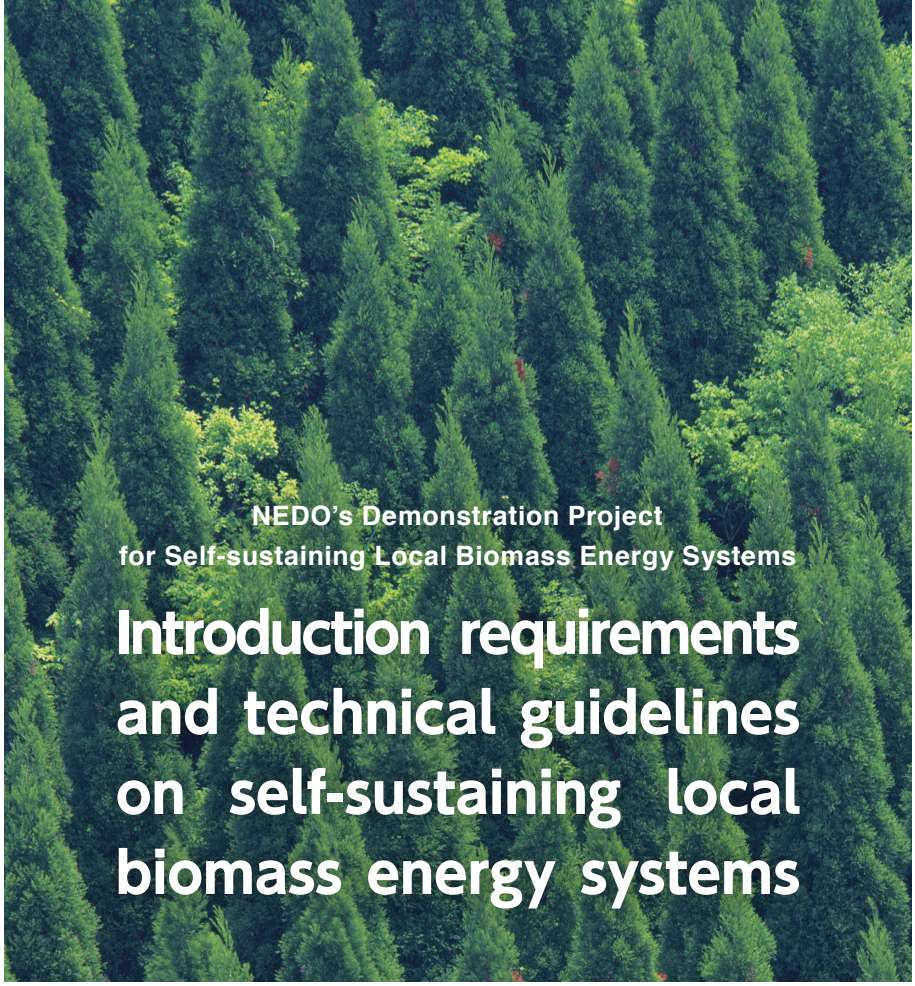


NEDO's Demonstration Project
for Self-sustaining Local Biomass Energy Systems

Introduction requirements and technical guidelines on self-sustaining local biomass energy systems

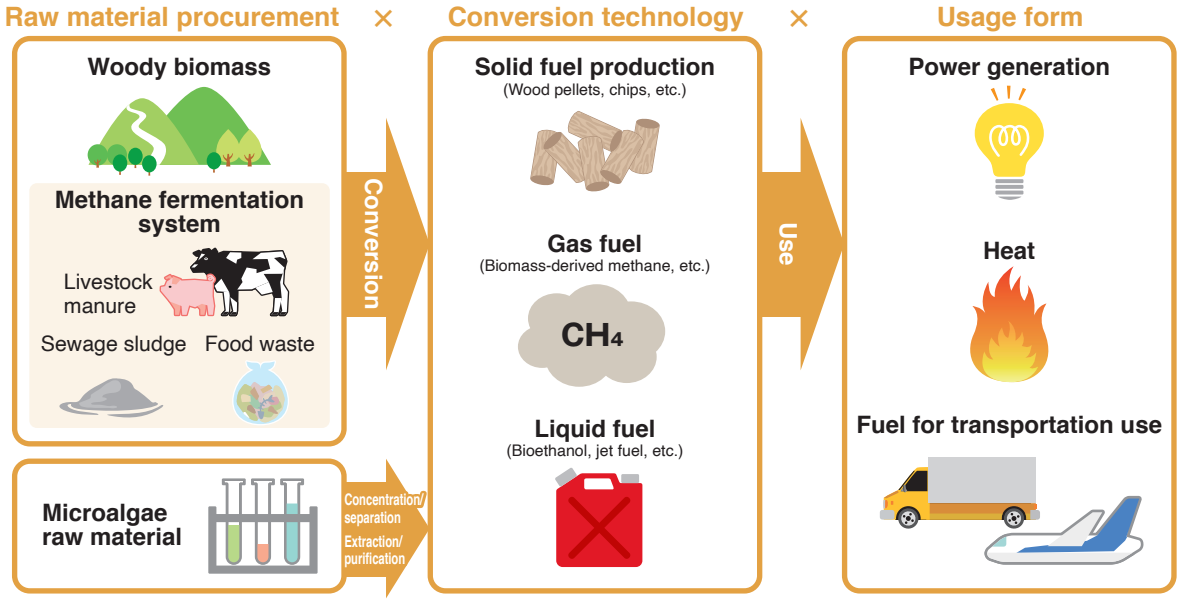
【Digest version】

NEDO
New Energy and Industrial Technology
Development Organization

contents

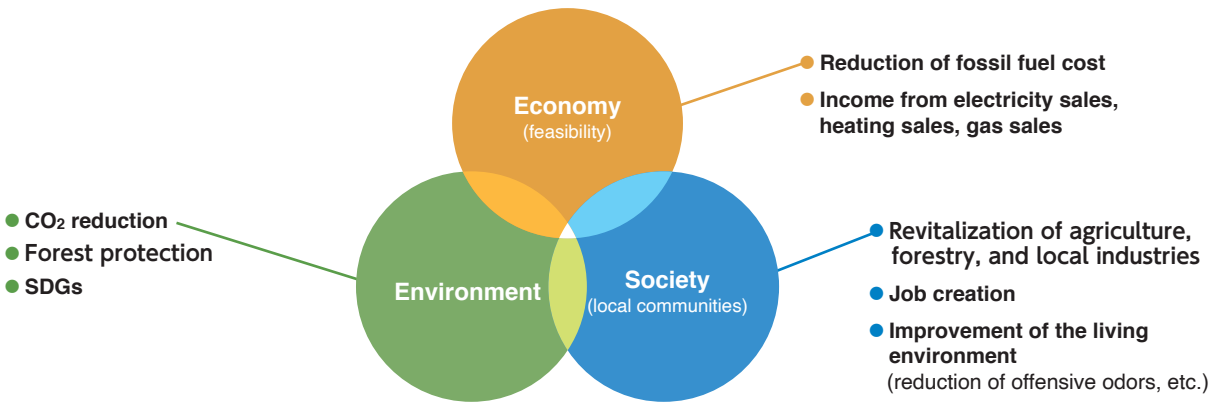
01 What are the uses of biomass?

Biomass is defined as "renewable, organic resources of biological origin, excluding fossil resources". Biomass consists of biomass resources used as raw matrial, types of energy use(electricity, heat, transport fuel, etc.,), and the energy conversion technology that interconnects these. Biomass utilization methods are broadly divided into materials utilization used for lumbering/construction and energy utilization. It is possible to make effective use of such resources by first using them as a energy source and then by finally using them as fuel, in a cascading manner. Depending on the application, it is also possible to convert such resources into liquid fuel, to be used in transportation. CO_2 is of course generated when it is burned in this process, but this is CO_2 that was already absorbed from the atmosphere during the growth processes of forests and other ecosystems, if these are sustainably managed. Therefore, biomass energy is classified as a form of renewable energy.



02 Three main points regarding the use of biomass energy

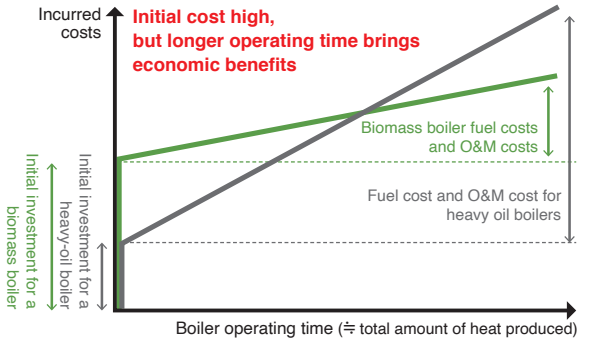
Biomass energy is significant as a business model because it can reduce fossil fuel usage and thus reduce cost, and it can bring profit via energy sales. However, biomass energy is not just significant from an economic standpoint—it also has significance for local communities and fostering of local symbiosis, such as in the revitalization of local agriculture, forestries, and industry, along with aiding the preservation of national land and the creation of jobs.
Which significance is emphasized depends on the business models and the business entitie(i.e., private sector or public sector). In order to conduct a biomass energy-focused business, it is important to share the purpose and significance of such an endeavor, due to it being essential that all stakeholders engage in mutual cooperation.



03 Economic effect of the use of woody biomass

The biomass fuel used for woody biomass boilers is carbon-neutral, and the boiler generates less sulfur and nitrogen than fossil fuels, and is stable in price.
On the other hand, biomass boilers have the disadvantage in that they require a certain large amount of space due to being relatively large in size, thus requiring a facility for carrying in fuel and silos, and this results in increases to initial cost.
However, the fuel cost per calorific value is low, so if a certain operating rate can be secured, economic advantages over using fossil fuels would become clear, from a medium- to long-term perspective.

Overview of a comparison of biomass boilers and fossil fuel boilers



Fuel cost per calorific value (example)

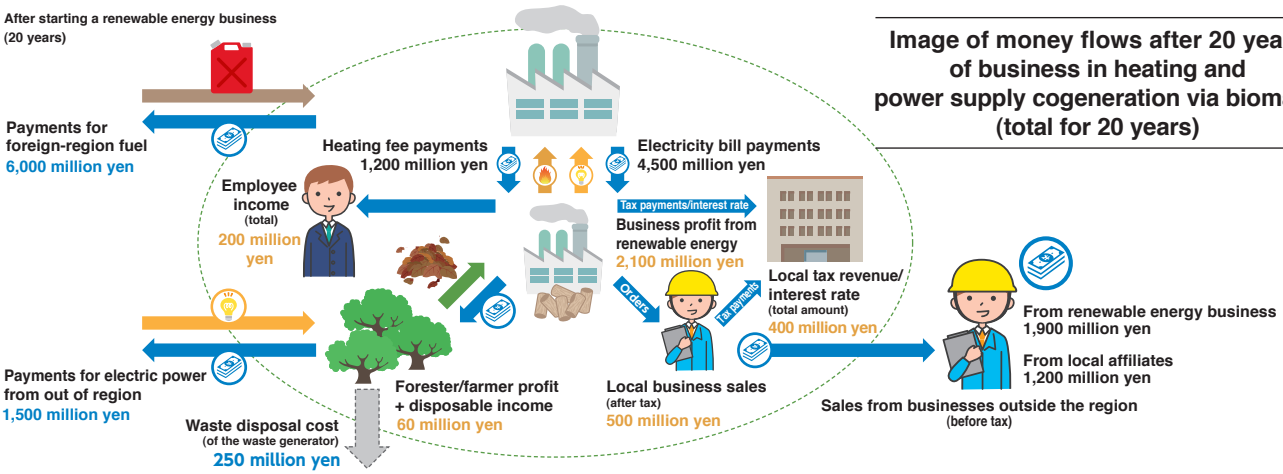
Fuel type	Fuel unit price	Lower calorific value	Fuel unit price per MJ
Unused material chips	**17.2～18.9** yen/kg(DB)	**8.1** MJ/kg(50%WB)	**1.1～1.2** yen/MJ
Construction waste chips	**3～5** yen/kg(WB)	**14.5** MJ/kg(20%WB)	**0.2～0.3** yen/MJ
Heavy oil A	68.2～82.3 yen/L	36.6 MJ/L	1.9～2.2 yen/MJ
City Gas	51.2～59.8 yen/m³	40.6 MJ/m³	1.3～1.5 yen/MJ
LNG	50.4～65.4 yen/kg	49.2 MJ/kg	1.0～1.3 yen/MJ

04 Ripple effect on local communities

From the upstream to the downstream, biomass has a long value chain, and its stakeholders are diverse. Therefore, there are certain difficulties that are unique to biomass-related business, such as in the need for the stable procurement of raw materials and the formation of various agreements with local stakeholders. However, to put it the other way around, these value chain and stakeholder issues mean that biomass-related business can relay major economic benefits to surrounding operational areas. The image below shows an example of the estimation of comprehensive local economic effects based on a 1 MWe combined heat & power supply example (FS) from a NEDO project.

If we were to not use biomass in this example, about 6 billion yen for electricity and heat would flow out of the region over 20 years, and we would incur costs for processing biomass (bark etc.), as a local issue. On the other hand, if local biomass is used for combined heat and power supply as according to the demonstration project plan, not only would the outflow of energy purchases be stopped, but 550 million yen would be circulated to those involved in agriculture, forestry, construction, and maintenance operations in the local region, and the tax revenue of the local government would increase by 400 million yen.

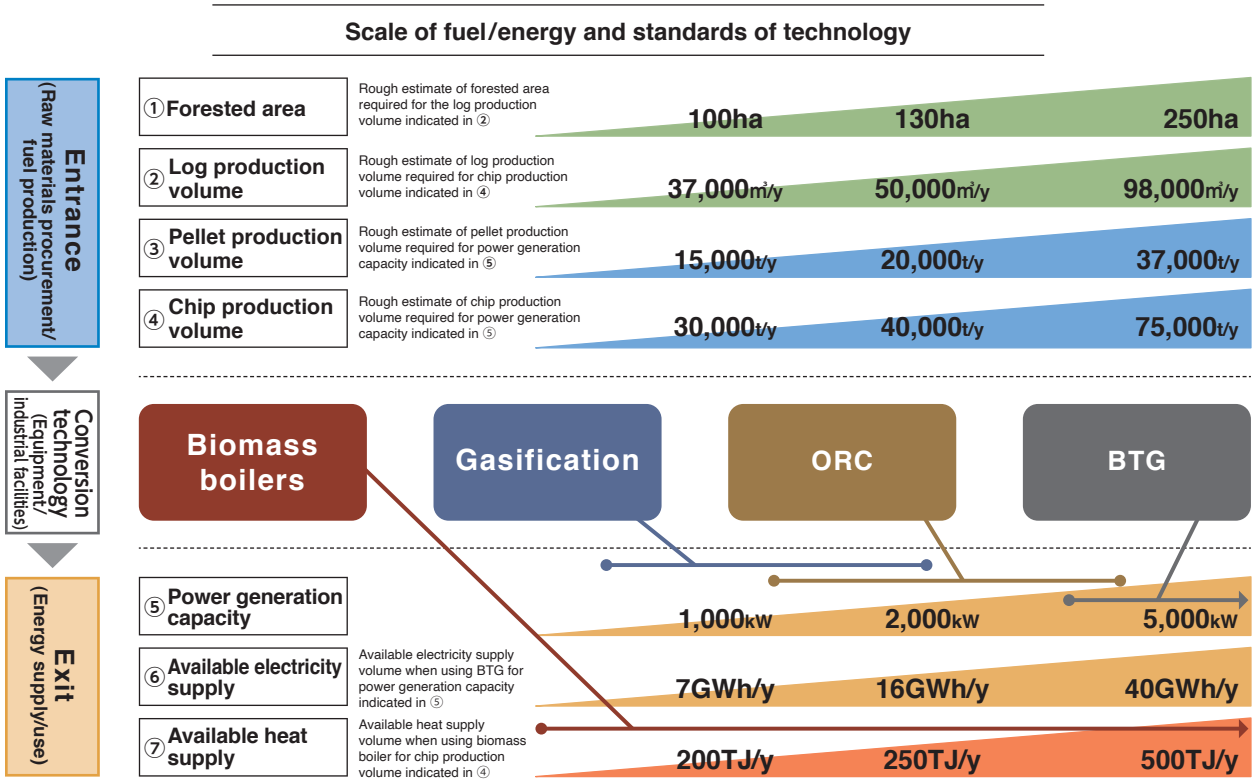
Image of money flows after 20 years of business in heating and power supply cogeneration via biomass (total for 20 years)



05 Significance of system selection(methodology) based on potential raw material (Entrance) and energy demand strategy (Exit) <Woody biomass>

For woody biomass, various types of raw biomass fuel exist, and the properties of such vary depending on the amount of moisture contained (i.e., dryness). In addition, there are multiple options depending on the technology to be employed, and this depends on the energy supply mode—and available fuel types and properties for such also differ. For example, BTG (Boiler, Turbine, Generator) is a technology that generates electric power by using the steam generated by directly burning wood chips and pellets in the biomass boiler. power. Most of Japan's biomass power plants use this technology. Here, fuel tolerance level is large, but on the other hand, power generation efficiency drops to below 20% at the small scale of 2 MW or less, thus 5MW and above is common. In another example, ORC (Organic Rankine Cycle) is a technology that rotates a turbine by evaporating a polymer organic medium for which the boiling point is lower than that of water. ORC has a track record of more than 300 in use in Europe, where heat utilization is common. While this method has high fuel efficiency and can handle bamboo and bark, it is viewed that it is essential to secure a corresponding heat demand destination because of the massive heat generated by this method.

In yet another example, pyrolysis gasification is a technology that gasifies wood chips or pellets via a pyrolysis/reduction reaction and that uses the resulting gas as fuel to generate electricity. Although it is possible to obtain relatively high power generation efficiency even on a small scale, this method is extremely delicate with respect to fuel type and water content; thus, securing stable quality such as regarding chip/pellet shape and water content is the most-important issue involved in this method. It is thus important to consider the system, not the technology itself, along with the type and properties of the raw fuel (“entrance”) that can be procured, as well as the energy demand (“exit”).



Note: Thermal demand volume for large saw mill is approximately 500TJ/year, while that of hot spring accommodation facility is 1-20TJ/year.

	Power generation only (medium/large scale)	Heat and power combined		Heat utilization/supply	
	BTG (Boiler･Turbine Generator)	ORC	Pyrolysis gasification	Dry chip boiler	Wet chip boiler
Unused forest materials	○	○	△ Water content less than 15%	○ Water content less than 40%	○ Water content less than 60%
Residual sawmill materials	○	○	△ Water content less than 15%	○ Water content less than 40%	○ Water content less than 60%
Construction waste	○	○	×	○	○
Bark	△	△	×	×	△ Water content less than 55%
Bamboo	△	○	×	×	○

06 Flow of the realization of woody biomass energy business

From concept to realization, woody biomass energy business energy business comes with many action items. With that in mind, NEDO's biomass energy introduction requirements/technical guidelines* explain the points to be noted, the detailed information, and the various data behind each action item.
(*The information as provided in the English guidelines only consists of summary information. For more details, please refer to the original Japanese version.)

Overview: Action items for woody biomass energy business

Note: Green text indicates introductory requirements/ technical guidelines.

	Phase Ⅰ Conception	Phase Ⅱ Feasibility Study	Phase Ⅲ Design and Construction	Phase Ⅳ Operation
Action items related to the complete edition (Chapter 1 of this volume)				
A. Business plan	1.1. Ⅰ.A Building of a business concept 1.2. Ⅰ.A Business model outline study	1.3. Ⅱ.A Re-examination and confirmation of the business concept 1.4. Ⅱ.A Consideration of the commercialization schedule	1.5. Ⅲ.A Review of future business plans 1.6. Ⅲ.A Formulation of a facility operation management plan	1.7. Ⅳ.A Consideration of optimizing operation plans
B. Implementation system/local cooperation	1.8. Ⅰ.B Becoming a business entity 1.9. Ⅰ.B Consulting with experts 1.10. Ⅰ.B Consulting with governments	1.11. Ⅱ.B Commercialization system construction, role adjustment 1.12. Ⅱ.B Consensus-building with local stakeholders 1.13. Ⅱ.B Holding of local councils 1.14. Ⅱ.B Council meeting explanations (for local governments)	1.15. Ⅲ.B Composition of the business entity 1.16. Ⅲ.B Hiring of staff 1.17. Ⅲ.B Local consensus-building	1.18. Ⅳ.B Fostering of local understanding
C. Business's balance sheet/financing	1.19. Ⅰ.C Business's balance sheet outline study 1.20. Ⅰ.C Obtaining a survey budget for FS research	1.21. Ⅱ.C Project cost estimation 1.22. Ⅱ.C Business's balance sheet, cashflow analysis 1.23. Ⅱ.C Confirmation of the subsidy system 1.24. Ⅱ.C Business's risk assessment 1.25. Ⅱ.C Budget formation	1.26. Ⅲ.C Application for equipment assistance 1.27. Ⅲ.C Application/contract for carbon offsetting 1.28. Ⅲ.C Financing, negotiation with financial institutions 1.29. Ⅲ.C Checking the trends of related support systems	1.30. Ⅳ.C Verification and improvement of business profitability
D. Ripple effects		1.31. Ⅱ.D Evaluation of the ripple effect by business		1.32. Ⅳ.D Verification and disclosure of ripple effects
Action items related to raw materials/fuel procurement (Chapter 2 of this volume)				
A. Procurement of raw materials and fuel	2.1. Ⅰ.A Specifics of raw fuel type 2.2. Ⅰ.A Confirming local availability of raw material scale	2.3. Ⅱ.A Survey of resource amounts 2.4. Ⅱ.A Confirmation of handling for cleaning methods 2.5. Ⅱ.A Possibility of survey on raw material collection 2.6. Ⅱ.A Consideration of raw fuel procurement costs 2.7. Ⅱ.A Study of raw fuel transportation systems	2.8. Ⅲ.A Fuel procurement contracts (standard lot delivery pricing) 2.9. Ⅲ.A Formulation of fuel procurement and inventory management plans	2.10. Ⅳ.A Confirmation of standards for received fuel 2.11. Ⅳ.A Verification and review of fuel procurement conditions
B. Fuel production	2.12. Ⅰ.B Confirmation of a base for fuel manufacturing	2.13. Ⅱ.B Confirmation of compliance with fuel standards 2.14. Ⅱ.B Study of a fuel manufacturing/ processing system		
Action items related to equipment installation (Chapter 3 of this volume)				
A. Installation of equipment	3.1. Ⅰ.A Confirming the reliability of equipment technology 3.2. Ⅰ.A Confirmation of equipment scale and investment scale	3.3. Ⅱ.A Selection of an appropriate scale 3.4. Ⅱ.A Formulation of a basic system plan 3.5. Ⅱ.A Selection of equipment/manufacturer 3.6. Ⅱ.A Study regarding fuel receiving & storage systems 3.7. Ⅱ.A Examination of an equipment/ construction ordering scheme	3.8. Ⅲ.A Basic design 3.9. Ⅲ.A Final design 3.10. Ⅲ.A Procurement of equipment 3.11. Ⅲ.A Construction, EPC contracting 3.12. Ⅲ.A O&M contracting 3.13. Ⅲ.A Insurance contracting	3.14. Ⅳ.A System/ equipment performance evaluation and improvement 3.15. Ⅳ.A Verification and improvement of the facility utilization rate 3.16. Ⅳ.A Safety measures 3.17. Ⅳ.A Study of the in-house production of O&M 3.18. Ⅳ.A Troubleshooting
B. Compliance with laws and regulations		3.19. Ⅱ.B Confirmation and response to laws and regulations as related to equipment installation	3.20. Ⅲ.B Acquisition of permits and notifications for business implementation	
C. Location selection	3.21. Ⅰ.C Site assumption	3.22. Ⅱ.C Location survey		
Action items related to the use and treatment of energy and by-products (Chapter 4 of this volume)				
A. Energy supply/use	4.1. Ⅰ.A Assumption of energy use 4.2. Ⅰ.A Specifics of the energy supply form	4.3. Ⅱ.A Survey of energy demand 4.4. Ⅱ.A Survey of the actual operation of existing energy equipment 4.5. Ⅱ.A Infrastructure survey of the installation site and the surrounding environment 4.6. Ⅱ.A Confirmation of intentions regarding the installation destination 4.7. Ⅱ.A Study of an energy supply & demand management system 4.8. Ⅱ.A Backup system consideration	4.9. Ⅲ.A Energy supply contracting	4.10. Ⅳ.A Verification and review of the energy supply conditions
B. System connection		4.11. Ⅱ.B Grid interconnection survey	4.12. Ⅲ.B FIT business application 4.13. Ⅲ.B Connection contracting, power sale contracting	
C. By-product treatment/use		4.14. Ⅱ.C Examination of the disposal method for by-products	4.15. Ⅲ.C Discussion of conditions regarding the effective use of by-products and the processing of such	4.16. Ⅳ.C Examination and adjustment for the effective use of by-products

07 Checklist for the implementation of a sustainable energy business (woody biomass)

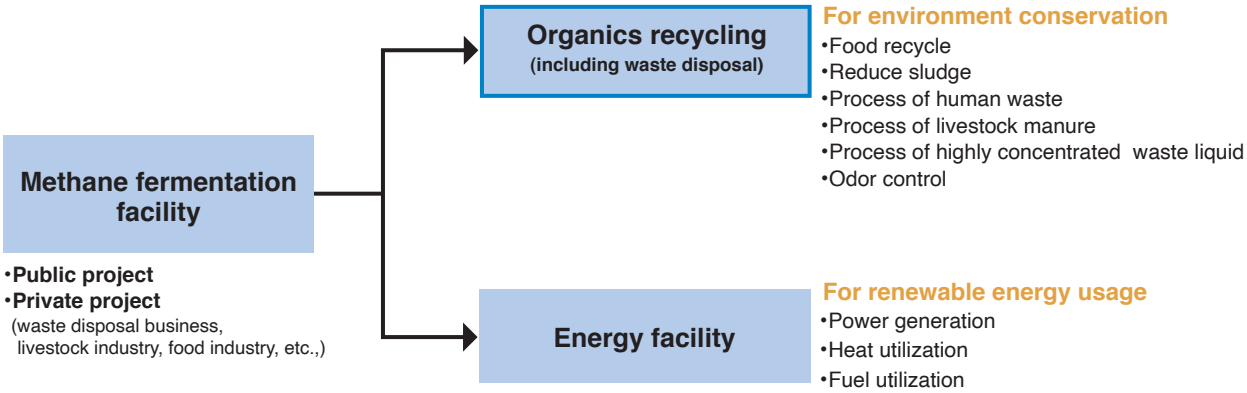
In the introduction requirements/technical guidelines, based on an analysis of past precedents, the points to be noted in each action item shown on the previous page are organized as a checklist, and we have put together a concrete explanation of each item and the "devices" that the Feasibility Study(FS)/demonstration project has worked on.

Checklist for an energy business involving woody biomass (excerpt from the conceptual stage)

Division	Action items	Corresponding items in Part 2 of this volume	Notes	Check
Overview section	Building of a business concept	1.1.I.A	Is the purpose of business organized? Also, can you share such purpose with stakeholders?	
			More than the purpose or needs of the business, is the technology and equipment to be adopted and the planning and business skill required decided beforehand?	
			Do grants and subsidies precede the decision on the purpose and necessity of the business?	
			Are there any elements in the plan that could cause opposition in the local area?	
			Is your plan subject to the problem from social perspective?	
	Business model outline study	1.2.I.A	Have you assumed implementers and bases involved in raw materials procurement/ processing, equipment operation, and the energy/use of by-products/refinement?	
			Is it a business that requires a special license, and is such a license expected to be acquired?	
	Becoming a business entity	1.8.I.B	Is there a plan where only the vision provides forward impetus as something that cannot be envisioned by the business entity itself?	
			Is there a person in charge that can play a central role in the realization of the business, and has a support system been established for such?	
			Is it possible to envision a business entity that includes financial and execution capabilities?	
	Consulting with experts	1.9.I.B	Have you consulted with and received advice from experts, specialized agencies, and support organizations, etc., regarding the implementation of the business concept?	
	Consulting with local governments	1.10.I.B	Have you consulted with or provided information to the local governments regarding the business concept? Is it possible to obtain the cooperation of such governments?	
	Business's balance sheet outline study	1.19.I.C	Do you have a target for profit structure and profitability (i.e., reduction of processing costs, power sales/heat sales, reduction of energy costs, etc.)?	
	Obtaining a survey budget for FS research	1.20.I.C	Is it possible to secure an FS budget that includes the utilization of the list for national supplementation?	
			Is it possible to build an FS survey implementation system that includes reliable technical experts and specialized institutions?	
Raw material/fuel procurement	Specifics of raw fuel type	2.1.I.A	Have you identified the types of raw fuel that you will use? Have you confirmed that such can be procured locally?	
			Have you confirmed the trends in raw materials and fuel prices and the level of competition with other raw materials?	
			Have you confirmed the properties of the raw materials or fuels as candidates for procurement in the local area?	
			Did you confirm the water content in the raw materials and fuels to be used? Also, do you have an accurate understanding of the moisture index of such?	
			Did you know the density of the raw materials and fuels to be used? Also, do you understand the conversion method for the volume and weight?	
			Did you compare the value of wood for fuel and wood for other uses?	
			Have you compared the value of the envisioned biomass fuel and fossil fuel?	
			Have you confirmed whether the raw materials are valuable or should be considered waste? Did you also consider measures regarding Wastes Disposal and Public Cleansing Act?	
	Confirming local availability of raw material scale	2.2.I.A	Have you assumed a required scale for the raw fuel to be used?	
	Confirmation of a base for fuel manufacturing	2.12.I.B	Do you understand the types and characteristics of the fuel that you expect to procure?	
			Is there a production base for fuel such as chips and pellets, etc., in the suburbs, or is the development of a new base planned?	
Installation of equipment	Confirming the reliability of equipment technology	3.1.I.A	Did you confirm that the equipment/technology that you plan to introduce has a proven track record of introduction on a commercial basis rather than simply as part of a demonstration project?	
			In the case of overseas products, are you assuming an import route to Japan?	
			For such overseas products, has a sample of the fuel to be used been presented by and obtained from overseas?	
			Did you understand the types and characteristics of the technologies that you plan to introduce (e.g., BTG, ORC, pyrolysis gasification, heat utilization boiler)?	
	Confirmation of equipment scale and investment scale	3.2.I.A	Do you understand the construction cost and investment scale of the entire system, not just the equipment alone?	
	Site assumption	3.21.I.C	Did you confirm that there is no problem with the topography or geology? (It would be good if the existence of past disasters, the possibility of disaster hazards, whether there is sufficient earth-bearing capacity, past land use could be confirmed.)	
			Can you envision a site that takes into account the biomass fuel procurement distance? Can you envision a site that takes into consideration the surrounding environment, access roads, water, electricity, and other infrastructure such as communications?	
Utilization and processing of energy and by-products	Assumption of energy use	4.1.I.A	Can you assume where the heat will be supplied to?	
			Do you understand the usage status of biomass energy and the characteristics of heat usage by sector?	
	Specifics of the energy supply form	4.2.I.A	Can you assume the heat medium (hot water, steam, etc.) required by the customer and the scale of heat demand expected?	
			Is the target region an area where the capacity of local power systems is tight?	

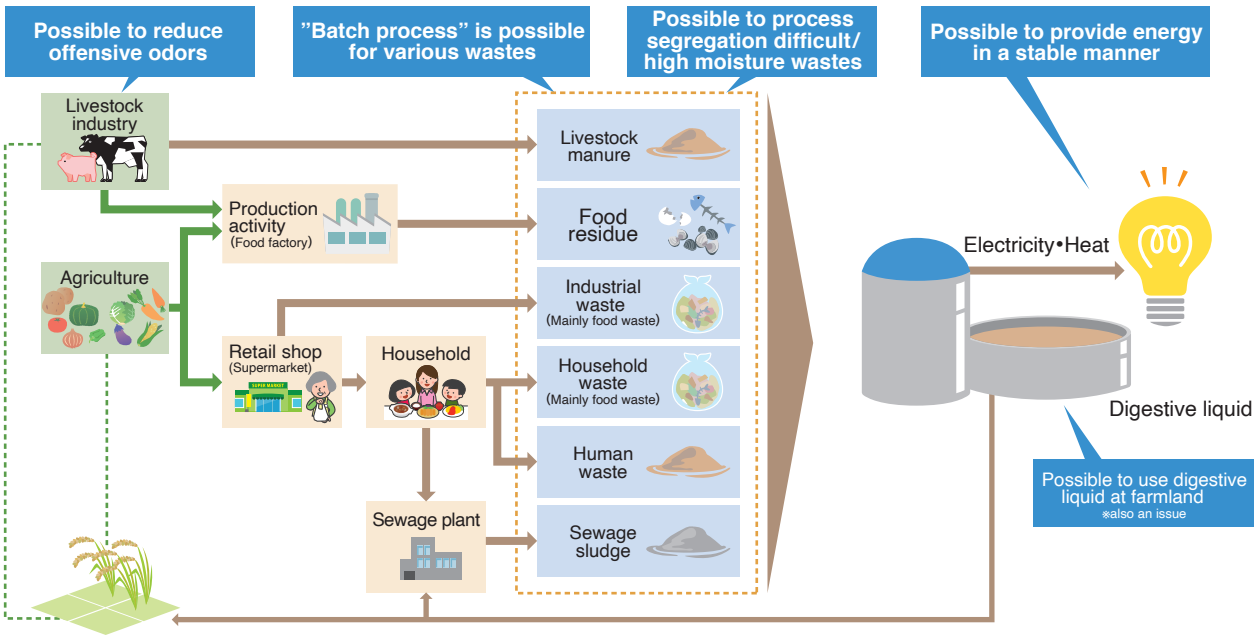
08 Two major characteristics of methane fermentation business

While one notable characteristic of methane fermentation business is to produce and utilize renewable energy, more important characteristic is the recycling of organic materials(including waste disposal process) for the purpose of environment conservation. Once releavant facility is up and running, as a local waste material processing infrastructure, it has to accept various kinds of waste materials and biomass resources discharged from relevant parties on a daily basis. As its business plays such an important role in the local area, it can not be halted easily. Therefore, it is necessary to consider this business from mid to long term business perspectives which can be continued even after current Feed in Tariff will end in 20 years time.



09 Positive effects on local communities from Methane fermentation business

As methane fermentation is capable of accepting various kinds of biomass, including raw materials with higher percentage of moisture content as well as mixed impurities,it can process all at once. Due to such an advantage, some local governments can streamline the infrastructure of waste disposal process by methane fermentation such as processing both human waste and raw garbage from residential household and food waste from the industry by a single methane fermentation facility. Additionally, methane fermantation has other significant benefits that can help reduce foul odors from livestock waste as well as stable renewable energy due to its small output fluctuation. Since its fermentation residue is rich in manure components(e.g., nitrogen, phosphorus and potassium) , it can be effectively utilized as a good manure for field crops. Because water treatment and incineration disposal processes will be required if liquid fertilizer(digestive fluid) or compost can not be supplied to others, it is nessary to secure those types of 'exit' strategy in advance for truly sustainable business.



10 Significance of system selection(methodology) based on potential raw material (Entrance) and energy demand strategy (Exit) <Methane fermentation>

Methane fermentation technology is broadly categorized in 2 types, which are 'wet' and 'dry' methane fermentation technologies but both are the same biological response process technology. The difference is the system structure suitable to the nature of the material used for the process.

For wet methane fermentation technology, its system is made most suited to process slurry raw material with higher water contents so that it became widely used in Japan to help reduce volume of the sewege treatment, as well as to properly dispose human waste and livestock manure. However, in order to avoid any potential blocks to the equipment and pipes, as a general rule, the waste generator is required to sort out wastes and remove any foreign objects on their side, to some extent. Additionally, they need to consider how to utilize digestive fluid produced as a result of the process, as well as water treatment. On the other hand, dry methane fermentation technology is made mostly suited to process solid raw material and it became widely used since 1980s in Europe in order to reduce a burden at final disposal site to be used as energy and as a system to produce compost. Based on such background, it gradually started to be used nowdays in Japan. As long as the moisture content of the raw material used is properly managed, solid residue will be created which can be best utilized as a compost and thermally recycled.

One important point at this point, is not to focus too much on technology such as wet or dry systems, but rather on a system based on 'Entry' and 'Exit' strategies of methane fermentation facility. In order to select most suitable system, first of all, you need to thoroughly understand main characteristics of the biomass you would like to process and use, and also take into consideration of all the other factors involved such as who will utilize those residues expected as a result (liquid fertilizer and compost) or whether there is a third party who can process them, etc., For example, Fuji Clean Co., Ltd. (Industrial waste disposer), has succesfully implemented a dry methane fermentation system as it could process food waste and waster papers that were difficult to recycle, the company already had its own incineration facility on site and it was also difficult to build a water treatment facility due to its mountaineous location. The system started its operation in 2018 and has been running succesfully.

From 'Entry' perspectives

❶ Raw material moisture content

- **High** Suitable for Wet(Dry system can be used with dewatering process)
- **Low** Suitable for Dry (Wet system can be used to some extent with moisture adjustment)

❷ Items not suitable for fermentation

- **Many** Suitable for Dry (Wet system can be used to some degree with proper separation)
- **Little** Suitable for both Wet and Dry systems

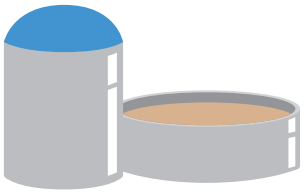
❸ Gas yield

- **Many** Suitable for both Wet and Dry systems
- **Little** Better suitable for Wet system

※Investment amount per raw material is larger for Dry system that it may be difficult as a business(may be resolved by mixing larger gas yield material, such as paper waste)

Methane fermentation facility

Wet or Dry systems



❼ Confirm economic efficiency →Select system

From 'Exit' perspectives

❹ Existence of water processing facility

- **Yes** Favorable to Wet system(For Dry system, simplified water processing system is required)
- **No** Favorable to Dry system(Wet system can be used if water processing facility is newly built)

❺ Existence of incineration facility

- **Yes** Favorable to Dry system(heat from residue can be recycled)
- **No** Favorable to Wet system(Dry system can be used if dry residue can be made as compost)

❻ Utilization of fermentation residue

Option to use digestive fluid(Liquid fertilizer)

- **Yes** Suitable for Wet system(Also for Dry system)
- **No** Suitable for Dry system(Wet system can be used with water processing)

Option to use sold residue(compost)

- **Yes** Favorable to both Wet and Dry systems
- **No** More suitable for Wet system (Dry system can be used with incineration facility)

Raw material	Main characteristics
Dairy cow manure	● **Free-stall barn :** As feces and urine and small amount of bedding materials are mixed and discharged as slurry manure(over 90% moisture) , it is suitable for wet methane fermentation material with higher moisture. ● **Stall barn :** At barn which separates feces and urine, semi solid manure (85-88% moisture) that feces and bedding materials are mixed are discharged.
Beef cattle manure	● Normally, its moisture content is between 55%~70% and fermentation tank may be blocked as manure with more bedding materials(sawdust and wheat straw) are more likely to be collected. Therefore, it is not suitable for Wet system. However, there are some cases where Dry system are under consideration for usage.
Swine manure	● As urine amount is larger comparing to that of feces, for slotted floor type swine housing, manure is already slurry that it can be used as a material for methane fermentation. However, you need to pay attention to its high nutrition concentration and its nature will vary depending on the type of swine housing.
Poultry manure	● **Broiler :** As its moister content is low as 20%~30% and it is discharged with bedding material, it is not suitable for methane fermentation alone. ● **Egg laying hens :** Although gas yield is large, but amount of ammonia is also large that either dilute to 3-5 times or mix with other raw materials, if used alone.
Garbage/ Food residue	● In general, it is easy to be decomposed and gas yield is large that it is suitable as raw material for methane fermentation. ● Materials not suitable for fermentation, are plastic, leather, stone, metal, fermentation inhibitor, drug, solvent, bones and shells from crustacea, etc.,
Paper waste/ Pruned branch	● Due to its large amount of gas yield, it is suitable for methane fermentation raw material for Dry system. ● To secure gas yield, there are some cases where paper waste is purchased with a fee.

11 Flow towards successful methane fermentation biomass energy business

Methane fermentation business has many action points for implementation, from planning to operation stages. At this NEDO's introduction to the installation requirements・technical guidelines for implementation of biomass energy system, various points to consider for each action point, as well as those details and various data are explained.

Overview of action items for methane fermentation biomass energy business

*Note: Blue text indicates introductory requirements/technical guidelines.

Action items related to the complete edition (Chapter 1 of Complete Edition)

	Phase Ⅰ Conception	Phase Ⅱ Feasibiity Study	Phase Ⅲ Design and Construction	Phase Ⅳ Operation
A. Business plan	1.1.Ⅰ.A Building of a business concept 1.2.Ⅰ.A Business model outline study	1.3.Ⅱ.A Re-examination and confirmation of the business concept 1.4.Ⅱ.A Consideration of the commercialization schedule	1.5.Ⅲ.A Review of future business plans 1.6.Ⅲ.A Formulation of a facility operation management plan	
B. Business structure・local cooperation	1.7.Ⅰ.B Consideration of business structure 1.8.Ⅰ.B Consulting with experts 1.9.Ⅰ.B Consulting with government	1.10.Ⅱ.B Commercialization system construction 1.11.Ⅱ.B Consensus-building with local stakeholders	1.12.Ⅲ.B Finalization of commercialization structure 1.13.Ⅲ.B Hiring of staffs 1.14.Ⅲ.B Conduct living environment impact survey 1.15.Ⅲ.B Local consensus-building	1.16.Ⅳ.B Fostering of local understanding
C. Business's balance sheet/financing	1.17.Ⅰ.C Review investment size for the facility 1.18.Ⅰ.C Obtaining a survey budget for FS research	1.19.Ⅱ.C Calculation of construction cost・O&M cost 1.20.Ⅱ.C Business's balance sheet, cashflow analysis 1.21.Ⅱ.C Confirmation of the subsidy system 1.22.Ⅱ.C Business's risk assessment (sort out the entire issues) 1.23.Ⅱ.C Consider to raise money for initial investment cost	1.24.Ⅲ.C Application for equipment assistance 1.25.Ⅲ.C Financing, negotiation with financial institutions	1.26.Ⅳ.C Verification and improvement of business profitability 1.27.Ⅳ.C Formulation of mid term budget for maintenance fee 1.28.Ⅳ.C Securing funds for major repair expected
D. Ripple effects		1.29.Ⅱ.D Evaluation of the ripple effect by business		1.30.Ⅳ.D Verification and disclosure of ripple effects

Action items related to raw materials procurement (Chapter 2 of Complete Edition)

Phase Ⅰ Conception	Phase Ⅱ Feasibiity Study	Phase Ⅲ Design and Construction	Phase Ⅳ Operation
2.1.Ⅰ Specifics of raw fuel type 2.2.Ⅰ Confirming local availability of raw material scale 2.3.Ⅰ Survey of resource amounts	2.4.Ⅱ Study how raw materials occur 2.5.Ⅱ Possibility of survey on raw material collection 2.6.Ⅱ Investigation of the nature of raw material 2.7.Ⅱ Investigation of the amount of gas produced from the raw material 2.8.Ⅱ Investigation of alternative raw material options	2.9.Ⅲ Finalizing raw material 2.10.Ⅲ Finalizing packing style and transport vehicle	2.11.Ⅳ Confirmation of the nature of raw material delivered 2.12.Ⅳ Confirmation of the amount of raw material delivered

Action items related to equipment installation (Chapter 3 of Complete Edition)

	Phase Ⅰ Conception	Phase Ⅱ Feasibiity Study	Phase Ⅲ Design and Construction	Phase Ⅳ Operation
A. Installation of equipment	3.1.Ⅰ.A Selecting of methane fermentation technology and confirm reliability	3.2.Ⅱ.A Implementation of basic design 3.3.Ⅱ.A Element technology (fermentation/incidental technology) 3.4.Ⅱ.A Create flowsheet/layout sheet/specification 3.5.Ⅱ.A Study how to order equipment・construction works 3.6.Ⅱ.A Quotations for each facility and calculate overall cost	3.7.Ⅲ.A Selection of construction company 3.8.Ⅲ.A Implementation design 3.9.Ⅲ.A Arranging equipments 3.10.Ⅲ.A Construction agreement 3.11.Ⅲ.A Manage construction and implementation work progress 3.12.Ⅲ.A O&M contracting 3.13.Ⅲ.A Insurance contracting 3.14.Ⅲ.A Securing sewege related facilities 3.15.Ⅲ.A Formulation of test run/plan 3.16.Ⅲ.A Confirmation of performance after test run 3.17.Ⅲ.A Confirmation of performance guanratee items 3.18.Ⅲ.A Confirmation of the handover of the facility	3.19.Ⅳ.A Operation management of the plant 3.20.Ⅳ.A System/equipment performance evaluation and improvement 3.21.Ⅳ.A Verification and improvement of the facility utilization rate 3.22.Ⅳ.A Troubleshooting 3.23.Ⅳ.A Understanding methane fermenter operation
B. Compliance with laws and regulations		3.24.Ⅱ.B Confirmation and response to laws and regulations as related to equipment installation	3.25.Ⅲ.B Acquisition of permits and notifications for business implementation	
C.Location selection	3.26.Ⅰ.C Site Assumption	3.27.Ⅱ.C Location survey and study where to set up		

Action items related to the use and treatment of energy and by-products (Chapter 4 of Complete Edition)

	Phase Ⅰ Conception	Phase Ⅱ Feasibiity Study	Phase Ⅲ Design and Construction	Phase Ⅳ Operation
A. Provision and energy use of supply	4.1.Ⅰ.A Assumption of energy use and energy supply	4.2.Ⅱ.A Specifics of the energy supply form and amount 4.3.Ⅱ.A Survey of energy demand	4.4.Ⅲ.A Energy supply contracting	4.5.Ⅳ.A Maintenance plan for the power generator and verification of its operation
B.System connection	4.6.Ⅰ.B Grid interconnection survey	4.7.Ⅱ.B Grid interconnection survey	4.8.Ⅲ.B FIT business application 4.9.Ⅲ.B Connection contracting, power sale contracting	
C. By-product treatment/use	4.10.Ⅰ.C Examination of digestive liquid process and utilization	4.11.Ⅱ.C Consider details on how to process and utilize residues after digestion 4.12.Ⅱ.C Invetigate how to utilize liquid fertilizer 4.13.Ⅱ.C Water process survey (release standard)	4.14.Ⅲ.C Survey on how to utilize liquid fertilizer for digestive liquid	4.15.Ⅳ.C Performance of water processing facility confirmation 4.16.Ⅳ.C Examination and adjustment for the effective use of by-products

12 Checklist towards sustainable business【methane fermentation】

In the introduction requirements/technical guidelines, based on the analytical findings of previoius cases, a checklist is created as follows to summarize all the points for consideration, which also includes specific details of each item and what kinds of special efforts will be required at feasibility study and demonstration projects.

■ Checklist for methane fermentation biomass energy business（Excerpt from the Conceptual Section）

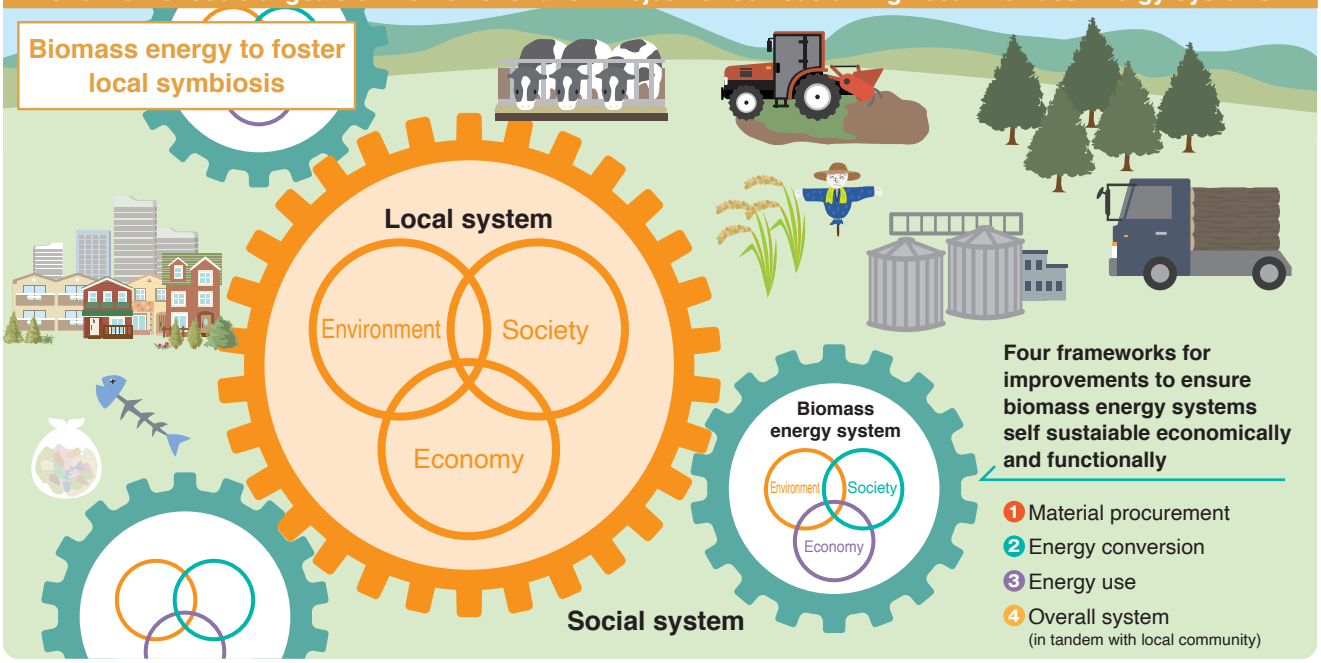
Division	Action items	Corresponding items in Part 2 of this volume	Notes	Check
Overall	Building of a business concept	1.1.I.A	Is the purpose of business organized? Also, can you share such purpose with stakeholders?	
			Are the plan and size of the business heavily depend on the technology and equipments to be installed?	
			Do grants and subsidies precede the decision on the purpose and necessity of the business?	
			Is your plan subject to the objections from local parties involved?	
			Is your plan subject to the problem from social perspective?	
	Business model outline study	1.2.I.A	Have you assumed implementers and bases involved in raw materials procurement, energy conversion and the energy use?	
			Can you make a clear target on profit structure and profitability(e.g., reduce processing fee, selling electric power, heat and liquid fertilizer, etc.,)	
			Is it a business that requires a special license, and is such a license expected to be acquired(e.g., related to Wastes Disposal and Public Cleansing Act, special application for development, etc.,) ? If so, are you prepared to get such licenses?	
	Developing business structure	1.7.I.B	Does your plan clearly define who the main operating body is, not just having a big vision without business itself?	
			Can you clearly imagine a main operating body which have sufficient abilities to manage funds as well as execute the business?	
			Do you have a key person who can mainly handle all the necessary procedures to implement the business and also have sufficient supporting system?	
	Consulting with experts	1.8.I.B	Have you consulted with and received advice from experts, specialized agencies, and support organizations, etc., regarding the implementation of the business concept?	
	Consulting with local governments	1.9.I.B	Have you consulted with or provided information to the local governments regarding the business concept? Is it possible to obtain the cooperation of such governments?	
	Confirming investment size for the facility	1.17.I.C	Do you clearly understand the entire investment size generally required for overall dry and wet methane fermentation business?	
			Do you have a clear image on overall construction cost and total size of investment for the entire system, not only for each facility alone?	
			Can you make a clear target on profit structure and profitability(e.g., reduce processing fee, selling electric power, heat and liquid fertilizer, etc.,)	
	Secure budget for FS study	1.18.I.C	Is it possible to secure an FS budget that includes the utilization of the list for national supplementation?	
			Is it possible to establish implementation structure required for FS study including reliable and skilled experts and special agencies?	
Procurement of raw materials	Listing up of raw material options	2.1.I	Can you clearly understand the merits and demerits of raw material required for methane fermentation?	
			Have you confirmed the types of raw materials? Can you also confirm whether they are either valuable resources or wasted materials?	
	Confirming local availability of raw material and procurement	2.2.I	Raw materials required for your business, can be procured in the local area in a stable and continuous manner?	
			Do you calculate the volume of the raw material required only from the power generation capacity? Or do you also calculate such volume by putting higher priority on income expected?	
	Survey of where to obtain raw materials from	2.3.I	Have you examined where the raw material is produced, its amount of generation and its main characteristics?	
Equipment installation	Selection of methane fermentation technology and confirm reliability	3.1.I.A	The equipments and technology under consideration, have proven track record on commercial bases, not only on demonstration project base?	
			Do you have clear understanding on the technical characteristics and raw materials required for both wet and dry methane fermentation systems?	
			Do you have clear understanding on exact import route, if it has to be purchased from abroad?	
	Site assumption	3.26.I.C	Did you confirm that there is no problem with the topography or geology? (It would be good if the existence of past disasters, the possibility of disaster hazards, whether there is sufficient earth-bearing capacity, past land use could be confirmed and also what is the usage situation based on the City Planning Act or even relationship with the local residents)	
			Can you envision a plan that takes into consideration on the usage of the surrounding land including other points, such as area to procure raw material, its surrounding environment, access to the main road, water, electricity and infrastructure such as communications?	
			Have you checked the land classification of the target options, as well as whether it is necessary to obtain any permissions for actual usage(e.g., area classification, usage classification) ?	
Use and treatment of energy and by-products	Assumption of where to use and how to supply energy	4.1.I.A	Can you assume where the electricity and heat will be supplied to?	
			Have you considered the size of the heat medium required (e.g., hot water or steam, etc.,) on the demand side?	
	Grid connection review	4.6.I.B	Is the target region an area where the capacity of local power systems is tight?	
			Have you already contacted electric power company for grid connection?	
	Consideration of process and utilization of digestive liquid	4.10.I.C	Do you have clear image on how to process and use digestive fluid? (Either release into water or use as liquid fertilizer after water processing)	

13 Demonstration Project for Self-sustaining Local Biomass Energy Systems

Biomass energy is expected to continue to become widely used as an important driver (‘gear’) that activates an entire local system from the three perspectives of economy, society, and the environment. In order to realize a sustainable biomass energy business and to promote the wider application of technology, it is necessary to use heat efficiently and to create an optimal system that takes advantage of local characteristics.

The New Energy and Industrial Technology Development Organization (NEDO) has launched and is now carrying out its " Demonstration Project for Self-sustaining Local Biomass Energy Systems " in FY2014 so as to build an optimal biomass energy utilization system that takes advantage of local characteristics. In this project, a feasibility study as a local self-sustaining system, a demonstration project, and a technology development project were set as action items, keeping in mind that renewable energy Feed-in Tariff systems (FITs) or subsidies are not relied on. These results are reflected in the introduction requirements and technical guidelines, and these results are disclosed every year.

Overview of societal goals of the Demonstration Project for Self-sustaining Local Biomass Energy Systems



Action items for Demonstration Project for Self-sustaining Local Biomass Energy Systems

1. **The requirements for local sustainability from an economic standpoint and the elemental technologies for each type of biomass fuel (unused wood, livestock waste, municipal waste, etc.) will be reviewed, and the introduction requirements and technical guidelines for such will be summarized.**
2. **Feasibility studies for demonstration projects will be conducted.**
3. **For businesses that are likely to be profitable, model verification that matches the requirements and technical guidelines for introduction will be performed, and technologies where improvement can be achieved will be developed.**
4. **Together with the introduction requirements and technical guidelines that reflect the results of development and demonstration, a business model will be published, and contribution toward furthering introduction promotion will be made.**

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