TOYO TIMES

TOYO COMMUNICATIONS

October 2019 | Vol. 17

TOYO ENGINEERING

TOYO COMMUNICATIONS
UP TO DATE

Toyo-China | Dong Benli & Khoo Kai Siang | Toyo-Japan

Discussing TOYO's Global Management and Future Vision

The Story of the Ever-growing Toyo-China

Mr. Khoo: Following the restoration of diplomatic relations between Japan and China in 1972, Toyo Engineering built many fertilizer and ethylene plants in China as the country moved toward modernization. From the late 1990s onward, foreign-owned corporations started setting up operations in China, and Toyo-China launched as a procurement center to support those projects.

Ms. Dong: In 2001, Toyo-China started providing support for Toyo-Japan's projects in China. We had a team of around 20 people. Since 2005, we have increasingly played a key role in project organization. Toyo-China has continued to grow, and we can now single-handedly manage projects with total investment in the range of JPY 30 billion. Over the last 10 years, we have completed more than 100 projects of various sizes, and our capabilities have been highly evaluated by our clients.

Mr. Khoo: What strengths let clients choose Toyo-China?

Ms. Dong: We feel proud to work at TOYO, and have an understanding of TOYO's culture and work practices. Our top priority is to meet the demands and expectations of our clients. I think that dealing with clients in a sincere manner on every project leads to repeat orders in the future.

Also, Toyo-China works in accordance with the universal TOYO project execution guidelines, such as business guides and procedures. In terms of construction safety, we have maintained a record of zero lost time incidents and accidents for 49 million continuous hours over the past 10 years.

Our extensive track record with procurement goes back to before Toyo-China's establishment. We now possess a supplier database with more than 4,000 entries that we always keep up to date. In this regard, Toyo-China functions as a procurement hub for our clients and the projects being undertaken by the TOYO group.

Mr. Khoo: I imagine that the reputation gained from clients placing repeat orders is likely to attract new clients?

Ms. Dong: We stand by our commitment to always complete projects within the budget, on time, and with no accidents—for every client. This attitude and the resultant project successes lead to repeat orders, and that reputation also brings in new clients.

Recent Expectations for Toyo-China

Mr. Khoo: China is a huge market for TOYO that will always warrant attention. For many years Toyo-China's major clients have been mainly Western or Japanese corporations, but we have seen a rapid rise in Chinese firms over the last few years. They show a growing tendency to stress quality over cost as well as ambitions to expand overseas. I think these Chinese corporations will become our target clients in the near future. It will therefore be vital that we have the necessary specialty products. For example, I think Toyo-China could specialize in the fields of chemical products and fine chemicals.

From a procurement perspective, not only do Chinese suppliers offer competitive prices for several kinds of equipment and materials, but their quality standards are also on the rise. We hope to see Toyo-China further strengthen its capabilities as a key procurement hub for

Khoo Kai Siang General Manager of Toyo-Japan's Corporate Strategy Department, Corporate Strategy Division

Khoo Kai Siang joined Toyo-Japan in 2006. He worked in engineering and construction in the Civil and Architecture Engineering Division before acquiring an MBA in the UK. He was seconded to Toyo-China to work in sales, and in April 2018 was appointed Toyo-Japan's youngest General Manager to head the Group Operation Department, and then the Corporate Strategy Division in the following year.

the TOYO group, but considering the growing demand for modularization, I think it can play a leading role in that area as well. Furthermore, it is possible that some of the rapidly expanding design institutes and engineering companies in China can become our EPC* partners.

Accordingly, there is potential for Toyo-China to serve as an intermediary between the TOYO group and clients, suppliers, and partners based in China.

Also, China is a hotbed of innovation, with novel business ideas often emerging. I'd like to see Toyo-China play a key role in linking the TOYO group to new business opportunities and venture firms in China.

Ms. Dong: I agree that Toyo-China's strengths lie in chemical products and fine chemicals. Going forward, we must further emphasize this selling point with the aim of expanding our business in both domestic and overseas markets.

I also think there are many potential business opportunities in China among areas such as e-business. We will monitor these new business fields and provide feedback to the TOYO group in a timely fashion.

*EPC: Engineering, Procurement and Construction

Diversity and True Globalization

Mr. Khoo: You are the TOYO group's first locally born group company President. What areas do you think need improvement for TOYO to become more globalized?

Ms. Dong: First would be diversity. At Toyo-China, everyone has an equal opportunity, regardless of gender or age. For example, half of our project managers are women. In China's engineering industry, it is normal for women to hold managerial positions, such as Project Manager or CEO. I also make an effort to offer capable young employees favorable conditions and challenging opportunities without being bound by years of service or seniority systems.

As for TOYO's globalization, I think all our platforms need to be in English so that everybody in the group can understand and share information in a timely manner. And training provided by Toyo-Japan experts at overseas group companies is essential if we are to strengthen the development of human resources across the entire group. These initiatives should enable the group to execute projects under a true global framework.

Future Vision for the TOYO Group

Mr. Khoo: One future vision I have for TOYO involves the optimal deployment of a 5,000 member global workforce, in which we flexibly move the right people to the right jobs. Moving human resources between group companies to meet demand will likely even out employee workloads. I want all our employees to feel that TOYO is a rewarding place to work and to grow globally, so everyone has an opportunity for advancement. In the near future, I hope that we can go beyond the limits of our group companies to determine the best employees for board member or managerial positions at Toyo-Japan or any other group company.

Ms. Dong: The free movement of human capital throughout the group is an excellent idea. I'd like to work with you on freely utilizing employees across all group companies to make the TOYO group even stronger and develop new business opportunities.

Mr. Khoo: In terms of TOYO's global management for this kind of personnel appointment, our traditional EPC business operations could be transferred to all group companies, and Toyo-Japan could then focus on new businesses and technological development. Group companies would have more responsibility than ever before, and should be able to handle projects worth JPY 50 billion, or even JPY 100 billion. To achieve this vision, Toyo-Japan must effectively transfer its technological and EPC execution know-how to group companies. Meanwhile, Toyo-Japan's role would be to specialize in new businesses and the development of high value-added technology to meet the needs of the coming society. We will definitely be required to develop non-EPC businesses to offset the EPC business, as it is susceptible to the impact of economic cycles. By creating this sort of global operations system, I believe that the TOYO group can make great strides.

Dong Benli President of Toyo-China

Dong Benli has a background in petrochemical plant processes and piping design. She joined Toyo-China in 2001, and after experience as a Project Manager, took up roles as the Head of the Engineering Division and the Procurement Division. She was appointed in April 2013 to lead Toyo-China, and is the TOYO group's first female, locally born President.

Toyo-India Jasbir Singh Soni &

Toyo-India's Steady Rise

Jasbir Singh Soni Executive Director Toyo-India

Jasbir Singh Soni joined Toyo-India in 1986. He initially worked on construction sites before serving as Head of the Piping Design, Engineering, Project, and Construction Divisions. He directed Toyo-India's successful completion of the Chambal fertilizer project in 2018, and assumed the role of Executive Director at Toyo-India in the same year, overseeing all project and EPC functions.

The Key to Success in the Indian Fertilizer Plant Project

Mr. Hosoi: At the end of the previous fiscal year, TOYO completed the on-schedule construction of a mega fertilizer project in India for Chambal Fertilisers and Chemicals Limited (refer to page 9). The client attended the completion ceremony, and gave TOYO's project execution a high appraisal. I had the experience of working as Project Director on the construction of an ethylene plant in Panipat, India, for a period of four years starting in 2006. However, this recent Chambal fertilizer project made me realize that the capabilities of Toyo-India have developed greatly in comparison to roughly 10 years ago.

Mr. Soni: Yes, I agree. We created extremely thorough plans for the project during the initial stages with support from Toyo-Japan. We set targets for each stage one month ahead of schedule, and were transparent in sharing our intent with the client and everyone involved. The client was also very cooperative and kind enough to voluntarily gather information for us about the most recent quality issues through the global fertilizer industry network. By combining this information from the client with feedback from previous TOYO projects, we smoothly executed the project and prevented the occurrence of problems during commissioning.

Mr. Hosoi: Building a healthy relationship with the client is a clear requirement for success. How is the improvement in project execution capabilities at Toyo-India laying the groundwork for this?

Mr. Soni: We managed to keep the overall project on schedule through conducting detailed engineering and material/equipment ordering on time. Deliveries were mostly on schedule, but we had to review construction processes in order to make up for lost time on some equipment that fell behind schedule. Also, the right decisions were made at the right time by transferring authority to the Construction Manager, which was a major factor in our success. Spending one extra rupee today to achieve the required progress is better than spending 10 rupees six months later, when it's too late. Those kinds of situations arose daily over the course of the project, and taking actions at the proper time helped. Before we reached the middle phase of construction, Toyo-Japan conducted a "cold eye review" on the construction schedule to determine targets for key stages. While the targets were quite challenging, we managed to achieve them by taking the required actions at the right time, such as adding more workers or heavy machinery. Looking back now, the period in which we achieved those set targets was the turning point in terms of how we managed each stage of the project. That gave us, as well as Toyo-Japan, the confidence that we could complete the project in time.

Ten Years of Evolution at Toyo-India

Mr. Hosoi: Over the last few years, Toyo-India has built up an impressive track record in constructing ethylene plants and fertilizer production facilities. You started construction on the Panipat ethylene plant in 2006, while at the same time executing an ethylene plant project in Singapore. After that, the company gained experience in executing projects in three different regions simultaneously: taking charge of ethylene plants in Egypt and Turkmenistan in 2013, then starting a large ethylene project in Malaysia in 2014. In fertilizer projects as well, Toyo-India took an order for construction in Nigeria in 2013 and then concurrently executed the Chambal fertilizer project in India, which started in 2015. It would be no exaggeration to say that Toyo-India is now the world's most knowledgeable EPC contractor in the area of ethylene and fertilizer plant construction. In reflecting on the past 10 years, what has changed the most in terms of management systems and project execution methods?

Mr. Soni: First, I think it's our greatly improved capabilities as a profit center. When we took charge of the detailed engineering on an ethylene project for the first time with the Panipat plant, Toyo-Japan was still heavily involved. We simply did as they instructed. However, we have gradually built on our experience through subsequent

& Eiji Hosoi Toyo-Japan

as a Key Group Company

Eiji Hosoi Senior Executive Officer Unit Director of Plant Business Unit

Eiji Hosoi joined Toyo-Japan in 1982. He has worked in the Civil/Architecture Engineering, Construction Planning, and Project Divisions, and has more than 30 years of overseas project experience in addition to experience working on secondment at Toyo-India. Appointed President of PT. Inti Karya Persada Tehnik (IKPT) in 2015, he has made valuable contributions to the company's growth. Mr. Hosoi returned to Japan in 2018 and was appointed Senior Executive Officer and Unit Director of the Plant Business Unit.

projects, and now we have the competency to single-handedly take on the responsibility of executing detailed engineering. Also, we established a construction division in 2011 to focus attention on developing our construction management capability in the TOYO group.

We are also starting to focus efforts on the development of Project Managers (PMs) as a measure to strengthen our project management function. First, we identified candidates with engineering backgrounds and the required aptitude. Their management skills were further enhanced through lecture sessions, and next they accumulated work experience through small projects handled solely by Toyo-India. We spent a great deal of time developing PMs by providing them with experience working on medium- to large-scale collaborative projects with the TOYO group.

Furthermore, we take feedback on past projects very seriously. For example, before we started the fertilizer project in India that we secured last year, all project members took part in a workshop with the core members of the Chambal fertilizer project so they could share detailed feedback.

Expectations for Toyo-India in Enhancing the Overall Capabilities of the TOYO Group

Mr. Hosoi: The notion that Toyo-Japan is the center of the TOYO group's operations is changing. Toyo-India will need to play a more important role in the group going forward. I'd like to see Toyo-India take a leading role in enhancing the overall capabilities of the TOYO group by implementing these initiatives for PM development and shared project feedback at all group companies. My future vision for the TOYO group calls for Toyo-India to be more deeply involved.

Mr. Soni: I'd like to see Toyo-Japan take the initiative in providing more opportunities for discussions involving TOYO group companies. And I truly hope that, based on mutual trust between Toyo-Japan and TOYO group companies, discussions that take into account the opinions of each company can contribute to decision making. I think this also applies to discussions on DXoT*1 and group management strategies. For example, we are conducting trials on the use of AWP*2 for the ongoing fertilizer production facility project in India. I think that Toyo-India can greatly contribute to identifying issues in this trial run, as well as areas that need improvement.

Mr. Hosoi: I think your comments offer some ideas on how to improve the TOYO group's management. One of the strengths of TOYO is its diverse portfolio of specialist products at each group company, and its clients in various markets around the world. For example, Toyo-India specializes in ethylene plants and fertilizer production facilities, as well as LNG regasification plants and refineries. What kind of strategic positioning for other products do you hope to employ?

Mr. Soni: We established a new business unit dedicated to investigating the future potential of the growing fine chemicals sector in India. Business opportunities in India are also on the rise in specialty chemicals and polymers. In addition, we are seeing an increase in Japanese companies entering the Indian market and projects related to industrial estates being developed through the Japan External Trade Organization.

Mr. Hosoi: We are now in an era in which the collective strengths of the group must be maximized by management instead of just for collaborative group projects. I certainly hope we can boost the overall capabilities of the TOYO group by providing more opportunities like this for other group companies as well, and by having active exchanges of our honest thoughts and opinions.

*1. DXoT: Digital Transformation of TOYO (Initiatives to Reform TOYO through the Introduction of the Latest Digital Technologies and IoT)
*2. AWP: AWP is a method to improve project efficiency. It provides each person involved with "packaged" information and materials at the right time that are sufficient for the specific work segment the person is about to perform at every step for furthering the project.

HERO: Consulting Service Contributing to Further Energy Savings

TOYO has launched Hybrid Energy system Re-Optimization (HERO), a service that supports energy saving and the reduction of greenhouse gas emissions at oil refineries and petrochemical plants. HERO develops a model that unifies the two elements which compose a plant: a process system for the production of chemicals and a utility system for the supply of electric power and/or steam. Through mathematical optimization based on this unified model, HERO identifies and proposes the best possible strategies from among vast numbers of feasible improvement options.

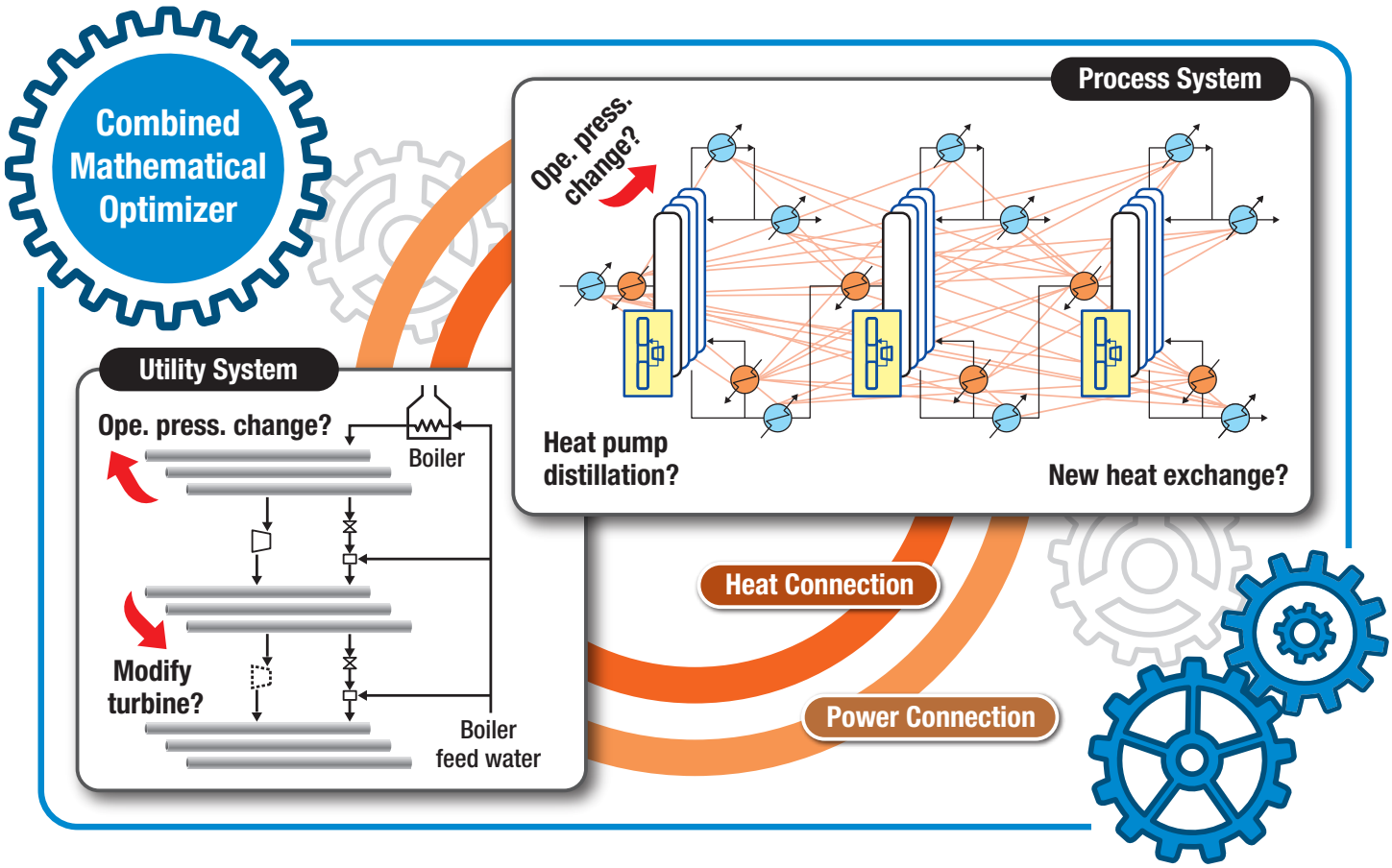
HERO was developed with a subsidy of Japan's New Energy and Industrial Technology Development Organization (NEDO). In the practical demonstration, several major Japanese oil refining and petrochemical manufacturing companies cooperated in exploring improvement strategies, which led to excellent results.

HERO takes into consideration all of the characteristics of each facility. The clients' operational philosophy and equipment modification constraints are fully embedded in its optimization models. While limiting costs to as low as possible, HERO proposes multiple improvement strategies after a few months of analysis, while the remuneration is determined in line with the results of initiatives, such as energy saving.

HERO Improvement Strategy Proposal Example

Case 1	Case 2	Case 3
Boiler Duty	MPS Export	Hot oil Duty
31.3 MW	2.7 MW	12.3 MW
−39.7%	+473%	−22.8%
18.9 MW	15.5 MW	9.5 MW

Oil refineries and petrochemical plants all over the world are making individual efforts with energy saving strategies and greenhouse gas emission reductions. HERO provides an effective strategy to advance those initiatives by using mathematical optimization to derive the optimal solution from vast combinations of variables. TOYO has incorporated the skills and know-how developed from its experience with plant construction into HERO, and will apply this new methodology to plants globally.



Continuous Manufacturing Plant for Monoclonal Antibodies

Example of a continuous manufacturing facility for monoclonal antibodies

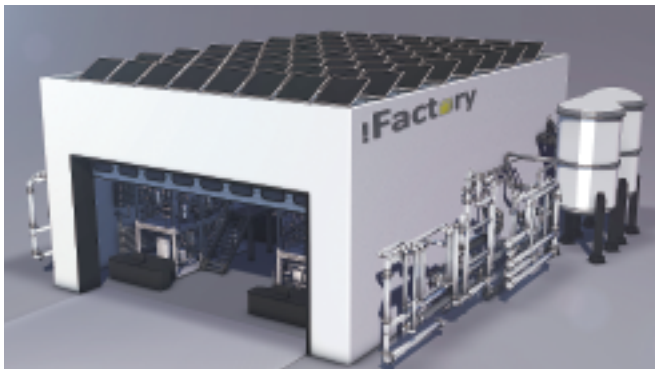
Left: Pall Corporation's continuous chromatography unit
Right: TPS's continuous virus inactivation unit

Antibody drugs attack substances that cause illnesses, and are useful in treatment and prevention. They target specific molecules in the body, such as cancer cells, and are highly effective while minimizing side effects. Because only one type of antibody drug product can be manufactured at one time in a traditional facility, they necessitate large capital investments. To reduce costs, manufacturers are showing interest in continuous manufacturing in downstream process from upstream.

TOYO's Japanese group company TEC Project Services Corporation (TPS) has developed an automated all-single-use virus inactivation system utilizing disposable pipes and resin bags. Refining antibody drugs requires an expensive material called "Protein A," which costs approximately one million yen per liter. The separation and refining processes of antibodies and Protein A account for two-thirds of the overall costs for antibody drug manufacturing. In traditional methods, small-batch processing reduces the amount of Protein A required, but has the problematic side effect of increasing labor costs. TPS's automatic virus inactivation system provides the solution by making automated continuous manufacturing possible, substantially reducing both material use and labor costs.

Until now, over half of the Protein A was wasted. However, 100% of it is used in continuous manufacturing, causing overall production costs to be reduced by 30%. This allows for lower drug prices, giving more patients access to high-performance pharmaceuticals. Also, TPS is working on the development of technologies aimed at solving problems in the pharmaceutical manufacturing field.

Development of "iFactory," Continuous Pharmaceutical Manufacturing Facility



iFactory model (image for reference)

TEC Project Services Corporation (TPS) took part in the Flow Science & Technology Consortium (FlowST), which was established by the National Institute of Advanced Industrial Science and Technology (AIST) in 2015 for the purpose of developing a continuous production method of pharmaceuticals and functional chemicals that are usually batch manufactured. TPS participated as a member of an implementation planning workgroup for continuous manufacturing production, an internal working group of FlowST. In May 2018, a joint proposal made as one of the core members* of the workgroup, entitled "Development of an iFactory for Production of Pharmaceuticals based on Reconfigurable Integrated Unit-Operation Modules," was adopted as a development item by the programs for innovating the strategic energy conservation technologies of the New Energy and Industrial Technology Development Organization (NEDO). TPS has been working to achieve a new concept of continuous pharmaceutical manufacturing plants: the "iFactory."

iFactory consists of modules for unit operation manufacturing processes called "iCube," which can be rearranged to easily alter the production line. TPS plays a role in the engineering and development of iCube for the upstream of the production line from reaction to liquid separation, solvent replacement, and crystallization. By shifting from a batch manufacturing process to a continuous one and making it easy to rearrange the production line, iFactory is expected to reduce energy use, waste, and manpower needs.

*Core members: TPS, Takasago Chemical Corporation, Mitsubishi Tanabe Pharma Corporation, Konica Minolta Chemical Co., Ltd., Yokogawa Solution Service Corporation, and AIST. Added in April 2019 were Taisei Corporation, Shimadzu Corporation, and Mitsubishi Kakoki Kaisha, Ltd.

Awarded Petrochemical Plant Project in Russia

TOYO has been awarded a contract to provide engineering, procurement, and technical advisory services on a project to construct ethylene and polyethylene plants for Irkutsk Polymer Plant, a wholly owned subsidiary of Irkutsk Oil Company (INK). Both plants will have a production capacity of 650,000 tons per year, and be located in Ust-Kut, Irkutsk region, Russian Federation.

The purpose of this project is to effectively utilize the associated gas from INK-owned oil fields by converting it into raw material for petrochemical products instead of flaring it off. Since signing a general engineering service agreement with INK in 2011, TOYO has supported INK in modernizing its industrial facilities. An improvement in the effectiveness of operations was recognized, both in resource management efficiency and lower environmental impact, which led to the current project.

Signing ceremony

Moreover, an affiliate of TOYO has concluded an agreement to dispatch around 40 staff members as a construction management team in order to supervise construction work that will be carried out through local construction. The team will conduct management for approximately three years starting from 2020.

TOYO has completed more than 40 projects in Russia since the 1960s, and is currently focusing on getting orders for ethylene and polyethylene plants by positioning them as leading products. This project marks TOYO's forty-seventh ethylene plant and its twenty-sixth polyethylene plant worldwide.

Awarded Olefin Expansion Project in Thailand

Signing ceremony

TOYO has been awarded a contract for engineering and procurement services for an olefin expansion project from Map Ta Phut Olefins Co., Ltd. (MOC), a joint venture company of SCG Chemicals Co., Ltd., Thailand, and The Dow Chemical Company, United States.

This project follows the FEED* carried out by TOYO in mid-2018, and is being conducted in order to increase MOC's annual ethylene and propylene production capacity from its current 1,700,000 tons to 2,050,000 tons. The new plant is to be constructed adjacent to existing facilities in Map Ta Phut, Rayong, Thailand, and is scheduled for completion in 2021.

Ethylene plants are one of TOYO's leading product fields, and this project represents TOYO's fourth ethylene project in Thailand. It is also TOYO's third project for SCG Chemicals, following the 1996 award of a new ethylene plant project and its capacity expansion project in the 2000s.

*FEED: Front End Engineering Design

Awarded Petrochemical Plant in Thailand

Toyo-Korea was awarded a contract for a petrochemical plant construction project from Bangkok Synthetics Company Ltd. (BST), Thailand, a major C4 downstream product manufacturer. The new plant will be located adjacent to BST's existing plant in Map Ta Phut, Rayong, Thailand, and will have an annual production capacity of 80,000 tons per year of 1,3-butadiene and 34,000 tons per year of 1-butene.

This contract was awarded as a result of the client's high evaluation of the various proposals during FEED work presented at the end of fiscal 2017. Toyo-Korea is responsible for detailed engineering, procurement of equipment and materials, and construction on a lump-sum turnkey basis. The plant is scheduled for completion in 2021.

Petrochemical plant construction is one of Toyo-Korea's strengths, and the company is actively pursuing the acquisition of projects outside of Korea.

Signing ceremony


Aerial view of the Steam Cracker Unit in Malaysia

On-spec Production from Steam Cracker Unit Achieved in PIC, Malaysia

TOYO is at the final stages of completing the Steam Cracker Unit (SCU) which is an integral part of the refinery owned by Pengerang Refining Company Sdn. Bhd., within the Pengerang Integrated Complex (PIC).

The SCU, with a production capacity of 1.29 million tons per year, began production of commercial grade ethylene and propylene in September 2019.

The project, which represents TOYO's largest individually led project to date, was a concerted effort of the TOYO group over a period of five years. The focus is now the start up of the steam cracker downstream units, namely the PyGas Hydrogenation Unit (PGHU), Benzene Extraction Unit (BZU), Butadiene Extraction Unit (BDU), and Methyl Tertiary Butyl Ether Unit (MTBE) before the official hand over to the owner.

Awarded Small-scale Geothermal Power Generation Project

TOYO Indonesian group company PT. Inti Karya Persada Tehnik (IKPT) was awarded a project for a small-scale geothermal power plant (SSGPP) project on the Dieng Plateau, central Java, by Indonesian state run company PT Geo Dipa Energi (GDE). A contract signing ceremony was held for the project at the opening event of the Indonesia Geothermal Association's seventh Indonesia International Geothermal Convention & Exhibition held in August 2019. It was attended by political and industry figures, including Indonesia's Vice President Jusuf Kalla.

The new Dieng SSGPP facility will have a power generation capacity of 10 MW. After completion, GDE's capacity in the region will reach 130 MW.

This project is part of the general national energy plan to reduce greenhouse gas emissions under the Indonesian government's commitment to the Paris Agreement. Its purpose is to increase the percentage of geothermal energy usage to 23% by 2025. IKPT is providing EPC* services in line with the needs of each region.

*EPC: Engineering, Procurement and Construction

Signing ceremony

Large Gas Chemical Complex in Turkmenistan Completed

The completed gas chemical complex

In October 2018, TOYO completed construction of a large gas chemical complex for Turkmengas, located on the Caspian Sea shelf in the western Turkmenbashi district of the Balkan Province, Turkmenistan. A completion ceremony was held, with the attendance of the President of Turkmenistan and other government officials as well as the ambassadors of the relevant countries, including Japan.

A consortium of TOYO and Korean companies Hyundai Engineering Co., Ltd. (HEC) and LG International Corporation (LGI) was awarded the project in 2014. TOYO carried out engineering, procurement and commissioning of three plants: a gas separation unit (560 million standard cubic feet per day), an ethylene production unit (400,000 tons per year), and a polypropylene production unit (80,000 tons per year). HEC and LGI handled a polyethylene plant (400,000 tons per year) and utilities, and were responsible for overall construction. The gas separation unit employs TOYO's proprietary technology COREFLUX®-C2, which enables a high recovery rate of ethane—the feedstock for ethylene—from natural gas.

Based on abundant natural gas for feedstock in Turkmenistan, which owns deposits that are ranked fourth in the world, the production and export of high-value-added chemicals contribute greatly to the country's economy. In addition to exports, products such as ethylene and propylene are also used as feedstock in the domestic carpet and plastic-molding industries, so the complex will also play a role in providing a wide range of training and employment opportunities for the regional industry.

Fertilizer Plant Completed in India

The completed fertilizer plant

In February 2019, Toyo-Japan and Toyo-India completed construction and handed over the third fertilizer plant for Chambal Fertilisers and Chemicals Limited (CFCL), India. Toyo-Japan and Toyo-India constructed an ammonia plant (capacity of 2,200 tons per day), a urea plant (two trains with a capacity of 2,000 tons per day each), and utilities facilities. This world's largest class plant applies the ammonia production technology of KBR, U.S., and TOYO's urea synthesis technology, ACES21®.

India is home to a population of 1.3 billion people, and its vast amount of land makes it a world leader in agriculture—a highly important industry both economically and politically. At the same time, the country has strong demand for highly efficient fertilizer plants due to the high cost in India of natural gas, which is used as feedstock. This plant meets that demand by employing the advanced technologies of KBR and TOYO.

Toyo-Japan and Toyo-India worked on several fertilizer plants for CFCL in the 1990s, which continue to operate smoothly today. Through the completion of the new plant, CFCL has become one of India's leading fertilizer manufacturing companies, with a total production capacity of 10,000 tons per day of urea across its three plants. Toyo-Japan and Toyo-India are currently working on a fertilizer plant construction project of a similar scale in India for Hindustan Urvarak & Rasayan Limited.

Polyethylene Swing Plant Completed in Indonesia

Night view of the completed polyethylene swing plant

TOYO has completed and handed over, more than a month ahead of schedule, a polyethylene swing plant constructed inside a petrochemical complex in Cilegon, Banten, on the western tip of Java, Indonesia, for PT Chandra Asri Petrochemical Tbk (CAP), Indonesia's largest private petrochemical company.

On this project, Toyo-Korea was responsible for detailed engineering and procurement outside of Indonesia, while PT. Inti Karya Persada Tehnik (IKPT) oversaw construction work and domestic procurement, and Toyo-Japan handled project management.

The plant has a polyethylene production capacity of 400,000 tons per year, and is capable of producing high density polyethylene (HDPE), linear low density polyethylene (LLDPE), and metallocene linear low density polyethylene (mLLDPE) in accordance with market needs.

TOYO has a record of projects for CAP such as ethylene plants (in the 1990s), butadiene plants and ethylene expansions (in the 2000s). Last year, TOYO also completed a synthetic rubber plant for PT. Synthetic Rubber Indonesia, a joint venture between Michelin of France and CAP. (Refer to article below.)

Synthetic Rubber Plant Project Completed in Indonesia

In May 2018, TOYO completed construction of a synthetic rubber plant with an annual production capacity of 120,000 tons and handed it over to the client, PT. Synthetic Rubber Indonesia (SRI), Indonesia. Toyo-Japan and PT. Inti Karya Persada Tehnik (IKPT) were jointly awarded the project in June 2015, in which IKPT took the lead in project execution and Toyo-Japan provided procurement services outside of Indonesia.

SRI is a joint venture company between Compagnie Financière du Groupe Michelin, France, and Indonesia's PT. Chandra Asri Petrochemical Tbk. (CAP). Michelin's process technology for producing synthetic rubber was employed in this project, and some of the items produced will be supplied domestically as raw materials for Indonesia's first locally produced environmentally friendly tires.

TOYO has built a strong relationship with CAP over the years, and the success of this project is expected to lead to more project awards in the future.

Plant opening ceremony

Awarded LNG Regasification Plant Project in India

Contract ceremony

Toyo-India has been awarded a project for the construction of a new regasification plant with a send out capacity of 5 million tons per year in an LNG terminal from HPCL Shapoorji Energy Pvt. Ltd. (HSEPL) at Chhara in Gujarat State on the west coast of India. Toyo-India will execute work on a lump-sum turnkey basis, from engineering to construction and commissioning. The regasification plant is scheduled for completion in the beginning of 2022.

HSEPL is a joint venture involved in LNG receiving, storage, and regasification. It was formed by major public oil refining company Hindustan Petroleum Corporation Limited and SP Ports Pvt. Ltd., a group company of Shapoorji Pallonji, a major construction group in India. HSEPL plans to expand the send out capacity of the 5 million tons per year plant currently being built to 10 million tons in the future.

TOYO has executed construction projects including phase I as well as phase II and III expansions for the Dahej Terminal of Petronet LNG Limited, as well as the Mundra Terminal of GSPC LNG Limited. As LNG demand is continuously growing in India due to rapid economic development, Toyo-India will develop sales for further orders as a leader in the construction of LNG regasification facilities.

Four Biomass Power Plant Projects Underway in Japan

Ceremony for safe construction of the Toyama biomass power plant

TOYO has positioned the infrastructure field, centered on power generation plants, as one of its core businesses, and is actively involved in photovoltaic and biomass power for renewable energy generation in Japan. In biomass, TOYO was awarded its first project in Ibaraki Prefecture in 2018, and successively obtained projects in Toyama, Tottori and Hokkaido Prefectures, totaling four projects currently underway.

All biomass power plants under construction are highly efficient biomass-fired plants using wood pellets and palm kernel shells, and apply 50,000 kW-class reheat systems.*

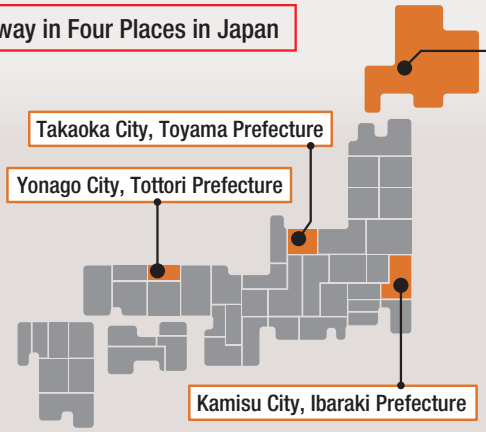
TOYO will continue to contribute to helping create a low carbon society by expanding its approach to biomass power generation.

*Reheat system: Steam, after expansion through a high pressure steam turbine, is sent back and reheated in the boiler, then resent to the low pressure steam turbine for further expansion. This system allows for high efficiency in power generation.

Four Biomass Power Plant Projects Underway in Four Places in Japan

Yonago Biomass Power
- ① Yonago Biomass Power Generation LLC.
- ② 54,500 kW dedicated biomass-fired power plant
- ③ Scheduled for completion in 2022

Toyama Biomass Power
- ① Equis Bioenergy K.K.
- ② 50,000 kW-class dedicated biomass-fired power plant
- ③ Scheduled for completion in 2021



① Client ② Facility type ③ Scheduled completion

Ishikari Biomass Power
- ① Ishikari Shinko New Energy Hatsuden Godo Kaisha
- ② 51,500 kW dedicated biomass-fired power plant
- ③ Scheduled for completion in 2022

Kamisu Biomass Power
- ① Obayashi Kamisu Biomass Power Generation Corp.
- ② 50,000 kW-class dedicated biomass-fired power plant
- ③ Scheduled for completion in 2021

Top: Aerial view of Setouchi Kirei Mega Solar Power Plant
Bottom: The Kinkai Habitat (approximately 16 hectares)

Completion of Japan's Largest Mega Solar Power Plant Project

In September 2018, TOYO completed construction of the Setouchi Kirei Mega Solar Power Plant and handed it over to Setouchi Future Creations LLC.

The power plant was constructed on 260 hectares (with a panel surface area of approximately 230 hectares) in the former Kinkai salt field (approximately 500 hectares) in Setouchi City, Okayama Prefecture. It represents Japan's largest solar power plant currently in operation and has approximately 900,000 polycrystalline silicon solar panels installed.

This project comprised three key concepts: power generation, safety and security, and environmental preservation. Regarding power generation, electricity is supplied at a maximum rate of approximately 235 MW, which is enough to power nearly 80,000 regular family homes for one year. Moreover, the plant's operations allow Setouchi City to reduce annual total CO_2 output by around half, or 192,000 tons. For safety and security, the project involved dredging the central drainage channel that runs from east to west along the former Kinkai salt field. Drainage pumps were expanded and emergency power generators were installed as strategies to prevent flooding. Under environmental preservation, a nature reserve area entitled the Kinkai Habitat was established to preserve the saline wetlands that are home to rare wild plants and animals.

With the Setouchi Kirei Mega Solar Power Plant, TOYO displayed its capabilities as an integrated engineering company to successfully complete a mega solar project and realize an ideal application of renewable energy.

Awarded Technical Study and Project Audit for Oil Depot in Iraq

TOYO has been awarded a contract by Basra Oil Company (BOC), a national oil company located south of Iraq, to carry out a technical study and project audit on FAO Oil Depot. In 2012, TOYO concluded a general engineering service agreement with BOC (previously South Oil Company) under which TOYO has conducted technical studies and developed implementation plans related to Iraqi crude oil export planning.

The Iraqi government aims to use FAO Oil Depot to export crude oil of 3.5 million barrels per day in 2020 and 6 million barrels per day in 2023. This contract involves studies to present a practical route to improve facility capacity for the government's export targets, including improvement of quality control and the oil blending function, through the modernization of the facility that is being constructed by a national company under the Iraqi Ministry of Oil.

Signing ceremony

For this project, the work is scheduled for an approximately eight-month period after the contract comes into effect. TOYO will provide solutions from the client's viewpoint, focusing on technical transfers by working as a team with BOC under the project policy "Of Iraq, for Iraq, by Iraq."

Construction Completed on Mega Solar Power Plant in Japan

Completion ceremony

In September 2019, TOYO completed construction work on a mega solar power plant (55 MW) in Gujo City, Gifu Prefecture, Japan, for Pacifico Energy Minami G.K., and held a completion ceremony.

The project began in February 2018, and faced several challenges during the work period, including unprecedented heat and heavy rain. Furthermore, there were constant challenges with natural elements, such as the steep slope on which the panels were installed as well as falling rocks. These challenges were overcome with assistance from the client, the construction staff, local municipal bodies, and others, and the project was successfully completed.

At present, TOYO is carrying out mega solar power plant projects in Fukushima, Chiba, Hyogo and Niigata Prefectures.

Awarded Large-scale Photovoltaic Power Plant in Japan

TOYO has been awarded a construction project for a mega solar power plant in Agano City, Niigata Prefecture, Japan, by Etrion Energy 6 G.K. The plant will have a power generating capacity of 45 MW (DC) and is scheduled for completion in 2021. The generated electricity will be sold to the Tohoku Electric Power Co., Inc.

Etrion Energy 6 G.K. is owned by Etrion Corporation, a solar energy development company which operates 11 photovoltaic power plants in Japan.

This will be TOYO's tenth project for a mega solar power plant, of which five plants are currently in commercial operation. The total power generating capacity of the 10 projects will exceed 700 MW, which will give TOYO the leading EPC achievement in Japan.

Groundbreaking ceremony

Twelve SPP* Plant Projects in Thailand Completed

The completed cogeneration power plant

In May 2017, the first of 12 cogeneration power plant projects jointly invested in by Mitsui & Co., Ltd., and private energy operator Gulf Energy Development Public Co., Ltd., Thailand, was completed, and the plant has commenced operations. The other plants were sequentially handed over on time to the client. The 12th project has been completed, and the plant started operations on July 1, 2019.

Under this project, 12 natural gas-fired combined cycle cogeneration power plants (four 130 MW, two 125 MW, six 120 MW, total generation capacity 1,490 MW) were constructed in seven different industrial parks in southern Thailand. Work began on each new plant every two months, and the Bangkok Project Office oversaw the entire project.

In Thailand, economic development has driven high demand for electricity, particularly in the suburbs of Bangkok. The construction of these 12 power plants is expected to contribute to the continuous development of the country's industry.

*SPP: Small Power Producers

Jakarta Mass Rapid Transit North-South Line Construction Completed

Jakarta Mass Rapid Transit

As part of a four-company consortium including PT. Inti Karya Persada Tehnik (IKPT), Mitsui & Co., Ltd., and Kobe Steel, Ltd. (KOBELCO), TOYO has completed a package involving construction and installation of an integrated railway system as well as track work, and handed it over to PT Mass Rapid Transit Jakarta in March 2019. Prior to the commencement of commercial operations on April 1, an opening ceremony was held on March 24, with the attendance of Joko Widodo, President of Indonesia.

Actively backed by the President, this development project aims to mitigate the severe traffic congestion in the country's capital of Jakarta, which has accompanied the rapid economic growth in recent years. It is also the first actual example of the railway package type infrastructure export projects promoted by the Japanese government, and employs a wide array of Japanese technologies. The success of this project contributes to strengthening the relationship of trust between the two governments, and is a significant event leading to the promotion of further economic cooperation.

Awarded Petrochemical Plant in Indonesia

TOYO has been awarded a contract for the construction of an acrylic acid plant with an annual production capacity of 100,000 tons from PT. Nippon Shokubai Indonesia, an Indonesian subsidiary of Nippon Shokubai Co., Ltd. The plant will be located in Cilegon, Banten, on the western tip of Java, Indonesia.

The award of the project resulted from TOYO's good relationship with Nippon Shokubai over the years and high evaluations of the project execution capability of Toyo-Japan and PT. Inti Karya Persada Tehnik (IKPT) in Indonesia. Toyo-Japan will manage part of the engineering and overseas procurement, and IKPT will be responsible for detailed engineering, domestic procurement, and construction work in cooperation with PT. SMCC Utama Indonesia, a local subsidiary of Sumitomo Mitsui Construction Co., Ltd. The plant is scheduled for completion in 2021.

Groundbreaking ceremony

Awarded Two Petrochemical Projects from Maruzen Petrochemical in Japan


Safety ceremony for the naphtha cracking furnace expansion project

TOYO has been awarded two construction projects for the Chiba plant of Maruzen Petrochemical Co., Ltd., Japan. The first project is to expand the existing naphtha cracking furnaces and was awarded in summer 2018. With the engineering and procurement work completed, local construction is now underway.

The second project was awarded in spring 2019 to TOYO's Japanese group company TEC Project Service Corporation (TPS) which is to construct a new propylene splitter at the same plant. In this project, TPS will be in charge of detailed engineering, procurement of equipment and materials, and construction, taking over the basic engineering conducted by Toyo-Japan in the previous year.

Ever since Maruzen Petrochemical awarded TOYO the project for the ethylene unit of its Chiba plant No. 3 in 1967, a number of projects have been implemented for the client over many years. TOYO will execute these two projects under a policy of placing the highest priority on safety, taking advantage of this experience.

Construction Completed on High Potency API Plant in Japan

TEC Project Services Corporation (TPS) has completed construction of the fourth plant for Yonezawa Hamari Chemicals, Ltd., and a completion ceremony was held in March 2019. The multi-purpose plant is capable of production of variable types and volumes to meet the forecast demand for high potency active pharmaceutical ingredients (API). It is expected to play an important role in Yonezawa Hamari Chemicals' strategic planning. TPS handled the entire project, from basic engineering to construction. Through the application of 3-D engineering using the latest digital technologies, TPS achieved a high quality of work.


Yonezawa Hamari Chemicals' fourth plant

TOYO ENGINEERING

GLOBAL NETWORK

Toyo Engineering Corporation

HEAD OFFICE / ENGINEERING CENTER
2-8-1 Akanehama, Narashino-shi, Chiba
275-0024, Japan
Tel: 81-47-451-1111
Fax: 81-47-454-1800

TOKYO HEAD OFFICE
11th Fl., Shin-Marunouchi Building,
1-5-1 Marunouchi, Chiyoda-ku, Tokyo
100-6511, Japan
Tel: 81-3-6268-6611
Fax: 81-3-3214-6011

OFFICES

Jakarta
Wisma IKPT, 2nd Fl., JL. MT. Haryono Kav.
4-5, Jakarta 12830, Indonesia
Tel: 62-21-835-4170
Fax: 62-21-835-4149

Tehran
3rd floor, No. 37, East Atefi St., Nelson
Mandela Blvd. (Jordan Ave.), Tehran,
1917797497, Iran
Tel: 98-21-262-00107/00104
Fax: 98-21-262-90349

Moscow
Room No. 605, World Trade Center,
Krasnopresnenskaya Nab., 12, Moscow
123610, Russia
Tel: 7-495-258-2064/1504
Fax: 7-495-258-2065

GROUP COMPANIES

TEC Project Services Corporation
2-8-1 Akanehama, Narashino-shi, Chiba
275-0024, Japan
Tel: 81-47-454-1178
Fax: 81-47-454-1550

Toyo Engineering Korea Limited
Toyo B/D. 11, Teheran-ro 37-gil,
(Yeoksam-dong), Gangnam-gu,
Seoul, 06142, Korea
Tel: 82-2-2189-1620
Fax: 82-2-2189-1890

Toyo Engineering Corporation (China)
18th Fl., Shanghai Zhongrong Plaza, No. 1088
Pudong South Road, Pudong New District,
Shanghai 200122, China
Tel: 86-21-6187-1270
Fax: 86-21-5888-8864/8874

PT. Inti Karya Persada Tehnik (IKPT)
JL. MT. Haryono Kav. 4-5, Jakarta 12830,
Indonesia
Tel: 62-21-829-2177
Fax: 62-21-828-1444
62-21-835-3091

Toyo Engineering & Construction Sdn. Bhd.
Suite 25.4, 25th Fl., Menara Haw Par,
Jalan Sultan Ismail, 50250 Kuala Lumpur,
Malaysia
Tel: 60-3-2731-1100
Fax: 60-3-2731-1110

Toyo Engineering India Private Limited
"Toyo Technology Centre," 71,
Kanjur Village Road, Kanjurmarg (East),
Mumbai-400 042, India
Tel: 91-22-2573-5000
Fax: 91-22-2573-5842

Toyo Engineering Europe, S.r.l.
10 Via Alzata, i-24030 Villa d'Adda,
Bergamo, Italy
Tel: 39-035-4390520

Toyo Engineering Canada Ltd.
Suite 440, 840-6th Avenue, S.W.
Calgary, Alberta T2P 3E5, Canada
Tel: 1-403-266-4400
Fax: 1-403-266-5525

Toyo U.S.A., Inc.
15415 Katy Freeway, Suite 600, Houston,
TX 77094, U.S.A.
Tel: 1-281-579-8900
Fax: 1-281-599-9337

TS Participações e Investimentos S.A.
Edifício Birmann 12, 1º andar,
Rua Alexandre Dumas, nº 1.711,
Santo Amaro, São Paulo,
SP 04717-004, Brazil
Tel: 55-11-5525-4834
Fax: 55-11-5525-4841

Cover: "The rhythm of the earth,"
design and illustration by Takayuki Ryujin