Analytic Review of Cost-Benefit Analysis on Replacing Ontario's Coal-Fired Power Generators

Prepared for the Power Workers' Union

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Executive Summary

This review critically examines the cost-benefit analysis prepared for the Ontario Ministry of Energy by DSS Management Consultants and RWDI Inc., as released in April 2005. The report considered several options for modifying the generating capacity in Ontario, and concluded that the replacing the coal-fired plants with a mix of nuclear and gas-fired generators would likely yield the greatest net benefits from among the options studied.

The report makes clear that on a strictly financial basis, the status quo is preferred. The final ranking arises because of large forecast gains in non-economic benefits due to improved air quality under the alternative scenarios. My review compares the April 2005 report with an earlier report by DSS/RWDI in July 2003 which also looked at scenarios for closing the coal-fired power plants. The 2003 report seemed to indicate relatively little gain in Ontario air quality and health effects from such a step, which appears to be at odds with the 2005 conclusions. Hence the first question to answer is:

How does the new study appear to generate large air quality benefits due to coal plant closures in light of an earlier report from the same groups apparently showing minimal impacts?

I also examine the specific elements of the new cost-benefit analysis to trace how the net benefit figures were derived. In particular I ask:

What drives the large environmental and health costs associated with the coal plant operations in the April 2005 report, and how credible are these cost estimates?

With respect to the first question I find that the two studies actually present nearly identical changes to air quality under comparable scenarios. There are some differences that can be attributed to small changes in assumptions about plant operations, scenario design and model structure, but this is not the source of the differences in the two studies' overall conclusions.

With respect to the second question, the April 2005 report employed a different epidemiological model than the 2003 report, which involved replacing standard acute effect parameters with a new (but undisclosed) set of "long term effect" parameters. The model applies the parameters to the entire population, whereas the cited studies only found significant effects on small subsets of the population. Other components of the 2005 epidemiological model were described as being the same as in the 2003 model but exhibit extremely large and unexplained variations compared to the 2003 version, with health effects in some cases 80 percent smaller or up to 24 times larger depending on the category. The instability of the epidemiological model reflects in part the considerable scientific uncertainty over the air pollution-health connection. At the very least it shows the speculative and arbitrary nature of the new epidemiological model. Since these numbers determine the overall cost-benefit ranking it indicates the results are not solid enough to base extremely costly policy decisions on.

To illustrate this point I recalculated the overall costs and benefits using adjustments to approximate the results from applying the epidemiological model used in the 2003 report (which is also the one used by the Ontario Medical Association) while leaving everything else constant. The ranking of scenarios changes considerably. Going from best to worst, S3 (nuclear/gas) and S1 (base case) are roughly tied, S4 (stringent controls) and S2 (all gas). In other words the Base Case (status quo) goes from most expensive to nearly the cheapest option just by using an approximation to the epidemiological model used in the 2003 Report.

There are other aspects of the analysis that need to be challenged.

- The analysis assumes that greenhouse gas emissions have a social cost equal to the projected emission permits price. This confuses costs with benefits and is analytically incoherent: among other things it implies that the socially optimal emissions reduction for Canada would be about one-tenth of our actual Kyoto commitment. It also ignores the specialist literature on the estimated economic damages of climate change in Canada, ignores the likelihood of induced greenhouse gas emissions as a result of importing electricity from US coal plants under the nuclear/gas option, and presupposes the successful introduction of a permits trading system that does not currently exist. This aspect of the report is arbitrary and highly speculative and should only have been included for illustrative purposes. Backing out the greenhouse gas "damages" changes the scenario ranking again to (from best to worst) S1, S4, S3 and S2. In other words the Base Case scenario is now the best option, followed by the stringent controls option.

- The analysis states (p. 2) that the Atikokan and Thunder Bay generating stations have, effectively, no important impacts on Ontario air quality or health and hence the benefits of emission reductions from these units are not considered in the analysis. Yet Scenario 4 (stringent controls) counts the costs of adding scrubbers and precipitators to both these generating plants. In other words the S4 analysis deliberately includes major upgrade costs which are assumed to generate no air quality improvements, thus "stacking the deck" against this option. However correcting this point is unlikely to change the order of preferred options.

Overall the DSS05 Report does not provide credible support for the decision to close the Ontario coal-fired power plants. As has been found previously the pollution increments attributable to OPG facilities are extremely small across Southern Ontario except in the immediate vicinity of the power plants themselves. The objective cost numbers—namely financial operating costs—clearly favour the status quo with coal plants by a wide margin, followed by refitted coal plants under scenario 4. The health impacts and environmental costs are “soft” numbers, dominated by imprecise parameters that have been substantially boosted by the adoption of a controversial new epidemiological model. Simply using the familiar epidemiological risk factors relied on by, among others, the Ontario Medical Association in its reports on air pollution and human health, leaves the status quo (scenario 1) approximately tied for first place as the best option. Removing the illustrative GHG cost numbers again puts the coal-based options well out in front as the best options. Overall the most balanced reading of the information in DSS03 and DSS05 is that the coal-fired power plants are good, low-cost sources of power for Ontario, their environmental and health impacts are modest and their continued operation yields a net social benefit for the province. The 2005 DSS cost benefit analysis does not provide a persuasive case for advocating closure of the OPG thermal plants.

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1 Comparison of Pollution Changes Between 2003 and 2005 Reports

How does the new study appear to generate large air quality benefits due to coal plant closures in light of an earlier report from the same groups apparently showing minimal impacts?

The two reports are DSS et al. (2003) and DSS et al. (2005), herein referred to as DSS03 and DSS05 respectively. Both reports present scenarios that involve a switch to combined cycle gas turbine plants (CCGT) and a retrofit to control emissions. In DSS03 the all-gas option involves using CCGT units rated at 800 MW output (pp. 12-13), whereas the DSS05 report uses a range of CCGT plant sizes (p. 58). In the emissions control scenario DSS03 assumes a retrofit to install wet flue gas desulphurization for SO_2 control and selective catalytic reduction units for NO_x control (p. 12). DSS05 additionally assumes that enhanced electrostatic precipitators are used (p. 6).

Both studies employ the CALPUFF and CALMET models implemented by RWDI Consultants. The meteorological model was initialized using data from 1999 in both cases. Base Case Stack parameters are identical between the models (DSS03: p. 52, DSS05: p. 55) and are supplied by OPG. Operating characteristics differ between reports. Under the DSS05 Base Case Nanticoke generates higher PM10 emissions but lower SO_2 emissions compared to DSS03, whereas under the emissions control scenario the PM_{10} emissions are more than 50% lower in DSS05 compared to DSS03, reflecting the assumed addition of electrostatic precipitators.

The two reports yield almost identical air pollution effects from closing the coal-fired generating (CFG) units. The results from both model runs (DSS03: p.57, DSS05: p. 72) clearly imply that CFG units have very small effects on air quality throughout most of Ontario, typically accounting for less than 1% of observed ozone levels and less than 5% of observed PM10 levels.

Comparison of Pollution Contributions by OPG in DSS05 and DSS03 Papers

	Approx Avg 1998		Base Case				Emission Controls				Gas Replacement			
	Average Concentrations		Ozone		PM10		Ozone		PM10		Ozone		PM10	
REGION	**Ozone**	**PM10**	**DSS05**	**DSS03**	**DSS05**	**DSS03**	**DSS05**	**DSS03**	**DSS05**	**DSS03**	**DSS05**	**DSS03**	**DSS05**	**DSS03**
Ottawa-Carleton RM	20	30	0.00	0.00	0.56	0.57	0.00	0.00	0.13	0.11	0.00	0.00	0.01	0.01
Durham RM			0.04	0.08	1.00	0.99	0.01	0.01	0.26	0.20	0.02	0.01	0.02	0.01
York RM			0.01	0.04	1.07	1.08	0.01	0.00	0.27	0.21	0.01	0.00	0.02	0.01
Toronto MM	20	40	0.03	0.07	1.12	1.12	0.01	0.01	0.30	0.23	0.02	0.01	0.02	0.01
Peel RM			0.01	0.04	1.00	1.08	0.00	0.00	0.28	0.21	0.01	0.00	0.02	0.01
Hamilton-Wentworth RM	20	40	0.05	0.12	1.65	1.74	0.02	0.01	0.44	0.35	0.01	0.01	0.02	0.02
Haldimand-Norfolk RM			1.97	2.94	3.93	3.14	1.03	0.52	1.24	0.84	0.07	0.31	0.03	0.05
Waterloo RM			0.01	0.02	1.17	1.34	0.00	0.00	0.31	0.24	0.00	0.00	0.02	0.02
Lambton County			0.43	0.89	1.69	2.54	0.28	0.14	0.70	0.45	0.03	0.06	0.02	0.02

		Base Case				Emission Controls				Gas Replacement			
		Ozone		PM10		Ozone		PM10		Ozone		PM10	
REGION		**DSS05**	**DSS03**	**DSS05**	**DSS03**	**DSS05**	**DSS03**	**DSS05**	**DSS03**	**DSS05**	**DSS03**	**DSS05**	**DSS03**
Ottawa-Carleton RM		0.0%	0.0%	1.6%	1.6%	0.0%	0.0%	0.4%	0.3%	0.0%	0.0%	0.0%	0.0%
Durham RM		0.2%	0.4%	2.9%	2.8%	0.1%	0.1%	0.7%	0.6%	0.1%	0.1%	0.1%	0.0%
York RM	Approximate %	0.1%	0.2%	3.1%	3.1%	0.1%	0.0%	0.8%	0.6%	0.1%	0.0%	0.1%	0.0%
Toronto MM	Contributions from OPG	0.2%	0.4%	3.2%	3.2%	0.1%	0.1%	0.9%	0.7%	0.1%	0.1%	0.1%	0.0%
Peel RM		0.1%	0.2%	2.9%	3.1%	0.0%	0.0%	0.8%	0.6%	0.1%	0.0%	0.1%	0.0%
Hamilton-Wentworth RM		0.3%	0.6%	4.7%	5.0%	0.1%	0.1%	1.3%	1.0%	0.1%	0.1%	0.1%	0.1%
Haldimand-Norfolk RM		9.9%	14.7%	11.2%	9.0%	5.2%	2.6%	3.5%	2.4%	0.4%	1.6%	0.1%	0.1%
Waterloo RM		0.1%	0.1%	3.3%	3.8%	0.0%	0.0%	0.9%	0.7%	0.0%	0.0%	0.1%	0.1%
Lambton County		2.2%	4.5%	4.8%	7.3%	1.4%	0.7%	2.0%	1.3%	0.2%	0.3%	0.1%	0.1%

Table 1. Top panel: for 8 Regional Municipalities plus Lambton County, the contribution of OPG Coal-Fired Generating plants to local Ozone and PM10 levels in the DSS05 and DSS03 Reports for three scenarios: Base Case, Emission Control Case and Gas Replacement Case. Ozone measured in parts per billion; PM10 measured in micrograms/m^3. The numbers show the increments attributed to OPG facilities. Approximate average 1998 observed concentrations shown for three cities with Environment Canada monitoring stations. **Bottom Panel:** Same as top panel but converted to percentages assuming typical average concentrations for ozone of 20 ppb and for PM10 of 35 mg/m^3. Average 1998 concentrations: see McKitrick, Green and Schwartz (2005) Appendix A.

Table 1 compares the two model runs across seven regional municipalities in Ontario, including Haldimand-Norfolk (where Nanticoke is) and Lambton county. It is clear that the contributions to local pollution levels from OPG facilities are extremely small under either model run. Except for Haldimand-Norfolk Regional Municipality and Lambton County (the neighbourhoods of the plants themselves) OPG facilities add about 1 mg/m^3 of measured PM_{10} levels and less than 0.05 parts per billion ozone to local air. The entries shown tend to be the largest ones in the underlying tables. The differences between columns are very small in level terms and cannot explain the large differences in health outcomes between the two reports.

Consequently, the answer to the first question is that the two reports actually predict the same effects on Ontario air quality from coal plant closures. Outside the immediate vicinity of the coal plants themselves the changes are very small in absolute and percentage terms.

2 Comparison of Social Cost Models Between the Two Reports

What drives the large environmental and health costs associated with the coal plant operations in the April 2005 report, and how credible are these cost estimates?

DSS05 changed epidemiological models compared to DSS03. Unfortunately the model parameters are not disclosed in either report so the specific changes cannot be exactly analyzed. DSS03 used the same model (p. 3) employed for the Ontario Medical Association reports on air pollution and health (also prepared by DSS consultants). DSS05 (p. 19) changed to a model that purports to measure long term health exposure effects rather than acute episodic effects.

Neither report provides adequate discussion of the considerable controversy surrounding these epidemiological models. Some of the literature challenging the risk estimates from air pollution-health studies is surveyed in McKitrick, Green and Schwartz (2005). The main criticisms outlined therein are as follows.

- Extensive clinical studies in laboratories over many years have failed to demonstrate a consistent physiological effect associated with contemporary ambient particle and ozone levels in outdoor air;
- Epidemiological studies routinely contradict one another regarding correlations between air pollution levels and health outcomes; indeed large multi-city studies have yielded results that are contradictory within the same study;
- Statistical estimates are sensitive to the particular modeling assumptions employed. Recent reanalyses of earlier studies have shown that introducing controls for missing confounders such as income, weather and other risk factors frequently causes effects previously attributed to pollution to become smaller and statistically insignificant.

It is noteworthy that the only reason the coal-based scenarios are ranked as worse than the other scenarios (DSS05 p. v) is the large health impact associated with the small OPG contributions to Ontario air pollution. Without this large cost item the rankings would prefer the base case. So it is important to assess how robust these numbers are.

2.1 Use of Long Term Exposure Coefficients

DSS05 uses new exposure parameters attributed to a rather old study, Dockery et al. (1993). This methodological choice is problematic on several grounds.

First, Dockery et al. (1993) failed to control for differing weather conditions and income levels among cities and study participants. These are now known to be important for explaining health outcomes.

Base Case Health Effects	DSS05	DSS03	Adjustment
Premature Death	668	80	0.12
Hospital Admissions	928	38	0.04
Emergency Room Visits	1,100	200	0.18
Minor Illnesses	333,600	1,800,000	5.40

Table 2. Base case pollution contributions from OPG are nearly identical between reports (see Table 1) yet implied health effects differ dramatically. Columns DSS05, DSS03 shows total number of people under each category in each report. "Adjustment" shows DSS03/DSS05, i.e. multiply DSS05 entry by adjustment factor to get DSS03 entry.

Second, Dockery et al. (1993) examined health impacts due to changes in fine particulate levels of 10—30 mg/m^3. Their statistical model does not have sufficient precision to handle variations at the level being considered here, typically 0—1 mg/m^3 (see Table 1). For a 20 mg/m^3 increase in PM_{10} exposure the Dockery et al. relative risk ratio is 1.26 (p. 1755), with a standard error of about 0.9. This is insufficient precision to reliably examine PM_{10} variations on the order of 0.5 mg/m^3.

Third, Dockery et al. (1993 p. 1758) actually found the air pollution effects were statistically insignificant for substantial subgroups of their sample population: nonsmokers, former smokers, female current smokers, those with no occupational exposure to fumes, gas or dust, and women who reported current occupational exposure. Dockery et al. (1993) came under considerable scrutiny after the US Environmental Protection Agency proposed new fine particulate rules based on its findings. As a result the study was re-examined and other studies were implemented to see if the results held up. Pope et al. (2002) reported on a larger survey conducted over a longer period of time, focused on $PM_{2.5}$. It too only resolved information on variations above 10 mg/m^3. Figure 4 in that study shows that large population subgroups showed no significant pollution effects: people under age 70, people with more than high school education, etc. Despite the fact that both these studies (which of are cited in DSS05) ruled out pollution effects on large subsegments of the population, model coefficients are applied in DSS05 to the entire population in Ontario. This substantially overstates the implications and precision of these studies.

As DSS05 states (p. 19) the use of long term mortality risk coefficients boosts the putative health effects approximately seven-fold compared to the acute-effects model used in DSS03. However the differences between the reports are more unusual than that. Table 1 showed that in terms of PM_{10} and ozone attributable to OPG operations, the Base Cases are extremely coherent between DSS03 and DSS05. Yet the estimated health effects are radically different, as shown in Table 2. Most health outcome measures are much larger in DSS05 than in DSS03, though the Minor Illness burden is smaller in the DSS05 case.

Present Value of Health Damages Under DSS2005 and DSS2003 Models

	S1		S2		S3		S4	
	DSS05	**DSS03**	**DSS05**	**DSS03**	**DSS05**	**DSS03**	**DSS05**	**DSS03**
Premature Death	$33,963	$4,076	$4,361	$523	$4,103	$492	$12,125	$1,455
Hospital Admissions	$76	$3	$11	$0	$10	$0	$28	$1
Emergency Room Visits	$15	$3	$2	$0	$2	$0	$6	$1
Minor Illnesses	$88	$475	$13	$0	$12	$912	$32	$352
TOTAL	**$34,142**	**$4,556**	**$4,387**	**$524**	**$4,127**	**$1,405**	**$12,191**	**$1,809**

Annualized Health Damages Under DSS2005 and DSS2003 Models

	S1		S2		S3		S4	
	DSS05	**DSS03**	**DSS05**	**DSS03**	**DSS05**	**DSS03**	**DSS05**	**DSS03**
Premature Death	$3,023	$363	$388	$47	$365	$44	$1,079	$129
Hospital Admissions	$7	$0	$1	$0	$1	$0	$2	$0
Emergency Room Visits	$1	$0	$0	$0	$0	$0	$1	$0
Minor Illnesses	$8	$42	$1	$0	$1	$81	$3	$31
TOTAL	**$3,039**	**$405**	**$390**	**$47**	**$367**	**$125**	**$1,085**	**$161**

Table 3. Present and Annualized values of health damages using new DSS05 model versus result if standard DSS03 model had been used. All figures in 2004 $millions. **Top Panel:** Under first scenario (S1) DSS05 computes total discounted present value of health costs of $34.1 billion. Applying adjustments from Table 2 to obtain DSS03-equivalent estimate yields costs of $4.6 billion. **Bottom Panel:** total present values converted to annual values by multiplying by 0.089, approximating the conversion factor used in DSS05.

The factors of adjustment between the two reports are very large, ranging from 0.04 to 5.4. This points to the extreme uncertainty in the epidemiological model, which in part reflects the extreme scientific uncertainty over the air pollution-health connection. It also indicates the influence of the decision to adopt a new set of epidemiological parameters. Because these numbers are so uncertain they cannot credibly carry the report's conclusions.

There would be good reason for reducing the death and disease rate calculations substantially even from the DSS03 levels (see McKitrick, Green and Schwartz 2005; McKitrick 2004 for details). However for the present purposes I simply recomputed the health cost estimates that would have been obtained by approximating the DSS03 epidemiological model, which is the same epidemiological model used by the Ontario Medical Association for studying the air pollution-mortality link. All other aspects of the DSS05 model, including the economic valuation of disease and mortality are kept the same.

Annualized Costs ($2004 Millions)

	S1	S2	S3	S4	
Financial Costs	$985	$2,076	$1,529	$1,367	
Health Damages	$3,020	$388	$365	$1,079	DSS05
Environmental Damages	$371	$141	$48	$356	
TOTAL COST	**$4,377**	**$2,605**	**$1,942**	**$2,802**	

	S1	S2	S3	S4	
Financial Costs	$985	$2,076	$1,529	$1,367	DSS05 with
Health Damages	$405	$47	$125	$161	DSS03 health
Environmental Damages	$371	$141	$48	$356	coefficients
TOTAL COST	**$1,761**	**$2,264**	**$1,702**	**$1,884**	

	S1	S2	S3	S4	
Financial Costs	$985	$2,076	$1,529	$1,367	As above
Health Damages	$405	$47	$125	$161	with marginal
Environmental Damages	$21	$1	$0	$6	GHG costs
TOTAL COST	**$1,411**	**$2,124**	**$1,654**	**$1,534**	removed

Table 4. Annualized costs of 4 Scenarios under DSS05 approach and with two sequential modifications: reverting to standard epidemiological model as used in DSS03, and removing illustrative damages assigned to greenhouse gases. Scenario 1 goes from highest cost to lowest cost, while Scenario 3 goes from lowest cost to second-highest cost.

Table 3 shows the results. The annualized health damages under all scenarios fall, and not surprisingly those associated with S1 fall the most, from $3 billion to $0.4 billion. This allows us to recompute the overall social costs of the four scenarios (DSS05 Table I-4) on an annualized basis. This is shown in the top two panels of Table 4. The topmost panel reproduces the estimates in DSS05, broken down into Financial Costs, Health Damages and Environmental Damages. The next panel applies the adjustment from Table 2 to obtain health damages comparable to the DSS03 model. These results are very close to results quietly mentioned in DSS05 as the “acute premature mortality” estimates (e.g. Table I-4 note b), provided “for reference purposes only” (p. 25). On the basis of these results DSS05 would have, like Table 4, concluded the S1 Base Case is the second-best option rather than the worst. The difference between S1 and S3 is very small, certainly within the range of uncertainty about the health parameters themselves. Consequently the cost-benefit analysis, when closely examined, gives no solid reason to conclude that the nuclear/gas scenario is preferable to the status quo, even taking acute health and environmental damages as given in the report itself.

2.2 Greenhouse Gas (GHG) Damage Estimates

DSS05 assumes (pp. 30-31) that carbon dioxide emissions damage the local environment by influencing long term climate change. The report concedes the implausibility of precise estimation of such numbers, e.g.:

> Practically, assessing the impact of relatively small quantities of GHG emissions is problematic. The dynamics of climate change are quite complicated and difficult to predict, let alone trying to predict the impacts of climate change on the environment and human economies. (p. 31)

The study then takes the approach of using a per-tonne cost equal to the negotiated cap on the abatement costs that will be faced by some large emitters under the Canadian plan for Kyoto. The rationale, however, is conflicted: the category is "environmental damages" (i.e. benefits of abatement) but the dollar value is based on possible compliance costs, assuming emitters have to purchase permits, rather than environmental damages. Either as an abatement cost or benefit it fails to provide a solid rationale for the use of these numbers. This matters because removing the speculative GHG costs further changes the ranking of the scenarios.

If the $15/tonne figure is meant to be "environmental damages" then there ought to be some reference to the literature on the estimated costs of climate change in Canada. Reinsborough (2003) and Adamowicz and Weber (2003) independently conducted econometric analyses of Canadian agriculture under conventional climate warming scenarios from the Canadian Climate Model. Both found climate change yielded net benefits for Canada. Reinsborough found a very small positive effect overall, while Adamowicz and Weber found a large positive impact, about $500 per acre under the central scenario. The benefits are spread widely over the whole agricultural area of Canada. These findings mirror those of other teams that project net global gains in agriculture (Mendelsohn *et. al.* 1999, 2000) and forestry (Sohngen and Mendelsohn 1998). Beyond these sectors most economic activity (manufacturing, services, etc) takes place indoors and is not affected by the weather.

If the $15/tonne figure is instead meant to be a compliance cost estimate, it is too early to assume that Canada will actually have a functioning emission permits market over the decades covered by this report. Kyoto itself only runs to 2012, there is no permits trading system at present, there is no specific proposal before Parliament to create one and there is no guarantee that the power generation sector will have to buy permits anyway. The $15/tonne cap is from a letter to the oil and gas sector in Alberta, not the Ontario power sector.

Hence the GHG damages should only have been included for illustrative purposes. At the very least it should be noted how strongly the results are influenced by including them. The third panel in Table 4 shows this by removing the GHG damage conjectures. The total environmental damages become very small, highlighting the fact that this entry is primarily GHG emissions. Under this variation, Scenario 1 (Base Case) emerges as the best option, followed by S4, S3 and S2.

2.3 Atikokan and Thunder Bay Refit

DSS05 notes (p. 2) that the two northernmost generating stations have effectively no role in the southern Ontario air pollution situation and their impact is ignored. Yet in S4 they are assigned the cost of installing full emissions control equipment, thereby building in a cost which is known to yield no corresponding benefit. Numerical details in the report are not adequate to back out the exact impact on the final results, but can be approximated as follows. If the emissions control upgrades for A&TB cost $200 million, at a conversion factor of 0.089 this implies about $35 million in annualized costs. Reducing the S4 costs by this amount does not change the rankings so the adjusted table is not shown.

3 Conclusions

Overall the DSS05 Report does not provide credible support for the decision to close the Ontario coal-fired power plants. As has been found previously the pollution increments attributable to OPG facilities are extremely small across Southern Ontario except in the immediate vicinity of the power plants themselves. The objective cost numbers—namely financial operating costs—clearly favour the status quo with coal plants by a wide margin, followed by refitted coal plants under scenario 4. The health impacts and environmental costs are "soft" numbers, dominated by imprecise parameters that have been substantially boosted by the adoption of a controversial new epidemiological model. Simply using the familiar epidemiological risk factors relied on by, among others, the Ontario Medical Association in its reports on air pollution and human health, leaves the status quo (scenario 1) approximately tied for first place as the best option. Removing the illustrative GHG cost numbers again puts the coal-based options well out in front as the best options. Overall the most balanced reading of the information in DSS03 and DSS05 is that the coal-fired power plants are good, low-cost sources of power for Ontario, their environmental and health impacts are modest and their continued operation yields a net social benefit for the province. The 2005 DSS cost benefit analysis does not provide a persuasive case for advocating closure of the OPG thermal plants.

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