SDB2006 ver1.0

Manual

2006.2.20

APEIS-IEA Project

Content

1. Introduction

In order to achieve sustainable development in the Asia Pacific region, it is necessary to consider integrated strategies aimed at developing a social economic system that considers the environment, and to introduce innovations in techniques, institution and management etc. into spheres like the economic/industrial policy, the science and technology policy, the national land use policy, the infrastructure development policy, and international cooperation policy.

In order to achieve this emission mitigation measures need to be developed in the form of a database system that can store and analyze the effect of mitigation measures for policymakers and the model developers in each country.

2. Abstract of SDB

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

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 policy interventions in the next10-50 years especially in the fields of energy supply, consumption, material recycling, water and land-use, and environmental burdens in as much detail as possible. This would be based on information described in the tables.

3. SDB engine

3.1 Future estimate with SDB engine

When analyzing the future scenarios using the module, it is necessary to give future demand for service exogenously and also the penetration levels of technologies, management and institution. The module calculates the operating quantity for them to satisfy the service demand. These activities produce other co-benefits and need input including goods and services. The characteristic of an activity to satisfy service demand also has the possibility of being influenced by other elements in the system. In addition, an activity and generation of I/O needs cost details

Social and institutional preference influence characteristics of activity (I/O, cost etc.) and selection between two or more activities that provide identical service. In this estimate, such technological characteristics, social preferences and institutional characteristics are derived deductively from time-wise quantitative trend and policy scenario.

The module assumes two kinds of drivers for change. The first is the demand change, and the second is a change in technical efficiency and social efficiency when the amount of demand is given. The former is included exogenously as a demand scenario, and the latter is given as a

trend or policy scenario.

The tables in SDB store data concerning a concrete characteristic of technology, institution and management, which is necessary for simulation with SDBE. These characteristics have the possibility of being changed with reference to technology, institution, lifestyle, etc. The level of the change depends on social trend and countermeasure in policy scenarios. The relationship between these elements is described in the tables.

Figure 3.1shows the conceptual mechanism of the change drawn by the integrated module.

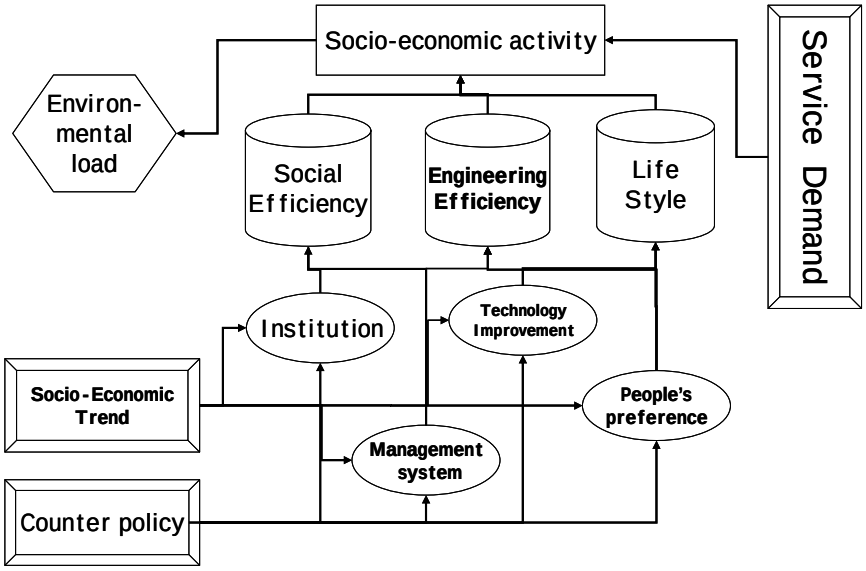
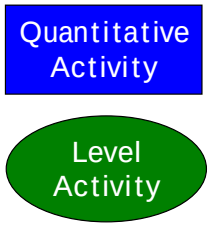


Figure 3.1 Outline of integrated module

3.2 Element of integrated module

1) Activity

Activity is of two kinds; quantitative activity and level activity. Quantitative activity has additive metrics. Level activity has no additive metrics to describe the level of activity. The size of the activity (activity level) can be quantified or measured.

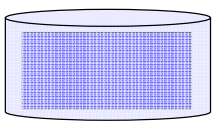


Mark of Activity

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.

2) Stock

Stock is attributed to a quantitative activity and has almost the same concept as that of capital. The stock decreases temporally by depletion



Mark of Stock

and increases with investment. Cost is required for the investment, and is proportional to the investment. Several concepts of stocks exist such as, 1)physical, 2)human, 3)intellectual, 4)social infrastructure, and 6)social relation. They are treated in the same style, and no difference exists in their calculation.

3) Flow

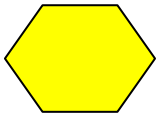
Flow of goods or service is between a quantitative activity and the confluence or between the confluences. When one edge is connected with a quantitative activity, it is input flow or output flow. Flow rate is attached to a flow. It denotes the amount of good or service moved from the upstream edge to 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). Flow is related to a quantitative activity.

Mark of Flow

4) Confluence

Inflows or outflows are attached to a confluence. When two or more flows occur, a preference for the influx flow can be determined. 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.



Mark of Confluence

5) Message

Level of activity influences characteristics of quantitative activity or flow in relation to other elements in the system. The flow without additive metrics is called a message. The message is described along the direction of cause and effect,

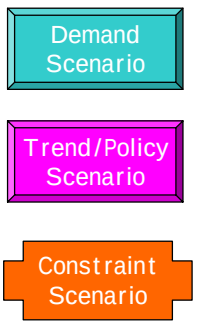
Mark of Message

6) Scenario

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

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

The selected element scenarios are called activated scenario elements.



Mark of Scenario

The element scenario not selected is called inert scenario.

4. Formulation

4.1 Service demand

$$D_j = D^0{}_j + \sum_{l'} d_{l',j} \cdot X_{l'}$$

$$X_l = S_l$$

Where,

D_j : Service demand of service *j*

D_j^0 : Service demand of service *j* without influence by other activity

X_l : Operation quantity of activity *l*

$d_{i,j}$: Demand change of service *j* by activity *l*

4.2 Service share of the activity l

$$\theta_{l,j} \cdot D_j = A_{l,j}^s \cdot X_l^s + A_{l,j}^r \cdot X_l^r$$

$A_{l,j}^s$: Output *j* from activity *l* that existed one period before.

$A_{l,j}^r$: Output *j* from activity *l* that is recruited newly.

X_l^s : Operation quantity of activity *l* that existed one period before.

X_l^r : Operation quantity of activity *l* that is recruited newly.

$\theta_{l,j}$: Service share of output *j* from activity *l*

D_j : Service demand of service *j*

4.3 Output quantity per operation

1) Output quantity per operation

$$\overline{A}_{l,j} = \frac{\overline{A}_{l,j}^{-1} \cdot \overline{S}_l^{-1} \cdot (1 - \frac{1}{\overline{T}_l^{-1}}) + \prod_{l'} (1 + a_{l',l,j}^r \cdot \theta_{l',l}^r) \cdot A_{l,j}^0 \cdot r_l}{S_l}$$

where

$\overline{A}_{l,j}^{-1}$: Average output *j* from activity *l* that existed one period before.

$A_{l,j}^0$: Output *j* from activity *l* that is recruited newly without influence of activities.

$a_{l',l,j}^s$, $a_{l',l,j}^r$: Change of output *j* from activity *l* by influence of activity *l'*.

$\theta_{l',l}^s$: Share of activity *l* influenced by activity *l'* to total stock quantity of activity *l*

$\theta_{l',l}^r$: Share of activity *l* influenced by activity *l'* to total recruited quantity of activity *l*

$\overline{S}_l^{-1}$: Stock quantity of activity l in previous term one period before..

$\overline{T}_l^{-1}$: Average lifetime of activity l that existed one period before.

2) Stock quantity

In the case that $\overline{A}_{l,j}^{-1} \cdot \overline{S}_l^{-1} \cdot (1 - 1/\overline{T}_l^{-1}) < \theta_{l,j} \cdot D_j$

$$X_l^s = \overline{S}_l^{-1} \cdot (1 - \frac{1}{\overline{T}_l^{-1}}), \quad X_l^r = \frac{\theta_{l,j} \cdot D_j - A_{l,j}^1 \cdot X_l^1}{A_{l,j}^2} = r_l, \quad X_l = X_l^{'} + X_l^{"} = S_l$$

In the case that $\overline{A}_{l,j}^{-1} \cdot \overline{S}_l^{-1} \cdot (1 - 1/\overline{T}_l^{-1}) \geq \theta_{l,j} \cdot D_j$

$$X_l^s = \theta_{l,j} \cdot D_{j,i}, \quad X_l^r = 0, \quad r_l = 0, \quad S_l = \overline{S}_l^{-1} \cdot (1 - \frac{1}{\overline{T}_l^{-1}})$$

$$A_{l,j}^s = \prod_{l'} (1 + a_{l',l,j}^s \cdot \theta_{l',l}^s) \cdot \overline{A}_{l,j}^{-1}$$

$$A_{l,j}^r = \prod_{l'} (1 + a_{l',l,j}^s \cdot \theta_{l',l}^s) \cdot \prod_{l'} (1 + a_{l',l,j}^r \cdot \theta_{l',l}^r) \cdot A_{l,j}^0$$

where

$A_{l,j}^s$: Output j from activity l that existed one period before.

$A_{l,j}^r$: Output j from activity l that is recruited newly.

$\theta_{l,j}$: Share of activity l to service j

D_j: Demand of service j.

X_l: Operating quantity

S_l: Stock quantity

r_l: Recruited stock quantity

3) Total output quantity

$$TA_{l,j} = \prod_{l'} (1 + a_{l',l,j}^s \cdot \theta_{l',l}^s) \cdot \overline{A}_{l,j} \cdot X_l$$

4.4 Input quantity

1) Input quantity per operation

$$\overline{E}_{l,k} = \frac{\overline{E}_{l,k}^{-1} \cdot \overline{S}_l^{-1} \cdot (1 - \frac{1}{\overline{T}_l^{-1}}) + \prod_{l'} (1 + e_{l',l,k}^r \cdot \theta_{l',l}^r) \cdot E_{l,k}^0 \cdot r_l}{S_l} = \overline{E}_{l,k}^s + \overline{E}_{l,k}^r$$

where

$\overline{E}_{l,k}$: Average input per operation k to activity l

$TE_{l,k}$: Total input of input k to activity l

$\overline{E}_{l,k}^{-1}$: Average input k to activity l that existed one period before.

$E^0_{l,k}$: Input k to activity l that is recruited newly without influence of activities.

$e^s_{l',l,k}$, $e^r_{l',l,k}$: Change of input k to activity l by influence of activity l'.

$\theta^s_{l',l}$: Share of activity l influenced by activity l' to total stock quantity of activity l

$\theta^r_{l',l}$: Share of activity l influenced by activity l' to total recruited quantity of activity l

$\overline{S}_l^{-1}$: Stock quantity of activity l in previous term one period before

$\overline{T}_l^{-1}$: Average lifetime of activity l that existed one period before.

2) Total input quantity

$$TE_{l,k} = \prod_{l'} (1 + e^s_{l',l,k} \cdot \theta^s_{l',l}) \cdot \overline{E}_{l,k} \cdot X_l$$

4.5 Lifetime of activity

$$\overline{T}_l = \frac{\overline{T}_l^{-1} \cdot \overline{S}_l^{-1} \cdot (1 - \frac{1}{\overline{T}_l^{-1}}) + \prod_{l'} (1 + t^r_{l',l} \cdot \theta^r_{l',l}) \cdot T_l^0 \cdot r_l}{S_l}$$

$$T_l = (1 + e^s_{l',l} \cdot \theta^s_{l',l}) \cdot \overline{T}_l$$

where

$\overline{T}_l$: Average lifetime of activity l

$\overline{T}_l^{-1}$: Average lifetime of activity l that existed one period before.

T_l^0 : Lifetime of activity l that is recruited newly without influence of activities.

$t^s_{l',l}$, $t^r_{l',l}$: Change of lifetime of activity l by influence of activity l'.

$\theta^s_{l',l}$: Share of activity l influenced by activity l' to total stock quantity of activity l

$\theta^r_{l',l}$: Share of activity l influenced by activity l' to total recruited quantity of activity l

$\overline{S}_l^{-1}$: Stock quantity of activity l in previous term one period before

$\overline{T}_l^{-1}$: Average lifetime of activity l that existed one period before.

4.6 Direct environmental burden emission

1) Direct environmental burden emission per operation

$$\overline{F}_{l,m} = \frac{\overline{F}_{l,j}^{-1} \cdot \overline{S}_l \cdot (1 - \frac{1}{\overline{T}_l}) + \prod_{l'} (1 + f^r_{l',l,m} \cdot \theta^r_{l',l,m}) \cdot F^0_{l,m} \cdot r_l}{S_l}$$

Where,

$\overline{F}_{l,m}$: Average direct emission of burden m per operation fixed of activity l

$\overline{F}_{l,m}^{-1}$: Average direct emission of burden m of activity l that existed one period before.

$F_{l,m}^{0}$: Direct emission burden m of activity l that is recruited newly without influence of activities.

$f_{l',l,m}^{r}$: Change of direct emission of activity l by influence of activity l'.

$\theta_{l',l}^{s}$: Share of activity l influenced by activity l' to total stock quantity of activity l

$\theta_{l',l}^{r}$: Share of activity l influenced by activity l' to total recruited quantity of activity l

$\overline{S}_{l}^{-1}$: Stock quantity of activity l in previous term one period before

$\overline{T}_{l}^{-1}$: Average lifetime of activity l that existed one period before.

2) Direct environmental burden emission per operation

$$TF_{l,m} = \prod_{l'}(1 + f_{l',l,m}^{s} \cdot \theta_{l',l,m}^{s}) \cdot \overline{F}_{l,m} \cdot X_{l}$$

4.7 Environmental burden emission

1) Environmental burden emission per operation

$$\overline{EB}_{l,m} = \overline{F}_{l,m} + \sum_{k}\left\{\prod_{l'}(1 + e_{l',l,k}^{s} \cdot \theta_{l',l,k}^{s}) \cdot \overline{E}_{l,k}^{s} \cdot EF_{k,m}\right\} +$$

$$+ \prod_{l'}(1 + f_{l',l,m}^{r} \cdot \theta_{l',l}^{r}) \cdot \sum_{k}\left\{\prod_{l'}(1 + e_{l',l,k}^{r} \cdot \theta_{l',l,k}^{r}) \cdot \overline{E}_{l,k}^{r} \cdot EF_{k,m}\}\right\}$$

Where,

$\overline{F}_{l,m}$: Average direct emission of burden m per operation fixed of activity l

$\overline{E}_{l,k}^{-1}$: Average input k to activity l that existed one period before.

$E_{l,k}^{0}$: Input k to activity l that is recruited newly without influence of activities.

$e_{l',l,k}^{s}$, $e_{l',l,k}^{r}$: Change of input k to activity l by influence of activity l'.

$\theta_{l',l}^{s}$: Share of activity l influenced by activity l' to total stock quantity of activity l

$\theta_{l',l}^{r}$: Share of activity l influenced by activity l' to total recruited quantity of activity l

$\overline{S}_{l}^{-1}$: Stock quantity of activity l in previous term one period before

$\overline{T}_{l}^{-1}$: Average lifetime of activity l that existed one period before.

2) Environmental burden emission per operation

$$TEB_{l,m} = \prod_{l'}(1 + f_{l',l,m}^{f} \cdot \theta_{l',l}^{f}) \cdot \overline{EB}_{l,m} \cdot X_{l}$$

4.8 Fixed cost of activity

1) Fixed cost per operation

$$B_l = \prod_{l'} (1 + b^r_{l',l} \cdot \theta^r_{l',l}) \cdot B^0_l$$

where

B_l : Fixed cost of activity l when activity is recruited with influence of activities.

B^0_l : Fixed cost of activity l without influence of activities when activity is recruited.

$b^r_{l',l}$: Change of lifetime of activity l by influence of activity l'.

$\theta^r_{l',l}$: Share of activity l influenced by activity l' to total recruited quantity of activity l

2) Total cost for recruiting

$$TB_l = B_l \cdot r_l$$

4.9 O+M cost of activity (without input cost)

1) O+M cost per operation (without input cost)

$$\overline{G}_l = \frac{\overline{G}^{-1}_l \cdot \overline{S}^{-1}_l \cdot (1 - \frac{1}{\overline{T}^{-1}_l}) + \prod_{l'} (1 + g^r_{l',l} \cdot \theta^r_{l',l}) \cdot G^0_l \cdot r_l}{S_l}$$

$\overline{G}_l$: Average O+M cost of activity l

$\overline{G}^{-1}_l$: Average O+M cost of activity l that existed one period before.

G^0_l : O+M of activity l that is recruited newly without influence of activities.

$g^s_{l',l}$, $g^r_{l',l}$: Change of O+M cost of activity l by influence of activity l'.

$\theta^s_{l',l}$: Share of activity l influenced by activity l' to total stock quantity of activity l

$\theta^r_{l',l}$: Share of activity l influenced by activity l' to total recruited quantity of activity l

$\overline{S}^{-1}_l$: Stock quantity of activity l in previous term one period before

$\overline{T}^{-1}_l$: Average lifetime of activity l that existed one period before.

2) Total O+M cost

$$TG_l = \prod_{l'} (1 + g^s_{l',l} \cdot \theta^s_{l',l}) \cdot \overline{G}_l \cdot X_l + TE_{l,k} \cdot PI_k + TEB_{l,m} \cdot PE_m$$

4.10 Emission factor per input

1) Emission factor per input

$$EF_{k,m} = \prod_{l'} (1 + ef_{l',k,m} \cdot \theta_{l',k,m}) \cdot EF^{0}_{k,m}$$

where

$EF_{k,m}$: Emission factor of environmental burden m per input k

$EF^{0}_{k,m}$: Emission factor of environmental burden m per input k without influence of activity

$ef_{l',k,m}$: Change of emission factor of environmental burden m per input k by influence of activity l'.

$\theta_{l,k,m}$: Share of activity l to total quantity of input k

2) Stock quantity

$$X_l = \theta_{l,k} \cdot \sum_{l'} TE_{l',k}$$

In the case that $\overline{S}_l^{-1} \cdot (1 - 1/\overline{T}_l^{-1}) < X_l$

$S_l = X_l, \quad r_l = X_l - \overline{S}_l^{-1} \cdot (1 - 1/\overline{T}_l^{-1})$

In the case that $\overline{S}_l^{-1} \cdot (1 - 1/\overline{T}_l^{-1}) \geq X_l$

$S_l = \overline{S}_l^{-1} \cdot (1 - 1/\overline{T}_l^{-1}), \quad r_l = 0$

4.11 Price of input

1) Price of input

$$PI_k = \prod_{l'} (1 + pi_{l',k} \cdot \theta_{l',k}) \cdot PI^{0}_{k}$$

where

PI_k : Price of input k

PI^{0}_{k} : Price of input k without influence of activity

$pi_{l,k}$: Change of price of input k by influence of activity l'.

$\theta_{l,k}$: Share of activity l to total quantity of input k

2) Stock quantity

$$X_l = \theta_{l,k} \cdot \sum_{l'} TE_{l',k}$$

In the case that $\overline{S}_l^{-1} \cdot (1 - 1/\overline{T}_l^{-1}) < X_l$

$$S_l = X_l, \quad r_l = X_l - \overline{S}_l^{-1} \cdot (1 - 1/\overline{T}_l^{-1})$$

In the case that $\overline{S}_l^{-1} \cdot (1 - 1/\overline{T}_l^{-1}) \geq X_l$

$$S_l = \overline{S}_l^{-1} \cdot (1 - 1/\overline{T}_l^{-1}), \quad r_l = 0$$

4.12 Price of environmental burden

1) Emission factor per input

$$PE_m = \prod_{l'} (1 + pe_{l',m} \cdot \theta_{l',m}) \cdot PE_m^0$$

where

PE_m : Price of environmental burden m

PE_m^0 : Price of environmental burden m without influence of activity

$pe_{l,m}$: Change of price of environmental burden m by influence of activity l

$\theta_{l,m}$: Share of activity l to total quantity of input k

2) Stock quantity

$$X_l = \theta_{l,k} \cdot \sum_{l'} TEB_{l',m}$$

In the case that $\overline{S}_l^{-1} \cdot (1 - 1/\overline{T}_l^{-1}) < X_l$

$$S_l = X_l, \quad r_l = X_l - \overline{S}_l^{-1} \cdot (1 - 1/\overline{T}_l^{-1})$$

In the case that $\overline{S}_l^{-1} \cdot (1 - 1/\overline{T}_l^{-1}) \geq X_l$

$$S_l = \overline{S}_l^{-1} \cdot (1 - 1/\overline{T}_l^{-1}), \quad r_l = 0$$

5. Tables

5.1 Main form

Figure 5.1 shows the main form of SDB database system. When the database system starts, the form opens automatically. Users can open each table through the form.

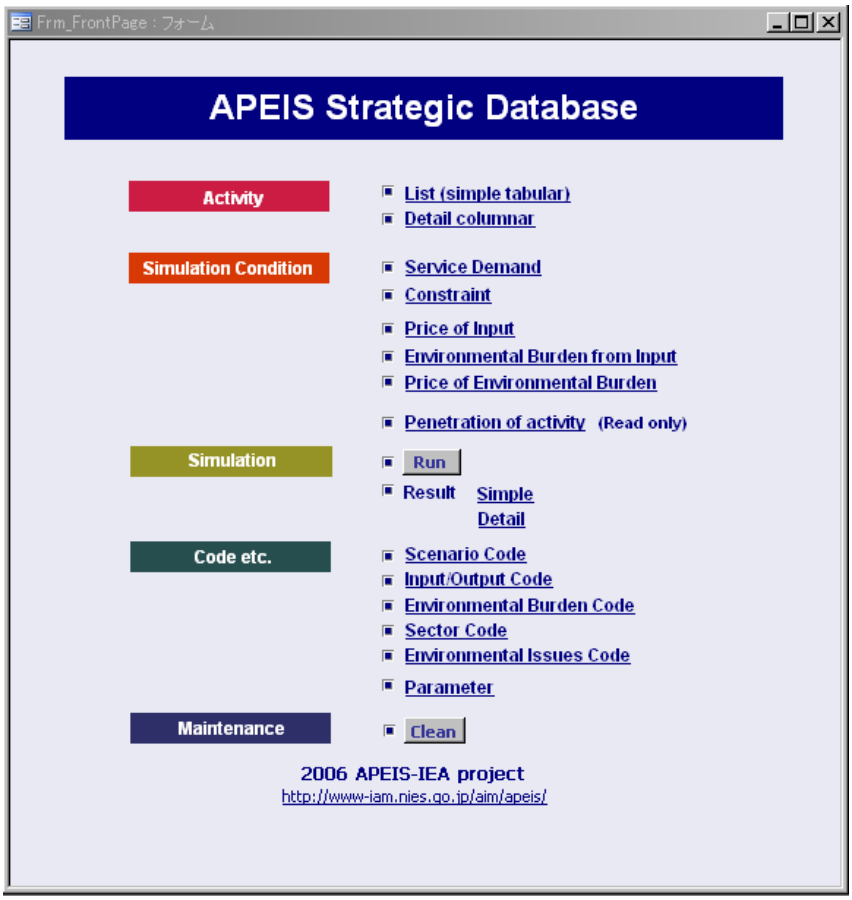


Figure 5.1 Screen of “List of Activity”

5.2 Activity

1) List of Activity (Simple tabular)

The activities stored in the database are listed in this table. By clicking the command button of each record, the table displays in detail the specifications of the corresponding activity.

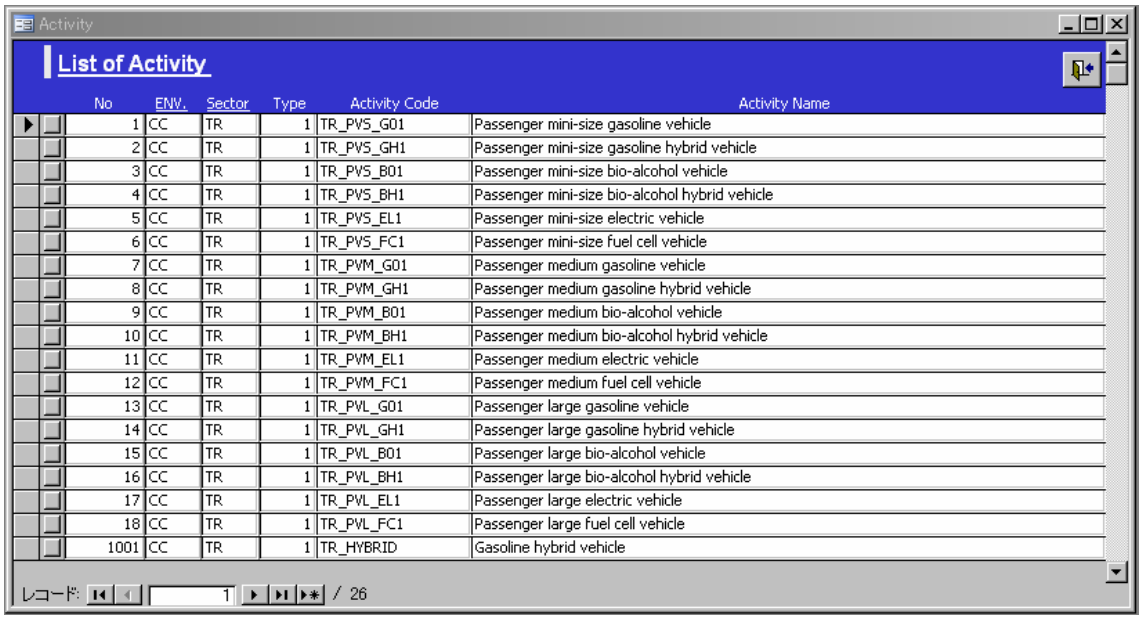


Figure 5.2 Screen of “List of Activity”

Table 5.1 List of item in “List of Activity”

Item	Format	Content
No	Integer	Number of activity
ENV.	String (10)	Code of the environmental issue which the activity mitigates / drives.
Sector	String (10)	Code of the sector to which the activity belongs.
Type	Integer	Type of the activity
Activity Code	String (20)	Code of the activity
Activity Name	String (50)	Name of the activity

2) Activity (Detail column)

The table stores data concerning characteristics of the activity. The indispensable item for simulation is different for each activity type (see Table 5.2).

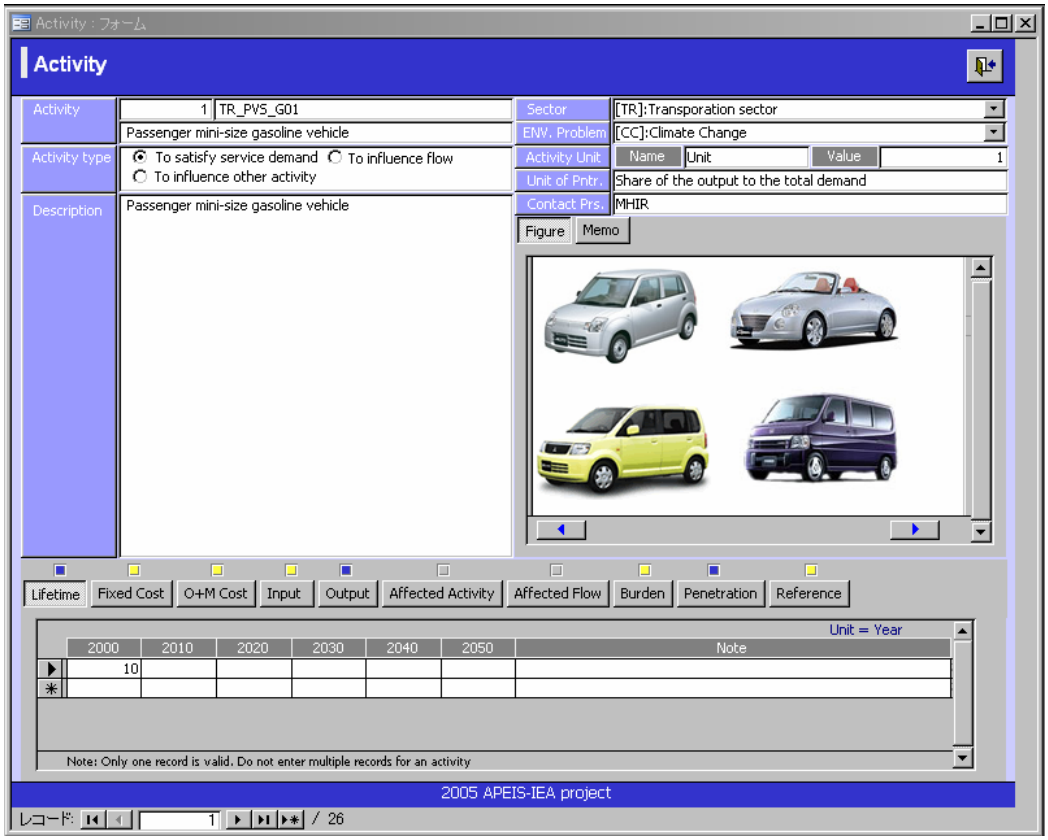


Figure 5.2 Screen of “Activity”

Table 5.2 Indispensable items for simulation

	Quantitative activity	Level activity	
	to satisfy service demand	to influence quantitative activity	to influence flow
Lifetime	++	++	++
Fixed cost	+	+	+
O&M cost	+	+	+
Input quantity	+	+	+
Output quantity	++	-	-
Affected activity	-	++	-
Affected flow	-	-	++
Environmental burden	+	+	+
Penetration	+	+	+
Reference	+	+	+

++: indispensable, +:dispensable, -:not wanted

Table 5.3 List of items in “Activity”(Detail column)

Item	Format	Content
Activity (No)	Integer	Number of the activity
Activity (Code)	String (10)	Code of the activity
Activity (Name)	String (50)	Name of the activity
Activity type	-	Type of the activity
Description	Memo	Description of the activity
Sector	-	Sector which the subject of the activity is classified into. Clicking “Sector” displays the table of sector.
Environmental issue	-	Code of the environmental issue which the activity mitigates / drives. Clicking “ENV. issue” displays the code table of environmental issue.
Activity unit	STR/INT.	Unit of activity amount
Contact Prs.	String	Contact person
Figure	Picture	Figure of activity.
Memo	Memo	Data source, estimation method, reference etc.

Table 5.4 List of items in the sub-form “Lifetime”

Item	Format	Content
(Value)	Single	Time-wise value of lifetime. Only one record is valid for an activity.
Note	Memo	Data source, estimation method, reference etc.

Table 5.5 List of items in the sub-form “Fixed cost”

Item	Format	Content
(Value)	Single	Time-wise value of fixed cost per activity. Only one record is valid for an activity.
Note	Memo	Data source, estimation method, reference etc.

Table 5.6 List of items in the sub-form “O&M cost”

Item	Format	Content
(Value)	Single	Time-wise value of operating and maintenance (O&M) cost per activity. The O&M cost here does not include the cost which accompanies inputs. Only one record is valid for an activity.
Note	Memo	Data source, estimation method, reference etc.

Table 5.7 List of items in the sub-form “Input”

Item	Format	Content
Input	-	Code and name of input. The list is linked to the

		"Input/Output" table displayed by clicking the column header.
(Value)	Single	Time-wise value of input per activity. Only one record is valid for an activity.
Note	Memo	Data source, estimation method, reference etc.

Table 5.8 List of items in the sub-form "Output"

Item	Format	Content
Input	-	Code and name of output. The list is linked to the "Input/Output" table displayed by clicking the column header.
(Value)	Single	Time-wise value of output per activity. Only one record is valid for an activity.
Note	Memo	Data source, estimation method, reference etc.

Table 5.9 List of items in the sub-form "Affected activity"

Item	Format	Content
Affected activity	-	Code and name of quantitative activity.
Affected item	-	Item is affected by the activity. The list of the item is as follows. 1)Fixed cost, 2)O&M cost (Recruited), 3)O&M cost (Stock), 4)Input (Recruited), 5)Input (Stock), 6)Output (Recruited), 7)Output (Stock), 8)ENV. (= Environmental burden) (Recruited), 9)ENV. (Stock), 10) Lifetime (Recruited), 11) Lifetime (Stock)
Detail of affected item	-	In the case that input, output or environmental burden is selected as affected item, the item is selected from the list of "detail of affected item".
Value	Single	Increase(+)/decrease(-) rate of affected item.
Note	Memo	Data source, estimation method, reference etc.

Table 5.10 List of items in the sub-form "Affected flow"

Item	Format	Content
Affected item	-	Item is affected by the activity. The list of the item is as follows. 1)SRV: Service demand, 2)I_P: Price of Input, 3)I_E: ENV. BRD. of Input, 4)E_P: Price of ENV. BRD., 5)INP: Input constraints, 6)ENB: Environmental burden constraints.
Detail of affected item	-	In the case of SRV, I_P, I_E or INP, users must select the detailed an item from the list of "detail of affected item".
ENV. BRD.	-	In the case of I_E, E_P or ENB, users must select an item from the list of "Environmental burden".

Value	Single	1)SRV: Increase(+)/decrease amount of service demand 2)I_P: Increase(+)/decrease(-) rate of price of input 3)I_E: Increase(+)/decrease(-) rate of environmental burden of input 4)E_P: Increase(+)/decrease(-) rate of price of environmental burden
Unit	-	Unit is shown automatically.
Note	Memo	Data source, estimation method, reference etc.

Table 5.11 List of items in the sub-form “Burden”

Item	Format	Content
Environmental burden	-	Code and name of environmental burden. The list is linked to the “Environmental burden” table displayed by clicking the column header.
(Value)	Single	Time-wise value of environmental burden emission per activity. The emission includes the direct emission, not include the emission with input.
Note	Memo	Data source, estimation method, reference etc.

Table 5.12 List of items in the sub-form “Penetration”

Item	Format	Content
No	Integer	Number of penetration
Activity	-	Code and name of activity.
(Value)	Single	Time-wise value of penetration. The unit is different between types of activity. 1: Activity type = “to satisfy service demand” Unit = "Share of the output to the total demand" 2: Activity type = “to influence other activity” Unit = "Introduction ratio to the corresponding activity" 3-1: Activity type = “to influence flow” Affected flow = “SRV”, “INP”, “ENB” Unit = " Stock number in the above base unit " 3-2: Activity type = “to influence flow” Affected flow = “I_P”, “E_P”, “I_E” Unit = " Introduction ratio to the corresponding activity "
Note	Memo	Data source, estimation method, reference etc.

Table 5.13 List of items in the sub-form “Reference”

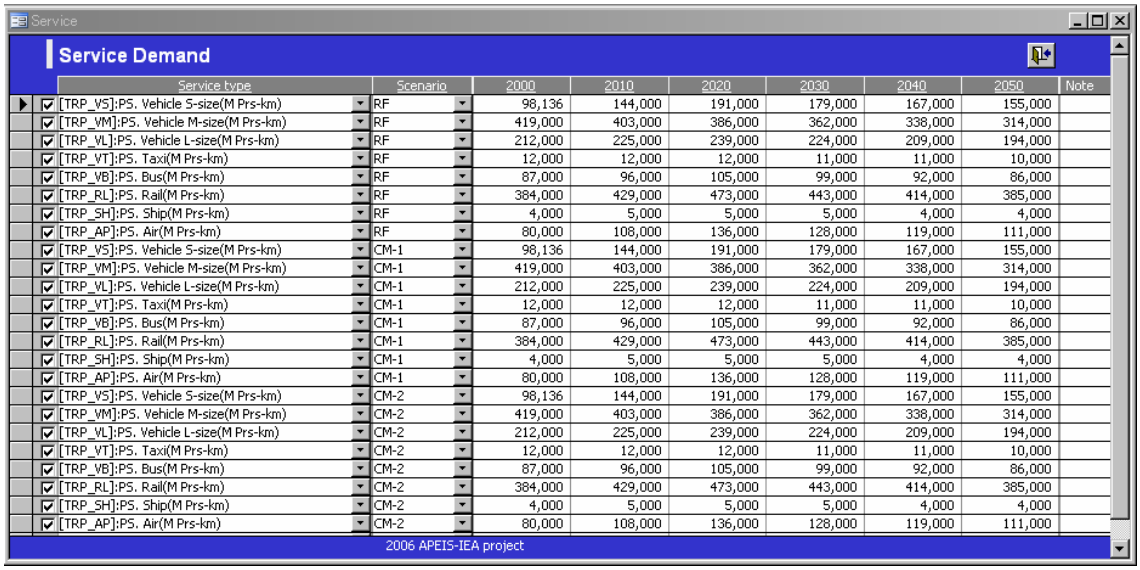
Item	Format	Content
No	Integer	Number of reference
(Upper)	Memo	Data source, estimation method, reference etc.

(Lower)	Hyperlink	Data source, estimation method, reference etc.

5.3 Simulation Condition

1) Service demand

The data for service demand in the reference year and its projections in the future years are entered in this table.



Service type	Scenario	2000	2010	2020	2030	2040	2050	Note
[TRP_VS]:PS. Vehicle S-size(M Prs-km)	RF	98,136	144,000	191,000	179,000	167,000	155,000	
[TRP_VM]:PS. Vehicle M-size(M Prs-km)	RF	419,000	403,000	386,000	362,000	338,000	314,000	
[TRP_VL]:PS. Vehicle L-size(M Prs-km)	RF	212,000	225,000	239,000	224,000	209,000	194,000	
[TRP_VT]:PS. Taxi(M Prs-km)	RF	12,000	12,000	12,000	11,000	11,000	10,000	
[TRP_VB]:PS. Bus(M Prs-km)	RF	87,000	96,000	105,000	99,000	92,000	86,000	
[TRP_RL]:PS. Rail(M Prs-km)	RF	384,000	429,000	473,000	443,000	414,000	385,000	
[TRP_SH]:PS. Ship(M Prs-km)	RF	4,000	5,000	5,000	5,000	4,000	4,000	
[TRP_AP]:PS. Air(M Prs-km)	RF	80,000	108,000	136,000	128,000	119,000	111,000	
[TRP_VS]:PS. Vehicle S-size(M Prs-km)	CM-1	98,136	144,000	191,000	179,000	167,000	155,000	
[TRP_VM]:PS. Vehicle M-size(M Prs-km)	CM-1	419,000	403,000	386,000	362,000	338,000	314,000	
[TRP_VL]:PS. Vehicle L-size(M Prs-km)	CM-1	212,000	225,000	239,000	224,000	209,000	194,000	
[TRP_VT]:PS. Taxi(M Prs-km)	CM-1	12,000	12,000	12,000	11,000	11,000	10,000	
[TRP_VB]:PS. Bus(M Prs-km)	CM-1	87,000	96,000	105,000	99,000	92,000	86,000	
[TRP_RL]:PS. Rail(M Prs-km)	CM-1	384,000	429,000	473,000	443,000	414,000	385,000	
[TRP_SH]:PS. Ship(M Prs-km)	CM-1	4,000	5,000	5,000	5,000	4,000	4,000	
[TRP_AP]:PS. Air(M Prs-km)	CM-1	80,000	108,000	136,000	128,000	119,000	111,000	
[TRP_VS]:PS. Vehicle S-size(M Prs-km)	CM-2	98,136	144,000	191,000	179,000	167,000	155,000	
[TRP_VM]:PS. Vehicle M-size(M Prs-km)	CM-2	419,000	403,000	386,000	362,000	338,000	314,000	
[TRP_VL]:PS. Vehicle L-size(M Prs-km)	CM-2	212,000	225,000	239,000	224,000	209,000	194,000	
[TRP_VT]:PS. Taxi(M Prs-km)	CM-2	12,000	12,000	12,000	11,000	11,000	10,000	
[TRP_VB]:PS. Bus(M Prs-km)	CM-2	87,000	96,000	105,000	99,000	92,000	86,000	
[TRP_RL]:PS. Rail(M Prs-km)	CM-2	384,000	429,000	473,000	443,000	414,000	385,000	
[TRP_SH]:PS. Ship(M Prs-km)	CM-2	4,000	5,000	5,000	5,000	4,000	4,000	
[TRP_AP]:PS. Air(M Prs-km)	CM-2	80,000	108,000	136,000	128,000	119,000	111,000	

Figure 5.3 Screen of “Service demand”

Table 5.14 List of items in “Service demand”

Item	Format	Content
(Check button)	-	Service demand with checking is valid for simulation.
Service type	-	Code and name of the service type. The list is linked to the “Input/Output” table displayed by clicking the column header.
Scenario	-	Code of the scenario type. The list is linked to the “Scenario” table displayed by clicking the column header.
(Value)	Single	Time-wise value of service demand. Linear interpolation is applied in the years that intervene. Time step is defined in the “Parameter” table hyperlinked at the column header. If the value in the base year is null, the module interprets the value is zero. If the value after the second, it interprets the value is same as that of the previous time.
Note	Memo	Data source, estimation method, reference etc.

2) Constraint

The data concerning constraint on amount of input and/or environmental emission in reference year as well as its projections in future years are entered in this table.

The SDBE cannot estimate the future combination of the activity under the constraint condition in the table. It only checks whether the total amount of input and/or environmental burden emission is below the constraints. If the amount exceeds the constraint, the message appears as shown in Figure 5.5.

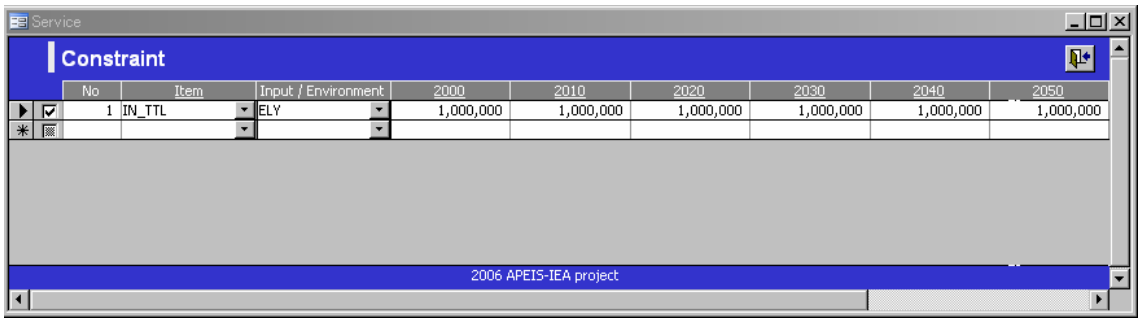


Figure 5.4 Constraint"

Table 5.15 List of item in "Constraint"

Item	Format	Content
(Check button)	-	Constraint with checking is valid for simulation.
Item	-	Code of item. 1) IN_TTL : Total amount of input 2) EB_TTL : Total amount of environmental burden emission
Input/Environment	-	Code of input and environmental burden. The list is linked to the "Input/Output" table and the "Environmental burden" table displayed by clicking the column header.
(Value)	Single	Time-wise value of constraint. Linear interpolation is applied in the years that intervene. Time step is defined in the "Parameter" table hyperlinked at the column header. If the value in the base year is null, the module interprets the value is zero. If the value after the second, it interprets the value is same as that of the previous time.
Note	Memo	Data source, estimation method, reference etc.

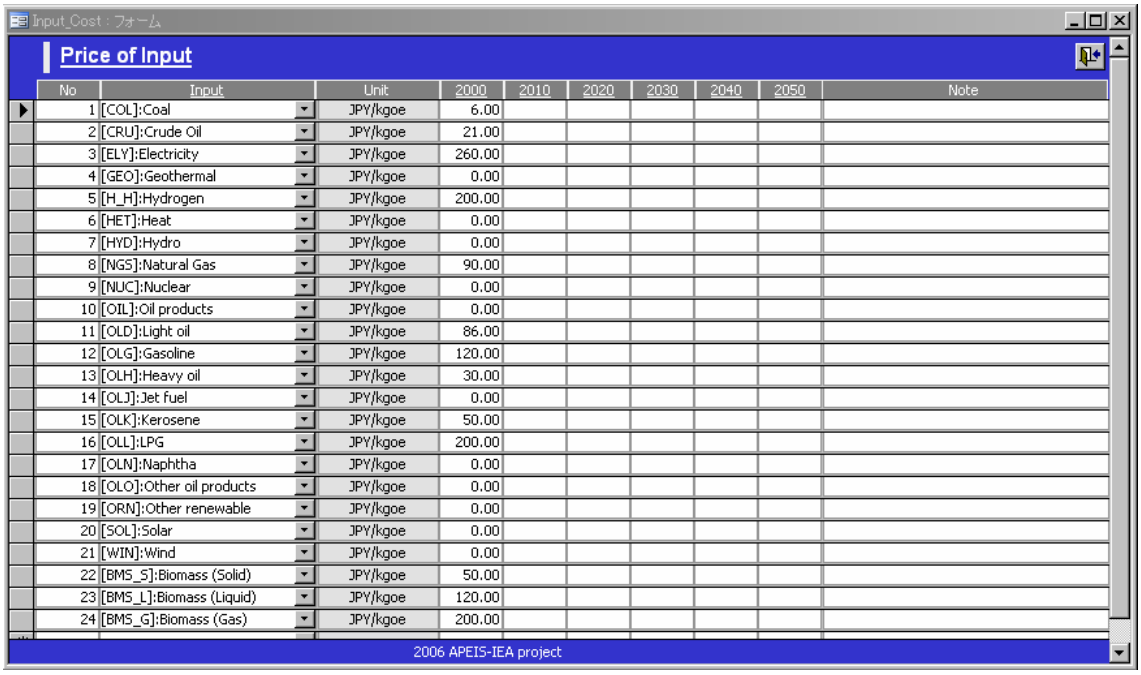
Over Resource/Environment Constraint

Warning	Message
IN_TTL	Supply constraint of input: Year=2009, Scenario=CM-1, Kind=ELY, Constraint=1000000, Consumption/Emission= 1035624
IN_TTL	Supply constraint of input: Year=2010, Scenario=CM-1, Kind=ELY, Constraint=1000000, Consumption/Emission= 1099601
IN_TTL	Supply constraint of input: Year=2011, Scenario=CM-1, Kind=ELY, Constraint=1000000, Consumption/Emission= 1162245
IN_TTL	Supply constraint of input: Year=2012, Scenario=CM-1, Kind=ELY, Constraint=1000000, Consumption/Emission= 1223556
IN_TTL	Supply constraint of input: Year=2013, Scenario=CM-1, Kind=ELY, Constraint=1000000, Consumption/Emission= 1283534
IN_TTL	Supply constraint of input: Year=2014, Scenario=CM-1, Kind=ELY, Constraint=1000000, Consumption/Emission= 1342180
IN_TTL	Supply constraint of input: Year=2015, Scenario=CM-1, Kind=ELY, Constraint=1000000, Consumption/Emission= 1399492
IN_TTL	Supply constraint of input: Year=2016, Scenario=CM-1, Kind=ELY, Constraint=1000000, Consumption/Emission= 1455472
IN_TTL	Supply constraint of input: Year=2017, Scenario=CM-1, Kind=ELY, Constraint=1000000, Consumption/Emission= 1510119

Figure 5.5 Warning message

3) Price of Input

The data for price of inputs are entered in this table.



No	Input	Unit	2000	2010	2020	2030	2040	2050	Note
1	[COL]:Coal	JPY/kgoe	6.00						
2	[CRU]:Crude Oil	JPY/kgoe	21.00						
3	[ELY]:Electricity	JPY/kgoe	260.00						
4	[GEO]:Geothermal	JPY/kgoe	0.00						
5	[H_H]:Hydrogen	JPY/kgoe	200.00						
6	[HET]:Heat	JPY/kgoe	0.00						
7	[HYD]:Hydro	JPY/kgoe	0.00						
8	[NGS]:Natural Gas	JPY/kgoe	90.00						
9	[NUC]:Nuclear	JPY/kgoe	0.00						
10	[OIL]:Oil products	JPY/kgoe	0.00						
11	[OLD]:Light oil	JPY/kgoe	86.00						
12	[OLG]:Gasoline	JPY/kgoe	120.00						
13	[OLH]:Heavy oil	JPY/kgoe	30.00						
14	[OLJ]:Jet fuel	JPY/kgoe	0.00						
15	[OLK]:Kerosene	JPY/kgoe	50.00						
16	[OLL]:LPG	JPY/kgoe	200.00						
17	[OLN]:Naphtha	JPY/kgoe	0.00						
18	[OLO]:Other oil products	JPY/kgoe	0.00						
19	[ORN]:Other renewable	JPY/kgoe	0.00						
20	[SOL]:Solar	JPY/kgoe	0.00						
21	[WIN]:Wind	JPY/kgoe	0.00						
22	[BMS_S]:Biomass (Solid)	JPY/kgoe	50.00						
23	[BMS_L]:Biomass (Liquid)	JPY/kgoe	120.00						
24	[BMS_G]:Biomass (Gas)	JPY/kgoe	200.00						

Figure 5.6 Screen of “Price of input”

Table 5.16 List of item in “Price of input”

Item	Format	Content
No	Integer	Number of the price of input
Input	-	Code and name of the input. The list is linked to the “Input/Output” table displayed by clicking the column header.
Unit	-	Unit of price of input. It is shown automatically with the unit of input and currency in the “Input/Output” and “Parameter” table.
(Value)	Single	Time-wise value of price of input. Linear interpolation is applied for the intervening years. Time step is defined in the “Parameter” table hyperlinked at the column header. If the value in the base year is null, the module interprets the value as zero. If the value after the second, it interprets the value as same as that of the previous time.
Note	Memo	Data source, estimation method, reference etc.

4) Environmental burden from input

The data for environmental burden from input are entered in this table.

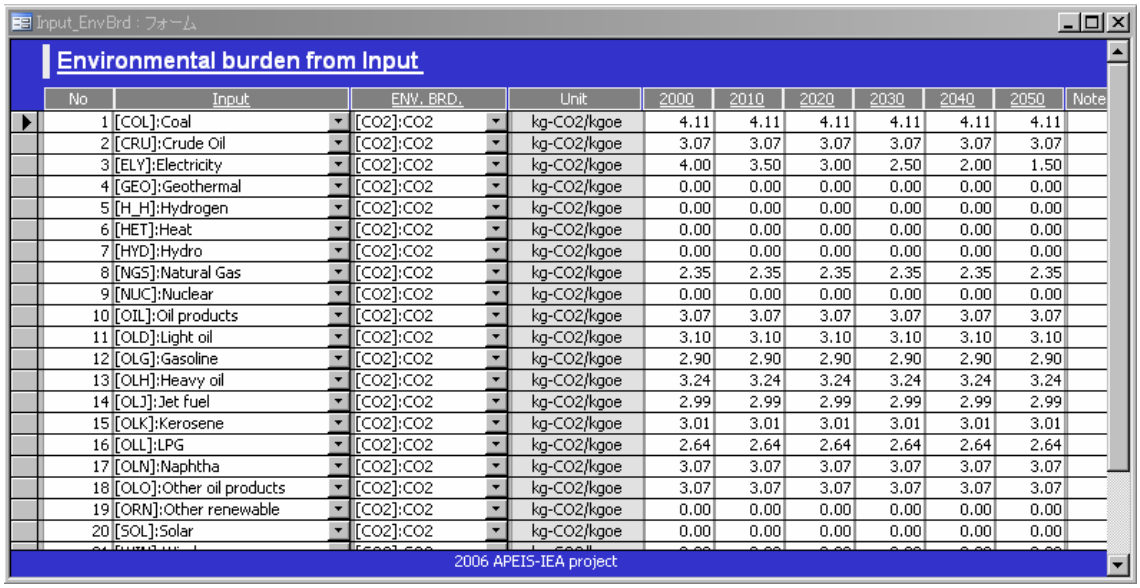


Figure 5.7 Screen of “Environmental burden from input”

Table 5.17 List of item in “Environmental burned from input”

Item	Format	Content
No	Integer	Number of the environmental burden from input
Input	-	Code and name of the input. The list is linked to the “Input/Output” table displayed by clicking the column header.
ENV. BRD.	-	Code and name of the environmental burden. The list is linked to the “Environmental burden” table displayed by clicking the column header.
Unit	-	Unit of environmental burden from input. It is shown automatically with the unit of input and currency in the “Environmental burden” and “Input/Output” table.
(Value)	Single	Time-wise value of environmental burden emission. Linear interpolation is applied in the years that intervene. Time step is defined in the “Parameter” table hyperlinked at the column header. If the value in the base year is null, the module interprets the value is zero. If the value after the second, it interprets the value is same as that of the previous time.
Note	Memo	Data source, estimation method, reference etc.

5) Price of Environmental burden

The data for price of environmental burden are entered in this table.

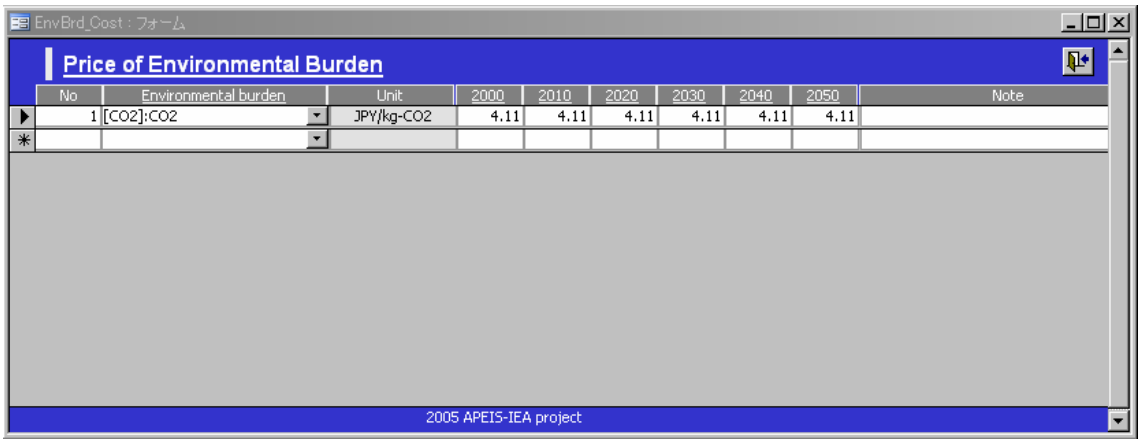


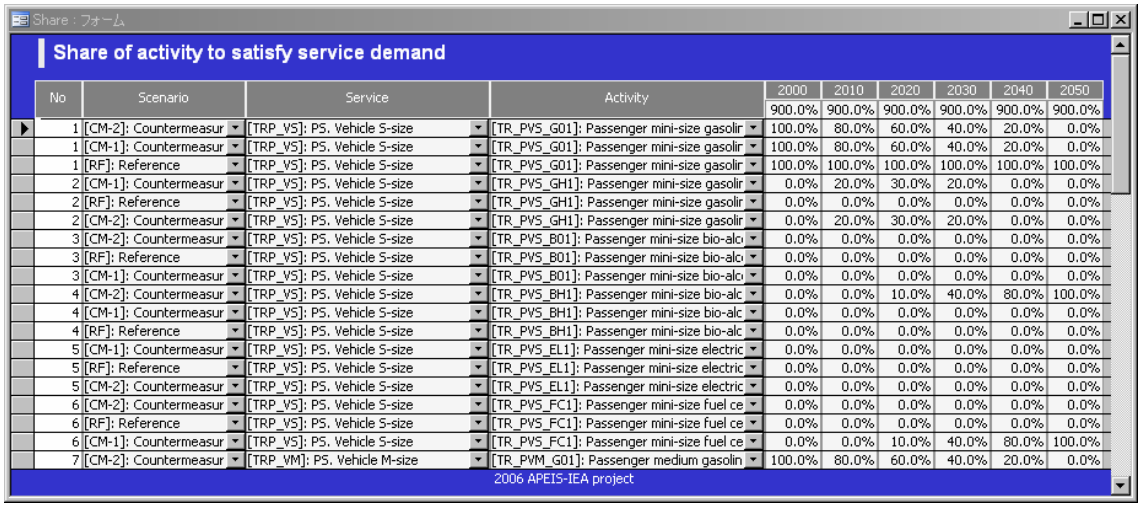
Figure 5.8 Screen of “Price of Environmental Burden”

Table 5.18 List of items in “Price of Environmental burden”

Item	Format	Content
No	Integer	Number of the environmental burden from input
Input	-	Code and name of the input. The list is linked to the “Input/Output” table displayed by clicking the column header.
ENV. BRD.	-	Code and name of the environmental burden. The list is linked to the “Environmental burden” table displayed by clicking the column header.
Unit	-	Unit of environmental burden from input. It is shown automatically with the unit of input and currency in the “Environmental burden” and “Input/Output” table.
(Value)	Single	Time-wise value of price of input. Linear interpolation is applied for the intervening years. Time step is defined in the “Parameter” table hyperlinked at the column header. If the value in the base year is null, the module interprets the value is zero. If the value after the second, it interprets the value is same as that of the previous time.
Note	Memo	Data source, estimation method, reference etc.

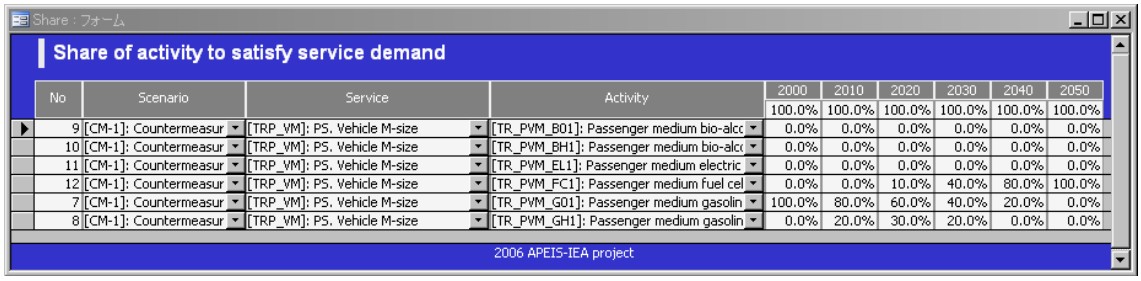
6) Share of activity to satisfy service demand

The table shows the share of activity. It contributes to checking the total share by using the filter function of Microsoft Access.



No	Scenario	Service	Activity	2000	2010	2020	2030	2040	2050
				900.0%	900.0%	900.0%	900.0%	900.0%	900.0%
1	[CM-2]: Countermeasur	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_G01]: Passenger mini-size gasolir	100.0%	80.0%	60.0%	40.0%	20.0%	0.0%
1	[CM-1]: Countermeasur	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_G01]: Passenger mini-size gasolir	100.0%	80.0%	60.0%	40.0%	20.0%	0.0%
1	[RF]: Reference	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_G01]: Passenger mini-size gasolir	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2	[CM-1]: Countermeasur	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_GH1]: Passenger mini-size gasolir	0.0%	20.0%	30.0%	20.0%	0.0%	0.0%
2	[RF]: Reference	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_GH1]: Passenger mini-size gasolir	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2	[CM-2]: Countermeasur	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_GH1]: Passenger mini-size gasolir	0.0%	20.0%	30.0%	20.0%	0.0%	0.0%
3	[CM-2]: Countermeasur	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_B01]: Passenger mini-size bio-alc	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
3	[RF]: Reference	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_B01]: Passenger mini-size bio-alc	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
3	[CM-1]: Countermeasur	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_B01]: Passenger mini-size bio-alc	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
4	[CM-2]: Countermeasur	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_BH1]: Passenger mini-size bio-alc	0.0%	0.0%	10.0%	40.0%	80.0%	100.0%
4	[CM-1]: Countermeasur	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_BH1]: Passenger mini-size bio-alc	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
4	[RF]: Reference	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_BH1]: Passenger mini-size bio-alc	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
5	[CM-1]: Countermeasur	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_EL1]: Passenger mini-size electric	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
5	[RF]: Reference	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_EL1]: Passenger mini-size electric	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
5	[CM-2]: Countermeasur	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_EL1]: Passenger mini-size electric	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
6	[CM-2]: Countermeasur	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_FC1]: Passenger mini-size fuel ce	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
6	[RF]: Reference	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_FC1]: Passenger mini-size fuel ce	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
6	[CM-1]: Countermeasur	[TRP_VS]: PS. Vehicle S-size	[TR_PVS_FC1]: Passenger mini-size fuel ce	0.0%	0.0%	10.0%	40.0%	80.0%	100.0%
7	[CM-2]: Countermeasur	[TRP_VM]: PS. Vehicle M-size	[TR_PVM_G01]: Passenger medium gasolin	100.0%	80.0%	60.0%	40.0%	20.0%	0.0%

Figure 5.9 Screen of “Share of activity to satisfy service demand”



No	Scenario	Service	Activity	2000	2010	2020	2030	2040	2050
				100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
9	[CM-1]: Countermeasur	[TRP_VM]: PS. Vehicle M-size	[TR_PVM_B01]: Passenger medium bio-alc	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
10	[CM-1]: Countermeasur	[TRP_VM]: PS. Vehicle M-size	[TR_PVM_BH1]: Passenger medium bio-alc	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
11	[CM-1]: Countermeasur	[TRP_VM]: PS. Vehicle M-size	[TR_PVM_EL1]: Passenger medium electric	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
12	[CM-1]: Countermeasur	[TRP_VM]: PS. Vehicle M-size	[TR_PVM_FC1]: Passenger medium fuel cel	0.0%	0.0%	10.0%	40.0%	80.0%	100.0%
7	[CM-1]: Countermeasur	[TRP_VM]: PS. Vehicle M-size	[TR_PVM_G01]: Passenger medium gasolin	100.0%	80.0%	60.0%	40.0%	20.0%	0.0%
8	[CM-1]: Countermeasur	[TRP_VM]: PS. Vehicle M-size	[TR_PVM_GH1]: Passenger medium gasolin	0.0%	20.0%	30.0%	20.0%	0.0%	0.0%

Figure 5.10 Screen of “Share of activity to satisfy service demand” (after filtering)

Table 5.19 List of items in “Share of activity to satisfy service demand”

Item	Format	Content
No	Integer	Number of the environmental burden from input
Scenario	-	Code and name of the scenario.
Service	-	Code and name of the service.
Activity	-	Code and name of the activity.
(Value)	Single	Time-wise value of share.

5.4 Code

1) Scenario Code

This table manages the scenario codes used in the database.

Table 5.20 List of items in “Scenario Code”

Item	Format	Content
No	Integer	Number of scenario code
Code	String (10)	Scenario code.
Name	String (50)	Name of scenario
Note	Memo	Explanatory note of scenario etc.

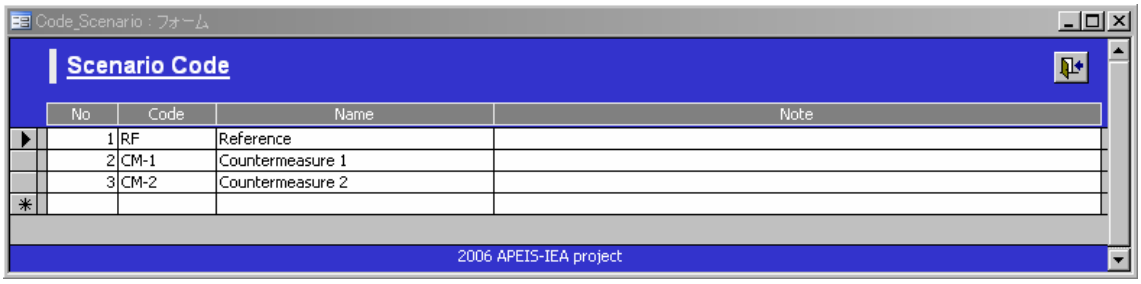


Figure 5.11 Screen of “Scenario Code”

2) Input/Output Code

This table manages the input/ouput codes used in the database.

Table 5.21 List of item in “Input/Output Code”

Item	Format	Content
No	Integer	Number of input/output code.
Code	String (10)	Input/output code
Name	String (50)	Name of input/output
Note	Memo	Explanatory note of input/output etc.

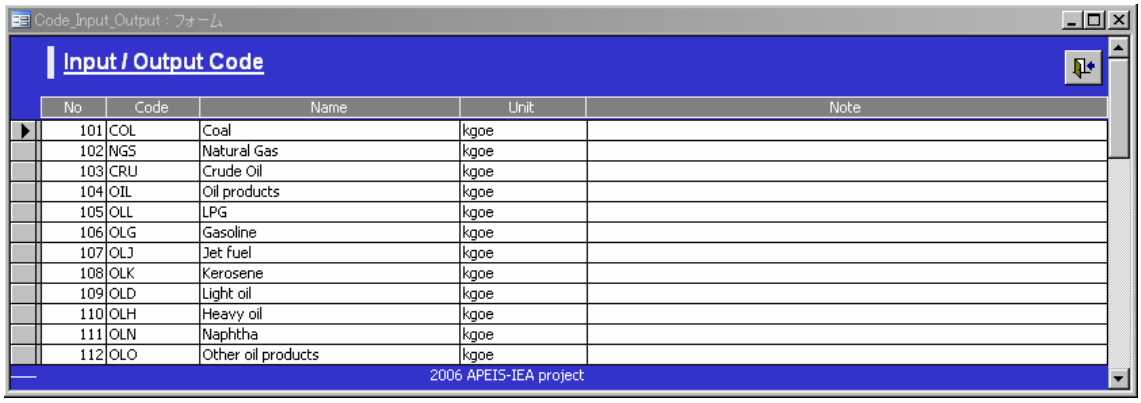


Figure 5.12 Screen of "Input/Output Code"

3) Environmental Burden Code

This table manages the environmental burden codes used in the database.

Table 5.22 List of item in "Environmental Burden Code"

Item	Format	Content
No	Integer	Number of environmental burden code.
Code	String (10)	Environmental burden code
Name	String (50)	Name of environmental burden
Note	Memo	Explanatory note of Environmental burden etc.

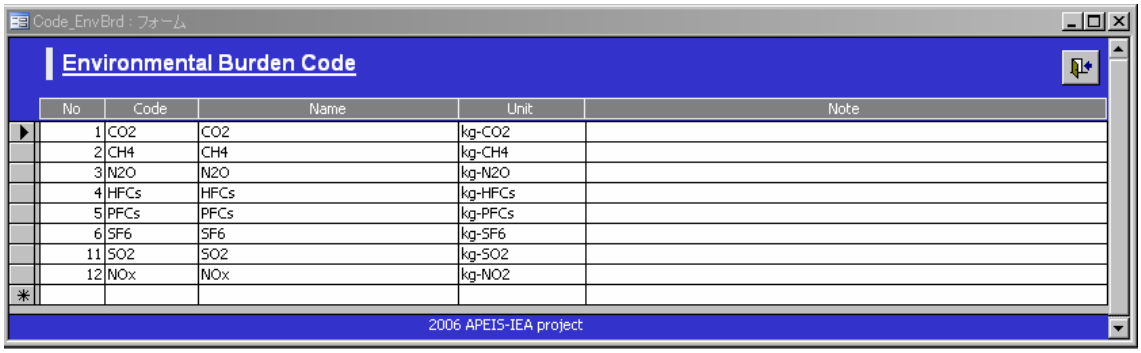


Figure 5.13 Screen of "Environmental Burden Code"

4) Sector Code

This table manages the sector codes used in the database.

Table 5.23 List of item in "Sector Code"

Item	Format	Content
No	Integer	Number of sector code.

Code	String (10)	Sector code
Name	String (50)	Name of sector
Note	Memo	Explanatory note of sector etc.

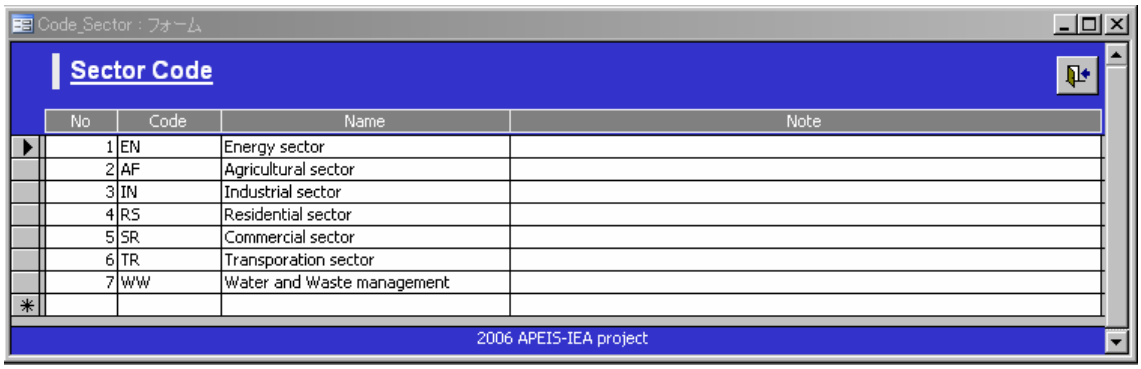


Figure 5.14 Screen of “Sector Code”

6. Simulation

6.1 What can users find by simulation?

SDBE estimates the future amounts of variables shown in Table 6.1 through assuming penetration levels of different activities.

Table 6.1 List of simulation output

Simulation output	Kind[*1]	Dimension
Input amount	IN	(Activity)*(Input)*(Year)
Output amount	OUT	(Activity)*(Output)*(Year)
Environmental burden	ENV	(Activity)*(Output)*(Year)
Operating quantity	DEV	(Activity)*(Year)
Stock quantity	STK	(Activity)*(Year)
Recruited quantity	RCT	(Activity)*(Year)
Total annualized investment cost	RCA	(Activity)*(Year)
Total initial investment cost	RCI	(Activity)*(Year)
Total operating cost including input cost etc.	MNT	(Activity)*(Year)

6.2 Procedure for simulation

Simulation with SDBE proceeds along the following steps.

1) Enter the data concerning specification of activities.
2) Enter the data concerning simulation condition.
3) Click the command button, “RUN”, on the main form.
4) If error exists, the report of error messages opens automatically. Adjust the data based on the message and go to 3).
5) If simulation ends normally, the message, “Simulation End!”, is displayed.

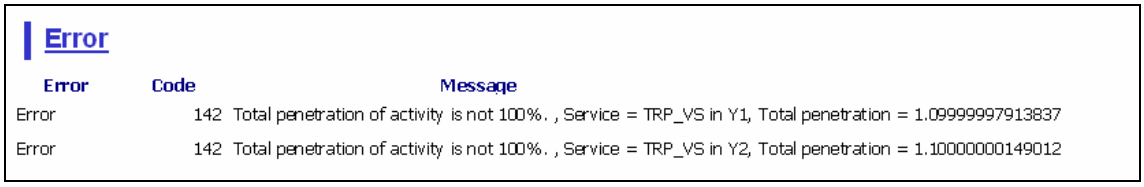


Figure 6.1 Example of error message

6.3 Display of simulation output

1) Simple

By clicking on the tab “Result Simple”, the trend of the environmental burden is displayed as

shown in Figure 6.2.

By double-clicking on the graph, the screen changes to the edit mode as in Figure 6.3. On right-clicking on the edit mode, the user can change the type of graph, the scale of axis and so on.

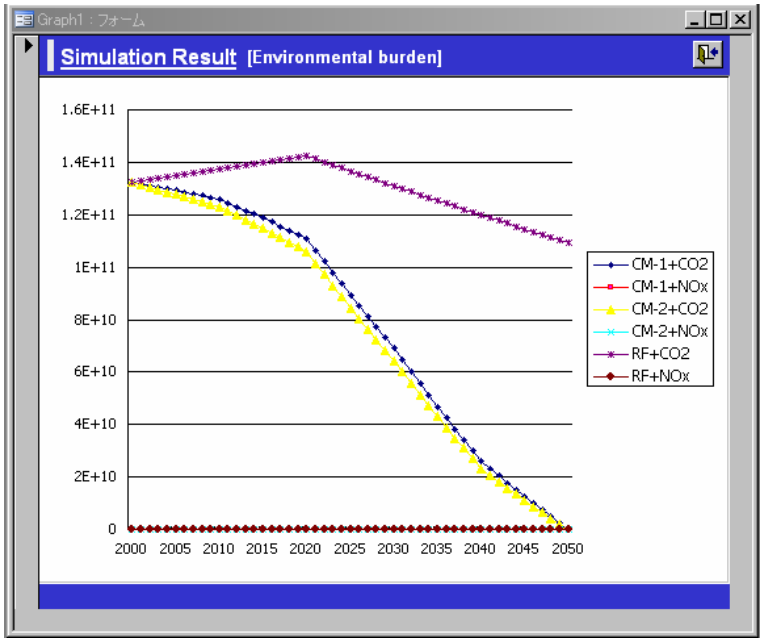


Figure 6.2 Example of simulation result

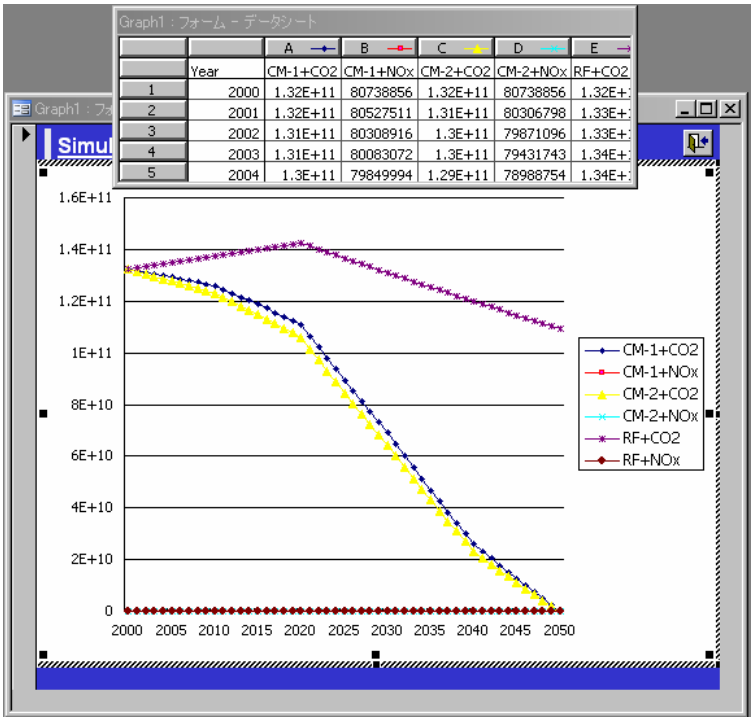


Figure 6.3 Example of simulation result (Edit mode)

2) Detail

By clicking “Result Detail”, a form is shown similar to Figure 6.4. By clicking “Edit”, the pivot table and the pivot chart is shown as in Figure 6.5 and Figure 6.6.

Pivot table and chart allows the user to create dynamic summary data. For example, if the user clicks the filter on the upper side of the form as shown in Figure 6.7, it shows the list. If the user selects ‘DEV’, it shows the operating quantity by activity. Pivot table shows results easily through selecting combinations of items in the list of the filter (Table 6.2).

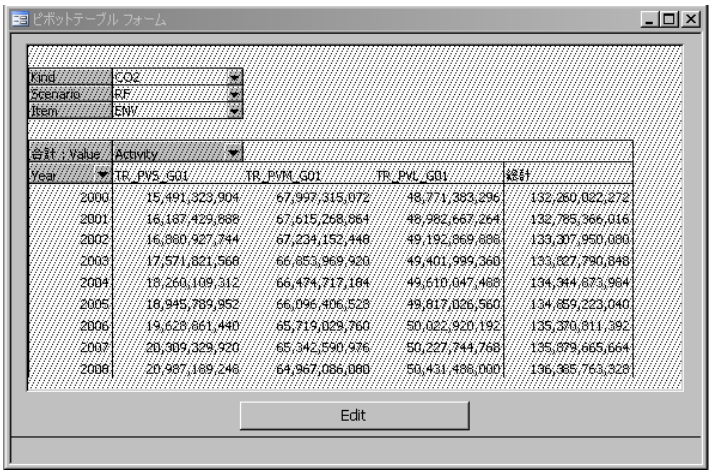


Figure 6.4 Form of pivot table

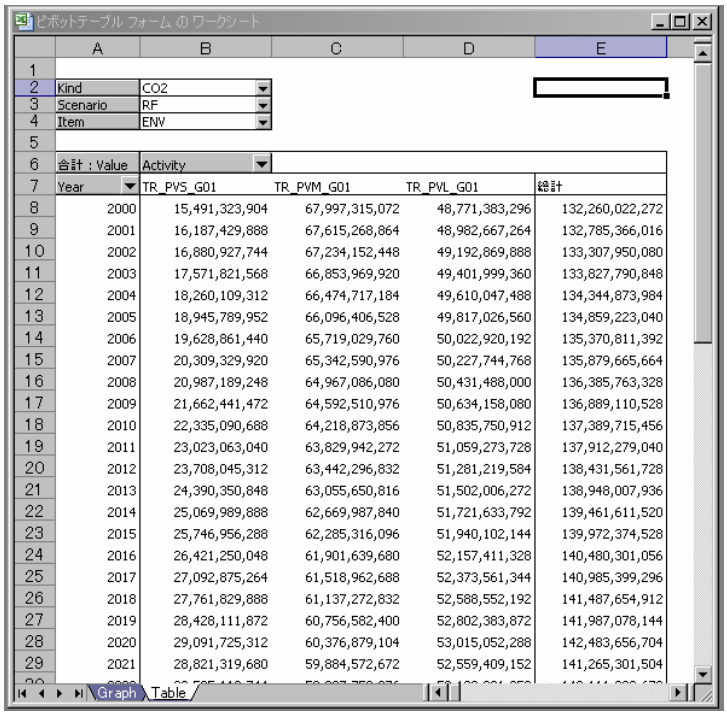


Figure 6.5 Example of pivot table

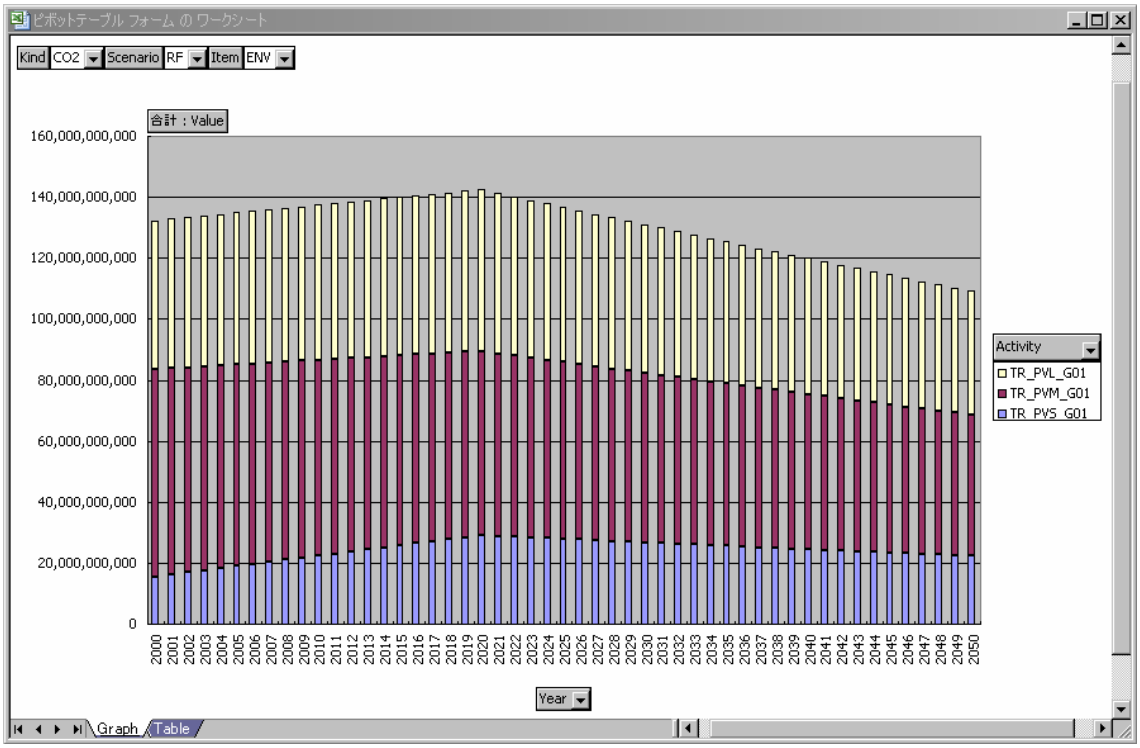


Figure 6.6 Example of pivot chart

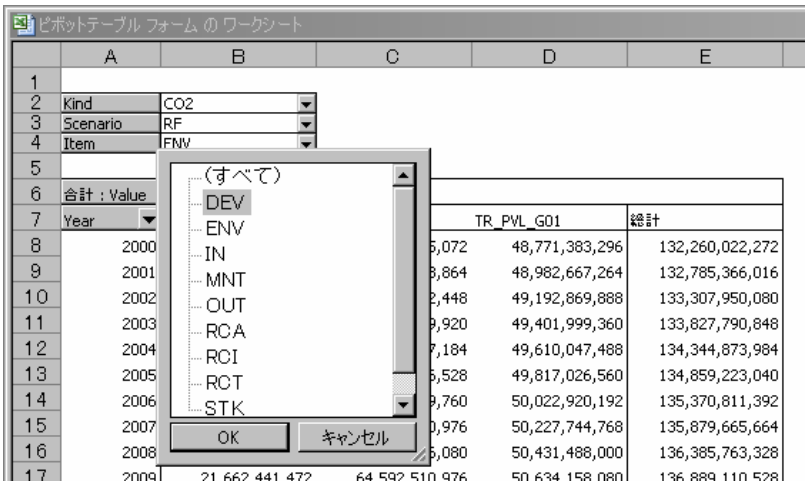


Figure 6.7 Example of edit of pivot table

Table 6.2 Filter of pivot table

Kind[*1]		Item
IN	Input amount	(Input/Output)
OUT	Output amount	(Input/Output)
ENV	Environmental burden	(Environmental burden)
DEV	Operating quantity	-
STK	Stock quantity	-
RCT	Recruited quantity	-
RCA	Total annualized investment cost	-
RCI	Total initial investment cost	-
MNT	Total operating cost including input cost etc.	-

7. Maintenance

It is possibile to store unwanted data which does not appear on the screen by changing code system etc. On clicking the command button, “Clean”, the unwanted data in the database is cleared.