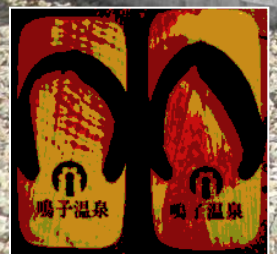

Do you like hot spring?
宮 城 県 産 業 経 済 部 観 光 課

Construction of “enetourism” which tourist bring leftover food to methane fermentation using hot spring.



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Introduction

To make sustainable society, various industry departments have to do something for that

Amount of food garbage from sightseeing area and accommodation are enormous.

A total of tourists in Japan about 3 billion/yr

Amount of food garbage from accommodation is 700 g/capita/day （It is more than 3 times of usual.)

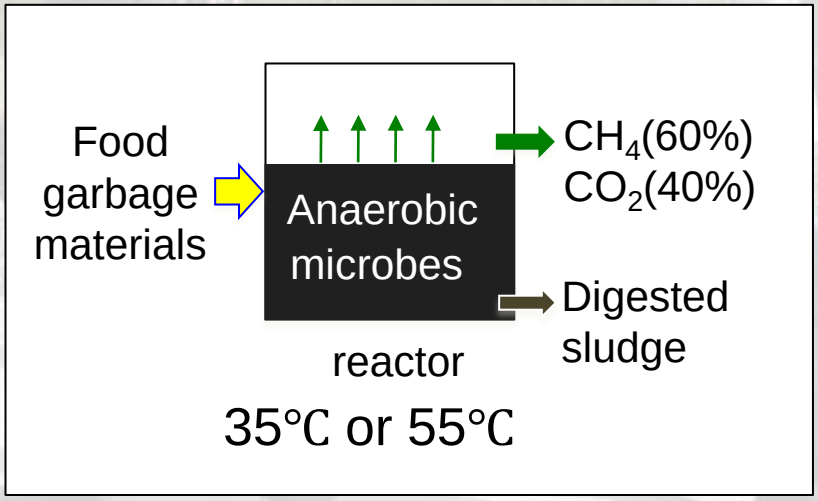
（incineration）

210,000 tons/year

Because of high water contents of food garbage,

Methane fermentation is suitable.

Anaerobic digestion of organic waste by anaerobic microbes.
They produce methane gas. To activate microbes, reactor is needed to keep warm.



Introduction

For making plus of energy balance and economical balance,
→ Huge scale of methane fermentation is common.


Conventional methane fermentation(treatment 24 tons/day)

Initial investment is immense.

Transfer of materials was not efficient.

Consuming energy for heating is large.

Cost of treatment for digested sludge is high.

It was not enough for evaluation of environmental and economic effect.

- **Small scale of methane reactor using hot spring for heating**
- **System for collection food garbage by tourist**
- **Use digested sludge as liquid fertilizers**
- **Evaluation of environmental and economic effect**

Tourism of low CO_2 emission = “enetourism”

Site of reseach

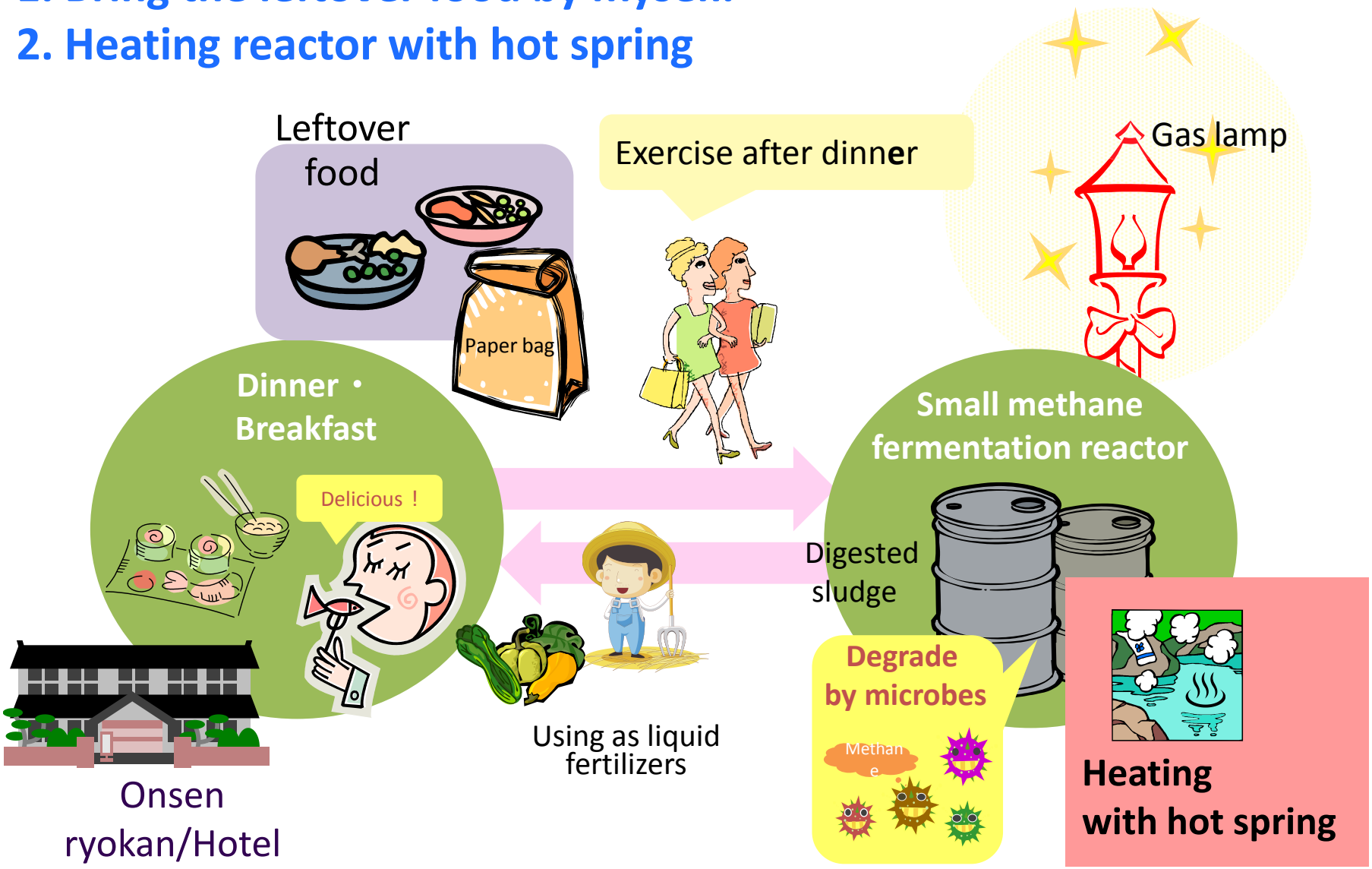
World heritage “Hiraizumi”

North-east Japan
One of the famous hot springs in Japan

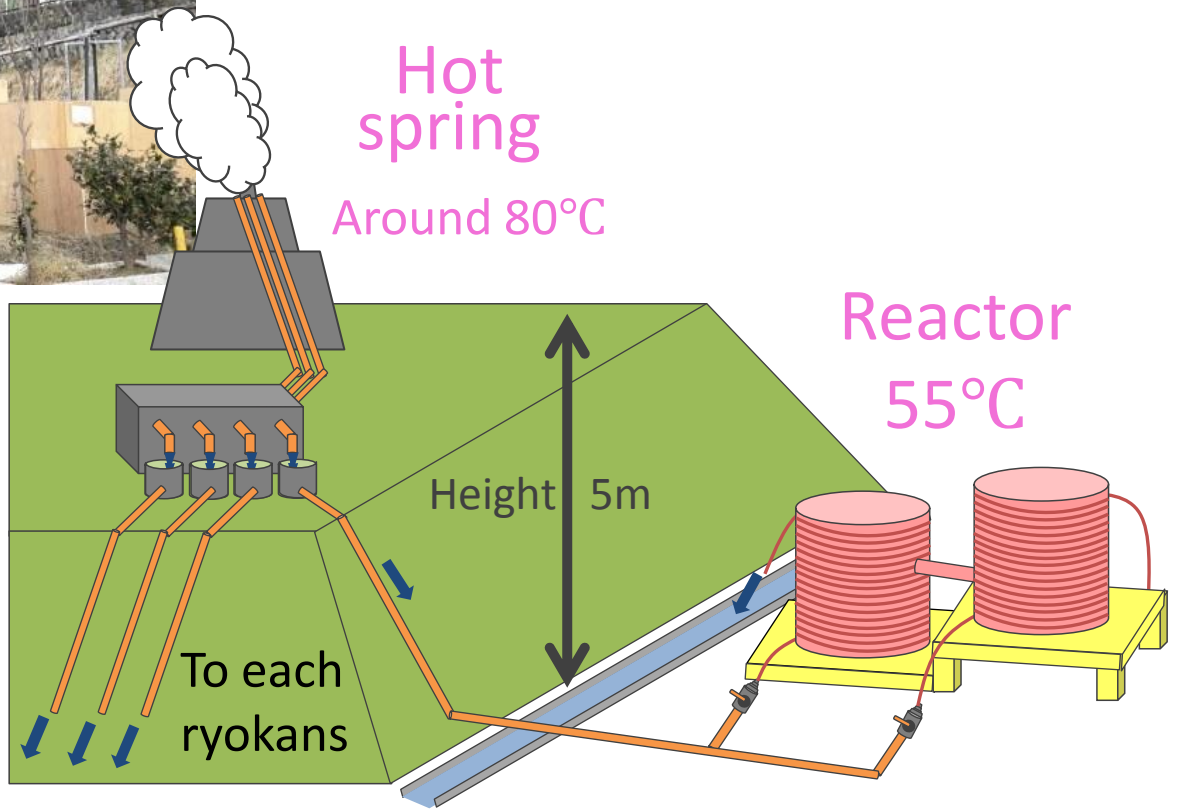
Ryokan(onsen hotel) 21
All of tourists
480,000/year

Outline of the research

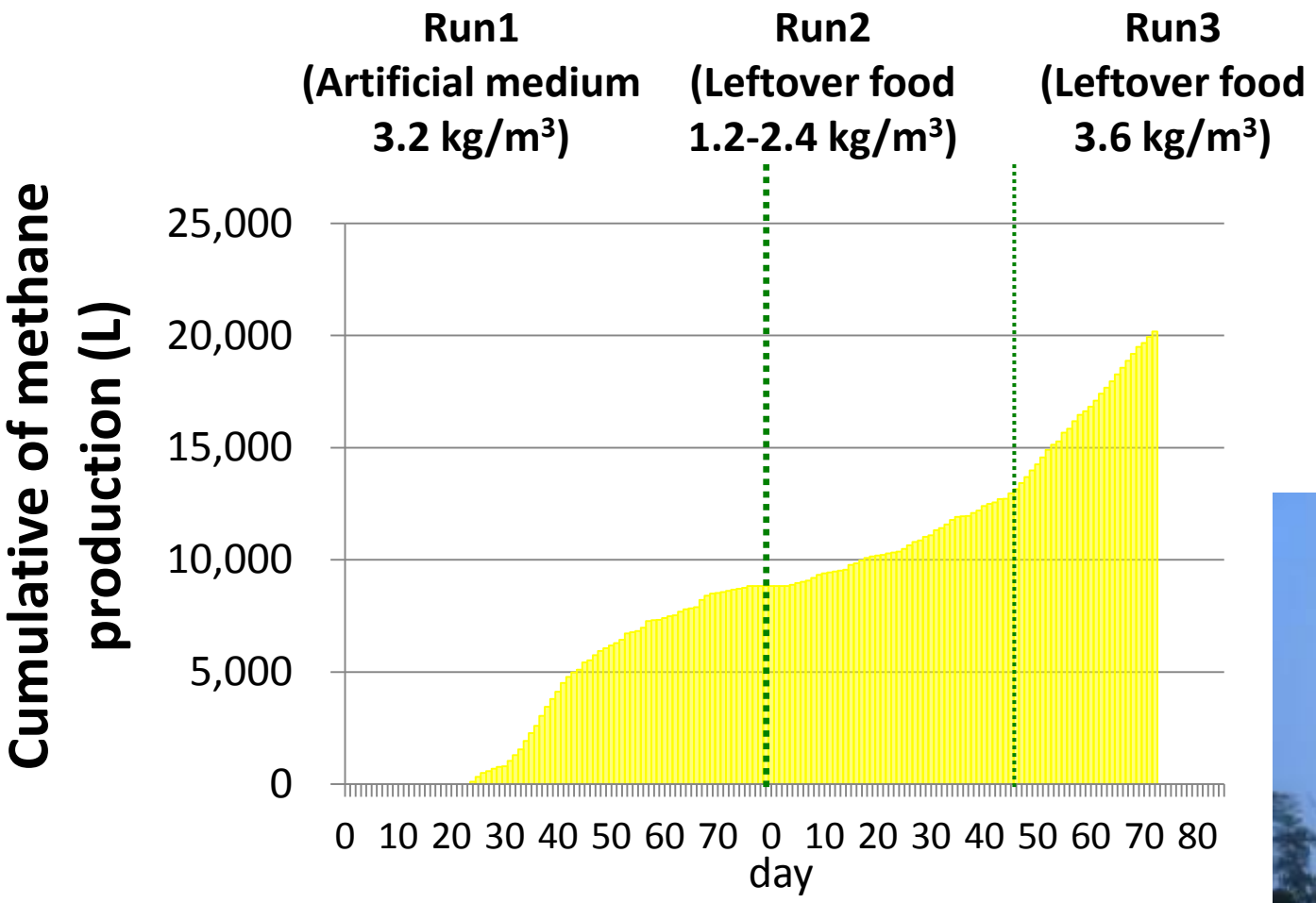
1. Bring the leftover food by myself.
2. Heating reactor with hot spring



Reactor heating with hot spring



Methane gas production



Average biogas production is 600 L/day.

→ Gaslamp can be lightning for 2-3 hours.

Components of leftover food



Table 2 Results of component of the leftover food per capita

	g	C/N	Composition (%)
Rice	160.2	37.3	**49.8**
Fish	43.8	7.0	13.6
Lettuce	38.5	21.8	11.9
Cucumber	20.7	17.3	6.8
other	5.4	16.1	1.9
peel	38.9	36.5	16.1
Total	**307.4**	**20.8**	100

Evaluation economical and environmental effect

Cost for treatment with hot spring reactor was infinitely cheaper, than that of the conventional reactor.

CO_2 emission from the hot spring reactor system was smaller than that from the conventional reactor system.

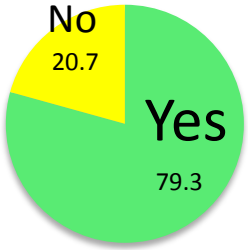
“Enetourism”

“Enetourism”

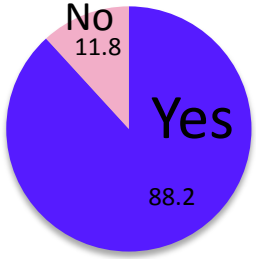
SPA × WASTE = ENE TOURISM

Field Science Center Tohoku Univ

Q1 Have you left the meal until now?



Q2 Did you increase your interest in energy, after participation to enetourism?



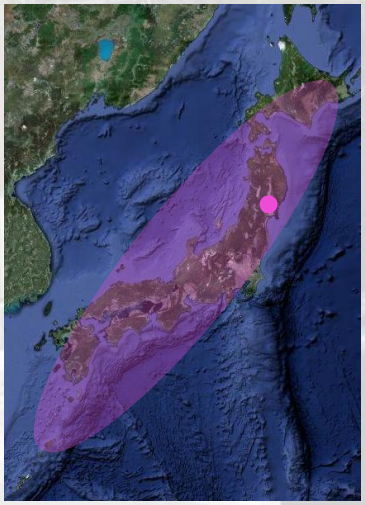
To make decentralized energy

① Small scale of methane reactor using hot spring	② regional development and Education by ene-tourism
③Use of digested sludge as fertilizer	④Apply ene-tourism to hot spring area

Naruko model

Construction of enetourism which tourist bring leftover food to methane fermentation using hot spring.

- **1 hot spring has 1 methane**
- **directly connect person to bioenergy**



person → Biomass → energy

Make a sustainable society