

EVALUATION OF THE DIMINISHING RETURNS OF A FULLY BEV FLEET VERSUS ELECTRIC HAUL TRUCKS AND SCOOPS: A CASE STUDY – EAGLE'S NEST PROJECT

MDEC 2026

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2025-10-02

CGM MINE
VENTILATION
SPECIALISTS



AGENDA

Introduction

- The project
- Objective

Design Criteria

- Diesel-powered mobile equipment
- Electric mobile equipment

Results

- Electric case
- Hybrid case
- Diesel case

Conclusion



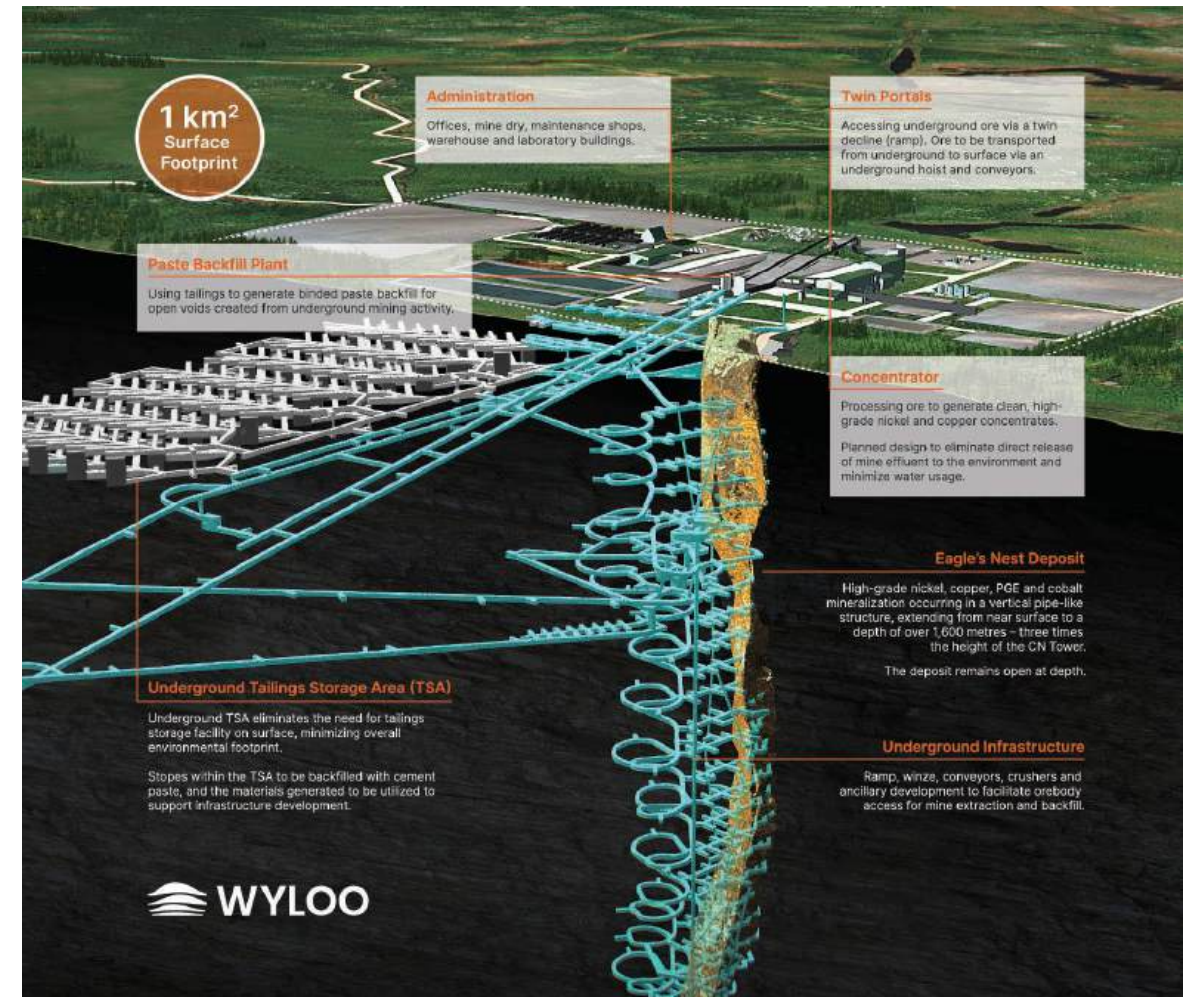
INTRODUCTION

- The Eagle's Nest
 - Wyloo metals
 - located 550 kilometres north of Thunder Bay
 - ring of Fire near McFaulds Lake
 - planned to produce nickel, copper, palladium, and platinum.
 - depth of 1.1 kilometers based on estimated resources.
 - feasibility study



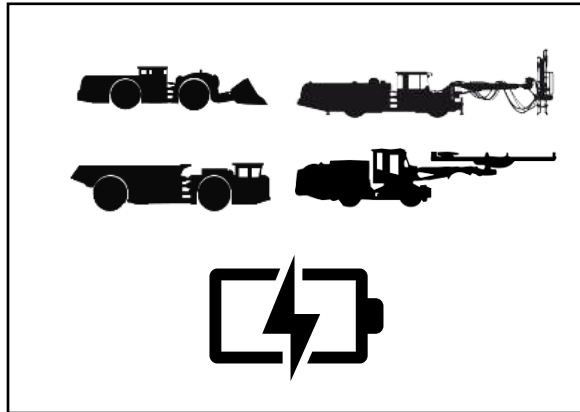
OBJECTIVE

- Mine of the future
 - Remotely controlled equipment
 - Ventilation-on-demand
- Client asked for a fully electric fleet
 - Supposed to save on ventilation costs
 - How about different levels of electrification?
 - Diminishing costs of electrifying everything?

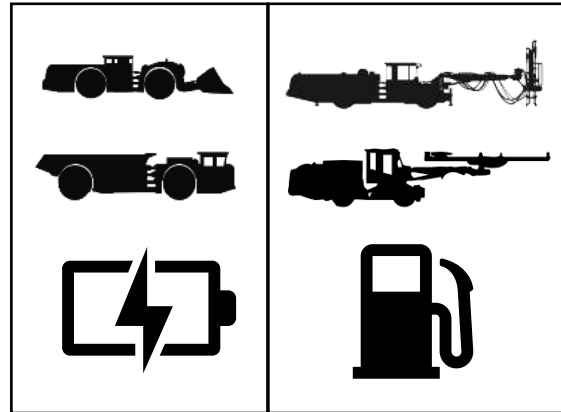


OBJECTIVE

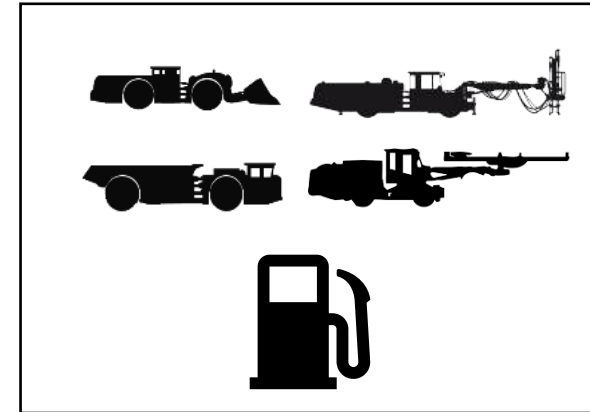
- Three scenarios



FULLY ELECTRIC



HYBRID



DIESEL POWERED

DIESEL-POWERED MOBILE EQUIPMENT

UG Equipment Fleet	Model	Engine	Power	Certificate #	Dilution rate
			(kW)		(m³/s)
Two Boom Jumbo	DD422i	Cummins, QSB4.5, Tier4F, Stage IV	122	1296	3.3
Mechanical Bolter	975 Omnia	MB OM904LA (Mercedes 904)	110	1191	4.3
Cable Bolter		DS4221	122	1296	3.3
LHDs	Toro LH515i	Volvo TAD1181VE	265	1343	6.4
Scissor lift	MEM SL3	MB OM904LA (Mercedes 904)	110	1191	4.3
Emulsion Loader	EC3	MB OM904LA (Mercedes 904)	110	1191	4.3
Boom Truck	Maclean	BT3	150	1192	6.7
Trans mixer	Skid-mounted	CCM	15	-	0.9
Shotcrete Sprayer	Maclean & Aliva	SS3 & 246	96	1250	3.5
Scissor lift Construction	MEM SL3	MB OM904LA (Mercedes 904)	110	1191	4.3
Pick-up truck	Landcruiser	1HZ PCNA	95	949	3.4
U/G Forklifts		S3L2-Y361DPH/DPA, Tier 4i	22	1229	1.0
U/G Haulage Trucks	TH545i	Volvo TAD1670VE Tier 4f	302	1275	8.0

ELECTRIC MOBILE EQUIPMENT



→ No specific value assigned to electric equipment underground



→ General minimum air speed of 0.25 m/s



→ Value of 0.25 m/s assigned to electric equipment underground
(Government of Australia, 2024)

ELECTRIC MOBILE EQUIPMENT

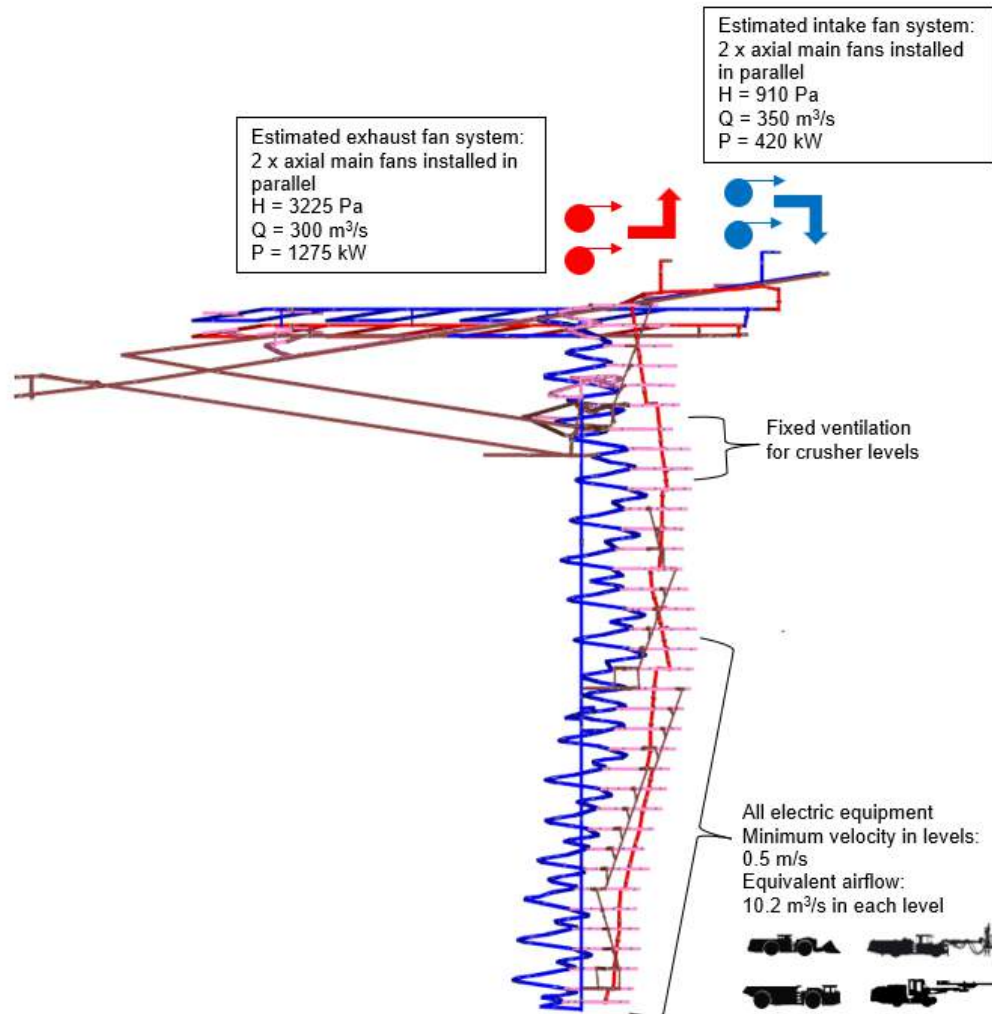
- Borden Lake Mine and Onaping Depth project, both in Ontario.
 - Used a minimum air speed value of 0.5 m/s for working areas as criterion
- 0.5 m/s was adopted as the minimum air speed for working areas.
 - value that would address regulatory standards
 - Address dust dilution
 - previously proposed in literature as a minimum rate to dilute heat and dust generated by the operation (Rawlins, 2023).

ELECTRIC MOBILE EQUIPMENT

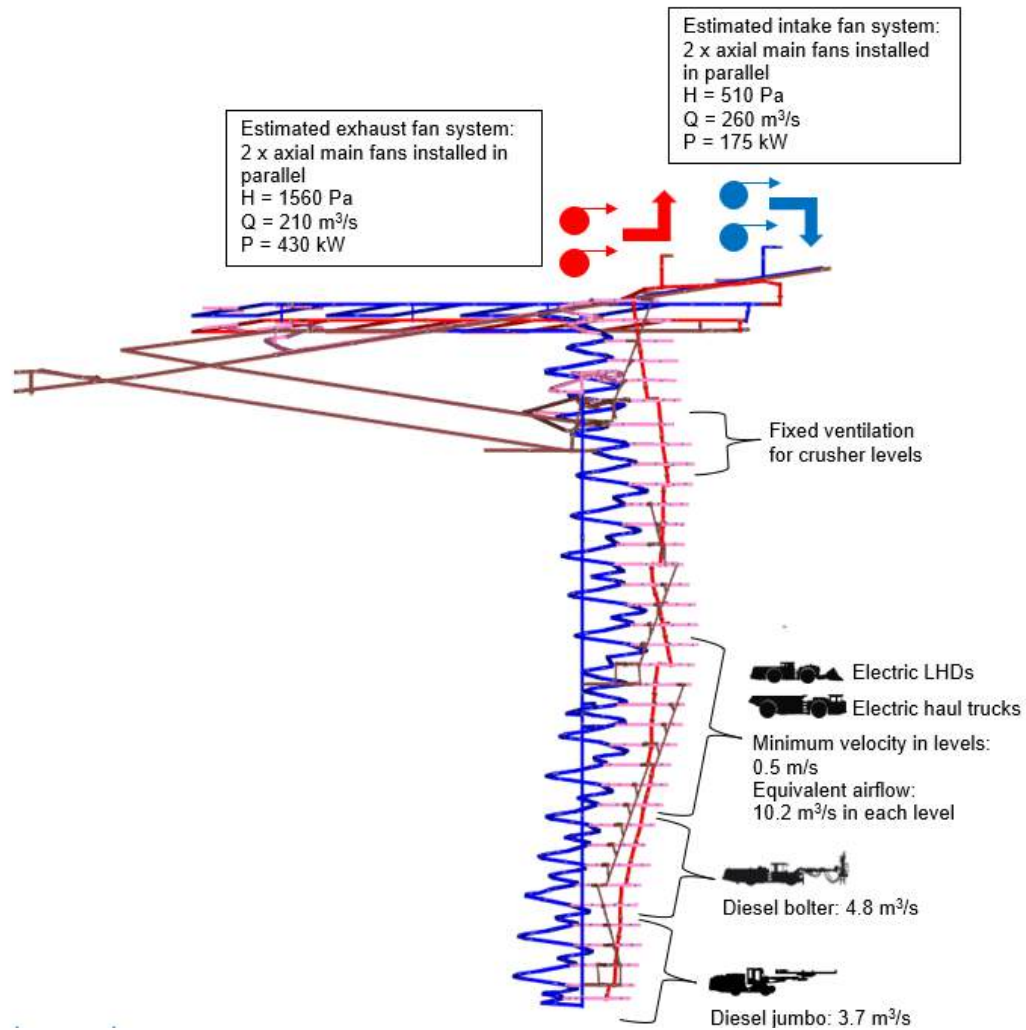
- Equivalent airflows that match the air speed criterion of 0.5 m/s were calculated for multiple cross-sectional areas relevant to Eagle's Nest.

		4.5m x 4.5m		5.0m x 5.0m		5.0m x 5.5m		5.5m x 6.0m		6.0m x 6.0m	
		20.25 m ²		25 m ²		27.5 m ²		33 m ²		36 m ²	
		(m ³ /s)	(KCFM)	(m ³ /s)	(KCFM)	(m ³ /s)	(KCFM)	(m ³ /s)	(KCFM)	(m ³ /s)	(KCFM)
Minimum speed	0.5 m/s	10.1	21.4	12.5	26.5	13.8	29.1	16.5	34.9	18	38.1

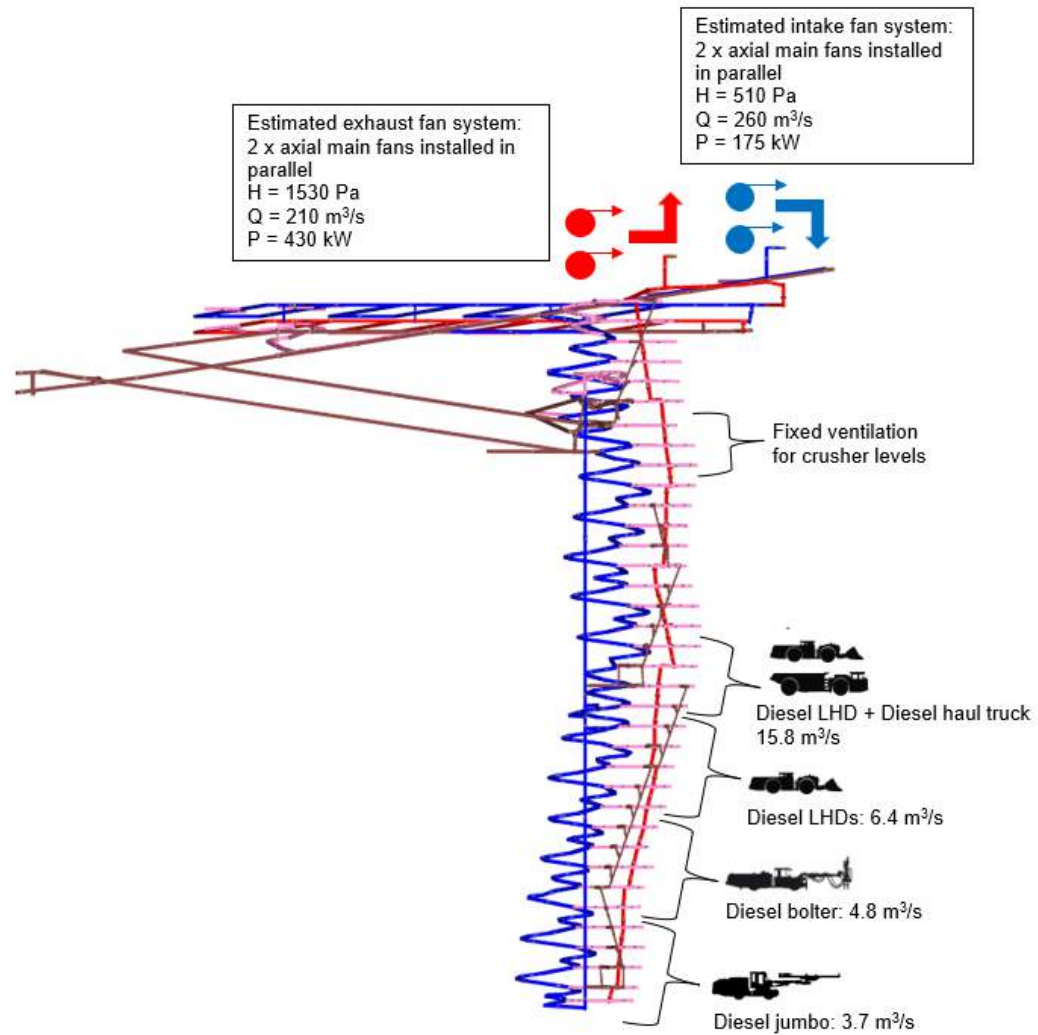
RESULTS – ELECTRIC CASE



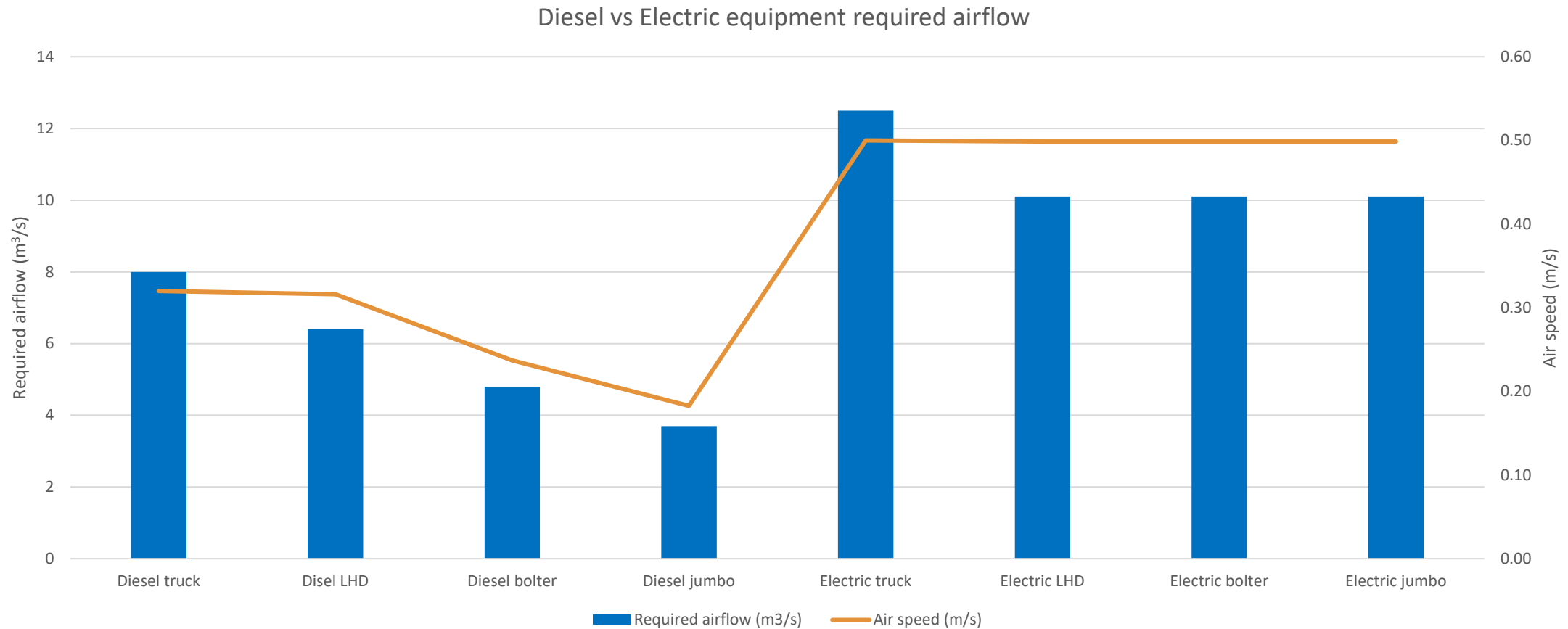
RESULTS – HYBRID CASE



RESULTS - DIESEL CASE



DIESEL VS ELECTRIC EQUIPMENT AIRFLOW COMPARISON



FAN DUTIES

Fan duty specifications				
Scenario	System	Total Airflow	Collar Pressure	Fan Electrical Power Input
		(m ³ /s)	(Pa)	(kW)
Scenario 1: Electric	Exhaust	300	3225	1273
	Intake	350	911	420
Scenario 2: Hybrid	Exhaust	210	1559	431
	Intake	260	506	173
Scenario 3: Diesel	Exhaust	210	1523	421
	Intake	260	506	173

CONCLUSION

- These findings should not be interpreted as evidence that a fully electric fleet is less advantageous from a ventilation perspective
- The governing ventilation criteria differ fundamentally between the scenarios
- For the electric fleet, ventilation requirements were controlled by a minimum air velocity criterion selected to address heat and dust management
- Whereas the hybrid and diesel cases were primarily governed by diesel equipment dilution requirements established through regulatory and equipment certification standards
- As a result, the comparison reflects the influence of different ventilation design bases rather than a direct comparison of equivalent contaminant control requirements.

CONCLUSION

- Regulatory frameworks remain largely rooted in diesel-powered operations.
- **Ventilating for heat, dust, and employing a minimum airflow criterion may limit the ventilation reductions that would otherwise be expected from the elimination of diesel exhaust emissions.**
- Additional analyses incorporating alternative minimum air velocity assumptions, such as 0.25 m/s, as well as ventilation strategies that may be enabled by reduced diesel emissions, could provide further insight into the true ventilation benefits of fleet electrification.



THANK YOU!

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