

4-2-2 Basic Energy Plan "Smart Plan 2014" for sewerage system

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1. Introduction

Bureau of Sewerage, Tokyo Metropolitan Government (hereinafter referred to as the "Bureau") has continuously been operating large numbers of facilities such as approximately 16,000 km long sewer pipe line, 20 water reclamation centers, and 87 pumping stations 24 hours a day year-round. These services are contributing to safe, secured, and comfortable urban development of Tokyo by preventing flooding, improvement of water quality, and preservation of public waters and living environment.

The Bureau has been using a large amount of energy to provide high quality sewerage services. The annual power consumption is approximately 980 million kWh which is equivalent to 1% of total annual consumption of the Tokyo metropolitan area (approximately 86,000 million kWh). On top of power consumption, the fuel equivalent to approximately 20 million m³ of city gas consumed. The Bureau is the largest consumer of fuel in the Tokyo metropolitan area. Also, the implementation of projects such as the improvement of combined sewers and the enhancement of flood prevention measures may further increase the energy consumption in the future. The Bureau is responsible for the reduction of power consumption as a major power consumer.

Further, power plants suffered serious damages by the Great East Japan Earthquake which occurred on March 11, 2011, the energy-saving measures such as rolling blackouts, and the restriction on electricity use in summer were implemented. The stagnant fuel supply due to the confusion in distribution networks caused disruptions of emergency power supplies. Thereafter, electricity prices were significantly increased by the suspension of nuclear power plants, and this had a significant impact on the management of sewerage system. Faced with these difficulties, the Bureau was forced to make a major shift in the energy supply system.

Japan's first basic energy-saving plan for sewerage system, "Smart Plan 2014" was established in June of 2014 for the optimum control of the energy for the sewerage system, and providing stable and sustainable sewerage services.

(1) Status of energy usage at the time of the development of the plan

Annually, the Bureau performs the pumping of approx. 2.8 billion m³ of rain and sewage at pumping stations and the incineration of approx. 80 million m³ of sludge and approx. 2 billion m³ of sewage at water reclamation centers. Annual energy usage of electricity and fuel such as city gas for these pumping and processing is amount to 4,620 TJ (tera joules) on a calorie basis. A proportion of 76% of total energy is electricity and 24% is fuel (Figure - 1). Total energy would be reduced by focusing on both electricity and fuel.

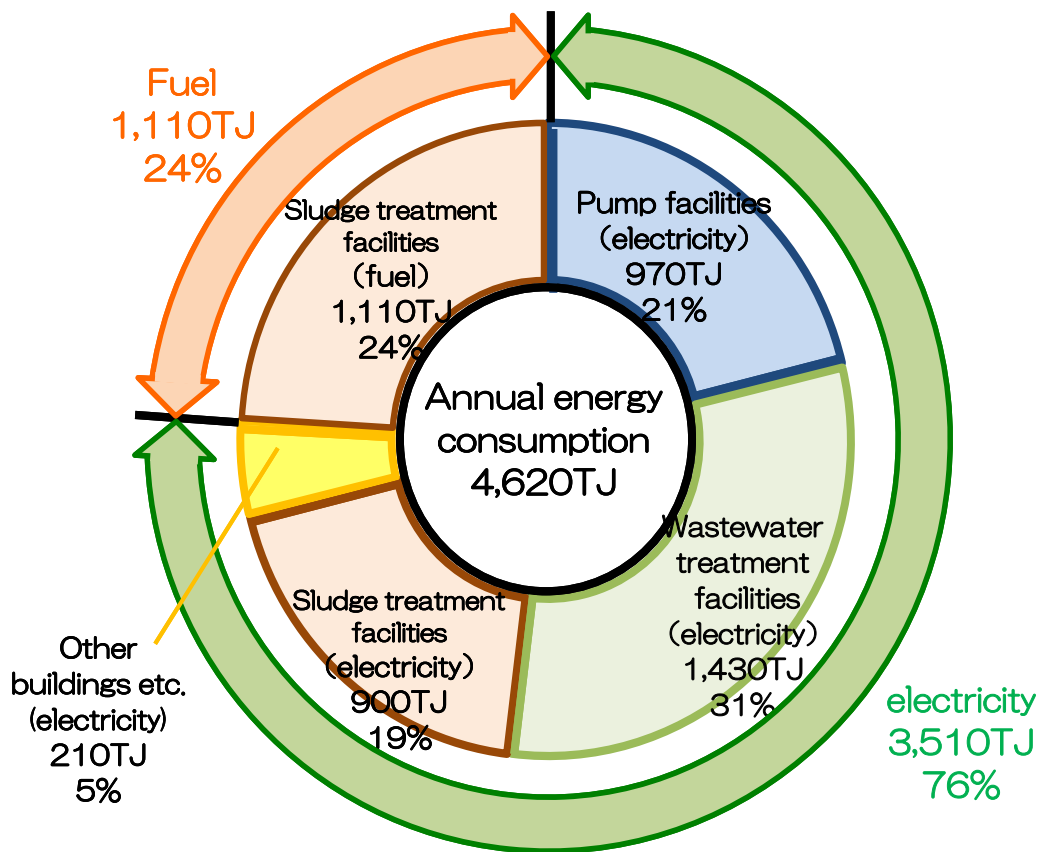


Figure -1 Proportion of energy usage by the Bureau(The fiscal year of 2013)

(2) Various problems relating to energy

I) Projected increase in future energy usage

Along with the efforts to improve the sewerage services, further reduction of energy consumption would be implemented in order to cope with the increase of the energy consumption for the prevention of flood and the improvement of combined sewer. The both tasks increase the power consumption due to the increases in the volume of pumping during rain, the increase in the volume of contaminated rain water collected at the beginning of rain that is to be treated at water reclamation centers. Taking these increases into consideration, further reduction in energy consumption is required.

ii) Impacts on the sewerage services by the Great East Japan Earthquake

As mentioned above, immediately after the Great East Japan Earthquake, the Bureau was forced to respond to the rolling blackouts while maintaining minimum functions such as wastewater treatment and rainwater discharge. Although, water reclamation centers and pump stations have been promoting the preparation of emergency power generation facility in order to maintain the sewerage function during a power outage, the completed number of facilities having the total planned capacity is approx. 70% in the end of the fiscal year of 2013. In addition, due to confusion of distribution system after the earthquake, the fuel supply to emergency power generation facilities was extremely difficult. As such, sewage was temporarily stored as much as possible in sewer pipe lines at the time of rolling blackouts, so that the number of pumps that are require to operate was minimized. Thus, the fuel of emergency power generation was reduced.

Bear in mind the aforementioned, in order to maintain continuous operation of sewerage system under any circumstances in the future, it is imperative to secure the expansion of emergency power generation facilities and emergency power sources as well as appropriate fuel supplies. Also, a reduction in external energy dependence by aggressive introduction of distributed power source and efforts to secure stable energy supply are required.

iii) Impacts on the management of sewerage system

After the earthquake, electricity prices increased significantly due to the increase in the proportion of thermal power generation by the suspension of nuclear power plant and soaring fuel procurement price by the fluctuations of foreign exchange rates. Therefore, the Bureau made various efforts of power consumption reduction and the annual power purchase was reduced from approx. 1,010 million kWh

before the earthquake to approx. 950 million kWh in FY2011 and 2012 after the earthquake. The reduction per year is approx. 60 million kWh. However, despite these efforts of reduction, electricity charges increased 3 billion yen during the fiscal year of 2012. In order to provide continuous stable sewerage services in the future, efforts to further reduction of purchased energy would be continued to implement so that the impact of electricity rates rise can be minimized.

2. Summary of Smart Plan 2014

The summary of the Smart Plan 2014 that aims to solve the various problems relating to energy and stably supply and continuous development of sewerage system are as follows:

(1) Targets, planning period, and concept of energy reduction

○ Targets

Increase the proportion of renewable energy and energy saved to 20% or more of the total energy consumption before the end of the fiscal year of 2024.

○ Planning period

From the fiscal year of 2014 to 2024

○ Method of energy reduction

The total energy consumption is defined as the sum of the energy purchased plus renewable energy and energy saved.

As shown in Figure - 2, the energy purchased (external procured energy) would be reduced by increasing the proportion of renewable energy (renewable energy + energy saved) of the total energy consumption.

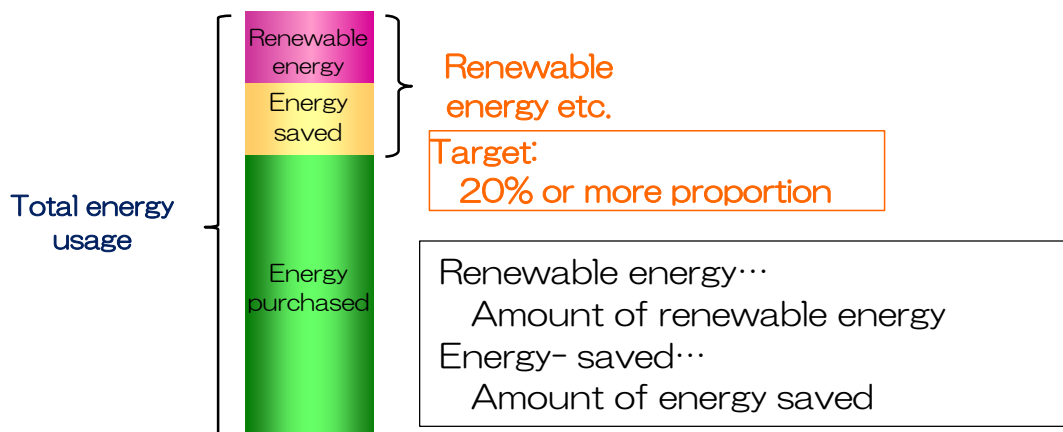


Figure -2 Image of proportion of renewable energy

(2) Projected future energy purchase amount

The purchase amount of energy is estimated to increase from 4,390TJ in the fiscal year of 2013 to 4,930 TJ in the fiscal year 2024 as shown in Figure 3 assuming the sewerage service improvements would be implemented as planned without taking countermeasures for the energy reduction. Therefore, further expansion of renewable energy utilization and further energy saving efforts are required so that the proportion of renewable energy and energy saved would be increased to 20% or more of the total energy usage and the energy purchase would be reduced to 4,060TJ or less before the end of the fiscal year of 2024.

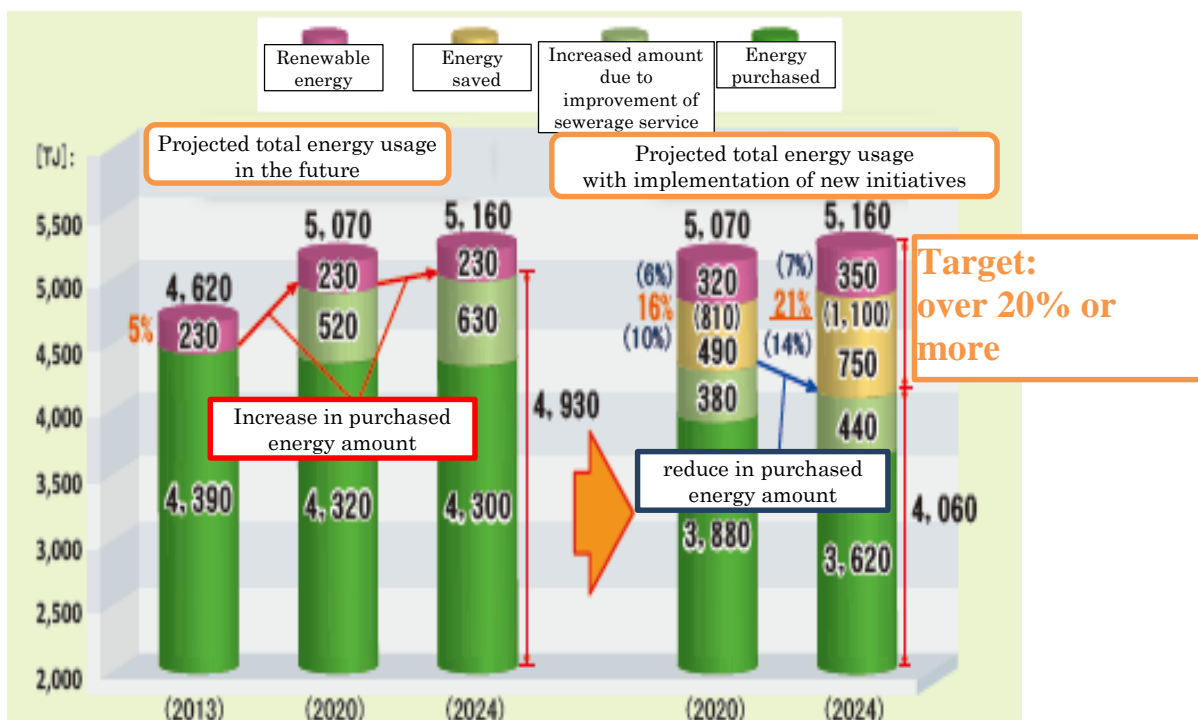


Figure -3 Projected total energy usage in the future and projected total energy usage with implementation of new initiatives

(3) Four policies

Based on the four policies of the Smart Plan 2014 plans, major efforts would be implemented in order to increase the proportion of renewable energy to 20% or more.

○ Policy 1 - Expansion of renewable energy utilization

To secure own energy for sewerage services, renewable energy such as new solar power generation and new power generation utilizing the unused low-temperature of waste heat from sludge incineration would be used as much as possible.

○ Policy 2 - Further promotion of energy saving

By advancing the development and introduction of novel advanced wastewater treatment method and an energy self-contained incineration system, the energy conservation would be promoted further and the energy consumption should be reduced.

○ Policy 3 - Introduction of smart management of energy

On top of the conventional energy conservation measures at individual facilities and equipment in a series of facilities, the "Energy Smart Management" which consists of the optimization of energy through the process of the entire facility from wastewater treatment to sludge treatment and the improvement of the efficiency of the operation management across multiple facilities from broad perspective is to be introduced for the smarter energy use.

○ Policy 4 - Strengthening of energy crisis management

In order to maintain the sewerage services under any circumstances, strengthening the countermeasures for energy crisis such as the expansion of emergency power generation and the introduction of distributed power sources as well as sharing the fuel required for the emergency power generation between facilities, would be implemented.

3. Specific efforts of the Smart Plan 2014 for the realization of the proportion of renewable energy and energy saved to more than 20%

The examples of concrete efforts for each of the four policies are described below:

(1) Policy 1 - Expansion of renewable energy utilization

i) Expand the introduction of solar power generation

The Bureau has a very small space available in wastewater treatment facilities, because they are located in urban areas.

As such, ingenuity such as the installation of solar panel onto the cover for odor prevention over reaction tanks in treatment plants for the utilization of space as well as the reduction of installation costs (Figure - 4) and the distributed installation of small-scale solar panels to pumping stations would be exercised.

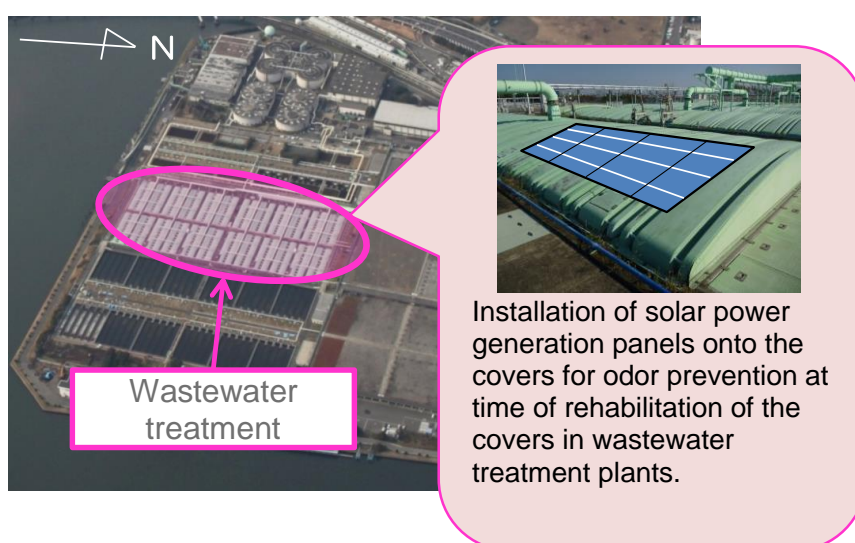


Figure -4 Image of introduction of solar panels to Morigasaki water reclamation center

ii) New power generation utilizing the waste heat of sludge incineration

The Bureau, for the purpose of extending the life of final waste disposal sites, must make the maxim reduction and the stabilization of sludge. For this purpose, all the sludge is incinerated.

As described previously, a large amount of energy is used for sludge treatment. A power generation technology utilizing incineration waste heat of the low-temperature that has not been used at the moment due to technical reasons should be developed and introduced (Figure -5).

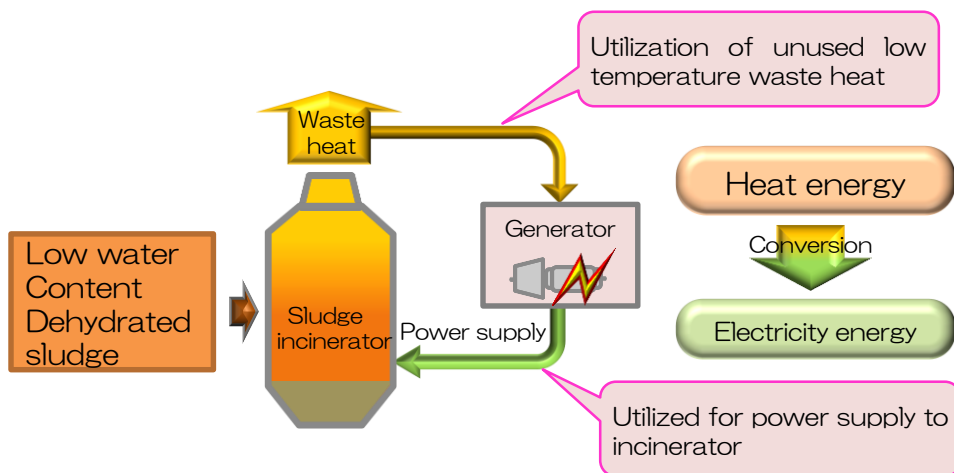


Figure -5 New power generation utilizing wasted heat of sludge incineration

(2) Policy 2 - Further promotion of energy saving

i) Development and introduction of "Self contained incineration system"

The Bureau, with the aim of expanding the renewable energy utilization and further energy saving, would develop and introduce a "Self contained incineration system" that is the combination of the ultra-low moisture content type dehydrator that can further reduce water content and the self-contained incinerator that can generate the power from the waste heat of sludge incineration for itself (Figure - 6).

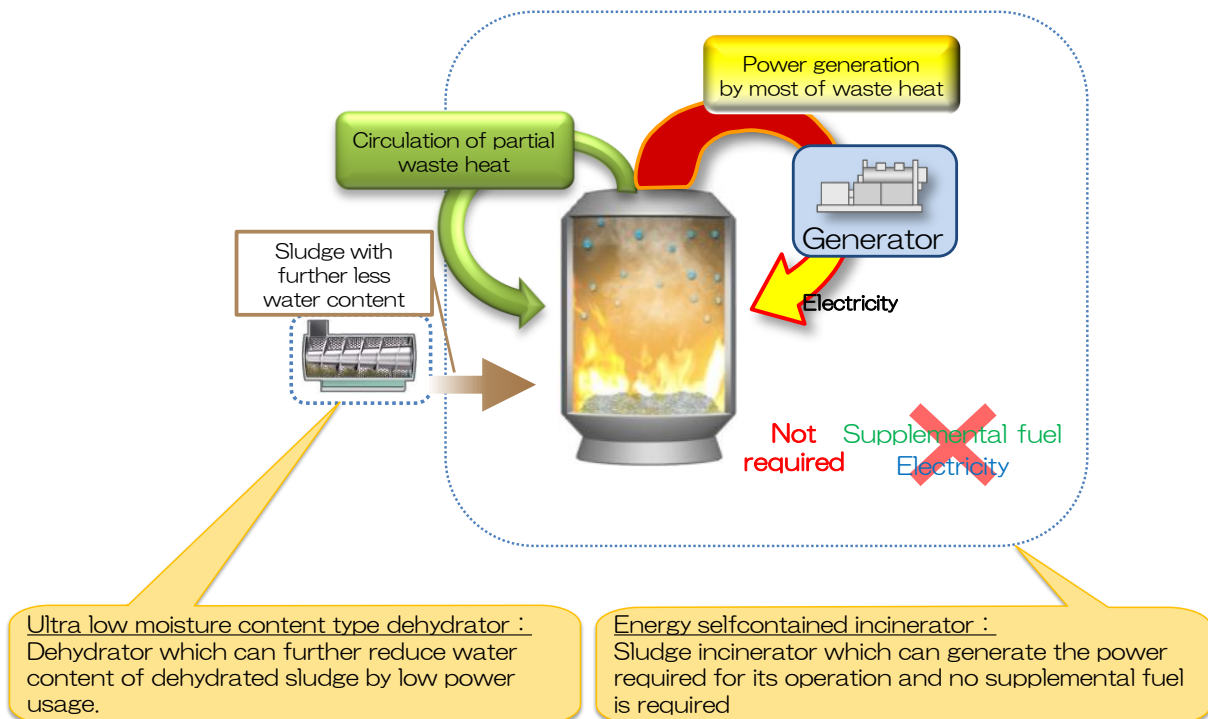


Figure -6 Energy selfcontained incinerator system

ii) Introduction of "Novel advanced wastewater treatment method"

In order to prevent red tide in a closed water area of the Tokyo bay, the Bureau has been introducing the advanced wastewater treatment method to reduce nitrogen and phosphorus in effluent, which is one of the generation factors of red tide, utilizing the opportunities of the rebuilding and expansion of facilities.

"Novel advanced wastewater treatment method " which can achieve more than 20% power reduction compared to ordinary advanced wastewater treatment method, while maintaining equivalent water quality of effluent, would be introduced (Figure -7).

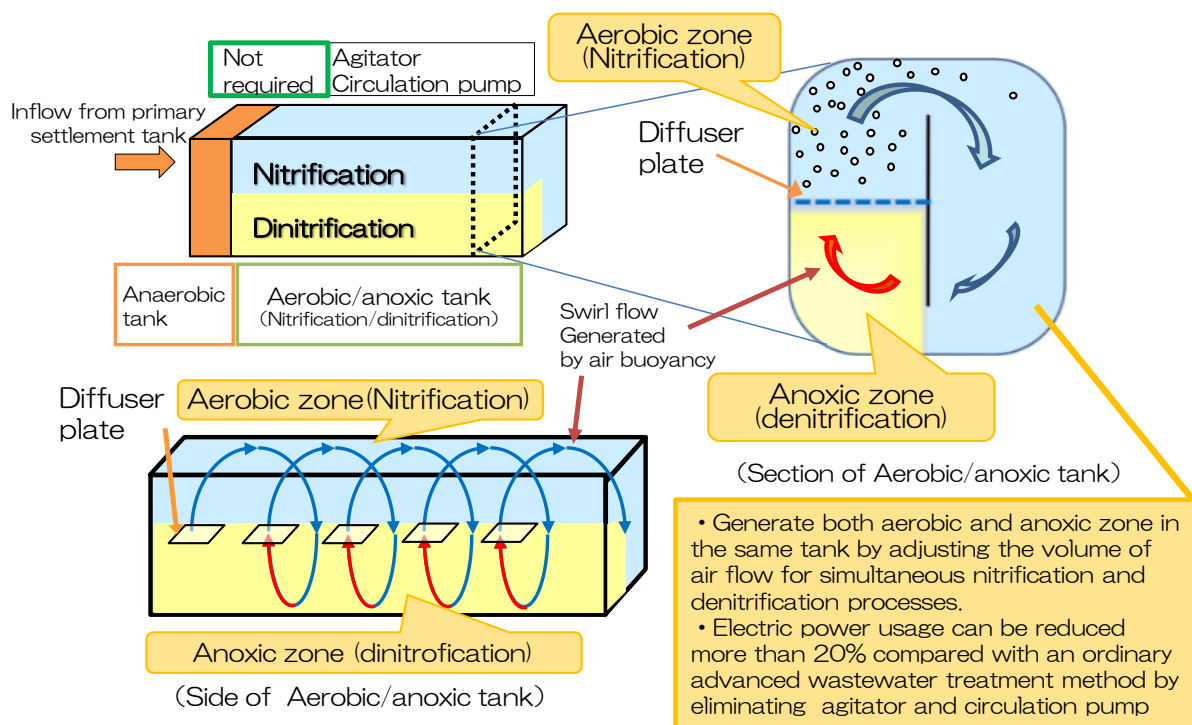


Figure -7 Introduction of "Novel advanced wastewater treatment method"

(3) Policy 3 - Introduction of Energy Smart Management

i) Energy management of the entire facility of water reclamation center

Optimization of the energy usage in a series of systems from wastewater treatment to sludge treatment would be promoted. For example, optimization is pursued with considering the total balance of the power, chemicals, and fuel consumption for water treatment facilities, concentration and dewatering equipment, and incinerators (Figure -8).

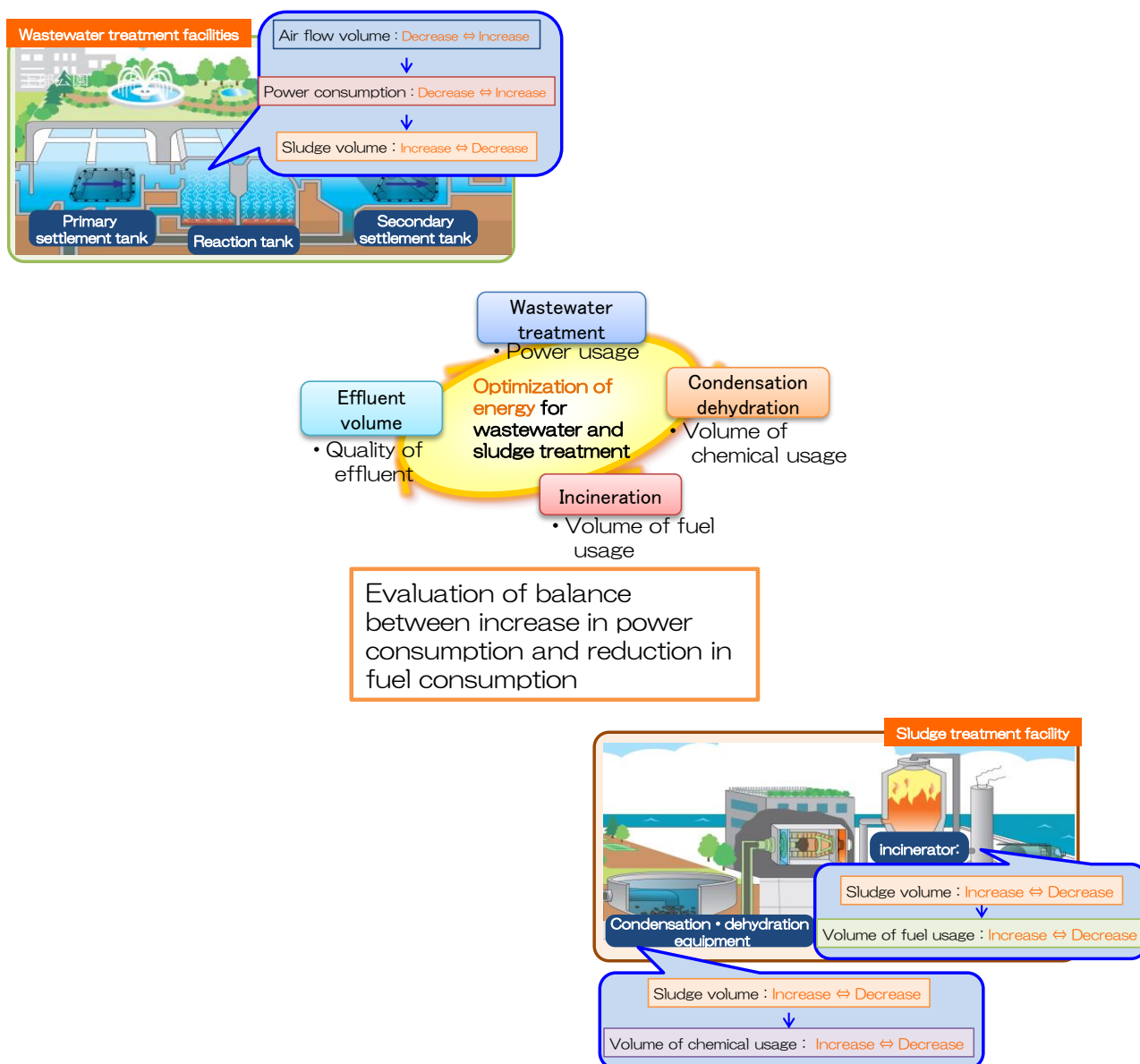


Figure -8 Image of energy optimization for water and sludge treatment

(4) Policy 4 - Strengthening of energy crisis management

i) Introduction of distributed power sources

Distributed power sources such as solar power and power storage equipment (NaS battery) are to be installed in water reclamation centers and pumping stations as a diversified power source (Figure - 9).

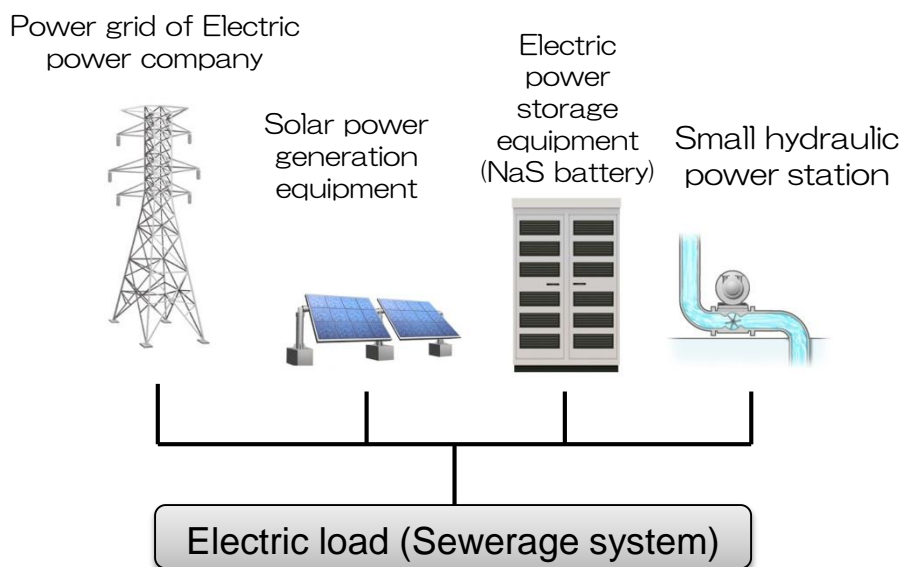


Figure -9 Image of distributed power sources

5. Summary

The role of sewerage system started with basic features such as the improvement of living environment, flood prevention, and water quality preservation of public waters. Along with progressive development of cities, aiming to the realization of more secured and safe cities and comfortable water environment, the role of sewerage system is diversified and advanced to flood measures, disaster countermeasures, advanced treatment of wastewater, and the improvement of combined sewer.

In addition to the counter measures for energy and greenhouse gases, the measures to secure energy stably are indispensable from the perspective of making a sustainable city.

The Bureau has been putting in efforts for the reduction of greenhouse gas, conservation of energy, and utilization of renewable energy. The Smart Plan is introduced to advance and accelerate these efforts in order to achieve the upgrading, improvement of efficiency, and stabilization of energy usage.

※ The energy consumption for the fiscal year of 2013 is an estimated value.