PEG's Alternative Econometric Model of Total Transmission Cost

VARIABLE KEY

YM =	Miles of Transmission line
D =	Ratched Maximum Peak Demand
MVA =	Substation Capacity per Line Mile in 2010
VOLT =	Average voltage of transmission line
CS =	Construction standards index
PCTPOH =	Percent of transmission plant overhead
PCTPTX =	Percent of transmission plant in total plant
Trend =	Time Trend

EXPLANATORY VARIABLE	PARAMETER ESTIMATE	T-STATISTIC	P-VALUE
YM	0.464	26.408	0.00
YM * YM	0.302	13.319	0.000
YM * D	-0.118	-8.482	0.000
D	0.586	32.940	0.000
D * D	0.144	8.944	0.000
MVA	0.013	1.371	0.171
VOLT	0.145	12.982	0.000
CS	0.270	12.860	0.000
PCTPOH	-0.615	-18.977	0.000
PCTPTX	0.279	13.386	0.000
Trend	-0.003	-1.623	0.105
Constant	11.757	412.278	0.000

Adjusted R^2 0.946

Sample Period   1995-2016

Number of Observations   1210

Hydro One's Total Transmission Cost Performance Using PEG's Model

[Actual - Predicted Cost (%)][1]

Year	Cost Benchmark Score
2004	-41.20%
2005	-44.20%
2006	-43.30%
2007	-38.50%
2008	-41.00%
2009	-34.70%
2010	-32.40%
2011	-31.80%
2012	-27.90%
2013	-25.30%
2014	-25.00%
2015	-21.60%
2016	-22.00%
2017	-20.50%
2018	-18.70%
2019	-16.40%
2020	-13.70%
2021	-11.00%
2022	-8.30%
Average 2004-2016	**-32.99%**
Average 2014-2016	**-22.87%**
Average 2019-2022	**-12.35%**

[1] Formula for benchmark comparison is $\ln(\text{Cost}^{HOSSM}/\text{Cost}^{Bench})$.

US Transmission Productivity Results Using PEG's Methods: Cost-Weighted Averages

(Growth Rates)[1]

Year	Scale Index	Input Quantity Index					Productivity				
		Summary	O&M	Capital	Transmission Capital	Allocated General Plant	TFP	O&M	Capital	Transmission Capital	Allocated General Plant
1996	1.18%	-0.67%	-0.70%	-0.76%	-0.79%	-0.20%	1.85%	1.88%	1.94%	1.97%	1.38%
1997	0.87%	-1.15%	0.56%	-0.95%	-0.86%	-4.73%	2.02%	0.31%	1.82%	1.73%	5.60%
1998	1.45%	-1.25%	-0.11%	-1.59%	-1.69%	1.34%	2.70%	1.56%	3.04%	3.14%	0.11%
1999	1.45%	-1.71%	-6.08%	-1.54%	-1.48%	-3.23%	3.16%	7.53%	2.99%	2.93%	4.68%
2000	0.66%	0.13%	6.55%	-0.61%	-0.79%	7.92%	0.53%	-5.89%	1.28%	1.46%	-7.26%
2001	1.63%	-0.03%	1.82%	-0.22%	-0.54%	15.24%	1.66%	-0.19%	1.85%	2.17%	-13.61%
2002	1.42%	-0.98%	-4.69%	-0.32%	-0.24%	-7.56%	2.39%	6.11%	1.74%	1.66%	8.97%
2003	1.52%	0.00%	3.35%	-0.49%	-0.53%	0.92%	1.52%	-1.83%	2.01%	2.05%	0.60%
2004	0.32%	1.21%	4.93%	0.33%	0.28%	3.39%	-0.89%	-4.61%	-0.01%	0.05%	-3.07%
2005	2.40%	1.55%	6.43%	0.35%	0.32%	1.52%	0.85%	-4.03%	2.04%	2.07%	0.87%
2006	1.72%	1.28%	3.07%	0.36%	0.37%	-1.38%	0.44%	-1.35%	1.36%	1.35%	3.10%
2007	1.04%	2.07%	4.26%	1.12%	1.31%	-3.03%	-1.02%	-3.22%	-0.08%	-0.27%	4.08%
2008	0.44%	2.15%	4.21%	1.45%	1.36%	3.68%	-1.71%	-3.77%	-1.01%	-0.92%	-3.25%
2009	-0.17%	2.73%	3.63%	2.40%	2.47%	1.66%	-2.90%	-3.80%	-2.58%	-2.64%	-1.84%
2010	0.64%	2.84%	5.90%	1.80%	1.91%	0.51%	-2.20%	-5.26%	-1.16%	-1.27%	0.13%
2011	0.32%	1.20%	-2.58%	2.32%	2.47%	-1.51%	-0.88%	2.90%	-1.99%	-2.15%	1.83%
2012	0.58%	2.08%	3.09%	1.87%	1.79%	7.53%	-1.50%	-2.51%	-1.29%	-1.21%	-6.95%
2013	0.26%	4.15%	2.64%	4.58%	4.57%	8.44%	-3.89%	-2.38%	-4.32%	-4.31%	-8.18%
2014	0.84%	3.44%	-3.03%	4.46%	4.57%	-0.72%	-2.60%	3.87%	-3.62%	-3.73%	1.56%
2015	0.61%	3.58%	-2.84%	4.73%	4.76%	2.33%	-2.97%	3.45%	-4.12%	-4.15%	-1.72%
2016	-0.07%	4.12%	2.99%	4.23%	4.22%	6.15%	-4.19%	-3.06%	-4.30%	-4.29%	-6.22%

Average Annual Growth Rate

Year	Scale Index	Summary	O&M	Capital	Transmission Capital	Allocated General Plant	TFP	O&M	Capital	Transmission Capital	Allocated General Plant
1996-2016	**0.91%**	**1.27%**	**1.59%**	**1.12%**	**1.12%**	**1.82%**	**-0.36%**	**-0.68%**	**-0.21%**	**-0.21%**	**-0.91%**
2005-2016	**0.72%**	**2.60%**	**2.31%**	**2.47%**	**2.51%**	**2.10%**	**-1.88%**	**-1.60%**	**-1.76%**	**-1.79%**	**-1.38%**

[1]All growth rates are calculated logarthmically.

Variations on the PSE Transmission MFP Work

	PSE Sample Period (2005-2016)	PEG Sample Period (1996-2016)
	Cost-Weighted	Cost-Weighted
Using PSE Program Code and Data		
As Reported and Replicated (Aggregated Industry)		na
Capital Price and Sample Corrections	-1.86%	na
Exclude HON*	-2.14%	na
Using PEG Program Code		
PEG cost data, code and calculating separate transmission and general capital stocks. Use PSE peak, miles, and 1989 net plant. (Excludes HON)	-1.90%	na
Upgrade Scale Index Methodology and Data to Allow for a Longer Trend	-1.87%	-1.36%
Use US rate of return (allows longer period)		
Add PEG peak demand and km of line (allows longer period)		
PEG output elasticity weights**		
Upgrade OM&A Methodology and Data (cumulative with above changes)	-2.15%	-0.66%
Exclude load dispatching, misc O&M, and rents		
Use PEG's general cost allocator		
Use regionalized Employment Cost Index		
Upgrade Capital Methodology and Data (cumulative with above changes)	-1.88%	-0.36%
PEG TFP Trends for US Power Transmission	-1.88%	-0.36%
Add HON to US results		
HON TFP Trend	-1.23%	na
Add HON to US results (assume 12% HON weight)	-1.80%	na
Difference	0.08%	na

* HON is excluded because the PSE method aggregates US and Canadian dollars in the calculation leading to an excessive weight given to HON.

** The elasticity weights were calculated from the parameter estimates in the benchmarking model

PEG's Alternative Econometric Model of Total Transmission Cost

1989 Capital Benchmark Year

VARIABLE KEY

YM =	Miles of Transmission line
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PCTPOH =	Percent of transmission plant overhead
PCTPTX =	Percent of transmission plant in total plant
Trend =	Time Trend

EXPLANATORY VARIABLE	PARAMETER ESTIMATE	T-STATISTIC	P-VALUE
YM	0.488	25.364	0.000
YM * YM	0.245	10.954	0.000
YM * D	-0.104	-7.296	0.000
D	0.540	29.225	0.000
D * D	0.150	9.017	< 2e-16
MVA	0.030	3.098	0.002
VOLT	0.224	19.545	0.000
CS	0.264	11.136	0.000
PCTPOH	-0.672	-18.407	0.000
PCTPTX	0.323	14.179	0.000
Trend	0.000	0.119	0.905
Constant	11.651	398.084	0.000

Adjusted R^2	0.942
Sample Period	1995-2016
Number of Observations	1210

Hydro One's Total Transmission Cost Performance Using PEG's Model

[Actual - Predicted Cost (%)][1]

Year	Cost Benchmark Score
2004	-37.30%
2005	-40.80%
2006	-40.10%
2007	-35.70%
2008	-38.80%
2009	-32.90%
2010	-31.00%
2011	-30.60%
2012	-26.90%
2013	-24.80%
2014	-24.90%
2015	-21.90%
2016	-22.70%
2017	-21.50%
2018	-20.10%
2019	-18.10%
2020	-15.80%
2021	-13.50%
2022	-11.20%
Average 2004-2016	**-31.42%**
Average 2014-2016	**-23.17%**
Average 2019-2022	**-14.65%**

[1] Formula for benchmark comparison is $\ln(\text{Cost}^{HOSSM}/\text{Cost}^{Bench})$.

PEG's Alternative Econometric Model of Total Transmission Cost

No Capital Gains in Capital Service Price

VARIABLE KEY

YM =	Miles of Transmission line
D =	Ratched Maximum Peak Demand
MVA =	Substation Capacity per Line Mile in 2010
VOLT =	Average voltage of transmission line
CS =	Construction standards index
PCTPOH =	Percent of transmission plant overhead
PCTPTX =	Percent of transmission plant in total plant
Trend =	Time Trend

EXPLANATORY VARIABLE	PARAMETER ESTIMATE	T-STATISTIC	P-VALUE
YM	0.473	27.076	0.000
YM * YM	0.280	11.926	0.000
YM * D	-0.101	-7.331	0.000
D	0.580	32.767	0.000
D * D	0.131	8.720	0.000
MVA	0.014	1.451	0.147
VOLT	0.167	15.460	0.000
CS	0.263	12.798	0.000
PCTPOH	-0.622	-18.985	0.000
PCTPTX	0.268	12.371	0.000
Trend	-0.004	-1.733	0.083
Constant	12.054	418.891	0.000

Adjusted R^2 0.945

Sample Period   1995-2016

Number of Observations   1210

Hydro One's Total Transmission Cost Performance Using PEG's Model

No Capital Gains in Capital Service Price

[Actual - Predicted Cost (%)][1]

Year	Cost Benchmark Score
2004	-42.30%
2005	-45.20%
2006	-44.90%
2007	-40.50%
2008	-43.40%
2009	-38.40%
2010	-35.20%
2011	-33.10%
2012	-28.40%
2013	-26.10%
2014	-25.30%
2015	-22.60%
2016	-22.20%
2017	-20.20%
2018	-18.00%
2019	-15.70%
2020	-12.90%
2021	-10.10%
2022	-7.20%
Average 2004-2016	**-34.43%**
Average 2014-2016	**-23.37%**
Average 2019-2022	**-11.48%**

[1] Formula for benchmark comparison is $\ln(Cost^{HOSSM}/Cost^{Bench})$.