


## LHD fuel cost comparison

Electric vs. Diesel

	Electric	Diesel	Remarks
LHD model	LH514E	LH514	
Nominal output (kW)	177	256	
Average load (%)	65%	50%	typical (depends on the mine application)
Nominal fuel consumption (g / kWh)		217	@100% engine load
Cost of electricity (CAD / kWh)	0.161002		estimated hydro cost
Cost of diesel fuel (CAD / litre)		\$1.20	
Fuel cost (CAD / hr)	\$18.52	\$39.77	
Fuel cost per year	\$64,831	\$139,211	CAD

Based on 3500 operating hours per year

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## Ventilation Costs



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## Study performed in a number of underground Gold Mines

Power consumer	MWh/year	USD millions/year
Camp	1,600	0.38
Crushers	2,200	0.52
Processing plant	15,200	3.60
▪ UG primary vent	2,200	0.52
▪ UG second vent	7,400	1.74
▪ UG other energy	4,400	1.05
Underground total	14,000	3.31
<b>Total mine site</b>	<b>33,000</b>	<b>7.80</b>

Source: Barrick Gold

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## Why Ventilate?

	Diesel Loader	Electric Loader
Remove diesel particulate	YES	Not Required
Remove gases (NO <sub>2</sub> , CO <sub>2</sub> , etc)	YES	Not Required
Remove heat / cool air	YES	Not Required
Remove Dust	YES	YES
Remove gases	YES	YES

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Ventilation Cost Comparison – Electric vs. Diesel			
Scenario	Electric	Diesel	Remarks
Model	LH514E	LH514	
Rated output (kW)	177	256	
Required Ventilation	0	34330	CFM (100 CFM per HP)
Ventilation Cost per hr		\$49,04	CAD
Ventilation Cost per year based on 3500 operating hours per year	\$0	\$171 648	CAD
Scenario	Electric	Diesel	Remarks
Model	LH514E	LH514	
Rated output (kW)	177	256	
Required Ventilation	0	20500	CFM (per CANMET test)
Ventilation Cost per hr		\$29,29	CAD
Ventilation Cost per year based on 3500 operating hours per year	\$0	\$102 500	CAD

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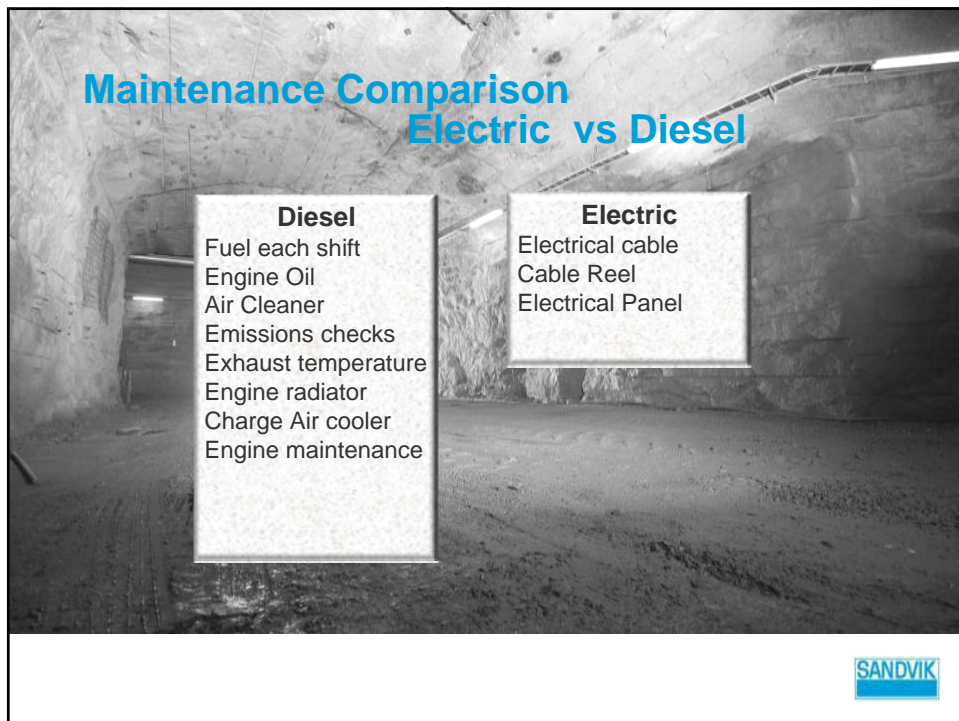
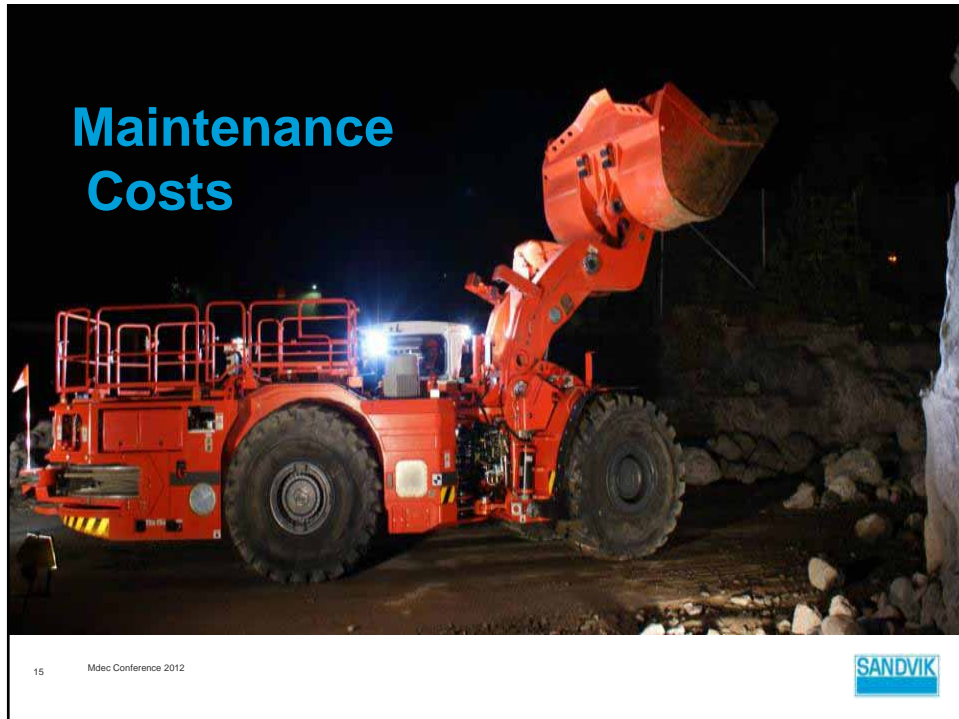
Heat balance calculation Example			
	Diesel LHD (kW)	Electric LHD (kW)	Remarks
Engine/Motor output	243	177	Same performance at lower output due to electric motor torque characteristics
Thermal Efficiency	32 %	95 %	
Heat dissipated from the prime mover (kW)	516	9	
Drivetrain losses (kW)	97,2	97,2	Includes complete powertrain plus hydraulic system
Total heat dissipation	614	107	
Ratio	5,8	1	

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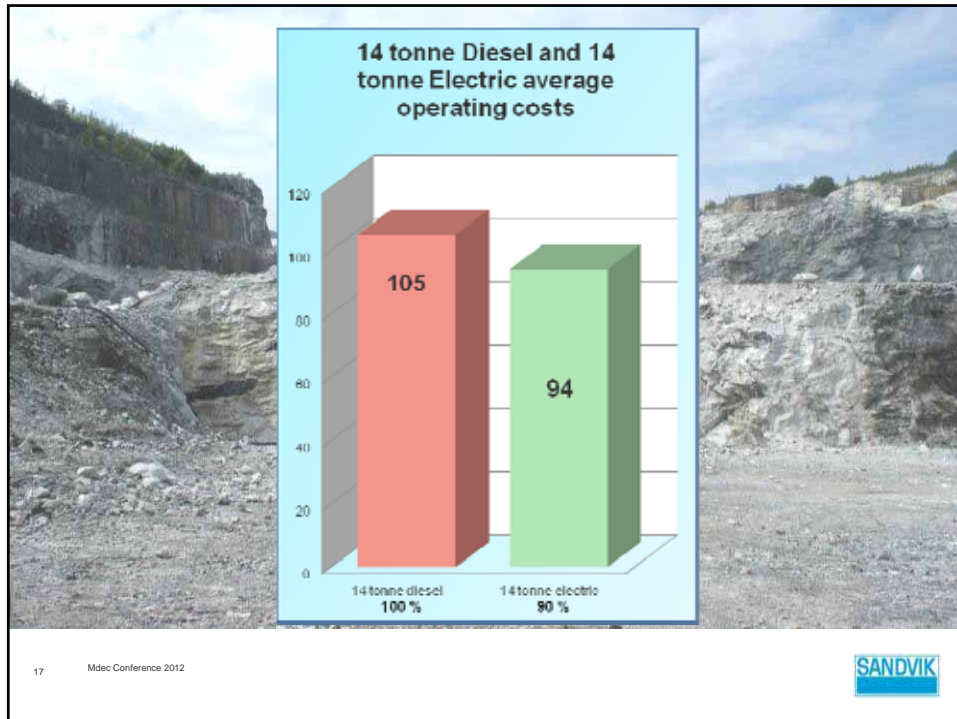
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Average operating costs (relative)	14 tonne D	14 tonne E
Maintenance components	28	28
Engine maintenance components	9	0
Service parts	2	2
Engine service components	2	0
Other parts	8	7
Lubricants	1,4	0,6
Tires	23	22
Fuel / Electricity	32	15
Refuelling (labour cost)	0,4	0
Cable	0	19
Cable maintenance (labour cost)	0	0,1
<b>Total</b>	<b>105</b>	<b>94</b>

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Electric LHD Productivity Due to Reduced Service Needs Calculations			
Basic information	14 tonne E	14 tonne D	Remarks
One way tramping distance (m)	200 m	200 m	
Effective working time (hour per shift)	7,60	6,60	Due to refueling and added service of diesel engine
Shifts per day	3	3	
Price of ore (USD/ ton)	7 400\$	7 400\$	
Ore grade (%)	0,80	0,80	
LHD Capacity (ton)	14	14	
Fill factor %	85	85	
Bucket Load (ton)	12	12	
Speed (Km / hour )	7	7	
Loading time (S)	5,50	5,50	
Cycle time (S)	257	257	
Buckets / Hour	14	14	
Tons per day	3 900	3 300	
Value of bucket / USD	710\$	710\$	
Value of ore / day	228 400\$	196 900\$	
Value of additional ore per day USD	31 500\$		
Value of additional ore per 300 days USD	9 437 000\$		

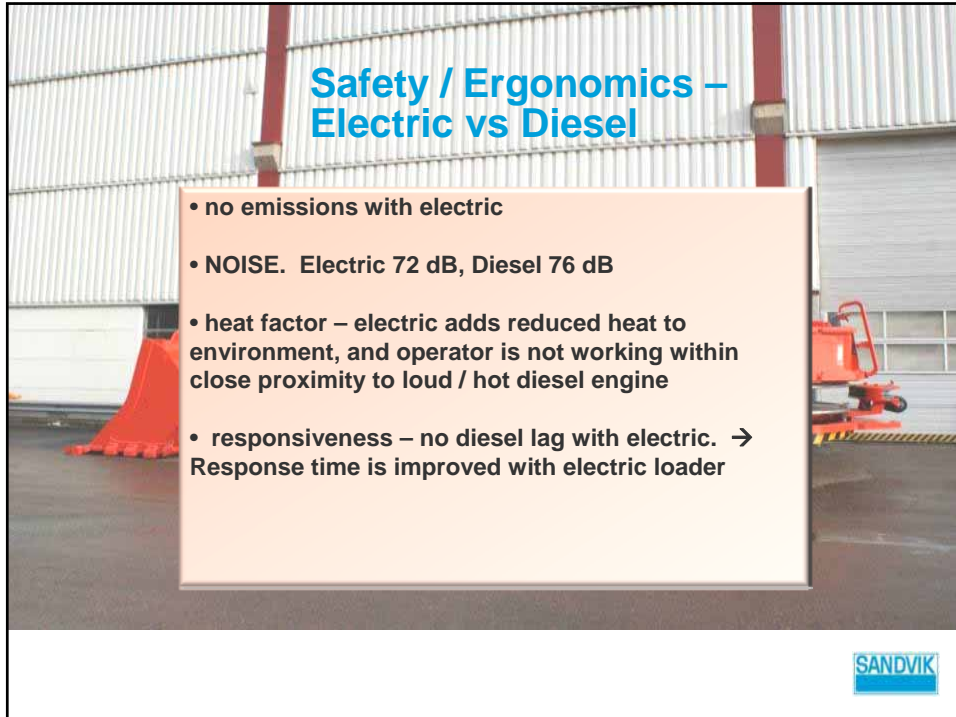


Maintenance Comparison Electric vs Diesel			
Maintenance cost			
	Electric	Diesel	Remarks
Relative Factor	73	84	
Maintenance Cost per year	\$115 068	\$100 000	CAD



### Safety / Ergonomics – Electric vs Diesel

- no emissions with electric
- NOISE. Electric 72 dB, Diesel 76 dB
- heat factor – electric adds reduced heat to environment, and operator is not working within close proximity to loud / hot diesel engine
- responsiveness – no diesel lag with electric. → Response time is improved with electric loader

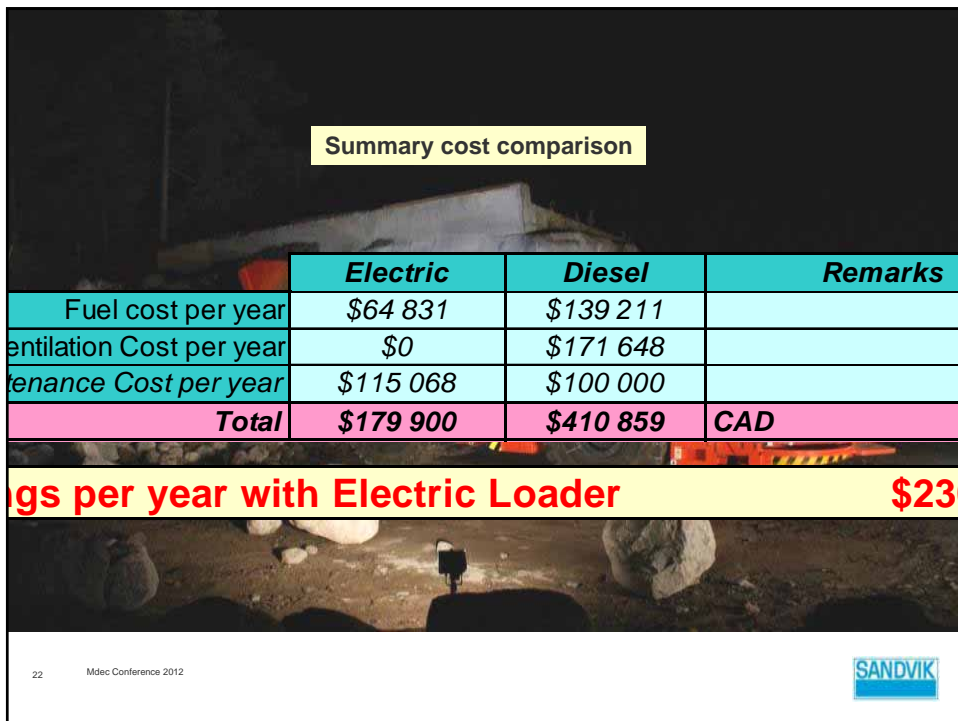


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### Summary cost comparison

	<i>Electric</i>	<i>Diesel</i>	<i>Remarks</i>
Fuel cost per year	\$64 831	\$139 211	
ventilation Cost per year	\$0	\$171 648	
tenance Cost per year	\$115 068	\$100 000	
<b>Total</b>	<b>\$179 900</b>	<b>\$410 859</b>	<b>CAD</b>

**Costs per year with Electric Loader** **\$230 000**



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## Other Factors to Consider

- Mine layout – cannot drive over cables
- tramming distance – maximum distance 300 meters
- moving around the mine – bucket mounted generator?
- how much production time is currently lost for:
  - fueling
  - engine maintenance
  - handling fuel and lubricants
  - for diesel PM's? (with no engine electric loader PM interval increases)
  - changing engine air filters
  - working at less than 100% engine performance because of dirty filters, faulty injectors, dirty fuel, etc.

