

“Quality Infrastructure Investment” Casebook

The Government of Japan :

Ministry of Foreign Affairs; Ministry of Finance, Ministry of Economy, Trade and Industry;
Ministry of Land, Infrastructure, Transport and Tourism; Ministry of Internal Affairs and
Communications; JICA

(edited by International Cooperation Bureau, Ministry of Foreign Affairs)

Background to the “Quality Infrastructure Investment” Casebook

● To achieve inclusive, sustainable, and resilient “quality growth,” it is necessary to promote “quality infrastructure investment” for bridging the infrastructure gap, which has become a bottleneck against global economic growth. The importance of quality infrastructure investment has been confirmed in recent years by the G20, APEC, the FfD, the 2030 agenda for sustainable development, etc.

1) Annex to the Beijing APEC Declaration in November 2014 “APEC Connectivity Blueprint”

“We will develop, maintain and renew quality infrastructure,[...]”

2) G20 Leaders’ communiqué Brisbane Summit, in the same month

“We endorse the Global Infrastructure Initiative, a multi-year work programme to lift quality public and private infrastructure investment.”

● In order to promote quality infrastructure investment globally, it is important to develop a common understanding of the concept among members of the international community. This casebook is intended to contribute to forging such a common understanding, by showcasing examples of “quality infrastructure investment” carried out by the Government of Japan, and by examining how they are contributing to the development of respective local economies.

Table of Contents (I)

(Railway Sector)

Delhi Mass Rapid Transport System Project (India, Japanese ODA Loan)

Taiwan High Speed Rail (Taiwan)

Capacity Enhancement of Mass Transit Systems in Metro Manila Project (Philippines, Japanese ODA Loan)

Intercity Express Programme (UK, JBIC/NEXI)

Yangon-Mandalay Railway Improvement Project Phase I (Myanmar, Japanese ODA Loan)

Jakarta Mass Rapid Transit (Indonesia, Japanese ODA Loan)

Mass Transit System Project in Bangkok “Purple Line” (Thailand, Japanese ODA Loan)

Dubai Metro (United Arab Emirates)

(Road and Bridge Sector)

Nhat Tan Bridge (Vietnam-Japan Friendship Bridge) Construction Project (Vietnam, Japanese ODA Loan)

Matadi Bridge (Democratic Republic of the Congo, Japanese ODA Loan)

Project for Construction of Neak Loeung Bridge (Cambodia, Grant Aid)

Project for Development of Traffic Management System in Phnom Penh (Cambodia, Grant Aid)

Table of Contents (II)

(Airport and Port Sector)

Terminal 2 Construction Project at Noi Bai International Airport (Vietnam, Japanese ODA Loan)

Mombasa Port Development Project (Kenya, Japanese ODA Loan)

New Bohol Airport Construction and Sustainable Environment Protection Project (Philippines, Japanese ODA Loan)

(Energy Sector)

Talimarjan Gas Thermal Power Station Extension Project (Uzbekistan, Japanese ODA Loan)

Olkaria I Units 4 and 5 Geothermal Power Project (Kenya, Japanese ODA Loan)

Kinyerezi Gas Coal-Fired Power Plant (Tanzania, JBIC/NEXI)

Safi High-Efficiency Thermal Power Station (Morocco, JBIC/NEXI)

Geothermal Power Plant of NPC (Iceland, JBIC/NEXI)

Nghi Son Refinery (Vietnam, JBIC/NEXI)

Nam Ngiep 1 Hydropower Project (Laos, JBIC)

Purulia Pumped Storage Project (India, Japanese ODA Loan)

Muara Karang Gas Power Plant Project (Indonesia, Japanese ODA Loan)

Bheramara Combined Cycle Power Plant Development Project (Bangladesh, Japanese ODA Loan)

Table of Contents (III) <Technology>

(Energy Sector)

Ultra Super Critical (USC) Coal-Fired Thermal Power Generation

Gas Turbine Combined Cycle (GTCC) Power Plant

Integrated Coal Gasification Combined Cycle (IGCC)

Know-How in Operation and Maintenance (O&M) of Thermal Power Plants

High Voltage Direct Current (HVDC)

High-Voltage and High-Capacity Underground Substation Technology

Stability Enhancement System (SES) for Power Grid

Various Environmental Measures and Technologies for Houses and Buildings

(Traffic Sector)

Japan's Shinkansen System

Urban Traffic System

Bridge Construction and Management Technologies

Consistent Support of Port Projects by the Use of Technologies and Know-How in Japan

Management of Airports in Japan

(Disaster Management Sector)

ICT Disaster Management Unit

Underground Discharge Channel Technology for Reduction of Flood Damage in Urban Areas

Solid State Weather and Precipitation Radar

(Other)

Large Floating Structure for Logistics and Offshore Development

GNSS Earth Observation Network System (GEONET)

Elements of Quality Infrastructure Investment	Basic Concept
(1) Effective mobilization of financial resources through PPP, etc. ... 1)	<ul style="list-style-type: none"> • Utilization of public financial resources through, for example, Japanese ODA Loans and JICA’s Private Sector Investment Finance, as catalysts for private financial resources • Support for building PPP-related systems and capacities in developing countries through technical cooperation • Co-financing with other donors
(2) Ensuring alignment with socioeconomic development and development strategies of developing countries/regions as well as comprehensive response to the needs... 2)	<ul style="list-style-type: none"> • Consistency with long-term plans and master plans (as well as support for preparing these plans) • Sharing and overcoming development issues through dialogue on ODA policies and industrial policies • Comprehensive approach (provision of various ODA tools according to recipient country’s needs and development stage) • Dialogue and cooperation with domestic and overseas stakeholders and development partners
(3) Application of high-quality standards (e.g. guidelines for environmental and social considerations)... 3)	<ul style="list-style-type: none"> • Compliance with international standards established to mitigate environmental and social impact (e.g. IFC Performance Standards)
(4) Ensuring the quality of infrastructure	
A. Economic efficiency (e.g. low life-cycle cost)... 4)	<ul style="list-style-type: none"> • Efficiency, durability, and strong operation and maintenance capacities • Construction management (utilization of ICT, strict observation of delivery deadlines, adjustment to plan changes, etc.) • Reduction in environmental burdens and social costs (e.g. reduction in congestion cost, design that minimizes the scale of land expropriation)
B. Inclusiveness ... 5)	<ul style="list-style-type: none"> • Improvement of welfare and economy of residents, including the poor • Promotion of well-balanced development between rural and urban areas • Gender consideration • Barrier-free
C. Safety and resilience ... 6)	<ul style="list-style-type: none"> • Resilience against natural disasters (systems taking into account durability, backups, and prompt recovery) • Ensuring safety in use and operation as well as security in and around construction sites
D. Sustainability ... 7)	<ul style="list-style-type: none"> • Harmony with the environment • Maintaining high performance and optimized operation • Continuation of management
E. Convenience and amenities ... 8)	<ul style="list-style-type: none"> • High trustworthiness of the service • High affinity with local culture and lifestyle • Reduction of users’ burdens through a highly integrated system (e.g. holistic development of a station and its surrounding areas) • Ease of operation and maintenance (system management, including operability of equipment and utilization of ICT) (e.g. measures to reduce metro congestion)
(5) Contribution to the local society and economy ... 9)	<ul style="list-style-type: none"> • Local job creation and giving back the benefits to the local community • By combining financial cooperation with technical cooperation, <ul style="list-style-type: none"> - development of local human resources for infrastructure operation - transfer of Japanese-style working culture, such as adhering to the delivery deadline and construction period - sharing of experience as a forerunner of emerging issues (such as disaster risk reduction and measures for aging society)

Railway Sector

Delhi Mass Rapid Transport System Project (India, Japanese ODA Loan)

Background, summary, etc.

[Background]

- Sharp increase in the population of the urban area in Delhi

9.42 million in 1991 → 16.75 million in 2011

- Deterioration of environment and traffic congestion due to the increased number of automobiles

Number of registered vehicles in Delhi: 1.83 million in 1990
→ 6.93 million in 2011

[Project summary]

The project consists of the construction of a rapid transport system (public works, electric / telecommunication / signal works, etc.) and the procurement of vehicles. Phase 1 (65 km) from October 1998 to November 2006. Phase 2 (125 km) from April 2006 to August 2011. Phase 3 (116 km) from June 2011 to April 2016.

[Result]

On average, about 2.5 million people use the metro every day (cf. 3 million people use underground railways per day in London). The metro system has contributed to reducing the number of vehicles by 120,000 in Delhi.



Characteristics as a “Quality Infrastructure” project

(5) Inclusiveness

(8) Convenience / amenities

(9) Contribution to the local society and economy

(3) Application of high-quality standards (e.g. guidelines for environmental and social considerations)

(4) Economic efficiency (e.g. low life-cycle cost)

(7) Sustainability

(6) Safety / resilience

- ✓ To improve the capacities regarding safe operation and vehicle maintenance, technical cooperation is provided to the Delhi Metro Rail Corporation with the cooperation of Tokyo Metro Co., Ltd. and Metro Sharyo Co., Ltd., both of which run Tokyo Metro trains.
- ✓ Technology and knowledge that based on Japan’s experience of urbanization and public transportation development were shared.
- ✓ With Japanese companies’ cooperation, the mindset of workers to gather punctually every morning and to attach the importance to the observance of delivery deadlines was fostered.
- ✓ People begin to wait in line for trains through such efforts as the station staff’s instruction, etc. The idea of “forming a line to wait” is introduced to the local people.
- ✓ A “clean” image is established by thoroughly applying rules for prohibiting disposal of rubbish in the metro.
- ✓ Women-only train carriages are introduced so that women can safely use public transportation.
- ✓ “Regenerative brake system”, introduced to metro as Japanese company’s energy-efficient technology, is expected to reduce CO₂ emission by 22 million tons (total reduction between 2002 and 2032). The project was registered by the United Nations as the world’s first CDM project in the railway sector.
- ✓ The concept of “safety” is firmly established by putting fences around construction sites, obliging workers to wear helmets and safety shoes, and having the workers place things in order at construction sites.
- ✓ Safety measures are tightened by introducing “On Site Visualization (OSV)” developed by Kobe University (which indicates the danger of collapse by color of light when the ground or a structure gets displaced).

Taiwan High Speed Rail (Taiwan)

Background, summary, etc.

[Project summary]

○ Existing section

- Total length: about 345 km between Taipei to Zuoying (Kaohsiung)
- Opening date: January 5, 2007, Banqiao to Zuoying
March 2, 2007, Taipei to Banqiao (Inauguration)
- Stations: 8 at the inauguration, 3 under construction
- Maximum speed: 300 km/h
- Shortest required time: 96 min. between Taipei and Zuoying (Kaohsiung)
[existing conventional lines: about 4.5 hours]
- Implementing agency: Taiwan High Speed Rail Corporation (which will operate the project for 35 years after the ground breaking in 1998)

○ New section (extension)

- 9.2 km between Nangang and Taipei
- To be opened : March 2016



Characteristics as a “Quality Infrastructure” project

(6) Safety / resilience

- ✓ The Taiwanese side awarded the contract to Japanese companies that have competitiveness in safety and resilience after the Taiwan Earthquake in 1999.
- ✓ No accidents resulting in fatalities or injuries to passengers during the 8 years of operation. Even when the Jiaxian Earthquake (of magnitude 6.4) occurred in March 2010, no passengers died or were injured.

(8) Convenience / amenities

- ✓ Trains run almost on time.
(Average delay: 0.24 minutes.; ratio of trains arriving within 5 minutes. before or after the schedule: 99.40%)
- ✓ High trustworthiness (ratio of trains not cancelled: 99.58%)

(9) Contribution to the local society and economy

- ✓ Japanese companies gave trainings to the Taiwanese staffs before the inauguration.

Capacity Enhancement of Mass Transit Systems in Metro Manila Project (Philippines, Japanese ODA Loan)

Background, summary, etc.

[Background]

○ Rapid rise in the population of the Manila Metropolitan Area

8.95 million in 1990 → 11.86 million in 2010

○ Problems of air pollution and greenhouse gases

Taking measures for eliminating air pollution and greenhouse gases is acutely necessary due to the worsening traffic congestion.

○ Worsening traffic congestion

The traffic congestion worsened as a result of the increase in the population and the number of registered vehicles in the center and suburbs of Metro Manila.



[Project summary]

The procurement of train cars and the enhancement of the depot facilities for the extension of LRT Line 1, as well as the improvement of the railway systems of LRT Line 2, will increase their transport capacities and contribute to reducing road congestion and air pollution in Metro Manila. Previously, the Japanese government has supported the procurement of train cars by Japanese ODA Loans (“Metro Manila LRT Line 1 Capacity Expansion Project” (I, II) (1994, 2000)). Upon the request from the Philippine Government for the use of advanced Japanese technology, the Japanese Government extended the loan under the STEP (Japan-tied loan conditions) (2013).

Characteristics as a “Quality Infrastructure” project

(1) Effective mobilization of financial resources through PPP, etc.

(2) Ensuring alignment with socioeconomic development and development strategies of developing countries/regions as well as comprehensive response to the needs

(3) Application of high-quality standards (e.g. guidelines for environmental and social considerations)...

(7) Sustainability

(4) Economic efficiency of reduction in life-cycle cost

✓ For LRT Line 1, the Philippines Government has intended to procure rolling stocks by the Japanese ODA Loan (STEP), railway systems by the Philippine Government’s funds while tapping private sector finance (PPP) for the civil works (except for the Depot) and the operation and maintenance.

✓ The project was conceptualized through the “Metro Manila Urban Transportation Integration Study” and aims at “harmonious development through the establishment of a master plan.” It is one of the ten flagship PPP projects of the Aquino Administration and thus contributed to the roll out of the PPP policy of the administration in its early period.

✓ The International Finance Corporation (IFC) supported the F/S on the extension of LRT Line 1. It also provided the transaction advisory service for procurement of the civil works as well as the concessions for the operation and maintenance, and procurement of equipment, etc.

✓ The project assists the Philippine Government in addressing environmental (by contributing to the reduction of air pollution) and urbanization (by mitigating traffic congestion through the establishment of a public transit system) challenges.

✓ While the train cars procured from other countries had trouble, the Japanese train cars procured in the 1990s have proven its high quality. The new rolling stocks to be procured through the project will be equipped with highly efficient inverters and other superior-quality components developed in Japan aiming at high development impact.

Intercity Express Programme (United Kingdom, JBIC/NEXI)

Background, summary, etc.

[Project summary]

- The Department for Transport's project to renew express train cars for main existing lines that have become decrepit
- Delivery of 866 train cars for the East Coast Main Line (ECML) and the Great Western Main Line (GWML)
- Provision of maintenance for 27 and a half years
- The largest scale in the UK railway history (about 5.7 billion pounds in total (about 8.5 billion dollars))

[Recent development]

- March 2015: arrival of train cars(Class 800) manufactured in advance at Southampton Port, UK
- Around summer of 2015: a train car plant to be completed in Newton Aycliffe, Durham County, UK
- 2016: beginning of mass production of Class 800 series



Characteristics as a “Quality Infrastructure” project

- | | | |
|---|---|--|
| (1) Effective mobilization of financial resources through PPP, etc. | } | ✓ The project company raised funds necessary for the procurement of train cars and the establishment of a maintenance base by the PPP scheme under the financial support of JBIC/NEXI. |
| (4) Economic efficiency
(e.g. low life-cycle cost) | | ✓ Introduction of environment-friendly train cars that do not use much energy by having light aluminum bodies and a driving system using energy efficient technology. |
| (6) Safety / resilience | } | ✓ A diesel-engine generator is installed under the floor of a train car so that the train can run in both electrified and non-electrified sections. |
| (7) Sustainability | | Because the generator can be removed, it is possible to change the operation smoothly in the future when it becomes necessary (e.g. expansion of electrified sections) . |
| (8) Convenience / amenities | } | ✓ Because contracts cover not only the delivery of train cars but also maintenance, it is possible to provide safe and stable transport service continuously. |
| (9) Contribution to the local society and economy | | ✓ A train car plant and a maintenance site are established locally. About 730 staff members are expected to be employed at the train car plant, including its R&D facility. |

Yangon-Mandalay Railway Improvement Project Phase I (Myanmar, Japanese ODA Loan)

Background, summary, etc.

[Background]

○ A sharp rise in the population living along the corridor and the demand for cargo transport

The existing facilities and train cars of the Yangon-Mandalay railways have become decrepit due to long-term insufficient maintenance and aging degradation. While the demand for passenger and cargo transport has been increasing, delays and derail accidents are major concerns for transportation service.

[Project summary]

Of the existing railway between Yangon and Mandalay (about 620 km), the first and second largest cities in Myanmar respectively, the decrepit facilities and equipment between Yangon and Toungoo (about 260 km) are rehabilitated and modernized to have safer and faster train operation and to increase cargo and passenger transport capacities, thereby contributing to the economic development of Myanmar.



Characteristics as a “Quality Infrastructure” project

(2) Ensuring alignment with socioeconomic development and development strategies of developing countries/regions as well as comprehensive response to the needs

(6) Safety / resilience

(9) Contribution to the local society and economy

(8) Convenience / amenities

- ✓ A priority project based on “Myanmar’s National Transport Master Plan” established by JICA
- ✓ The project connects the three main cities – Yangon, Nay Pyi Taw, and Mandalay – contributing to the improvement of the railway transport service, the vitalization of the economic activities along the line, and the improvement of the public transportation service that connects the emerging cities along the line.
- ✓ Japan’s railway system technology has been introduced through the grant aid project entitled “Project for Installation of Operation Control Center System and Safety Equipment.” In addition, assistance to improve the railway maintenance capacity has been implemented through the technical cooperation project entitled “Project on Improvement of Service and Safety of Railway.”
- ✓ The project aims to enhance reliability of the train services through improvements in speed, punctuality and new facilities.

Jakarta Mass Rapid Transit (Indonesia, Japanese ODA Loan)

Background, summary, etc.

[Background]

- **Sharp rise in the population of the Jakarta metropolitan area**

21 million in 2000 → 28 million in 2010

- **Air pollution and greenhouse gas**

Taking measures for reducing air pollution and greenhouse gas is acutely necessary due to the worsening traffic congestion.

- **Deterioration of traffic condition**

The traffic congestion deteriorated as a result of an increase in the population of the center and suburbs of the metropolitan area and an increase in the total number of registered vehicles.

Number of registered vehicles (two-wheeled vehicles and passenger vehicles): 2.67 million in 2000 → 9.63 million in 2010

[Project summary]

The purpose of the project is to construct a mass rapid transit system in the Jakarta metropolitan area, where traffic congestion is serious, in order to improve the passenger transport capacity and mitigate traffic congestion.



Characteristics as a “Quality Infrastructure” project

(2) Ensuring alignment with socioeconomic development and development strategies of developing countries/regions as well as comprehensive response to the needs

(3) Application of high-quality standards (e.g. guidelines for environmental and social considerations)

(4) Economic efficiency of reduction in life-cycle cost

(8) Convenience / amenities

✓ In the “National Railway Master Plan” (2011), Ministry of Transportation of Indonesia designated this project as one of the main projects for dealing with an increased railway demand expected by 2030.

✓ This project assists the Indonesian Government to address issues, such as environmental consideration (by contributing to the reduction of air pollution) and urban problems (by mitigating traffic congestion through the development of a public transit system).

✓ Public works: The mud pressure shield method, for which Japanese companies have comparative advantage, is used to minimize impact on the ground surface and mitigate traffic congestion.

✓ Railway system: The project adopted train cars in accordance with “STRASYA,” the standard specification of urban railway system which enables the public and private sectors in Japan to promote exports to Asian countries. The project also adopted Japan’s signal system and the IC card “FeliCa.”

Mass Transit System Project in Bangkok “Purple Line” (Thailand, Japanese ODA Loan)



Background, summary, etc.

[Background]

Increasing demand for transport in Bangkok, traffic congestion, air pollution, etc.

[Project summary]

- Project for the development of an urban railway (elevated railway) (23 km in total; scheduled to open in December 2016)
- In November 2013, a consortium of Japanese companies received orders for the provision and maintenance of railway system (such as train cars and signals).
- Japanese train cars were introduced for the first time in urban railway projects in Bangkok.
- Japanese railway companies received an order for the maintenance of overseas train cars for the first time.

Characteristics as a “Quality Infrastructure” project

- | | | |
|---|---|--|
| 4) Economic efficiency
(e.g. low life-cycle cost) | } | ✓ Japanese companies concluded a 10-year maintenance contract in addition to the provision of a railway system. The life-cycle cost of the railway system will be reduced through appropriate maintenance and management. |
| 6) Safety / resilience
7) Sustainability
8) Convenience/amenities | } | ✓ Japanese companies established a new company for the maintenance service. By dispatching technical experts, it became possible to train local employees and to transfer maintenance skills gradually.

✓ Defects in train cars are prevented by continuing appropriate maintenance. This enabled passengers to travel safely and stably. |
| 9) Contribution to the local society and economy | } | ✓ Contribution has been made to improve the skills level of local maintenance. |

Dubai Metro (United Arab Emirates)

Background, summary, etc.

[Background]

Due to the population increase associated with the rapid economic growth, chronic traffic congestion has become a social issue in Dubai.

[Project summary]

- This is the first urban traffic system in the Gulf countries and the longest fully-automatic driverless metro network in the world (registered in the Guinness Book of World Records).
- Red Line: 52.9 km, 29 stations, 220 cars; Green Line: 23.4 km, 20 stations, 175 cars
- A Japanese company constructs cars, signals, communication systems, power receiving equipment, station service equipment, a car base, station buildings, elevated viaducts, tunnels, and a set of necessary public works.



Characteristics as a "Quality Infrastructure" project

- (4) Economic efficiency (e.g. low life-cycle cost)
 - (6) Safety / resilience
 - (7) Sustainability
 - (8) Convenience / amenities
- ✓ The system enjoys the highest operating rate and stable punctuality. (The annual average operating rate is 100%; the punctuality rate is 99.8%)
 - ✓ The system started to operate only 49 months after the conclusion of the contract, which was a surprisingly short construction period compared to the other same sized fully-automatic driverless system.
 - ✓ It is the longest fully-automatic driverless metro network in the world (registered in the Guinness Book of World Records) and has received high acclaim - for example, it won the GCC Winners 2012 Transport Project of the Year.
 - ✓ Wi-Fi can be used in the train. Cellular phones can be used even underground.
- (9) Contribution to the local society and economy
- ✓ The daily average number of passengers exceeds 500,000 per day, which contributes to the mitigation of the traffic congestion.

Road and bridge sector

Nhat Tan Bridge (Vietnam-Japan Friendship Bridge) Construction Project (Vietnam, Japanese ODA Loan)

Background, summary, etc.

[Background]

○ **Deterioration of traffic conditions**

Deterioration of traffic conditions due to rapid increasing of automobiles as a result of population growth in the central part and suburbs of the metropolitan area.



[Project summary]

To meet increasing traffic demand, a bridge (3.9 km long; 8 lanes) over the Song Hong River, which runs across Hanoi City, and approach roads (north and south roads of 5.9 km in total) were constructed under the STEP (Japan-tied loan conditions). Japanese ODA Loans (54.1 billion yen in total) were provided for Phase I (approved in March 2006; 13.7 billion yen), Phase II (approved in January 2011; 24.8 billion yen) and Phase III (approved by March 2013; 15.6 billion yen). The bridge opened in January 2015.

[Result]

Efficiency improvement of distribution, mitigation of traffic congestion (required time between Noi-bai airport and Hanoi City was reduced by about 20 min)

Promotion of economic development and improvement of international competitiveness in Hanoi City and the northern part of Vietnam

Characteristics as a "Quality Infrastructure" project

- | | | |
|--|---|--|
| 4) Economic efficiency
(e.g. low life-cycle cost) | } | ✓ A Japanese company contributed to the reduction of environmental burdens and the improvement of cost efficiency in the construction, applying "Steel Pipe Sheet Pile Wall structure," its soft-ground construction method, for the foundation of the bridge. |
| 6) Safety / resilience | | ✓ The above-mentioned structure was used in Vietnam for the first time. As a result of the application for this project, the method was adopted as the country's bridge design standard, contributing to safe construction of bridges. |
| 8) Convenience / amenities | } | ✓ The procurement of equipment and materials for construction and labor management was carried out by Japanese companies to secure the quality and safety of the construction. |
| 9) Contribution to the local society and economy | | ✓ The Noi Bai International is connected with central Hanoi by a high-standard highway and bridges to shorten the required time for transportation by about 20 min (i.e. 55 min → 35 min). |
| | } | ✓ Japanese skilled engineers transfer skills to Vietnamese engineers. |
| | | ✓ Bridge parts and materials are manufactured local subsidiary of a Japanese company (many of whose employees are Vietnamese). |

Matadi Bridge (Democratic Republic of the Congo, Japanese ODA Loan)

Background, summary, etc.

[Background]

Matadi City has Matadi Port, the largest port in the country, and is an important point on the arterial road connecting the outer bay with the capital. Meanwhile, because there is no bridge over the Congo River (its basin area is the second largest in the world), which runs through the City, people had to use ships to cross the river or transport goods.



[Project summary]

In 1974, Japan concluded a Japanese ODA Loan contract of 34.5 billion yen with the Zaire Government (at the time) and completed the bridge in 1983. As only one bridge over the Congo River and only one suspension bridge in the Republic of the Congo (its length is 772 m), it has been playing an important role for more than 30 years since its completion.

Characteristics as a "Quality Infrastructure" project

- | | |
|---|--|
| (4) Economic efficiency
(e.g. low life-cycle cost) | ✓ According to the maintenance manual prepared by a Japanese company, Organization pour l'Équipement de Banana-Kinshasa (OEBK) in the Democratic Republic of the Congo has continued appropriate maintenance for more than 30 years. In addition, the Japanese company has continued to give advice about the maintenance of the bridge even after withdrawal of Japanese engineers due to conflicts in the country. |
| (6) Safety / resilience
(7) Sustainability | ✓ Because the bridge became decrepit, the FY2014 grant aid project entitled "Projet d'Aménagement du Pont Maréchal à Matadi (Matadi Bridge Conservation Plan)" has been implemented to introduce a dehumidification system to delay the corrosion process of the main bridge cables. |
| (9) Contribution to the local society and economy | ✓ Because many of the engineers engaged in the construction of the bridge retired, a technical cooperation, "Project on Capacity Development for Bridge Management (Matadi)" was implemented for updating skills in the maintenance of the bridge and training young engineers of OEBK. |

Project for Construction of Neak Loeung Bridge (Cambodia, Grant Aid)

Background, summary, etc.



[Background]

○ People's cross point of the Mekong River was a bottleneck along the National Route 1.

Waiting time for a ferry to cross the Mekong River: about 7 to 8 hours during the busy period

Daily average traffic volume: about 2,400 PCU/day (2004) ⇒ more than 5,000 PCU/day (2008); the ferry transport capacity reached the limit.

○ Importance as part of the Asian Highway and the Southern Economic Corridor

National Route 1 is important not only as a main arterial road in Cambodia but also as a critical route of the southern part of the Indochina Peninsula. Enhancement of this route is expected to have a significant economic spillover on surrounding region and neighboring countries.

[Project summary]

A bridge is constructed at Neak Loeung, where National Route 1 crosses the Mekong River.

Project components: the main bridge of 640m long; access bridge of 1,575m; and an access road of 3,245m(5,460m in total length).

Characteristics as a "Quality Infrastructure" project

- | | | |
|--|---|---|
| 2) Ensuring alignment with socioeconomic development and development strategies of developing countries/regions as well as comprehensive response to the needs | ✓ | "Development and restoration of transport infrastructures" is specified in Cambodia's National Strategic Development Plan (NSDP). |
| | ✓ | National Route 1 is designated as an international arterial road that connects Ho Chi Minh – Phnom Penh – Bangkok as Asian Highway 1. Completion of the bridge will facilitates the physical-distribution, which will contribute to regional specialization and the strengthening of supply chains. |
| 3) Application of high-quality standards (e.g. guidelines for environmental and social considerations) | ✓ | Avoidance or reduction of transfer of residents in accordance with the JICA Guidelines |
| | ✓ | Support for Cambodia's public consultation and the provision of explanation and consultation to local NGOs |
| | ✓ | Selection of a route that avoids transfer of residents as much as possible |
| | ✓ | Application of prefabricated construction method for the assembling of reinforcing steel, whereby ensuring high quality while making the construction labor-saving |
| 4) Economic efficiency (e.g. low life-cycle cost) | ✓ | Selecting a prestressed concrete cable-stayed bridge, taking into consideration the economic efficiency of maintenance |
| 5) Inclusiveness | ✓ | Improving the quality of life of neighboring residents (e.g. increasing job opportunities and access to medical services), reduction in the payment of ferry charges by free passage of the bridge (benefit to the poor) |
| 8) Convenience / amenities | | |
| 9) Contribution to the local society and economy | ✓ | |
| | ✓ | Elimination of the waiting time for ferry; crossing during the night time becomes possible |
| | ✓ | Local job creation of about 1,000 people per day; transfer of construction skills to local engineers |

Project for Development of Traffic Management System in Phnom Penh (Cambodia, Grant Aid)

Background, summary, etc.

[Background]

○ Increase in the use of cars

Number of registered vehicles: 62,000 in 2000 → 235,000 in 2011

○ Inefficient signal control system

There was no coordination of signal cycle among nearby intersections and the cycle neither correspond to the length of congestion.

[Project summary]

Installation of traffic signals at 100 intersections (including replacement of 64 signals among the 69 existing signals) and a traffic control center.

[Result]

Improvement of urban traffic condition is expected to increase the average travel time by 14% and reduced the number of police officers dispatched for traffic control by 20%.

○ Deterioration of traffic congestion

Average speed in the City: 20 km/h in 2001 → 15 km/h in 2012



Characteristics as a “Quality Infrastructure” project

- | | | |
|---|---|---|
| (2) Ensuring alignment with socioeconomic development and development strategies of developing countries/regions as well as comprehensive response to the needs | ✓ | In the “Project for Comprehensive Urban Transport Planning in Phnom Penh Capital City,” Japan developed the urban transport master plan which sets 2035 as the target year. In the Project, this project was proposed as one of the short-term top-priority action plans. |
| (4) Economic efficiency (e.g. low life-cycle cost) | ✓ | Reduction of environmental burdens and inefficiency of economic activities through the mitigation of traffic congestion |
| (7) Sustainability | ✓ | Reduction in the number of police officers dispatched for traffic control by 20% and the improvement of traffic flow by the installation of traffic signals at intersections with heavy traffic |
| (8) Convenience / amenities | ✓ | Reduction in the maintenance cost by the adoption of Japan’s high-level traffic control center software as well as energy-saving and longer-lasting LEDs |
| (9) Contribution to the local society and economy | ✓ | Improvement of traffic safety and reduction of travel time by mitigating traffic congestion |
| | ✓ | Implementation of OJT for the responsible agency’s operators and managers on the operation of the traffic control system |
| | ✓ | Basic education about the traffic control system for the traffic police |
| | ✓ | Awareness-raising activities regarding the traffic signals |

Airport and Port Sector

Terminal 2 Construction Project in Noi Bai International Airport (Vietnam, Japanese ODA Loan)

Background, summary, etc.

[Background]

○ Sharp increase in the number of passengers at the existing International Airport Terminal

Although the planned capacity is 6 million per year, the actual numbers of both domestic and international passengers sharply increased to 9.5 million in 2010 and then to 12.8 million in 2013.

[Project summary]

The purpose of the project is to expand passenger capacity and to improve safety by constructing the new Noi Bai International Airport Terminal 2 with the capacity of 10 million passengers per year. The Terminal 2 is exclusively for the international flights, and the modern facilities for supplying fuel to airplanes were installed. Japanese ODA Loans (59,253 million yen in total, STEP (Japan-tied loan conditions)) were provided in three phases, Phase I (approved in March 2010; 12,607 million yen), Phase II (approved in March 2012; 20,584 million yen) and Phase III (approved by December 2013; 26,062 million yen). The construction period was shortened for three months and a completion ceremony was held in January 2015.

[Result]

Increase in the number of international passengers per year: 3.67 million in 2010 → 7.27 million in 2017 (target year)
Increase in the annual number of arrival and departing of international passenger flights: 28,000 in 2010 → 54,000 in 2017 (target year)



Characteristics as a “Quality Infrastructure” project

- 6) Safety / resilience } ✓ Neither fatal accidents nor troubles that influenced the management of the existing airports occurred during the construction period.
- 8) Convenience / amenities } ✓ The latest system for handling passengers' luggage was introduced.
✓ A system for supplying fuel to airplanes by the use of underground pipes was introduced in Vietnam for the first time. Smooth supply of fuel made it possible to increase the number of direct long-distance flights.
✓ Customer satisfaction committee was established by reference to Narita Airport's efforts and has continued activities to improve customer services.
- 9) Contribution to the local society and economy } ✓ Japanese concept of safety management and quality control was taught to nearly 51,000 Vietnamese construction workers.
✓ Since the Airports Corporation of Vietnam, the implementing agency, had lacked sufficient knowledge, know-how, and experience about the operation and maintenance of the latest equipment to be installed in the new terminal, technical cooperation was provided to support the operation and maintenance of the airport (through public-private cooperation, among the Ministry of Foreign Affairs, the Ministry of Land, Infrastructure, Transport and Tourism, JICA, the New Kansai International Airport Engineering Co., Ltd. and the Narita International Airport Corporation).
✓ Technical assistance by Japanese experts concerning the fuel supply system, including the establishment of a business plan, a staff recruitment plan, an organization and personnel distribution plan, facility charges setting, and a training plan, as well as training courses in Japan were provided. Technical cooperation also covered such areas as the operation and maintenance of the facilities in the terminal building and the organization as well as personnel distribution for the facilities.

Mombasa Port Development Project (Kenya, Japanese ODA Loan)



Background, summary, etc.

[Background]

○ The largest international port in East Africa

Mombasa Port is the largest commercial port in East Africa. It is the only international trade port in Kenya that deals with containers, liquid, bulk, general cargoes, etc. It is also strategically important as the gateway of the “Northern Corridor,” which connects Indian Ocean and inland countries including Uganda and Rwanda.

○ Increasing container cargoes

The volume of container cargoes handled at the port increased about threefold during this decade (from 300,000 TEU/year in 2002 to 900,000 TEU/year in 2012). The volume is expected to increase continuously and exceed 2.6 million TEU in 2025.

[Project summary]

In the project, container terminals are constructed and cargo handling machineries are procured to deal with an increasing demand of container cargo volume and improve the efficiency of port management including cargo handling, thereby contributing to the promotion of trade and the socio-economic development in the East Africa region. The project applies the STEP (Japan-tied loan conditions) for the best use of advanced technologies and know-how of Japanese firms.

Characteristics as a “Quality Infrastructure” project

- | | | |
|---|---|---|
| (1) Effective use of funds through PPP, etc. | } | ✓ Port operator selection process is on-going to outsource the port operation management of the berths to be constructed in this project. The port development through the Japanese ODA Loan serves as a catalyst to promote the mobilization of private financial resources. |
| (2) Ensuring alignment with socioeconomic development and development strategies of developing countries/regions as well as comprehensive response to the needs | | ✓ According to Kenya’s long-term development plan “VISION 2030,” infrastructure development is regarded as the foundation that supports the three pillars: “economy,” “society,” and “politics.”
✓ Trade Mark East Africa (TMEA, a non-profit organization organized, financed, and managed by eight donors, including DFID, to promote smooth intraregional trade) implements support rehabilitate the existing berths, institutional capacity strengthening, and the improvement of cargo handling, etc. |
| (3) Application of high-quality standards, such as guidelines for environmental and social considerations | } | ✓ With regard to landfill works, additional sedimentation basins and silt curtains are applied for reducing turbidity. And for reducing dust during the construction, mitigation measures such as water spraying are introduced. |
| (4) Economic efficiency
(e.g. low life-cycle cost) | | ✓ CO ₂ emission is greatly reduced through procurement of environment-friendly port cranes manufactured by a Japanese company, contributing to Kenya’s environmental conservation. |
| (7) Sustainability | | ✓ The maintenance cost is expected to be reduced by applying heavy-duty anticorrosion materials to piles for the berths construction in which Japan has superiority. |
| (9) Contribution to the local society and economy | } | ✓ About 1,700 Kenyan workers are employed for the construction. High-level welding technology is transferred through the construction works. The application of technologies in which Japanese companies have superiority (special steel materials and foundation improvement technology) makes it possible to carry out high-quality and punctual construction works. |

New Bohol Airport Construction and Sustainable Environment Protection Project (Philippines, Japanese ODA Loan)

Background, summary, etc.

[Background]

- **Sharp increase in the number of passengers in the existing airport**
39,268 in 2001 → 572,476 in 2010
- **Expected increase in the number of tourists to Bohol, a province with rich sightseeing resources**
About 5 million in 2010 → about 1.4 million in 2020



[Project summary]

The project is to construct a new airport to meet the increasing demand for air traffic to the Province of Bohol, which has attractive sightseeing resources (such as diving spots), as well as to replace the existing airport which is unextendable due to the limited land availability. The project features the “Eco-Airport” concept that uses Japanese technology and is supplemented by the implementation of a technical cooperation project that curbs impacts to the natural environment from an increase in the number of tourists as a result of the opening of the new airport. The project applies STEP (Japanese-tied loan condition).

Characteristics as a “Quality Infrastructure” project

- | | |
|---|---|
| (1) Effective mobilization of financial resources through PPP, etc | ✓ This project assists a Philippine Government’s PPP priority project through a Japanese ODA Loan for construction and applies a PPP scheme for operation and maintenance. In addition, technical cooperation project is implemented to curb the impact on the natural environment around the airport as a result of an increase in the number of tourists. |
| (3) Application of high-quality standards (e.g. guidelines for environmental and social considerations) | ✓ Under the “Eco-Airport concept,” the airport is constructed with consideration for the environment by the use of Japan’s excellent technologies, such as solar power systems and geo-textile sheets on infiltration ponds for the prevention of environmental damage by waste water from the airport. |
| (4) Economic efficiency (e.g. low life-cycle cost) | |
| (5) Inclusiveness | ✓ Well-balanced development between rural and urban areas is promoted through the construction of an airport in local cities of the Philippines. |
| (7) Sustainability | ✓ The opening of the new airport will result in an increase in the number of tourists. In order to mitigate negative impacts on the natural environment, a technical cooperation project is implemented, consisting of (i) support of tourism development compatible with environmental protection; and (ii) support in strengthening and monitoring of the drainage facilities of hotels and others. |

Energy Sector

Talimarjan Gas Thermal Power Station Extension Project (Uzbekistan, Japanese ODA Loan)



Background, summary, etc.

[Background]

○ Power supply-demand gap

While electric power demand has been increasing in Uzbekistan in line with its stable economic growth, electric power supply is likely to become insufficient due to such factors as aging and inefficient power generation facilities. (According to the estimations in 2010, the power supply-demand gap would be 1,200 MW in 2014.)

○ Status as a national project

The modernization of existing power plants and the development of a new power source by the use of natural gas are among the priority issues of the Uzbek government. This project is positioned as one of the national projects in the power sector.

[Project summary]

In Talimarjan in the southern part of Uzbekistan, two combined-cycle gas turbines (about 900 MW in total) are installed by co-financing with the Asian Development Bank (ADB) to mitigate power shortage and promote economic development.

Characteristics as a “Quality Infrastructure” project

(1) Effective mobilization of financial resources through PPP, etc

✓ This is a co-financing project with ADB by the use of “Accelerated Co-Financing Scheme with ADB” (ACFA).

(2) Ensuring alignment with socioeconomic development and development strategies of developing countries/regions as well as comprehensive response to the needs

✓ The Uzbek government puts priority on the following issues: the improvement of energy efficiency and the stable power supply through modernization of existing power plants; and the development of new power sources by the use of domestic natural gas. In the Presidential resolution in March 2009, this project was positioned as a national priority in the power sector to be carried out from 2010 to 2014.

(4) Economic efficiency (e.g. low life-cycle cost)

✓ The two combined-cycle gas turbines ordered to a Japanese company in 2013 are excellent in output, thermal efficiency, etc. and highly economical.

(9) Contribution to the local society and economy

✓ JICA has been contributing to the development of human resources by providing training courses to cultivate the power sector experts' capacity to operate and maintain gas combined-cycle power generators, and to improve power sector policy planning and power company's managerial competence.

Olkaria I Units 4 and 5 Geothermal Power Project (Kenya, Japanese ODA Loan)

Background, summary, etc.

[Background]

○ Excessive dependence on hydropower generation

Kenya depends on hydropower generation for 46% of power generation and there is a high risk of power shortage caused by large-scale drought. Because of this, higher priority has been recently given to the development of geothermal power as stable energy source for power generation that does not depend on the climate.

○ Promotion of a long-term development plan

Kenya's long-term development plan "Vision 2030" regards "economy," "society," and "politics" as the three main pillars. As a basis to support these three pillars, the energy sector contribute for satisfying needs to secure necessary power supply, to increase the rural electrification rate, and to improve electricity quality in the urban areas.

[Project summary]

In the Project, Olkaria I Geothermal Power Plant Units 4 and 5 (2 units of 70 MW plant) have been constructed in Nakuru County in Kenya to stabilize power supply, thereby contributing for Kenya's economic development through improvement of the investment climate. Other geothermal power plants also adopt turbines produced by Japanese companies, and Japanese technology is utilized in about 90% of Olkaria's geothermal power generation. In particular, the turbine for Olkaria I Unit 1 has been used since 1981 and has contributed to the power generation in Kenya.



Characteristics as a "Quality Infrastructure" project

- | | | |
|---|---|---|
| (1) Effective mobilization of financial resources through PPP, etc. | } | ✓ The installation of steam-water pipes and the construction of power transmission lines from the power generation facilities are financed by the World Bank, the European Investment Bank (EIB), and German government-owned development bank (KfW Group). |
| (2) Ensuring alignment with socioeconomic development and development strategies of developing countries/regions as well as comprehensive response to the needs | | ✓ According to Kenya's long-term development plan "VISION 2030," the energy sector is recognized as one of the important basis that support the three pillars : "economy," "society," and "politics." |
| (3) Application of high-quality standards (e.g. guidelines for environmental and social considerations) | } | ✓ Measures for environmental consideration have been carried out, including selection of the location of a power plant in remote area from villages and the adoption of environmentally friendly piping design. |
| (7) Sustainability | | ✓ Japanese technology is applied to manufacture and process a stainless material (alloy) used for geothermal turbines that are directly exposed to gas that includes impurities, such as sulfur. Market share of Japanese companies in geothermal turbines is about 70% on the world market (on the basis of installed capacity). |
| (9) Contribution to the local society and economy | } | ✓ Through implementation of "Project for Capacity Strengthening for Geothermal Development in Kenya" and the "Project for Reviewing GDC's Geothermal Development Strategy" to improve the capacities of the staff of the Geothermal Development Company in Kenya, contribute for the development of geothermal sector in Kenya comprehensively. |

Kinyerezi Gas Thermal Power Station (Tanzania, JBIC/NEXI)

Background, summary, etc.

[Background]

○ Persistent power shortage

Drastic development of electric power was an urgent issue for Tanzania, which was bothered by persistent power shortage and high cost resources such as leased power generation equipment.

[Project summary]

This project is to construct a first gas fired 240 MW combined cycle power plant. Generated electricity will be supplied for TANESCO, the state owned company in Tanzania.



Characteristics as a "Quality Infrastructure" project

(2) Ensuring alignment with socioeconomic development and development strategies of developing countries/regions as well as comprehensive response to the needs

- ✓ It is urgent for Tanzania to replace the existing high-cost energy power generation with highly efficient power generation using natural gas and to secure power sources not influenced by weather conditions, such as drought. From this domestic circumstances, a highly efficient gas-fired power plant is constructed.
- ✓ The construction of a highly efficient power plant that uses natural gas as fuel corresponds to the World Bank's and IMF's direction of guidance.

(4) Economic efficiency (e.g. low life-cycle cost)

- ✓ This project is expected to supply approximately 20% of Tanzania's power generation capacity and uses natural gas produced in Tanzania. The efficiency of the plant in this project is 30 to 40% higher than that of other plants in the country.

(9) Contribution to the local society and economy

- ✓ As a part of the EPC contract, a Japanese company supplies a power plant control system and an educational simulator, which contribute to the development of human resources for safe technology transfer.

Safi High-Efficiency Coal-Fired Power Plant (Morocco, JBIC/NEXI)

Background, summary, etc.

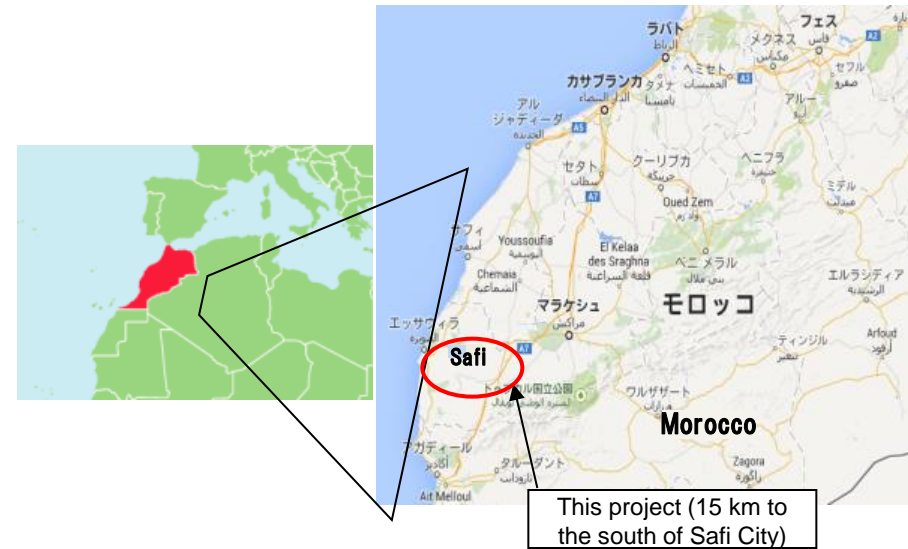
[Background]

In Morocco, the electricity demand is expected to increase. This project is planned as the source of stable base load electricity.

[Project summary]

About 15 km to the south of Safi City in Morocco, an ultra super critical coal-fired power plant with a total output of 1,386 MW (693 MW × 2 units) will be constructed as an IPP project to sell electricity to the Office National de l'Electricité et de l'Eau Potable for 30 years.

(Project site)



This project (15 km to the south of Safi City)

Characteristics as a "Quality Infrastructure" project

(2) Ensuring alignment with socioeconomic development and development strategies of developing countries/regions as well as comprehensive response to the needs

(4) Economic efficiency (e.g. low life-cycle cost)
(7) Sustainability

(9) Contribution to the local society and economy

- ✓ Since the demand for electricity has been steadily increasing, Morocco imports some electricity from other countries. Thus it is a national challenge to increase domestic power generation. The plant is expected to provide a base load electricity after its completion.
- ✓ The plant is the first ultra super critical power plant in Africa. The development of highly efficient power generation (power generation efficiency: 43% (LHV)) contributes to the development of a power source with minimum environmental burden.
- ✓ More than 150 local workers will be employed for the construction and operation of the power plant. Thus, this project contributes to job creation and human resource development in Morocco.

Geothermal Power Plant of NPC (Iceland, JBIC/NEXI)

Background, summary, etc.

[Background]

In Iceland, renewable energy, such as hydraulic and geothermal power, which accounts for more than 99% of total power generation, provides inexpensive electric power for energy consuming industries, such as the aluminum smelting industry and the silicon metal industry. The electric power created by this plant is also planned to be sold to silicon metal plants to be newly constructed.

[Project summary]

Steam turbines for two geothermal power plants with an output of 45 MW (90 MW in total) are exported to the National Power Company (NPC) in Iceland.



Characteristics as a “Quality Infrastructure” project

(2) Ensuring alignment with socioeconomic development and development strategies of countries/regions as well as comprehensive response to the needs

✓ In Iceland, where fossil fuels are insufficient, almost all domestic electric power is produced by renewable energy. In addition, inexpensive electricity charges have attracted energy consuming industries. This project is planned to sell electric power to newly established plants. Therefore, this project is relevant to Iceland’s energy and industrial strategies.

(4) Economic efficiency (e.g. low life-cycle cost)

✓ Japanese companies’ turbines for geothermal power generation have a market share of about 70%. Only Japanese manufacturers can sell large turbines with an output of 10 MW or more. They will also contribute to reduction in the cost of power generation by virtue of the economy of scale of large turbines.

(7) Sustainability

✓ This project takes advantage of geothermal power. It can be operated as long as steam is supplied. In addition, it is possible to generate suitable electric power in an environment-friendly way because it hardly emits CO₂.

Nghi Son Refinery (Vietnam, JBIC/NEXI)

Background, summary, etc.

[Background]

In Vietnam, where the demand for petroleum products has been increasing, most of them are imported because of its limited refining capacity in Dung Quat Refinery, which is the only refinery in the country whose operation began in 2009.

[Project summary]

A refinery with a capacity of 200,000 barrels per day is located in Thanh Hoa Province, Vietnam (about 200 km to the south of Hanoi), together with a petrochemical plant in the downstream sector. The refinery refines crude oil imported from Kuwait (heavy crude oil) and produces petroleum products, such as diesel and jet fuels, and high-value-added petrochemical products, such as polypropylene, paraxylene, and benzene.

Refinery Plan in Vietnam



Characteristics as a "Quality Infrastructure" project

- 2) Ensuring alignment with socioeconomic development and development strategies of developing countries/regions as well as comprehensive response to the needs
 - ✓ As the second refinery in Vietnam, Nghi Son Refinery corresponds to the Vietnam Government's energy policy, which aims to reduce the ratio of imported petroleum products. It is planned that Dung Quat Refinery and Nghi Son Refinery will satisfy about 60% of domestic demand by 2020. Additionally, further expansion of Dung Quat Refinery and construction of the third refinery is planned, to meet the demand in Vietnam.
 - ✓ Partnership has been formed whereby Japan as sponsor and operator, Kuwait as supplier of crude oil, and Vietnam as provider of local business know-how and growing markets.
- 3) Application of high-quality standards (e.g. guidelines for environmental and social considerations)
 - ✓ Although some residents had to be transferred, the use of ECA finance made it possible to give more environmental and social consideration through ECA's consultations with the sponsors (this project has been planned by complying with Vietnam's local standards, the Equator Principles, the World Bank's standards, and each of the ECA standards).
- 9) Contribution to the local society and economy
 - ✓ Optimal operation was achieved under the leadership of a well-experienced Japanese company. In addition, the project contributed to technology transfer to Vietnam and human resource development in Vietnam's petroleum sector through cooperation with Petro Vietnam as well as proactive employment and education of Vietnamese people.

Nam Ngiep 1 Hydropower Project (Laos, JBIC)

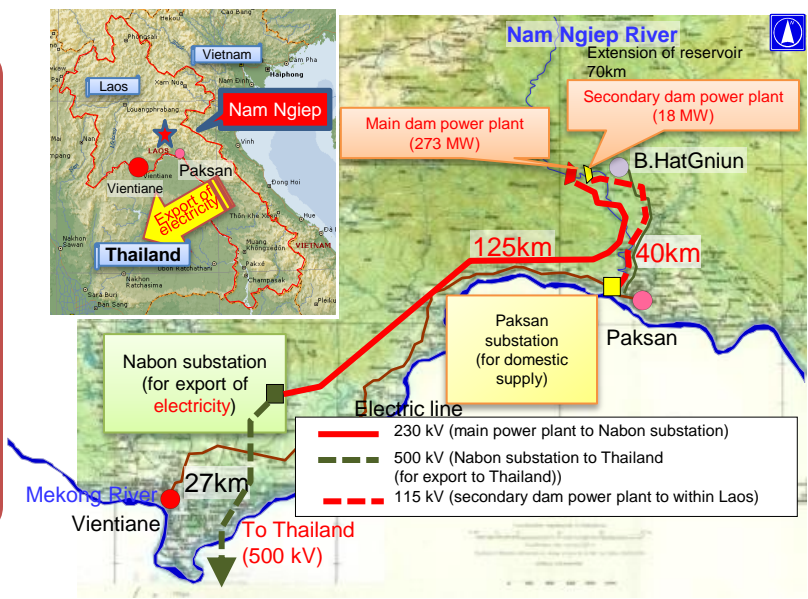
Background, summary, etc.

[Background]

The export of electricity to the neighboring Mekong Basin region including Thailand is one of the main revenue sources for Laos, a country with little natural resources and weak industrial structure. At the same time, given the increasing demand for electricity in Laos, it is imminently necessary to expand the domestic supply of electricity as well.

[Project summary]

Nam Ngiep 1 Power Company Limited (NNP1) constructs and operates a large scale hydro power plant (with the total capacity of 290 MW) . The electricity produced is going to be sold to Thailand and Laos for 27 years.



Characteristics as a "Quality Infrastructure" project

- 1) Effective mobilization of financial resources through PPP, etc
 - 2) Ensuring alignment with socioeconomic development and development strategies of developing countries/regions as well as comprehensive response to the needs
 - 7) Sustainability
 - 9) Contribution to the local society and economy
- ✓ International co-financing among JBIC, ADB, Thai and Japanese banks.
 - ✓ Laos, which has abundant water resources in the Mekong River, contributes to mitigating the tight demand-supply in the Mekong Basin region through the export of electricity to those countries. This project, to supply electricity to Thailand and Laos, contributes not only to stable supply of electric power in the entire region but also to that of Laos itself
 - ✓ A Japanese electric power company, which has abundant proven track records of hydroelectric power generation, plays a big role in this project. Diligent care is also taken to mitigate the impact of resettlement activities and the environmental impact arising from the construction of the project
 - ✓ NNP1 will hire around 1,000 local workers during the construction period and will implement long-term education program about operation and maintenance of the power plant to local workers. The project contributes to employment and capacity building in Laos.

Purulia Pumped Storage Project (India, Japanese ODA Loan)

Background, summary, etc.

[Background]

○ Constant power shortage

Since 1998, the peak-hour supply capacity has remained low at around 11~13%; the annual supply capacity has been around 6~8%

○ Necessity for well-balanced composition of electrical source.

Under the power structure where thermal power generation exceeded 90% of the total, it was necessary to eliminate the peak-hour supply-demand gap by developing a pumped storage hydropower source for pumping up water by utilizing nighttime surplus power supplied from thermal power plants.

[Project summary]

In the Purulia district 300 km to the northwest of Kolkata City in the Province of West Bengal, the peak-hour power supply capacity will be improved by the construction of a pumped storage power plant with an output of 900 MW (225 MW × 4 generating units) and electric transmission and substation facilities for the plant.



Characteristics as a “Quality Infrastructure” project

(4) Economic efficiency
(e.g. low life-cycle cost)

✓ The pumped storage power plant with four generating units of 225 MW is still the largest in India. When this project was carried out, the Kanna River Pumped Storage Power Plant in Japan had the world’s largest design equipment capacity (2,820 MW). Japan, utilizing such technology and expertise, contributed to the reduction of the peak-hour supply-demand gap.

(7) Sustainability

✓ The plant has been operating without any major trouble since the beginning of its operation in 2008. As the executing agency highly appreciated this project, it entrusted the construction consultant for this project with a feasibility study about a new pumped storage project.

(9) Contribution to the local
society and economy

✓ As a CSR activity, the project management consultants cooperated with a local NGO to support neighboring schools (electrification of school buildings through the provision of transformers and the distribution of electric power), contributing to the local communities’ educational activities.

Muara Karang Gas Power Plant Project (Indonesia, Japanese ODA Loan)

Background, summary, etc.

[Background]

○ Tight power supply

No power plant had been constructed in the Java-Bali region since the currency crisis in 1997. The demand for power has increased at an annual rate of 9% since 2000. The power supply has failed to keep up with the increased power demand since 2004.

○ Air pollution and greenhouse gas

The existing power plants that burn heavy oil has worsened air pollution and greenhouse gas. There is an increasing demand for replacing the existing power plants with gas turbine combined cycle (GTCC) power plants.

[Project summary]

The project replaced the existing power plant that burns heavy oil with GTCC power plant and increased the output from 300 MW to about 720 MW, thereby improving power supply-demand balance for the power sector in the Java-Bali region and contributing to stabilize the Indonesian economy and society. The GTCC power plants that have main components made in Japan such as the Tanjung Priok Thermal Power Plant, the Keramasan Thermal Power Plant, and the Cilegon Combined Cycle Power Plant, have operated steadily since the beginning of operation and have contributed to the economic development of Indonesia as the key power source for the Java-Bali power system.



Characteristics as a “Quality Infrastructure” project

(3) Application of high-quality standards (e.g. guidelines for environmental and social considerations)

✓ GTCC that burns natural gas is adopted to contribute to the reduction of air pollution.

(4) Economic efficiency
(e.g. low life-cycle cost)
(7) Sustainability

✓ GTCC power generation is the method whereby a gas turbine generates electric power, and the resultant exhaust heat is also used for a steam turbine, to generate electric power. It is possible to use energy effectively and reduce CO₂ emissions, contributing not only saving energy but also mitigating climate change.

✓ The F-type gas turbine developed by a Japanese company was adopted and its thermal efficiency is the highest level in the world.

Bheramara Combined Cycle Power Plant Development Project (Bangladesh, Japanese ODA Loan)

Background, summary, etc.

[Background]

○ Power supply-demand gap

Bangladesh's recent economic growth has resulted in a sharp increase in the demand for electricity, but the supply cannot keep up with the demand. Because of this, planned power outages have been carried out for many hours in various regions.

○ Decentralization of power sources

As electrification has been delayed in the western part of Bangladesh, it is necessary to construct a large power plant there to develop the local economy and industries. In addition, it is important to geographically spread power sources, which are currently concentrated in the eastern part of the country, in order to secure stable supply of electricity.

[Project summary]

In Bheramara, Khulna Division in the western part of Bangladesh, a gas turbine combined cycle (GTCC) power plant of about 400 MW is constructed by a Japanese ODA Loan. Once it starts its operation, the power plant will supply approximately 4% of the total power demand in the whole country, mitigating power shortage and developing economy and industries.



Characteristics as a "Quality Infrastructure" project

(2) Ensuring alignment with socioeconomic development and development strategies of developing countries/regions as well as comprehensive response to the needs

(4) Economic efficiency
(e.g. low life-cycle cost)

(5) Inclusiveness

(9) Contribution to the local society and economy

✓

✓

✓

The GTCC power generation system uses natural gas, which emits less CO₂. It produces power highly efficiently, because it generates power by a gas turbine while operating a steam turbine to generate power by the use of the high-temperature exhaust gas produced by the gas turbine. Its high combustion efficiency contributes to the effective use of energy and the reduction of greenhouse gas emission.

The land of Bangladesh is divided into the eastern and western parts by the Padma (Ganges) River and the Yamuna (Brahmaputra) River. Most of the power plants concentrate in the eastern part, where gas fields exist. Because electrification has been delayed in the western part, the first large power plant in the western part is to be constructed to develop the local economy and industries through the establishment of a power source there.

Technology

(Energy Sector)

Ultra Super Critical (USC) Coal-Fired Thermal Power Generation

Technical summary

- Ultra super critical (USC) coal-fired thermal power system has a technology that fires pulverized coal in the boiler, produces high-temperature and high-pressure (a temperature of 593 degrees centigrade or more and a pressure of 22.1 MPa or more), and rotates the turbine to generate electric power in a highly efficient manner.
- By using high-temperature/pressure-resist material (high chrome steel) for boiler pipes and adopting unique welding and processing technology, USC achieves high thermal efficiency (maximum efficiency: 45%) that cannot be achieved by subcritical or super critical (SC) technology.
- Currently, USC can be supplied by only several companies in the world, such as MHPS, IHI, and Siemens.

Characteristics as "Quality Infrastructure" technology

- Achievement of high efficiency of 45% by high-temperature and high-pressure steam conditions ((4) Lifecycle cost, etc.)
- Maintenance of availability at the world's highest level by the operation and maintenance (O&M) experience developed jointly by both electric power companies and manufacturers ((4) Lifecycle cost, etc.)
- High environmental performance achieved by a highly-efficient flue-gas treatment system (De-NOx, De-Sox and dust removal) ((7) Sustainability)
- Adaptability to various coal fuels (optimal combustion by suitable design and tuning) ((7) Sustainability)

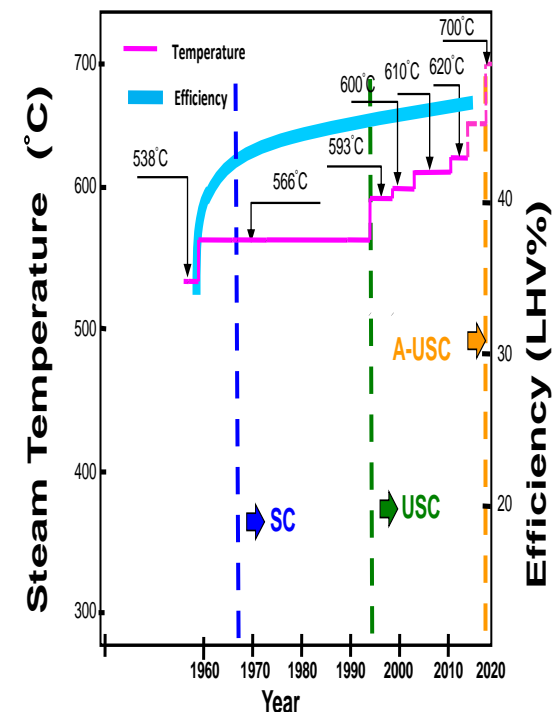
Electric Power Development:
Isogo Coal-fired Thermal Power Plant



Ultra super critical (USC) boiler



Improvement in steam temperature and efficiency



Domestic and overseas experiences

- [Domestic] Electric Power Development: Isogo, Tachibana Bay; Tokyo Electric Power: Hirono, Hitachinaka
Kansai Electric Power: Maizuru, etc.
- [Overseas] Taiwan: Dalin; South Korea: Taean; Malaysia: Jimah; Poland: Turow, Kozenice, etc.

Gas Turbine Combined Cycle (GTCC) Power Plant

Technical summary

- Gas turbine combined cycle (GTCC) power plant is a highly efficient power generating technology which consists of a gas turbine turned by combustion gas and a steam turbine turned by steam generated by heat recovery steam generator using exhaust gas from the gas turbine.
- To make a large GTCC system highly efficient, it is particularly important to develop a large frame gas turbine that can withstand high-temperature and high-pressure gas. Because of this, Japanese manufacturers have developed (i) heat-resistant material and (ii) high performance cooling technology so that their latest main products can withstand a high temperature of 1,600 degrees centigrade. Their technology is at the highest level in the world.

Large frame gas turbine



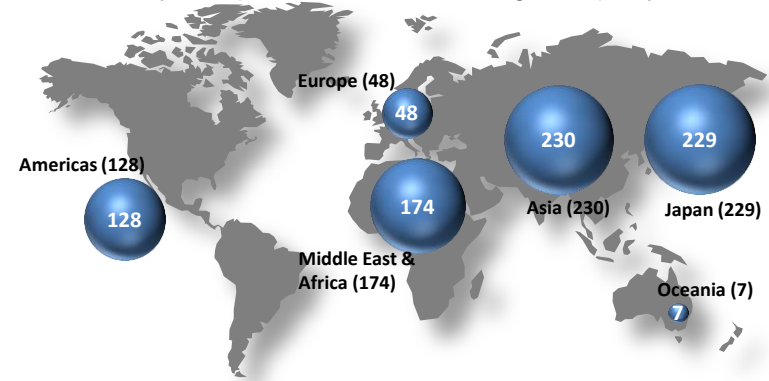
Characteristics as “Quality Infrastructure” technology

- GTCC uses liquefied natural gas (LNG), which emits less CO₂ than coal. Furthermore, by effectively using exhaust gas from gas turbine, its thermal efficiency is 10% higher than the efficiency when a gas turbine or steam turbine alone is used. The Thermal efficiency of Japanese GTCC has achieved over 60%, which is the world’s highest technology level.
(3) Environmentally-friendly and social considerations, etc.)

Domestic and overseas experiences

- Japanese manufacturers have overwhelming performance records and have a large market share in the production of GTCC.
 - Number of delivered gas turbines: 816 (in the whole world, including Japan) (as of March 2015)
 - World market share of gas turbines in 2014: 19% (large ones with an output of 170 MW or more)
 - US, South Korea, Indonesia, Thailand, Myanmar, India, Near and Middle East, Turkey, Uzbekistan, etc.

Gas Turbine Global Experience
by a Japanese Manufacturing Company



Total Number of Units: 816

Integrated Coal Gasification Combined Cycle (IGCC)

Technical summary

- IGCC is a highly efficient power generating technology whereby integrating coal gasifier with GTCC. The gas turbine is rotated by synthesis gas produced from coal, while a steam turbine is turned by exhaust heat generated by the gas turbine.
- Its power generation efficiency is higher by 15% to 20% than that of conventional coal-firing thermal power generation, such as ultra super critical (USC). Therefore, CO₂ emissions can be significantly reduced.

Characteristics as “Quality Infrastructure” technology

- Improvement in power generation efficiency
IGCC can achieve the highest power generation efficiency of about 48% to 50% (net, LHV) or about 53% to 55% (gross, LHV). Therefore, restricts CO₂ emissions significantly, while that of conventional coal-firing thermal power generation, is about 42% (net, LHV).
((4) Reduction in life-cycle cost; (7) Sustainability)
- Improvement in environmental characteristics
Improvement in power generation efficiency can reduce the emissions, such as SO_x, NO_x, etc. per power generation (kWh). ((7) Sustainability)
- Flexibility to “Variety of Coal”
It is possible to use wider range of coal that are difficult to fire and use by the conventional coal-firing thermal generation. ((7) Sustainability)
- Reduction and recycling of waste
While a lot of coal ash is generated by conventional coal-firing thermal generation, the volume of waste by IGCC is halved as granulated slag which is non-leaching of harmful substances originally contained in coal. Discharged slag can be recycled for cement or raw materials. ((7) Sustainability)

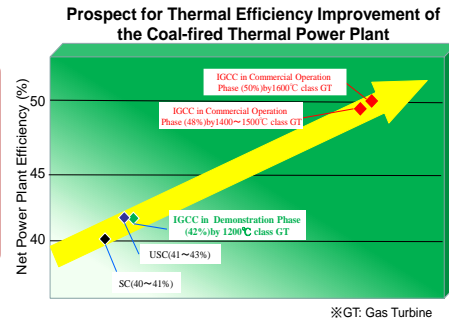
Domestic and overseas experiences

[Domestic]

- Results: Joban Joint Power (jointly invested in by Tokyo Electric Power and Tohoku Electric Power) / Nakoso (Fukushima Prefecture) (250 MW)
- Plans: (i) Tokyo Electric Power / Nakoso, Hirono (Fukushima Prefecture) (540 MW each): demonstrative operation is scheduled to begin in the early 2020s; if reliability is confirmed by the demonstrative operation, the plants will begin to operate for commercial use.
(ii) Osaki Coolgen (jointly invested in by Chugoku Electric Power and Electric Power Development) / Osaki (Hiroshima Prefecture) (166 MW): demonstrative operation is scheduled to begin in 2017.

[Overseas]

- Plans: Introduction in Latin American countries is under consideration.



Know-How in Operation and Maintenance (O&M) of Thermal Power Plants

Technical summary

- High operation rate and power generation efficiency in ultra super critical (USC) coal-fired thermal power plants and gas turbine combined cycle (GTCC) power plants have been continuously achieved by advanced operation and maintenance (O&M) know-how of the power plants.
- Introducing the latest USC and GTCC power plants, the core competency of Japanese companies is the ability to offer one total technical support package of all systems, which covers the supply of highly efficient and reliable machinery, construction methods, and operation, and maintenance.

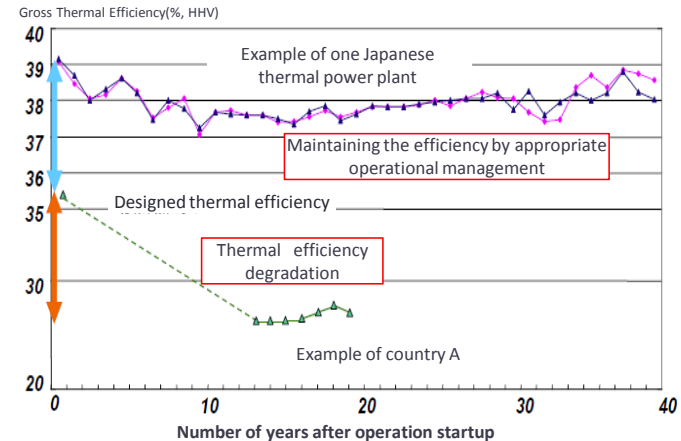
Characteristics as “Quality Infrastructure” technology

- High-level maintenance know-how and after-sales service of Japanese manufacturers have provided customers with high efficiency and availability of thermal power plants. ((4) Reduction in life-cycle cost)
- Proper operation management and periodical inspection, as well as careful repair and after-sales service achieved the prevention of unplanned outages and performance degradation, contributing towards stable power supply and fuel cost savings. The fuel cost savings will also realize early recovery of the initial investment. ((4) Reduction in life-cycle cost; (7) Sustainability)

Domestic and overseas experiences

- For example, a remote monitoring system, monitoring GTs all over the world, which was developed by a Japanese manufacturer, provided 24 hour monitoring of plant operation, and also allows for early countermeasures if the plant experiences an operational trouble.
- In addition, the manufacturer concluded an MOU with Uzbekenergo to cooperate in O&M (January 27, 2015). In the MOU, the manufacturer has promised the following items to Uzbekenergo: (i) support for operation and maintenance; (ii) support for training; and (iii) the provision of technical seminars.

Advantages of Japanese Boiler Technologies (comparison of age-related degradation for coal fired power generation)



Source: The Federation of Electric Power Companies of Japan



The training of a Japanese manufacturer for customer engineers

High Voltage Direct Current (HVDC)

Technical summary

- With the recent expansion of international linkage and the increasing introduction of renewable energy, Direct Current (DC) transmission is increasingly applied to meet the demand for the underwater power transmission to cover remote places and islands, as well as marine wind power generators.
- Advantages of HVDC power transmission includes the following:
 - (i) Larger capacity and longer distance of transmission compared with Alternating Current (AC); and
 - (ii) ease and speed of controlling electric current running through cables

Characteristics as “Quality Infrastructure” technology

- Japanese manufacturers are excellent in the power device technology and the converter transformer used as core of the HVDC system and can provide high-quality and highly-reliable (low unavailability rate) power devices.
 - ((3) Safety / resilience)
- To promote overseas operation, a joint venture has been formed with a Japanese electric power company, and a support system covering processes from design to operation and maintenance (O&M) has been established.
 - ((4) Economic efficiency of reduction in life-cycle cost)

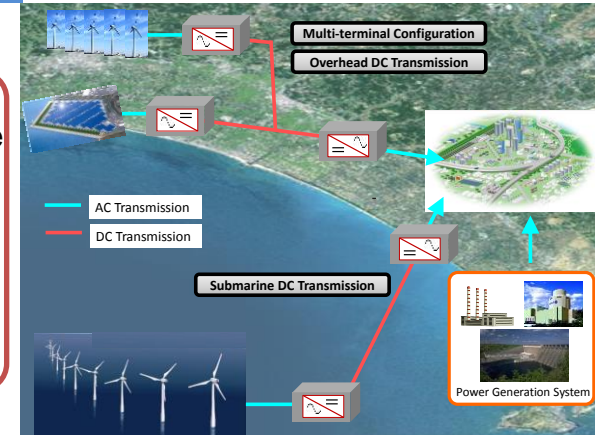
Domestic and overseas experiences

[Domestic]

- HVDC between Hokkaido and Honshu (North Honshu), Kii Channel HVDC
- Reinforced HVDC between Hokkaido and Honshu (project in progress) ⇒ Japan’s first next-generation HVDC system

[Overseas]

- HVDC converter station in Montenegro, Italy ⇒ Japanese manufacturers’ first HVDC for Europe



Kii Channel HVDC converter



HVDC converter station in Montenegro, Italy

High-Voltage and High-Capacity Underground Substation Technology

Technical summary

- An underground substation is a substation of which the main equipment has been made compact applying SF6 gas insulating technology and all the equipment has been installed underground.
- The demand for underground substations has been increasing in overpopulated cities such as in Southeast Asian countries to use land effectively and conserve landscape. As examples so far, substations have been constructed under commercial buildings and temples.

Characteristics as "Quality Infrastructure" technology

- High reliability, safety, and disaster resistance ((6) Safety / resilience)
Japan's substation equipment and technology, which have supported the capital city of Tokyo for more than 20 years, have achieved high quality and reliability.
- Environmental harmony and high security suitable for populated areas ((8) Convenience / amenities)
Because all the main equipment is installed underground and the exposure of equipment on the ground is minimized, an underground substation is suitable for security. In addition, it is possible to conserve urban landscape suitable for a modern city.
An underground substation has high economic effects because of the efficient management of the space above the substation (offices, commercial buildings, etc.)

Domestic and overseas experiences

[Domestic]

- Tokyo Electric Power Company area: Shintoyosu substation, Takanawa substation; Chubu Electric Power Company area : Meijo substation, etc.
* The Shintoyosu substation is a large underground substation that is the first 550 kV-class substation in the world.

[Overseas]

- High-Capacity Underground Substation in cities in Australia, China, Hong Kong, the US, the UK, etc.



Tokyo Electric Power Takanawa Substation



Tokyo Electric Power Shintoyosu Substation

Stability Enhancement System (SES) for Power Grid

Technical summary and characteristics

◆ By monitoring and controlling the power system in real time with IT and power electronics technologies, Stability Enhancement System (SES) for power grid makes the following possible: (i) preventing blackout and minimizing the impact caused by blackout; and (ii) maximizing the Total Transmission Capacity (TTC) of the existing equipment with minimum investment.

○ Increase in the role of renewable energy in the world

- ✓ Implementation of power generation equipment will increase by 90% in 2040, compared with 2013.
- ✓ In particular, wind and solar power generation will be increased by 370% and 850% respectively.

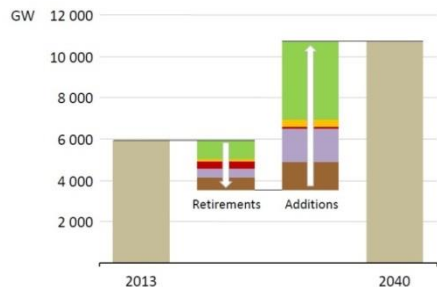


Figure : Power capacity by source, 2013-2040

Renewables
Nuclear
Oil
Gas
Coal

(Source) World Energy Outlook 2014

○ High effect of investment for SES

Measures	(i) Generation output limitation	(ii) Reinforcement of trans./distr. equipment	(iii) Stability Enhancement System (SES)
Effect	Reduction of loading of transmission wires	Increase in transmission capacity	Maximization of transmissible power / prevention of outage
Advantage / disadvantage	Economic loss by reduction of generation	Increase in investment amount	High effect of investment
Loss / investment amount	Loss of several billion yen/year due to power shortage	Several dozen billion yen needed for equipment investment	Several billion yen needed for equipment investment

Characteristics as "Quality Infrastructure" technology

○ Prevention of large-scale blackout by unique state-of-the-art technology ((6) Safety / resilience)

✓ The online pre-calculating stabilizing system*, which is a Japanese unique technology, draws the best countermeasure just after a fault.

* A system that continuously calculates and forecasts the possible situations of power grid in real-time and constantly plans the countermeasures against the predicted faults.

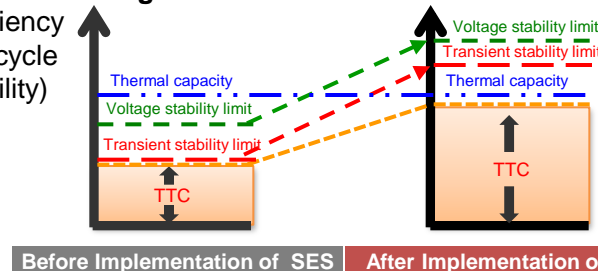
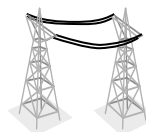
[Reference] International comparison of electricity outage time (per year)

			(Source) Current Situation of the Electric Industry 2009
16 min.	100 min.	37 min.	



○ Maximum use of the TTC of existing transmission and transformation equipment, which realizes high effect of investment

((4) Economic efficiency of reduction in life-cycle cost; (7) Sustainability)



Domestic and overseas experience

○ Domestic

✓ By the introduction of this system, Chubu Electric Power Company reduced the enhancement cost of the transmission and transformation equipment by about 100 billion yen.

○ Overseas

✓ Japanese consortiums have been carrying out feasibility studies in several states of India.

Various Environmental Measures and Technologies for Houses and Buildings

Technical summary and characteristics

- In Japan, various advanced measures for houses and buildings have been carried out, combining technologies for creating, saving, and storing energy. The Ministry of Land, Infrastructure, Transport and Tourism of Japan has supported model measures under the CO₂ emission reduction leading project and other projects.

Example: CO₂ emission reduction leading project

This is a project to construct highly comfortable and energy-efficiency structures by taking various environmental measures, including the use of highly heat-insulating and heat-shielding exterior and windows; design of wind flow through the adoption of natural aeration and ventilation systems; and reduction of cooling and heating load by the use of underground heat, which temperature is stable throughout the year.

- In addition, Japan has been promoting life cycle carbon minus housing (LCCM housing), which makes the total CO₂ emissions throughout the life-cycle negative by reducing CO₂ emissions during the use of the house and the stages of material manufacturing and construction as well as by prolonging the life of the house.

Characteristics as “Quality Infrastructure” technology

- In the CO₂ emission reduction leading project and in LCCM housing, various environmental measures and technologies have been adopted for making the indoor environment comfortable and ensuring high energy-efficiency performance.

((3) Application of high-quality standards, such as guidelines for environmental and social considerations; (4) Economic efficiency of reduction in life-cycle cost; (7) Sustainability; (8) Convenience / amenities)



Life cycle carbon minus housing (LCCM housing) in winter

Domestic and overseas experience

[Domestic]

- LCCM demonstration building (Building Research Institute in Tsukuba City)
- The CO₂ emission reduction leading project (The Tokyo Square Garden and many others)

[Overseas]

- Japan's environmental measures and technologies are expected to contribute greatly to Asian countries that have a hot and humid climate like Japan.

(Traffic Sector)

Japanese Shinkansen System

Technical summary and characteristics

- Excellent systems (*) have been developed and an operation and maintenance system for safe and stable operation of the systems have been also established.
* Systems: dedicated lines, signal system, operation management system, earthquake measures, etc.
- These systems are combined to realize Shinkansen's "safety," "frequency," "reliability," "environmental friendliness," and "efficiency."

Characteristics as "Quality Infrastructure" technology

- It enables to reduce the cost of construction, maintenance, and operation because of high transport capacity, light rolling stock, and small civil engineering structures.
(4) Economic efficiency of reduction in life-cycle cost
- Because the know-how on operation and maintenance has been accumulated, the Shinkansen system is highly reliable and safe. (ZERO fatality/injury for the 50 years since the inauguration ; the average delay time is less than one minute.) (4) Economic efficiency of reduction in life-cycle cost; (6) Safety / resilience; (8) Convenience / amenities
- The light and energy-saving rolling stock produces little noise along the lines. (7) Sustainability
- By virtue of the wide body, it enables installation of more seats than other countries' rolling stock. Moreover, because of wide space in front of the seat, travel is comfortable.
(8) Convenience / amenities

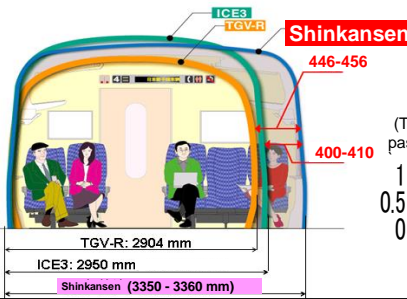
Domestic and overseas experience

- [Domestic] Six lines with a total length of 2,630 km are now in operation. Even now, projects for extending some lines are now in progress.
- [Overseas] Shinkansen system has been adopted in the rolling stock, signals, and operation management system of Taiwan High Speed Rail. The punctuality and reliability have been realized also in foreign countries.

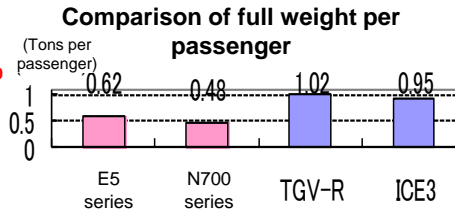
○ Large and light train cars

	Shinkansen (E5 series)	Shinkansen (N700 series)	TGV (France) (TGV-R) (Note 1)	ICE (Germany) (ICE3) (Note 1)
Top speed (km/h)	320	300	320	320
Body width (mm)	3,350	3,360	2,904	2,950
Seat interval (mm)	1,040	1,040	900	920
Full length (m)	253	405	400	400
No. of cars	10	16	20	16
Capacity (no. of passengers)	731	1,323	750	858
Full weight (t) (Note 2)	454	635	766	818
Full weight/capacity (t/no. of passengers)	0.62	0.48	1.02	0.95

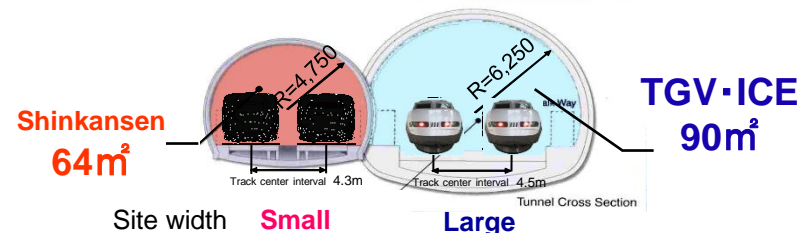
Application of wide body



Note 1) When two trains are combined
Note 2) When no passengers are on board



○ Small structure Comparison of tunnel sectional



The tunnel sectional area for Shinkansen is small, mainly because of the high level of air tightness in the train cars.

Urban Traffic System

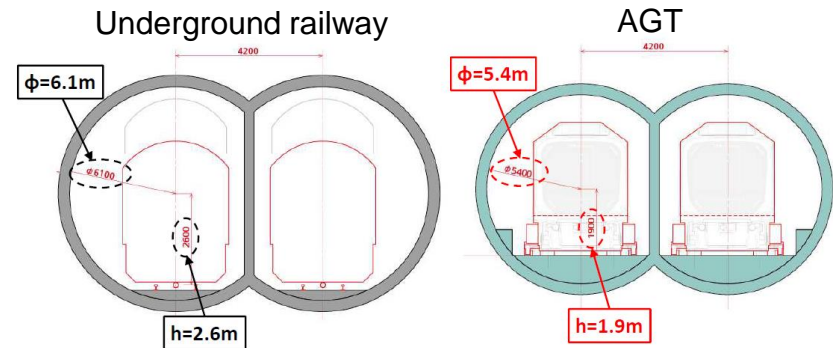
Technical summary and characteristics

- Monorail is a midscale transport system that runs on or under a single track beam. AGT (Automated Guideway Transit) is a midscale transport system that runs on an exclusive guideway automatically along a guide railway.
- Mechanical multistory parking lots are efficiently constructed and maintained in keeping with redevelopment in urban areas where parking sites are difficult to acquire.

Characteristics as “Quality Infrastructure” technology

◆ Monorail and AGT

- Because their turning radius is small and they can easily respond to a steep slope, the flexibility in line shape is high and the construction section can be made smaller. Therefore, the cost can be reduced. ((4) Economic efficiency of reduction in life-cycle cost)
- In addition, to run on an exclusive track, such as an elevated one, trains are not caught in congestion, resulting in excellent punctuality and rapidity. ((8) Convenience / amenities)



◆ Mechanical multistory parking lots

- In large cities where motorization is in progress, multistory parking lots contribute to the solution of traffic problems, such as on-street parking, and enable an efficient urban development. ((8) Convenience / amenities)

Domestic and overseas experience

◆ Domestic results

- 18 lines have introduced monorail and AGT routes, including Tokyo Monorail and Yurikamome.
- There are many mechanical multistory parking lots.

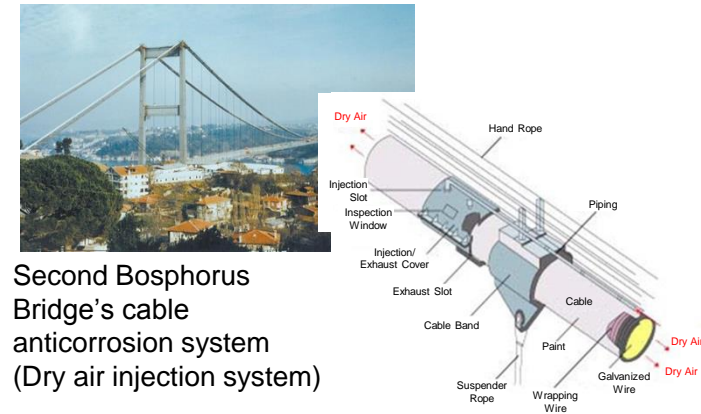
◆ Foreign results

- Japanese companies have received orders for monorail systems from China, South Korea, Singapore, and UAE, as well as orders for AGT from Singapore and Macao.
- A Japanese company have received an order for mechanical multistory parking lots from the Housing and Development Board of the Singapore Government.

Bridge Construction and Management Technologies

Technical summary and characteristics

- High performance steel: The steel for bridge high performance structures (SBHS) standardized in Japan (JIS G3140) has higher strength and constructability (shortening or omission of welding preheat) than conventional ones. Repainting is unnecessary for weatherproof steel materials.
- Rapid construction technology: There are various methods of constructing flyovers in a short time for mitigating urban congestion
- Long-life technology: anticorrosion system controlling the humidity in the suspension bridge cables was developed for prolonging the life of the Honshu-Shikoku Bridges
- Efficient inspection technology: There is a non-destructive inspection system for finding 0.2-mm cracks in concrete by photo images taken from a running vehicle or a boat under the bridge



Characteristics as “Quality Infrastructure” technology

- Based on the conditions at the construction site, it enables to adopt a rational bridge structure by the use of high-strength materials, to cut construction cost through a decreased amount of steel materials, as well as to reduce the maintenance and to prolong the life of the bridge by the use of weatherproof steel materials. ((4) Economic efficiency of reduction in life-cycle cost)
- The construction of flyovers in a short period enables to reduce the cost of congestion stemmed from traffic regulation while ensuring the safety of the construction site. ((4) Economic efficiency of reduction in life-cycle cost; (6) Safety / resilience)
- The non-destructive inspection system, which does not accompany traffic regulation, enables to ensure the safety of the bridge and reduce the life-cycle cost ((4) Economic efficiency of reduction in life-cycle cost; (6) Safety / resilience)

Domestic and overseas experience

[Domestic]

- Tokyo Gate Bridge SBHS
- Akashi Strait Bridge (cable anticorrosion system)

[Overseas]

- First and Second Bosphorus Bridges, Turkey (cable anticorrosion system)
- US State of Illinois's bridge inspection (non-destructive inspection)

Consistent Support of Port Projects by the Use of Technologies and Know-How in Japan

Technical summary and characteristics

In the port sector, in order to create jobs and income for supported countries, integrated development of ports and seaside industrial area is planned at the stage of "Plan", and infrastructure technologies, such as rapid construction method of quays and other structures are utilized at the stage of "Build". Moreover, at the stage of "Operate", efficient operation is realized by advanced skills through capacity building, and technical transfer of "Information Technology" such as port EDI. Japan's advanced port technologies and know-how are provided in this way for each project.

Characteristics as "Quality Infrastructure" technology

Plan

Industry-oriented port development ((9) Contribution to the local society and economy)
 [Summary] "Japanese successful business model (Japan Model)" of integrated development of seaside industrial areas and ports is utilized for contributing to the creation of jobs and income in the supported countries.

Build

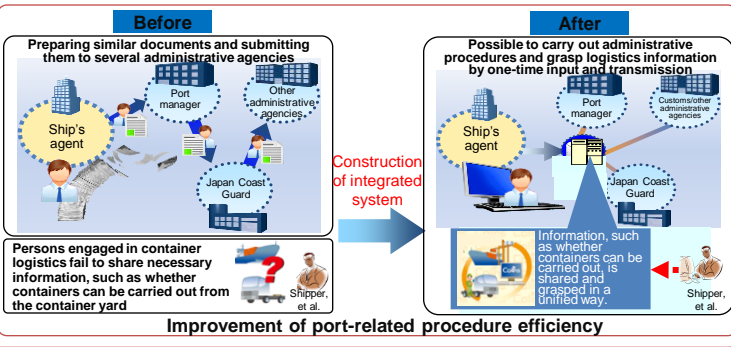
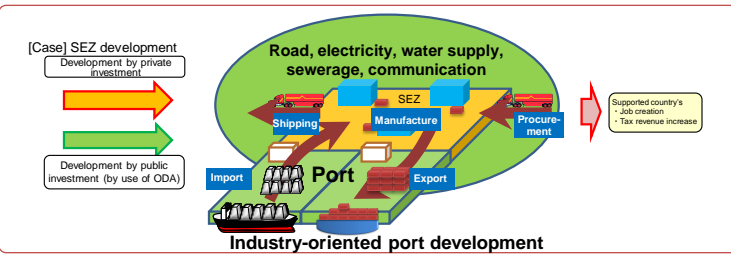
Rapid construction method of quays and other structures (jacket construction method)
 ((4) Economic efficiency of reduction in life-cycle cost)
 [Summary] Jackets manufactured at factories are unified with the foundation piles at the construction site, contributing to rapid construction and early use.

Operate

Container Crane (gantry crane) ((4) Economic efficiency of reduction in life-cycle cost; (7) Sustainability; (9) Contribution to the local society and economy)
 [Summary] The terminal construction cost is reduced with less weight of cranes, and the CO2 emissions is reduced by the introduction of environment-friendly port cranes. In addition, capacity building contributes to efficient management of terminals.

Information Technology

Improvement of port-related procedure efficiency (port EDI system etc.)
 ((8) Convenience / amenities)
 [Summary] Electronic system is constructed for port-related administrative procedures, such as ship record of entering and leaving a port for efficient and simplified procedures. In addition, container status information is shared with single window.



Domestic and overseas experience

- "Industry-oriented port development": (domestic) Kashima Port; (overseas) Myanmar (Thilawa Port)
- "Rapid construction method of quays and other structures (jacket construction method)": (domestic) all over Japan; (overseas) Myanmar (Thilawa Port) * planned
- "Container crane (gantry crane)": (domestic) five major ports, etc.; (overseas) the US, Myanmar, Kenya, etc.
- "Improvement of port-related procedure efficiency (port EDI system etc.)": (overseas) Myanmar * in progress

Management of Airports in Japan

Technical summary and characteristics

- Eco-Airport
 - 1) Measures are carried out in airports and their surroundings to promote environmental conservation and good environment creation.
- Air traffic control system in Japan
 - 2) (Tool for providing electronic data on geographical features and obstacles) Electronic data on geographical features and obstacles are provided by the use of satellite images and remote surveying technology, which comply with the international standards established by ICAO (International Civil Aviation Organization).
 - 3) (Flight procedure design tool) This system automatically designs flight routes according to the international flight procedure standards and international rules established by ICAO.
 - 4) (Aircraft stand management system) This system efficiently manages and operates the aircraft apron (spot) of airports.
 - 5) (Ramp Control System) This system manages taxiing (moving between a spot and a runway) of aircraft at airports.

Characteristics as “Quality Infrastructure” technology

- 1) It enables to reduce environmental burdens at airports and its surroundings
Airport in a geo-environmental perspective, airport that can coexist with the surrounding environment, etc.
((4) Reduction in life-cycle cost; (7) Sustainability)
- 2) It provides digital data on structures and other obstacles and geographical heights around an airport
((8) Convenience / amenities)
- 3) It significantly reduces design works by flight procedure designers and ensures accurate design quality not depending on the skill level of the designer ((8) Convenience / amenities)
- 4) It warns to operators after automatically checking the restrictive conditions for parking at spots, and provides supports in efficient allocation of spots ((8) Convenience / amenities)
- 5) It reduces operation errors, provides supports to analyze the causes of delay and to consider measures against them, and speeds up operations by the use of touch monitors. ((8) Convenience / amenities)



LED lamps/lighting



Introduction of new energy
(Solar generation, wind generation, etc.)

Domestic and overseas experience

- Eco-Airport
 - [Domestic] Introduction of Eco-Airport at 31 airports in Japan according to the Eco-Airport guidelines
 - [Overseas] Introduction of Eco-Airport at about 30% of the 18 main airports in the ASEAN region on the initiative of Japan
- Air traffic control system in Japan
 - [Domestic] Haneda Airport, Narita Airport, etc. (Aircraft Stand Management System, etc.)
 - [Overseas] Thailand, Indonesia, Vietnam, etc. (flight procedure design tool)



Data on obstacles

Spot management system

(Disaster Management Sector)

ICT Disaster Management Unit

Technical summary

- ICT disaster management units are radio communications equipment mainly transported to areas stricken by disasters for the emergency restoration of communications functions. Three types of ICT disaster management unit are available; units of car type and attaché case type, both of which are referred to as MDRU (Movable and Deployable ICT Resource Unit), and container-type unit.
- The ICT disaster management unit incorporates functions to provide disaster management officials and disaster-affected residents with means of information communication, such as compact portable base stations and disaster-dedicated IP phones.

Container type



Car type



Attaché case type



Characteristics as “Quality Infrastructure” technology

- It enables to provide a minimum-required ICT environment (a compact portable base station, Wi-Fi network, and information processing server) immediately in case of disaster. ((8) Convenience / amenities)
- It enables to be easily carried because units of container type, car type, and attaché case type are miniaturized (and their contents are exchangeable according to needs). ((8) Convenience / amenities)
- It contributes to bridging the digital divide in villages without electricity, by using solar panels. ((5) Inclusiveness, (9) Contribution to the local society and economy)

Domestic and overseas experience

- ITU, the Ministry of Internal Affairs and Communications of Japan, and the Department of Science and Technology of Philippines signed a cooperation document for the joint project (in May 2014). Following this, the parties concerned have been working on the introduction of ICT disaster management unit, including the start of a feasibility study using MDRU in the Philippines (in December 2014).

Underground Discharge Channel Technology for Flood Damage Reduction in Urban Areas

Outline of the Technology

- The underground floodway is a drastic anti-flood measure to be applied in a highly populated urban area where ordinary flood control measures are difficult to be employed. It is expected to meet an increasing demand in densely-populated cities in Southeast Asia..
- The technology relies on Japan's advanced tunnel excavation technology such as shield method and jacking method..

Why it is designated as “Quality Infrastructure” technology

- It is effective for flood damage reduction in densely-populated areas, such as metropolitan areas. ((2) Response to developing countries' needs)
The technology is effective in such cities as in South East Asia that have highly populated and are vulnerable to flood damage.
* Japan's knowledge on the development of a comprehensive master plan for flood damage reduction can be also applied.
- It reduces social costs through the application of underground construction works ((4) Mitigation of environmental impacts and social costs)
The use of Japan's superior underground excavation technology makes it possible to construct underground floodways without large-scale relocation of residents or impacts on economic activities



Metropolitan outer area discharge channel

Domestic and overseas experience

[in Japan]

- Metropolitan outer area discharge channel (the Naka River and Ayase River in the Tone River system), etc.
- * This is one of the world's largest discharge channels and has been constructed 50 m underground (with the largest inner diameter of 10.9 m and a total length of 6.3 km).

[in foreign countries]

- Ciliwung River discharge channel construction project (Special Province of Jakarta in Indonesia), etc.



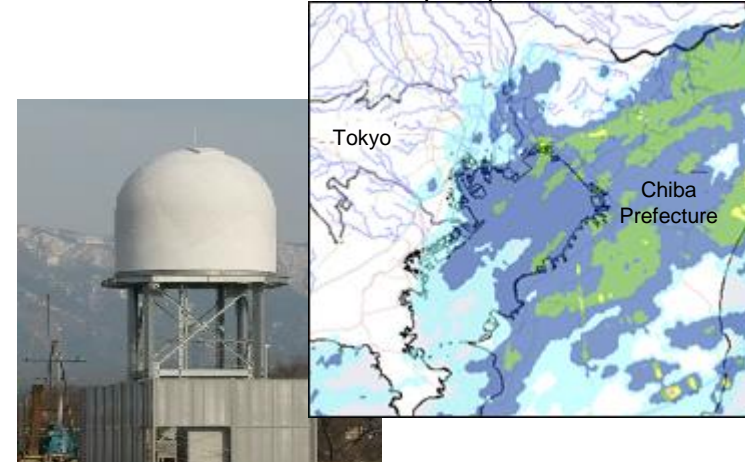
Ciliwung River discharge channel construction project

Solid-State Weather and Precipitation Radar

Technical summary

- Solid-state weather and precipitation radar, unlike conventional weather radar, uses solid-state devices in place of electron tubes for radio wave oscillation and amplification.
- Compared with conventional weather radar of electron tube type, solid-state weather and precipitation radar radiates radio waveforms featuring less fluctuation, and enables weather observation in the conventionally available range within a shorter time with lower power consumption and with the same precision as ensured by weather radar of electron tube type.
- In the world, only four manufacturers, all of them Japanese, have developed solid-state weather and precipitation radar as commercially available products.

Appearance and observation results of solid-state weather and precipitation radar



Characteristics as “Quality Infrastructure” technology

- Solid-state weather and precipitation radar provides rainfall data that is as precise as or more precise than that provided by weather radars of electron tube type, and nevertheless, the volume of reception data required can be halved, making it possible to grasp rainfall information promptly. Furthermore, no large-sized electron tubes or high-voltage circuit parts (i.e., transformers or capacitors) are used for solid-state weather and precipitation radar, thereby realizing significant size and weight reduction of finished products.
((8) Convenience / amenities)
- High-voltage loads are imposed on transmitters of electron tube type, resulting in a reduction in product life, and such transmitters need to be replaced every two years. In contrast, solid-state transmitters operate for at least 10 years. ((4) Reduction in life-cycle cost)
- Each solid-state transmitter consists of a number of modules. Therefore, the transmitter can continue operating with reduced output if some of the modules malfunction. Furthermore, solid-state transmitters allow service maintenance without stopping the system while weather radar of electron tube type needs to stop operating for approximately half a day for maintenance.
((6) Safety / resilience (8) Convenience / amenities)

Domestic and overseas experience

[Domestic] Operated by the Ministry of Land, Infrastructure, Transport and Tourism, the Japan Meteorological Agency, the Tokyo Metropolitan Government, and universities.

[Overseas] Delivered to weather-related administrations, universities, private weather information companies, and other organizations in India, the Philippines, Indonesia, Australia, the United States, Belgium, Norway, Denmark, and Croatia.

(Other)

Large Floating Structure for Logistics and Offshore Development

Technical summary and characteristics

○ **Versatile application with a safe, stable and reliable feature**

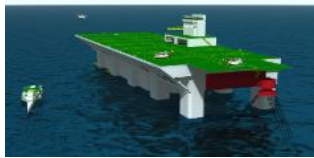
Japanese maritime industries have developed cutting edge technology on large floating structure with a feature of high sway control ability and directional control function which enable its application for many purposes, such as oil stockpiling bases, logistics hub systems, airports, offshore unit.

○ **Flexible in size with an advanced jointing and cutting skills**

Advanced skills on jointing and cutting the structure on the ocean make it possible to easily expand or reduce the size of structure, change the purpose of use, and flexibly meet short-term infrastructure demands.

○ **Multipurpose and multifunctional use with various innovative technologies**

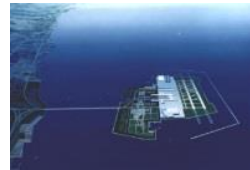
Various innovative technologies make it possible to construct multipurpose and multifunctional floating structures that have a high level of design flexibility while ensuring safety and stability (e.g. SPB tank (Self-supporting, Prismatic shape, IMO type B: SPB)).



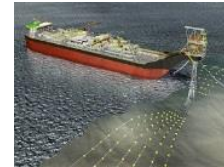
Logistics hub system



Oil stockpiling base



Airport



Offshore unit



Element technology (SPB tank)

Characteristics as “Quality Infrastructure” technology

○ Safety / resilience

- High sway control ability and directional control function
- Minimum impact from natural disasters

○ Convenience

- Versatile application for many purposes
- Flexible in size with an advanced jointing and cutting skills
- High level design flexibility

○ Sustainability

- Smaller environmental burden

○ Reliability

Large floating structure technology has been sophisticated through iteration of design, numerical simulation and model testing.

Landing/taking-off test



Tank test for “dock-in” into Logistic-Hub



Tank test

Domestic and overseas experience

[Domestic]

- Floating oil stockpiling base: Shirashima Island, Kamigoto Island
- Pilot project for practical use of floating structure for an airport (1998-2000)

[Overseas]

- FPSO* : Latin America, Asia, Africa, etc
- SPB tank: Chinese contractors, etc

* FPSO: Floating Production, Storage, and Offloading system

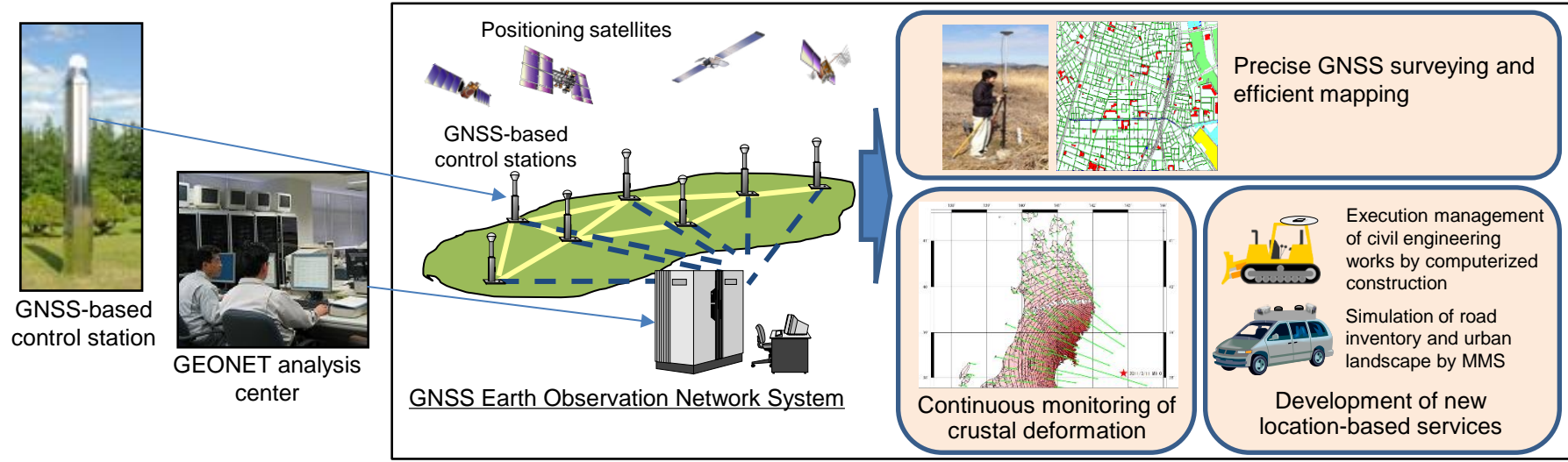
GNSS Earth Observation Network System (GEONET)

Technical summary and characteristics

- This system consists of about 1,300 GNSS-based control stations all over Japan and processes GNSS signals received from the stations to establish dense and accurate locational standards and provide the products to users (such as GNSS observation data and coordinates of the stations).
- The data are used as bases for precise GNSS surveying in Japan, providing precise location-based services and continuously monitoring tectonic deformation.

Characteristics as “Quality Infrastructure” technology

- The know-how accumulated over nearly 20 years in system administration and maintenance enables to operate the system stably and continuously almost without fail and to grasp the location of national land in real time. ((6) Safety / resilience)
- It enables to provide new location-based services. ((8) Convenience / sustainability)



Domestic and overseas experience

- [Domestic] About 1,300 GNSS-based control stations have been established all over Japan. As infrastructure for surveying and positioning in Japan, they have been used by not only the central government but also various private services.
- [Overseas] There are plans to develop the system in Asian countries (such as Thailand, Myanmar, and Vietnam).