DURHAM YORK ENERGY CENTRE

SUMMARY OF ANALYSIS OF AMBIENT AND EMISSION MONITORING TO IDENTIFY LOCAL AIRSHED IMPACTS

Prepared for:

The Regional Municipality of Durham
605 Rossland Road E
Whitby, ON L1N 6A3

The Regional Municipality of York
17250 Yonge Street,
Newmarket, ON L3Y 6Z1

Prepared by:

Matthew Adams, Ph.D.

Summary

This analysis aimed to determine whether the Durham York Energy Centre (DYEC) affects local air quality by releasing pollutants that increase air pollution levels. The study examined data from two ambient air monitoring stations, one located upwind and the other downwind of the DYEC and emission data from the DYEC itself. The pollutants analyzed in this report included fine particulate matter ($PM_{2.5}$), nitrogen oxides (NO_X), sulphur dioxide (SO_2), total suspended particulate (TSP) including metals, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDDs/PCDFs). The study compared the emissions reported by the DYEC to the National Pollutant Release Inventory with all reported emission sources in Durham and York Regions. The results showed that the DYEC's emissions did not significantly contribute to air pollution in the local area, as indicated by the measurements taken at the upwind and downwind monitoring stations. For a more comprehensive report, please review ANALYSIS OF AMBIENT AND EMISSION MONITORING TO IDENTIFY LOCAL AIRSHED IMPACTS, 2023.

Data

The DYEC has a plan in place to monitor and report on the quality of the outdoor air. This plan is required to comply with conditions set out in the Environmental Assessment Notice of Approval and the Environmental Compliance Approval. The monitoring includes both continuous and non-continuous methods. Continuous monitoring devices measure air pollution in real time as air is drawn through the device. Non-continuous methods involve sampling the air for a specific period and then analyzing the sample in a laboratory to determine the amount of pollutants present.

Three monitoring stations were established according to the plan, with one located upwind, one downwind, and one at the property line. For this analysis, we focus on the upwind and downwind sites, which are currently operational. The locations were chosen based on wind patterns, with the upwind station situated west of the DYEC and the downwind station located east of Rundle Road. The Rundle Road station was selected because it is in the dominant downwind direction from the DYEC and within the range where the highest potential air pollution impact is expected. The two monitoring stations and the DYEC stack location are presented in Figure 1.

The DYEC also has an Air Emissions Monitoring Plan in place, which involves continuous monitoring of selected pollutants emitted by the boilers at the facility. The real-time emissions data is made available on the DYEC website.

Overall, these monitoring plans ensure that the DYEC is actively monitoring the air quality in the surrounding area and complying with regulations regarding emissions.

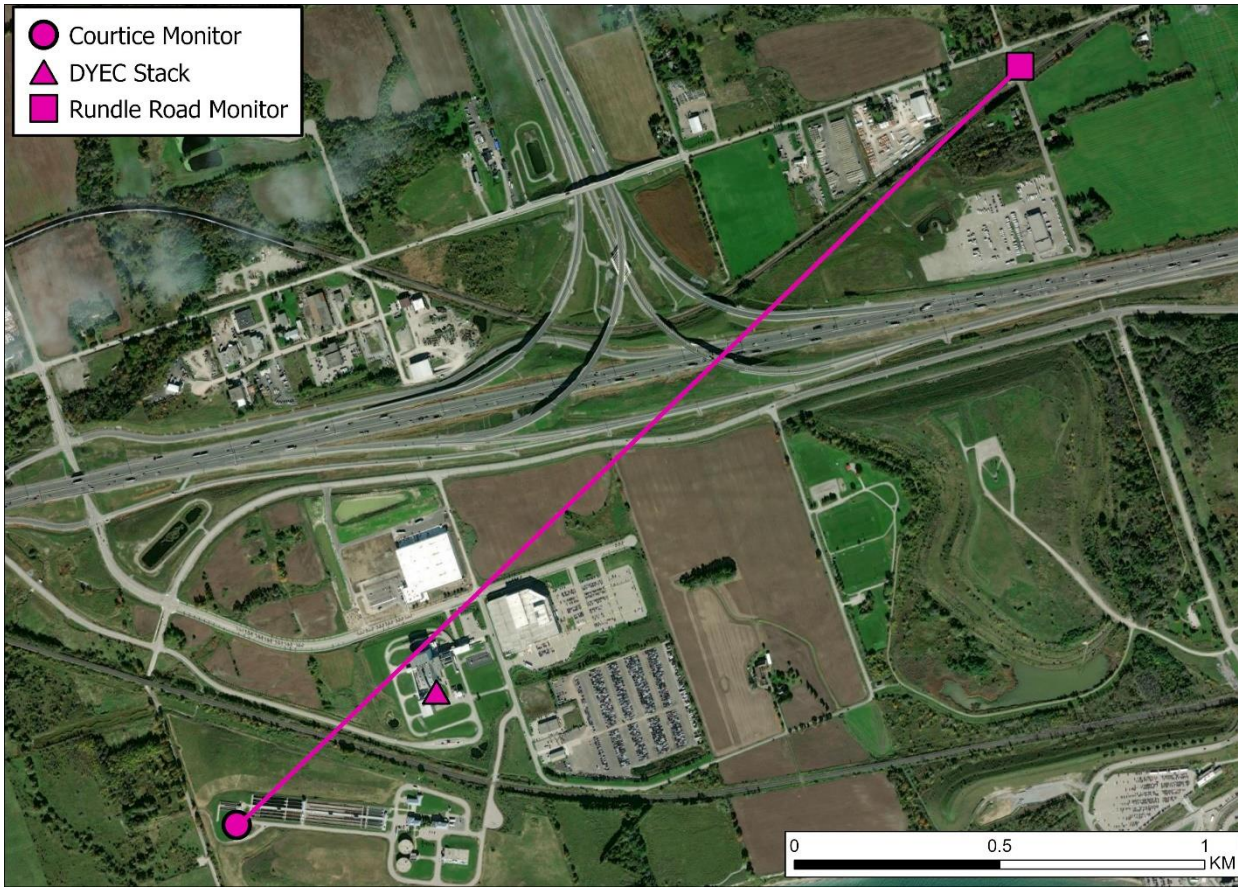

Figure 1: Map of Ambient Air Monitoring Locations Relative to the DYEC

Analysis

Upwind and downwind air monitoring data were compared. If the DYEC impacted local air quality, the downwind air monitor should demonstrate a consistently higher concentration than the upwind air monitor (Figure 2).

There are three approaches used to analyze the data on air pollution. These approaches are based on the availability of data and the air monitoring method.

The first approach is for three groups of pollutants: dioxins and furans (PCDD/PCDF), polycyclic aromatic hydrocarbons (PAHs), and total suspended particulate (TSP) including metals. Pollution in the air was sampled for 24-hour periods to obtain a 24-hour average concentration. This sampling method is known as discrete sampling.

The second approach is for nitrogen oxides (NO_X) and sulphur dioxide (SO_2), where hourly measurements were conducted at the Courtice and Rundle Road locations. In addition, both pollutants were monitored continuously at the DYEC stack.

The third approach also involves ambient monitoring but does not include continuous emissions monitoring. Fine particulate matter was included in this approach.

By using these approaches, we can analyze data on various pollutants present in the air. This information is crucial for identifying potential impacts to air quality.

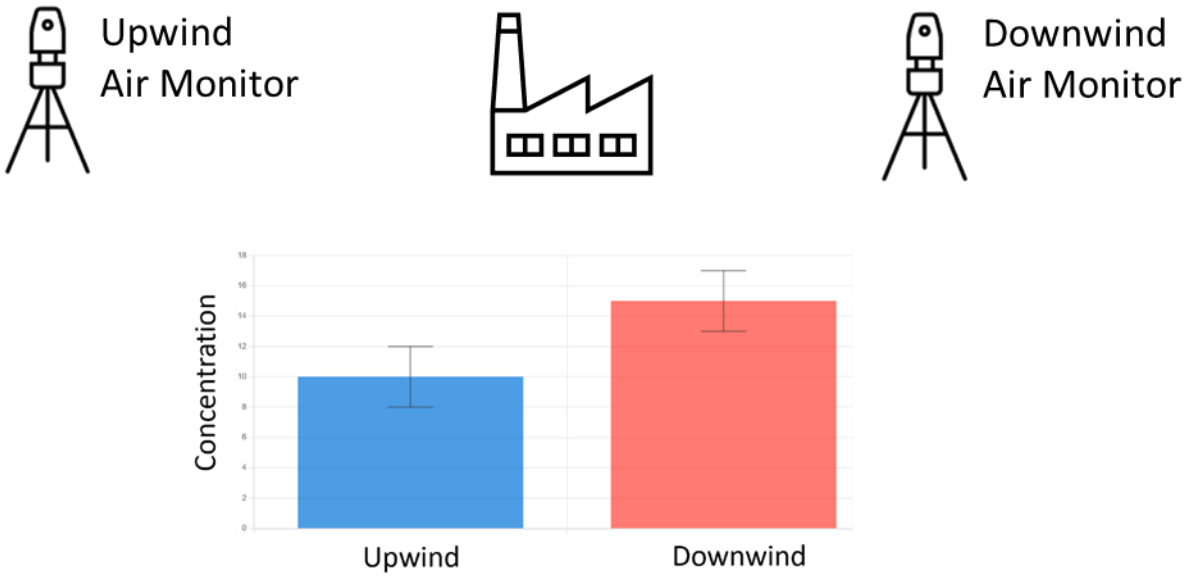

Figure 2: Concept of Upwind and Downwind Air Monitoring Comparison. The graph shown in this figure is not an actual representation of the air quality surrounding the DYEC. Instead, it illustrates what one may expect to see downwind if the DYEC was consistently contributing to the emissions to the ambient air.

Findings

This report aims to assess the impact of the Durham York Energy Centre (DYEC) on local air quality. Analyzing data from two monitoring stations, one upwind and one downwind of the DYEC, helps understand its influence. However, evaluating a single source's impact on air quality is complex due to other natural and human-caused sources in the area. The monitoring stations were strategically placed, with Rundle Road as the downwind location and Courtice as the upwind reference. Examining wind direction and speed data from January 2016 to June 2022 confirmed that Rundle Road was predominantly downwind.

DIOXINS AND FURANS

Exposure to polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzo-furans (PCDFs) has been linked to various health problems, including skin disorders, liver issues, developmental effects on the nervous system, certain cancers, and disruptions to the endocrine, immune, and reproductive

systems. Minimizing exposure to these substances is important due to their potential risks. Dioxins and furans are produced during combustion processes.

Dioxins and furans were sampled using discrete sampling for 94 days. Seventeen compounds were analyzed in each sample, and toxic equivalency (TEQ) values were calculated. TEQ is determined by applying toxic equivalency factors (TEF) to each compound, with the most toxic form of dioxin (2,3,7,8-TCDD) assigned a TEF of 1. The concentrations of each compound are then multiplied by their respective TEFs, and the sum of the 17 compounds can be compared to the Ontario Ministry of the Environment, Conservation and Parks (MECP) Ambient Air Quality Criteria (AAQC) of 0.1 pg TEQ/m^3.

The average TEQ/m^3 values for Rundle Road (0.0157) and Courtice (0.0127) were below the MECP AAQC, indicating that the ambient air contained only 12.7% to 15.7% of the allowable TEQ concentration. Additionally, no significant increases were observed between upwind and downwind conditions, suggesting that the DYEC did not significantly contribute to changes in air pollution levels.

DYEC's annual dioxins and furan emissions are emitted by Canada's largest emitter in less than one day.

The DYEC accounts for a small proportion (2.2%) of regional dioxins and furans emissions reported to the National Pollutant Release Inventory in the Durham and York Regions (Figure 3). Other nearby sources were responsible for a larger share of emissions. Five other locations to the west of the DYEC emit these compounds, with two sites releasing 25-50% of total regional emissions. These sites are likely why Courtice and Rundle Road during westerly winds (Rundle Road downwind) demonstrate their highest concentrations compared to concentrations during the other two wind patterns, which may explain why Courtice and Rundle Road recorded higher concentrations during westerly winds (with Rundle Road being downwind).

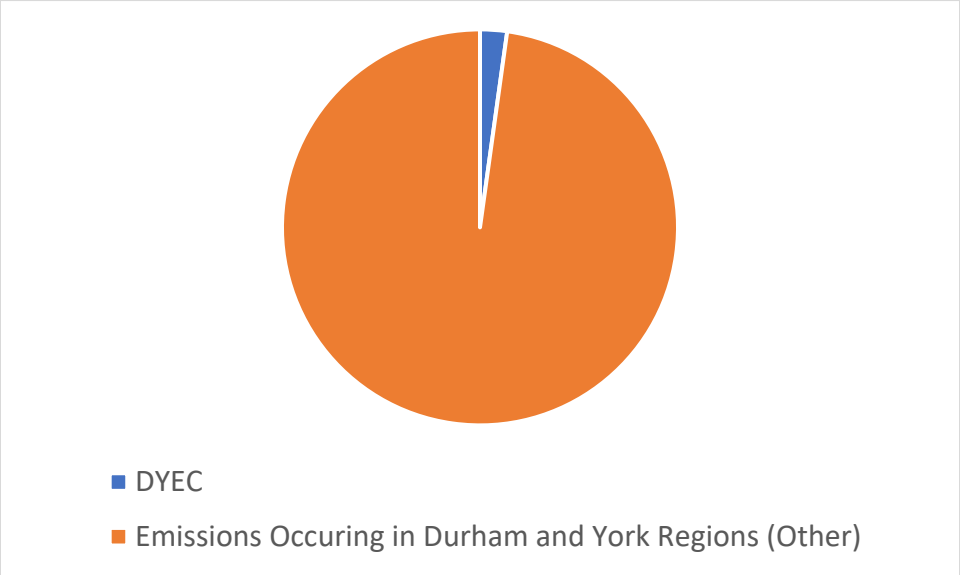

Figure 3: DYEC Proportion of Regional Dioxins and Furans Emissions

Based on the data analysis, it is unlikely that DYEC emissions significantly impact local concentrations of dioxins and furans. The concentrations measured were below the Ontario AAQC, which is positive considering other emission sources in the area.

PAHs

PAHs are chemicals that form when burning coal, oil, gas, wood, and garbage. They can be harmful, cause mutations in DNA, and are known to cause cancer. In the air, PAHs can exist as gases or attached to particles. Although many PAH compounds exist, regulations and reporting usually focus on around 14 to 20. The DYEC's monitoring plan measures 25 PAHs and adds their concentrations to get a total level. Unlike dioxins and furans, no special adjustments are made, and the values are added together evenly. Six PAHs have specific criteria to compare the measured concentrations. One of them, benzo(a)pyrene, is used to represent all PAHs during monitoring. The AAQC for benzo(a)pyrene was set to protect human health based on the cancer-causing effects of PAH exposure.

Benzo(a)pyrene concentrations are below the set limits, with measurements of 0.03 ng/m^3 at Courtice and 0.04 ng/m^3 at Rundle Road. (Ontario Ambient Air Quality Criteria: 0.05 ng/m^3; O. Reg. 419/05 Schedule Upper Risk Thresholds: 5 ng/m^3)

There was no significant increase in benzo(a)pyrene levels at the downwind air monitor compared to the upwind monitors when either Courtice or Rundle Road were downwind. However, concentrations consistently tended to be higher at the Rundle Road monitor regardless of the wind direction. The largest difference between the monitoring stations occurred during crosswind conditions, with Rundle Road showing an increase of +0.0177 ng/m^3. When Rundle Road was

upwind, the increase was +0.0144 ng/m^3, and when it was downwind, the increase was the smallest at +0.0092 ng/m^3. Upwind monitor conditions indicated a background level from 0.0315 ng/m^3 (Courtice Upwind) to 0.0521 ng/m^3 (Rundle Downwind).

Based on the ambient air monitoring data analysis, no evidence suggests that the DYEC impacts the ambient air quality in terms of PAHs.

Total Suspended Particulate

Total suspended particulate (TSP) measures all particles in the air, including larger particles that settle quickly and smaller particles that can travel deeper into the body. TSP is a good indicator of local effects because it represents the mass of particles in a given volume of air. The MECP sets criteria for TSP levels, and the DYEC monitors 29 metals within TSP. The average concentrations at Courtice (25 µg/m^3) and Rundle Road (32 µg/m^3) are below the criteria (60 µg/m^3) see Figure 4, and all metal species analyzed also fall below the criteria at both locations. Rundle Road consistently shows higher TSP concentrations during all wind conditions. Eight metal species are higher at Rundle Road when downwind, except for Iron, Manganese, and Titanium during crosswinds. The DYEC's manganese emissions are minimal compared to regional emissions. Overall, the measured TSP concentrations are below the set standards. The data does not indicate any significant patterns of increased TSP or metal species concentrations due to the DYEC emissions. However, the higher concentrations at Rundle Road during all wind conditions suggest that a local source may contribute to TSP pollution.

In one day, brake dust from passenger vehicles emits more Zinc, Manganese, and Copper along the 401 in Durham than the DYEC does in a year.

Passenger vehicle counts were obtained from the MTO iCorridor tool (https://icorridor-mto-on-ca.hub.arcgis.com/), which indicated 91,500 daily passenger vehicles along the 401 through Durham Region on the 401 (58.6 km in length) for a total of 5,361,900 km driven per day. Particulate matter from brake wear was estimated from the average of many studies in a review paper, which was a rate of 5.7 mg per km driven[3]. The daily emissions were 30.8 kg of particulate matter multiplied by trace metal rates per kilogram of particulate matter[3]. Each rate was provided as a range, and the 20th percentile between those ranges was used.

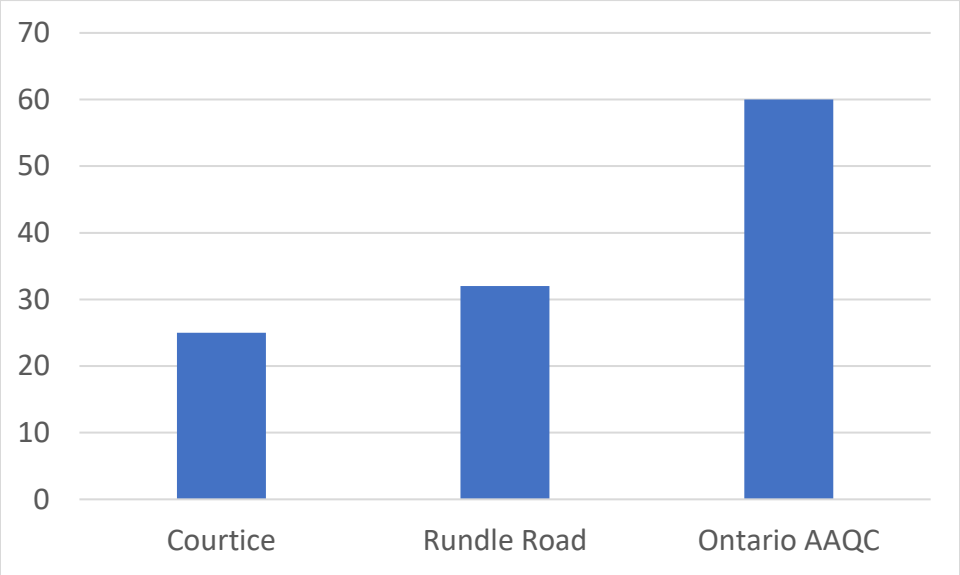

Figure 4: TSP Concentrations (µg/m^3) Compared to Ontario Ambient Air Quality Criteria

Nitrogen Oxides

Two measures were used to monitor nitrogen oxides (NO_X): ambient air monitoring and continuous emission monitoring. The long-term concentrations of NO_X at Rundle Road (7.5 ppb) and Courtice (7.1 ppb) were similar. When the DYEC boilers were not operating, the concentration difference between the two monitors was 2.6 ppb indicating background differences. The analysis also examined the relationship between emission concentrations and the difference in downwind concentrations at Rundle Road compared to Courtice. However, no relationship was found between emissions and the difference in ambient air pollution concentrations. The analysis suggests that the DYEC does not significantly impact the ambient air pollution concentrations in the area. Furthermore, the mapping of emission sources from Canada's National Pollutant Release Inventory (NPRI) indicates the presence of other local sources of NO_X.

Annual NO_X emissions of the DYEC are equivalent to 15 days of vehicle emissions along the 401 in the Durham Region.

Truck and passenger vehicle counts were obtained from the MTO iCooridor tool (https://icorridor-mto-on-ca.hub.arcgis.com/), which indicated 18,000 daily trucks and 91,500 daily passenger vehicles along the 401 through Durham Region on the 401 (58.6 km in length). The number of vehicles was multiplied by emission factors from a near-road air pollution study conducted in Canada[4], which resulted in 7,377 kg of NO_X emitted daily (15 days = 111 tonnes of NO_X emitted).

Sulphur Dioxide

Similar to NO_X, the analysis comparing measured emissions with differences in ambient measurements did not show any relationship. However, we observed that SO_2 concentrations are

significantly higher at the Courtice monitor when it is upwind of the Rundle Road air monitor. This suggests the presence of a nearby emission source. Furthermore, Courtice concentrations were higher than Rundle Road when the DYEC boilers were not operating. If there is a local source of SO_2 pollution, the concentrations are likely diluted as they disperse over the short distance to the Rundle Road air monitor.

Based on the analysis, no evidence suggests that the emissions from the DYEC impact local SO_2 concentrations. However, the findings do indicate the existence of a local source near the Courtice air monitor.

Particulate Matter

The DYEC reports 0.1% of industrial emissions for $PM_{2.5}$ in Durham and York Regions based on the NPRI. The concentrations measured at the two monitoring stations did not differ meaningfully. Both monitoring locations reported the same 8.0 $\mu g/m^3$ concentration during Rundle Road downwind conditions. NPRI emission mapping of industrial sources demonstrates many sources, with no single source representing more than 25% of emissions. The analysis does not suggest any impact from the DYEC on ambient $PM_{2.5}$ concentrations.

Conclusion

The analysis of ambient air pollution data for PCDD/PCDFs, PAHs, TSP, NO_X, SO_2 and $PM_{2.5}$ indicates that the DYEC is not impacting the local airshed. The region has multiple known stressors, such as those high emitters identified in the NPRI data. After reviewing the ambient monitoring data, one primary concern arose, which included elevated concentrations of benzo(a)pyrene that have included individual samples exceeding Ontario AAQC during the period evaluated. These elevated concentrations do not seem influenced by DYEC emission, and while they may be elevated at Rundle Road, it is not possible to infer the expected concentrations at residential locations within the region. Future exceedances should be individually evaluated to examine the relative wind directions during the exceedance and identify baseline conditions using the upwind monitor; however, the analysis indicates that local and regional sources influence the ambient air monitors, both Courtice and Rundle Road. The dual monitoring program effectively compares upwind and downwind concentrations and should be maintained to evaluate future conditions.

Overall, it is concluded that the DYEC's Air Emissions Monitoring Plan effectively controls emissions so that it does not significantly contribute to air pollution in the local airshed.

References

1. Gullett, B., Touati, A., & Oudejans, L. (2008). PCDD/F and aromatic emissions from simulated forest and grassland fires. *Atmospheric Environment*, *42*(34), 7997-8006.
2. Amiro, B. D., Todd, J. B., Wotton, B. M., Logan, K. A., Flannigan, M. D., Stocks, B. J., ... & Hirsch, K. G. (2001). Direct carbon emissions from Canadian forest fires, 1959-1999. *Canadian Journal of Forest Research*, *31*(3), 512-525.
3. Grigoratos, T., & Martini, G. (2015). Brake wear particle emissions: a review. *Environmental Science and Pollution Research*, *22*, 2491-2504.
4. Evans, G. (2019). *Near-road air pollution pilot study final report*. https://hdl.handle.net/1807/96917