

Environment

Message on Environment

Since its inception, Toyo has been providing solutions backed by comprehensive integrated engineering technologies, high tech application capabilities and project skills in project execution.

Through such execution, Toyo promotes development, introduction and improvement of technologies, offering following features: -Approaches to new and clean energy, -CO₂ reduction and energy conservation, -Recycle technologies of wastes and waste water, -Technologies for eliminating hazardous/toxic substances, -Construct plants to reduce environmental impact. Toyo's site construction work realizes following objectives: -Reduce environmental impact, -Prevent pollution, -Proper management of construction wastes.

Toyo, as Global enterprise company, fulfills social responsibilities of domestic and international Clients on basis of accumulated knowledge and experience, by offering technologies that contribute towards conservation of environment.

• • • Project applying technologies, contributing to environmental conservation • • •

Toyo applies integrated management to each project with cut –edge technologies of our proprietary and licensed processes for providing solutions to Clients. Toyo completes the project satisfying the expected purpose and target, in terms of quality, healthy, safety, security and environment.

Followings are some projects which apply technologies contributing to environmental conservation especially for technologies for clean energy, CO₂ reduction and saving energy.

Application of Technology for Clean Energy

• Gas to Liquids (GTL)

GTL is a process that transforms natural gas or associated gas into a clean diesel fuel or naphtha containing less impurities than petroleum-derived products.

Since November 2007, Toyo has been developing a compact, cost efficient Micro-GTL process jointly with Velocys Inc., and MODEC, Inc. Because of the compactness, the Micro-GTL plant can be installed not only onshore but also onboard a ship. Early commercialization of on-board GTL (floating GTL) is expected to be effectively developed and utilized because it will allow development of deep-sea natural gas that has not been easily exploited.



The module was fabricated in Thailand and reached PETROBRAS' refinery plant in Foltaleza city, Ceara state, Brazil in May, 2011. The project aims to achieve commercialization by 2013, after constructing and operating a demonstration plant.



Module of Micro-GTL demonstration plant being assembled in Thailand



Module of Micro-GTL demonstration plant being loaded on ship in Thailand bound for Brazil



3 The Module was off-loaded in Brazil

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• Mid-Scale Electric – Motor – Driven LNG Plant

Toyo and Hitachi, Ltd. together are cooperating and executing front end engineering and design for Eastern Star Gas Limited, an Australian gas development company, for mid-scale electric-motor-driven LNG plant to be constructed in Newcastle, New South Wales, Australia.

The electric-motor-driven, mid-scale technology for LNG plant offers advantages in terms of environmental conservation, because applying electric motor instead of gas turbine in compression process, offers high reliability, high energy efficiency, low environmental impact, a small footprint and low noise.

It also has advantages of flexibility in production capacity to expand as required, and is suited for development of coal bed methane and mid-small gas fields which is not developed because of economic and geographical location.

Mid-scale Electric-Motor-Driven LNG plant is expected to expand market in future in middle and small gas field application.



Image of Mid-Scale Electric-Motor-Driven LNG Plant



Application of Technology for CO₂ Reduction

Image of FPSO system

• Floating Production, Storage and Offloading (FPSO) system utilizing Carbon Dioxide Capture and Storage (CCS) Technology

MODEC and Toyo Offshore Production Systems Pte. Ltd. (MTOPS), a joint company created by Toyo and MODEC, Inc. and established in Singapore, received contract from MODEC for a topside processing facilities to be installed on a FPSO system.

This FPSO will be delivered to offshore Brazil and used to develop the Guara offshore area for Petrobras, national oil company in Brazil. This facility uses the environment-conscious CCS technology that dissociates CO₂ in the produced gas and returns it to the oil/gas reservoir.

Application of Technology for Save Energy/Reduce CO₂ Emission

Higher Efficiency Combined Electric Power Generation Plant

Toyo and Mitsui & Co., Ltd. have contracts with special purpose company (SPC) wholly owned by Gulf JP Co., Ltd. (Gulf JP). Gulf JP is an independent power producer in Thailand whose main owner is Electric Power Development CO., Ltd. in Japan. According to the contract, cogeneration gas turbine combined cycle power plants are to be constructed at seven sites in the suburbs of Bangkok (six 110MW and one 120MW,total generation capacity 780MW).

Toyo will be responsible for supply of equipment and materials and Mit-Power (Thailand) Ltd., a SPC of Mitsui in Thailand, will undertake the construction work.

Electric power generation facilities supplied by Toyo is a type of combined power generation consisting of heat recovery steam generation (HRSG), gas turbine generator (GTG) and steam turbine generator (STG). Because of applying high efficiency type of power generation turbine, the efficiency of 49% and higher can be realized.



Environment

The project began in October, 2010 and is schedule to be completed by October 2013. As of March 2011, major purchase orders for equipment and materials were issued, and design and fabrication work is in progress. Ground preparation work was started in construction site and piling work was commenced in a part of site.



Piling in Construction Site Nong-kae industrial area located in 90km north from Bangkok, 30km northeast from Ayutaya world heritage



Photo of Ayutaya, world heritage in Thailand



• Energy saving urea process(ACES21[®])

Since its establishment in 1961, Toyo has been a leader in urea technologies worldwide, designing, engineering, constructing, and commissioning over 100 urea plants based on its own process.

The history of urea plants is the history of energy conservation. While producing one ton of urea required 0.93 tons of steam and 140kWh of electric power in the past, the newest process ACES21^{\circ} requires only 0.43 ton of steam (54% less) and 118kWh electric power (16% less) to produce one ton of urea which greatly contributes to energy conservation and CO₂ reduction.





ACES21[®] P.T. Pupuk Kujang, Indonesia

Urea product



Energy consumption per ton of urea



••• Efforts for Environment •••

Office^{*1} Activities for Energy and Resource Saving

* 1:Office means Toyo's Head Office and Engineering Center

• Reduction of CO₂ emissions

CO₂ emissions from office are calculated from electricity consumption, urban gas consumption, and consumption of fuel oil A used for emergency power generation.

Toyo launched energy-saving activities in 2000 with office lights being turned off during lunch breaks and unnecessary lights removed. In 2001, Toyo made energy saving investments, such as installing lighting inverter stabilizers, which produced positive results in 2002 and after.

CO₂ emissions in 2010 were reduced by 30% from the 1992 level.

In wake of earthquake disaster and to overcome shortage of electric supply this summer in office, we implement emergency measures to save electricity, such as removal of lights, raising temperature of air conditioning, closing blinds on windows, switching off lights, limiting operation of number of elevators, etc.



• Reduction of general waste and recycle waste^{*2}

Discharge of general and recyclable waste has decreased gradually over the year and each waste is reduced to 221 ton and 179 ton respectively in 2010 which is the same level of 2009.



*2:Recycling waste is the recyclable general waste including paper output from personal computer and photo-copy machine, newspaper, glass bottle and can.

Construction Waste Gross Discharge

Domestic construction sites

(1) Percentage of construction waste by category

The figure to the right shows the weight of construction waste and its categories in proportion. The weight of construction waste discharge from domestic construction sites in 2010 was 846 ton, about 1,087 ton less than that of discharged in 2009.

Toyo implements various kinds of construction and percentage of waste by category tends to be different in each year.

The four categories of waste marked with (*) an asterisk are recyclable.

(2) Percentage of construction waste by disposal methods

Percentage of construction waste by disposal method (recycle, landfill, and incineration) is shown in the figure to the right, that is, 80% recycled, 19% landfill and1% incinerated in 2010. As the mix of construction waste increased, the recycling rate decreased to 80% from 94.9% in 2009.

(3) Recycling rates of four items specified by the Construction Material Recycling Act

The recycling rates of four items specified by the Construction Material Recycling Act are illustrated to the right.

The recycling rates for wood waste, metal waste, asphalt/concrete waste and concrete waste have been kept to 100%.



Percentage of construction waste by category (domestic)

Percentage of construction waste by disposal method (domestic)



Recycling rates of for four items specified by the Construction Material Recycling Act.(domestic)



Overseas project sites

Weight of construction waste discharge and percentage by category

The total discharge weight in 2010 (Jan. to Dec. 2010) was 32.0 thousand ton, about 50% decreased from 2008 and 42% decreased from 2009.

The reason of increase of construction surplus earth/sludge in 2010 was discharged to outside from site instead of using backfill in 2009 in Venezuela project.



Weight of construction waste discharge and percentage by category

(Proportions of individual waste categories to the total discharge weight except construction surplus earth/sludge in each year shown as percentage)



Toyo implements various kinds of construction method and percentage of waste by category tends to be different in each year. The weight of construction waste discharge in 2010, except construction surplus earth/sludge was 12.5 thousand ton decreased 76% from 2009.

Activities for Reducing Environmental Impact in Engineering, Procurement and Construction

• Engineering activities

Toyo makes efforts to reduce the environmental impact in plant operation. These efforts start in engineering stage. Based on ISO 14001 and ISO 9001, Toyo reduces the environmental impact that occurs in plant operation, through the following work processes:

(1) Clarification and confirmation of Client requirements (environmental specifications)

- (2) Design review
- (3) Design verification
- (4) Design validation

Toyo makes efforts to reduce environmental impact in design work through "Eliminate 3M - Principle" (Eliminating *Muri* (overdoing), *Muda* (wasting), and *Mura* (irregularity)), while striving for efficient design work and methodology as an environmental target.

Case (1)

In design stage of processes, it is proposed to Client to set design pressure lower from experience and knowledge/know-how. As a result, design pressure was set lower, and type of pumps applied smaller one contributing reduce of electric consumption and saving resources.

Case (2)

In piping design stage, eliminating wastage and reducing re-do work were set as target for environment. Then it is realized reducing of revised work and saving energy by proper using of work check sheets and implementing periodical model review (design verification on screen by using of 3D computer soft).



Procurement activities

In purchasing activities, "Inquiry System" is applied and used for selection of vendors investigating efficiently vendor's data such as purchase order records in past project and their fabrication capability. Also "Inquiry System" is paperless system that can be accessed by vendors for getting inquiry document package.



"Delivery control system of Equipment and Materials" is applied for expediting, inspection and transportation activities after ordering the equipment. This system can be commonly used in Toyo's Head Office, Global Toyo's procurement office, and at construction site by sharing progress of manufacturing and delivery status. This enables to work efficiency by sharing information.

Screen showing equipment and material name, fabrication start and finish date, and delivery date





Screen sample showing fabrication progress

>>>>> http://www.toyo-eng.co.jp/en/

• Construction activities

Among Toyo's business activities, site construction work creates the largest environmental impact. At construction sites, the following environmental targets are set and efforts are made to reduce the impact on environment:

- (1) Appropriate treatment of construction wastewaste control by manifest and ledger
 - •monitoring waste disposal agency by regular patrol
- (2) Appropriate treatment of chemicals (paint, etc.)
 - preparation and implementation of procedures for waste treatment
 - education of workers by Material Safety Data Sheet (MSDS)
- (3) Environmentally conscious construction method
 - Regular inspection and its records for storage of construction machines
 - •Stopping construction work during night
- (4) Environmentally conscious material transportation
 - Regular inspection and its records for storage of transportation vehicles
 - Control of dust emission by spraying water on road and pavement
- (5) Turbid water treatment and oily water separation
 - Sedimentation separation and oil separation from water using tank with notched plate



Baby of sea turtle in Venezuela site