Korea AIM / Enduse Scenario

- AIM / Energy Snapshot tool
- AIM / Enduse Model Study

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Vision

We have many things to reduce green house gas emission

1. Technology improvement will reduce GHG emission.
2. To give incentive to appliance will change energy consumption and life style.
3. Tax policy effect on each emission sector.

Scenario A

People		
	Goal of life	Social success
	Residence	Urban orientation
	Family	Self-dependent
Population		
	Birth rate	Downslide
	Immigration of foreign workers	Urban orientation
	Family	Self-dependent

*Japan cases are used in other factors

AIM / Energy Snapshot tool

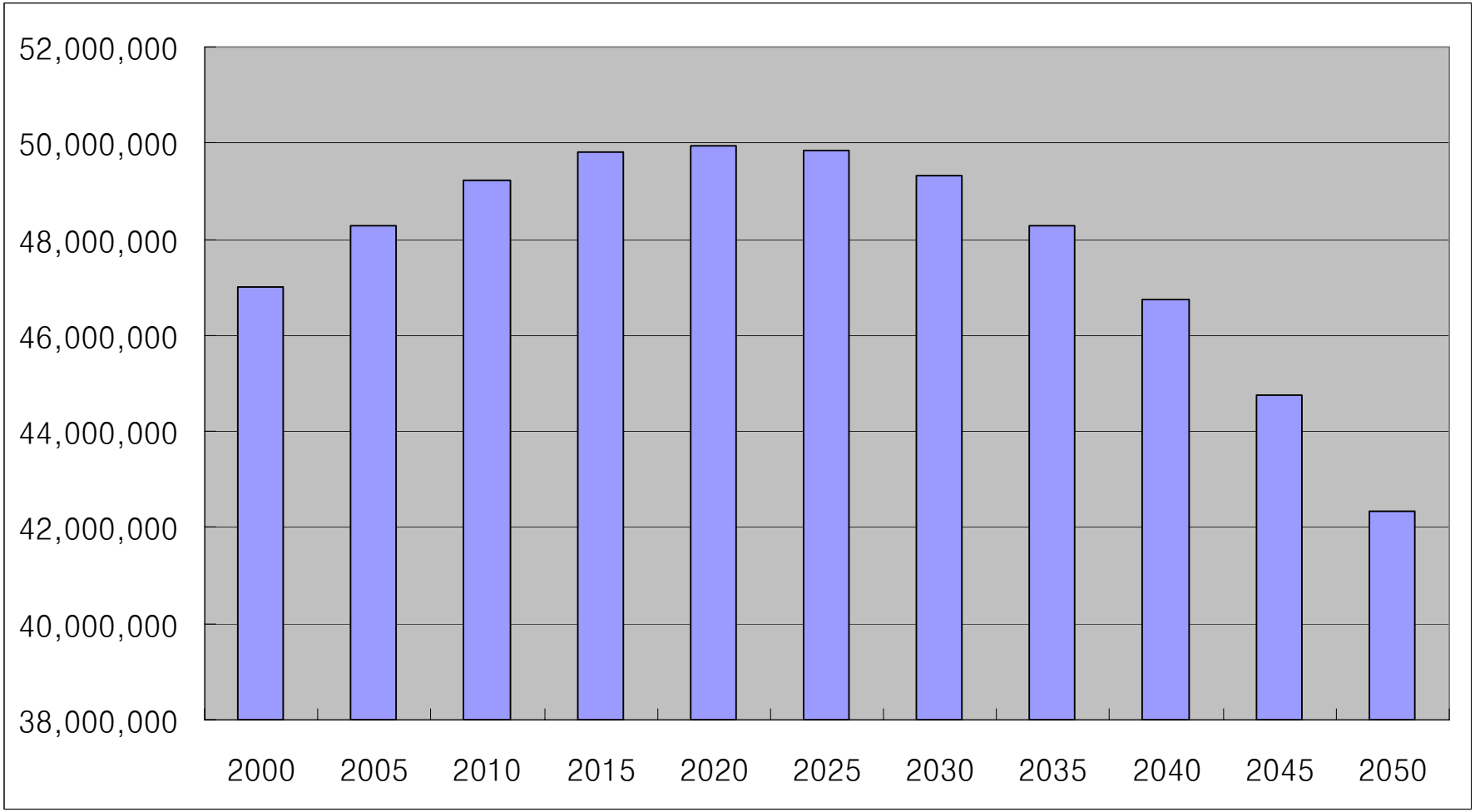
* We'll simulate these three parts

	Factor
Residential	*Household*, Life style, ...
Passenger Transportation	*Person*, GDP, Life style, population density
Freight Transportation	*Person*, GDP, Industrial Stucture, ...
Industrial	
Commercial	
Power generation	

* This table shows major factor that we calculated

Factor : Population

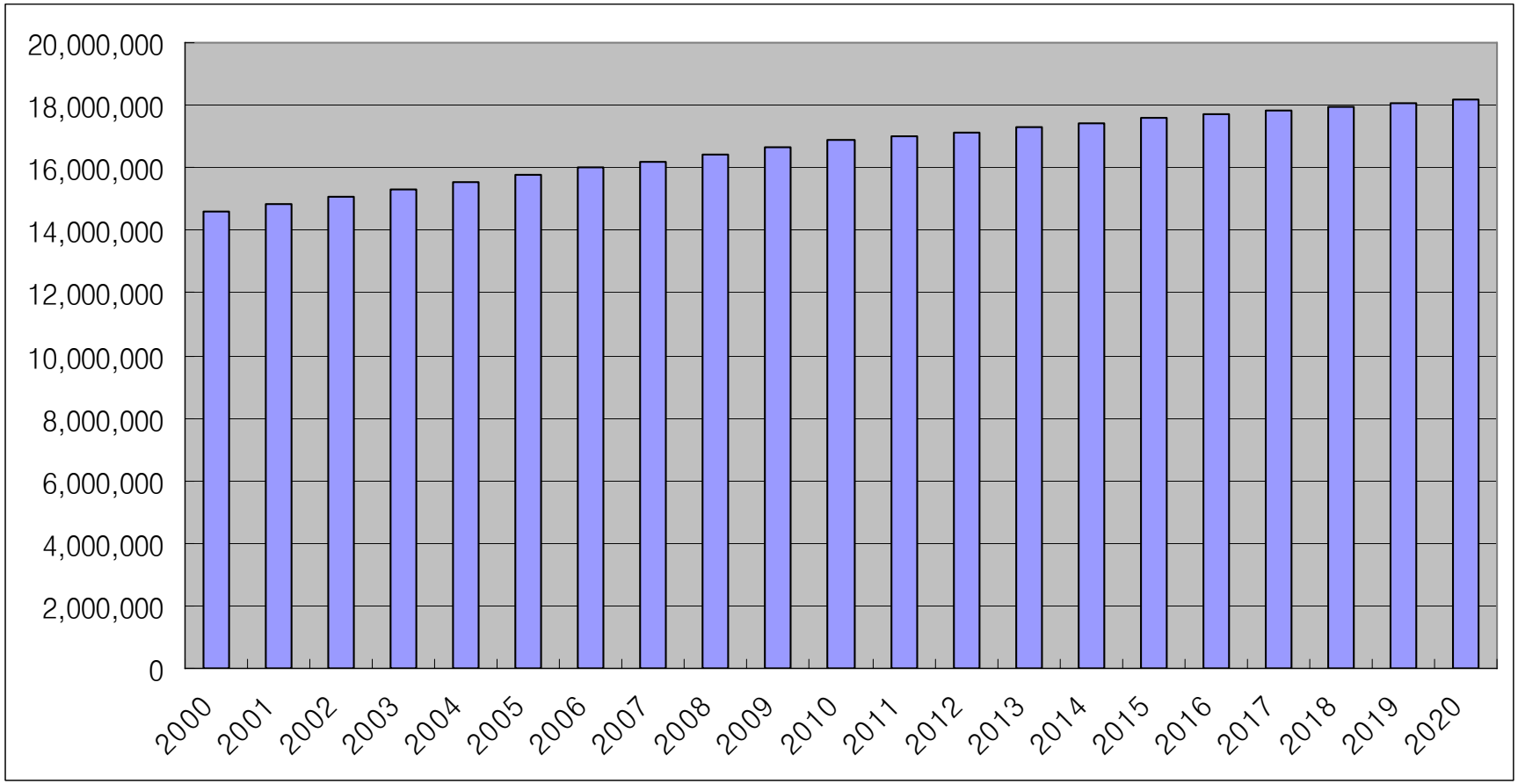
Unit : person



Source : Korea National Statistical Office(KNSO)

Factor : Household

Unit : household



* KNSO estimate household sector to 2020 year. 2050 data is assumed

Source : Korea National Statistical Office(KNSO)

Residential sector

Residential sector

1. Energy service demand

	Unit	2000	2050					
			REF		CM		CM/REF	
			A	B	A	B	A	B
Cool	Mtoe	2	2	3	2	3	90%	90%
Warm	Mtoe	2	3	2	2	1	67%	67%
Hot Water	Mtoe	2	2	3	2	2	80%	80%
Cooking (S)	Mtoe	3	4	2	4	2	100%	100%
Cooking (E)	Mtoe	0	0	1	0	1	100%	100%
Lighting	Mtoe	0	0	0	0	0	80%	80%
Refrigerator	Mtoe	0	0	0	0	0	100%	100%
ICT	Mtoe	0	0	0	0	0	100%	100%
Appliance	Mtoe	2	2	2	2	2	100%	100%
					0	0		
					0	0		

* This sector is calculated by household change from 2000 to 2050

Source : EBT(korea_ex.xls)
korea energy economic institute(KEEI)

2. Energy share

	Unit	2000								
		COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Cool	-	0%	0%	0%	0%	0%	0%	0%	100%	100%
Warm	-	0%	77%	0%	0%	0%	23%	0%	0%	100%
Hot Water	-	0%	71%	0%	0%	2%	27%	0%	0%	100%
Cooking (S)	-	0%	0%	100%	0%	0%	0%	0%	0%	100%
Cooking (E)	-	0%	0%	0%	0%	0%	0%	0%	100%	100%
Lighting	-	0%	0%	0%	0%	0%	0%	0%	100%	100%
Refrigerator	-	0%	0%	0%	0%	0%	0%	0%	100%	100%
ICT	-	0%	0%	0%	0%	0%	0%	0%	100%	100%
Appliance	-	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%

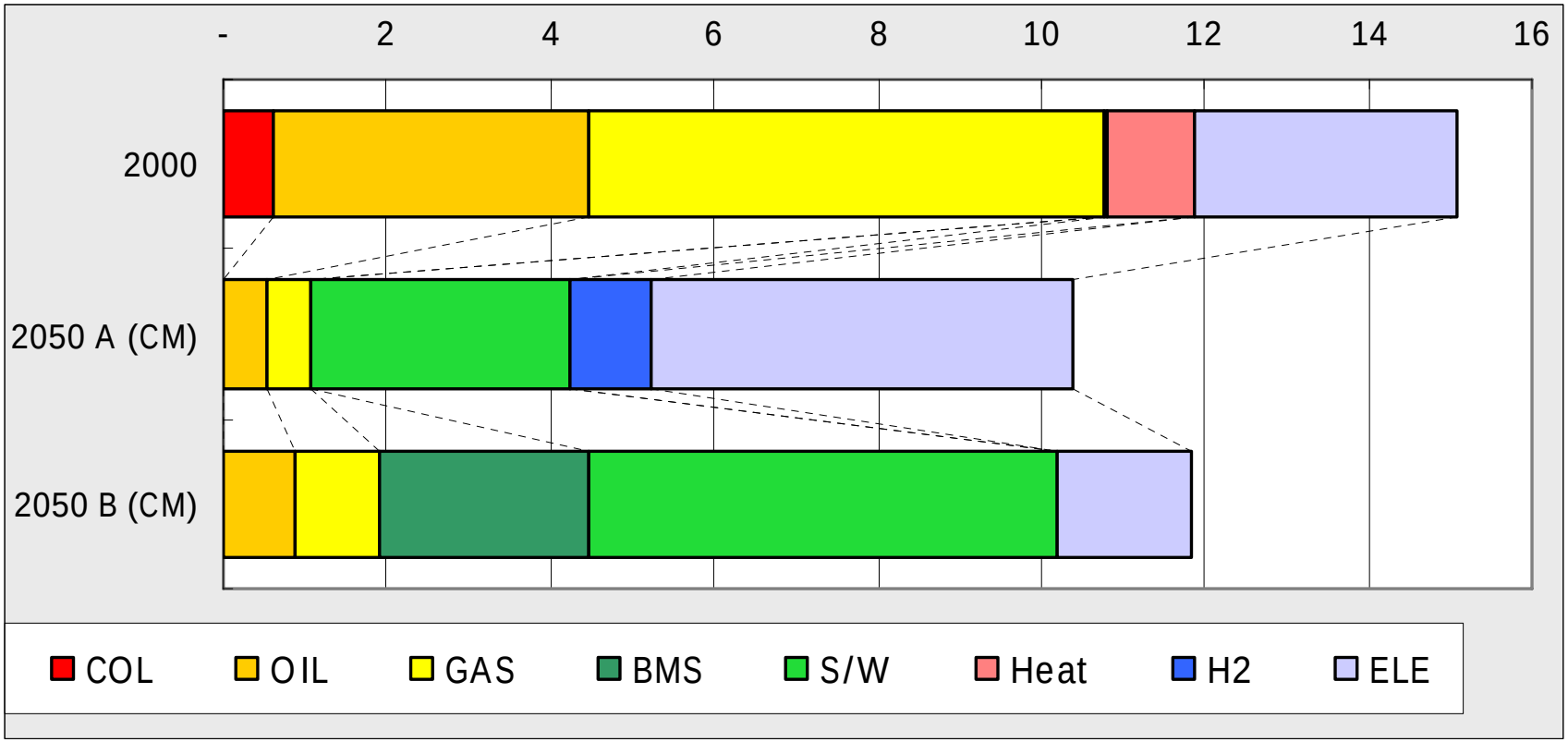
	2050 A (CM)									2050 B (CM)								
	COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total	COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Cool								100%	100%								100%	100%
Warm		5%	5%			10%		80%	100%		5%	5%	50%				40%	100%
Hot Water		5%	5%		10%	10%		70%	100%		10%	10%	20%	30%			30%	100%
Cooking (S)		5%	5%					90%	100%		15%	20%	35%				30%	100%
Cooking (E)								100%	100%								100%	100%
Lighting								100%	100%								100%	100%
Refrigerator								100%	100%								100%	100%
ICT								100%	100%								100%	100%
Appliance								100%	100%								100%	100%
									0%									0%
									0%									0%

3. Energy efficiency

	Unit	2000							
		COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Cool	toe/toe								2.84	-
Warm	toe/toe		0.90	0.90	0.90		1.00		3.69	-
Hot Water	toe/toe		0.75	0.75	0.75	1.00	1.00		0.62	-
Cooking (S)	toe/toe		0.45	0.45	0.45	0.45			0.70	-
Cooking (E)	toe/toe								1.00	-
Lighting	toe/toe								1.00	-
Refrigerator	toe/toe								1.00	-
ICT	toe/toe								1.00	-
Appliance	toe/toe								1.00	-
										-
										-

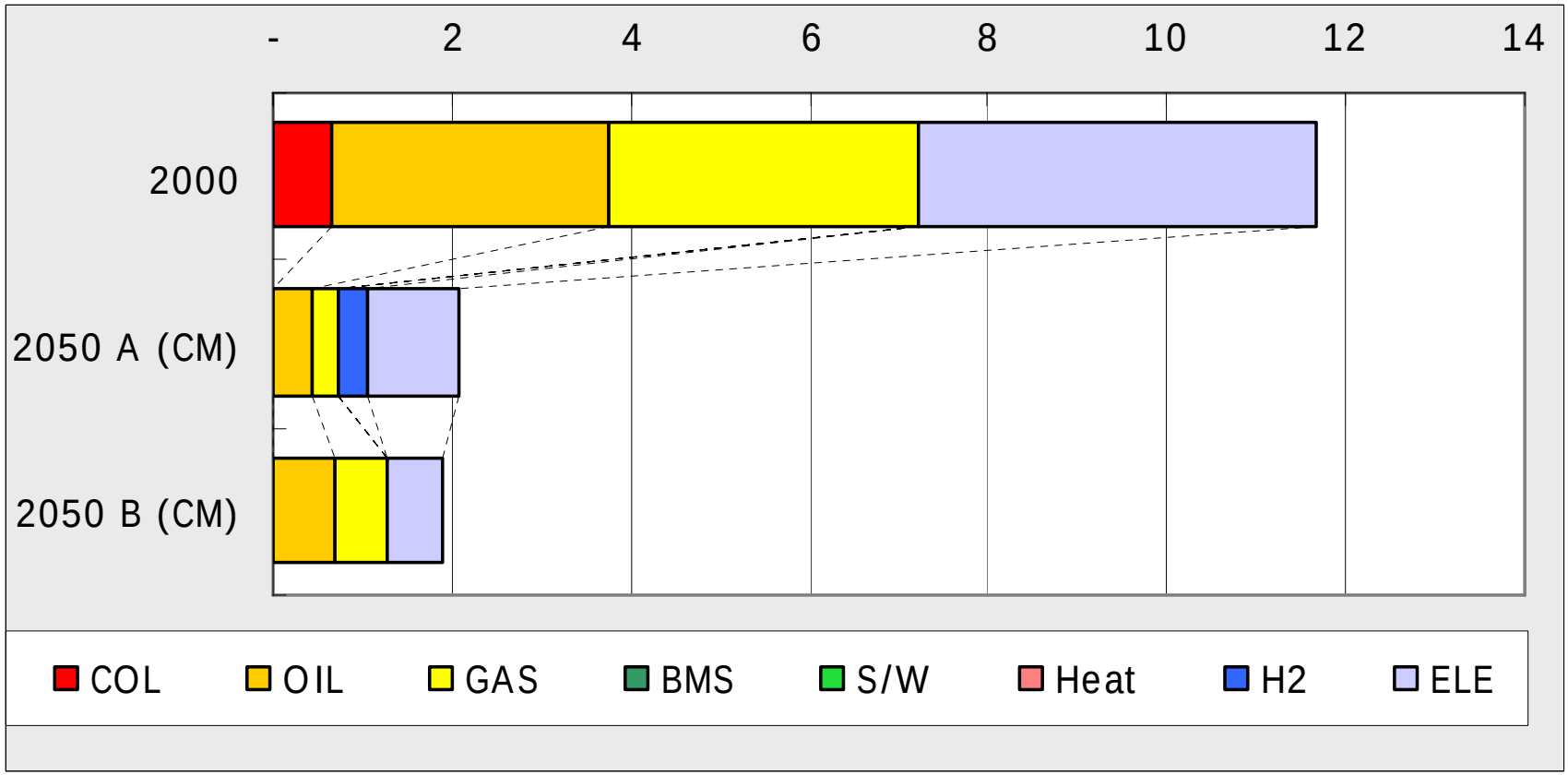
	2050 A (CM)									2050 B (CM)								
	COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total	COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Cool								8.00	-								8.00	-
Warm		0.90	0.90	0.90		1.00		8.00	-		0.90	0.90	0.90		1.00		8.00	-
Hot Water		0.95	0.95	0.95	0.95	1.00		6.00	-		0.95	0.95	0.95	0.95	1.00		6.00	-
Cooking (S)		0.55	0.55	0.55	0.55			0.80	-		0.55	0.55	0.55	0.55		0.55	0.80	-
Cooking (E)								1.11	-								1.11	-
Lighting								1.50	-								1.50	-
Refrigerator								1.50	-								1.50	-
ICT								2.00	-								2.00	-
Appliance								1.50	-								1.50	-
									-									-
									-									-

4. Energy consumption

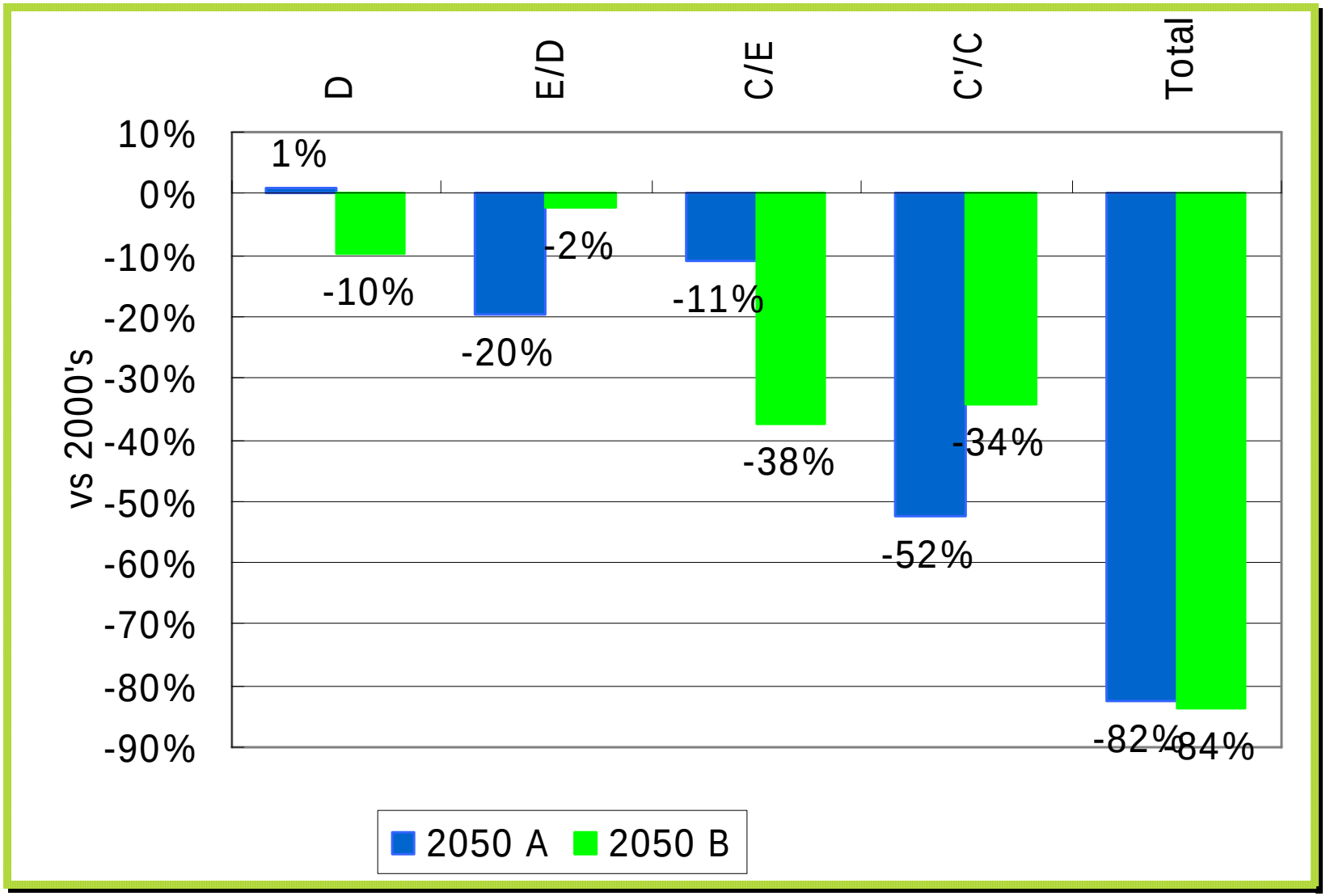


Energy consumption in residential sector

5. CO_2 emission in residential sector



Factor Analysis



D : Service demand , E/D : Energy Intensity , C'/E : CO_2 intensity , C'/C : Change of CO_2 intensity

Transportation sector

1. Passenger
2. Freight

1. Energy service demand

	Unit	2000	2050					
			REF		CM		CM/REF	
			A	B	A	B	A	B
Mini Prv. Pss. Vhc.	B p-km	12	13	13	13	13	100%	100%
Small Prv. Pss. Vhc.	B p-km	71	75	75	75	75	100%	100%
Large Prv. Pss. Vhc.	B p-km	59	62	62	62	62	100%	100%
Commerial Pss. Vhc.	B p-km	14	14	14	14	14	100%	100%
Bus	B p-km	119	125	125	125	125	100%	100%
Passenger Train	B p-km	45	47	47	47	47	100%	100%
Passenger Ship	B p-km	0	0	0	0	0	100%	100%
Passenger Air	B p-km	6	6	6	6	6	100%	100%
					0	0		
					0	0		
					0	0		

* This sector is calculated by person change

2. Energy share

	Unit	2000								
		COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Mini Prv. Pss. Vhc.	-	0%	100%	0%	0%	0%	0%	0%	0%	100%
Small Prv. Pss. Vhc.	-	0%	100%	0%	0%	0%	0%	0%	0%	100%
Large Prv. Pss. Vhc.	-	0%	100%	0%	0%	0%	0%	0%	0%	100%
Commerial Pss. Vhc.	-	0%	100%	0%	0%	0%	0%	0%	0%	100%
Bus	-	0%	100%	0%	0%	0%	0%	0%	0%	100%
Passenger Train	-	0%	0%	0%	0%	0%	0%	0%	100%	100%
Passenger Ship	-	0%	100%	0%	0%	0%	0%	0%	0%	100%
Passenger Air	-	0%	100%	0%	0%	0%	0%	0%	0%	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%

Korea depend on OIL energy in this sector

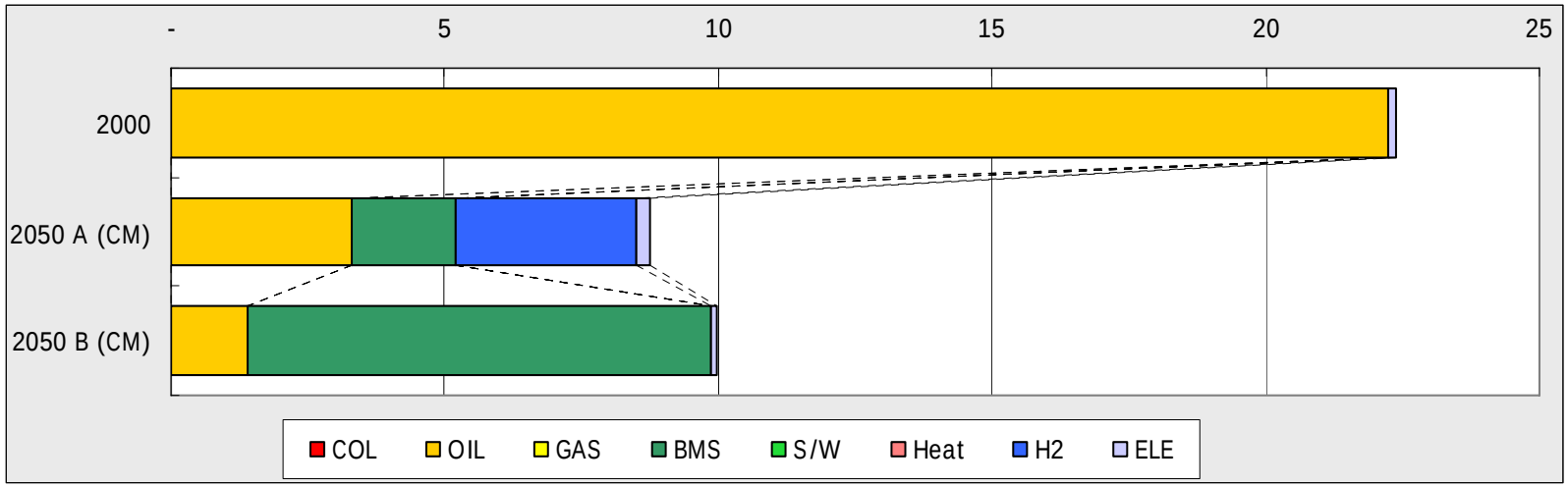
	2050 A-scenario								2050 B-scenario							
	COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total	COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Mini Prv. Pss. Vhc.								100%	100%				100%					100%
Small Prv. Pss. Vhc.		20%		20%			60%		100%				100%					100%
Large Prv. Pss. Vhc.		20%		20%			60%		100%				100%					100%
Commerial Pss. Vhc.		20%		20%			60%		100%				100%					100%
Bus							100%		100%				100%					100%
Passenger Train								100%	100%								100%	100%
Passenger Ship		50%		50%			0%		100%				100%					100%
Passenger Air		100%							100%		100%							100%
									0%									0%
									0%									0%
									0%									0%

3. Energy efficiency

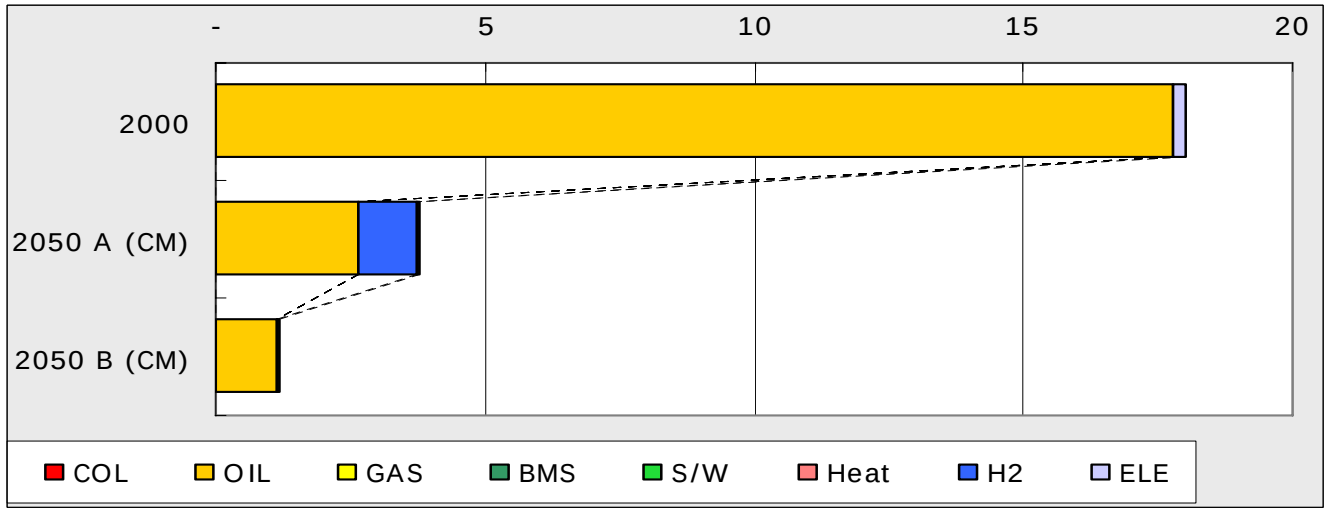
	Unit	2000							
		COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Mini Prv. Pss. Vhc.	'00=1.0		1.00		1.00			3.00	3.00	-
Small Prv. Pss. Vhc.	'00=1.0		1.00		1.00			3.00	3.00	-
Large Prv. Pss. Vhc.	'00=1.0		1.00		1.00			3.00	3.00	-
Commerial Pss. Vhc.	'00=1.0		1.00		1.00			3.00	3.00	-
Bus	'00=1.0		1.00		1.00			3.00	3.00	-
Passenger Train	'00=1.0								1.00	-
Passenger Ship	'00=1.0		1.00		1.00			1.00		-
Passenger Air	'00=1.0		1.00		1.00					-
										-
										-
										-

	2050 A-scenario								2050 B-scenario							
	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total	COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Mini Prv. Pss. Vhc.	3.00		3.00			4.00	5.00	-		3.00		3.00			4.00	5.00	-
Small Prv. Pss. Vhc.	3.00		3.00			4.00	5.00	-		3.00		3.00			4.00	5.00	-
Large Prv. Pss. Vhc.	3.00		3.00			4.00	5.00	-		3.00		3.00			4.00	5.00	-
Commerial Pss. Vhc.	3.00		3.00			4.00	5.00	-		3.00		3.00			4.00	5.00	-
Bus	3.00		3.00			4.00	5.00	-		3.00		3.00			4.00	5.00	-
Passenger Train							2.00	-							1.00	2.00	-
Passenger Ship	1.33		1.33			1.33		-		1.33		1.33			1.33		-
Passenger Air	1.50		1.50					-		1.50		1.50			1.50		-
								-									-
								-									-
								-									-

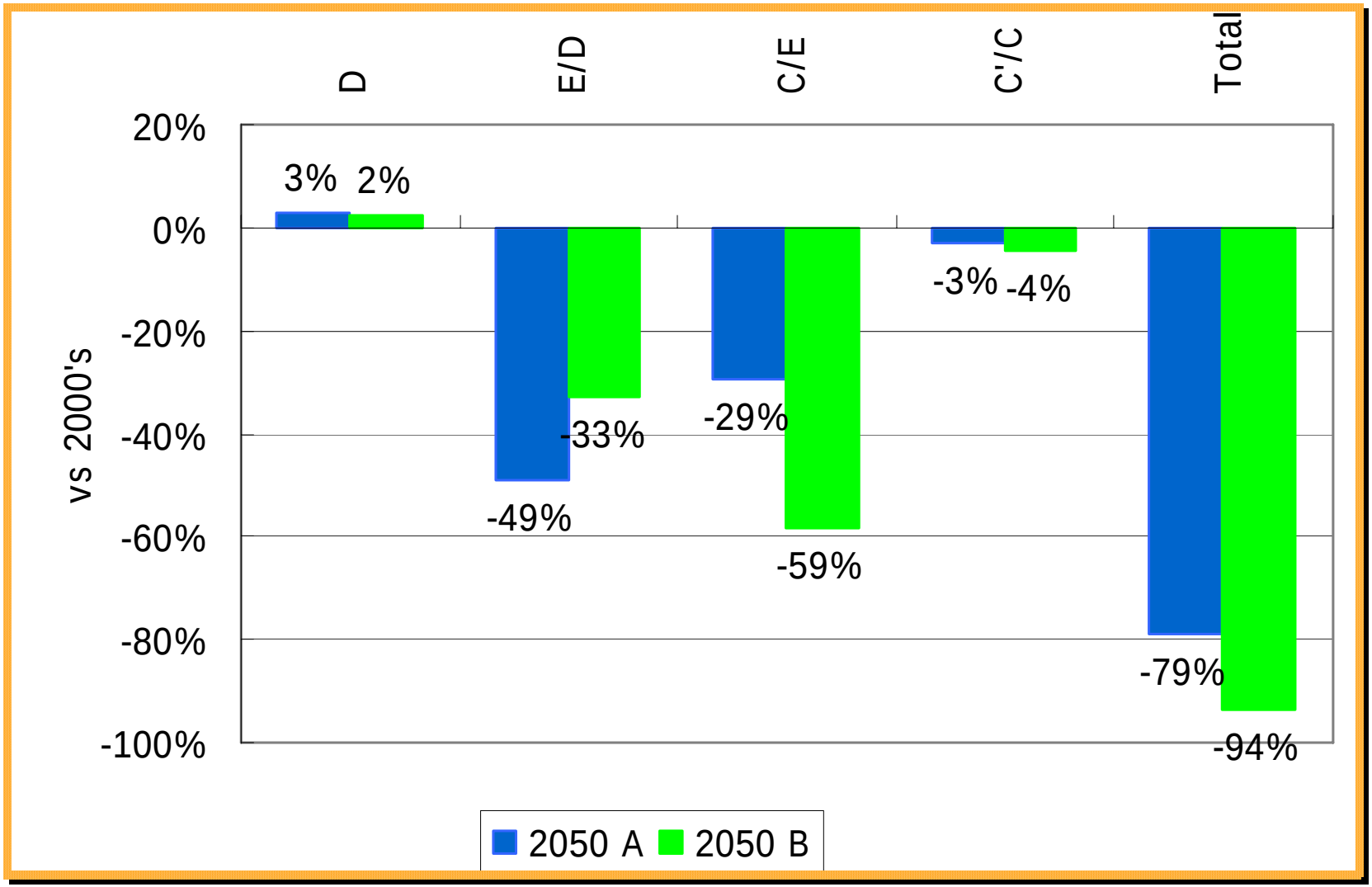
4. Energy consumption



5. CO_2 emission



Factor Analysis



D : Service demand , E/D : Energy Intensity , C'/E : CO_2 intensity , C'/C : Change of CO_2 intensity

Freight Transportation Sector

1. Energy service demand

	Unit	2000	2050					
			REF		CM		CM/REF	
			A	B	A	B	A	B
Small Freight Vehicle	B t-km	44	46	46	46	46	100%	100%
Large Freight Vehicle	B t-km	39	41	41	41	41	100%	100%
Freight Train	B t-km	12	13	13	13	13	100%	100%
Freight Ship	B t-km	1	1	1	1	1	100%	100%
Freight Air	B t-km	13	14	14	14	14	100%	100%
					0	0		
					0	0		
					0	0		
					0	0		
					0	0		
					0	0		

2. Energy share

	Unit	2000								
		COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Small Freight Vehicle	-	0%	100%	0%	0%	0%	0%	0%	0%	100%
Large Freight Vehicle	-	0%	100%	0%	0%	0%	0%	0%	0%	100%
Freight Train	-	0%	0%	0%	0%	0%	0%	0%	100%	100%
Freight Ship	-	0%	100%	0%	0%	0%	0%	0%	0%	100%
Freight Air	-	0%	100%	0%	0%	0%	0%	0%	0%	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-scenario							2050 B-scenario							
	GAS	BMS	S/W	Heat	H2	ELE	Total	COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Small Freight Vehicle					50%	50%	100%				100%					100%
Large Freight Vehicle					100%		100%				100%					100%
Freight Train						100%	100%								100%	100%
Freight Ship		50%					100%				100%					100%
Freight Air							100%		100%							100%
							0%									0%
							0%									0%
							0%									0%
							0%									0%
							0%									0%
							0%									0%

We want to change energy share as this chart

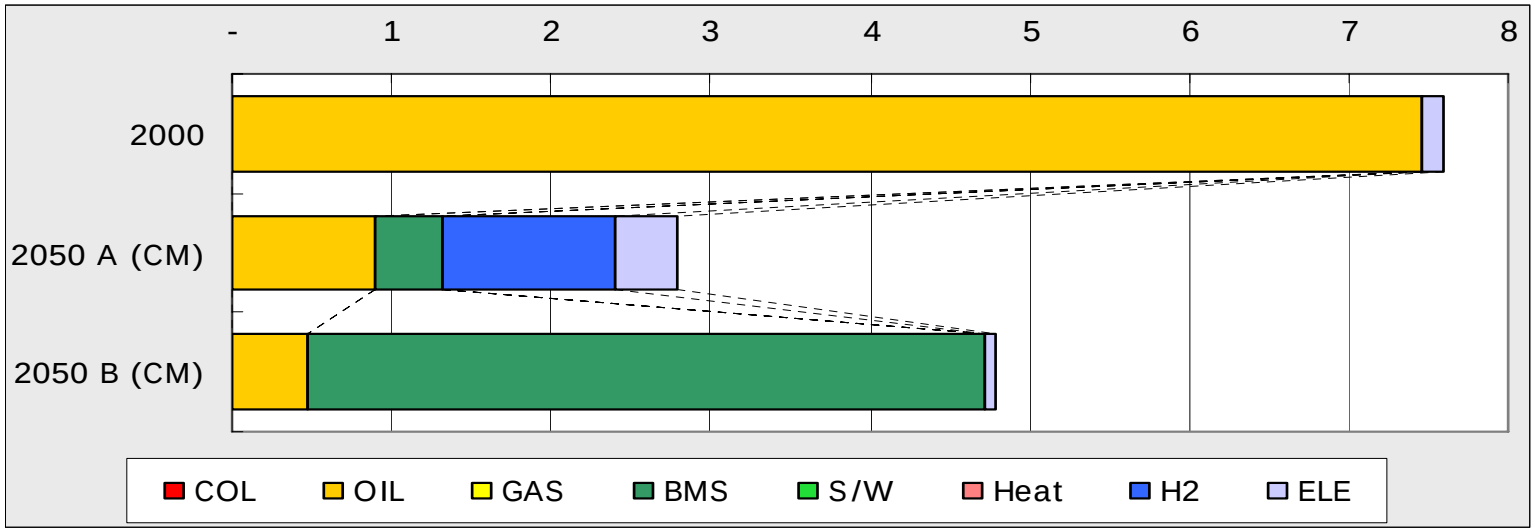
3. Energy efficiency

		2000							
		COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Small Freight Vehicle	'00=1.0		1.00		1.00			3.00	3.00	-
Large Freight Vehicle	'00=1.0		1.00		1.00			3.00	3.00	-
Freight Train	'00=1.0								1.00	-
Freight Ship	'00=1.0		1.00		1.00					-
Freight Air	'00=1.0		1.00		1.00					-
										-
										-
										-
										-
										-

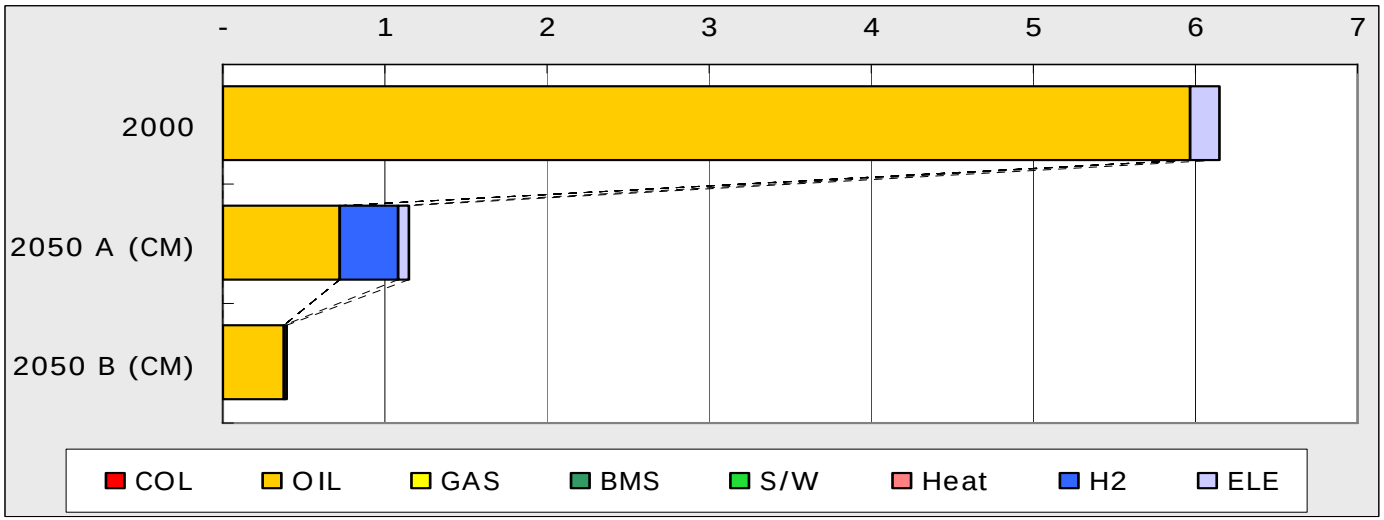
	2050 A-scenario									2050 B-scenario								
	COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total	COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Small Freight Vehicle		3.00		3.00			4.00	5.00	-		2.00		2.00			4.00	5.00	-
Large Freight Vehicle		1.52		1.52			4.00	5.00	-		1.52		1.52			4.00	5.00	-
Freight Train								2.00	-							1.00	2.00	-
Freight Ship		1.33		1.33			1.33		-		1.33		1.33			1.33		-
Freight Air		1.50		1.50					-		1.50		1.50			1.50		-
									-									-
									-									-
									-									-
									-									-
									-									-

Freight Transportation Sector

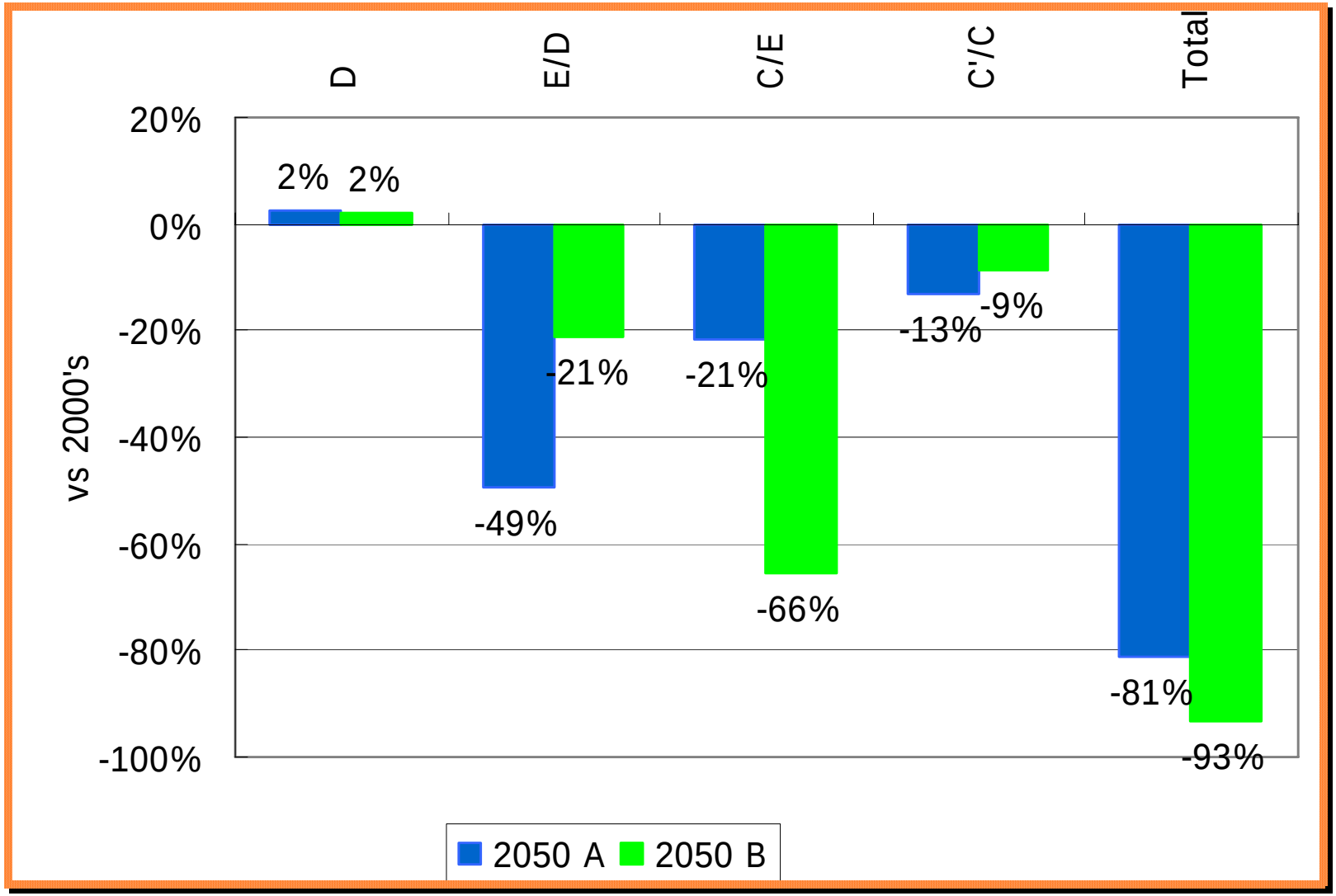
4. Energy consumption



5. CO_2 emission



Factor Analysis



D : Service demand , E/D : Energy Intensity , C'/E : CO_2 intensity , C'/C : Change of CO_2 intensity

AIM / Enduse Model

Control parameters

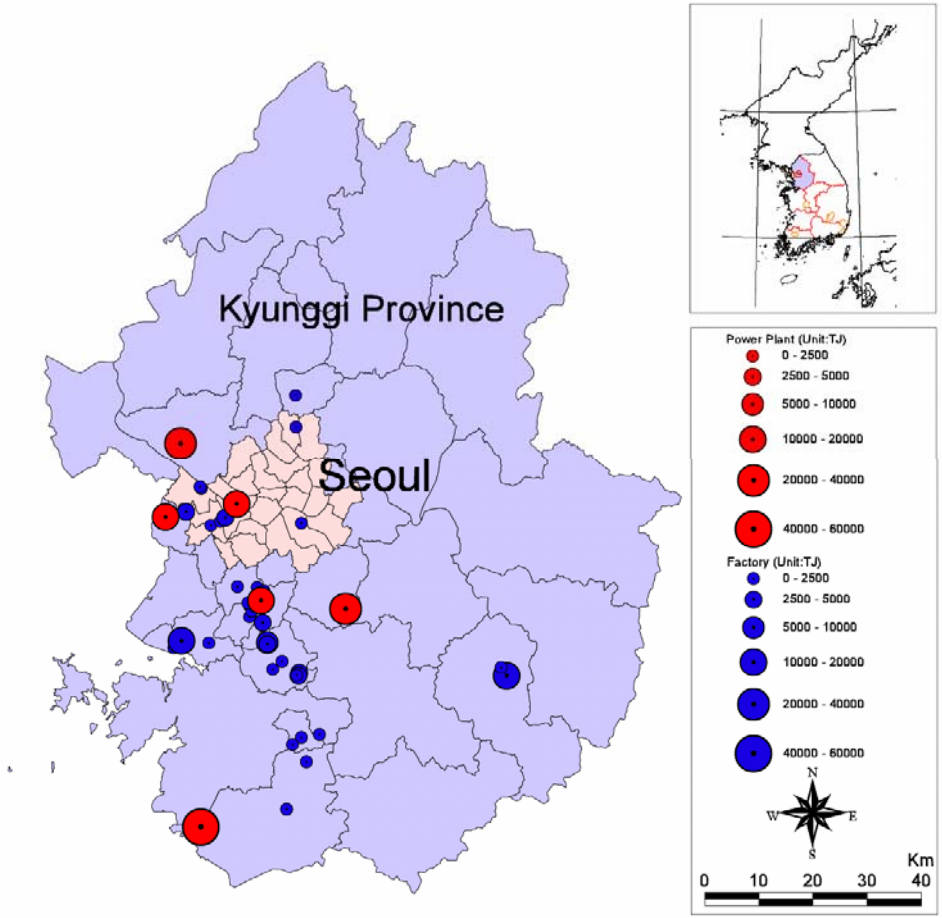
Parameters used in computation

- Start year of calculation : 2001
- End year of calculation : 2050
- Discount rate : 20.00%
- Unit of price : US$
- Unit of energy : person*km , ton*km
- Greenhouse gas / Air pollutant : CO2, SO2, NOx, CO, PM
  - Unit : kg*(Each gases)

Region

Region Classification

- Region Name : Seoul (Korea)
- Region Code : SU



Sector

Sector Classification

- Sector Name : Transportation sector
- Sector Code : TRN

Service

Service Classification

Service_Code	Service_Name	Service_Unit
AIR	Airline	person*km
AIRF	Airplane (Freight)	ton*km
BUSL	Buses mores than 25persons	person*km
BUSM	Buses mores than 16persons	person*km
BUSS	Buses less than 16persons	person*km
JEEP	Jeeps	person*km
PASL	Private Passenger Cars more than 2000cc	person*km
PASM	Private Passenger Cars less than 2000cc	person*km
PASS	Private Passenger Cars less than 1500cc	person*km
SUB	Subway	person*km
TRAN	Train	person*km
TRANF	Train (Freight)	ton*km
TRK1	Trucks less than 1.0 ton	ton*km
TRK2	Trucks less than 5.0 ton	ton*km
TRK3	Trucks more than 5.0 ton	ton*km
TXCM	Taxi more than 1500cc(company)	person*km
TXPM	Taxi more than 1500cc(private)	person*km

Service

Service Demand

Service _Code	Year1	Value1	Year 2	Value2	Year 3	Value3	Year 4	Value4	Year 5	Value5
PASC	2001	1,627,067,000	2010	1,696,770,000	2020	1,636,142,000	2030	1,573,598,000	2050	1,442,851,000
PASS	2001	12,216,750,000	2010	13,239,400,000	2020	14,149,730,000	2030	14,570,140,000	2050	15,205,610,000
PASM	2001	14,193,370,000	2010	16,721,080,000	2020	18,369,970,000	2030	19,275,030,000	2050	20,822,090,000
PASL	2001	2,691,938,000	2010	3,342,490,000	2020	3,776,609,000	2030	4,039,230,000	2050	4,516,610,000
TXPM	2001	2,694,312,000	2010	2,949,926,000	2020	2,814,031,000	2030	2,399,089,000	2050	1,578,368,000
TXCM	2001	2,309,278,000	2010	2,528,364,000	2020	2,411,889,000	2030	2,056,245,000	2050	1,352,810,000
JEEP	2001	10,531,910,000	2010	10,063,980,000	2020	9,508,938,000	2030	8,978,678,000	2050	7,928,766,000
BUSS	2001	13,806,110,000	2010	16,556,190,000	2020	17,836,450,000	2030	18,410,590,000	2050	19,298,320,000
BUSM	2001	2,643,477,000	2010	2,810,346,000	2020	2,864,921,000	2030	2,844,535,000	2050	2,770,419,000
BUSL	2001	8,660,633,000	2010	8,132,325,000	2020	7,961,468,000	2030	7,690,340,000	2050	7,101,089,000
TRAN	2001	7,913,469,000	2010	9,810,791,000	2020	11,230,620,000	2030	12,436,590,000	2050	15,044,070,000
SUB	2001	26,662,920,000	2010	33,055,580,000	2020	37,839,410,000	2030	41,902,710,000	2050	50,688,110,000
AIR	2001	5,775,346,000	2010	7,160,034,000	2020	8,196,240,000	2030	9,076,375,000	2050	10,979,340,000
TRK1	2001	4,121,302,000	2010	4,730,281,000	2020	5,151,170,000	2030	5,396,891,000	2050	5,843,270,000
TRK2	2001	3,006,487,000	2010	2,957,467,000	2020	3,014,963,000	2030	3,019,750,000	2050	3,007,585,000
TRK3	2001	1,825,859,000	2010	1,931,980,000	2020	2,027,096,000	2030	2,070,426,000	2050	2,139,161,000
TRANF	2001	886,403,100	2010	1,098,926,000	2020	1,257,963,000	2030	1,393,047,000	2050	1,685,115,000
AIRF	2001	101,345,700	2010	125,644,200	2020	143,827,500	2030	159,272,100	2050	192,665,400

- We used service demand values calculated by existing study in Korea

Technology

Energy Device Data

Technology_Code	Technology_Name	Energy_Value
CMAL_1	compact private passenger Cars(Existing)	0.0018780
CMAL_2	compact private passenger Cars(New)	0.0015739
CMAL_3	compact private passenger Cars(LPG_Existing)	0.0053699
CMAL_4	compact private passenger Cars(LPG_New)	0.0045005
CMAL_5	compact private passenger Cars(Electric)	0.0003597
CMAL_6	compact private passenger Cars(full cell-meth)	0.0007405
SMAL_1	small private passenger Cars(Existing)	0.0019599
SMAL_2	small private passenger Cars(New)	0.0016367
SMAL_3	small private passenger Cars(LPG_Existing)	0.0073277
SMAL_4	small private passenger Cars(LPG_New)	0.0061193
SMAL_5	small private passenger Cars(Electric)	0.0002831
SMAL_6	small private passenger Cars(full cell-meth)	0.0007697
SMAL_7	small private passenger Cars(Diesel)	0.0014731
SMAL_8	small private passenger Cars(CNG)	0.0016131
...	...	...

- Each energy devices are divided by fuel used
- Energy value will be improved as technology improvement

Technology / Combination of removal

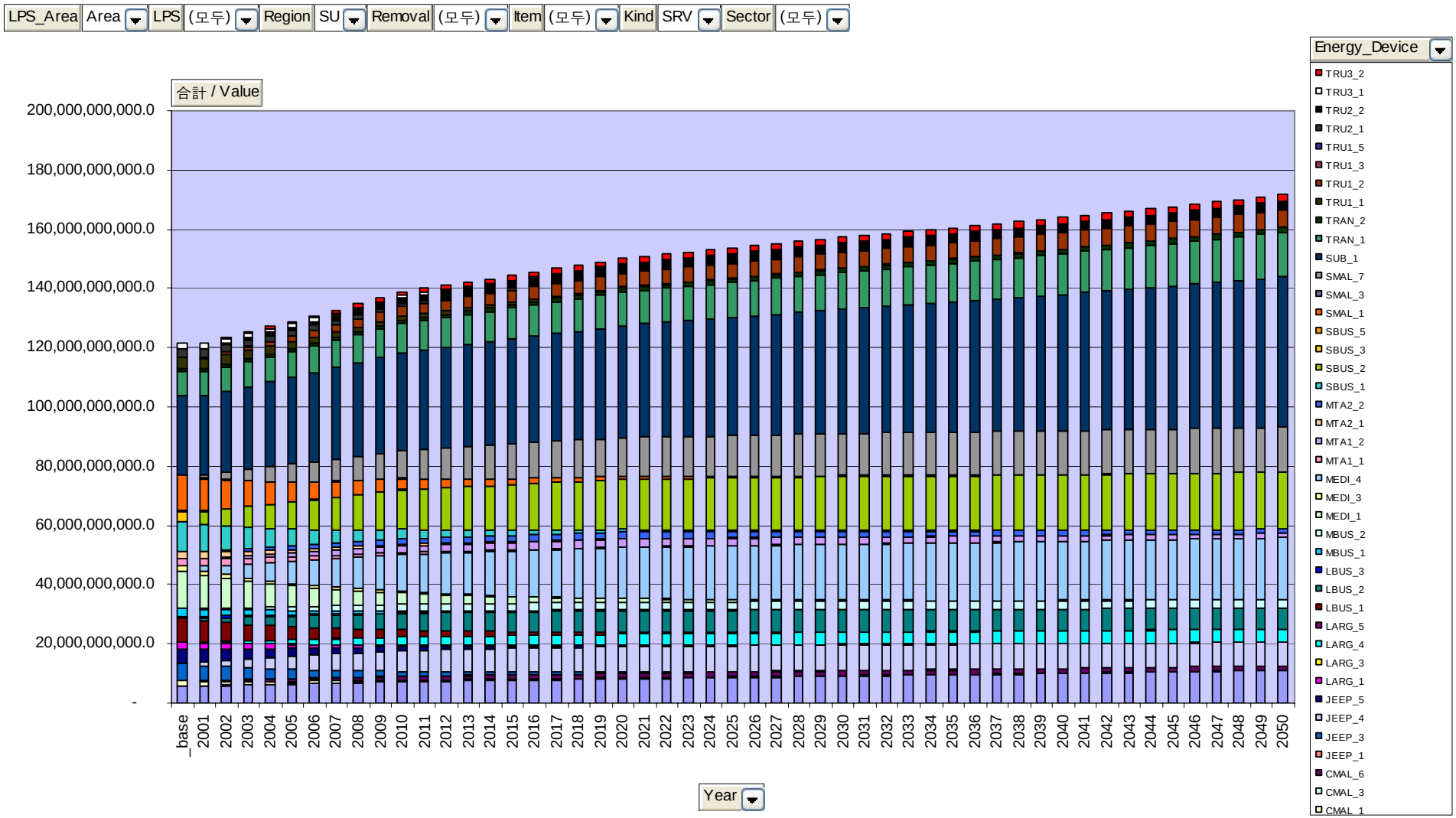
Energy Device Data

Kg*(each gases)

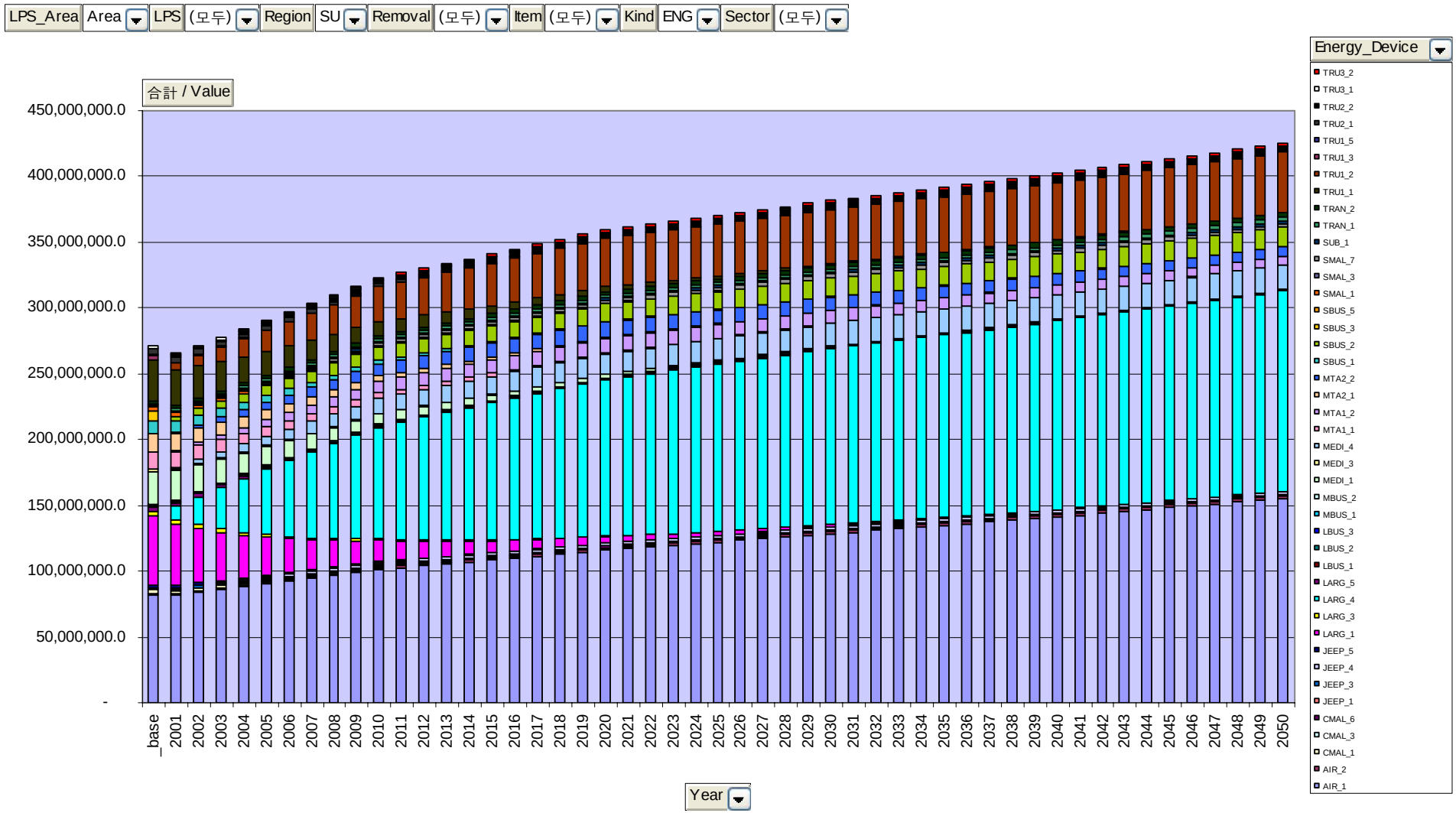
Energy_Code	Energy_Name	Gas_Energy Value(us$)	Gas_CO2	Gas_SO2	Gas_NOx	GasCO	Gas_PM
OLG1	Passenger_Gasoline	36.53	18.72	-	0.07	0.56	-
OLG2	Compact_Passenger_Gasoline	36.53	18.72	-	0.09	0.74	-
OLT1	Diesel oil(1.0_transport)	8.36	20.01	0.44	1.10	0.38	0.11
OLT2	small_passsenger_Diesel	14.38	20.01	0.04	0.07	0.14	0.01
OLT3	Medium_passsenger_Diesel	14.38	20.01	0.04	0.05	0.11	0.01
OLT4	Large_passsenger_Diesel	14.38	20.01	0.04	0.04	0.07	0.00
OLT5	Small_Bus_Diesel	14.38	20.01	0.04	0.37	0.30	0.09
OLT6	Medium_Bus_Diesel	14.38	20.01	0.04	0.25	0.29	0.11
OLT7	Large_Bus_Diesel	14.38	20.01	0.04	1.18	0.99	0.19
OLT8	Small_Truck_Diesel	14.38	20.01	0.04	0.26	0.54	0.04
OLT9	Medium_Truck_Diesel	14.38	20.01	0.04	0.21	0.24	0.09
OLT10	Large_Truck_Diesel	14.38	20.01	0.04	0.89	0.88	0.14
OLT11	Jeep_Diesel	14.38	20.01	0.04	0.26	0.31	0.03
OBT	B heavy oil(transport)	8.35	20.90	0.56	0.17	0.01	0.56
OCT	C heavy oil(0.5_transport)	3.10	20.90	0.23	0.16	0.01	0.06
LPT	Liquefied petroleum gas(transport)	17.66	17.04	-	-	-	-
OLJ	Jet fuel	4.65	19.32	-	-	-	-
MET	Methane	18.01	20.01	-	-	-	-
CNG	CNG	4.53	13.48	-	-	-	-

- Application of emission restriction

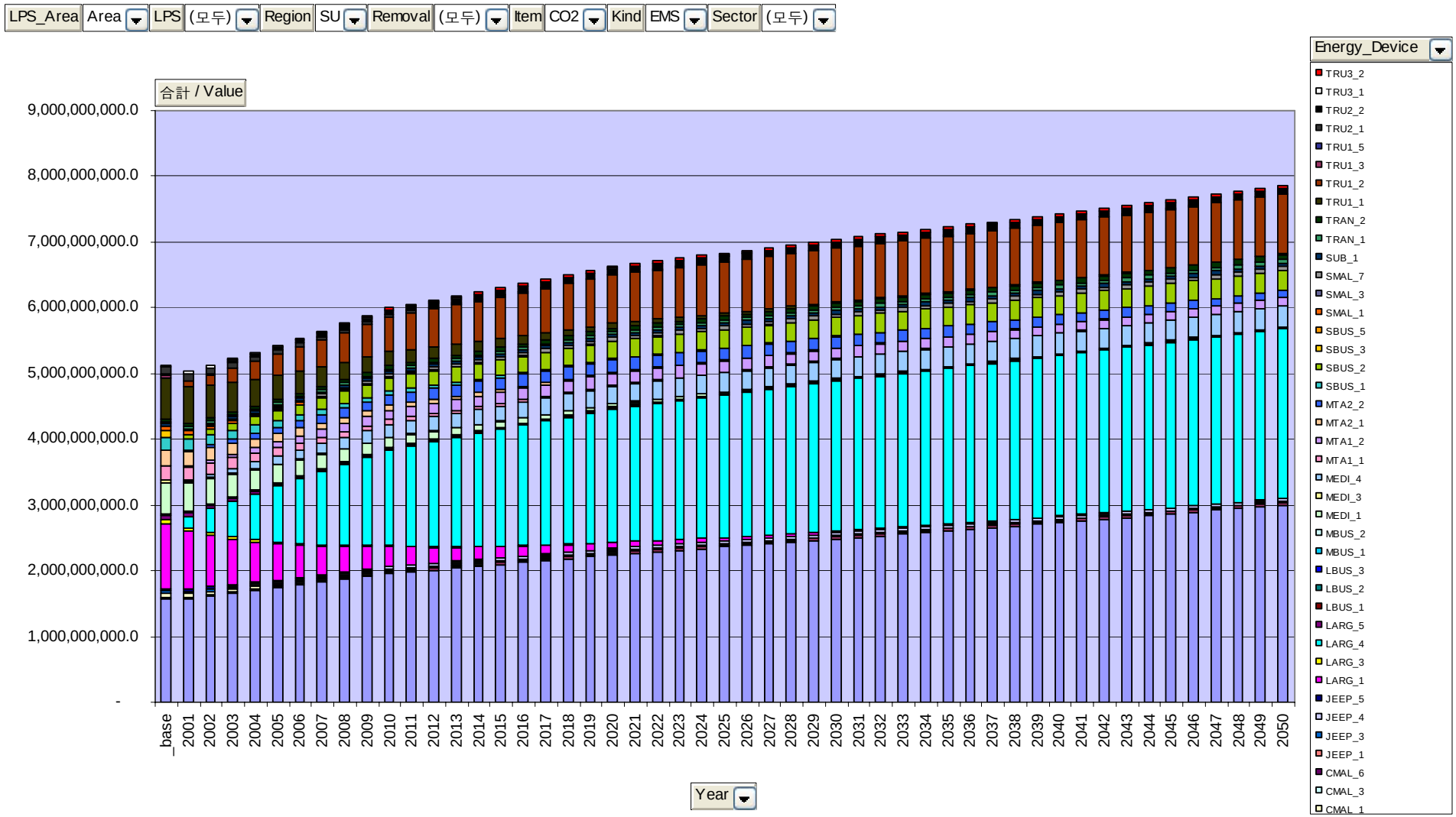
Service Demand



Energy Consumption

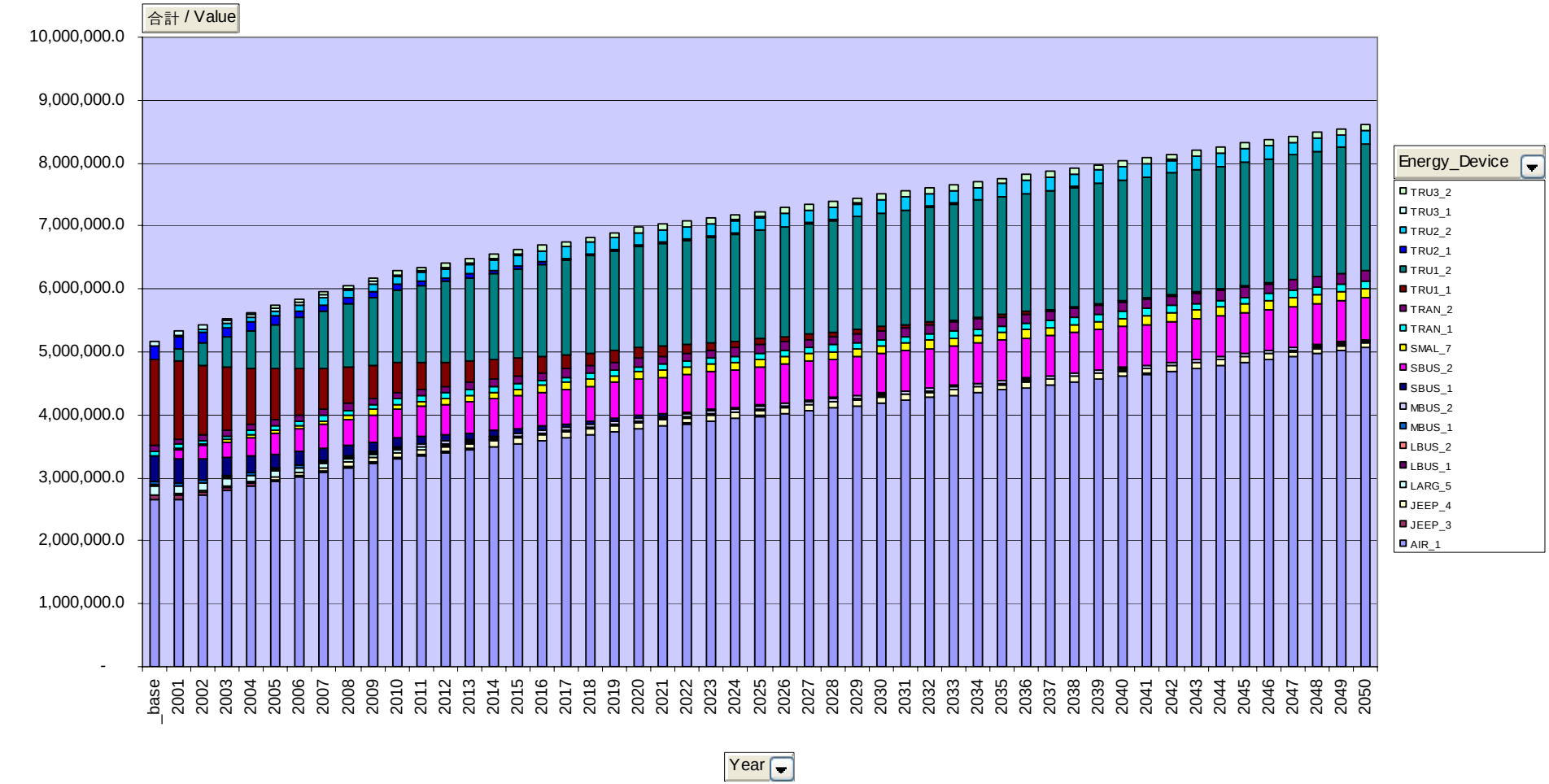


Emission : CO2



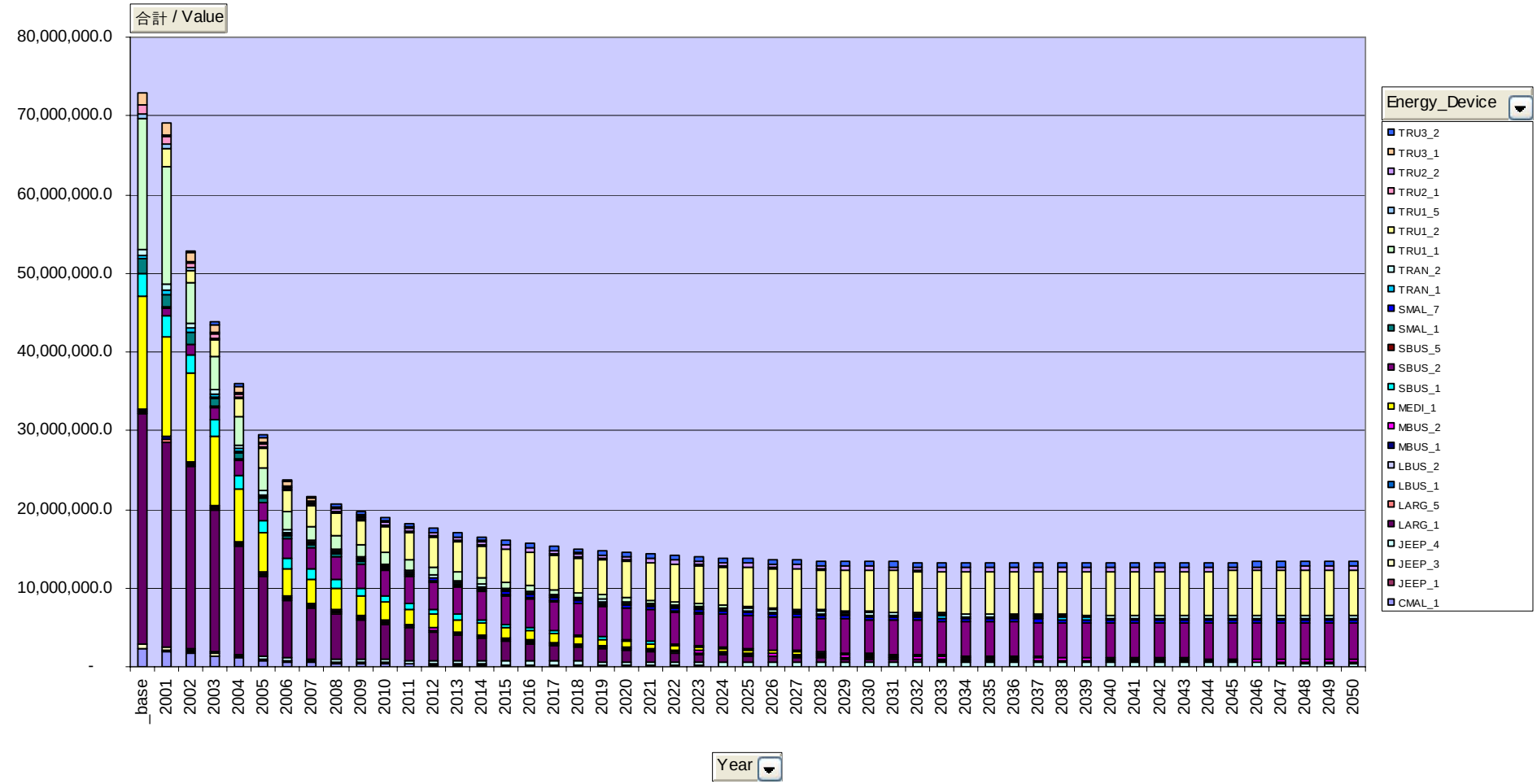
Emission : SO2

LPS_Area | Area | LPS | (모두) | Region | SU | Removal | (모두) | Item | SO2 | Kind | EMS | Sector | (모두)

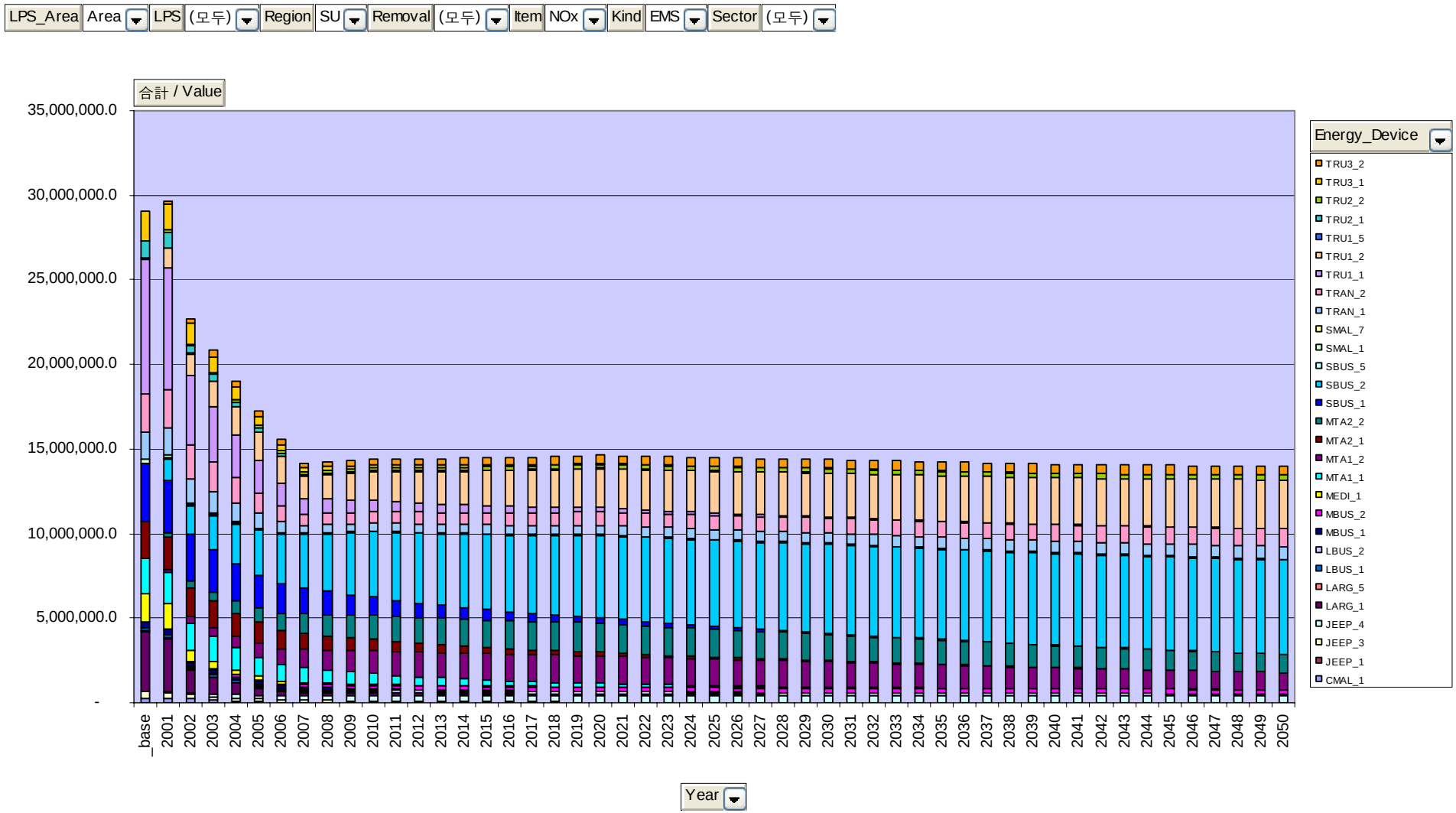


Emission : CO

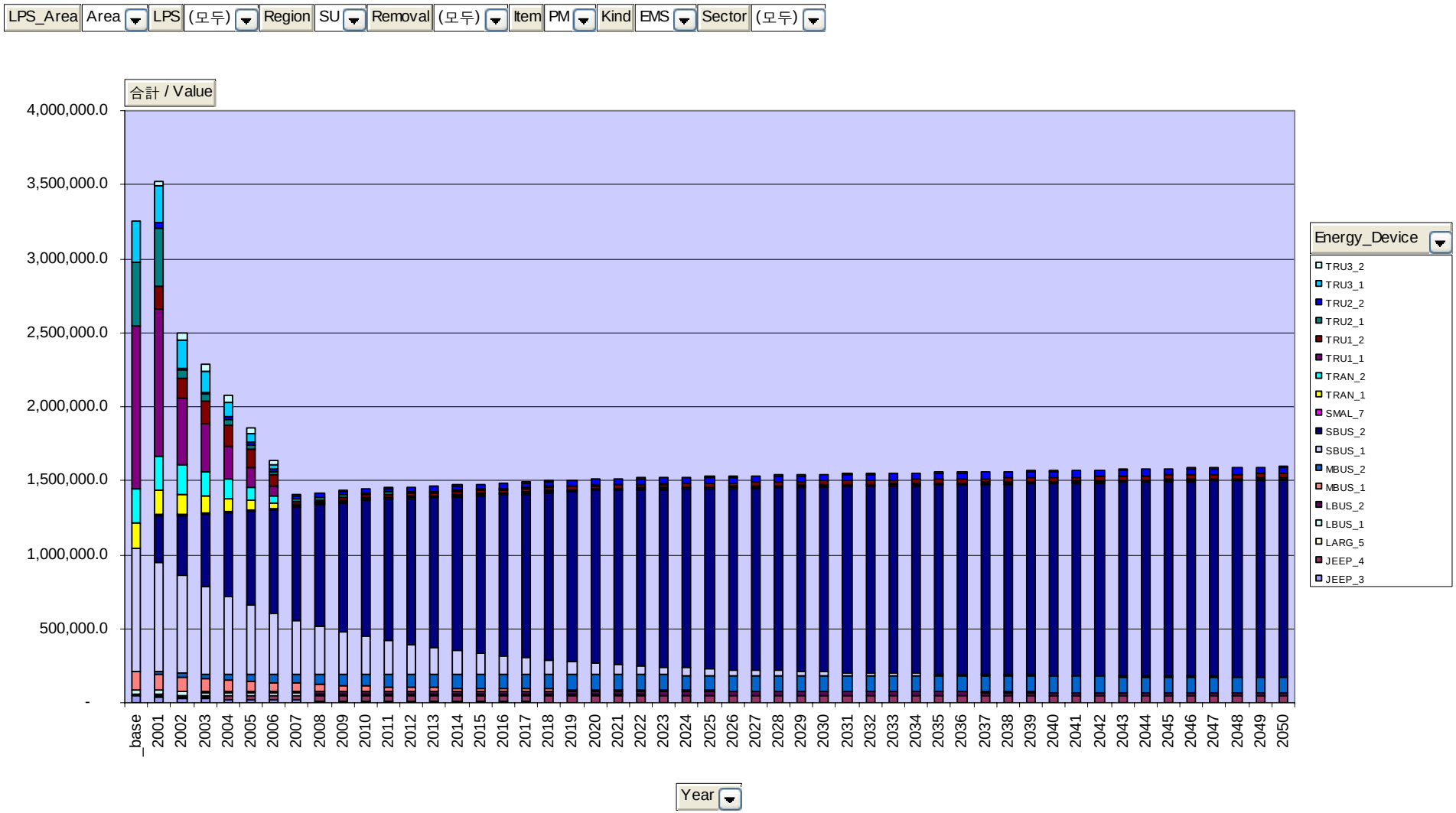
LPS_Area | Area | LPS | (모두) | Region | SU | Removal | (모두) | Item | CO | Kind | EMS | Sector | (모두)



Emission : NOx



Emission : PM


LPS_Area
Area
LPS
(모두)
Region
SU
Removal
(모두)
Item
PM
Kind
EMS
Sector
(모두)
合計 / Value
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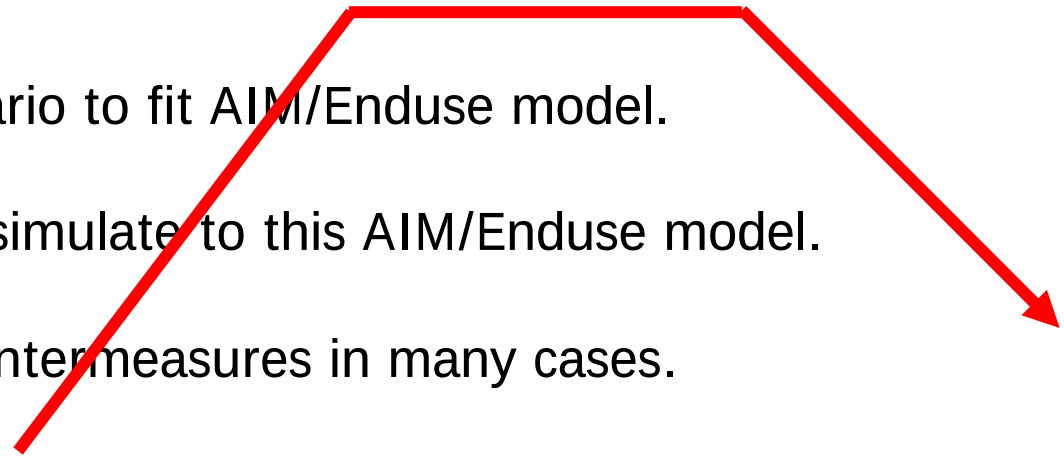
TRU2_2
TRU2_1
TRU1_2
TRU1_1
TRAN_2
TRAN_1
SMAL_7
SBUS_2
SBUS_1
MBUS_2
MBUS_1
LBUS_2
LBUS_1
LARG_5
JEEP_4
JEEP_3

After come back to KOREA

We will set up scenario to fit AIM/Enduse model.

We will get data to simulate to this AIM/Enduse model.

We will develop countermeasures in many cases.



To reduce GHG emission compare to present situation