

STATISTICS

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The statistics were compiled before the official statistics of the individual countries for 1991 were available. Some figures in the annual report may therefore vary slightly from the official statistics of the individual countries.

DEFINITIONS

Used expressions have the following meanings according to Nordel definitions.

Installed capacity is the installed generating capacity of a power station given in MW and constitutes the arithmetic sum of the rated capacity of the units installed.

Transmission capacity is the rated capacity in MW of a line with due regard taken to the limits imposed by the transformers connected to it.

Electricity generation is given in GWh and represents that output the individual countries officially report.

Back-pressure generation is the generation of electric energy by a generator set driven by steam which, when discharged from the turbine, is applied for a purpose irrelevant to power generation (such as district heating, process steam etc).

Condense power generation is defined as the output from a turbo-generator set operated by steam that is expanded in a cooling water con-

denser to enable the steam to be utilised exclusively for electric power generation.

Imports and exports is the exchange of power given in GWh for the commercial blocks of power delivered or received by the individual countries. Net imports is the difference between imports and exports.

Electrical energy turnover is given in GWh and is the sum of domestic generation and imports including electric boilers etc.

Gross consumption of electrical energy is given in GWh and is the sum of domestic generation and imports excluding electric boilers etc.

Net consumption of electrical energy is given in GWh and is the sum of the power delivered to and metered at the consumers plus the power produced by industry for its own consumption.

Losses are defined as the difference between gross consumption and net consumption.

Occasional power to electric boilers is defined as intermittent deliveries of temporary surplus power for raising steam or district heating in electric boilers on terms agreed upon by the parties concerned.

Pumped storage power is electrical energy used for pumping up water in reservoirs for generation later on in pumped storage plants.

Storage capacity of a reservoir is given in GWh and is equivalent to the power that is expected to be generated by all downstream power stations by full discharge of the impounded water.

Storage contents of a reservoir at a certain time is indicated in GWh as being the quantity of energy which can be extracted from the water contents above the lowest regulated water level at all power stations below the reservoir.

Rate of storage contents at a given time is given as a percentage of the total reservoir capacity in terms of GWh.

UNITS AND SYMBOLS

Power Units

kW = kilowatt

MW = megawatt = 1000 kW

Energy Units

J = joule

kJ = kilojoule

PJ = petajoule = 10^{15} J = $23,9 \times 10^3$ toe

kWh = kilowatt-hour = 3 600 kJ

MWh = megawatt-hour = 1 000 kWh

GWh = gigawatt-hour = 1 million kWh

TWh = terawatt-hour = 1 000 GWh = 10^9 kWh

Mtoe = 1 million tons of oil equivalent corresponds to 11,63 TWh

Symbols

~ Alternating current (AC)

= Direct current (DC)

INSTALLED CAPACITY

In 1991 the total net capacity in the Nordel countries increased by 700 MW to 83 305 MW (including 424 MW wind power).

Of the total capacity almost 55% consisted of hydro power. The

nuclear capacity was 12 310 MW.

The distribution of hydro and thermal power differs considerably between the Nordel countries. In Denmark the generating plants are almost entirely thermal, whereas in

Norway they are hydro.

In Iceland hydro power dominates, while Sweden has somewhat more thermal than hydro installations. In Finland thermal power was about 80% of the installed capacity.

Fig. S1 Installed capacity on Dec 31, 1991 and corresponding average-year generation by hydro power.

	DENMARK	FINLAND	ICELAND	NORWAY	SWEDEN	NORDEL
Hydro power, MW	10	2 718	775	26 611	16 318 ²⁾	46 432
Geothermal power, MW	–	–	45	–	–	45
Nuclear power, MW	–	2 310	–	–	10 000	12 310
Conv. thermal power, MW	9 002	8 548	116	278	8 150	26 094
of which						
Back-pressure, MW	564	4 660	–	165	3 619	9 008
Condense, MW	8 139 ¹⁾	3 026	–	78	2 771	14 014
Gasturbine, diesel, MW	299	862	116	35	1 760	3 072
Total installed capacity 1991, MW	9 012	13 576	936	26 889	34 468	84 881³⁾
Commissioned in 1991, MW	514	196	50	3	358	1 121
Decommissioned in 1991, MW	312	83	–	–	67	462
Average-year generation, GWh	35	12 380	4 500	107 997	63 290	188 202
Change, hydro power generation, GWh	–	60	300	9	60	429

1) Incl. German share of Enstedværket

2) Incl. Norwegian share of Linnvasselv

3) In addition there is 424 MW wind power capacity, of which 409 MW in Denmark, 3 MW in Norway, and 12 MW in Sweden

Fig. S2 Changes in installed capacity 1991 (larger than 10 MW).

Power category/Plant	Commissioned	Decommissioned	Change in average-year generation GWh	Type of fuel ¹⁾
	MW	MW		
DENMARK				
Conv. thermal power, total	514	312		
of which				
HC Ørstedværket	–	42		K
Kyndbyværket	–	195		K/O
Hillerød	72	–		G
Renov. Asnæsværket and Amagerværket	28	–		K/O
Fynsværket	387	73		K/O
FINLAND				
Hydro power, total	13	–	60	
Voikkaa	13	–	60	
Conv. thermal power, total	183	83		
of which				
Pori	35	15		T/O
Pietarsaari	36	18		A
Kaukas	77	29		A
Kaipola	26	11		K (A,T,O)
ICELAND				
Hydro power, total	50	–	300	
Blanda	50	–	300	
NORWAY				
Hydro power, total	1	–	9	
SWEDEN				
Hydro power, total	54	67	60	
of which				
Älvkarleby	48	5	60	
Porjus	–	50	–	
Nuclear power, total	30	–		
of which				
Ringhals 2, increase in capacity	25	–		
Conv. thermal power, total	270	–		
of which				
Lund	20	–		G
Ängelholm	30	–		G
Karlskoga	36	–		G
Värtan, Stockholm	130	–		K
Hudiksvall	14	–		
Linköping	14	–		
1) O=oil, K=coal, G=gas, T=peat, A=garbage, waste				

Fig. S5 Existing interconnections between Nordel and other countries.

Countries	Terminal stations	Rated voltage kV	Transmission capacity MW		Total length km	Of which cable km
			From Nordel	To Nordel		
DENMARK – GERMANY						
	Kassø – Audorf	400~	} 1 000 ¹⁾	} 1 000 ¹⁾	107	–
	Kassø – Flensburg	220~			40	–
	Ensted – Flensburg	220~			34	–
FINLAND – RUSSIA						
	Imatra – GES 10	110~	0	100	20	–
	Yllikälä – St. Petersburg	±85=	1 065	1 065	–	–
	Nellimö – Kaitakoski	110~	0	50	20	–
NORWAY – RUSSIA						
	Kirkenes – Boris Gleb	154~	50	50	10	–

1) Transmission capacity alters between 800 MW and 1 200 MW due to prevailing operating conditions

Fig. S6 Decided interconnections between Nordel countries.

Countries	Terminal stations	Rated voltage kV	Transmission capacity as per design rules MW		Total length km	Of which cable km	Commis- sioning year
			From Denmark	To Denmark			
DENMARK – NORWAY							
	Tjele – Kristiansand	350=	440	440	252	127	1993

Fig. S7 Decided interconnections between Nordel and other countries.

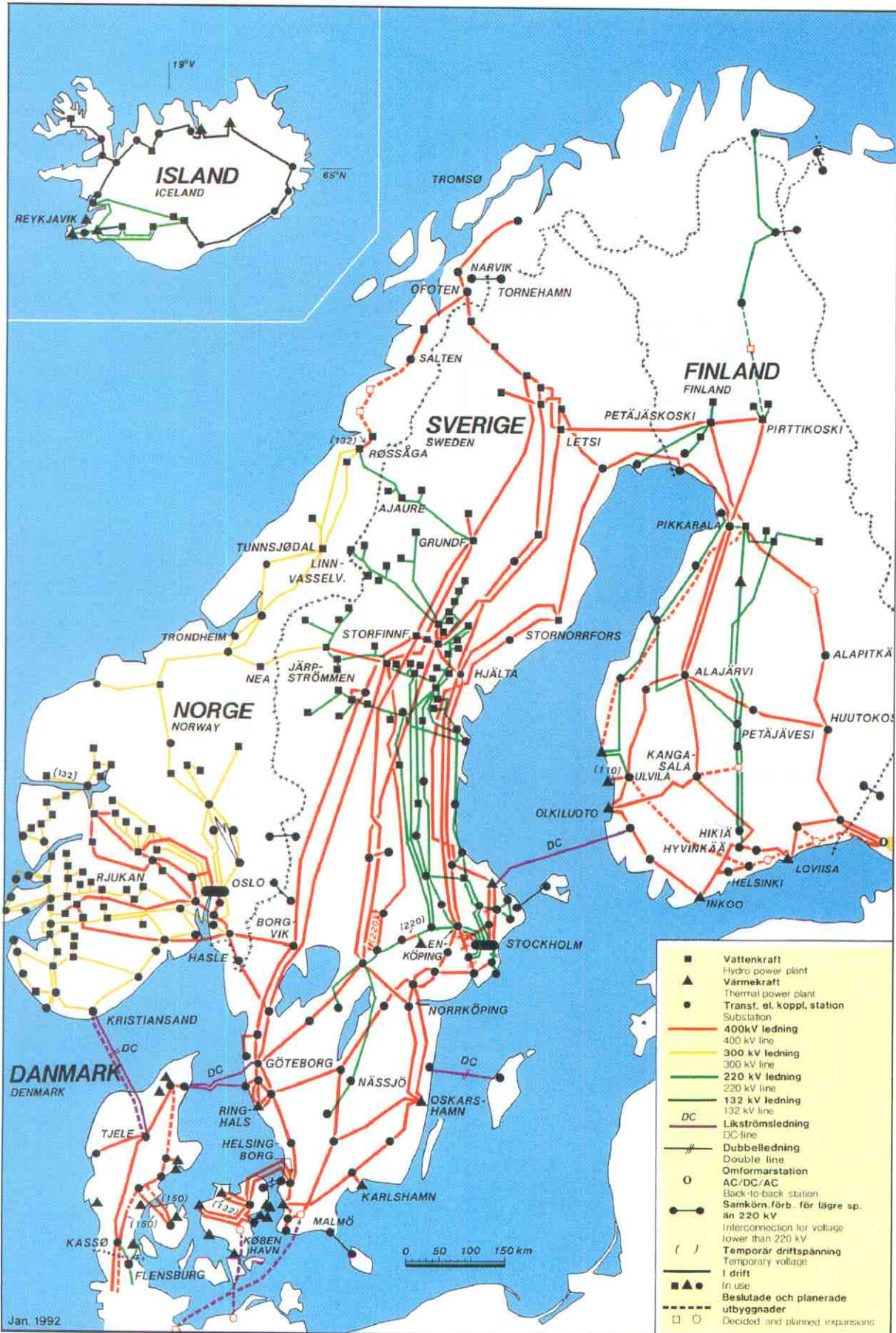
Countries	Terminal stations	Rated voltage kV	Transmission capacity MW		Total length km	Of which cable km	Commis- sioning year
			From Nordel	To Nordel			
DENMARK – GERMANY							
	Spanager – Rostock	400=	600	600	182	64 (prel)	1995
SWEDEN – GERMANY							
	Arrie – Lübeck	400=	600	600	250	220	1994

Fig. S8 Transmission lines, 110 – 400 kV.

	400 kV AC and DC In service 31.12.91 km	220-300 kV AC and DC In service 31.12.91 km	110, 132, 150 kV In service 31.12.91 km
	DENMARK	1 076 ¹⁾	247 ²⁾
FINLAND	3 399 ⁴⁾	2 480	14 250
ICELAND	–	492	1 390
NORWAY	1 841 ³⁾	5 228 ^{2) 5)}	9 700
SWEDEN	10 565 ⁴⁾	4 763 ²⁾	15 000

- 1) Of which 129 km in service with 150 kV and 46 km with 132 kV
- 2) Of which 80 km in Denmark and 96 km in Sweden (Kontiskan), 89 km in Denmark and 151 km in Norway (Skagerrak) in service with 250 kV DC, and 75 km in Denmark and 74 km in Sweden (Kontiskan 2) in service with 285 kV DC
- 3) Of which 13 km in service with 60 kV and 113 km with 50 kV
- 4) Of which 99 km in Finland and 99 km in Sweden DC sea-cable, and 34 km in Finland and 2 km in Sweden DC land-cable (Fenno-Skan)
- 5) Incl. 20 km 300 kV line upgraded to 400 kV

Fig. S9 The Nordel main grid.



ELECTRICITY GENERATION

Fig. S10 Total electricity generation within Nordel 1991.

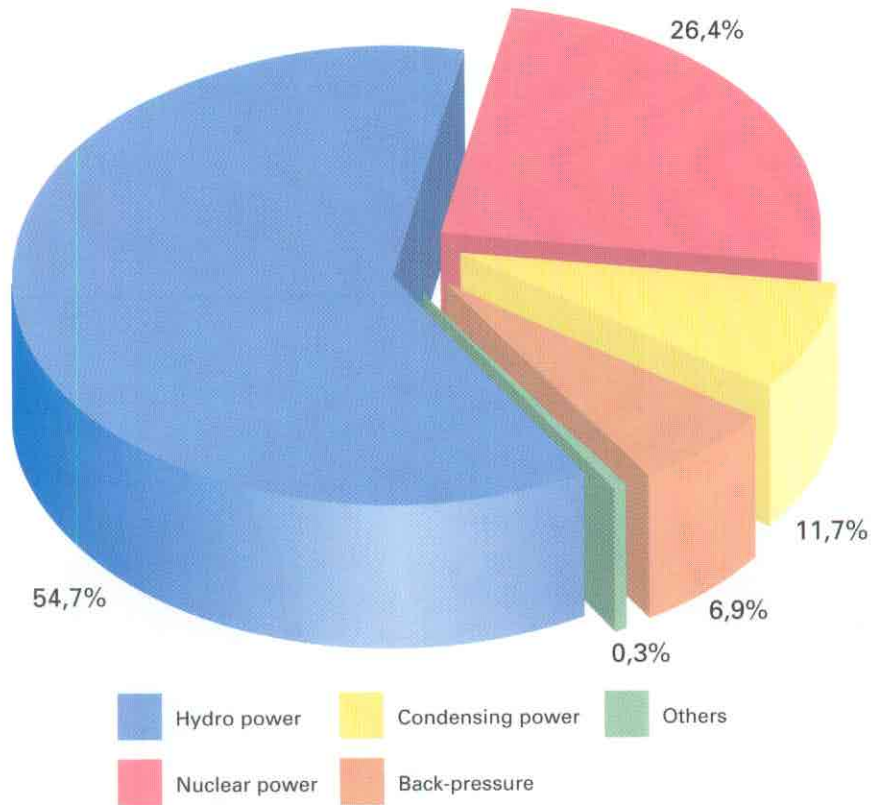


Fig. S11 Electricity generation (GWh).

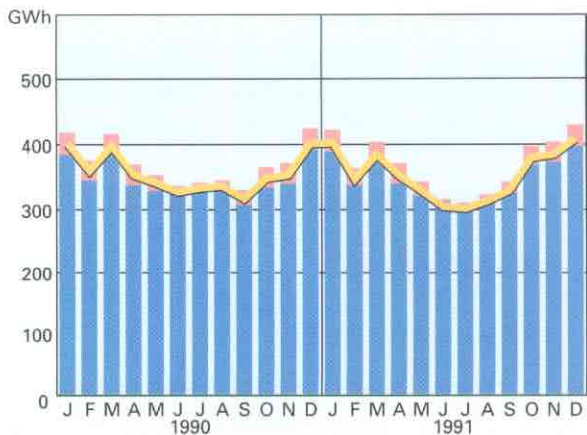
	DENMARK	FINLAND	ICELAND	NORWAY	SWEDEN	NORDEL
Hydro power	32	12 966	4 154	110 524	62 329 ³⁾	190 005
Wind power	728	-	-	-	15	743
Geothermal power	-	-	267	-	-	267
Nuclear power	-	18 398	-	-	73 513	91 911
Conv. thermal power	33 409	23 868	6	426	6 722	64 431
of which						
Back-pressure	515	16 694	-	289	6 337	23 835
Condense	32 894 ¹⁾	7 168	-	130	325	40 517
Gasturbine, diesel etc	-	6	6	7	60	79
Total generation 1991	34 169 ²⁾	55 232	4 427	110 950	142 579	347 357
Change as against 1990	41.9%	7.1%	-0.4%	-8.8%	0.6%	1.0%

1) Incl. generation in combined heat- and power stations
 2) Of which German share of Enstedværket 2 319 GWh
 3) Of which Norwegian share of Linnvasselv 87 GWh

Fig. S12 Generation and gross consumption of electricity excl. occasional power to electric boilers etc.



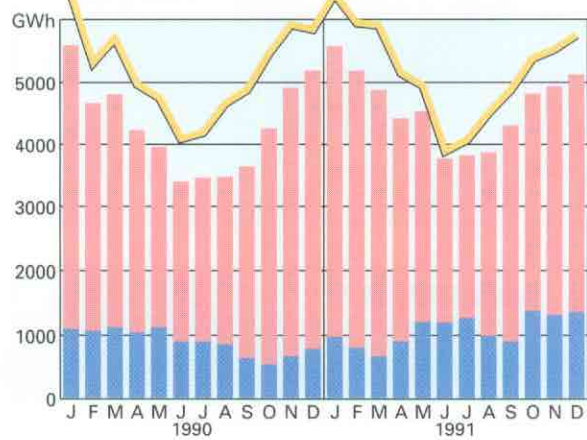
ICELAND



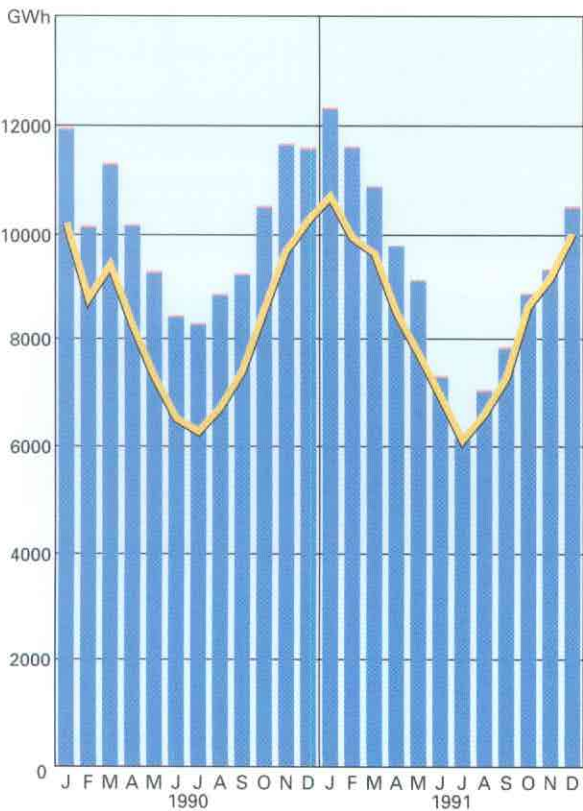
DENMARK



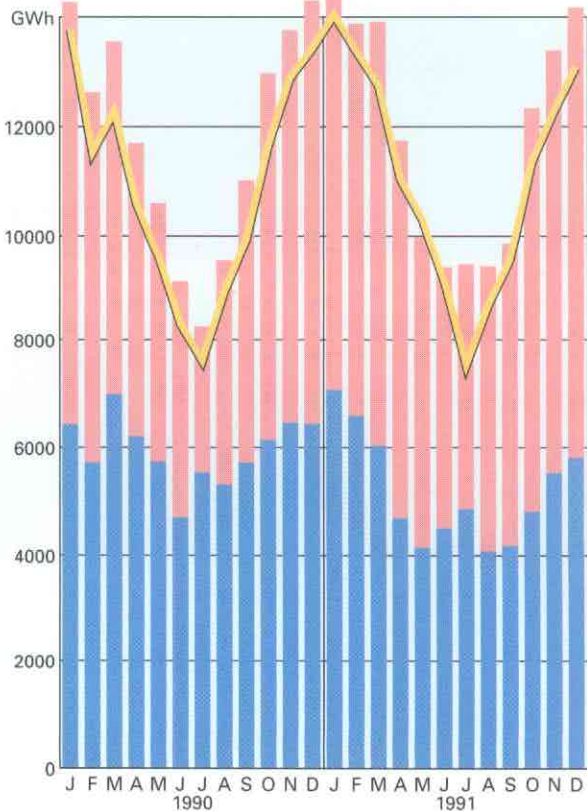
FINLAND



NORWAY



SWEDEN



WATER RESERVOIRS

The curves show the impounded water in per cent of total storage capacity for 1990 and 1991. The field gives upper and lower extremes for the period 1981 – 1990. which are composed of the weekly maximum and minimum recorded

Fig. S13 Water reservoirs 1990 and 1991.

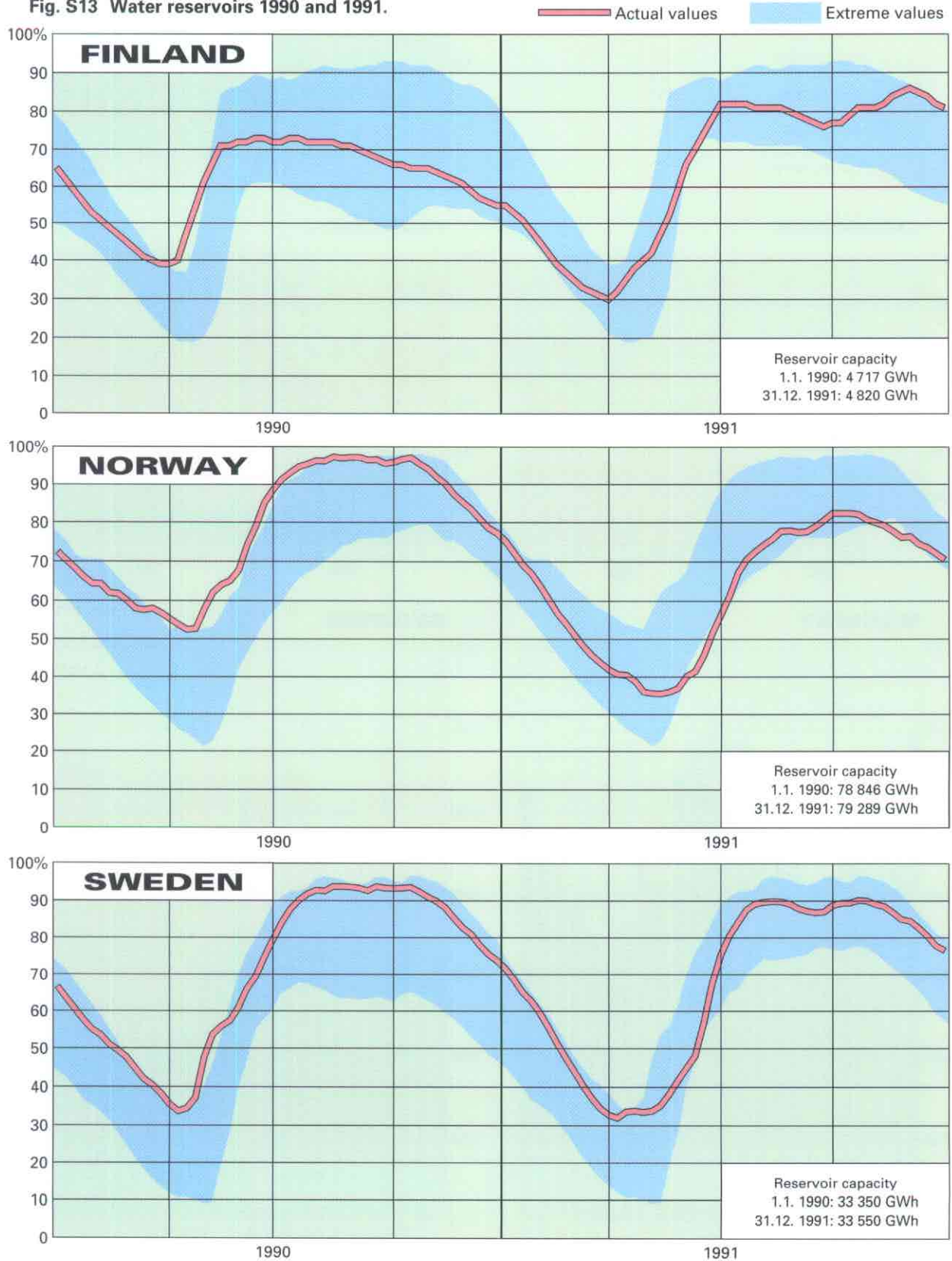


Fig. S14 Maximum and minimum load on the 3rd Wednesday in January and July 1991.

	Installed net capacity 31.12.91 MW	Max. and min. system load 1991							
		3rd Wednesday in January				3rd Wednesday in July			
		MAX Local time	MW	MIN Local time	MW	MAX Local time	MW	MIN Local time	MW
DENMARK¹⁾									
West of the Great Belt (ELSAM)	4 352 ²⁾	08 – 09	3 286	02 – 03	1 622	10 – 11	1 916	04 – 05	1 083
East of the Great Belt excl. Bornholm (ELKRAFT)	4 031	17 – 18	2 482	03 – 04	1 333	10 – 11	1 401	04 – 05	737
FINLAND									
	13 576	08 – 09	9 589	03 – 04	7 620	12 – 13	6 249	04 – 05	4 546
ICELAND									
	936	18 – 19	611	03 – 04	468	20 – 21	390	07 – 08	342
NORWAY									
South of 67,5°N	25 119	08 – 09	17 254	01 – 02	14 162	09 – 10	9 465	05 – 06	7 096
North of 67,5°N	1 773	15 – 16	1 075	23 – 00	635	09 – 10	524	02 – 03	401
SWEDEN									
	34 480 ³⁾	08 – 09	23 460	01 – 02	17 133	11 – 12	12 399	04 – 05	8 461
NORDEL									
excl. Iceland Central-European time	83 331	08 – 09	56 910	01 – 02	42 975	11 – 12	31 150	04 – 05	22 322

1) To some extent the capacity is not available at operational planning, e.g. foreign owned plants, plants out of operation for long-term, and wind power
 2) Of which German share of Enstedværket 300 MW
 3) Of which Norwegian share of Linnvasselv 25 MW

Fig. S15 Electrical energy turnover in 1991 (GWh).

	DENMARK	FINLAND	ICELAND	NORWAY	SWEDEN	NORDEL
Generation	34 169	55 232	4 427	110 950	142 579	347 357
Imports	3 075	7 833	–	3 242	6 225	20 375
Total generation and imports	37 244	63 065	4 427	114 192	148 804	367 732
Exports	5 046 ¹⁾	665	–	6 025	7 519 ²⁾	19 255
Total electrical energy turnover (incl occasional power to electric boilers etc) 1991	32 198	62 400	4 427	108 167	141 285	348 477
Change as against 1990	3.4%	0.1%	-0.4%	2.4%	0.9%	1.4%

1) Of which German share of Enstedværket 2 319 GWh
 2) Of which Norwegian share of Linnvasselv 1 GWh

EXCHANGE OF ELECTRICAL ENERGY

Fig. S16 Exchange of electrical energy between the Nordel countries 1963 – 1991.

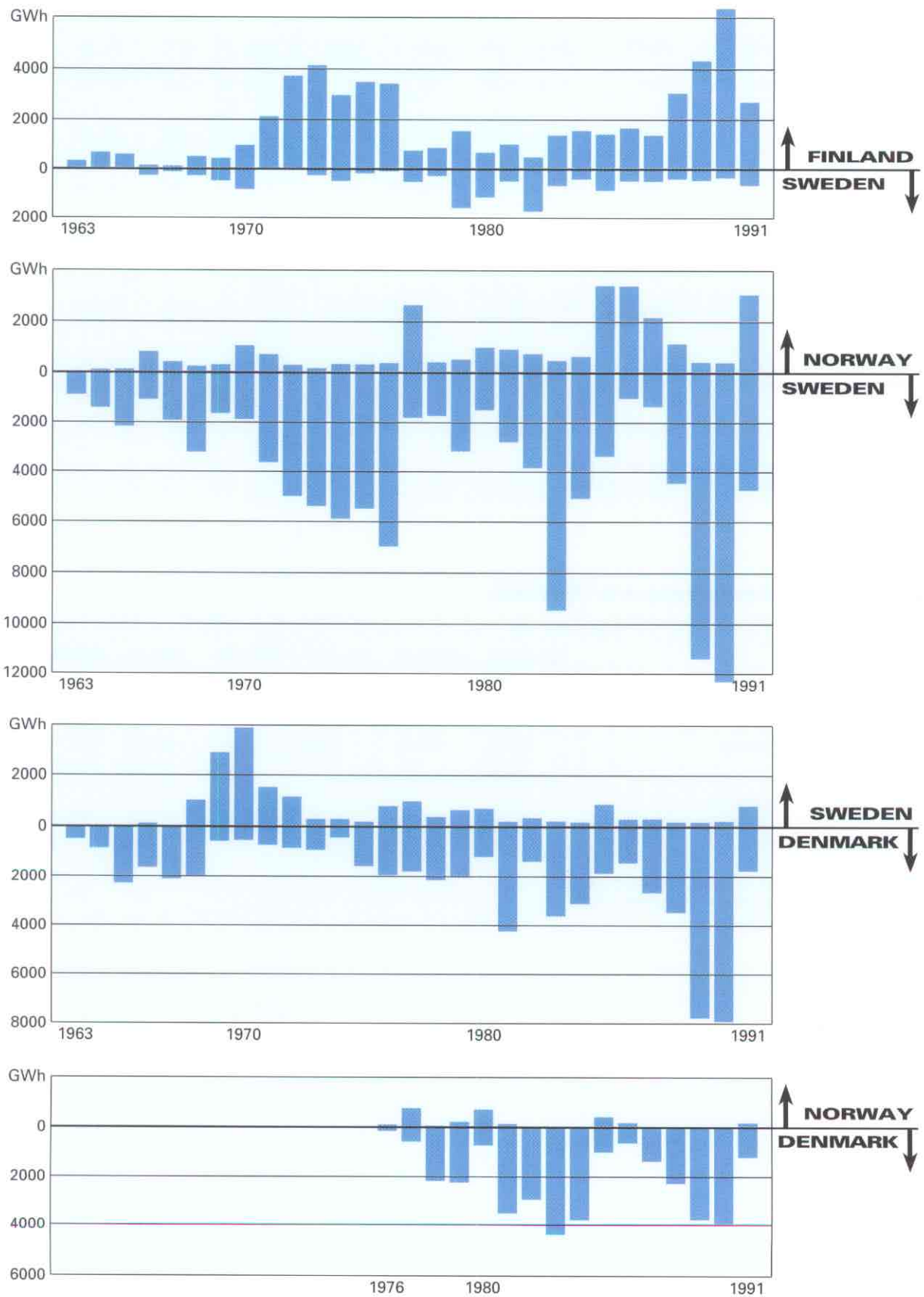


Fig. S17 Electrical energy exchanges within Nordel in 1991 (GWh).

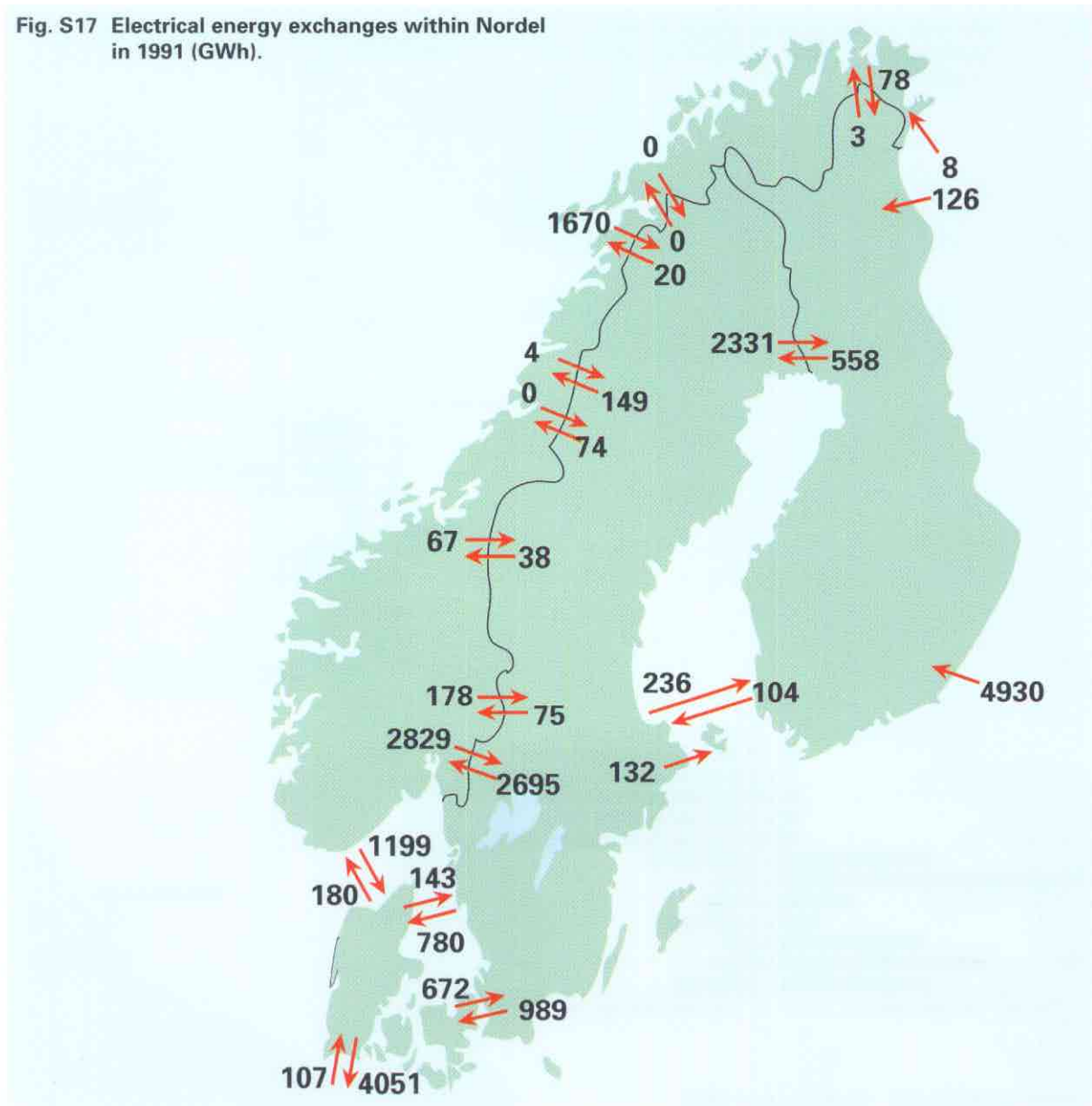


Fig. S18 Exchange of electrical energy in 1991 (GWh).

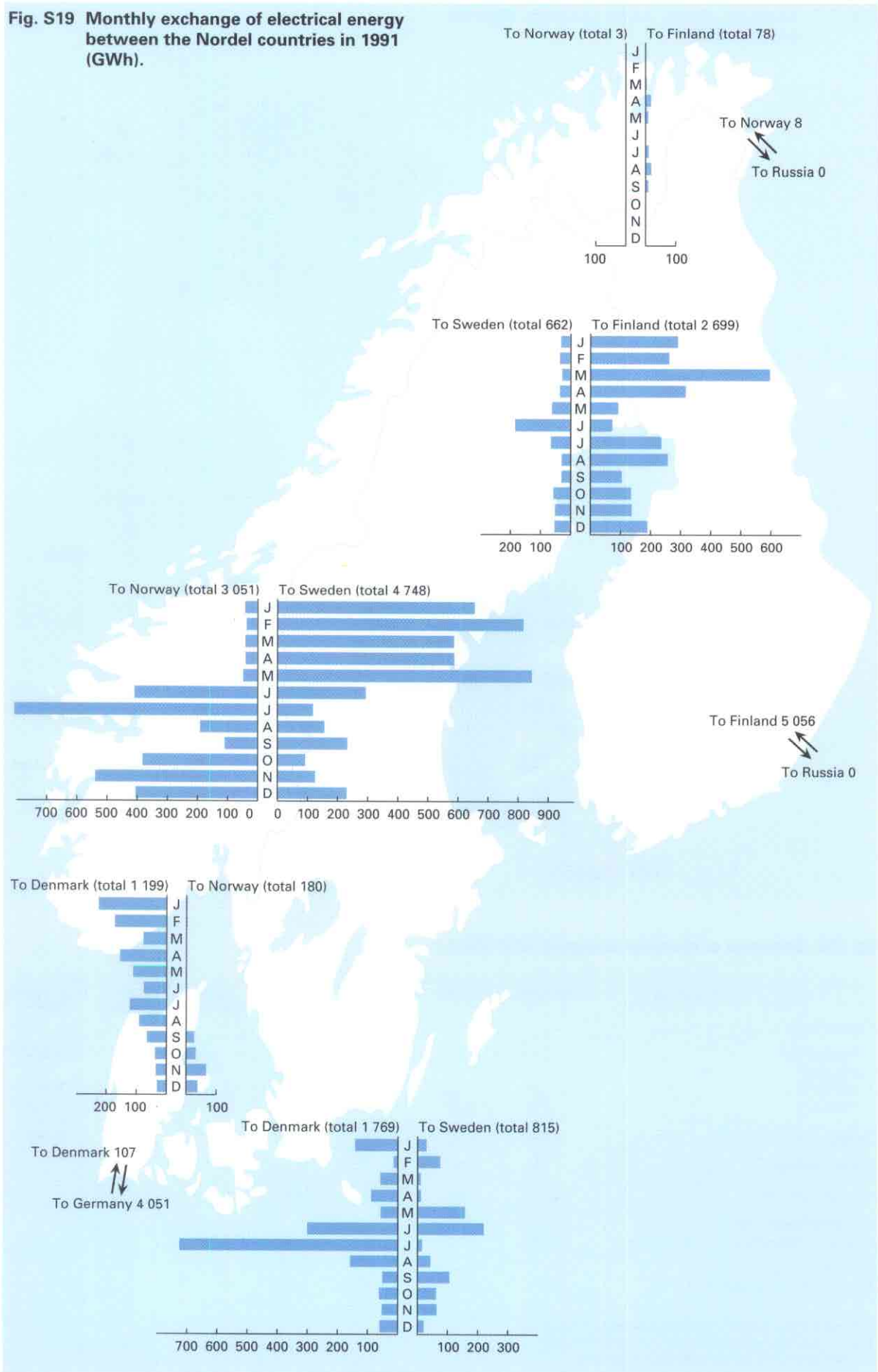
Imports to:	DENMARK	FINLAND	NORWAY	SWEDEN	Nordel countries	Other countries	Total exports 1991
Exports from:							
DENMARK	-	-	180	815	995	4 051 ¹⁾	5 046 ¹⁾
FINLAND	-	-	3	662	665	-	665
NORWAY	1 199	78	-	4 748	6 025	-	6 025
SWEDEN	1 769	2 699	3 051	-	7 519 ²⁾	-	7 519 ²⁾
Nordel countries	2 968	2 777	3 234	6 225	15 204	4 051	19 255
Other countries	107	5 056	8	-	5 171		
Total imports 1991	3 075	7 833	3 242	6 225	20 375		
NET EXCHANGE 1991							
Imports(+) / Exports(-)	-1 971	7 168	-2 783	-1 294			
NET EXCHANGE/ GROSS CONSUMPTION ³⁾	-6.1%	11.5%	-2.7%	-1.0%			

1) Of which German share of Enstedværket 2 319 GWh

2) Of which Norwegian share of Linnvasselv 1 GWh

3) Excl. occasional power to electric boilers etc

Fig. S19 Monthly exchange of electrical energy between the Nordel countries in 1991 (GWh).



ELECTRICITY CONSUMPTION

Fig. S20 Net electricity consumption distributed on consumer groups excl. electric boilers etc. in 1991.

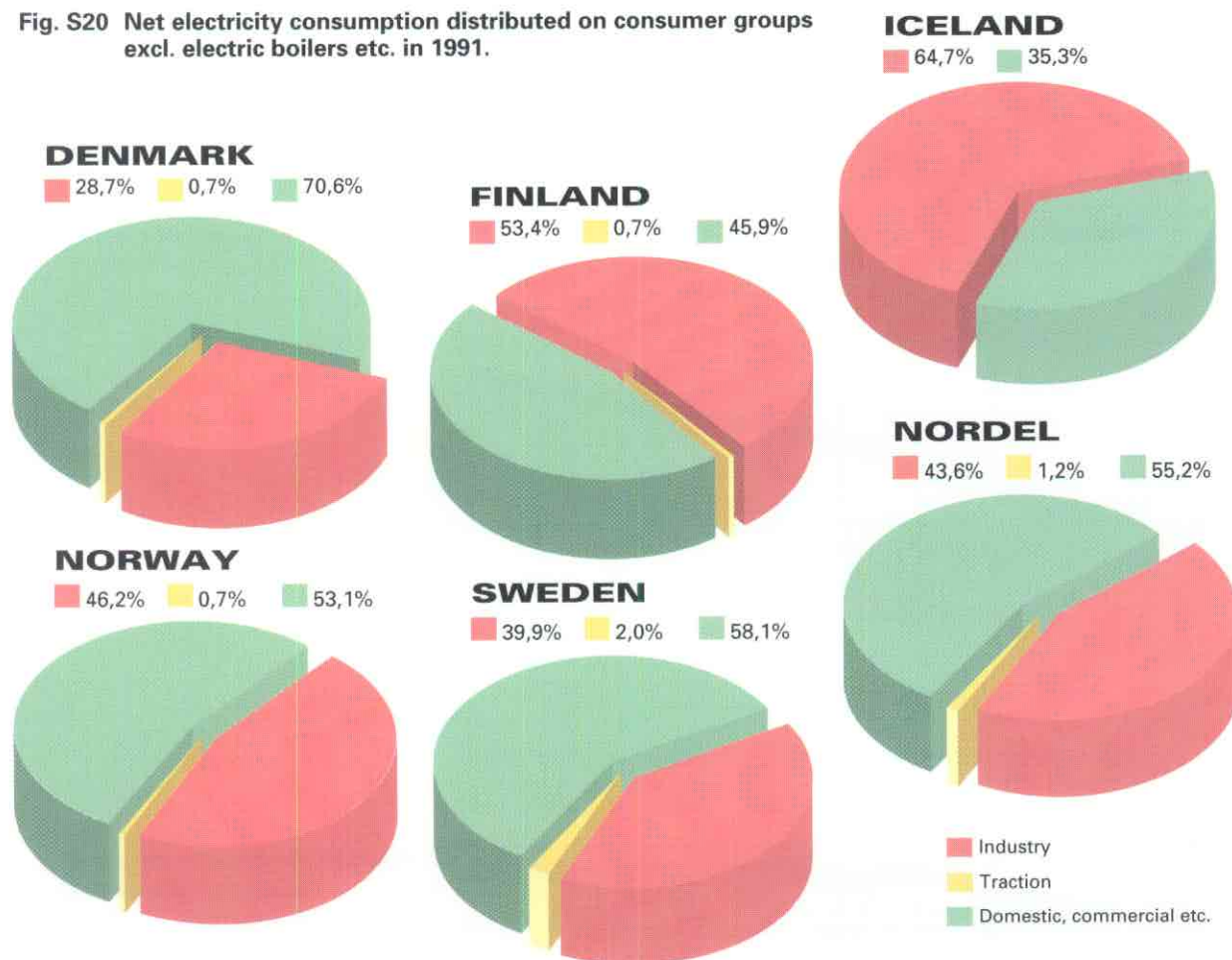


Fig. S21 Electrical energy consumption in 1991 (GWh).

	DENMARK	FINLAND	ICELAND	NORWAY	SWEDEN	NORDEL
Electrical energy turnover	32 198	62 400	4 427	108 167	141 285	348 477
Occasional power to electric boilers etc.	–	66	197	6 953 ¹⁾	8 390	15 606
Gross consumption 1991	32 198	62 334	4 230	101 214	132 895	332 871
Losses etc.	2 300	3 084	423	9 668	9 450	24 925
Net consumption	29 898	59 250	3 807	91 546	123 445	307 946
of which						
Industry	8 600	31 650	2 465	42 292	49 200	134 207
Traction	200	425	–	650	2 500	3 775
Domestic, commercial etc.	21 098	27 175	1 342	48 604	71 745	169 964
Change in gross consumption as against 1990	3.4%	0.3%	–0.8%	2.0%	1.9%	1.7%
Average change in gross consumption during the last 10 years	2.8%	4.2%	1.7%	1.8%	3.1%	2.9%
Gross consumption per inhabitant (kWh)	6 247	12 434	16 400	23 743	15 374	14 267
Average population 1991 (mill. inh.)	5.15	5.01	0.26	4.26	8.64	23.33

1) Of which pumped storage power 659 GWh

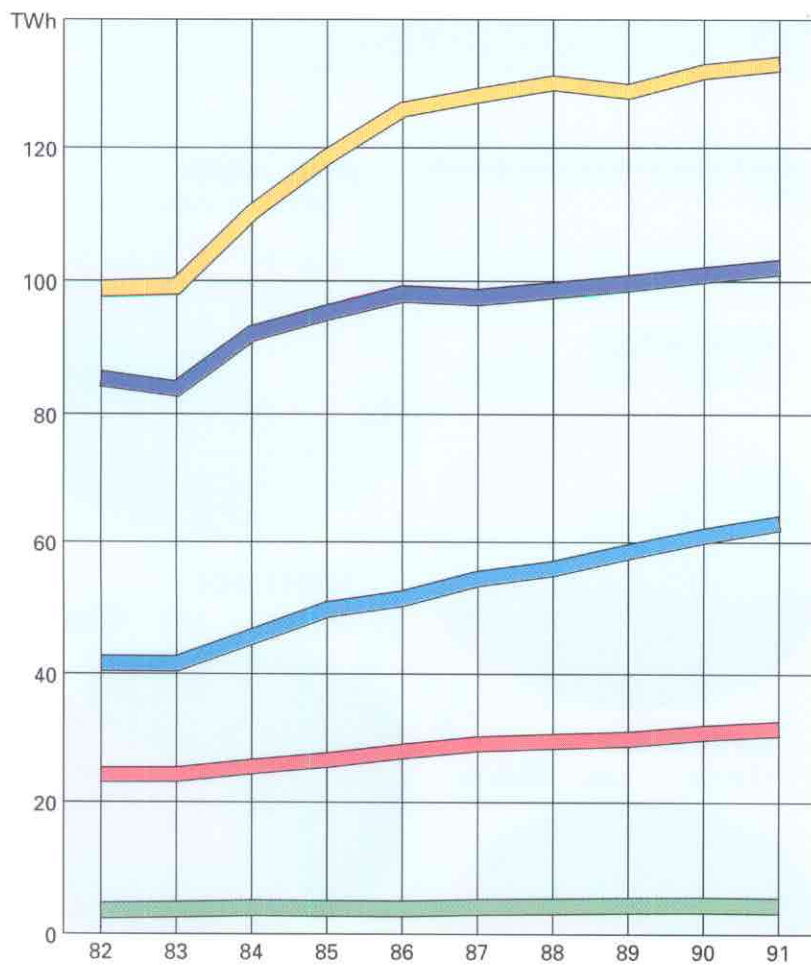


Fig. S22 Gross consumption of electrical energy 1982 – 1991.

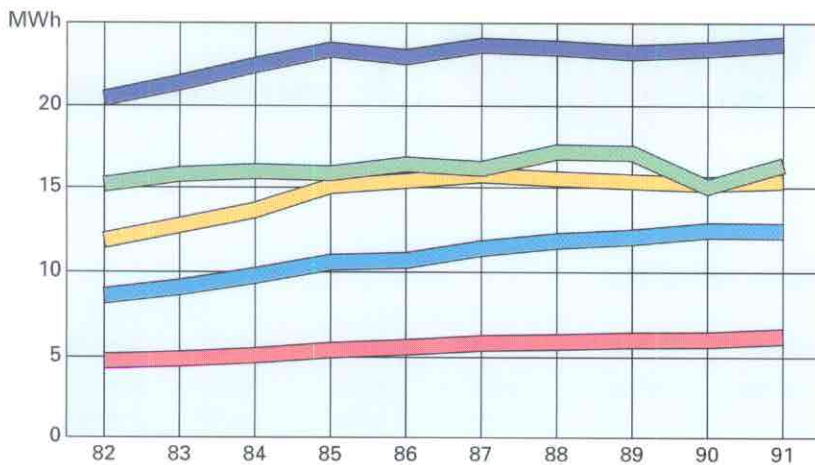


Fig. S23 Gross per capita consumption of electrical energy 1982 – 1991.

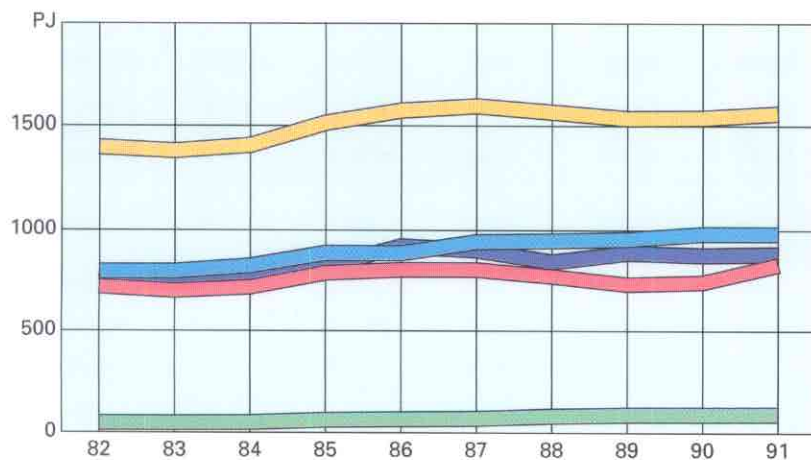


Fig. S24 Total energy supply 1982 – 1991.



Fig. S25 Distribution of electricity on energy sources, 1991, 1995 and 2000.

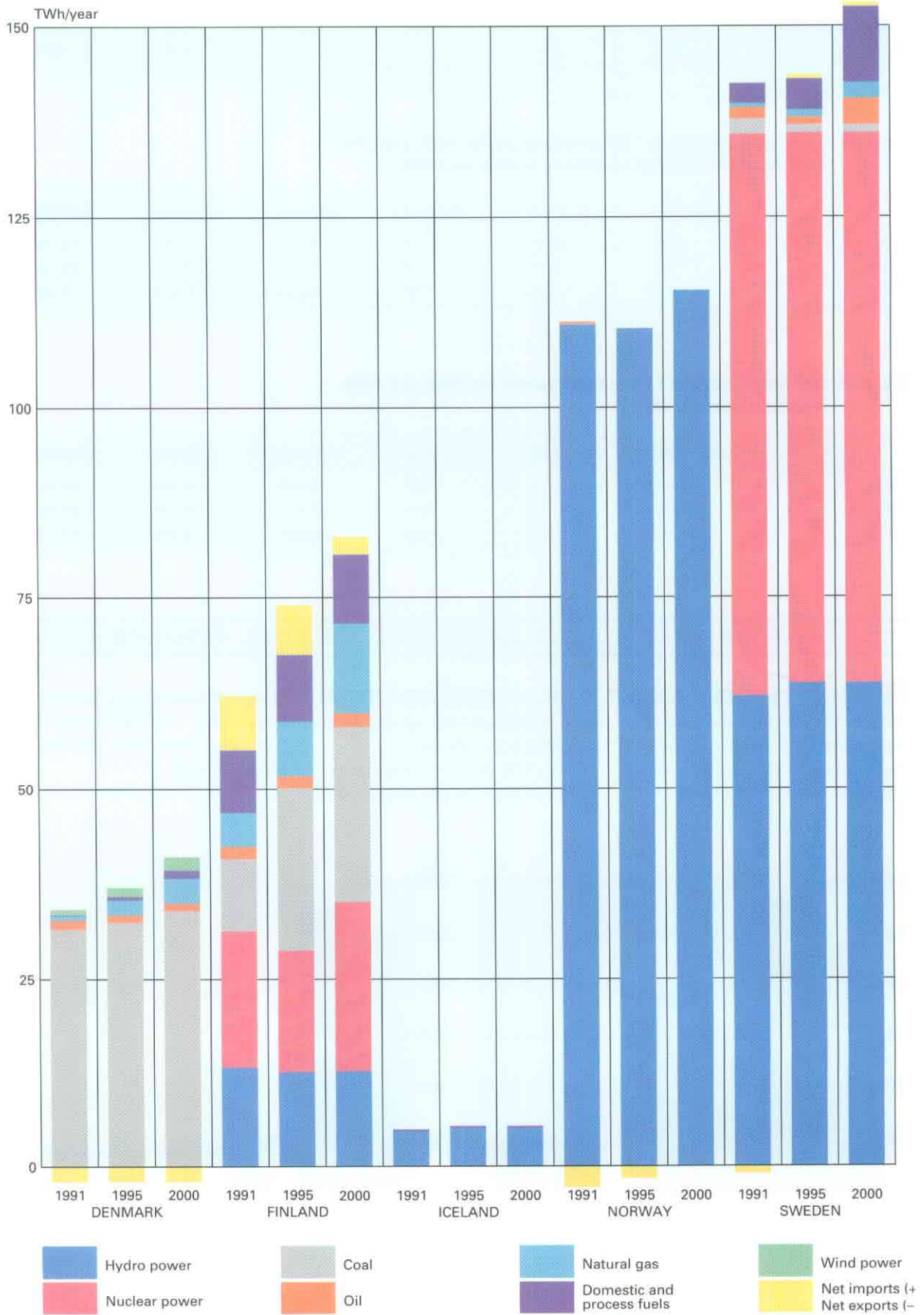


Fig. S26 Electrical energy consumption in 1991 and forecast for 1995 and 2000, excl. occasional power to electric boilers etc (TWh).

	DENMARK	FINLAND	ICELAND	NORWAY	SWEDEN	NORDEL
1991	32.2	62.3	4.2	101.2	132.9	332.8
1995	35	74	4.9	106	144	364
2000	39	83	5.1	111	153	391

Fig. S27 Peak load demand in 1991 and forecast for 1995 and 2000, excl. occasional power to electric boilers etc (MW).

	DENMARK	FINLAND	ICELAND	NORWAY	SWEDEN	NORDEL
1991	6 200	10 300	670	17 874	24 200	59 244
1995	7 100	13 000	700	19 100	28 500	68 400
2000	7 800	14 600	750	20 300	30 000	73 450

Fig. S28 Installed capacity in 1991 and forecast for 1995 and 2000 (valid per Dec. 31, MW).

	DENMARK	FINLAND	ICELAND	NORWAY	SWEDEN	NORDEL
1991	9 012	13 576	936	26 889	34 468	84 881
1995	9 450	15 050	1 050	27 550	35 400	88 500
2000	10 550	16 550	1 050	29 050	35 900	93 100

ENVIRONMENTAL GAINS FROM THE NORDEL COOPERATION

Based on the electricity consumption and the thermal power generation within Nordel, calculations show a substantial environmental gain as a result of the cooperation.

This is compared to each individual Nordel country generating its own electricity demand.

For 1991 the environmental gain of the Nordel cooperation resulted

in lower emission to nature of 45 000 tonnes SO₂, 30 000 tonnes NO_x, 8 million tonnes CO₂ and 160 000 tonnes of ashes.

