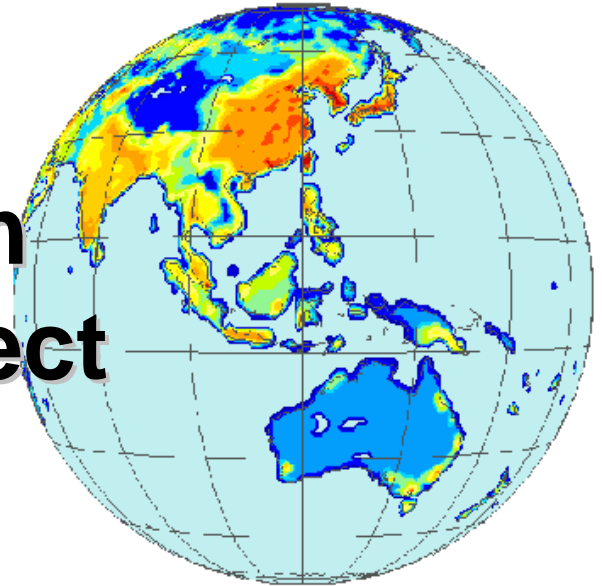# CGE Model and its Role in Low Carbon Society Project

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The 11th AIM International Workshop
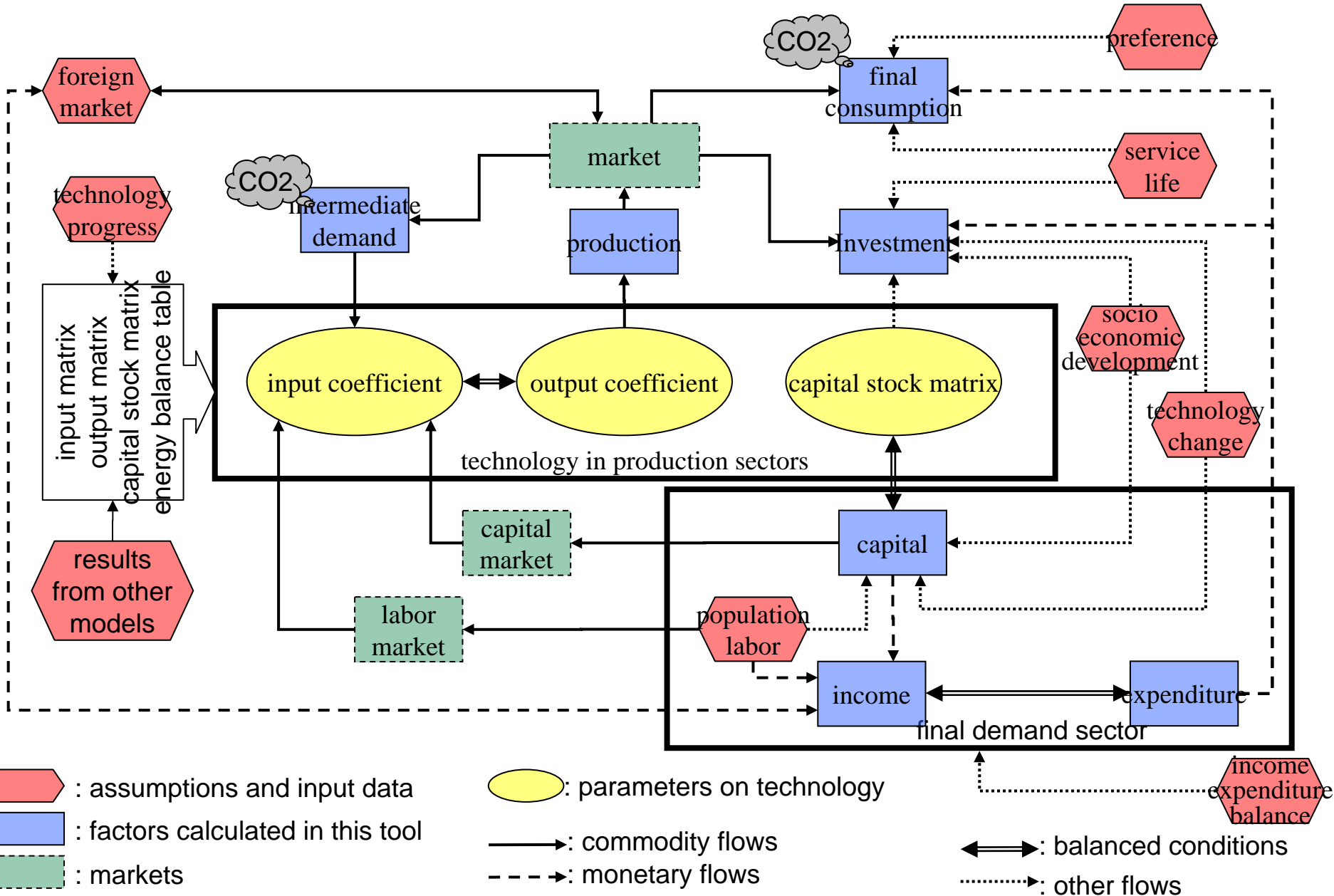
Ohyama Memorial Hall, NIES

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Role of this tool

> ➤ This tool draws the balanced macro economy, based on social conditions such as population, technology and preference, countermeasures proposed by other teams, and the energy efficiency and primary energy supply estimated from bottom-up models.

> ➤ Supply and demand of energies are estimated from hybrid account system which consists of energy balance table and SNA.

> ➤ Based on the story lines, capital stock, income from/to the rest of the world and other account are taken into account.

Image of tool

foreign market

technology progress

CO2

intermediate demand

CO2

market

production

final consumption

preference

service life

Investment

input matrix output matrix capital stock matrix energy balance table

input coefficient ⟷ output coefficient

capital stock matrix

technology in production sectors

socio economic development

technology change

results from other models

capital market

capital

population labor

labor market

income ⟷ expenditure

final demand sector

income expenditure balance

⬡ : assumptions and input data

⬯ : parameters on technology

🟦 : factors calculated in this tool

——→ : commodity flows

⟷ : balanced conditions

🟩 : markets

– – → : monetary flows

······→ : other flows

Overall of this tool (1)

commodities and activities

➢ primary energy
- coal, crude oil, natural gas, nuclear, hydro, other renewable (solar, wind, waste, biomass, ...)

➢ final energy
- coal products, oil products, town gas, electricity, heat, hydrogen, biomass (solid, liquid, gas)

➢ Non-energy
- agriculture, forestry, fishery, foods, textile, paper, chemical (material, products), cement, other ceramic, steel, non-steel metal, machinery, other production, construction, water, whole sale & retail trade, finance & insurance, real estate, transport (passenger, freight), communication, public service, other service

Overall of this tool (2)

i: commodity
e∈*i*: energy goods
n∈*i*: non-energy goods
j: activity
V_{ji}: output
U_{ij}: intermediate demand
CAP_j: capital input
$CAPH_j$: capital input (private)
$CAPG_j$: capital input (public)
LAB_j: labor input
W_i: waste generation from final
demand sector
IMP_i: import
EXP_i: export
CH_i: final consumption (household)
CG_i: final consumption (government)
IH_i: fixed capital formation (private)
IG_i : fixed capital formation (public)
TK: total capital
TL: total labor
GDP: gross domestic products
P_i: commodity price
PK_j: capital price
PL: labor price
K_{ij}: capital stock by sectors by
investment goods
SK_i: social stock by investment goods
$CO2$: CO2 emissions

① $V_{j,i} = f_j\left(U_{e,j}, U_{n,j}, CAP_j, LAB_j\right)$: production function

② $\sum_j V_{j,i} + W_i + IMP_i - EXP_i = \sum_j U_{ij} + CH_i + CG_i + IH_i + IG_i$: commodity market

③ $TK = \sum_j CAP_j$: capital market

④ $TL = \sum_j LAB_j$: labor market

⑤ $GDP = \sum_i CH_i + CG_i + IH_i + IG_i + EXP_i - IMP_i$: calculation of GDE

⑥ $\sum_i P_i * U_{i,j} + PK_j * CAP_j + PL * LAB_j = \sum_i P_i * V_{j,i}$: expenditure and income in production sector

⑦ $\begin{cases} \sum_j PK * CAPH_j + PL * TL + \sum_i W_i + ah = \sum_i P_i * \left(CH_i + IH_i\right) \text{: expenditure and income in household} \\ \sum_j PK * CAPG_j + ag = \sum_i P_i * \left(CG_i + IG_i\right) \text{: expenditure and income in government} \end{cases}$

⑧ $IMP_i = imp_i(*), EXP_i = exp_i(*)$: assumption of import and export

⑨ $K_{i,j} = k_j\left(CAP_j\right)$: fixed capital stock matrix

⑩ $IH_i + IG_i = \sum_j g_j\left(d_i, g_j, K_{i,j}\right) + gs\left(d_i, gs, SK_i\right)$: investment goods market

⑪ $CAP_j = CAPH_j + CAPG_j = \sum_i K_{i,j}$: capital stock

⑫ $CO2 = \sum_e ef_e * \left(CH_e + CG_e + \sum_j er_{e,j} * U_{e,j}\right)$: CO2 emission

ah: net income transfer in household
ag: net income transfer in government
d_i: service year
g_j, gs: change in 2050
ef_e: emission factor
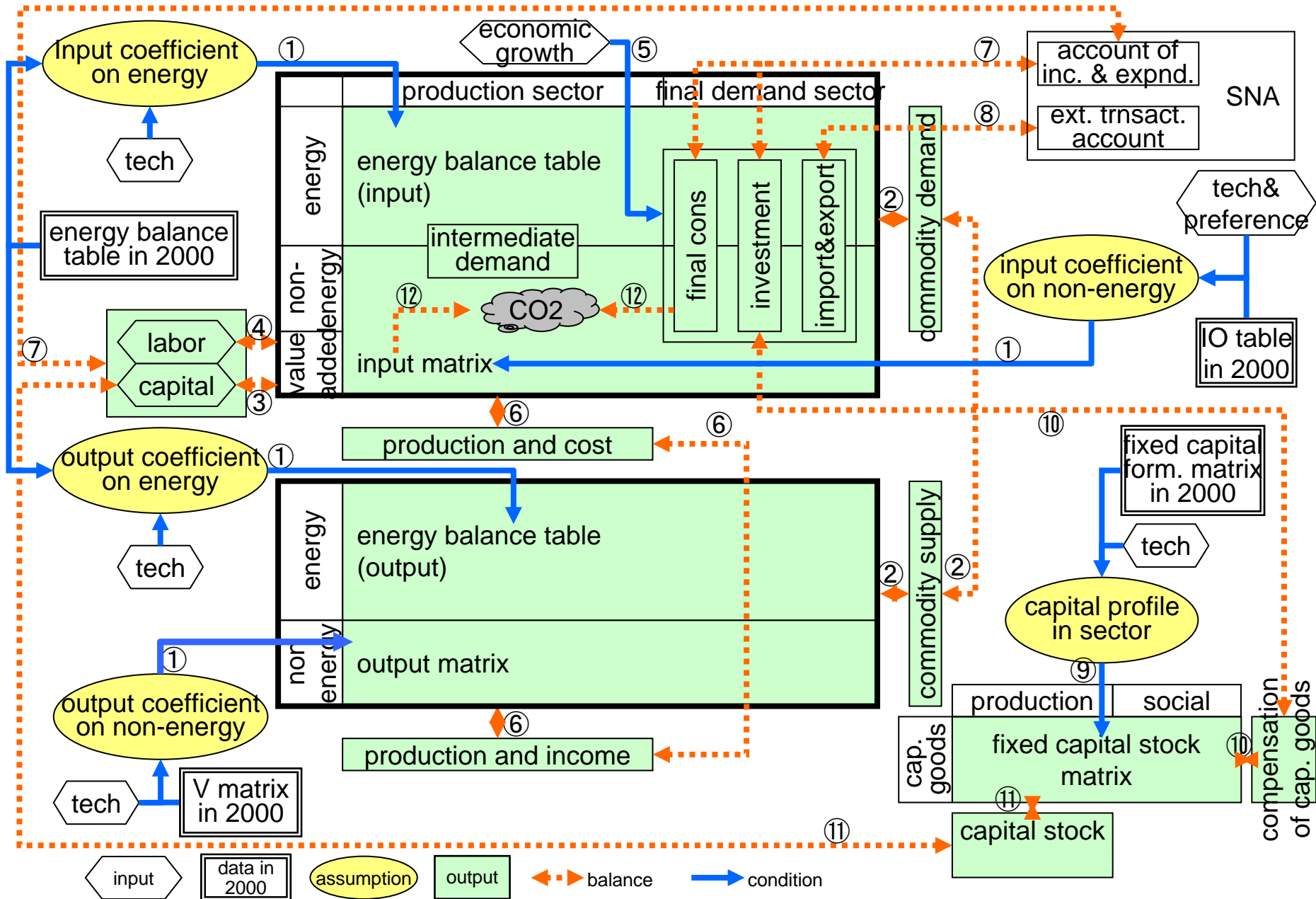$er_{e,j}$: fuel combustion rate

f_j: production function
imp_i: import function
exp_i: export function
k_j: capital stock matrix
g_j, gs: investment function

Image of input & output

Attempts to draw low carbon society