

ELECTRICITY

IEA ELECTRICITY DATA SYSTEM

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Roberta Quadrelli
Head, non-OECD Statistics
Energy Statistics Division

iea



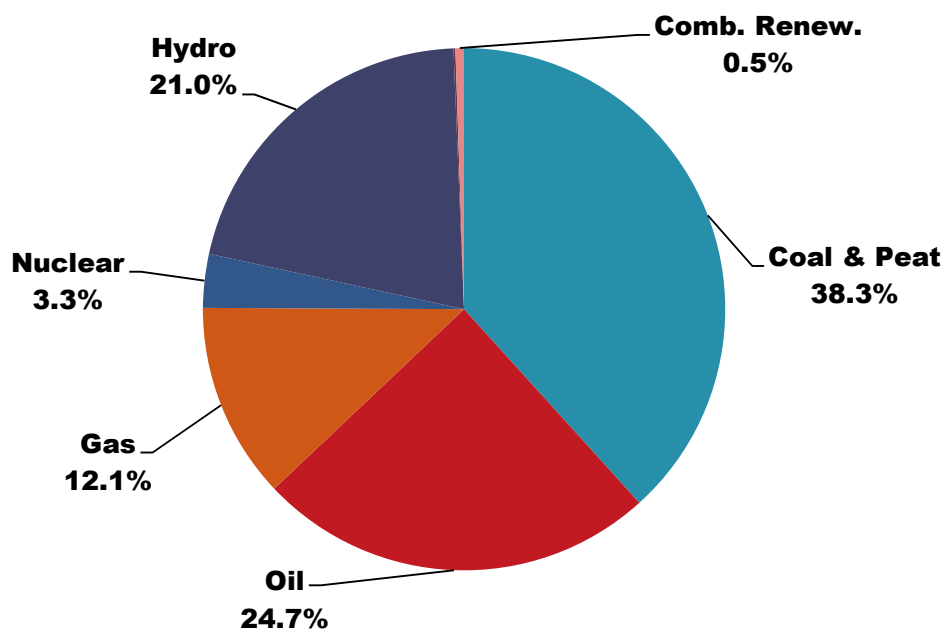
**International
Energy Agency**

OUTLINE

- Overview: the importance of electricity
- Electricity data collection and the IEA Annual Electricity and Heat Questionnaire

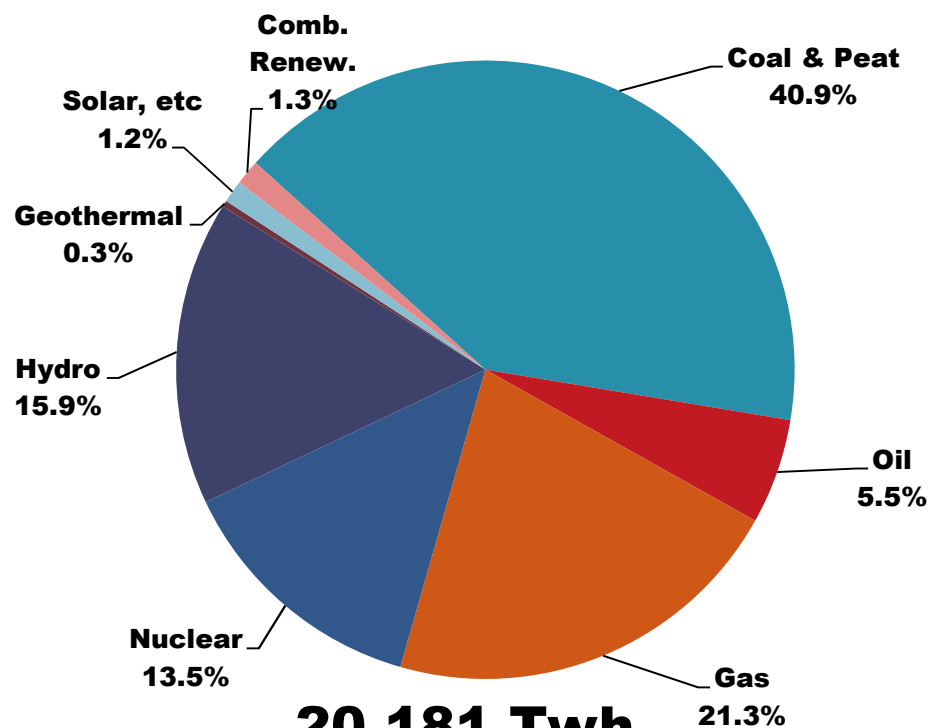
WORLD FUEL SHARES OF ELECTRICITY

1973



6,116 Twh

2008

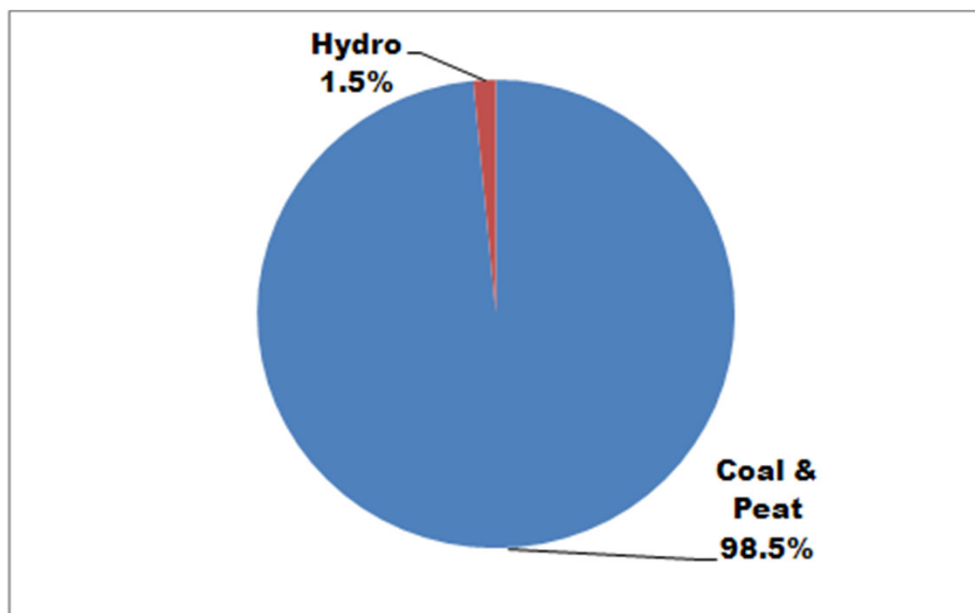


20,181 Twh

**Electricity generation more than tripled - coal largest source
Oil replaced by nuclear and gas**

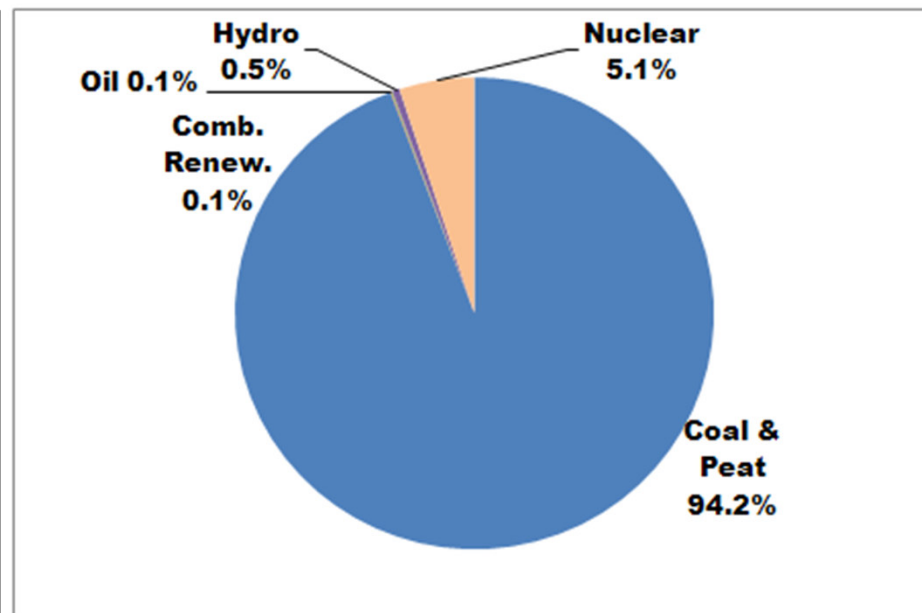
SOUTH AFRICA: FUEL SHARES OF ELECTRICITY

1973



64,390 Gwh

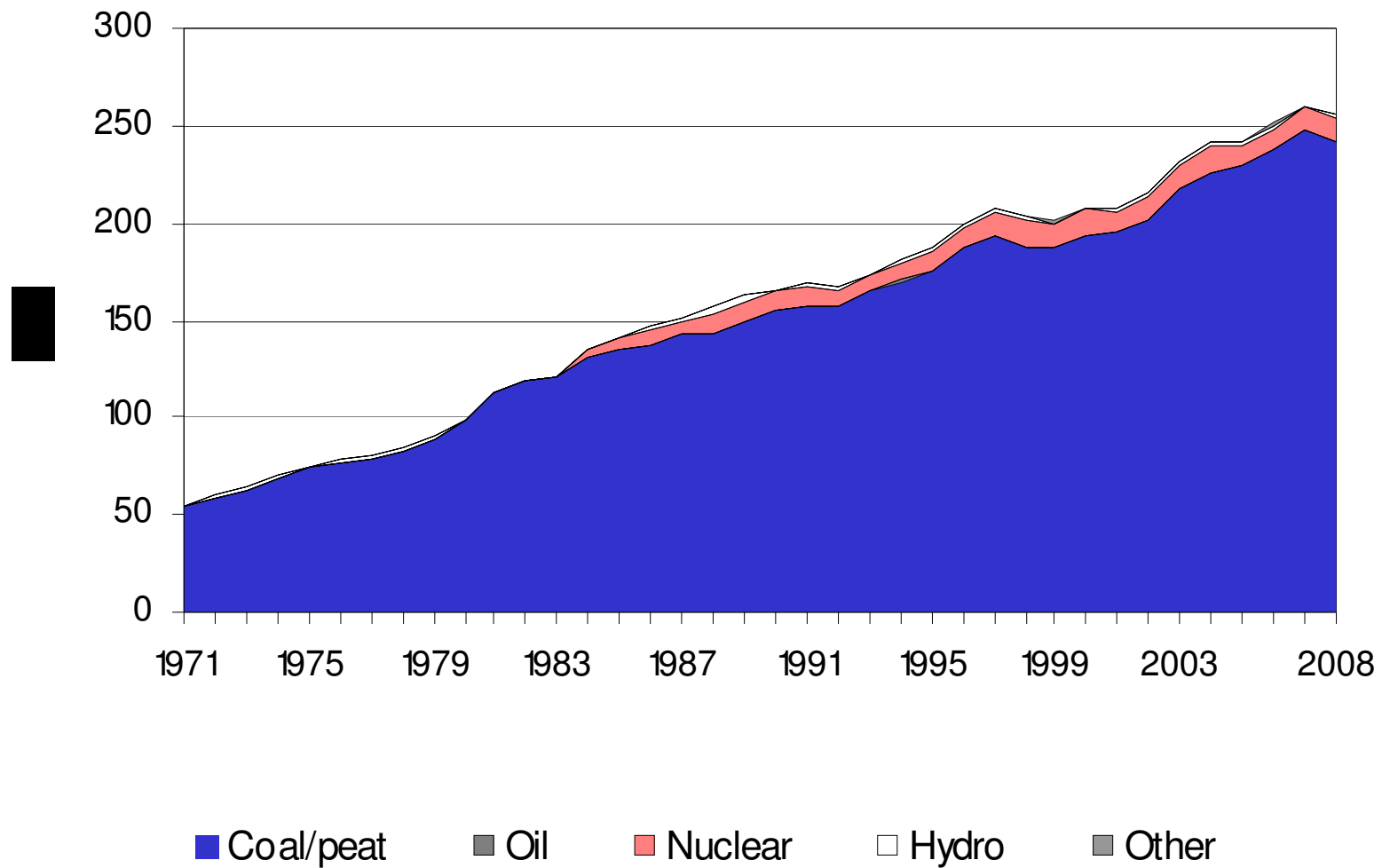
2008



255,519 Gwh

Electricity generation up almost 3 times; coal still absolutely dominant

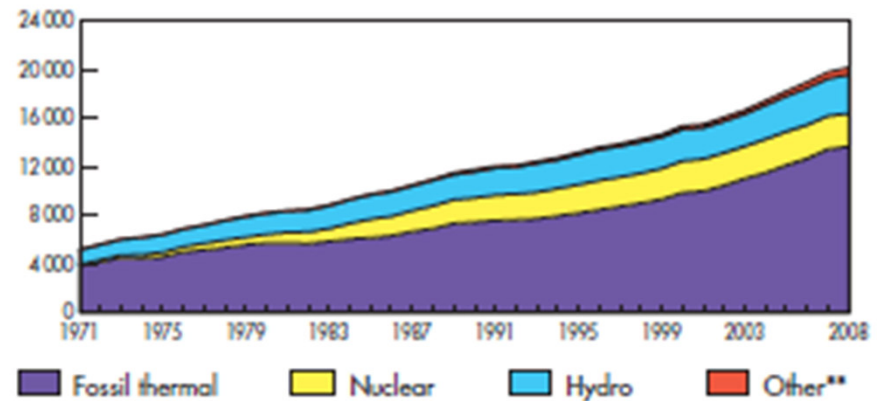
South Africa: Electricity generation in time



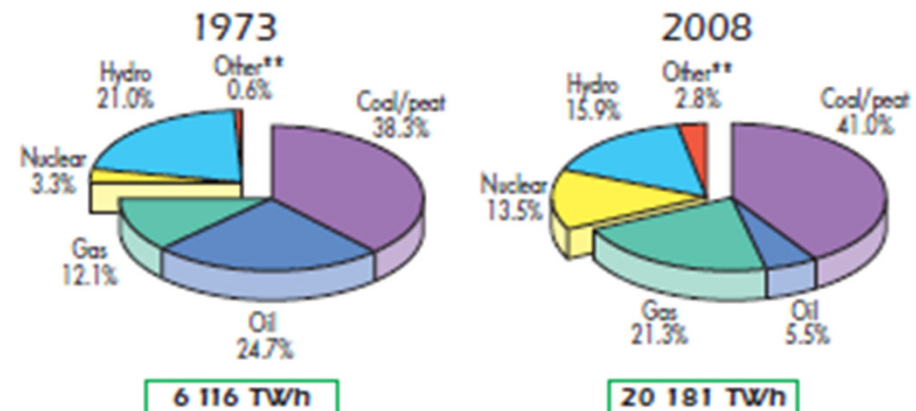
Global electricity generation

Electricity Generation by Fuel

Evolution from 1971 to 2008 of world electricity generation*
by fuel (TWh)



1973 and 2008 fuel shares of electricity generation*



*Excludes pumped storage.

**Other includes geothermal, solar, wind, combustible renewables and waste, and heat

Fossil thermal electricity



Coal/peat	TWh
People's Rep. of China	2 733
United States	2 133
India	569
Germany	291
Japan	288
South Africa	241
Australia	198
Russian Federation	197
Korea	192
Poland	143
Rest of the world	1 278
World	8 263

2008 data

Oil	TWh
Japan	139
Saudi Arabia	116
United States	58
Mexico	49
Indonesia	43
Iraq	36
Kuwait	36
Islamic Rep. of Iran	36
India	34
Pakistan	32
Rest of the world	532
World	1 111

2008 data

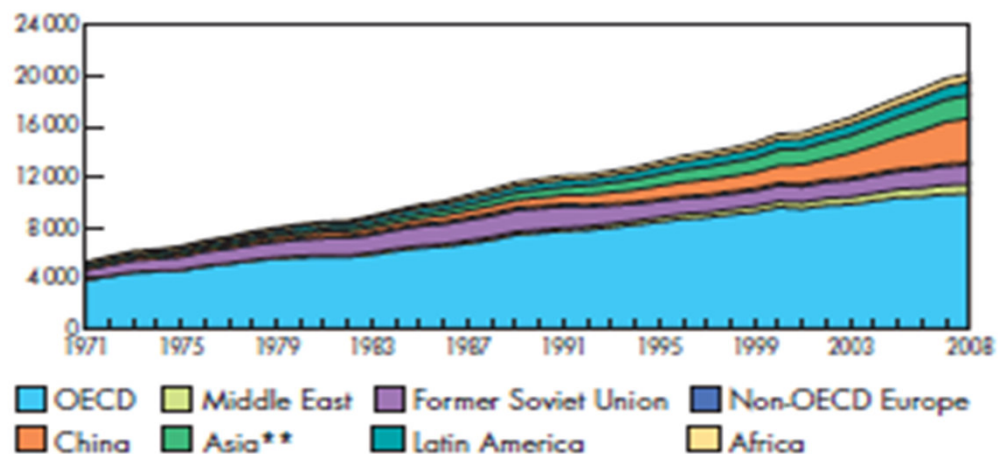
Gas	TWh
United States	911
Russian Federation	495
Japan	283
United Kingdom	177
Islamic Rep. of Iran	173
Italy	173
Mexico	131
Spain	122
Thailand	102
Turkey	99
Rest of the world	1 635
World	4 301

2008 data

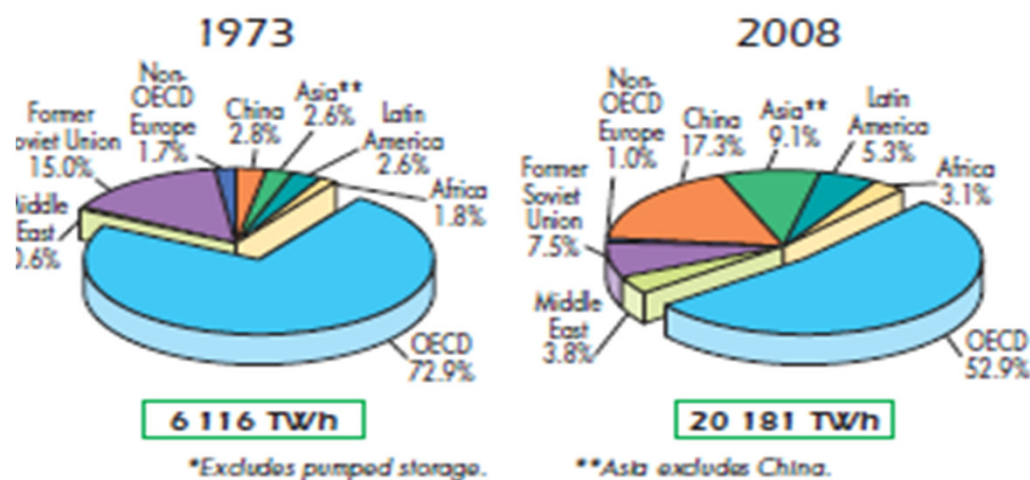
Electricity Generation by Region

Electricity generation by region

Evolution from 1971 to 2008 of world electricity generation*
by region (TWh)



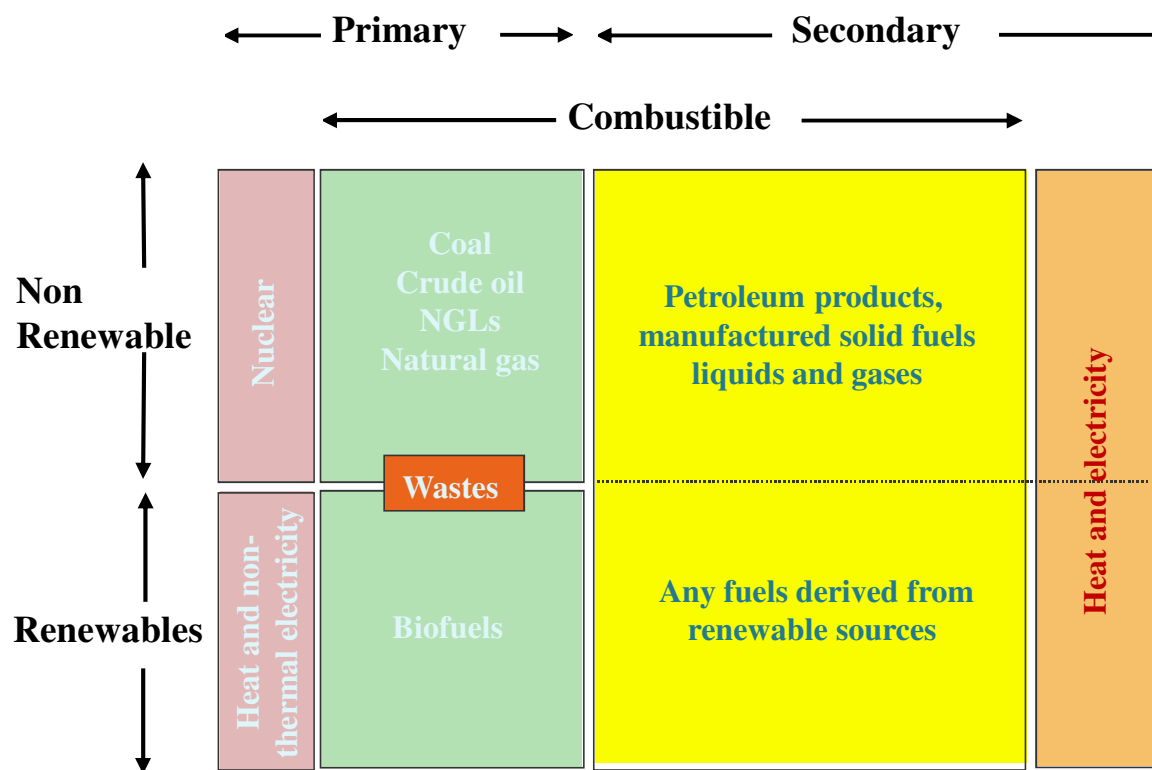
1973 and 2008 regional shares of electricity generation*



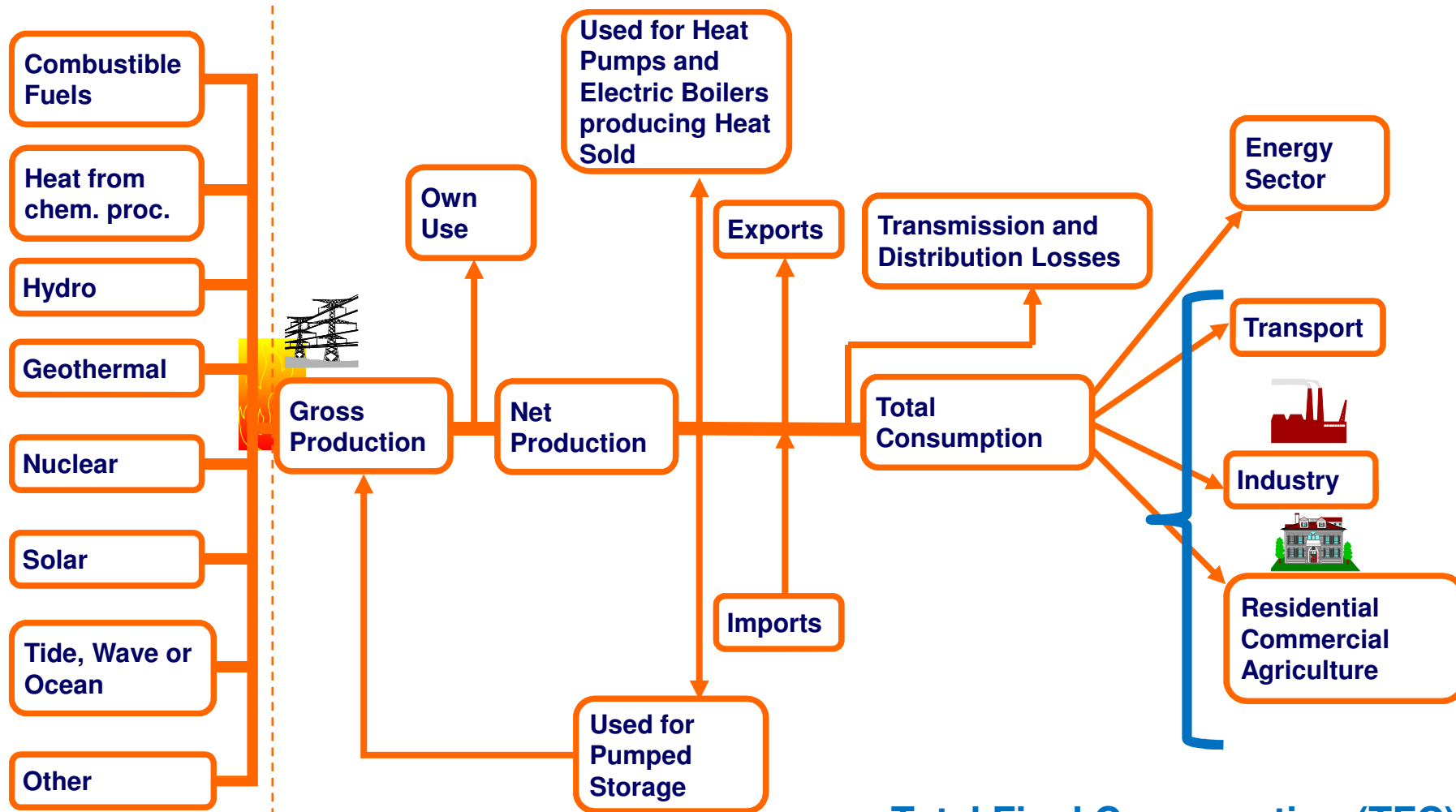


ELECTRICITY DATA COLLECTION

Electricity and heat as energy commodities

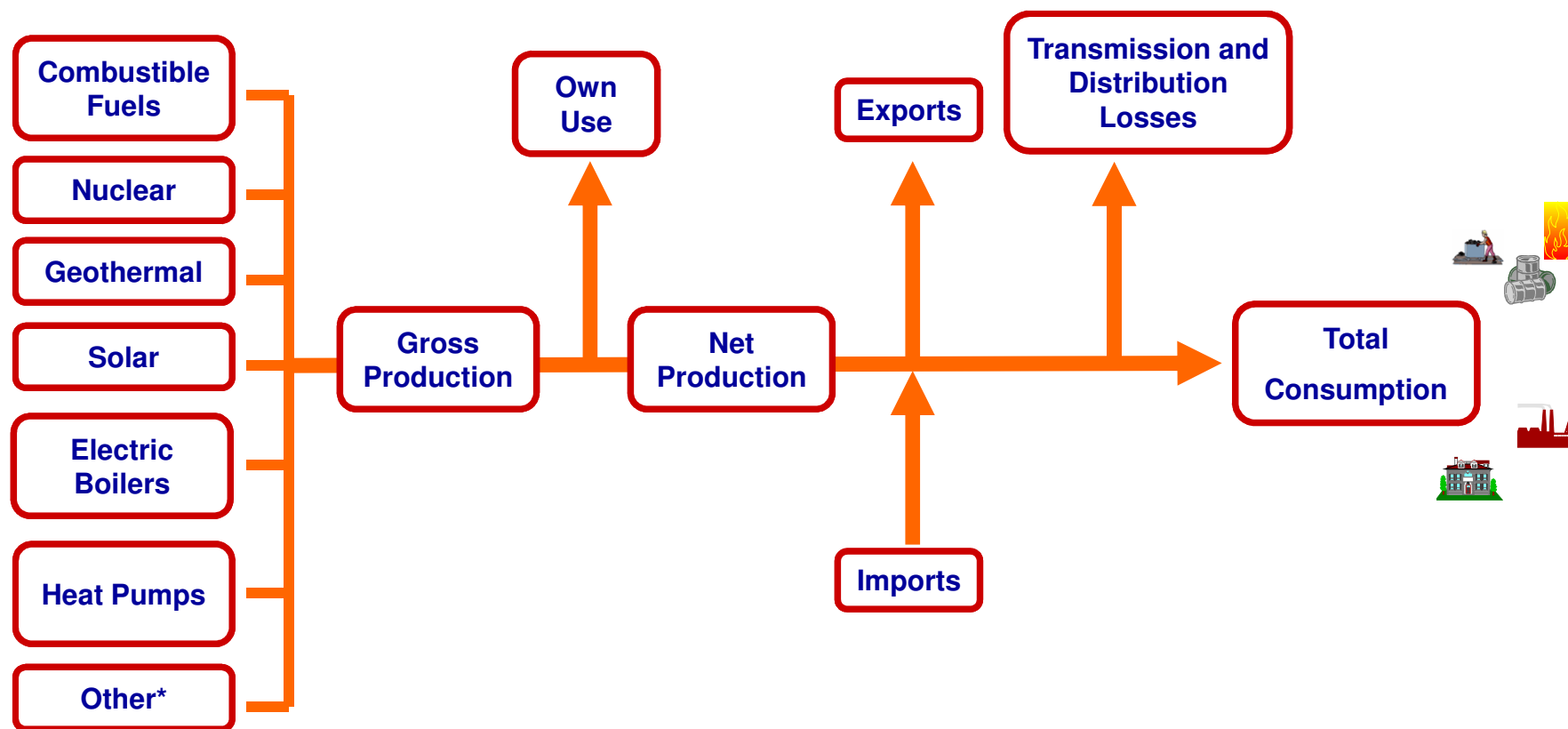


Electricity statistics: flows

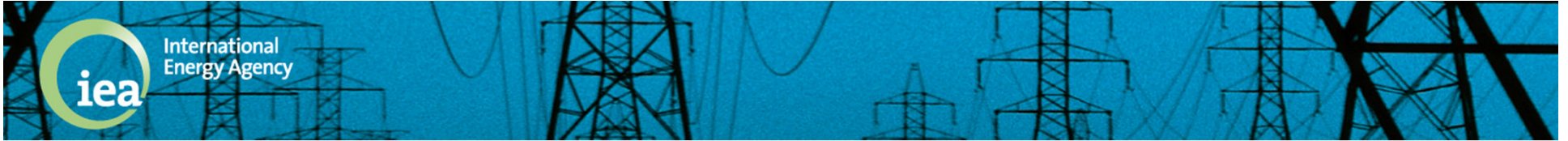


Total Final Consumption (TFC)

Heat statistics: flows



* Chemical heat, **Recovered heat sold**



The electricity and heat questionnaire: Production

Gross electricity and heat production:

Gross electricity: sum of the electrical energy production by all the generating sets concerned (including pumped storage), measured at the output terminals of the main generators

Gross heat: heat produced by the installation -- includes the heat used by the installation's auxiliaries (space heating, liquid fuel heating etc) and losses in the installation/network heat exchanges

Net electricity and heat production:

Net production = gross production - own use.

The electricity and heat questionnaire:

Type of producer/plant

Type of Producers

- **Main Activity Producer** : Their primary activity is to generate electricity and/or heat for sale to third parties. Sale need not take place through the public grid.
- **Autoproducer** : Generate electricity and heat, wholly or partly for their own use as an activity which supports their primary activity.

Type of Plants

- **Electricity Only**
- **Combined Heat and Power (CHP)**
- **Heat Only**

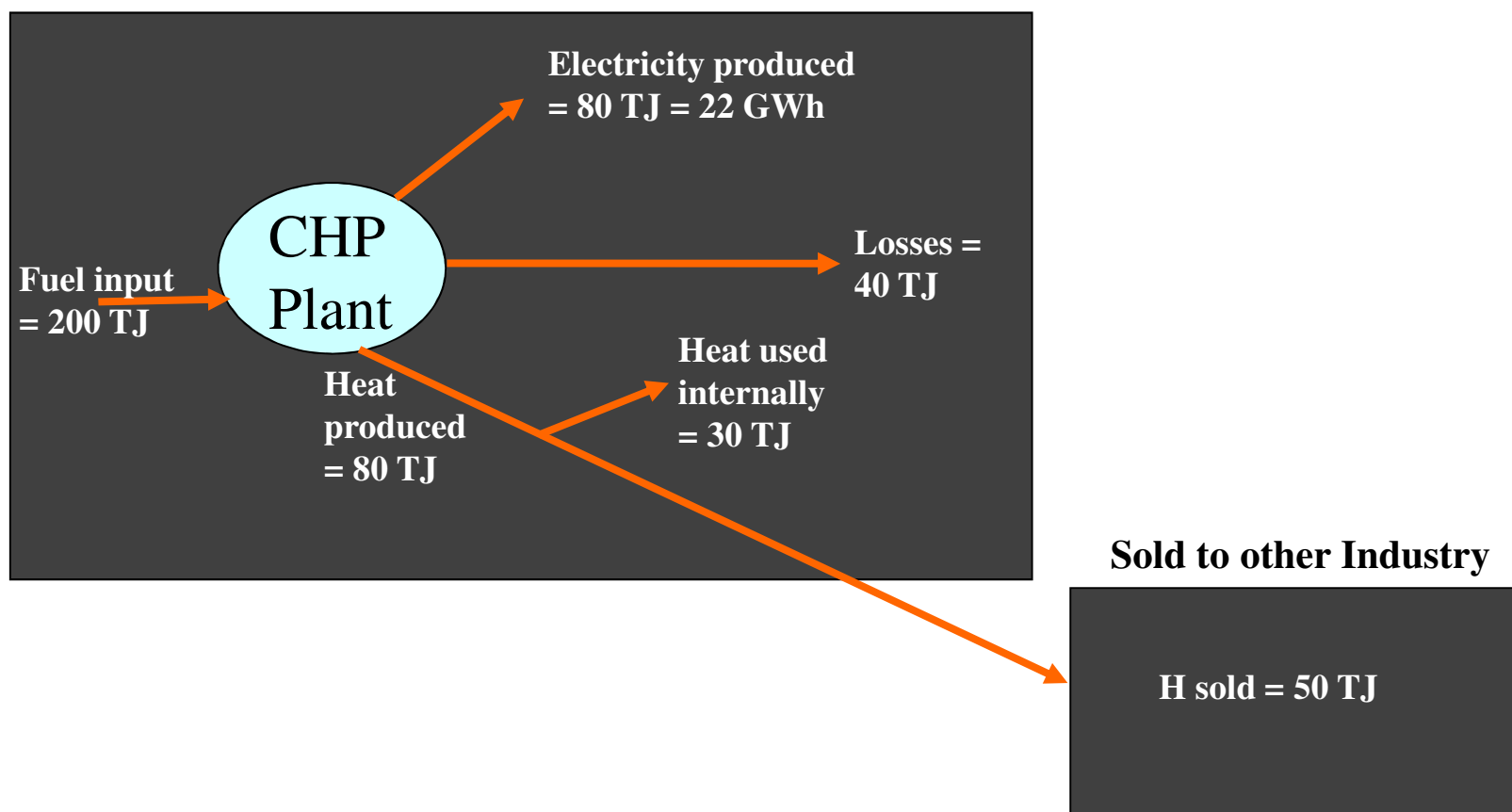
What to report as production in different types of plants

	Electricity Only	CHP	Heat Only
Main Activity Producer		Report all electricity and heat produced and all fuel used	Report all heat produced and all fuel used
Auto producer	Report all production and all fuel used	Report all electricity produced and heat <u>sold</u> with corresponding fuel used	Report heat <u>sold</u> and corresponding fuel used

Heat from *Autoproducer* should comprise only the heat sold to third parties.
In all cases Heat from Chemical Processes (as a primary energy form) is included.

AUTOPRODUCERS

Example: Iron & Steel Industry



Transformation vs. Energy

- **Transformation** : Fuel used for
 - Primary or secondary conversion of energy to electricity (e.g. hydro and coal to electricity)
- **Energy** : Fuels and electricity used by the energy industry to support:
 - Extraction (mining, oil and gas production)
 - Plant operations of transformation activities

QUESTIONNAIRE STRUCTURE

- **Table 1: Gross electricity and heat production**
- **Table 2: Net electricity and heat production**
- **Table 3: Electricity and heat supply and consumption**
- **Table 4: Electricity and heat consumption in industry**
 - **and energy sectors**
- **Table 5: Net electricity and heat production by**
 - **autoproducers**
- **Table 6: Gross electricity and heat production from**
 - **combustible fuels**
- **Table 7a: Net maximum electrical capacity and peak**
 - **load**
- **Table 7b: Net maximum capacity of combustible fuels**
- **Table 8: Imports and Exports of electricity and heat**

TABLE 1. GROSS ELECTRICITY AND HEAT PRODUCTION

Chile

2008		MAIN ACTIVITY PRODUCER PLANTS			AUTOPRODUCER PLANTS			TOTAL	
Menu		ELECTRICITY (ONLY)	CHP	HEAT (ONLY)	ELECTRICITY (ONLY)	CHP	HEAT (ONLY)	MAIN ACTIVITY PRODUCER	AUTOPRODUCER
ELECTRICITY UNIT: GWh (10 ⁶ kWh)		A	B	C	D	E	F	G(=A+B+C)	H(=D+E+F)
Electricity	1	55 394	226		1 227	2 857		55 620	4 084
Nuclear	2							0	0
Hydro	3	23 772			421			23 772	421
<i>Pumped Hydro</i>	4							0	0
Geothermal	5							0	0
Solar	6							0	0
Tide, Wave and Ocean	7							0	0
Wind	8	38						38	0
Combustible Fuels	9	31 584	226		806	2 857		31 810	3 663
Heat from Chemical Sources	10								0
Other Sources	11							0	0
HEAT Unit: TJ									
Heat	12					0	0	0	0
Nuclear	13							0	0
Geothermal	14							0	0
Solar	15							0	0
Combustible Fuels	16							0	0
Heat Pumps	17							0	0
Electric Boilers	18							0	0
Heat from Chemical Sources	19								0
Other Sources	20							0	0

Type of
Plant

Type of
Producer

Sources of
electricity
and heat

TABLE 2. NET ELECTRICITY AND HEAT PRODUCTION

Chile

2008		MAIN ACTIVITY PRODUCER PLANTS			AUTOPRODUCER PLANTS			TOTAL	
Men		ELECTRICITY (OHLT)	CHP	HEAT (OHLT)	ELECTRICITY (OHLT)	CHP	HEAT (OHLT)	MAIN ACTIVITY PRODUCER	AUTOPRODUCER
ELECTRICITY UNIT: GWh (10 ⁶ kWh)		A	B	C	D	E	F	G(=A+B+C)	H(=D+E+F)
Electricity	1	53 900	171		1 217	2 793		54 071	4 010
Nuclear	2							0	0
Hydro	3	23 259			421			23 259	421
<i>Pumped Hydro</i>	4							0	0
Geothermal	5							0	0
Solar	6							0	0
Tide, Wave and Ocean	7							0	0
Wind	8	38						38	0
Combustible Fuels	9	30 603	171		796	2 793		30 774	3 589
Heat from Chemical Sources	10								0
Other Sources	11							0	0

HEAT Unit: TJ

Heat	12		0	0		0	0	0	0
Nuclear	13							0	0
Geothermal	14							0	0
Solar	15							0	0
Combustible Fuels	16							0	0
Heat Pumps	17							0	0
Electric Boilers	18							0	0
Heat from Chemical Sources	19								0
Other Sources	20							0	0

TABLE 3. ELECTRICITY AND HEAT SUPPLY AND CONSUMPTION

Chile

2008			ELECTRICITY (GWh)	HEAT (TJ)
Menu			A	B
Total Gross Production	1	(=)	59 704	
Own Use	2	(-)	1 623	0
Total Net Production	3	(=)	58 081	
Total Imports (Balance)	4	(+)	1 154	
Total Exports (Balance)	5	(-)		
Used for Heat Pumps	6	(-)		
Used for Electric Boilers	7	(-)		
Used for Pumped Storage	8	(-)		
Used for Electricity Production	9	(-)		
Electricity/Heat Supply	10	(=)	54 153	0
Distribution Losses	11	(-)	5 081	
Final Consumption (Calculated)	12	(=)	54 154	0
Statistical Differences	13		1	0
Final Consumption (Observed)	14		54 153	0
Energy Sector	15		645	0
Industry Sector	16		36 509	0
Transport Sector	17		426	
Rail	18		426	
Pipeline Transport	19			
Non-specified (Transport)	20			
Residential	21		8 749	
Commercial and Public Services	22		7 636	
Agriculture/Forestry	23			
Fishing	24		188	
Non-specified (Other)	25			

= Total in Table 1

Own use = gross - net

= Total in Table 2

= Trade totals in Table 8

= Totals in Table 4

TABLE 4. ELECTRICITY AND HEAT CONSUMPTION IN INDUSTRY AND ENERGY SECTORS

Chile			
2008		ELECTRICITY (GWh)	HEAT (TJ)
		A	B
Energy Sector	1	645	0
Coal Mines	2		
Oil and Gas Extraction	3	645	
Patent Fuel Plants (Energy)	4		
Coke Ovens (Energy)	5		
BKB Plants (Energy)	6		
Gas Works (Energy)	7		
Blast Furnaces (Energy)	8		
Petroleum Refineries	9		
Nuclear Industry	10		
Coal Liquefaction Plants (Energy)	11		
Liquefaction (LNG) / Regasification Plants	12		
Gasification Plants for Biogas	13		
Gas-to-Liquids (GTL) Plants (Energy)	14		
Charcoal Production Plants (Energy)	15		
Non-specified (Energy)	16		
Industry Sector	17	36 509	0
Iron and Steel	18	605	
Chemical (including Petrochemical)	19	601	
Non-Ferrous Metals	20		
Non-Metallic Minerals	21	607	
Transport Equipment	22		
Machinery	23		
Mining and Quarrying	24	20 279	
Food, Beverages and Tobacco	25		
Paper, Pulp and Printing	26	5 345	
Wood and Wood Products	27		
Construction	28		
Textiles and Leather	29		
Non-specified (Industry)	30	9 072	

TABLE 5. NET ELECTRICITY PRODUCTION BY AUTOPRODUCERS

Chile		Unit = GWh		
2008		ELECTRICITY (ONLY) PLANTS	CHP PLANTS	TOTAL
		A	B	C
Total Net Production	1	1 217	2 793	4 010
Industry Sector	17	0	2 793	2 793
Iron and Steel	18			0
Chemical (including Petrochemical)	19			0
Non-Ferrous Metals	20			0
Non-Metallic Minerals	21			0
Transport Equipment	22			0
Machinery	23			0
Mining and Quarrying	24			0
Food, Beverages and Tobacco	25			0
Paper, Pulp and Printing	26		2 793	2 793
Wood and Wood Products	27			0
Construction	28			0
Textiles and Leather	29			0
Non-specified (Industry)	30			0
Transport Sector	31	0	0	0
Rail	32			0
Pipeline Transport	33			0
Non-specified (Transport)	34			0
Other Sectors	35	1 217	0	1 217
Residential	36			0
Commercial and Public Services	37			0
Agriculture/Forestry	38			0
Fishing	39			0
Non-specified (Other)	40	1 217		1 217

TABLE 6. GROSS ELECTRICITY AND HEAT PRODUCTION FROM COMBUSTIBLE FUELS

- **Table 6A – Coal and coal products**
- **Table 6B – Oil**
- **Table 6C – Natural gas**
- **Table 6D – Combustible renewables and wastes**

Efficiency for combustible fuels – Table 6

	1998	1999	2000	2001	2002	2003	2004	2005	2006
Main Activity Producer Electricity Plants									
Fuel Input (kilotonnes)	9,345	9,469	9,566	11,398	12,179	13,882	11,505	14,917	15,917
Fuel Input (Terajoules)	176,112	178,690	183,055	226,992	264,102	307,973	236,220	327,454	317,097
Gross Electricity Production (GWh)	17,828	18,141	18,547	22,739	25,680	30,540	23,431	32,450	31,500
Efficiency (%)	36.44	36.55	36.47	36.06	35.00	35.70	35.71	35.68	35.76
Main Activity Producer CHP Plants									
Fuel Input (kilotonnes)	0	0	0	0	0	0	0	0	0
Fuel Input (Terajoules)	0	0	0	0	0	0	0	0	0
Gross Electricity Production (GWh)	0	0	0	0	0	0	0	0	0
Gross Heat Production (Terajoules)	0	0	0	0	0	0	0	0	0
Efficiency (%)									

Efficiency = Output / Input (both measured in energy units)

- Electricity Plants: 25 – 50 %
- CHP Plants: 30 – 65 %
- Heat Plants: 60 – 90 %

TABLE 6A. GROSS ELECTRICITY AND HEAT PRODUCTION FROM COMBUSTIBLE FUELS

Chile

2008			MAIN ACTIVITY PRODUCER PLANTS			AUTOPRODUCER PLANTS			TOTAL	
			ELECTRICITY (ONLY)	CHP	HEAT (ONLY)	ELECTRICITY (ONLY)	CHP	HEAT (ONLY)	ELECTRICITY	HEAT
FUELS		UNITS	A	B	C	D	E	F	G	H
ANTHRACITE	Fuel input	1 10 ³ t								
	Fuel input	2 TJ (NCV)								
	Elec. prod.	3 GWh								
	Heat prod.	4 TJ								
COKING COAL	Fuel input	5 10 ³ t								
	Fuel input	6 TJ (NCV)								
	Elec. prod.	7 GWh								
	Heat prod.	8 TJ								
OTHER BITUMINOUS COAL	Fuel Input	10 ³ t				7				
	Fuel Input (NCV)	TJ				200				
	Elec. Prod.	Gwh							14 112	
	Heat prod.	12 TJ								
SUB-BITUMINOUS COAL	Fuel input	13 10 ³ t								
	Fuel input	14 TJ (NCV)								
	Elec. prod.	15 GWh								
	Heat prod.	16 TJ								

Should match fuel questionnaire

Reported input in tonnes units and energy gives implicit calorific value (kJ/kg)

TABLES 7A AND 7B – NET CAPACITY AND PEAK LOAD

- **Net maximum capacity on 31 December**
 - **By fuel type**
 - **Single-fired and multi-fired**
 - **By type of generation**
- **Peak load**
 - **Highest simultaneous demand during the year**
 - **Available capacity at peak load**
 - **Date of peak load**

Trade - Table 8

- **Trade in electricity between all countries includes quantities in transit.**

The countries of origin (for imports) and destination (for exports) are neighboring countries from which the electricity has been received (imports) and to which it has been sent (exports).

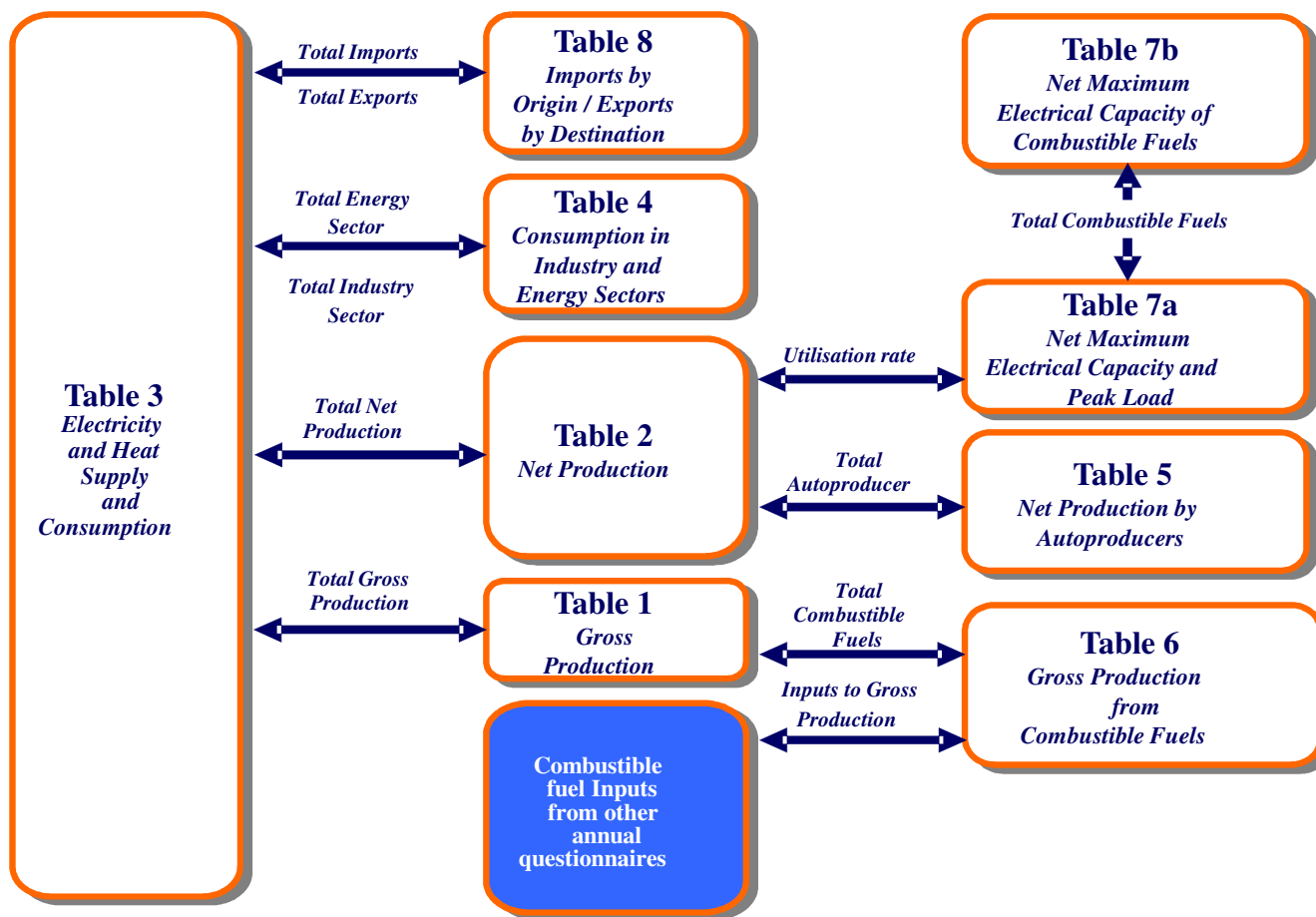
TABLE 8 – IMPORTS AND EXPORTS

■

Chile

2008		Report Electricity in Columns A and B (Unit = GWh)		Report Heat in Columns C and D (Unit = TJ)	
Menu		IMPORTS A	EXPORTS B	IMPORTS C	EXPORTS D
Switzerland	47				
Tajikistan	48				
Turkey	49				
Turkmenistan	50				
Ukraine	51				
United Kingdom	52				
United States	53				
Uzbekistan	54				
Non-specified/Other	55	1 154			
TOTAL	56	1 154	0	0	0

ELECTRICITY & HEAT QUESTIONNAIRE STRUCTURE



TIME SERIES

6a. Gas Coke	6a. Coal Tar	6a. BKB
6a. Coke Oven Gas	6a. Blast Furnace Gas	6a. Oxygen steel furnace gas
6b. Natural gas liquid	6b. Refinery gas	6b. LPG Liquefied Natural Gas
6b. Kerosene type jet fuel	6b. Other Kerosene	6b. Diesel (distillate fuel oil)
6b. Bitumen	6b. Petroleum coke	6b. Other oil products

Start / Cover / Menu / Table1 / Table2 / Table3 / Table4 / Table5

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Main Activity Producer Electricity Plants											
Fuel Input (kilotonnes)	4	1	1	1	1	2	2	2	3	3	9
Fuel Input (Terajoules)	170	60	61	50	52	80	89	105	129	107	364
Gross Electricity Production (GWh)	5	4	5	4	4	6	6	7	9	8	28
Efficiency (%)	10.59	24.00	29.51	28.80	27.69	27.00	24.27	24.00	25.12	26.92	27.69

- **Alternative method to view data**
- **View average plant efficiencies**

DATA VERIFICATION

- **Intra-table consistency checks**
- **Comparison with other questionnaires**
- **Ratio of gross to net generation**
- **Calorific values**
- **Capacity factor**
- **Distribution losses vs. energy supplied**
- **Own use vs. total production**
- **Efficiencies**
- **Changes in time series**

South Africa: some electricity data issues

- **Consumption by sector**
- **Autoproducer data**
- **Efficiencies**
- **Data on capacity by source?**



THANK YOU

roberta.quadrelli@iea.org