

APPENDIX A
GAMS SOURCE PROGRAM

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* An Energy-Economy Model to Evaluate the Future Energy Demand-Supply System
*                               in Indonesia
*                               Author : Agus Sugiyono
*                               January 1995

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$OFFSYMREF OFFSYMLIST OFFUELLIST OFFUELXREF
FILE FSAVE /EEBAS.OUT/;
PUT FSAVE;
PUT "*" BASE CASE "*" /;

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SETS

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T           Time period   /1990, 2000, 2010, 2020, 2030/
TFIRST(T)  First period
TLAST(T)   Last period
RG         Region        /JAV, SMT, KAL, OTH/
ITR        Iteration     /1*3/

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AT All Technology

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/COA-I Coal to Industry Sector
COA-O Coal to Other Sector
GAS-I Gas to Industry Sector
GAS-T Gas to Transportation Sector
GAS-O Gas to Other Sector
OIL-I Oil to Industry Sector
OIL-T Oil to Transportation Sector
OIL-O Oil to Other Sector
BIO-O Biomass Fuel to Other Sector
COA-P Electric from Coal
GAS-P Electric from Gas
OIL-P Electric from Crude Oil
HYDRO Electric from Hydropower
GEOTR Electric from Geothermal
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ET(AT) Electricity Technology

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/COA-P, GAS-P, OIL-P, HYDRO, GEOTR/

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NT(AT) Nonelectric Technology

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/COA-I, COA-O, GAS-I, GAS-T, GAS-O, OIL-I, OIL-T, OIL-O, BIO-O/

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TCOA(AT) Coal Base Technology

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/COA-I, COA-O, COA-P/

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TGAS(AT) Gas Base Technology

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/GAS-I, GAS-T, GAS-O, OIL-P/

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TOIL(AT) Oil Base Technology

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/OIL-I, OIL-T, OIL-O, GAS-P/

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FOSS Fossil fuel for regional transportation

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/COAL, NGAS, COIL/

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EDM Electricity Sectoral Demand

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/ELE-I, ELE-T, ELE-O/

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NIND(AT) Nonelectricity in Industry Sector

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/COA-I, GAS-I, OIL-I/

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NTRA(AT) Nonelectricity in Transportation Sector

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/GAS-T, OIL-T/

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NOTH(AT) Nonelectricity in Other Sector

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/COA-O, GAS-O, OIL-O, BIO-O/

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SCALARS

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NYPER Number of years per period /10./
BET Discount factor /0.95/
DK Depreciation rate on capital per year /0.10/

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A0	Initial level of total factor productivity	/1.0/
GA0	Initial growth rate for technology per decade	/0.25/
DELA	Decline rate of technology change per decade	/0.08/
PFPF	Proportional factor of production function	/0.10/
PFEC	Proportional factor of energy cost	/6500/
PFFC	Proportional factor of foreign transp. cost	/900/
PFDC	Proportional factor of domestic transp. cost	/90/

PARAMETERS

R(RG) Rate of social time preference per year

/JAV	.025
SMT	.020
KAL	.020
OTH	.025/

K0(RG) Initial capital (Billion 1990 US dollar)

/JAV	107.86
SMT	86.74
KAL	29.52
OTH	25.75/

I0(RG) Initial investment (Billion 1990 US dollar)

/JAV	23.477
SMT	10.402
KAL	2.306
OTH	2.900/

C0(RG) Initial consumption (Billion 1990 US dollar)

/JAV	5.729
SMT	2.539
KAL	0.563
OTH	0.708/

N0(RG) Initial nonelectric energy

E0(RG) Initial electric energy

L0(RG) Initial population

Y0(RG) Initial productivity (Billion 1990 US dollar)

/JAV	56.53
SMT	27.21
KAL	9.88
OTH	7.15/

ESUB(RG) Production value share of energy

/JAV	0.30
SMT	0.12
KAL	0.12
OTH	0.30/

KPVS(RG) Capital value share

/JAV	0.30
SMT	0.30
KAL	0.30
OTH	0.30/

ELVS(RG) Elasticity of electricity in industry

/JAV	0.40
SMT	0.40
KAL	0.40
OTH	0.40/

A(RG) Output scaling factor

RESBIO(RG) Limit of biomass use per annum (MTOE)

/JAV	10.0
SMT	14.0
KAL	15.0
OTH	8.0/

RESGEO(RG) Limit of geothermal use per annum (MTOE)

/JAV	4.113
SMT	2.585
KAL	0.001
OTH	1.792/

RESHYD(RG) Limit of hydropower use per annum (MTOE)

/JAV	2.215
SMT	8.226
KAL	11.390
OTH	17.718/

EATRN(RG) Income elasticity in transportation sector

/JAV	0.403
SMT	0.403
KAL	0.403
OTH	0.403/

EAPUB(RG) Income elasticity in others sector

/JAV	0.312
SMT	0.312
KAL	0.312
OTH	0.312/

EFF0(RG) Final electric conversion efficiency

/JAV	3.0
SMT	2.8
KAL	2.7
OTH	2.3/

EFFA(RG) Constant term of electric conversion eff.

/JAV	7.3333
SMT	7.3333
KAL	7.3333
OTH	7.3333/

EFFB(RG) Time dependence term of electric conversion eff.

/JAV	-0.003
SMT	-0.003
KAL	-0.003
OTH	-0.003/

GL0(RG) Population after 2100

/JAV	161
SMT	103
KAL	27
OTH	75/

GLA(RG) Constant term of population

/JAV	0.490
SMT	1.788
KAL	1.788
OTH	1.788/

GLB(RG) Time dependence term of population

/JAV	-0.056
SMT	-0.037
KAL	-0.049
OTH	-0.025/

CH(AT) Carbon Emission Coefficient (Ton Carbon per TOE)

/COA-I	1.000
COA-O	1.000
GAS-I	0.578
GAS-T	0.578
GAS-O	0.578
OIL-I	0.825
OIL-T	0.825
OIL-O	0.825
BIO-O	0.000
COA-P	1.000
GAS-P	0.578
OIL-P	0.825
HYDRO	0.000
GEOTR	0.000/

BETA(T) Annual discount factor
 AL(T) Technical progress
 L(T,RG) Level of population (Million)
 EFF(T,RG) Electric power conversion efficiency
 DKT Depreciation rate per decade
 SHARE Income per capita in 1990
 NEGISHI(RG) Share of income percapita
 ;

TABLE RESF(FOSS,RG) Resource of fossil fuel (MTOE)

	JAV	SMT	KAL	OTH
COAL	39	15762	5955	68
NGAS	306	1580	601	22
COIL	185	1161	140	11

;

TABLE ECST(ET,RG) Electricity cost coefficient (Dollar per TOE)

	JAV	SMT	KAL	OTH
COA-P	550.000	550.000	550.000	550.000
GAS-P	480.000	480.000	480.000	480.000
OIL-P	500.000	500.000	500.000	500.000
HYDRO	600.000	600.000	600.000	600.000
GEOTR	580.000	580.000	580.000	580.000

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TABLE NCST(NT,RG) Nonelectric cost coefficient (Dollar per TOE)

	JAV	SMT	KAL	OTH
COA-I	83.720	83.720	83.720	83.720
COA-O	83.720	83.720	83.720	83.720
GAS-I	62.790	62.790	62.790	62.790
GAS-T	62.790	62.790	62.790	62.790
GAS-O	62.790	62.790	62.790	62.790
OIL-I	104.650	104.650	104.650	104.650
OIL-T	104.650	104.650	104.650	104.650
OIL-O	104.650	104.650	104.650	104.650
BIO-O	60.000	60.000	60.000	60.000

;

TABLE CTRD(FOSS,RG) Domestic transport. cost of fossil (Dollar per TOE)

	JAV	SMT	KAL	OTH
COAL	0.980	0.980	0.980	0.980
NGAS	4.790	4.790	4.790	4.790
COIL	0.670	0.670	0.670	0.670

;

TABLE CTRF(FOSS,RG) Foregin transport. cost of fossil (dollar per TOE)

	JAV	SMT	KAL	OTH
COAL	1.960	1.960	1.960	1.960
NGAS	9.580	9.580	9.580	9.580

COIL 1.340 1.340 1.340 1.340
;

TABLE PR00(AT,RG) Energy production in 1990 (MTOE)

	JAV	SMT	KAL	OTH
COA-I	2.442	0.422	0.015	0.022
COA-O	0.132	0.011	0.002	0.002
GAS-I	3.852	0.942	0.542	0.582
GAS-T	0.404	0.017	0.002	0.005
GAS-O	2.604	1.102	0.002	0.003
OIL-I	8.455	3.342	1.142	1.152
OIL-T	8.708	2.570	1.073	1.782
OIL-O	6.876	2.642	0.452	0.402
BIO-O	7.130	6.342	1.642	1.924
COA-P	0.612	0.322	0.107	0.112
GAS-P	0.173	0.031	0.023	0.031
OIL-P	2.708	0.712	0.409	0.442
HYDRO	0.678	0.335	0.137	0.142
GEOTR	0.868	0.012	0.001	0.022

;

TABLE DMD0(EDM,RG) Lower bound of electricity energy (MTOE)

	JAV	SMT	KAL	OTH
ELE-I	0.792	0.154	0.015	0.103
ELE-T	0.005	0.000	0.000	0.000
ELE-O	0.672	0.125	0.015	0.103

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TABLE IMD0(FOSS,RG) Lower bound of domestic import of fossil (MTOE)

	JAV	SMT	KAL	OTH
COAL	0.000	0.000	0.000	0.000
NGAS	0.000	0.000	0.000	0.000
COIL	0.000	0.000	0.000	0.000

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TABLE EXD0(FOSS,RG) Lower bound of domestic export of fossil (MTOE)

	JAV	SMT	KAL	OTH
COAL	0.000	0.000	0.000	0.000
NGAS	0.000	0.000	0.000	0.000
COIL	0.000	0.000	0.000	0.000

;

TABLE IMF0(FOSS,RG) Lower bound of foreign import of fossil (MTOE)

	JAV	SMT	KAL	OTH
COAL	0.000	0.000	0.000	0.000
NGAS	0.000	0.000	0.000	0.000
COIL	0.000	0.000	0.000	0.000

;

TFIRST(T) = YES\$(ORD(T) EQ 1);
TLAST(T) = YES\$(ORD(T) EQ CARD(T));
DISPLAY TFIRST, TLAST;

EFF(T,RG) = EFF0(RG)/(1+EFFA(RG)*EXP(EFFB(RG)*NYPER*(ORD(T)-1)));
L(T,RG) = GL0(RG)/(1+GLA(RG)*EXP(GLB(RG)*NYPER*(ORD(T)-1)));
L0(RG) = L('1990',RG);

BETA(T) = BET**(NYPER*ORD(T));
BETA(TLAST) = BETA(TLAST)/(1-BET);

E0(RG) = SUM(ET, PR00(ET,RG));
N0(RG) = SUM(NT, PR00(NT,RG));
A(RG) = Y0(RG)/((K0(RG)**KPVS(RG) * L0(RG)**(1-KPVS(RG)))*(1-ESUB(RG)) *
(E0(RG)**ELVS(RG) * N0(RG)**(1-ELVS(RG)))*ESUB(RG));

DKT = (1-DK)**NYPER;
AL(T) = A0 * EXP((GA0/DELA) * (1.-EXP(-DELA*(ORD(T)-1))));

SHARE = SUM(RG, Y0(RG)/L0(RG));
NEGISHI(RG) = (Y0(RG)/L0(RG))/SHARE;

DISPLAY E0, N0, BETA, A, AL, L, L0, EFF, DKT;

VARIABLES

PRO(AT,T,RG) Energy production (MTOE)
DMD(EDM,T,RG) Energy demand (MTOE)
EC(T,RG) Energy cost
TDC(T,RG) Domestic transport cost
TFC(T,RG) Foreign transport cost
EE(T,RG) CO2 emission (Billion Ton of Carbon)

IMD(FOSS,T,RG) Domestic import of energy
EXD(FOSS,T,RG) Domestic export of energy
IMF(FOSS,T,RG) Foreign import of energy

K(T,RG) Capital stock
C(T,RG) Consumption
I(T,RG) Investment
Y(T,RG) Output (Million 1990 US dollar)
UTILITY Objective
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POSITIVE VARIABLE

K, C, I, Y, PRO, DMD, EC, EE, IMD, EXD, IMF
;

EQUATIONS

ECOST(T,RG) Energy cost equation
TDCOST(T,RG) Domestic transportation cost equation
TFCOST(T,RG) Foreign transportation cost equation
EEM(T,RG) Carbon emission equation

LMCOA(RG) Limit of coal reserve
LMGAS(RG) Limit of gas reserve
LMOIL(RG) Limit of oil reserve
LMBIO(T,RG) Limit of biomass reserve
LMGEO(T,RG) Limit of geothermal reserve
LMHYD(T,RG) Limit of hydropower reserve

IEDBAL(FOSS,T) Balance of regional transport. of fossil

EBAL(T,RG) Electricity balance
PRDUP(AT,T,RG) Upper bound of energy production
DMDUP(EDM,T,RG) Upper bound of electricity energy
EXDUP(FOSS,T,RG) Upper bound of domestic export
IMDUP(FOSS,T,RG) Upper bound of domestic import
IMFUP(FOSS,T,RG) Upper bound of foreign import

IXCOA(T,RG) Maximum domestic import of coal
IXOIL(T,RG) Maximum domestic import of oil
IXGAS(T,RG) Maximum domestic import of gas

MXCOA(T,RG) Maximum foreign import of coal
MXOIL(T,RG) Maximum foreign import of oil
MXGAS(T,RG) Maximum foreign import of gas

CC(T,RG) Capacity constraint
KK(T,RG) Capital balance
TM(T,RG) Terminal condition
YY(T,RG) Output equation

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TRNDMD(T,RG)    Demand on transportation sector
PUBDMD(T,RG)    Demand on other sectors

UTIL  Objective function equation
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ECOST(T,RG)..   EC(T,RG) =E= (SUM(ET, ECST(ET,RG)*PRO(ET,T,RG)) +
SUM(NT, NCST(NT,RG)*PRO(NT,T,RG)) + PFFC*TFC(T,RG) +
PFDC*TDC(T,RG) )*NYPER/PFEC;

TDCOST(T,RG)..  TDC(T,RG) =E= SUM(FOSS, (CTRD(FOSS,RG)*IMD(FOSS,T,RG) +
CTRD(FOSS,RG)*EXD(FOSS,T,RG)));
TFCOST(T,RG)..  TFC(T,RG) =E= SUM(FOSS, CTRF(FOSS,RG)*IMF(FOSS,T,RG));

EEM(T,RG)..     EE(T,RG) =E= SUM(AT, CH(AT)*PRO(AT,T,RG));

LMCOA(RG)..      SUM(T, (SUM(TCOA, PRO(TCOA,T,RG)) -
IMD('COAL',T,RG)+EXD('COAL',T,RG)-IMF('COAL',T,RG) ) *
NYPER) =L= RESF('COAL',RG);
LMGAS(RG)..      SUM(T, (SUM(TGAS, PRO(TGAS,T,RG)) -
IMD('NGAS',T,RG)+EXD('NGAS',T,RG)-IMF('NGAS',T,RG) ) *
NYPER) =L= RESF('NGAS',RG);
LMOIL(RG)..      SUM(T, (SUM(TOIL, PRO(TOIL,T,RG)) -
IMD('COIL',T,RG)+EXD('COIL',T,RG)-IMF('COIL',T,RG) ) *
NYPER) =L= RESF('COIL',RG);

LMBIO(T,RG)..    PRO('BIO-0',T,RG) =L= RESBIO(RG);
LMGEO(T,RG)..    PRO('GEOTR',T,RG) =L= RESGEO(RG);
LMHYD(T,RG)..    PRO('HYDRO',T,RG) =L= RESHYD(RG);

IEDBAL(FOSS,T).. SUM(RG, IMD(FOSS,T,RG)-EXD(FOSS,T,RG)) =E= 0;

EBAL(T,RG)..     SUM(EDM, DMD(EDM,T,RG)) =E= EFF(T,RG)*SUM(ET, PRO(ET,T,RG));
PRDUP(AT,T+1,RG).. PRO(AT,T+1,RG) =G= PRO(AT,T,RG)*DKT;

DMDUP(EDM,T+1,RG).. DMD(EDM,T+1,RG) =G= DMD(EDM,T,RG)*1.05;

EXDUP(FOSS,T+1,RG).. EXD(FOSS,T+1,RG) =G= EXD(FOSS,T,RG)*DKT;
IMDUP(FOSS,T+1,RG).. IMD(FOSS,T+1,RG) =G= IMD(FOSS,T,RG)*DKT;
IMFUP(FOSS,T+1,RG).. IMF(FOSS,T+1,RG) =G= IMF(FOSS,T,RG)*DKT;

IXCOA(T,RG)..    IMD('COAL',T,RG) =L= SUM(TCOA, PRO(TCOA,T,RG));
IXOIL(T,RG)..    IMD('COIL',T,RG) =L= SUM(TOIL, PRO(TOIL,T,RG));
IXGAS(T,RG)..    IMD('NGAS',T,RG) =L= SUM(TGAS, PRO(TGAS,T,RG));

MXCOA(T,RG)..    IMF('COAL',T,RG) =L= SUM(TCOA, PRO(TCOA,T,RG));
MXOIL(T,RG)..    IMF('COIL',T,RG) =L= SUM(TOIL, PRO(TOIL,T,RG));
MXGAS(T,RG)..    IMF('NGAS',T,RG) =L= SUM(TGAS, PRO(TGAS,T,RG));

YY(T,RG)..       Y(T,RG) =E= A(RG)*AL(T) * (K(T,RG)**KPVS(RG) *
L(T,RG)**(1-KPVS(RG)))*(1-ESUB(RG)) *
(DMD('ELE-I',T,RG)**ELVS(RG) *
SUM(NIND, PRO(NIND,T,RG)))*(1-ELVS(RG)))*ESUB(RG);

TRNDMD(T,RG)..   SUM(NTRA, PRO(NTRA,T,RG))+DMD('ELE-T',T,RG) =G=
PFPF*A(RG)*AL(T)*Y(T,RG)**EATRN(RG)*L(T,RG)**(1-EATRN(RG));

PUBDMD(T,RG)..   SUM(NOTH, PRO(NOTH,T,RG))+DMD('ELE-O',T,RG) =G=
PFPF*A(RG)*AL(T)*Y(T,RG)**EAPUB(RG)*L(T,RG)**(1-EAPUB(RG));

CC(T,RG)..       Y(T,RG) =E= C(T,RG) + I(T,RG) + EC(T,RG);
KK(T+1,RG)..     K(T+1,RG) =E= DKT*K(T,RG) + NYPER*I(T,RG);
TM(TLAST,RG)..   R(RG) * K(TLAST,RG) =L= I(TLAST,RG);

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UTIL..    UTILITY =E=  SUM((T,RG), NEGISHI(RG)*L(T,RG)*BETA(T)*
                        LOG(C(T,RG)/L(T,RG)))
                        ;

** Initialization of Variable **

K.LO(T,RG) = K0(RG);
C.LO(T,RG) = C0(RG);
I.LO(T,RG) = I0(RG);
Y.LO(T,RG) = Y0(RG);
Y.FX(TFIRST,RG) = Y.LO(TFIRST,RG);

PRO.LO(AT,T,RG) = PRO0(AT,RG);
PRO.FX(AT,TFIRST,RG) = PRO.LO(AT,TFIRST,RG);

DMD.LO(EDM,T,RG) = DMD0(EDM,RG);

IMD.LO(FOSS,T,RG) = IMD0(FOSS,RG);
IMD.FX(FOSS,TFIRST,RG) = IMD.LO(FOSS,TFIRST,RG);

EXD.LO(FOSS,T,RG) = EXD0(FOSS,RG);
EXD.FX(FOSS,TFIRST,RG) = EXD.LO(FOSS,TFIRST,RG);

IMF.LO(FOSS,T,RG) = IMF0(FOSS,RG);
IMF.FX(FOSS,TFIRST,RG) = IMF.LO(FOSS,TFIRST,RG);

OPTION ITERLIM = 100000;
OPTION RESLIM = 999999;
OPTION SOLPRINT = OFF;

MODEL ENERGY /ALL/;

SOLVE ENERGY MAXIMIZING UTILITY USING NLP;

** Result Report **

PUT /;
PUT " Aggregate " /;
PUT "-----" /;
PUT "Total primary energy production (MTOE)" /;
PUT " Year      Coal      Gas      Oil      Hydro.  Geothm.  Biomass      Total" /;
LOOP(T,
  PUT (ORD(T)*NYPER+1980):5:0;
  PUT SUM((TCOA,RG), PRO.L(TCOA,T,RG)):10:3;
  PUT SUM((TGAS,RG), PRO.L(TGAS,T,RG)):9:3;
  PUT SUM((TOIL,RG), PRO.L(TOIL,T,RG)):9:3;
  PUT SUM(RG, PRO.L('HYDRO',T,RG)):9:3;
  PUT SUM(RG, PRO.L('GEOTR',T,RG)):9:3;
  PUT SUM(RG, PRO.L('BIO-0',T,RG)):9:3;
  PUT SUM((AT,RG), PRO.L(AT,T,RG)):10:3;
  PUT /;
);

PUT /;
PUT "Economic indicator and CO2 emission" /;
PUT " Year      Income      Popul.  Ele_eff.  Y_per_cap  CO2_Em." /;
LOOP(T,
  PUT (ORD(T)*NYPER+1980):5:0;
  PUT SUM(RG, Y.L(T,RG)):10:3;
  PUT SUM(RG, L(T,RG)):10:3;
  PUT (SUM(RG, EFF(T,RG))/4):10:3;
  PUT (1000*SUM(RG, Y.L(T,RG))/SUM(RG, L(T,RG))):10:3;
  PUT SUM(RG, EE.L(T,RG)):10:3;
  PUT /;
);

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PUT /;
PUT "Energy demand each sector & Elec-nonelec. energy (MTOE)" /;
PUT " Year Indust. Transp. Other Total Elec. Non-ele" /;
LOOP(T,
  PUT (ORD(T)*NYPER+1980):5:0;
  PUT (SUM(RG, SUM(NIND, PRO.L(NIND,T,RG))+DMD.L('ELE-I',T,RG)/EFF(T,RG))):10:3;
  PUT (SUM(RG, SUM(NTRA, PRO.L(NTRA,T,RG))+DMD.L('ELE-T',T,RG)/EFF(T,RG))):9:3;
  PUT (SUM(RG, SUM(NOTH, PRO.L(NOTH,T,RG))+DMD.L('ELE-O',T,RG)/EFF(T,RG))):9:3;
  PUT (SUM(RG, SUM(NIND, PRO.L(NIND,T,RG))+DMD.L('ELE-I',T,RG)/EFF(T,RG) +
    SUM(NTRA, PRO.L(NTRA,T,RG))+DMD.L('ELE-T',T,RG)/EFF(T,RG) +
    SUM(NOTH, PRO.L(NOTH,T,RG))+DMD.L('ELE-O',T,RG)/EFF(T,RG))):9:3;
  PUT SUM((ET,RG), PRO.L(ET,T,RG)):11:3;
  PUT SUM((NT,RG), PRO.L(NT,T,RG)):9:3;
  PUT /;
);

PUT /;
PUT " Regional " /;
PUT "-----" /;
PUT "Regional of primary energy production (MTOE)" /;
LOOP(RG,
  PUT "REGION =";
  PUT ORD(RG):2:0 /;
  PUT " Year Coal Gas Oil Hydro. Geo. Biomass Total"/;
  LOOP(T,
    PUT (ORD(T)*NYPER+1980):5:0;
    PUT SUM(TCOA, PRO.L(TCOA,T,RG)):9:3;
    PUT SUM(TGAS, PRO.L(TGAS,T,RG)):9:3;
    PUT SUM(TOIL, PRO.L(TOIL,T,RG)):9:3;
    PUT PRO.L('HYDRO',T,RG):9:3;
    PUT PRO.L('GEOTR',T,RG):9:3;
    PUT PRO.L('BIO-O',T,RG):9:3;
    PUT (SUM(TCOA, PRO.L(TCOA,T,RG))+SUM(TGAS, PRO.L(TGAS,T,RG))+
      SUM(TOIL, PRO.L(TOIL,T,RG))+PRO.L('HYDRO',T,RG)+
      PRO.L('GEOTR',T,RG)+PRO.L('BIO-O',T,RG)):9:3;
    PUT /;
  );
);

PUT /;
PUT "Regional of economic indicator & exogenous variable" /;
PUT "Income (Billion 1990 US dollar)" /;
PUT " Year Java Sumatera Kalimant OthIsland Total" /;
LOOP(T,
  PUT (ORD(T)*NYPER+1980):5:0;
  PUT Y.L(T,'JAV'):10:3;
  PUT Y.L(T,'SMT'):10:3;
  PUT Y.L(T,'KAL'):10:3;
  PUT Y.L(T,'OTH'):10:3;
  PUT SUM(RG, Y.L(T,RG)):10:3;
  PUT /;
);
PUT "Income per capita (1990 US dollar)" /;
PUT " Year Java Sumatera Kalimant OthIsland Total" /;
LOOP(T,
  PUT (ORD(T)*NYPER+1980):5:0;
  PUT (1000*Y.L(T,'JAV')/L(T,'JAV')):10:3;
  PUT (1000*Y.L(T,'SMT')/L(T,'SMT')):10:3;
  PUT (1000*Y.L(T,'KAL')/L(T,'KAL')):10:3;
  PUT (1000*Y.L(T,'OTH')/L(T,'OTH')):10:3;
  PUT (1000*SUM(RG, Y.L(T,RG))/SUM(RG, L(T,RG))):10:3;
  PUT /;
);
PUT "Population (Million)" /;

```

```

PUT " Year          Java  Sumatera  Kalimant OthIsland      Total" /;
LOOP(T,
  PUT (ORD(T)*NYPER+1980):5:0;
  PUT L(T,'JAV'):10:3;
  PUT L(T,'SMT'):10:3;
  PUT L(T,'KAL'):10:3;
  PUT L(T,'OTH'):10:3;
  PUT SUM(RG, L(T,RG)):10:3;
  PUT /;
);
PUT "Electricity use efficiency (%)" /;
PUT " Year          Java  Sumatera  Kalimant OthIsland      Average" /;
LOOP(T,
  PUT (ORD(T)*NYPER+1980):5:0;
  PUT EFF(T,'JAV'):10:3;
  PUT EFF(T,'SMT'):10:3;
  PUT EFF(T,'KAL'):10:3;
  PUT EFF(T,'OTH'):10:3;
  PUT (SUM(RG, EFF(T,RG))/4):10:3;
  PUT /;
);

PUT /;
PUT "CO2 Emission (Billion TON)" /;
PUT " Year          Java  Sumatera  Kalimant OthIsland      Total" /;
LOOP(T,
  PUT (ORD(T)*NYPER+1980):5:0;
  PUT EE.L(T,'JAV'):10:3;
  PUT EE.L(T,'SMT'):10:3;
  PUT EE.L(T,'KAL'):10:3;
  PUT EE.L(T,'OTH'):10:3;
  PUT SUM(RG, EE.L(T,RG)):10:3;
  PUT /;
);

PUT /;
PUT "Domestic import of coal (MTOE)" /;
PUT " Year          Java  Sumatera  Kalimant OthIsland      Total" /;
LOOP(T,
  PUT (ORD(T)*NYPER+1980):5:0;
  PUT IMD.L('COAL',T,'JAV'):10:3;
  PUT IMD.L('COAL',T,'SMT'):10:3;
  PUT IMD.L('COAL',T,'KAL'):10:3;
  PUT IMD.L('COAL',T,'OTH'):10:3;
  PUT SUM(RG, IMD.L('COAL',T,RG)):10:3;
  PUT /;
);

PUT /;
PUT "Domestic import of oil (MTOE)" /;
PUT " Year          Java  Sumatera  Kalimant OthIsland      Total" /;
LOOP(T,
  PUT (ORD(T)*NYPER+1980):5:0;
  PUT IMD.L('COIL',T,'JAV'):10:3;
  PUT IMD.L('COIL',T,'SMT'):10:3;
  PUT IMD.L('COIL',T,'KAL'):10:3;
  PUT IMD.L('COIL',T,'OTH'):10:3;
  PUT SUM(RG, IMD.L('COIL',T,RG)):10:3;
  PUT /;
);

PUT /;
PUT "Domestic import of gas (MTOE)" /;
PUT " Year          Java  Sumatera  Kalimant OthIsland      Total" /;
LOOP(T,

```

```

    PUT (ORD(T)*NYPERS+1980):5:0;
    PUT IMD.L('NGAS',T,'JAV'):10:3;
    PUT IMD.L('NGAS',T,'SMT'):10:3;
    PUT IMD.L('NGAS',T,'KAL'):10:3;
    PUT IMD.L('NGAS',T,'OTH'):10:3;
    PUT SUM(RG, IMD.L('NGAS',T, RG)):10:3;
    PUT /;
);

PUT /;
PUT "Domestic export of coal (MTOE)" /;
PUT " Year      Java Sumatera Kalimantan OthIsland      Total" /;
LOOP(T,
    PUT (ORD(T)*NYPERS+1980):5:0;
    PUT EXD.L('COAL',T,'JAV'):10:3;
    PUT EXD.L('COAL',T,'SMT'):10:3;
    PUT EXD.L('COAL',T,'KAL'):10:3;
    PUT EXD.L('COAL',T,'OTH'):10:3;
    PUT SUM(RG, EXD.L('COAL',T, RG)):10:3;
    PUT /;
);

PUT /;
PUT "Domestic export of oil (MTOE)" /;
PUT " Year      Java Sumatera Kalimantan OthIsland      Total" /;
LOOP(T,
    PUT (ORD(T)*NYPERS+1980):5:0;
    PUT EXD.L('COIL',T,'JAV'):10:3;
    PUT EXD.L('COIL',T,'SMT'):10:3;
    PUT EXD.L('COIL',T,'KAL'):10:3;
    PUT EXD.L('COIL',T,'OTH'):10:3;
    PUT SUM(RG, EXD.L('COIL',T, RG)):10:3;
    PUT /;
);

PUT /;
PUT "Domestic export of gas (MTOE)" /;
PUT " Year      Java Sumatera Kalimantan OthIsland      Total" /;
LOOP(T,
    PUT (ORD(T)*NYPERS+1980):5:0;
    PUT EXD.L('NGAS',T,'JAV'):10:3;
    PUT EXD.L('NGAS',T,'SMT'):10:3;
    PUT EXD.L('NGAS',T,'KAL'):10:3;
    PUT EXD.L('NGAS',T,'OTH'):10:3;
    PUT SUM(RG, EXD.L('NGAS',T, RG)):10:3;
    PUT /;
);

PUT /;
PUT "Foreign import of coal (MTOE)" /;
PUT " Year      Java Sumatera Kalimantan OthIsland      Total" /;
LOOP(T,
    PUT (ORD(T)*NYPERS+1980):5:0;
    PUT IMF.L('COAL',T,'JAV'):10:3;
    PUT IMF.L('COAL',T,'SMT'):10:3;
    PUT IMF.L('COAL',T,'KAL'):10:3;
    PUT IMF.L('COAL',T,'OTH'):10:3;
    PUT SUM(RG, IMF.L('COAL',T, RG)):10:3;
    PUT /;
);

PUT /;
PUT "Foreign import of oil (MTOE)" /;
PUT " Year      Java Sumatera Kalimantan OthIsland      Total" /;
LOOP(T,

```

```

PUT (ORD(T)*NYPER+1980):5:0;
PUT IMF.L('COIL',T,'JAV'):10:3;
PUT IMF.L('COIL',T,'SMT'):10:3;
PUT IMF.L('COIL',T,'KAL'):10:3;
PUT IMF.L('COIL',T,'OTH'):10:3;
PUT SUM(RG, IMF.L('COIL',T,RG)):10:3;
PUT /;
);

PUT /;
PUT "Foreign import of gas (MTOE)" /;
PUT " Year      Java Sumatera Kalimantan OthIsland      Total" /;
LOOP(T,
  PUT (ORD(T)*NYPER+1980):5:0;
  PUT IMF.L('NGAS',T,'JAV'):10:3;
  PUT IMF.L('NGAS',T,'SMT'):10:3;
  PUT IMF.L('NGAS',T,'KAL'):10:3;
  PUT IMF.L('NGAS',T,'OTH'):10:3;
  PUT SUM(RG, IMF.L('NGAS',T,RG)):10:3;
  PUT /;
);

PUT /;
PUT "Demand sector (MTOE) " /;
LOOP(RG,
  PUT "REGION =";
  PUT ORD(RG):2:0 /;
  PUT " Year      Industry      Transport OtherSector" /;
  LOOP(T,
    PUT (ORD(T)*NYPER+1980):5:0;
    PUT (SUM(NIND, PRO.L(NIND,T,RG))+DMD.L('ELE-I',T,RG)/EFF(T,RG)):12:3;
    PUT (SUM(NTRA, PRO.L(NTRA,T,RG))+DMD.L('ELE-T',T,RG)/EFF(T,RG)):12:3;
    PUT (SUM(NOTH, PRO.L(NOTH,T,RG))+DMD.L('ELE-O',T,RG)/EFF(T,RG)):12:3;
    PUT /;
  );
);

PUT /;
PUT "Electricity & nonelectricity energy (MTOE)" /;
LOOP(RG,
  PUT "REGION =";
  PUT ORD(RG):2:0 /;
  PUT " Year      Industry      Transport      Other      Total"/;
  PUT "          ELE      NON      ELE      NON      ELE      NON      ELE      NON"/;
  LOOP(T,
    PUT (ORD(T)*NYPER+1980):5:0;
    PUT (DMD.L('ELE-I',T,RG)/EFF(T,RG)):8:3;
    PUT SUM(NIND, PRO.L(NIND,T,RG)):8:3;
    PUT (DMD.L('ELE-T',T,RG)/EFF(T,RG)):8:3;
    PUT SUM(NTRA, PRO.L(NTRA,T,RG)):8:3;
    PUT (DMD.L('ELE-O',T,RG)/EFF(T,RG)):8:3;
    PUT SUM(NOTH, PRO.L(NOTH,T,RG)):8:3;
    PUT SUM(ET, PRO.L(ET,T,RG)):8:3;
    PUT SUM(NT, PRO.L(NT,T,RG)):8:3;
    PUT /;
  );
);

PUT /;
PUT "Electricity energy production by fuel (MTOE)" /;
LOOP(RG,
  PUT "REGION =";
  PUT ORD(RG):2:0 /;
  PUT " Year      Coal      Gas      Oil      Hydr.      Geoth.      Total" /;
  LOOP(T,

```

```

        PUT (ORD(T)*NYPER+1980):5:0;
        PUT PRO.L('COA-P',T,RG):8:3;
        PUT PRO.L('GAS-P',T,RG):8:3;
        PUT PRO.L('OIL-P',T,RG):8:3;
        PUT PRO.L('HYDRO',T,RG):8:3;
        PUT PRO.L('GEOTR',T,RG):8:3;
        PUT SUM(ET, PRO.L(ET,T,RG)):9:3;
        PUT /;
    );
);

PUT /;
PUT "Production of all energy technology (MTOE)" /;
LOOP(RG,
    PUT /;
    PUT "REGION =";
    PUT ORD(RG):2:0 /;
    PUT " Year COAL-IND COAL-OTH GAS-IND GAS-TRA GAS-OTH " /;
    LOOP(T,
        PUT (ORD(T)*NYPER+1980):5:0;
        PUT PRO.L('COA-I',T,RG):10:3;
        PUT PRO.L('COA-O',T,RG):10:3;
        PUT PRO.L('GAS-I',T,RG):10:3;
        PUT PRO.L('GAS-T',T,RG):10:3;
        PUT PRO.L('GAS-O',T,RG):10:3;
        PUT /;
    );
    PUT /;
    PUT " Year OIL-IND OIL-TRA OIL-OTH BIO-OTH " /;
    LOOP(T,
        PUT (ORD(T)*NYPER+1980):5:0;
        PUT PRO.L('OIL-I',T,RG):10:3;
        PUT PRO.L('OIL-T',T,RG):10:3;
        PUT PRO.L('OIL-O',T,RG):10:3;
        PUT PRO.L('BIO-O',T,RG):10:3;
        PUT /;
    );
    PUT /;
    PUT " Year COAL-P GAS-P OIL-P HYDRO GEOTR" /;
    LOOP(T,
        PUT (ORD(T)*NYPER+1980):5:0;
        PUT PRO.L('COA-P',T,RG):10:3;
        PUT PRO.L('GAS-P',T,RG):10:3;
        PUT PRO.L('OIL-P',T,RG):10:3;
        PUT PRO.L('HYDRO',T,RG):10:3;
        PUT PRO.L('GEOTR',T,RG):10:3;
        PUT /;
    );
);
);

```

APPENDIX B
OUTPUT PROGRAM

* BASE CASE *

Aggregate

Total primary energy production (MTOE)

Year	Coal	Gas	Oil	Hydro.	Geothm.	Biomass	Total
1990	4.201	14.328	38.854	1.292	0.903	17.038	76.616
2000	49.997	33.152	38.854	2.829	5.430	17.038	147.301
2010	105.336	38.779	38.854	2.829	5.714	20.329	211.841
2020	202.000	58.025	38.854	3.275	5.918	24.266	332.339
2030	330.592	106.616	40.897	5.380	5.918	34.887	524.290

Economic indicator and CO2 emission

Year	Income	Popul.	Ele_eff.	Y_per_cap	CO2_Em.
1990	100.770	181.583	0.324	554.953	45.528
2000	175.846	216.110	0.333	813.688	102.739
2010	259.477	246.529	0.342	1052.524	161.845
2020	412.429	272.131	0.351	1515.554	270.585
2030	677.386	293.032	0.360	2311.644	430.793

Energy demand each sector & Elec-nonelec. energy (MTOE)

Year	Indust.	Transp.	Other	Total	Elec.	Non-ele
1990	27.154	15.536	33.926	76.616	7.877	68.739
2000	91.817	21.497	33.986	147.301	18.507	128.794
2010	141.487	33.014	37.340	211.841	25.576	186.265
2020	230.749	51.203	50.387	332.339	38.064	294.275
2030	372.424	78.268	73.598	524.290	59.553	464.737

Regional

Regional of primary energy production (MTOE)

REGION = 1

Year	Coal	Gas	Oil	Hydro.	Geo.	Biomass	Total
1990	3.186	9.568	24.212	0.678	0.868	7.130	45.642
2000	27.089	13.224	24.212	2.215	4.113	7.130	77.983
2010	53.295	20.216	24.212	2.215	4.113	9.730	113.781
2020	106.342	30.602	24.212	2.215	4.113	10.000	177.484
2030	176.327	45.306	24.212	2.215	4.113	10.000	262.173

REGION = 2

Year	Coal	Gas	Oil	Hydro.	Geo.	Biomass	Total
1990	0.755	2.773	8.585	0.335	0.012	6.342	18.802
2000	15.467	13.076	8.585	0.335	0.012	6.342	43.817
2010	33.626	12.152	8.585	0.335	0.012	6.342	61.051
2020	61.779	17.711	8.585	0.335	0.012	7.168	95.591
2030	92.821	46.280	8.585	0.335	0.012	13.297	161.330

REGION = 3

Year	Coal	Gas	Oil	Hydro.	Geo.	Biomass	Total
1990	0.124	0.955	2.690	0.137	0.001	1.642	5.549
2000	3.821	5.821	2.690	0.137	0.001	1.642	14.112
2010	13.718	4.955	2.690	0.137	0.001	2.333	23.834
2020	26.223	7.135	2.690	0.137	0.001	4.096	40.282
2030	46.072	12.396	2.690	0.137	0.001	6.613	67.910

REGION = 4

Year	Coal	Gas	Oil	Hydro.	Geo.	Biomass	Total
1990	0.136	1.032	3.367	0.142	0.022	1.924	6.623
2000	3.619	1.032	3.367	0.142	1.304	1.924	11.389
2010	4.697	1.457	3.367	0.142	1.588	1.924	13.174
2020	7.656	2.576	3.367	0.588	1.792	3.002	18.981
2030	15.371	2.635	5.410	2.693	1.792	4.976	32.877

Regional of economic indicator & exogenous variable

Income (Billion 1990 US dollar)

Year	Java	Sumatera	Kalimant	OthIsland	Total
1990	56.530	27.210	9.880	7.150	100.770
2000	99.729	47.130	16.742	12.245	175.846

2010	143.680	70.760	29.413	15.625	259.477
2020	221.971	118.619	50.165	21.674	412.429
2030	349.146	203.431	85.857	38.951	677.386
Income per capita (1990 US dollar)					
Year	Java	Sumatera	Kalimant	OthIsland	Total
1990	523.166	736.519	1020.201	265.789	554.953
2000	792.808	1022.680	1299.303	390.628	813.688
2010	1035.097	1273.049	1820.394	434.259	1052.524
2020	1504.611	1830.244	2621.780	533.068	1515.554
2030	2281.733	2778.939	3980.772	860.967	2311.644
Population (Million)					
Year	Java	Sumatera	Kalimant	OthIsland	Total
1990	108.054	36.944	9.684	26.901	181.583
2000	125.792	46.084	12.886	31.348	216.110
2010	138.808	55.583	16.157	35.980	246.529
2020	147.527	64.810	19.134	40.659	272.131
2030	153.018	73.205	21.568	45.242	293.032
Electricity use efficiency (%)					
Year	Java	Sumatera	Kalimant	OthIsland	Average
1990	0.360	0.336	0.324	0.276	0.324
2000	0.370	0.345	0.333	0.283	0.333
2010	0.379	0.354	0.342	0.291	0.342
2020	0.390	0.364	0.351	0.299	0.351
2030	0.400	0.373	0.360	0.307	0.360
CO2 Emission (Billion TON)					
Year	Java	Sumatera	Kalimant	OthIsland	Total
1990	29.317	9.609	2.991	3.612	45.528
2000	55.334	30.718	9.592	7.095	102.739
2010	85.581	48.677	19.168	8.418	161.845
2020	144.631	80.707	33.222	12.024	270.585
2030	223.115	129.561	56.658	21.458	430.793
Domestic import of coal (MTOE)					
Year	Java	Sumatera	Kalimant	OthIsland	Total
1990	0.000	0.000	0.000	0.000	0.000
2000	26.375	0.000	0.000	3.619	29.995
2010	53.295	0.000	0.000	4.697	57.992
2020	106.342	0.000	0.000	7.656	113.998
2030	176.327	0.000	0.000	8.707	185.034
Domestic import of oil (MTOE)					
Year	Java	Sumatera	Kalimant	OthIsland	Total
1990	0.000	0.000	0.000	0.000	0.000
2000	1.347	0.000	0.000	3.367	4.714
2010	24.212	0.000	0.000	3.367	27.579
2020	24.212	0.000	0.000	3.367	27.579
2030	8.442	0.000	0.000	5.410	13.853
Domestic import of gas (MTOE)					
Year	Java	Sumatera	Kalimant	OthIsland	Total
1990	0.000	0.000	0.000	0.000	0.000
2000	11.390	0.000	0.000	1.032	12.422
2010	20.216	0.000	0.000	1.457	21.673
2020	30.602	0.000	0.000	2.576	33.179
2030	26.107	0.000	0.000	1.467	27.573
Domestic export of coal (MTOE)					
Year	Java	Sumatera	Kalimant	OthIsland	Total
1990	0.000	0.000	0.000	0.000	0.000
2000	0.000	15.075	14.920	0.000	29.995
2010	0.000	5.256	52.736	0.000	57.992
2020	0.000	70.886	43.112	0.000	113.998
2030	0.000	170.002	15.032	0.000	185.034

Domestic export of oil (MTOE)

Year	Java	Sumatera	Kalimant	OthIsland	Total
1990	0.000	0.000	0.000	0.000	0.000
2000	0.000	4.714	0.000	0.000	4.714
2010	0.000	27.579	0.000	0.000	27.579
2020	0.000	27.579	0.000	0.000	27.579
2030	0.000	13.303	0.550	0.000	13.853

Domestic export of gas (MTOE)

Year	Java	Sumatera	Kalimant	OthIsland	Total
1990	0.000	0.000	0.000	0.000	0.000
2000	0.000	12.422	0.000	0.000	12.422
2010	0.000	21.168	0.505	0.000	21.673
2020	0.000	23.581	9.598	0.000	33.179
2030	0.000	8.839	18.735	0.000	27.573

Foreign import of coal (MTOE)

Year	Java	Sumatera	Kalimant	OthIsland	Total
1990	0.000	0.000	0.000	0.000	0.000
2000	0.000	0.000	0.000	0.000	0.000
2010	0.000	0.000	0.000	0.000	0.000
2020	0.000	0.000	0.000	0.000	0.000
2030	0.000	0.000	0.000	0.000	0.000

Foreign import of oil (MTOE)

Year	Java	Sumatera	Kalimant	OthIsland	Total
1990	0.000	0.000	0.000	0.000	0.000
2000	0.000	0.000	0.000	0.000	0.000
2010	11.692	0.000	0.000	1.542	13.234
2020	24.212	0.000	0.000	0.538	24.750
2030	8.442	0.000	0.000	0.187	8.630

Foreign import of gas (MTOE)

Year	Java	Sumatera	Kalimant	OthIsland	Total
1990	0.000	0.000	0.000	0.000	0.000
2000	0.000	0.000	0.000	0.000	0.000
2010	0.000	0.000	0.000	0.000	0.000
2020	0.000	0.000	0.000	0.000	0.000
2030	0.000	0.000	0.000	0.000	0.000

Demand sector (MTOE)

REGION = 1

Year	Industry	Transport	OtherSector
1990	16.949	10.084	18.609
2000	45.570	13.762	18.651
2010	71.710	20.777	21.295
2020	115.642	31.186	30.656
2030	173.032	45.914	43.227

REGION = 2

Year	Industry	Transport	OtherSector
1990	5.746	2.587	10.469
2000	29.046	4.293	10.477
2010	43.505	7.060	10.486
2020	72.575	11.694	11.321
2030	124.990	18.881	17.459

REGION = 3

Year	Industry	Transport	OtherSector
1990	2.330	1.075	2.144
2000	10.314	1.652	2.145
2010	18.033	2.963	2.838
2020	30.693	4.988	4.601
2030	52.752	8.037	7.120

REGION = 4

Year	Industry	Transport	OtherSector
1990	2.129	1.790	2.704

2000	6.886	1.790	2.713
2010	8.239	2.214	2.721
2020	11.838	3.334	3.809
2030	21.649	5.436	5.792

Electricity & nonelectricity energy (MTOE)

REGION = 1

Year	Industry		Transport		Other		Total	
	ELE	NON	ELE	NON	ELE	NON	ELE	NON
1990	2.200	14.749	0.972	9.112	1.867	16.742	5.039	40.603
2000	9.320	36.250	0.994	12.768	1.909	16.742	12.223	65.759
2010	13.958	57.752	1.017	19.760	1.953	19.342	16.927	96.854
2020	21.874	93.769	1.040	30.146	1.997	28.658	24.911	152.573
2030	33.717	139.316	1.064	44.850	2.043	41.184	36.824	225.349

REGION = 2

Year	Industry		Transport		Other		Total	
	ELE	NON	ELE	NON	ELE	NON	ELE	NON
1990	1.040	4.706	0.000	2.587	0.372	10.097	1.412	17.390
2000	2.822	26.224	0.000	4.293	0.380	10.097	3.202	40.614
2010	4.169	39.336	0.000	7.060	0.389	10.097	4.558	56.493
2020	6.845	65.730	0.000	11.694	0.398	10.923	7.243	88.347
2030	12.096	112.894	0.000	18.881	0.407	17.052	12.503	148.827

REGION = 3

Year	Industry		Transport		Other		Total	
	ELE	NON	ELE	NON	ELE	NON	ELE	NON
1990	0.631	1.699	0.000	1.075	0.046	2.098	0.677	4.872
2000	1.002	9.312	0.000	1.652	0.047	2.098	1.049	13.063
2010	1.728	16.305	0.000	2.963	0.048	2.789	1.776	22.057
2020	2.895	27.798	0.000	4.988	0.050	4.552	2.944	37.338
2030	5.105	47.647	0.000	8.037	0.051	7.069	5.156	62.754

REGION = 4

Year	Industry		Transport		Other		Total	
	ELE	NON	ELE	NON	ELE	NON	ELE	NON
1990	0.373	1.756	0.003	1.787	0.373	2.331	0.749	5.874
2000	1.647	5.239	0.003	1.787	0.382	2.331	2.031	9.357
2010	1.921	6.317	0.003	2.212	0.390	2.331	2.315	10.860
2020	2.563	9.276	0.003	3.331	0.399	3.409	2.965	16.016
2030	4.659	16.991	0.003	5.433	0.408	5.383	5.070	27.807

Electricity energy production by fuel (MTOE)

REGION = 1

Year	Coal	Gas	Oil	Hydr.	Geoth.	Total
1990	0.612	0.173	2.708	0.678	0.868	5.039
2000	3.014	0.173	2.708	2.215	4.113	12.223
2010	7.718	0.173	2.708	2.215	4.113	16.927
2020	15.702	0.173	2.708	2.215	4.113	24.911
2030	27.615	0.173	2.708	2.215	4.113	36.824

REGION = 2

Year	Coal	Gas	Oil	Hydr.	Geoth.	Total
1990	0.322	0.031	0.712	0.335	0.012	1.412
2000	0.322	0.031	2.502	0.335	0.012	3.202
2010	0.322	0.031	3.858	0.335	0.012	4.558
2020	0.322	0.031	6.543	0.335	0.012	7.243
2030	0.322	0.031	11.803	0.335	0.012	12.503

REGION = 3

Year	Coal	Gas	Oil	Hydr.	Geoth.	Total
1990	0.107	0.023	0.409	0.137	0.001	0.677
2000	0.107	0.023	0.781	0.137	0.001	1.049
2010	0.107	0.023	1.508	0.137	0.001	1.776
2020	0.107	0.023	2.676	0.137	0.001	2.944
2030	0.107	0.023	4.888	0.137	0.001	5.156

REGION = 4

Year	Coal	Gas	Oil	Hydr.	Geoth.	Total
1990	0.112	0.031	0.442	0.142	0.022	0.749
2000	0.112	0.031	0.442	0.142	1.304	2.031

2010	0.112	0.031	0.442	0.142	1.588	2.315
2020	0.112	0.031	0.442	0.588	1.792	2.965
2030	0.112	0.031	0.442	2.693	1.792	5.070

Production of all energy technology (MTOE)

REGION = 1

Year	COAL-IND	COAL-OTH	GAS-IND	GAS-TRA	GAS-OTH
1990	2.442	0.132	3.852	0.404	2.604
2000	23.943	0.132	3.852	4.060	2.604
2010	45.445	0.132	3.852	11.052	2.604
2020	81.462	9.178	3.852	21.438	2.604
2030	127.009	21.704	3.852	36.142	2.604

Year	OIL-IND	OIL-TRA	OIL-OTH	BIO-OTH
1990	8.455	8.708	6.876	7.130
2000	8.455	8.708	6.876	7.130
2010	8.455	8.708	6.876	9.730
2020	8.455	8.708	6.876	10.000
2030	8.455	8.708	6.876	10.000

Year	COAL-P	GAS-P	OIL-P	HYDRO	GEOTR
1990	0.612	0.173	2.708	0.678	0.868
2000	3.014	0.173	2.708	2.215	4.113
2010	7.718	0.173	2.708	2.215	4.113
2020	15.702	0.173	2.708	2.215	4.113
2030	27.615	0.173	2.708	2.215	4.113

REGION = 2

Year	COAL-IND	COAL-OTH	GAS-IND	GAS-TRA	GAS-OTH
1990	0.422	0.011	0.942	0.017	1.102
2000	15.134	0.011	7.748	1.723	1.102
2010	33.293	0.011	2.702	4.490	1.102
2020	61.446	0.011	0.942	9.124	1.102
2030	92.488	0.011	17.064	16.311	1.102

Year	OIL-IND	OIL-TRA	OIL-OTH	BIO-OTH
1990	3.342	2.570	2.642	6.342
2000	3.342	2.570	2.642	6.342
2010	3.342	2.570	2.642	6.342
2020	3.342	2.570	2.642	7.168
2030	3.342	2.570	2.642	13.297

Year	COAL-P	GAS-P	OIL-P	HYDRO	GEOTR
1990	0.322	0.031	0.712	0.335	0.012
2000	0.322	0.031	2.502	0.335	0.012
2010	0.322	0.031	3.858	0.335	0.012
2020	0.322	0.031	6.543	0.335	0.012
2030	0.322	0.031	11.803	0.335	0.012

REGION = 3

Year	COAL-IND	COAL-OTH	GAS-IND	GAS-TRA	GAS-OTH
1990	0.015	0.002	0.542	0.002	0.002
2000	3.712	0.002	4.458	0.579	0.002
2010	13.609	0.002	1.554	1.890	0.002
2020	26.114	0.002	0.542	3.915	0.002
2030	45.963	0.002	0.542	6.964	0.002

Year	OIL-IND	OIL-TRA	OIL-OTH	BIO-OTH
1990	1.142	1.073	0.452	1.642
2000	1.142	1.073	0.452	1.642
2010	1.142	1.073	0.452	2.333
2020	1.142	1.073	0.452	4.096
2030	1.142	1.073	0.452	6.613

Year	COAL-P	GAS-P	OIL-P	HYDRO	GEOTR
1990	0.107	0.023	0.409	0.137	0.001
2000	0.107	0.023	0.781	0.137	0.001
2010	0.107	0.023	1.508	0.137	0.001
2020	0.107	0.023	2.676	0.137	0.001
2030	0.107	0.023	4.888	0.137	0.001

REGION = 4

Year	COAL-IND	COAL-OTH	GAS-IND	GAS-TRA	GAS-OTH
1990	0.022	0.002	0.582	0.005	0.003
2000	3.505	0.002	0.582	0.005	0.003
2010	4.583	0.002	0.582	0.430	0.003
2020	7.542	0.002	0.582	1.549	0.003
2030	15.257	0.002	0.582	1.608	0.003

Year	OIL-IND	OIL-TRA	OIL-OTH	BIO-OTH
1990	1.152	1.782	0.402	1.924
2000	1.152	1.782	0.402	1.924
2010	1.152	1.782	0.402	1.924
2020	1.152	1.782	0.402	3.002
2030	1.152	3.825	0.402	4.976

Year	COAL-P	GAS-P	OIL-P	HYDRO	GEOTR
1990	0.112	0.031	0.442	0.142	0.022
2000	0.112	0.031	0.442	0.142	1.304
2010	0.112	0.031	0.442	0.142	1.588
2020	0.112	0.031	0.442	0.588	1.792
2030	0.112	0.031	0.442	2.693	1.792