

Japanese Technology Crosses the Borders NEDO's International Biomass projects

NEDO

(New Energy and Industrial Technology Development Organization)

Director General

New Energy Technology Development Department

Fumiaki ISHIDA

November, 2009

<http://www.nedo.go.jp>



Overview of NEDO (1/2)

- Incorporated Administrative Agency under the Ministry of Economy, Trade and Industry (METI) of Japan
- Established: 1980, after the second oil crisis
- Number of personnel: 1,000 (as of Apr. 2008)
- Budget: ¥233 billion (Apr. 2008 ~ Mar. 2009)
(US\$2.5 billion)



Overview of NEDO (2/2)

Main Activities of NEDO :

1. R&D for **industrial, new energy and energy-conservation** technologies
2. Introduction and dissemination for **new energy and energy-conservation** technologies
3. To contribute to the fulfillment of Japan's Kyoto Protocol commitment (acquisition of emission reduction credits through the Kyoto Mechanisms)
4. **International cooperation**



What is NEDO International cooperation?

International Cooperative Demonstration Projects Utilizing Photovoltaic Power Generation Systems (PV Demonstration)



Photovoltaic power generation system technologies, which advance energy and environmental initiatives in Japan and other countries, are being demonstrated in cooperation with host countries that have climatic conditions that differ from Japan's in an effort to improve the durability and reliability of the technologies.



International Projects for Increasing the Efficient Use of Energy (Model Project)

Highly energy efficient technologies that are already commercialized in Japan are introduced into energy intensive industries* of host countries to upgrade existing equipment. The new technologies are then operated at the project sites in host countries to demonstrate their effectiveness and to promote dissemination of the technologies.

(*Iron and steel, oil refining, petrochemical, cement, etc.)

International Cooperative Research Program

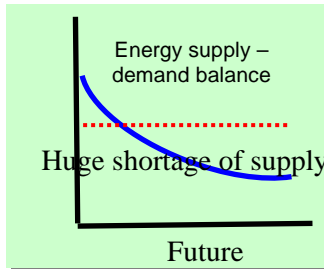
(Cooperative Research)



Cooperative research involves establishing and operating research facilities in counterpart countries, implementing joint research, and inviting foreign researchers to Japan. This program addresses specific issues in technology development and stimulates the indigenous research and development efforts of counterpart countries.

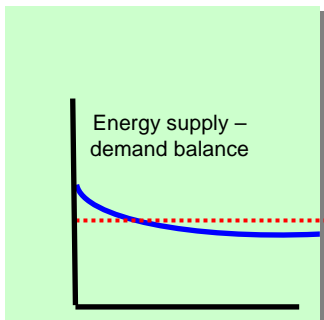
NEDO International project objective

Future prospect

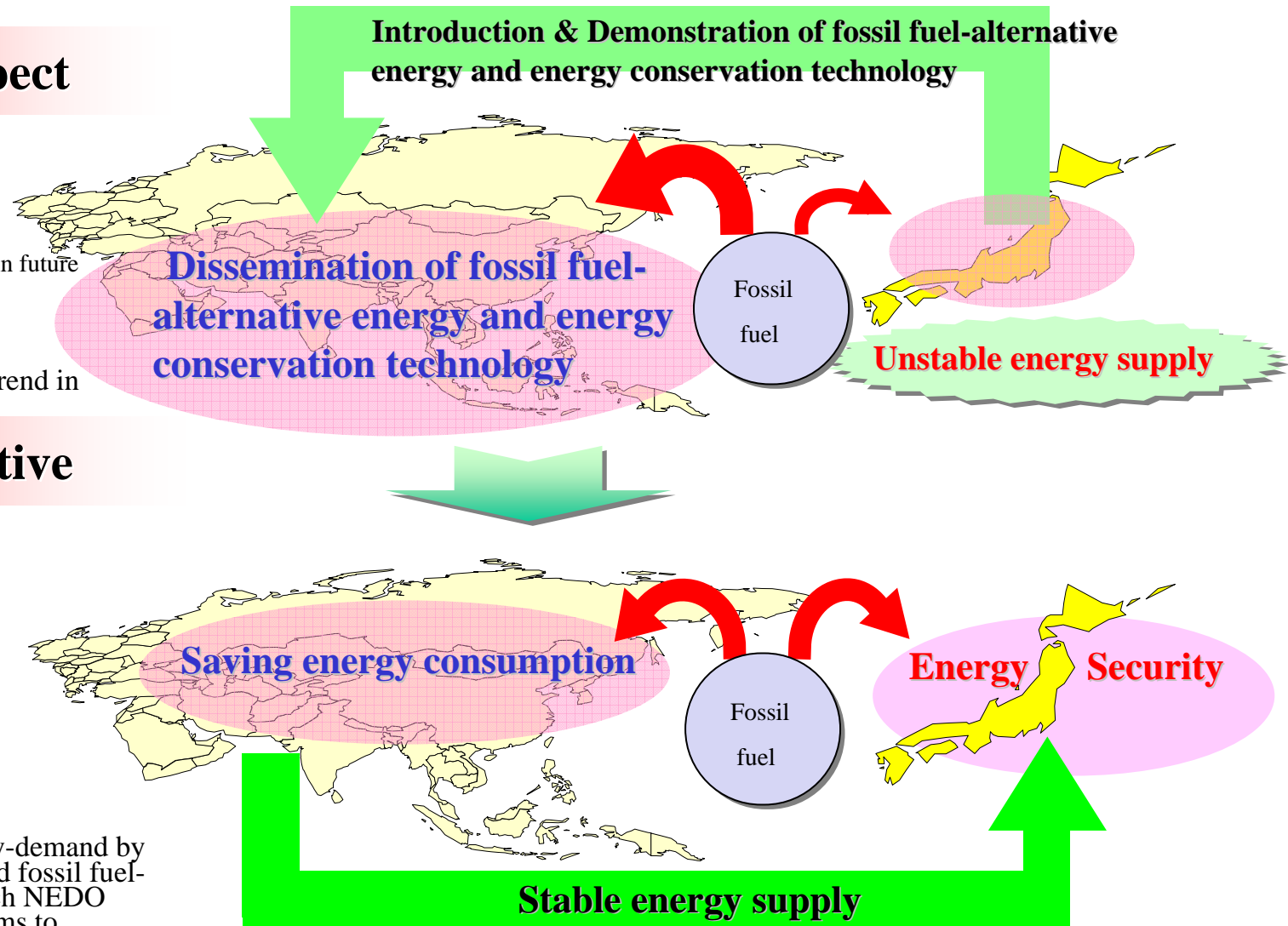


Current energy demand trend in Asia

Project objective

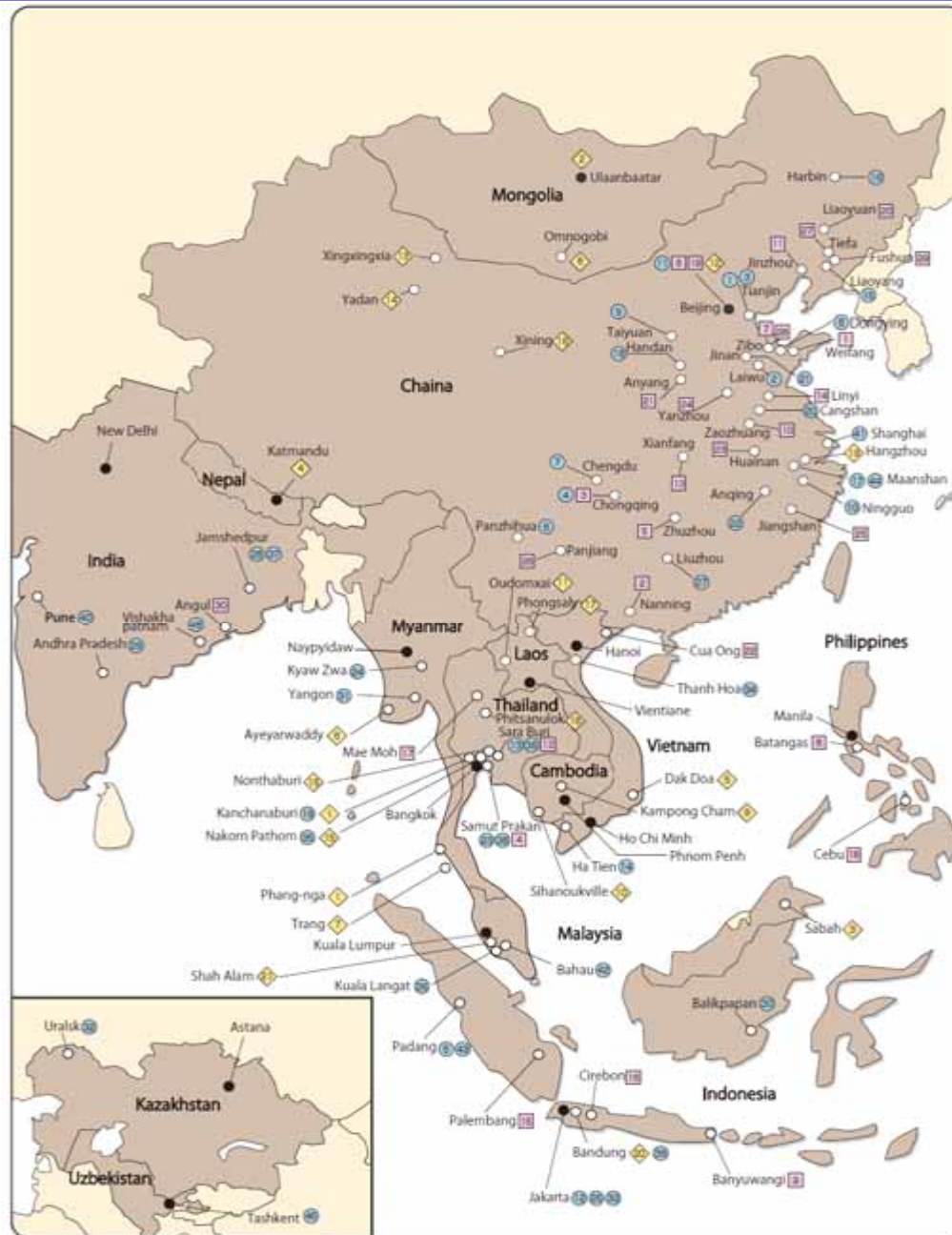


Good balance of supply-demand by saving consumption and fossil fuel-alternative energy which NEDO International project aims to



Implementation Sites

- Concerned with Photovoltaic
2 1 projects (since 1992)
1 . 3 projects(av. yearly)
- Energy conservation
3 4 projects(since 1993)
2 . 1 projects(av. yearly)
- Fossil fuel-alternative energy
8 projects(since 1993)
0 . 5 projects(av. yearly)



International Model Project Fossil fuel-alternative energy

Host country(site Firm) share responsibilities(such as auxiliary equipment, installation)

Project period: Less than 3 years in principle

5 years demonstration after the completion of the project

Totally 8 projects were completed. 1 of 8 is concerned with Bio-Fuel production.

Bio-Fuel production

- Longer payback period compared with project for energy conservation
- Less dissemination potentiality (considering current market mechanism)
- However, become bigger potentiality by Incentive policy and development of laws

1 project under implementation

conversion from Oil to Natural gas

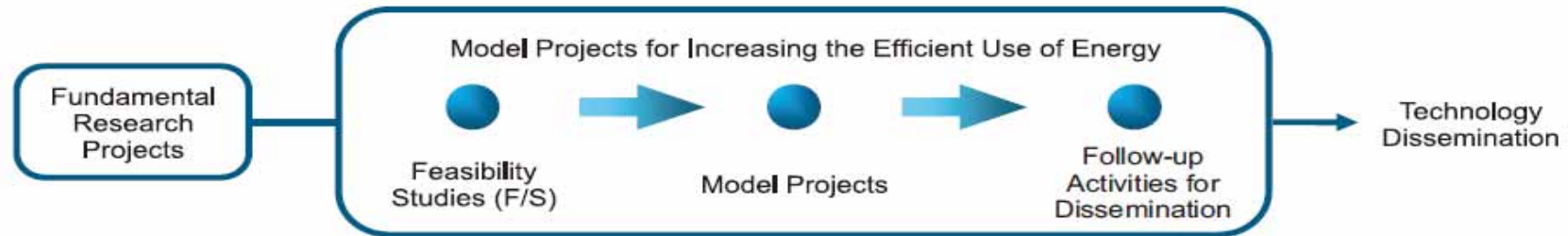
4 projects under feasibility study

3 for direct combustion of industrial waste

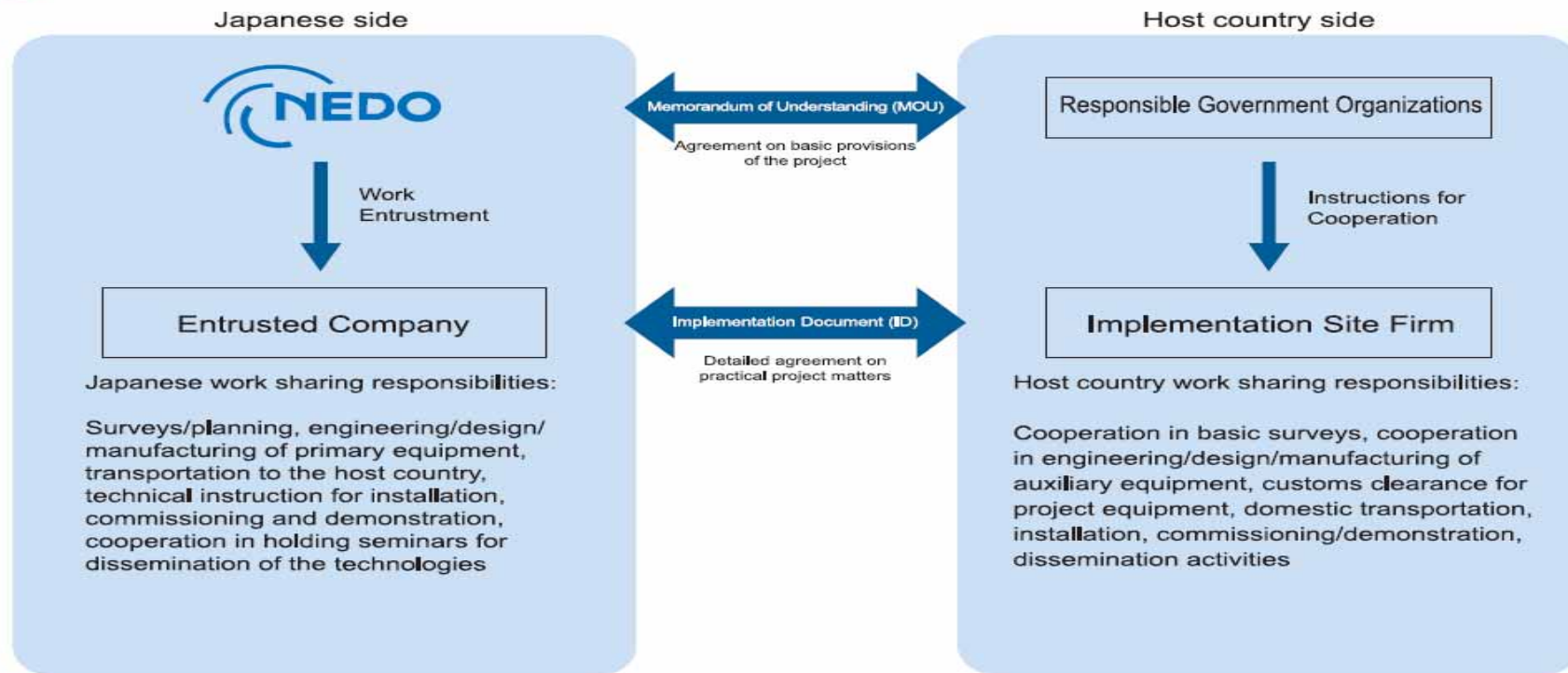
1 for Bio-Fuel production



Procedure and Scheme of International Model Project



3 Project Implementation Scheme



The Model Project for Utilization of Paper Sludge and Solid Waste (1997-2000)

1. Project Overview

In this project, paper sludge and solid wastes discharged during the papermaking process were incinerated in a fluidized bed incinerator and heat generated through incineration was recovered and reused to generate steam.

By incinerating sludge and other wastes that were previously landfilled, the amount of fossil fuel consumed to produce steam was decreased, as were methane emissions from the wastes. Incineration, therefore, drastically reduced the amount of landfilled sludge while simultaneously reducing pollution.

2. Process

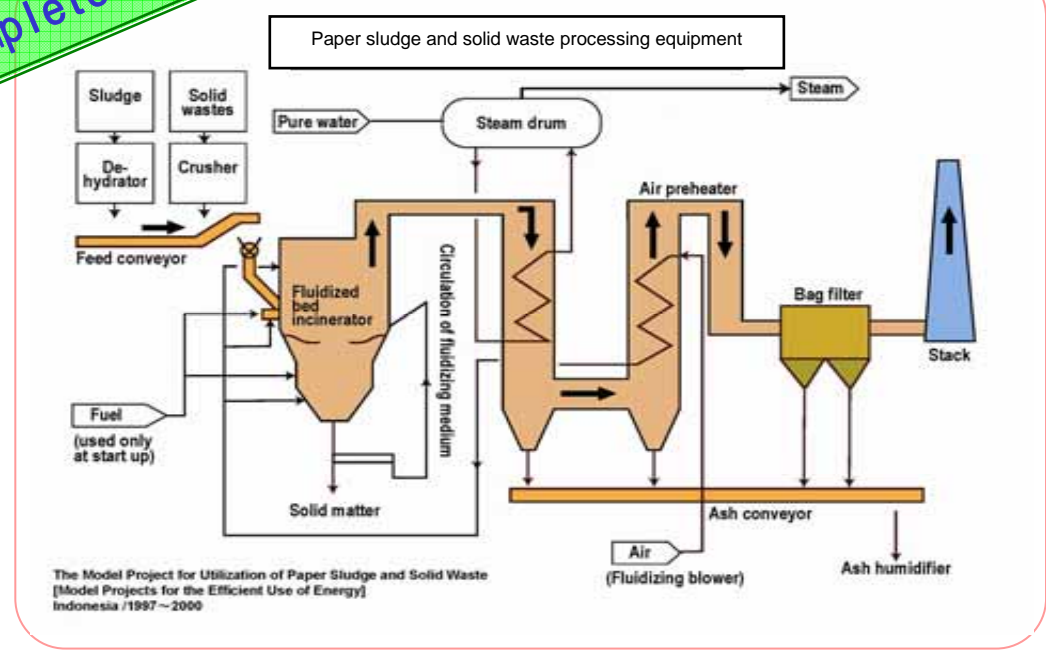
This system was developed for paper mills where paper sludge and other solid wastes discharged from effluent treatment facilities are landfilled on site or in vacant lots nearby. Using a fluidized bed incinerator, sludge and wastes are incinerated instead of landfilled, and combustion gas is generated. Heat extracted from the combustion gas is then recovered in an exhaust heat recovery boiler and used to pre-heat combustion air for the incinerator through an air preheater. Steam is also generated in the boiler and reused in the papermaking process.

Country	Indonesia
Entrusted company	Babcock-Hitachi K.K.
Implementation site	PT. Fajar Surya Wisesa Tbk.
Counterpart	Ministry of Industry and Trade
Energy conservation effect	Oil equivalent: 9,000 t/yr*
GHG emission reduction	CO ₂ equivalent: 23,000 t/yr*, Methane: 3,200 t/yr*
Cost (NEDO portion)	1.12 billion yen (900 million yen)

Completed

3. System Flow

*According to design



The Model Project for Ethanol Production from Molasses and Bagasse in the Sugar Factory in Thailand (2006 ~ 2007)

1 . Project Out.line

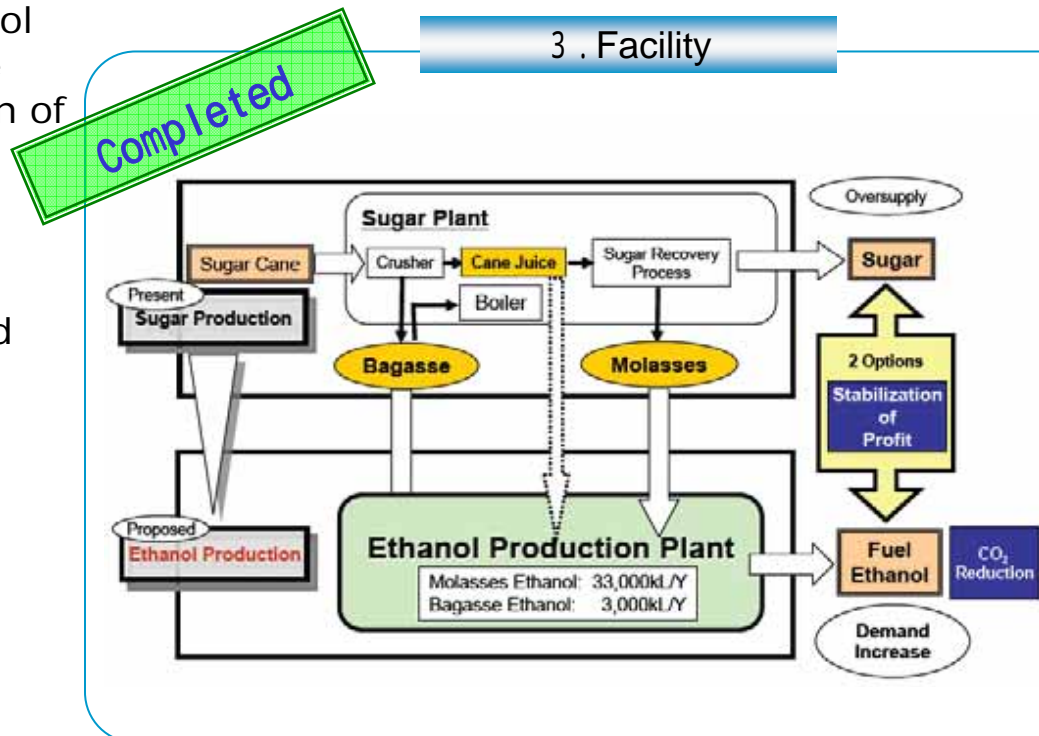
- This project introduces ethanol manufacturing technology to a sugar refinery in Thailand, where the sugar industry is one of the key domestic industries, with the aim of upgrading the sugar/ethanol production processes at the refinery.
- The introduction and utilization of ethanol for fuel is being actively promoted by the Government of Thailand, as the utilization of ethanol reduces fossil fuel consumption.

2 . Outline of Process

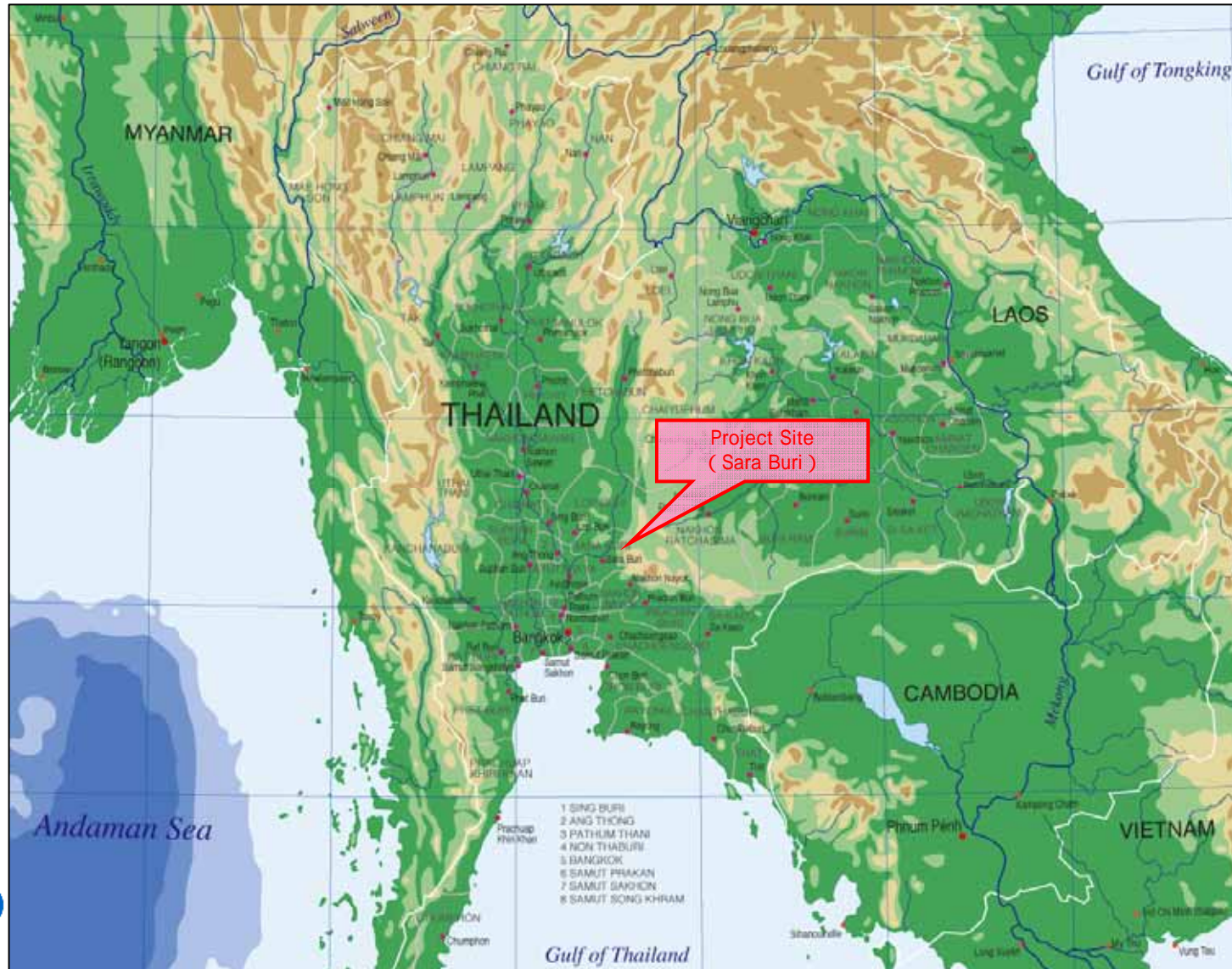
- 1) A repeated batch fermentation method with agglomerated yeast developed in Japan is being used to produce ethanol from molasses.
- 2) A recombinant E. coli, 'KO11', which can convert C₅ sugars into ethanol, is being used to produce ethanol from bagasse.

Host Country	Thailand
Project Site	Thai Roong Ruang Energy Co., Ltd.
Counterpart	Office of the Cane and Sugar Board, Ministry of Industry
Energy Conservation	18,400 toe/y
GHG Reduction	54,600 t-CO ₂ y


3 . Facility



Project Site

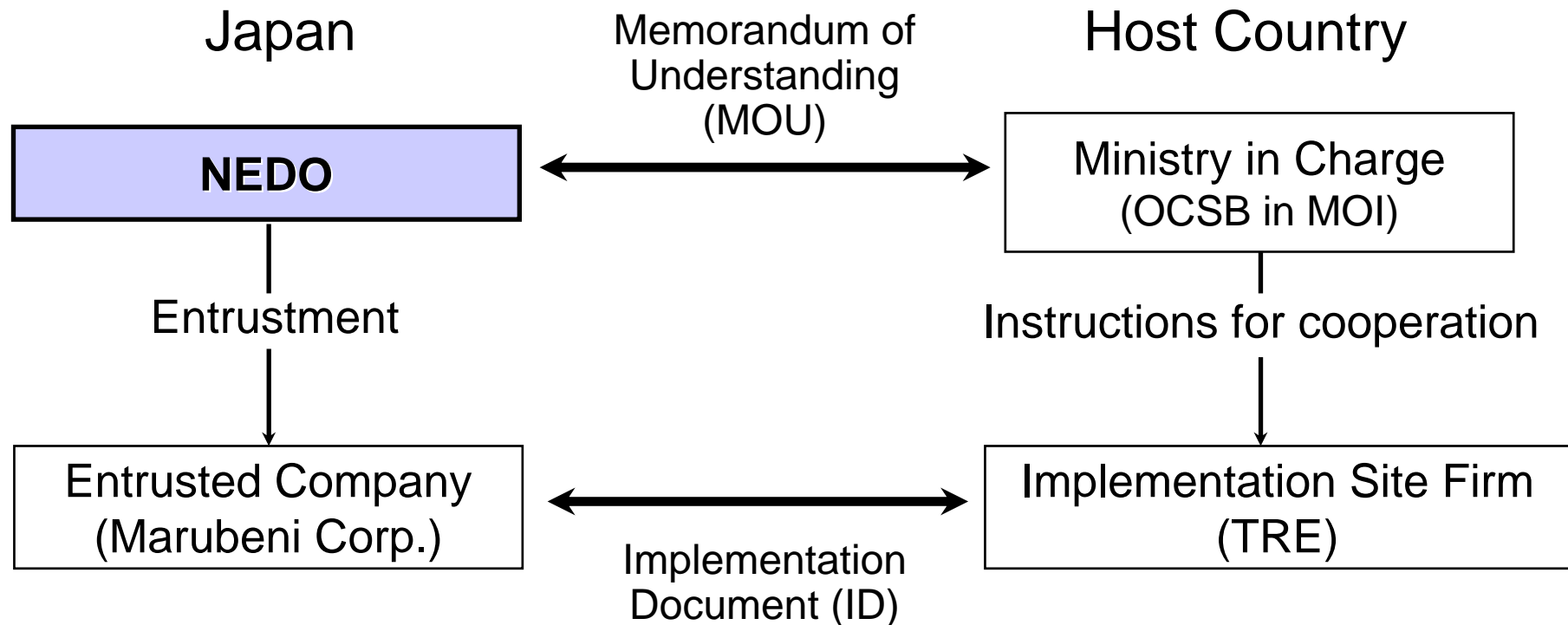


Fuel Ethanol Policy in Thailand

Country	Situation	Raw Material								
<p>Thailand</p>	<ul style="list-style-type: none"> ● Thai government has introduced E10 (Gasohol 91, 95), E20 and E85, and subsidized such prices with the tax exemption in oil-related taxes. (The price of E20 is BHT6.0/L lower than the premium gasoline.) ● Due to this Thai government's policy, the demand for fuel ethanol is expected to increase, and the ethanol production is spread mainly by the sugar companies. ● Approx 4,000 service stations (18,400 in total) have started the sales of gasohol. Total consumption amount of E10, E20 and E85 is currently 12.58 mil L/D. (1.246 mil L/D of fuel ethanol is required.) <table border="1" data-bbox="562 1137 1711 1278"> <thead> <tr> <th></th> <th>2004</th> <th>2005</th> <th>2006</th> </tr> </thead> <tbody> <tr> <td>E10 Gasohol Consumption</td> <td>59,600kL/Y</td> <td>674,900kL/Y</td> <td>1,279,300kL/Y</td> </tr> </tbody> </table>		2004	2005	2006	E10 Gasohol Consumption	59,600kL/Y	674,900kL/Y	1,279,300kL/Y	<p>Sugar Cane</p> 
	2004	2005	2006							
E10 Gasohol Consumption	59,600kL/Y	674,900kL/Y	1,279,300kL/Y							

Implementation Framework of Model Project

Parties involved and conclusions of MOU, Agreement and ID



Outline of Project

Sugar production is a key industry in Thailand. The object of this project is fuel ethanol production from molasses and bagasse in the sugar factory. Molasses is a byproduct of the sugar refining process. And bagasse is the underutilized residue of the sugar cane.



Molasses

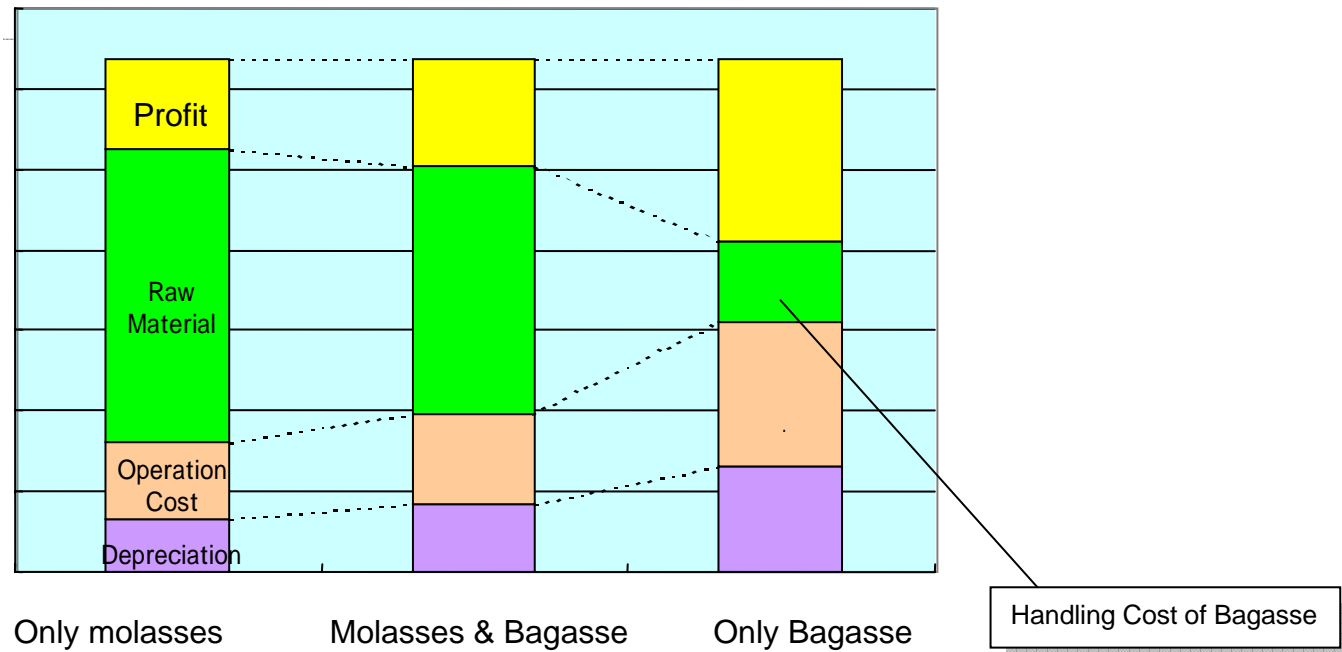


Bagasse

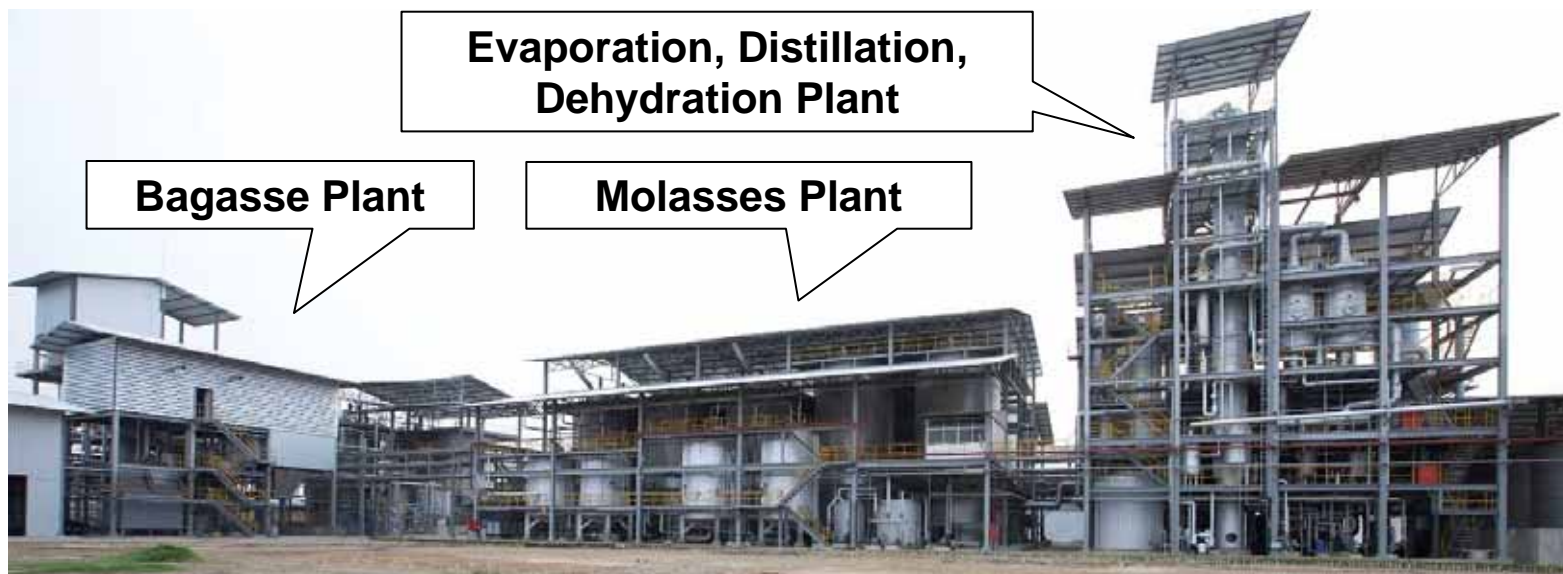
Effects of Bagasse-to-ethanol Process

Process	Merit	Demerit
Molasses-to-ethanol Process	Plant Cost is lower.	Raw material cost fluctuates.
Bagasse-to-ethanol Process	Raw material cost is stably low.	Plant cost is higher.

Break-down of Ethanol Production Cost



Picture of Plant



[Introduction Effect of Equipment]

Energy Saving Effect : 18,400 toe/y

GHG Emission Reduction : 54,600 t-CO₂/y



Opening Ceremony
(Left : MOI Minister,
Right : President of NEDO)

Main Equipment

Bagasse Feed Conveyor



Bagasse Washer



Continuous Belt Washer for Sugar Recovery



Hydrolysis Percolator



Bagasse Fermentor



Main fermentor ; 350m³ 2sets
Storage tank ; 350m³ 1set



International Cooperative Research Program

Research Period Maximum 2 years

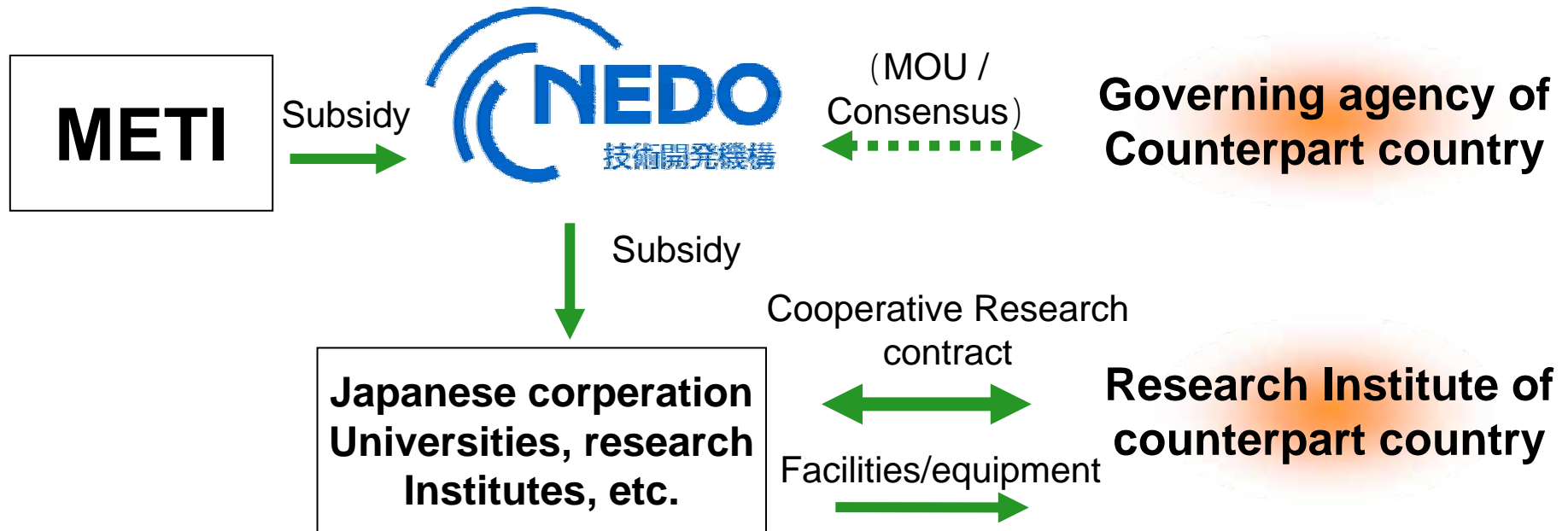
For fossil fuel-alternative energy

2007 Adopted 1 project	for Bio-fuel production
2008 Adopted 5 projects	1 for efficient use of Bio-fuel 1 for Methane co-Fermentaion 2 for Bio-fuel production 1 for Photovoltaic evaluation
2009 Adopted 5 projects	1 for gasification of wood tip 3 for Bio-fuel production 1 for μ smart-gird



Research of Bio-fuel production mainly from non-eatable material

Scheme of International Cooperative Research Program



Cooperative Research Consortium

- Research Implementation site
- Researcher
- Role
- Intellectual property



The Cooperative Research Program “Development of an Efficient Process for Production of Fuel Ethanol from Soft Biomass (2008 ~ 2009)”

1 . Objective

The world has been focused on the production of fuel ethanol from biomass. Starchy materials and saccharide compete with foods, so the objective of this project is to develop the production technology of fuel ethanol from cellulosic materials.

2 . Project outline

Bench plant is constructed to research and development ethanol production process by cone stover with saccharification by concentrated sulfuric acid and continuous fermentation.

3 . Novelty of Technology

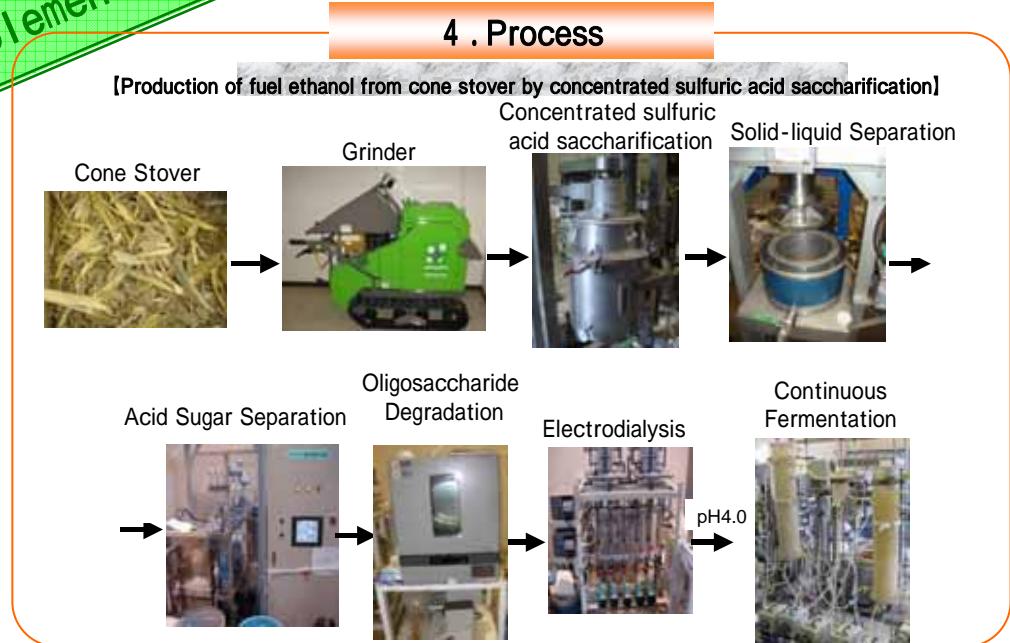
- Simultaneous operation of methane fermentation of distilled waste water and desulfurization, and use biogas from the methane fermentation for distillation energy, besides reuse of the effluents
- Development of coherent yeast which has simultaneous fermentation of glucose and xylose



Host Country	China
Research Period	2 years
Contact Grant	Kumamoto University
Collaborating Institution	Beijing University
Expected Result	Development of zero-emission type of the production process of fuel ethanol, which the energy balance is high.

Under Implementation

4 . Process



The cooperative research program “Development of Technology to produce Ethanol from unused agricultural Cellulosic Biomass in Indonesia(2008)

1 . Objective

The Project aims to develop Ethanol production technologies from EFB(Empty Fruit Bunches) by saccharification technology (Hydrothermal treatment and Enzymatic saccharification) which MHI has been developing in Japan under Joint Research with NEDO.

In addition, effectiveness to make fertilizer from fermentation residue and case study for business structure was verified.

2 . Project outline

Saccharification liquid was made in Japan by EFB delivered from Indonesia with Hydrothermal treatment and Enzymatic saccharification. And the Saccharification liquid was fermented in both Indonesia and Japan to develop Ethanol production technologies.

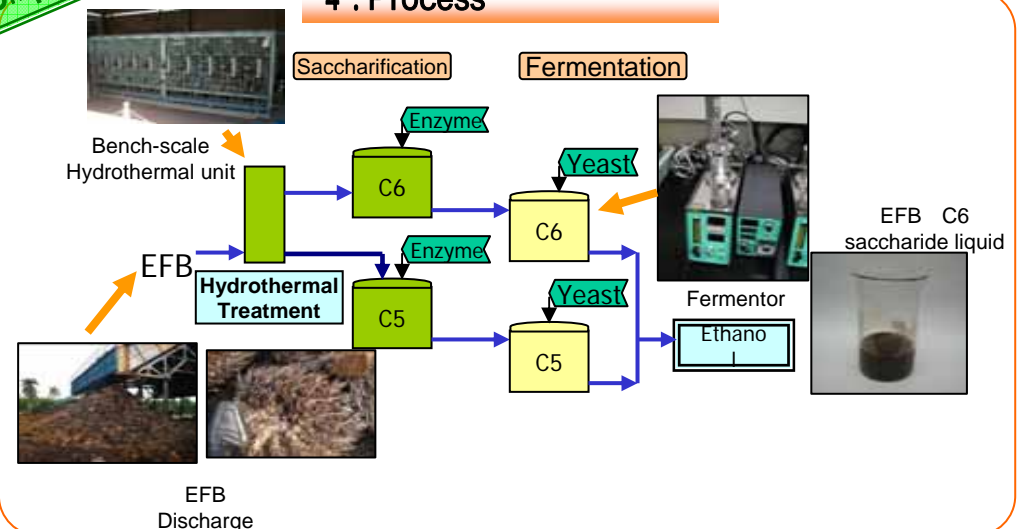
3 . Technical topics

It is first time to research and develop ethanol production technologies by EFB with Hydrothermal treatment and Enzymatic saccharification. In addition, it is possible that residue can be used as fertilizer since no chemical material is used in this process.

Counterpart country	Indonesia
Research period	1 year
Japanese Corporation	Mitsubishi Heavy Industries , Ltd (MHI)
Research Institute of counterpart country	Center for Energy Resources Development Technology(BPPT)
Expected result	It can contribute to Ethanol production by EFB which might cause environmental problem. Moreover, it contributes to stable growth of Palm Oil industries in Indonesia and energy security.

Completed

4 . Process



The cooperative research program for Ethanol production from old Oil Palm tree in Malaysia(2007 ~ 2008)

1 . Objective

Oil palm trees have an economic life span of approximately 25 years, after which old trees are felled and replanted. Most of felled trees become troublesome waste. Based on new findings that felled Oil Palm trunk contains large quantity of sap in which fermentable sugars exist, comprehensive Ethanol production method was researched and developed

2 . Project outline

Research and development of sap squeezing system from trees and cost-effective ethanol production

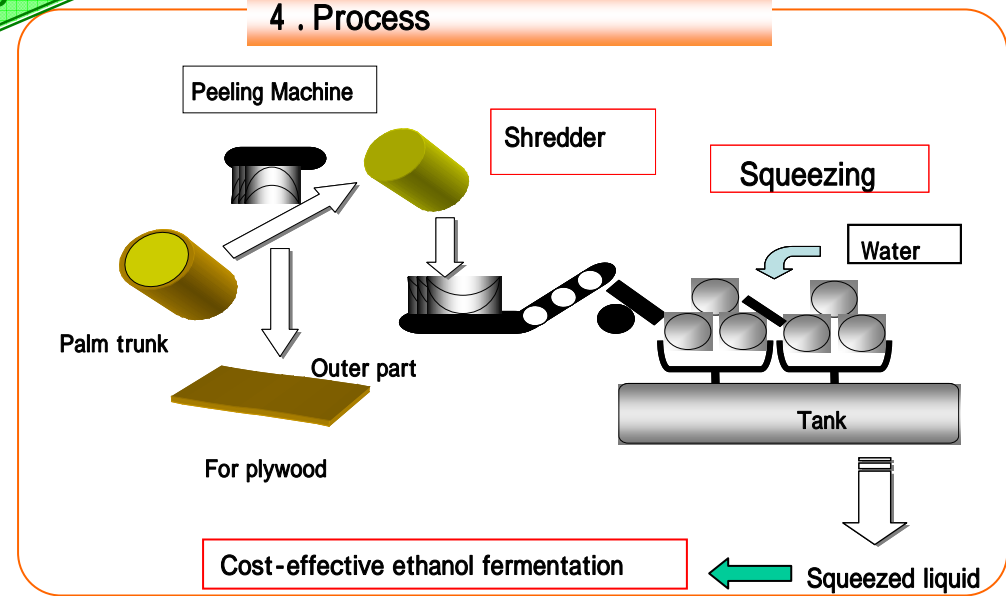
3 . Technical topics

It is new findings that felled Oil Palm trunk contains large quantity of sap in which fermentable sugars exist. It is first trial to research and develop comprehensive Ethanol production method from sap in old Oil Palm tree.

Counterpart country	Malaysia
Research period	2 years
Japanese Institute	JIRCAS
Research Institute of counterpart country	Forest Research Institute Malaysia University Science of Malaysia
Expected result	It is possible to produce cost-effective ethanol not only in Malaysia but also in other countries, such as Indonesia from felled old Palm trees which might cause environmental problem.

Completed

4 . Process



Outline of Ethanol production from old Oil Palm tree in Malaysia

Objective: Ethanol production development from old Oil Palm trees.

In Malaysia, 20 – 30 million palm trees are cut down every year.

Although some of portion of the old felled trunks is utilized, most of them have no practical way of utilization and become troublesome wastes.

Point: Sap in which abundant glucose and other fermentable sugars exist

Research content:

- (1) Analysis of sugar content in sap
- (2) Development of sap squeezing system
- (3) Development of fermentation
- (4) Study for low cost production

Cooperative Research Consortium:

Japan International Research Center for Agricultural Sciences

Forestry and Forest Products Research Institute

Sojitz Machinery Corporation

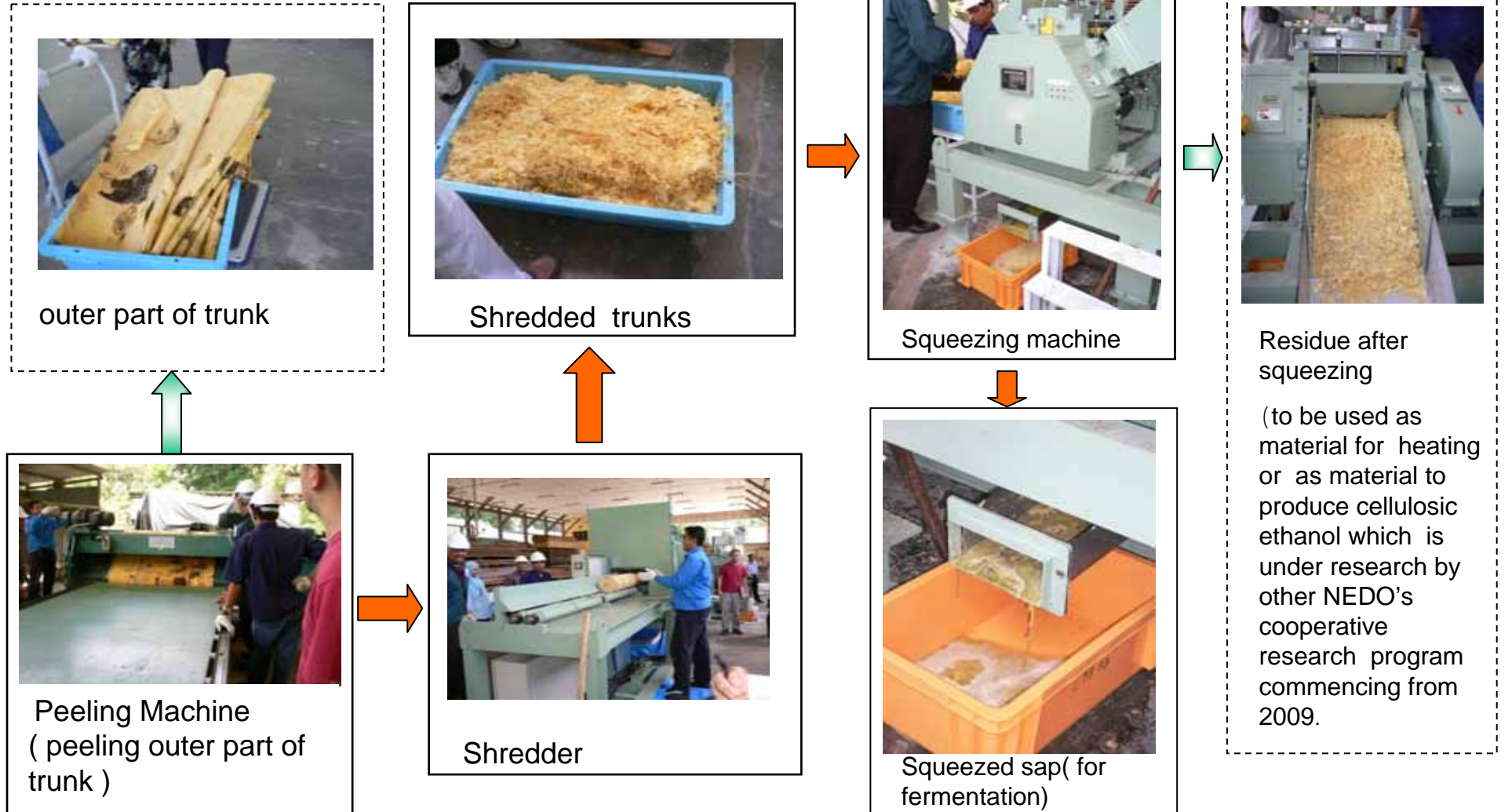
Forest Research Institute Malaysia (FRIM)

University Science Malaysia



Research Situation

At Forest Research Institute Malaysia / FRIM as of January, 2009



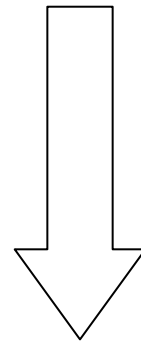
Comparison between old oil palm tree(25 years) and Sugar cane

	Sugar cane	Oil palm trunk (after maturing)		
		A (Center)	B (Middle)	C (Outer)
Water content	70%	83%	75%	68% × 0.8
Fermentable Sugar content in squeezed sap	16%	16%	14%	15%
Fermentable Sugar content per weight	112g/kg	95.4g/kg	107.8 kg/trunk	
Yield	60-90 tonnage/ha	154-168 tonnage/ha (136-148 trunks/ha)		
Possible Ethanol production	4.5-7.2 kL/ha	9.5-10.3 kL/ha		

Feature of old Oil Palm tree as energy resources



- Large quantity of sap
- High content of fermentable sugar
- Easy degradable parenchyma



- Troublesome waste
- Huge amount
- Easy to plan usage

High potentiality as fuel ethanol resources

Potential(estimated theoretically) : 2.7 million kL yearly in Malaysia
4.4 million kL yearly in Indonesia

Finally

Current NEDO International cooperation

International Model Project

Commercial scale

International Cooperative Research Program

Laboratory Bench scale

Subject to be considered

Establish middle stage scheme between above 2 phase to make seamless R & D program such as project to focus on Pilot scale

