Introduction of AIM/Energy Snapshot Tool (ESS)

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- Background
- Structures & Flows
- Operation
  - Demand Settings (Residential Sector)
  - Transformation Sector (Electricity, Other)
  - Analysis

Background

Asia Pacific Integrated Model (AIM)
Japan Low-Carbon Society Project

Background of development

- In scenario developing processes, a tool with following feature would be useful
  - Clear assumptions & calculation processes
  - Easy interpretation of the results
  - Easy sensitivity analysis
  - Keep energy balance

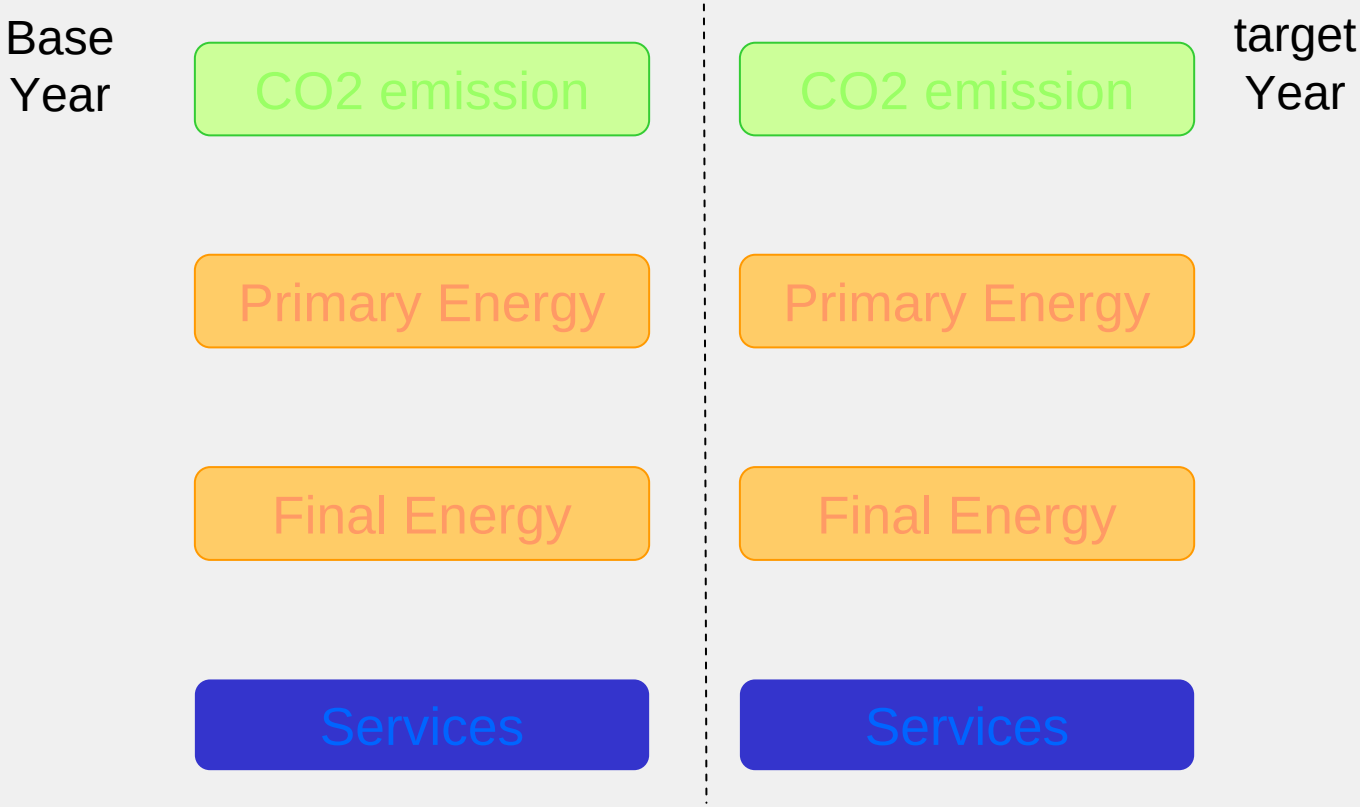
- Tools for describe future energy balance table in a spreadsheet: **Energy Snapshot Tool (ESS)**

AIM/Energy Snapshot Tool

- Excel format
- Based on energy balance table
- Step by step approach
- The tool can be used for;
  - Developing and designing future scenarios
  - “What if” analysis
  - Check the consistency among the sectors
  - Analyze the impacts of countermeasures
  - Communication among stakeholders

Structure & Flow

Calculation processes



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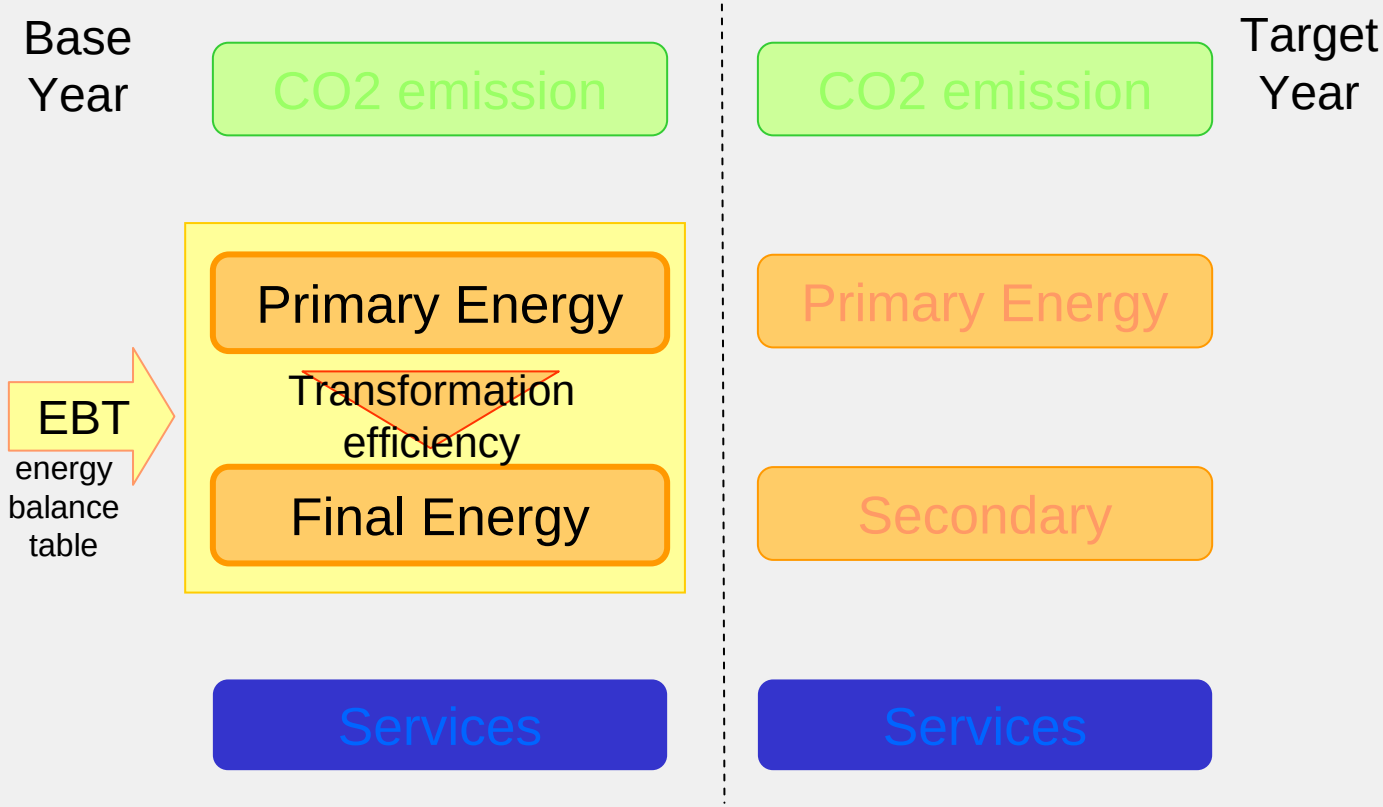
Calculation processes



1. Obtain energy balance table from national statistics etc. (Base Year)

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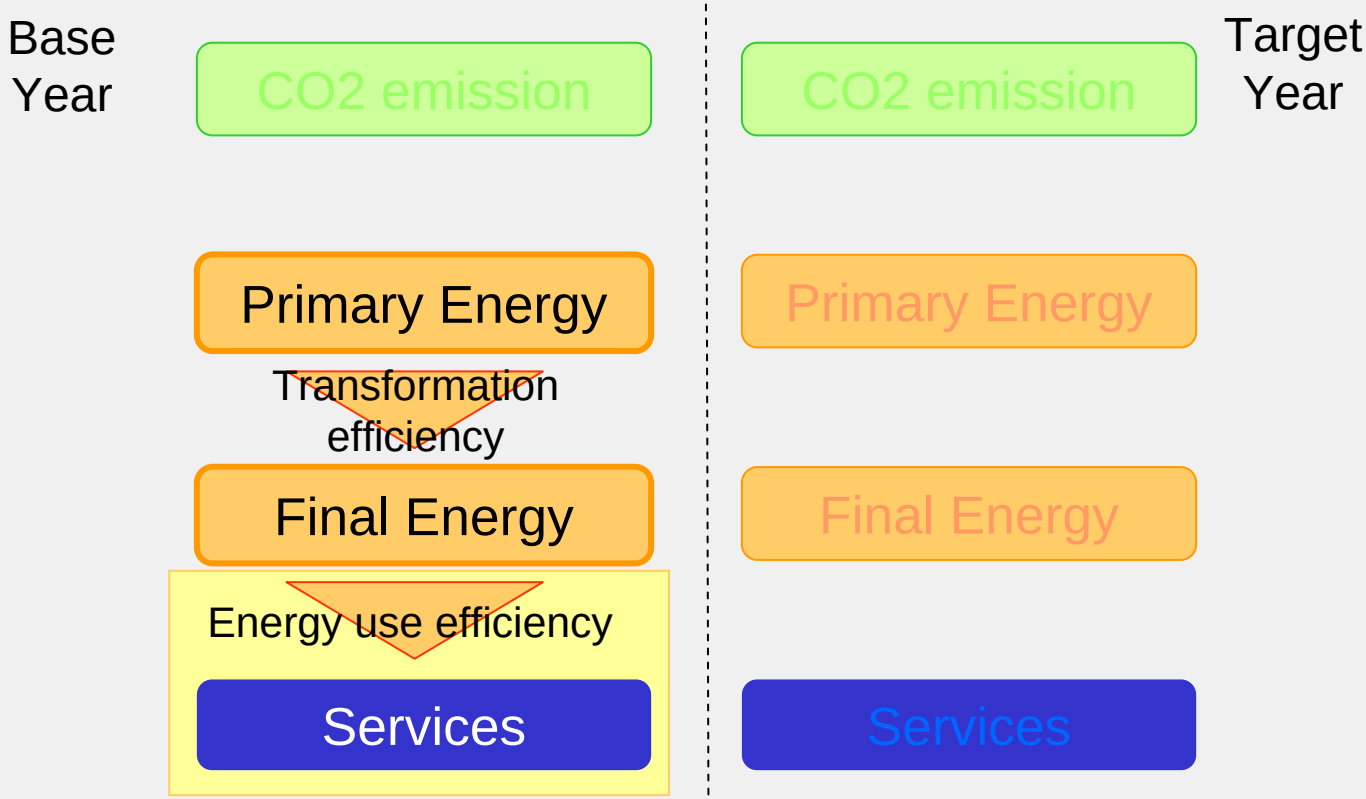
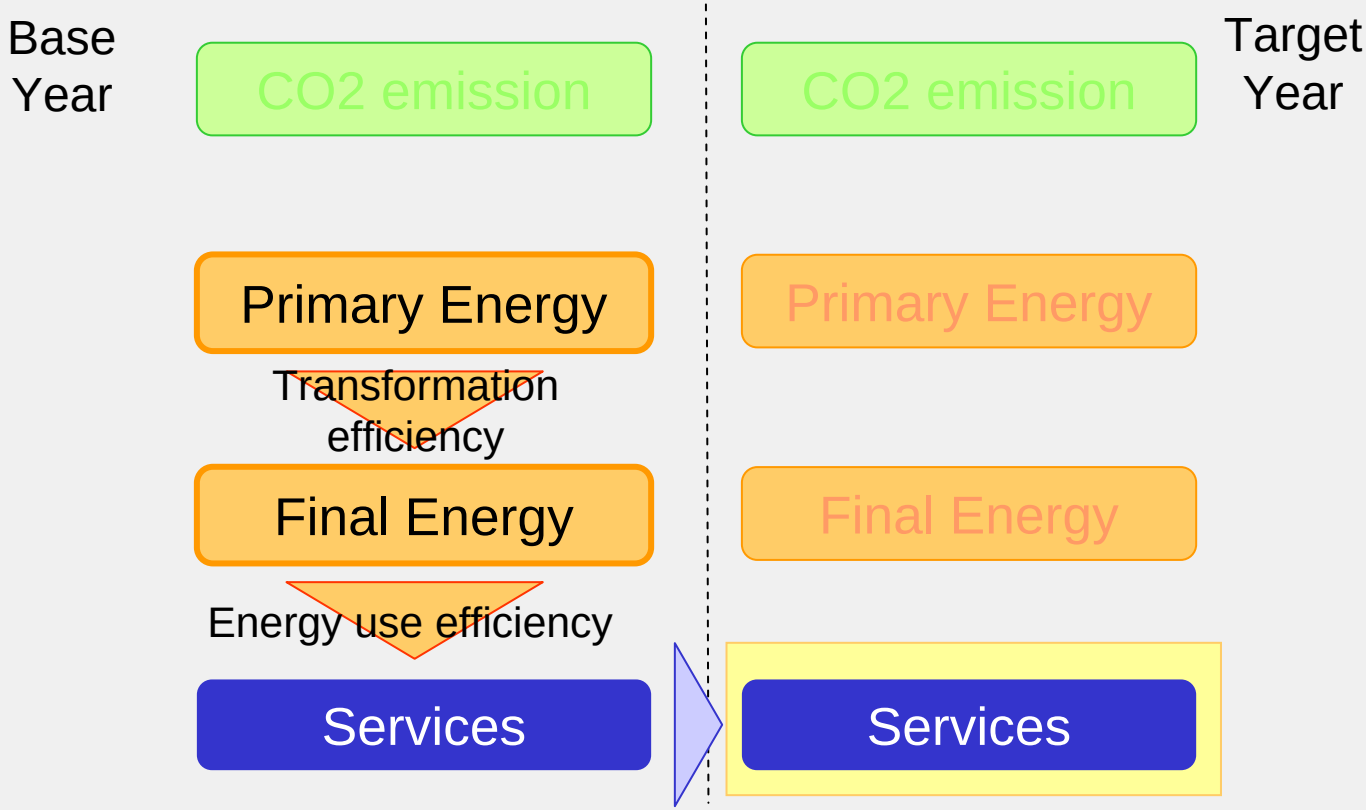
Calculation processes



2. Set “energy use efficiency” & “energy service demand” (Base Year)

Calculation processes



3. Assume changes of “energy service demand” in Target Year (Scenario)

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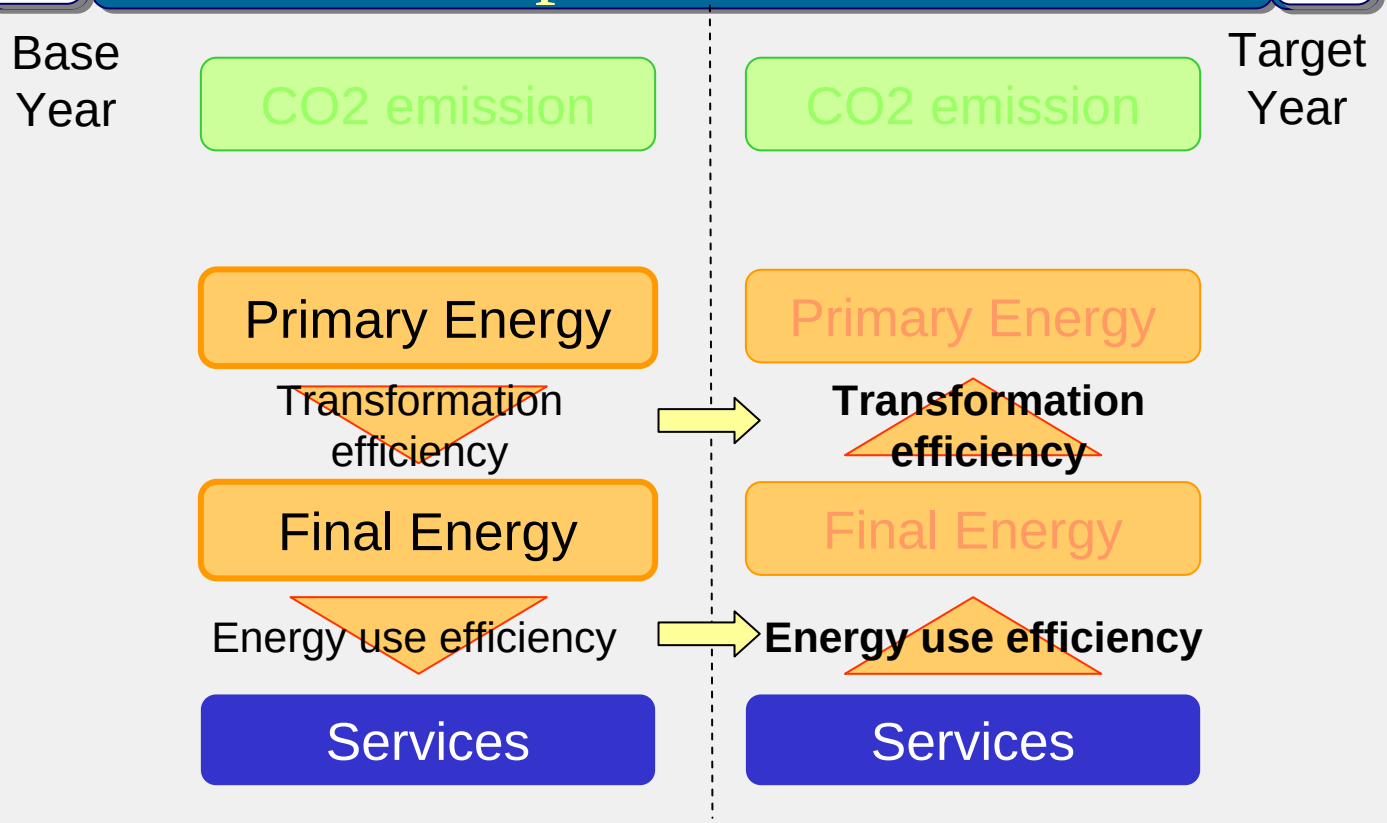
Calculation processes



4. Assume changes of “energy use efficiency”, “transformation efficiency” in Target Year (Scenario)

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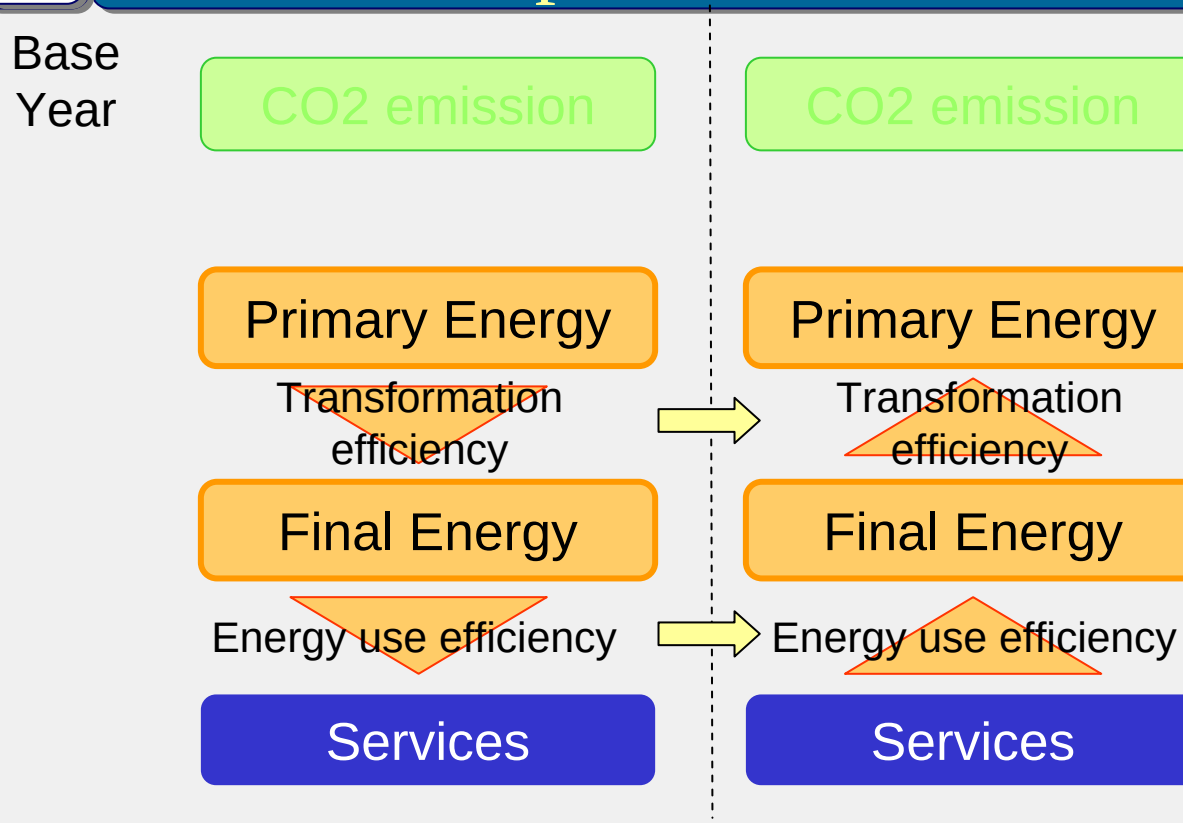
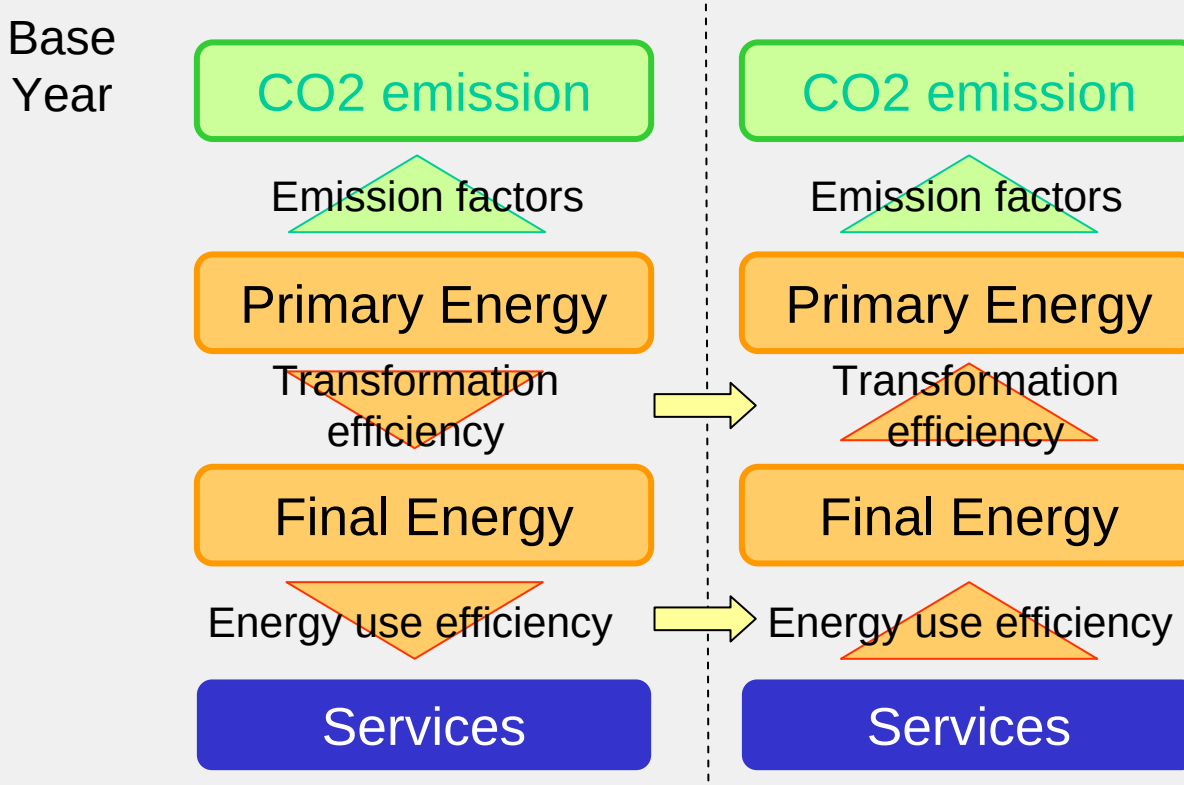
Calculation processes



5. Calculate primary energy and final energy in Target Year

Calculation processes



6. Calculate CO2 emissions by multiplying “emission factors” of each energy

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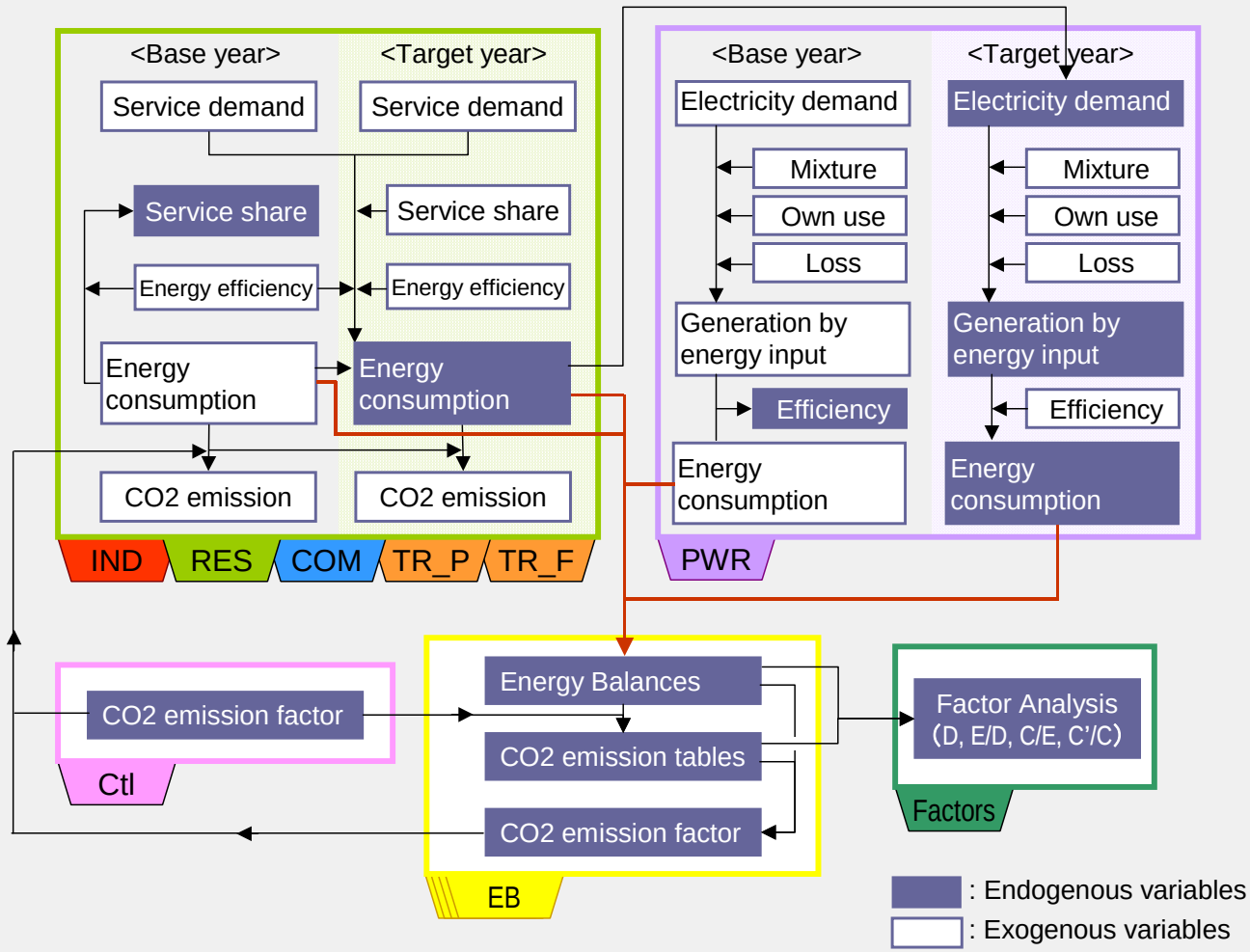
Structure of the model



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Contents

Operation

Fundamental settings (CTL)

Unit, Simulation Year, Scenario Name, Emission Factor

Unit

Energy	CO2
Mtoe	MtC

Simulation Year

Base Year	Target Year
2000	2050

Scenario Name

Scenario 1	Scenario 2
A	B

Emission Factor

COL	OIL	GAS	BMS	NUC	HYD	S/W
1.05	0.8	0.55	0	0	0	0

Unit: MtC / Mtoe

General rules

- White cells: User input
- Colored cells: Automatically calculated values

Contents

Enduse sector

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Enduse sector (IND, RES, COM, TR_P, TR_F)

Residential | Transportation_P | Industry | Commercial | Transportation_F

Residential sector

1 Energy service demand

	Unit	2000	2050 REF A	2050 REF B	2050 CM A	2050 CM B	2050 CM/REF A	2050 CM/REF B
Cool	Mtoe	4	4	4	4	4	90%	100%
Warm	Mtoe	81	81	81	65	81	80%	100%
Hot Water	Mtoe	55	55	55	55	55	100%	100%
Cooking	Mtoe	60	60	60	30	60	50%	100%
Others	Mtoe	5	5	5	5	5	100%	100%
	Mtoe				0	0		
	Mtoe				0	0		
	Mtoe				0	0		
	Mtoe				0	0		
					0	0		
					0	0		

REF = Reference case
CM = Countermeasure case

4-6 Energy consumption / CO2 Emission

		Unit	COL	OIL	GAS	BMS	S/W
4 Energy Consumption	2000	Mtoe	45	13	5	213	0
	2050 A (CM)		53	12	38	86	0
	2050 B (CM)		45	13	5	214	0
5 Emission Factor	2000	MtC/Mtoe	1.05	0.80	0.55	0.00	0.00
	2050 A (CM)		1.05	0.80	0.55	0.00	0.00
	2050 B (CM)		1.05	0.80	0.55	0.00	0.00
6 CO2 Emission	2000	MtC	47	10	3	0	0
	2050 A (CM)		56	10	21	0	0
	2050 B (CM)		47	10	3	0	0

2 Service Share

	Unit	2000 COL	2000 OIL	2000 GAS	2000 BMS	2000 S/W	2000 Heat	2000 H2	2000 ELE	2000 Total
Cool	-	0%	0%	0%	0%	0%	0%	0%	100%	100%
Warm	-	23%	8%	2%	48%	0%	3%	0%	16%	100%
Hot Water	-	14%	4%	1%	71%	0%	5%	0%	4%	100%
Cooking	-	7%	0%	1%	92%	0%	0%	0%	0%	100%
Others	-	0%	0%	0%	0%	0%	0%	0%	100%	100%
	-	0%	0%	0%	0%	0%	0%	0%	0%	0%
	-	0%	0%	0%	0%	0%	0%	0%	0%	0%
	-	0%	0%	0%	0%	0%	0%	0%	0%	0%
	-	0%	0%	0%	0%	0%	0%	0%	0%	0%
	-	0%	0%	0%	0%	0%	0%	0%	0%	0%
	-	0%	0%	0%	0%	0%	0%	0%	0%	0%

	2050 A (CM) COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total	2050 B (C COL	OIL	GAS	BMS	S/W
Cool	0%	0%	0%	0%	0%	0%	0%	100%	100%	0%	0	0	0%	0%
Warm	61%	8%	2%	10%	0%	3%	0%	16%	100%	23%	8%	2%	48%	0%
Hot Water	0%	6%	50%	30%	0%	10%	0%	4%	100%	14%	4%	1%	71%	0%
Cooking	7%	0%	1%	92%	0%	0%	0%	0%	100%	7%	0%	1%	92%	0%
Others	0%	0%	0%	0%	0%	0%	0%	100%	100%	0%	0%	0%	0%	0%
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0%	0%
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0	0	0	0

AIM
Japan Low Carbon Society 2050

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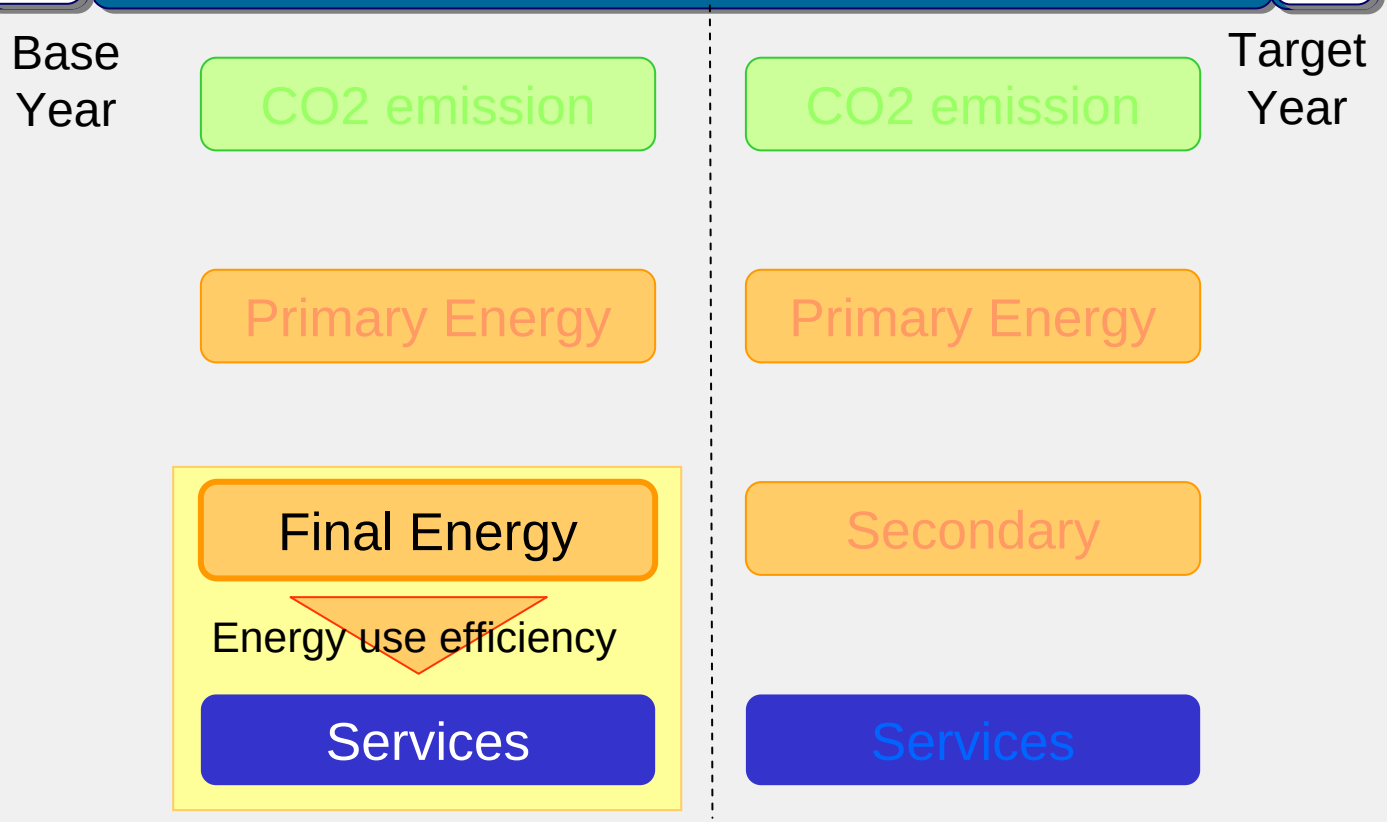
Japan Low-Carbon Society Project

Enduse sector (IND, RES, COM, TR_P, TR_F)



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0. Classification of service demand

- Set classification of energy service demand & its unit in residential sector
- Scenario name, base year and target year set in CTL sheet will shown in each table

	Unit	2000	2050					
			REF		CM		CM/REF	
			A	B	A	B	A	B
Cool	Mtoe	12	12	12	12	12	100%	100%
Warm	Mtoe	72	72	72	72	72	100%	100%
Hot Water	Mtoe	34	34	34	34	34	100%	100%
Cooking	Mtoe	2	2	2	2	2	100%	100%
Others	Mtoe	11	11	11	11	11	100%	100%
					0	0		
					0	0		
					0	0		
					0	0		
					0	0		
					0	0		

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1. Energy Cons. in base year

- Past record of energy use in residential sector
- If the appropriate data is not available, use data of EBT (one sector), or make a guess!!

		2000								
		COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Cool	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0
Warm	Mtoe	30.0	10.0	3.0	50.0	0.0	3.0	0.0	5.0	101.0
Hot Water	Mtoe	10.0	3.0	1.0	50.0	0.0	3.0	0.0	2.0	69.0
Cooking	Mtoe	5.0	0.0	1.0	113.0	0.0	0.0	0.0	0.0	119.0
Others	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0
	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Generation	Mtoe									0.0
Cogeneration	Mtoe									0.0
	Mtoe									0.0
Total	Mtoe	45	13	5	213	0	6	0	14	296

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2. Energy use eff. in base year

- Set energy efficiency of each energy use
  - Energy use efficiency: Ratio between the consumption of energy to service demand
  - Keep consistency
  - The value can be relative value (Base Year=1.00)

	Unit	2000								
		COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Cool	toe/toe								2.00	-
Warm	toe/toe	0.70	0.70	0.70	0.90		1.00		3.00	-
Hot Water	toe/toe	0.80	0.80	0.80	0.80	1.00	1.00		1.00	-
Cooking	toe/toe	0.80		0.50	0.45	0.45			0.70	-
Others	toe/toe								1.00	-
	toe/toe									-
	toe/toe									-
	toe/toe									-
	toe/toe									-
										-
										-

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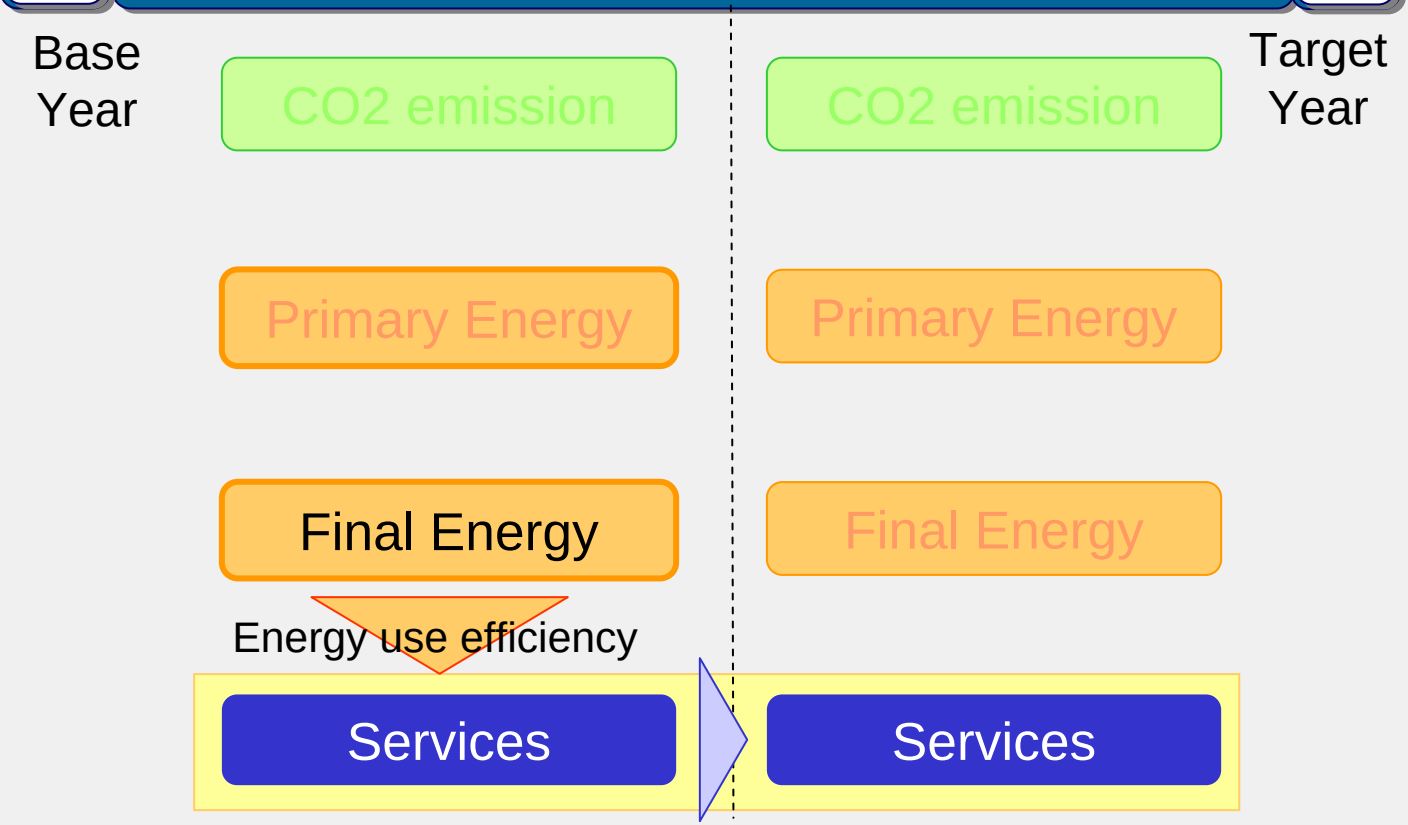
Enduse sector (IND, RES, COM, TR_P, TR_F)



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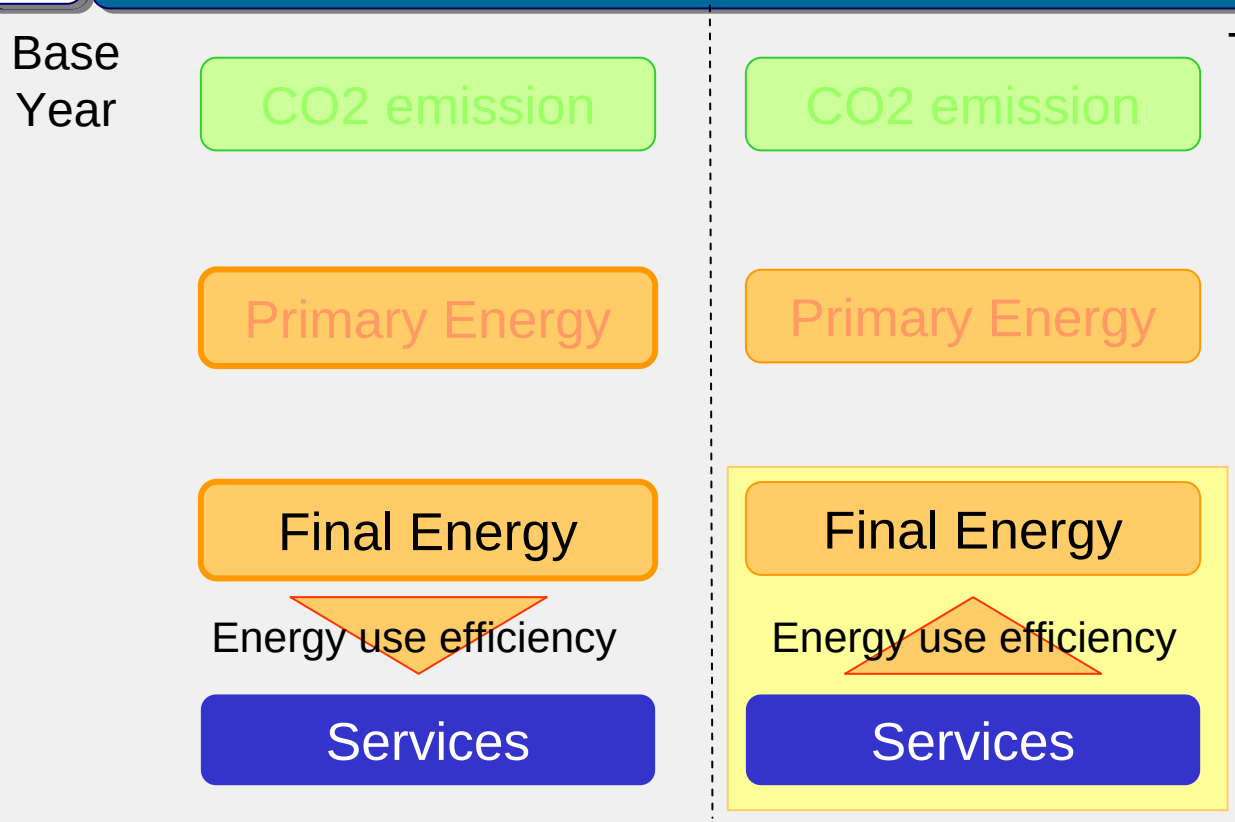
3. Service Demand

- Service demand in base year
  - Service demand (Mtoe) = Final Energy/EE
- Assume service demand in target year
- Reference case, Countermeasure case

	Unit	2000	2050					
			REF		CM		CM/REF	
			A	B	A	B	A	B
Cool	Mtoe	4	4	4	4	4	90%	100%
Warm	Mtoe	81	81	81	65	81	80%	100%
Hot Water	Mtoe	55	55	55	55	55	100%	100%
Cooking	Mtoe	60	60	60	30	60	50%	100%
Others	Mtoe	5	5	5	5	5	100%	100%
	Mtoe				0	0		
	Mtoe				0	0		
	Mtoe				0	0		
	Mtoe				0	0		
					0	0		
					0	0		

Enduse sector (IND, RES, COM, TR_P, TR_F)



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4. Service share in target year

- Set service share to fulfill the service demand
  - Assume the technology used
  - Check “total value” (=100%)

	Unit	2050 A (CM)								
		COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Cool	-	0%	0%	0%	0%	0%	0%	0%	100%	100%
Warm	-	61%	8%	2%	10%	0%	3%	0%	16%	100%
Hot Water	-	0%	6%	50%	30%	0%	10%	0%	4%	100%
Cooking	-	7%	0%	1%	92%	0%	0%	0%	0%	100%
Others	-	0%	0%	0%	0%	0%	0%	0%	100%	100%
	-	0%	0%	0%	0%	0%	0%	0%	0%	0%
	-	0%	0%	0%	0%	0%	0%	0%	0%	0%
	-	0%	0%	0%	0%	0%	0%	0%	0%	0%
	-	0%	0%	0%	0%	0%	0%	0%	0%	0%
	-	0%	0%	0%	0%	0%	0%	0%	0%	0%
	-	0%	0%	0%	0%	0%	0%	0%	0%	0%

5. Energy use eff. in target year

- Set energy efficiency of each energy use in Target Year
  - Keep consistency
  - The value can be relative value (Base Year=1.00)

	Unit	2050 A (CM)								
		COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Cool	toe/toe								2.00	-
Warm	toe/toe	0.90	0.70	0.70	0.90		1.00		3.00	-
Hot Water	toe/toe	0.80	0.80	0.80	0.80	1.00	1.00		1.00	-
Cooking	toe/toe	0.80		0.50	0.45	0.45			0.70	-
Others	toe/toe								1.00	-
	toe/toe									-
	toe/toe									-
	toe/toe									-
	toe/toe									-
										-
										-

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6. Energy Cons. in Target year

- Calculated automatically
- Additional Input
  - Generation: PV etc.
  - CHP: Fuel cells, Gas engine etc.

		2050 A (CM)								
		COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Cool	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	1.8
Warm	Mtoe	50.6	8.0	2.4	8.3	0.0	2.4	0.0	4.0	75.7
Hot Water	Mtoe	0.0	4.2	35.0	21.0	0.0	5.6	0.0	2.0	67.8
Cooking	Mtoe	2.5	0.0	0.5	57.0	0.0	0.0	0.0	0.0	60.0
Others	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0
	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Generation	Mtoe									0.0
Cogeneration	Mtoe									0.0
	Mtoe									0.0
Total	Mtoe	53	12	38	86	0	8	0	13	210

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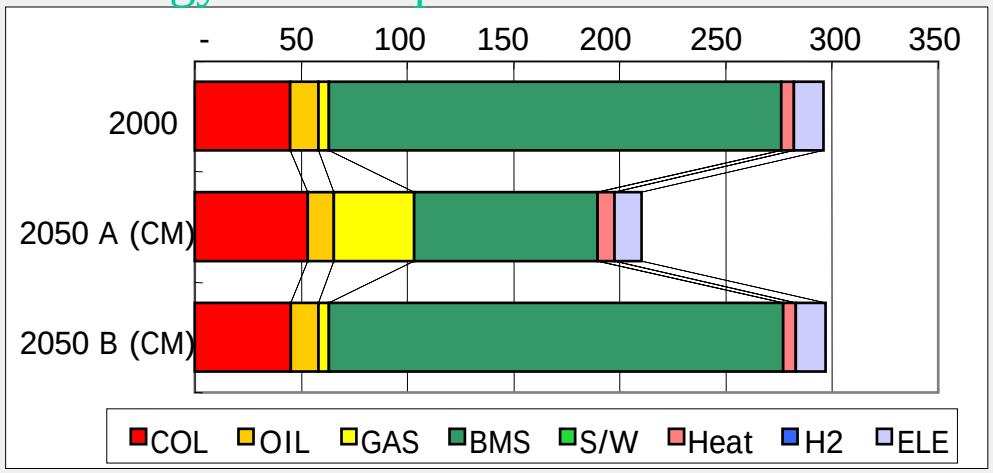
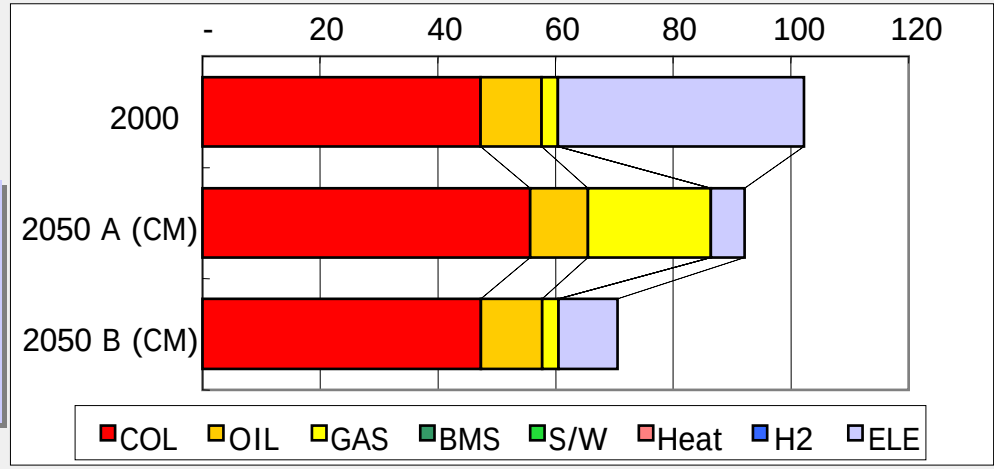
7. Check the results

Energy Consumption



CO2 Emission



Note: Before implement CO2 analysis, assumption of energy transformation needed to be made

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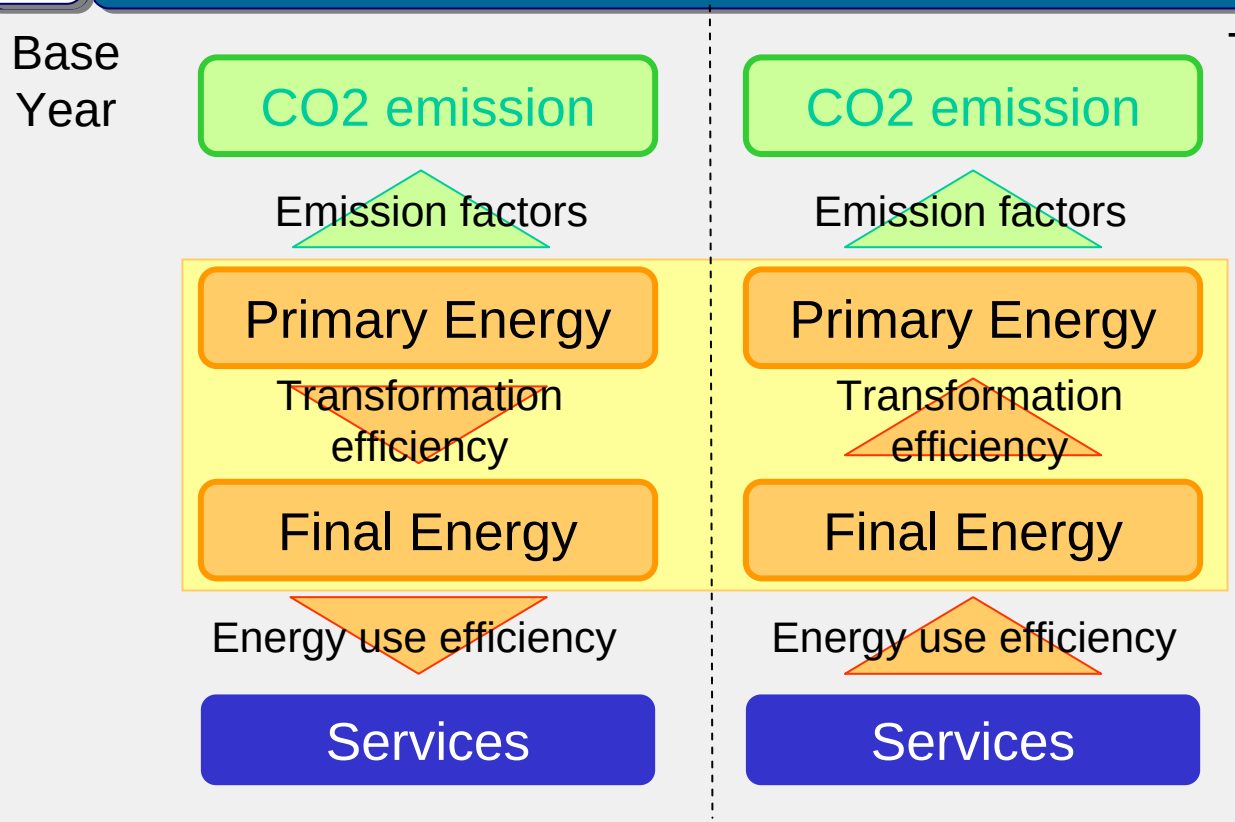
Contents

Transformation Sector

Transformation Sector



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Electricity Generation (PWR)

- Goal: Primary energy consumed for electricity generation in target year.

Power generation sector

Solver		2000	2050							
			Supply & Demand		Only Demand		Only Supply		No	
			A	B	A	B	A	B	A	B
1. Electricity demand at receiver end										
	Mtoe	98	88	86	88	86	98	98	98	98
2. Difference between demand and supply										
	Mtoe	12.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Electricity supply at receiver end										
Electricity supply	Mtoe	103	88	86	88	86	98	98	98	98
Transmission Loss		6.84%	5.31%	5.31%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%
4. Electricity supply before tranmission										
Electricity supply	Mtoe	111	93	91	93	91	104	104	104	104
Pumped storage (PS)										
Ele. demand of PS	Mtoe	0	1	1	0	0	1	1	0	0
Efficiency		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Generation of PS	Mtoe	0	1	1	0	0	1	1	0	0
Own use										
Own use in plant	Mtoe	6	4	4	5	5	5	4	6	6
Own use rate										
COL		6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%
GAS		4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
OIL		5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
NUC		4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%
HYD		0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
HYD(P)		0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
GEO		8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%

P
S

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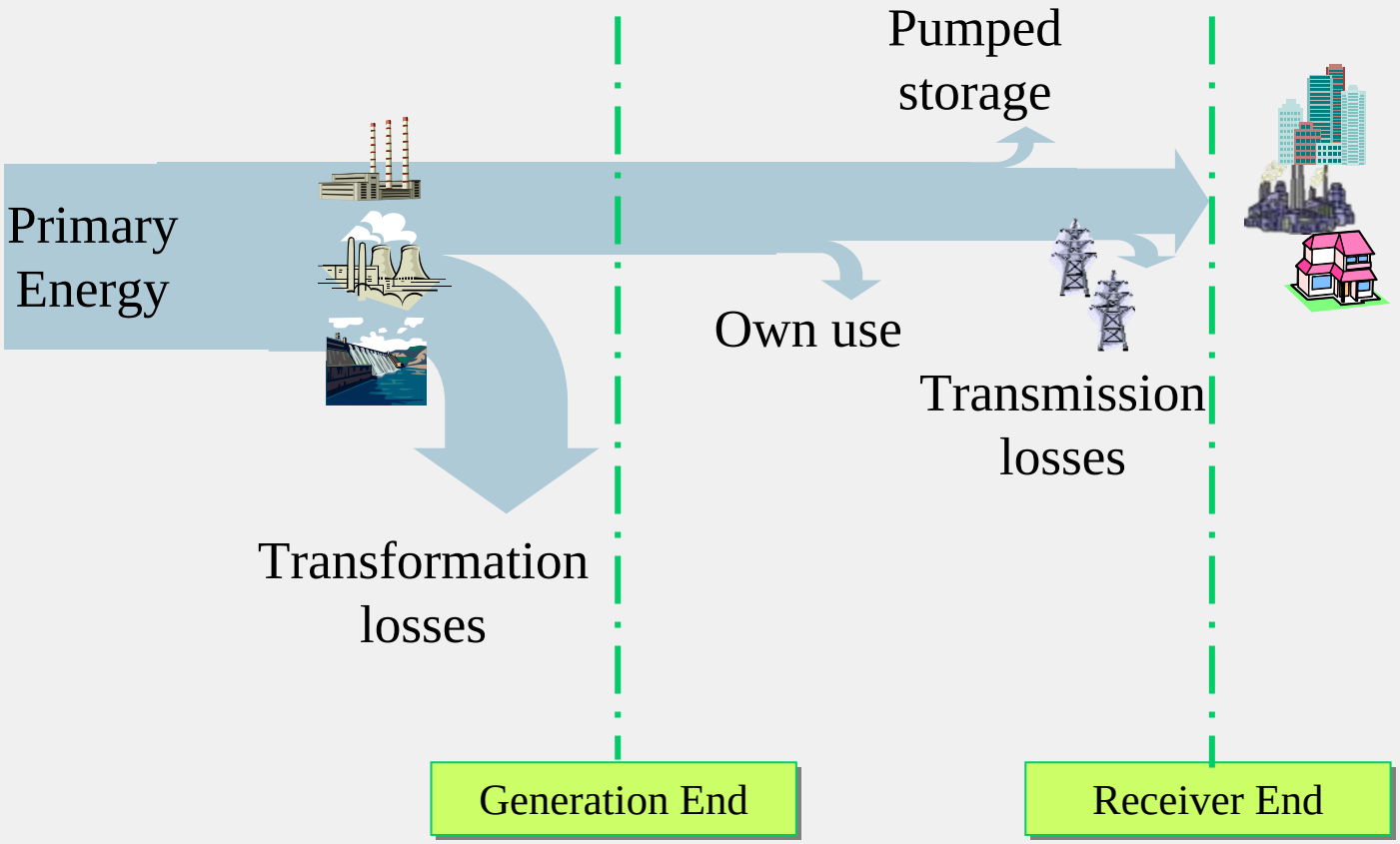
Electricity Generation (PWR)



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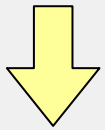
Electricity Generation (PWR)

- Data setting for reference year
  - Electricity demand at receivers end
  - Electricity transmission losses
  - Efficiency of pumped storage (Def: ratio between consumed energy while pumping and generated energy)
  - Own use rate of electricity plant
  - Electricity supply at generation end
  - Primary Energy Consumption

Electricity Generation (PWR)

- Data setting for target year (scenario)
  - Electricity transmission losses
  - Efficiencies of pumped storage
  - Own use rate
  - Mixture of energy
  - Thermal efficiency



- Click “Solver”!!
  - “Electricity supply at generation end” is calculated automatically so that the electricity demand of the end-user would be fulfilled
  - Primary energy supply for electricity generation is calculated

Other energy transformation (EB_SD)

(a) Energy use for CCS

(b) Amount of carbon captured

(c) Heat supply

(d) Feedstock

(e) Losses of Coal/Oil/Gas during refining processes

2050 A (CM)

	COL	OIL	GAS	BMS	NUC	HYD	S/W	Heat	H2	ELE	Total	'90=100
Energy Balances												
Power Gnr.	15	0	41	0	92	8	1			-66	90	
CCS	(e)								(a)	3	3	
Heat											0	
Coal/Oil/Gas		2									2	
Hydrogen			12				13	(c)	-14		11	
Industrial	23	39	45	5			0	0	0	29	140	
Residential	0	1	1	0			8	0	4	14	27	
Commercial	0	1	1	0			3	0	5	18	28	
Trans. Prv.	0	4	0	2			0	0	3	2	11	
Trans. Frg.	0	3	0	9			0	0	3	1	17	
Enduse	23	48	47	16			11	0	14	64	223	
Total	38	59	100	16	92	8	25	0	0	-0	330	
Feedstock in total	(d)	14										
Emission Factor (MtC/Mtoe)	1.05	0.80	0.55	0.00	0.00	0.00	0.00	(0.00)	(0.47)	(0.00)		
CO2 Gnr. (MtC)	40	29	55	0	0	0	0	-	-	-	124	43.6
CO2 CCS (MtC)	-16		-23					-	-	(b)	-39	
											0	
											0	
CO2 Ems. (MtC)	24	28.6	33	0	0	0	0	-	-	-	85	30.0

Asia Pacific Integrated Model (AIM)
Japan Low-Carbon Society Project

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Analysis

Factor analysis (Factors)

- Extended Kaya Identity

$$C = D \times \frac{E}{D} \times \frac{C'}{E} \times \frac{C}{C'}$$

$$\frac{\Delta C}{C} = \frac{\Delta D}{D} + \frac{\Delta (E/D)}{(E/D)} + \frac{\Delta (C'/E)}{(C'/E)} + \frac{\Delta (C/C')}{(C/C')} + \text{Cross term}$$

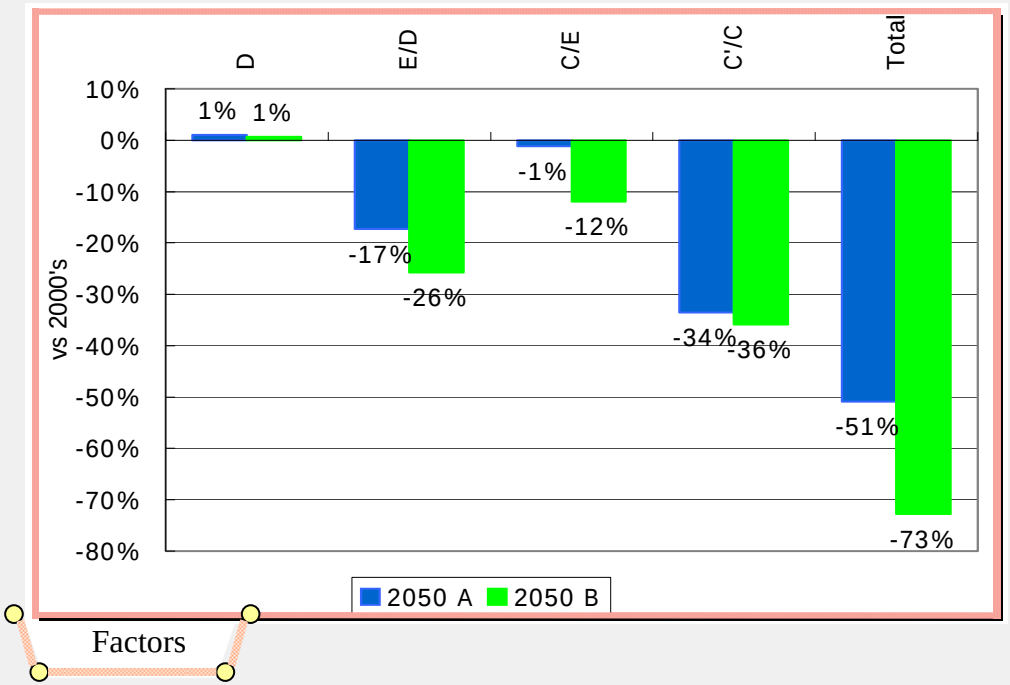
C: CO2 emission
D: Driving forces (service demand)
E: Energy Consumption
C': CO_2 emission without measures in transformation sector

E/D: Energy Intensity
C'/E: CO_2 intensity in end-use sector
C/C': CO_2 intensity in transformation sector

Factor analysis (Factors)

- Kaya Identity

$$\frac{\Delta C}{C} = \frac{\Delta D}{D} + \frac{\Delta(E/D)}{(E/D)} + \frac{\Delta(C'/E)}{(C'/E)} + \frac{\Delta(C/C')}{(C/C')} + \text{Cross term}$$



Asia Pacific Integrated Model (AIM)
Japan Low-Carbon Society Project

Application of AIM/Energy Snapshot Tool to Japan

- Japan Low Carbon Society Scenario -

Ms. Maho MIYASHITA (TAKIMI) **Mizuho Information & Research Institute**
Prof. P.R. Shukla **Indian Institute of Management**
Dr. Mikiko KAINUMA **National Institute for Environmental Studies**

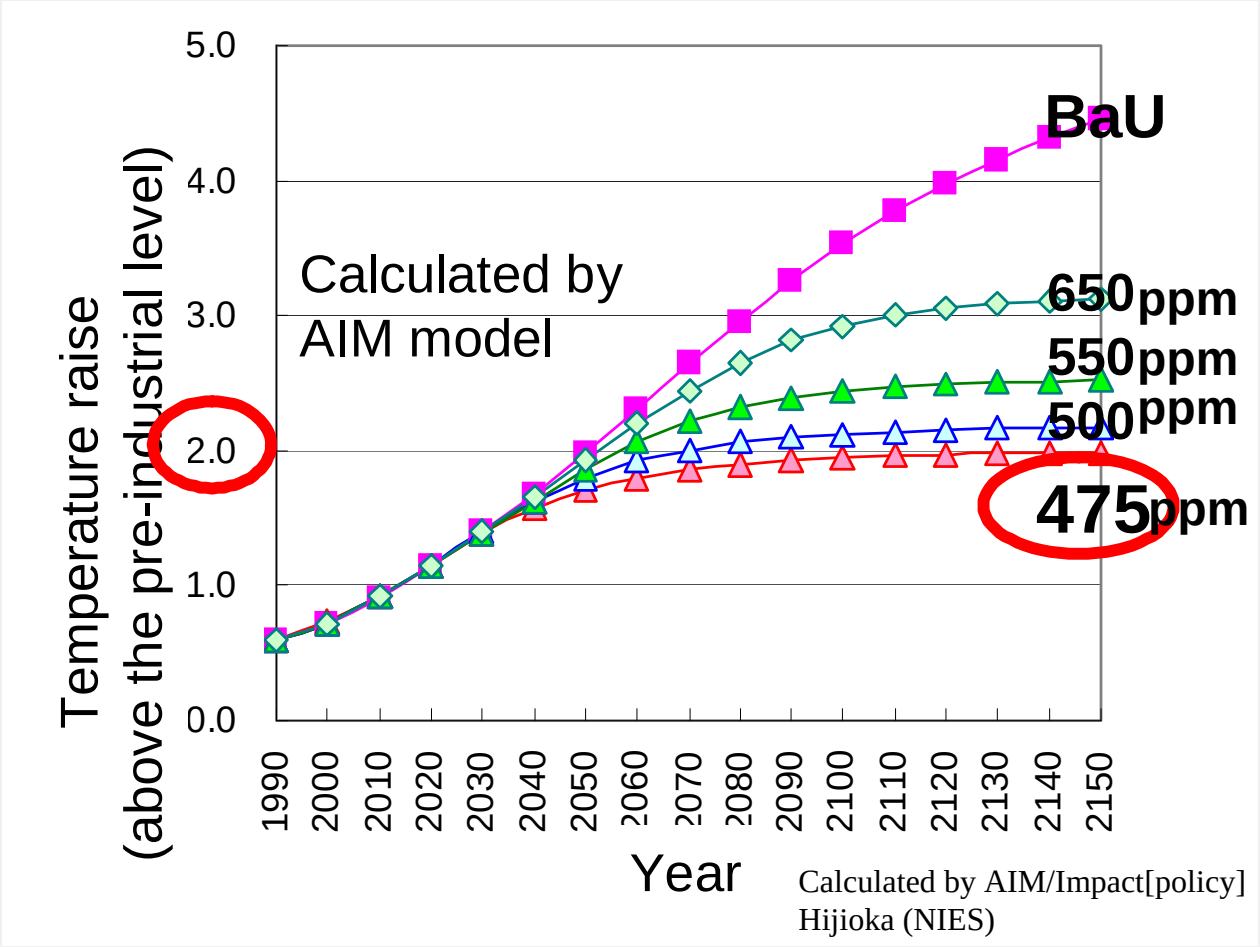
The United Nations Commission on Sustainable Development
30 April – 11 May, 2007

Contents

- Why do we need Low Carbon Society?
- Overview of Japan LCS project
- Approach to develop Japan LCS scenario
  - Visions of 2050
  - Narrative description of scenarios
  - Quantification of scenarios
- 70% CO2 emission reduction by 2050

Contents

Why do we need Low Carbon Society?



Calculated by AIM/Impact[policy]
Hijioka (NIES)

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Japan Low-Carbon Society Project

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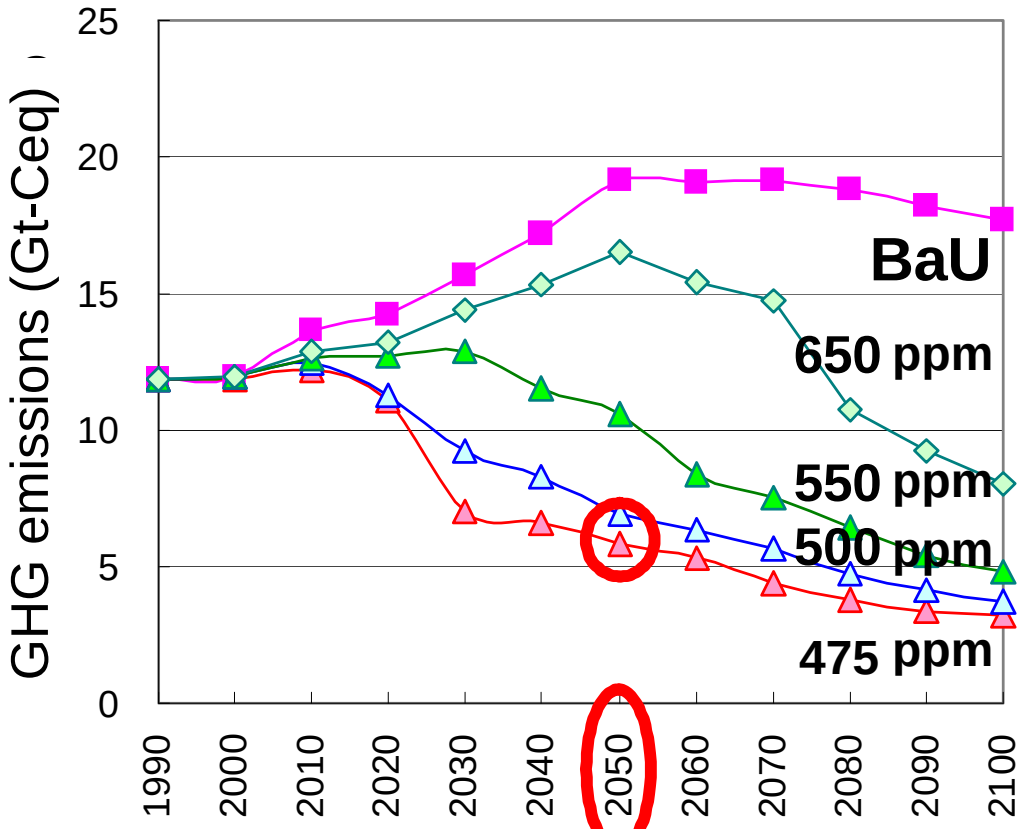
Why do we need Low Carbon Society?



Calculated by AIM/Impact[policy]
Hijioka (NIES)

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Japan Low-Carbon Society Project

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Why do we need Low Carbon Society?

To control temperature raise below 2ºC (EU target), Global GHG emissions should be reduced by 50% in 2050

Japanese reduction target in 2050 should be 60-80%

Japan Low-Carbon Society Project

Asia Pacific Integrated Model (AIM)
Japan Low-Carbon Society Project

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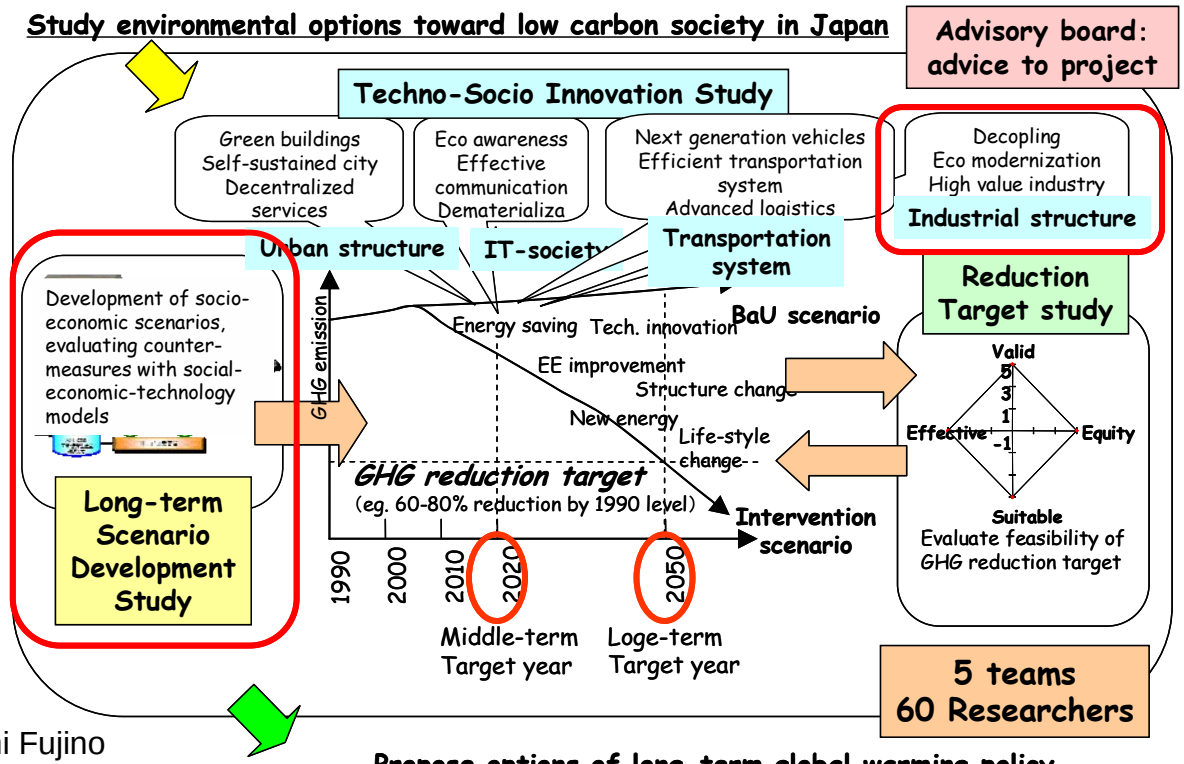
Overview of Japan LCS project

Japan Low Carbon Society Scenarios toward 2050

FY2004-2006 (PhaseI),2007-2008 (Phase II)
Global Environmental Research Program, MOEJ



Junichi Fujino

Asia Pacific Integrated Model (AIM)
Japan Low-Carbon Society Project

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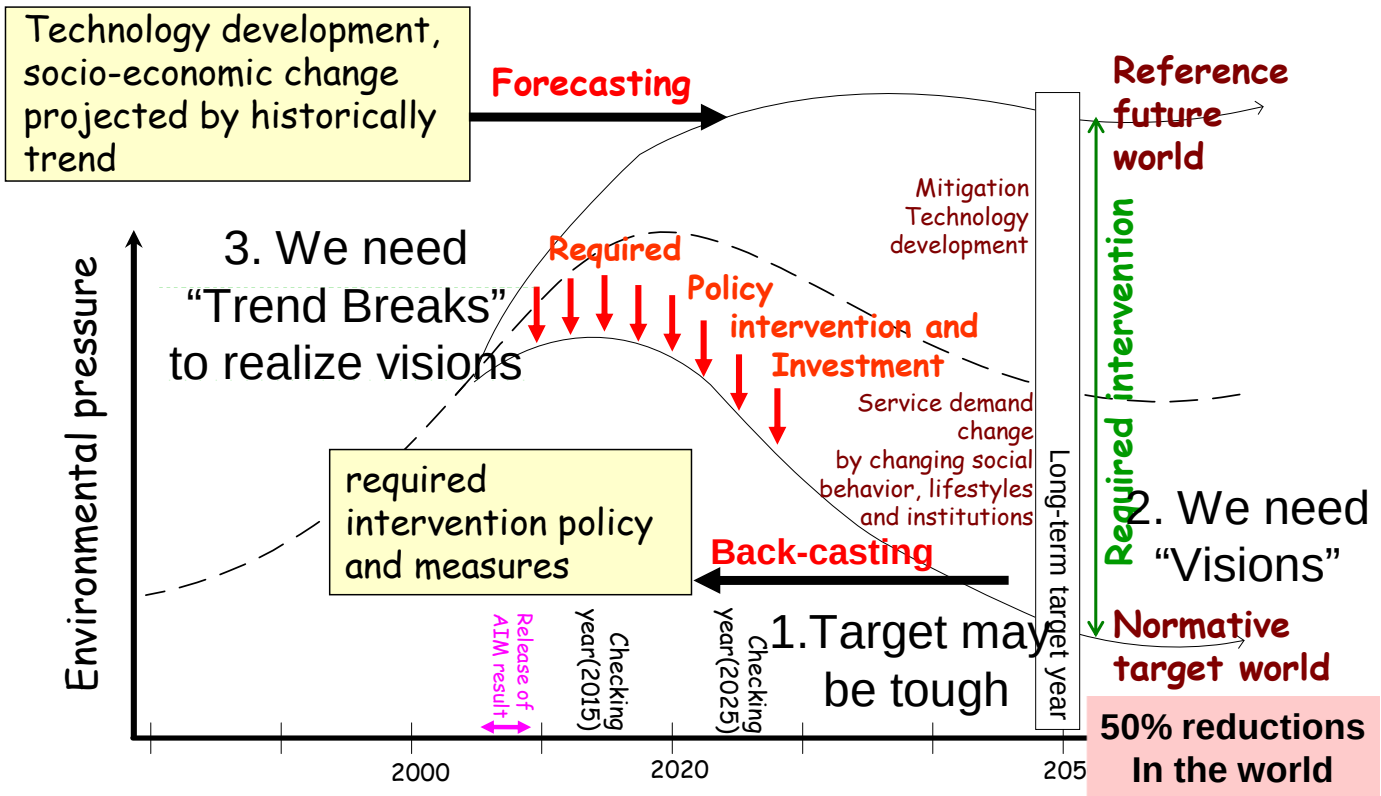
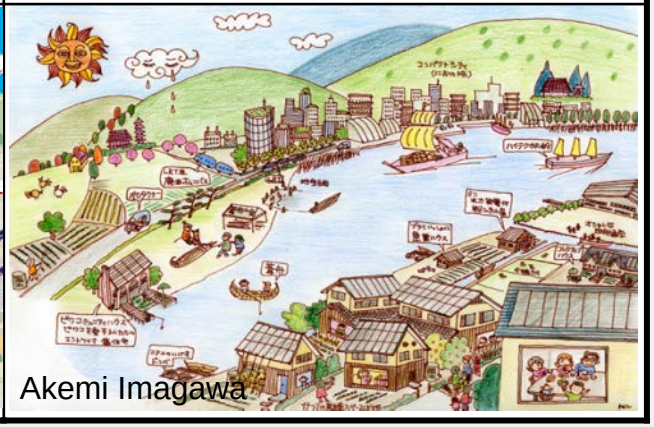
Approach to develop Japan LCS scenario



Junichi Fujino

Asia Pacific Integrated Model (AIM)
Japan Low-Carbon Society Project

Visions of 2050

Vision A "Doraemon"	Vision B "Satsuki and Mei"
Vivid, Technology-driven	Slow, Natural-oriented
Urban/Personal	Decentralized/Community
Technology breakthrough Centralized production /recycle	Self-sufficient Produce locally, consume locally
Comfortable and Convenient	Social and Cultural Values
	 Akemi Imagawa

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Visions of 2050

Doraemon is a Japanese comic series created by Fujiko F. Fujio. The series is about a robotic cat named Doraemon, who travels back in time from the 22nd century. He has a pocket, which connects to the fourth dimension and acts like a wormhole.

Satsuki and Mei's House reproduced in the 2005 World Expo. Satsuki and Mei are daughters in the film "My Neighbor Totoro". They lived an old house in rural Japan, near which many curious and magical creatures inhabited.

Narrative description of scenarios

Scenario A

Technical progresses in the industrial sectors are considerably high because of vigorous R&D investments by the government and business sectors. The economic activities as a whole are so dynamic that average annual per capita GDP growth rate is kept at the level of 2%. The other reasons for such high economic growth are high rates of consumption in both business and household sectors.

The employment system has been drastically changed from that in 2000 and equal opportunities for the employment have been achieved. Since workers are employed based on their abilities or talents regardless of their sex, nationality and age, the motivation of the worker is quite high in general.

As many women work outside, the average time spent for housekeeping has decreased. Most of the household works are replaced by housekeeping robots or services provided by private companies. Instead, the time used for personal career development has increased.

The new technologies, products, services are positively accepted in the society. Therefore, purchasing power of the consumer is strong and upgrade cycles of the commodities are short.

Household size becomes smaller and the number of single-member households has increased. Multi-dwellings are preferred over detached houses, and the urban lifestyle is more popular than the lifestyle of countryside.

Narrative description of scenarios

Scenario B

Although average annual growth rate of per capita GDP is approximately 1%, people can receive adequate social services no matter where they live. Volunteer works or community based mutual aid activities are the main provider of the services. Since the levels of medical and educational service in the countryside have drastically improved, continuous migration of population from city to countryside has been observed.

The number of family who own detached dwellings has increased. The trend is especially prominent in the countryside. The size of the houses and the floor area per houses has also increased with the increasing share of detached houses.

The ways people work have also changed. The practice that husbands work outside and wives work at home is not common anymore. In order to avoid the excessive work of the partner, the couples help each other and secure the income according to their life plan. Housework is shared mainly among family members, but free housekeeping services provided by local community or social activity organizations are also available. As a result of the changes in lifestyle, the time spent within family has increased. The time spent on hobby, sports, cultural activities, volunteer activities, agricultural works, and social activities has also increased.

Quantification of scenarios

	Unit	2000	2050				model
			A		B		
Population	Mil.	127	94	***74%***	100	***79%***	
Household	Mil.	47	43	***91%***	42	***89%***	Population and Household model
Average number of person per household		2.7	2.2	***81%***	2.4	***89%***	
GDP	Tril. JPY	520	1009	***194%***	668	***128%***	
Share of production							Inter-sector and Macro Economic Model
Primary	%	1.7%	1.1%		2.3%		
Secondary	%	27.5%	18.3%		21.8%		
Teritary	%	70.8%	80.5%		75.9%		
Office floor space	Mil. m2	1,654	1,934	***117%***	1,718	***104%***	Building Dynamics Model, Inter-sector and Macro Economic Model
Travel passenger volume	bill. p-km	1,399	948	***68%***	1,010	***72%***	Transportation demand model, Inter-sector and Macro Economic Model
Private car	%	53.6%	40.2%		41.6%		
Public transport	%	38.9%	52.1%		50.6%		
Walk/bicycle	%	7.5%	7.7%		7.8%		
Freight transport volume	bill. t-km	580	465	***80%***	500	***86%***	
Industrial production							Inter-sector and Macro Economic Model
Steel production	Mil. t	107	74	***69%***	63	***59%***	
Etylen production	Mil. t	8	4	***50%***	3	***38%***	
Cement production	Mil. t	82	56	***68%***	45	***55%***	
Paper production	Mil. t	32	17	***53%***	28	***88%***	

Asia Pacific Integrated Model (AIM)
Japan Low-Carbon Society Project

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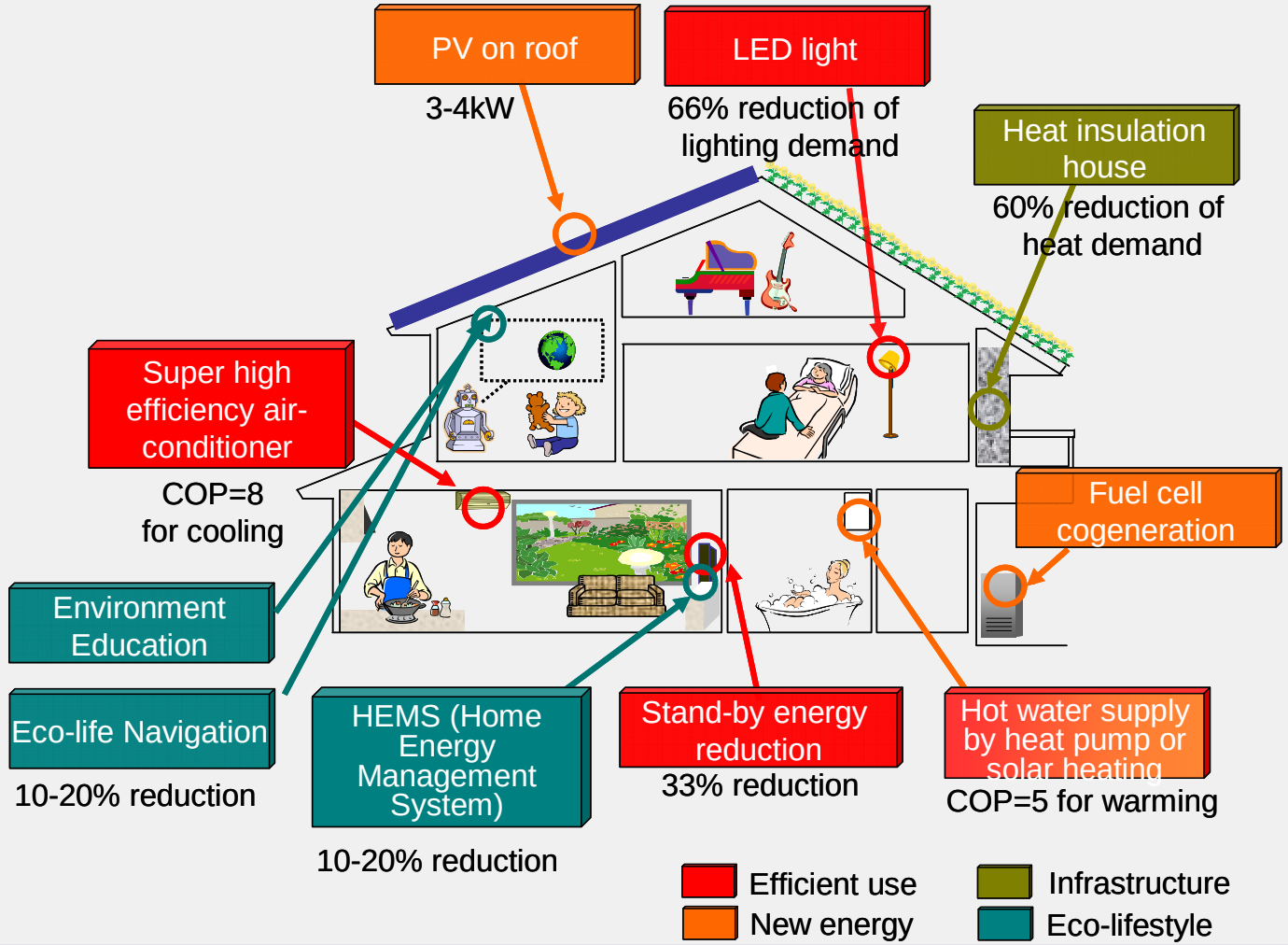
Quantification of scenarios



Asia Pacific Integrated Model (AIM)
Japan Low-Carbon Society Project

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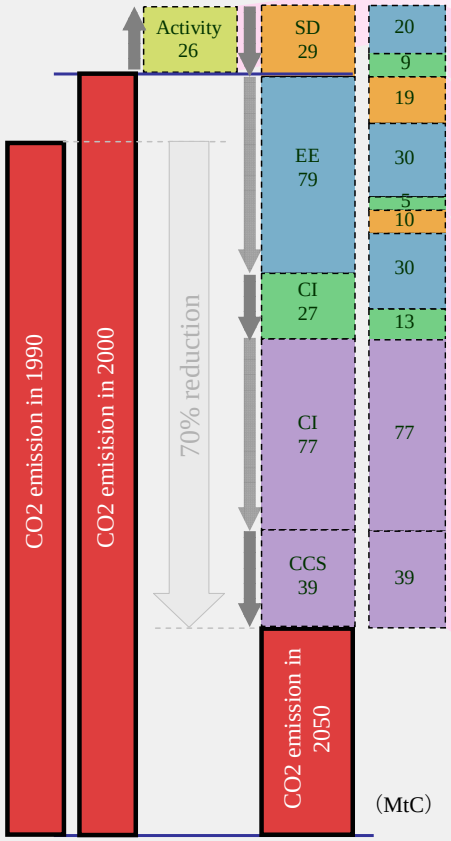
70% CO2 emission reduction by 2050

Scenario A :2050



Main factors to reduce CO2 emissions

[Society]
- Activity: • High economic growth; • Decrease of population and number of households

[Industrial]
- Energy Intensity Imp.: • Energy efficient improvement of furnace and motor etc.
- Carbon Intensity Imp.: • Fuel switching from coal/oil to natural gas

[Residential and commercial]
- Reduction of service demands: • High insulation dwelling and building; • Home/Building energy management system
- Energy Intensity Imp.: • Efficient air-conditioner, Efficient water heater, Efficient lighting system
- Carbon Intensity Imp.: • Fuel cell system; • Photovoltaic on the roof

[Transportation]
- Reduction of service demands: • Intensive land-use, Concentrated urban function; • Public transportation system
- Energy Intensity Imp.: • Motor-driven mobiles: Electric battery vehicles, Fuel cell battery vehicles
- Carbon Intensity Imp.

[Energy transformation]
- Carbon Intensity Imp.: • Nuclear energy; • Effective use of electricity in night time with storage; • Hydrogen supply with low-carbon energy sources
- CCS: • Advanced fossil fueled plants + CCS; • Hydrogen supply using fossil fuel + CCS

EE: Energy Efficiency Improvement, CI: Carbon Intensity Improvement, SD: Reduction of Service Demands

Asia Pacific Integrated Model (AIM)
Japan Low-Carbon Society Project

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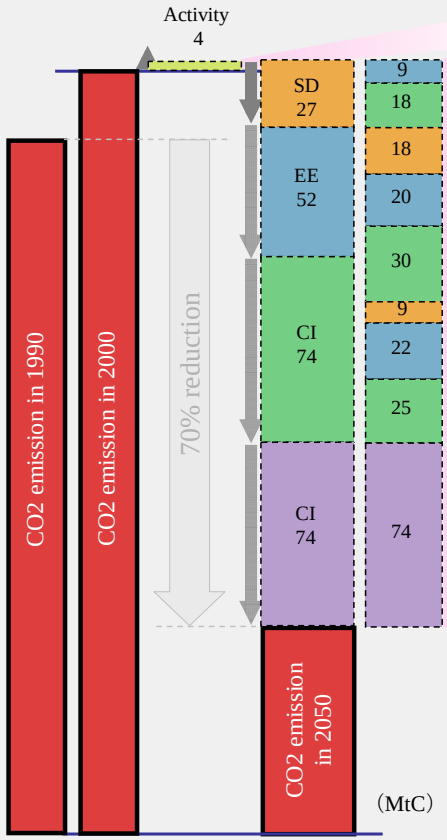
70% CO2 emission reduction by 2050

Scenario B :2050



Main factors to reduce CO2 emissions

[Society]

- Activity
  - Reduction of final demand by material saturation
  - Reduction of raw material production
  - Decrease of population and number of households

[Industrial]

- Energy Intensity Imp.
  - Energy efficient improvement of furnace and motor etc.
- Carbon Intensity Imp.
  - Increase of Fuel switching from coal/oil to natural gas /biomass

[Residential and commercial]

- Reduction of service demands
  - High insulation dwelling and building
  - Eco-life navigation system
- Energy Intensity Imp.
  - Efficient air-conditioner, Efficient water heater, Efficient lighting system
- Carbon Intensity Imp.
  - Photovoltaic on the roof
  - Expanding biomass energy use in home
  - Diffusion of solar water heating

[Transportation]

- Reduction of service demands
  - Shortening trip distances for commuting through intensive land use
  - Infrastructure for pedestrians and bicycle riders (sidewalk, bikeway, cycle parking)
- Energy Intensity Imp.
- Carbon Intensity Imp.
  - Biomass-hybrid engine vehicle

[Energy transformation]

- Carbon Intensity Imp.
  - Expanding share of both advanced gas combined cycle and biomass generation

EE: Energy Efficiency Improvement, CI: Carbon Intensity Improvement, SD: Reduction of Service Demands

Asia Pacific Integrated Model (AIM)
Japan Low-Carbon Society Project

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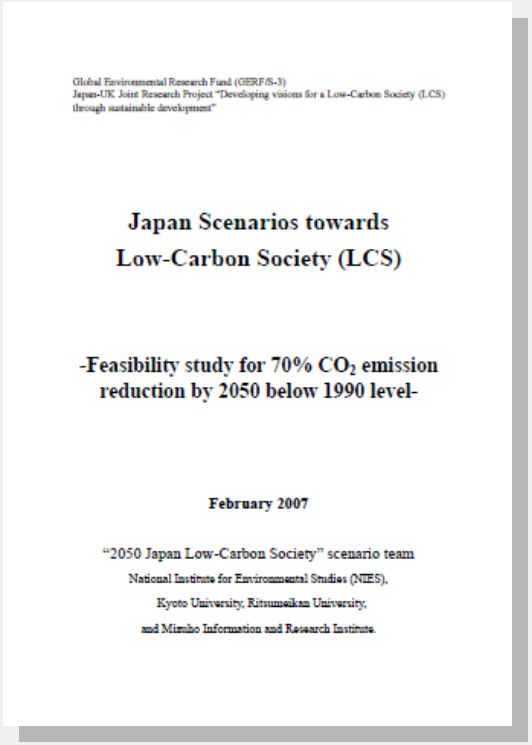


Global Environmental Research Fund (GERF/S-3)
Japan-UK Joint Research Project "Developing visions for a Low-Carbon Society (LCS) through sustainable development"

Japan Scenarios towards Low-Carbon Society (LCS)

-Feasibility study for 70% CO_2 emission reduction by 2050 below 1990 level-

February 2007

"2050 Japan Low-Carbon Society" scenario team
National Institute for Environmental Studies (NIES),
Kyoto University, Ritsumeikan University,
and Mizuho Information and Research Institute.

Please see more details !!! at

http://2050.nies.go.jp/index.html

Asia Pacific Integrated Model (AIM)
Japan Low-Carbon Society Project

Application of AIM/Energy Snapshot Tool to Asian Countries

Prof. P.R. Shukla	**Indian Institute of Management**
Dr. Jiang Kejun	**China Energy Research Institute**
Prof. Ram Shrestha	**Asian Institute of Technology**
Dr. Mikiko Kainuma	**National Institute for Environmental Studies**
Ms. Maho Miyashita (Takimi)	**Mizuho Information & Research Institute**

The United Nations Commission on Sustainable Development
30 April – 11 May, 2007

Asia Pacific Integrated Model (AIM)
Japan Low-Carbon Society Project

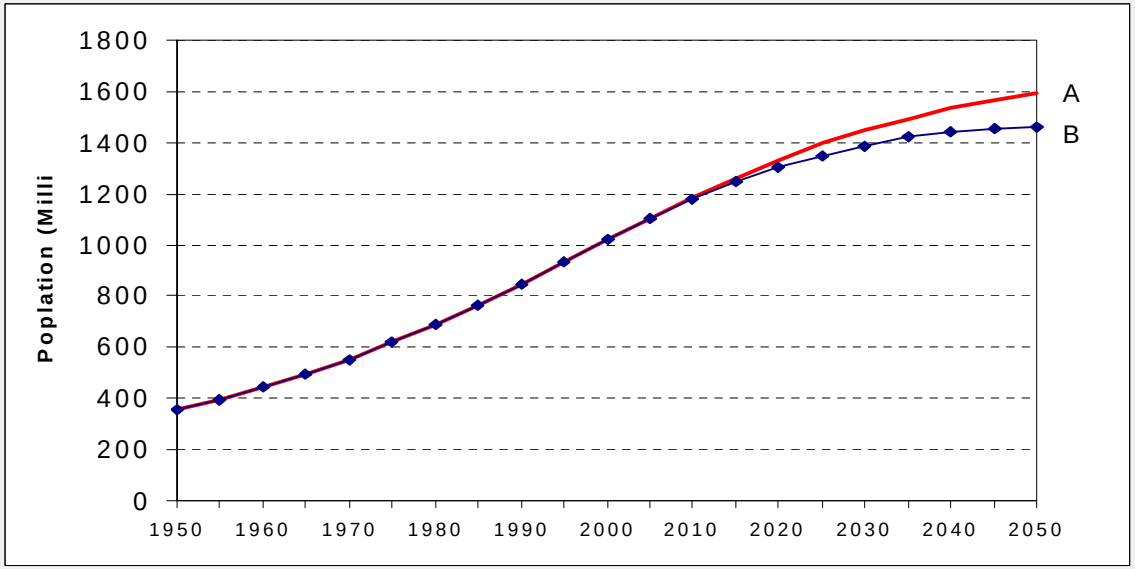
Application to India

- Introduction of Analysis of Residential Sector -

Scenario of 2050

Scenario A
A large part still resides in villages though demographic indicators have changed but still a long improvement to go. The economy is dependent largely on the manufacturing sector.
Scenario B
Policy makers are aspiring for characterized by high growth rates, rapidly improving demographic indicators, driven by economic reforms and high levels of social spending. Higher penetration of technologies takes place, aided by close cooperation with the developed countries in the east and west. Higher incomes also bring about enhanced environmental consciousness amongst people.

Scenario of 2050



Scenario A : UN Population Projections

Scenario B : Own projections for a highly urbanized India

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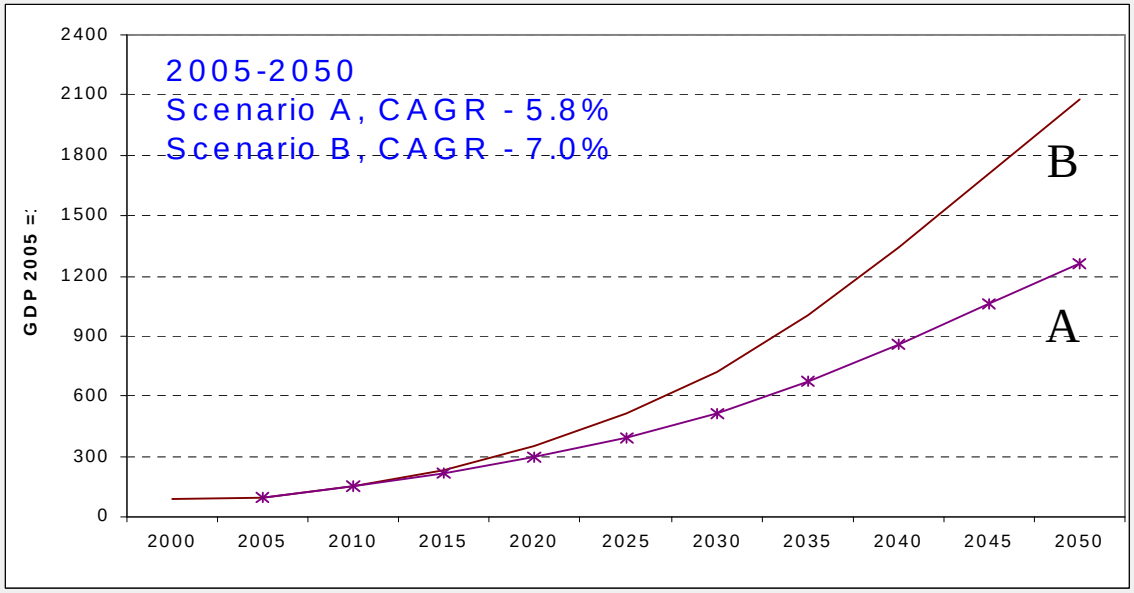
Japan Low-Carbon Society Project

Scenario of 2050



Scenario A : Closer to GDP estimates in the WEO, 2006 of IEA

Scenario B : Assumes 8% CAGR till 2032 as per Planning Commission Estimates

Scenario of 2050

Assumption of Service Demand

2000=1

Service	2050 A	2050 B
Cooling (AC + Cooler)	21.6	12.9
Cooking (Stove)	1.5	1.6
Cooking (Elect)	3.5	3.0
Lighting	3.4	3.1
ICT	33.3	16.7
Appliance	42.3	19.2

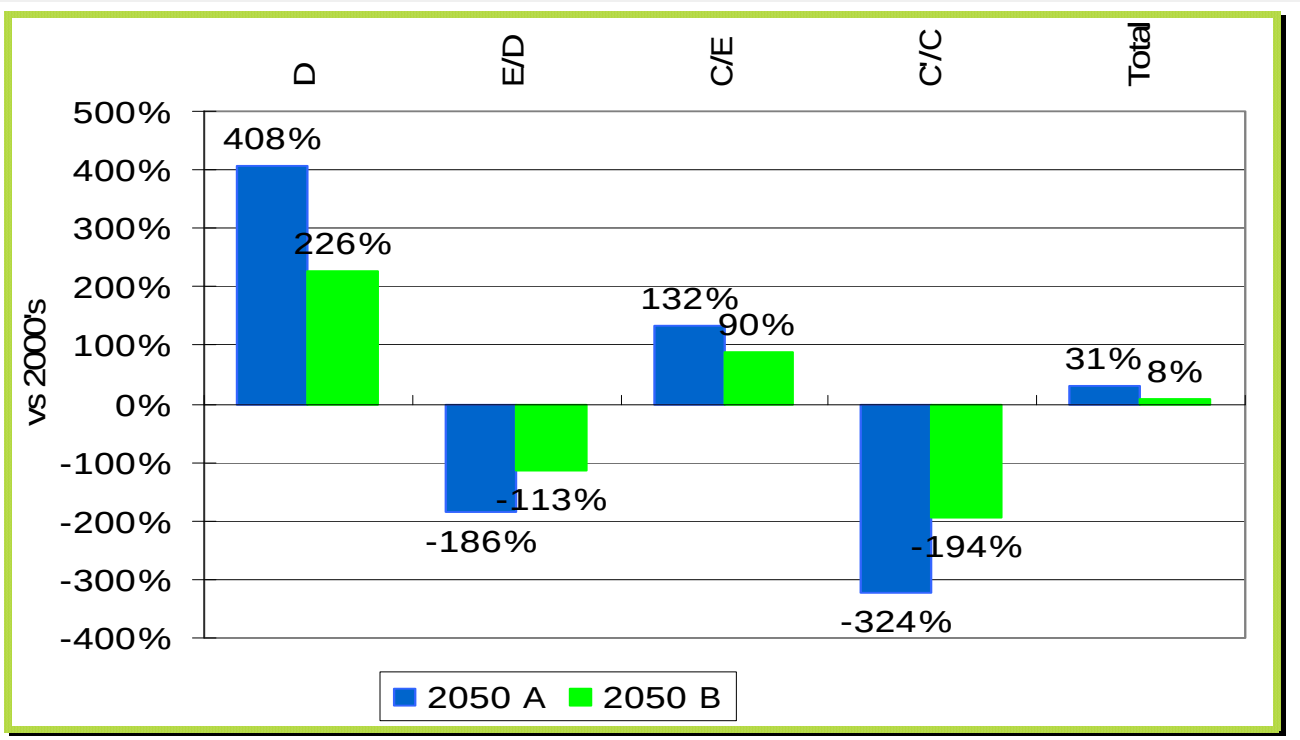
Scenario of 2050

Assumption of Energy Efficiency

Service	2000					2050				
	Oil	Gas	Bmass	S/W	Elect	Oil	Gas	Bmass	S/W	Elect
Cool					2.90					4.00
Cooking (Stove)	0.60	0.60	0.10		0.50	0.65	0.65	0.50	0.50	0.70
Cooking (Elect)					1.00					1.11
Lighting					1.00					1.50
Refrigerator					1.00					1.50
ICT					1.00					2.00

Simulation Results

Factor Analysis



Application to Thailand

- Introduction of Analysis of Transportation Sector -

Scenario of 2050

Scenario A

This scenario is characterized by a Thai economy concentrated on industries that have a comparative advantage in the world market. In this scenario, Thailand follows closely the national development plans and policies. The economic growth is moderate at 5% per year during 2000-2030 and then slows down to 4% per year for the remaining twenty years of the time period considered.

Scenario B

This scenario is characterized by Thailand being more and more integrated into global markets. Market forces are predicted to lead to high economic growth and there would be a faster transition towards industry and commerce based economy. The GDP is assumed to increase by 6% per year during the first thirty years (2000-2030) and by 5% per year in the remaining twenty years (2030-2050) reflecting the possible slowdown of the economic growth

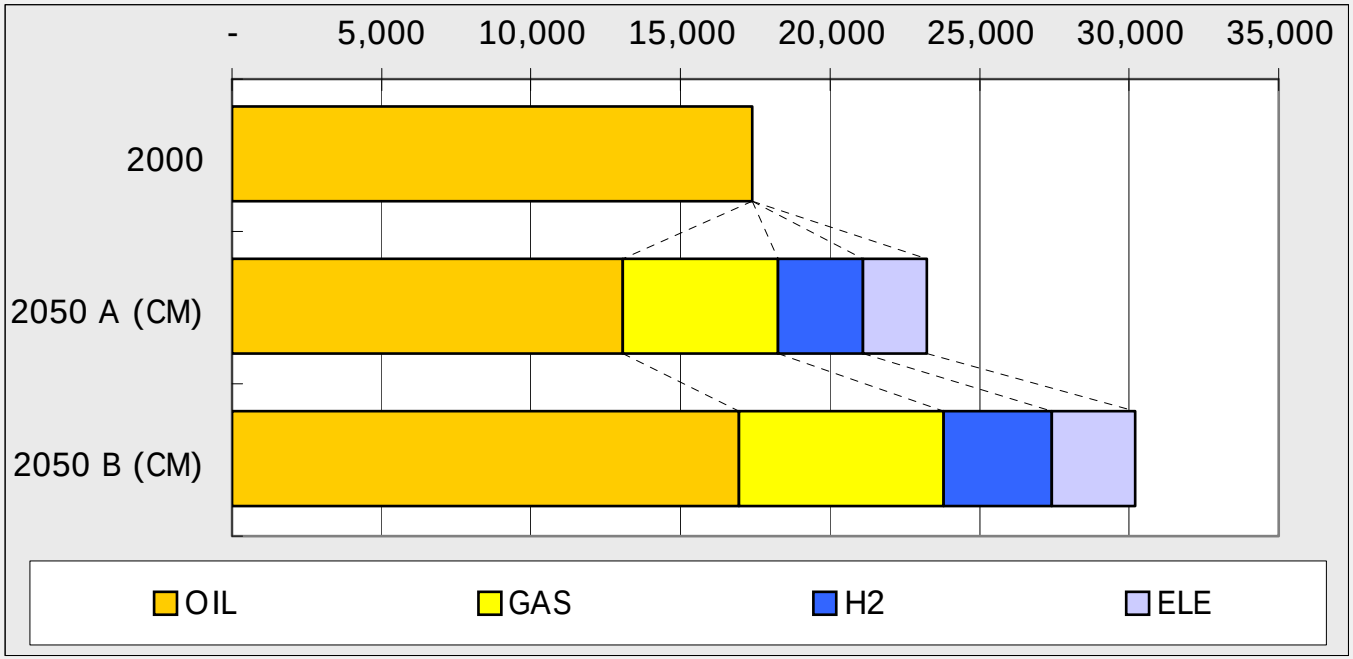
Scenario of 2050

- **Energy efficiency projection:**
- Efficiency of oil, gas and electricity based vehicles doubles by 2050

- **Fuel mix projection**
- In road transport, by 2050 hydrogen substitutes 20% of the oil and CNG substitutes 25% of the oil. In rail transport, electricity substitutes 50% of the oil by 2050.

Simulation Results

Energy Consumption



Asia Pacific Integrated Model (AIM)
Japan Low-Carbon Society Project

Asia Pacific Integrated Model (AIM)
Japan Low-Carbon Society Project

Application to China

- Introduction of Analysis of Residential Sector in Shenyang City -

Overview of Shenyang city

Population : 7.2 million
Area : 12,980 km2
Average Temperature : 8.3℃
Latitude : 42 degrees north latitude
Disposable Income : 16,393 yuan (the 20th among 600 cities)
Energy Consumption/10 thousand yuan : 1.1toc/10 thousand yuan
(80% of country average)

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Japan Low-Carbon Society Project

Scenario of 2020

	The method used for calculation	Estimated Value (2000=1)
Population	Estimation from rate of population increase	1.13
Household	Estimation from population and size of household	1.22
GDP	Based on th 11th 5 year plan	4.01
Average floor space	Estimation from GDP/Capita	2.05
Diffusion Rate of District Heating System	Same as value of 2004 (80%)	1.51
Diffusion Rate of Appliances	Estimation from past trend (1985-2004)	1.67
Energy efficiency	15% increase (BaU1) 30% increase (BaU2)	1.15(BaU1) 1.3(BaU2)

Scenario of 2020

	The method used for calculation	Estimated Value (2000=1)
Warming	Average floor space ＊ Energy service demand / floor space	2.05 ＊ 1
Hot water	Number of households ＊ Intensity	1.22 ＊ 1
Cooking	Number of households ＊ Intensity	1.22 ＊ 1
Lighting/Appliances	Number of households ＊ Diffusion rate of appliances	1.22 ＊ 1.67

Scenario of 2020

BaU1	BaU2	CM1	CM2
Energy efficiency : 15% increase	Energy efficiency : 30% increase	BaU1+ Introduction of energy saving house (50%)	BaU1+ Introduction of heat pump (50%)

Simulation results