AN ANALYSIS OF POWER SECTOR REFORMS IN INDIA AND CANADA

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❖ Power Sector scenario of India and Canada:

Canada:

The electricity generation in Canada uses natural resources more. At present too, almost 65% of electricity is generated by hydro plants. The Nelson Electric Light Company, the first company to build a hydro site in British Columbia commenced its operation producing power for the City of Nelson on February 1, 1896. The Sandon plant was the second in March 1897. Development of the electricity sector gathered momentum after the First World War with the creation of provincial utilities in Nova Scotia, New Brunswick, Manitoba, Saskatchewan and British Columbia in the 1920s. Publicly owned electric companies emphasised mainly on rural electrification and hydroelectric development. In Manitoba and British Columbia, private companies repaidly developed the hydropower. Since 1960, large hydroelectric projects, mainly in Quebec, British Columbia, Manitoba and Newfoundland and Labrador, significantly increased the country's generation capacity

Hydroelectric mega-projects were undertaken by most provinces during the 1960s and 1970s. Many hydro power stations were started during this period like BC Hydro developed power stations along the Peace and Columbia Rivers, Manitoba Hydro undertook the Nelson River Hydroelectric Project, In Labrador, the controversial Churchill Falls Generating Station was built after 20 years of negotiations, and NB Power undertook the construction of the Mactaquac Dam, near Fredericton. But hydroelectric development was most active in Quebec. Between 1965 and 1984, Hydro-Quebec built 7 large power stations on the Manicouagan and Outardes rivers while the first 3 plants of the 16,000-MW James Bay Project were built on La Grande River. The 5 plants of the second phase were commissioned between 1987 and 1996.

The homes, offices and factories of Canada are large users of electricity or hydro which is often called in many regions of Canada. In 2007, per capita power consumption of Canada was among the highest in the world, with an average of 16,995 kWh per annum.

Canada is the world's second-largest producer of hydroelectricity after China,[[]which accounted for 58% of all electric generation in 2007 which is now approximately 65%. Canada is the world's sixth-largest producer of electricity generated by nuclear power, producing 97 billion kWh in 2013

Canada has a long nuclear history. The first Canadian nuclear reactor, the ZEEP, was built in 1945. Two years later, the National Research Council of Canada began operations on the NRX (National Research Experimental) heavy-water reactor at Chalk River Laboratories, near Ottawa. In 1957, it was followed by the National Research Universal Reactor (NRU).

In the meantime, Ontario Hydro, Canadian General Electric and Atomic Energy of Canada Limited began working on an experimental nuclear power plant. The 22 MW reactor generated Canada's first nuclear energy to the grid on June 4, 1962.

The first full-scale nuclear power plant, the Douglas Point Nuclear Generating Station, started commercial service on September 26, 1968. Douglas Point generated 220 MW and was built for \$91 million. The CANDU reactor was then built at three locations in Ontario in the next 25 years, in Pickering, Bruce County and Clarington.

On the 20 nuclear reactors operational in Canada, only two are located outside Ontario. In Ontario, Canadian-designed CANDU nuclear reactors supplied more than half the provincial electricity demand in 2007. Ontario became the first jurisdiction in North America to fully eliminate coal as a source of electricity generation In April 2014.

64.5% of Canadian domestic electricity use was produced with the renewable sources in the year 2009. Canada is the 4th highest in the world for renewable energy production. However, these figures do not indicate provincial generation mixes. Historic producers of coal, like Alberta (66.9%), Nova Scotia (58.2%), and Saskatchewan (54.8%) rely mainly on coal-fired generating stations. The hydro-rich provinces are such as Manitoba (99.5%), Quebec (97.2%), Yukon (94.1%), and British Columbia (88.7%), hydroelectric power accounts for the bulk of all electric generation.

Under government leadership, provincial power companies invested heavily in the power sector to stimulate economic development. The power sector has been deregulated there for the same.

The liberalization process of the 1990s have changed some parameters such as the unbundling of generation, transmission and distribution functions of incumbent utilities to grow a competitive wholesale market. In the cases of large exporters like Quebec and British Columbia, have to comply with the Order 888 of the Federal Energy Regulatory Commission and other U.S. market rules. Most provincial governments still maintain a strong financial stake as operators in the electrical markets.

India:

The first demonstration of an electric light in Calcutta (now Kolkata) was conducted on 24 July 1879 by P.W. Fleury & Co. Kilburn & Co. The company was renamed as the Calcutta Electric Supply Corporation later. The control of the company was transferred from London to Calcutta in 1970. Motivated by the success of electricity in Calcutta, power was thereafter introduced in Bombay (now Mumbai) which saw electric lighting demonstration for the first time in 1882 at Crawford Market and

the Bombay Electric Supply & Tramways Company (BEST). It set up a generating station to provide electricity for the tramway in 1905.

The first hydroelectric installation in India was installed near a tea estate at Sidrapong for the Darjeeling Municipality in 1897. The hydro-electric power plants at Darjeeling and Shivanasamudram were established in 1898 and 1902 respectively and were among the first in Asia. The first electric street light in Asia was lit in Bangalore on 5 August 1905. India is blessed with immense amount of hydro-electric potential and was ranked 5th in terms of exploitable hydro-potential on global scenario in the year 2014

The installed capacity of hydro on 31 May 2014 was approximately 40,661.41 MW which was 16.36% of total electricity generation in India with the major share of 97% of public sector in this sector. National Hydroelectric Power Corporation (NHPC), Northeast Electric Power Company (NEEPCO), Satluj jal vidyut nigan (SJVN), Tehri Hydro Development Corporation, NTPC-Hydro are a few public sector companies engaged in development of hydroelectric power in India.

The development of wind power in India began in the 1990s by Tamil Nadu Electric Board near Tuticorin which has significantly increased in the last decade. As of 31 March 2016, the installed capacity of wind power was 26.74 GW, spread across many states of India.

India has the fifth largest installed wind power capacity in the world. In the year 2015-16, wind power accounted for 8.5% of India's total installed power capacity, and 2.5% of the country's power output. India targets to install an additional 60 GW of wind power capacity by 2022.

India is endowed with vast solar energy. As of 31 January 2017, the installed capacity was 9 GW indicating 1% of the utility electricity generation. New solar installations in India are expected to be 4.8 GW in 2016-17 with nearly 21 GW developments in pipeline.

India started utilizing grid management on a regional basis in the 1960s. Individual State grids were interconnected to form 5 regional grids covering mainland India. Those grids were the Northern, Eastern, Western, North Eastern and Southern Grids. In the 1990s, the Indian government began planning for a national grid. The first interconnection of regional grids was established in October 1991 when the North Eastern and Eastern grids were interconnected

The Ministry of Power is India's apex central government body regulating the electrical energy sector in India. This ministry was created on 2 July 1992. The renewable energy programme was initiated in the country after the setting up of the CASE (Commission on Additional Sources of Energy) in 1981 and the DNES (Department of Non conventional Energy Sources) in 1982. State nodal agencies were established in several states to co-ordinate, implement, and facilitate renewable energy programmes. IREDA (Indian Renewable Energy Development Agency) was set up in 1987 to finance renewable energy projects. A full-fledged Ministry, the MNES (Ministry of Non- Conventional Energy Sources) was formed in 1992 to promote renewable energy development and utilisation in the country. As a result,

India has many achievements in several areas in the renewable energy field. India is on the 7th rank in the world for renewable energy production

Renewable energy projects in India are regulated and championed by the central government's Ministry of New and Renewable Energy.

❖ Growth of electricity sector in both the countries:

Canada

Canada generated 651.8 terawatt-hours (TWh) in 2013, showing 10% increase since 2003. In 2013, the leading type of power generation by utilities in Canada was hydroelectricity, with a share of 60.1%. followed by Nuclear (15.8%), natural gas (10.3%), coal (10%), wind (1.8%), fuel oil (1.2%), biofuels and waste (0.8%), wood (0.4%) and solar (0.1%). Other sources, such as petroleum coke make up the remaining 0.5%. When adding nuclear energy, it showed that over 77 percent of Canada's electricity generation does not emit greenhouse gases. Moreover, Canada exports large quantities of electricity to the United States, which is primarily hydroelectricity with reservoir storage

The following data shows the total electricity generation of Canada from the year 2001-2013.

Year	2001	2002	2003	2004	2005	2006	2007
Total Electricity Generated (GWh)a	569,402	581,068	569,917	580,444	604,370	592,636	614,583
Electricity Generated by Energy Source (GWh)a							
Natural Gas	38,899	35,688	35,641	37,154	37,436	40,508	42,233
Diesel Fuel Oil, Light Fuel Oil and Kerosene	780	723	862	894	932	758	1,031
Heavy Fuel Oil	14,012	13,535	16,937	16,797	14,608	8,960	10,289
Coal	102,742	101,754	100,826	91,792	93,992	87,317	96,808
Hydro	329,881	346,917	334,560	337,606	360,026	351,936	364,877
Nuclear	72,320	71,252	70,652	85,240	86,830	92,419	88,191
Wood and Other	4,306	4,434	4,324	4,232	4,164	4,047	4,392
Petroleum Coke, Still Gas, Coke and Coke Oven Gas ¹	6,462	6,765	6,114	6,730	6,383	6,691	6,762

Source: Statistics Canada, Report on Energy Supply and Demand in Canada, 1990–2013, Ottawa, 2015.

Year	2008	2009	2010	2011	2012	2013
Total Electricity Generated (GWh)a	614,926	588,906	579,366	608,181	619,810	622,884
Electricity Generated by Energy Source (GWh)a						
Natural Gas	39,070	41,082	47,807	56,479	57,317	54,145
Diesel Fuel Oil, Light Fuel Oil and Kerosene	979	1,071	1,085	1,052	1,035	1,072
Heavy Fuel Oil	8,332	8,243	5,357	4,570	4,655	4,931
Coal	90,987	76,367	77,869	72,838	63,080	63,964
Hydro	373,822	365,108	348,110	372,077	390,838	402,275
Nuclear	90,585	84,992	85,527	88,291	89,492	82,378
Wood and Other	4,147	4,747	5,361	9,674	10,408	10,589
Petroleum Coke, Still Gas, Coke and	7,004	7,295	8,251	3,199	2,986	3,530

Coke Oven Gas¹

Source: Statistics Canada, Report on Energy Supply and Demand in Canada, 1990–2013, Ottawa, 2015.

India:

The total installed electricity capacity of India after deducting the retired capacity (if any) which are very old and obsolete as of 31 June 2016, including thermal power generation capacity and excluding renewable power was 82,415 MW against the target of 155,870 MW during the 12th five-year plan which would end on 31 March 2017.

The installed captive power generation capacity (above 1 MW capacity) in the industries was 47,200 MW as on 31 March 2016. Another 75,000 MW capacity diesel power generation sets (excluding sets of size above 1 MW and below 100 kVA) have been also installed in the country. In addition, there are innumerable DG sets of capacity less than 100 kVA to cater to emergency power needs during the power outages in all sectors such as industrial, commercial, domestic and agriculture.

The following data indicates the total installed electricity generation in India from the year 2001-2011.

Year	Thermal *	Hydro	Nuclear	Total	Non- utilities	Grand Total	% Share of generation of electricity in utility to total electricity generation	% Annual growth electricity generation
2000-01	409940	74362	16902	501204	59638	560842	89.37	4.55
2001-02	424385	73579	19475	517439	61681	579120	89.35	3.26
2002-03	449289	64014	19390	532693	63850	596543	89.30	3.01
2003-04	472080	75242	17780	565102	68173	633275	89.23	6.16
2004-05	492835	84610	17011	594456	71417	665873	89.27	5.15
2005-06	505001	101494	17324	623819	73640	697459	89.44	4.74
2006-07	538350	113502	18802	670654	81800	752454	89.13	7.89
2007-08	585282	120387	16957	722626	90477	813102	88.87	8.06
2008-09	617832	113081	14713	745626	95905	842531	88.50	3.62
2009-10	670965	106680	18636	796281	109693	905974	87.89	7.53
2010- 11(P)	704323	114257	26266	844846	114224	959070	88.09	5.86

Source : The Government of India from www.data.gov.in

❖ Renewable electricity production in India and Canada:

Canada's electricity generation includes more on renewable energy side while in India it is growing. Compared to China, the renewable energy production of the total energy is quite less which can be seen from the following table.

Renewable electricity produced as of % of of total electricity production

year	in India	in Canada
1991	24.48929396	62.37871882
1992	22.80740221	61.41041299
1993	20.75265214	61.67921442
1994	19.55881334	61.72232798

1995	21.21909967	60.40045134
1996	17.26053911	61.00409818
1997	15.76729394	63.10607423
1998	16.01513081	62.35094142
1999	16.70110829	60.40605432
2000	15.25807575	61.18370484
2001	13.59094803	60.60030119
2002	13.20704353	58.03265624
2003	12.05516116	59.88641921
2004	13.46942476	58.91556496
2005	14.4825005	58.44631709
2006	16.61901808	59.63563628
2007	17.54042472	59.61839537
2008	17.86408569	60.0250196
2009	16.50983374	61.13106575
2010	15.66005525	62.59320494
2011	16.04374444	61.26763484
2012	17.31689839	61.95213565
2013	15.62123639	63.24845745

Source: The worldbank retrived from <http://data.worldbank.org/indicator/REG.ELEC>.

❖ **An analysis of power sector in India and Canada:**

Canda is a developed country and India is developing countries. The history of electricity sector shows that both the countries initiated power sector at same time. Both the countries have implemented many measures to increase the growth and development of power sector.

Mainly 6 points have been considered to compare power sector performance in both the countries. They are

1. Total electricity generation
2. Renewable energy production
3. Per capita electricity consumption
4. Access of electricity to population
5. Co2 emission from energy sector
6. Transmission and distribution losses

The performance of power sector between India and Canada can be compared by following data

• **Total electiricty generation in both the countries**

year	Total in India in Gwh	total in Canada
2001	501204	569,402
2002	517439	581,068
2003	532693	569,917
2004	565102	580,444
2005	594456	604,370
2006	623819	592,636
2007	670654	614,583
2008	722626	614,926

	2009	745626	588,906	
	2010	796281	579,366	
	2011	844846	608,181	
	2012	871,224	619,810	
	2013	907,040	622,884	
Government of Statistics Canada, Demand in Canada, 1990–2013, Ottawa, 2015.	2014	961,552	6,39,000	Source: Source : The India from www.data.gov.in and Report on Energy Supply and
	2015	1,043,666	5,92,800	

The above table indicates that the production of electricity has increased more in India compared to Canada between the period 2001-2013.

- **Per capita consumption in KWh:**

The following data indicates that though production of electricity has increased in India, per capital consumption is quite less compared to Canada due to more population

year	in IndiaKWh	in canada kwh
1971	97.99059417	9300.717215
1972	100.5276586	9903.776234
1973	100.8556904	10297.94798
1974	104.2248132	10820.67527
1975	114.8167636	10436.94257
1976	124.406065	11043.83876
1977	126.5479235	11762.48109
1978	136.2367266	12231.86054
1979	136.0678597	12384.14961
1980	142.0579095	12763.71325
1981	152.2672038	13196.82731
1982	158.5190351	12937.26688
1983	166.1428653	13409.72659
1984	183.8218471	14290.40542
1985	194.0977967	14800.05397
1986	208.5924097	15302.58739
1987	220.8809087	15736.76083
1988	240.7513611	16326.41755
1989	257.8230059	16402.57131
1990	272.8997419	16109.27998
1991	291.8029859	16104.46973
1992	305.3875353	16080.34644
1993	321.5660742	16235.99151
1994	342.3165272	16325.65728
1995	359.9000978	16503.27042
1996	360.9460365	16572.68325

1997	376.6451221	16608.55298
1998	387.0335251	16385.40196
1999	393.2069477	16625.3869
2000	394.8025371	16990.57839
2001	394.9535072	16807.14499
2002	411.8229523	16959.60079
2003	431.707988	17191.15419
2004	452.8961733	17235.41178
2005	469.3687485	17012.78163
2006	510.7030141	16560.99591
2007	543.3566224	16771.07783
2008	562.9352825	16459.68647
2009	601.5505835	15537.59153
2010	643.8797543	15341.50262
2011	698.4302265	15738.82487
2012	724.4907458	15322.65853
2013	765.0034087	15519.33597

Source: the World bank retrieved from
<http://data.worldbank.org/indicator/EG.consu.locations=CA>

• **Electricity access to % population in India:**

year	access to % population in India	access to % population in canada
1990	50.9	100
2000	62.3	100
2010	75	100
2012	78.7	100

Source: The Worldbank retrived from
<http://data.worldbank.org/indicator/EG.acess.locations=CA>

The above data shows that 100% people are having access to electricity in Canada since 1990 while in India it is not the same.

• **Time taken to get electricity**

year	Time required to get electricity (days) in India	Time required to get electricity (days) in Canada
2009	60	169
2010	60	169
2011	60	169
2012	60	142
2013	101.8	142
2014	101.8	142
2015	86.2	137
2016	45.9	137

Source : The worldbank

The above figure says that It takes less time to get electricity in India compared to Canada.

- **CO2 emissions from electricity and heat production, total (% of total fuel combustion)**

year	in India	in Canada
1971	21.57583068	23.3985
1972	23.12153968	22.91312
1973	23.926931	22.86924
1974	26.34788973	21.49977
1975	26.97070786	23.21566
1976	28.46515605	23.28982
1977	27.52108775	24.68121
1978	25.08982295	25.06203
1979	27.01247957	24.48828
1980	31.11692051	25.34287
1981	32.18260121	25.58544
1982	33.66285456	28.06608
1983	35.38149694	29.75433
1984	34.58372466	31.02714
1985	38.20521629	30.57312
1986	39.9559514	29.92636
1987	42.500393	31.60509
1988	42.2545996	32.90593
1989	43.17129171	33.45998
1990	43.88750538	32.94353
1991	45.28882286	33.62583
1992	46.93646243	34.26684
1993	49.36218936	32.50455
1994	48.88262227	32.41466
1995	51.62561437	32.84873
1996	52.60225045	32.13591
1997	51.58198732	33.72451
1998	53.03642211	36.25681
1999	53.77984626	35.84303
2000	55.26233184	36.64101
2001	56.04162779	38.21394
2002	55.05721943	37.65193
2003	56.27862135	38.0326
2004	57.01750992	36.46952
2005	55.72961729	37.83118
2006	55.66156771	37.7754
2007	55.41539628	38.99314
2008	54.40156195	37.88022
2009	52.91901076	37.28504

2010	52.21603612	37.37482
2011	52.34741643	36.20815
2012	53.84407968	36.60343
2013	52.85558326	36.57704

Source: The Worldbank

It can be said that earlier the CO₂ emission was less in India but since the contribution of renewable energy has increased in Canada while has not increased the same in India, India shows increasing trend of CO₂ emission from energy compared to Canada.

- **Transmission and Distribution loss:**

Year	T&D loss in India	T&D loss in Canada
1991	19.24411757	7.169478092
1992	18.25873937	7.06044257
1993	18.0163228	6.891717423
1994	17.80084081	6.586427629
1995	18.73271019	7.081543915
1996	20.56402374	7.617174205
1997	20.71579384	6.962343096
1998	22.13077493	6.908407208
1999	25.68169742	7.447166829
2000	27.22068922	7.805698849
2001	28.24195685	7.52229645
2002	26.68001088	8.209655365
2003	26.74018226	6.499112871
2004	25.66334937	6.288081485
2005	25.16558235	8.251871098
2006	23.65556796	8.535023292
2007	22.76850708	7.456771762
2008	21.25537069	8.344765277
2009	20.95394974	8.716966202
2010	19.64007123	8.629299248
2011	19.39441768	8.847334503
2012	18.89775068	8.486184913
2013	18.45502229	8.641501792

Source: The worldbank

The above data indicates that the T&D loss in Canada has remained stable to 6-8% while in India has been 3 to 4 times higher than Canada.

❖ **Research methodology:**

This paper uses some statistical methods to compare the performance of power sector between India and Canada. It uses the mean average and T-test or Z-test distribution method. The data used for it are from the above tables. They can be explained as under:

- **Total electricity generation in GWh:**

The null hypothesis used here is that “There is no difference in total electricity generation between India and Canada”.

Group Statistics					
	Country	N	Mean	Std. Deviation	Std. Error Mean
Elec Generation	1	15	726548.53	172753.421	44604.741
	2	15	598552.87	20983.267	5417.856

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Elec Generation	Equal variances assumed	31.935	.000	2.849	28	.008	127995.667	44932.573	35955.463	220035.870
	Equal variances not assumed			2.849	14.413	.013	127995.667	44932.573	31883.314	224108.019

The above statistical calculations indicate that hypothesis is rejected it means there is a difference in the total electricity production between both the countries. The difference of mean says that total electricity generation is more in India while on the other side, its high standard deviation and the data also shows that growth is more in India compared to Canada.

- Renewable electircity production as of % of of total electricity production:**

Group Statistics					
	Renewable electricity output (% of total electricity output) in canada	N	Mean	Std. Deviation	Std. Error Mean
Renewable electricity output (% of total electricity output) in India	1	23	16.94825147259189	3.084148482181581	.643089413627109
	2	23	60.91281770060	1.418472564848	.2957719757154

			792	822	88
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Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Renewable electricity output (% of total electricity output) in India	Equal variances assumed	6.367	.015	-62.110	44	.000	-43.96456622801604	.707845361316935	45.39113481693440	-42.537997639097680
	Equal variances not assumed			-62.110	30.909	.000	-43.96456622801604	.707845361316935	45.40839924071953	-42.520733215312546

The above calculation shows that the null hypothesis mentioning that there is no difference in renewable electricity generation in both countries is rejected and the data shows that Canada produces more renewable energy compared to India.

- Per capita consumption in KWh:**

Group Statistics					
	in canada kwh	N	Mean	Std. Deviation	Std. Error Mean
in IndiaKWh	1	43	325.21475757298776	187.656037702081680	28.617277463848820
	2	54	13208.04860785940000	3833.829800189525000	521.718153952262400

Independent Samples Test		
	Levene's Test for Equality of Variances	t-test for Equality of Means

	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
in India KWh	125.814	.000	-21.991	95	.000	-12882.833850286414000	585.835391409147500	-14045.864148970217000	-11719.803551602610000
			-24.656	53.319	.000	-12882.833850286414000	522.502421748262800	-13930.694734967694000	-11834.972965605133000

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For this too the null hypothesis mentioning that there is no difference between per capita consumption between India and Canada is rejected. The data shows that per capita consumption of electricity is quite high in Canada compared to India.

- **Access to electricity:**

Group Statistics					
	access to % population in canada	N	Mean	Std. Deviation	Std. Error Mean
access to % population in India	1	4	66.725	12.6740	6.3370
	2	4	100.000	.0000	.0000

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2- tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
access to % populati on in India	Equal variances assumed	17.1 28	.006	-5.251	6	.002	-33.2750	6.3370	-48.7810	-17.7690
	Equal variances not assumed			-5.251	3.00 0	.013	-33.2750	6.3370	-53.4421	-13.1079

For this too Canada is ahead as null hypothesis indicating both are same is rejected.

- **Time taken to get electricity:**

Group Statistics					
	Time required to get electricity (days) in Canada	N	Mean	Std. Deviation	Std. Error Mean

Time required to get electricity (days) in India	1	8	71.96	21.497	7.600
	2	8	150.88	15.151	5.357

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Time required to get electricity (days) in India	Equal variances assumed	2.114	.168	-8.487	14	.000	-78.913	9.298	-98.856	-58.969
	Equal variances not assumed			-8.487	12.578	.000	-78.913	9.298	-99.069	-58.756

This too shows that there is difference in time taken to get electricity in both the countries. But here India takes less time compared to Canada.

- **CO2 emissions from electricity and heat production, total (% of total fuel combustion)**

Group Statistics					
	Country	N	Mean	Std. Deviation	Std. Error Mean
CO2 emissions from electricity and heat production, total (% of total fuel combustion)	1	43	43.3739022739 2171	11.7159909803 56292	1.78667187453 4026
	2	54	29.1525361176 2999	7.37460482361 4674	1.00355660402 9083

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Si	t	df	Sig.	Mean Difference	Std. Error	95% Confidence Interval of the Difference	

		g.			(2-tailed)		Difference	Lower	Upper
CO2 emissions from electricity and heat production, total (% of total fuel combustion)	17.856	.000	7.293	95	.000	14.221366156291720	1.950016401530845	10.350094138301241	18.092638174282200
			6.940	67.368	.000	14.221366156291720	2.049224791168923	10.131507381451028	18.311224931132410

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The data shows that initially the CO₂ emission was more or less similar in both the countries but the difference has increased with the time. Due to more renewable energy production, Canada emits less CO₂ compared to India now. The null hypothesis is also rejected here. As value of t is zero.

❖ Problems/Lacuna of power sector in India and Canada:

Canada:

In Canada the co-operatives have to strive to grow electricity sector when basic needs are not being met by the state. The first wave of electricity co-operatives that incorporated between 1940 and 1960 in Alberta and Quebec was made up of rural, distribution co-operatives as a result of right-wing government who did not publicly fund rural electrification schemes. As it was unprofitable for private utilities, farmers were forced to collectively organize and fund the expansion of electricity networks. The second wave, which started in 1990 but expanded mainly after 2006, has primarily taken place in Ontario's deregulated power sector. Although Alberta also has a deregulated power sector that similarly resulted in rate increases and failed to spur the development of renewable. In Ontario, co-operatives remain a marginal player in a sector dominated by well-financed, politically savvy private utilities. This creates challenges for the success of electricity co-operatives and makes them vulnerable to co-operation.

India:

The power sector of India faces more problems compared to Canada. The problems can be listed as under:

- Demand is more compared to supply which leads to low per capita consumption. It is 765KWh only which is less than the half amount of Canada.
- Less access to electricity which shows that electricity is not available to entire population of country. It is available to 78% people only.
- Poor pipeline connectivity and infrastructure to harness India's abundant coal bed methane and natural gas potential.
- Average transmission, distribution and consumer-level losses exceeding 30% at once upon the time which includes auxiliary power consumption of thermal power stations, fictitious electricity generation by wind generators & independent power producers etc.
- Losses in the connector systems/service connections leading to premature failure of capital equipments like transformers

- India lacks of clean and reliable energy sources which is indicated by renewable energy produced in India in this paper.

❖ **Conclusion:**

It can be concluded that though conventional and renewable energy production started at more or less same time in both the countries, the performance of power sector in both the countries is not same. The growth of electricity sector is more in India since the year 2000 but due to more population, electricity is not available to all. Transmission and Distributions loss is also high in India hence India has still miles to go for the better performance of power sector and full availability of electricity to all with better per capita consumption.

❖ **Suggestions:**

Canada:

It is believed that electricity co-operatives can contribute to more renewable, democratic, and locally-acceptable forms of development in Canada. No doubt, this will require public intervention in the form of supportive policy and partnerships, mainly to grow the partnerships with municipalities.

It is argued that enacting transformative change will require that co-operatives look beyond the pragmatic value of membership and embrace the political potential of the co-operative movement.

India:

It is quite clear that long-term policy perspective and policy certainty is needed for the growth of power sector and mainly for the growth of the renewable energy sector in India. The experience of the past few years shows that major changes in policy and practice are required to fulfil the need of the country for mainly renewable energy growth.

Integration between the renewable energy sector with conventional energy sources and the integration of different sources of renewable energy themselves is highly needed.

There is a wide scope for synergies between different energy sources that can expand economic efficiency as well as meet the energy needs of the country. India needs a long-term policy to integrate the different sectors of energy. This policy should specify the role of renewable energy in addressing the needs of energy access and energy security. India should increase the per capita availability of electricity consumption and should make electricity available to all.

Entrepreneurs should be encouraged to decide their own mix of renewable energy to achieve the lowest price for a pre-defined service quality.

Development of renewable electricity sector is strongly recommended for India for its Sustainable development also.

India should tap its potential to produce electricity so that it could be available to all and per capita availability for the same can go high too.

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