



# Wood Boiler/CHP-based District Heating/Cooling

## Deployment Experience in Japan

October 25<sup>th</sup>, 2019

**Sustainable District Energy Conference**

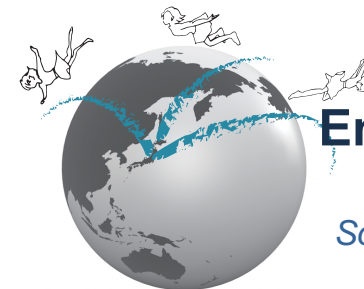


**Shiwa Green  
Energy**

*Energy for Local Jobs  
and Economy*

**Katsuhiro Yamaguchi  
President /CEO**

EneWaza Chinter, Tokyo  
Shiwa Green Energy, Iwate  
Japan



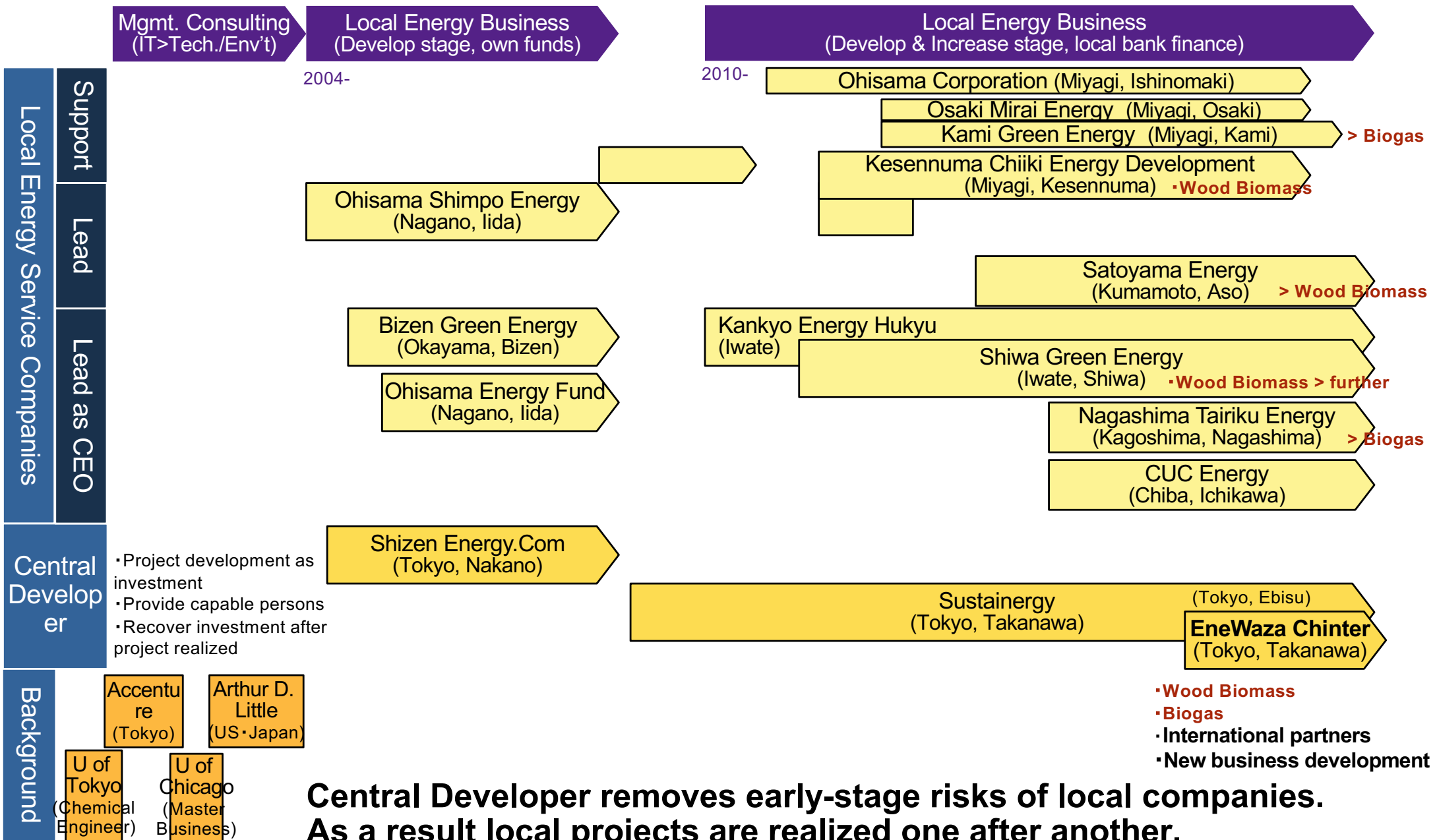
**EneWaza Chinter**

*Energy Technology &  
Solutions, Realized Locally,  
with International Best*



# Local ESCo's Development History

I have been launching renewable/efficiency ESCo's in local areas. Biomass, Heat/Cool, Efficiency are our emphases.



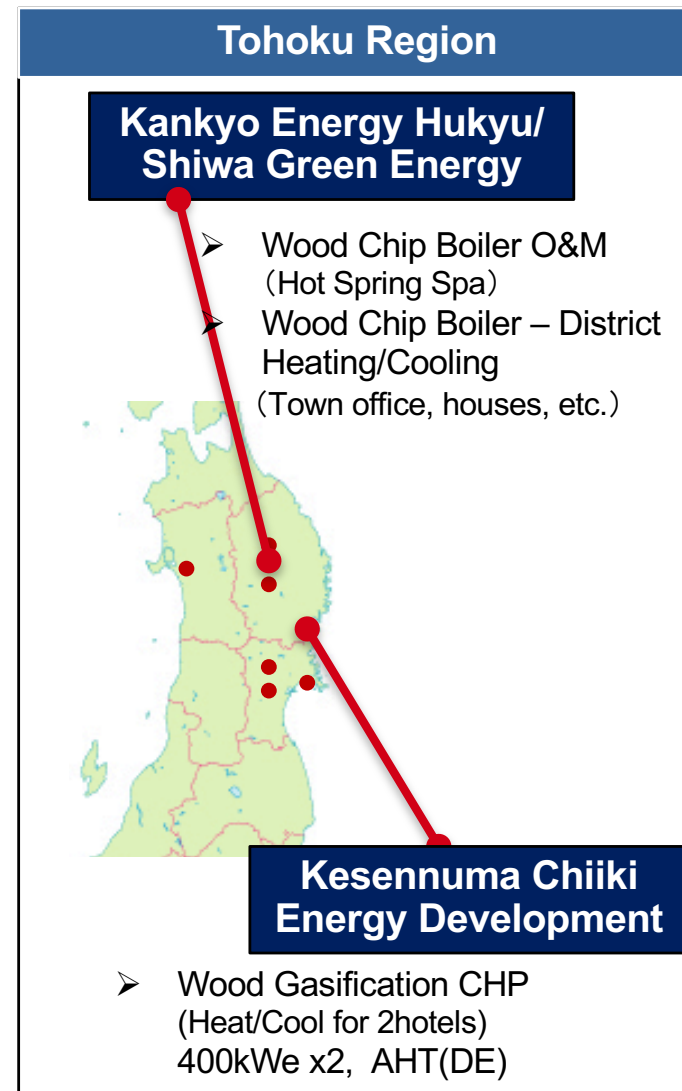
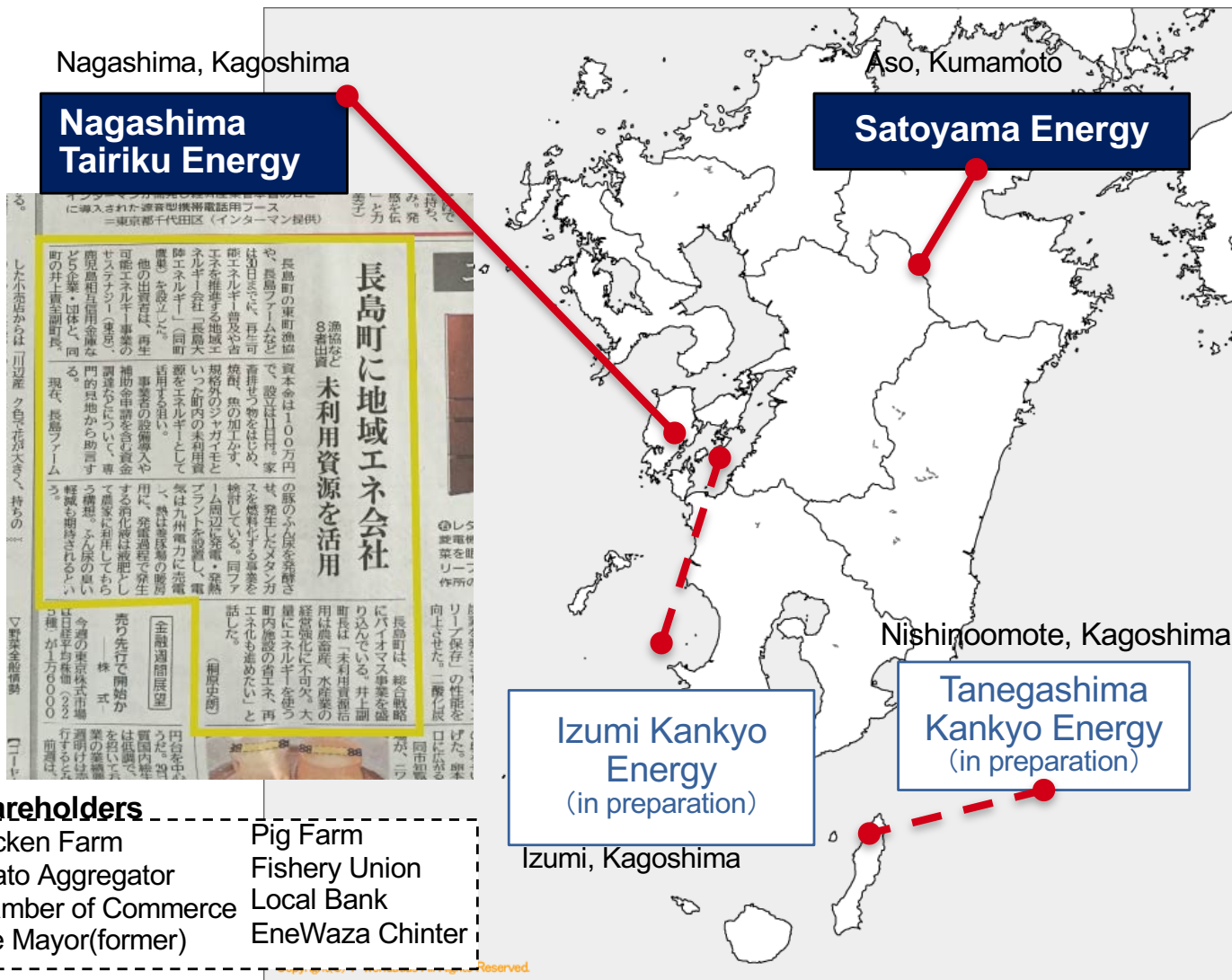
**Central Developer removes early-stage risks of local companies. As a result local projects are realized one after another.**





# Local Joint ESCo's Business Model

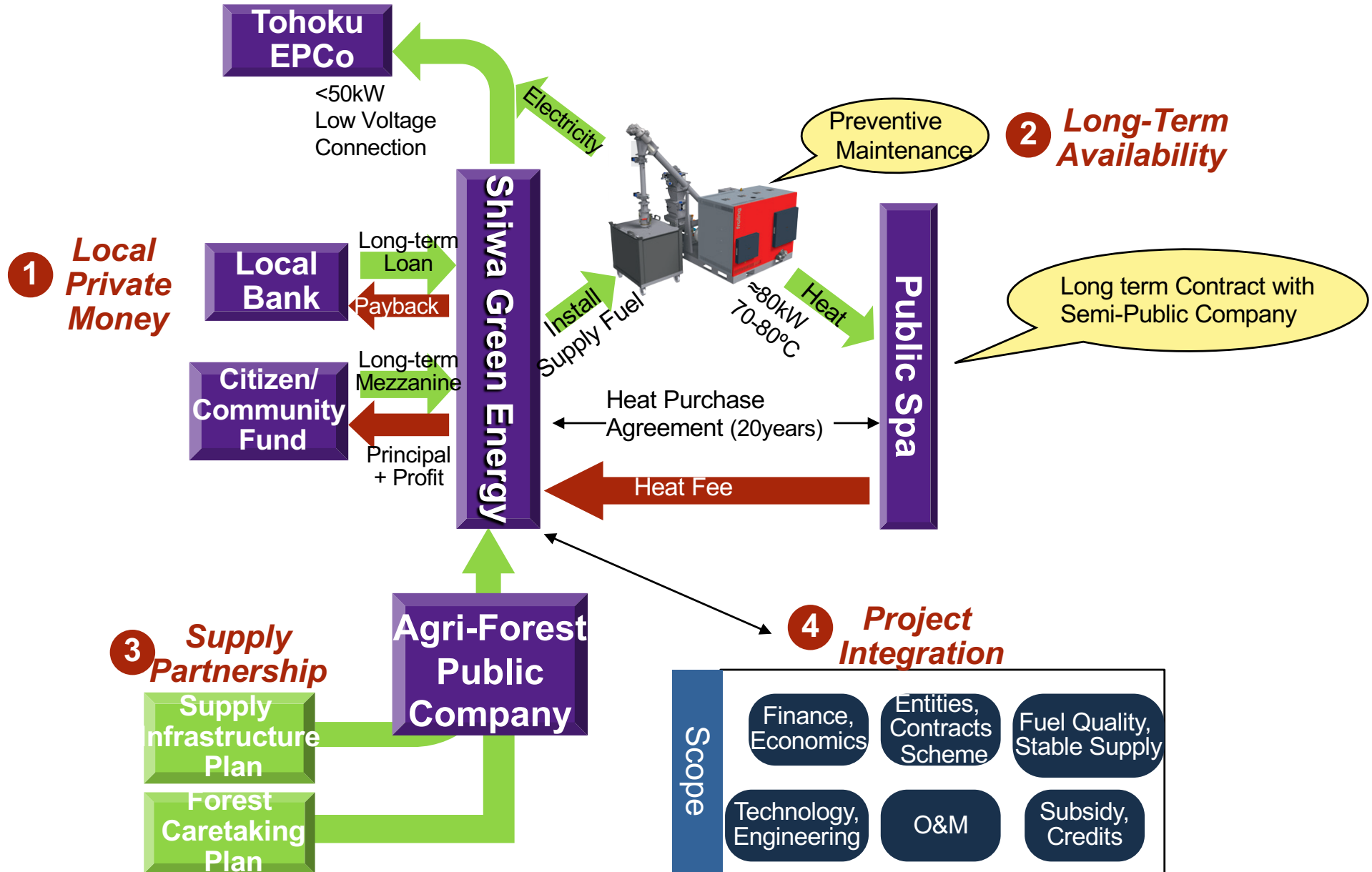
I have formed local energy service JVs in 10 country sides of Japan, realizing new ways of energy efficiency and renewables, empowering communities.



Each location has 2-3 members (max 10), doing O&M hands-on, as well as new projects development.



We coordinate and integrate all parts of chain to complete the whole scheme. Public entities will be stable counterparts, adding viability to this local system.



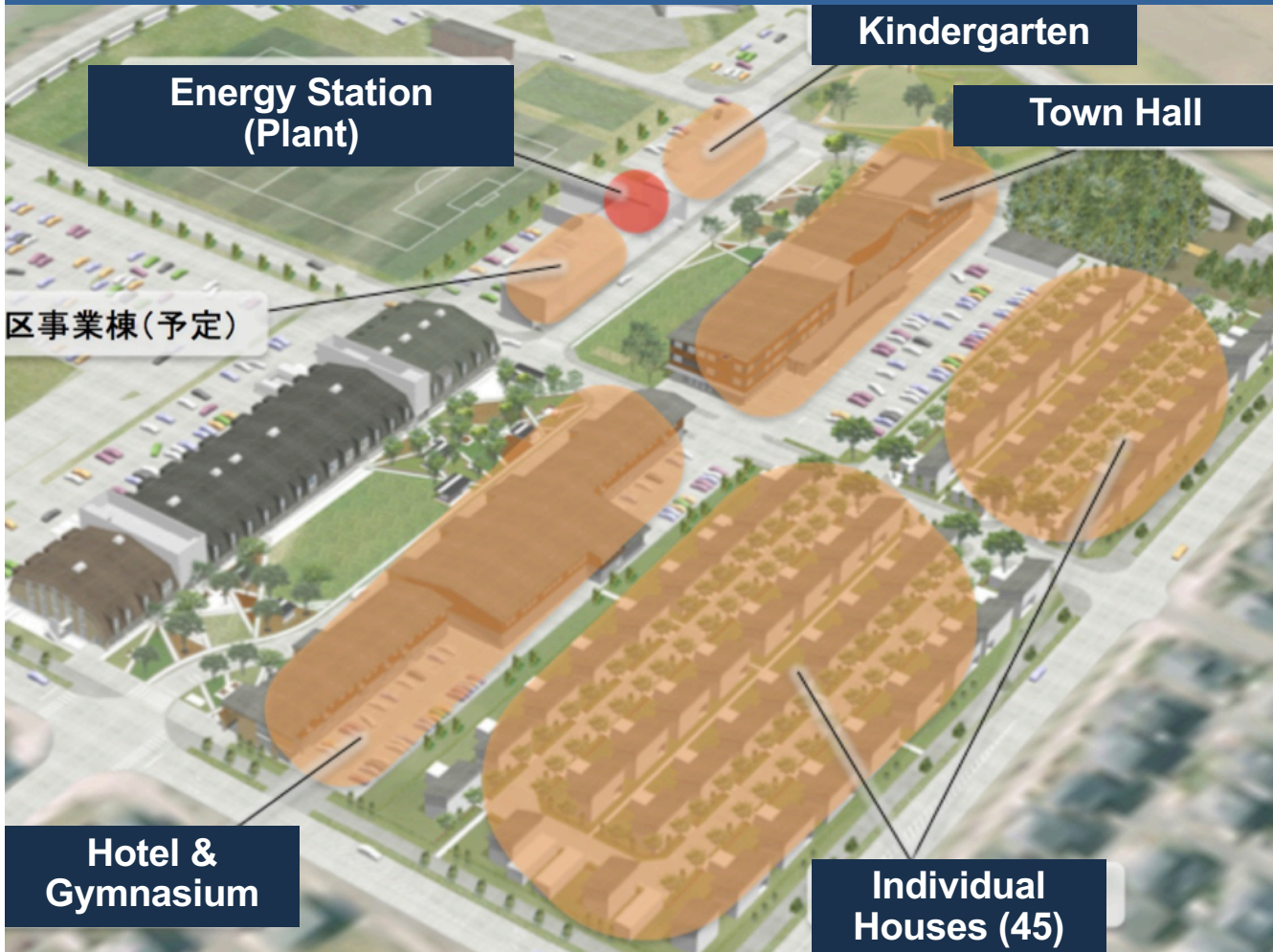




# Wood Boiler – District Heating/Cooling Shiwa Town, Ogal District

District-wide renewable energy coverage, with high standards of insulation and air tightness. Mix of space heating, cooling, and hot water usage.

## Supplied Area by Wood DHC



## Heat Use in Houses







## Pipes Underground

We laid pipes before paving this new district. Common European pre-insulated pipes, flexible only. Pipes are 3.5km long, trench 1.6km.

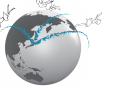


## Energy Station in Construction



We later learned that there are more effective / efficient ways...





## Machines inside Energy Station

**500kW<sub>th</sub> wood chip boiler works all year. In summer hot water is poured into the absorption chiller, to create cold water.**

### Wood Chip Boiler



### Buffer Tanks



### Absorption Chiller



### Pumps & Pipes





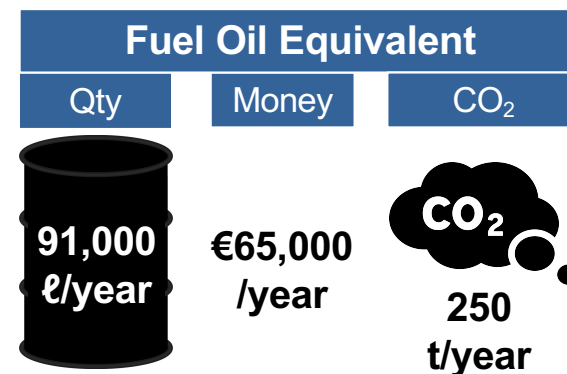
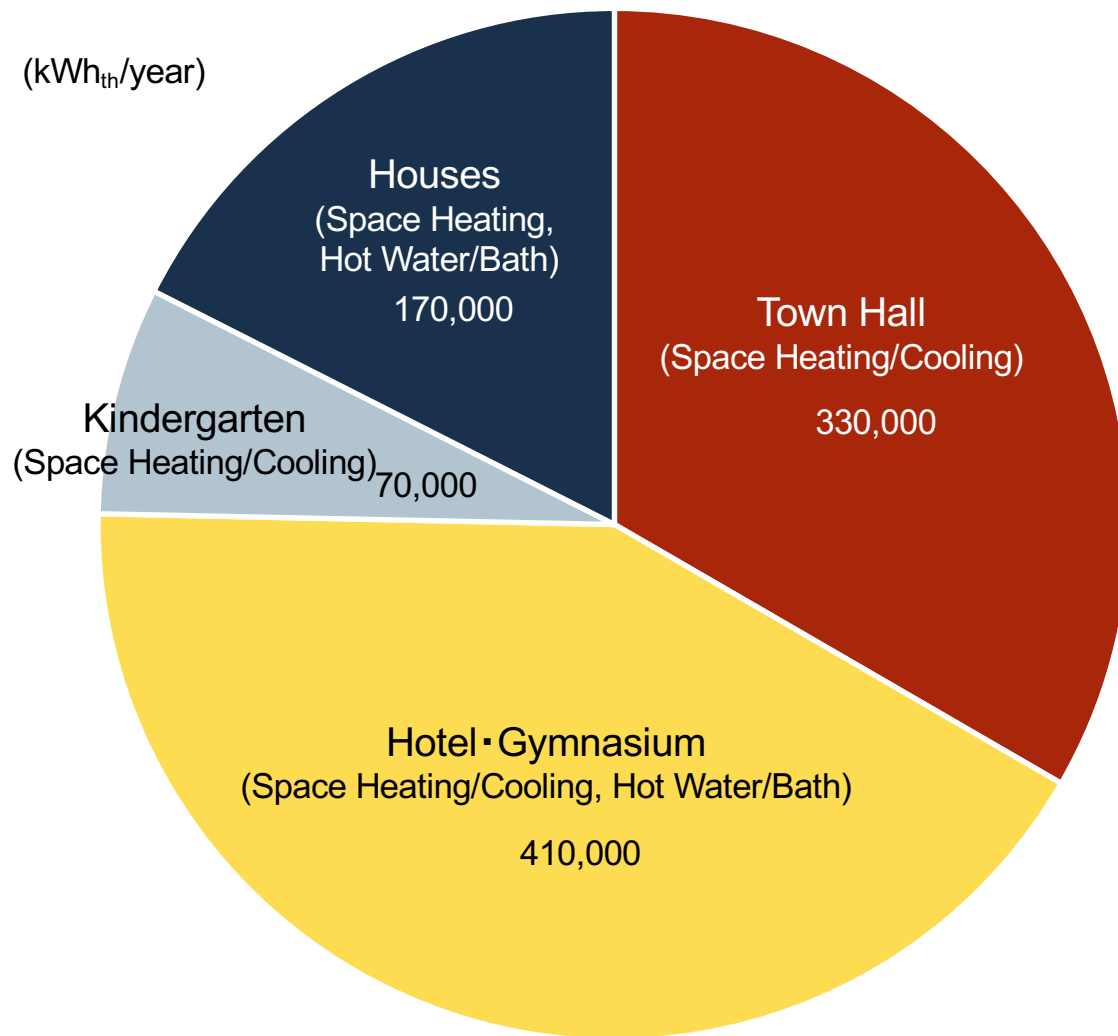
**Heat-driven chillers, to make use of local and/or low-quality resources. Available heat temperature and use temperature determine technology choice.**

Chiller Technology		COP (efficiency)	Input Temperature	Output Temperature	Notes
Absorption Chiller	LiBr	~0.7	88°C (desired)	7~12°C	<ul style="list-style-type: none"> <li>• Common in Japan for space cooling</li> <li>• Single effect for &lt;100°C input               <ul style="list-style-type: none"> <li>- renewable heat</li> <li>- cogeneration heat</li> </ul> </li> </ul>
	Ammonia	~0.5 (or lower)	100~200°C	-60~+3°C	<ul style="list-style-type: none"> <li>• Industrial use in Japan</li> </ul>
Adsorption Chiller		~0.5	60~80°C	12~15°C	<ul style="list-style-type: none"> <li>• Small scale</li> <li>• Relatively new</li> </ul>





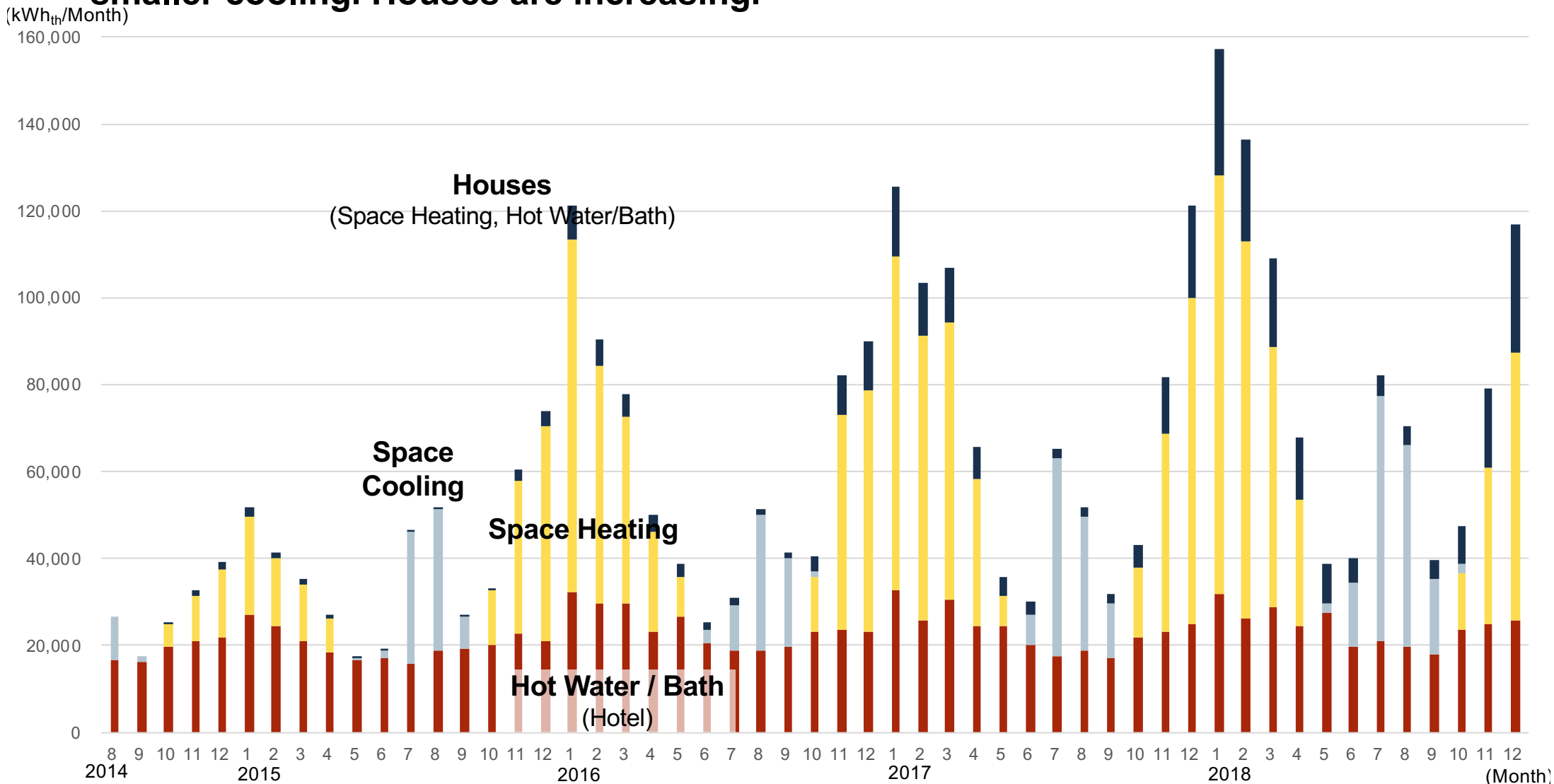
**Hotel uses most, with yearly hot water/bath purpose. Houses have meaningful weight.**





# Heat Supply Monthly by Use Category *Shiwa DHC*

**Year-constant demand of hot water/bath. Larger (than expected) space heating, smaller cooling. Houses are increasing.**



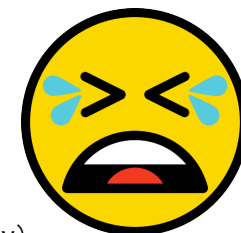
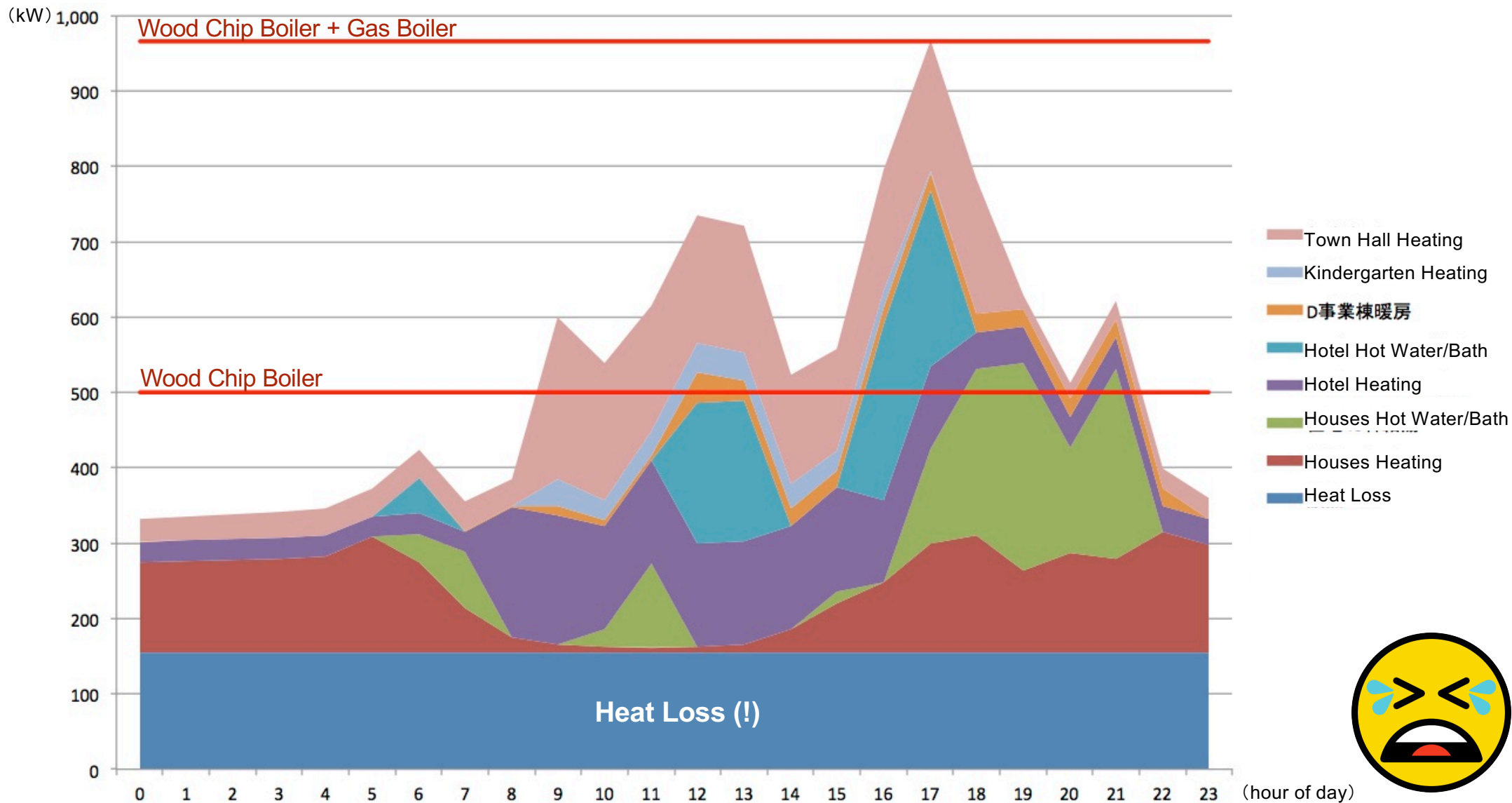
Heat Users





# Heat Loss through Pipes Winter Heat Demand (plan)

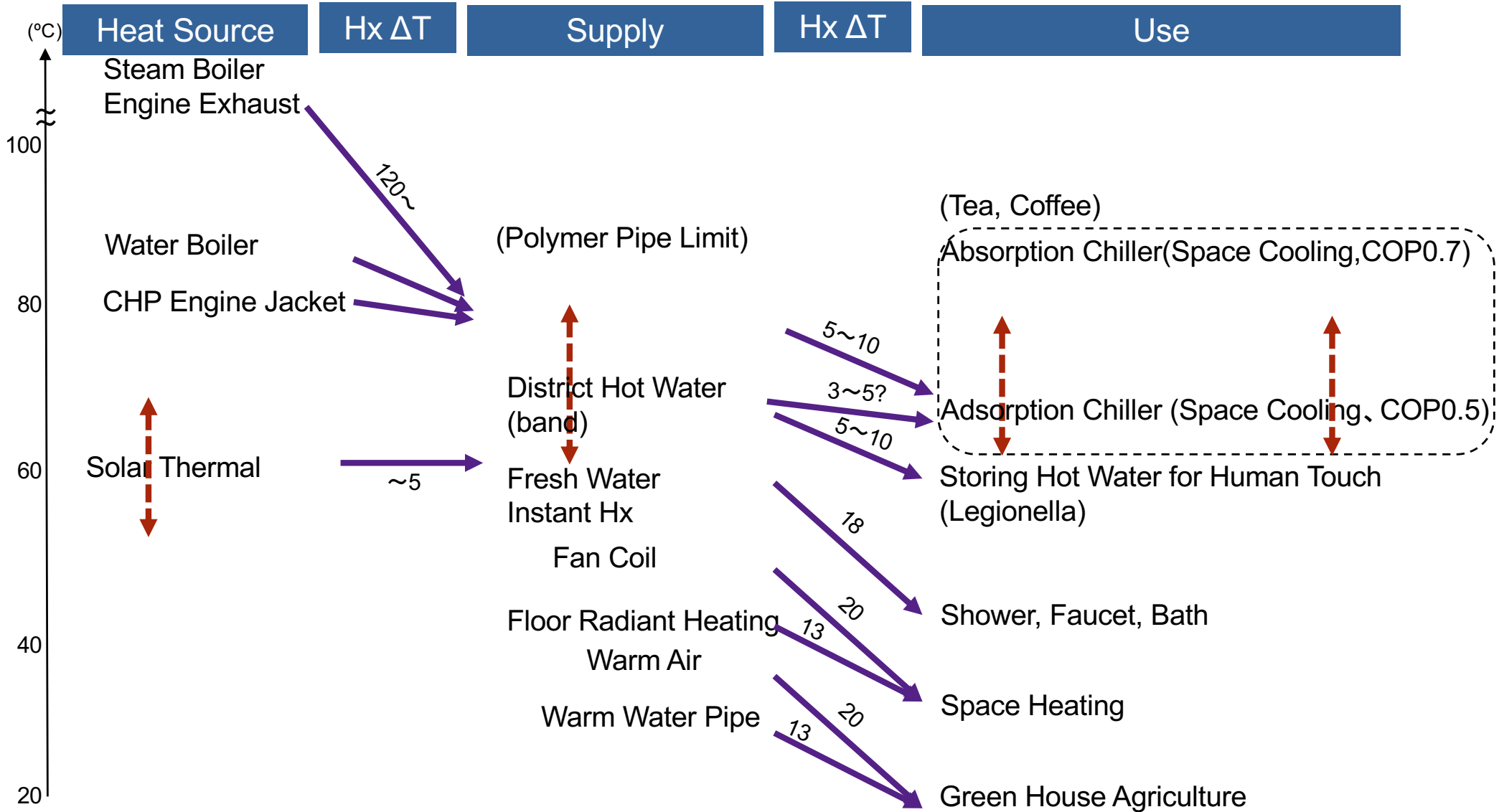
Heat loss in winter was expected to be significant, yet the reality was even worse...





# Temperature Strategy

Heat can flow only downward.. Use of heat-driven chillers require you to fit within small temperature range.

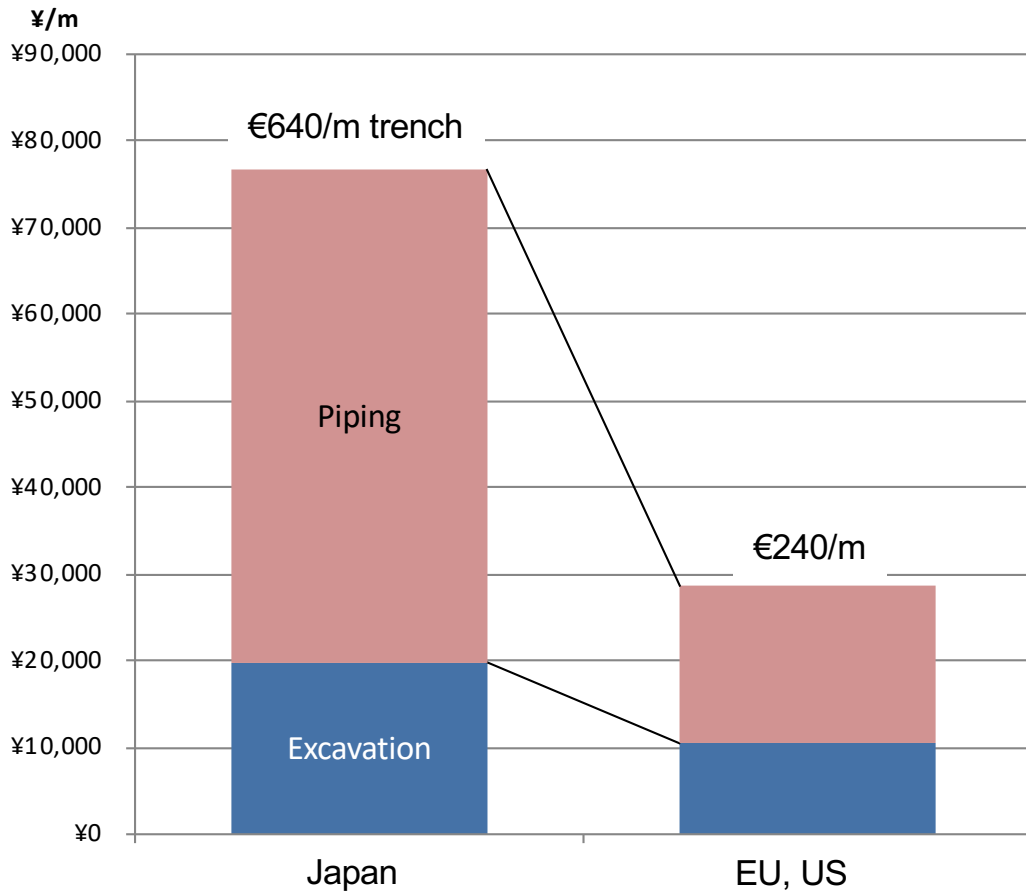




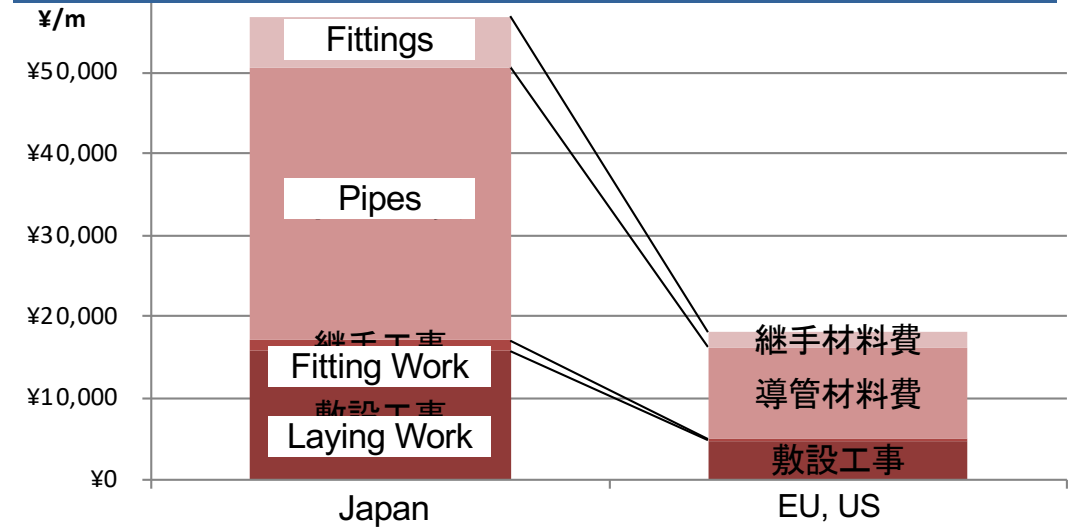
# Cost of Piping in Japan

Cost of piping in Japan, for unclear reasons, is 2.5 to 3 times of Europe(!). We need to tackle in upcoming projects...with help of experienced people.

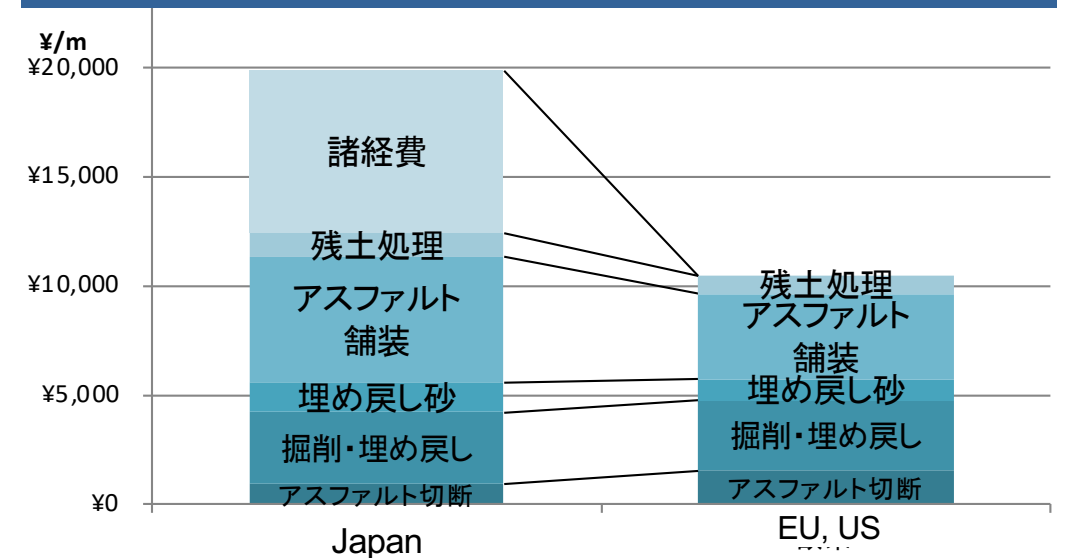
## Total Piping Cost



## Pipe Cost



## Excavation Cost







Our colleagues have been working technical details hands-on, facing troubles of machines at O&M, dealing with different contractors at installation sites.

## Chip Boiler O&M



## Local Installers Team



**Piping / Plumbing**  
Odashima Steel Works



**Electric**  
Odanaka Electric



**Building / General Construction**  
Hakozaki Works



**Shiwa Green Energy**

**EneWaza Colleagues**

- Energy Equipments & Parts
- Detailed Design
- Installation Site Instructions
- Integration Responsibility as Owner



# Wood CHP – Shared Heating/Cooling Kesenuma

## Wood CHP runs constantly at capacity, displacing fuel oil for space heating /cooling, bath warming, shower/faucet hot water, at 2 hotels on nearby hills.



Local ESCo:  
Kesenuma Chiiki Energy Development

### Plaza Hotel at Hilltop



### Hotel Kanyo on Another Hill



## Wood Gasifiers for Syngas



## Gas Engines in Containers



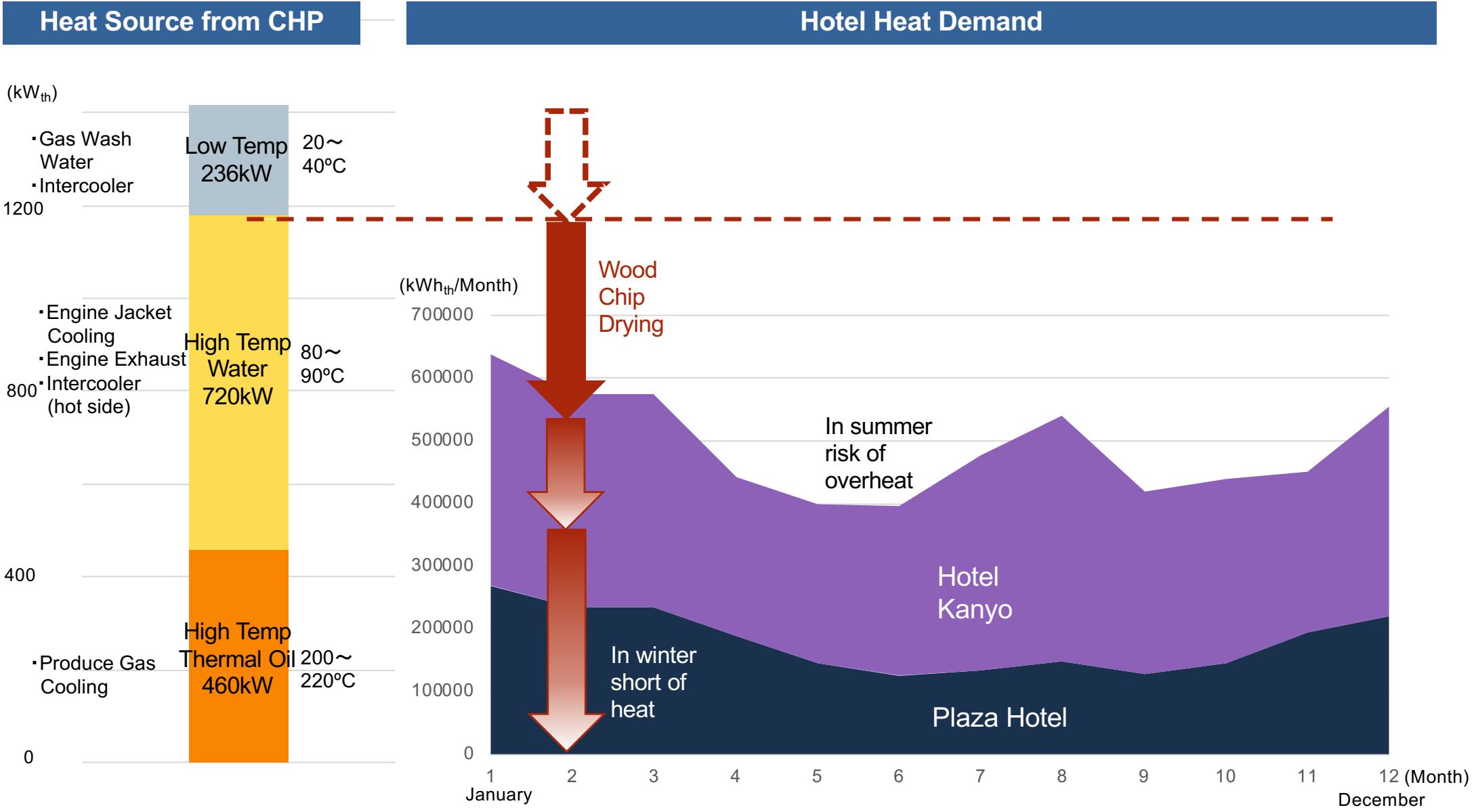
Electricity  
400kW<sub>e</sub> x2  
Sold to Grid  
FIT@¥40/kWh  
≈ €33 x20years





# Heat Sources & Temperatures Wood Gasification CHP, Kesennuma

**3 main sources of heat from Wood gasification CHP, with varied temperatures. Higher temperature makes absorption chillers run efficiently. Blended to 95°C**

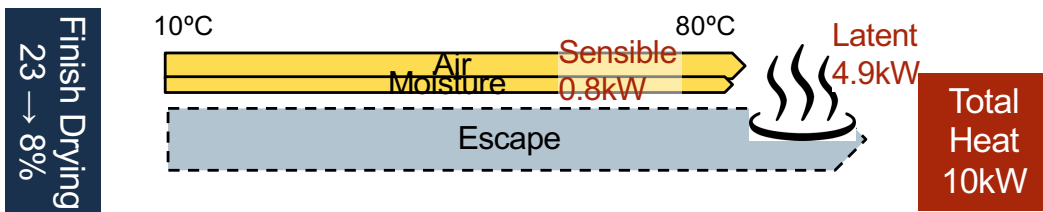
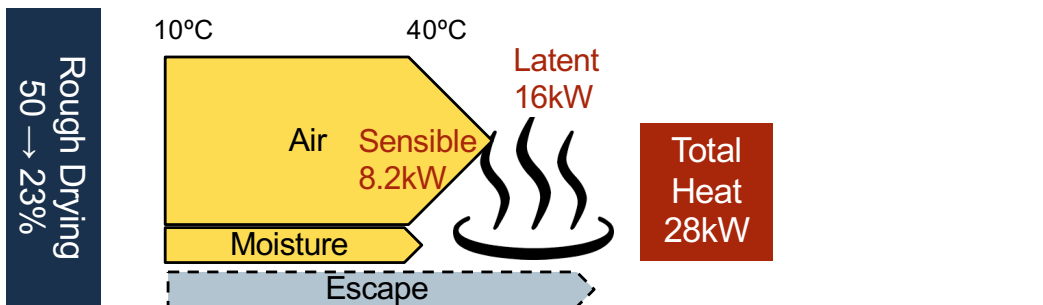
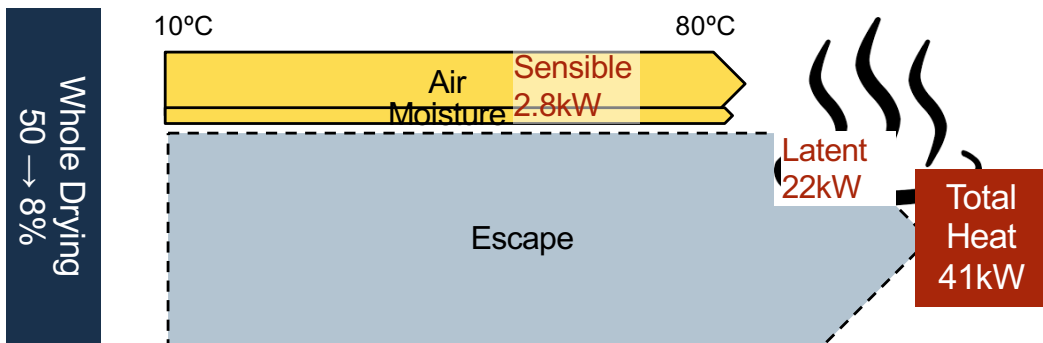




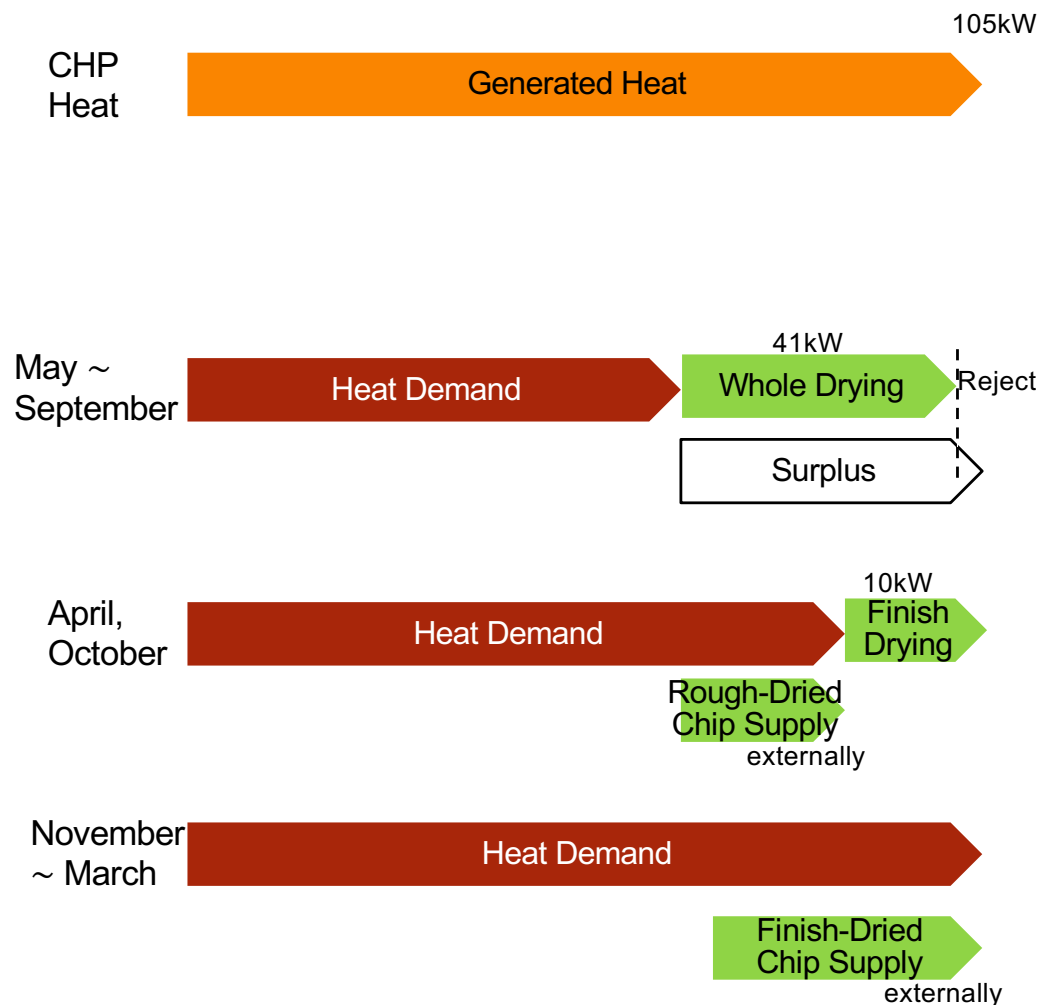
# Wood Chip Drying Heat Balance

Drying requires about 40% of CHP heat. That does not replace fossil fuel. We try to use non-usable low temperature heat and seasonal surplus for drying.

## Heat Requirement for Chip Drying



## Heat Supply and Distribution (Kikyoso)







# District Piping for 2 Hotels in Kesenuma

Pipe route goes up the cliff, and under paved road edge to the next hill. One hot water circuit (2 pipes) to each hotel. Total about 550m trench, 1,100m pipe.

Trench at Road Edge



Pipe Routes



Cliff Climbing Pipes to Plaza H



Cooling Tower at H Kanyo

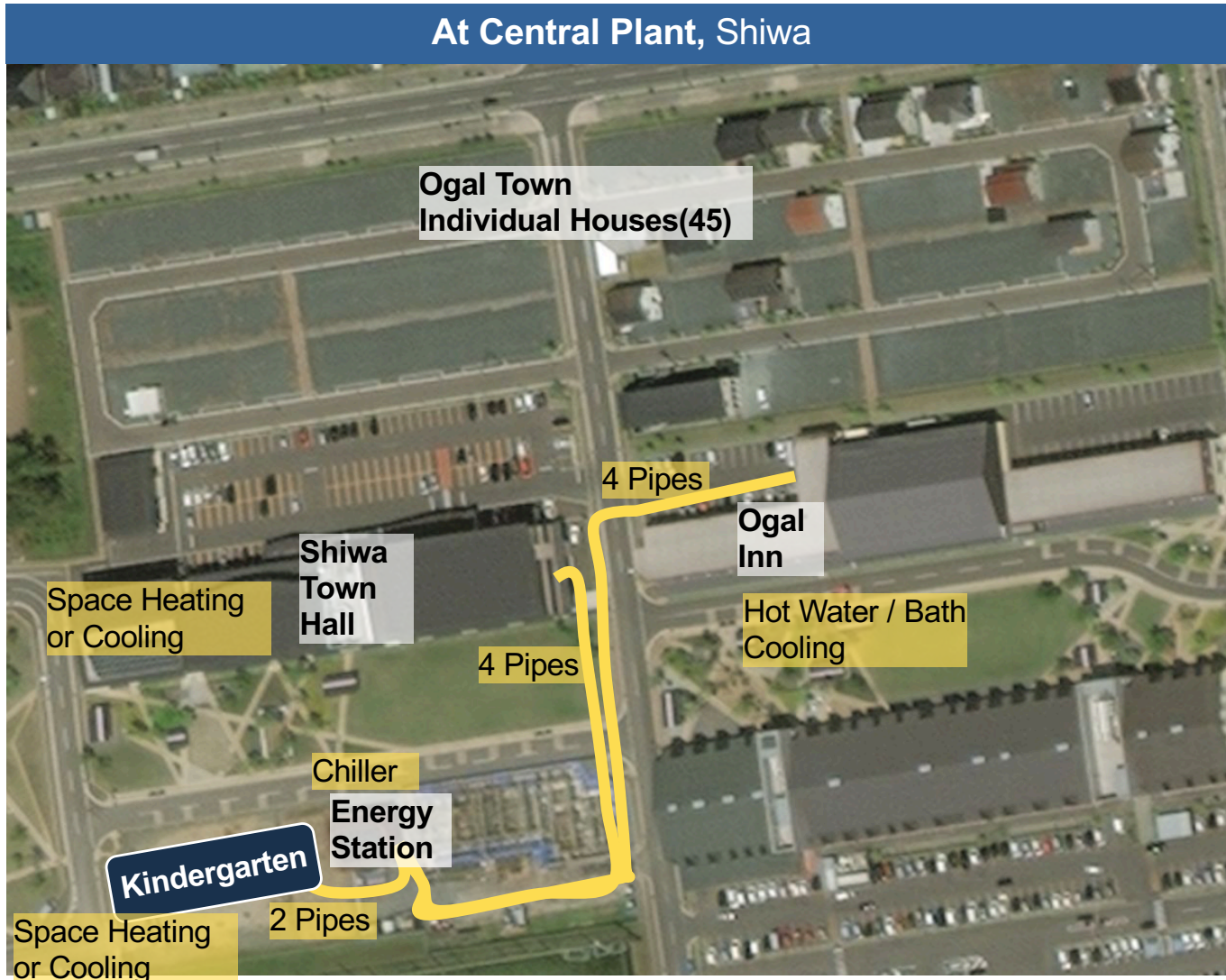






# Cooling and Pipe Topology

In summer both space cooling and hot water/bath warming are required. If we have a central absorption chiller, 2 circuits (4 pipes) need to go to users.





# Form a close local team to control installation cost. Small wood CHPs in local series. Develop profitability to afford additional infrastructure investment.

Energy Use

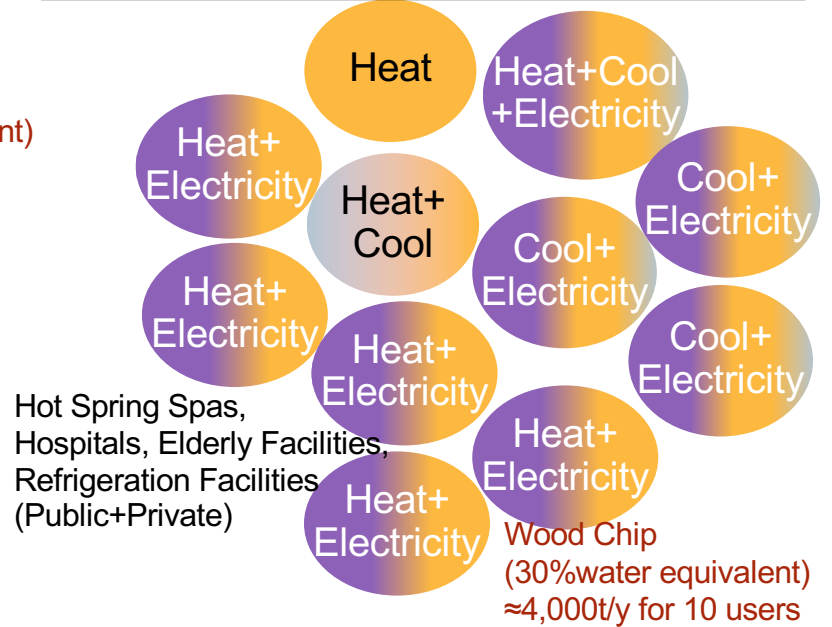
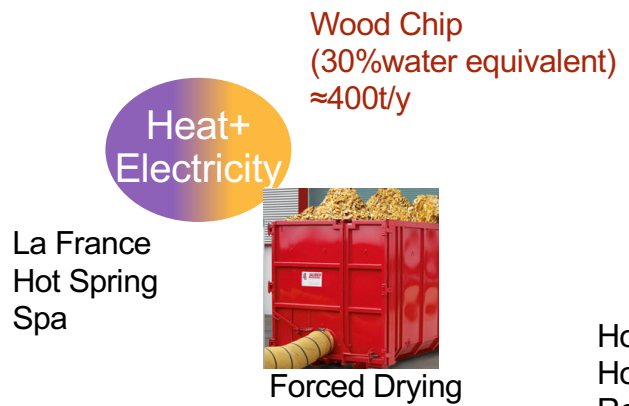
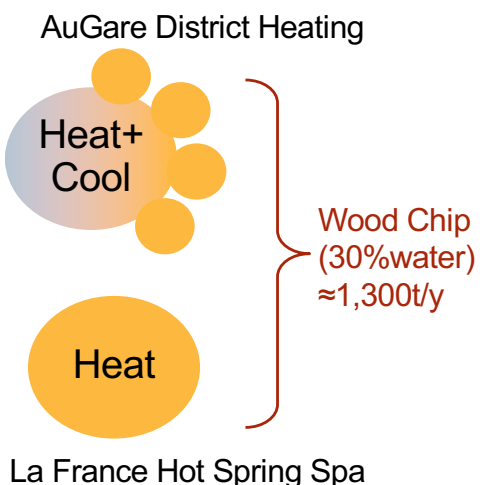
Installer

Supply Infrastructure

To Date

2019-20

2020 -



EPC with DH experience and EPC as public tender

**Just Get Workable System**

Local Installer Team(core) "Do it yourself"(with friends)

**Cost Control / Lower**

Local Installer Team (extended) (Detail Design+Parts Direct Purchase ->contract with proper budget)

Wood Yard, Drum Chipper

**Initial Push by Town Government**

Sieve

Chipper Suitable for Gasification (Disk or Screw Chipper)

Forced Drying

**Stronger Infrastructure by Business Investment ->Public Private Partnership**