Ministry of Energy and Mineral Resources
Ministry of Industry
The Republic of Indonesia

Energy Audit Program Study

Special Assistance for Project Implementation (SAPI)
for
Climate Change Program Loan

Study on the Institutional Framework of
Energy Efficiency and Conservation
through Energy Audit and Roadmap for GHG Mitigation
in
The Republic of Indonesia

Final Report

(Summary)

July 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

THE INSTITUTE OF ENERGY ECONOMICS, JAPAN

Introduction

(1) Background to the study

Japan International Cooperation Agency (JICA) provided a Climate Change Program Loan (CCPL) in 2008 to support the efforts of the Government of Indonesia to respond to the impacts of climate change. The policy matrix for CCPL covers issues in the forestry, energy, agriculture, water resources, and cross-cutting sectors. The loan is expected to contribute to reducing CO2 emissions in the country by promoting energy efficiency through an energy audit program and a CO2 reduction roadmap. Upon monitoring policy actions for 2008, GOI and JICA concluded that formulation of a medium-term energy audit program, combined with the CO2 reduction roadmap of Ministry of Industry (MOI), would be necessary to promote energy efficiency in Indonesia. The policy matrix of CCPL includes actions for 2009 to “design a mid-term energy audit and efficiency program, including medium-term targets, incentive mechanisms, and monitoring and evaluation framework,” and to “design a CO2 roadmap implementation program, including incentive mechanisms, and a monitoring and evaluation framework.”

The Ministry of Energy and Mineral Resources (MEMR), MOI, and JICA have agreed to start a new joint study to analyze medium-term targets for the energy audit program, incentives to promote energy efficiency, and a monitoring and evaluation mechanism to support implementation of the two actions above by MEMR and MOI.

(2) Objectives of this study

This study analyzes the basis of the framework of the energy audit program, in combination with the CO2 reduction roadmap, including medium-term targets (CO2 reduction, audit recipients, etc.), incentive options, and monitoring and evaluation mechanisms as the basis for policy options to promote energy conservation in Indonesia.

(3) Scope of the Study

This study is based on the following 10 items.

1) Review of current program
2) Medium-term targets: total number of audit recipients and reducing CO2 emissions through energy audits
3) Selection of target sectors
4) List of technologies and scenario for their introduction
5) Incentives for improving energy efficiency by audit recipients
6) Cost and benefit analysis of potential technologies and incentive options

7) Monitoring and reporting framework

8) Evaluation framework

9) Review of regulations to expand participants of the energy audit program

10) Publication of results of model audit cases

(3) Selection of Model Project for Energy Audit System

In this study an action program is formulated for the following selected model projects and the effects are evaluated.

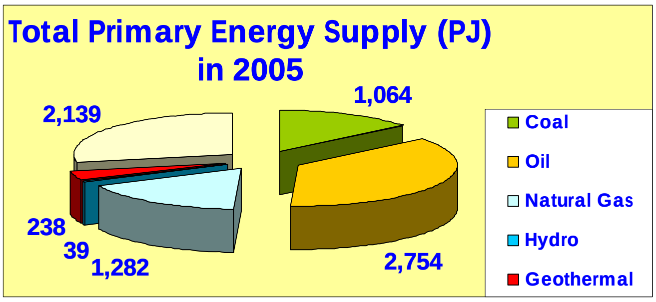
1) Cement Industry

2) Steel Industry

3) Office Buildings

1. Status of Energy Efficiency

Figure 1.1 shows the primary energy supply in Indonesia (2005). Oil accounts for the largest share of primary energy supply, with 36.6%. The government's goal is to reduce the share of oil to below 20% by 2025 and to increase the share of coal, natural gas, and renewable energy sources.

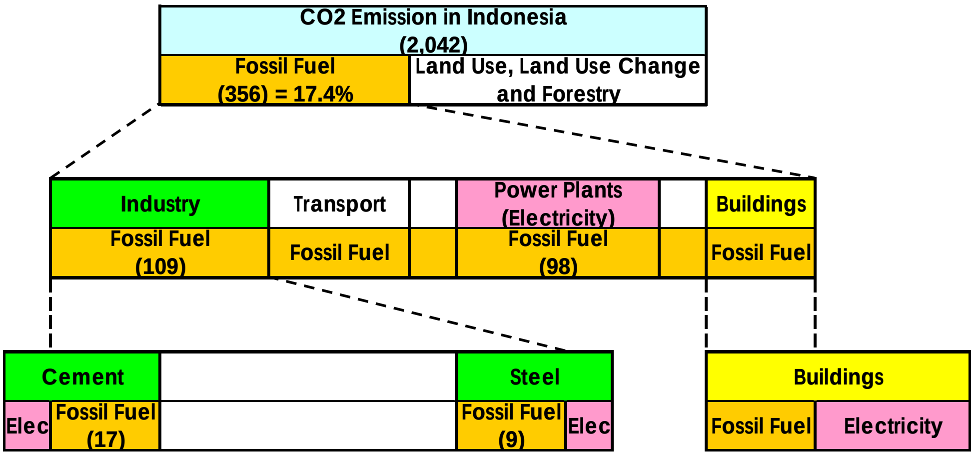


	Coal	Oil	Natural Gas	Hydro	Geothermal	Others
2005	14.2%	36.6%	17.1%	0.5%	3.2%	28.5%
President Decree No.5 of 2006 on National Policy	33.0%	20.0%	30.0%	2.0%	5.0%	10.0%

Source: IEA

Figure 1.1 Total Primary Energy Supply in Indonesia (2005)

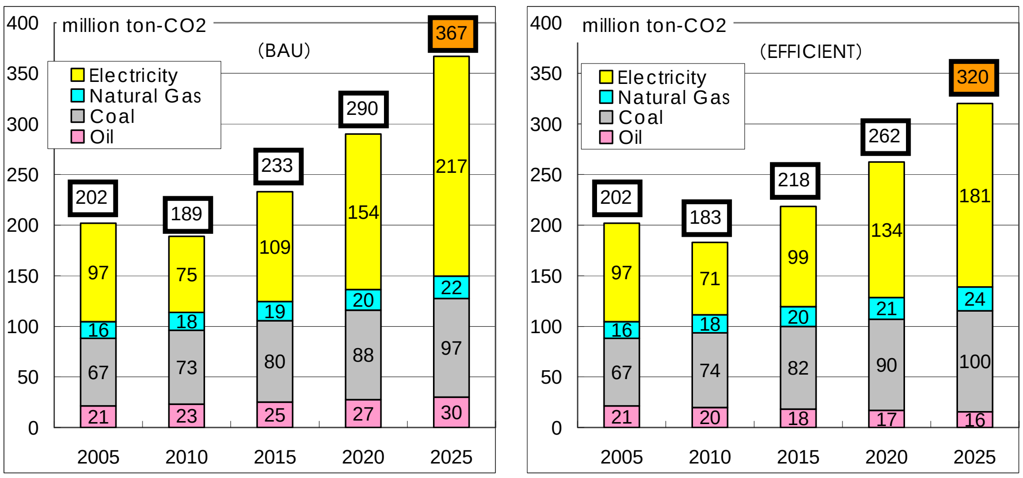
Figure 1.2 shows CO2 emissions in Indonesia (2005). About 2 billion tons of CO2 are released each year in Indonesia. CO2 originating from fossil fuels accounts for about 17.4%, with about 360 million tons. The industrial sector generates about 110 million tons of CO2 emissions and the power sector generates about 98 million tons. In the cement and steel industries, energy is consumed in two forms at the end-use level: electricity and heat generated by the direct combustion of fossil fuels. To clearly link energy efficiency to reducing CO2 emissions, it is necessary to re-allocate and calculate CO2 emissions generated by the power sector at the end-use level according to energy consumption. In office buildings, energy is consumed mostly in the form of electricity.



Source: IEA, WRI

Figure 1.2 CO2 Emissions in Indonesia (2005)

If energy consumption remains at the 2005 level until 2025, CO2 emissions will increase at an annual rate of 3% from 202 million tons in 2005 to 367 million tons in 2025 in the business-as-usual (BAU) case. If energy efficiency measures are taken (the efficient case), CO2 emissions can be reduced by about 12.7% or 47 million tons by 2025 compared to the BAU case.



Source: Road Map (MOI)

Figure 1.3 CO2 Emissions Scenario until 2025

There are two important pieces of energy-efficiency legislation: the Energy Law established in August 2007 and the Energy Regulations established in November 2009. The most important provisions are included in Articles 12 and 13. These two articles provide for the scope of application of the obligation to promote energy efficiency, and the extent to which energy efficiency is improved, assignment of an energy manager, implementation of an energy audit, and formulation of a saving-energy program. Article 18 provides for government incentives (supports) and Article 21 provides for government to share the costs of an energy audit.

Articles 12 and 13 show the procedures for promoting energy efficiency. An energy manager must be assigned in each place of business where energy of over 6,000 tons of oil equivalent (toe) is consumed annually. This requirement applies to all industrial sectors, power sector, and office buildings. An energy audit body, whether an organization or an individual, is requested to evaluate the status of energy efficiency and develop an improvement plan under the supervision of the assigned energy manager. The energy auditor can be an internal energy auditor of the company or an external energy auditor. The auditor evaluates energy efficiency and proposes improvements. Based on this proposal, the energy manager develops an energy efficiency plan and presents the plan to the government. After the plan is approved, energy efficiency investment is provided and the results of the investment are monitored and reported.

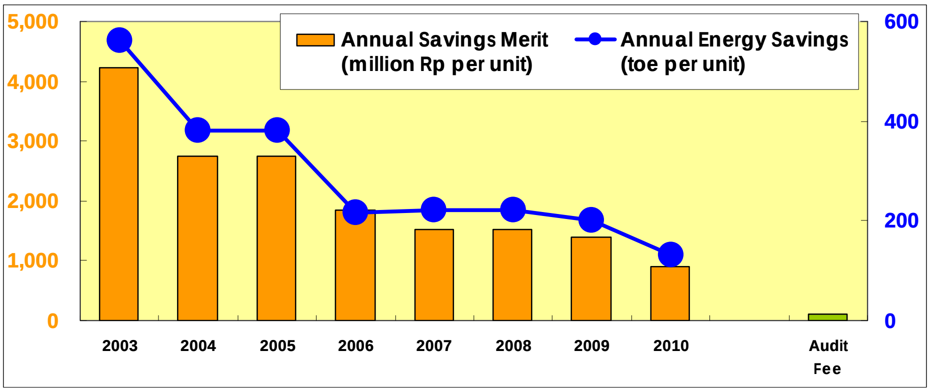
Table 1.1 is a diagram of the energy-saving survey conducted by J-power from 2008 to 2009. An entity that consumes over 6,000 toe of energy annually must carry out an energy-saving plan and assign an Energy Manager. It is estimated that 710 of about 20,000 companies in the industrial sector, 15 of 18 power generators, and 35 of 3,400 office buildings are included in the category. In terms of the number of places of business, about 2,000 of about 24,000 are included. It is estimated that those entities cover about 10% of total energy consumption. The coverage of only 35 office buildings, which is 1% of the total, is very small .

Table 1.1 Number of Users Covered by Article 12 (more than 6,000 toe)

<table>
<tr><th colspan="3">Annual Energy Consumption (toe)</th><th>less than 6,000</th><th>6,000 ~ 12,000</th><th>12,000 ~ 16,000</th><th>more than 16,000</th><th>Total</th><th>Energy Audit</th></tr>
<tr><td rowspan="5">Number (Unit)</td><td rowspan="4">Company</td><td>Industry</td><td>19,568</td><td>305</td><td>96</td><td>309</td><td>20,278</td><td>710</td></tr>
<tr><td>Power Plant</td><td>3</td><td>1</td><td>0</td><td>14</td><td>18</td><td>15</td></tr>
<tr><td>Buildings</td><td>3,366</td><td>35</td><td>0</td><td>0</td><td>3,401</td><td>35</td></tr>
<tr><td>Total</td><td>22,937</td><td>341</td><td>96</td><td>323</td><td>23,697</td><td>760</td></tr>
<tr><td colspan="2">(Business Unit)</td><td>23,697</td><td>760</td><td>419</td><td>763</td><td>25,639</td><td>1,942</td></tr>
<tr><td rowspan="5">Share (%)</td><td rowspan="4">Company</td><td>Industry</td><td>96.5%</td><td>1.5%</td><td>0.5%</td><td>1.5%</td><td>100.0%</td><td>3.5%</td></tr>
<tr><td>Power Plant</td><td>16.7%</td><td>5.6%</td><td>0.0%</td><td>77.8%</td><td>100.0%</td><td>83.3%</td></tr>
<tr><td>Buildings</td><td>99.0%</td><td>1.0%</td><td>0.0%</td><td>0.0%</td><td>100.0%</td><td>1.0%</td></tr>
<tr><td>Total</td><td>96.8%</td><td>1.4%</td><td>0.4%</td><td>1.4%</td><td>100.0%</td><td>3.2%</td></tr>
<tr><td colspan="2">(Business Unit)</td><td>92.4%</td><td>3.0%</td><td>1.6%</td><td>3.0%</td><td>100.0%</td><td>7.6%</td></tr>
</table>

Source: J-Power Report (JICA study 2009)

Figure 1.4 summarizes energy audit results of the energy partnership program since 2003. The table shows the number of audits for industrial sector and office buildings. The figure shows annual potential and energy savings in financial terms based on an entity audit. The left axis shows the energy-saving merit per audit based on the accumulated total, while the right axis shows the energy-saving potential per audit. If the number of audits increases, energy-saving effect per audit decreases in terms of both quantity and merit. Since energy audit expenses are about 100 million Rp, cost effectiveness is assumed to go down.



	Energy Audit conducted by Government							
	2003	2004	2005	2006	2007	2008	2009	2010
Total (unit)	12	9		32	200		40	160
(accumulated)	12	21	21	53	253	253	293	453

Source: MEMR

Figure 1.4 Trends of Average Saving Merit and Energy Saved by Energy Audit

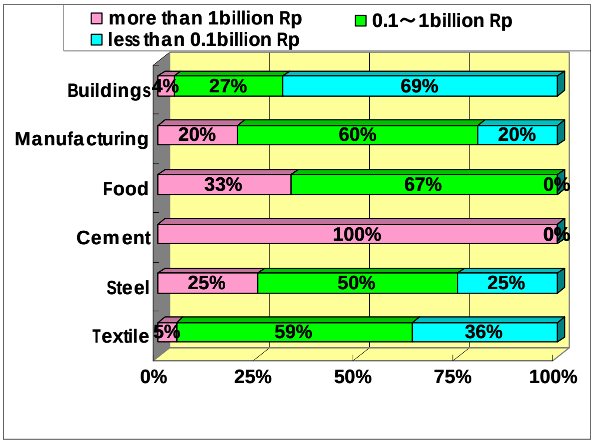
To make a further analysis of individual cases, 20 cases from the industry sectors and 30 cases from office buildings were examined. When looking at energy-saving achievements in terms of total energy consumption, the industry sectors achieved 2.2% and office buildings achieved 17.8%. Considering the results, energy audits in the industry sectors produced only small-scale improvements through energy management such as more efficient use of pumps and fans in a factory, and they did not lead to large-scale energy savings through more advanced technologies in production processes. On the contrary, audits of office buildings show relatively large improvements because their energy consumption consists mainly of electricity and devices using electricity are commonly used ones.

Table 1.2 Results of Energy Audit (2007-2008)

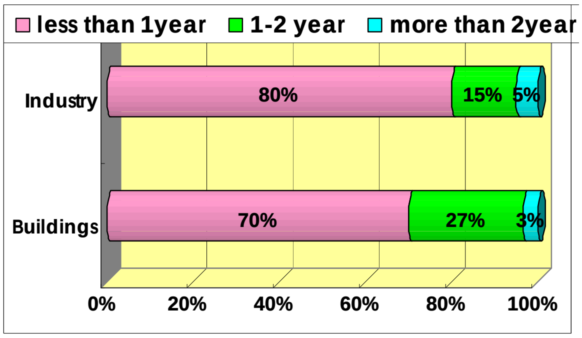
	Industry	Buildings
Energy Audit (unit)	20	30
Saving Energy (toe per unit)	180	386
(Energy Savings Ratio)	2.2%	17.8%
Savings Merit (million Rp per unit)	1,267	676
(Calculated at electricity price of)	(622Rp/kWh)	(850Rp/kWh)

Source: MEMR

Figure 1.5 includes audit results other than for government partnership programs. It shows that a majority of the programs had investments smaller than 1 billion Rp, and that return on investment (ROI) was achieved in less than one year in most cases. There is a possibility that energy-saving effects may have been overestimated because of the high unit price of electricity used. Even after adjusting for the unit price of electricity, the return on investment will be largely achieved in less than two years, so the trend will be similar.



Investment per unit by sector



Payback Period for Investment

Source: EMI

Figure 1.5 Results of Energy Audit by Private Companies

If the current energy audit program is expanded, Indonesia will need to increase the number of audits and the amount of energy savings per audit. When increasing the number of audits, the average energy-saving effects per audit will become smaller because factories and buildings with low energy-saving potential may be added. Therefore, payment of audit expenses by the government will cause financial problems sooner or later.

In addition, an increase in the amount of energy savings per audit requires energy saving to be linked to production processes in the industry sectors, especially in large-scale plants. In other words, it requires the various advanced technology options with larger investments as listed in the CO2 road map. So, business managers are not willing to go in this direction.

To solve above two problems, there are following solutions:

1) To introduce energy service company (ESCO) to reduce financial burden of energy audits for the government by making effective use of private corporations, especially when expanding the scope of energy audit coverage for office buildings (the limit of 6,000 toe should be lowered).
2) To build a system to persuade the industry sectors to actively introduce effective energy-saving technologies through technological and financial support from the government.

2. Selection of Model Project in Energy Audit System

Figure 2.1 shows an overall picture of model project selection and implementation. The sectors involved are cement industry, steel industry, and office buildings. As for energy audits conducted by an ESCO, cement has 21 internal audits, steel has 18 internal and 65 external audits, and office buildings have 442 cases. Considering the profitability of investment, as well as technological and financial support from the government, the number of actual investments will be 21 for cement, 51 for steel, and 200 for office buildings.

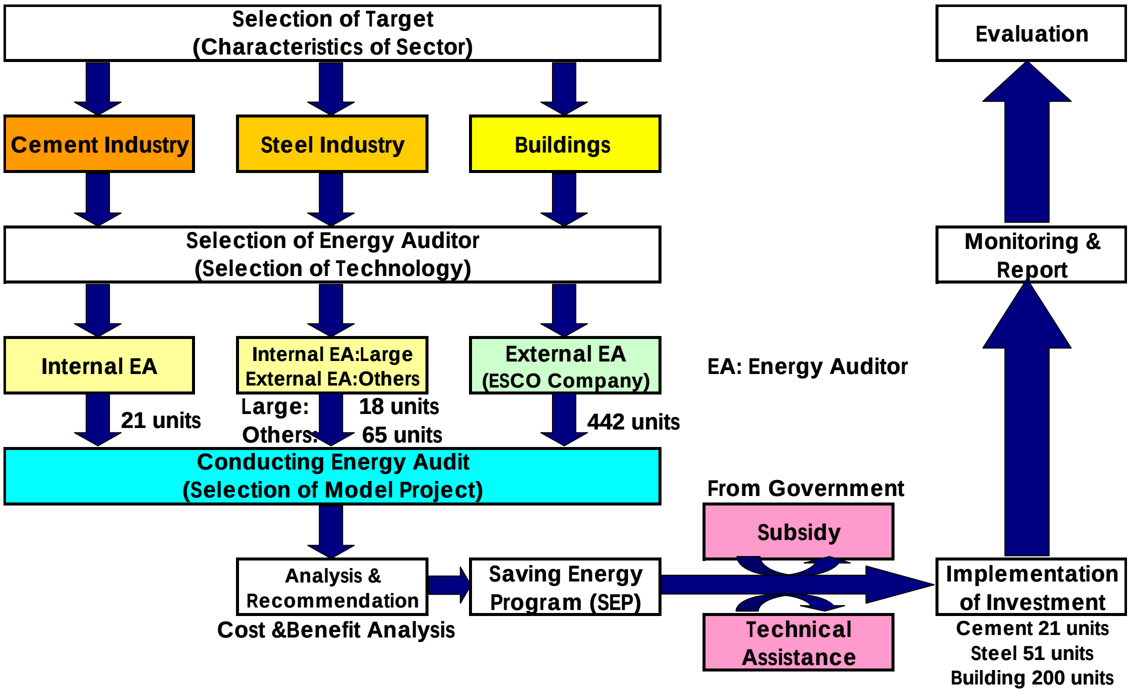
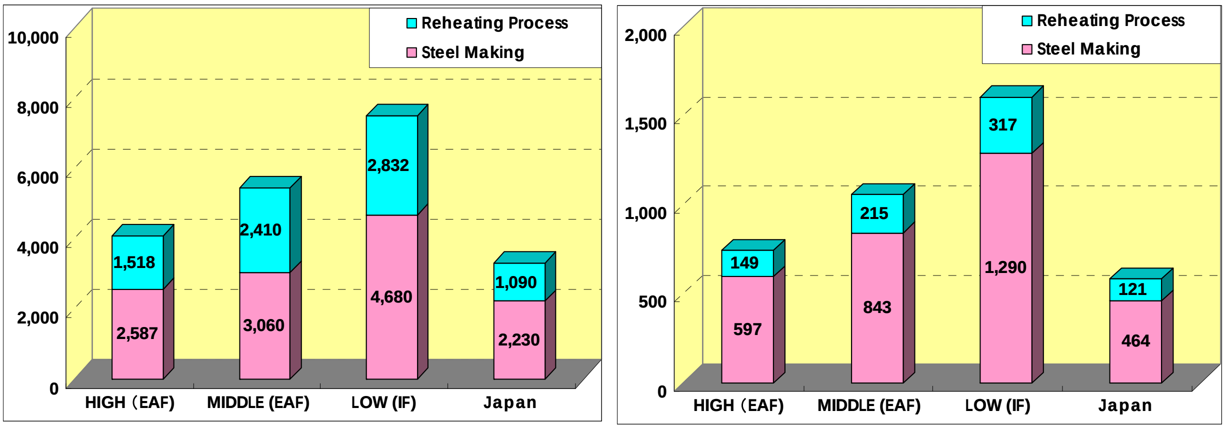


Figure 2.1 Flow of Investment on Proposed Model Projects

As for the cement industry, the three major companies, state-run entities Gresik group, Indo-cement, and Holcim, occupy almost 90% of the domestic market. Domestic demand for cement is strong, so cement production is expected to increase from about 39 million tons in 2008 to 92 million tons in 2025. On the other hand, the energy-saving level is 3927 MJ per ton of cement, which approaches the top class globally. CO2 emissions are expected to increase from 35 million tons in 2005 to 79 million tons in 2025. The steel industry has various types of companies from upstream such as steel making and rolling to downstream such as finished products, so the market structure is complicated and competitive. A rough categorization reveals the following players: Krakatau steel plant owned by the government, five private major groups with full-scale systems including electric furnace and rolling mill, a group of independent manufacturers (some having an induction furnace), and foreign manufacturers like Chinese ones that are aggressively exporting to Indonesia.

In general, as the economy grows, demand for steel increases. However, the current total capacity utilization rate is low because low-price imported products including semi-manufactured products drives away the demand for domestic products. As for the energy-saving level, even when steel making and rolling are picked out from the upstream, there are large differences among companies. Figure 2.2 summarizes data from the survey report of Mitsubishi Research Institute (MRI) in Japan. When comparing the results for 2008 between Indonesia and Japan, energy consumption in Indonesia is 1.2 times to 2.3 times as large as that in Japan.

Energy Consumption (MJ/ton) CO2 Emission (kg-CO2/ton)



Note: EAF: Electric Arc Furnace, IF: Induction Furnace

Source: Estimated by IEEJ based on MRI Report (2010)

Figure 2.2 Comparison of Energy Consumption and CO2 Emissions between Japan and Indonesia

Total office buildings can be expressed by number of buildings and total floor area (TFA). Energy consumption is almost proportional to TFA instead of the number of buildings. Major buildings are picked out from among commercial buildings, hospitals, hotels, schools, and government offices in Indonesia for analysis. There are about 2,300 buildings and TFA is about 47 million square meters. TFA of the buildings that have 50,000 square meters or more reaches about 10 million square meters.

The table below shows the energy consumption of 30 office buildings. The average floor area is 26,374 square meters; annual energy consumption is 386 toe; and, annual power consumption per unit floor area (square meter) is 170 kWh. It should be noted that the calculation is only an estimate for about 2,300 buildings; it does not represent all buildings in Indonesia.

Table 2.1 Results of Energy Audits (2007-2008)

Total floor area (㎡)	Number of Building	Total floor area per unit (㎡)	Energy Consumption		Ratio of Saving Energy
			(toe/unit,y)	(kWh/㎡,y)	
791,207	30	26,374	386	170	17.8%

Source: EMI Report

The cement industry has already achieved a rather high energy-saving level. However, there are three options in terms of reducing CO_2 emissions as shown in Table 2.2. There are many successful examples overseas of these three options, and some entities are trying to apply them in Indonesia. First, the coal used for baking to make clinker should be replaced with a mixture of coal and biomass. In other words, alternative fuels should be used. Secondly, reducing the use of clinker, the base material of cement, by mixing fly ash or sludge would reduce CO_2 emissions. In other words, mixed cement should be used. Finally, reducing the use of fossil fuel, purchased to generate power, by finding another source of power can lead to reduction of CO_2 emissions. When evaluating these three options from among the four items in Table 2.2, "self-power produced by waste heat recovery" is effective for saving energy.

Table 2.2 Energy-saving Options for Cement Industry

Technological Options	Experience in other countries	External Constraints	Applicable to other sectors	Cost and Benefit (EIRR)
Alternative of Fuel (Biomass)	EXCELLENT	INAPPROPRIATE (Needs for building of supply infrastructure)	GOOD	FAIR
Blended Cement	EXCELLENT	FAIR (Constraint of material availability)	INAPPROPRIATE (Specified to Cement sector)	GOOD
Self power produced by Waste Heat Recovery	EXCELLENT	GOOD (Stand Alone)	EXCELLENT	EXCELLENT (including Avoided Cost of PLN)

For the steel industry, four technological options for the steel-making process and two technological options for the rolling process are listed. In steel making process there are scrap pre-heater, oxygen lancing, and ladle pre-heater, and hot charge of billets and regenerative burners in rolling process. These options are all introduced for the purpose of improving thermal efficiency, and reducing heat loss between cooling and heating.

All technological options are adopted around the world and are evaluated highly. In terms of application to other sectors and investment profitability, however, introduction of regenerative burners is preferable because it only requires a burner change and partial modification with a short downtime. Therefore, regenerative burners are selected as introductory models.

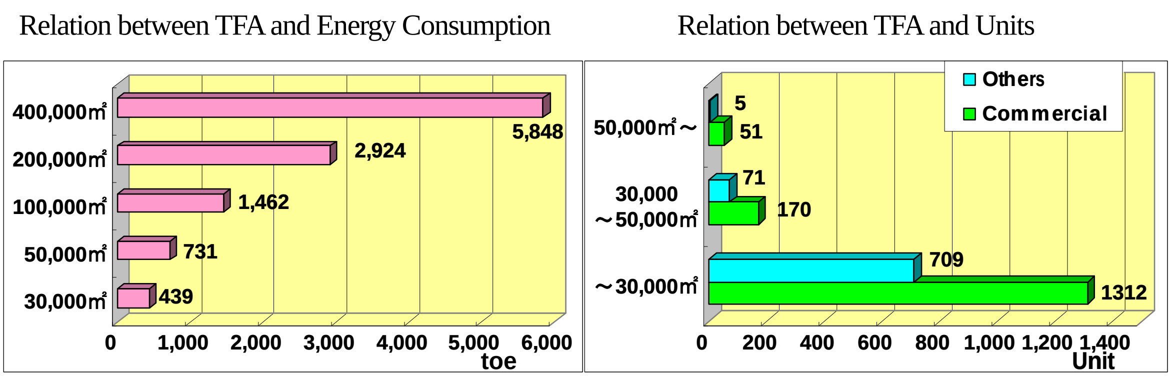
In office buildings, conventional energy equipment such as air conditioner does not require any specialized knowledge or information, so replacing an old chiller-type air conditioner with new one is selected as model case for energy saving.

Table 2.3 Energy-saving Options for Steel Industry

	Technological Options	Experience in other countries	External Constraints	Applicable to other sectors	Cost and Benefit (EIRR)
Steel Making	Scrap Preheater	EXCELLENT	GOOD	INAPPROPRIATE (Specified to Steel sector)	GOOD
	Oxygen Lancing	EXCELLENT	FAIR (Needs for availability of Oxygen)	INAPPROPRIATE (Specified to Steel sector)	FAIR
	Ladle Preheater	EXCELLENT	GOOD	INAPPROPRIATE (Specified to Steel sector)	GOOD
Rolling	Hot Charge of Billets	EXCELLENT	FAIR (Needs for adjustment of production process)	INAPPROPRIATE (Specified to Steel sector)	EXCELLENT
	Regenerative Burners	EXCELLENT	EXCELLENT (only Replacement)	EXCELLENT	EXCELLENT

3. Proposal for Expansion of Energy Auditing System

The left figure below shows the relation between office energy consumption and TFA. 6,000 toe defined under the energy-saving regulation is equivalent to 400,000 m^2 in total floor area. Therefore, it is limited to sizable buildings. Annual energy consumption for a building in the 50,000-m^2 class is approximately 700 toe. On the other hand, the relation between sizes and number of office buildings is shown in the right figure. Total floor area is less than 30,000 m^2 in 80% of the total. Considering the cost effectiveness of energy auditing expenses for energy-saving amount, 50,000 m^2 is calculated as the lower limit. The coverage is about 2%. If total floor area is more than 30,000 m^2, some 10% will be covered.



Source: EMI and JICA team joint study

Figure 3.1 Relations among TFA, Energy Consumption, and Units of Building

Table 3.1 indicates the functional level of technical skills that energy managers, energy auditors, and ESCOs should have. The levels of the required technologies are classified into three categories: production process-linked advanced technologies, general-purpose energy-saving technologies, and basic energy-saving technologies. An energy manager is not considered to be well-versed into all of these energy-saving technologies as an expert, and is rather expected to control and manage the organization to promote basic energy saving.

It is also necessary to clarify the functional levels of technical skills required for energy auditors. Energy auditors include internal auditors and external auditors. It is important to classify external auditors into two types: Grade A engaged in advanced technologies and Grade B engaged in general-purpose technologies. Currently, most of external auditors in Indonesia are considered to fall under Grade B. For companies that are already making use of internal auditors, they are selected in-house and are generally familiar with production processes. Therefore, they can be narrowed down to Grade A. To sum up, the case in which an internal audit is possible refers to major companies and the case in which external audit is required refers to small and medium-size companies. Finally, ESCO can be effective for companies which energy conservation at the level of external audit Grade B suffices. This means that office buildings do not generally require advanced industrial energy-saving technologies.

Table 3.1 Demarcation of Energy Manager, Energy Auditor, and Introduction of ESCO

	Energy Manager	Enegy Auditor			ESCO Company
		External		Internal	
		GRADE A	GRADE B		
Highly advanced technology (linked to production process)	Not Required	Required	Not Required	Required	Not Required
Conventional technology for Saving Energy	Not Required	Required	Required	Required	Required
Basic knowledge for Saving Energy Management	Required	Required	Required	Required	Required

Table 3.2 shows the classification of company performance and Table 3.3 shows rankings of energy managers and energy auditors. First, Table 3.2 indicates that cement companies own three skills in general: highly advanced technology, conservation technology, and basic knowledge of energy conservation. Meanwhile, the skills required of steel companies may depend on corporate size (although size alone is not sufficient for evaluating technological capability). The owners of office buildings should be considered to have no skills. Based on this assumption, the cement industry has energy managers and internal energy auditors, and the steel industry has energy managers, external and internal auditors, and energy auditors. Finally, it is rational for the owners of buildings to leave all duties to ESCOs.

Table 3.2 Level of Technologies Required by Companies for Saving Energy (at present)

	Cement Industry	Steel Industry			Building Owner
		Large Company	Medium Company	Small Company	
Highly advanced technology (linked to production process)	Sufficient	Sufficient	insufficient	insufficient	insufficient
Conventional technology for Saving Energy	Sufficient	Sufficient	Case by case	insufficient	insufficient
Basic knowledge for Saving Energy Management	Sufficient	Sufficient	Sufficient	Case by case	Case by case

Table 3.3 shows what type of experts (an energy manager, an energy auditor and ESCO company) can be available within each of the above three sectors, based on Table 3.1 and Table 3.3. First, in the cement industry there are many persons who could be found and appointed as an energy manager and an internal auditor inside their companies. Secondly, in the steel industry, medium and small companies need to depend on an external auditor of Grade-A outside while a large company is in the same situation as cement companies. Finally, since few owners in office buildings could find a right person to do business as an energy auditor and even an energy manager inside, an ESCO company will be possibly in charge of energy management and energy auditing instead.

Table 3.3 Availability of Energy Manager, Energy Auditor, and ESCO in Three Sectors

	Energy Manager	Enegy Auditor			ESCO Company
		External		Internal	
		GRADE A	GRADE B		
Cement Industry	Available	-	-	Available	-
Steel Industry	Available	Dependent	-	Available	-
Building Owner	-	-	-	-	Dependent

Because the energy-saving regulation of Indonesia obliges planning and implementation of energy saving based on an energy audit, the exemption of most energy savings of office buildings from legal obligation seems to be very wasteful from the viewpoint of the spread and promotion of energy saving. However, a numerical increase means increases of governmental efforts and expenses, such as assignment of energy managers and audit expenses. Therefore, as shown in Figure 3.2, the system of institutionally introducing ESCOs and having them represent the government or owners can save the government manpower and cost much more.

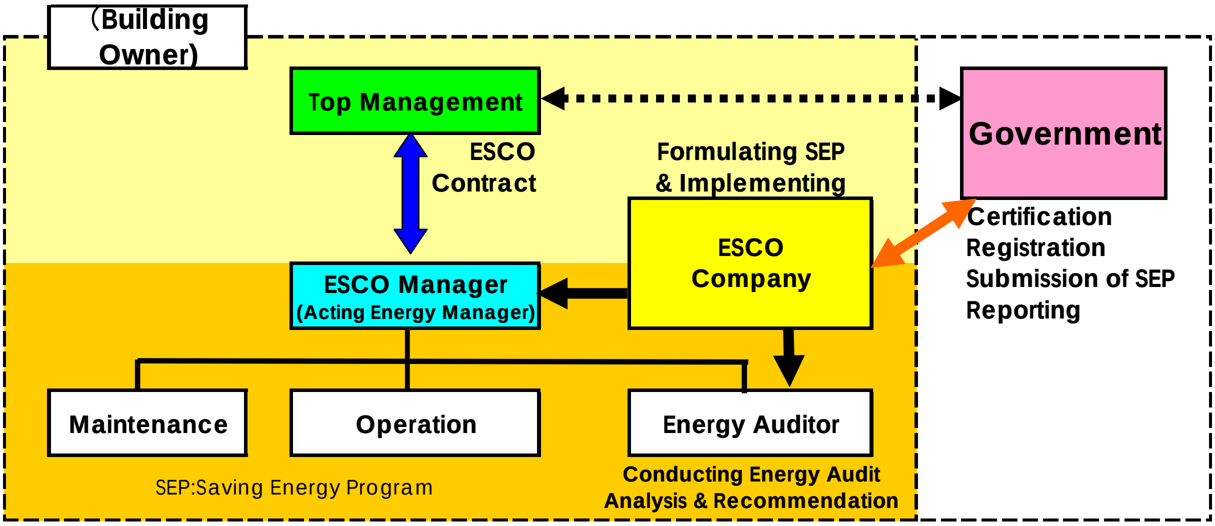


Figure 3.2 Introduction of ESCO Model in Energy Audit System

As stated above, classification of energy managers and energy auditors, stratification of energy auditors, and institutional introduction of ESCO model are necessary for promoting energy conservation. At the same time, various assistance systems are needed to implement the model project. To implement investments in the cement or steel industry, institutional arrangements such as technological support and subsidies, are needed. Besides, personnel training and man-power development of energy auditors as experts will be an urgent issue. As financial support to introduce ESCO model is essential, it is very important that procedures are carried out smoothly and consistently. To accelerate energy conservation, a new organization specific to energy saving is required.

4. Cost Effectiveness

This section describes the cost effectiveness of model projects of cement industry, steel industry, and office buildings in order to examine energy saving measures mentioned in section 2.. In addition, cost effectiveness is analyzed for one unit with an evaluation period of ten years.

(1) Cement Industry

First, the model project, “Self-power produced by Waste Heat Recovery,” in the cement industry is examined. This equipment produces about 10,000 kW and replaces some 20% of electricity purchased from PLN. Referring to the 2009 statistics of PLN, the purchase price from PLN is set at 622 Rp/kWh. The equipment cost is set at 20 million Rp/kW. The investment criterion required is an IRR of 20%. In fact, equipment will be introduced in a total of 21 cases. We expect a CO_2 emissions reduction of 1.5 million tons or 1.9% compared to BAU.

Figure 4.1 shows the IRR of a cement company for an investment to introduce self-power generation through waste heat recovery. The purchase price of electricity from PLN is 622 Rp/kWh. This is the current subsidized electricity price in Indonesia. Considering 10% customs duties on imported parts of equipment, 32% corporate tax, and other conditions, the IRR is only 9.3%, making investment difficult to implement. However, if the electricity price increases from 622 Rp/kWh to 1,151 Rp/kWh, which is the same as generation cost including transmission and distribution of PLN, the IRR will increase to 23%. This figure exceeds our target of an IRR of 20%. And, PLN can save electricity equivalent to 370 billion Rp. However, the cost of electricity incurred by companies will greatly increase. The production cost of cement will also increase. Therefore, the cost competitiveness of companies may be weakened at an international level.

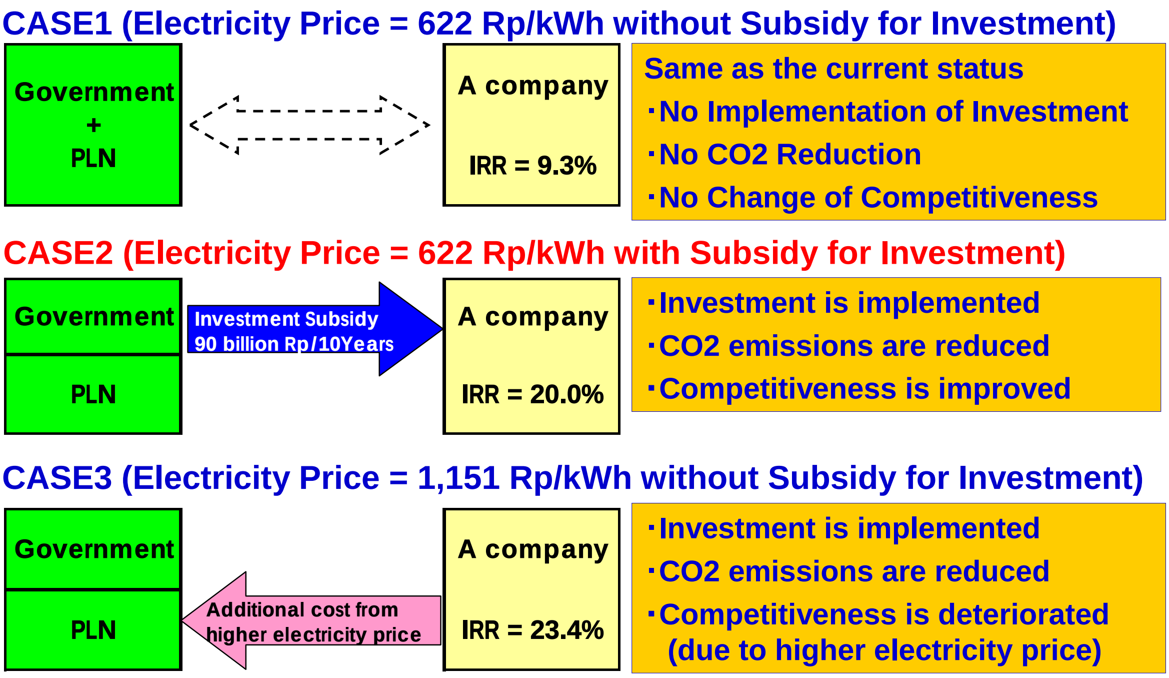


Figure 4.1 IRR of a Cement Company for Investment on Self-power Produced by WHR

Figure 4.2 shows the electricity price subsidy received by PLN. At present, the average generation cost of PLN is 1,052 Rp/kWh. However, PLN sells electricity at 622 Rp/kWh. This price is lower than the generation cost. To bridge the gap, PLN gets a subsidy from the government. When considering transmission and distribution losses, the deficit balance is further expanded. In other words, the government gives subsidies to end-users.

Subsidy: 529 Rp/kWh (at user)

Breakdown

- **Deficit: 430Rp/kWh**
  - **Sales Price : 622 Rp/kWh (for Industrial)**
  - **Production Cost : 1,052Rp/kWh (at Power Station)**
  - **Deficit : 430Rp/kWh**
- **Transmission Loss: 99Rp/kWh**

Figure 4.2 PLN Electricity Price Subsidy

Figure 4.3 shows a comparison of the IRR of each party. If the government provides a subsidy of 90 billion Rp for introducing energy-saving equipment to a cement plant, the IRR of the cement company will increase 20% without the electricity price rising and the cement company can save electricity equivalent to 370 billion Rp. That is, the government can save a subsidy of 280 billion Rp (370 billion minus 90 billion). Total IRR of the parties becomes 33.6%. The government also gets an additional benefit in the form of CO2 reductions. This CO2 volume reaches 0.7 million ton over 10 years.

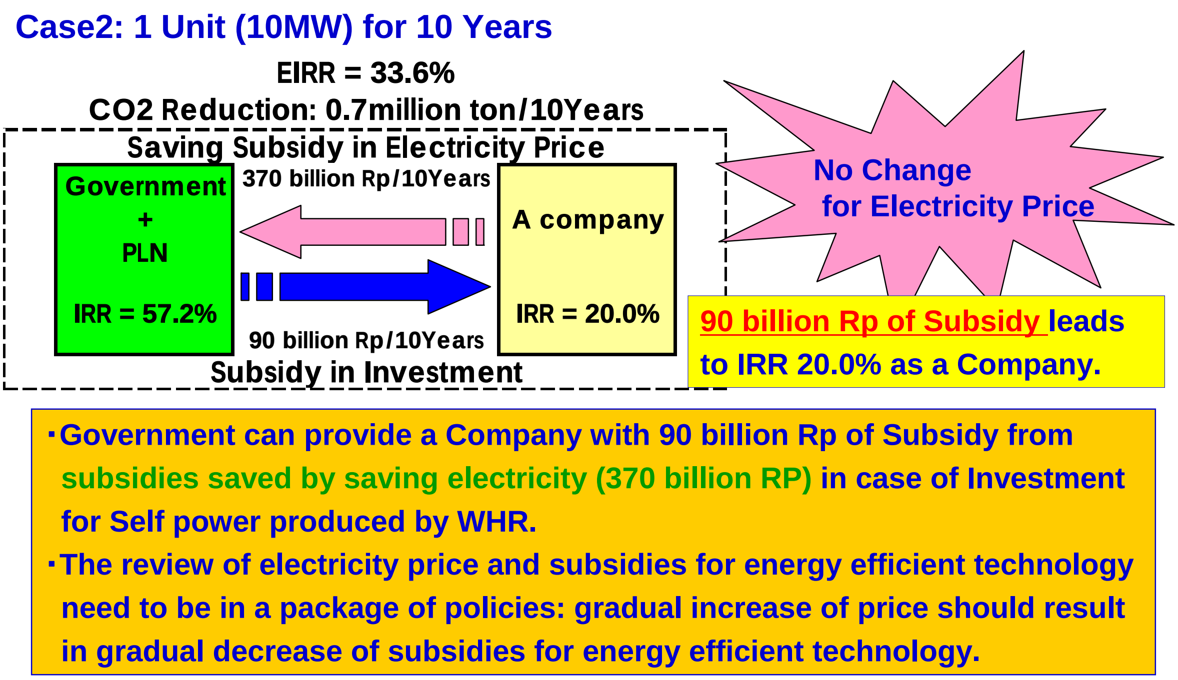


Figure 4.3 Comparison of IRR of Each Party

(2) Iron and Steel Industry

The model project of the steel industry is the introduction of regenerative burners to a reheating furnace in the rolling process. The energy-saving rate is set at 30% compared with existing burners judging from past experience. Moreover, it is assumed that a trial calculation is performed for two fuels: oil and gas. The oil price is set at 5,760 Rp/L and the gas price is set at 1,960 Rp/L oil equivalent. The equipment cost is set at 33 billion Rp for 12 pairs of burners. The evaluation period is 10 years. Expected CO2 emission reduction is 0.33 million ton compared to BAU in 2025. In fact, it is assumed that a total of 51 units are introduced, 12 pairs of burners in 18 units at major companies and two pairs of burners in 33 units at small and medium-size companies.

Figure 4.4 shows cash flow and IRR of companies introducing regenerative burners. IRR was calculated for the two cases of oil (5,760 Rp/L) and gas (1,960 Rp/L oil equivalent). IRR for oil use is 59.9% and IRR for gas use is 17.2%. As gas is very cheap due to subsidies, its profitability is lower. A slightly larger subsidy to steel companies will make investment practical. A company can implement this project with some outside technical assistance. In addition, there are some subsidies required at an early stage for steel companies. Regenerative burners can sharply reduce oil consumption by more than 30%. Moreover, using gas burners leads to the whole oil substitutes.

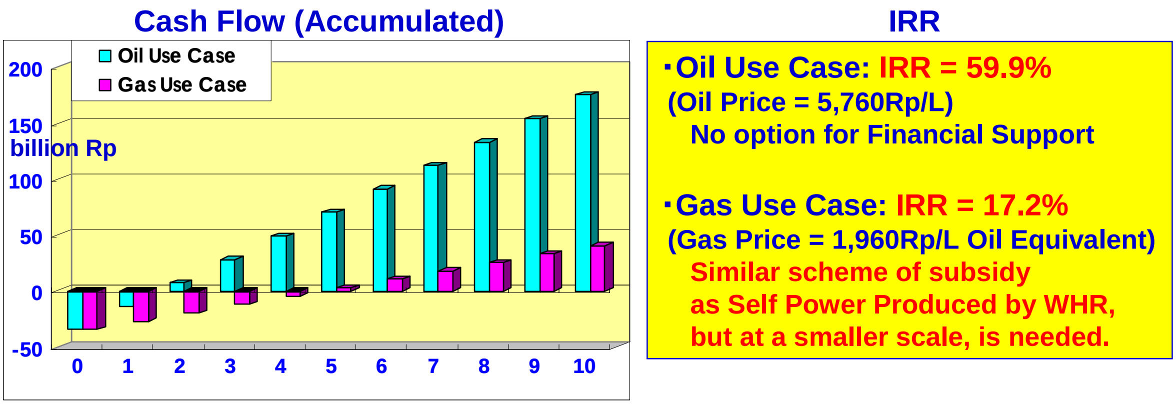


Figure 4.4 Cash Flow and IRR in a Steel company for Investment on Regenerative Burners

Figure 4.5 shows how much Indonesia can reduce foreign payments by cutting oil consumption. Pertamina does not have sufficient oil-refining capacity, therefore, petroleum products are imported. If regenerative burners are introduced, a steel company can save 301 billion Rp in oil purchases, which consists of 288 billion Rp for import cost and 13 billion Rp for domestic transportation cost. No deficits are incurred by Pertamina and the Government because the price for sales to industry is cost-basis linked to the Singapore Market.

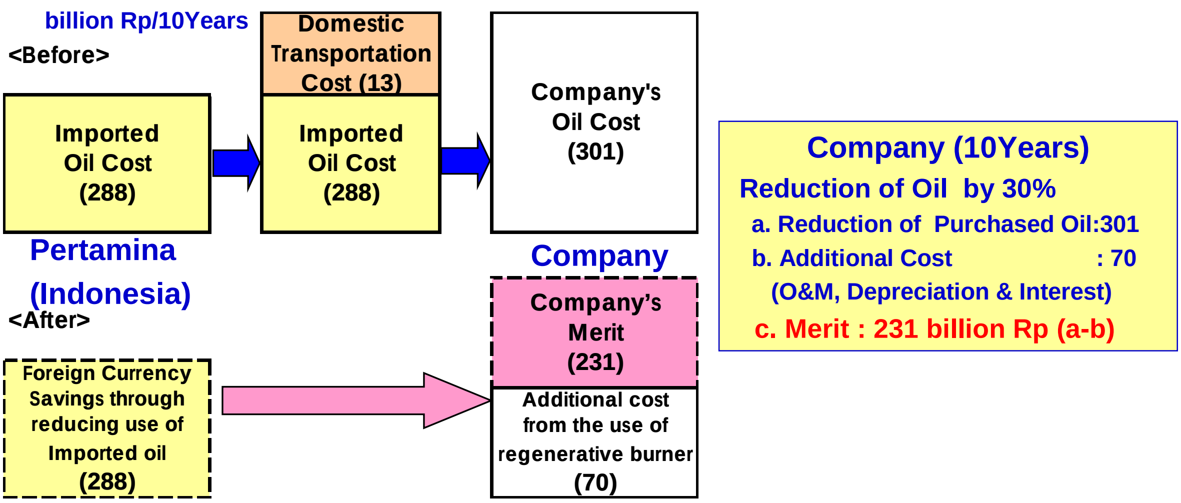


Figure 4.5 Profits and Foreign Currency Savings (in case of introducing "Regenerative Burners")

(3) Office Building

This section shows a case in which electricity consumption can be reduced by replacing old air conditioners with more efficient new ones: chillers with a coefficient of performance (COP) of 4.7. Electricity price is assumed to be 850 Rp/kWh, which is the average price PLN charges for commercial use.

We considered introduction of chillers with a capacity of 4.2 MW in a building with a total floor area of 50,000 m^2. The evaluation period is set at 10 years. If it is economical for a building owner to make such an investment for installing high efficiency air conditioner, there is a possibility of introducing ESCO model as well as direct investment for a building owner.

When calculating the IRR for a building owner using the current power purchase price of PLN, 850 Rp/kWh, the IRR was 8.5%, which is not acceptable. If the electricity price is raised to 1,151 Rp/kWh, the IRR for the building owner would be 17.6% without a subsidy. This electricity price rise means a cost increase for the building owner. However, Indonesia should raise electricity prices gradually to reduce the deficits of PLN, and this is preferable from the viewpoint of energy saving.

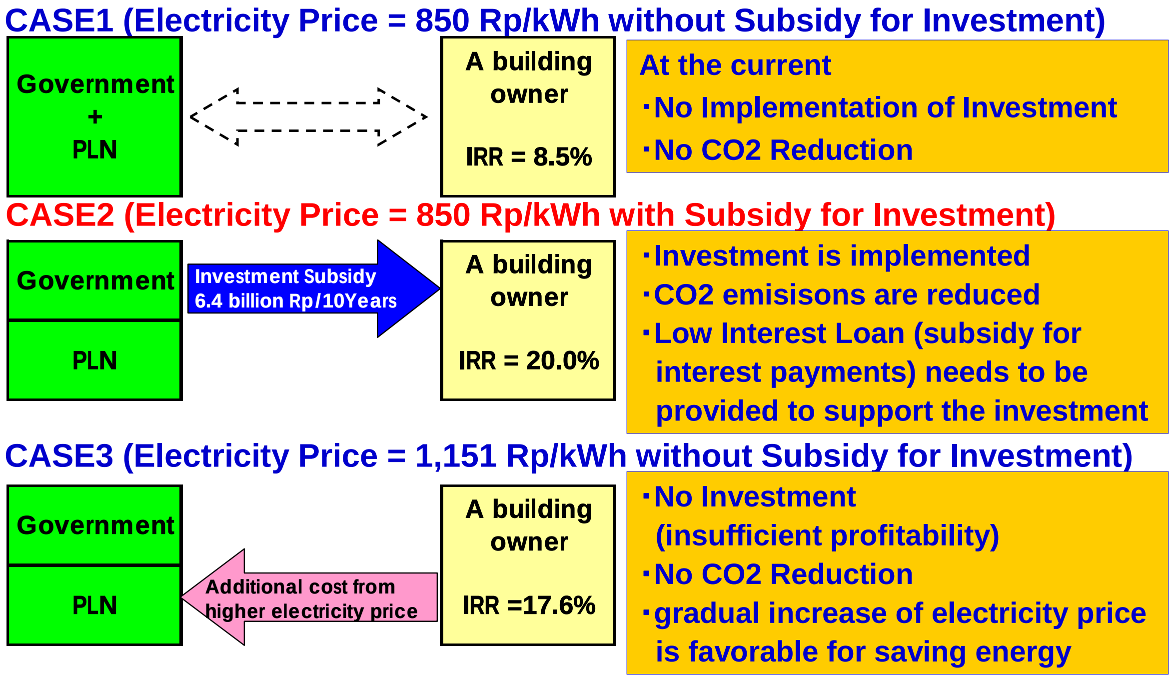


Figure 4.6 IRR of a Building Owner for Investment to Replace Old Air Conditioners

Figure 4.3 uses the same logic as that for the cement industry (Figure 4.2). The average cost of power generation of PLN is 1,052 Rp/kW. Sales price is 850 Rp/kWh. This means a deficit of 202 Rp/kWh. Furthermore, when a transmission loss of 99 Rp/kWh is taken into consideration, the deficit is 301 Rp/kWh. This means the government pays 7 billion Rp to commercial users as a subsidy over 10 years.

Subsidy: 301 Rp/kWh (at user)

Breakdown

- **Deficit: 202Rp/kWh**
  - Sales Price : 850 Rp/kWh (for Commercial)
  - <u>Production Cost : 1,052Rp/kWh (at Power Station)</u>
  - Deficit : 202Rp/kWh
- **Transmission Loss: 99Rp/kWh**

Figure 4.7 PLN Electricity Price Subsidy PLN

If the government can pay out 6.4 billion Rp as a subsidy for replacing air conditioners, the investment will be acceptable because the IRR becomes 20%. If the investment is implemented, the cost of electricity can be reduced by 7 billion Rp over 10 years. The subsidy for buildings is a little lower than the subsidy for PLN. This investment will reduce CO2 emissions by 22,000 tons over 10 years. If the government gives subsidy to building owners to promote energy saving, Indonesia will acquire additional CO2 reduction at lower cost than the current electricity subsidy to PLN.

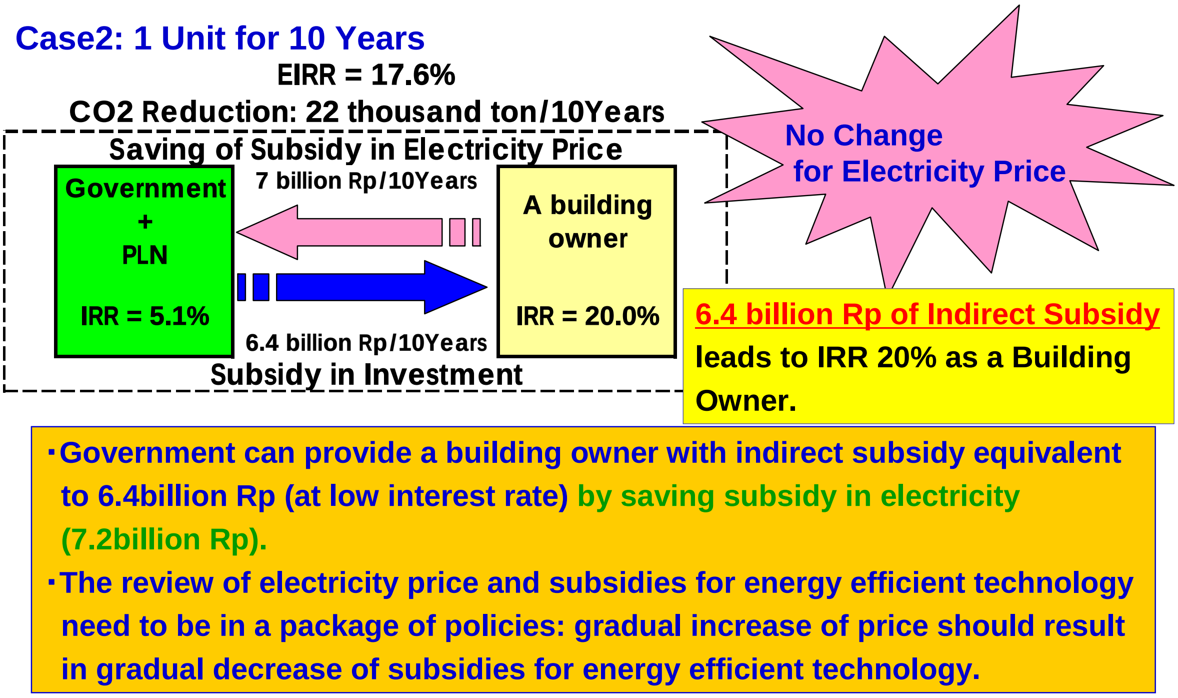


Figure 4.7 Comparison of IRR of Each Party (with Subsidy for Investment)

Figure 4.8 shows what will happen when introducing an ESCO model in case the IRR for a building owner becomes 20% and the subsidy is available as explained previously.

First, an ESCO model has three stakeholders: funding company, ESCO, and client. The ESCO undertakes an energy audit of a building to calculate the profitability of an energy-saving investment. Based on the calculation, the three stakeholders conclude a contract on the allocation of energy saving merits and cost sharing; this contract is called an ESCO contract, which details energy saving merits, lease, ESCO fees, and others.

After concluding the contract, the funding company makes an investment and the ESCO is responsible for installing equipment. The equipment is owned by the funding company and is leased to the client. The ESCO guarantees energy-saving merits to the client and takes responsibility for the operation and maintenance of equipment.

Figure 4.8 to the left side shows the flows of funds among the three stakeholders—funding company, ESCO, and client—while the figure to the right shows the allocation of profits. From the profits after deducting cost from energy-saving merits, the funding company makes a return on investment, while the ESCO takes ESCO fees to cover the costs of guaranteeing energy-saving merits plus operation and maintenance. Then, the client takes the remaining balance as profit. Specifically, the model receives a subsidy of 6.4 billion Rp from the government over 10 years; the funding company takes 5.2 billion Rp; the ESCO takes 5.1 billion Rp; and, the client takes 1.7 billion Rp as profit. The amount of profit that can satisfy a client might be an issue. But, an ESCO business is acceptable as long as there remains any profit for a client. This is because the client generally will receive equipment free of charge after the ESCO contract expires.

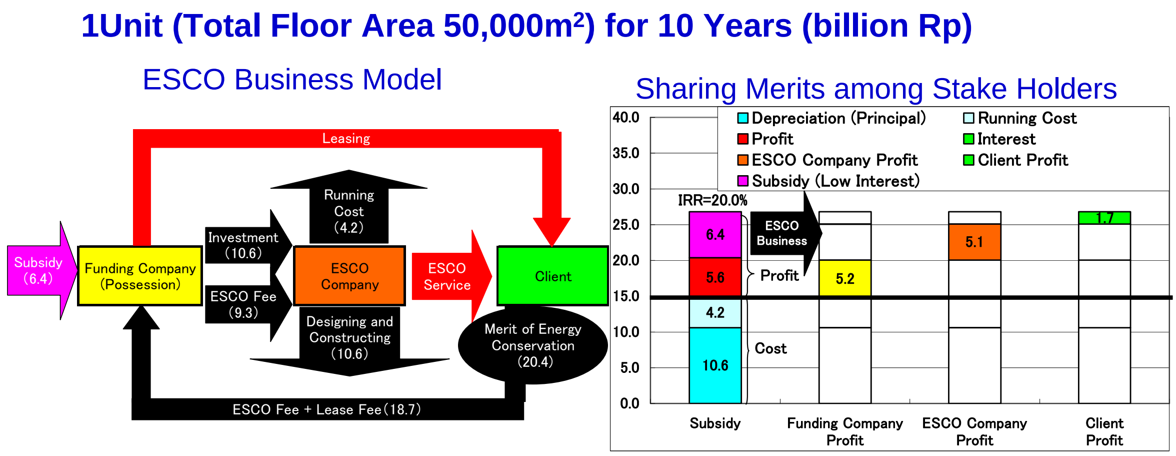


Figure 4.8 Introducing ESCO Business Model to Commercial Buildings

5. Medium-term Targets

On the basis of our interviews in Indonesia as well as various technical and economic considerations, we have decided the following targeted sectors.

Figure 5.1 shows the implementation flow of the model project. Table 5.1 summarizes the number of audit and investment programs as well as investment amounts.

It is planned to carry out a model project for the cement industry to invest in waste heat recovery power generation plants. There will be 21 internal audit programs and 21 investment programs in total. The total investment will be 4.2 trillion Rp.

It is planned to introduce regenerative burners for the steel industry. There will be 18 internal audits of major companies and 65 external audits of small and medium-size companies. There will be 18 large-scale investments with 12 pairs of burners and 33 small-scale investments with two pairs of burners. The total investment will be 760 billion Rp.

As for office buildings, 442 audits and 200 investments will be carried out. The total investment will be 2 trillion Rp.

During the period from 2010 to 2025, 546 energy audits, in total, will be conducted, and 272 investments will be made. The total investment will be 6.96 trillion Rp, while CO2 emissions will be reduced annually by about 2.3 million toe, and this is the medium-term target.

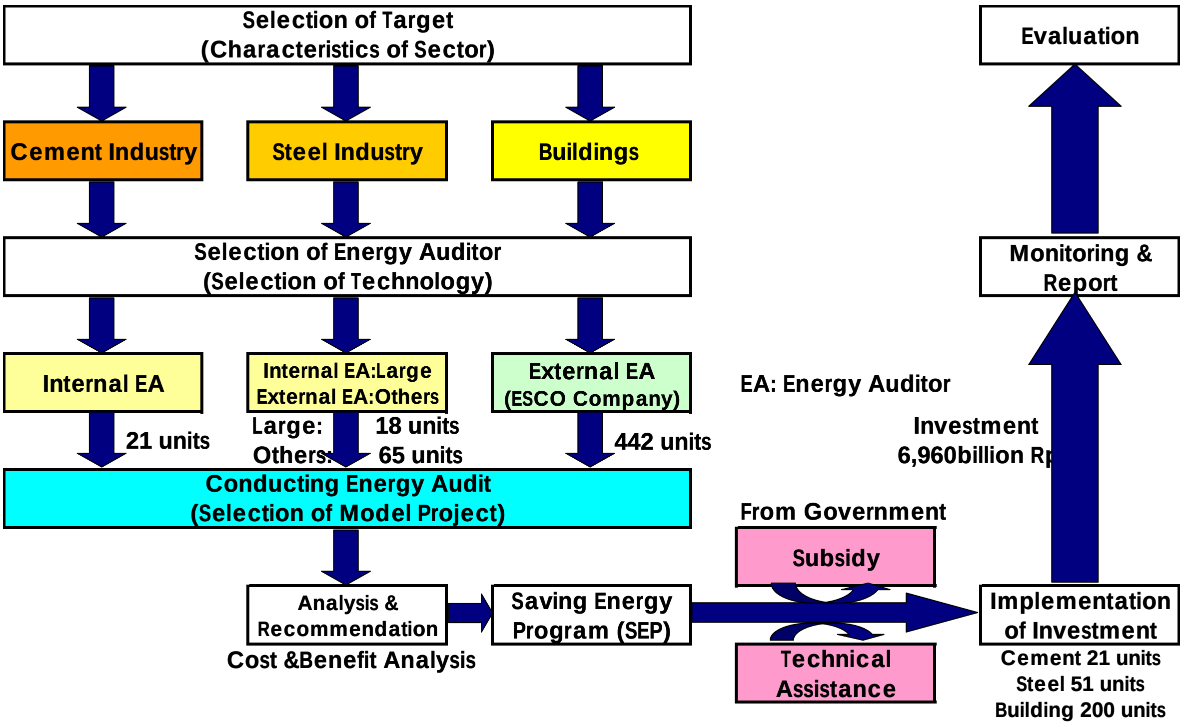


Figure 5.1 Flow of Proposed Model Project

Table 5.1 Mid-term Target of Energy Audit and CO2 Reduction

Mid-term Target

Item		Duration	Target
Conducting Energy Audit	1) Cement Industry	2010-2025	21 units
	2) Steel Industry		83 units
	3) Buildings		442 units
	Total		546 units
CO2 Reduction		2025	2.3million ton/Year

Investment for achieving Mid-term Target

Implementation of Investment	Cement Industry (Self Power Produced by WHR)	2010-2025	21 units (4,200 billion Rp)
	Steel Industry (Regenarative Burners)	2010-2025	51 units (760 billion Rp)
	Buildings (ESCO Business)	2015-2025	200 units (2,000 billion Rp)

Total Investment : 6,960 billion Rp

Table 5.2 shows the cost to be subsidized by the government, i.e., incentives. An energy audit will cost 200 million Rp per industrial object and 100 million Rp per office building, respectively. The cost of investments in 200 office buildings will be borne by the ESCOs themselves, which means that government subsidization is not required, so only 246 investments requiring 55 billion Rp have to be subsidized by the government. As already analyzed, about 1.95 trillion Rp is required as subsidies for investing in equipment in the industry sector and about 1.28 trillion Rp as low-interest loan for ESCO programs for office buildings. In addition, exemption from tariffs on imported equipment, devices, and parts will be about 260 billion Rp, so the total subsidy will amount to about 3.54 trillion Rp. However, the deficit of PLN will be reduced by about 9.2 trillion Rp by waste heat recovery power generation and other energy-saving measures. From this table, CO2 emissions can be reduced by about 2.3 million ton if about 6.97 trillion Rp is invested in energy-saving programs. For this investment to be profitable, however, the government must provide a subsidy incentive (i.e., fiscal spending) of about 3.5 trillion Rp for energy-saving investments. This would in turn reduce electricity subsidy to PLN by about 9.2 trillion Rp and result in a fiscal surplus of about 5.7 trillion Rp.

Table 5.2 Re-allocation of Current Expenditure by Government

<Evaluation Period:10 Years>

billion Rp

	Without the Project	With the Project
Government Expenditure (Incentives)	BAU	BAU +3,543
Subsidies to PLN	BAU	BAU -9,209
Outgoing Cash flow	BAU	BAU -5,666

Figure 5.2 summarizes the model project from the viewpoint of fiscal spending by the government, focusing on the merits for Indonesia as a whole. In the left column of Figure 5.2, the investment on the model project is 6.96 trillion Rp, while in the right column the effects expected from the investment are listed such as reduction of CO2 emissions, reduction of petroleum product imports by investing in regenerative burners, reduction of subsidy for electricity rates, and a ten-year cost merit obtained from waste heat recovery power generation of 11.4 trillion Rp (for companies).

If all these effects of the investment are evaluated, a significant advantage is gained. For an individual company, the deduction of payments of 15% in loan interest would increase the above-mentioned cost merit to 4.55 trillion Rp. Furthermore, the company must depreciate equipment investment of 4.2 trillion Rp over ten years, resulting in a surplus of only 0.35 trillion Rp. Considering the burden of corporate tax, the investment is no longer profitable. Therefore, it is necessary to increase the internal rate of return (IRR) by granting an appropriate subsidy to companies investing in energy-saving equipments.

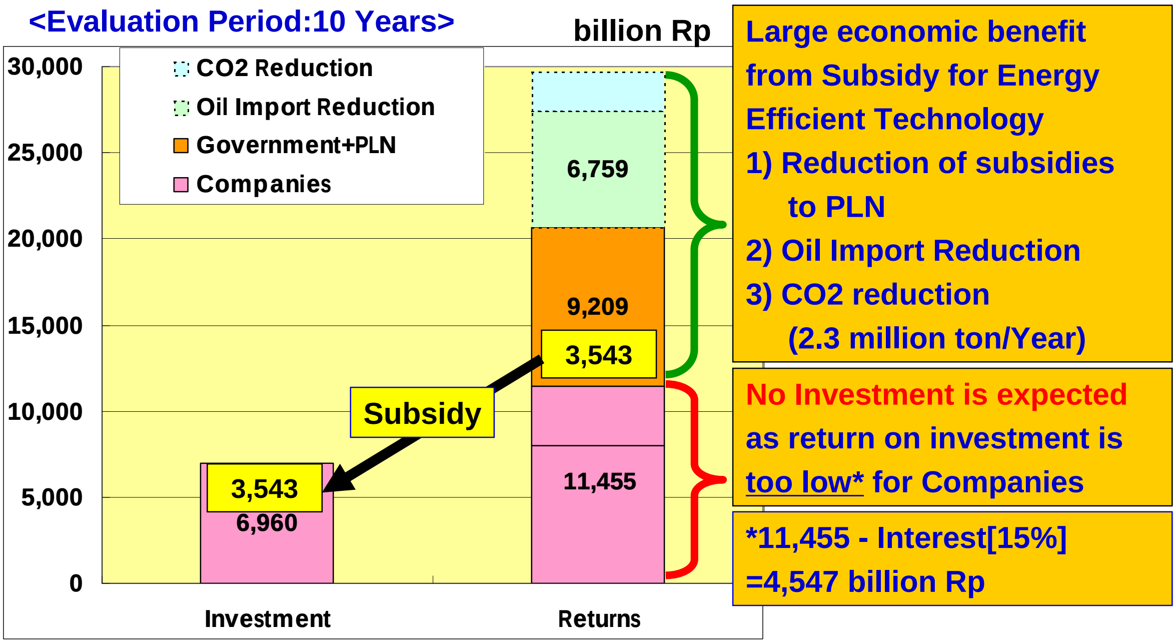


Figure 5.2 Effects of Proposed Model Project (All of Indonesia)

6. Conclusion and Future Tasks

To extend the energy audit system by executing the model project, the following three measures are to be taken:

First: Partial amendment of and supplement to the 2009 Regulation. These include: 1) expansion of the scope of energy audit for the buildings sector covered by the regulation by introducing ESCO model; 2) introduction of more effective and better performing technologies through technical and financial assistance from the government.

Second: Establishment of new organizations and foundations to promote energy-saving investments. This is because the following should be paid an attention to when implementing the investment. First. so many projects will be proposed to the government and all projects require complicated procedures; and second, when providing loans for projects, it is necessary to examine them thoroughly to avoid inappropriate burden of investments risks, and credit risks of ESCO companies and clients. If multiple government agencies performed these processes at the same time, it would likely lead to confusions and troubles over the framework of energy ocnservation, and therefore, a new unified institution for energy efficiency is required. A new organization with such a specific energy-saving mission is required. An Indonesian version of NEDO, ECCJ (Energy Conservation Center) and a revolving fund is necessary

Third: Development of competence of energy auditors

The incentive (fund) of 3.5 trillion Rp required for the investment on model projects can be raised by implementing the investment itself. These model energy saving investments will lead to a reduction of the subsidy for electricity of 9.2 trillion Rp. , and as a result, the government successfully create 5.7 trillion Rp of improved fiscal space.

The tasks proposed through this study that require further detailed analyses include:

1) Conducting a more detailed investigation to institutionalize the ESCO model,

2) Preparing programs to develop the required competence of energy auditors, and

3) Further study and planning for establishment of a new institution.

Energy Audit Program Study

- on selected Model Projects -

Shinji OMOTEYAMA
(Director for Planning & Administration)

Harumi HIRAI
(Team Leader, Oil Economist)

May 25, 2010 in Jakarta

Contents

1. Objective of This Study

Objective of This Study

1.Background : Policy matrix for CCPL

2.Objective : Reduction of CO_2 emission by Energy Efficiency Improvement (through Energy Audit and CO_2 Road Map)

3. Duration :Dec 2009 to May 2010

4. Counterparts : MEMR and MOI

5. Primary Content :

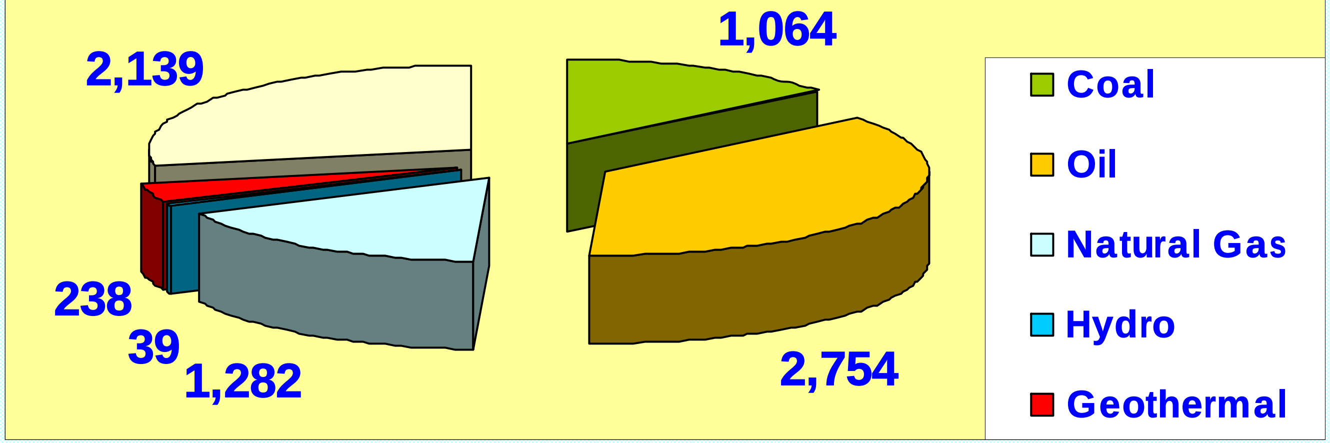
a) Expansion of Energy Audit System for a more general regulatory framework

b) Mid-term Target on the Proposed Model Project Study in Cement and Steel industry, and Office buildings

c) Cost and Benefit Analysis of Investment on Incentives from Government

2. Current Status of Energy Conservation

Policy of Energy Mix on Primary Energy Supply in Indonesia

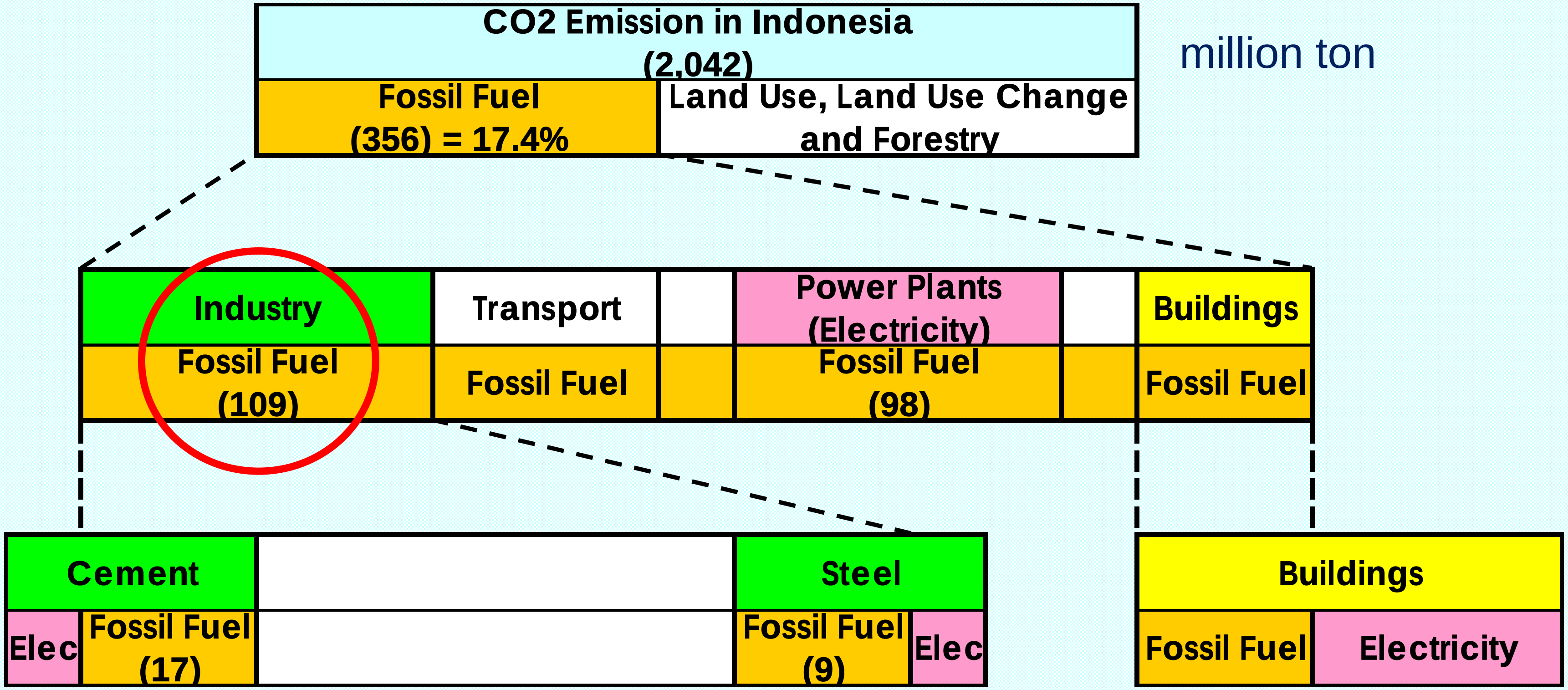


Source: IEA

	Coal	Oil	Natural Gas	Hydro	Geothermal	Others
2005	14.2%	36.6%	17.1%	0.5%	3.2%	28.5%
President Decree No.5 of 2006 on National Policy	33.0%	20.0%	30.0%	2.0%	5.0%	10.0%

By 2025

CO2 Emission of Each Sector in 2005 in Indonesia



million ton

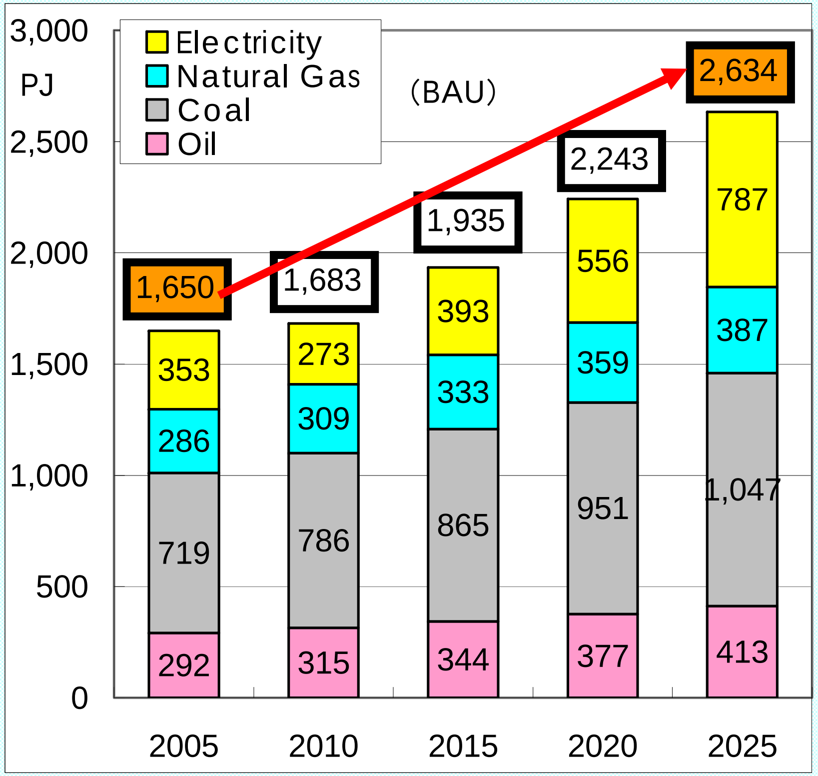
Source: IEA, WRI

Since CO_2 emissions are expected to increase sharply due to robust economic growth, efforts to reduce emissions from fossil fuel use, especially in the Industry sector, will become more important.

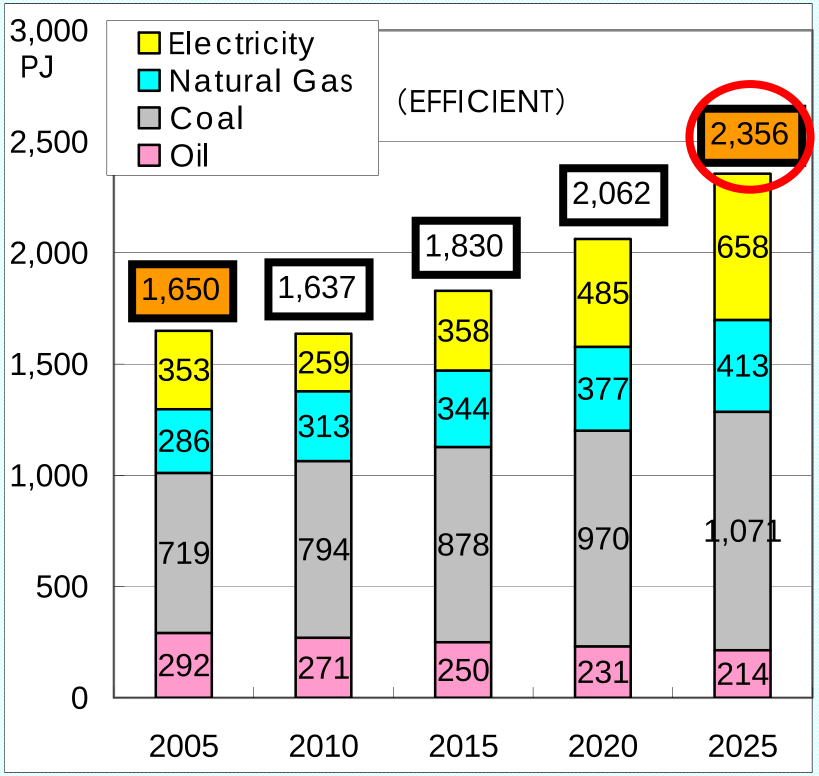
Road Map :10.5% reduction in 2025
Energy Consumption in Industry (2005 – 2025)

IEE JAPAN

Energy Consumption (BAU)



Energy Consumption (EFFICINET)



Source: Road Map (MOI)

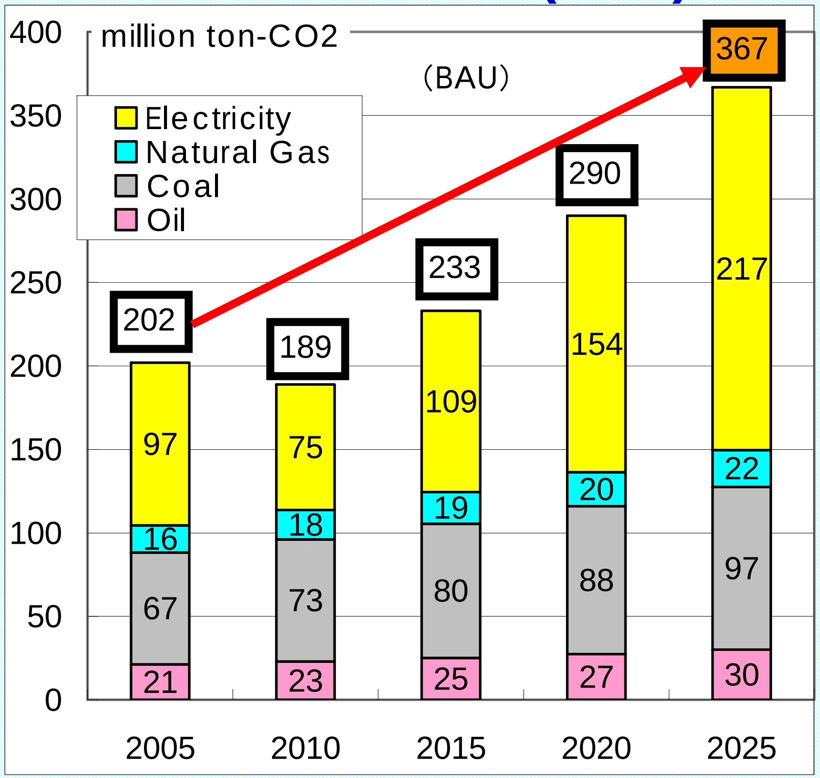
BAU: Increase from 1,650 PJ to 2,634 PJ by 2.4% annually

Efficient Case: Reduction by 278 PJ (10.5%) in 2025 compared to BAU

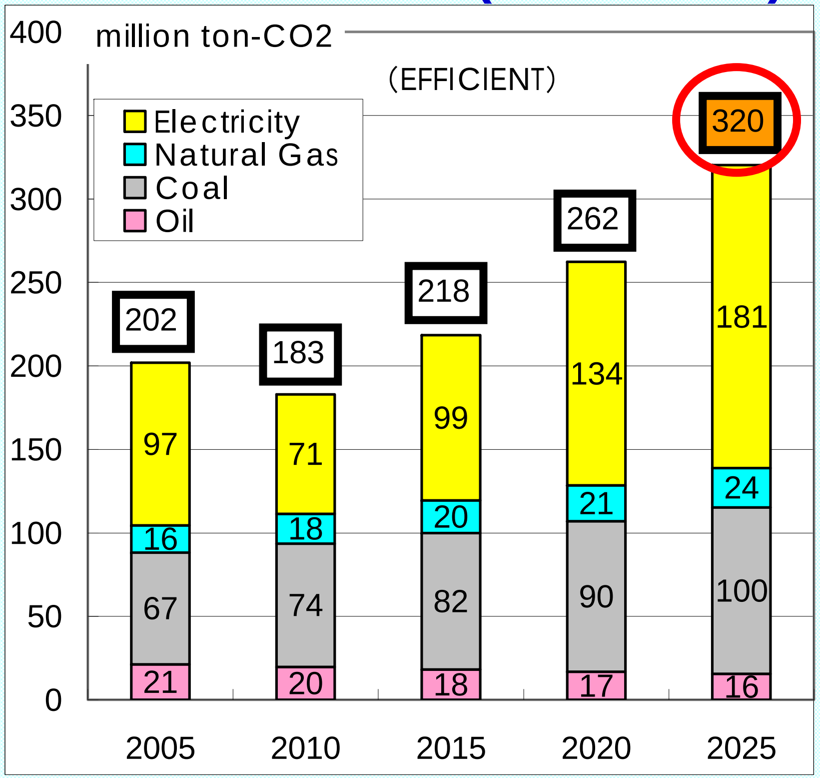
Road Map : 12.7% reduction in 2025
CO2 Emissions in Industry (2005 – 2025)

IEE JAPAN

CO2 Emissions (BAU)



CO2 Emissions (EFFICINET)



Source: Road Map (MOI)

BAU: Increase from 202 million ton to 367 million ton by 3.0%annually
(excluding CO2 emission from non fossil fuel)
Efficient Case: Reduction by 47 million ton (12.7%) in 2025 compared to BAU

Legislative Framework of Energy Conservation (1)

Energy Law (No.30 of August 2007)

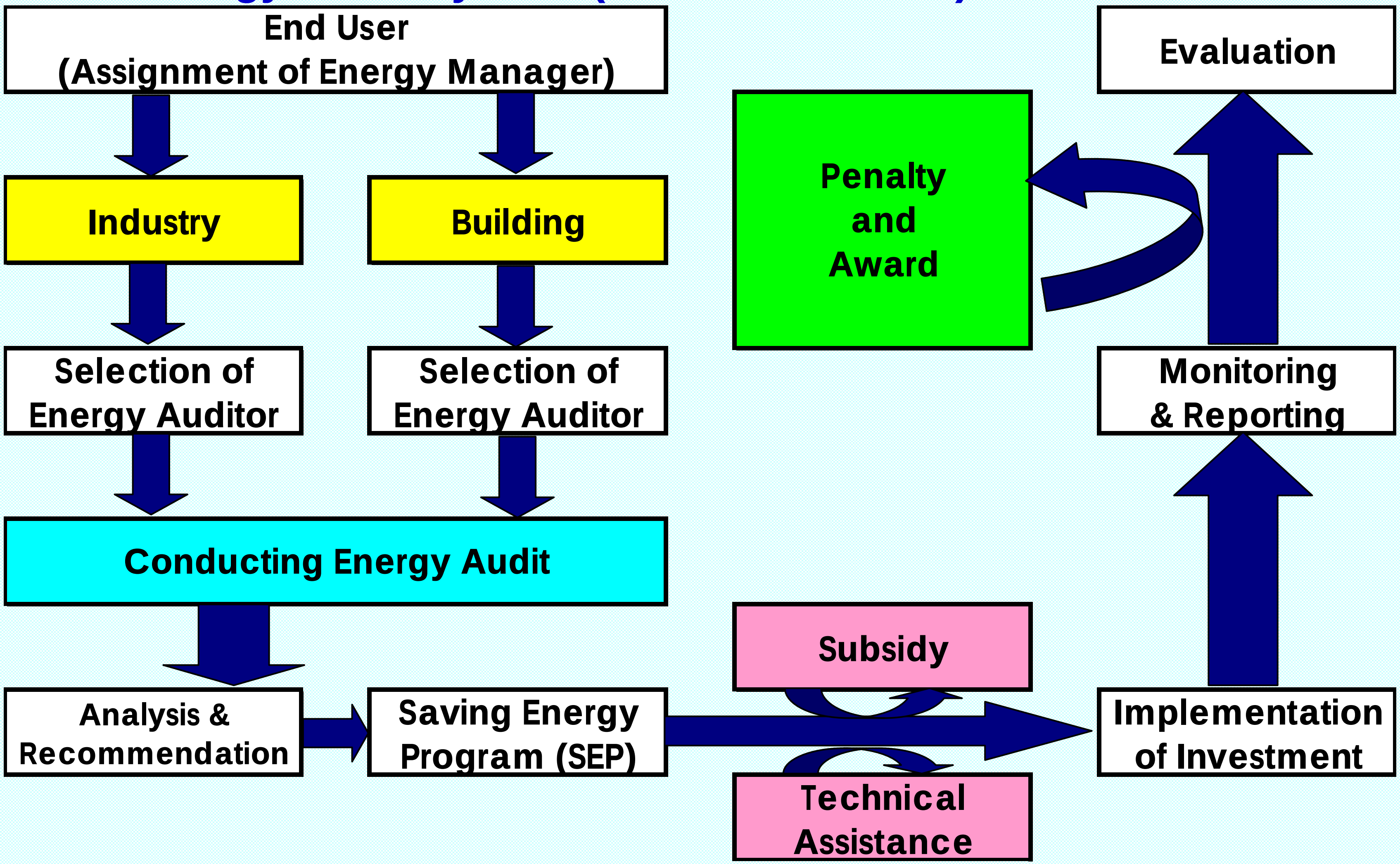
1) Establishment of National Energy Council
2) Formulation of National Energy Plan
3) Energy Conservation,4) Energy Prices

Government Regulation regarding Saving Energy (No.70 of Nov.2009)

1) Formulation of Master plan for Energy Conservation (Article 2 and 3)
2) Responsibilities and Role of Central and Local Government (Article 4, 5 and 6)
3) Responsibilities of Energy users (Article 12 and 13)
4) Standard and Labeling (Article 15 and 16)
5) Information service and education (Article 17)
6) Provision of Incentives (Article 18) and Success Criteria (Article 19)
7) Implementation Method (Article 20)
8) Subsidy for Energy Audit Fee (Article 21) and Disincentives (Article 22-27)
9) Guidance and supervision (Article 28)

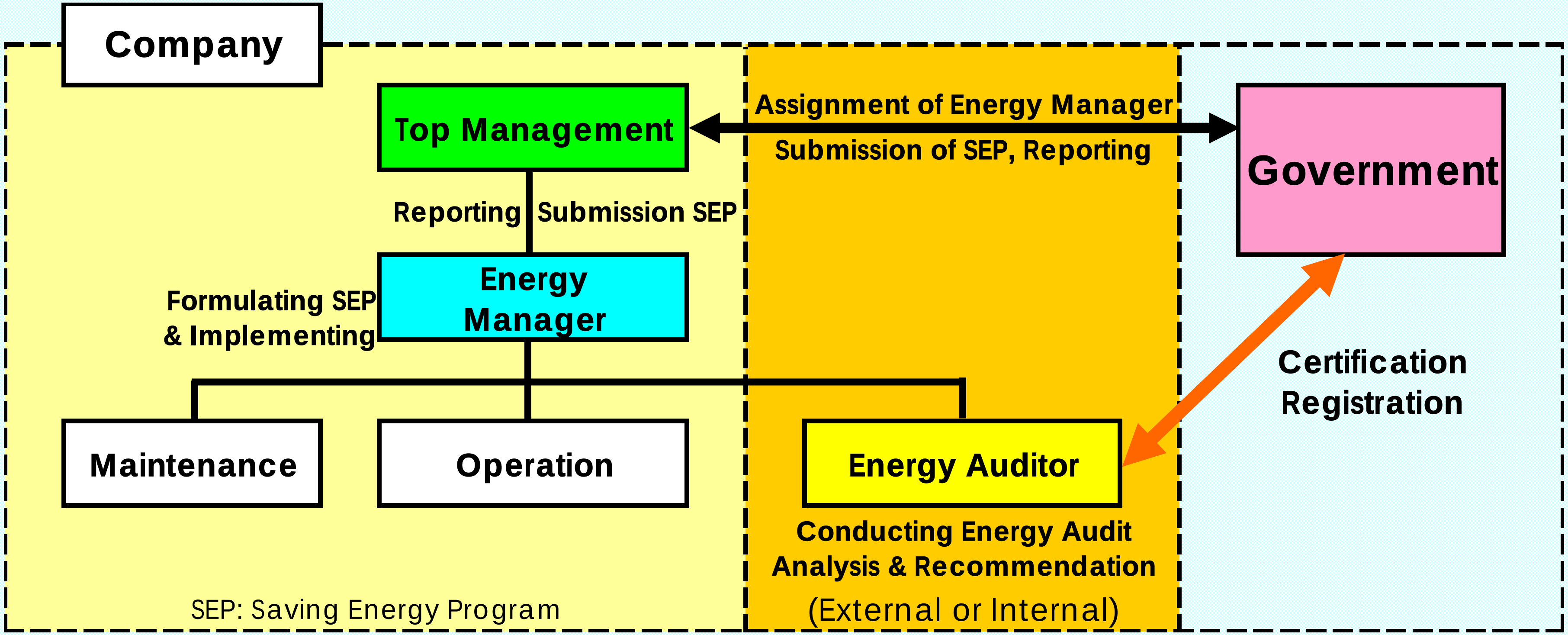
Legislative Framework of Energy Conservation (2)

Flow of Energy Audit System (Article 12 and 13)



Legislative Framework of Energy Conservation (3)

Function and Role of Energy Manager and Energy Auditor (Article 12 and 13)



Conducting Energy Audit, and Formulating and implementing of SEP are under the control of Energy Manager assigned by the regulation. SEP has to be based on the analysis and recommendation by Energy Auditor (Internal or external).

Legislative Framework of Energy Conservation (4)

The number of users covered by Article 12 (more than 6,000 toe)

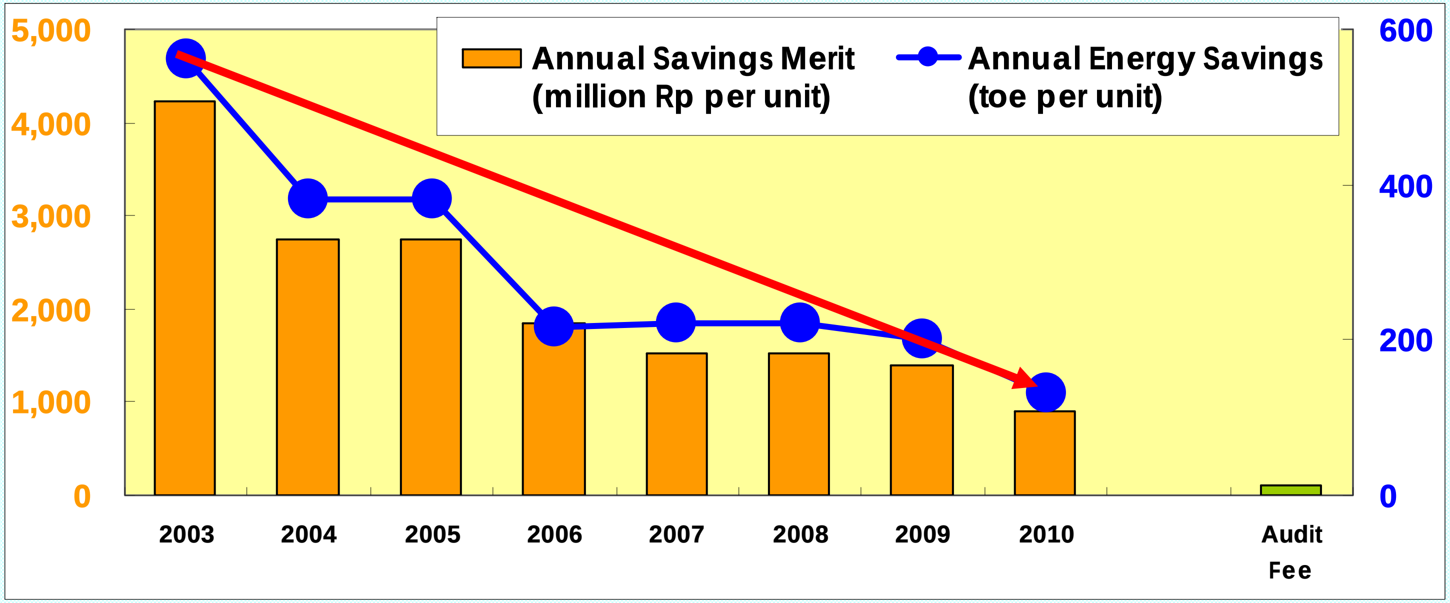
Annual Energy Consumption (toe)			less than 6,000	6,000 ～ 12,000	12,000 ～ 16,000	more than 16,000	Total	Subject to Energy Audit
Number (Unit)	Company	Industry	19,568	305	96	309	20,278	710
		Power Plant	3	1	0	14	18	15
		Buildings	3,366	35	0	0	3,401	35
		Total	22,937	341	96	323	23,697	760
	(Business Unit)		23,697	760	419	763	25,639	1,942
Share (%)	Company	Industry	96.5%	1.5%	0.5%	1.5%	100.0%	3.5%
		Power Plant	16.7%	5.6%	0.0%	77.8%	100.0%	83.3%
		Buildings	99.0%	1.0%	0.0%	0.0%	100.0%	1.0%
		Total	96.8%	1.4%	0.4%	1.4%	100.0%	3.2%
	(Business Unit)		92.4%	3.0%	1.6%	3.0%	100.0%	7.6%

Source: J-Power Report (JICA study 2009)

Annual consumption of 6,000 toe for buildings corresponds to nearly 400,000㎡ of building（reference to 28 page) . Thus, the regulation covers only a small part of building sector as a target of Energy Audit.

Current Status of Energy Audit (1)

Trends in Average of Saving Money and Saving Energy
(per unit on the cumulative basis)



	Energy Audit conducted by Government							
	2003	2004	2005	2006	2007	2008	2009	2010
Total (unit)	12	9		32	200		40	160
(accumulated)	12	21	21	53	253	253	293	453

Source : MEMR

As the number of energy audit increases, saving money and saving energy (per unit on the cumulative basis) marginally reduces.

Current Status of Energy Audit (2)

IEE JAPAN

Results of Energy Audit (2007-2008)

	Industry	Buildings
Energy Audit (unit)	20	30
Energy Saving (toe per unit)	180	386
(Energy Saving Ratio)	2.2%	17.8%
Saving Money (mm Rp per unit)	1,267	676
(Calculated at electricity price of)	(622Rp@kWh)	(850Rp@kWh)

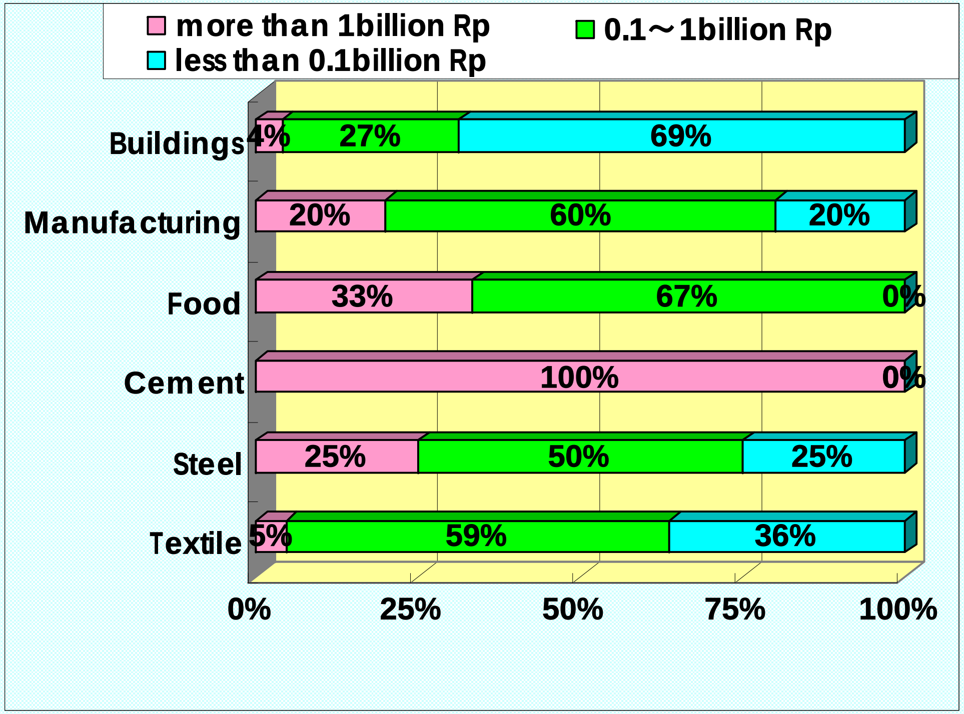
Source : EMI Report

- **Energy Saving Ratio in Buildings is 17.8% (not so bad).**
- **The potential in Industry is only 2.2%, but audits on sector-specific technology would likely lead to greater saving potential.**

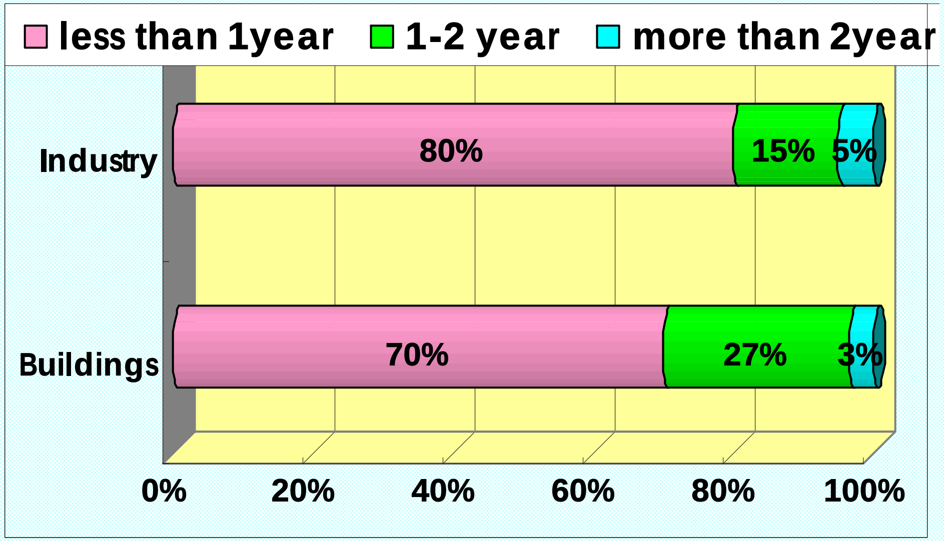
Current Status of Energy Audit (3)

Results of Energy Audit (2007-2008)

Investment per unit by sector



Payback Period for Investment



Source : EMI Report

Majority of energy conservation is through methods that are low in costs and quick in returns:

- **Low Cost : Investment of less than 1billion Rp**
- **Quick Return : Payback Period of less than 1 Year**

Conclusion of the Review of the Current status of Energy Audits

Problems of expansion of Energy Audit System

Existing Energy Audit System will surely face two hurdles in near future;

1) Number of increase (Energy Audit)

Decrease in Effectiveness while Increase in Energy Audit Fee

2) Economies of Scale (Extending saving amount per unit)

More advanced and costly technologies discourage a user to invest.

Ways to solve the Problems

The followings steps are required to be adopted;

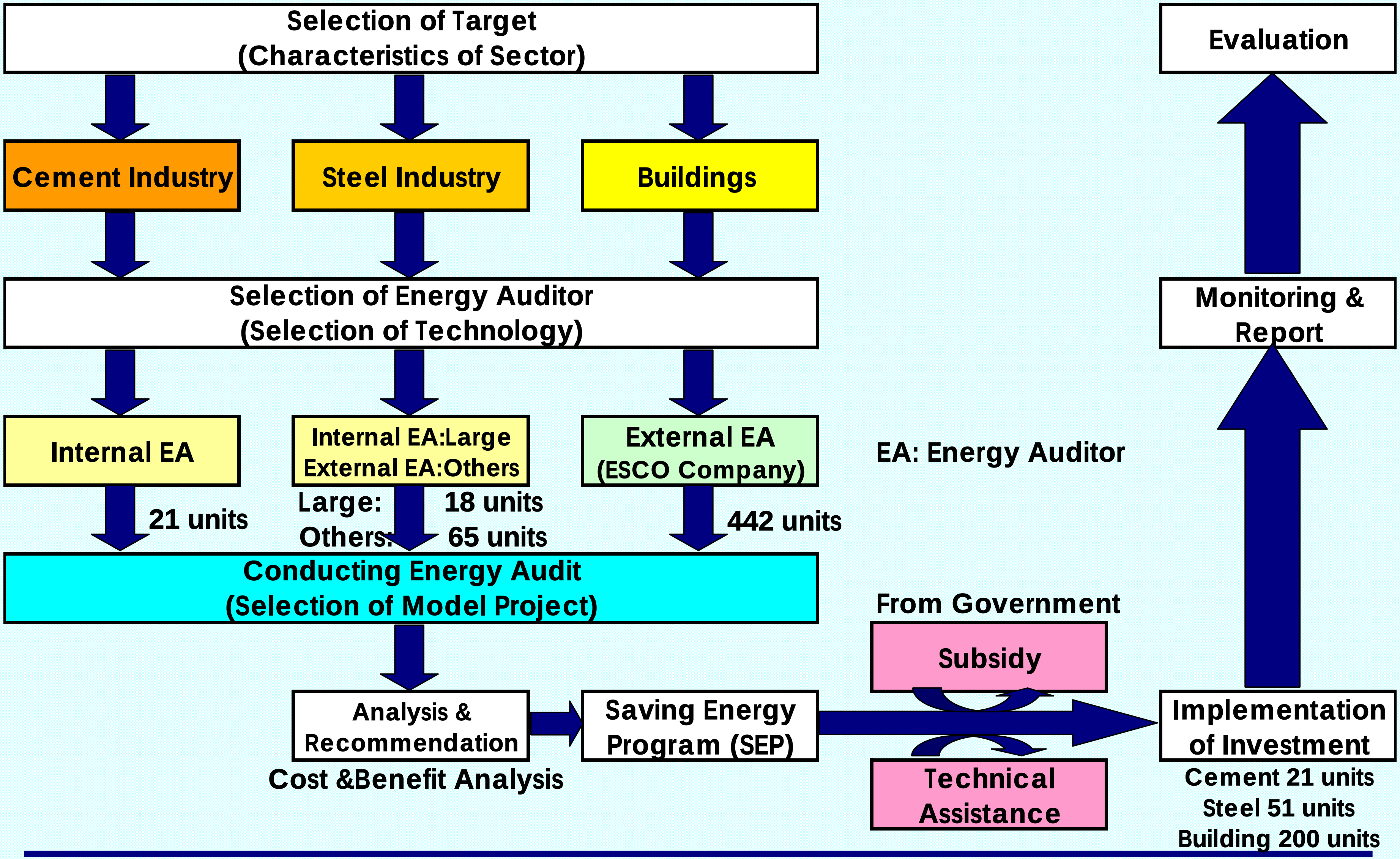
1) Expansion of the Scope covered by the regulation in Building by introducing ESCO Model to Energy Audit System

2) Introduction of technologies of more effective and better performance assisted technically and financially by Government

3. Selection of Model Project for Energy Audit System

(as Analytical Tools for Study and Evaluation on Energy Audit System)

Flow of Implementing Investment on the proposed Model Projects



Characteristics of Selected Sector (1)

- **Cement Industry**

1) Oligopoly : 3 Group (Gresik, Indocement, Holcim) Market Share 90%
2) Robust Demand Growth :39 million ton (2008) to 92 million ton (2025)
3) Continuous expansion of capacity
4) Strong Competitiveness
5) High level of Energy Efficiency: 3,927 MJ/ton-Cement (Top class in the world)
6) CO_2 Emission : 35 million ton (2008) to 79 million ton (2025) – BAU

- **Iron and Steel Industry**

1) Complicated and Heterogeneous Market Structure
   a) 1 National Company :
      Direct Reduced Iron (DRI) – Rolling (Slab) – Sheet (HRC,CRC)
   b) 5 Private Company Groups + Independents :
      Electric Arc Furnace (EAF) – Rolling (Billet) –Bars
   c) New comers : Induction Furnace – Rolling (Billet) – Bars
2) Strong Price-Busters: Foreign Producers

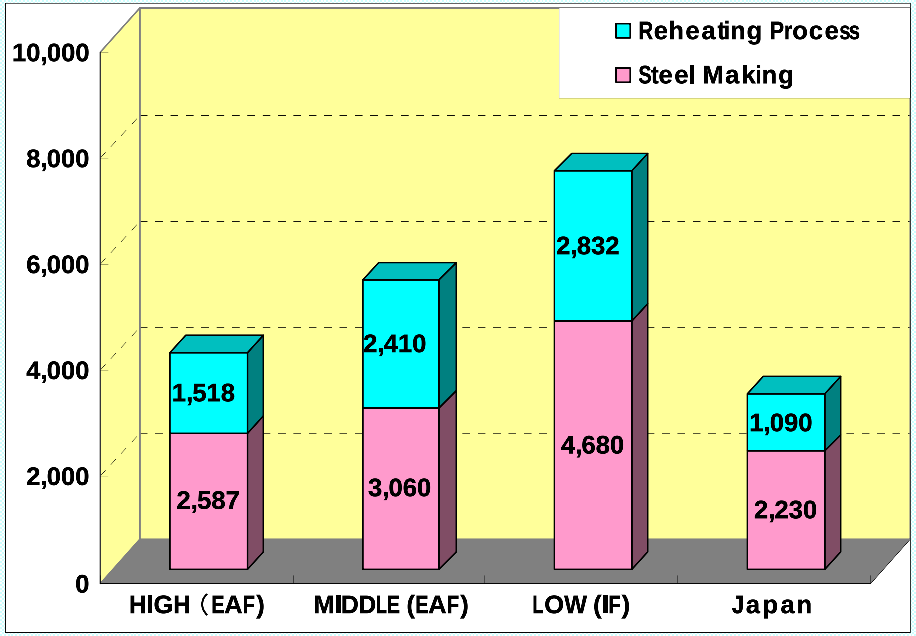
Characteristics of Selected Sector (2)

- **Iron and Steel Industry**

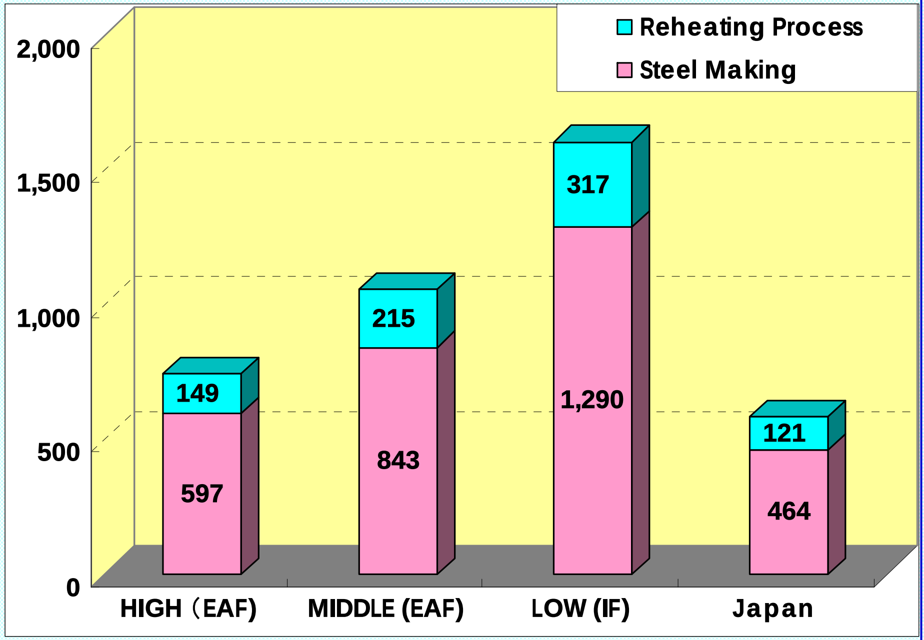
3) Low utilization of plant due to Importation of semi and finished products

4) Big difference in Energy efficiency among companies

Energy Consumption (MJ/ton)



CO2 Emission (kg-CO2/ton)



Note: EAF: Electric Arc Furnace, IF: Induction Furnace

Source : Estimated by IEEJ based on MRI Interim Report (2010)

Characteristics of Selected Sector (3)

- **Buildings**

1) Assessment: Total Stocks (Total Floor Area 47 million m^2 : 2,300 units)

   a) more than 50,000 m^2 (TFA) of Buildings → 10 million m^2 in a total

   b) 30,000 - 50,000 m^2 (TFA) of Buildings → 9 million m^2 in a total

2) Estimation of Energy Consumption and CO2 Emission in a total

Total Floor Area (1,000㎡)	Number of Building (unit)	Total Floor Area per unit (㎡)	Electricity Consumption (kWh/㎡,y)	CO2 Emission (1,000 ton)
47,000	2,300	20,000	170*	7,800

Source : EMI Report

* Estimation is based on the results of EMI Energy Audit (2007-2008)

Total floor area (㎡)	Number of Building	Total floor area per unit (㎡)	Energy Consumption		Ratio of Saving Energy
			(toe/unit,y)	(kWh/㎡,y)	
791,207	30	26,374	386	170	17.8%

Source : EMI Report

Selection of Technology for Model Project (1)

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Cement Industry

1) The current level of energy efficiency is high.

2) The following 3 options are considered for further energy saving.

Criteria of Selection

Technological Options	Experience in other countries	External Constraints	Applicable to other sectors	Cost and Benefit (EIRR)
Alternative of Fuel (Biomass)	EXCELLENT	INAPPROPRIATE (Needs for building of supply infrastructure)	GOOD	FAIR
Blended Cement	EXCELLENT	FAIR （Constraint of material availability)	INAPPROPRIATE (Specified to Cement sector)	GOOD
Self power produced by Waste Heat Recovery	EXCELLENT	GOOD (Stand Alone)	EXCELLENT	EXCELLENT (including Avoided Cost of PLN)

Selection of Technology for Model Project (2)

Iron and Steel Industry

Criteria of Selection

	Technological Options	Experience in other countries	External Constraints	Applicable to other sectors	Cost and Benefit (EIRR)
Steel Making	Scrap Preheater	EXCELLENT	GOOD	INAPPROPRIATE (Specified to Steel sector)	GOOD
	Oxygen Lancing	EXCELLENT	FAIR (Needs for availability of Oxygen)	INAPPROPRIATE (Specified to Steel sector)	FAIR
	Ladle Preheater	EXCELLENT	GOOD	INAPPROPRIATE (Specified to Steel sector)	GOOD
Rolling	Hot Charge of Billets	EXCELLENT	FAIR (Needs for adjustment of production process)	INAPPROPRIATE (Specified to Steel sector)	EXCELLENT
	Regenerative Burners	EXCELLENT	EXCELLENT (only Replacement)	EXCELLENT	EXCELLENT

Buildings : Introduction of a new type of AC (Chiller) with COP 4.7

Outline of Model Project (1)
Cement Industry

- Self Power Produced by WHR (Electricity)

1) Energy Audit : Internal Audit 21units (2010-2025)

2) Capacity : 10MW/unit x 21units

(Almost 20% of a total Electricity Consumption)

3) Cost:20 million Rp/kW (Machinery 75%,Construction 25%)

4) Electricity Price :622 Rp/kWh

5) IRR:20%

(Criteria for Investment)

6) Evaluation Period:10 Years

7) CO2 emission reduction:

1.5 million ton, or 1.9%

compared to BAU (2025)

Outline of Model Project (2)
Iron and Steel Industry

- **Regenerative Burners (Heat)**

1) Reheating Furnace in Rolling Process
2) Energy Audit : Internal Audit 18units (Large size factory)
   External Audit 65units (Mid-size factory) (2010-2025)
3) Capacity : 300,000 ton/year per unit (12 pairs) :Large size factory
   50,000 ton/year per unit (2 pairs) :Medium size factory
4) Cost: 33 billion Rp/12 pairs, 5 billion Rp/2 pairs
5) Oil Price : 5,760 Rp/L (Gas Price: 1,960 Rp/L oil equivalent)
6) Saving Energy : 30%
7) IRR:20%
   (Criteria for Investment)
8) Evaluation Period:10 Years
9) CO_2 emission reduction :
   0.33 million ton
   compared to BAU (2025)

Outline of Model Project (3)
Buildings

- <u>Replacement of Air Conditionings</u> (Electricity)

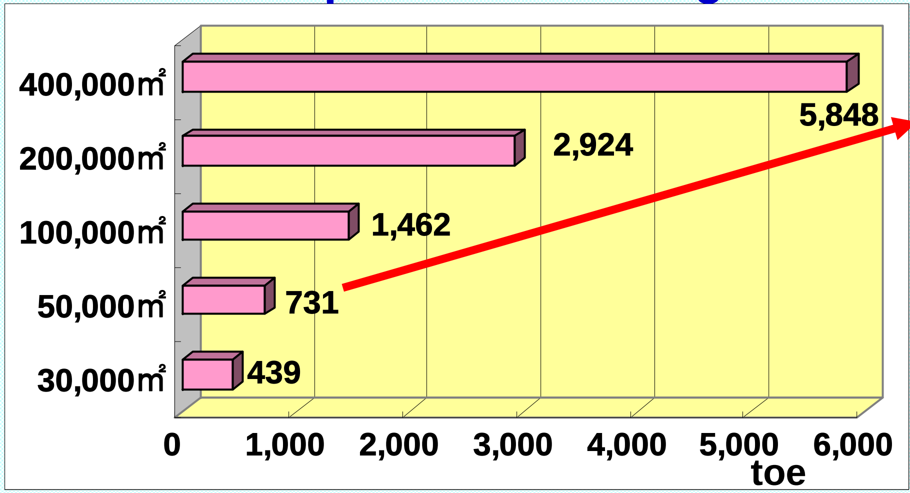
1) Energy Audit : External Audit 442 units (2010-2025)
(TFA 30,000m² - 50,000m²: 242 units, TFA 50,000m² - : 200 units)
2) Capacity : 4.2 MW/unit (TFA 50,000m² per unit) x 200 units
3) Cost:10 billion Rp (COP 4.7 of Chiller from COP 2.0 of old one)
4) Electricity Price :850 Rp/kWh
5) IRR:20%
(Criteria for Investment)
6) Evaluation Period:10 Years
7) CO_2 emission reduction:
0.47 million ton (2025)
8) ESCO Model introduction

4. Proposal for Expansion of Energy Audit System

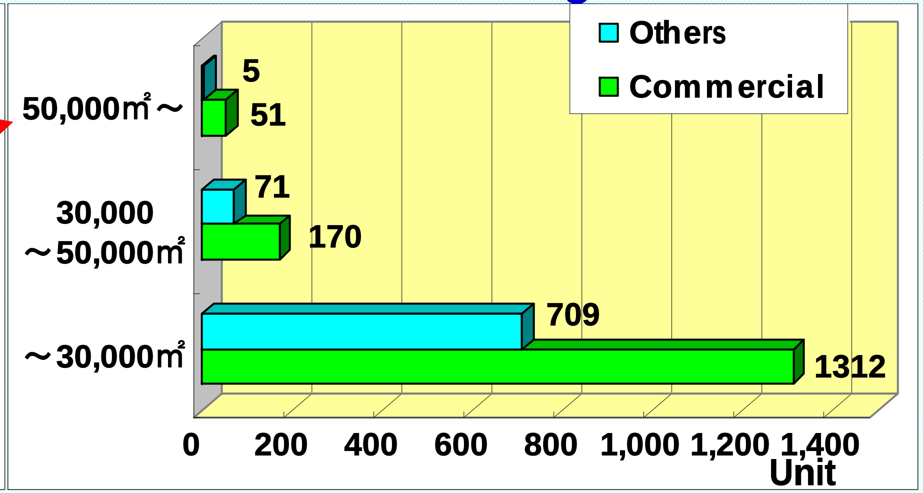
(as for implementation of the proposed Model Project)

Proposal for Expansion of the Target covered by the regulations in Building

Relation between TFA and Energy Consumption for Buildings



Relation between TFA and Units of Building



Source : EMI and JICA team joint study, TFA: Total Floor Area

- The building that annually consume more than 6,000 toe of energy (Article12) corresponds to nearly 400,000㎡(TFA) and almost all buildings have less than 50,000㎡ (TFA).
- In order to further energy saving in Buildings, the target of Energy Audit is required to be expanded down to 50,000㎡ (TFA), 700 toe per year.

Proposal for Demarcation of Energy Manager and Energy Auditor, and Introduction of ESCO

	Energy Manager	Enegy Auditor			ESCO Company
		External		Internal	
		GRADE A	GRADE B		
Highly advanced technology (linked to production process)	Not Required	Required	Not Required	Required	Not Required
Conventional technology for Saving Energy	Not Required	Required	Required	Required	Required
Basic knowledge for Saving Energy Management	Required	Required	Required	Required	Required

1) Demarcation between Energy Manager and Energy Auditor

2) Skill required to Energy Auditors can be divided into 2 grades (A and B).
Grade A: Advanced technologies, Grade B: General technologies

3) Internal Auditors as Grade A must be more familiar with specific energy saving technology in each sector.

4) There is in need for capacity building of External Auditor for Grade A.

5) Introduction of ESCO can reduce manpower and administration costs of the government. .

Selection of type of Energy Auditor on Model Project

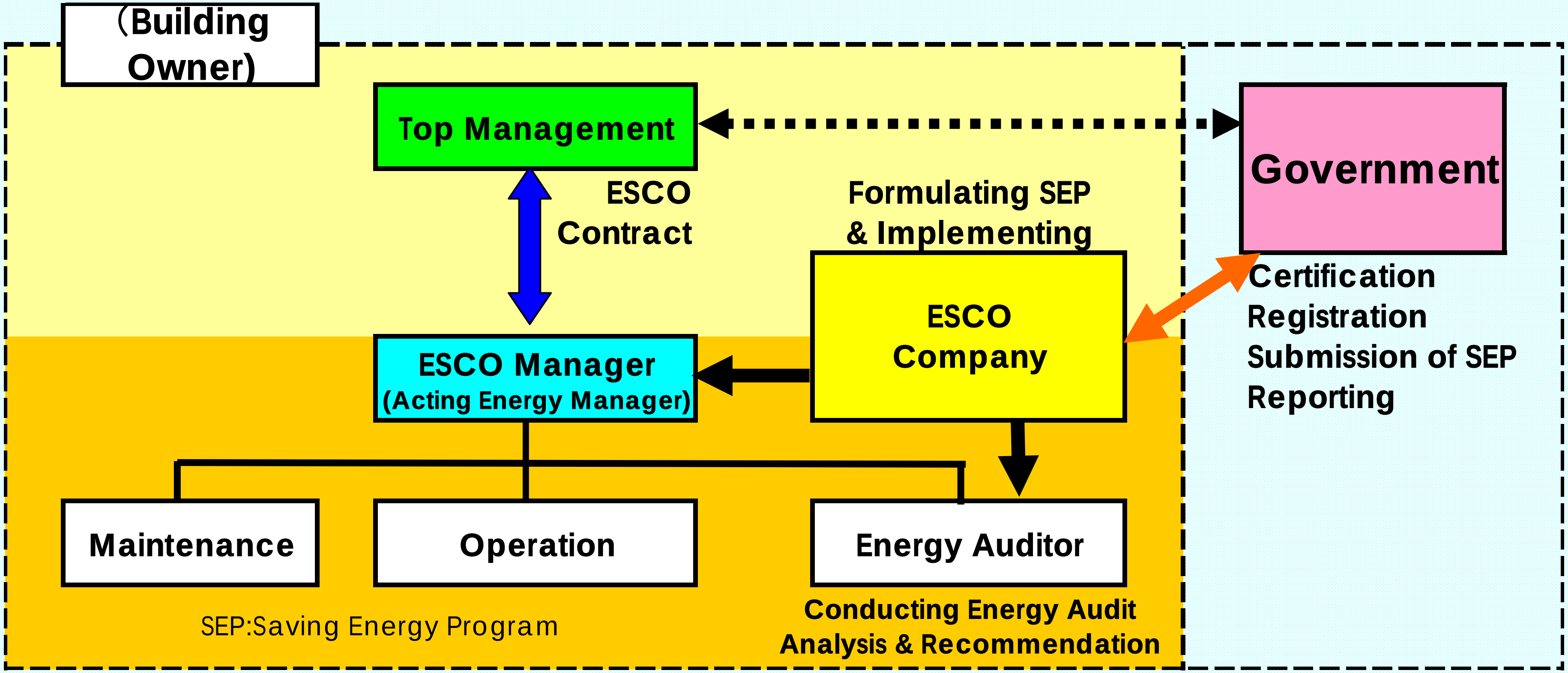
Required Skills and Capability for Saving Energy (at the moment)

	Cement Industry	Steel Industry			Building Owner
		Large Company	Medium Company	Small Company	
Highly advanced technology (linked to production process)	Sufficient	Sufficient	insufficient	insufficient	insufficient
Conventional technology for Saving Energy	Sufficient	Sufficient	Case by case	insufficient	insufficient
Basic knowledge for Saving Energy Management	Sufficient	Sufficient	Sufficient	Case by case	Case by case

Selection of type of Energy Auditor on Model Project

	Energy Manager	Enegy Auditor			ESCO Company
		External		Internal	
		GRADE A	GRADE B		
Cement Industry	Available	-	-	Available	-
Steel Industry	Available	Dependent	-	Available	-
Building Owner	-	-	-	-	Dependent

Proposal for Introduction of ESCO Model in Energy Audit system



Introduction of ESCO can save Government "Manpower and Cost" by granting the qualification of Acting Energy Manager and Energy Auditor to an ESCO company.

Proposal for Creation of a specified foundation for Saving Energy

Required Function

1) Support for Technology and Subsidy in Investment :"NEDO"

2) Capacity building for Energy Auditor : "NEDO" + "ECCJ"

3) Public Awareness through Education and Seminar: "ECCJ"

4) Arrangement for Financial Scheme in support of ESCO and Investor :"Revolving Fund"

NEDO: New Energy and Industrial Technology Development Organization

ECCJ: The Energy Conservation Center, Japan

Revolving Fund: Like The Energy Efficiency Revolving Fund in Thailand

5. Cost and Benefit Analysis

(regarding Government Incentives based on Model Project)

Cement Industry
Self Power Produced by WHR (Electricity)

1) Capacity : 10MW/unit x 21units

(Almost 20% of a total Electricity Consumption)

2) Cost:20 million Rp/kW (Machinery 75%,Construction 25%)

3) Electricity Price :622 Rp/kWh

4) IRR:20%

(Criteria for Investment)

5) Evaluation Period:10 Years

6) CO_2 emission reduction:

1.5 million ton, or 1.9% compared to BAU (2025)

Conditions for Investment for Self Power Produced by WHR

Conditions

- Electricity Price from PLN: 622 Rp/kWh (for Industrial)
- Import Duty:10%, Corporate Tax:32%
- Discount Rate:15%
- Production of Electricity:69,920MWh/unit・Year

Subsidy in Electricity Prices for PLN (at the current)

Subsidy: 529 Rp/kWh (at user)

Breakdown

- **Deficit: 430Rp/kWh**

Sales Price	:	622 Rp/kWh (for Industrial)
Production Cost	:	1,052Rp/kWh (at Power Station)
Deficit	:	430Rp/kWh

- **Transmission Loss: 99Rp/kWh**

IRR in a Cement company for Investment for Self Power Produced by WHR

CASE1 (Electricity Price = 622 Rp/kWh without Subsidy for Investment)

Government + PLN

A company

IRR = 9.3%

Same as the current status

- No Implementation of Investment (insufficient profitability)
- No CO_2 Reduction
- No Change of Competitiveness

CASE2 (Electricity Price = 622 Rp/kWh with Subsidy for Investment)

Government

PLN

Investment Subsidy 90 billion Rp/10Years

A company

IRR = 20.0%

- Investment is implemented
- CO_2 emissions are reduced
- Competitiveness is improved

CASE3 (Electricity Price = 1,151 Rp/kWh without Subsidy for Investment)

Government

PLN

Additional cost from higher electricity price

A company

IRR = 23.4%

- Investment is implemented
- CO_2 emissions are reduced
- Competitiveness is deteriorated (due to higher electricity price)

Comparison of IRR of Each Party (with Subsidy for Investment)

Case2: 1 Unit (10MW) for 10 Years

EIRR = 33.6%

CO_2 Reduction: 0.7million ton/10Years

Saving Subsidy in Electricity Price

Government + PLN

IRR = 57.2%

370 billion Rp/10Years

90 billion Rp/10Years

A company

IRR = 20.0%

Subsidy in Investment

No Change for Electricity Price

90 billion Rp of Subsidy leads to IRR 20.0% as a Company.

- **Government can provide a Company with 90 billion Rp of Subsidy from subsidies saved by saving electricity (370 billion RP) in case of Investment for Self power produced by WHR.**
- **The review of electricity price and subsidies for energy efficient technology need to be in a package of policies: gradual increase of price should result in gradual decrease of subsidies for energy efficient technology.**

Iron and Steel Industry (Rolling Process)
Regenerative Burners (Heat)

1) Capacity : 300,000 ton/year per unit (12 pairs) x 18 units :Large size factory

50,000 ton/year per unit (2 pairs) x33 units :Medium size factory

2) Cost: 33 billion Rp/12 pairs, 5 billion Rp/2 pairs

3) Oil Price : 5,760 Rp/L (Gas Price: 1,960 Rp/L oil equivalent)

4) Saving Energy : 30%

5) IRR:20%

(Criteria for Investment)

6) Evaluation Period:10 Years

7) CO_2 emission reduction :

0.33 million ton

compared to BAU (2025)

PT GUNUNG GARUDA

Cash Flow and IRR in a Steel company for Investment for Regenerative Burners

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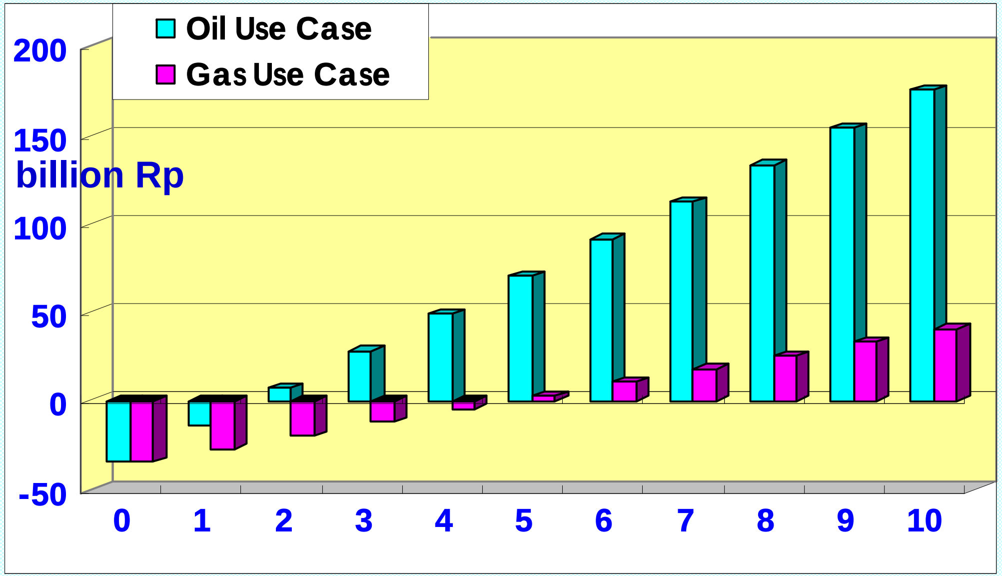
Cash Flow (Accumulated)



IRR

- **Oil Use Case: IRR = 59.9%**
  (Oil Price = 5,760Rp/L)
  No option for Financial Support

- **Gas Use Case: IRR = 17.2%**
  (Gas Price = 1,960Rp/L Oil Equivalent)
  Similar scheme of subsidy
  as Self Power Produced by WHR,
  but at a smaller scale, is needed.

- A company can implement this project with some technical assistance from outsiders.
  (In addition, at an early stage there are some subsidies required.)
- Regenerative Burners can give much contribution to reducing more than 30%of Oil.
- When using Gas burners, it is as a strong tool for Oil alternatives.

Profits and Savings of Foreign Currencies
(in case of introduction of "Regenerative Burners")

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billion Rp/10Years

<Before>

Imported Oil Cost (288) → Domestic Transportation Cost (13) + Imported Oil Cost (288) → Company's Oil Cost (301)

Pertamina (Indonesia)

Company

<After>

Foreign Currency Savings through reducing use of Imported oil (288) → Company's Merit (231) + Additional cost from the use of regenerative burner (70)

Company (10Years)

Reduction of Oil by 30%

a. Reduction of Purchased Oil:301

b. Additional Cost : 70

(O&M, Depreciation & Interest)

c. Merit : 231 billion Rp (a-b)

- Indonesia can save foreign currencies through reducing oil use as Pertamina has to import Oil Products.

(No deficits are incurred by Pertamina or Government because the price of oil for industrial use is cost-basis and linked to the price at the Singapore Market.)

Buildings
Replacement of Air Conditionings (Electricity)

1) Capacity : 4.2 MW/unit (TFA 50,000m^2 per unit) x 200 units

2) Cost:10 billion Rp (COP 4.7 of Chiller from COP 2.0 of old one)

3) Electricity Price :850 Rp/kWh

4) IRR:20%

(Criteria for Investment)

5) Evaluation Period:10 Years

6) CO2 emission reduction:

0.47 million ton (2025)

7) ESCO Model introduction

Conditions for Investment for replacement to new AC from old ones

Conditions

・Electricity Price from PLN: 850 Rp/kWh (for Commercial)

・Discount Rate:15%

・Reduction Electricity:2,390 MWh/unit・Year

Subsidy in Electricity Prices for PLN (at the current)

Subsidy: 301 Rp/kWh (at user)

Breakdown

・Deficit: 202Rp/kWh

Sales Price : 850 Rp/kWh (for Commercial)

Production Cost : 1,052Rp/kWh (at Power Station)

Deficit : 202Rp/kWh

・Transmission Loss: 99Rp/kWh

IRR in a building owner for Investment for replacement to new AC from old ones

CASE1 (Electricity Price = 850 Rp/kWh without Subsidy for Investment)

Government + PLN

A building owner

IRR = 8.5%

Same as the current status

- No Investment (insufficient profitability)
- No CO2 Reduction

CASE2 (Electricity Price = 850 Rp/kWh with Subsidy for Investment)

Government

PLN

Investment Subsidy
6.4 billion Rp/10Years

A building owner

IRR = 20.0%

- Investment is implemented
- CO2 emisisons are reduced
- Low Interest Loan (subsidy for interest payments) needs to be provided to support the investment

CASE3 (Electricity Price = 1,151 Rp/kWh without Subsidy for Investment)

Government

PLN

Additional cost from higher electricity price

A building owner

IRR =17.6%

- No Investment (insufficient profitability)
- No CO2 Reduction
- gradual increase of electricity price is favorable for saving energy

Comparison of IRR of Each Party (with Subsidy for Investment)

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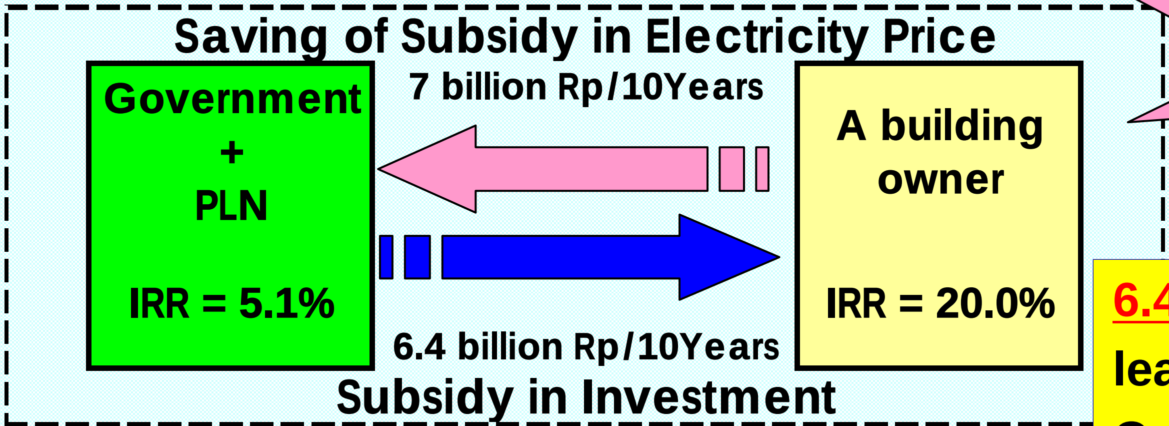
Case2: 1 Unit for 10 Years

EIRR = 17.6%

CO_2 Reduction: 22 thousand ton/10Years



No Change for Electricity Price

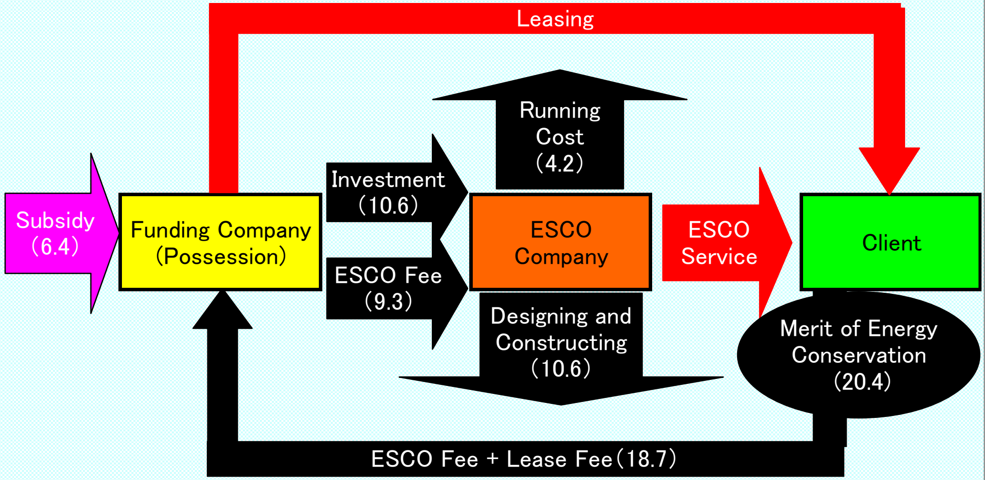
6.4 billion Rp of Indirect Subsidy leads to IRR 20% as a Building Owner.

- **Government can provide a building owner with indirect subsidy equivalent to 6.4billion Rp (at low interest rate) by saving subsidy in electricity (7.2billion Rp).**
- **The review of electricity price and subsidies for energy efficient technology need to be in a package of policies: gradual increase of price should result in gradual decrease of subsidies for energy efficient technology.**

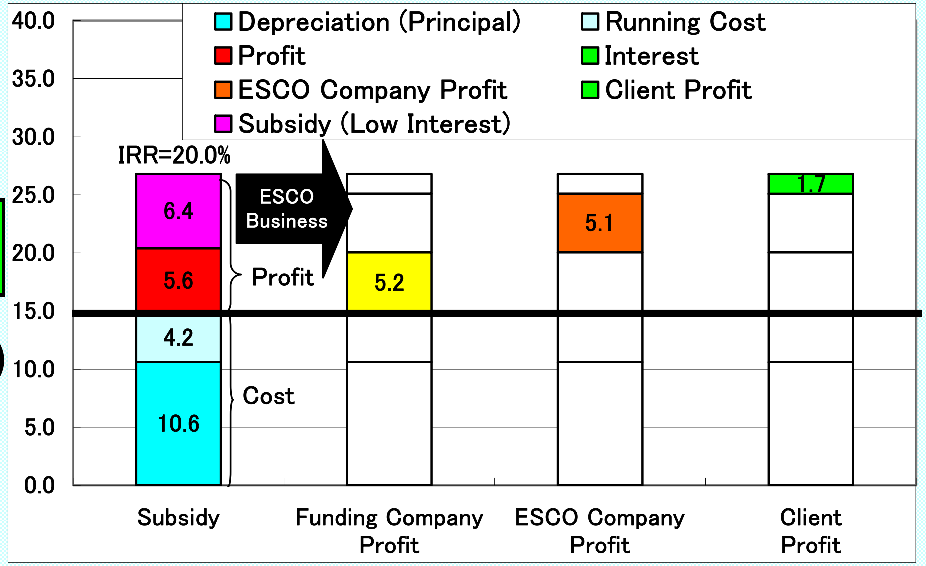
Introducing ESCO Business Model to Commercial Buildings

1Unit (Total Floor Area 50,000m^2) for 10 Years (billion Rp)

ESCO Business Model



Sharing Merits among Stakeholders

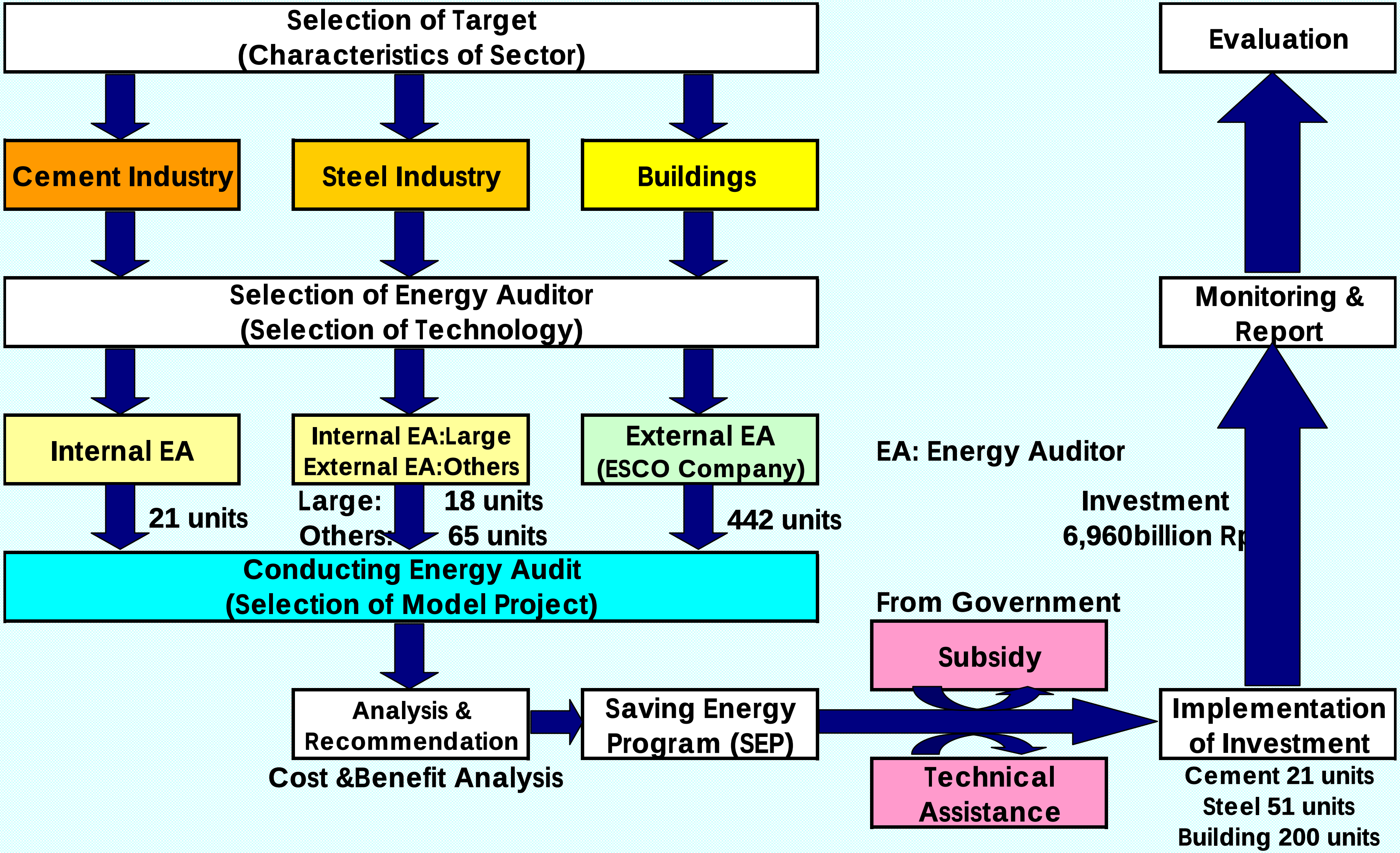


Saving Merit can be distributed to Funding Company (5.2 billon Rp), ESCO Company (5,1 billion Rp) and Client (1.7 billion Rp), respectively, even under the current electricity prices if any financial supports from Government.

6. Mid-term Target

(Expenditure [Incentives] and Return of Government)

Flow of Implementing the proposed Model Project



Mid-term Target of Energy Audit and CO2 Reduction

Mid-term Target

Item		Duration	Target
Conducting Energy Audit	1) Cement Industry	2010-2025	21 units
	2) Steel Industry		83 units
	3) Buildings		442 units
	Total		546 units
CO2 Reduction		2025	2.3million ton/Year

Investment for achieving Mid-term Target

Implementation of Investment	Cement Industry (Self Power Produced by WHR)	2010-2025	21 units
			(4,200 billion Rp)
	Steel Industry (Regenarative Burners)	2010-2025	51 units
			(760 billion Rp)
	Buildings (ESCO Business)	2015-2025	200 units
			(2,000 billion Rp)

Total Investment : 6,960 billion Rp

Re-allocation of the current expenditure by Government

<Evaluation Period:10 Years>

billion Rp

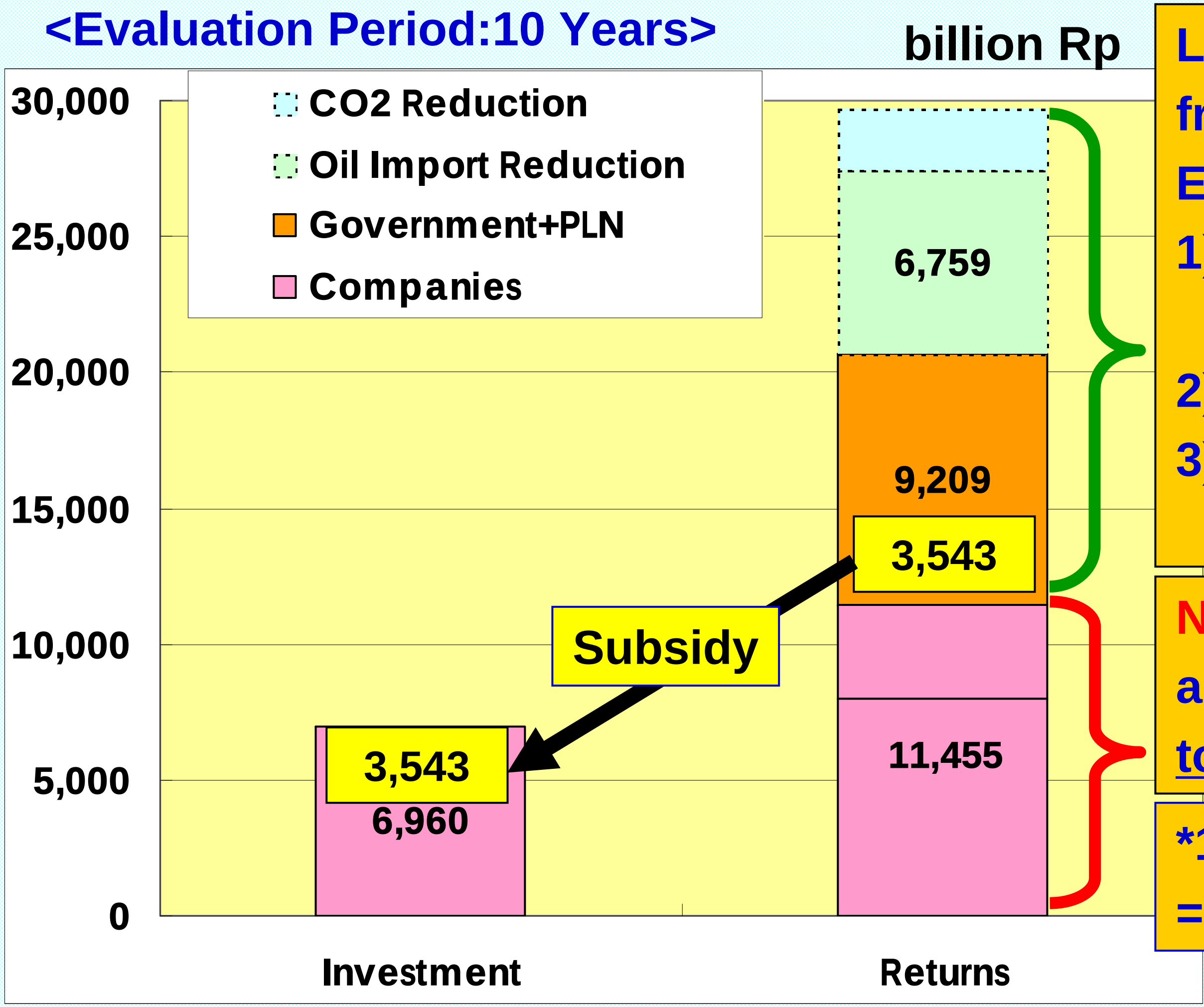
	Without the Project	With the Project
Government Expenditure (Incentives)	BAU	BAU +3,543
Subsidies to PLN	BAU	BAU -9,209
Outgoing Cash flow	BAU	BAU -5,666

		Duration	Amount of Value
Government Expenditure (Incentives)	Fee of Energy Audit	Before decision making	55 billion Rp
	Direct Subsidy	After investing	1,947 billion Rp
	Indirect Subsidy	10 Years in operation	1,280 billion Rp
	Import Duty Exemption	When imported	260 billion Rp
	Total	-	3,543 billion Rp
Return	Saving deficits of PLN (Electricity)	10 Years in Full Operation	9,209 billion Rp

Re-allocating current expenditures can result in 5,666 billion Rp more of fiscal space for Government in 10 years and 2.3 million ton/year of CO_2 reduction.

Effect of the Proposed Model Project (All Indonesia)

<Evaluation Period:10 Years>



Large economic benefit from Subsidy for Energy Efficient Technology

1) Reduction of subsidies to PLN
2) Oil Import Reduction
3) CO2 reduction (2.3 million ton/Year)

No Investment is expected as return on investment is <u>too low*</u> for Companies

*11,455 - Interest[15%] =4,547 billion Rp

7. Conclusion and Next Stage

(for the implementation of the Proposed Model Project)

Conclusion (1)

・Review of Regulation No.70 of November 2009

1) Demarcation between Energy Manager and Energy Auditor
2) Required Skill of Energy Auditor divided into 2 Grades
   (Grade A: Advanced technologies, Grade B: General technologies)
3) Stipulation of ESCO model and Qualification

・Creation of a specialized institution for Saving Energy

Required function : Indonesian “NEDO” + “ECCJ” + ”Revolving Fund”

1) Assistance for Investment and Development regarding Saving Energy
2) Capacity building for Energy Auditor and Energy Manager
3) Public Awareness (Education and Seminar)
4) Arrangement and Development of Financial Scheme

Conclusion (2)

・**Required Capacity Building for Energy Auditor**

・**Investment (2010-2025)**

Actions required

1) Energy Audit : 546 units

2) Investment : 6,960 billion Rp

3) Government Expenditure (investment subsidy) : 3,543 billion Rp

Outcome

1) CO_2 reduction : 2.3 million ton/Year (2025)

2) Profits (Saving Deficits of PLN) : 9,209 billion Rp

Recommendation toward Next Stage

1. Further Study on ESCO Model
2. Detailed Design for Capacity Building and Subsidy Mechanisms
3. Further Study and Planning for Establishment of a new Institution

 # Replication (scaling up) of "Model Project" to the other sectors (Textile, Food and Non metal)