첫번째: CGE 모형 소개

강성원

KEI

2016.08.03

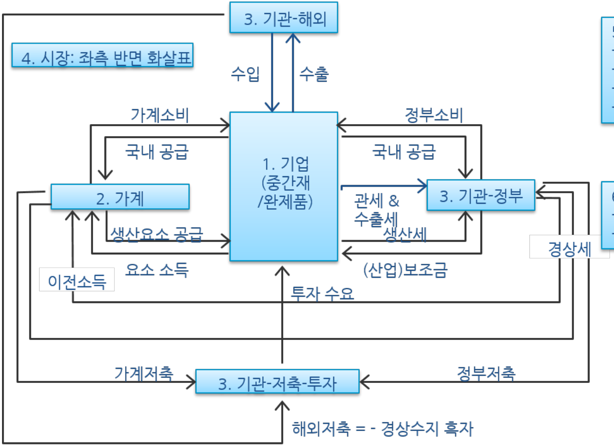
개관

차 례

모형 개관

1. 축차 동태 1국 일반균형 모형
2. 산업(Activity)과 재화(Commodity)를 구분
3. 구성요소
   - 산업: 중간재와 생산요소를 구입하여 제품을 생산하고 시장에 공급
     - 7개 산업: 4개 에너지 산업 (전력, 석탄, 석유, 가스-열), 에너지 집약적 산업, 에너지 비 집약 산업, 농업
   - 가계: 생산요소 판매 수익(요소수입)과 이전소득을 재원으로 제품을 구입하고 나머지를 저축
   - 기관(정부, 해외, 저축-투자): 비시장 경제주체
     - 정부: 조세를 징수하여 제품을 구입하고 가계이전소득 및 산업보조금을 지출하고 나머지는 저축
     - 해외: 수입품 판매 수익으로 수출품을 구입하고 나머지는 저축
     - 저축-투자: 가계, 정부, 해외부문의 저축을 집적하여 제품(투자재)를 구입
   - 시장균형: 제품 및 생산요소의 수요와 급이 일치하는 가격을 파악
   - 동태방정식: 자본축적, 인구변동 등 시간 경과에 따른 변화를 반영
4. 입력자료
   - 사회회계행렬 (Social Accounting Matrix): 경제주체간 거래관계를 행렬로 표시
   - 온실가스-산엽연관표: 특정 재화의 특성 산업 투입에 따른 온실가스 배출량을 표시

흐름도



5. Dynamics: 동태모형
- 인구
- 자본형성
- 소비구조 변화
- 생산성

6. 기후변화
- 배출량 추정 대상 온실가스
- 배출량 저감 정책

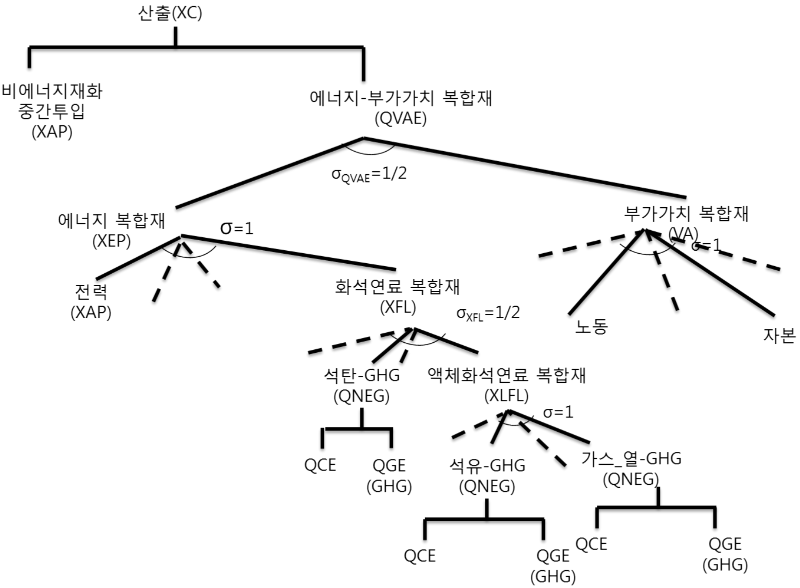
2010 SAM

	ELEC-a	GASHeat-a	OIL-a	COAL-a	ENIT-a	NEINT-a	AGRI-a	CO2-a	ELEC-c	GASHeat-c	OIL-c	COAL-c	ENIT-c	NEINT-c	AGRI-c	CO2-c	Labor	Capital	Household	GoV	NRES	Ptaxin	Ptaxetc	Tarrif	YTAX	S-I	ROW
ELEC-a	0	0	0	0	0	0	0	0	41534.49	0	0	0	0	0	0	0	0	0	0	2427.788	0	0	0	0	0	0	0
GASHeat-a	0	0	0	0	0	0	0	0	0	30161.79	0	0	0	0	0	0	0	0	0	116.0256	0	0	0	0	0	0	0
OIL-a	0	0	0	0	0	0	0	0	0	0	103050.7	0	0	0	0	0	0	0	0	49.77111	0	0	0	0	0	0	0
COAL-a	0	0	0	0	0	0	0	0	0	0	0	6912.343	0	0	0	0	0	0	0	1.195342	0	0	0	0	0	0	0
ENIT-a	0	0	0	0	0	0	0	0	0	0	0	0	532006.5	0	0	0	0	0	0	1692.023	0	0	0	0	0	0	0
NEINT-a	0	0	0	0	0	0	0	0	0	0	0	0	0	2387212	0	0	0	0	0	749.6459	0	0	0	0	0	0	0
AGRI-a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52969.02	0	0	0	0	55.90367	0	0	0	0	0	0	0
CO2-a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5092.352	0	0	0	0	0	0	0	0	0	0	0
ELEC-c	556.757	64.474	815.588	72.901	7486.617	24304.22	272.211	0	0	0	0	0	0	0	0	0	0	0	7975.42	0	0	0	0	0	0	0	83.761
GASHeat-c	8575.153	20534.6	470.029	0.785	3160.66	8720.109	9.565	0	0	0	0	0	0	0	0	0	0	0	7870.849	0	0	0	0	0	0	455.704	18.034
OIL-c	2300.089	681.308	83242.31	67.988	52686.65	22582.39	1632.669	0	0	0	0	0	0	0	0	0	0	0	10533.37	0	0	0	0	0	0	2220.658	40993.88
COAL-c	8892.316	469.276	0	5046.834	8129.638	286.481	103.351	0	0	0	0	0	0	0	0	0	0	0	81.243	0	0	0	0	0	0	-909.442	23.69
ENIT-c	639.452	61.631	2806.869	355.885	239669.9	247991.8	1451.984	0	0	0	0	0	0	0	0	0	0	0	23337.58	0	0	0	0	0	0	2139.022	140680.3
NEINT-c	7651.798	1518.722	7589.852	808.42	93588.16	1034045	17100.04	0	0	0	0	0	0	0	0	0	0	0	527027.6	183108.5	0	0	0	0	0	370461.2	449400.4
AGRI-c	1.268	0.281	1.534	2.866	1430.396	41220.73	3685.653	0	0	0	0	0	0	0	0	0	0	0	14509.49	0	0	0	0	0	0	1949.315	776.428
CO2-c	2427.788	116.0256	49.77111	1.195342	1692.023	749.6459	55.90367	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Labor	3438.079	925.373	1112.996	141.264	46078.63	480825.7	3828.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital	9153.961	3779.67	5012.656	441.533	65433.41	487873.2	23425.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Household	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	536350.3	595119.7	0	39046	1075.434	0	0	0	0	0	0
GoV	0	0	0	0	0	0	0	5092.352	0	0	0	0	0	0	0	0	0	0	0	0	0	140861.3	13654.09	0	83753	0	0
NRES	-47.827	-5.84	369.524	-1.204	6563.552	-2947.43	-2.314	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ptaxin	263.253	2110.82	1487.932	-26.574	6848.875	30835.62	486.808	0	0	0	0	0	0	0	0	0	0	0	46452.57	0	0	0	0	0	0	31724.56	20677.39
Ptaxetc	110.188	21.479	141.412	1.645	930.019	11473.83	975.517	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tarrif	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YTAX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	83753	0	0	0	0	0	0	0	0
S-I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	450050.3	16113.83	2853.031	0	0	0	0	0	-60976.1
ROW	0	0	0	0	0	0	0	0	97.461	19653.69	113890.6	15211.04	127127.8	305088.1	10608.94	0	0	0	0	0	0	0	0	0	0	0	0

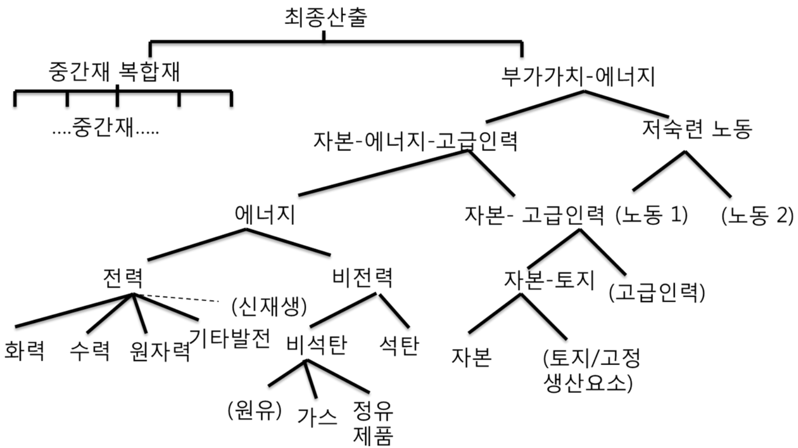
2010 온실가스-산업연관표

	ELEC-a	GASHeat-a	OIL-a	COAL-a	ENIT-a	NEINT-a	AGRI-a	Household	Total
GASHeat-c	439	43	1	0	55	200	0	171	908
OIL-c	105	16	49	1	785	517	45	289	1807
COAL-c	1884	57	0	0	852	32	11	9	2846
process	0	0	0	0	291	0	0	0	291
Total	2428	116	50	1	1983	750	56	469	5852

Toy 생산함수: All ind



표준모형 생산함수: All ind



차 례

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GAMS program 구조 (1):Declaration

1. Title

```
$TITLE Hybrid model top down module trial version
```

2. Declaration: Set

```
SET
A(AC) /ELEC-a,GASHeat-a,OIL-a,COAL-a,ENIT-a,NEINT-a,AGRI-a /
```

3. Declaration: Parameter

```
PARAMETERS
alpha_nres(A) net residue to output ratio
```

4. Declaration: Variable

```
Variables
VA(A)                  Demand for Value Added composite
```

5. Data loading

```
table sam(ACT,ACTP) data in CSV format
$Ondelim
$include b_sam_br_g.csv
$Offdelim
```

6. Declaration:Equation

```
Equations
AspPr(C) Absorption Price PA f of PD and PMT;
AspPr(C)$((SAM('ROW',C) ne 0) and (sum(A,SAM(A,C))>0))..
(1/alphaq(C))*(((deltaq(C))**(sigmaq(C))*(PD(C))
```

GAMS program 구조 (2): Solving Model

1. calibration and initialization

```
PC0(A)=1;
```

2. Declaration: Model

```
Model
BR 7 ind model
/ImPr.XMT
ResI/;
```

3. setting up initial values

```
PC.L(A)        =        PC0(A)        ;
```

4. solve and save results

```
Loop (t,SOLVE BR Using MCP;
PCREP(A,t)        =        PC.L(A)        ;
Ks.Fx('Capital')=Ks.L('Capital')*(1-delta)+sum(C,XAF.L('S-I',C));
);
```

5. display results

```
display warlasrep;
```

6. export output

차 례

Production: zero profit + input demand

1. 각각의 nest 마다 가상의 생산자가 존재: 투입재를 조합해서 복합재를 구성

2. Zero profit condition (Each nest): $P = MC, PQ = TC$

3. input demand (Each nest): $X_i^d = f(P_i, P_j, P_q, Q)$

Production: Top nest (Leontief), zero profit condition

$$
\begin{aligned}
(ActR_a) \qquad & PC_a \cdot \alpha_a^{nres} \cdot XC_a + \sum_c PA_c \cdot ica_{c,a} XC_a + PVAE_a QVAE_a \\
\geq \quad & PC_a (1 - tain_a - taex_a) XC_a + crevI * crevIw_a * CREV_a
\end{aligned}
$$

```
ActR(A)$(sum(C,SAM(A,C))>0 and not ghg('process',A))..
PC(A)*alpha_nres(A)*XC(A)
+sum(C$M(C),PA(C)*ica(C,A)*XC(A))
+PVAE(A)*QVAE(A)
=g=
PC(A)*(1-ta_in(A)-ta_ex(A))*XC(A)
+crevI*crevIw(A)*CREV(A);
```

$$
\begin{aligned}
(ActRp_a) \qquad & PC_a \cdot \alpha^n res_a \cdot XC_a + \sum_c PA_c \cdot ica_{c,a} XC_a + \sum_{gc} \theta^P_{gc,a} XC_a \cdot gtax_{gc} + PVAE_a QVAE_a \\
\geq \quad & PC_a (1 - tain_a - taex_a) XC_a + crevI * crevIw_a * CREV_a
\end{aligned}
$$

```
ActRp(A)$(ghg('process',A) ne 0)..
PC(A)*alpha_nres(A)*XC(A)
+sum(C$M(C),PA(C)*ica(C,A)*XC(A))
+sum(GC,thetaP(GC,A)*XC(A)*gtax(GC))
+PVAE(A)*QVAE(A)
=g=
PC(A)*(1-ta_in(A)-ta_ex(A))*XC(A)
+crevI*crevIw(A)*CREV(A);
```

Production: Top nest (Leontief), input demand

$$(QVAED_a) \qquad QVAE_a = XC_a$$

```
QVAED(A)$(sum(C,SAM(A,C))>0)..QVAE(A)=e=XC(A);
```

$$(INTDM_{c,a}) \qquad XAP_{c,a} = ica_{c,a} XC_a$$

```
INTDM(C,A)$(M(C) and SAM(C,A)$M(C)>0)..XAP(C,A)=e=ica(C,A)*XC(A);
```

$$(INTDG_{gc,a}) \qquad QINTG_{gc,a} = \theta^P_{gc,a} XC_a$$

```
INTGD(GC,A)$(ghg('process',A)>0)..QINTG(GC,A)=e=thetaP(GC,A)*XC(A);
```

Production: 에너지-부가가치 복합재 (QVAE:CES)

1. Zero Profit condition: $P = MC$ $[VAEPr_a]$

$$PVAE_a \quad = \quad (1/\alpha_a^{VAE}) \cdot [\delta_{XEP,a}^{\sigma_a^{VAE}} PEP_a^{(1-\sigma_a^{VAE})} + \delta_{VA,a}^{\sigma_a^{VAE}} PVA_a^{(1-\sigma_a^{VAE})}]^{1/(1-\sigma_a^{VAE})}$$

```
VAEPr(A)$(sum(C,SAM(A,C))>0)..PVAE(A)=e=(1/alphaaVAE(A))*
(
deltaXEP(A)**sigmaaVAE(A)*PEP(A)**(1-sigmaaVAE(A))
+ deltaVA(A)**sigmaaVAE(A)*PVA(A)**(1-sigmaaVAE(A))
)**(1/(1-sigmaaVAE(A)));
```

2. input demand: VA_a $[XVAD_a]$, XEP_a $[XEPD_a]$

$$(XVAD_a) \qquad VA_a = \delta_{VA,a}^{\sigma_a^{VAE}} \left[\frac{PVAE_a}{PVA_a}\right]^{\sigma_a^{VAE}} \alpha_a^{VAE(\sigma_a^{VAE}-1)} QVAE_a$$

```
XVAD(A)$(sum(C,SAM(A,C))>0)..
VA(A)=e=(deltaVA(A)**sigmaaVAE(A))*((PVAE(A)/PVA(A))**sigmaaVAE(A))
*( alphaaVAE(A)**(sigmaaVAE(A)-1))*QVAE(A);
```

$$(XEPD_a) \qquad XEP_a = \delta_{XEP,a}^{\sigma_a^{VAE}} \left[\frac{PVAE_a}{PEP_a}\right]^{\sigma_a^{VAE}} \alpha_a^{VAE(\sigma_a^{VAE}-1)} QVAE_a$$

```
XEPD(A)$(sum(C,SAM(A,C))>0)..
XEP(A)=e=(deltaXEP(A)**sigmaaVAE(A))*((PVAE(A)/PEP(A))**sigmaaVAE(A))
*( alphaaVAE(A)**(sigmaaVAE(A)-1))*QVAE(A);
```

Production: 부가가치 복합재 (VA:Cobb-Douglas)

1. Zero Profit condition: $P = MC$ $[VAPr_a]$

$$(VAPr_a) \qquad PVA_a = \prod_k \left[\frac{R_k}{\lambda_k \lambda_{k,a} \delta^f_{k,a}}\right]^{\delta^f_{k,a}} \prod_l \left[\frac{W_l}{\lambda^T \lambda_a \delta^f_{l,a}}\right]^{\delta^f_{l,a}}$$

```
VAPr(A)$(sum(C,SAM(A,C))>0)..PVA(A)=e=
(
     prod(K,(R(K)/(lambdak*lambdaka(A)*deltaf(K,A)))**(deltaf(K,A)))*
     prod(L,(W(L)/(lambdat*lambda(A)*deltaf(L,A)))**(deltaf(L,A)))
);
```

2. input demand: L^d_a $[LDA_{l,a}]$, K^d_a $[KDA_{k,a}]$

$$(LDA_{l,a}) \qquad L^d_a = \delta^f_{l,a}\left[\frac{PVA_a}{W_l}\right] VA_a$$

```
LDA(L,A)$(sum(C,SAM(A,C))>0)..LD(L,A)=e=deltaf(L,A)*(PVA(A)*VA(A))/W(L);
```

$$(KDA_{k,a}) \qquad K^d_a = \delta^f_{k,a}\left[\frac{PVA_a}{R_k}\right] VA_a$$

```
KDA(K,A)$(sum(C,SAM(A,C))>0)..KD(K,A)=e=deltaf(K,A)*(PVA(A)*VA(A))/R(K);
```

Production: 에너지 복합재 (XEP:Cobb-Douglas)

1. Zero Profit condition: $P = MC$ $[XEPr_a]$

$$(XEPr_a) \qquad PEP_a \quad = \quad \prod_{c \in ELECC} \left[\frac{PA_c}{\delta^c_{c,a}}\right]^{\delta^c_{c,a}} \left[\frac{PFL_a}{1 - \sum_{c \in ELECC} \delta^c_{c,a}}\right]^{1-\sum_{c \in ELECC} \delta^c_{c,a}}$$

```
XEPr(A)$(sum(C,SAM(A,C))>0)..PEP(A)=e=
  prod(C$ELECC(C),(PA(C)/deltaC(C,A))**(deltaC(C,A)))*
(PFL(A)/(1-sum(C$ELECC(C),deltaC(C,A))))**(1-sum(C$ELECC(C),deltaC(C,A)))
;
```

2. input demand: XFL_a $[XFLD_a]$, $XAP_{c,a|c \in ELECC}$ $[INTDE_{c,a}]$

$$(XFLD_a) \qquad XFL_a = (1 - \sum_{c \in ELECC} \delta^c_{c,a}) \left[\frac{PEP_a}{PFL_a}\right] XEP_a$$

```
XFLD(A)$(sum(C,SAM(A,C))>0)..
XFL(A)=e=(1-sum(C$ELECC(C),deltaC(C,A)))*(PEP(A)/PFL(A))*XEP(A);
```

$$(INTDE_{c,a}) \qquad XAP_{c,a|c \in ELECC} = \delta^c_{c,a} \left[\frac{PEP_a}{PA_c}\right] XEP_a$$

```
INTDE(C,A)$(ELECC(C) and SAM(C,A)$ELECC(C)>0)..
XAP(C,A)=e= deltaC(C,A)*(PEP(A)/PA(C))*XEP(A);
```

Production: 화석연료 복합재 (XFL:CES),Zero Profit Condition

Zero Profit condition: $P = MC$ $[XFLPr0_a]$,$[XFLPr1_a]$

$$(XFLPr0_a) \qquad PFL_{a|sam(coal-c,a)=0} \quad = \quad PLFL_a$$

$$(XFLPr1_a) \qquad PFL_{a|sam(coal-c,a)>0} \quad =$$

$$\left[\sum_{c \in sfule} \delta_{c,a}^{c} {}^{\sigma_a^{XLF}} \left[\frac{PNEG_{c,a}}{AEEI_{c,a}} \right]^{(1-\sigma_a^{XLF})} + (1 - \sum_{c \in sfule} \delta_{c,a}^{c})^{\sigma_a^{XLF}} PLFL_a{}^{(1-\sigma_a^{XLF})} \right]^{1/(1-\sigma_a^{XFL})}$$

```
XFLPr0(A)$(sum(C$sfuel(C),SAM(C,A)=0))..PFL(A)=e=PLFL(A);


XFLPr1(A)$(sum(C$sfuel(C),SAM(C,A) >0))..PFL(A)=e=
(
sum(C$SfuelA(A,C),
deltaC(C,A)**sigmaaXFL(A)*(PNEG(C,A)/AEEI(C,A))**(1-sigmaaXFL(A)))
+
(1-sum(C$SfuelA(A,C),deltaC(C,A)))**(sigmaaXFL(A))*PLFL(A)**(1-sigmaaXFL(A))
)**(1/(1-sigmaaXFL(A)));
```

Production: 화석연료 복합재 (XFL:CES), Input demand

Input Demand: $XLFL_a$ [$XLFLD1_a$,$XLFLD0_a$], $QNEG_{c,a|c \in sfuel}$ [$NEGDS_{c,a}$]

$$(NEGDS_{c,a}) \qquad QNEG_{c,a|c \in sfuel} = \delta_{c,a}^{C}{}^{\sigma_a^{XFL}} \left[\frac{PFL_a}{PNEG_{c,a}} \right]^{\sigma_a^{XFL}} AEEI_{c,a}^{(\sigma_a^{XFL}-1)} XFL_a$$

```
NEGDS(C,A)$(Sfuel(C) and (sum(CP$sfuel(CP),SAM(CP,A)) >0))..
QNEG(C,A)=e=
(deltaC(C,A)**sigmaaXFL(A))
*((PFL(A)/PNEG(C,A))**sigmaaXFL(A))
*((AEEI(C,A))**(sigmaaXFL(A)-1))
*XFL(A);
```

$$(XLFLD1_{a|\sum_{c \in sfuel} sam(c,a)>0}) \qquad XLFL_a = (1 - \sum_{c \in sfuel} \delta_{c,a}^{C})^{\sigma_a^{XFL}} \left[\frac{PFL_a}{PLFL_a} \right]^{\sigma_a^{XFL}} XFL_a$$

```
XLFLD1(A)$(sum(C$sfuel(C),SAM(C,A) >0))
..XLFL(A)=e=
(1-sum(C$sfuel(C),deltaC(C,A)))**sigmaaXFL(A)
*(PFL(A)/PLFL(A))**(sigmaaXFL(A))
*XFL(A);
```

$$(XLFLD0_{a|\sum_{c \in sfuel} sam(c,a)=0}) \qquad XLFL_a = XFL_a$$

```
XLFLD0(A)$(sum(C$sfuel(C),SAM(C,A)=0))
..XLFL(A)=e=XFL(A);
```

Production: Gas-Oil 복합재 (XLFL:Cobb-Douglas)

1. Zero Profit condition: $P = MC$ $[XLFLPr1_a]$

$$(XLFLPr1_a) \qquad PLFL_a = \prod_{c \in Lfuel} \left[\frac{PNEG_{c,a}}{\delta^c_{c,a} \cdot AEEI_{c,a}} \right]^{\delta^C_{c,a}}$$

```
XLFLPr1(A)$(Lfuelmix(A) eq 1)..PLFL(A)=e=
prod(C$LfuelA(A,C),(PNEG(C,A)/(deltaC(C,A)*AEEI(C,A)))**deltaC(C,A));
```

2. Input Demand: $QNEG_{c,a|c \in Lfuel}$ $[NEGDL1_{c,a}]$

$$(NEGDL1_{c,a}) \qquad QNEG_{c,a|c \in Lfuel} = \delta^C_{c,a} \frac{PLFL_a}{PNEG_{c,a}} XLFL_a$$

```
NEGDL1(C,A)$(Lfuel(C) and Lfuelmix(A) eq 1)
..QNEG(C,A)=e=deltaC(C,A)*(PLFL(A)/PNEG(C,A))*XLFL(A);
```

Production: 화석연료-온실가스 복합재 (QNEG:Leontief)

1. Zero Profit condition: $P = MC$ $[NEGPr_{c,a|c\in fuel}]$

$$(NEGPr_{c,a}) \qquad PNGE_{c,a} = PA_c + \sum_{gc} \theta^E_{gc,c,a} \cdot gtax_{gc}$$

```
NEGPr(C,A)$(ghg(C,A)>0)
..PA(C)+sum(GC,thetaE(GC,C,A)*gtax(GC))=e=PNEG(C,A);
```

2. Input Demand: $QCE_{c,a|c\in fuel}$ $[NELQCEDL1_{c,a}]$, $QGE_{gc,c,a|c\in fuel}$ $[GD_{gc,c,a|c\in fuel}]$

$$\begin{aligned} (NELQCEDL1_{c,a|c\in fuel}) \qquad & QCE_{c,a} = QNEG_{c,a} \\ (GD_{gc,c,a|c\in fuel}) \qquad & QGE_{gc,c,a} = \theta^E_{gc,c,a} QNEG_{c,a} \end{aligned}$$

```
NELQCED(ENC,A)$(SAM(ENC,A)>0)
..QCE(ENC,A)=e=QNEG(ENC,A);
GD(GC,ENC,A)$(ghg(ENC,A)>0)
..QGE(GC,ENC,A)=e=thetaE(GC,ENC,A)*QNEG(ENC,A);
```

Production: 산업산출(XC_a)= 상품생산($XP_{c|c=a}$)

1. Zero Profit condition: $P = MC$ [$ComPr_c$]

$$(ComPr_{c,a}) \qquad \sum_a \theta_{a,c} PC_a = PP_c$$

```
ComPr(C)$(sum(A,SAM(A,C))>0)
..sum(A$XPXC(C,A),theta(A,C)*PC(A))=g=PP(C);
```

2. Input Demand: XC_a [$ActDC_a$]

$$(ActDC_a) \qquad XC_a = \sum_c \theta_{a,c} XP_c$$

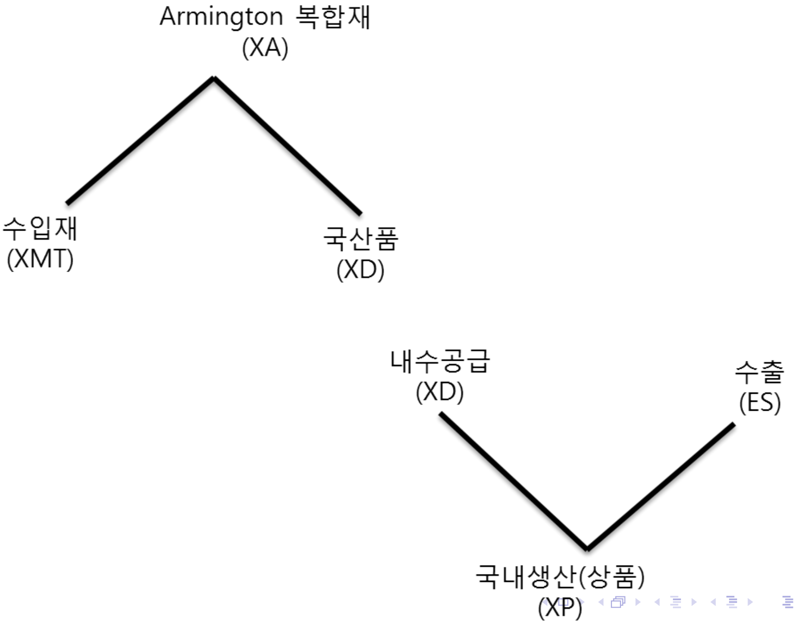
```
ActDC(A)$(sum(C,SAM(A,C))>0)
..XC(A)=g=sum(C$XPXC(C,A),theta(A,C)*XP(C));
```

차 례

Trade: 해외부문(ROW)+수출 결정

1. 해외부문
    - 해외: 수입품을 판매하고 그 수익으로 수출품을 구입하고 나머지를 저축
    - 수입: 교역조건에 따라 시장수요의 일부분은 수입하여 충당
    - 지출: 교역조건에 따라 수출된 국내산출의 일부분을 구입
    - 해외 청산: 수입 = 수출+해외저축
2. Equations
    - 수입가격: 국제가격과 국내가격 관계
    - 수입업자 zero profit: Armington 복합재 가격 결정
    - 수입, 국산 수요 결정
    - 수출가격: 국제가격과 국내가격 관계
    - 국내생산자 zero profit : CET 복합재 가격 결정
    - 수출, 내수 공급 결정
    - 해외부문 balance

수입-내수-수출 관계: Armingtion and CET



수입의 결정: Armington 복합재 생산의 input demand

- 수입가격: 해외가격에 환율을 적용한 국내가를 지불하고 수입세를 납부한 후 소비자가격에 전가
- 총수요-수입수요-내수수요 관계식: 수입업자 zero profit condition

$$PA_cXA_c = PD_cXD_c + PMT_cXMT_c$$

- 수입, 내수 수요::주어진 총수요를 충당하는데 비용을 최소화하는 내수-수입 조합 = Armington 복합재 생산

$$\begin{aligned} \min \quad & PD_cXD_c + PMT_cXMT_c \\ s.t \quad & XA_c = \alpha_c^q(\delta_c^q XD_c^{-\rho_c^q} + (1-\delta_c^q)XMT_c^{-\rho_c^q})^{-\frac{1}{\rho_c^q}} \end{aligned}$$

수입업자= Armington 복합재 생산자, zero profit condition

1. 수입재 국내가격 $[ImPr_c]$

$$(ImPr_c) \qquad pwm_c(1+tm_c)EXR = PMT_c$$

```
ImPr(C)$(SAM('ROW',C) ne 0)..pwm(C)*(1+tm(C))*EXR=g=PMT(C);
```

2. zero profit condition: $P = MC$ $[AspPr_c]$

$$\begin{aligned} &(AspPr_c) \\ &PA_c \quad = \quad (1/\alpha_c^q)[\delta_c^{q\,\sigma_c^q} PD_c{}^{(1-\sigma_c^q)} + (1-\delta_c^q)^{\sigma_c^q} PMT_c{}^{(1-\sigma_c^q)}]^{(1/(1-\sigma_c^q))} \end{aligned}$$

```
AspPr(C)$((SAM('ROW',C) ne 0) and (sum(A,SAM(A,C))>0))
..(1/alphaq(C))*
(((deltaq(C))**(sigmaq(C))*(PD(C))**(1-sigmaq(c))
+ (1-deltaq(C))**sigmaq(C)*(PMT(C))**(1-sigmaq(c)))
**(1/(1-sigmaq(C))))=g=PA(C);
```

수입업자= Armington 복합재 생산자, input demand

Input demand: XD_c $[XDD_c]$ XMT_c $[XMTD_c]$

$$(XDD_c) \qquad XD_c = \delta_c^{q\,\sigma_c^q} \left[\frac{PA_c}{PD_c}\right]^{\sigma_c^q} \alpha_c^{q\,(\sigma_c^q-1)} XA_c$$

```
XDD(C)$((SAM('ROW',C) ne 0) and (sum(A,SAM(A,C))>0))
..XD(C)
=g=
(deltaq(C)**sigmaq(C))*((PA(C)/(PD(C)))**sigmaq(C))
*(alphaq(C)**(sigmaq(C)-1))*XA(C);
```

$$(XMTD_c) \qquad XMT_c = \delta_c^{q\,\sigma_c^q} \left[\frac{PA_c}{PMT_c}\right]^{\sigma_c^q} \alpha_c^{q\,(\sigma_c^q-1)} XA_c$$

```
XMTD(C)$((SAM('ROW',C) ne 0) and (sum(A,SAM(A,C))>0))
..XMT(C)
=g=
((1-deltaq(C))**sigmaq(C))*((PA(C)/(PMT(C)))**sigmaq(C))
*(alphaq(C)**(sigmaq(C)-1))*XA(C);
```

수출의 결정: 상품생산자의 output diversification

- 수출가격: 수출세를 지불하고 해외가격으로 판매하여 이를 환전한 수입을 취득
  - 해외가격에 대해서는 가격수용자이기 때문에 수출세만큼 손실 발생
- 총산출-수출공급-내수공급 관계식: 생산자의 revenue max condition

$$PP_c XP_c = PD_c XD_c + PET_c ES_c$$

- 수출, 내수 공급:주어진 산출물을 판매하여 수익을 극대화하는 수출-내수 조합. CET 함수 사용

$$\begin{aligned} \max \quad & PET_c ES_c + PD_c XD_c \\ s.t. \quad & XP_c = \alpha_c^t (\delta_c^t ES_c^{\rho_c^t} + (1-\delta_c^t) XD_c^{\rho_c^t})^{\frac{1}{\rho_c^t}} \end{aligned}$$

생산자 revenue maximization solution

1. 수출재 가격 $[ExPr_c]$

$$(ExPr_c) \qquad pwe_c(1-te_c)EXR = PET_c$$

```
ExPr(C)$(SAM(C,'ROW') ne 0)..PET(C)=g=pwe(C)*(1-te(C))*EXR;
```

2. zero profit condition: $P = MC$ $[ProdPr_c]$

$$(ProdPr_c)$$

$$PP_c = (1/\alpha_c^t)[\delta_c^{t\,\sigma_c^t} PET_c{}^{(1-\sigma_c^t)} + (1-\delta_c^t)^{\sigma_c^t} PD_c{}^{(1-\sigma_c^t)}]^{(1/(1-\sigma_c^t))}$$

$$\left(\rho_c^t = 1-(1/\sigma_c^t) \qquad \sigma_c^t = \frac{1}{1-\rho_c^t}\right)$$

```
ProdPr(C)$((SAM(C,'ROW') ne 0) and (sum(A,SAM(A,C))>0))
..PP(C)=g=
(1/alphat(C))*
(((deltat(C))**(sigmat(C))*(PET(C))**(1-sigmat(c))+
(1-deltat(C))**(sigmat(C))*(PD(C))**(1-sigmat(c)))
**(1/(1-sigmat(C))));
```

생산자의 Supply decision

Output supply : XD_c [XDS_c] ES_c [ESS_c]

$$(XDS_c) \qquad XD_c = (1-\delta_c^t)^{\sigma_c^t}\left[\frac{PP_c}{PD_c}\right]^{\sigma_c^t}\alpha_c^{q\,(\sigma_c^t-1)}XP_c$$

```
XDS(C)$(SAM(C,'ROW') ne 0)
..((1-deltat(C))**sigmat(C))*((PP(C)/PD(C))**sigmat(C))
*(alphat(C)**(sigmat(C)-1))*XP(C)=g=XD(C);
```

$$(ESS_c) \qquad ES_c = \delta_c^{t\,\sigma_c^t}\left[\frac{PP_c}{PET_c}\right]^{\sigma_c^t}\alpha_c^{t\,(\sigma_c^t-1)}XP_c$$

```
ESS(C)$(SAM(C,'ROW') ne 0)
..(deltat(C)**sigmat(C))*((PP(C)/PET(C))**sigmat(C))
*(alphat(C)**(sigmat(C)-1))*XP(C)=g=ES(C);
```

해외: Trade balance

1. Trade balance [CAB]

$$(CAB) \qquad \sum_c pwm_c XMT_c = \sum_c pwe_c ES_c + FSAV + tm_{in}(\sum_c PMT_c XMT_c / EXR)$$

```
CAB..
sum(C$(SAM('ROW',C) ne 0),pwm(C)*XMT(C))
=e=
sum(C$(SAM(C,'ROW') ne 0),pwe(C)*ES(C))
+FSAV
+(tm_{in})*(sum(C$(SAM('ROW',C) ne 0),PMT(C)*XMT(C))/EXR);
```

2. Trade balance adjustment [ForS]

$$\begin{aligned} (ForS) \qquad FSAV &= fasv0 * FSAD \\ FASD(t+1) &= FASD(t) \times (1 + TBg(t)) \end{aligned}$$

FSAV, EXR 중 하나는 fix. 나머지는 조정되는데 현재 모형은 FSAV가 수출입 전망에 맞추어 모형 외부에서 삽입되고 EXR가 조정

```
ForS..FSAV=e=fsav0*FSAD;
FSAD=FSAD*(1+TBg(t));
```

차 례

가계: Income balance + Consumption Demand

1. 소득 수취 → 감가상각(강제저축) → 조세지불→소비, 재량저축
   - 소득 = 요소소득 + 이전소득 + 잔폐물 판매소득
   - 소득세 = 소득세율*(소득-감가상각)
   - 가처분소득 = (1-소득세율)*(소득-감가상각)
   - 소비 = 한계소비성향*가처분소득
   - 저축 = 한계저축성향*가처분소득+감가상각

2. Equations
   - 재량소비, 재량저축: Roy's identity
   - income balance: Roy's identity를 사용하면 redundant. 포함되지 않음
   - 소득, 총저축 정의식은 포함

가계:Income definition

1. 요소소득 : LY_h [$HouseLY_h$], KY_h [$HouseKY_h$]

$$(HouseLY_h) \qquad LY_h = \sum_L shr_{L,h} L_l^s W_l$$

$$(HouseKY_h) \qquad KY_h = \sum_K shr_{K,h} K_k^s R_k$$

```
HouseLY(H)..LY(H)=e=sum(L,shr(L,H)*Ls(L)*W(L));
HouseKY(H)..KY(H)=e=sum(K,shr(K,H)*Ks(K)*R(K));
```

2. 이전소득 : TR_h [$Tras_h$]

$$(Tras_h) \quad TR_h = tr0_{per,h} \cdot cpi \cdot Oldpop + crev_h \cdot crevhshr_h \cdot TCREV$$

```
Tras(H)..Tr(H)=e=tr0_per(H)*cpi*Oldpop+crevh*crevh_share(H)*TCREV;
```

3. 총소득: YH_h [$HouseY_h$]

$$(HouseY_h) \quad YH_h = LY_h + KY_h + TR_h + ResinC;$$

```
HouseY(H)..YH(H)=e=LY(H)+KY(H)+TR(H)+ResinC;
```

4. 가처분소득: YD_h [$HouseYD_h$]

$$(HouseYD_h) \quad YD_h = (1 - TINSR) \cdot \left[LY_h + KY_h + TR_h + ResinC - \delta \sum_k shr_{k,h} K_k^s \right]$$

```
HouseYD(H)..YD(H)
=e=(1-TINSR)*(LY(H)+KY(H)+TR(H)+ResinC-delta*sum(K,shr(K,H)*Ks(K)));
```

가계:Consumption and Saving

1. consumption: $XAC_{c,h}$ $[HouseD_{c,h}]$

$$(HouseD_{c,h}) \quad XAC_{c,h} = \frac{\mu_{c,h} YD_h}{PA_c(1+tc_{in})}$$

```
HouseD(C,H)$(SAM(C,'Household') ne 0)
..XAC(C,H)=e=mu(C,H)*(YD(H)/(PA(C)*(1+tc_{in})));
```

2. savings: 한계저축성향, 저축

$$(Saver_h) \qquad MPS_h = \mu^s_h$$

$$(Hsave_h) \qquad SH_h = MPS_h \cdot YD_h + \delta \sum_k shr_{k,h} K^s_h$$

```
Saver(H)..MPS(H)=e=mus(H);
Hsave(H)..SH(H)=e=MPS(H)*YD(H)+delta*sum(K,shr(K,H)*Ks(K));
```

차 례

정부: 수입, 지출, 예산균형

1. 정부: 정부수입을 정부소비 및 정부저축에 사용
   - 정부 수입: 조세
     - 수출입: 관세, 수출세
     - 간접세: 순생산물세(PTAXin), 기타생산세(PTAXex)
     - 탄소세(TCREV)
     - 소득세(YTAX)
   - 정부 지출: 정부소비, 이전지출
     - 정부소비:정부가 생산물을 구입하여 시장수요의 일부 구성
     - 이전지출:정부가 가계에 소득을 이전
   - 정부 예산균형식: 정부수입 = 정부지출 + 정부저축

2. Equations
   - 정부 수입
     - 세율 정의식
   - 정부 지출: 소비지출, 이전지출
   - 예산 균형식 : 정부 저축

정부:수입

1. 정부수입: YG [$GovI$]

$$
\begin{aligned}
&(GovI)\\
YG \quad &= \sum_a (tain_a + taex_a) PC_a XC_a + \sum_c (tm_c) \cdot pwm_c \cdot XMT_c \cdot EXR + \sum_c (te_c) \cdot pwe_c \cdot ES_c \cdot EXR \\
&+ \quad TINSR \cdot \left[\sum_h (YH_h - \delta \sum_k shr_{k,h} K_k^s) \right] \\
&+ \quad \sum_{gc,a} gtax_{gc} QINTG_{gc,a} + \sum_{gc,c,a} gtax_{gc} QGE_{gc,c,a} \\
&+ \quad (tc_{in}) \sum_{c,h} PA_c XAC_{c,h} + (tg_{in}) \sum_c PA_c XAF_{gov,c} + (tiv_{in}) \sum_c PA_c XAF_{s-i,c} + (tm_{in}) \sum_c PMT_c XMT_c
\end{aligned}
$$

```
GovI..YG=e=
sum(A$(sum(C,SAM(A,C))>0),(ta_in(A)+ta_ex(A))*PC(A)*XC(A))
+sum(C$(SAM('ROW',C) ne 0),tm(C)*pwm(C)*XMT(C)*EXR)
+sum(C$(SAM(C,'ROW') ne 0),te(C)*pwe(C)*ES(C)*EXR)
+(TINSR)*sum(H,(YH(H)-delta*sum(K,shr(K,H)*Ks(K))))
+sum((GC,A)$(ghg('process',A)>0),gtax(GC)*QINTG(GC,A))
+sum((GC,C,A)$(ghg(C,A)>0),gtax(GC)*QGE(GC,C,A))
+tc_{in}*sum((C,H)$(SAM(C,'Household') ne 0),PA(C)*XAC(C,H))
+tg_{in}*sum(C$(SAM(C,'Gov') ne 0),PA(C)*XAF('Gov',C))
+tiv_{in}*sum(C$(SAM(C,'S-I') ne 0),PA(C)*XAF('S-I',C))
+tm_{in}*sum(C$(SAM('ROW',C) ne 0),PMT(C)*XMT(C));
```

정부:지출, 예산균형

1. 정부 지출: $XAF_{gov,c}$ [$GovE_c$], TR_h [$Tras_h$]

$$XAF_{gov,c} \quad = \quad qgr0_c \cdot \frac{\sum_c PA_c XA_c}{PA_c(1+tg_{in})} + \frac{qg0_c}{\sum_c qg0_c} \frac{crevc \cdot TCREV}{PA_c(1+tg_{in})}$$

```
GovE(C)$(SAM(C,'Gov') ne 0)
..XAF('Gov',C)=e=qgr0(C)*sum(CP,PA(CP)*XA(CP))*(1/(PA(C)*(1+tg_{in})))
+(qg0(C)/sum(CP,qg0(C)))*crevc*TCREV/(PA(C)*(1+tg_{in}));
```

2. 예산균형: [$GovB$], 정부저축(SG) 결정

$$SG = YG - \sum_c PA_c(1+tg_{in})XAF_{gov,c} - \sum_h TR_h - crevI * TCREV$$

```
GovB..SG=e=
YG-sum(C$(SAM(C,'Gov') ne 0),PA(C)*(1+tg_{in})*XAF('Gov',C))
-sum(H,TR(H))-crevI*TCREV;
```

예산균형은 정부저축 혹은 소득세율을 조정하여 달성. 현재 소득세율이 fix 되어 정부저축이 조정

3. 소득세율: [$Ytax$] 실효소득세율 $TINSR$ 결정

$$(Ytax) \quad TINSR = \frac{\sum_h (YH_h - \delta \sum_k shr_{k,h} K_k^s) * TINS0 - crevtax * TCREV}{\sum_h (YH_h - \delta \sum_k shr_{k,h} K_k^s)}$$

```
Ytax..TINSR=e
=(sum(H,(YH(H)-delta*sum(K,shr(K,H)*Ks(K))))*TINS0-crevtax*TCREV)
/sum(H,(YH(H)-delta*sum(K,shr(K,H)*Ks(K))));
```

차 례

저축-투자: 투자 결정? Warlas dummy 결정

1. 저축-투자 부문: 정부, 민간, 해외저축과 투자소비 잔폐물 수입으로 투자재 구입
2. 투자수요: $XAF_{s-i,c}$ [Inv_D] 초기치의 일정 배수

$$(InvD_c) \qquad XAF_{s-i,c} = qinv0_c \cdot IVAD$$

```
InvD(C)$(SAM(C,'S-I') ne 0)..XAF('S-I',C)=e=qinv_o(C)*IVAD;
```

3. 투자-저축 균형: [$InvM$], Warlas dummy ($Warlas$) 결정

$$(InvM) \qquad PA(t+tiv_{in})XAF_{s-i,c} = Warlas + \sum_h SH_h + SG + FSAV * EXR + ResinI;$$

```
InvM..
sum(C$(SAM(C,'S-I') ne 0),PA(C)*(1+tiv_{in})*XAF('S-I',C))
=e=Warlas+sum(H,SH(H))+SG+FSAV*EXR+ResinI;
```

4. 상품시장 청산에 의해 결정된 투자지출의 합은 Warlas=0 인 투자-저축 균형을 만족(Warlas' law)
5. 개별 투자수요는 상품시장 청산에 의해 결정되는 투자수요의 합을 초기치의 비중에 따라 배분
6. 현재 저축-투자 청산은 MPS가 고정되어 있어서 IVAD를 조정하여 달성
   - 투자를 외삽하려면 MPS를 고정시키는 방정식을 없애고 투자를 고정하는 방정식을 도입

차 례

시장청산조건: 요소시장

1. 요소시장: 기업의 요소수요의 합 = 요소공급 [$LabM_l$,$CapM_k$

$$(LabM_l) \qquad L_l^s = \sum_a LD_{l,a}$$

$$(CapM_k) \qquad K_l^s = \sum_a KD_{k,a}$$

```
LabM(L)..Ls(L)=g=sum(A$(SAM(L,A)>0),LD(L,A));
CapM(K)..Ks(K)=g=sum(A$(SAM(K,A)>0),KD(K,A));
```

2. 요소공급: Reduced form 노동 공급 [$Labsup_l$], Capital Evolution

$$(Labsup_l) \qquad L_l^s = LW_l^0(1-TINSR)\left[\frac{W_l}{cpi}\right]^{\varepsilon_l^L}$$

$$K_{k,0}^s = K_0$$

$$K_{k,t+1}^s = (1-\delta)K_{k,t}^s + \sum_c XAF_{s-i,c}$$

```
Labsup(L)..Ls(L)=e=Lw0(L)*(((1-TINSR)*(W(L)/cpi))**epsilon_L(L));
Ks.Fx(K)        =         Ks0(K)         ;
Ks.Fx('Capital')=Ks.L('Capital')*(1-delta)+sum(C,XAF.L('S-I',C));
```

시장청산조건: 생산물시장

생산물시장: 국내수요 = 아밍턴 재화 공급
[$ComMENCN_c$(화석연료이외),$ComMENC_c$(화석연료)]

$$(ComMENCN_c) \qquad XA^c = \sum_a XAP_{c,a} + \sum_h XAC_{c,h} + \sum_{fin=\{gov,s-i\}} XAF_{fin,c}$$

$$(ComMENC_c) \qquad XA^c = \sum_a QCE_{c,a} + \sum_h XAC_{c,h} + \sum_{fin=\{gov,s-i\}} XAF_{fin,c}$$

```
ComMENCN(C)$(ENCN(C))
..XA(C)=g=sum(A$XAPA(C,A),XAP(C,A))
+sum(H$XACH(H,C),XAC(C,H))+sum(FD$FD_C(C,FD),XAF(FD,C));
ComMENC(C)$(ENC(C))
..XA(C)=g=sum(A$XEPA(C,A) ,QCE(C,A ))
+sum(H$XACH(H,C),XAC(C,H))+sum(FD$FD_C(C,FD),XAF(FD,C));
```

차 례

Etc: Normalization, 잔폐물 수입

1. Normalization [Norm]: cpi =1, $cwrt_c$ guarantees initial period cpi=1

$$(Norm) \qquad cpi = \sum_c PA_c * cwrt_c$$

```
Norm..cpi=e=sum(C,PA(C)*cwrt(C));
```

2. 잔폐물 수입 [ResC, ResI]: sum of residue demand = residue supply from household and investment

$$(ResC) \qquad ResinC = \theta_c^{Res} \cdot \sum_a PC_a \alpha_a^{nres} XC_a$$

$$(ResI) \qquad ResinI = \theta_{iv}^{Res} \cdot \sum_a PC_a \alpha_a^{nres} XC_a$$

```
ResC..ResinC=e=thetaRes_c
*sum(A$(sum(C,SAM(A,C))>0),PC(A)*alpha_nres(A)*XC(A));
ResI..ResinI=e=thetaRes_iv
*sum(A$(sum(C,SAM(A,C))>0),PC(A)*alpha_nres(A)*XC(A));
```

Etc: 탄소세수

Carbon tax revenue [$Creve_a$(no process emission), $Crevp_a$ (with process),$TCREV_{sum}$ (total)]

$$CREVE_a \qquad CREV_a|\text{no process emission} = \sum_{gc} gtax_{gc}[\sum_{c,a} QGE_{gc,c,a}]$$

$$CREVEP_a \qquad CREV_a|\text{with process emission} = \sum_{gc} gtax_{gc}[\sum_{c,a} QGE_{gc,c,a}] + \sum_{gc} gtax_{gc} QINTG_{gc,a}$$

$$TCREV sum \qquad TCREV = \sum_{a} CREV_a$$

```
CREVE(A)$(ghg('process',A) eq 0)
..CREV(A)=e=sum(GC,gtax(GC)*sum(C$fuelA(A,C),QGE(GC,C,A)));
CREVP(A)$(ghg('process',A) ne 0)
..CREV(A)=e=sum(GC,gtax(GC)*sum(C$fuelA(A,C),QGE(GC,C,A)))
+sum(GC,gtax(GC)*QINTG(GC,A));
TCREVsum..TCREV=e=sum(A,CREV(A));
```

차 례

Dynamics: 자본, 고용, 노령인구, 노동생산성, 무역수지,탄소세

자본	$K^s_{k,t+1} = (1-\delta)K^s_{k,t} + \sum_c XAF_{s-i,c}$
고용	$LW^0_{t+1} = LW^0_t \cdot (1+g^L_t)$
노령인구	$OldPop_{t+1} = OldPop_t \cdot (1+g^{OP}_t)$
노동생산성	$\lambda^T_{t+1} = \lambda^T_t + lpgrow_t$
무역수지	$FASD_{t+1} = FASD_t \times (1+g^{TB}_t)$
탄소세	$gtax_{GC,t+1} = gtax_{gc,t} + gtaxPolicy_{gc,t}$

```
Ks.Fx('Capital')=Ks.L('Capital')*(1-delta)+sum(C,XAF.L('S-I',C));
Lw0(L)=Lw0(L)*(1+lgrow(t));
Oldpop=Oldpop*(1+Oldpopg(t));
FSAD=FSAD*(1+TBg(t));
lambdat=lambdat+lpgrow(t);
gtax(GC)=gtax(GC)+gtax_policy(GC,t);
```

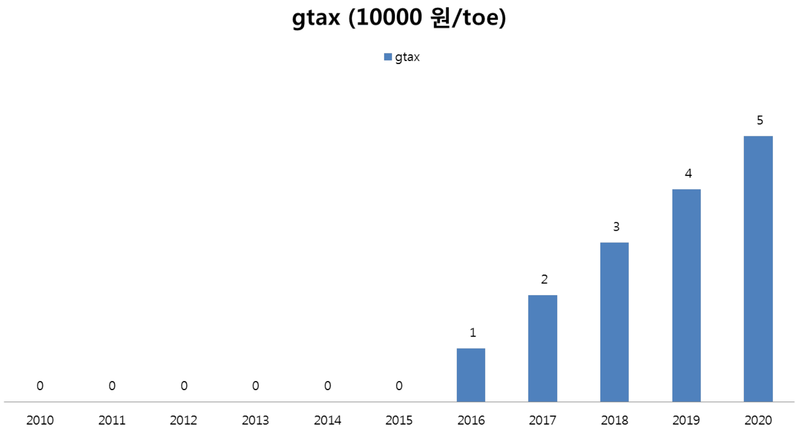
차 례

차 례

인구, 경제성장, 탄소세

- 고용: 통계청 인구전망에 2010년 연령별 취업률 적용
- 노령인구: 통계청 인구전망
- 국제수지:중장기 환경전망 및 대응전략(2012) 위탁연구 성과 활용
- 경제성장: 2010∼20년간 연평균 3.0% 성장
- 탄소세: 2016년 1만원/toe 에서 연 1만원/toe씩 5년간 인상
- 산업구조는 사전에 설정하지 않았고, AEEI는 불변으로 가정

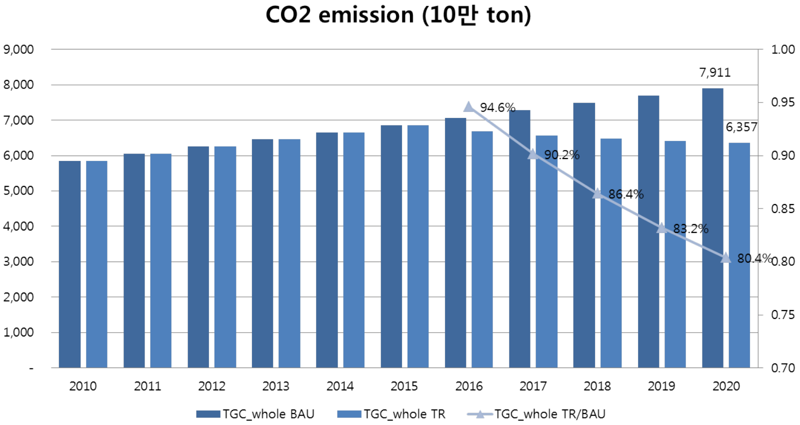
탄소세


gtax (10000 원/toe)
gtax
0
0
0
0
0
0
1
2
3
4
5
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

차 례

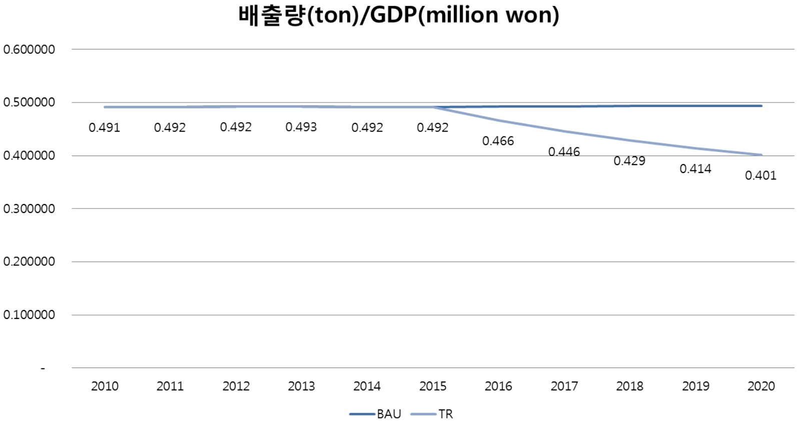
배출량

- 2020년 CO2 배출량 19.6% 감축 가능



원단위배출량

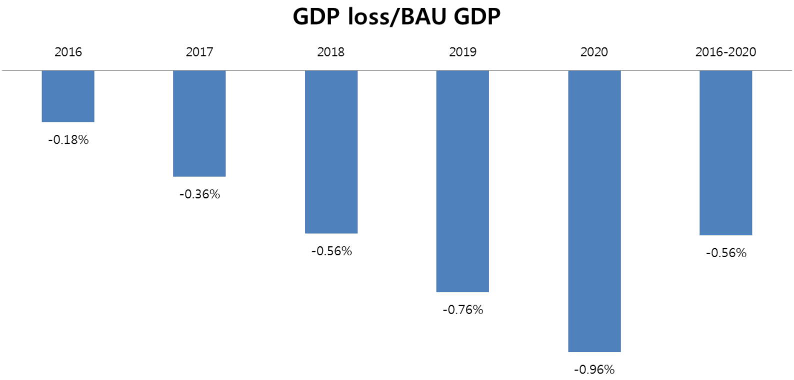
- 2020년 CO_2 배출량/GDP 18.9% 감축 가능



차 례

GDP loss

- 탄소세로 인한 GDP 손실: BAU GDP 0.18%(2016)∼0.95%(2020)
  - 2016∼2020 GDP 손실/BAU GDP 평균= 0.56%

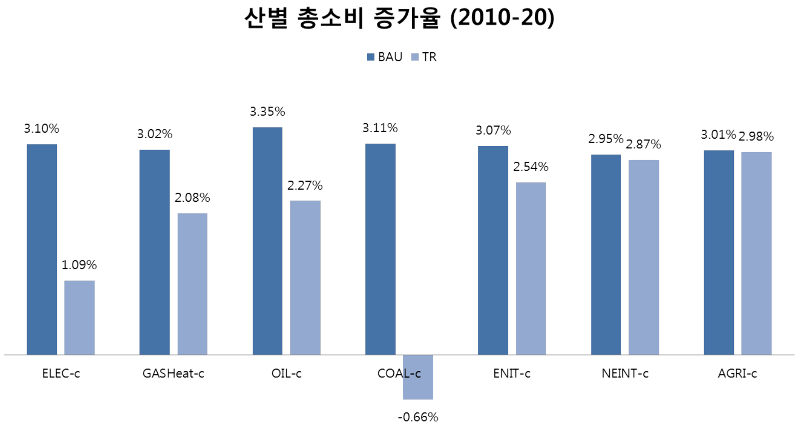


차 례

탄소세와 산별 총소비 증가율

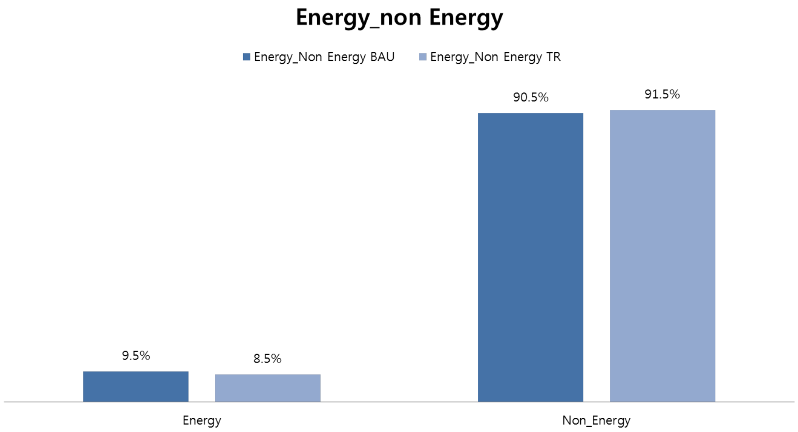
- 에너지 산업 증가율 하락 > 비 에너지 산업 증가율 하락
  - 에너지 산업 share 하락
- 비 에너지 Sector: 에너지 집약 산업 증가율 하락> 타 산업 증가율 하락
  - 에너지 집약 산업 (EINT)share 감소
- 에너지 Sector: 석탄 증가율 하락 > 기타 에너지 산업 증가율 하락
  - 석탄 share 감소

총소비 증가율: 산업

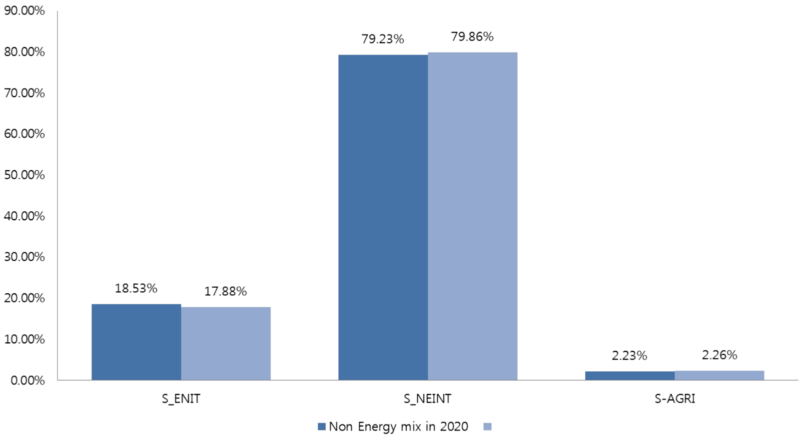


산별 총소비 증가율 (2010-20)
BAU
TR
3.10%
1.09%
3.02%
2.08%
3.35%
2.27%
3.11%
-0.66%
3.07%
2.54%
2.95%
2.87%
3.01%
2.98%
ELEC-c
GASHeat-c
OIL-c
COAL-c
ENIT-c
NEINT-c
AGRI-c

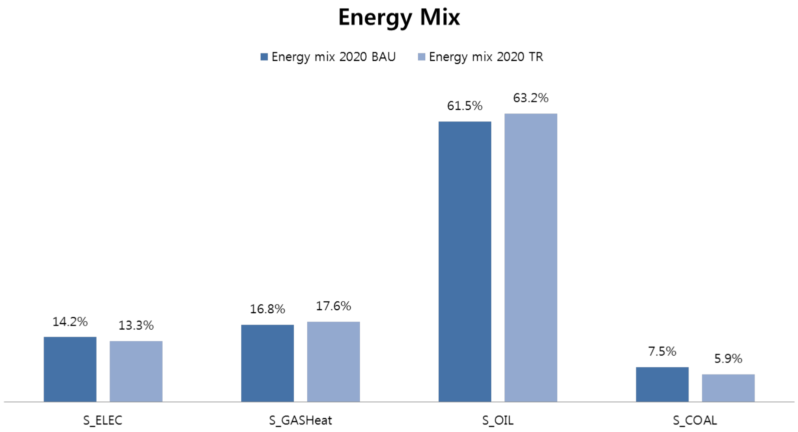
에너지-비에너지 비중 변화



비에너지 secter 비중 변화



에너지 secter 비중 변화

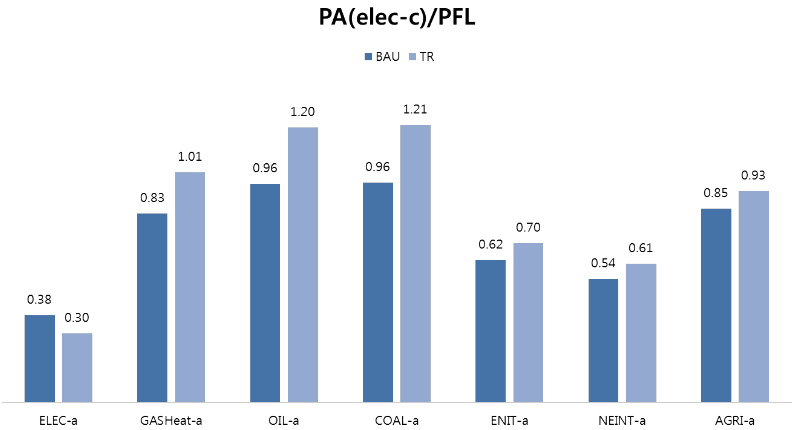


Discussion

- 감축은 Energy mix 변화보다는 산출 하락이 주도
  - 석탄-비석탄 에너지복합재 대체탄력성 0.5: 너무 낮은가?

- 에너지 Sector 내에서는 석탄 비중 하락이 뚜렷
  - ’전력화(Electrification)’현상이 나타나지 않음
    - 전력의 석탄 의존도가 높아서 탄소세부과 이후 타 에너지원 보다 가격경쟁력이 악화
  - Gas 와 Oil이 비석탄복합재로 석탄과 대체되다 보니 석유의 share가 증가하는 현상 발생

전력가격/비전력에너지복합재가격



감사합니다.