greatly. These functions are already possible to use.

(8) Financial Mechanism

In this chapter the Study team investigated the existing financial support schemes and considered the possibility to apply various types of schemes namely tax benefits, subsidies and low rate loans in the Philippines. Then the Study team discussed the suitable schemes with the DOE introducing the similar cases of the neighboring countries of the Philippines but were unable to reach a determination of priority of the schemes.

DOE mentioned the low possibility of the application of the subsidy scheme which needs funds, but the Study team explained the effectiveness of the subsidy scheme for the dissemination of high-efficient equipment showing the estimation of the effects on energy conservation and the national benefits via the dissemination of high-efficient air-conditioners on the assumption that a subsidy scheme is applied.

Regarding home air conditioners, twenty-three (23) % of annual electricity consumption savings could be realized if users switched over to an inverter type one from non-inverter type one. The initial cost difference can be recovered via an electricity charge reduction within approximately 4.4 years. The required amount of subsidies is 20% of the equipment cost to shorten the recovery period to two (2) or three (3) years. The investment of approximately 45 billion PHP as a subsidy for a high-efficient air-conditioner will generate approximately 115 billion PHP as a national benefit in our estimation.

(9) ESCO

The ESCO business in the Philippines is a recent phenomenon, and has many issues such as ESCO awareness, their capability and financing, etc. Currently, the DOE conducts an accreditation scheme for ESCOs, which is also stipulated in the draft bill. The recommendations for promoting ESCO are as follows;

1) Introduction of ESCO business through the DOE website and so on
2) Standardization of EPC conducted by DOE
3) Workshops or seminars on ESCO financing for financial institutes
4) Tightening the DOE ESCO accreditation
5) Review of the current accounting regulation for government agencies
6) Demonstration projects for government agencies

7) Bundling of ESCO projects for government buildings
8) Joint financing between the government and financial institutes
9) Credit guarantee for ESCOs by the government

(10) EE&C Standards for Buildings

The Philippines has a guideline for EE&C standards for buildings. It also is stipulated in the draft EE&C bill. After introducing Japanese cases, the items to be considered in the case of introduction in the Philippines were analyzed and presented below.

Table 15-4 Outline of Consideration Items in case of Introduction

Items	Contents	Japanese Case (reference)
Concretization of guidelines	- Applicability of the guideline - Format reports to be submitted etc.	- Indicators easy to be judged (PAL,CEC)
Size of buildings to apply energy conservation standards	- Construction only or inclusion of retrofitting - Target by floor area or energy consumption etc.	- Inclusion of construction and large retrofitting - Floor area standards
Work flow	- Work flow of the procedures	- Submission in applying construction permission
Structure	- Implementing agency (DOE) - Agency who receives reports	- Implementing agency（Ministry of Land, Infrastructure, Transport and Tourism）
Schedule for execution	- Necessity of establishment	

(11) Economic Evaluation

In this chapter, the Study team forecasted the energy conservation amount and its national benefits in two cases, which are the EMS installation case and the national target achievement case. Estimates of the energy conservation amount and economic benefits are shown in the following table.

Table 15-5 Summary of Economic Evaluation

		EMS introduction case	Achievement of national target case
Energy conservation amount (Accumulation)	(Final energy consumption)	29,165 ktoe 4.7%	64,325 ktoe 10.3%
	(Primary energy consumption)	40,255 ktoe 3.9%	94,681 ktoe 9.2%
Energy cost reduction	(Accumulation of 16 years)	PHP 900 billion	PHP 1,909 billion
	(Present value)	PHP 387 billion	PHP 831 billion

These estimates show a very large national economic benefit. In the EMS installation case, the targets are designated and estimates were made on the specific assumption that they will reduce 1% of their energy intensity year by year as regulated by EE&C Law, but on the achievement of the national target case, an estimate was made on the ambiguous assumption of achieving the national target by all of the energy users of the country that require attention. That is, it is difficult to estimate the effects of schemes other than EMS, so the estimated figures above does not mean that the introduction of EE&C Law will automatically bring about the achievement of the national target.

However, the estimates were based on the belief that they will be an aid to considering the economic effects of the introduction of EE&C Law and accompanying schemes.

15.4 For the Future

Various opinions and questions concerning the contents of the bill will be raised by the time of filing or during the consultation process in congress. In studying the targeted contents of the Study and writing this report, we have put forth our best efforts to provide useful information such as background information and its interpretation, advantages & disadvantages and consideration points, aiming to make this report helpful for future discussion.

In aiming to establish EE&C law, there is a great amount of work to be done and DOE plans to commission it to an outside party. Based on this situation, the possibilities for future cooperation lie in the following areas:

- (Depending on the work to be commissioned to outside parties), support for a detailed design for selected measures (IRR establishment)
- Support in conducting the work to be commissioned to an outside party (provision of advice/recommendations)
- IEC activities targeting congresspersons (training in Japan etc.)
- Continuous support for the newly developed database

Appendix I

Republic of the Philippines
SENATE OF THE PHILIPPINES
Pasay City

SENATE / House Bill No. __________

Introduced by: HON.____________

AN ACT
INSTITUTIONALIZING ENERGY EFFICIENCY AND CONSERVATION, ENHANCING THE EFFICIENT USE OF ENERGY, AND GRANTING INCENTIVES TO ENERGY EFFICIENCY AND CONSERVATION PROJECTS, AND FOR OTHER PURPOSES

Be it enacted by the Senate and House of Representatives of the Philippines in Congress assembled:

CHAPTER I
Title and Declaration of Policy

SECTION 1. Short Title. – This Act shall be known as the "Energy Efficiency and Conservation Act of 2011"

SECTION 2. Policy Declaration. – It is hereby declared the policy of the State to institutionalize energy efficiency conservation as a national way of life geared towards the efficient and judicious utilization of energy by formulating, developing, and implementing energy efficiency and conservation plans and programs to enhance energy supply security of the country, cushion impact of high price of imported fuels to local markets and protect the environment in support to the economic, social and development goals of the country.

SECTION 3. Roles of Energy Users. – All Energy users shall exert efforts to use every available energy resources judiciously and efficiently in compliance with the fundamental policies of this act.

SECTION 4. Scope. – This Act shall establish a framework for introducing and institutionalizing fundamental policies on energy efficiency and conservation including promotion of efficient and judicious utilization of energy and the definition of responsibilities of the various government agencies and private entities.

SECTION 5. Definition of Terms. – For purposes of this Act, the following terms shall, unless the context indicates otherwise, have the following meanings:

(a) ***Certified Energy Manager (CEM)*** refers to Professionals who become eligible for this certification after demonstrating expertise in several areas ranging from standards, air quality, energy audits, lighting, procurement and even financing. It recognizes individuals who have demonstrated high levels of experience, competence, proficiency, and ethical fitness in the energy management profession. A person appointed under Type 2 Designated Sector and responsible in the supervision and maintenance of the facilities for proper management of energy consumption and perform other functions deem necessary for the efficient and judicious utilization of energy.

(b) ***Demand Side Management*** refers to measures undertaken by distribution utilities to encourage end-users in the proper management of their load to achieve efficiency in the utilization of fixed infrastructures in the systems.

(c) ***Designated Establishment (Type 1 / Type 2 Designated Establishment)*** refers to private establishment in industrial, commercial, and power sectors consuming energy and/or having other index equivalent to such energy for the previous year beyond the level specified by the Department of Energy (DOE). Such establishments shall be categorized as Type 1 / Type 2 Designated Establishment, according to the energy consumption amount [Type 1:>500,000 FOEL, Type 2>2,000,000 FOEL].

(d) ***Distribution Utility*** refers to any electric cooperative, private corporation, government-owned utility, or existing local government unit (LGU) which has an exclusive franchise to operate the system of wires extending between the delivery points of the transmission system and the customer point of connection. A distribution utility shall have the obligation to provide distribution services to any end-user within its franchise area.

(e) ***Energy Audit*** refers to the evaluation of energy consumption and a review of current energy cost, as in a home or business, to determine ways in which energy can be conserved to achieve savings. The three types of energy audit are walk-through audit, preliminary audit and detailed audit.

(f) ***Energy Conservation*** refers to reducing loss and waste in various energy stages from energy production to energy consumption, and using energy more efficiently and rationally through application of appropriate energy management system and adopting measures which are technologically feasible, economically sound and environmentally and socially affordable.

(g) ***Energy Conservation Officer (ECO)*** is a person appointed by Type 1 Designated Establishments responsible in the supervision and maintenance of the facilities for proper management of energy consumption and perform other functions deem necessary for the efficient and judicious utilization of energy prescribed by the law.

(h) ***Energy Efficiency*** refers to the efficient utilization of energy resources through cost-effective options towards the use of less energy for the same or higher performance than regular products or energy systems.

(i) ***Energy Management*** refers to the process of managing energy consumption in an organization to ensure that energy has been efficiently consumed.

(j) ***Energy Using Entities*** refers to all energy demand sectors such as commercial, industrial, transport, agricultural, household, government buildings and the power generation, transmission and distribution industry sectors.

(k) ***Energy Consumption Report*** refers to the periodical report submitted to the DOE by Type 1/Type 2 Designated Establishments and Transmission Utility with regard to the energy consumption and/or energy loss and other status of energy use. The items to be reported in the Energy Consumption Report shall be specified by the DOE.

(l) ***Report Energy Conservation*** refers to the periodical report submitted to the DOE by Type 2 Designated Establishments and Transmission Utility with regard to the EE&C plan. The items to be reported in the Energy Conservation Report shall be specified by the DOE.

(m) ***Specific Energy Consumption (SEC)*** refers to the energy consumption volume required per unit, such as production volume, sales amount, transportation ton-km, transportation km, floor space, or other numbers having close relation to energy consumption.

(n) ***System Loss refers*** to the difference between the electric energy purchased and/or generated and the electric energy sold by a Distribution Utility. For purposes of this Act, the term System Loss shall consist of the following components: Technical System Loss, referring to loss inherent in the physical delivery of electric energy, including conductor loss, transformer core loss, and technical errors in meters; Non-Technical Loss, referring to energy loss not related to the physical characteristics of the electrical system, including those attributable to pilferage, tampering of meters, and erroneous meter reading; and Administrative Loss, or the energy required for the operation of the distribution system and any un-billed energy for community-related activities.

(o) ***Waste Heat Recovery*** refers to the use of heat that is produced in a thermodynamic cycle (as in a furnace, combustion engine, etc.) in another process, through the use of waste heat gas recovery systems that capture and use some of the thermal energy in the flue gas or in any other medium that would otherwise be ejected into the environment.

CHAPTER 2
Type 1 and Type 2 Designated Establishments

SECTION 6. Type 1 Designated Establishment. - Establishments with an annual energy consumption of more than 500,000 Liters of Oil Equivalent (LOE) but less than 2,000,000 LOE are hereby categorized as Type 1 Designated Establishment and shall include the following sectors:

A. Building Sector
    a. Commercial Building
    b. Hotel
    c. Hospital Building
    d. Educational Institutions
    e. Office Building
B. Industrial/Manufacturing(Medium size industrial/manufacturing plant)
    a. Food and Beverages
    b. Plastic
    c. Metal Fabrication
    d. Chemical
    e. Appliance
C. Transport Sector (Fleet)
    a. Railway
    b. Road Transport
    c. Sea Freight and Passenger Vessel
    d. Ai Transport cargo and passenger vessel
D. Power Sector
    a. Power Generation
    b. Distribution Utilities

SECTION 7. **Obligations of Type 1 Designated Establishments**.-Type 1 Designated Establishment shall have the following obligations:

(a) Employ an Energy Conservation Officer (ECO) and duly notify the Department of Energy (DOE) as to its appointment and/or dismissal from service. The ECO shall manage the maintenance of energy consuming facilities, the improvement and supervision of methods for using energy, the conduct of regular energy audit, energy monitoring and control, and preparation of periodic energy consumption report;

(b) Keep records on monthly energy consumption data and other energy-related items;

(c) Set up targets and plans for implementation of energy efficiency and conservation annually.

(d) Submit a *Semi-Annual Energy Consumption Report* to the DOE, on every 30th of June and 30th of December and every year thereafter.

(e) Conduct through competent energy auditors, accredited energy service company or service provider the periodic Energy Audit once every three (3) years and submit Energy Report to the DOE upon the accomplishment of the conducted energy audit.

SECTION 8. Type 2 Designated Establishment. - Energy intensive establishments with an annual energy consumption that is equal to or more than 2,000,000 Liters of Oil Equivalent (LOE) are hereby categorized as Type 2 Designated Establishment and shall include the following sectors:

A. Building Sector
   a. Commercial
   b. Hotel
   c. Hospital
   d. Educational Institutions
   e. Office
B. Industrial/Manufacturing sector
   a. Cement
   b. Mining
   c. Food and Beverages
   d. Electronic/Semi-Conductor
   e. Steel & Metal
   f. Chemical
   g. Vehicle
   h. Appliance
C. Transport Sector (Fleet)
   a. Railway
   b. Road Transport Fleet
   c. Sea Freight and Passenger Vessel
   d. Air Transport cargo and passenger vessel
D. Power Sector
   a. Power Generating Plants
   b. Distribution and Transmission Utilities

SECTION 9. Obligations of Type 2 Designated Establishments.-Type 2 Designated Establishments shall have the following obligations:

(a) Employ one (1) Certified Energy Manager (CEM) in reference to the provision in Section 11 and duly notify the Department of Energy (DOE) as to its appointment and/or dismissal thereof from service, as the case may be. The CEM shall manage the maintenance of energy consuming facilities, the improvement and supervision of methods for using energy, the conduct of regular energy audit, energy monitoring and control, and preparation of periodic energy consumption and energy conservation program reports of the establishment;

(b) Keep records on monthly energy consumption data and other energy-related items.

(c) Set up targets and plans for implementation of energy efficiency and conservation on an annual basis.

(d) Submit a *Semi-Annual Energy Consumption Report* and an *Annual Energy Conservation Program Report* to the DOE every 30th day of June and 30th day of December and every year thereafter .

(e) Conduct, through competent energy auditor, accredited energy service company or energy provider, periodic Energy Audit once every three (3) years and submit Energy Report to the DOE upon the accomplishment of the conducted energy audit.

CHAPTER 3

Roles of the Department of Energy and Other Concerned Government Agencies

SECTION 10. Responsibilities of the DOE.- The DOE shall be the primary government agency in the planning, formulation and development of energy management policies and other related energy efficiency and conservation programs and measures. The DOE is tasked to consult and coordinate with other government agencies and the private sectors or create an inter-agency committee if so requires, for the effective implementation of energy saving policies of the government. It shall also promote collaborative efforts with the business industry, particularly the commercial, industrial, transport and the power sectors, to broaden and accelerate the efficient and judicious utilization of energy in these sectors.

SECTION 11. Responsibilities of Other Concerned Government Agencies. – The following shall be the functions and/or roles of other government agencies in the promotion of energy efficiency and conservation:

A. *The Department of Environment and Natural Resources (DENR).* – The DENR, in coordination with the Department of Energy, Department of Interior and Local Government, Department of Transportation and Communication and the Metro Manila Development Authority, shall be responsible in the development of plans and programs to institutionalize the Anti-Smoke Belching campaign nationwide in the road transport. It shall also establish and implement energy conservation and environmental educational awareness campaign program.

B. *Department of Science and Technology (DOST).* – The DOST shall be responsible in carrying-out strategic research and development program aimed at facilitating the development of energy efficient technologies and the promotion thereof.

C. *Department of Transportation and Communication (DOTC).-* The DOTC, in coordination with the DOE, shall be responsible in ensuring compliance requirement of vehicle manufacturers and importers on Minimum Energy Performance Standard (MEPS) for road transport vehicles and to display the energy consumption label in coordination with the vehicle manufacturers, road transport industry associations, public transport group and Non-Government Organizations. It shall also be responsible in ensuring compliance and enforcement of energy management system in seaborne vessels and air transport sectors.

D. *Department of Trade and Industry (DTI).-* The DTI, in consultation with the DOE, shall require manufacturers, importers and dealers to comply with the Minimum Energy Performance Standard and to display the Energy Label on packaging or product themselves of every Designated Machinery and Equipment, appliances, vehicles and other fuel-using combustion equipment and electric devices to show energy requirement and consumption efficiency of these products.

E. *Department of Public Works and Highways (DPWH)*.- The DPWH, in coordination with the DOE, shall be responsible in ensuring the implementation of *Guidelines on Energy Conserving Design in Building* as part of the National Building Code.

F. *Department of Interior and Local Government* (DILG).- The DILG, in coordination with the DOE, shall be responsible in ensuring compliance of all Local Government Units (LGU) in implementing energy efficiency and conservation through adoption of appropriate Energy Management System.

G. *Department of Education* (DepEd) and the Commission on Higher Education (CHED).- The DepEd and CHED, in coordination with the DOE, shall establish energy efficiency and conservation concepts for incorporation in the educational curriculum for primary, secondary and tertiary education to reinforce strong values formation among Filipino students.

H. *National Electrification Administration* (NEA).- The NEA shall be responsible in lowering the distribution system line losses in all Rural Electric Cooperatives (RECs). It shall endeavor to enhance the operational capability of Electric Cooperatives through Demand Side Management.

I. *Energy Regulatory Commission* (ERC).- The ERC, in collaboration with the DOE, shall perform the regulatory functions in relation to the energy efficiency and conservation programs of Generation Utilities, Transmission Utilities and Distribution Utilities. It shall also be responsible in requiring all power generating plant facilities to improve power plant efficiency as per requirement under ERC declaration on power plant heat rate mandatory standard. It shall also be tasked to develop and implement framework on Demand Side Management for Distribution Utilities (DUs) and Electric Cooperatives (ECs).

J. *Philippine Information Agency* (PIA).- The PIA shall be responsible in the conduct of awareness, information and advocacy campaign on energy efficiency and conservation by utilizing the different forms of media such as print, radio, television, digital and interpersonal communication to ensure that needed information will reach the general population.

K. *Government Financial Institutions* (GFIs). – The GFIs shall set aside lending funds for Energy Efficiency and Conservation Projects at concessional rates of interest to attract private sector investments on energy efficiency and conservation projects.

CHAPTER 4
Creation of the Energy Efficiency and Conservation Center of the Philippines (EECCP)

SECTION 12. Creation of the Energy Efficiency and Conservation Center of the Philippines (EECCP) – There is hereby created the Energy Efficiency and Conservation Center of the Philippines (EECCP) which shall be under the supervision of the Department of Energy.

The ECCP shall have the following powers and functions: (a) develop and promote the conservation and the efficient utilization of energy in the demand sectors including energy efficient technologies; (b) develop and implement database monitoring system; (c) develop and facilitate capacity building on energy management system, including but not limited to the training of Energy Manager and Energy Auditor; (d) promote energy efficiency and conservation in partnership with industry associations, non-government organization and advocacy groups; and (d) promote bilateral and multi-lateral agreement with other countries on the aspect of energy efficiency and conservation in the country.

CHAPTER 5
Certification for Professional Competency and Accreditation for Professional Services

SECTION 13. Certified Energy Manager (CEM) and Certified Energy Conservation Officer (CECO). – The Commission on Higher Education (CHED) and State Universities and Colleges (SCUs) shall formulate and develop appropriate training course modules for Energy Manager and Energy Conservation Officer under a Certification Course Program for inclusion in the school curricula.

Similarly, competent Non-Profit Organizations and other private training institutions duly accredited by the DOE and CHED shall offer professional certification program for Certified Energy Manager and Certified Energy Conservation Officer.

SECTION 14. Accreditation of Energy Service Company (ESCO) and other Energy Efficiency Service Provider (EESP). - The Department of Energy shall formulate and develop an ESCO Accreditation System as an important component for market development measures of the country and for the following purposes: (a) establishing the development of professional and qualified ESCOs and energy engineers; (b) enhance standing of ESCOs, and particularly their energy auditing services; (c) enhance support services procurement and selection procedures; (d) enhance support to public sector incentive schemes in the promotion of energy efficiency; and (e) reduce wastage and false claims amongst industry players.

The development of this sector serves to expand the general service sector and underpins economic development through enhancing cost competitiveness and at the same time strengthens Philippine energy security. The accreditation of this energy service sector is a natural segment of the knowledge economy, providing sustainable environmental and energy saving benefits.

CHAPTER 6
Measures in the Industrial and Commercial Sectors

SECTION 15. Measures for Industrial and Commercial Sectors. - Private establishments in the industrial and commercial sectors whose designation as Type 1 and Type 2 Designated Establishment shall implement the following measures:

(a) Designated establishments shall adopt the following measures such as but not limited to: (1) use fuel and electricity judiciously and efficiently; (2) conserve energy in the forms of heat, cooling and heat transfer; (3) prevent heat loss by radiation and conduction; (4) recovery of waste heat; (5) heat conversion to power via cogeneration; (6) prevent electricity loss by resistance; (7) use of energy efficient technology as well as application of no-investment measures;

and (8) improve average Specific Energy Consumption (SEC) performance by at least one percent (1%).

(b) Type 1 Designated Establishments shall comply with the requirements and provisions of SECTION 7 particularly in the employment of Energy Conservation Officer, keeping energy consumption data, development and setting up of targets and plans, among others.

(c) Type 2 Designated Establishments shall comply with the requirements and provisions of SECTION 9 particularly in the employment of Certified Energy Manager, keeping energy consumption data, development and setting up of targets and plans, among others.

CHAPTER 7
Measures in the Power Industry Sector

SECTION 16. Measures for Generation Utilities. - For purposes of ensuring appropriate and effective implementation of energy efficiency and conservation in the power sector, Designated Generation Utilities shall implement the following measures:

(a) Designated Power Generation Utilities shall adopt and comply in the standard heat rate set by the Energy Regulatory Commission and reduce own-use energy consumption through efficient utilization of electricity and fuel.

(b) Type 1 Designated Generation Utilities shall comply with the requirements and provisions of SECTION 7 particularly in the employment of Energy Conservation Officer, keeping energy consumption data, development and setting up of targets and plans, among others.

(c) Type 2 Designated Generation Utilities shall comply with the requirements and provisions of SECTION 9 particularly in the employment of Certified Energy Manager, keeping energy consumption data, development and setting up of targets and plans, among others.

SECTION 17. Measures for Transmission Utility. - For purposes of ensuring appropriate and effective implementation of energy efficiency and conservation in the power sector, Designated Transmission Utilities shall implement the following measures:

(a) Designated Transmission Utilities shall adopt and comply in the allowable Transmission System Loss set by the Energy Regulatory Commission.

(b) Type 2 Designated Transmission Utilities shall comply with the requirements and provisions of SECTION 9 particularly in the employment of Certified Energy Manager, keeping energy consumption data, development and setting up of targets and plans, among others.

SECTION 18. Measures for Distribution Utilities. – For purposes of ensuring appropriate and effective implementation of energy efficiency and conservation in power sector, Designated Distribution Utilities shall implement the following mandatory measures:

(a) Designated Distribution Utilities shall adopt and comply in the allowable distribution System Loss set by the Energy Regulatory Commission.
(b) Type 1 Designated Distribution Utilities shall comply with the requirements and provisions of SECTION 7 particularly in the employment of Certified Energy Conservation Officer, keeping energy consumption data, development and setting up of targets and plans, among others.
(c) Type 2 Designated Distribution Utilities shall comply with the requirements and provisions of SECTION 9 particularly in the employment of Certified Energy Manager, keeping energy consumption data, development and setting up of targets and plans, among others.

CHAPTER 8
Measures in the Transportation Sector

SECTION 19. Measures for Designated Freight and Passenger Carriers for Fleet Management. – For purposes of ensuring appropriate and effective implementation of fleet management for energy efficiency and conservation in the transport sector which include land, sea and air transports, the following mandatory measures shall be implemented:

(a) Designated Transportation Establishment shall adopt the following measures such as but not limited to: (a) use transport fuel and electricity judiciously and efficiently; (b) use of energy efficient technology; and (c) improve fuel mileage performance by at least one percent (1%) per year based on the result registered in the last two years.
(b) Type 1 Designated Transport Establishment shall comply with the requirements and provisions of SECTION 7 particularly in the employment of Certified Energy Conservation Officer, keeping energy consumption data, development and setting up of targets and plans, among others.
(c) Type 2 Designated Transport Establishment shall comply with the requirements and provisions of SECTION 9 particularly in the employment of Certified Energy Manager, keeping energy consumption data, development and setting up of targets and plans, among others.

SECTION 20. Mass Transport System

(a) To support fuel efficiency program, the DOTC, DPWH, DTI and National Economic and Development Authority (NEDA) shall formulate a Mass Transport System Infrastructure Program that will address current and future requirements in mass transport.
(b) Mass transport system projects utilizing light rail system shall be granted to duly identified investors through a build-operate-transfer scheme or government-private sector partnership to ease up the government from high capital expenditures.
(c) The DOTC shall intensify the regulation and administration of registration among public utility vehicles ensuring that only public utility vehicles that adhere to standards set as provided in Section 21(a) shall be granted a franchise to operate.
(d) The DOTC together with the Metro Manila Development Authority and the respective urban development authorities shall permanently designate strategic loading and unloading stations/terminal for public utility vehicles. The locations of loading stations that will be constructed shall be strategically determined to aid in the traffic decongestion of national highways

CHAPTER 9
Measures For Manufacturers, Importers and Retailers

SECTION 21. Measures for Manufacturers, Importers, and Retailers —For purposes of ensuring appropriate and effective implementation of energy efficiency and conservation in Machinery and Equipment; manufacturers, importers and retailers shall implement the following measures:

(a) Manufacturers and Importers shall comply with the Minimum Energy Performance Standard (MEPS) set by the DOE and DTI.
(b) Manufacturers and Importers shall display the Energy Label on packaging or product of every designated machinery and equipment.
(c) Retailers engaged in selling the designated machinery and equipment shall endeavor to provide information that contributes to general consumers' efforts towards the energy efficiency and conservation, such as by giving indications of the energy label of the designated machinery and equipment.
(d) Manufacturers and Importers, and related industry associations shall submit Sales Volume Report to the DOE annually.

CHAPTER 10
Measures for Building Sector

SECTION 22. Measures for New and Retrofitted Building Construction. – In coordination with the Department of Energy, the Department of Public Works and Highways, and the City and Municipal Building Officials shall integrate the "Guidelines on Energy Conserving Designs in Buildings" to the National Building Code and enforce implementation of the same to ensure energy efficient building compliance.

For purposes of ensuring appropriate and effective implementation of energy efficiency and conservation in the Designated Building sector, the following measures shall be implemented:

(a) Owner of the Building for new and retrofitted building construction shall comply with the DOE-set "Guidelines on Energy Conserving Design in Buildings" as an integrated part of the "National Building Code".
(b) Endeavor to contribute to energy conservation of buildings by properly implementing energy efficient building design measures to reduce heat gain through building envelope, efficient utilization of facilities such as lighting system, air conditioning and ventilation systems, steam and hot water supply system, electrical equipment and devices, among others.

SECTION 23. Measures for Government Buildings. - The Department of Energy shall formulate and develop plans and programs aimed at reducing government building's monthly consumption of electricity (in kilowatt-hours) and government vehicle's monthly consumption of petroleum products (in liters) through implementation of Energy Management System in Government Buildings by adopting measures for the efficient utilization of electricity and fuels.

A. Electricity Conservation and Efficiency
   (a) Each government entity is mandated to adopt and implement an electricity efficiency program to reduce electricity consumption of its average monthly consumption based on its actual registered average consumption in the last two years.
   (b) The Government, thru the Department of Budget and Management (DBM) in coordination with the DOE, shall institute the government procurement guidelines on energy efficient lighting and appliances based on DOE-certified energy efficiency ratings.

B. Fuel Conservation and Efficiency in the Use of Government Vehicles

(a) Each government entity is mandated to adopt and implement a program that will reduce its fuel consumption for transport of its average monthly consumption based on its actual registered average consumption in the last two years.

(b) Purchase of new government vehicles shall be limited to engine displacements of no more than 1600cc and 2500cc for gasoline and diesel engines, respectively;

(c) Government vehicles shall be used for official business purposes only.

CHAPTER 11
Awareness through Information, Education, and Communication (IEC)

SECTION 24. Measures for Information, Education and Communication.- To increase awareness and educate various sectors regarding energy conservation and management, the DOE shall:

(a) Design and embark on extensive Energy Management Education Program that will increase consciousness of the Energy Efficiency and Conservation Program among Government, Residential, Commercial, Transport, Power and Industrial sectors;

(b) Educate the demand sectors through various media such as television, radio, print, digital and interpersonal communication on energy efficiency and conservation;

(c) Study, in coordination with DepED and CHED, the incorporation of energy conservation and management subjects in the primary, secondary and tertiary education curricula.

(d) Promote Energy Service Company (ESCO) and other energy efficiency service provider.

Business establishments engaged in supplying energy to general consumers, business establishment engaged in retailing energy-consuming machinery and equipment, and other business establishments capable of cooperating with the government to promote energy efficiency and conservation through their business activities, shall endeavor to provide information that contributes to general consumers' efforts towards energy efficiency and conservation, such as:

(a) Making notifications on the status of energy use by consumers;

(b) Giving indications of the performance required for buildings to prevent heat loss through exterior walls, windows, etc. of the buildings and to realize the efficient utilization of energy for air conditioning systems, etc. installed in the buildings; and

(c) Giving indications of the performance of machinery and equipment relative to its energy consumption.

CHAPTER 12

Energy Efficiency and Conservation Recognition Award

SECTION 25. Energy Efficiency and Conservation Recognition Award. - As part of promoting energy efficiency and conservation in all the demand sectors, the **DOE** shall give recognition awards to establishments which have been able to exceed its specific energy consumption performance based on the period under consideration. As such, proper energy efficiency award shall be given to recognize the due diligence and efforts of the participating establishment.

The DOE shall identify members of the Steering Committee and the Technical Evaluation Committee composed of appropriate government agencies, private companies engaged in the energy sector and Non-Profit organizations with advocacy on energy saving, conservation and environment protection.

CHAPTER 13

Incentives for Energy Efficiency and Conservation Projects

SECTION 26. Incentives for Energy Efficiency and Conservation Projects- The DOE shall provide endorsement for availment of incentives to the Board of Investment (BOI) for pioneering energy efficient technologies, as determined by the DOE, upon consultation with proper government agencies, for a period of five years (5) upon the effectivity of this Act.

CHAPTER 14

Energy Efficiency and Conservation Fund

SECTION 27. Energy Efficiency and Conservation Fund – An Energy Conservation Fund is hereby established to facilitate the implementation of energy efficiency and conservation activities. It shall be administered by a Committee to be chaired by the Secretary of Energy or his/her duly designated Undersecretary. The Fund shall be exclusively used to: 1) promote efficient use of energy, 2) dissemination of energy efficient and conserving technologies, capacity building, and 3) propagate public awareness on energy and conservation.

Initial funding of PhP10 Billion shall be sourced from Special Account of the General Fund of Government Shares from Royalties in Energy Projects.

CHAPTER 15
Miscellaneous Provisions

SECTION 28. Recommendation, Disclosure and Order – Upon finding of probable cause for violation of any of the prohibited acts under Section 31 hereof, the DOE may consider the following measures prior to the imposition of the appropriate sanctions/penalties for said violations:

(a) Provide recommendations on necessary measures in such cases as when the DOE finds remarkably insufficient reports, false returns, and non -submission of notifications or reports;
(b) Disclose the name of establishment in cases where said establishment that has received recommendations under the preceding paragraph has failed to follow the recommendations by the DOE; and
(c) Issue Order to the establishment to take measures in cases when the said establishment failed to follow or comply with the recommendations or notices issued by the DOE

SECTION 29. Reports and On-site Inspections – To the extent possible for the enforcement of this Act, the DOE may opt to conduct surprise visits to Designated Establishments. The purpose of surprise visit is to conduct and inspect energy-consuming facilities, verify energy monitoring records and other documents related to the compliance requirement of this Act.

CHAPTER 16
FINAL PROVISIONS

SECTION 30. Implementing Rules and Regulations- The DOE shall, in consultation with relevant government agencies and/or entities, energy demand sectors/end-users and non-government organizations, promulgate the Implementing Rules and Regulations (IRR) of the Act within six (6) months from the date of effectivity of this Act.

SECTION 31. Prohibited Acts - The following acts shall be prohibited:

(a) Failure and/or willful refusal to submit periodic reportorial compliance reports to the DOE;
(b) Failure and/or willful refusal to appoint a Certified Energy Conservation Officer and Certified Energy Manager; and
(c) Failure to comply with the Order under Section 29 hereof failure/willful refusal to submit energy audit report.

SECTION 32. Penalties-Any person who willfully commits any of the prohibited acts enumerated under this Act shall, upon conviction, be punished by a fine of not less than one hundred thousand pesos (P100,000.00) but not more than five hundred thousand pesos (P500,000.00) or by imprisonment of not less than six (6) months but not more than one (1) year or both, at the discretion of the court; Provided, That if the violation is committed by a judicial person, the penalty herein shall be imposed upon the official and/or employee thereof responsible for the violation: Provided, further, That if the violation is committed by a government official or employee including those in government-owned and controlled corporations he/she shall; in addition to the penalty provided above, be subjected to administrative disciplinary action.

SECTION 33. Contingency Powers- In times of critical energy supply disruptions or imminent danger thereof, the President shall direct the adoption of stringent energy conservation measures, including but not limited to power/fuel allocations or rationing; limiting the operating hours of commercial, industrial and similar establishments; restricting the use of government and private motor vehicles; staggering or limiting working hours in both public and private sectors; and the temporary closure of all energy intensive industries.

SECTION 34. Separability Clause.- If for any reason, any section or provisions of this Act is declared unconstitutional or invalid, such parts not affected thereby shall remain in full force and effect.

SECTION 35. Repealing Clause- All laws, Presidential decrees, executive orders, issuances rules and regulations, inconsistent with the provisions of this Act are hereby repealed or modified accordingly.

SECTION 36. Effectivity.- This Act shall take effect fifteen (15) days after its publication in at least two (2) newspapers of general circulation upon its approval.

Appendix II

Market Research on High-Efficient Appliances/ Equipment and Awareness Survey on Energy Efficiency and Conservation for the Philippines

Development Study on Energy Efficient and Conservation for the Philippines

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TOKYO ELECTRIC POWER COMPANY

Development Study on Energy Efficiency and Conservation in the Philippines

- Assist DOE in establishing energy efficiency and conservation (EE&C) law
- Recommend effective measures in promoting EE&C
- Acquire detailed information of energy market
  - Market research on high-efficient appliances/ equipment
  - Demand and awareness survey on EE&C

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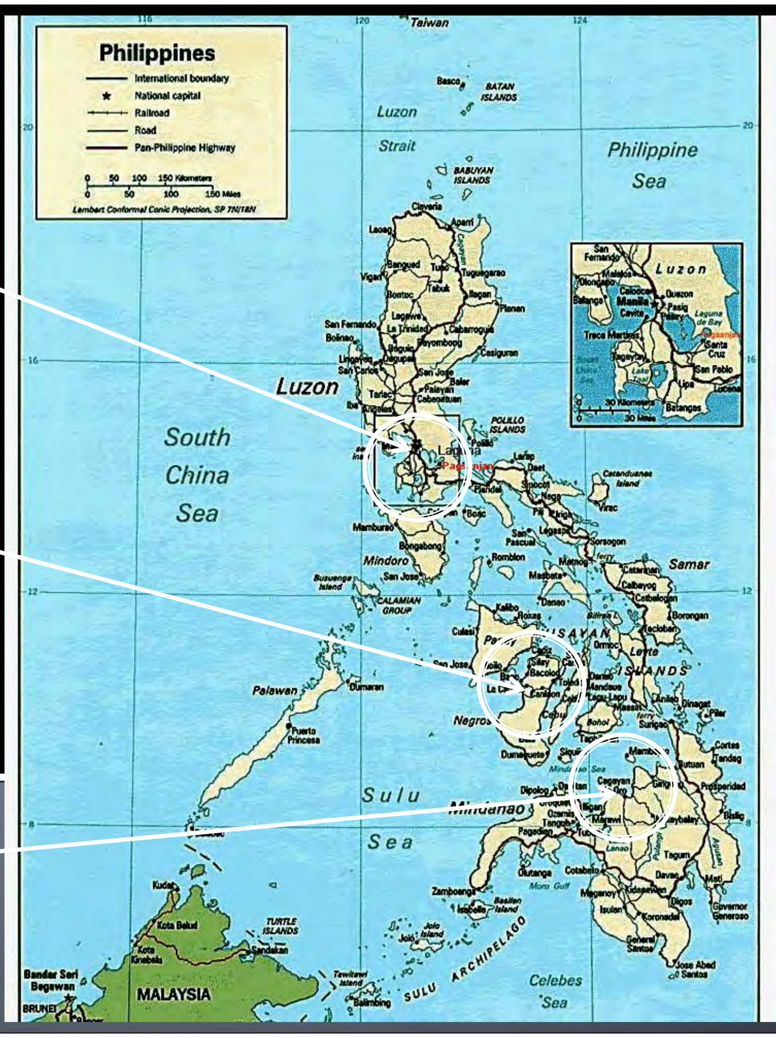
Areas of the Study

Metro Manila (LUZON)

Bacolod City, Negros Occidental (VISAYAS)

Cagayan de Oro, Misamis Oriental (MINDANAO)



No. of Questionnaires Distributed and Collected

	Makers/ Importers	Retailers	Residential	Business Establishments	Industry Association
BACOLOD					
Target		10	50	25	
Distributed		19	50	25	
Collected		7	46	7	
Interviewed		3	4	4	
CAGAYAN DE ORO					
Target		10	50	25	
Distributed		20	75	35	
Collected		11	72	14	
Interviewed		3	6	6	
METRO					
Target	45	30	100	50	5
Distributed	67	86	183	128	6
Collected	26	32	120	78	4
Interviewed	5	2	10	8	2
TOTAL TARGET	45	50	200	100	5
TOTAL COLLECTED	26	50	238	100	4

Market research on high efficient electrical appliances/equipment

Demand and awareness survey on energy efficiency and conservation

Objectives of the Survey

- **Market Research**
  - Market penetration of high-efficient electric appliances (EA) that are eligible to Energy Efficiency Standards and Labelling (EES&L)
  - Market penetration of high-efficient EAs that consume large volume of energy at residential sector
  - Data on energy efficiency, specification, market prices
  - Status of display and label at retail shops
  - Sales promotion strategies of retailers and manufacturers/importers

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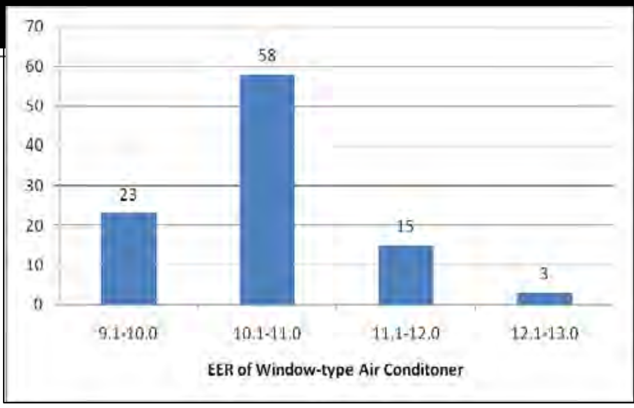
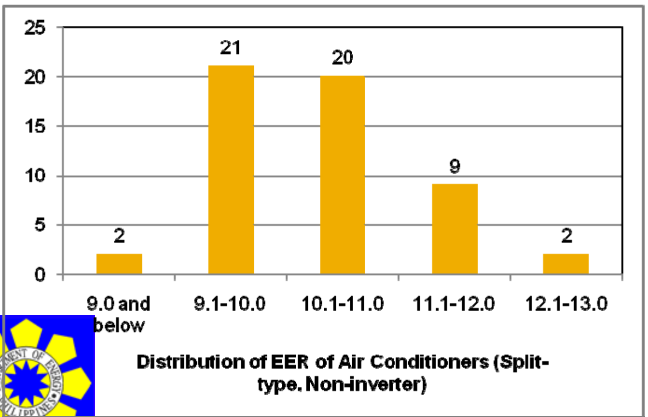
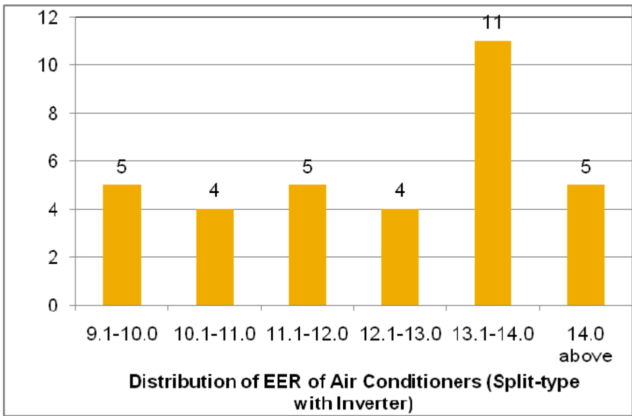
Manufacturers and Importers

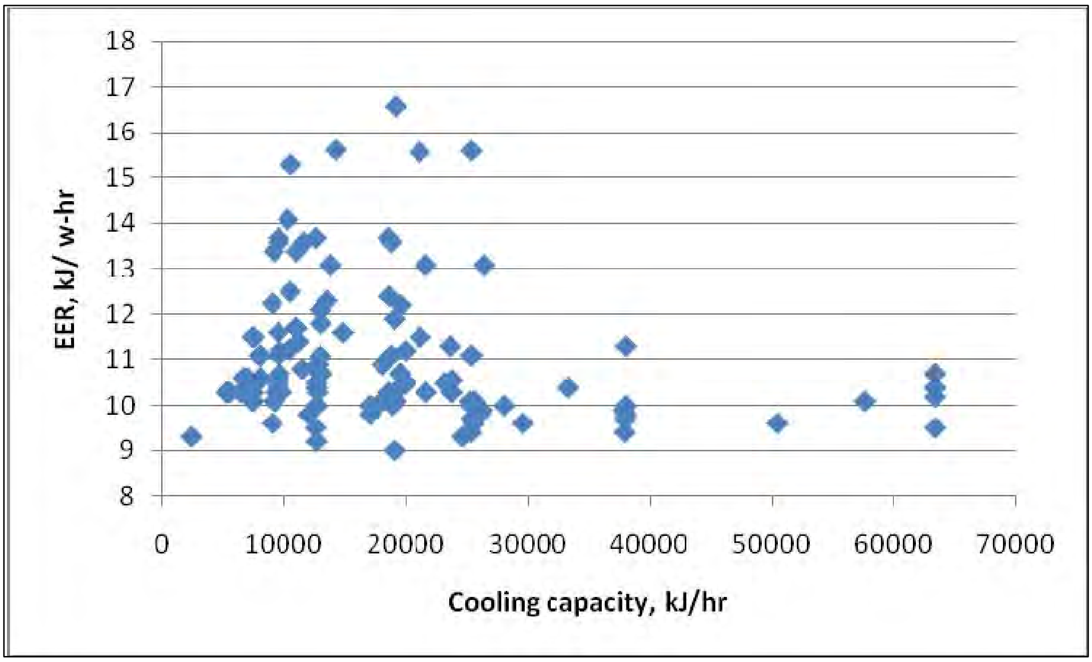
Distribution of EER of air conditioners



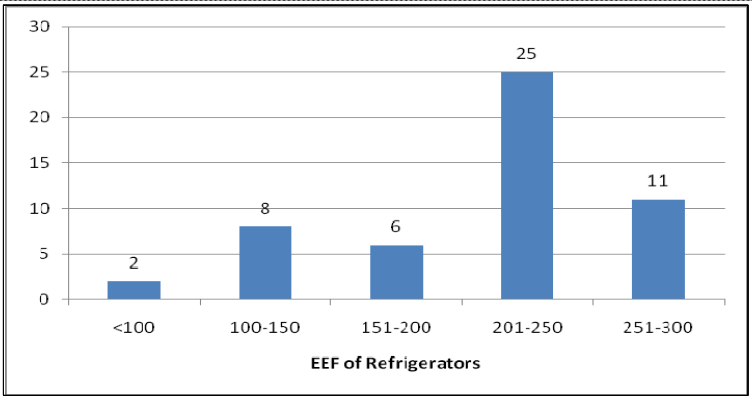




Manufacturers and Importers

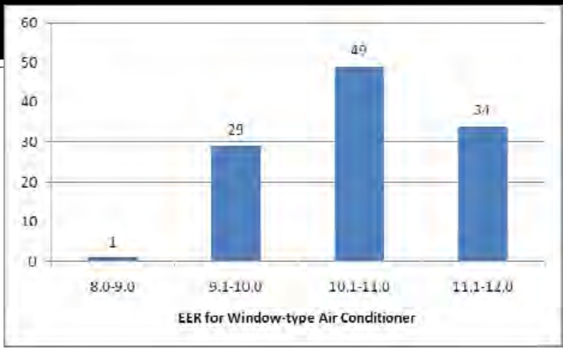


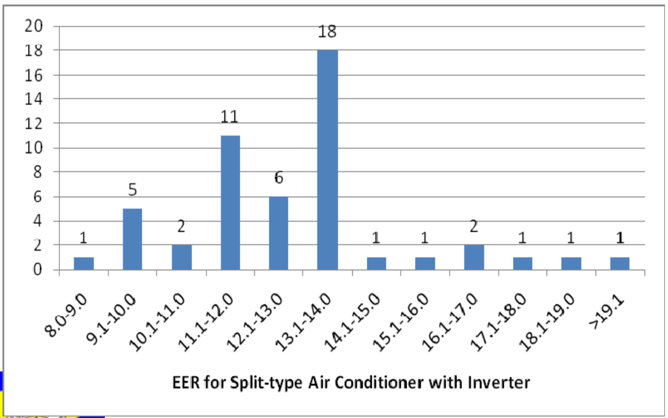
Distribution of EEF of refrigerators

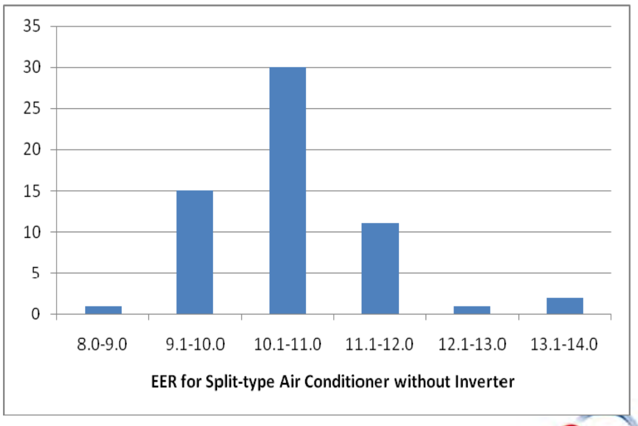


	Refrigerators	Freezers	Chillers
EEF	71 to 300	71 to 149	No data provided
Total no. of models surveyed	60	26	10
Price,PhP/EEF	40 to 97	Incomplete data provided	Incomplete data provided

Retailers

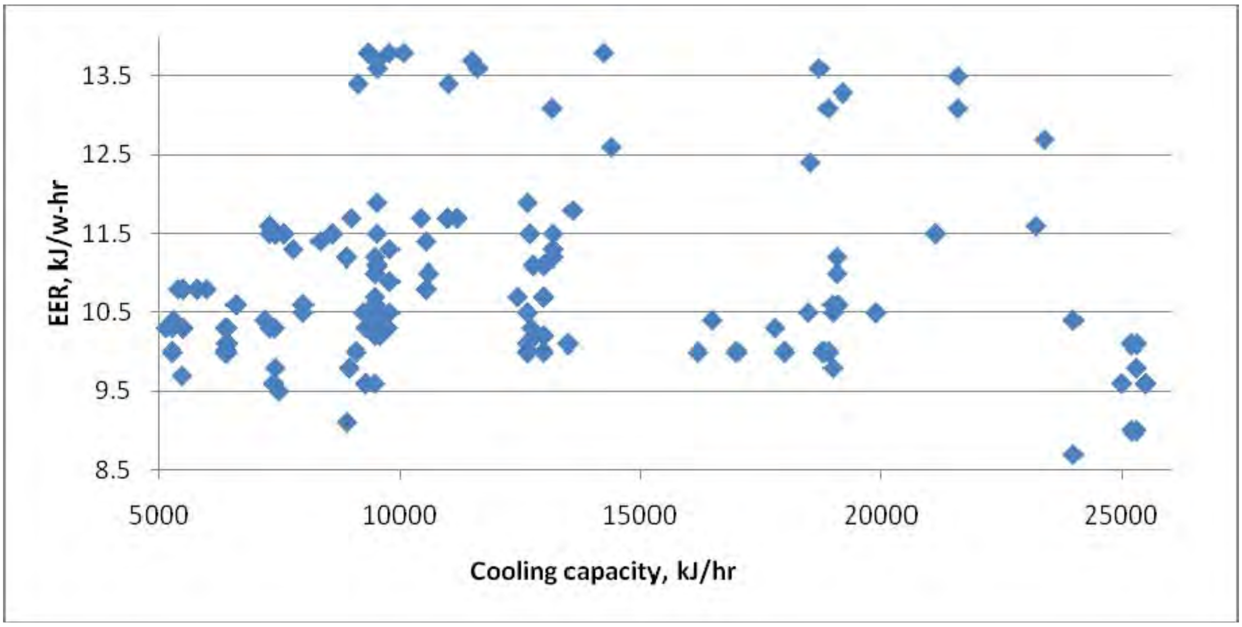




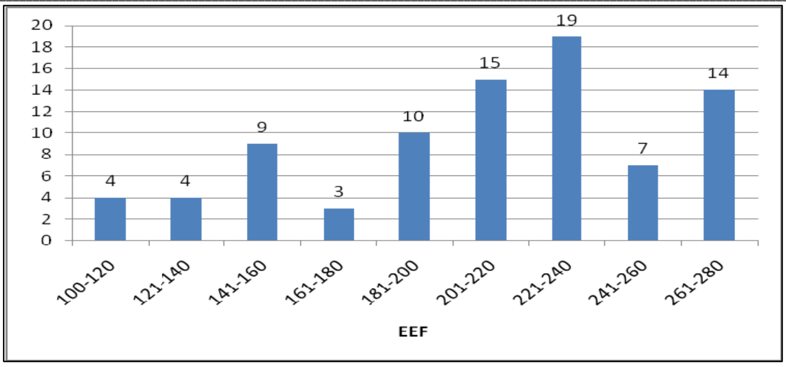


Distribution of EER of air conditioners

Retailers



Retailers



	Refrigerators	Freezers
EEF	107 to 275	150 to 270
Total no. of models surveyed	197	66
Price,PhP/EEF		
range	36 to 475	60.41 to 77.95
average	65.96	53.31

Distribution of EEF of refrigerators

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Method of Payment

95% by cash
83% by credit cards
33% by checks
12% by in-house financing

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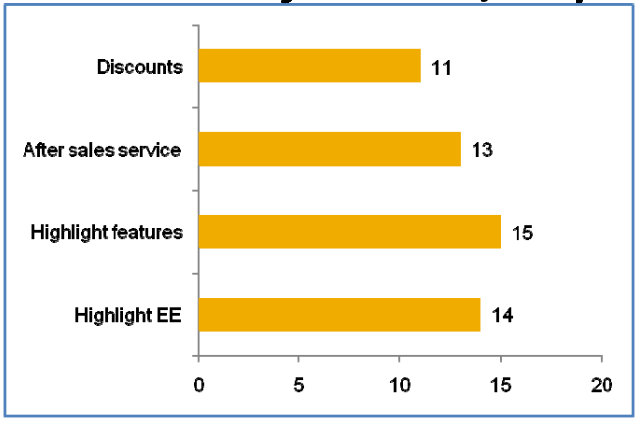
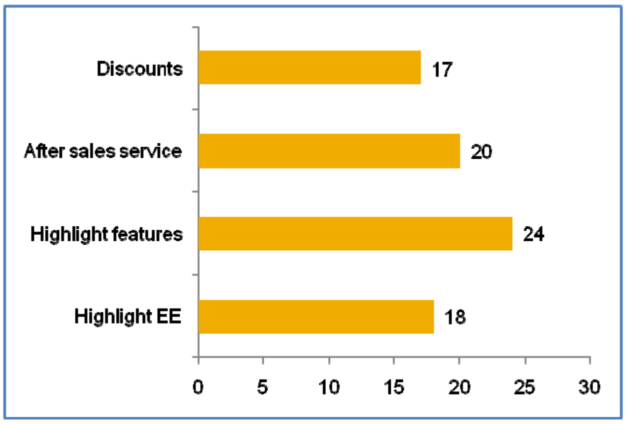
Sales Promotion Strategy

Manufacturers/ Importers



Others – product presentation, warranty offer, give aways, highlight brand name, exhibits, lease to own scheme from financial institutions

Retailers



Others – extension of installment period, cater all credit cards, give aways, freebies, exhibits

Energy Efficiency/ EES & L Awareness

- 70% of manufacturers and 83% of retailers say that product labels motivate customers to purchase high-efficient products
- Main reason why customers do not buy high-efficient products are high initial cost, unawareness to EE standards and labeling and unawareness to long term benefits of using high efficient appliances/equipment
- Class C and D customers primarily consider price while Class A and B are mostly already conscious of EE
- For industrial/commercial consumers, one of the major concerns is the capacity

Status of Display of Yellow Tags/Labels

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Comments on Government's Effort on Energy Efficiency

- Promotion of high efficient appliances on the part of the government is not strongly felt. At present, the effort on promotion is exerted in large part by the manufacturers.
- Strict enforcement of energy labeling should be implemented to guide consumers in making informed purchase decisions (e.g. monitoring of uncertified lighting products sold at a lower price)
- Lack of accredited facilities for testing appliances
- Acceptance of test results from the country of origin
- Provision of tax incentives

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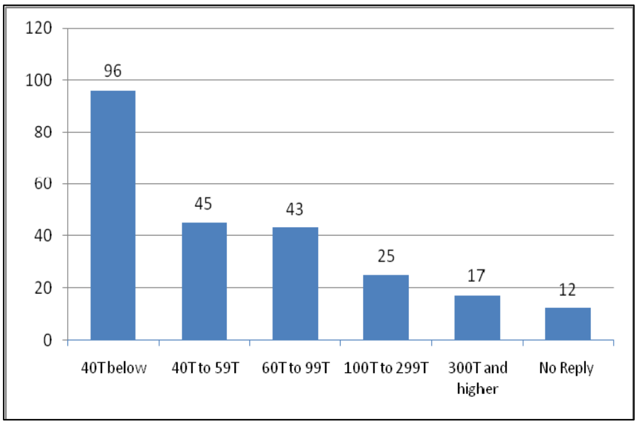
Industry Association

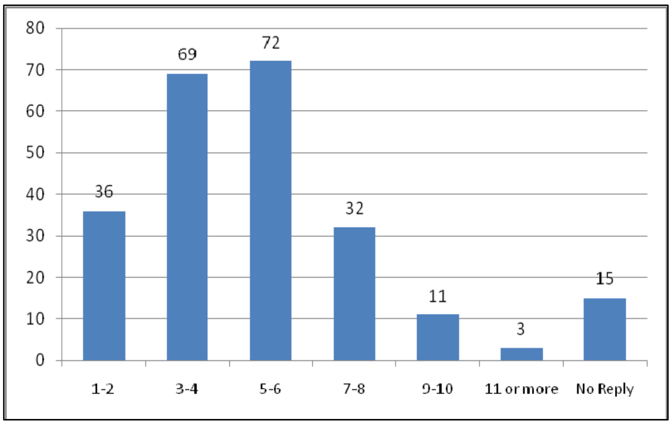
- Philippine Appliance Industry Association (PAIA)
- Philippine Lighting Industry Association (PLIA)
- Philippine Retailers Association (PRA)
- Integrated Institute of Electrical Engineers (IIEE)

Objectives of the Survey

- **Demand and awareness survey**
  - Grasp actual consumption patterns of residential, commercial and industrial users
  - Investigate energy conservation awareness
  - Assume breakdown of energy demand (e.g. Causes of current peak demand) and changes in future demand

Profile of Residential Respondents





Profile of Residential Respondents based on Monthly Family Income Bracket (PhP)

Profile of Residential Respondents based on household size (no. of people/ household)

Profile of Electricity Consumption

	Highest Month (March to May)	Lowest Month (June to November)	Current Billing (June – July)
Total kWh / month	54, 018	33, 295	46, 403
Total No. of Respondents	160	160	186

Profile of Utility Consumption

	Water Consumption	Energy Used for Cooking		
Volume, m³ / month	5,098	Electricity	LPG	Charcoal
No of Respondents	149	57	172	17

Profile of Electrical Appliance

Lighting

	IB	FL	CFL	Halogen	LED
No.of Bulbs	221	373	1131	11	19

Refrigerator

	Samsung	LG	Whitewesti ng- house	Sharp	GE
No. of units	17	11	13	13	44

Airconditioning

	Window-type AC	Split-type AC	AC with Inverter
No. of units	131	14	1

Criteria for Purchasing Electrical Appliances

	6	5	4	3	2	1
Price	12	9	18	28	38	65
Brand/Maker	24	20	27	36	33	37
Energy rating/energy efficiency	16	17	21	30	41	56
Design	39	45	32	15	12	7
Functions/features	59	24	43	34	32	26
Capacity	40	45	36	21	17	8

Note: 1 being the priority

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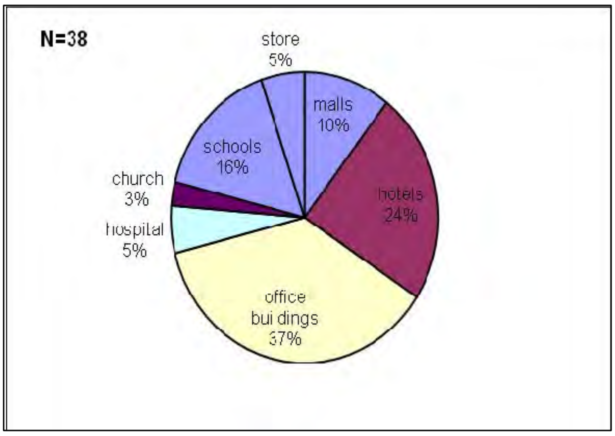
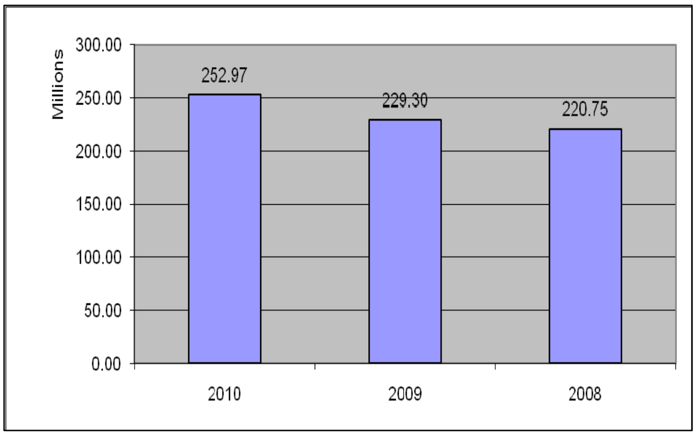
Profile of Commercial Respondents



Composition of Commercial Respondents According to Specific Line of Business



Annual Electricity Consumption (in kWh) for Commercial Establishments

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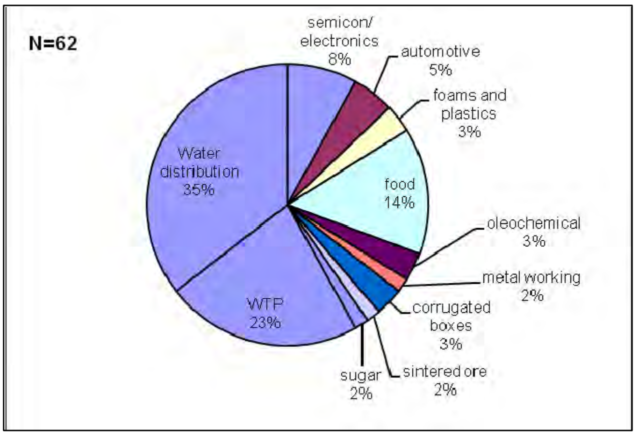
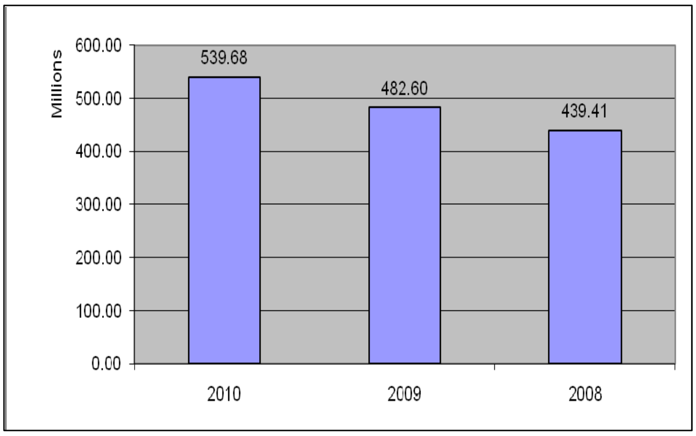
Profile of Industrial Respondents



Composition of Industrial Respondents According to Specific Line of Business



Annual Electricity Consumption (in kWh) for Industrial Facilities

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Comments on Government's Effort on Energy Efficiency

Residential Respondents:

- Info in energy efficiency/conservation is not cascaded down to consumers. Awareness/trainings conducted are more for industrial consumers.
- More efforts have to be exerted to disseminate info down to household consumers since the residential sector comprise a very large proportion of total energy consumption when taken as a whole.
- Go down to the barangay level and ask assistance from private sector, homeowner's associations, and religious group in information dissemination.
- Exert more effort to facilitate information drive for public

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Comments on Government's Effort on Energy Efficiency

Commercial / Industrial Respondents:

- Appreciates the governments initiatives, at least the government is doing something
- Promotion of DOE is not visible. They should use the industry associations, such as PHILEXPORT and Chamber of Commerce, to disseminate information
- The government should push the accreditation of ESCOs so that the companies who will be implementing EE&C will be more comfortable dealing with ESCOs knowing that they have been screened by the DOE
- In a large sugar company interviewed, the electric bills are kept for payment purposes but not organized for monthly monitoring of energy consumption.

Comments on Government's Effort on Energy Efficiency

Commercial / Industrial Respondents:

- Although their company has been energy audited, recommendations are not yet implemented due to high investment cost
- No designated energy manager. Energy management is just a side responsibility of the engineering/ maintenance section
- Most firms interviewed get funding for implementation of energy consumption reduction programs from internal funds
- DOE programs on EE & C not well-disseminated. Promotion through industry associations is suggested

Appendix III

Overview of EE&C Scheme for Transportation Sector in Japan

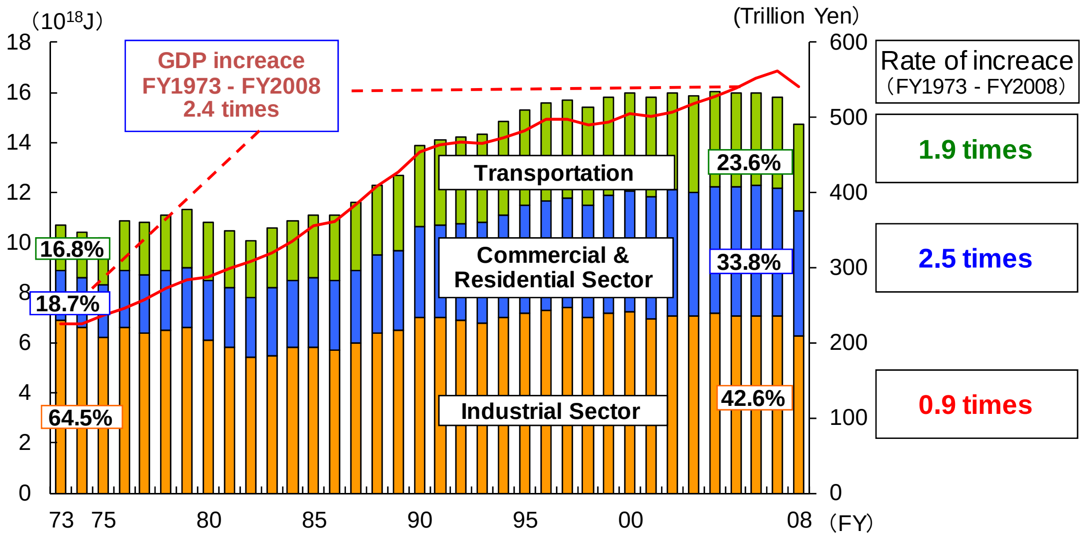
JICA Study Team

Topics

1. Introduction
2. Revised EE & C law for transportation
3. Compulsory items for carriers
4. Compulsory items for consigners
5. EE & C measures

1. Introduction - Transition of Energy Consumption

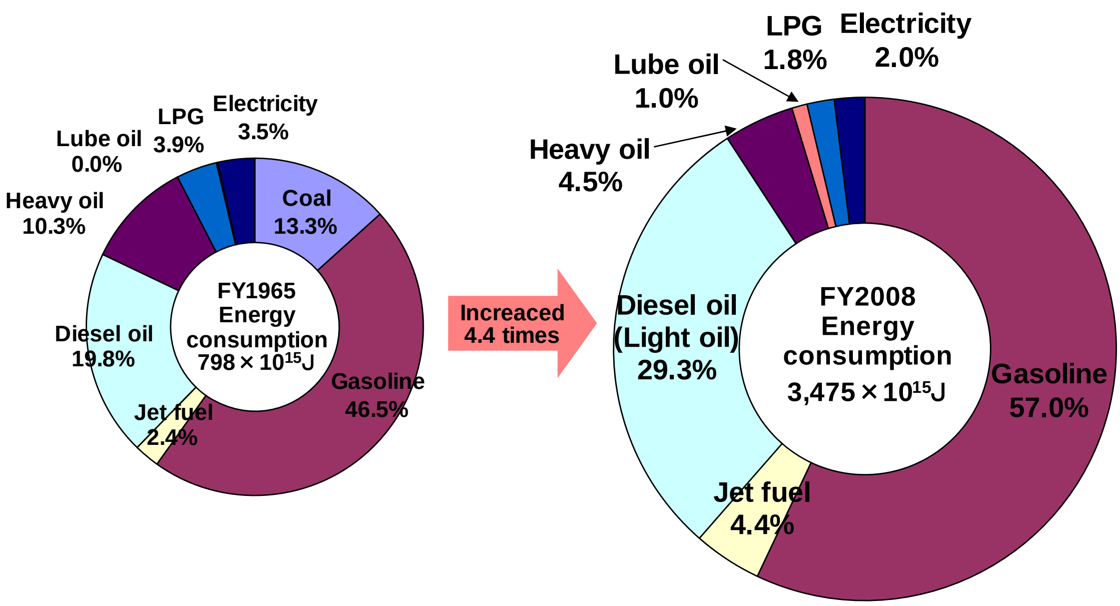
- Energy consumption in the different sectors from 1973 to 2008 has, except the Industrial Sector, increased in proportion to the rate of growth for GDP.
- There has been a double increase in Transportation since 1973, however the tendency since 2005 has been to decrease.



Source: White paper on energy 2010, METI

1. Introduction – Composition of Energy Sources in the transportation sector

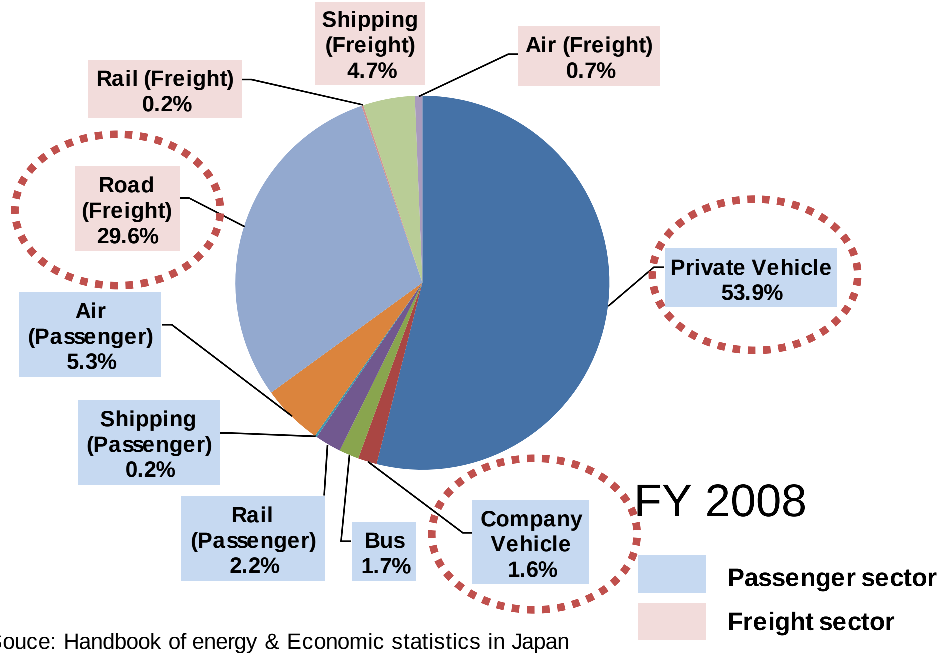
- 4.4 times increase in energy consumption between 1965 and 2008.
- There was coal consumption in 1965.
- Petroleum based energy accounts for 98% in 2008.



Source: White paper on energy 2010, METI

1. Introduction – Energy consumption in the Transport Sector

- Transportation is divided into Passenger & Freight.
- Passenger sector (blue) accounts for 65%, Freight（pink） accounts for 35%.
- Vehicles account for a large portion (over 80%) of both sectors.



Souce: Handbook of energy & Economic statistics in Japan

2. Revised EE & C law for transportation

Issues prior to revised EE & C Law

●To constrain the increases in energy consumption in the Transport Sector according to rate of increase in GDP.

●To enforce EE & C activities between carriers and the industrial sector.

Revisions of the EE & C Law （effective April, 2006）

●New measures for the Transport Sector are added.

●Submission of an energy saving plans and periodical reports on energy consumption shall be compulsory for consigners as well as carriers above a certain scale.

●The promotion of public transport usage as a measure against use of praivate vehicles.

2. Revised EE & C law for transportation

◆Legal action

	Situation	Action
1	Remarkably insufficient efforts and no significant reductions in energy consumption	Provide recommendations on necessary measures
2	Failure to follow the above recommendations	The company name is disclosed in public
3	Failure to implement recommended corrective measures without good cause	Give a legal order in line with recommendations
4	Failure to comply with order	Fine of up to one million Yen

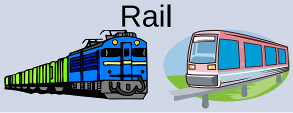
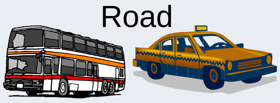
Light

Heavy

3. Compulsory items for carriers

Transport operators with carrying capacity over a fixed scale.

Designated as **specified carriers** by the Ministry of Land, Infrastructure and Transport.
(617 carriers in 2009)

Carriers	Standard	Freight	Passenger
Rail 	Rolling stock	300 cars	300 cars
Road 	No. of vehicles	200 vehicles	Buses 200 vehicles Taxis 350 vehicles
Ship 	Total shipping tonnage	Total tonnage 20,000	Total tonnage 20,000
Air 	Total maximum take off weight	9,000 tons	

3. Compulsory items for carriers

Evaluation criteria for specified carriers (summary)

A)Energy consumption intensity* is looked at over the mid to long term with the goal of annual average reductions of over 1%.

B)Determine policy explaining approach to energy saving.

C)Energy manager should be designated, and an structure to implement energy saving is prepared.

*The energy consumption intensity for each transport operator is calculated according to the following:

Freight carriers: energy consumption (kl) ÷ transport ton kilo

Passenger carriers: energy consumption (kl) ÷ transport kilo （rolling stock / shipping kilometerage）

Air carriers: energy consumption (kl) ÷ useable ton kilo

3. Compulsory items for carriers

D) Carriers work towards implementation of the following:

	Policies for implementation
Common	• Strengthened cooperation between consigners and other carriers
Rail	• Introduction of energy saving vehicles • Introduction of freight cars able to carry large containers • Secure the exact transport capacity for demand, by determining the number of trains etc. • Proper inspection and maintenance of vehicles
Vehicles	• Introduction of low fuel consuming vehicles • Education of operating staff, eco drive based on use of digital tachographs • In response to traffic, increase of truck sizes and promotion of trailered transport • Improvement of loading ratio based on implementation of shared transport and delivery, securing of backhaul etc.
Shipping	• Introduction of low fuel consuming vehicles • Implementation of energy saving operations such as economical speed operations etc • Increase of vessel size based on traffic • Improvement of loading ratio based on implementation of shared transport and delivery,
Air	• Introduction of airfreight with excellent energy efficiency • Rationalization of ground energy usage • Selection of optimal materials based on traffic • Reduction in distances for forwarding flights (ferry flights) by allowing knock on delays/cancellations OR manipulation of flight schedules

3. Compulsory items for carriers

Specified carriers submit the following reports to the Ministry of Land, Infrastructure and Transport.

(1) **Mid- & long-term plan report**

- To be submitted every year from the year following designation as specified carriers.
- Submit plans for mid- & long-term energy saving measures covering about 3~5 years.
- Submit explanation when plans are not achieved.

(2) **Periodical report**

- To be submitted every year from the year following designation as specified carriers.
- Report is submitted on energy consumption, the status of energy usage and the status of implementation of the energy saving measures etc.

4. Compulsory items for consigners

Consigners ordering freight over a fixed scale

⇩

Designated as specified consigners by the Ministry of Economy, Trade and Industry
（874 consigners in 2009）

- Consigners are companies which order freight transport (transport companies etc.) for their business activities.
- Companies providing their own transport are also consigners.
- Companies where the annual volume of freight transport is over 3000 ton-kilo are designated as specified consigners

*Ton-kilo = Freight volume [ton] x transported distance [kilometers]

4. Compulsory items for consigners

Evaluation criteria for specified consigners (summary)
A)Energy consumption intensity is looked at over the mid to long term with the goal of annual average reductions of over 1%.
B)Determine policy explaining approach to energy saving.
C)Consigners make an effort to implement the following policies:

Policies for implementation
• In-house research • Promote use of rail or shipping (modal shift) • Push to move from private to commercial freight • Implement shared transport with other organizations • Standardize and downsize goods to achieve improved loading ratios

4. Compulsory items for consigners

Specified consigners submit the following documents to the Minister of Economy, Trade and Industry and the Minister having jurisdiction over business.

(1) Mid- & long-term plan report

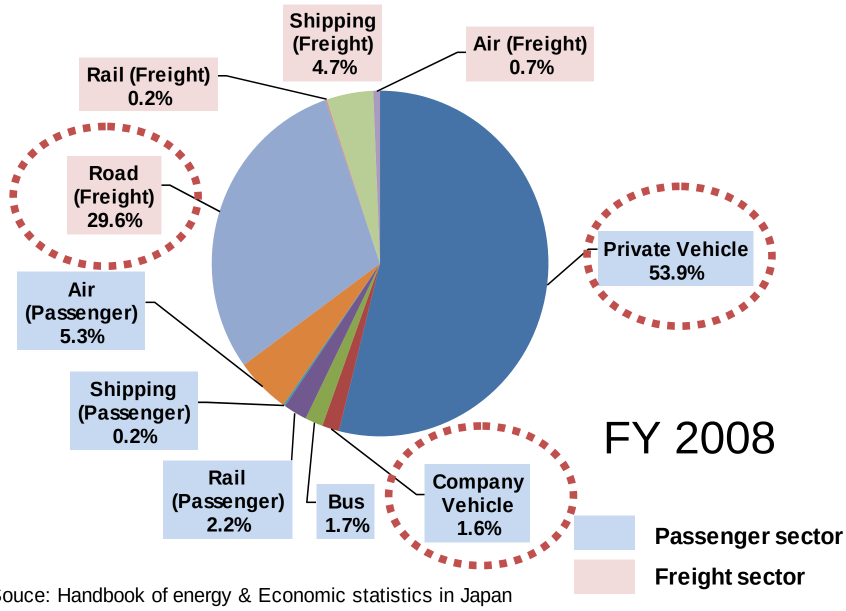
●To be submitted every year from the year following designation as specified consigners.
●Submit plans for mid- & long-term energy saving measures covering about 3~5 years.
●Submit explanation when plans are not achieved.

(2) **Periodical report**

●To be submitted every year from the year following designation as specified consigners.
●Report is submitted on energy consumption, the status of energy usage and the status of implementation of the energy saving measures etc.

5. EE & C measures

Top runner standard for freight & passenger vehicles is stated in EE & C law.



Souce: Handbook of energy & Economic statistics in Japan

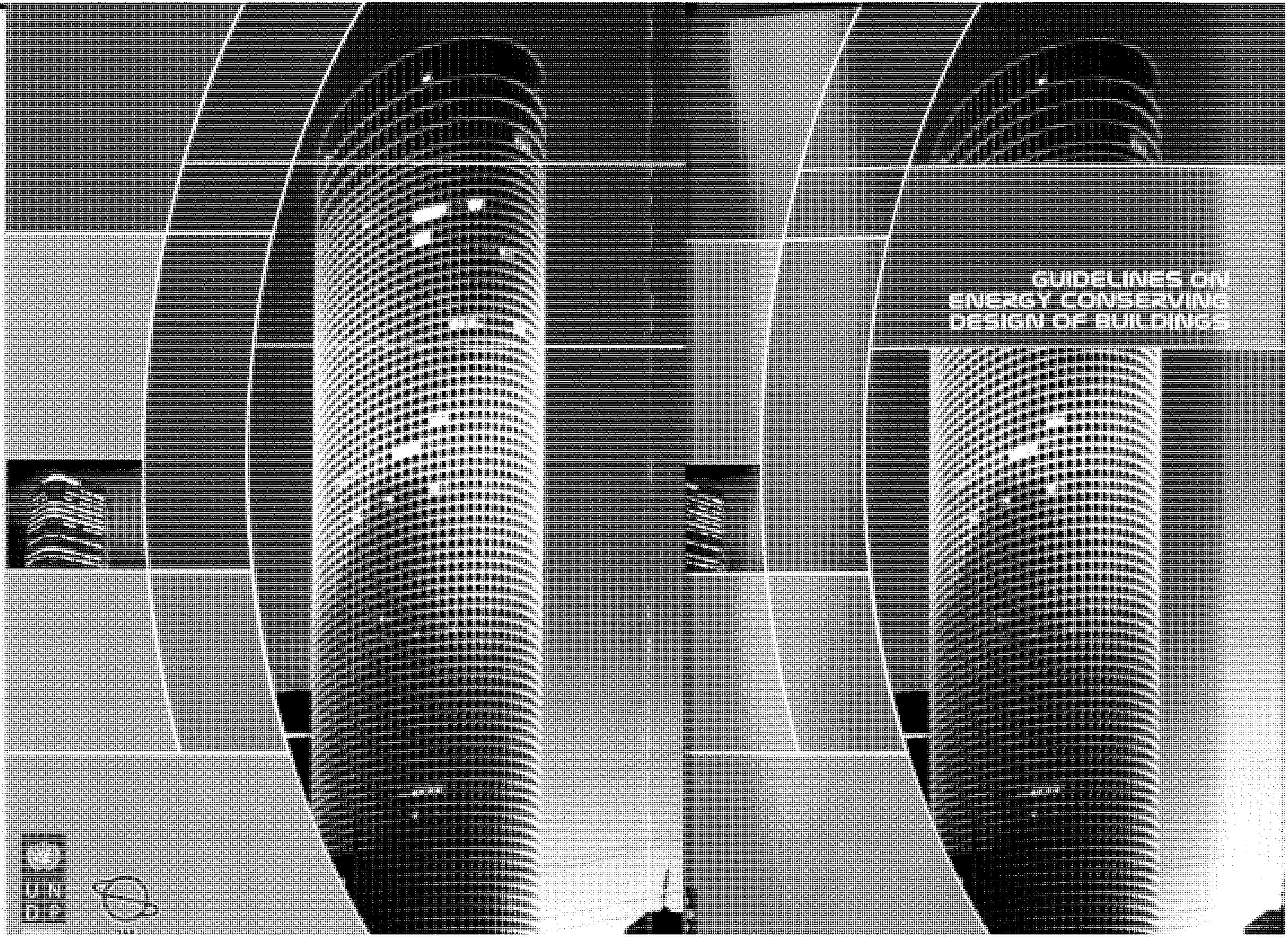
Please see a next topic

Appendix IV

Estimation of Project Cost

	Project Cost (PHP)	Remarks/ Calculation Conditions
Division for IEC	<A> 20,000,000 <B> 20,000,000 (Total 40,000,000)	**<A> Mass media campaign, giveaways, show event, recognition awards etc.:** PHP 20,000,000: current budget of DOE-EUMB-EECD: DOE) **<B> Training and seminars for engineers** PHP 20,000,000 (an estimation)
Division for Energy Management System and Energy Audit Scheme	<A> 2,200,000 <B> 3,300,000 (Total 5,500,000)	**<A> EMS:** Random check and site inspection - number of sites: 150 - 2 experts for a visit and 4 days to work - expert unit cost/ day: 1,219 (1.5 times of the staff) - managerial cost: 50% **<B> Energy Audit:** Hiring experts to check reports - 340 reports - 50 reports to handle/ person - expert unit cost/ day: 1,219 (1.5 times of the staff) - managerial cost: 50%
Division for Accreditation of Energy Managers and Energy Auditors	<A> 6,200,000 <B> 3,000,000 (Total: 9,200,000)	**<A> EMS:** Hiring experts for setting standards for examination and training: PHP 2,000,000 (an estimation) Providing examination - number of applicants per year: CEM: 1,000/ 3 years = 340/ year CECO: 5,000/ 3 years = 1700/ year - unit cost for exam: CEM: PHP 5,042[*1], CECO: PHP 1,018[*2] - initial cost for facility: PHP 1,920,500[*1] *1: estimation of Serbian case, *2: 1/5 of CEM **<B> Energy Audit:** Hiring experts for setting standards: PHP 2,000,000 (an estimation) Providing examination - unit cost for exam: PHP 3,550[*1] - number of applicants: 340 energy audits/ year 5 energy audits / person, 2 experts for 1 energy audit 340/5*2 = 136 auditors - initial cost: PHP 500,000 (an estimation)
Division for MEPS and Labeling	6,000,000	**<A> Setting standards of MEPS and classification of labeling:** PHP 2,000,000 (an estimation) **<B> Evaluation of policy and measure:** PHP 2,000,000 (an estimation) **<C> Monitoring:** PHP 2,000,000 (an estimation)
Division for Database Management	750,000	**<A> Maintain database:** PHP 750,000 (an estimation)

Appendix V


GUIDELINES ON
ENERGY CONSERVING
DESIGN OF BUILDINGS
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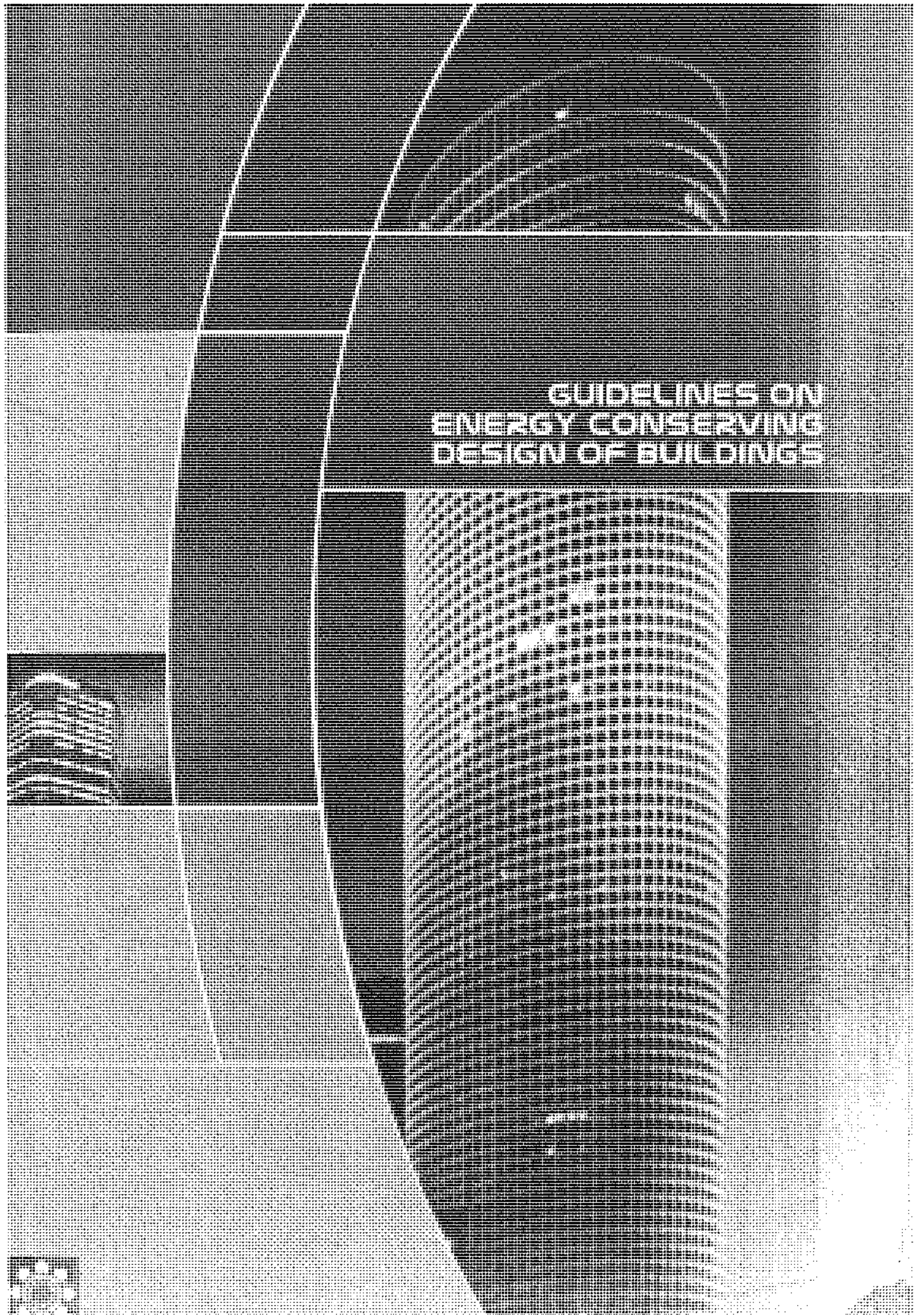
GUIDELINES ON
ENERGY CONSERVING
DESIGN OF BUILDINGS

Second Printing, November 2008

Republic of the Philippines
DEPARTMENT OF ENERGY
Energy Center, Merritt Rd., Fort Bonifacio, Taguig

MESSAGE

With climate change already affecting our lives, there is a need to design buildings that will have the least impact to the environment. Appropriate lighting in buildings, for instance, will greatly contribute to energy conservation. By conserving energy, we lessen our use of carbon-based fuels and it is but one way to address climate change.

We need to design buildings by considering the entire life cycle process without sacrificing functionality and economic returns. I am confident that this is going to be the advent of more environmentally safe buildings.

The purpose of this guideline is to provide a reference for building industry professionals and implement energy efficient systems, including efficient lighting, within the buildings. This booklet will serve as another milestone for the government in its attempt to address climate change through energy efficiency.

Angelo T. Reyes
Secretary

Preface

This document, Guidelines on Energy Conserving Design of Buildings, addresses the need to provide energy efficiency guidelines in the design and construction of buildings in the Philippines.

These Guidelines form part of the efforts of the Department of Energy (DOE) through the Philippine Efficient Lighting Market Transformation Project (PELMATP), as supported by the United Nations Development Programme - Global Environmental Facility (UNDP-GEF), to address the barriers to the widespread use of energy-efficient lighting systems in the Philippines.

These Guidelines were developed thru a consensus development process facilitated by the Institute of Integrated Electrical Engineers of the Phils., Inc. (IIEE), Philippine Lighting Industry Association (PLIA) and the Energy Efficiency Practitioners Association of the Philippines (ENPAP) together with various experts, professionals and stakeholders from Bureau of Product Standards (BPS), Department of Public Works and Highways (DPWH), DOE-Lighting and Appliance Testing Laboratory (DOE-LATL), Fujihaya, Manila Electric Company (MERALCO), Philippine Society of Mechanical Engineers (PSME), Philippine Society of Ventilation, Air Conditioning and Refrigeration (PSVARE), United Architects of the Philippines (UAP).

Though conscientious efforts have been exerted to make the contents of these guidelines as technically sound as possible, it is advised that it be applied by duly qualified and competent professionals. Any concern or issue as to its applicability, accuracy or completeness of this document shall be addressed to the Department of Energy for further validation and interpretation.

In this second printing, prominent changes were done more for clarity and relevance to certain provisions of international standards, especially ASHRAE, by additions and deletions. Data on *Table 3.4 Maximum*

Lighting Power Density for Building Interiors were adjusted to conform with data provided by the Department of Energy – EECD. Also, values for *Table 6.1 Outdoor Requirements for Ventilation* were changed to align with data from ASHRAE while provisions for Commercial Stores and Sports and Amusement Facilities were deleted and placed under consideration. Moreover, values from *Table 6.6 Minimum Performance Rating of Various Airconditioning System* were attuned to be consistent with the latest standards. The Committee deemed it also necessary to include figures of basic hood styles used in kitchen ventilation to provide practitioners for clarity.

Comments on the Guidelines regarding omissions and errors, as well as, conflicts with accepted international standards are most welcome and will be highly appreciated. All suggestions will be studied and considered for inclusion in the Guidelines's next edition.

Table of Contents

Section 1. Purpose

1.1 To encourage and promote the energy conserving design of buildings and their services to reduce the use of energy with due regard to the cost effectiveness, building function, and comfort, health, safety and productivity of the occupants.

1.2 To prescribe guidelines and minimum requirements for the energy conserving design of new buildings and provide methods for determining compliance with the same to make them always energy-efficient.

Section 2. Application and Exemption

2.1 Application

2.1.1 These guidelines are applicable to the design of:

a. New buildings and their systems; and
b. Any expansion and/or modification of buildings or systems.

2.1.2 These guidelines shall not be used to circumvent any applicable safety, health or environmental requirements.

2.2 Exemptions

2.2.1 Residential dwelling units; and

2.2.2 Areas with industrial/manufacturing processes.

Section 3. Lighting

3.1 Scope

This section shall apply to the lighting of spaces and areas of buildings, such as:

3.1.1 Interior spaces of buildings;

3.1.2 Exterior areas of buildings such as entrances, exits, loading docks, parking areas, etc.;

3.1.3 Roads, grounds and other exterior areas including open-air covered areas where lighting is required and is energized through the building's electrical service.

3.2 Exemptions

The following are exempted but are encouraged to use energy efficient lighting system whenever applicable.

3.2.1 Areas devoted for theatrical productions, television broadcasting, audio-visual presentations and those portions of entertainment facilities where there are special or customized lighting needs.

3.2.2 Specialized lighting system for medical or dental purposes.

3.2.3 Outdoor athletic facilities.

3.2.4 Display lighting required for art exhibits, products, and merchandise.

3.2.5 Exterior lighting for public monuments.

3.2.6 Special lighting for research laboratories.

3.2.7 Emergency lighting that is automatically "off" during normal operations.

3.2.8 High-risk security areas requiring additional special lighting.

3.2.9 Rooms for elderly persons and people with disability requiring special lighting needs.

3.3 General Requirements of Energy-Efficient Lighting Design

This Guideline sets out the minimum requirements for achieving energy-efficient lighting installations. The requirements of this Guideline are generally expressed in terms of illumination level, luminous efficacy, and lighting power density. In the course of selecting an appropriate indoor illumination level for a space, energy efficiency should be taken into consideration in addition to other lighting requirements. On the other hand specific efficiency requirements for each type of lamp, control gear and luminaires shall conform to relevant Philippine National Standards.

3.3.1 The lighting design shall utilize the energy efficient lighting equipment. The lighting system shall be so chosen as to provide a flexible, effective and pleasing visual environment in accordance with the intended use, but with the least possible energy requirements.

3.3.2 The use of task-oriented lighting shall be used whenever practicable.

3.3.3 In the design of general lighting in buildings with centralized air conditioning equipment, consideration should be given to integrated lighting and air conditioning systems which use luminaires with heat removal capabilities. (See related requirement in Section Air Conditioning.)

3.3.4 The lighting system shall be designed for expected activity. The task shall be analyzed in terms of difficulty, duration, criticalness and location in order to determine the lighting needs throughout the

space, always keeping in mind that higher illumination levels than necessary are likely to waste energy while on the other hand, levels lower than needed could impair visual effectiveness. Table 3.1 lists the recommended illuminance levels.

3.3.5 The most efficient lamps appropriate to the type of lighting, color rendition and color appearance shall be selected. The use of such types of lamps reduces power requirements. Refer to Table 3.2 Efficacy Ranges and Color Rendering Indices of Various Lamps.

3.3.6 In general, the normal artificial light source should be the fluorescent lamp. In down light installation, high-pressure discharge lamps can be used. In large high bay areas, high-pressure discharge lamps should be used. Where good color rendering is required, the tubular fluorescent lamp and other high-pressure discharge lamps except high-pressure sodium lamps should be used. However, if moderate color rendering is of comparatively minor importance, high-pressure sodium lamps can be used. If very good color rendering is required, the tubular fluorescent lamp should be used.

3.3.7 The most efficient combination of luminaires, lamps and ballasts appropriate for the lighting task and for the environment shall be selected so that lamp light output is used effectively. The selected luminaire should meet the requirements with respect to light distribution, uniformity and glare control. The use of highly polished or mirror reflectors are recommended to reduce the number of lamps installed without reducing the illumination level. Where ballasts are used, these should be of the electronic type or low loss type with a power factor of at least 85%.

3.3.8 The highest practical room surface reflectance should be considered in the lighting design. The use of light finishes will attain the best overall efficiency of the entire lighting system. Dark surfaces should be avoided because these absorb light. Table 3.3 lists the recommended room surface reflectances.

3.3.9 Selective switching possibilities should be provided so that individual or specific group of fixtures can be turned off when not needed and lighting levels can be adapted to changing needs.

3.7.2 Switches for task lighting areas may be mounted as part of the task lighting fixtures. Switches controlling the same load from more than one location should not be credited as increasing the number of controls to meet the requirements of Section 3.6.

Exceptions:

1. Lighting control requirements for spaces, which must be, used as a whole should be controlled in accordance with the work activities and controls may be centralized in remote locations. These areas include public lobbies of office buildings, hotels and hospitals; retail and department stores and warehouses; storerooms and service corridors under centralized supervision.

2. Manual and automatic control devices may reduce the number of controls required by using an equivalent number of controls from Table 3.7.

3. Automatic controls.

4. Programmable controls.

5. Controls requiring trained operators.

6. Controls for safety hazards and security.

3.8 Compilation of Information

a. Data of lamps and luminaires.
b. Lighting power density and projected illumination per area/application.
c. Relevant drawings and plans.

Table 3.1 Recommended Design Illuminance Levels

Task	Min. & Max. (Lux)	Applications
Lighting for infrequently used areas	50 – 150	Circulation areas and corridors
	100 – 200	Stairs
	100 – 200	Hotel, escalators
Lighting for working interiors	200 – 300	Infrequent reading and writing
	300 – 750	General offices, typing and computing
	300 – 750	Conference rooms
	500 – 1000	Deep-plan general offices
	500 – 1000	Drawing offices
Localized lighting for exacting tasks	500 – 1000	Proofreading
	750 – 1500	Designing, architecture and machine engineering
	1000 – 2000	Detailed and precise work

Table 3.2 Efficacy Ranges and Color Rendering Indices of Various Lamps

Lamp Type	Rated Power Ranges (watts)	Efficacy Ranges (lumens per watt)	Minimum Color Rendering Index (CRI)
Incandescent Lamp	10 - 100	10 – 25	100
Compact Fluorescent Lamp	3 - 125	41 - 65	80
Linear Fluorescent Lamp			
halophosphate	10 – 40	55 - 70	70
triphosphor	14 - 65	60 - 83	80
Mercury Vapor Lamp	50 -2000	40 - 63	20
Metal Halide Lamp	Up to 1000	75 - 95	65
Low Pressure Sodium Lamp	20 -200	100 - 180	0
High Pressure Sodium Lamp	50 - 250	80 - 130	21

Table 3.3 Recommended Room Surface Reflectances

Surface	% Reflectance
Ceilings	80-92
Walls	40-60
Furnitures	26-44
Floors	21-39

Table 3.4 Maximum Lighting Power Density for Building Interiors

Area/Activity	Lighting Power Density (W/m^2)
Auditoriums, Churches	8
Food Service	
Snack Bars and Cafeteria	14
Leisure/Dining Bar	10
Offices and Banks	10
Retail Stores (*)	
Type A (**)	23
Type B (***)	22
Shopping Centers/Malls/Arcades	15
Clubs/Basements/Warehouses/ General Storage Areas	2
Commercial Storage Areas/Halls Corridors/Closets	4
Schools	
Preparatory/Elementary	17
High School	18
Technical/Universities	18
Hospitals/Nursing Homes	16
Hotels/Motels	
Lodging rooms/Guest rooms	12
Public Areas	17
Banquet/Exhibit	20

Notes:
(*) Value is based on data provided by the Department of Energy-EECD.
(**) Includes general merchandising and display lighting except for store front, etc.
(***) Type A -Fine and mass merchandising.
(****) Type B -General, food and miscellaneous merchandising.

Table 3.5 Maximum Values for Lighting Power for Building Exteriors

Building Area/Space	Lighting Power
Exits (w/ or w/o canopy)	60 W/Lm of door opening
Entrance (w/o canopy)	90 W/Lm of door opening
Entrance (w/ canopy)	
High traffic (e.g., retail,,hotel, airport, theater, etc.)	100 W/m² of area w/ canopy
Light traffic (e.g.,hospital, office, school, etc.)	10 W/m² of area w/ canopy
Loading area	3 W/m²
Loading door	50 W/Lm of door opening
Total power allowance for the exterior (inclusive of above allowances) of building perimeter for buildings of up to 5 storey (above ground) plus 6W/Lm of building perimeter for each additional storey	100 W/Lm

Note: W/Lm = watts per linear meter

Table 3.6 Maximum Values for Lighting Power for Roads and Grounds

Area/Space	Lighting Power (W/m²)
Store and work area	2.0
Other activity areas for casual use (e.g., picnic grounds, gardens, parks, etc.)	1.0
Private driveways/walkways	1.0
Public driveways/walkways	1.5
Private parking lots	1.2
Public parking lots	1.8

Table 3.7 Control Types and Equivalent Number of Control Points

Type of Control	Equivalent Number of Control Points
Manually operated on-off switch	1
Occupancy Sensor	2
Timer – programmable from the space being controlled	2
3 Level step-control (including off) or pre-set dimming	2
4 Level step-control (including off) or pre-set dimming	3
Continuous (Automatic) dimming	3

Section 4. Electric Power and Distribution

4.1 Scope

This section applies to the energy conservation requirements of electric motors, transformers and distribution systems of buildings except those required for emergency purposes.

4.2 Electric Motors

4.2.1 This section shall apply to any general-purpose, T-frame, single speed, foot-mounted, polyphase induction motor of design A and B configuration that is continuous rated and operating at 230/460 volts, 60 Hz, as defined in NEMA Standard MG 1. Motors affected are rated from 1 to 200 hp, drip-proof and totally enclosed fan-cooled enclosures. It shall not apply to other types as regard to the efficiency requirements.

4.2.2 A motor's performance shall equal or exceed the nominal full load efficiency levels given in Table 4.1. Motors operating more than 750 hours a year should be of energy efficient types as shown in Table 4.2. Energy efficient motors are higher quality motors with increased reliability, providing savings in reduced downtime, replacement and maintenance cost.

4.2.3 The nameplates of these motors shall include not only all the information required by the Philippine Electrical Code Part 1, but also the rated full load efficiency and full load power factor as determined by Philippine National Standard PNS IEC 61972:2005 (IEC published 2002), Methods for Determining Losses and Efficiency of Three Phase Cage Induction Motors.

High efficiency motors are basically high flux density, low core loss and low current density motors which should be employed whenever applicable.

4.2.4 Motor Selection

4.2.4.1 The type and the size of the squirrrel-cage induction motor shall be selected only after an accurate determination of the starting and running requirements of the load has been made, taking into account the following factors:

1. maximum overload expected
2. ambient conditions
3. power supply conditions
4. future expansion
5. deterioration of the driven load
6. duty cycle
7. speed

4.2.4.2 The first five factors above should be considered carefully as they suggest the selection of larger motors at the expense of low power factor and low efficiency.

4.2.4.3 In cases where higher kW rating is necessary due to special requirements of the application, the motor rating may be increased but not to exceed 125% of the calculated maximum load to be served. If this rating is not available, the next higher rating may be selected.

4.2.4.4 Motors with high speeds are generally more efficient than those of lower speeds and should be considered as much as possible.

4.2.4.5 Where an application requires varying output operation of motor-driven equipment such as a centrifugal pump, a variable speed drive shall be considered instead of throttling the output of the pump.

4.2.4.6 Other applicable requirements specified in the latest edition of the Philippine Electrical Code Part 1 shall be complied with.

4.3 Transformers

4.3.1 All owner-supplied transformers that are part of the building electrical system shall have efficiencies not lower than 98%. The transformer should be tested in accordance with relevant Philippine

National Standards (PNS) at the test conditions of full load, free of harmonics and at unity power factor.

4.3.2 The average power factor of the loads being served by the transformers at any time should not be less than 85%. In cases where load power factors are below this value, capacitors or power factor improving devices shall be provided so that automatic or manual correction can be made.

4.3.3 Transformer load grouping schemes shall be so designed such that the transformers is loaded to not less than 75% of its full load ratings and that no-load circuits or partially loaded circuit combinations should be minimized as much as possible.

4.3.4 Disconnect switches or breakers shall be provided at the primary (supply) side of transformer to allow electrical disconnection during no load period.

4.3.5 Transformers located inside a building should have sufficient ventilation and should have a direct access from the road for ease of maintenance at all times.

4.4 Power Distribution

4.4.1 In the calculation of the wire sizes to be used, the Philippine Electrical Code, Part I have specified the procedure and the factors to be considered in order to arrive at the minimum acceptable wire size.

4.4.2 The sum of the operating cost over the economic life of distribution system should be minimized rather than the initial cost only. Operating cost shall include but not limited to maintenance and energy losses.

4.5 Metering for Energy Auditing

4.5.1 Buildings whose designed connected electrical load is 250 kVA and above shall have metering facilities capable of measuring voltage, current, power factor, maximum demand and energy consumption. In addition, it shall have provision for feeder metering facilities.

4.5.2 For metering facilities should have capabilities of measuring energy consumption and current. Where possible, a feeder circuit shall be serving a particular group of loads sharing the same function for better monitoring and control. These loads can be grouped as follows:

4.5.2.1 Lighting Load

4.5.2.2 Chillers

4.5.2.3 Air Handling Units, Unitary Air Conditioning Systems

4.5.2.4 Other Motor Loads (exhaust fan, pumps, etc.)

4.5.3 In multiple tenant buildings, each tenant unit shall have a provision for measuring the tenant's energy consumption. Power to common utilities such as water pump, elevator, etc. need not meet these tenant provisions.

4.5.4 In order to facilitate metering safely and quickly by qualified personnel, an adequate working space in front of the electrical panels and meters shall be provided.

Table 4.1 Minimum Acceptable Full Load Efficiency

Motor Size	Open Drip-Proof Motors			Totally Enclosed Fan-Cooled Motors		
	revolutions per minute			revolutions per minute		
	1200	**1800**	**3600**	**1200**	**1800**	**3600**
0.8 kW (1 hp)	72.0	77.0	80.0	-	72.0	75.5
1.2 kW (1.5 hp)	82.5	82.5	82.5	82.5	81.5	78.5
1.6 kW (2 hp)	84.0	82.5	82.5	82.5	82.5	82.5
2.4 kW (3 hp)	85.5	86.5	82.5	84.0	84.0	82.5
4.0 kW (5 hp)	86.5	86.5	85.5	85.5	85.5	85.5
6.0 kW (7.5 hp)	88.5	88.5	85.5	87.5	87.5	85.5
8.0 kW (10 hp)	90.2	88.5	87.5	87.5	87.5	87.5
12.0 kW (15 hp)	89.5	90.2	89.5	89.5	88.5	87.5
16.0 kW (20 hp)	90.2	91.0	90.2	89.5	90.2	88.5
20.0 kW (25 hp)	91.0	91.7	91.0	90.2	91.0	89.5
24.0 kW (30 hp)	91.7	91.7	91.0	91.0	91.0	89.5
32.0 kW (40 hp)	91.7	92.4	91.7	91.7	91.7	90.2
40.0 kW (50 hp)	91.7	92.4	91.7	91.7	92.4	90.2
48 kW (60 hp)	92.4	93.0	93.0	91.7	93.0	91.7
60 kW (75 hp)	93.0	93.6	93.0	93.0	93.0	92.4
80 kW (100 hp)	93.0	93.6	93.0	93.0	93.6	93.0
100 kW (125 hp)	93.6	93.6	93.0	93.0	93.6	93.0
120 kW (150 hp)	93.6	94.1	93.6	94.1	94.1	93.6
160 kW (200 hp)	94.1	94.1	93.6	94.1	94.5	94.1

Table 4.2 Minimum Acceptable Full Load Efficiency for High Efficient Motors

Motor Size	Open Drip-Proof Motors			Totally Enclosed Fan-Cooled Motors		
	revolutions per minute			revolutions per minute		
	1200	1800	3600	1200	1800	3600
0.8 kW (1hp)	74.0	80.0	82.5	74.0	80.0	82.5
1.2 kW (1.5hp)	84.0	84.0	82.5	85.5	84.0	82.5
1.6 kW (2 hp)	85.5	84.0	84.0	86.5	84.0	84.0
2.4 kW (3 hp)	86.5	86.5	84.0	87.5	87.5	85.5
4.0 kW (5hp)	87.5	87.5	85.5	87.5	87.5	87.5
6.0 kW (7.5 hp)	88.5	88.5	87.5	89.5	89.5	88.5
8.0 kW (10 hp)	90.2	89.5	88.5	89.5	89.5	89.5
12.0 kW (15 hp)	90.2	91.0	89.5	90.2	91.0	90.2
16.0 kW (20 hp)	91.0	91.0	90.2	90.2	91.0	90.2
20.0 kW (25 hp)	91.7	91.7	91.0	91.7	92.4	91.0
24.0 kW (30 hp)	92.4	92.4	91.0	91.7	92.4	91.0
32.0 kW (40 hp)	93.0	93.0	91.7	93.0	93.0	91.7
40.0 kW (50 hp)	93.0	93.0	92.4	93.0	93.0	92.4
48 kW (60 hp)	93.6	93.6	93.0	93.6	93.6	93.0
60 kW (75 hp)	93.6	9.41	93.0	93.6	94.1	93.0
80 kW (100 hp)	94.1	94.1	93.0	94.1	94.5	93.6
100 kW (125 hp)	94.1	94.5	93.6	94.1	94.5	94.5
120 kW (150 hp)	94.5	95.0	93.6	95.0	95.0	94.5
160 kW (200 hp)	94.5	95.0	94.5	95.0	95.0	95.0

Section 5. Overall Thermal Transfer Value of Building Envelope

5.1 Scope

This section applies to air-conditioned buildings with a total cooling load of 175 kW or greater. The requirements and guidelines of this section cover external walls, roofs and air leakage through the building envelope.

The design criterion for building envelope, known as the Overall Thermal Transfer Value (OTTV), shall be adopted. The OTTV requirement which shall apply only to air-conditioned buildings is aimed at achieving the energy conserving design for building envelopes so as to minimize external heat gain and thereby reduce the cooling load of the air conditioning system.

5.2 Concept of OTTV

5.2.1 The solar heat gain through building envelope constitutes a substantial share of heat load in a building, which will have to be eventually absorbed by the air-conditioning system at the expense of energy input. To minimize solar heat gain into a building is therefore the first and foremost consideration in the design of energy efficient building. The architectural techniques used to achieve such purpose are too numerous to mention. Siting and orientation of a rectangular building to avoid exposure of its long facades to face east and west, for instance, is a simple means of reducing solar heat gain if the building sites permits. Appropriate choice of building shape to minimize building envelope area and selection of light colors for wall finish to reflect solar radiation are other common sense design alternatives to lower solar heat input.

5.2.1.1 The OTTV concept takes into consideration the three basic elements of heat gain through the external walls of a building, as follows:

- **a.** heat conduction through opaque walls;
- **b.** heat conduction through glass windows;
- **c.** solar radiation through the glass windows.

5.2.2 These three basic elements of heat input are averaged out over the whole envelope area of the building to give an overall thermal transfer value, or OTTV in short. This concept, in essence, helps to preserve a certain degree of flexibility in building design.

5.2.3 For the purpose of energy conservation, the maximum permissible OTTV has been set at 45 W/m^2.

5.2.4 OTTV Formula for Building Envelope

5.2.4.1 To calculate the OTTV of an external wall, the following basic formula shall be used:

$$OTTV = \frac{(Aw \times Uw \times TDeq) + (Af \times Uf \times \Delta T) + (Af \times SC \times SF)}{Ao}$$

Where:

OTTV	:	overall thermal transfer (W/m^2)
Aw	:	opaque wall area (m^2)
Uw	:	thermal transmittance of opaque wall (W/m^2 °K)
TDeq	:	equivalent temperature difference (°K), see sub paragraph 5.2.4.1.1
Af	:	fenestration area (m^2)
Uf	:	thermal transmittance of fenestration (W/m^2)
ΔT	:	temperature difference between exterior and interior
SC	:	shading coefficient of fenestration
SF	:	solar factor (W/m^2), see sub paragraph 5.2.5.1.2
Ao	:	gross area of exterior wall (m^2) = Avs + Af

5.2.4.1.1 Equivalent Temperature Difference

Equivalent Temperature Difference (TDeq) is that temperature difference which results in the total heat flow through a structure as caused by the combined effects of solar radiation and outdoor temperature. The TDeq across a structure takes into account the types of construction (mass and density), degree of exposure, time of day, location and orientation of the construction and design condition. By adopting the TDeq concept, the unsteady heat flow through a construction may then be calculated using the steady state heat flow equation:

$$q = A \times U\ TDeq$$

For the purpose of simplicity in OTTV calculation, the TDeq of different types of construction have been narrowed down to three values according to the densities of the constructions, as given in Table 5.1.

5.2.4.1.2 Solar Factor

The Solar Factor for vertical surfaces has been experimentally determined for this zone. From data collected over a period of time for the eight primary orientations, the average Solar Factor for vertical surfaces has been worked out to be 130 W/m^2. This figure has to be modified by a correction factor when applied to a particular orientation and also if the fenestration component is sloped at an angle skyward. For the purpose of the building regulations, any construction having a slope angle of more than 70° with respect to the horizontal shall be treated as a wall. For a given orientation and angle of slope, the Solar Factor is to be calculated from the following formula:

$$SF : 130 \times CF\ (W/m^2)$$

Where CF is the correction factor with reference to the orientation of the façade and the pitch angle of the fenestration component and is given in Table 5.2.

5.2.4.2 As walls at different orientations receive different amounts of solar radiation, it is necessary in general to compute first the OTTVs individual walls, then the OTTV of the whole building envelope is obtained by taking the weighted average of these values. To calculate for the envelope of the whole building, the following formula shall be used:

$$OTTV = \frac{A_{01} \times OTTV_1 + A_{02} \times OTTV_2 + \ldots + A_{0x} \times OTTV_x}{A_{01} + A_{02} + A_{0x}}$$

5.2.4.3 The gross area of an exterior wall shall include all opaque wall areas, window areas and door areas, where such surfaces are exposed to outdoor air and enclose an air-conditioned space. The fenestration area shall include glazing, glazing bars, mullions, jambs, transoms, heads and sills of window construction and shall be measured from the extreme surfaces of the window construction

5.2.4.4 Where more than one type of material and/or fenestration is used, the respective term or terms shall be expanded into sub-elements, such as

$$(Aw_1 \times Uw_1 \times TDeq_1) + (Aw_2 \times Uw_2 \times TDeq_2), \text{ etc.}$$

5.2.4.5 In the case of a mixed-use building where the residential portion and the commercial portion are distinctly and physically separated from each other, e.g., in the form of a residential tower block and a commercial podium, the OTTVs of the two portions should be separately computed.

5.2.4.6 Exterior Walls (with Day lighting)

5.2.4.6.1 The calculation procedure for the OTTV of exterior walls considering day lighting is the same as given Section 5.2. The day lighting aspect is explained in the following sections.

5.2.4.6.2 A credit for day lighting is provided for several reasons. In day lighting applications, the Window to Wall Ratio (WWR) is usually large. Glazing allows more heat gain to the interior space than an isolated wall and, due to this; a larger WWR normally causes a higher level of cooling needs in the space. However, artificial lighting energy savings due to day lighting can be greater than the additional energy penalty for space cooling due to the increased glazed surface area when the building envelope is carefully designed to allow day lighting. The transparent portions of the building envelope should be designed to prevent solar gains above that necessary for effective for day lighting. To make sure that day lighting is being effectively utilized, automatic day lighting controls shall be used to turn off the artificial lights when sufficient natural light is available.

5.2.4.6.3 Day lighting credit may be taken for those areas with installed automatic lighting controls for all lights within 4 meters of an exterior wall. Day lighting credit is accounted for by a 10% reduction in the OTTVs. These reduced OTTV values are then used in the calculation of the building's OTTV using Equation 5.2.4.1.

5.2.4.6.4 If the automatic day lighting control credit is taken, then the visible transmittance of the fenestration system used for that exterior wall(s) where day lighting is applied shall not be less than 0.25.

5.2.5 Air Leakage

5.2.5.1 General

The infiltration of warm air and exfiltration of cold air contribute substantially to the heat gain of an air-conditioned building. As a basic requirement, buildings must not have unenclosed doorways, entrances, etc., and where heavy traffic of people is anticipated, self-closing doors must be provided.

5.2.6 Weather-stripping of Windows and Doors

5.2.6.1 The concept of OTTV is based on the assumption that the envelope of the building is completely enclosed to minimize the infiltration of warm air and exfiltration of cool air. Infiltration and exfiltration contribute substantially to the building's heat gain, as the warmer infiltrated air must be cooled in order to maintain the desired comfort condition.

5.2.6.2 As a basic requirement, the building must not have unenclosed doorways, entrances, etc. For commercial buildings where heavy traffic of people is anticipated, self-closing doors should be provided.

5.2.6.3 To further minimize the exfiltration of cool air and infiltration of warm air through leaky windows and doors, effective means of weather-stripping should also be incorporated.

5.2.6.4 Preferably, doors and windows should be designed to meet the following criteria when tested under a pressure differential of 75 Pa:

a. windows: leakage to limit to 2.77 m^3/h per meter of sash crack

b. swinging revolving or sliding doors: leakage to limit to 61.2 m^3/h per meter of door crack

c. air curtains may be used in very high volume entrances only when revolving or self-closing sliding doors are not appropriate.

5.3 Units Located at the Perimeter of the Building Envelope in Air-conditioned Buildings

5.3.1 Subject to Subsection 5.3.2, in air-conditioned building where shops or other units are designed such that they located along the perimeter of the building envelope, the door openings of such shops or units shall be designed to face the interior of the building.

5.3.2 Where the door opening of any shop or unit is designed to pen to the exterior of the building, then:

a. That shop or unit with the door opening to the exterior shall be completely separated from the other parts of the building; and

b. That shop or unit, if it is to be air-conditioned, shall have its own individual air-conditioning system separate and independent from the main or central system.

5.3.3 Zoning for Temperature Cool

5.3.3.1 At least one thermostat for the regulations of space temperature shall be provided for each separate air handling system and zone.

5.3.3.2 Each air handling system shall be equipped with a readily accessible means of shutting off or reducing the energy used for the air-conditioning system during periods of non-use or alternative uses of building spaces or zones served by the system.

5.3.3.3 For the purpose of meeting the requirements of Subsection 5.3.3.2, the following devices shall be regarded as satisfactory:

a. Manually adjustable automatic timing devices;
b. Manual devices for use by operating personnel; or
c. Automatic control systems.

5.3.4 In any development, an automatic control device acceptable to the Building Authority shall be installed in every guest room for the purpose or automatically switching off the lighting and reducing the air-conditioning when a room is not occupied.

5.3.4.1 All buildings used or intended to be used as offices, a hotel or shop or a combination thereof shall be provided with data logging facilities for the collection of data for energy auditing.

5.4 Roof Insulation and Roof OTTV

5.4.1 Thermal Transmittance of Roof

5.4.1.1 Solar heat gain into a building through an uninsulated roof increases air temperature indoor. In all buildings, directional radiation received on the roof can be one of the main causes of thermal discomfort.

5.4.1.2 For an air-conditioned building, solar heat gain through the roof also constitutes a substantial portion of the cooling load. From on-site solar radiation measurements taken, the intensity of the radiation on a horizontal surface can be as much as 3 times of that on a vertical surface.

The purpose of roof insulation is therefore two-folds: to conserve energy in air-conditioned buildings and to promote thermal comfort in non air-conditioned buildings. In both cases, the building regulations require that the roof shall not have a thermal transmittance or U-value greater than the values tabulated in Table 5.3.

5.4.1.3 Where more than one type of roof is used, the average thermal transmittance for the gross area of the roof should be determined from:

$$Ur = \frac{Ar_1 \times Ur_1 + Ar_2 \times Ur_2 + \ldots + Ar_x \times Ur_x}{Ar_1 \times Ar_2 + \ldots + Ar_x}$$

Equation 5.1

Where:

U_r : the average thermal transmittance of the gross roof area ($W/m^2\,°K$)

U_{r1} : U_{rx} : the respective thermal transmittance of different roof sections ($W/m^2\,°K$)

A_{r1} : A_{rx} : the respective area of different roof sections (m^2)

Similarly, the average weight of the roof should be calculated as follows:

$$Wr = \frac{Ar_1 \times Wr_1 + Ar_2 \times Wr_2 + \ldots + Ar_x \times Wr_x}{Ar_1 \times Ar_2 + \ldots + Ar_x}$$

Equation 5.2

Where:

Wr : average weight of roof (kg/m^2)

Wr_1 Wr_n : the respective weight of different roof sections (kg/m^2)

5.5 OTTV of Roof

5.5.1 In the case of air-conditioned building, the concept of overall thermal transfer value, or OTTV, is also applicable to its roof if the latter is provided with skylight. The OTTV concept for roof takes into consideration three basic elements of heat gain, as follows:

a. heat conduction through opaque roof;
b. heat conduction through skylight;
c. solar radiation through skylight.

The maximum permissible OTTV for roofs is set at 45 W/m^2, which is the same as that for walls.

5.5.1.1 To calculate the OTTV of a roof, the following basic formula shall be used.

$$OTTV = \frac{(Ar \times Ur \times TDeq) + (As \times Us \times \Delta T) + (As \times SC \times SF)}{Ao}$$

Equation 5.3

Where,

OTTV	:	overall thermal transfer value (W/m^2)
Aw	:	opaque wall area (m^2)
Uw	:	thermal transmittance of opaque wall ($W/m^2\,°K$)
TDeq	:	equivalent temperature difference (°K), see sub-paragraph 5.2.2.1
As	:	skylight area (m^2)
Us	:	thermal transmittance of skylight area ($W/m^2\,°K$)
T	:	temperature difference between exterior and interior design conditions
SC	:	shading coefficient of skylight
SF	:	solar factor (W/m^2), see sub paragraph 5.2.2.2
Ao	:	gross area of roof (m^2) – Ar + As

5.5.1.1.1 Equivalent Temperature Difference

For the purpose of simplicity in OTTV calculation, the TDeq of different types of roof constructions have been standardized in Table 5.4.

5.5.1.1.2 Solar Factor

For a given orientation and angles of slope, the Solar Factor is given by:

$$SF = 320 \times CF \ (W/m^2) \qquad \text{Equation 5.4}$$

Where CF is the correction factor with reference to the orientation of the roof and the pitch angle of its skylight and is given in Table 5.5.

5.5.1.2 If a roof consists of different sections facing different orientations or pitched at different angles, the OTTV for the whole roof shall be calculated as follows:

$$OTTV = \frac{Ao_2 \times OTTV_2 + Ao_2 \times OTTV_2 + \ldots + Ao_x \times OTTV_x}{Ao_1 + Ao_2 + \ldots + Ao_x} \qquad \text{Equation 5.5}$$

5.5.1.3 The gross area of a roof shall include all opaque roof areas and skylight areas, when such surfaces are exposed to outdoor air and enclose an air-conditioned space.

5.5.1.4 When more than one type of material and/or skylight is used, the respective term or terms shall be expanded into sub-elements as:

$$(Ar_1 \times Ur_1 \times TDeq_{.,}) + (Ar_2 \times Ur_2 \times TDeq_2) + \ldots$$

5.5.1.5 The OTTV requirement for roof applies to an air-conditioned building and is over the U-value requirement.

5.5.1.6 The OTTV of the roof should not be computed together with the walls. Each should be treated separately.

5.5.1.7 The use of reflective coatings which are reasonably impervious to moisture degradation are strongly recommended for roofs as stop overlays.

5.5.1.8 The values in Table 5.3 may be exceeded by 50% if any one of the following applies:

a. The roof area is shaded from direct solar radiation by ventilated double roof;

b. External roof surface reflective treatments are used where the solar reflectivity is equal to or greater than 0.7 and the treatment is free from algae growth.

5.6 Submission Proeedure

At the time of submission of building plans, the architect should provide the information on roof insulation by:

a. Submitting a drawing showing the cross sections of typical parts of the walls and roof construction, giving details of the type and thickness of basic construction materials, insulation and air space;

b. If the building is air-conditioned, calculating the OTTV of the walls and roof assembly.

Table 5.1 Equivalent Temperature Difference for Walls

Wall Construction Mass Per Unit Area	TDeq
0 –125 kg/m^2	15 °K
126 – 195 kg/m^2	12 °K
Above 195 kg/m^2	10 °K

Table 5.2 Solar Correction Factor Wall

Slope Angle	Orientation							
	N	NE	E	SE	S	SW	W	NW
70°	1.32	1.63	1.89	1.65	1.32	1.65	1.89	1.63
75°	1.17	1.48	1.75	1.50	1.18	1.50	1.75	1.48
80°	1.03	1.33	1.59	1.35	1.04	1.35	1.59	1.33
85°	0.87	1.17	1.42	1.19	0.89	1.19	1.42	1.17
90°	0.72	1.00	1.25	1.02	0.74	1.02	1.25	1.00

Note: The correction factors for other orientations and other pitch angles are found by interpolation.

Table 5.3 Maximum U-value for Roof

Weight Group	Weight Range (kg/m^2)	Maximum Thermal Transmittance (W/m^2 K)	
		Air-conditioned Building	Non air-conditioned Building
Light	Under 50	0.5	0.8
Medium	50 to 230	0.8	1.1
Heavy	Over 230	1.2	1.5

Table 5.4 Equivalent Temperature Difference for Roof

Roof Construction (Mass Per Unit Area)	TDeq
0 – 50 kg/m^2	24 °K
51– 230 kg/m^2	20 °K
Over 230 kg/m^2	16 °K

Table 5.5 Solar Correction Factor for Roof

Slope Angle	Orientation							
	N	NE	E	SE	S	SW	W	NW
0°	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5°	1.00	1.01	1.02	1.02	1.00	1.02	1.02	1.01
10°	1.01	1.03	1.04	1.03	1.01	1.03	1.04	1.03
15°	1.01	1.03	1.05	1.03	1.01	1.03	1.05	1.03
20°	1.00	1.03	1.06	1.03	1.01	1.03	1.06	1.03
25°	0.98	1.02	1.06	1.03	0.99	1.03	1.06	1.02
30°	0.95	1.01	1.03	1.01	0.97	1.01	1.05	1.01
35°	0.93	0.98	1.03	0.99	0.94	0.99	1.03	0.98
40°	0.90	0.96	1.01	0.96	0.91	0.96	1.01	0.96
45°	0.86	0.92	0.98	0.92	0.87	0.93	0.98	0.92
50°	0.81	0.89	0.95	0.89	0.83	0.89	0.95	0.89
55°	0.77	0.84	0.91	0.85	0.78	0.85	0.91	0.84
60°	0.71	0.85	.86	0.80	0.73	0.80	0.86	0.79
65°	0.66	0.74	0.81	0.75	0.67	0.75	0.81	0.74

Note:
1. The Correction Factors for other orientations and other pitch angles may be found by interpolation.
2. For the purpose of the building regulations, any construction with a pitch angle less than 70° shall be treated as a roof.

Section 6. Air Conditioning and Ventilating System

6.1 Scope

The requirements in this Section represent minimum design criteria. The designer should evaluate other energy conservation measures, which may be applicable to the proposed building.

6.2 Load Calculation

6.2.1 Calculation Procedures

Cooling system design loads for the purpose of sizing system and equipment should be determined in accordance with the procedures in the latest edition of the ASHRAE Handbook of Fundamentals or other equivalent publications.

6.2.2 Indoor Design Conditions

The indoor conditions in an air-conditioned space shall conform to the following:

1. Design Dry Bulb Temperature	25 °C
2. Design Relative Humidity	55%
3. Maximum Dry Bulb Temperature	27 °C
4. Minimum Dry Bulb Temperature	23 °C
5. Maximum Relative Humidity	60 %
6. Minimum Relative Humidity	50 %

Note:
Indoor design conditions may differ from those presented above because of special occupancy or process requirement, source control, air contamination or local regulations.

6.2.3 Outdoor Design Conditions

The outdoor conditions shall be taken as follows:

1. Design Dry Bulb Temperature 35 °C
2. Design Wet Bulb Temperature 27 °C

6.2.4 Ventilation

The quality and quantity of air used to ventilate air-conditioned spaces shall always be sufficient and acceptable to human occupation and comply with applicable health and/or air quality requirements. Ventilation requirements shall conform to the design criteria in Table 6.1.

Exception: Outdoor air quantities may exceed those shown in Table 6.1 because of special occupancy or process requirements, source control, air contamination or local regulations.

6.2.5 Kitchen Ventilation

Figures 6.1 through 6.6 show the six basic hood styles for Type 1 applications. The style names are not used universally in all standards and codes but are well accepted in the industry. The styles are as follows:

1. Wall-mounted canopy – Used for all types of cooking equipment located against the wall. (See Figure 6.1)

2. Single-island canopy – Used for all types of cooking equipment in a single-line island configuration. (See Figure 6.2)

3. Double-island canopy – Used for all types of cooking equipment mounted back-to-back in an island configuration. (See Figure 6.3)

4. Back shelf – Used for counter-height equipment typically located against the wall, but could be freestanding. (See Figure 6.4)

5. Eyebrow – Used for direct mounting to oven and some dishwashers. (See Figure 6.5)

6. Pass-over – Used over counter-height equipment when pass-over configuration (from the cooking side to the serving side) is required. (See Figure 6.6)

6.3 System Design and Sizing.

Air conditioning system and equipment shall be sized as close as possible to the space and system loads calculated in accordance with Section 6.2. The design of the system and the associated equipment and controls should take into account important factors such as nature of application, type of building construction, indoor and outdoor conditions, internal load patterns, control methods for efficient energy utilization and economic factors.

6.3.1 Engineered systems and equipment should be properly sized and selected to meet maximum loads and should have good unloading characteristics to meet the minimum load efficiency. These should be arranged in multiple units or increments of capacity to meet partial and minimum load requirements without short cycling.

Chilled water systems 700 kW (200 TR) or less – minimum of 2 chiller units.

Above 700 kW to 4218 kW (1200 TR) – minimum of 3 chiller units.

Above 4218 kW to 8787 kW (2500 TR) – minimum of 4 chiller units.

Above 8787 kW – depends on the good judgment of the design engineer.

6.3.2 Considerations should be given at the design stage for providing centralized monitoring and control to achieve optimum operation with minimum consumption of energy.

6.4 Fan System Design Criteria

6.4.1 General

The following design criteria apply to all air conditioning fan systems used for comfort ventilating and/or air conditioning. For the purpose of this Section, the energy demand of a fan system is the sum of the demand of all fans, which are required to operate at design conditions to supply air from the cooling source to the conditioned space(s) or exhaust it to the outdoors.

Exception: Systems with a total fan motor power requirement of 7.5 kW or less.

6.4.2 Constant Volume Fan Systems

For fan systems that provide a constant air volume whenever the fans are operating, the power required by the motor of the combined fan system at design conditions shall not exceed 0.5 $W/m^3/h$.

6.4.3 Variable Air Volume (VAV) Fan Systems

6.4.3.1 For fan systems that are able to vary system air volume automatically as a function of load, the power required by the motors of the combined fan system at design conditions shall not exceed 0.75 $W/m^3/h$.

6.4.3.2 Individual VAV fans with motors rated at 7.5 kW and larger shall include controls and devices such as variable speed drive necessary to make the fan motor operate efficiently even at flow rates of as low as 40% of the rated flow.

6.5 Pumping System Design Criteria

6.5.1 General

The following design criteria apply to all pumping systems used for comfort air conditioning. For purposes of this Section, the energy demand of a pumping system is the sum of the demand of all pumps that are required to operate at design conditions to supply fluid from the cooling source to the conditioned space(s) and return it back to the source.

Exception: Systems with total pump motor power requirement of 7.5 kW or less.

6.5.2 Pressure Drop

Chilled water and cooling water circuits of air conditioning systems shall be designed at a maximum velocity of 1.2 m/s for a 51 mm

diameter pipe and a pressure drop limit of 39.2 kPa per 100 equivalent meter for piping over 51 mm diameter. To minimize erosion for the attainment of the piping system, the water velocities found in Table 6.3 should not be exceeded.

6.5.3 Variable flow

Pumping systems that are provided with control valves designed to modulate or step open or close, depending on the load, shall be required for variable fluid flow. The system shall be capable of reducing system flow to 50% of the design flow or less.

Flow may be varied using variable speed driven pumps, multiple stage pumps or pumps riding their performance characteristic curves. Pumps with steep performance curve shall not be used since they tend to limit flow rates. Variable speed or staged pumping should be employed in large pumping systems.

Exceptions:
1. Systems where a minimum flow greater than 50% of the design flow rate is required for the proper operation of the equipment served by the system.
2. Systems that serve only one control valve.

6.6 Air Distribution System Design Criteria

6.6.1 General

The temperature and humidity of the air within the Conditioned space shall be maintained at an air movement from 0.20 to 0.30 m/s.

6.6.1.1 The air in such conditioned space(s) should at all times be in constant motion sufficient to maintain a reasonable uniformity of temperature and humidity but shall not cause objectionable draft in any occupied portion(s). In cases wherein the only source of air contamination is the occupant, air movement shall have a velocity of not more than 0.25 m/s as the air enters the space.

6.6.2 Air Distribution

Air distribution should be designed for minimum resistance and noise generation. Ductworks should deliver conditioned air to the spaces as directly, quietly and economically as possible and return the air to the cooling source. When the duct layout has few outlets, conventional low velocity design, which corresponds, to a flow resistance of 0.8 to 1.5 Pa per equivalent meter shall be used. In complex systems with long runs and medium to high pressure of 375 to 2000 Pa ductwork should be designed at pressure drop of not greater than 3 to 5 Pa per equivalent meter.

6.6.3 Separate Air Distribution System

6.6.3.1 Areas that are expected to operate non-simultaneously for more than 750 hours per year shall served by separate air distribution systems. As an alternative, off-hour controls shall be provided in accordance with Section 6.7.3.

6.6.3.2 Areas with special process temperature and/or humidity requirements should be served by air distribution systems separate from those serving the areas requiring only comfort cooling, or shall include supplementary provisions so that the primary systems may be specifically controlled for comfort purposes only.

Exception: Areas requiring comfort cooling only that are served by a system primarily used for process temperature and humidity control need not be served by a separate system if the total supply air to these areas is no more than 25% of the total system supply air or the total conditioned area is less than 100 sq. m.

6.6.3.3 Separate air distribution systems should be considered for areas having substantially different cooling characteristics, such as perimeter zones in contact to interior zones.

6.6.3.4 Use of light-troffers as path for return air maybe considered to reduce the power for air circulation of centralized air conditioning system.

6.7 Controls

6.7.1 System Control

6.7.1.1 Each air-conditioned system shall be provided with at least one control device for the regulation of temperature.

6.7.1.2 All mechanical ventilation system (supply and exhaust) equipment either operating continuously or not shall be provided with readily accessible manual and/or automatic controls or other means of volume reduction, or shut-off when ventilation is not required.

6.7.2 Zone Control

6.7.2.1 Each air-conditioned zone shall be controlled by individual thermostatic controls responding to temperature within the zone.

6.7.2.2 Systems that serve zones that can be expected to operate non-simultaneously for more than 750 hours per year (i.e. approximately 3 hours per day on a 5 day week basis) shall include isolation devices and controls to shut off the supply of conditioned air to each zone independently.

Isolation is not required for:

1. For zones expected to operate continuously.
2. Systems which are restricted by process requirements.
3. Gravity and other non-electrical ventilation system may be controlled by readily accessible manual damper.

6.7.3 Control Area

6.7.3.1 The supply of conditioned air to each zone/area should be controlled by individual control device responding to the average temperature within the zone. Each controlled zone shall not exceed 465 sq. m in area.

6.7.3.2 For buildings where occupancy patterns are not known at the time of system design, such as speculative buildings, isolation areas may be pre-designed.

6.7.3.3 Zones may be grouped into a single isolation area provided the total conditioned floor area does not exceed 465 sq. m per group nor include more than one floor.

6.7.4 Temperature Controls

Where used to control comfort cooling, temperature controllers should be capable of being set locally or remotely by adjustment or selection of the sensors, between 23 °C and 27 °C or in accordance with local regulations.

6.7.5 Location

Thermostats in controlled zones should be located where they measure a condition representative of the whole space and where they are not affected by direct radiation, drafts, or abnormal thermal conduction or stratification.

6.8 Piping Insulation

6.8.1 All chilled water piping shall be thermally insulated in accordance with Table 6.4 to prevent heat gain and avoid sweating on the insulation surface. The insulation shall be suitably protected from damage.

6.8.2 Chiller surfaces especially the evaporator shell and compressor Suction line(s) should be insulated to prevent sweating and heat gain. Insulation covering surfaces on which moisture can condense or those exposed to ambient conditions must be vapor-sealed to prevent any moisture seepage through the insulation or to prevent condensation in the insulation.

Exceptions:

1 Piping that conveys fluids that have not been cooled through the use of fossil fuels or electricity.

2. Piping at fluid temperatures between 20 °C and 40 °C.

3. When the heat gain of the piping without insulation does not increase the energy requirements of the building.

6.8.3 For materials with thermal resistance greater than 0.032 sq. m °C/W-mm, the minimum insulation thickness shall be as follows:

$$t = \frac{0.032 \text{ x thickness in Table 6.4}}{\text{actual R value}} \quad \text{Equation 6.1}$$

Where :
t = minimum thickness in mm
R = actual thermal resistance, sq. m °C/W-mm

6.8.4 For materials with thermal resistance lower than 0.028 sq. m °C/W-mm, the minimum insulation thickness shall be:

$$t = \frac{0.028 \text{ x thickness in Table 6.4}}{\text{actual R value}} \quad \text{Equation 6.2}$$

Where:
t = minimum thickness in mm
R = actual thermal resistance, sq. m °C/W-mm

6.9 Air Handling System Insulation

6.9.1 All air handling ducts and plenums installed as part of the air distribution system and which are outside of air-conditioned spaces shall be thermally insulated sufficiently to minimize temperature rise of the air stream within them and to prevent surface condensation. Insulated ducts located outside of buildings shall be jacketed for rain tightness and for protection against damage. Air ducts or plenums within air-conditioned spaces may not be insulated if the temperature difference, TD, between the air outside and within the ducts or plenums would not cause surface condensation. Due consideration should be paid to the due point temperature of the air surrounding the ducts or plenums.

The required insulation thickness shall be computed using insulation material having resistivity ranging from 0.023 to 0.056 sq. m °C/W-mm and the following equation:

$$L = \frac{kRs\,(Dp - to)}{(Db - Dp)} \qquad \text{Equation 6.3}$$

Where:
Db = ambient still air-dry bulb temperature, °C
Dp = dew point, °C
To = operating temperature, °C
Rs = surface thermal resistance = 0.115 sq. m °C/W-mm
k = mean thermal conductivity, W-mm/sq. m °C
L = thickness, mm

Exceptions:

1. *When the heat gain of the ducts, without insulation, will not increase the energy requirements of the building*
2. *Exhaust air ducts.*

6.9.2 The thermal resistance of the insulation, excluding film resistance should be:

$$R = \frac{TD}{347} = \text{sq. m °C/W-mm} \qquad \text{Equation 6.4}$$

Where:
TD = temperature differential in °C

6.10 Air Conditioning Equipment

6.10.1 Minimum Equipment Performance

Air conditioning equipment shall have a minimum performance corresponding to the rated conditions shown in Table 6.5. Data furnished by equipment supplier or manufacturer or certified under a nationally recognized certification program or rating procedure shall be acceptable to satisfy these requirements.

6.10.1.1 Performance Rating

The performance rating of the air conditioning equipment shall be measured by its EER or kWe/TR whichever is applicable.

The EER shall not be less than those quoted in Table 6.6 while kWe/TR shall not be greater than the figures in the same table.

6.10.2 Field-assembled Equipment and Components

6.10.2.1 When components from more than one supplier are used as parts of the air conditioning system, component efficiencies shall be specified based on the data provided by the suppliers/manufacturers, which shall provide a system that complies with the requirements of Section 6.10.1.

6.10.2.2 Total on-site energy input to the equipment shall be determined by the energy inputs to all components such as compressor(s), pump(s), fan(s), purge device(s), lubrication accessories and controls.

6.10.3 Air Conditioning Equipment Controls

Air conditioning equipment should have a means of controlling its capacity based on load requirement.

6.10.4 Air Conditioning Equipment with Energy Efficiency Ratio (EER) Label.

The designer shall consider air conditioning unit with the highest EER label available (particularly window and split types) to ensure high cooling capacity but low power consumption of the equipment. For details, please refer to PNS 396-1, Household appliances Energy Efficiency Ratio (EER) and labeling requirements – Part 1: Non-ducted air conditioners.

$$\text{Energy Efficiency Ratio (EER)} = \frac{\text{Cooling capacity, kJ/h}}{\text{Power input, W}}$$

Equation 6.5

Note: 1TR = 12,000 BTU/h
1 BTU = 1.055 kJ

6.11 Heat Recovery

Whenever there is a big demand for hot water requirement and if economical, heat recovery system shall be adopted.

6.12 Thermal Comfort in Non Air Conditioned Building

6.12.1 General Principles of Thermal Comfort

6.12.1.1 The main variables that affect human comfort are as follows:

a. dry bulb temperature;
b. relative humidity or wet bulb temperature;
c. air movement;
d. ventilation; and
e. thermal radiation from hot surface(ceiling, walls, and glass window).

To lesser extent, certain other factor also affects human comfort like indoor air quality.

6.12.1.2 In tropical climate, warm and humid conditions prevail during most parts of the year. Therefore, for non air-conditioned buildings, the control of these factors affecting comfort, such as ventilation, air movement and radiation from ceiling and walls, are very important in the local context.

6.12.2 Thermal Comfort by Natural Ventilation

6.12.2.1 Apart from meeting physiological needs, ventilation also serves to provide during a thermally comfortable indoor environment by removing indoor heat gain from various sources. The formula which relates ventilation to indoor temperature build-up is given as follows:

$$Q = \frac{q_s}{\rho C_p(T_2 - T_1)}$$

Equation 6.6

Where:
Q : ventilation rate, m^3/sec
q_s : sensible heat gains, W
ρ : air density, kg/m^3 (about 1.2)
C_p : specific heat of air, J/kg-°K (about 1000)
$(T_2 - T_1)$: total temperature rise of incoming air, °K

6.12.2.2 As a general rule, ventilation rate of 2.8 m^3/min to 5.7 m^3/min per person is adequate in practice if the average indoor air temperature rise of not more than 14 °C is to be maintained as a result of body heat. Where power-driven and other heat sources are present, a higher ventilation rate is necessary.

6.12.3 Natural Ventilation by Window Opening

6.12.3.1 The influence of the size of windows on the internal air movement depends to a great extent on whether the room is crossed-ventilated. If the window is located on one wall of a room, its size will have little effect on the internal air velocity. However, an even distribution of windows and the correct choice of sashes will help to improve the ventilation even when the windows are located on one wall.

6.12.3.2 When cross ventilation in a room is assured, the relationship between ventilation rate and design wind speed is governed by the following equation:

$$Q = 17\,C_e\,V\,A \qquad \text{Equation 6.7}$$

Where:
- Q : ventilation rate in m^3/min
- C_e : effectiveness of opening (C_e is assumed to be 0.5 to 0.6 for perpendicular winds and 0.25 to 0.35 for diagonal winds)
- V : design wind speed in km/h
- A : area of opening in m^2

6.12.3.3 The design wind speed for a particular type of structure, locality and orientation has to be duly corrected to allow for height and screening effects of other buildings. The coefficient of discharge C_e is found to decrease fairly rapidly with an increase in the distance between the two openings in series, i.e., with an increase in room width. At 5.5 m, it will level off to about 0.47. In Equation 6.7, C_e is used to modify the external wind speed.

To determine the wind velocity near a building, the wind available at the time and height of the building, as well as the velocity gradient due to the ground friction, must be considered.

A general equation, known as the 'Power Law' is given by Equation 6.8:

$$Vz = Vg\frac{(Z)^a}{Zg} \qquad \text{Equation 6.8}$$

Where:
- Vz : velocity at height z, m/s
- Vg : gradient velocity, m/s
- Z : height, m
- Zg : gradient height, m
- a : a power index as given in the following table

Values of 'a'

Type of Country	Zg (meter)	a
Open country	274	0.16
Moderately rough, wooded country, small town	396	0.28
Rough, center of large town	518	0.40

6.12.3.4 Natural Ventilation by Jack Roof and Roof Ventilator

6.12.3.4.1 The performance of roof ventilators is normally rated in terms of speed and indoor and outdoor temperature differential to take into account the two natural motive forces of ventilation: thermal force and wind effect. The performance for roof cowls can be rated in the simplified equations as follows:

$$Q = 208\,AV \qquad \text{Equation 6.9}$$

Where:
Q= ventilation rate (m^3/h)
A= throat area of ventilator (cm^2)
V= wind speed (km/h)

6.12.3.4.2 For jack roof, the performance is poorer than that of roof cowl and there is no quantitative assessment of jack roof. However, assuming that jack roof are about 50% as efficient as cowl ventilators since the winward side of a jack roof does not act as exhaust opening, it has been worked out that the net area of opening of jack roofs required per metre run of a building is about 1.2 m^2 for a building width of 18 m.

6.12.3.4.3 Jack roof or roof ventilator should not be situated more than 9 m from other jack roof or roof ventilator. For jack roof, a minimum net area of 1.2 m^2 per meter run of jack roof is necessary, and for roof cowl ventilator, design should be substantiated by anticipated performance based on manufacturer's data or calculated from Equation 6.9.

6.12.3.5 Provisions for Natural Ventilation and Lighting

6.12.3.5.1 In natural regulations, it is specified that every building shall be provided with:

a. natural lighting by means of windows, skylights, fan-lights, doors, and other approved natural light transmitting media; and

b. natural ventilation by means of windows, skylights, fanlights, doors, louvers or similar ventilation openings.

6.12.3.5.2 In general, openings facing the sky, street courtyard or airweil will be considered as acceptable sources of natural lighting and ventilation.

6.12.3.5.3 In the case of a building other than factory or warehouse, any part of the building within 9 m from an acceptable opening shall be deemed to be adequately and ventilated by natural means.

6.12.3.5.4 In the case of a factory or warehouse, the maximum effective coverage of any window and other opening on an external wall shall be deemed to be 12 m from the opening, whereas the coverage of any jack roof or other opening on the roof shall be deemed to be 9 m measured horizontally from the opening.

6.12.3.5.5 In addition, the building regulations also specify that every room in any building be provided with natural lighting and ventilation by means of one or more sources having an aggregate of not less than x percent of the floor space of the room, of which at least y percent shall have opening to allow free uninterrupted passage of air. The respective values of x and y are given in Table 6.7 according to the types of occupancy or types of usage of the room.

6.12.3.5.6 In the case of public garages, two or more slides of the garage shall have opening for cross ventilation and the area opening shall be at least 50% of the area of the wall where is located.

6.12.3.5.7 For terrace houses having a depth greater than 12m, permanent ventilation from front to rear shall be provided to facilitate cross ventilation by suitable vents in all front, back and cross walls at each floor. Such vents shall have a net opening area of not less than 0.4 m^2 each.

6.12.3.6 Mechanical Ventilation

6.12.3.6.1 Where site conditions dictate that the normal requirements for natural lighting and ventilation cannot be met, the building regulations may allow the use of mechanical ventilation as substitute.

6.12.3.6.2 According to the regulations, the quantity of fresh air supply for mechanical ventilation of any room or space in a building shall be in accordance with the specified rates in Table 6.8.

Unless justified by exceptional circumstances, the ventilation rate shall not be exceeded by more than 30%.

6.12.3.7 Thermal Insulation

6.12.3.7.1 Besides roof insulation, the building regulations also specify that in the case of a non air-conditioned building, any external wall abutting a habitable room shall have U-value of not more than 3.5 W/m °K.

6.12.3.8 Sun-shading

6.12.3.8.1 To encourage the provision of sun-shading devices in residential building for the purpose of improving thermal comfort, the building regulations make a special provision to relax the requirement pertaining to boundary clearance. Where overhangs, canopies, awnings, or other sun-shading devices are provided, these devices are permitted to project up to a point not less than 1600 mm from the lot boundary instead of the normal requirement of 2300 mm for boundary clearance.

6.12.3.8.2 To take advantage of this relaxation, the designer should ensure that only non-combustible materials are used for the construction of the shading devices.

6.12.3.8.3 It should be noted that the relaxation is only in respect of the projection of the shading devices; whereas the walls from which such devices project shall comply with the normal boundary clearance requirement.

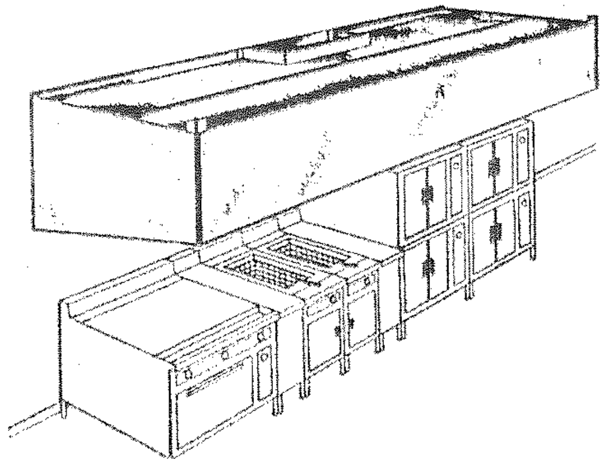

Figure 6.1 Wall Mounted Canopy

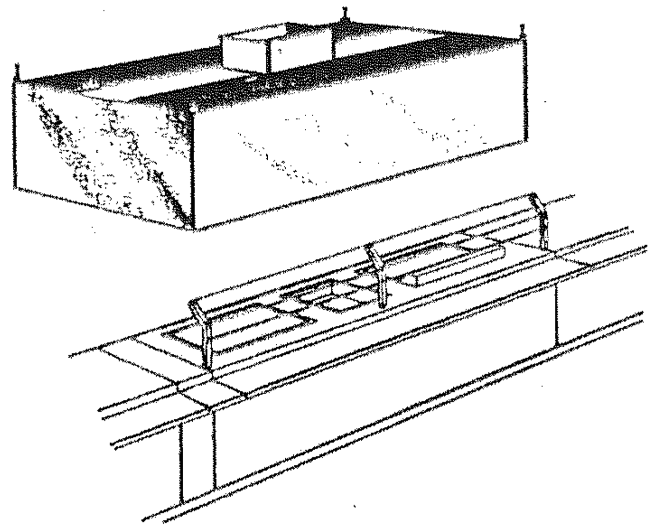

Figure 6.2 Single Island Canopy

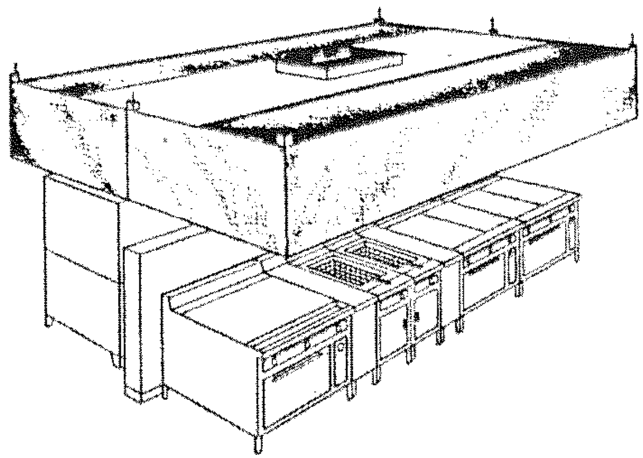

Figure 6.3 Double Island Canopy

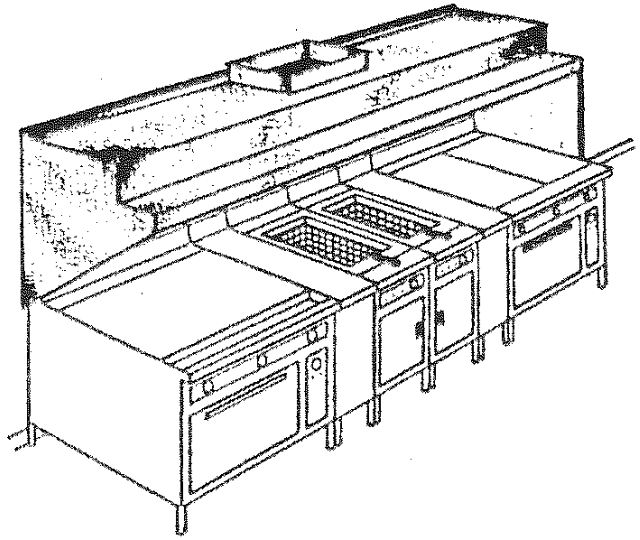

Figure 6.4 Back Shelf Canopy

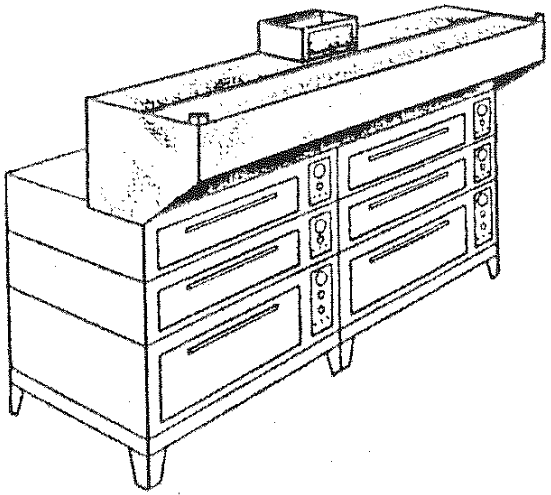

Figure 6.5 Eyebrow

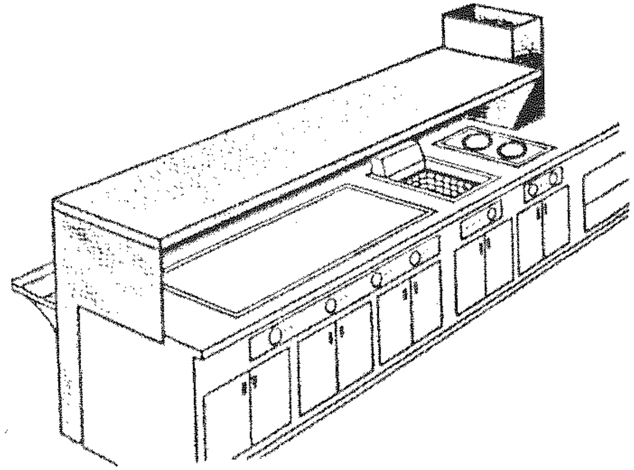

Figure 6.6 Pass-over

Table 6.1 Outdoor Air Requirements For Ventilation

Facility/Area	Outdoor Air Requirements (L/s)	
	Smoking	Non-Smoking
Hotels & Other Lodging Facilities		
Bedrooms (S/D)	15.0(b)	7.5(b)
Living rooms (suite)	10.0(b)	5.0(b)
Baths, toilets	25.0(b)	25.0(b)
Lobbies	7.5	2.5
Conference rooms (small)	17.5	3.5
Large assembly rooms	17.5	3.5
Offices		
Work areas	—	2.5
Meeting & waiting areas	—	3.5
Hospitals		
Patient rooms	-	3.5 (c)
Medical procedure areas	-	3.5
Operating rooms	-	10.0
Recovery & ICU rooms	-	7.5
Autopsy rooms	-	30.0
Physical therapy areas	-	7.5
Educational Facilities		
Classrooms	-	2.5
Laboratories	-	5.0
Training shops	-	3.5
Libraries	-	2.5
Auditoriums	-	3.5

Notes:

(a) All figures are in liters per second (l/s).
(b) Unit is on a per room basis.
(c) Unit is on a per bed basis.
(d) Outdoor air requirements for ventilation on Commercial Stores, Sports and Amusement Facilities, and other facilities/areas not covered above are under consideration.

Table 6.2 Typical Model Code Exhaust Flow Rates For Conventional Type 1 Hood

Wall-mounted canopy	Q= 0.5A
Single-island canopy	Q= 0.75A
Double-island canopy	Q= 0.5A
Eyebrow	Q= 0.5A
Back shelf/Pass-over	Q= 0.45 x Length of hood

Notes:

Q = exhaust flow rate, cu. m/sec
A = area of hood exhaust aperture, sq. m

Table 6.3 Maximum Water Velocity to Minimize Erosion

Normal Operation (hours per year)	**Water Velocity** (m/s)
1500	3.1
2000	2.9
3000	2.7
4000	2.4
6000	2.1
8000	1.8

Note: The noise criteria are not included anymore since noise in piping system is usually caused by entrained air which could be eliminated.

Table 6.4 Minimum Insulation Thickness For Various Pipe Sizes

Piping System Types	Fluid Temp. Range (°C)	Pipe Sizes (mm)			
		Condensate drains to 50	50 or less	63 to 76	89 and larger
Chilled Water	4.5 to 13.0	25	38	38	50
Refrigerant or Brine	4.5 and below	50	50	63	63

Note: Insulation thickness (mm) in Table 6.4 are based on insulation having thermal resistivity in the range of 0.028 to 0.032 sq. m °C/W-mm on a flat surface at a mean temperature of 24 °C. Minimum insulation thickness shall be increased for materials having K value less than 0.028 sq. m °C/W-mm or maybe reduced for materials having K value greater than 0.032 sq. m °C/W-mm.

Table 6.5 Standard Rated Conditions For Air Conditioning Systems

Stream	Water Cooled Water Chiller (°C)	Air Cooled Water Chiller (°C)	Water Cooled Package A/C Units, (°C)
Chilled Water Supply	7.0	7.0	-
Chilled Water Return	12.0	12.0	-
Cooling Water Supply	29.5	-	29.5
Cooling Water Return	35.0	-	35.0
Condenser Air Inlet	-	35.0	-
Evaporator Return Air	-	-	27.0 (*) 19.0 (**)

Note:
* Dry Bulb Temperature
** Wet Bulb Temperature

Table 6.6 Minimum Performance Rating of Various Air Conditioning System

Air Conditioning Equipment	EER	kWe/TR
Unitary A/C units		
Up to 20 kW_r capacity	10.3	-
21 to 60 kW_r capacity	9.8	-
61 to 120 kW_r capacity	9.7	-
Over 120 kW_r capacity	9.5	-
Scroll chillers (up to 175 kW_r)		
Air cooled	-	1.0
Water cooled	-	0.8
Screw chillers (above 245 kW_r)		
Air cooled	-	0.8
Water cooled	-	0.65
Centrifugal chillers (up to 14 kW_r)		
Water cooled	-	0.58

Notes:
EER = kJ/kWh
See Equation 6.10.4
kW_e/TR = kilowatt electricity per ton of refrigeration
1TR = 3.51685 kW_r

Table 6.7 Size of Opening for Natural Lighting & Ventilation

Type of Occupancy or Usage of Room	x% of Floor Area of Room	y% of x open a
Residential	15%	50%
Store, Utility, Garage (in residential premises)	10%	50%
Water-closet, Toilet, Bathroom Laundry	10% or 0.2 m^2 (whichever is greater)	100%
Business	15%	50%
School classroom	20%	50%
Hospital, Nursing home	15%	100%
Lobby, Corridor, Staircase	10%	50%
Warehouse	10%	50%

Table 6.8 Fresh Air Supply for Mechanical Ventilation

Type of Building/Occupancy	Minimum Fresh Air Supply	
	Air Change per hour	m^3/h per person
Office	6	18
Restaurant, Canteen	6	18
Shop, Supermarket, Department Store	6	18
Workshop, Factory	6	18
Classroom, Theater, Cinema	8	-
Lobby, Concourse, Corridor, Staircase	4	-
Toilet, Bathroom	10	-
Kitchen (commercial, institutional & industrial)	20	-
Car Park	6	-

Note: Unless justified by exceptional circumstances, the ventilation rate shall not be exceeded by more than 30% of the above values.

Appendix A. Percentage of Solar Radiation Absorbed by Selected Building Materials

Building Material	Percentage (%)
Brick (common)	
Light red	55
Red	68
Marble	
White	44
Dark	66
Polished	50 – 60
Metals	
Steel	45 – 81
Galvanized iron, new	64
Galvanized iron, dirty	92
Copper, polished	18
Copper, tarnished	64
Lead sheet, old	79
Zinc, polished	46
Paints	
White emulsion	12 – 20
White paint, 4.3 mm on aluminum	20
White enamel on iron	25 – 45
Aluminum oil base paint	45
Gray paint	75
Red oil base paint	74
Black gloss paint	90
Green oil base paint	50
Black paint, 4.3 mm on aluminum	94 – 98
Roofing materials	
Tile clay, red	64
Tile	65 – 91

Appendix A. (Continued)

Building Material	Percentage (%)
Miscellaneous	
Aluminum, polished	15
Concrete	60
Concrete, rough	60
Plaster, white wall	7
Wood	60
Aluminum foil	15
Ground Cover	
Asphalt pavement	93
Grass, green after rain	67
Grass, high and dry	67 – 69
Sand, dry	82
Sand, wet	91
Sand, white powdered	45
Water	94
Vegetable fields and shrubs, wilted	70
Common vegetable fields and shrubs	72 – 76
Ground, dry and plowed	75 – 80
Bare moist ground	90

Where specific material is not mentioned above, an approximate value may be assigned with the use of the following color guide:

Color	% Absorption
White, smooth surfaces	25 – 40
Gray to dark gray, light green	40 – 50
Green to dark green, red, brown	50 – 70
Dark brown, blue	70 – 80
Dark blue, black	80 – 90
Perfectly black	~ 100
Sand, wet	91
Sand, white powdered	45
Water	94
Vegetable fields and shrubs, wilted	70
Common vegetable fields and shrubs	72 – 76
Ground, dry and plowed	75 – 80
Bare moist ground	90

Note: All asbestos in building material shall be omitted to apply fiber cement board.

Appendix B. Thermal Conductivities of Building Materials

Construction Materials	Density (kg/m^3)	Thermal Conductivity (W/m-°K)
Asphalt, roofing	2240	1.226
Bitumen		1.298
Brick		
(a) common	1925	0.721
(b) face	2085	1.297
Concrete	2400	1.442
	64	0.144
Concrete, light weight	960	0.303
	1120	0.346
	1280	0.476
Cork board	144	0.042
Fiber board	264	0.052
Fiber glass (see Glass Wool and Mineral Wool)		
Glass, sheet	2512	1.053
Glass wool, mat or guilt (dry)	32	0.035
Gypsum plaster board	880	0.170
Hard board		
(a) Standard	1024	0.216
(b) Medium	640	0.123
Metals		
(a) Aluminum alloy, typical	2672	211
(b) Copper, commercial	8794	385
(c) Steel	7840	47.6
Mineral wool, felt	32 – 104	0.032 – 0.035
Plaster		
(a) Gypsum	1216	0.370
(b) Perlite	616	0.115
(c) Sand/cement	1568	0.533
(d) Vermiculite	640 – 960	0.202 – 0.303
Polystyrene, expanded	16	0.035
Polyurethane, foam	24	0.024
PVC flooring	1360	0.713

Appendix B (Continued)

Construction Materials	Density (kg/m^3)	Thermal Conductivity (W/m-°K)
Soil, loosely packed	1200	0.375
Stone, tile		
(a) Sandstone	2000	1.298
(b) Granite	2640	2.927
(c) Marble/terrazzo/ceramic/mosaic	2640	1.298
Tile, roof	1890	0.836
Timber		
(a) Across grain softwood	608	0.125
(b) Hardwood	702	0.138
(c) Plywood	528	0.138
Vermiculite, loose granules	80 – 112	0.065
Wood chipboard	800	0.144
Woodwool slab	400	0.086
	480	0.101

Appendix C. K-Values of Basic Materials

Construction Materials	Density (kg/m^3)	Thermal Conductivity (W/m-°K)
Asbestos cement sheet	1488	0.317
Asbestos insulating board	720	0.108
Asphalt, roofing	2240	1.226
Bitumen		1.298
Brick		
(a) Dry (covered by plaster or tiles outside)	1760	0.807
(b) Common brickwall (brickwall directly exposed to weather outside)	1760	1.154
Concrete	2400	0.1442
	64	0.144
Concrete, light weight	960	3.303
	1120	0.346
	1280	0.476
Cork board	144	0.042
Fiber board	264	0.052
Fiber glass (see Glass Wool and Mineral Wool)		
Glass, sheet	2512	1.053
Glass wool, mat or guilt (dry)	32	0.035
Gypsum plaster board	880	0.170
Hard board		
(a) Standard	1024	0.216
(b) Medium	640	0.123
Metals	6272	211
	8784	385
	7840	47.6
Mineral wool, felt	32 – 104	0.035 – 0.032
Plaster		
(a) Gypsum	1216	0.370
(b) Perlite	616	0.115
(c) Sand/cement	1568	0.533
(d) Vermiculite	640 – 960	0.202 – 0.303
Polysterene, expanded	16	0.035
Polyurethane, foam	24	0.024
PVC flooring	1360	0.713
Soil, loosely packed	1200	0.375

Appendix C (Continued)

Construction Materials	Density (kg/m^3)	Thermal Conductivity (W/m-°K)
Stone tile		
(a) Sand stone	2000	1.298
(b) Granite	2640	2.927
(c) Marble/terrazzo/ceramic/mosaic	2640	1.298
Tile, roof	1890	0.836
Timber		
(a) Across grain softwood	608	0.125
(b) Hardwood	702	0.138
(c) Plywood	528	0.138
Vermiculite, loose granules	80 – 112	0.065
Wood chipboard	800	0.144
Woodwool slab	400	0.086
	480	0.101

Appendix D. Air Space Resistances for Walls and Roofs

Types of Air Space	Thermal Resistance (m^2-°C/W)		
	5 mm	20 mm	100 mm
Air space resistance (R_a) for Walls			
Vertical air space (Heat flows horizontally)			
(a) High Emissivity	0.110	0.148	0.160
(b) Low Emissivity	0.250	0.578	0.606
Air Space Resistancec, (R_a) for Roof			
Horizontal or sloping air space (Heat flows downward)			
(a) High Emissivity			
(i.) Horizontal air space	0.110	0.148	0.174
(ii.) Sloped air space 22.5°	0.110	0.148	0.165
(iii.) Sloped air space 45°	0.110	0.148	0.158
(h) Low Emissivity			
(i.) Horizontal air space	0.250	0.572	1.423
(ii.) Sloped air space 22.5°	0.250	0.571	1.095
(iii.) Sloped air space 45°	0.250	0.570	0.768
Attic Space Resistances (R_{attic})			
(a) High Emissivity		0.458	
(b) Low Emissivity		1.356	

Notes:
1. Ordinarily, high emissivity is assumed for air spaces bounded by building materials of moderatelysmooth surfaces. Low emissivity only applies where one or both sides of the air space is bounded by a reflective surface such as that of an aluminum foil.
2. Interpolation within the range of pitch angles from horizontal to 45° is permitted. For angle beyond 45°, the value for 45° can be used; no extrapolation is needed.
3. Interpolation within the range of thickness from 5 mm to 100 mm is permitted. For air space less than 5 mm, extrapolation basing on R_a = 0 for zero thickness is allowed; otherwise R is assumed to be zero. For air space greater than 100 mm, the R_a for 100 mm should be used, i.e. extrapolation is not permitted.
4. In the case of air space in roof, reflective foil used should be installed within the reflective surface facing downward as dust deposit will render an upward-facing surface ineffective after a while.

Appendix I. Glass Performance Data

Glass Type	Clear-10	Dark Green-10	Bronze-10	Dark Blue-10
Code	FL	DNFL	BFL	DBFL
Color	Clear	Dark Green	Bronze	Dark Blue
Thickness	10 mm	10 mm	10 mm	10 mm
Substrate	None	None	None	None
Visible Light, %				
Transmittance	85.60	57.50	27.90	42.00
Reflectance, out	9.10	6.80	5.40	6.00
Reflectance, in	9.10	6.80	5.40	6.00
Solar Energy, %				
Transmittance	75.10	20.70	28.90	26.50
Reflectance, out	8.00	5.20	5.50	5.40
Reflectance, in	8.00	5.20	5.50	5.40
Absorptance	16.90	74.00	65.60	68.10
Shading Coefficient	0.91	0.48	0.54	0.52
U-value, Summer W/m^2-°K	5.78	6.32	6.26	6.28
U-value, Winter W/m^2-°K	6.27	6.26	6.26	6.26
Solar heat gain coefficient	0.79	0.41	0.47	0.45
Relative heat gain W/m^2-°K	620	349	389	377

Note:
1. Above data is on monolithic substrate only.
2. Calculation of U-value, Relative Heat Gain based on ASHRAE condition (GSBDL-GL)

Appendix J. Glass Performance Data

Glass Type	Clear-8	Dark Green-8	Bronze-8	Dark Blue-8
Code	FL	DNFL	BFL	DBFL
Color	Clear	Dark Green	Bronze	Dark Blue
Thickness	8 mm	8 mm	8 mm	8 mm
Substrate	None	None	None	None
Visible Light, %				
Transmittance	86.50	62.90	35.30	48.90
Reflectance, out	9.20	7.20	5.70	6.30
Reflectance, in	9.20	7.20	5.72	6.30
Solar Energy, %				
Transmittance	77.90	27.80	36.30	33.80
Reflectance, out	8.20	5.40	5.70	5.60
Reflectance, in	8.20	5.40	5.70	5.60
Absorptance	13.90	66.70	58.00	60.50
Shading Coefficient	0.94	0.53	0.60	0.58
U-value, Summer W/m^2-°K	5.81	6.34	6.27	6.29
U-value, Winter W/m^2-°K	6.36	6.35	6.35	6.35
Solar heat gain coefficient	0.81	0.46	0.52	0.61
Relative heat gain W/m^2-°K	635	386	428	415

Note:

1. Above data is on monolithic substrate only.
2. Calculation of U-value, Relative Heat Gain based on ASHRAE condition (GSBDL-GL)

Appendix K. Glass Performance Data

Glass Type	Clear-6	Dark Green-6	Bronze-6	Dark Blue-6
Code	FL	DNFL	BFL	DHFL
Color	Clear	Dark Green	Bronze	Dark Blue
Thickness	6 mm	6 mm	6 mm	6 mm
Substrate	None	None	None	None
Visible Light, %				
Transmittance	87.50	68.90	44.70	57.00
Reflectance, out	9.20	7.60	6.10	6.80
Reflectance, in	9.20	7.60	6.10	6.80
Solar Energy, %				
Transmittance	80.50	37.40	45.60	43.20
Reflectance, out	8.60	5.80	6.20	6.00
Reflectance, in	8.60	5.80	6.20	6.00
Absorptance	10.90	56.90	48.30	50.70
Shading Coefficient	0.96	0.61	0.68	
U-value, Summer W/m^2-°K	5.82	6.33	6.25	6.28
U-value, Winter W/m^2-°K	6.44	6.44	6.44	6.44
Solar heat gain coefficient	0.83	0.53	0.59	0.57
Relative heat gain W/m^2-°K	649	435	475	464

Note:
1. Above data is on monolithic substrate only.
2. Calculation of U-value, Relative Heat Gain based on ASHRAE condition (GSBDL-GL)