New Integrated Modeling with Special Reference to APEIS

～Environmental Strategic Database Engine～

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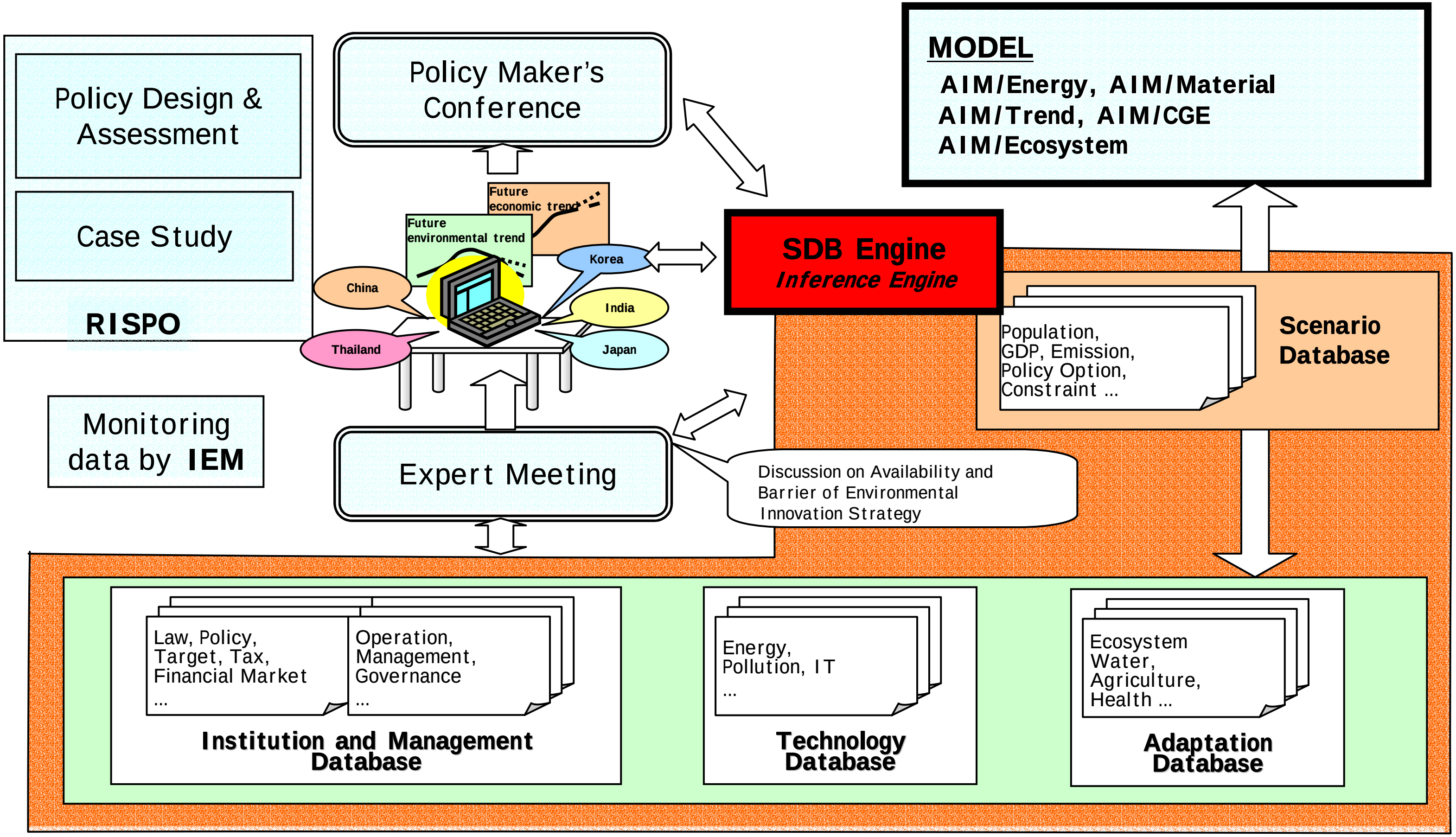
Concept of Environmental Strategic Database

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 politica 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:

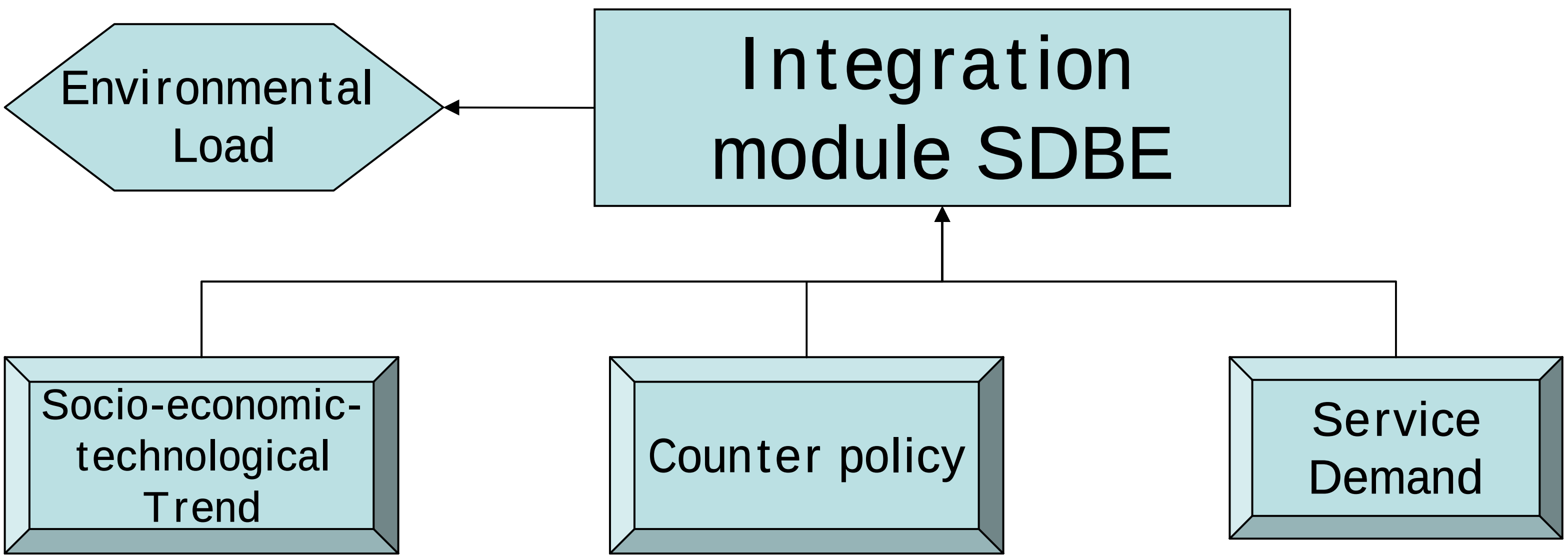
- Perturbation analysis of a key concept or idea of environmental innovation
- Generic and integrated approach on technological, economical and institutional aspects of a target concept/idea

What SDBE cannot do:

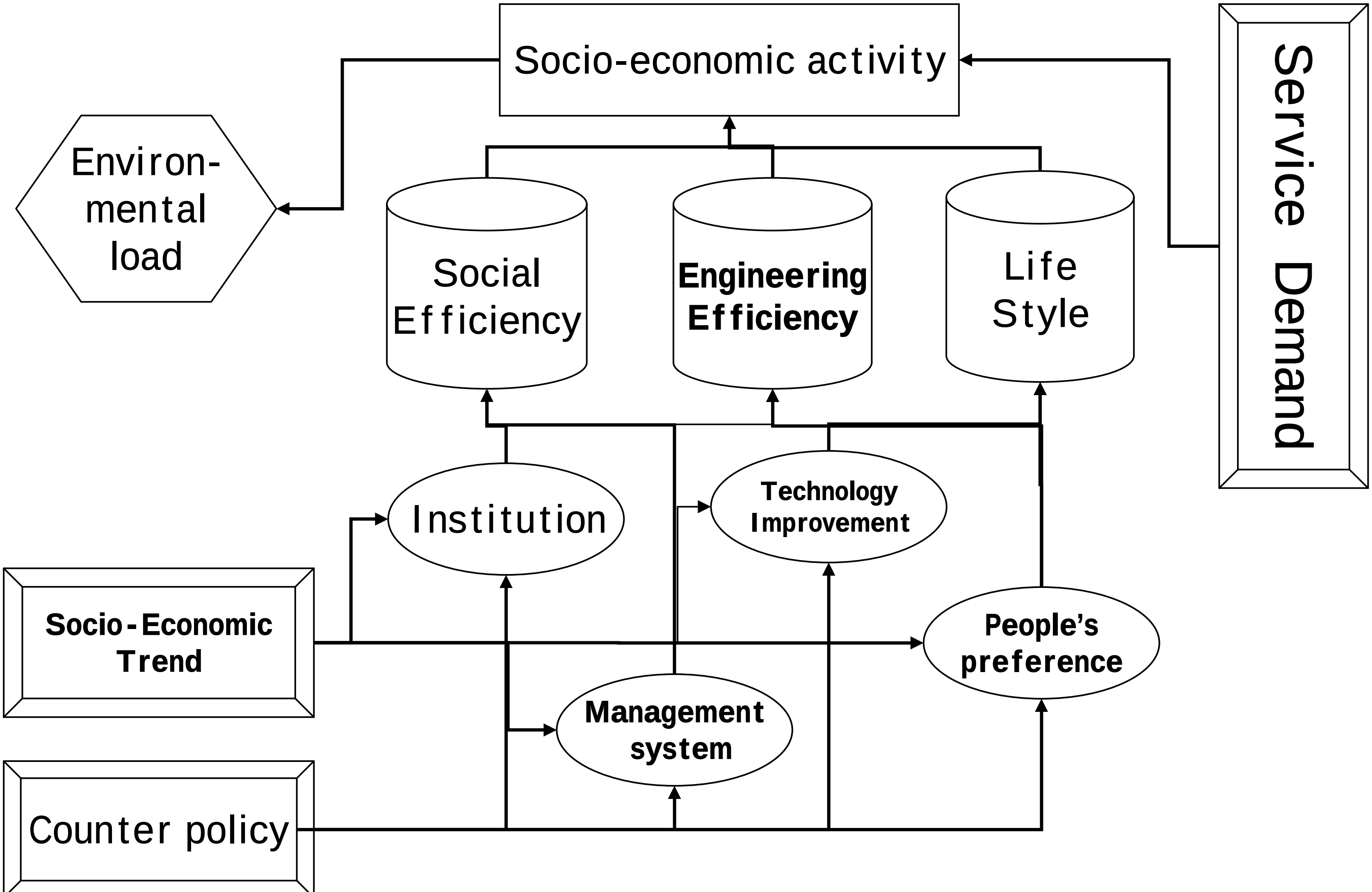
- Macro-economic consistency of analysis
- Detailed engineering analysis and capital cohort structures

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

Initialization stage:

System characteristics at the beginning of the time step are set. Information needed for the setting is state variable values in the previous time step, or from demand scenarios, trend and policy scenarios, etc.

Substitution of parameter values.

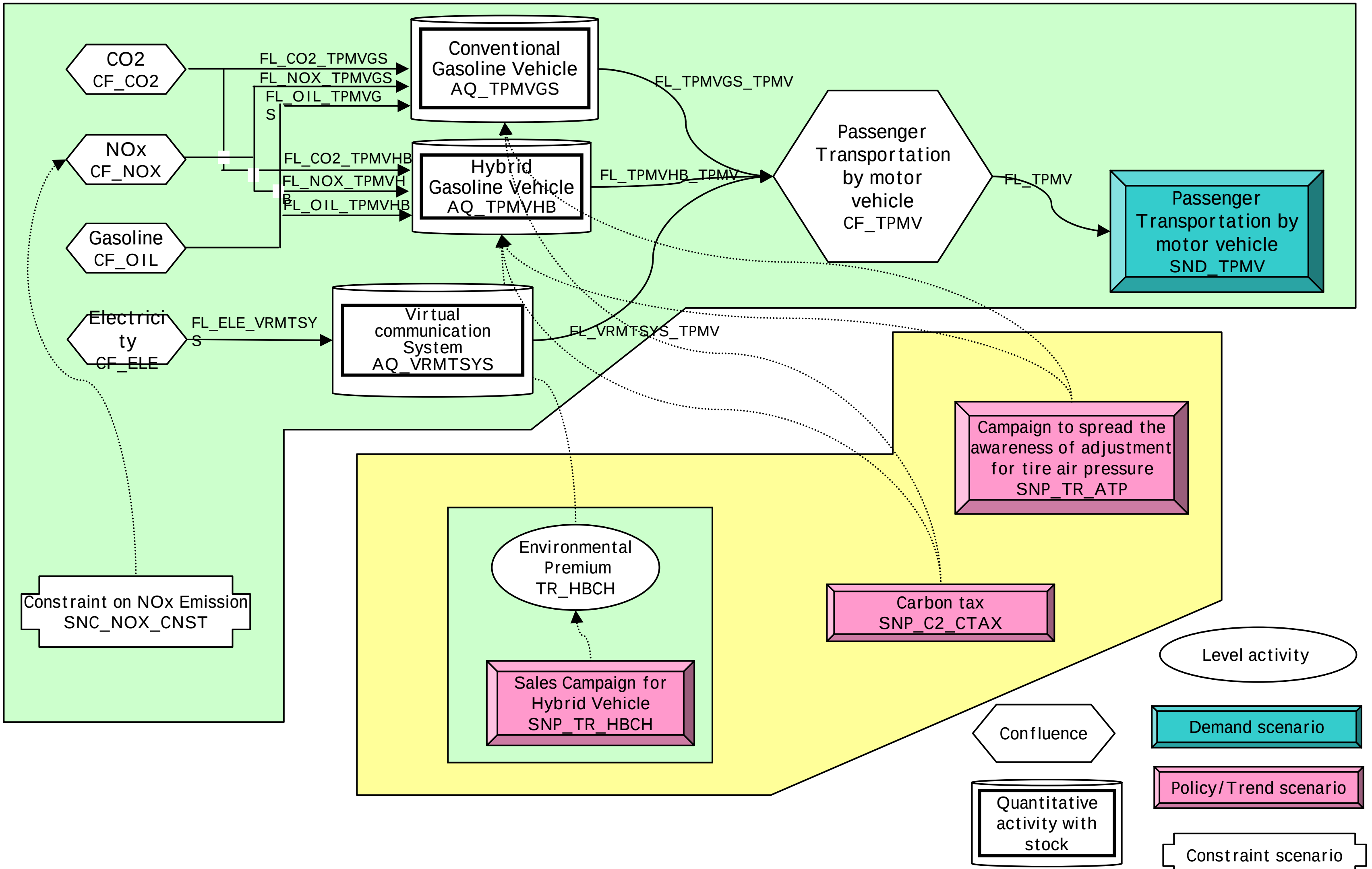
Accompanying calculation stage:

System characteristic values derived from trend and policy scenarios, etc. are calculated one by one based on the causal relations assumed. As for the cause and effect relationships of the inference, trend and policy scenarios are starting points of the causes. Algebraic calculation stage.

Main calculation stage:

To fulfill demand scenarios, required amounts of quantitative activities in the system are calculated. As for the causal relation of this stage, demand scenarios are the outsets of the causes. Mathematical programming stage.

Elements of SDBE



Activity

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

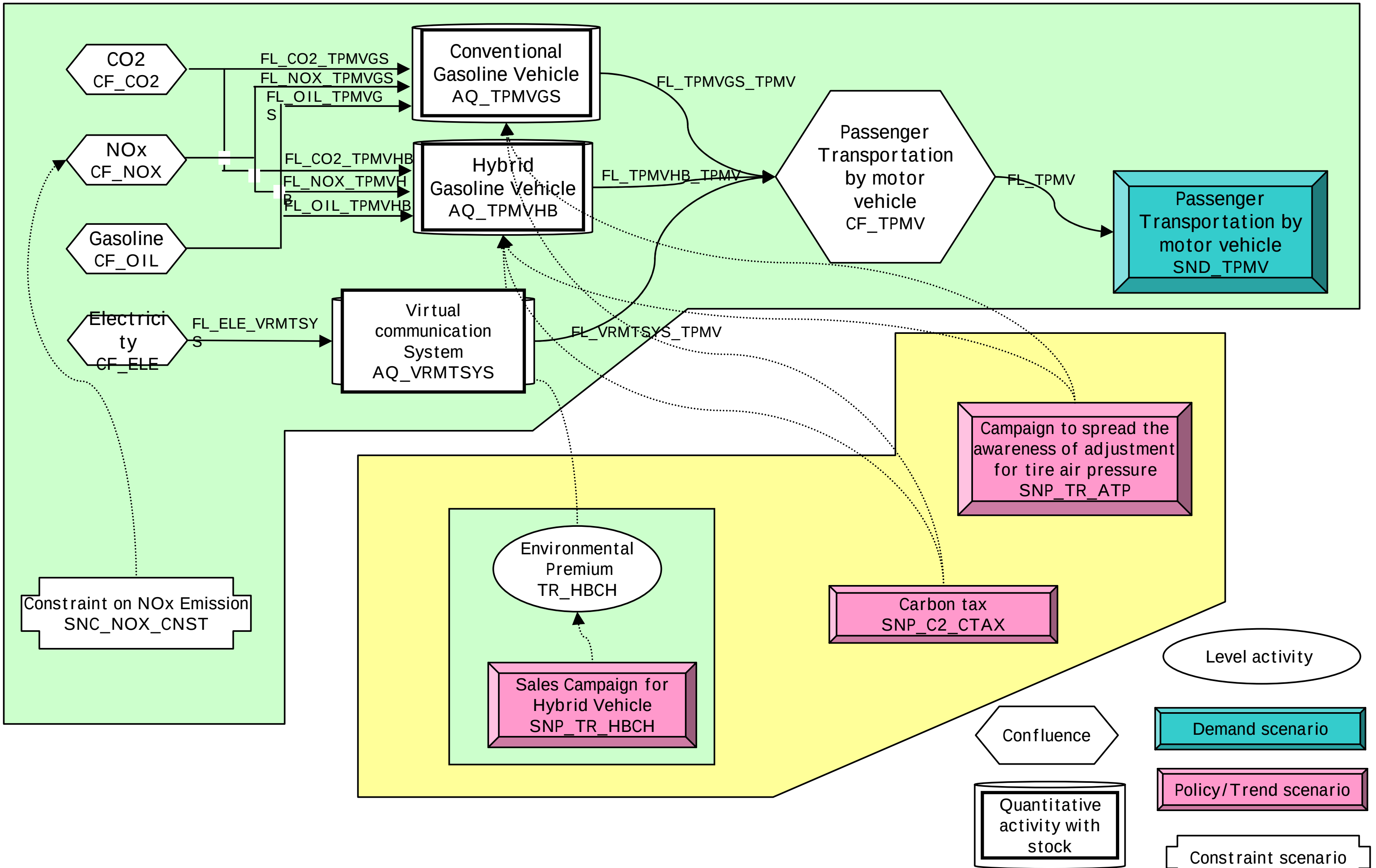
- Two kinds of activity:
1) Quantitative activity has countably additive metrics
2) Level activity has no countably additive metrics to describe the level of activity.

- 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.

Elements of SDBE



Stock

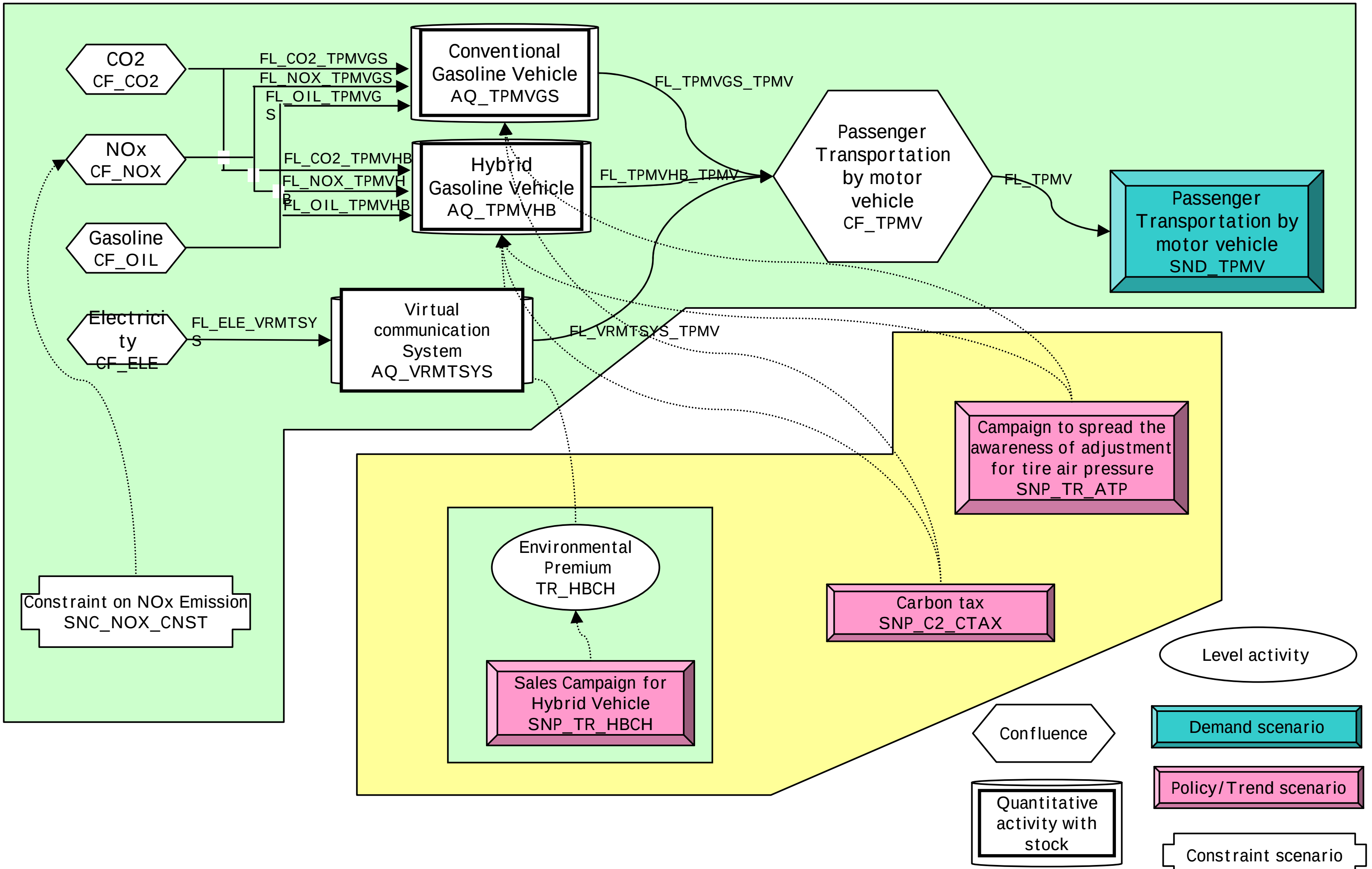
- Stock is attached to a quantitative activity and has almost same concept as that of capital.

- 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).

Elements of SDBE



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.

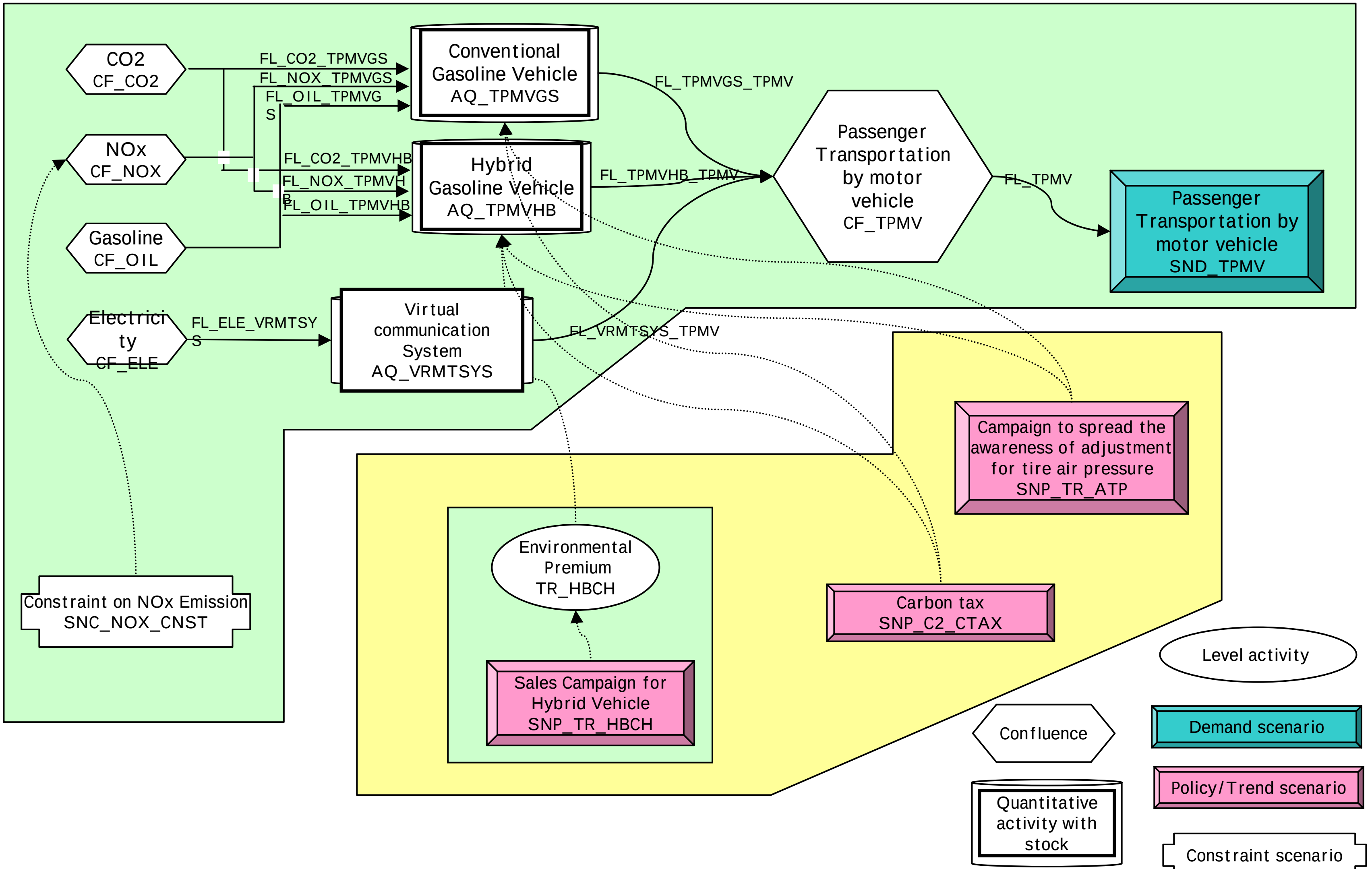
•Flow rate is attached to a flow. It denotes the amount of good or service moved from the upstream edge to the downstream edge within a unit time.

•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.

Elements of SDBE



Confluence

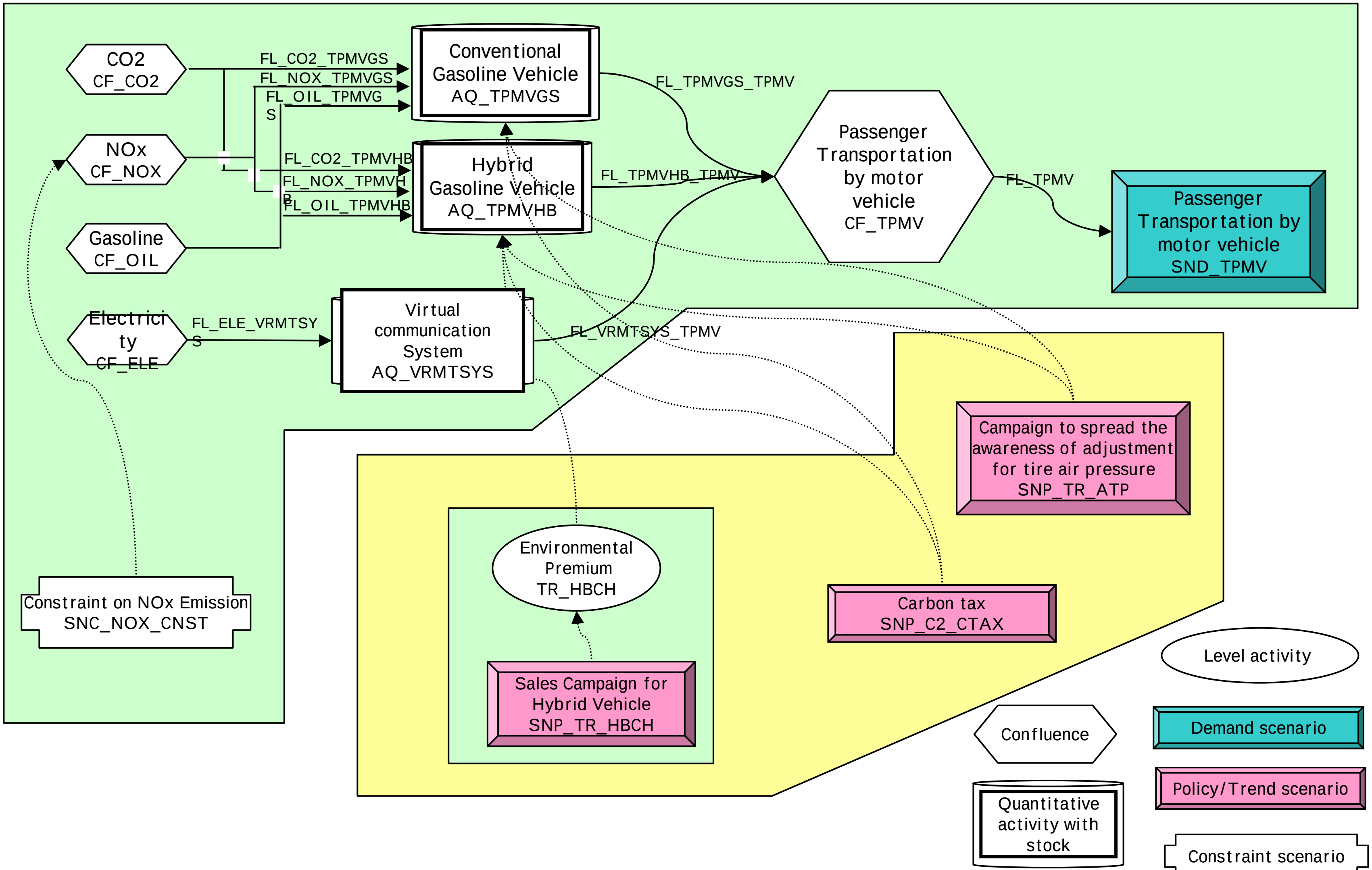
- Inflows or outflows are attached to confluence.

- 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.

Elements of SDBE



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.

What we should take care to apply SDBE

- Need systematic and quantitative preparation of upstream and downstream causal nexus from the view points of technological, economical and institutional characteristics
- Appropriate abstraction of the system description
- Complementary role and position with other AIM models