Modelling for low carbon lifestyle in Japan

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10th December, 2016

Japan's GHG reduction target

- INDC (2030 target) ***26％ reduction***

Unit: Million t-CO2

Sector	**CO2 emission Left: 2030 (Right):2013**	**Reduction percentage**
Household	122 (201)	39.3%
Service	168 (279)	39.8%
Industry	401 (429)	6.5%
Transport	163 (225)	27.2%
Energy conversion	73 (101)	27.7%

- Target towards 2050

  80％ reduction

INDC: 40% reduction by 2030

Assumption

- Energy consumption per capita is constant (2013 level)
- Without technology improvement
- Electricity CO_2 emission factor will be 0.37kg CO_2/kWh (0.551kg CO_2/kWh)

	2030/2013	2030		2013				
		CO2 emission		CO2 emission	Per capita emission (kgCO2/person)		Emission factor	
Coal	-	0	0%	0	0	0%		
Kerosene	92%	21,145	15%	23,082	181	11%	0.0678	tCO2/GJ
LPG	92%	12,180	9%	13,296	104	7%	0.059	tCO2/GJ
City gas	92%	19,497	14%	21,283	167	11%	0.0499	tCO2/GJ
Electricity	62%	88,280	62%	143,508	1127	71%	0.551	kgCO2/kWh
Heat	92%	61	0%	67	1	0%	0.057	tCO2/GJ
Total	70%	141,264	100%	201,346	1582	100%		

※Electricity emission factor in 2030 is 0.37kgCO2/kWh

※Total includes error adjustment

Unit of CO2 emission: kt-CO_2

・Because of population reduction (-8.5%) and emission factor decrease (-33%), 30% of CO2 emission can be reduced.

・2030 target will be achieved with 85% level of CO2 emission per capita.

Reduction target in 2050 - 80% reduction -

Assumption is same as 2030's case

- Several electricity emission factor

2013 level

Incl. CCS or other advanced technology

	0.37 kgCO2/kWh	0.3 kgCO2/kWh	0.2 kgCO2/kWh	0.1 kgCO2/kWh	0.011 kgCO2/kWh
Coal	0	0	0	0	0
Kerosene	17,602	17,602	17,602	17,602	17,602
LPG	10,139	10,139	10,139	10,139	10,139
City gas	16,230	16,230	16,230	16,230	16,230
Electricity	73,487	59,584	39,723	19,861	2,185
Heat	51	51	51	51	51
Total	117,592	103,689	83,828	63,967	46,290
2050/2013	58%	51%	42%	32%	23%

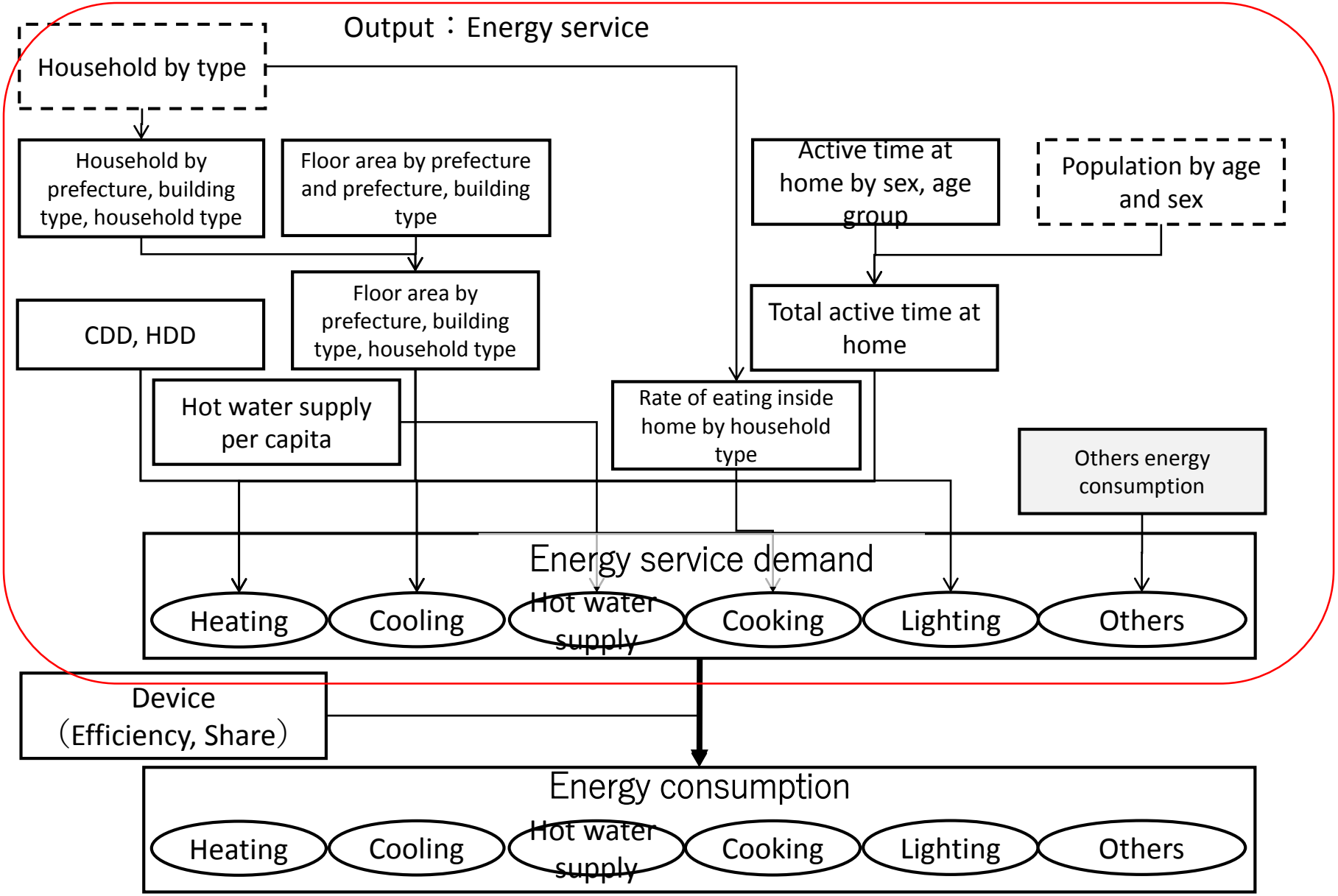
・Because of population reduction (-24%) and emission factor decrease (-33%～-98%), 40％～77% of CO2 emission can be reduced.

・2050 target will be achieved with 34%-87% level of CO2 emission per capita.

Energy service demand model in household sector

Input：Energy service demand in base year, related socio-economic variables

Output：Energy service



Scenarios

Socio-economic scenario

- BaU: Per capita energy service demand is as same as 2010's level
- Base: Per capita energy service demand vary based on social and economic trends
- LCS: Per capita energy service demand will be reduced by LC lifestyles

Technology scenario

- Tech: Energy efficiency of devices will be improved.
    - Electrification of devices is not considered.

		Socio economic scenario		
		BaU	Base	LCS
Technology scenario	-	BaU	Base	LCS
	Tech	BaU+Tech	Bae+Tech	LCS+Tech

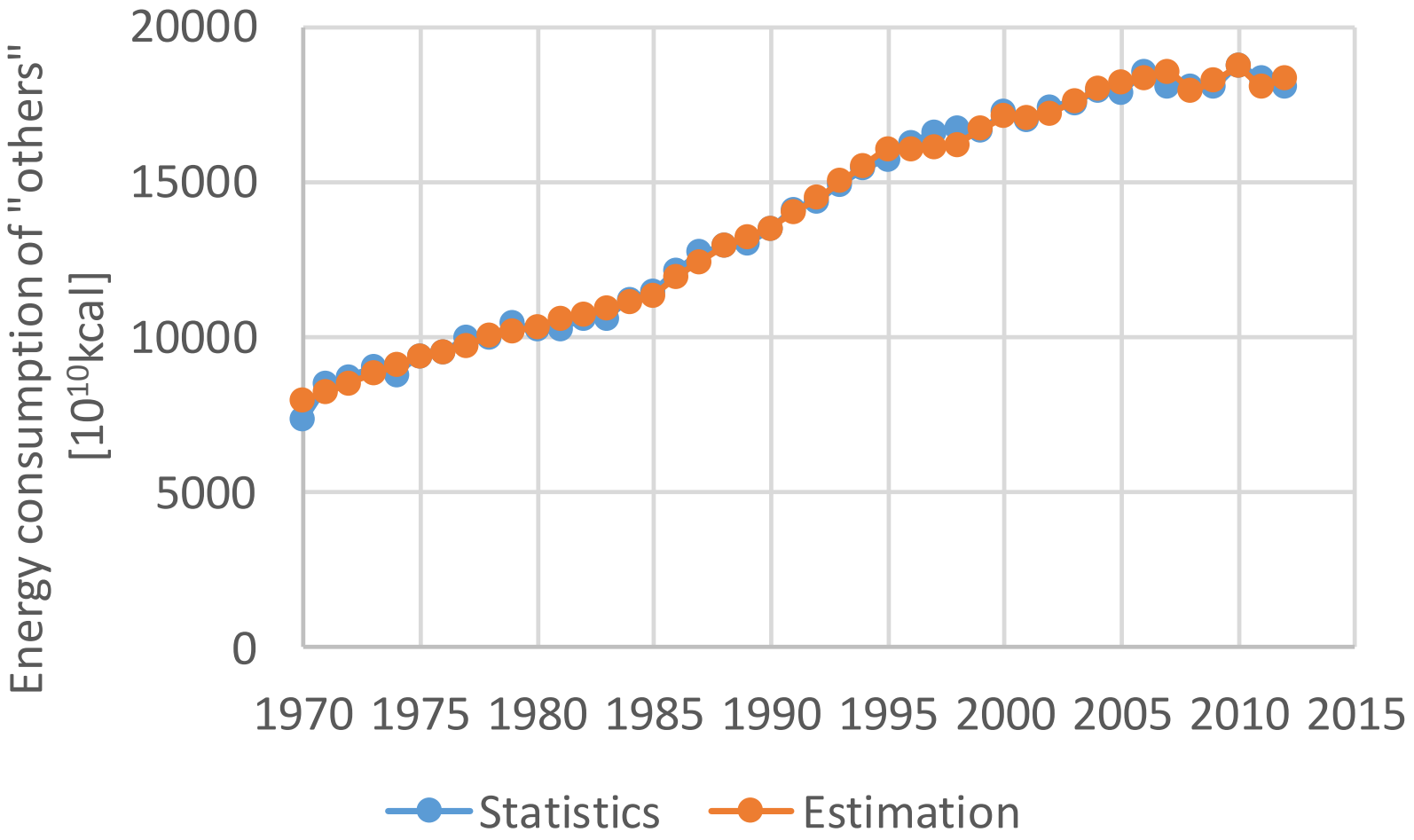
Data (1)

data	Description
Population	National Institute of population and social security research, Population projection by sex, age group　Middle case
Number of household	National Institute of population and social security research (-2040) , and household projection(2040-2050) by household type (Matsuhashi et al)
Housing (Floor area)	Statistic Bureau, Housing and land survey (2008,2013) Average floor area by prefecture, household type and building type
Time use	NHK broadcasting culture research institute, Time use survey by sex, age group (2010)
Rate of eating at home	Statistic Bureau, Family income and expenditure survey (2010), Rate of eating at home by household type Rate of eating at home＝(total food expenditure-expenditure for home-meal replacement and dining-out） / total food expenditure
Hot water supply per capita	Result of questionnaire survey about energy consumption in household sector.

Data (2)

data	Description
CDD/HDD	Base: CDD 10% increase HDD 10% decrease LCS: Base + 10% decrease (lifestyle change)
Others energy consumption	Multiple regression analysis. Explained variable: GDP per capita, average household size.
GDP per capita	Almost SSP2
Other energy saving lifestyle	LCS: As for “Others energy consumption per capita”, energy saving lifestyle (reduce unnecessary energy consumption etc)

“Others” energy consumption



Energy service demand model in household sector

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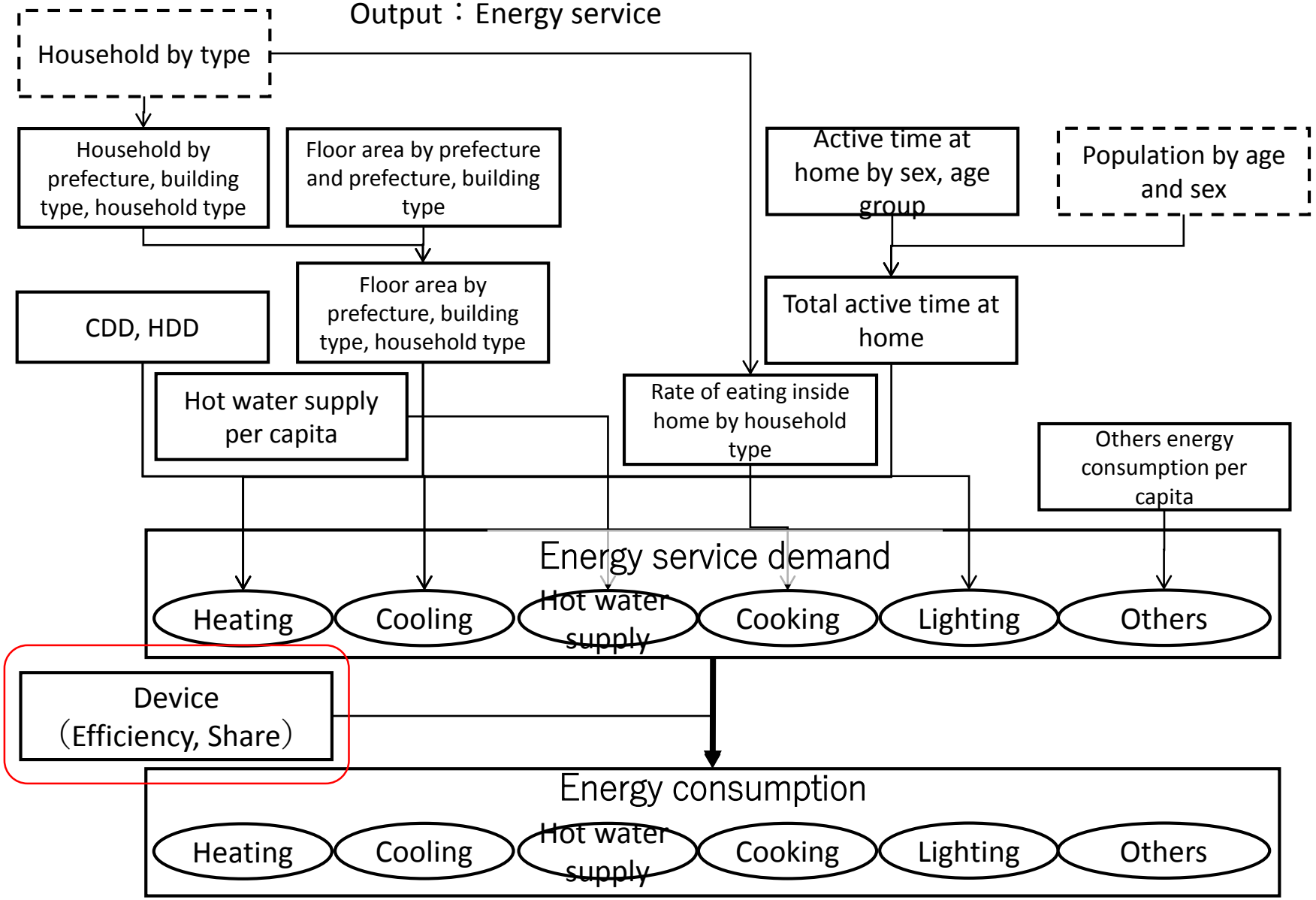


Energy efficiency of device (1)

Energy service type	Energy	Annual improvement rate of energy devices
Heating	Electricity	1.5％
	Gas	No change
	Kerosene	No change
Cooling	Electricity	1.5％
Hot water supply	Electricity	0.5％
	Gas	0.25％
	Kerosene	No change
	Coal	No change
	Heat	No change
Cooking	Electricity	0.25％
	Gas	0.25％
	Coal	No change
Lighting/Others	Electricity	1％

Device energy consumption reduction with annual improvement rate

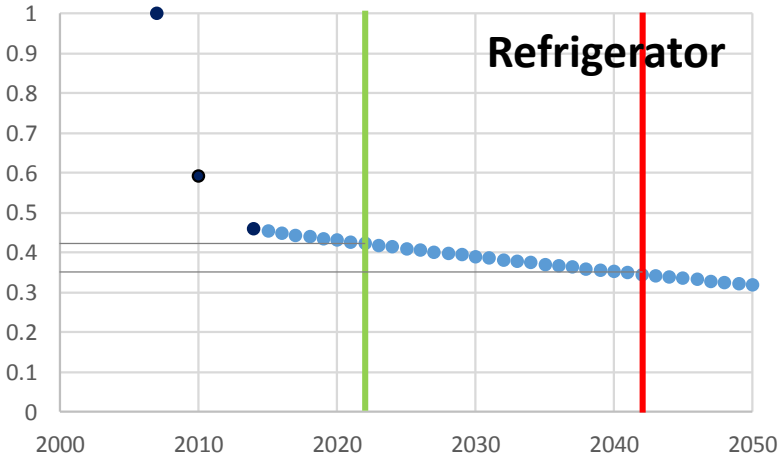
■1.5%
2030 26％ reduction
2050 45％ reduction

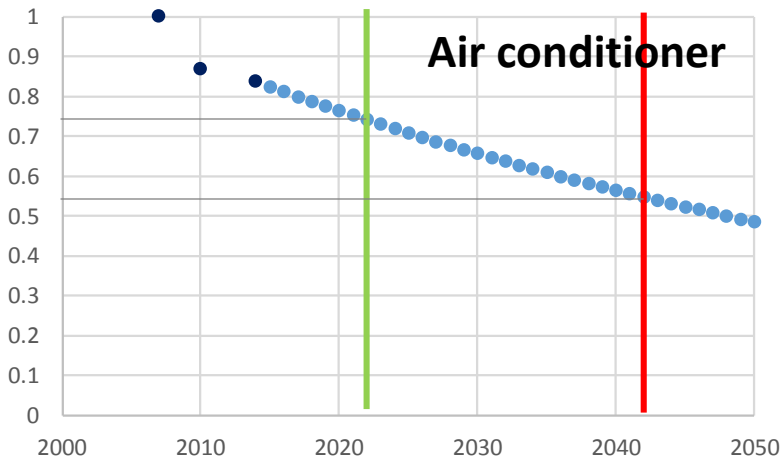
■1.0％
2030 18％ reduction
2050 33％ reduction

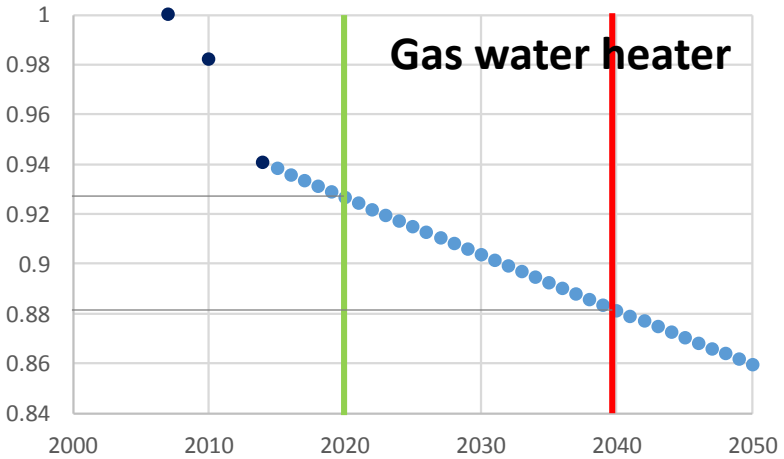
■0.5%
2030 9.5％ reduction
2050 18％ reduction

■0.25％
2030 5％ reduction
2050 10％ reduction

Energy efficiency of device(2)





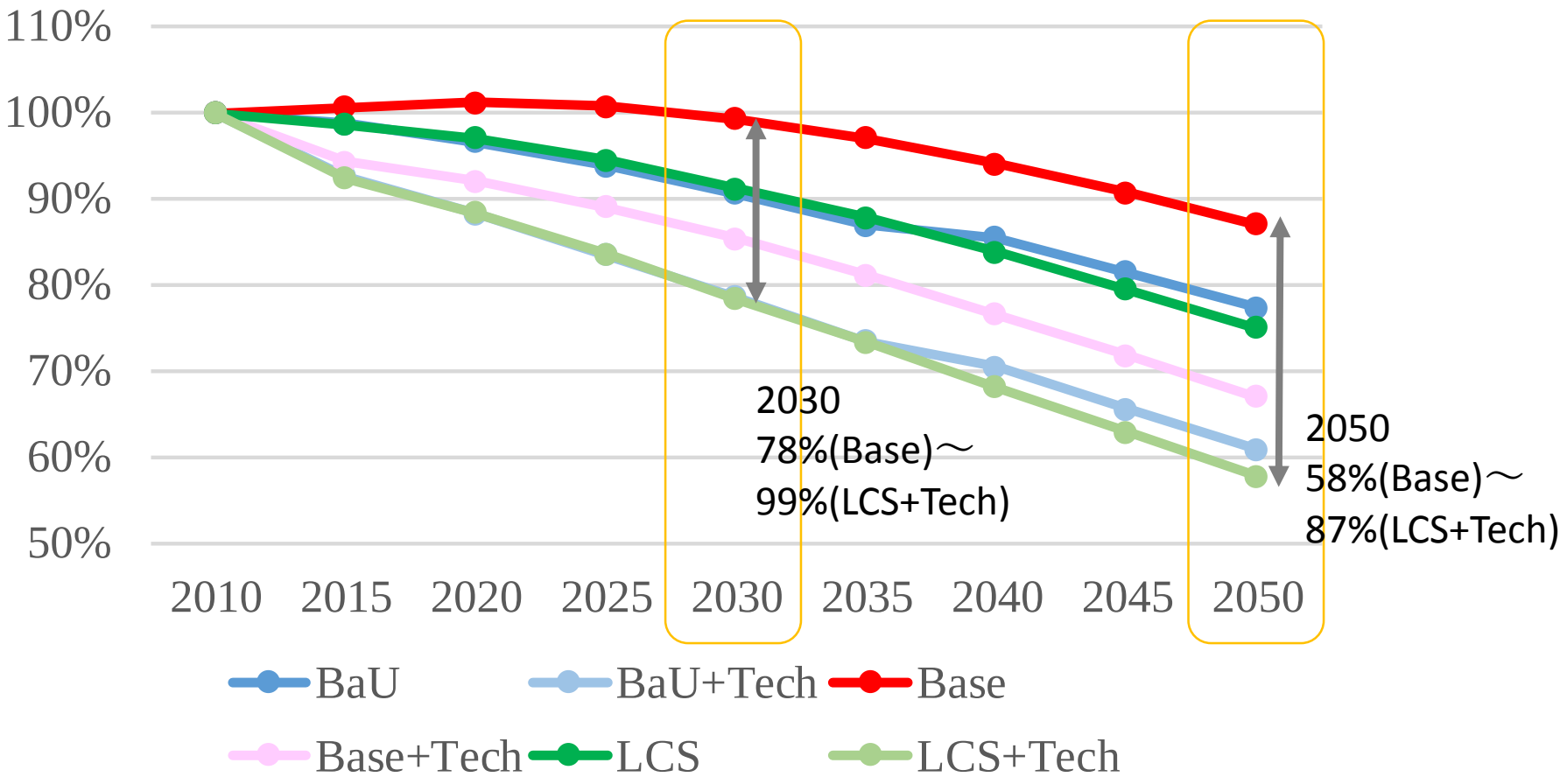


Average energy efficiency of sales and stock are different.

- Main electric device: 8 years gap
- Water heater and cooking stove: 10 years gap

Green line: 2030's stock average
Red line: 2050's stock average

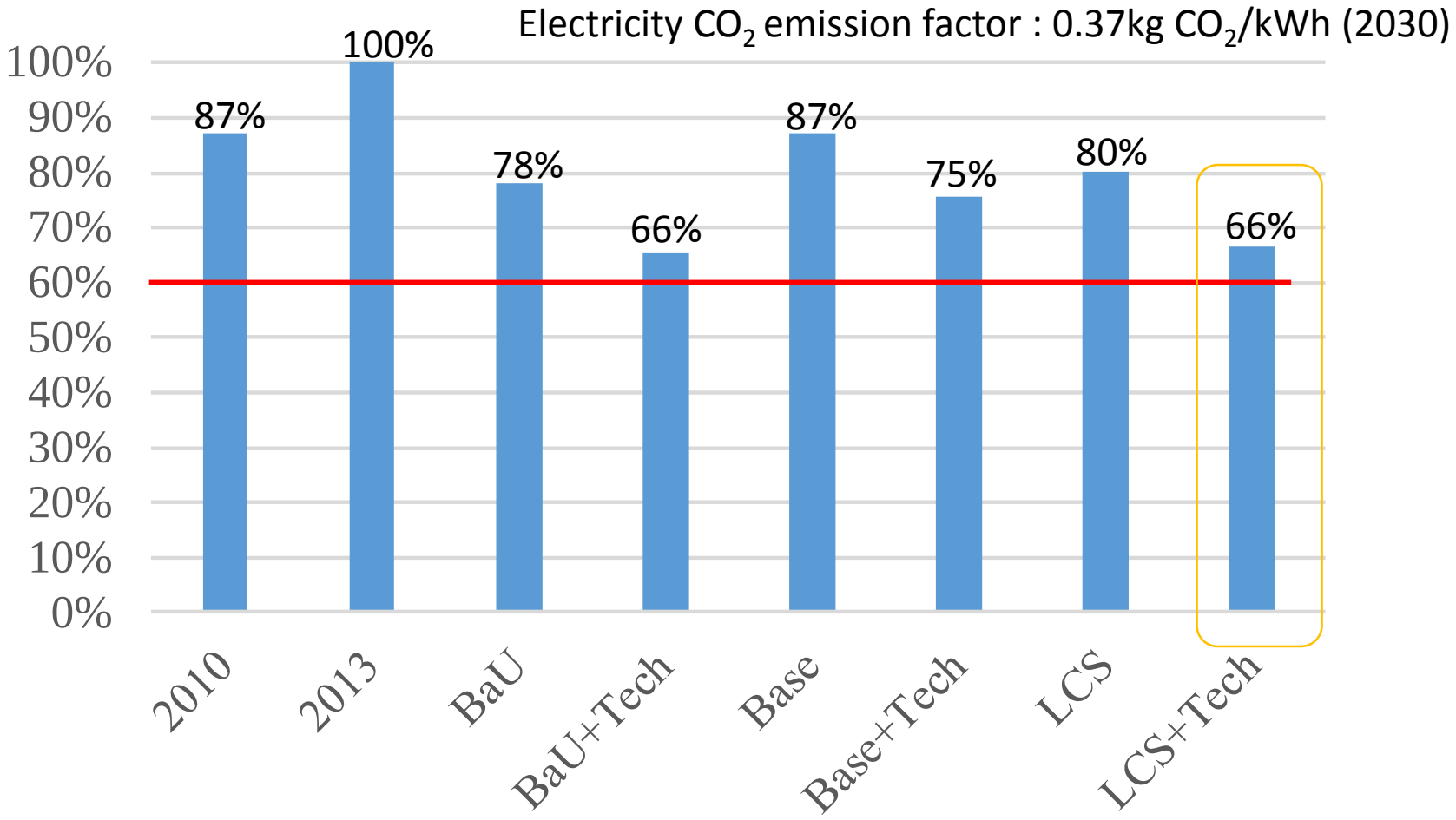
Result: Energy consumption (Tentative)



LCS+Tech: ***22% reduction*** compared with 2010 level in 2030

42% reduction compared with 2010 level in 2050

Result: CO_2 emission in2030



LCS+Tech: ***34% reduction*** compared with 2010 level in 2030

Device electrification will lead 40% reduction in household sector in 2030

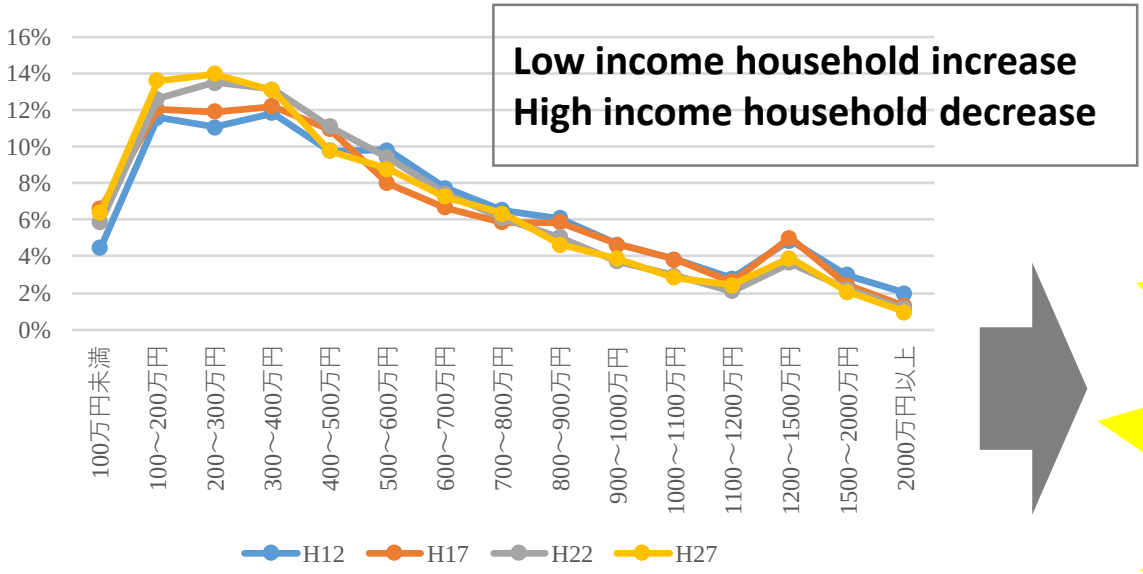
For future research

In this research

- Regional distribution
- Household type difference
- Population structure change (Aging society)

- Technology change (sales base)

Technology improvement vs lifestyle change (demand decrease)



Low income household increase
High income household decrease

Distribution of household income level

Device replacement demand will be lower …?

Future aged household will replace devices appropriately…?

(1) Develop narrative scenario by household type, income level and eco-conscious action level
(2) Set time use, device possession

How is it possible that eco-conscious household will increase?

Electricity consumption per household

	Nuclear household	Aged couple household	Young single household
2030 Min	1795 kWh	1618 kWh	967 kWh
2030 Max	7534 kWh	7325 kWh	2277 kWh
2010	4399 kWh	5363 kWh	2368 kWh

Thank you for your attention!

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Outline of the analysis

- Base year: 2010
- Target year: 2030
- 13 lifestyle type
  - 3 household type
  - 2 income level
  - 2 environmental awareness

■ *Assumption* ■

✓ Each lifestyle type in the same household type live in the **same type home**.

✓ **Family member composition** in the same household type is same.

Table 13 lifestyle type

Household	Economic wellbeing	Environmental awareness
Middle-aged nuclear family	High	Low
	High	High
	Low	Low
	Low	High
Elderly couple	High	Low
	High	High
	Low	Low
	Low	High
	Elderly caring for elderly	
Young, living alone	High	Low
	High	High
	Low	Low
	Low	High

Summary of future setting by household type

- ✓ Device possession
- ✓ Energy efficiency of device
- ✓ Time spent at home
- ✓ Use of energy-saving technique

Case		Appliances, devices	Energy efficiency of devices	Time spent at home	Use of energy-saving techniques
Miidle-aged nuclear family	High-income, environmentally unconcerned	Many	Good	Somewhat long	None
	High-income, environmentally concerned	Intermediate	Very good	Short	A little
	Low-income, environmentally unconcerned	Intermediate	Bad	Long	None
	Low-income, environmentally concerned	Few	Good	Short	A lot
Elderly couple	Economically comfortable, environmentally unconcerned	Many	Good	Somewhat long	None
	Economically comfortable, environmentally concerned	Intermediate	Very good	Short	A little
	Economically uncomfortable, environmentally unconcerned	Intermediate	Bad	Long	None
	Economically uncomfortable, environmentally concerned	Few	Good	Short	A lot
	Elderly caring for elderly	Intermediate	Good	Very long	Intermediate
Young, living alone	High-income, environmentally unconcerned	Many	Good	Somewhat long	None
	High-income, environmentally concerned	Intermediate	Very good	Short	A little
	Low-income, environmentally unconcerned	Intermediate	Bad	Very long	None
	Low-income, environmentally concerned	Few	Good	Short	A lot