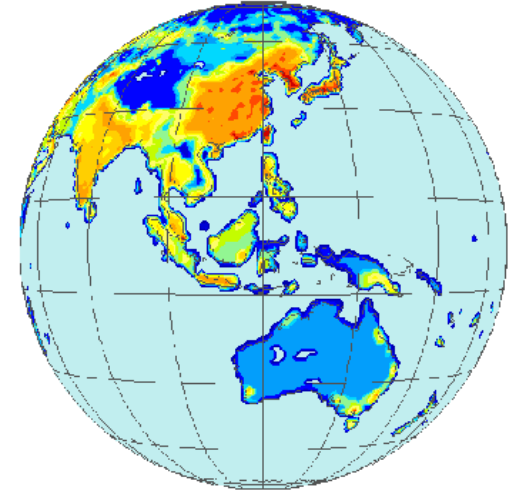


Advanced LCS Model: Backcast Model



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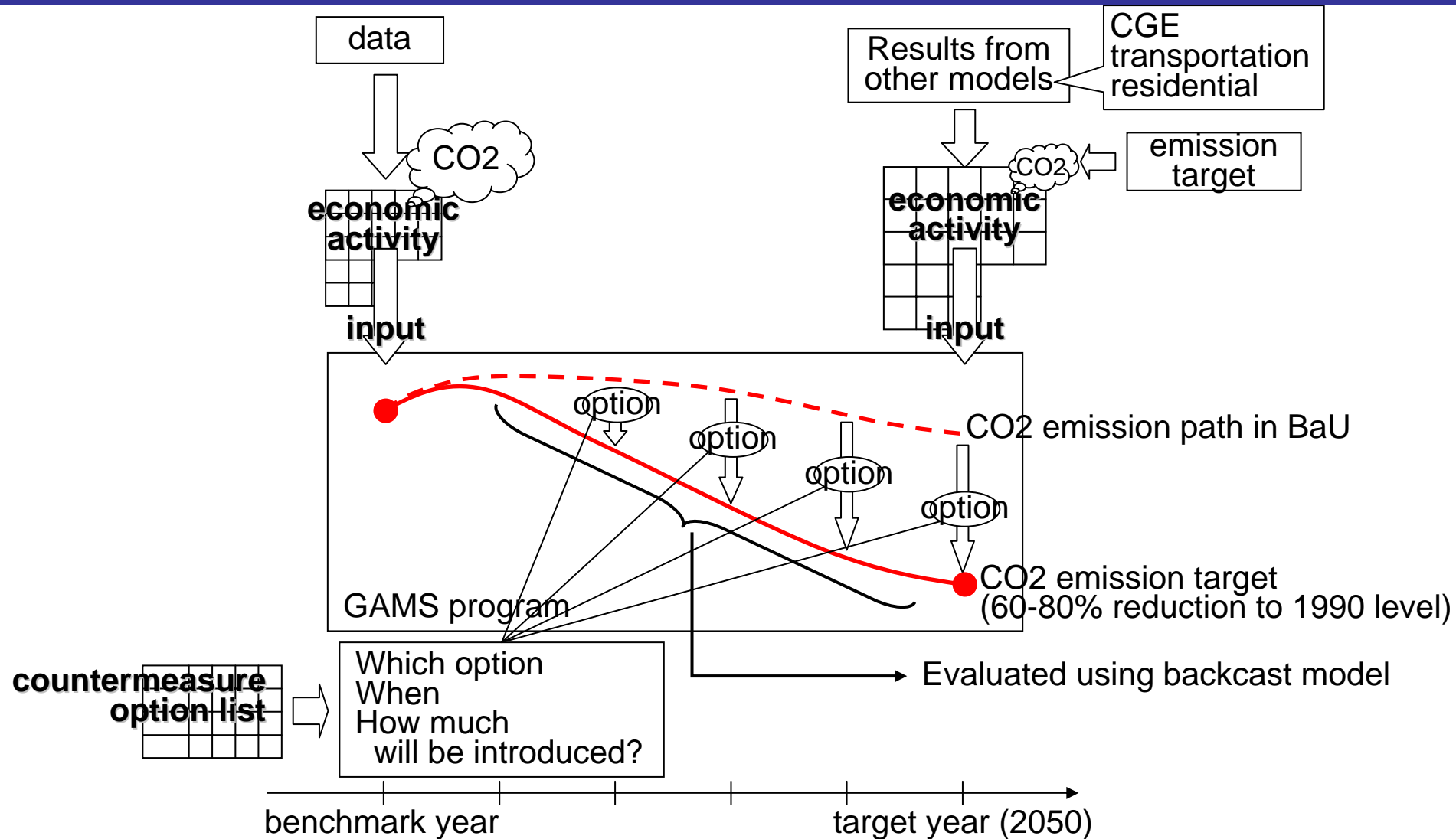
Purpose of Backcast model

Purpose: Representing intertemporal optimal strategy on introduction of new technologies and economic activity change in order to achieve the future targets such as carbon emissions in 2050.

Core model: Dynamic optimization model with linear programming.

- The countermeasures proposed by the other models can be introduced, and evaluated.

Concept of backcast model

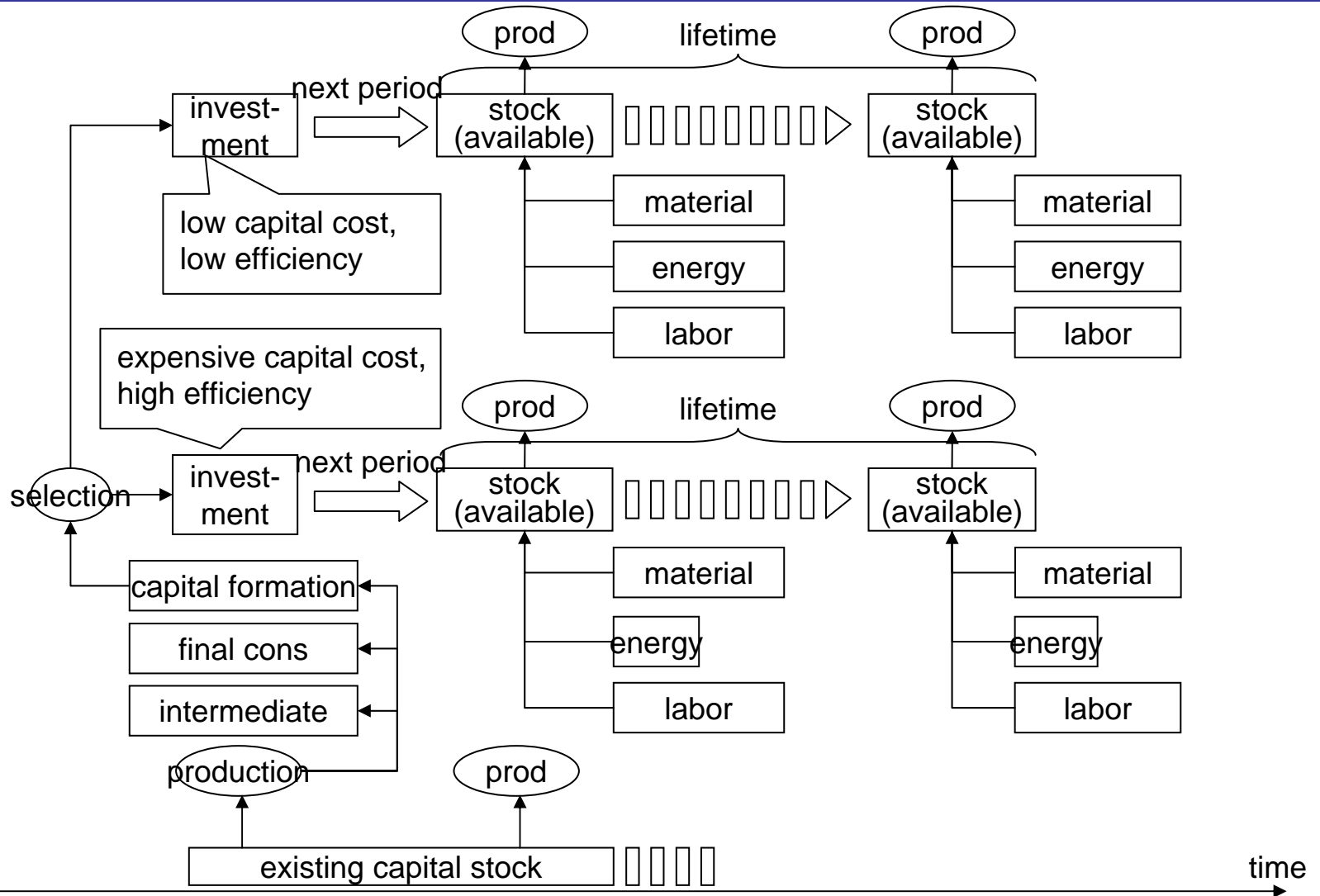


Model features

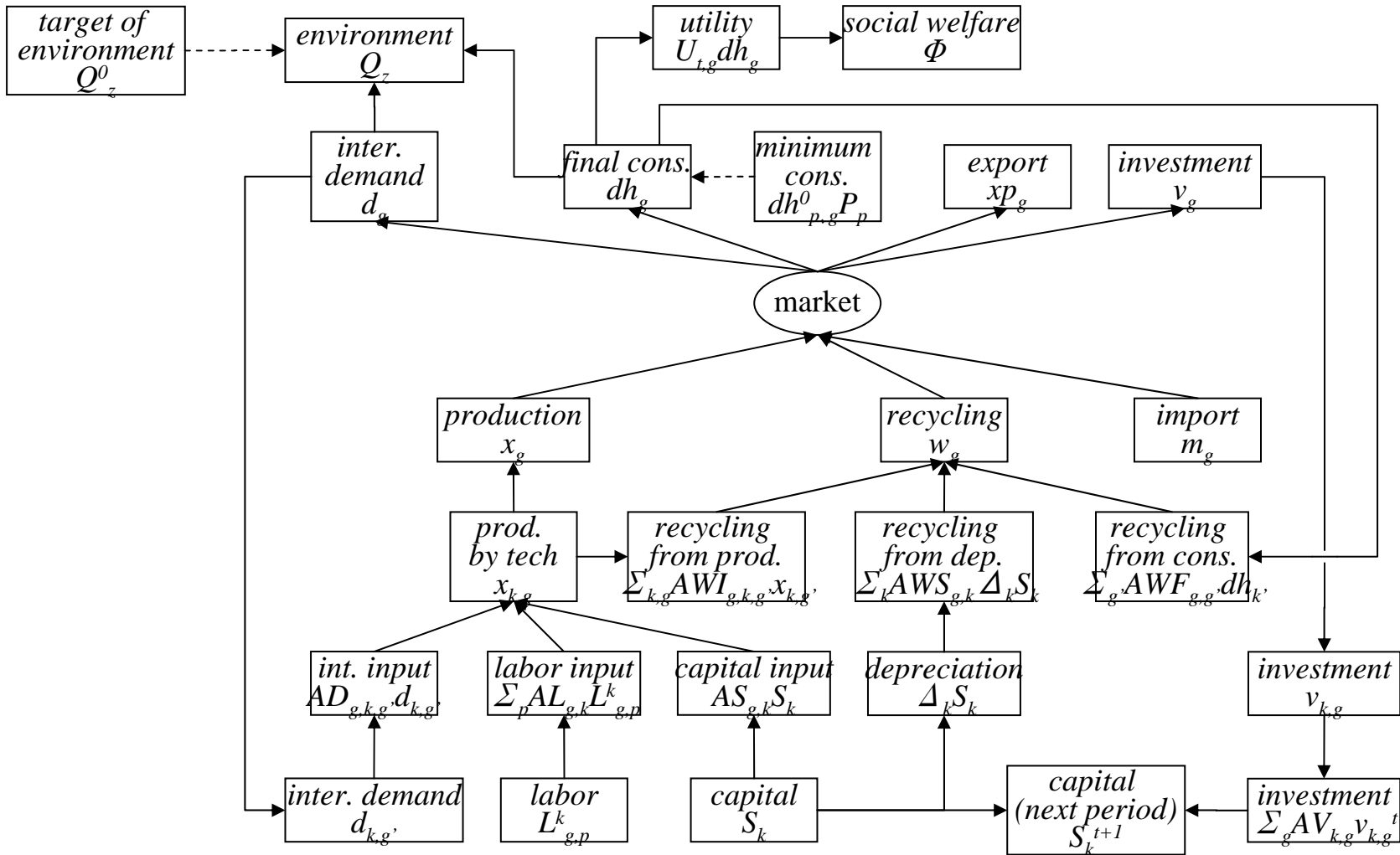
- Production function: Mechanism of goods and services production processes,
- Supply-demand balances of all goods and services,
- Stock dynamics equation,
- Recycling of materials,
- Population dynamics,
- Balance of time use: allocation 24 hours to working hours, free time and so on,
- Trade condition: Import and export,
- Minimum service requirement,
- Constraint on carbon emission, and
- Social welfare derived from final consumption and installed stock: Objective function of this model.



Technology selection and energy demand in backcast model



Model structure



Backcast model

- 1st version (preliminary results)
 - simple selection of technologies

- 2nd version (under development)
 - introduction of sub-sectors by energy saving technologies

- 3rd version (not yet developed)
 - complete backcast model

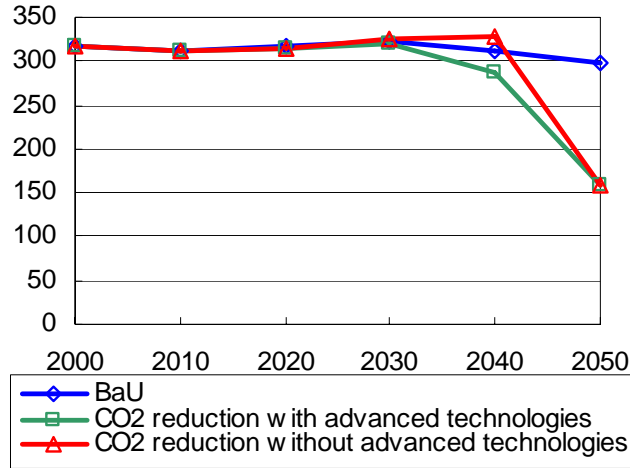
outline of 1st version model

- time period: 2000, 2010, ..., 2080
 - target year: 2050
 - to avoid the terminal condition, 2080 is the final period.
 - lifetime of equipment
 - industry: 20 years
 - household: 10 years
- technology options
 - conventional
 - energy-saving
 - **energy efficiency**: twice
 - **capital cost**: twice
- CO2 constraint
 - emissions after 2050: half of those in 2000.
 - emissions up to 2040: no constraint
- Scenario
 - BaU
 - countermeasure 1: CO2 constraint + energy saving option
 - countermeasure 2: only CO2 constraint (no energy saving option)
- 26 sectors
 - Agriculture, forestry and fishing
 - Mining
 - Food products and beverages
 - Textiles
 - Pulp, paper and paper products
 - Chemicals
 - Petroleum products
 - Coal products
 - Non-metallic mineral products
 - Basic metal
 - Fabricated metal products
 - Machinery
 - Electrical machinery, equipment and supplies
 - Transport equipment
 - Precision instruments
 - Others
 - Construction
 - Electricity
 - Gas
 - Water supply
 - Wholesale and retail trade
 - Finance and insurance
 - Real estate
 - Transport and communications
 - Public services
 - Other service activities

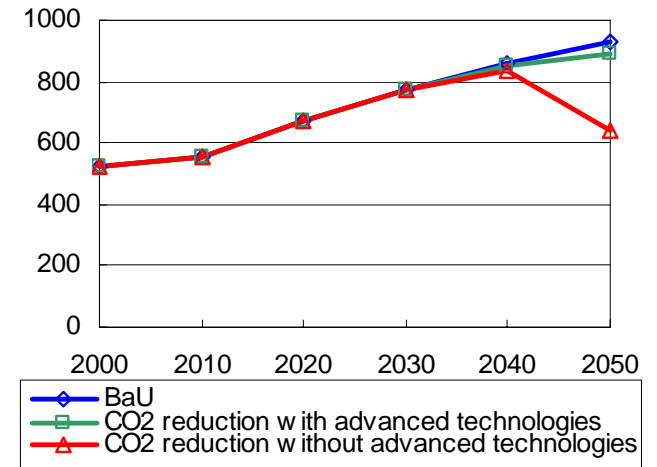


preliminary results from 1st version model

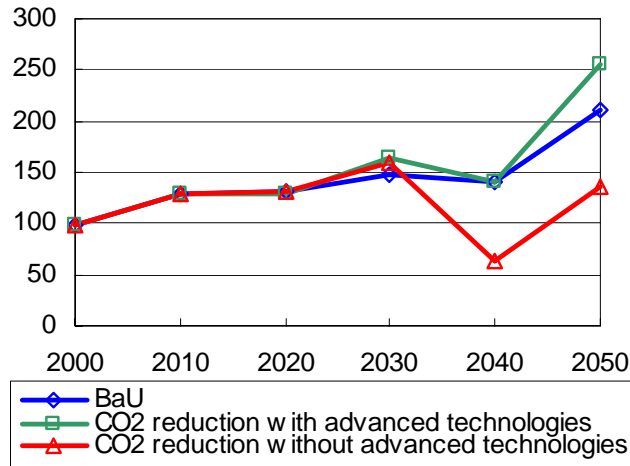
(1) CO2 emissions (MtC)



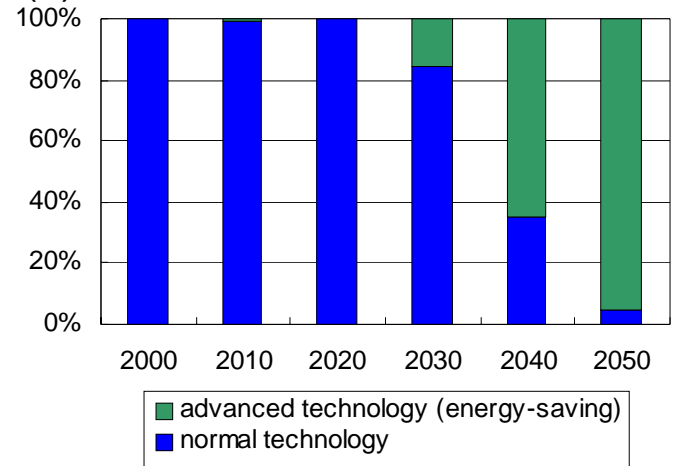
(2) GDP (tri. yen at 2000 price)



(3) investment (tri. yen at 2000 price)




(4) investment in countermeasure 1



Dataset for 2nd version model

sector	Technology		Unit	Energy consumption (kgoe/Unit)		Capital cost (JPY/Unit)		Life time (year)
	LC tech (energy saving)	Conventional tech		LC tech	Conv. tech	LC tech	Conv. tech	
industry steel	High efficiency coke oven	Conventional coke oven	Crude steel 1t (converter)	COL 291.56	COL 298	9,247	8,026	30
	High efficiency sintering furnace	Conventional sintering furnace	Crude steel 1t (converter)	COL 39.45	COL 44	14,868	13,063	30
	High efficiency blast furnace	conventional blast furnace	Crude steel 1t (converter)	COL 8.64	COL 8.72	20,650	18,200	30
	High efficiency electric furnace	High efficiency electric furnace	Crude steel 1t (electric furnace)	ELE 5.27	ELE 5.50			
:	:	:	:	ELE 30.41	ELE 38.80	25,181	19,581	30



sets		sun-sets		sub-sub-sets		remarks
<i>g</i>	(goods)	energy	energy goods or not	<i>e</i>	energy goods	including fossil fuels, renewable energy, final energy
				<i>ne</i>	non-energy goods	
		market	marketable goods or not	<i>p</i>	marketable goods	
				<i>g</i>	public goods	disaster prevention, transportation infrastructure, medical service etc.
				<i>h</i>	household production goods	including service in household
		transport	transport service or not	<i>t</i>	transport service	transport service in production sectors, public sector and household sector
				<i>nt</i>	non-transport service	
		final	potential final demand or not	<i>f</i>	potential final demand goods	
				<i>i</i>	non-potential final demand goods	
<i>i</i>	(institutional sector)			<i>j</i>	production sector	private sectors
				<i>g</i>	public sector	government and public non financial sector
				<i>h</i>	household sector	
<i>k</i>	(technology)					technology is attributed to any sector.
<i>p</i>	(attribute)	sex	sex	<i>m</i>	male	
				<i>f</i>	female	
		res	residential area	<i>D</i>	high density city	
				<i>t</i>	traditional city	
				<i>r</i>	rural city	
				<i>n</i>	nature protection area	
	AIM, NIES	age	age	<i>00</i>	under 14 years old	
				<i>15</i>	from 15 to 64 years old	