

STATISTICS

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The statistics were compiled before the official statistics of the individual countries for 1992 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 utilized 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 net imports including electric boilers etc.

Gross consumption of electrical energy is given in GWh and is the sum of domestic generation and net 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 = 1 000 kW

Energy Units

J = joule

kJ = kilojoule

PJ = petajoule = 10^{15} J = 23.9×10^3 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 1992 the total net capacity in the Nordel countries increased by 872 MW to 86 335 MW (including 472 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, 1992 and corresponding average-year generation by hydro power.

	DENMARK	FINLAND	ICELAND	NORWAY	SWEDEN	NORDEL
Hydro power, MW	10	2 748	875	26 958	16 380 ²⁾	46 971
Geothermal power, MW	–	–	45	–	–	45
Nuclear power, MW	–	2 310	–	–	10 000	12 310
Conv. thermal power, MW	9 496	8 488	119	278	8 156	26 537
of which						
Back-pressure, MW	636	4 640	–	165	3 633	9 074
Condense, MW	8 561 ¹⁾	2 986	–	78	2 757	14 382
Gasturbine, diesel etc, MW	299	862	119	35	1 766	3 081
Total installed capacity in 1992, MW	9 506	13 546	1 039	27 236	34 536	85 863 ³⁾
Commissioned in 1992, MW	482	160	103	362	90	1 197
Decommissioned in 1992, MW	162	190	–	7	14	373
Average-year generation, Hydro power, GWh	35	12 460	4 950	109 354	63 500	190 299
Change, Hydro power generation, GWh	–	80	450	1 362	210	2 102

1) Incl. German share of Enstedværket (300 MW)

2) Incl. Norwegian share of Linnvasselv (25 MW)

3) In addition there is 472 MW wind power capacity, of which 449 MW in Denmark, 3 MW in Norway, and 20 MW in Sweden

Fig. S2 Changes in installed capacity 1992 (larger than 10 MW).

Power category/Plant	Commissioned MW	Decommissioned MW	Change in average-year generation GWh	Type of fuel ¹⁾
DENMARK				
Conv. thermal power, total	474	127		
of which				
HC Ørstedværket	–	70		
Svanemølleværket	–	35		
Vestkraft B3	402	–		K/O
Vestkraft T5	–	57		
Decentralized CHP-stations	72	–		G
FINLAND				
Hydro power, total	30	–	80	
of which				
Kurkiaska	27	–	80	
Conv. thermal power, total	130	190		
of which				
Kaukopää	90	64		A
Tainionkoski	–	21		A
Rauma	–	25		K/A
Parainen	–	28		O
Lielähti	–	12		A
Kangas	–	13		O
ICELAND				
Conv. thermal power, total	3	–		O
Hydro power, total	100	–	450	
Blanda	100	–	450	
NORWAY				
Hydro power, total	362	7	1 362	
of which				
Haukrei	16	–	46	
Hellandsfoss	32	–	134	
Svartisen	310	–	1 200	
SWEDEN				
Hydro power, total	62	–	210	
of which				
Hällby	14	–	14	
Conv. thermal power, total	20	14		
of which				
Hudiksvall	14	–		G
Slite	–	14		
1) O=oil, K=coal, G=gas, T=peat, A=garbage, waste				

Fig. S3 Decided power plants (larger than 10 MW).

Power category/Plant	Capacity MW	Estimated commissioning	Average-year generation GWh	Type of fuel ¹⁾
DANMARK				
Conv. thermal power				
Helsingør	55	1993		G
Amager forbrænding	15	1993		A
Svanemølleværket	60	1994-95		G
Næstved	32	1995		A/G
Østkraft	37	1995		K
Silkeborg	60	1995		G
Skærbækværket	394	1998		G
Nordjyllandsværket	385	1999		K/O
FINLAND				
Hydro power				
Isohaara	54	1993	70	
Koivukoski	25	1995	20	
Conv. thermal power				
Kotka	69	1993		G/A
Uimaharju	95	1993		A
Meri-Pori	560	1993		K
Mussalo	90	1994		G
Oulu	113	1995		T
Martinlaakso	79	1995		G
Vuosaari	450	1996		G
NORWAY				
Hydro power				
Meråker	97	1994	436	
Tevla	50	1994	98	
Hekni	56	1995	230	
Grøa	33	1997	104	
Svartisen II + III	350	1998	248	
SWEDEN				
Hydro power				
Klippen	27	1994	94	
Conv. thermal power				
Halmstad	172	1993		G

1) O=oil, K=coal, G=gas, H=straw, T=peat, A=garbage, waste

THE GRID SYSTEM IN THE NORDEL COUNTRIES

Sweden is electrically connected to Denmark, Finland and Norway. Between Finland and Norway there is a 220 kV link, and a few lines from Norway to Finland for local consumption.

At the end of the year total transmission capacity between the Nordel countries was about 5 600 MW in

both directions. The DC cable connection between Denmark (Jutland) and Norway has the capacity of 550 MW in both directions. From southern Jutland there are 400, 220 and 60 kV interconnection links to Germany.

Between Finland and Russia there is a 1 000 MW DC link. This is

the first main grid connection of this size between Russia and western Europe.

Between Finland and Russia and between Norway and Russia there has for many years been a number of local interconnections.

Iceland is not electrically connected to the other Nordel countries.

Fig. S4 Existing interconnections between the Nordel countries.

Countries	Terminal stations	Rated voltage kV	Transmission capacity as per design rules MW		Total length km	Of which cable km		
			From Denmark	To Denmark				
DENMARK – NORWAY								
	Tjele – Kristiansand	±250=	550	550	240/pol	127/pol		
			From Finland	To Finland				
FINLAND – NORWAY								
	Ivalo – Varangerbotn	220~	50	50	228	–		
			From Sweden	To Sweden				
DENMARK – SWEDEN								
	Teglstrupgård – Sofiero	132~	350 ¹⁾	350 ¹⁾	23	10		
	Hovegård – Helsingborg no 1	400~	}	700 ¹⁾	}	1 100 ¹⁾	91	8
	Hovegård – Helsingborg no 2	400~				91	8	
	Vester Hassing – Göteborg	250=	260	260	176	87.5		
	Vester Hassing – Lindome	285=	300	300	149	87.1		
	Hasle (Bornholm) – Borby	60~	60	60	47.6	43.3		
FINLAND – SWEDEN								
	Ossauskoski – Kalix	220~	}	900	}	700	93	–
	Petäjäskoski – Letsi	400~				230	–	
	Keminmaa – Svartbyn	400~				134	–	
	Hellesby (Åland) – Skattbol	70~	35	35	76.5	56		
	Raumo – Forsmark	400=	500	500	235	198		
NORWAY – SWEDEN								
	Sørnes – Tornehamn	132~	}	200	}	200	39	–
	Ritsem – Ofoten	400~				58	–	
	Røssåga – Ajaure	220~	260 ²⁾	100 ²⁾³⁾	117	–		
	Linnvasselv, transformer	220/66~	50	50	–	–		
	Nea – Järpströmmen	275~	500 ²⁾	500 ²⁾	100	–		
	Lutufallet – Höljes	132~	40	20	17.5	–		
	Eidskog – Charlottenberg	132~	100	100	13	–		
	Hasle – Borgvik	400~	}	1 100 ²⁾	}	1 100 ²⁾	106	–
	Hasle – Trollhättan	400~				135	–	
TOTAL			5 605	5 625				

1) Also at parallel operation of the 132 kV and 400 kV interconnections the transmission values are 700 MW and 1 100 MW. The values can be higher on favourable generation and load conditions

2) Transmission capacity is occasionally reduced because of design fault case

3) 100 MW with maximum generation in Gejmån – Ajaure – Gardikfors. With minimum generation in these stations and up to 250 MW surplus generation in Helgeland the transmission capacity is 200 MW

ELECTRICITY GENERATION

Fig. S10 Total electricity generation within Nordel 1992.

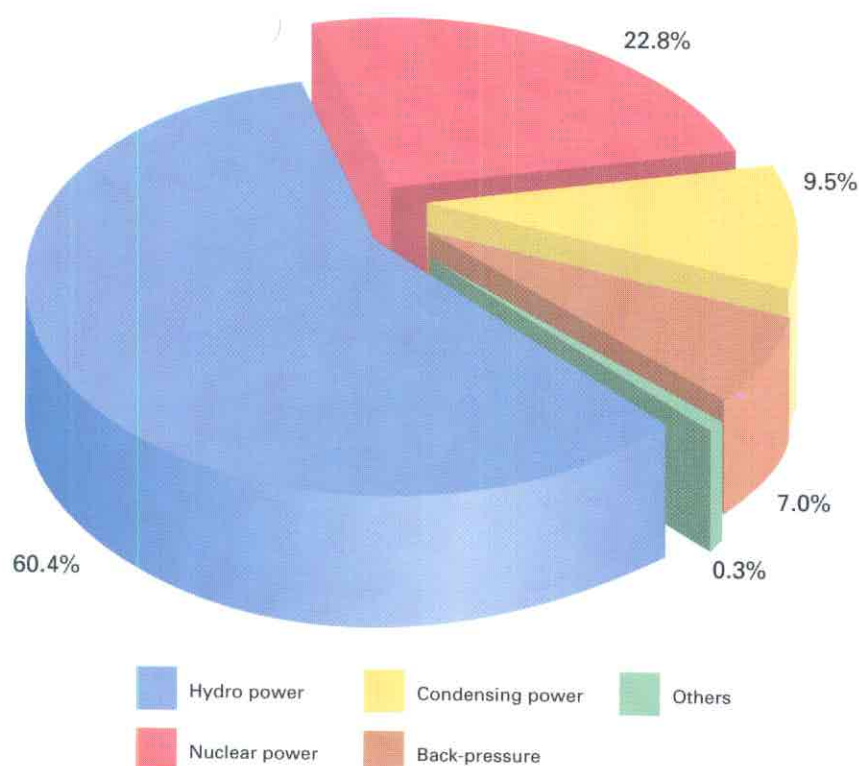


Fig. S11 Electricity generation in 1992 (GWh).

	DENMARK	FINLAND	ICELAND	NORWAY	SWEDEN	NORDEL
Hydro power	26	14 986	4 305	117 259	72 664 ³⁾	209 240
Wind power	793	1	–	–	33	827
Geothermal power	–	–	230	–	–	230
Nuclear power	–	18 195	–	–	60 841	79 036
Conv. thermal power of which	27 951	21 508	5	422	7 500	57 386
Back-pressure	431	16 889	–	287	6 755	24 362
Condense	27 520 ¹⁾	4 614	–	128	641	32 903
Gasturbine, diesel etc	–	5	5	7	104	121
Total generation 1992	28 770 ²⁾	54 690	4 540	117 681	141 038	346 719
Change as against 1991	–15.6%	–0.7%	2.6%	6.0%	–1.1%	–0.1%

1) Incl. generation in combined heat- and power stations

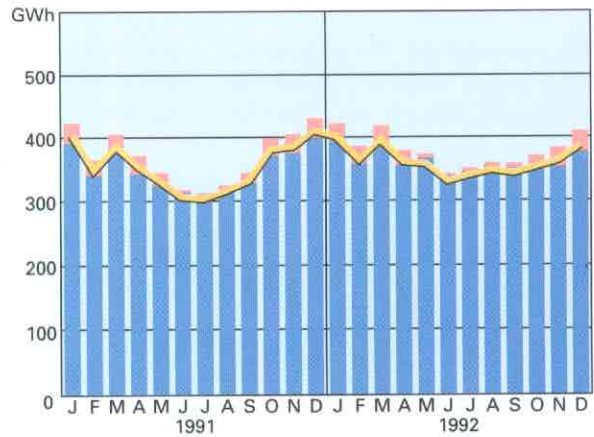
2) Of which German share of Enstedværket 1 970 GWh

3) Of which Norwegian share of Linnvasselv 127 GWh

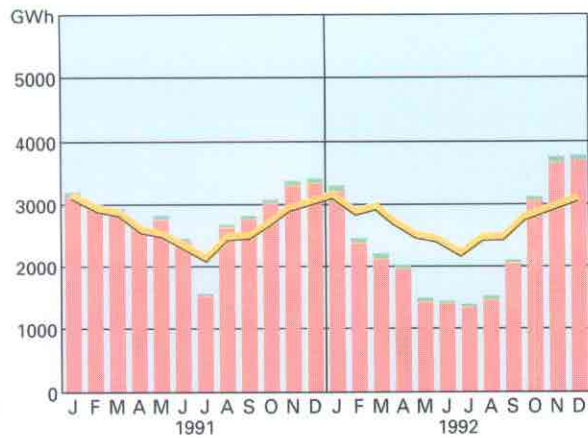
Fig. S12 Generation and gross consumption of electricity excl. occasional power to electric boilers etc.



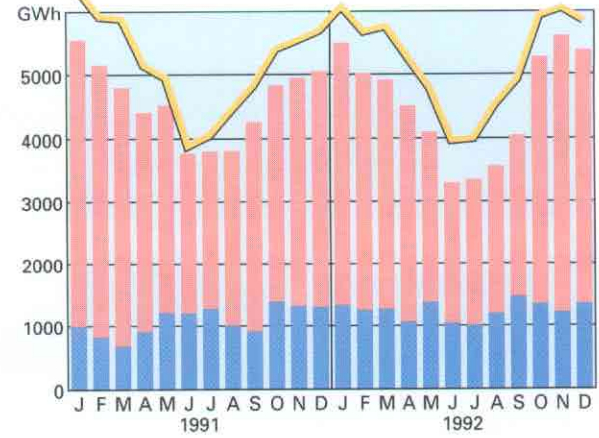
ICELAND



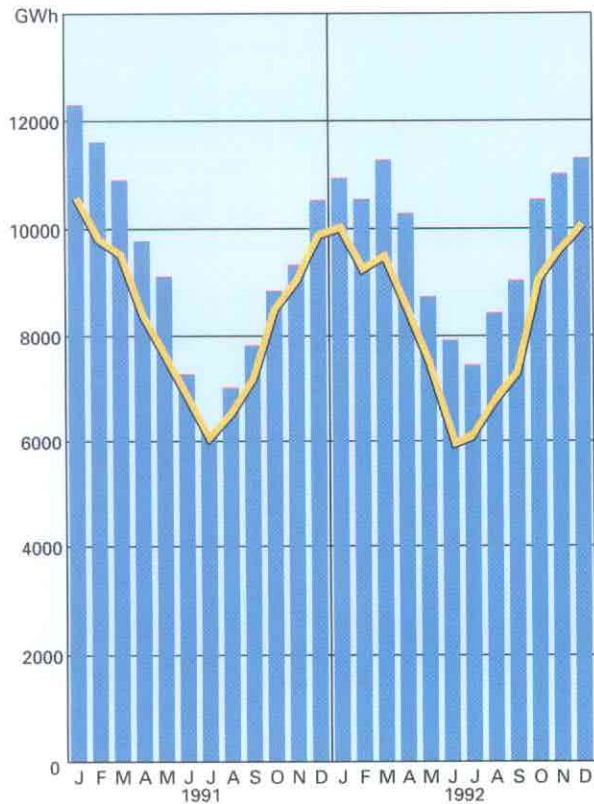
DENMARK



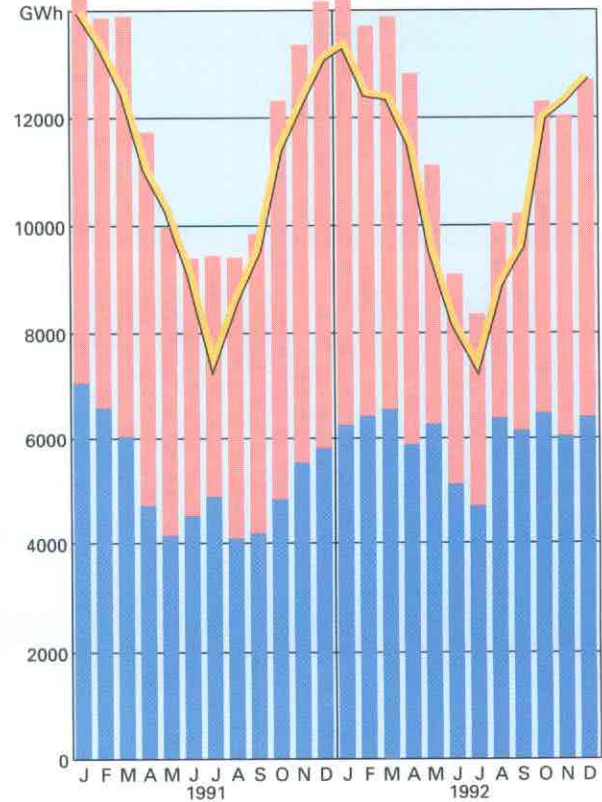
FINLAND



NORWAY



SWEDEN



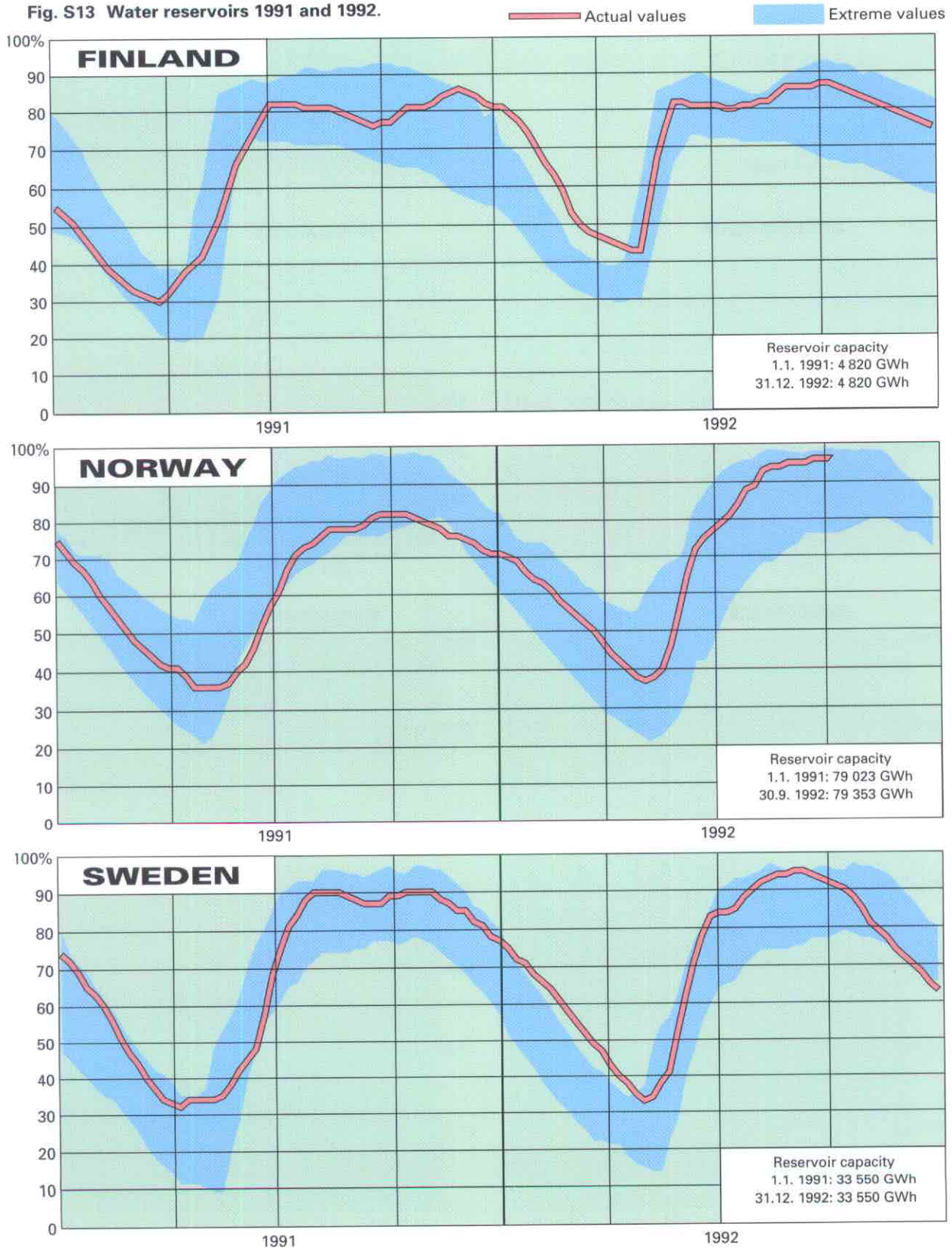
WATER RESERVOIRS

The curves show the impounded water in per cent of total storage capacity for 1991 and 1992. The field

gives upper and lower extremes which are composed of the weekly maximum and minimum recorded

for the period 1982 – 1991. Values for Norway are not recorded after Sept. 30, 1992.

Fig. S13 Water reservoirs 1991 and 1992.



LOAD, ELECTRICAL ENERGY TURNOVER

Fig. S14 Maximum and minimum load on the 3rd Wednesday in January and July 1992.

	Installed net capacity 31.12.92 MW	Max. and min. system load 1992							
		3rd Wednesday in January				3rd Wednesday in July			
		MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
		Local time	MW	Local time	MW	Local time	MW	Local time	MW
DENMARK¹⁾									
West of the Great Belt (ELSAM)	5 113 ²⁾	08 – 09	3 040	02 – 03	1 399	10 – 11	1 899	04 – 05	1 017
East of the Great Belt excl. Bornholm (ELKRAFT)	4 137	17 – 18	2 293	02 – 03	1 227	11 – 12	1 365	04 – 05	712
FINLAND									
	13 546	08 – 09	9 270	03 – 04	7 248	12 – 13	5 865	03 – 04	4 747
ICELAND									
	1 039	18 – 19	601	03 – 04	462	13 – 14	499	04 – 05	398
NORWAY									
	27 239	16 – 17	15 663	02 – 03	12 334	12 – 13	9 160	05 – 06	7 115
SWEDEN									
	34 556 ³⁾	08 – 09	20 460	02 – 03	14 485	11 – 12	11 315	04 – 05	7 905
NORDEL									
excl. Iceland Central-European time	84 591	08 – 09	50 569	03 – 04	36 807	12 – 13	29 488	04 – 05	21 522
1) Public utilities excl. wind power. To some extent the capacity is not available at operational planning, e.g. foreign owned plants, and plants out of operation for long-term									
2) Of which German share of Enstedværket 300 MW									
3) Of which Norwegian share of Linnvasselv 25 MW									

Fig. S15 Electrical energy turnover in 1992 (GWh).

	DENMARK	FINLAND	ICELAND	NORWAY	SWEDEN	NORDEL
Generation	28 770	54 690	4 540	117 681	141 038	346 719
Imports	8 651	8 942	–	1 270	8 846	27 709
Total generation and imports	37 421	63 632	4 540	118 951	149 884	374 428
Exports	4 884 ¹⁾	696	–	9 945	11 003 ²⁾	26 528
Total electrical energy turnover	32 537	62 936	4 540	109 006	138 881	347 900
Change as against 1991	1.3%	1.0%	2.6%	0.7%	–1.7%	–0.1%

1) Of which German share of Enstedværket 1 970 GWh
2) Of which Norwegian share of Linnvasselv 6 GWh

EXCHANGE OF ELECTRICAL ENERGY

Fig. S16 Exchange of electrical energy between the Nordel countries 1963 – 1992.

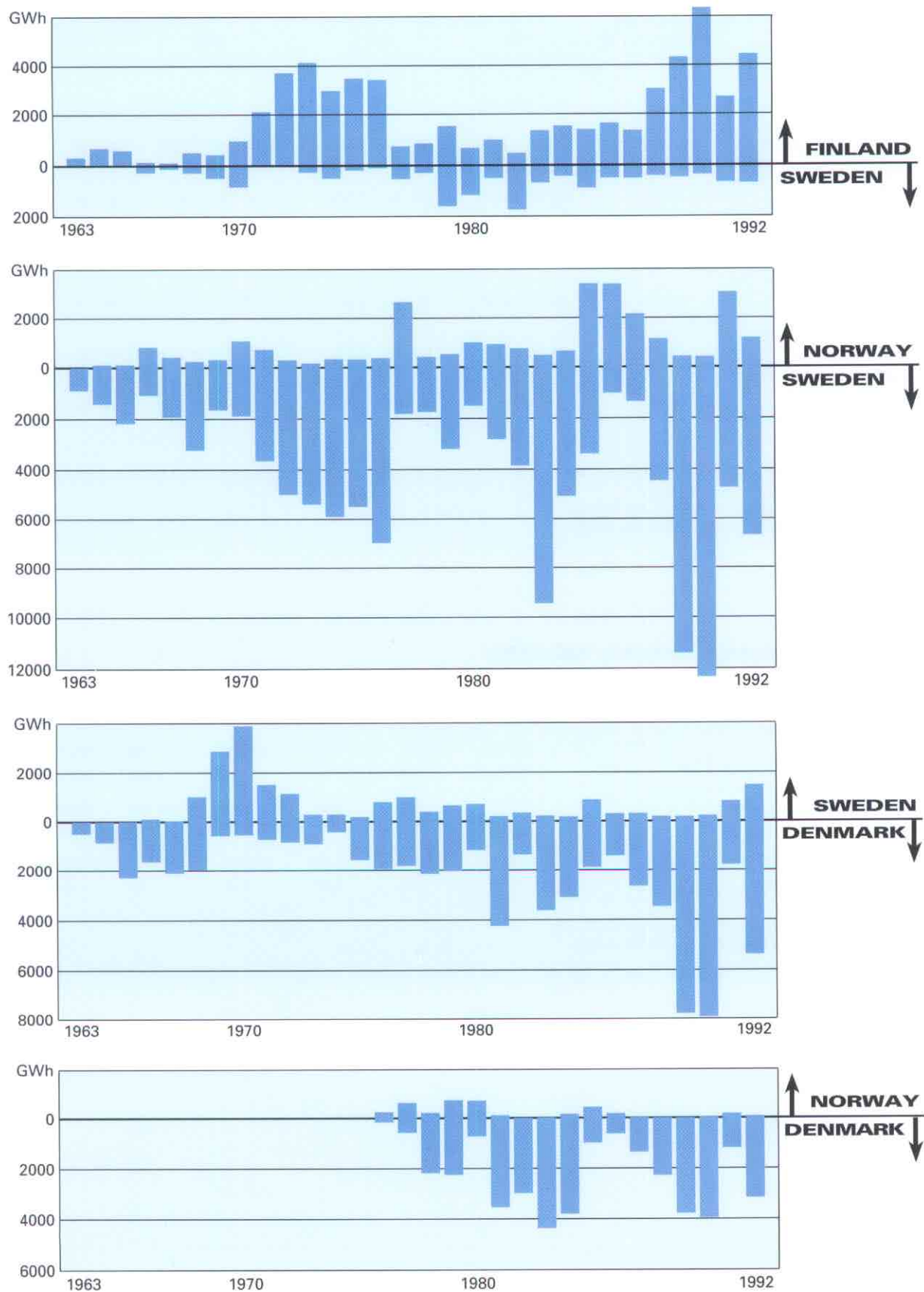


Fig. S17 Electrical energy exchanges within Nordel in 1992 (GWh).

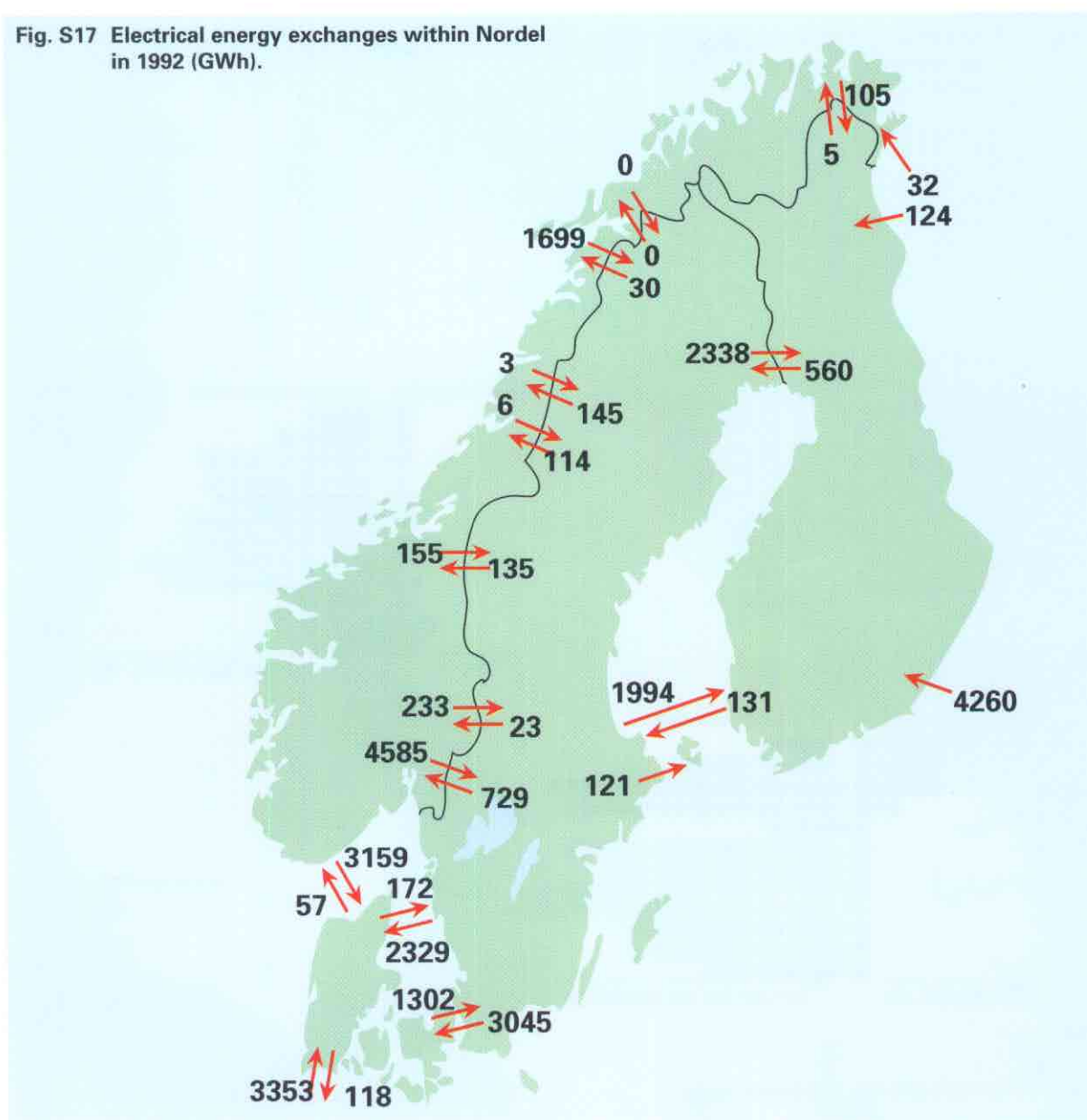


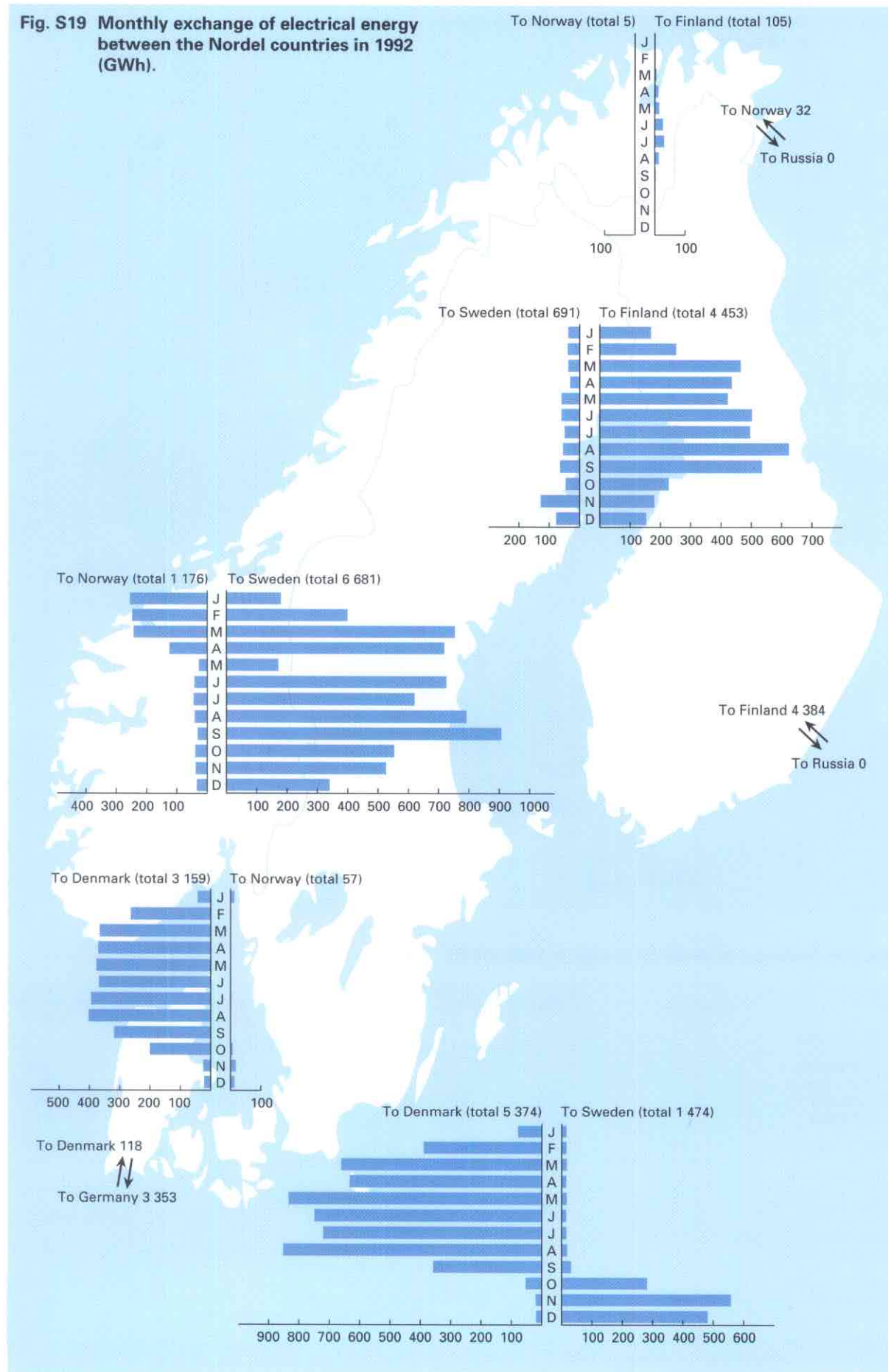
Fig. S18 Exchange of electrical energy in 1992 (GWh).

Imports to:	DENMARK	FINLAND	NORWAY	SWEDEN	Nordel countries	Other countries	Total exports 1992
Exports from:							
DENMARK	–	–	57	1 474	1 531	3 353 ¹⁾	4 884 ¹⁾
FINLAND	–	–	5	691	696	–	696
NORWAY	3 159	105	–	6 681	9 945	–	9 945
SWEDEN	5 374	4 453	1 176	–	11 003 ²⁾	–	11 003 ²⁾
Nordel countries	8 533	4 558	1 238	8 846	23 175	3 353	26 528
Other countries	118	4 384	32	–	4 534		
Total imports 1992	8 651	8 942	1 270	8 846	27 709		
NET EXCHANGE 1992 Imports(+) / Exports(–)	3 767	8 246	–8 675	–2 157	1 181		
NET EXCHANGE/ GROSS CONSUMPTION	11.6%	13.1%	8.7%	1.7%	0.4%		

1) Of which German share of Enstedværket 1 970 GWh

2) Of which Norwegian share of Linnvasselv 6 GWh

Fig. S19 Monthly exchange of electrical energy between the Nordel countries in 1992 (GWh).



ELECTRICITY CONSUMPTION

Fig. S20 Net electricity consumption distributed on consumer groups excl. electric boilers etc. in 1992.

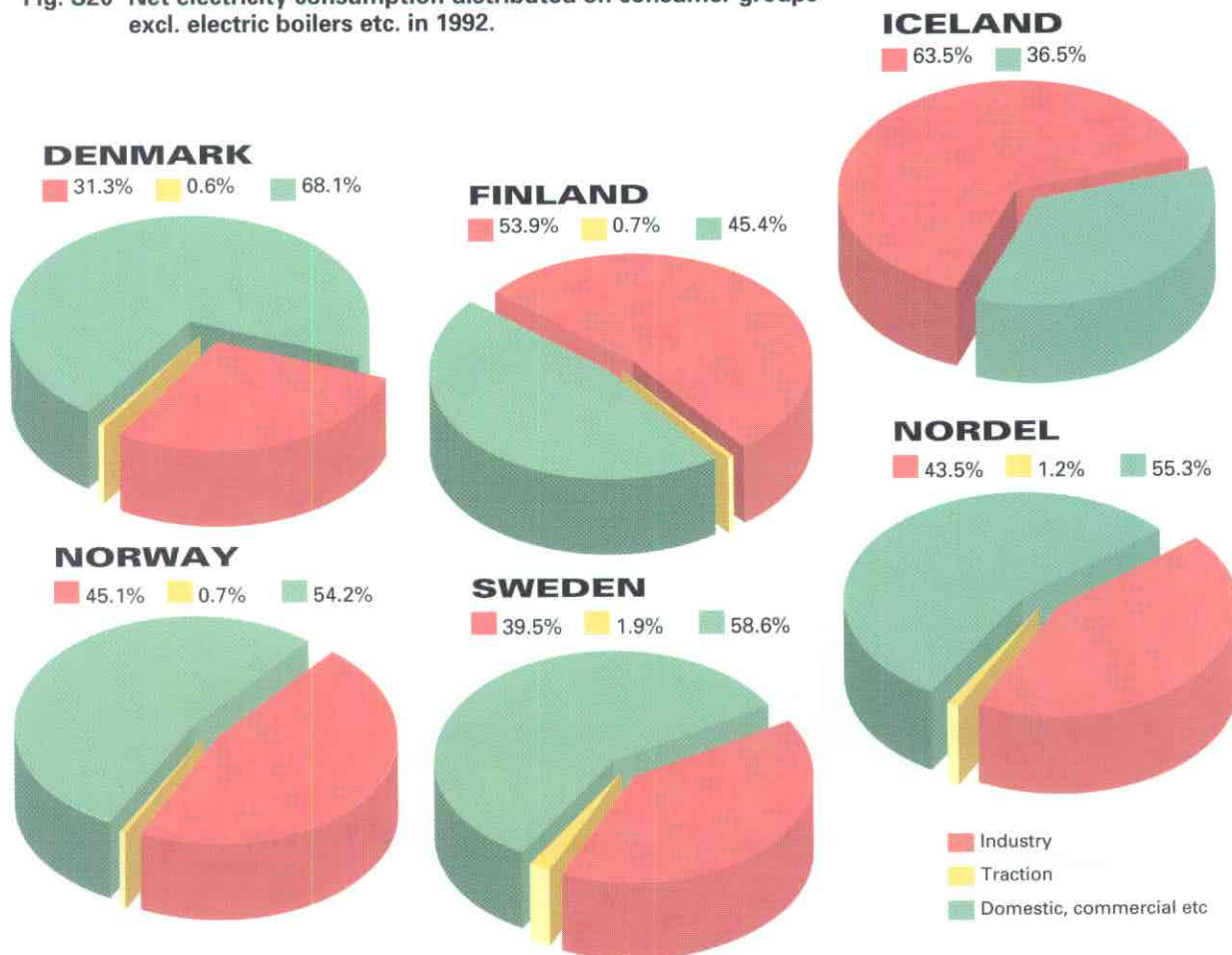


Fig. S21 Electricity consumption in 1992 (GWh).

	DENMARK	FINLAND	ICELAND	NORWAY	SWEDEN	NORDEL
Electrical energy turnover	32 537	62 936	4 540	109 006	138 881	347 900
Occasional power to electric boilers etc.	0	72	220	8 954 ¹⁾	8 420	17 666
Gross consumption 1992	32 537	62 864	4 320	100 052	130 461	330 234
Losses etc.	2 213	2 934	380	8 021	9 656	23 204
Net consumption	30 324	59 930	3 940	92 031	120 805	307 030
of which						
Industry	9 486	32 280	2 500	41 505	47 700	133 471
Traction	200	435	0	680	2 353	3 668
Domestic, commercial etc.	20 638	27 215	1 440	49 846	70 752	169 891
Change in gross consumption as against 1991	1.3%	1.1%	2.1%	-0.2%	-1.8%	-0.4%
Average change in gross consumption during the last 10 years	2.6%	4.2%	1.9%	1.7%	3.1%	2.9%
Gross consumption per inhabitant (kWh)	6 293	12 468	16 615	23 343	15 009	14 082
Average population 1992 (mill. inh.)	5.17	5.04	0.26	4.29	8.69	23.45
1) Of which pumped storage power 654 GWh						

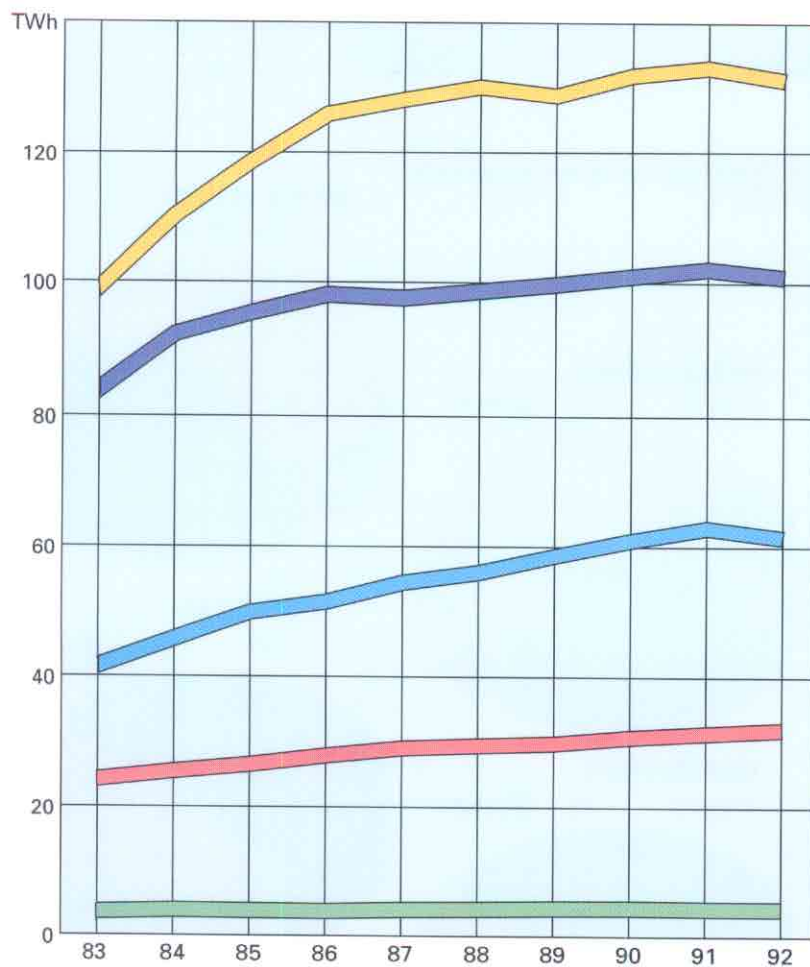


Fig. S22 Gross consumption of electrical energy 1983 – 1992.



Fig. S23 Gross per capita consumption of electrical energy 1983 – 1992.

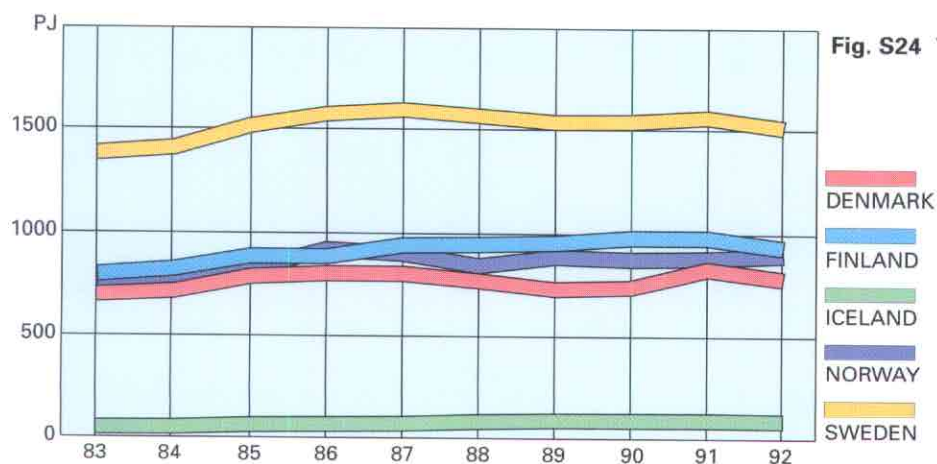


Fig. S24 Total energy supply 1983 – 1992.

FORECASTS

Fig. S25 Distribution of electricity on energy sources, 1992, 1995 and 2000.

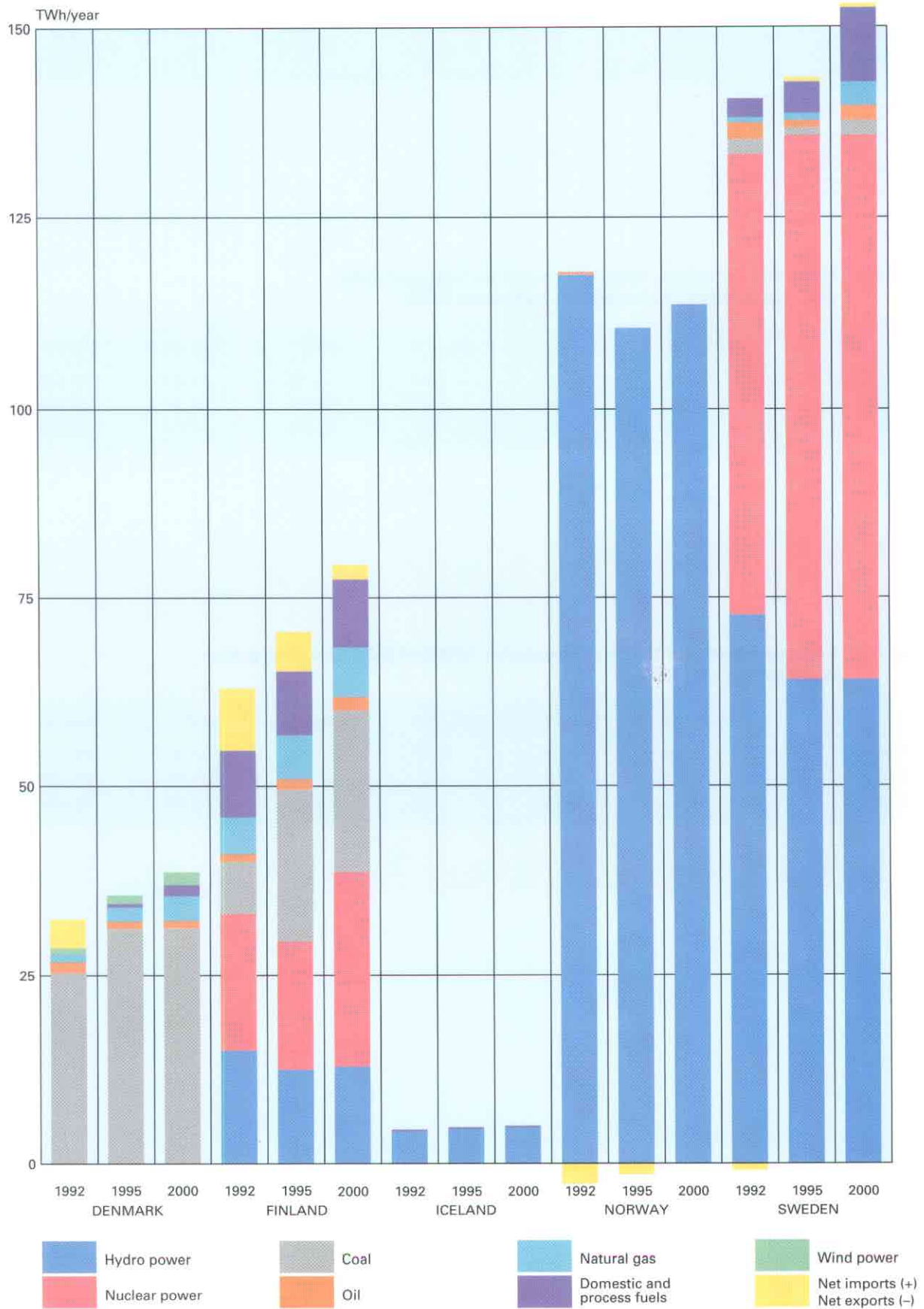


Fig. S26 Electrical energy consumption in 1992 and forecast for 1995 and 2000, excl. occasional power to electric boilers etc (TWh).

	DENMARK	FINLAND	ICELAND	NORWAY	SWEDEN	NORDEL
1992	32.5	62.9	4.3	100.1	130.5	330.3
1995	36	71	4.9	108	144	363
2000	39	79	5.1	114	153	390

Fig. S27 Peak load demand in 1992 and forecast for 1995 and 2000, excl. occasional power to electric boilers etc (MW).

	DENMARK	FINLAND	ICELAND	NORWAY	SWEDEN	NORDEL
1992	6 000	10 400	670	16 778	23 900	57 748
1995	7 158	12 400	690	19 100	28 500	67 848
2000	7 810	13 900	740	20 300	30 000	72 750

Fig. S28 Installed capacity in 1992 and forecast for 1995 and 2000, excl wind power (valid per Dec. 31, MW).

	DENMARK	FINLAND	ICELAND	NORWAY	SWEDEN	NORDEL
1992	9 506	13 546	1 039	27 236	34 536	85 863
1995	9 650	14 700	1 050	27 600	35 400	88 400
2000	11 050	16 400	1 050	29 100	35 900	93 500

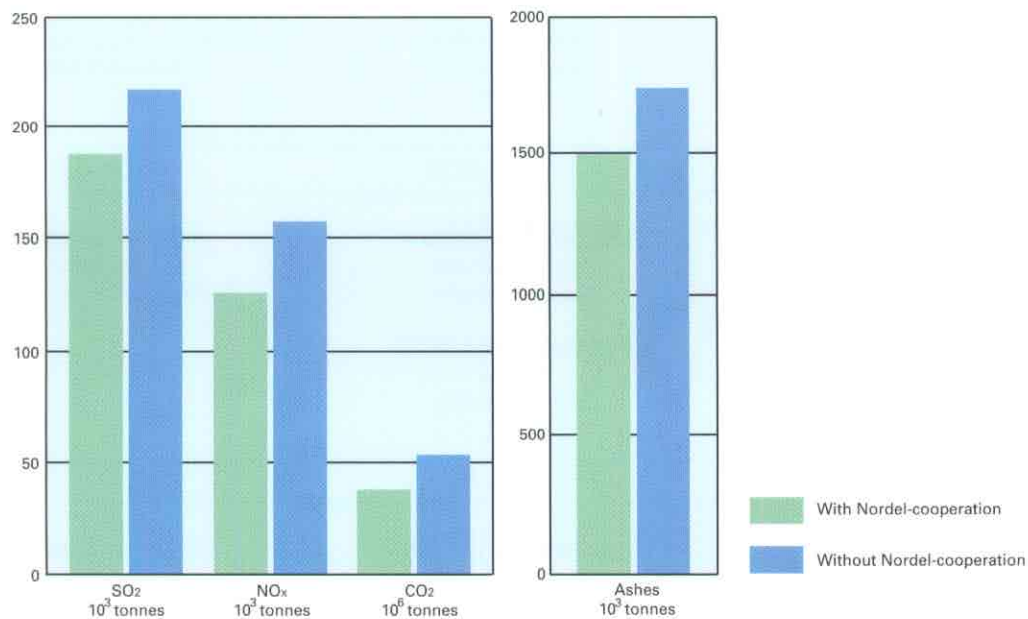
ENVIRONMENT

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 1992 the environmental gain of the Nordel cooperation resulted

in lower emission to nature of 29 000 tonnes SO_2 , 32 000 tonnes NO_x , 16 million tonnes CO_2 and 380 000 tonnes of ashes.



During the last three years the Nordel cooperation has resulted in reduced emissions with 144 000 tonnes

of sulphur dioxide, 112 000 tonnes of nitrogen oxide, around 36 million tonnes of carbon dioxide and

almost 1.2 million tonnes of ashes.

