PRIMAFF Review No.98(2020.11),pp4-5

Challenges and opportunities of biogas value chain post feed-in tariff (FIT) scheme

ASAI Masayasu

1. Introduction

In biogas plants (BGPs), organic waste such as livestock manure and food waste with high moisture content undergo fermentation and decomposition through the action of anerobic microorganisms, producing biogas and a by-product digestate. Conducting fermentation in a closed facility, such as a fermenter, can suppress odor, and the introduction of BGP is particularly beneficial since it enables using the biogas as fuel for electricity and heat, and using the digestate which is abundantly present in fertilizer components, as fertilizer for crop cultivation, among other things. In this study, the entire process of biogas production and use, from procuring the organic waste as the raw material to the use of the digestate, is referred to as the biogas value chain (BVC).

According to the renewable energy feed-in tariff (FIT) scheme introduced in July 2012, electricity produced by BGPs can now be sold to electricity companies at a higher than normal purchase price(1). This has enabled BGPs to strengthen their position as power-generation businesses with the goal of generating revenue from the sale of electricity, rather than the conventional business of processing waste. This has resulted in a significant increase in the number of manure-based BGPs, predominantly in Hokkaido.

Table. Biogas plant sources of revenue

Revenue source	Content
From dairy farmers	Manure treatment consignment fee, Digestate (liquid fertilizer + transportation costs), Compost (bedding), Fuel for generator, Fuel for heavy equipment (normal use, emergency use)
From crop farmers	Digestate (liquid fertilizer + transportation costs), Fuel for heavy equipment (normal use, emergency use)
From local governments (public facilities)	Waste treatment fees (kitchen waste, urine, septic tank sludge, sewage sludge), Energy usage fees (normal use, emergency use)
From other sources	Raw material for fertilizer (requires concentration of ingredients from liquid manure), Energy usage fees (Private facilities, etc.), New businesses (business such as greenhouse horticulture, fish farming using waste heat)
From electricity companies	Fees for sale of electricity

Material: Prepared by the author based on Ishii (2019).

However, the FIT scheme was created as a temporary measure, and the regulations stipulate that the system will undergo a drastic overhaul by the end of 2020. It is unclear whether the current system will continue in the future, and whether the FIT price may be lowered. Furthermore, given that the current high FIT price is ultimately widely borne by electricity consumers in the form of an electricity levy, it is essential that BGP is not reliant on the FIT scheme in the future, but instead seeks a way of operating independently. In this instance, diversifying revenue sources within the BVC, as shown in the Table 1, is the key to ensure sustainable BGP operations.

Therefore, I surveyed a number of BGPs, some that are currently operating and selling electricity under the FIT and others that are not. I also consulted experts regarding how both BVCs differ depending on the FIT. I then compared the effect and challenges of each system. The results are summarized below.

2. FIT scheme and BVC

The outline of the BVC that came to light through this investigation is shown in the Figure 1. Under conditions where BGP owners can apply to the FIT, the simplest BVC would be to sell the entire amount as electricity and treat the digestate as wastewater within the BGP. Although these conditions require huge costs of equipment installation and operation(2), in most cases, the current FIT price makes the operation feasible. There have been a large number of “power-generation-oriented” BGPs established with the main aim of generating revenue from sale of electricity, particularly since the start of the FIT scheme.

On the other hand, when the profitability of BGPs is considered under conditions that are not reliant on the FIT, it is necessary to secure multiple sources of revenue, as shown in the Table 1. Therefore, in “circular-economy-oriented” BGPs, which generate new value while retaining the main focus as waste treatment, the number of involved stakeholders increases, making coordination of these parties indispensable; hence, local governments, or third-parties such as JA (Japan Agricultural Cooperatives) often take the initiative in introducing these BGPs.

For example, in Ooki, Fukuoka Prefecture, and the neighboring Miyama, BGPs introduced to process kitchen waste and urine do not sell electricity under the FIT, instead, all the generated power is used within related facilities. Furthermore, all the digestate is spread to farmland within the municipalities as liquid fertilizer. According to the interviews with local government, a digestate utilization promotion committee was set up mainly by local government staff to secure end users of the digestate. The committee also conducted

Original; Japanese
Translated and published in Feb. 2021

field experiments together with measuring effect components as crop nutrients, and conducted activities to ensure widespread use of the system, including distribution of guidebooks on how to use the digestate. All such efforts resulted in the success of the BGP.

Another example is a BGP in Kushiro[3], the introduction of which was led by JA Akan. The BGP was built within an existing composting center that dealt with dairy cattle manure from 18 dairy farms. Manure with high moisture content, which the composting center had struggled to process, is to be treated by the BGP, and the generated energy is to be used for fully mature composting[4]. Based on calculations of the total revenue from the sale of electricity to neighboring large-scale dairy farmers[5], revenue from manure treatment fees paid by dairy farmers and the sale of recycled bedding, and that from crop farmers for the sale of fully matured compost and sale of liquid manure, it is estimated that the BGP investment costs will be recovered in less than 11 years, even without the FIT. Furthermore, there are plans to burn the surplus biogas in a boiler and cultivate greenhouse bananas using the heat generated. Our survey with local stakeholders revealed that the following factors lowered the hurdles normally associated with introduction of BGP: Using an existing composting center kept down the installation costs of introducing the BGP, and consensus building among dairy farmers on the introduction of the BGP progressed smoothly because all the farmers were already members of the composting center.

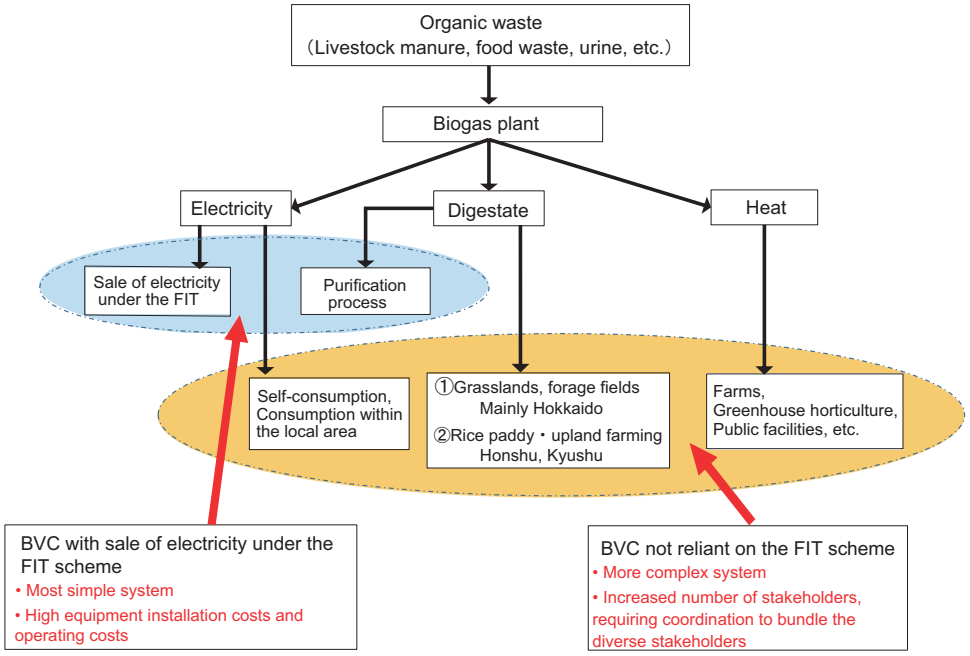

Figure . Conceptual diagram of Biogas Value Chain (BVC)
Source: Prepared by author based on inspection surveys

3. Future outlook

Under the current high-level FIT system, wastewater treatment is completed within the facility (the cost is internalized), and not having the cost of searching for end users of the digestate or the cost of negotiating with crop farmers was a major advantage of BGPs that focused on "electricity generation business." However, no new added value is generated with wastewater treatment alone, and if the FIT scheme is abolished, the sustainability of this business is uncertain. The results of this study suggest that BGP operations that do not rely on the FIT require coordination with a larger number of stakeholders. As seen in Ooki and Miyama, naturally, there are increased costs associated with the cost of searching for and negotiating with collaborators to steadily cultivate their understanding (such as rice farmers using digestate). BGP operation requires the strong conviction of local governments attempting to achieve "circular economy" and a shared vision among stakeholders, even to take on these costs. Despite that, JA Akan made effective use of existing facilities and community connections to reduce the introduction and negotiation costs. There are a large number of composting centers throughout Japan facing the same challenges as JA Akan, and their initiative can be a good model for the future.

However, in BGPs led by local governments and JA, the livestock farmers, who are the suppliers of the organic waste raw material, leave the operation of the BGP to the local government and JA, which creates concerns about the lack of self-help regarding matters such as increasing energy production. In centralized BGPs in Japan[5], there are often complaints about problems with the inconsistency of the raw material. In Danish BGPs, the farmers who supply the livestock manure are also involved in the construction and operation of the BGPs in the form of investment, and common rules are in place to ensure the consistency and improve the quality of livestock manure, to increase revenue from the sale of electricity[6] (Asai and Takai, 2017). In Japan, fees are often collected from livestock farmers for manure treatment, but farmers feeling that they are paying extra may conversely become an impediment to BGP operations. Creating a mechanism that encourages farmers to actively work to improve the raw materials is also an important step for moving away from the FIT scheme.

Note

(1) Under the FIT scheme, the purchase price for power generated with biomass (methane fermented biogas), including livestock manure, is JPY39/kWh as of 2020, and electricity can be sold for this fixed price for 20 years from the start of electricity supply.

(2) The national average cost for digestate treatment is reported to be JPY5000/t (Toyo Sekkei Co., Ltd. Nihon Suido Consultants, Co., Ltd., 2015).

(3) Operations were planned to start from the spring of 2020, but overseas technicians were unable to come to Japan due to the

Original; Japanese
Translated and published in Feb. 2021

COVID-19 pandemic, so the aim now is to start operations in 2021.
(4) Difficulties in fully mature composting of dairy cattle manure due to low temperatures has been a long-standing issue. In addition, there is no free space for grid connection to power companies in the local area; therefore, FIT sale of electricity is currently not possible.
(5) The sale price of electricity is calculated at a unit price of JPY19/kWh.
(6) A large number of dairy farmers participate in centralized BGPs and supply livestock manure. However, from the perspective of transport costs, almost all BGPs operate under a raw material collection radius of within 10 km.
(7) Bonuses are paid for manure with dry matter content and nitrogen content at or above a certain standard based on tests for the composition of livestock manure brought into the BGP, while fine is applied for poor quality manure.

【References】

ASAI, M. and H. TAKAI (2017) "Danish Biogas Policies and Partnerships among Prominent Actors in the Biogas Sector: Lessons Learnt from Two Newly Developed Biogas Projects," *J. of Agric. Policy Res*. (27): 25-47.
ISHII, K. (2019) "Challenges and Outlook for Promoting the Introduction of Methane Fermentation of Waste-based Biomass" Workshop on the Demonstration Project for Biomass Energy Regional Independence Systemization "Towards facilitating businesses not reliant on the FIT System."
Toyo Sekkei and Nihon Suido Consultants (2015) "FY2014 Report on Business Consignment to Promote Introduction of Waste-based Biomass Utilization" Ministry of the Environment "FY2014 Ministry of the Environment Consignment Business Report", 1-203.

Original; Japanese
Translated and published in Feb. 2021