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Estimating energy consumption by purpose and analyse standby power in non-residential buildings in Japan

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Contents

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1. Purposes & results of the study
2. Measured buildings
3. Measurement system
4. Estimating energy consumption by purpose
5. Standby energy consumption of non-residential buildings
6. Conclusions & discussion

Purposes & results of the study

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The purposes of the study:

1. Find method to estimate energy consumption by purpose in non-residential buildings
2. Find the standby power consumption in non-residential buildings

The results of the study:

1. Methods to estimate the annual energy consumption for AC, domestic hot water, lighting, cooking, transformer loss, and other devices from available data, such as monthly energy consumption & outside temperature data
2. Standby power accounts for 14% to 20% of electricity consumption in a non-residential building

Measured Buildings

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We measured the energy consumption of 18 non-residential buildings in detail.
Especially, we selected buildings using large energy for heat.

building	floor area(m2)	energy use per area(MJ/m2)	measured points		
			Electricity	Town Gas	LPG
Bank A	285	311	68	0	0
Bank B	316	416	75	0	0
City hall A	15,100	247	258	0	3
City hall B	2,611	187	172	0	0
Convention hall	6,000	515	146	0	3
Elderly nursing home A	3,265	426	63	0	2
Elderly nursing home B	5,298	392	390	0	1
Elderly nursing home C	4,013	513	271	0	0
Elderly nursing home D	4,877	840	307	0	3
Food plant A	1,370	8,981	98	0	2
Food plant B	1,830	3,305	72	0	4
School lunch facility A	960	1,457	76	0	0
School lunch facility B	2,432	3,600	223	0	2
Restaurant A	1,163	5,957	125	5	0
Restaurant B	626	5,672	70	2	0
Restaurant C	313	16,641	51	7	0
Restaurant D	495	7,461	72	0	3
Restaurant E	1,486	5,410	117	2	0
Total			2,654	16	23

Measurement system

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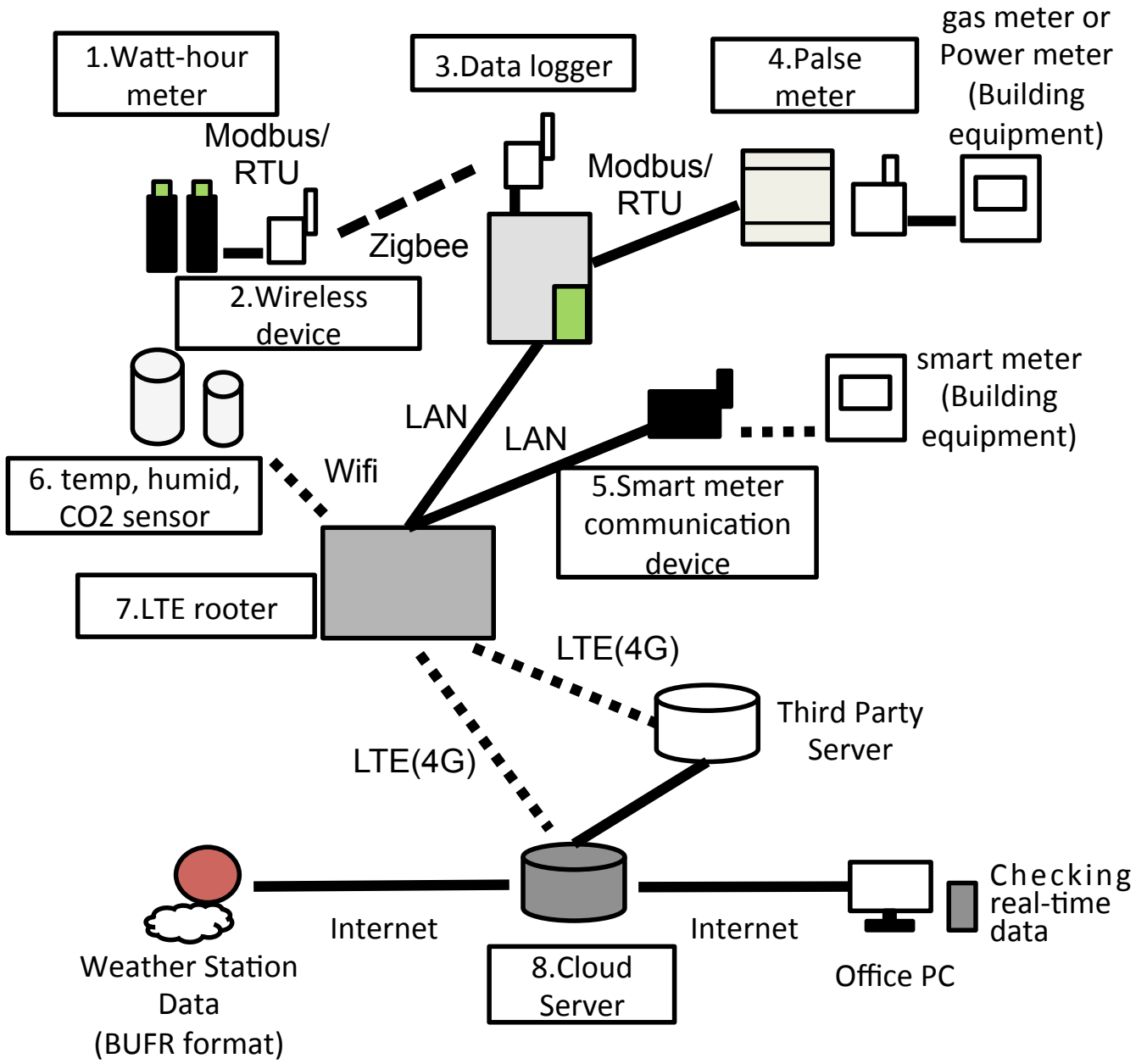
Measurement system features:

1.Flexiblity

2.Real-time check of data lost

3.Low cost



Estimating energy consumption by purpose

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Abstract of estimation methods

1.AC

AC is estimated from the difference between the monthly consumption and the baseline (the smallest monthly consumption).

2.Domestic hot water

Domestic hot water is estimated by the regression equation of $(T{\downarrow}use - T{\downarrow}water)/COP$
and the monthly consumption.

3.Lighting

Lighting is estimated by multiplying the rated inputs and the annual use time by each lighting appliance.

4.Transfomer loss

Transformer loss is estimated from the monthly electricity consumption, the rated unload loss, and the rated load loss.

5.Cooking and other devices

Cooking and other devices are estimated from subtracting the above estimated values from the total energy consumption.

Comparison

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The comparison between the estimated energy consumption of each purpose and the measured value shows a maximum difference of 17%

Energy consumption (GJ/year)		AC	domestic hot water	Lighting	Cooking	Other devices Transformer loss	Total
BankA	Measured value	22		11		54	88
	Estimated value	24		11		53	88
	Difference	8%		1%		-3%	1%
Restaurant C	Measured value	85		1,141	3,453	524	5,203
	Estimated value	95		1,263	3,252	560	5,210
	Difference	10%		11%	-6%	13%	0%
Elderly nursing home B	Measured value	469	371	**229**	251	787	2,108
	Estimated value	440	393	**191**	251	819	2,094
	Difference	-6%	6%	**-17%**	0%	4%	-1%

Standby Power Consumption of non-residential buildings

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The standby power definition in this study

1. AC: the electricity consumption when AC is not used.

2. Lighting and Outlet: the electricity consumption when there are no employees within the building; however, the electricity consumption of computer server and EPS are excluded.

3. Transformer: load and unload losses.

4. Other: electricity consumption of vending machines and the emergency exit signs when the building is closed.

Standby power in City hall A

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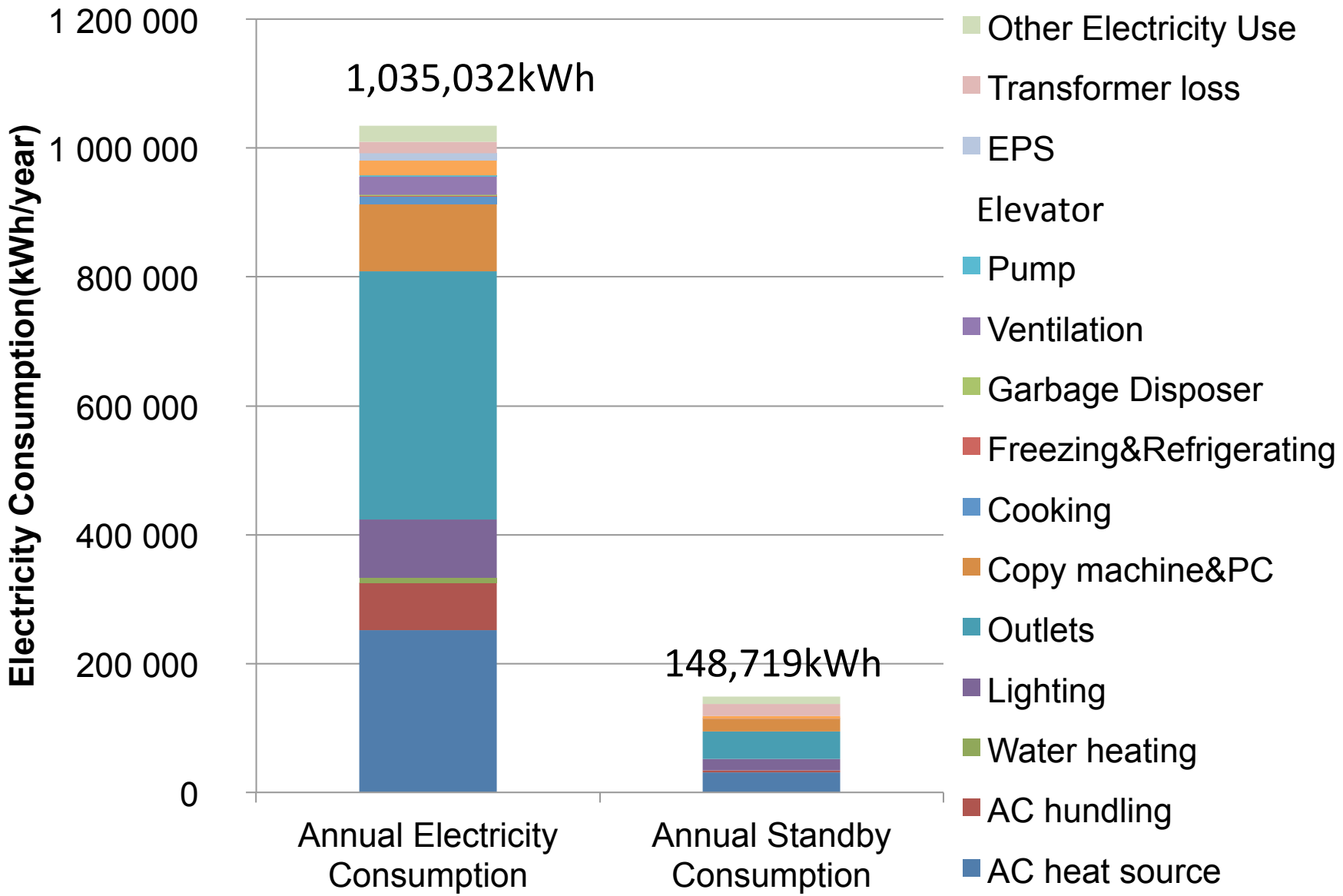

Standby power in City hall B

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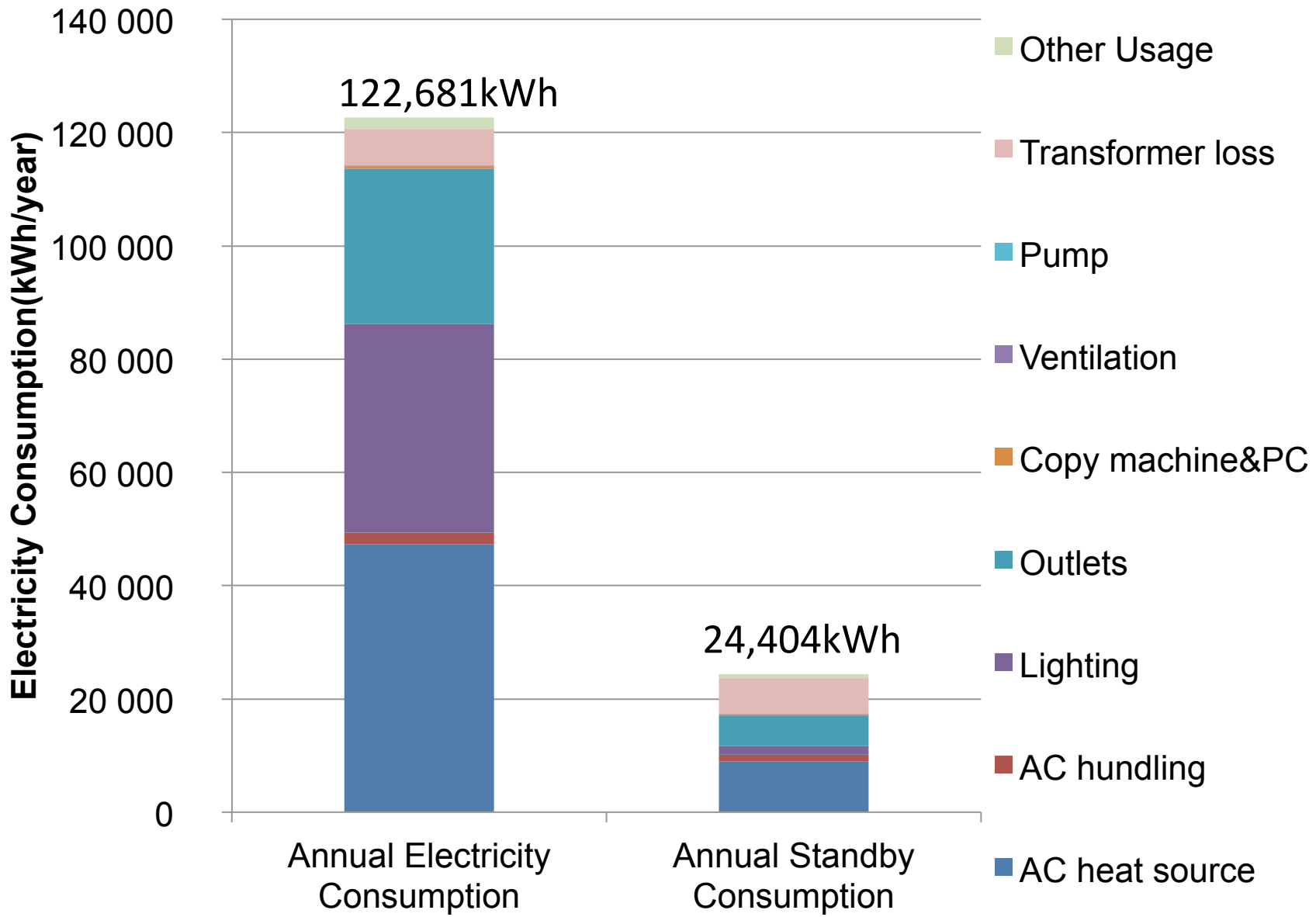

Conclusions & Discussion

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Conclusions

1. The methods can estimate the annual energy consumption for AC, domestic hot water, lighting, cooking, transformer loss, and other devices from available data and it helps engineers to find effective measures for energy saving
2. The standby power accounts for 14% to 20% of the total electricity consumption in a non-residential building

Discussion point

1. While more energy saving measure proceeds, the standby power will account for larger percentage of electricity consumption. How should we handle the issue?