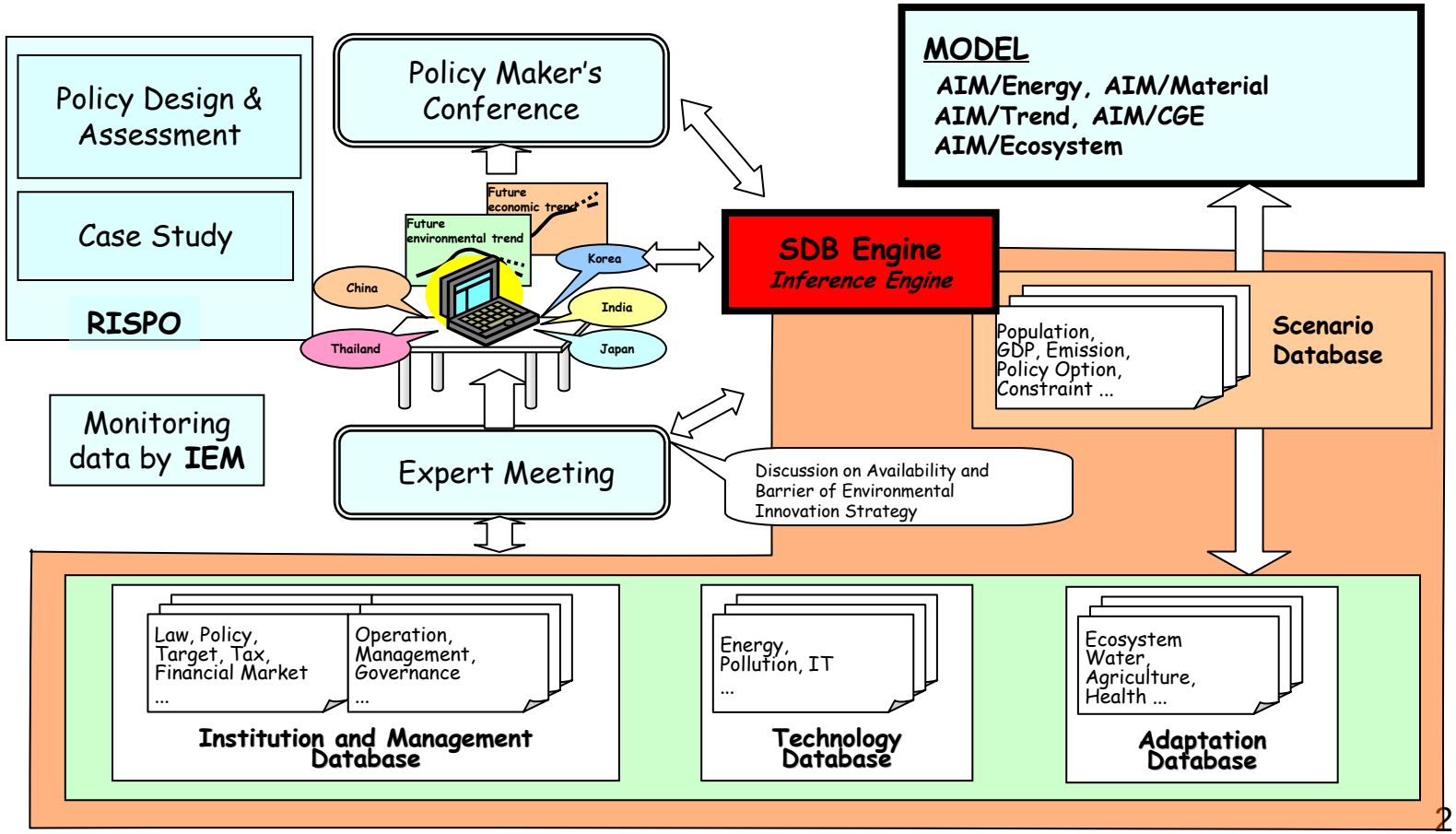
~Environmental Strategic Database Engine~

Concept of Environmental Strategic Database

Strategic database for the environmental policy decision is composed of tables of technologies, management institutions, and scenarios, etc. and an integrated module part (Inference Engine, SDBE) where this information are integrated and analyzed.



Integrating module of SDB (SDBE)

The purpose of the integrating module (Inference engine of SDB, SDBE) is to evaluate and analyze the effect of the technological, sociological and political transition and intervention for future 10-50 years, especially in the fields of energy supply, consumption, material recycling, water and land-use, environmental burdens and the correspondence measures as inclusively as possible, based on information described by the tables.

What SDBE can do and cannot do

What SDBE can do:

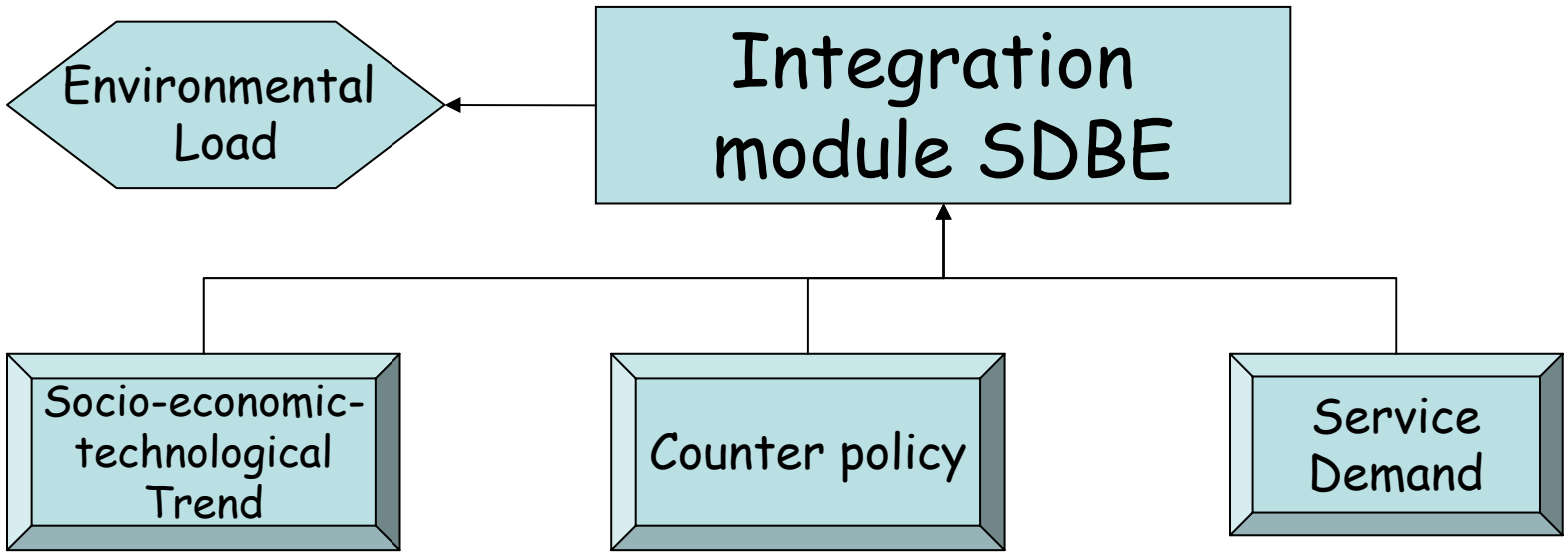
- Perturbation analysis of a key concept or idea of environmental innovation
- Generic and integrated approach on technological, economical and institutional aspects of a target concept/idea

What SDBE cannot do:

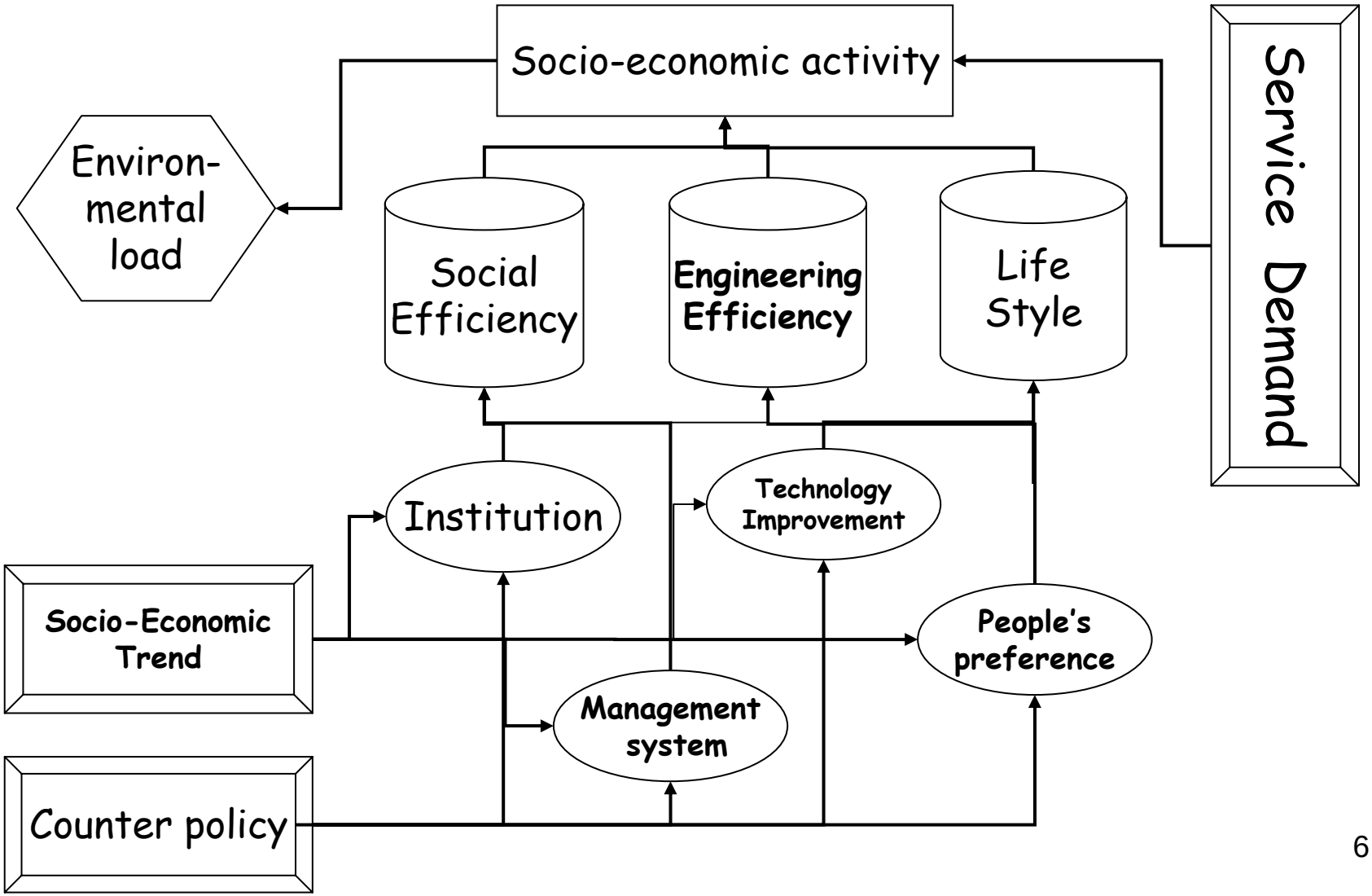
- Macro-economic consistency of analysis
- Detailed engineering analysis and capital cohort structures

Two driving forces and preferences which change the future in SDBE

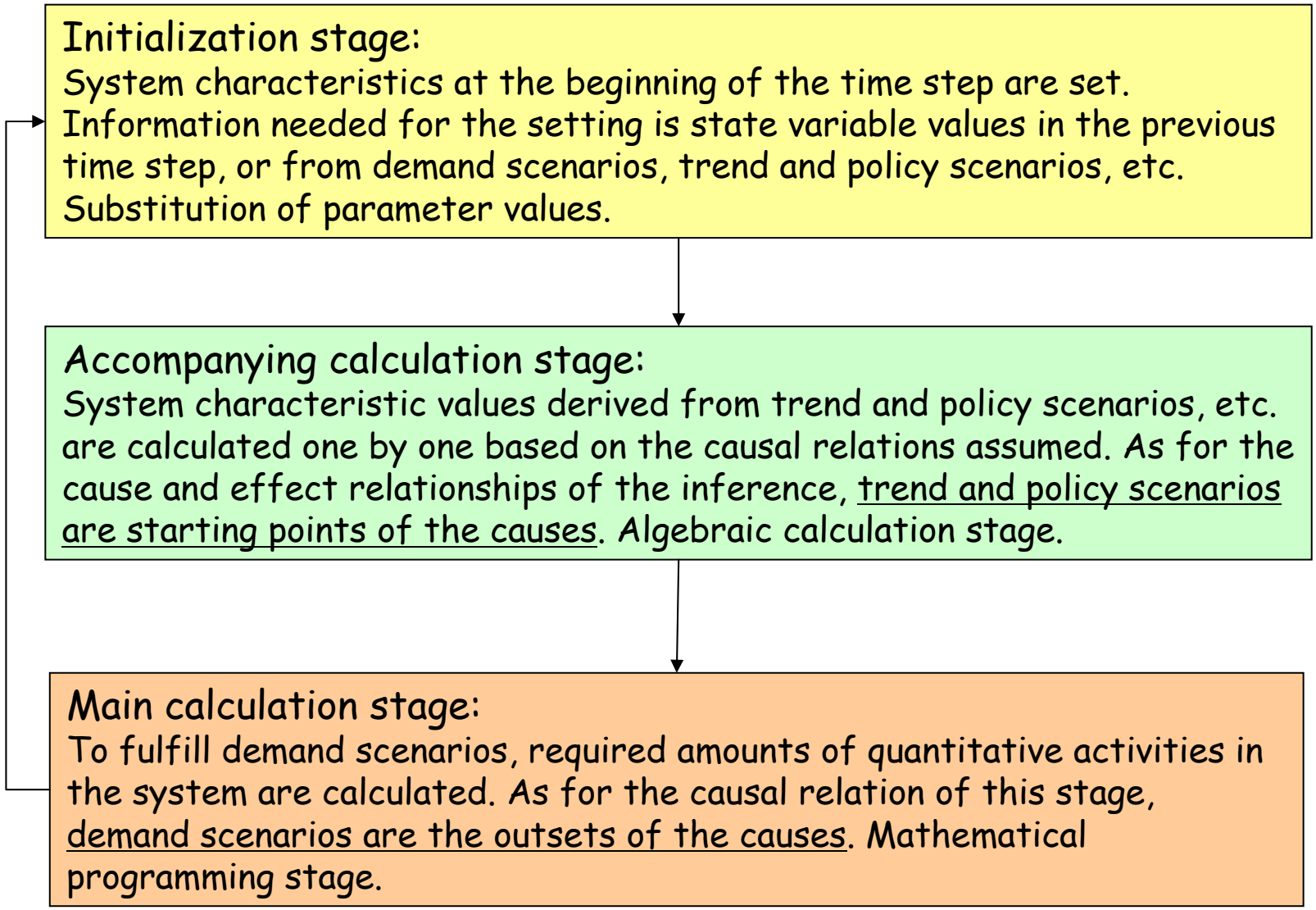
- Changes of demands given by demand scenarios
- Changes in technical and social efficiencies given by trend and policy scenarios
- Changes of preference given by trend and policy scenarios



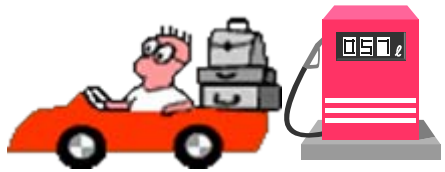
Integration module of SDB (SDBE)

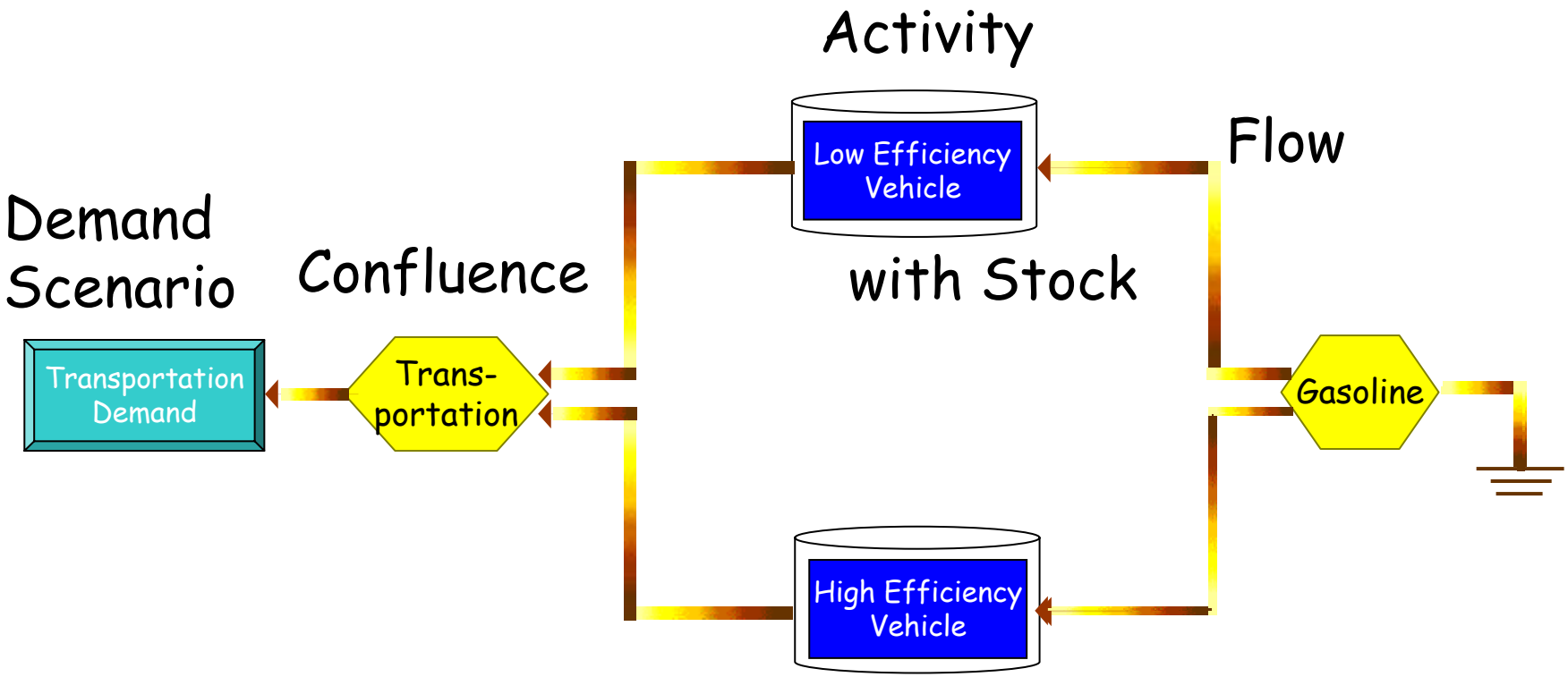


Multi calculation stages



Combination of Data Card (Simplest example)





Activity

Quantitative Activity

Level Activity

- Activity to produce service or goods. The size of the activity (activity level) can be quantified or measured.

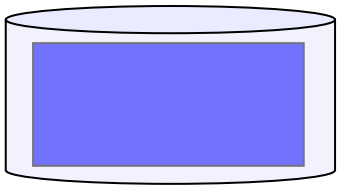
- Two kinds of activity:
1)Quantitative activity has countably additive metrics
2)Level activity has no countably additive metrics to describe the level of activity.

- Two kinds of quantitative activities:
1)with capital (stock), 2) without capital (stock)

- Quantitative activities are evaluated at the main calculation stage. Level activity is evaluated at the accompanied calculation stage.

- The amounts of inputs, outputs and costs of a quantitative activity are proportional to the amount of the activity. The I/O coefficients are prescribed or estimated based on other variables and scenarios. Level activity is algebraically calculated with other variables and parameters of the system. Quantitative activity is calculated by mathematical programming of a minimum cost problem.

Stock



•Stock is attached to a quantitative activity and has almost same concept as that of capital.

• The stock decreases temporally by depletion and increases by investment. Cost is required for the investment, and proportional to the investment.

•Several concepts of stocks may be exist such as, 1)physical, 2)human, 3)intellectual, 4)social infrastructure, and 6)social relation ones. They are treated in the same style, and no difference exists from the view point of parsing information in the calculation.

•The minimum capacity among these stocks restricts the maximum amounts of the activity (Leontief assumption).

Flow

•Flow of goods or service between a quantitative activity and the confluence or between the confluences. When one edge is connected with a quantitative activity, it is input flow or output flow.

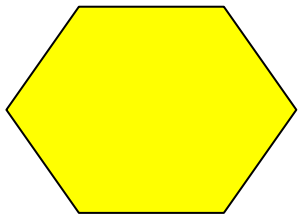
•Flow rate is attached to a flow. It denotes the amount of good or service moved from the upstream edge to the downstream edge within a unit time.

•The size of the flow rate is proportional to the amount of the connected activity. The proportionality coefficient is called "conductance" (flow rate /activity).

•Usually, flow is attached to a quantitative activity. Independent flow that connects between confluences exists, too. Conductance is not defined to independent flow.

•A price is attached to a flow. The flow price is a shadow price of the flow rate in the minimization problem of the total cost of the system.

Confluence



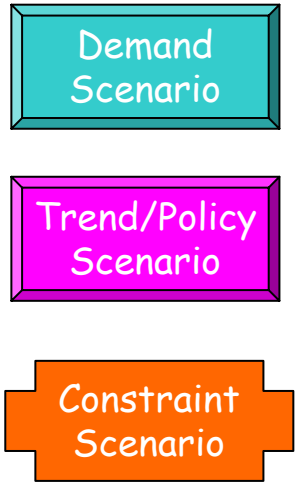
- Inflows or outflows are attached to confluence.

- When two or more flows flow in, a preference of the influx flow can be added. The preferences are functions of flow costs, etc.

- In a confluence, as a rule, total inflow rate = total outflow rate is approved. There are confluences with gushing out or suction, too.

- Price can be added to gushing out flow.

Scenario



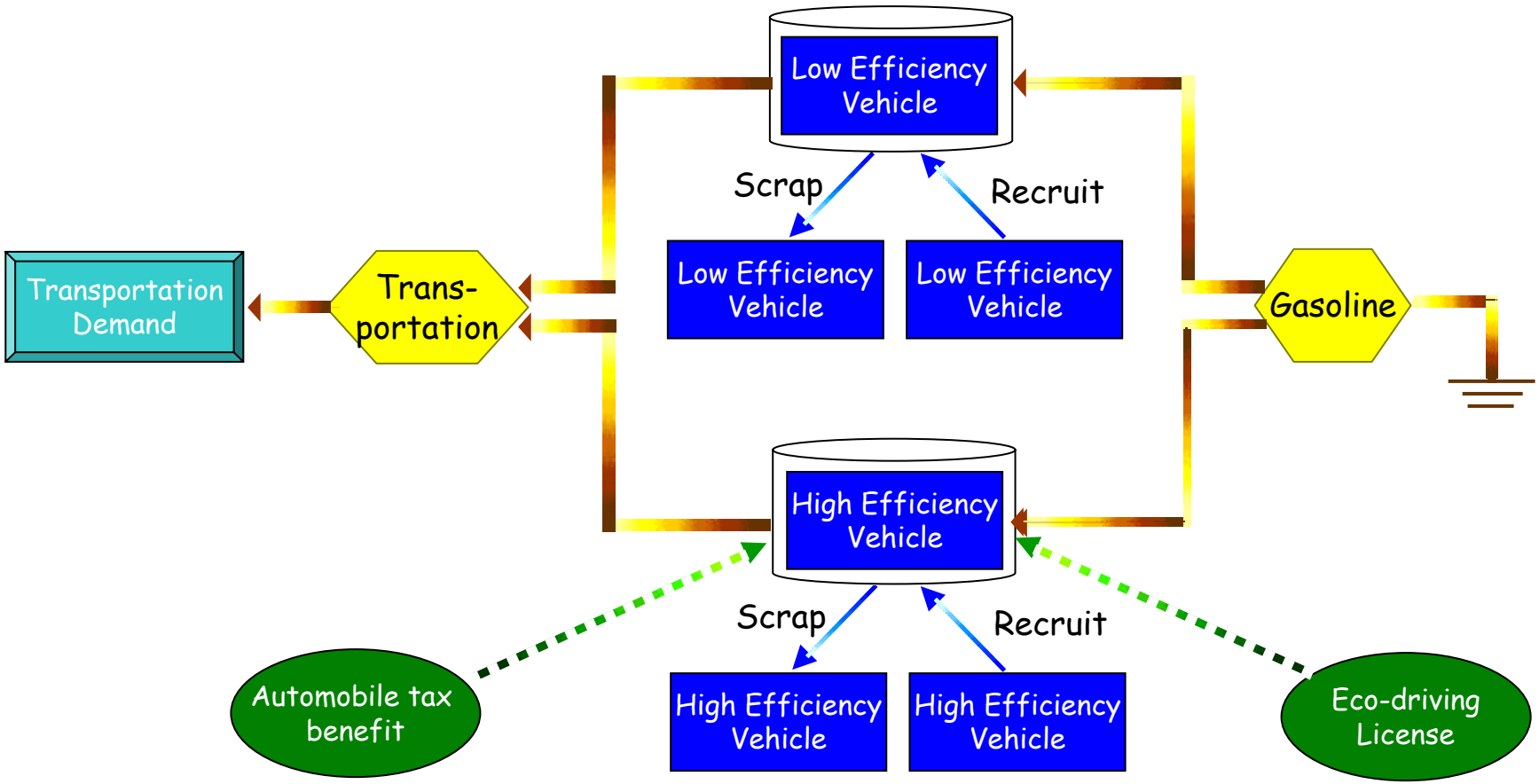
- Scenarios are time serial information of 1) demand, 2) trend /policy and 3) constraints temporally change.

- The scenarios concerning 1)-3) is called element scenarios. The element scenarios may have inconsistency among them. Therefore, it is necessary to select compatible, necessary and sufficient combination among them according to the target cases.

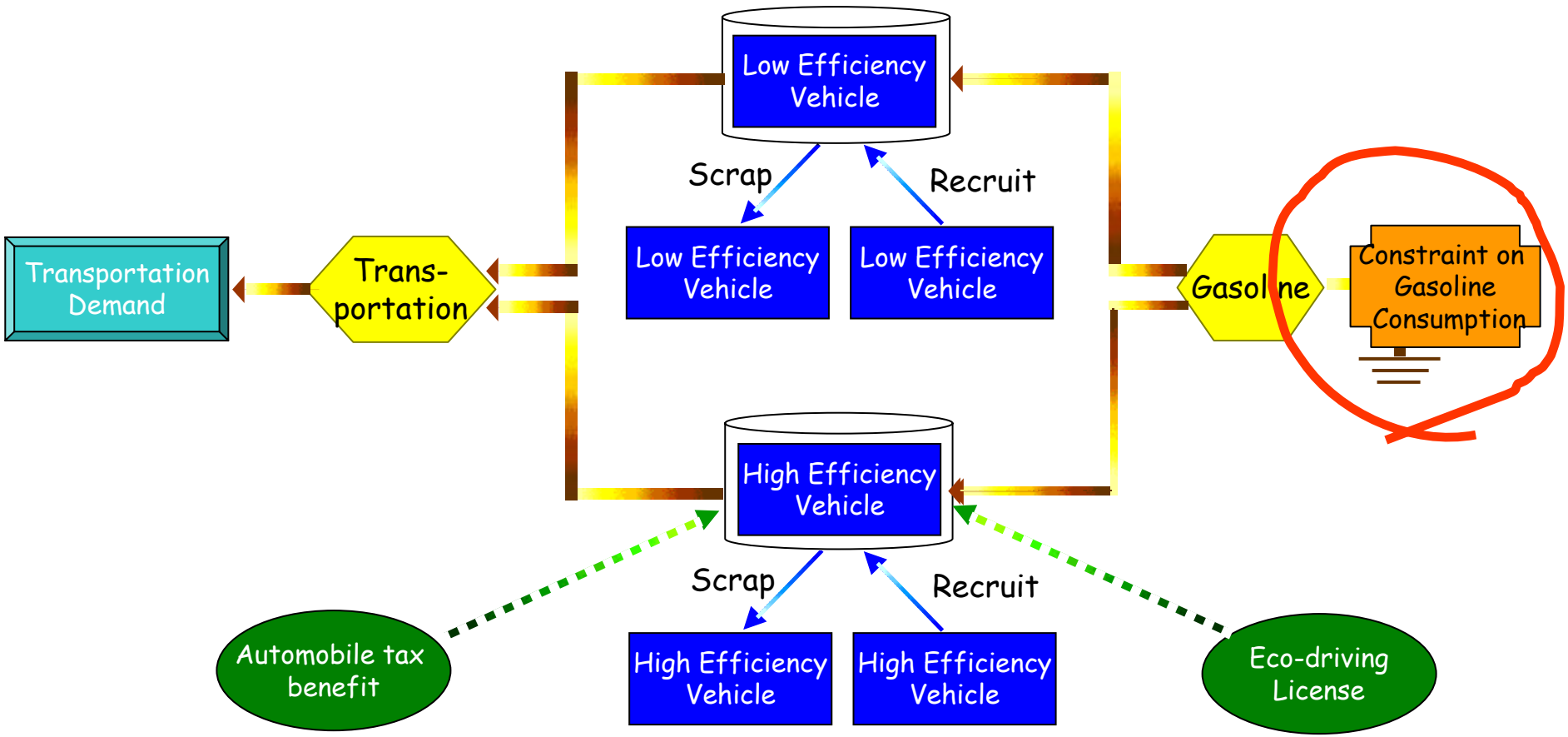
- The selected element scenarios are called activated scenario elements. The element scenario not selected is called inert scenarios.

- The group of the element scenarios activated at the same time is called an examination scenario group.

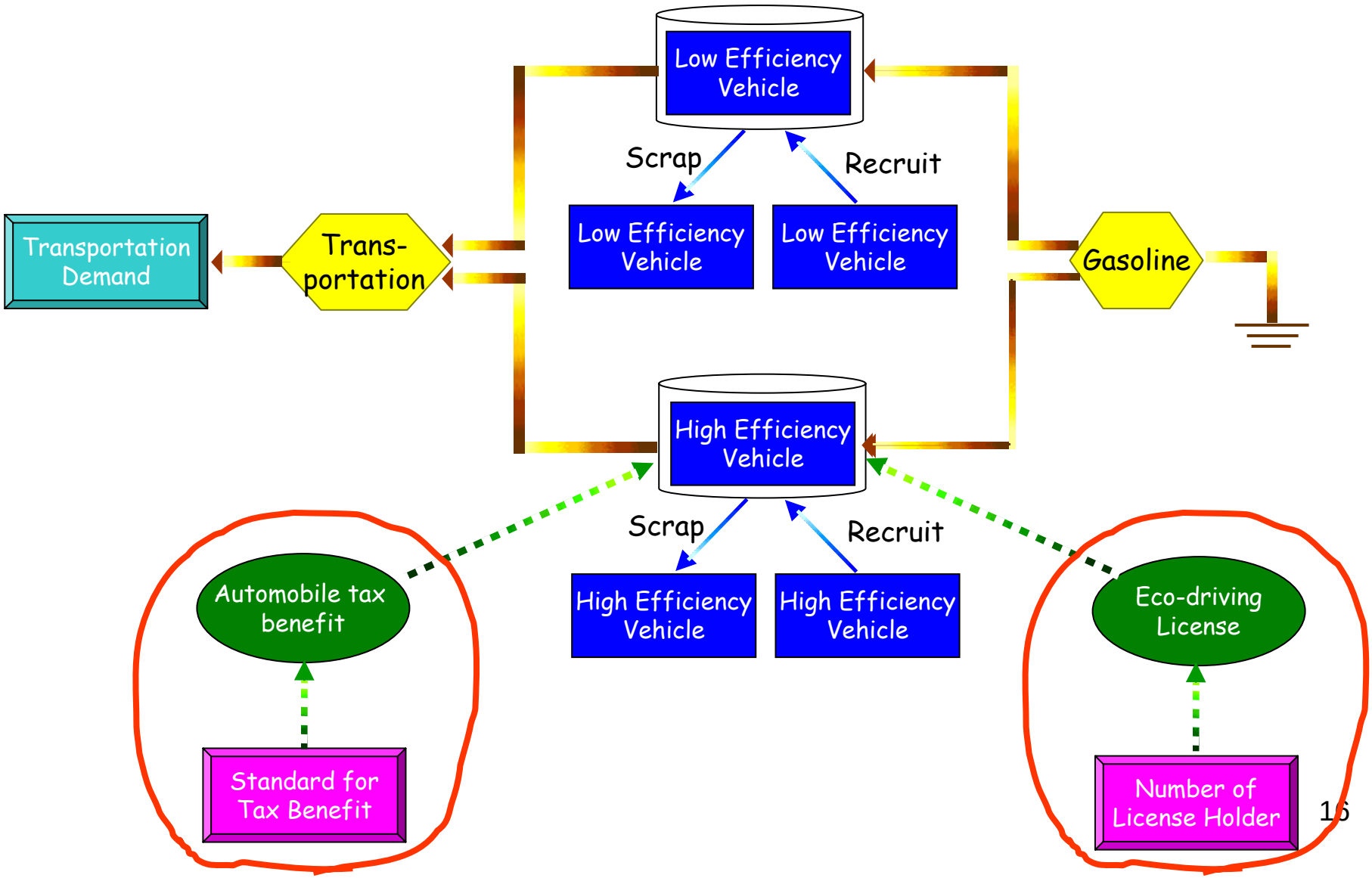
Explanation of Level Activity



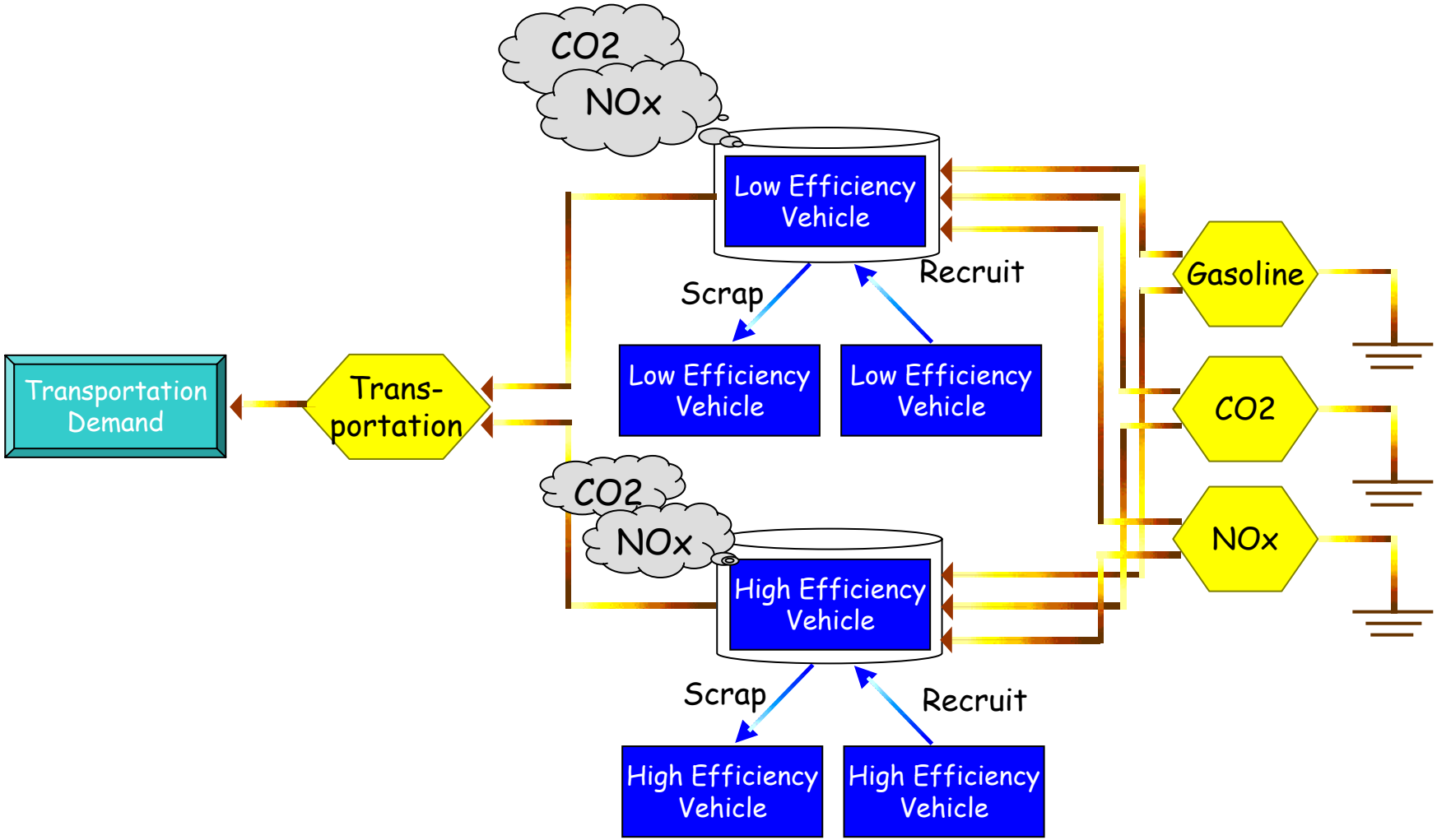
Explanation of Constraint Scenario



Explanation of Trend/Policy Scenario



Explanation of Bads



Exercise I (Cooking)

I-1) Biomass Cooking

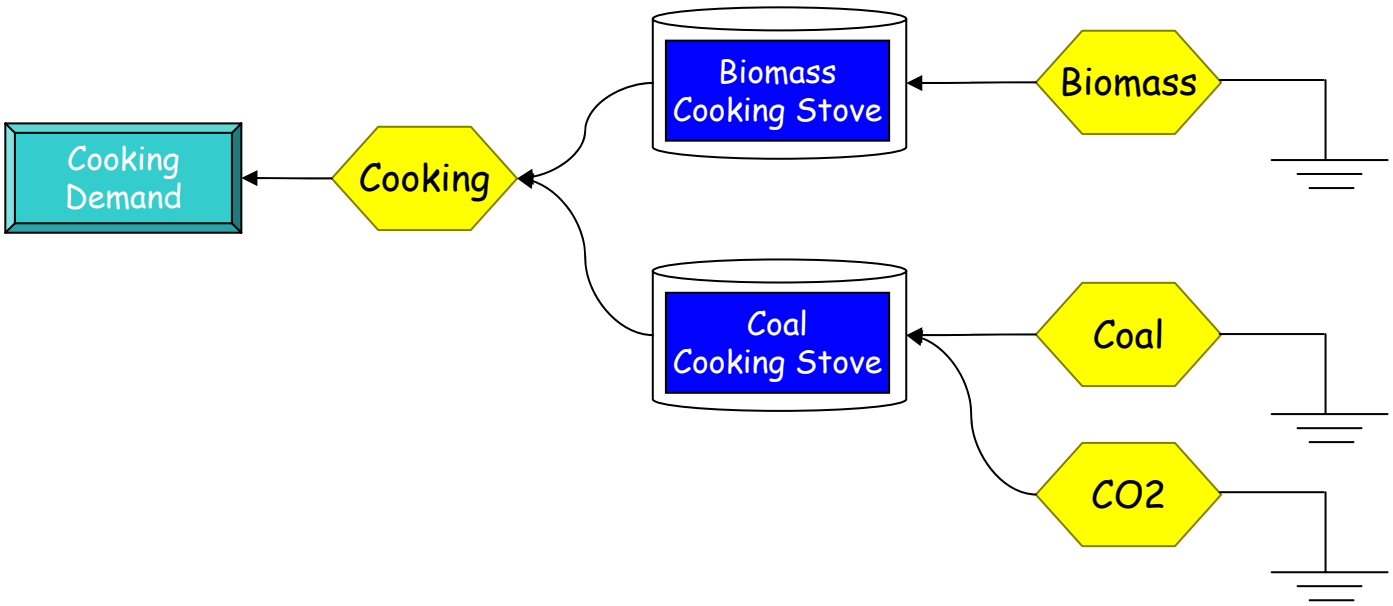
Keywords : Cooking Demand, Biomass Cooking Stove, Biomass Fuel

I-2) I-1 + Coal Cooking

Keywords : Coal Cooking Stove, Coal

I-3) I-2 + CO2 from Coal Combustion

Keywords : CO2



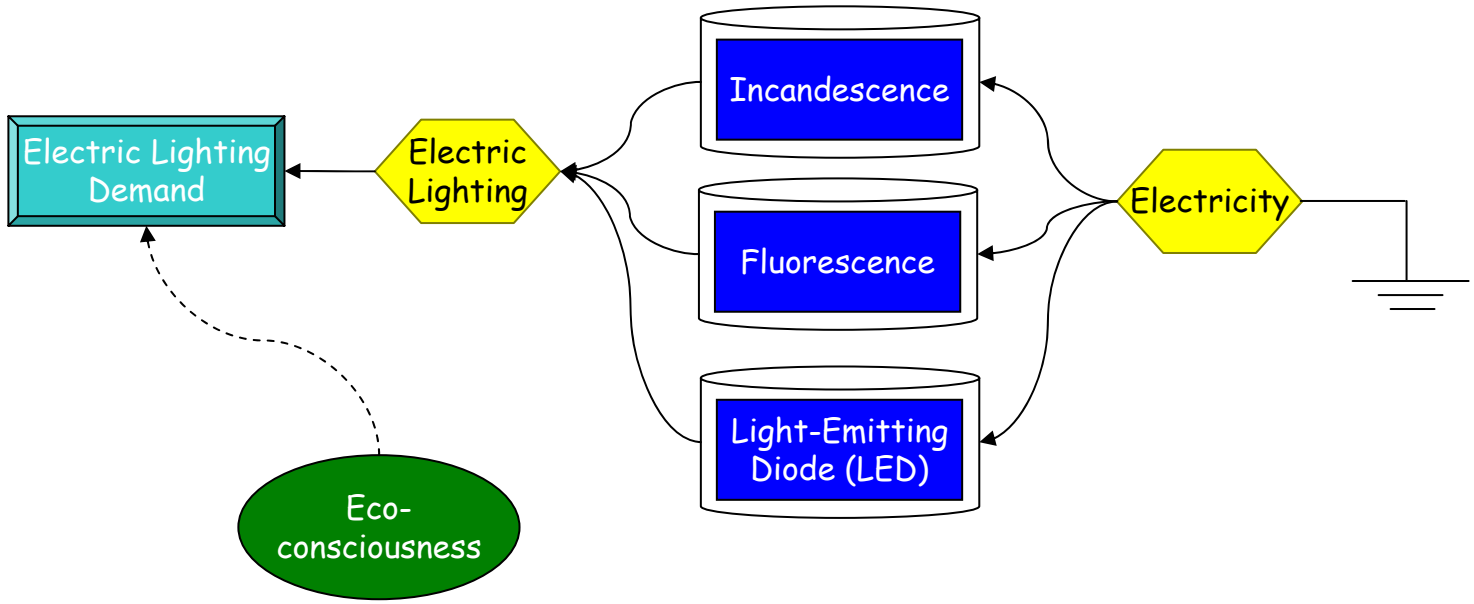
Exercise II (Electric Lighting)

I-1) Incandescence, Fluorescence, Light-Emitting Diode (LED)

Keywords : Electric Lighting Demand, Incandescence, Fluorescence, Light-Emitting Diode (LED), Electricity

I-2) I-1 + Reduction in Useless Light

Keywords : Reduction in Useless Light based on Eco-consciousness



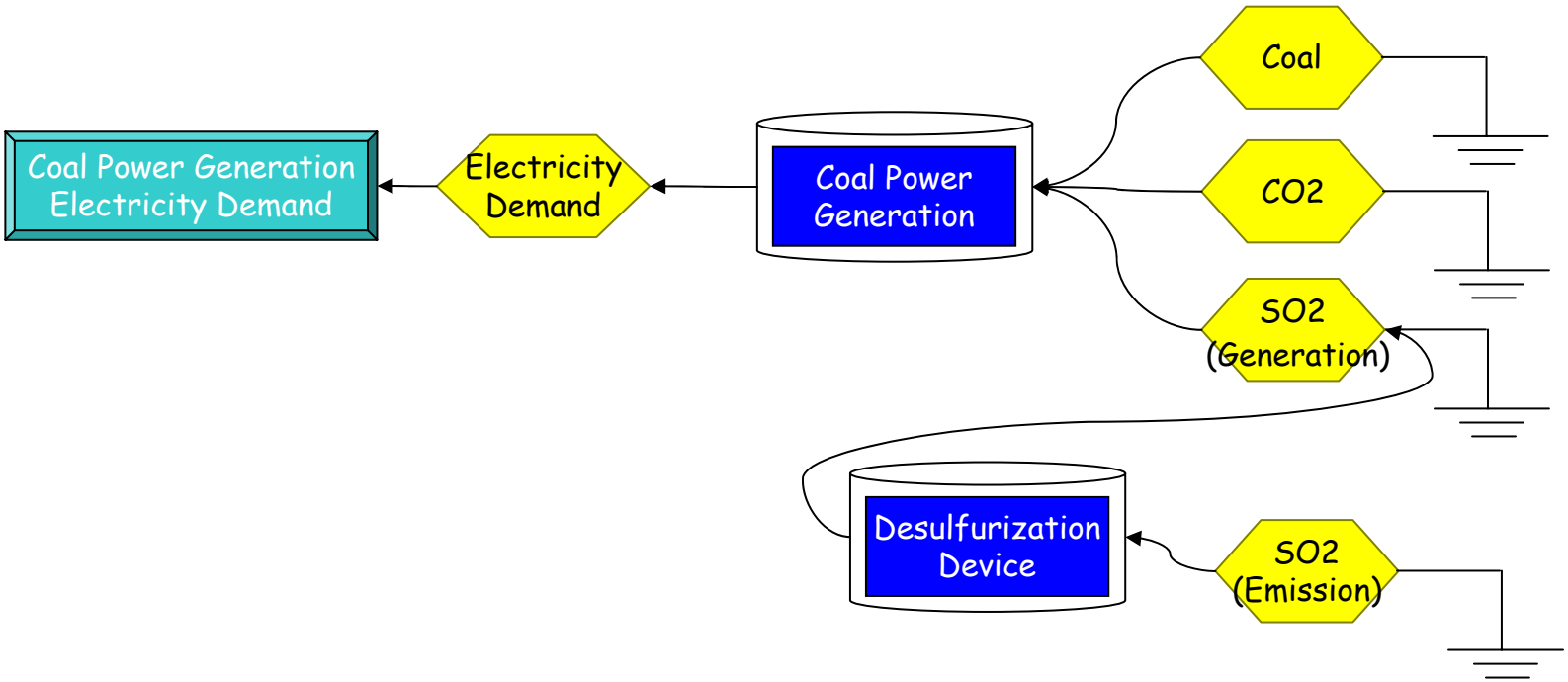
Exercise III （Coal power generation)

I-1) Coal Power Generation

Keywords : Coal Power Generation Electric Demand, Coal Power Generation, Coal, CO2, SO2

I-2) I-1 + Flue Gas Desulfurization Device

Keywords : Flue Gas Desulfurization Device (Reduction Rate 90%)



Exercise IV (Road Transportation System)

I-1) Diesel Vehicle

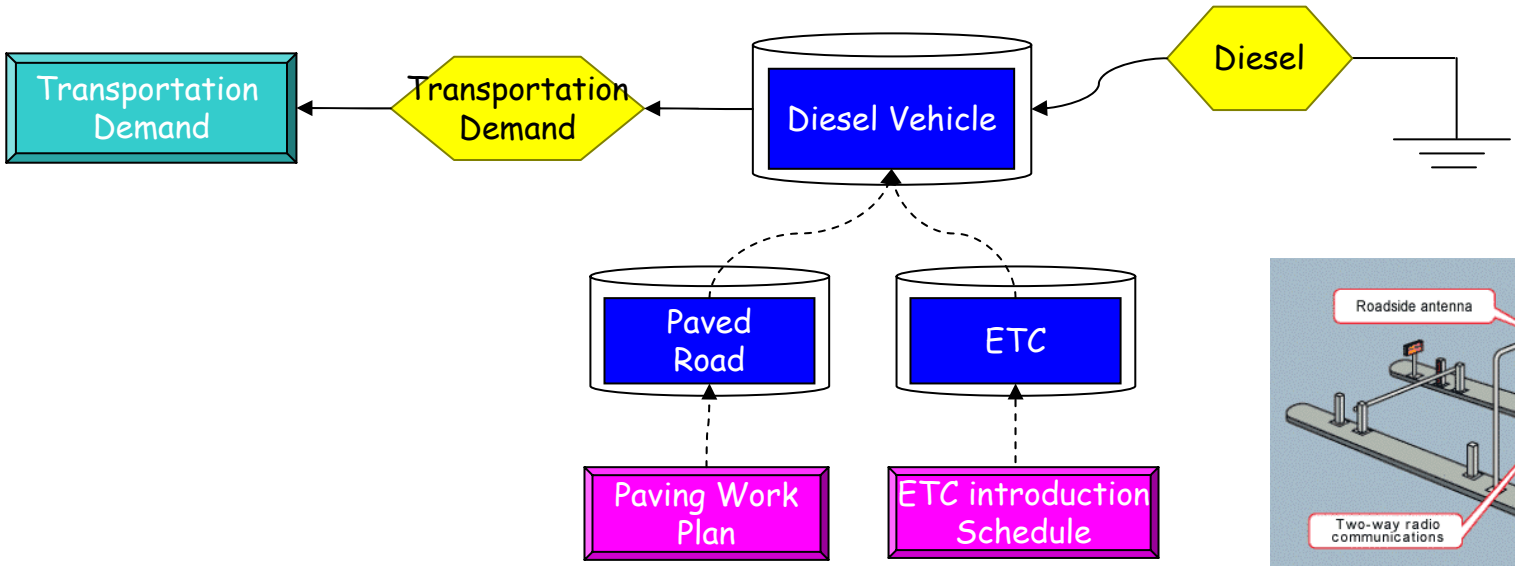
Keywords : Transportation Demand, Diesel Vehicle, Diesel

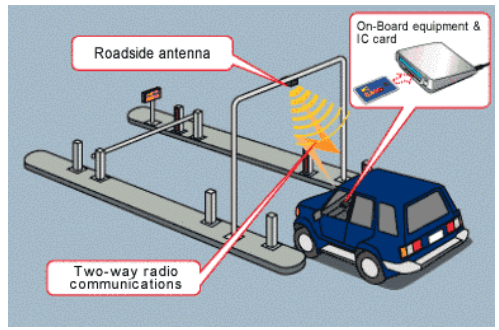
I-2) I-1 + Paved Road

Keywords : Paved Road to increase fuel efficiency of vehicle,
Paving work plan

I-3) I-2 + Electronic Toll Collection system (ETC)

Keywords : ETC to decrease congestion, ETC introduction schedule





Exercise V (Steel Production)

I-1) Steel production

Keywords : Steel Demand, Steel Plant, Coal, Iron Ore

I-2) I-1 + *CO2,SO2*

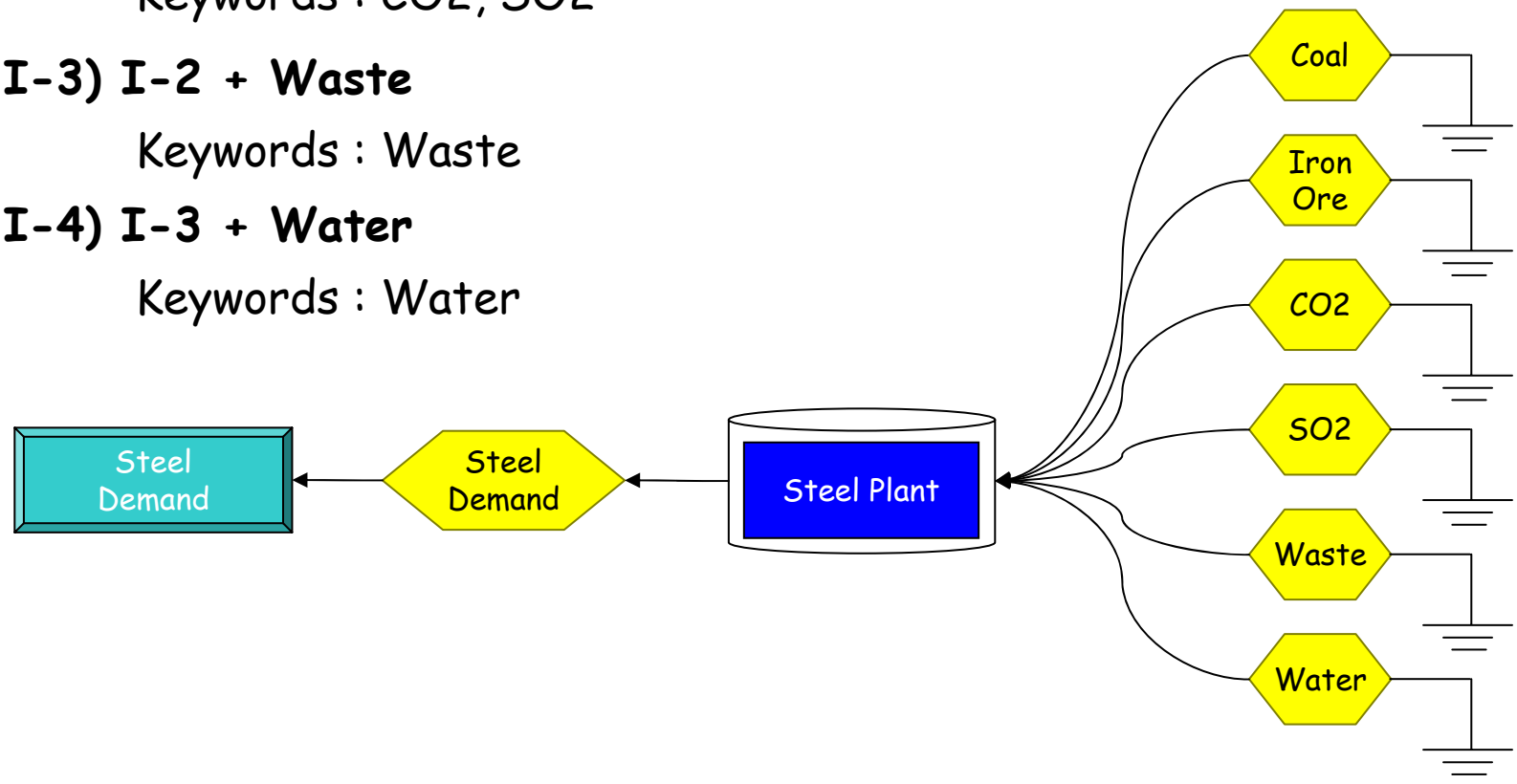
Keywords : *CO2, SO2*

I-3) I-2 + Waste

Keywords : Waste

I-4) I-3 + Water

Keywords : Water



Exercise VI (Toilet Service)

I-1) Toilet Service

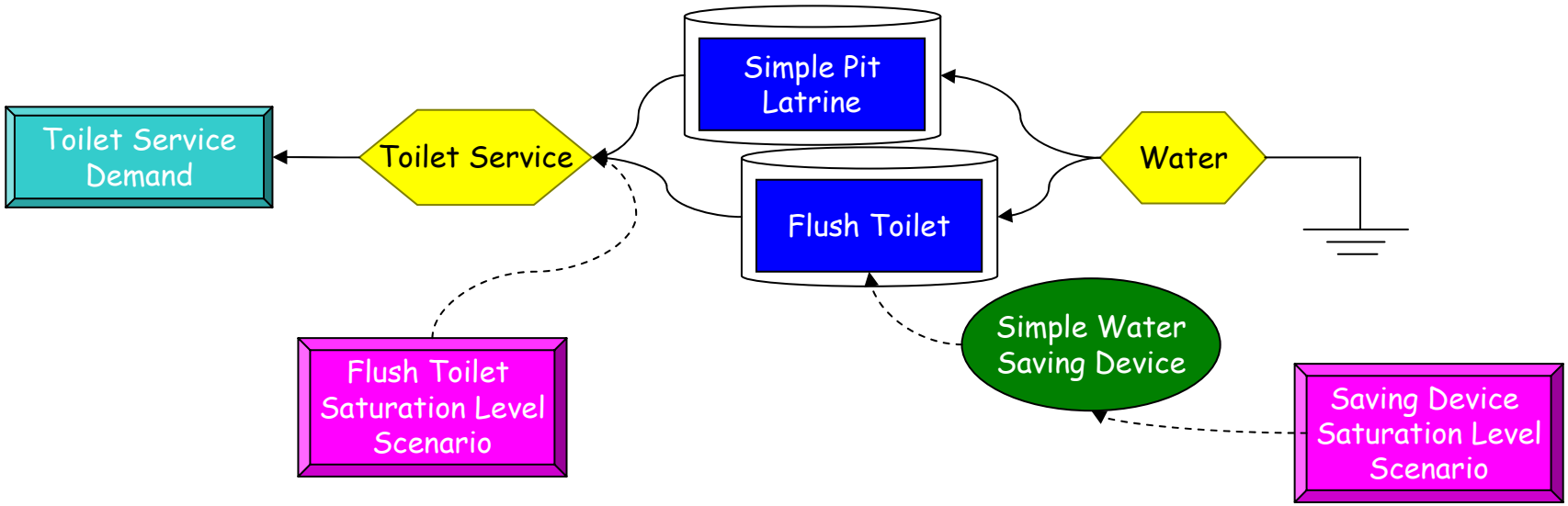
Keywords : Toilet Service Demand, Flush Toilet, Simple Pit Latrine, Water

I-2) I-1 + Flush Toilet Saturation Level

Keywords : Flush Toilet Saturation Level Scenario

I-3) I-2 + Simple Water Saving Device

Keywords : Simple Water Saving Device, Saving Device Saturation Level Scenario



Exercise VII （Waste)

I-1) Waste from Household Activity

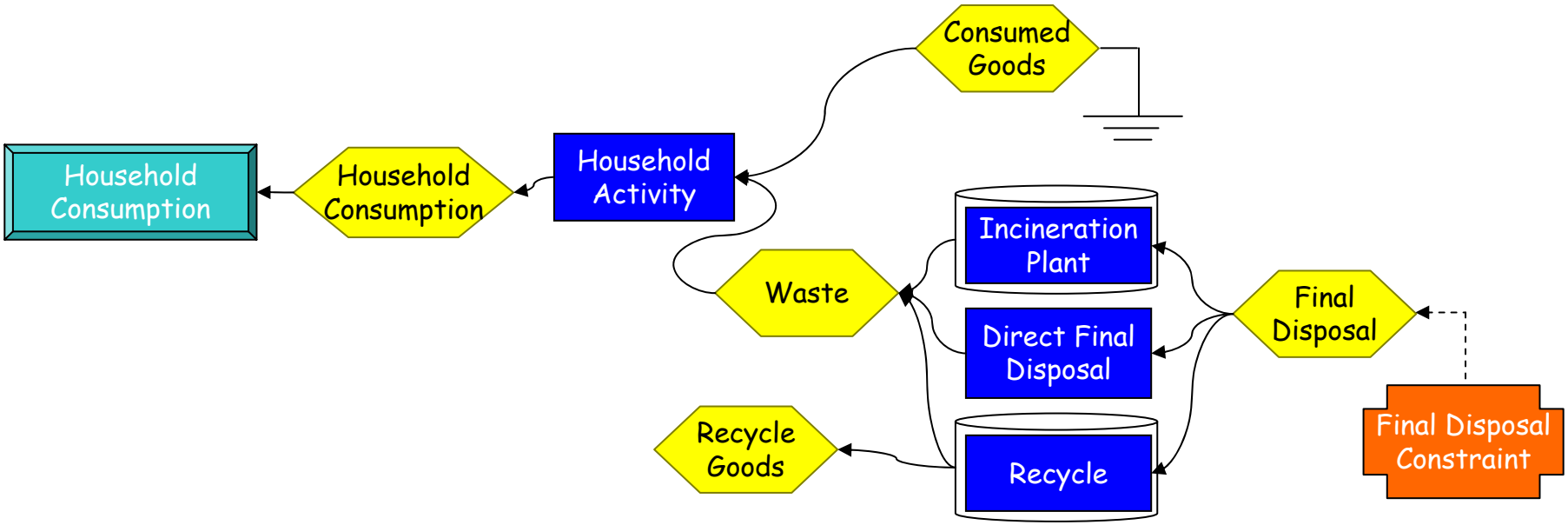
Keywords : Household Consumption, Household Activity, Consumed Goods, Waste

I-2) I-1 + Waste Disposal Device

Keywords : Incineration Plant, Direct Final Disposal, Recycle Plant

I-3) I-3 + Final Disposal Constraint

Keywords : Final Disposal Constraint



Data cards: Activity with stock (1/2)

Item	Content	Format	Code	Value	Memo
Name of activity	Code of activity	(AN16)	AQ*	AQ_TPMVHB	Hybrid gasoline vehicle
Subject of activity	Code of subject	(AN16)	OBJCT	RES_TRMV	Family budget
Unit of activity	Code of unit	(AN16)	UNIT	KPKM	1000 person-km
Activity in reference year	Activity	(F)	QACT0	0	
Price per activity	Function of accompanying variables	(GAMS)	PACT	0	
Tax on activity	Function of accompanying variables	(GAMS)	TAX	0	
Start year of activity	Start year of activity	(I)	YSTAC	2000	
End year of activity	End year of activity	(I)	YEDAC	9999	
Inflow/Outflow (1)					
Name	Code of flow	(AN16)	FL*	FL_TPMVHB _TPMV	Passenger transportation
Confluence of In/Outflow ahead	Code of confluence	(AN16)	CF*	CF_TPMV	
Input/Output	IN/OUT	(I/O)	FLDIR	O	Output
Conductance in Reference Year	Conductance	(F)	FLCD0	15	
Conductance	Function of accompanying variables	(GAMS)	CDCHG		
Tax on flow	Function of accompanying variables	(GAMS)	TAX		
Inflow/Outflow (2)					
Name	Code of flow	(AN16)	FL*	FL_OIL _TPMVHB	Gasoline (toe)
Confluence of In/Outflow ahead	Code of confluence	(AN16)	CF*	CF_OIL	
Input/Output	IN/OUT	(I/O)	FLDIR	I	Input
Conductance in Reference Year	Conductance	(F)	FLCD0	-0.48	(25km/L)
Conductance	Function of accompanying variables	(GAMS)	CDCHG	1+TR_ATP	
Tax on flow	Function of accompanying variables	(GAMS)	TAX		
Inflow/Outflow (3)					
Name	Code of flow	(AN16)	FL*	FL_CO2_TPMVHB	CO2 (tCO2)
Confluence of In/Outflow ahead	Code of confluence	(AN16)	CF*	CF_CO2	CO2
Input/Output	IN/OUT	(I/O)	FLDIR	I	Input
Conductance in Reference Year	Conductance	(F)	FLCD0	1.2	
Conductance	Function of accompanying variables	(GAMS)	CDCHG	1+TR_ATP	
Tax on flow	Function of accompanying variables	(GAMS)	TAX	CTAX	

Data cards: Activity with stock (2/2)

Inflow/Outflow (4)					
Name	Code of flow	(AN16)	FL*	FL_NOX _TPMVHB	NOx (kgNOx)
Confluence of In/Outflow ahead	Code of confluence	(AN16)	CF*	CF_NOX	NOx
Input/Output	IN/OUT	(I/O)	FLDIR	I	Input
Conductance in Reference Year	Conductance	(F)	FLCD0	0.15	
Conductance	Function of accompanying variables	(GAMS)	CDCHG	1+TR_ATP	
Tax on flow	Function of accompanying variables	(GAMS)	TAX		
Name of stock	Code of stock	(AN16)	SK*		
Unit of stock	Code of unit	(AN16)	UNIT	STK_N	Stock number
Conversion factor of stock to activity	Function of accompanying variables	(GAMS)	ACTSK	15	15,000 prs-km/year
Stock quantity at beginning of reference year	Stock quantity	(F)	QSTK0	0	
Recruit price per stock	Function of accompanying variables	(GAMS)	PRCR	1,800,000 - TR_HBCH	
Operating and maintenance price per stock	Function of accompanying variables	(GAMS)	PSTK	30,000	
Tax on stock	Function of accompanying variables	(GAMS)	TAX		
Tax on recruit	Function of accompanying variables	(GAMS)	TAX_R		
Rest of stock life at beginning of reference year	Lifetime	(F)	STLF0	5	
Introduction year	Year	(I)	YSTSK	-9999	
Withdrawal year	Year	(I)	YESTK	9999	
Lifetime of recruit	Function of accompanying variables	(GAMS)	RCRLF	10	
Inflow/Outflow of recruit (1)					
Name	Code of flow	(AN16)	FL*		
Conductance	Function of accompanying variables	(GAMS)	RCRCD		
Payback period	Function of accompanying variables	(GAMS)	SKPBK		

Data cards: Level Activity

Example "Sales Campaign for Hybrid Vehicle"

Item	Content	Format	Code	Value	Memo
Name	Code of activity	(AN16)	AL	AL_TR_HBCH	
Variable of accompanying calculation	YES/ NO	(Y/N)	ALSUB		
Sequence of accompanying calculation	Sequence	(I)	ALORD		
Subject of activity	Code of subject	(AN16)	OBJCT	IN_TRN	
Unit of activity	Code of unit	(AN16)	UNIT	JPY	
Total cost of activity	Function of accompanying variables (case of main part) Function of predomination variables (case of sub-part)	(F)		0	
Tax on activity	Function of predomination variables	(GAMS)	ALCTN	0.001	=200/200000
Activity quantity in reference year	Activity quantity in reference year	(GAMS)	T		
Start year	Start year of activity	(F)	QACT0		
End year	End year of activity	(I)	YSTAC	2002	
Activity quantity	Function of accompanying variables (case of main part) Function of predomination variables (case of sub-part)	(I)	YEDAC	2010	
Name	Code of activity	(GAMS)	QACT	= 200,000 * CST_TR_HBCH/ 2,400,000,000	

Data cards: Confluence

Example "Gasoline"

Item	Content	Format	Code	Value	Memo
Name	Code of confluence	(AN16)	CF*	CF_OIL	
Subject of activity	Code of subject	(AN16)	OBJCT		
Unit of flow	Unit of flow	(AN16)		TOE	toe
Flow price in reference year	Price per flow	(F)	PCNF0		
Condition of balance	YES/NO	(Y/N)		N	
Maximum allowable preference	Change rate of maximum allowable preference	(GAMS)	MXSCG		
Gush price	Function of accompanying variables	(GAMS)	PUPWL	0.11+0.02* (TIME-2000)	
Preference condition of inflow					
Preference function	Function of accompanying variables	(GAMS)	PRFRC		
Targeted flow (1)					
Name of flow	Code of flow	(AN16)	FL*		
Reference share	Function of accompanying variables	(GAMS)	SHRE0		
Change of reference price	Function of accompanying variables	(GAMS)	PFLW0		
Maximum condition of flow (1)					
Name of flow	Code of flow	(AN16)	FL*		
Maximum allowable share	Function of accompanying variables	(GAMS)	SHRMX		
Minimum condition of flow (1)					
Name of flow	Code of flow	(AN16)	FL*		
Maximum allowable share	Function of accompanying variables	(GAMS)	SHRMX		

Data cards: Demand Scenario

Example "Gasoline"

Item	Content	Format	Code	Value	Memo
Name of scenario	Code of scenario	(AN16)	SND*	SND_TMPV	
Flag of activation	YES/ NO	(Y/N)	SNACT	Y	
Code of demand type	Code of confluence	(AN16)	SNCNF	CF_TMPV	
Demand quantity (1)	(Year, Value)	(I, F)	QSND	(2000, 150000)	
Demand quantity (2)	(Year, Value)	(I, F)	QSND	(2020, 220000)	
Demand quantity (3)	(Year, Value)	(I, F)	QSND	(2050, 300000)	

Data cards: Policy/Trend Scenario

Example "Expenditure for "Sales Campaign for Hybrid Vehicle" "

Item	Content	Format	Code	Value	Memo
Name of scenario	Code of scenario	(AN16)	SND*	SNP_TR_HBCH	
Flag of activation	YES/ NO	(Y/N)	SNACT	N	
Name of variable / invariable	Code of variable / invariable	(AN16)	SNVAR	CST_TR_HBCH	
Quantity (1)	(Year, Value)	(I, F)	SNVAL	(2005, 1,000,000,000)	
Quantity (2)	(Year, Value)	(I, F)	SNVAL	(2015, 5,000,000,000)	
Quantity (3)	(Year, Value)	(I, F)	SNVAL	(2020, 5,000,000,000)	

Example "Constraint of NOx emission "

Item	Content	Format	Code	Value	Memo
Name of scenario	Code of scenario	(AN16)	SND*	SNP_TR_ NOX	
Flag of activation	YES/ NO	(Y/N)	SNACT	N	
Quantity (1)	Required condition of scenario	(I, F)	SNCEQ	(2000, xxxxx)	
Quantity (2)	Required condition of scenario	(I, F)	SNCEQ	(2020, xxxxx)	
Quantity (3)	Required condition of scenario	(I, F)	SNCEQ	(2030, xxxxx)	