

캐나다 에너지統計

第14次 WEC總會 개최국인 캐나다의 에너지 경제 실태를 파악하기 위하여 캐나다 에너지 統計 자료를 게재한다.

GENERAL FEATURES OF THE CANADIAN ENERGY ECONOMY

With a population of approximately 26 million and an area of some 10 million square kilometres, Canada is the second largest and one of the least densely populated countries in the world. The country enjoys a diversified economy, with a 1987 GDP of \$424 billion (1981 Canadian dollars). The climate in Canada ranges from extreme heat in the summers to extreme cold in the winters. This fact, combined with the energy intensive nature of the country's industries and the large distances between population centres has made Canada the most energy intensive country in the industrialized world.

Energy is a critical component of the Canadian economy. A large energy resource base has allowed Canada to achieve and maintain since 1969 its status as a net energy exporting country. The energy sector is a major contributor to the Canadian economy, employing more than 300,000 Canadians and accounting for 6% of GDP and 14% of total investment. Although Canada is well endowed with energy resources, there are major regional differences in both energy production and consumption, and in the contribution to the economy (for example, in the prairie provinces, the energy sector contributes as much as 20% of GDP). Alberta produces about 83% of Canada's oil and 87% of its natural gas (and its natural markets often lie to the South rather than the East). In contrast, Quebec and Ontario account for almost 60% of domestic petroleum consumption and virtually half of Canadian natural gas requirements.

Canada is a net exporter of all main energy forms. In 1987, net energy exports amounted to \$7.6 billion. The United States is by far Canada's most important customer, accounting for 80% of all energy exports. It is the destination of all of our exports of oil, natural gas and electricity and roughly one-third of our uranium exports. The importance of energy in Canada's trade balance is even greater if the export of energy-intensive goods, equipment and systems, and energy expertise are included. Canadian manufacturers, utilities and engineering consultants have won international acclaim for their work, and they are encouraging Canadians to place an even greater emphasis on the export opportunities of the technologies and systems they have developed.

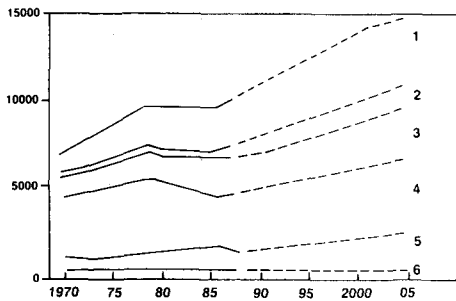
Canada has an abundance and diversity of energy resources. In addition, Canada has huge potential energy resources – those which will require new technologies and/or higher prices to develop. For example, the potential of the oil sands has been estimated as comparable to the combined proven reserves of Saudi Arabia, the United

Arab Emirates and Kuwait. The trend, in the domestic oil sector in particular, will be away from traditional sources of supply and towards the frontiers and non-conventional sources. In fact, conventional light and medium crude oil production is expected to fall as a proportion of total domestic supply from around 2/3 in 1987 to 1/3 in 2005.

A significant trend in the energy demand sector of the Canadian economy over the last decade or so has been the change from a sector dominated by oil and gas to one characterized by a much more diverse mixture of energy forms. This trend is likely to continue. Electricity is now the fastest growing component of domestic energy demand. Electric power generation in Canada is expected to increase at an average annual rate of about 2.5% to the year 2005. British Columbia, Manitoba, Ontario, Quebec, and Newfoundland are all endowed with considerable hydro-electric resources. Hydro-electricity has also become a major source of energy exports, now accounting for about 10% of total energy exports. Canada also has an indigenous nuclear power industry established around the CANDU power reactor design. CANDU reactors in Ontario, Quebec, and New Brunswick generate over 15% of the electricity produced in Canada.

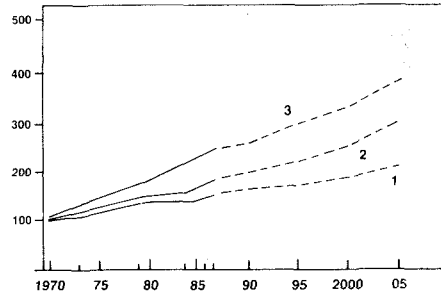
Energy policy in Canada has passed through three distinct phases since World War II; a period of producer orientation when the petroleum industry was in its infancy (from the late 1940's to the early 1970's); a period of consumer orientation, when the focus was on security, "made in Canada" prices, strict regulation of exports, capturing rents, and Canadianization (from the early 1970's to the early 1980's); and the current market orientation, with its emphasis on deregulation and economic efficiency. In conjunction with the emphasis on a market-oriented energy sector, the government has a continued interest in energy mega-projects as an instrument of regional development. A major challenge facing energy policy-makers is to develop policies to harmonize energy and environmental policies, while ensuring that a balance is maintained between economic and environmental needs. Canadians are increasingly concerned about the multiple impacts on the environment of energy consumption and production. This concern will continue to be reflected in the efforts of the government to ensure that energy development takes place in a manner which respects the environment; and a will to integrate environmental considerations at all stages of energy decision-making, from production and transportation to consumption.

3.1 PRIMARY ENERGY SUPPLY BY SOURCE (PJ)



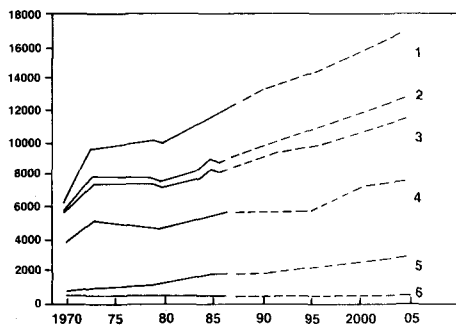
1. HYDRO POWER 3. NATURAL GAS 5. COAL
2. NUCLEAR POWER 4. CRUDE OIL, PETR. PRODUCTS 6. OTHER

3.2 PRIMARY ENERGY, ECONOMIC ACTIVITY AND ELECTRICITY (1970 = 100)



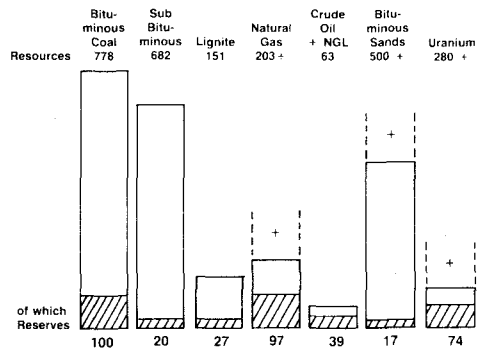
1. PRIMARY ENERGY 2. GDP 3. ELECTRICITY

3.3 INDIGENOUS ENERGY PRODUCTION (PJ)

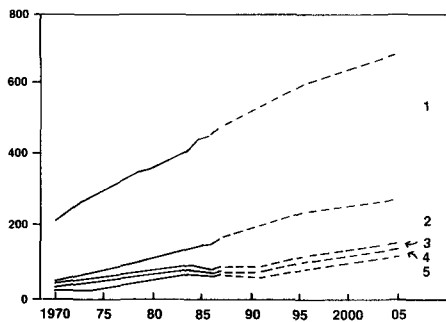


1. HYDRO POWER 3. NATURAL GAS 5. COAL
2. NUCLEAR POWER 4. CRUDE OIL, NGL 6. OTHER

3.4 CONVENTIONAL ENERGY RESOURCES (EJ)

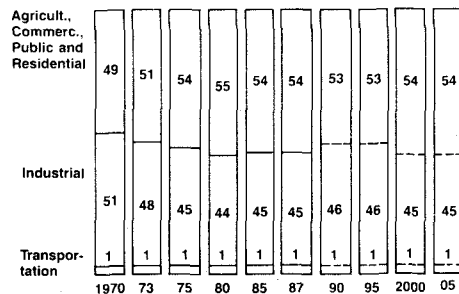


3.5 ELECTRICITY SUPPLY BY SOURCE (TWh)



1. HYDRO POWER AND OTHER 3. GAS 5. COAL
2. NUCLEAR POWER 4. OIL

3.6 ELECTRICITY CONSUMPTION BY SECTORS (PERCENT)



統計資料

4.1 GENERAL ENERGY DATA	1970	1973	1979	1980	1984	1985	1986	1987
Population 10 ⁶	21	22	24	24	25	25	25	26
GDP 10 ⁶ CDN \$ (1980)	192	239	305	310	342	357	368	383
GDP 10 ⁶ US \$ (1980)	164	204	261	265	292	305	315	328
GDP/Capita CDN \$ (1980)	9 064	10 892	12 899	12 964	13 737	14 227	14 560	14 978
GDP/Capita US \$ (1980)	7 742	9 297	11 038	11 089	11 751	12 170	12 369	12 812
Primary Energy Supply								
Total PJ	6 735	7 755	9 356	9 405	9 412	9 709	9 833	10 025
Total Mtoe	165	185	223	224	225	231	234	239
Per Capita GJ	316	353	394	391	377	386	388	391
Per GDP MJ/CDN \$ (1980)	35	32	31	30	27	27	27	26
Per GDP MJ/US \$ (1980)	41	38	36	35	32	32	31	30
Electricity Supply								
Total TWh	207	256	330	350	398	419	435	452
Per Capita kWh	9 718	11 615	13 879	14 528	15 933	16 635	17 148	17 658
Per GDP Wh/CDN \$ (1980)	1 078	1 071	1 082	1 129	1 164	1 174	1 182	1 180
Per GDP Wh/US \$ (1980)	1 262	1 255	1 264	1 321	1 363	1 374	1 381	1 378

4.2 PRIMARY ENERGY SUPPLY (PJ)	1970	1973	1979	1980	1984	1985	1986	1987
Indigenous Production								
Coal	349	490	782	859	1 326	1 413	1 313	1 324
Crude Oil & NGL	3 155	4 366	3 626	3 502	3 584	3 615	3 679	3 836
Natural Gas	2 009	2 618	2 858	2 601	2 687	2 927	2 758	2 959
Nuclear Power	10	143	330	356	488	566	667	723
Hydro Power	1 480	1 822	2 297	2 373	2 679	2 843	2 908	2 961
Other i)	309	324	285	310	311	347	370	387
Total Production (Mtoe)	7 312	9 763	10 178	10 001	11 075	11 711	11 695	12 190
Imports (+)								
Coal	508	438	500	451	535	424	395	367
Crude Oil & NGL	1 206	1 818	1 319	1 169	531	607	757	863
Refined Petroleum Products	425	229	79	106	206	188	265	291
Natural Gas	10	14	—	—	—	—	9	4
Electricity	12	8	6	11	9	10	18	12
Total Imports (Mtoe)	2 161	2 507	1 904	1 737	1 281	1 229	1 444	1 537
Exports (-)								
Coal	120	319	395	437	700	762	721	701
Crude Oil & NGL	1 496	2 678	821	651	939	1 205	1 382	1 441
Refined Petroleum Products	128	242	242	263	288	330	301	348
Natural gas	810	1 061	969	771	748	910	731	971
Electricity	20	59	113	109	149	155	140	170
Total Exports (Mtoe)	2 574	4 359	2 540	2 231	2 824	3 362	3 275	3 631
Marine-Bunkers	61	96	61	53	67	80	78	86
Stock Changes	-109	-88	-65	-62	-22	-16	-17	-25
Total Energy Supply (Mtoe)	-55	-68	-121	-39	-98	147	-13	-46
Total Energy Supply (Mtoe)	6 735	7 755	9 356	9 405	9 412	9 709	9 833	10 025
(Mtoe)	160	185	223	224	225	231	234	239

i) Waste wood, spent liquor, and primary steam

4.3 TRANSFORMATION SECTOR (PJ)	1970	1973	1979	1980	1984	1985	1986	1987
Conversion	1 484	1 648	2 392	2 487	2 848	3 026	3 061	3 120
Energy Sector Own Use	283	297	330	308	312	372	395	415
Statistical Differences (±)	59	53	230	199	167	56	79	80
Total Use in Transformation (Mtoe)	1 826	1 998	2 952	2 994	3 327	3 454	3 535	3 615
(Mtoe)	46	48	71	72	79	82	84	88

4.4 FINAL ENERGY DEMAND (PJ)	1970	1973	1979	1980	1984	1985	1986	1987
(Mtoe)	4 909	5 757	6 404	6 411	6 085	6 255	6 298	6 410
	117	135	152	153	145	149	150	153

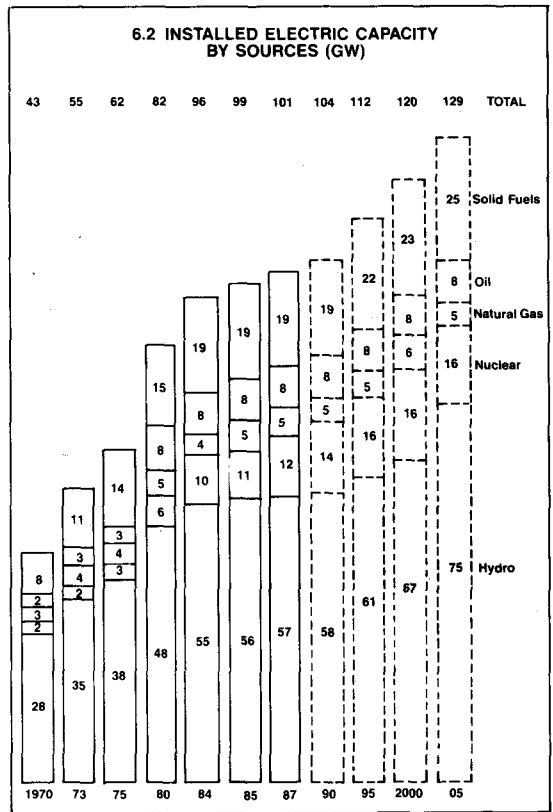
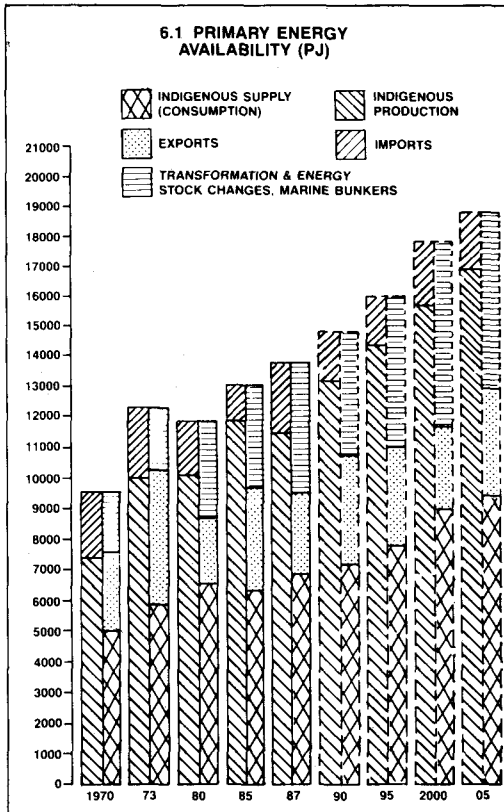
5.1 FINAL ENERGY DEMAND BY SOURCES AND SECTORS (PJ)	1970	1973	1979	1980	1984	1985	1986	1987
Coal								
Industry	268	254	245	245	232	232	227	214
Transportation	9	5	—	—	—	—	—	—
Other sectors	45	17	5	4	4	4	4	4
Total Coal	322	276	250	249	236	236	231	218
(Mtoe)	8	7	6	6	6	6	6	5
Refined Petroleum Products i)								
Industrial (Total)	483	677	710	648	491	500	580	609
– of which Petrochemical	83	96	183	159	175	221	218	239
Transportation	1 205	1 462	1 667	1 703	1 429	1 576	1 592	1 642
Other Sectors (Total)	969	894	838	809	507	470	457	428
Agriculture	164	153	148	141	66	67	69	68
Commercial & Public	301	273	247	239	212	178	173	167
Residential	504	468	443	429	229	226	215	193
Non-Energy Use	166	223	232	233	187	196	168	189
Total Refined Petroleum Products	2 822	3 256	3 446	3 396	2 748	2 743	2 797	2 868
(Mtoe)	67	78	82	81	66	66	66	68
Natural Gas								
Industrial (Total)	383	506	688	691	716	743	697	742
– of which Petrochemical	—	—	83	100	158	160	144	139
Transportation	—	—	—	—	—	1	1	1
Other Sectors (Total)	417	506	701	685	818	873	849	789
Agriculture	—	—	9	10	14	15	15	16
Commercial & Public	185	245	321	301	370	393	380	338
Residential	232	261	371	374	434	465	454	435
Total Gas	800	1 012	1 389	1 376	1 534	1 616	1 546	1 532
(Mtoe)	19	24	33	33	37	39	37	37
Electricity								
Industrial	340	383	451	480	555	593	590	619
Transportation	2	7	8	8	9	10	10	11
Other Sectors (Total)	315	400	574	595	692	710	754	775
Agriculture	5	8	27	28	31	32	33	28
Commercial & Public	158	205	259	261	299	305	329	345
Residential	152	187	288	306	362	373	392	402
Total Electricity	657	790	1 034	1 083	1 256	1 313	1 354	1 405
(Mtoe)	16	19	25	26	30	31	32	33
Other Sources ii)	309	324	285	310	311	347	370	387
(Mtoe)	7	7	7	7	7	8	8	9
Total Final Energy Demand	4 909	5 657	6 404	6 411	6 085	6 255	6 298	6 410
(Mtoe)	117	135	152	153	145	149	150	153

i) Including gas plant LPGs

ii) Waste wood, spent liquor, and primary steam

5.2 ELECTRICITY SUPPLY BY SOURCE (TWh)	1970	1973	1979	1980	1984	1985	1986	1987
Coal	36.5	33.6	52.7	60.9	84.0	79.5	71.7	84.2
Oil	6.4	9.2	14.7	13.5	6.3	6.8	6.1	10.1
Natural Gas	6.4	16.2	11.0	9.4	6.1	6.8	7.0	6.2
Nuclear Power	1.1	15.3	35.3	38.0	52.2	60.5	71.3	77.3
Hydro Power	158.3	194.8	245.4	253.5	286.2	303.7	310.7	316.3
Other	1.0	1.1	1.3	1.6	2.3	1.7	1.8	2.3
Net Imports	-2.4	-14.0	-29.6	-27.2	-39.1	-40.3	-34.0	-44.0
Total	207.3	256.2	330.8	349.7	398.0	418.7	434.6	452.4
– of which Public Supply	176.0	220.3	294.7	313.6	359.5	380.1	396.5	414.8
Autogeneration	32.0	35.9	36.1	36.1	38.5	38.6	38.2	37.6

5.3 SECTOR OIL SUBSTITUTION INDICATORS (OAR, OUR)	1970	1973	1979	1980	1984	1985	1986	1987
Oil Application Ratio (OAR)								
Industrial	0.15	0.19	0.18	0.17	0.16	0.17	0.19	0.19
Transport	0.38	0.42	0.42	0.44	0.46	0.55	0.53	0.51
Agriculture, Commercial, Residential and Public Service	0.31	0.26	0.21	0.21	0.16	0.16	0.15	0.13
Electricity Generation	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Oil Use Ratio (OUR)								
Industrial	0.28	0.32	0.30	0.27	0.21	0.21	0.23	0.24
Transport	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Agriculture, Commercial, Residential and Public Service	0.55	0.49	0.40	0.39	0.25	0.23	0.22	0.21
Electricity Generation	0.03	0.04	0.04	0.04	0.02	0.02	0.01	0.02
OAR = $\frac{\text{Oil Consumption in Sector}}{\text{Total Oil Consumption in Country}}$								
OUR = $\frac{\text{Oil Consumption in Sector}}{\text{Total Energy Consumption in Sector}}$								



6.3 CANADIAN NUCLEAR REACTORS

Name	Location	Power MW gross	Operator	Commercial Operation	Name	Location	Power MW gross	Operator	Commercial Operation
In operation									
NPD	Ontario	25	OH AECL	1962	Pickering 7	Ontario	540	OH	1984
Pickering 1	Ontario	542	OH	1971	Pickering 8	Ontario	540	OH	1986
Pickering 2	Ontario	542	OH	1971	Bruce 5	Ontario	890	OH	1985
Pickering 3	Ontario	542	OH	1972	Bruce 6	Ontario	890	OH	1984
Pickering 4	Ontario	542	OH	1973	Bruce 7	Ontario	890	OH	1986
Bruce 1	Ontario	904	OH	1977	Bruce 8	Ontario	845	OH	1987
Bruce 2	Ontario	904	OH	1977	Under Construction				
Bruce 3	Ontario	904	OH	1978	Darlington 1	Ontario	935	OH	1990
Bruce 4	Ontario	904	OH	1979	Darlington 2	Ontario	935	OH	1989
Point Lepreau	New Brunswick	680	NBP	1983	Darlington 3	Ontario	935	OH	1991
Gentilly 2	Quebec	685	HQ	1983	Darlington 4	Ontario	935	OH	1992
Pickering 5	Ontario	540	OH	1983					
Pickering 6	Ontario	540	OH	1984					

AECL — Atomic Energy of Canada Ltd.
 HQ — Hydro-Quebec
 NBP — New Brunswick Power Corporation
 OH — Ontario Hydro

Source: Canadian Nuclear Association

6.4 SOURCES OF ENERGY INFORMATION IN CANADA

Energy, Mines & Resources Canada
 580 Booth Street
 Ottawa, Ontario
 K1A 0E4

National Energy Board
 473 Albert Street
 Ottawa, Ontario
 K1A 0H5

Statistics Canada
 Holland & Scott Streets
 Tunney's Pasture
 Ottawa, Ontario
 K1A 0T6

7.1 EXPLANATIONS AND DEFINITIONS

SYMBOLS AND ABBREVIATIONS EMPLOYED:

na = not available
 - = magnitude zero

CONVERSION FACTORS

Indigenous production of electricity has been shown at 1 TWh electricity = 9.36 PJ of primary energy.
 Imports, exports and final demand are shown at
 1 TWh electricity = 3.6 PJ
 1 Mtoe of electricity = 42 PJ

In rounding data, each figure has been rounded off to the nearest final digit. The sum of the parts may not therefore equal the total.

S.I. MULTIPLIERS AND EQUIVALENTS

(k)	= kilo	= 10 ³	J	= 1 Joule	= 0.239 cal = 1 Ws
(M)	= mega	= 10 ⁶	1 kWh final demand	= 3.6 MJ or 860 kcal	
(G)	= giga	= 10 ⁹	1 Ton	= 1000 kg	
(T)	= tera	= 10 ¹²	1 kg	= 2.2046 lb.	
(P)	= peta	= 10 ¹⁵	1 Btu	= 0.252 kcal	= 1.055 kJ
(E)	= exa	= 10 ¹⁸	1 Therm	= 10 ⁹ Btu	= 25 200 kcal = 105 506 kJ
			1 Toe	= 42 GJ	
			1 Tce	= 29.3 GJ	

OIL SUBSTITUTION INDICATORS

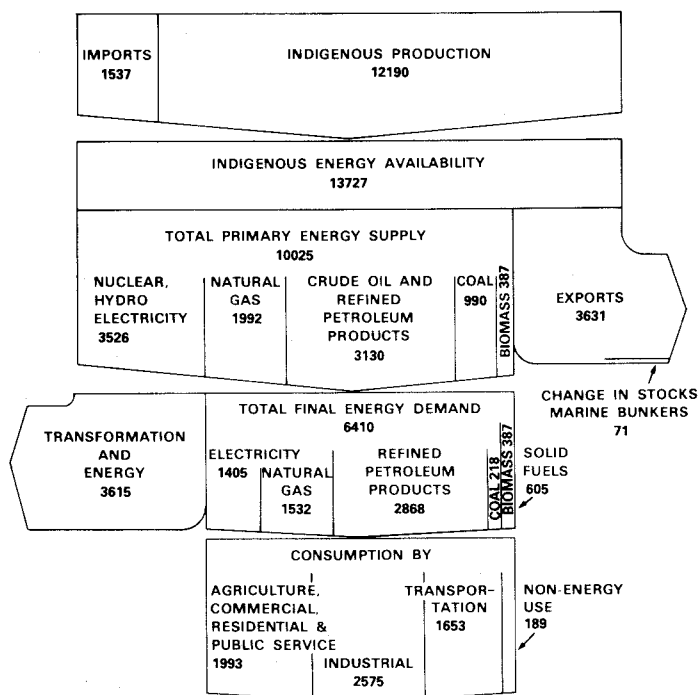
$$OAR = \frac{\text{Oil Consumption in Sector}}{\text{Total Oil Consumption in Country}}$$

$$OUR = \frac{\text{Oil Consumption in Sector}}{\text{Total Energy Consumption in Sector}}$$

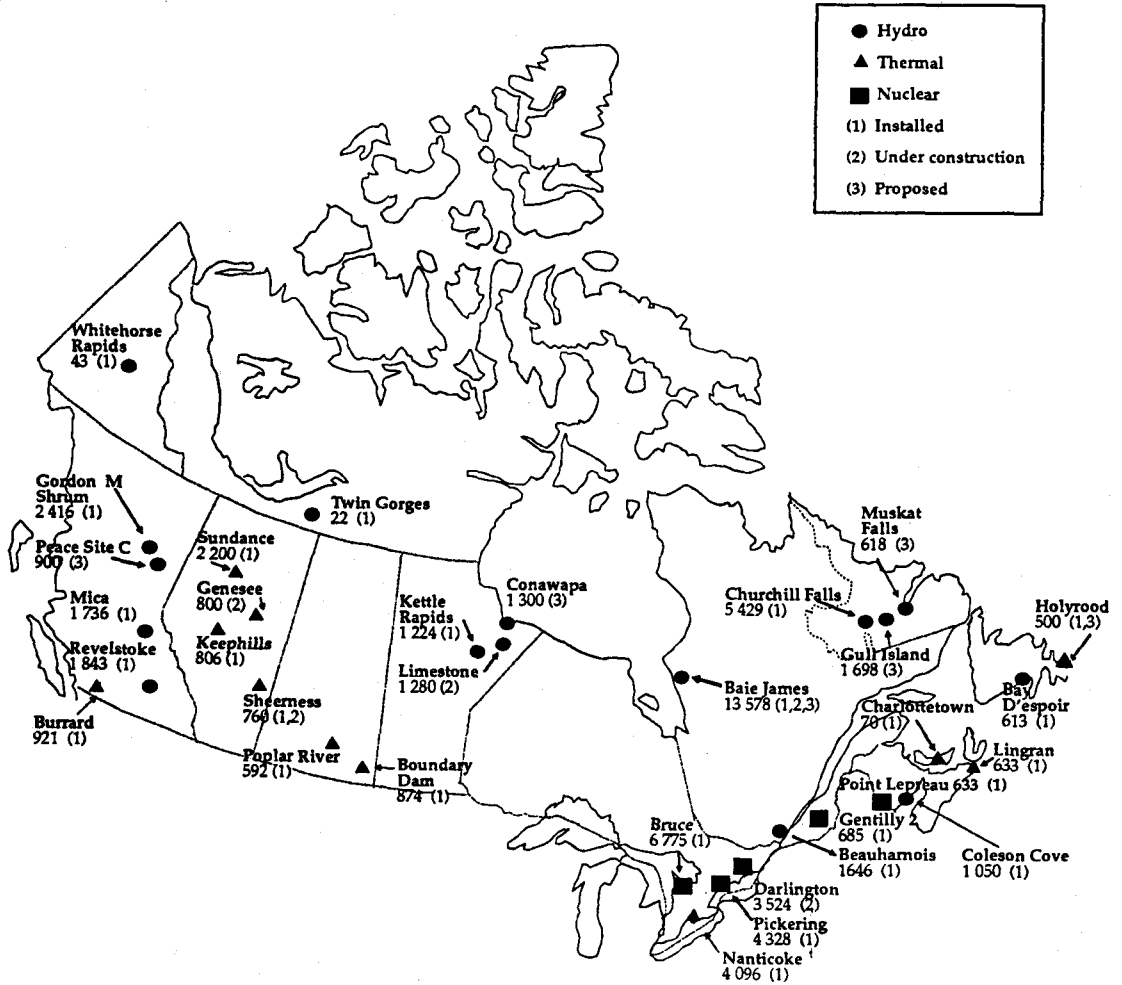
CURRENCY CONVERSION

Local currency is converted to 1980 US \$ according to the following conversion —
 1980 US Dollars Per Canadian Dollar = 0.8554.

ENERGY FLOW DIAGRAM 1987 (PJ)



MAJOR ELECTRICITY GENERATING STATIONS IN CANADA, 1988 (MW)



The National Energy Data Profile is published by the Canadian Member Committee/World Energy Conference, 305-130 Albert St., Ottawa, Ontario, Canada K1P 5G4

Primary Source of Data: Energy, Mines and Resources Canada, 580 Booth Street, Ottawa, Ontario K1A 0E4.