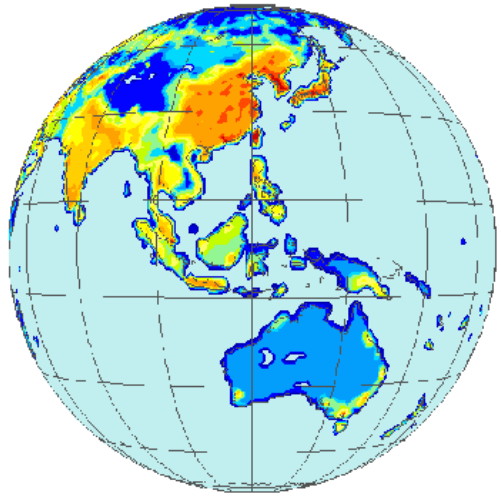
AIM/CGE Model in Low Carbon Society Project



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AIM/Enduse and AIM/CGE

AIM/Enduse model

- This model can treat and assess the individual technology.
- But, this model is partial equilibrium model on energy.
- When the energy demand is changed, the economic activity is also changed.

AIM/CGE model

- This tool draws the balanced macro economy, based on social conditions such as population, technology and preference, countermeasures proposed by other references and model results, and the energy efficiency and primary energy supply estimated from AIM/Enduse model.
- Based on the story lines, capital stock, income from/to the rest of the world and other account are taken into account.
- Supply and demand of energies are estimated from hybrid account system which consists of energy balance table and SNA.
- This tool includes the concept of AIM/Energy snapshot tool.

Process of model development and simulations

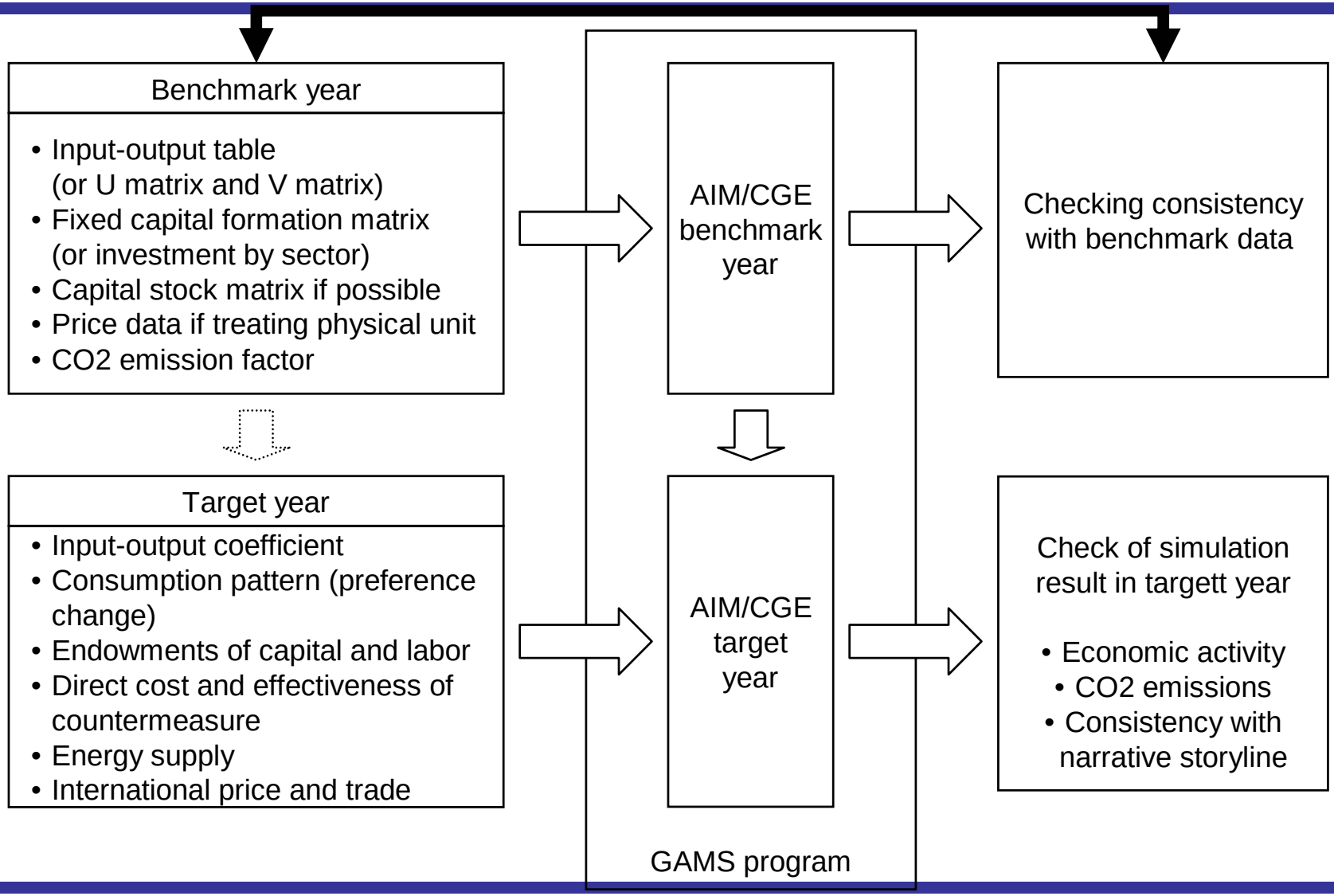
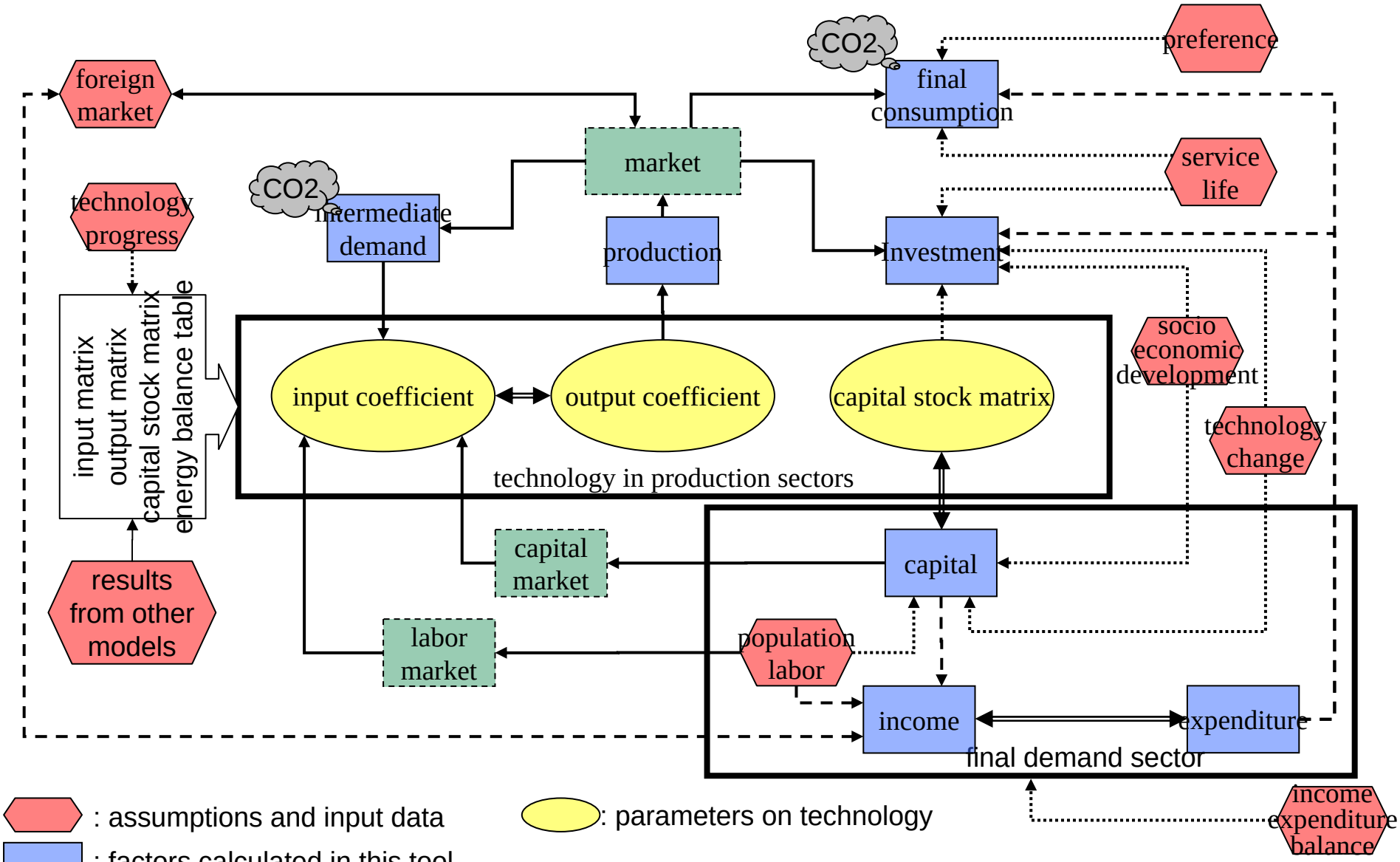


Image of AIM/CGE



Overall of AIM/CGE (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, 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

Definition of commodity and activity can be changed according to your purpose.

Overall of AIM/CGE (2)

i: commodity
$e \in i$: energy goods
$n \in i$: 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
$\sum_j PK * CAPH_j + PL * TL + \sum_i W_i + ah = \sum_i P_i * \left(CH_i + IH_i\right)$: expenditure and income in household
$\sum_j PK * CAPG_j + ag = \sum_i P_i * \left(CG_i + IG_i\right)$: expenditure and income in government

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

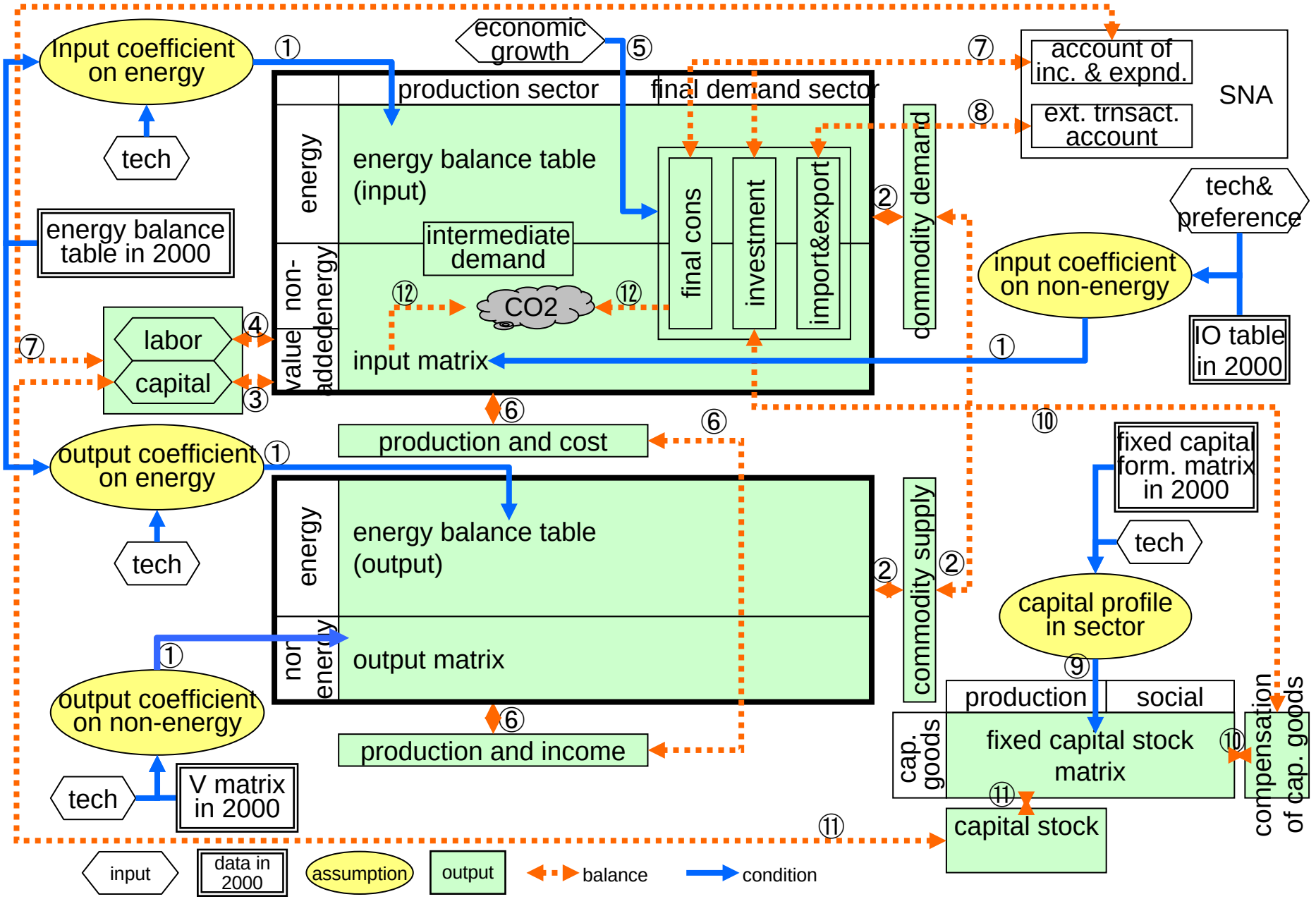
⑪ $CAP_j = CAPH_j + CAPG_j = \sum_i K_{i,j}$: capital stock

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

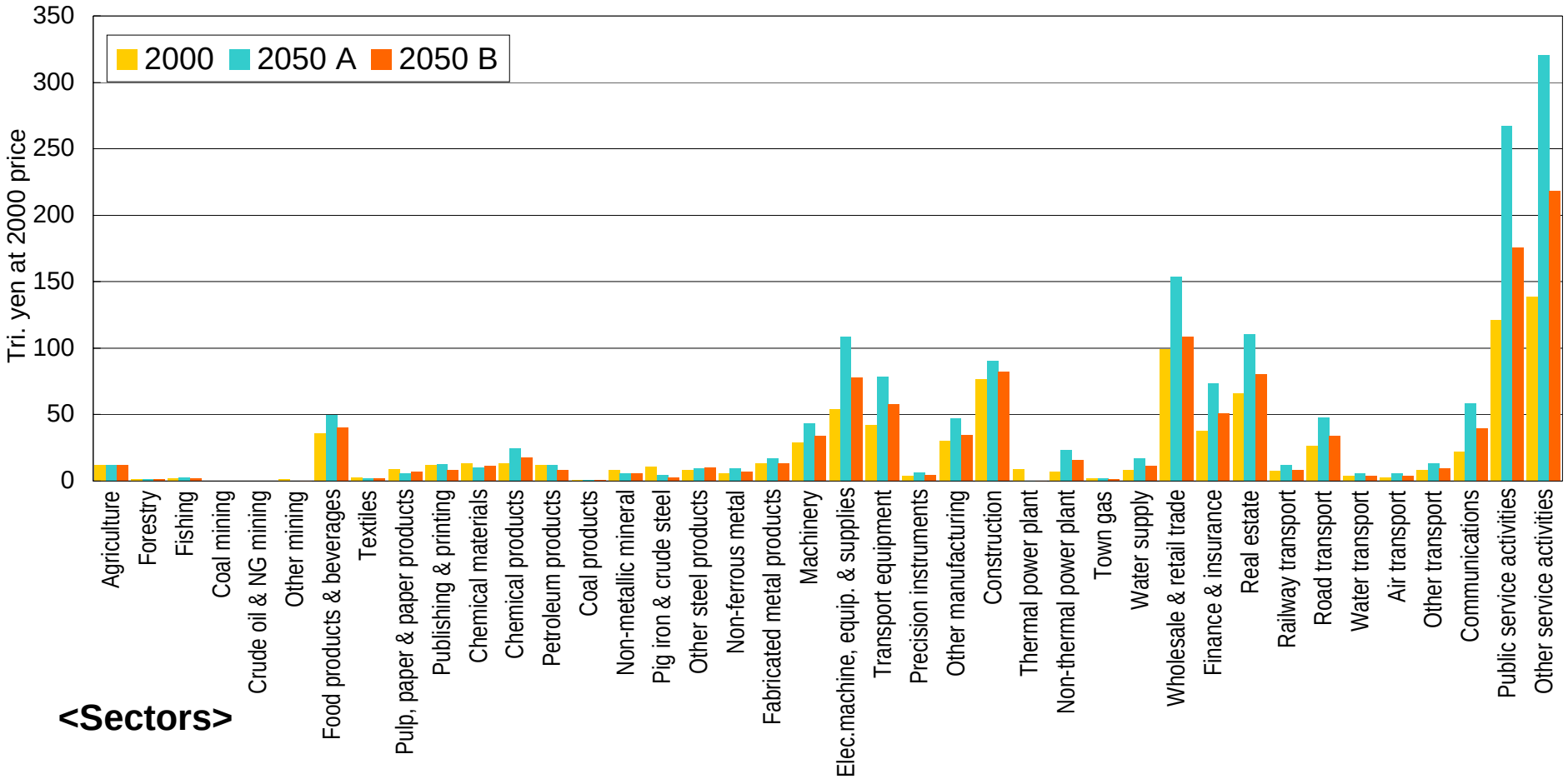
ah: net income transfer in household
ag: net income transfer in government
d_i: service year
g_j, gs: change in 2050
ef_e: emission factor
$er_{e,j}$: fuel combustion rate

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

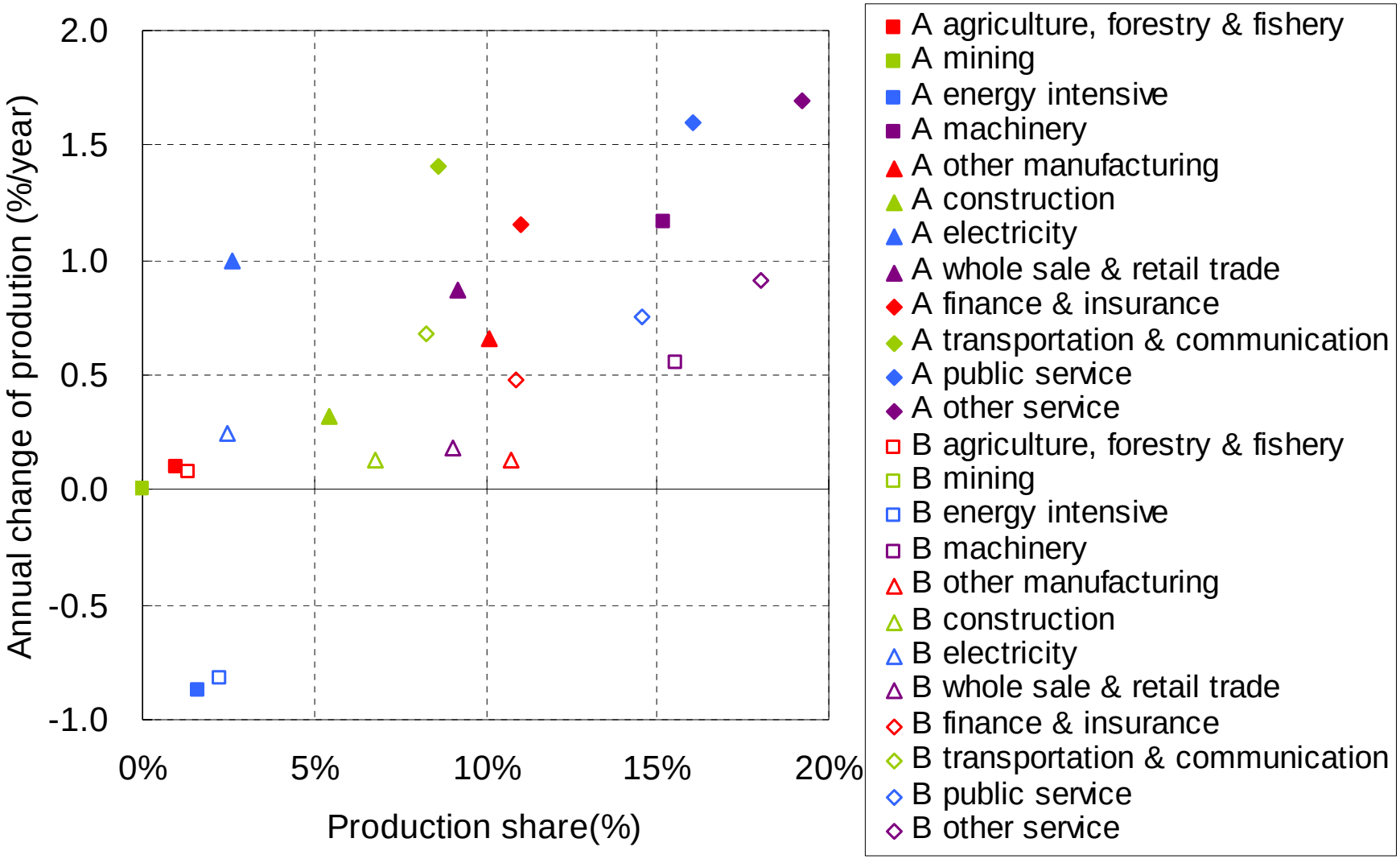
Image of input & output



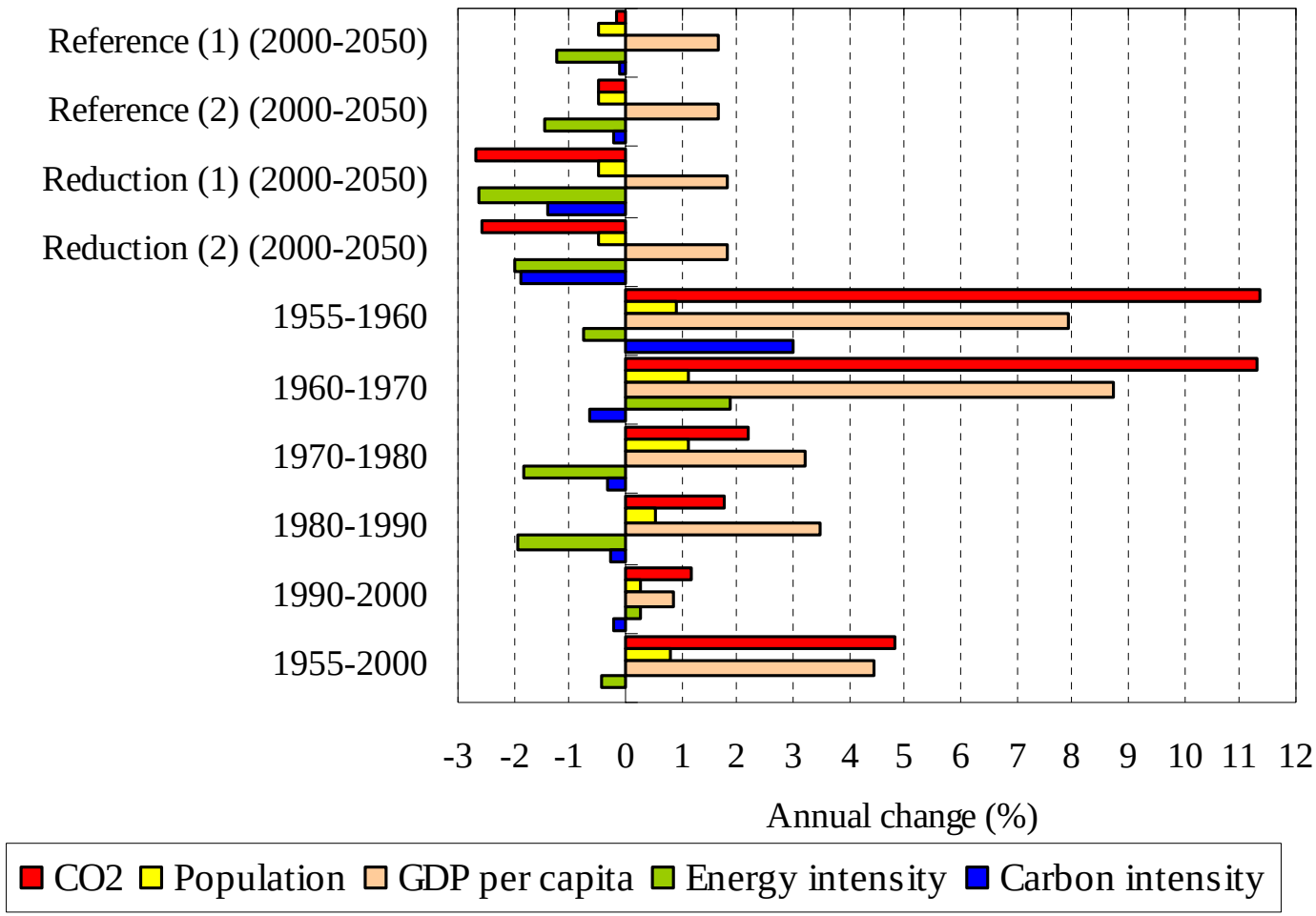
Preliminary results



Preliminary results



Attempts to draw low carbon society



CO2 emission change is disaggregated based on Kaya Identity.