

Fuel consumption and emission calculations

The fuel consumed and corresponding emission improvement of each run when the EMD locomotives are replaced by the K LW hybrid is estimated by

1. considering first the total tractive work,
2. applying the inefficiency factor for total work, and
3. using the fuel consumption rates and emission g/kWh rates to determine fuel consumed and the emissions¹.

The EMD fuel consumption rates used in the calculation are as follows:

- GP38: 9.4 kWh/gal
- GP40: 9.4 kWh/gal

The emissions g/kWh rates for K LW hybrid were taken from the OEM information sheets and the EPA's Tier 0+ rate for the EMD engines, assuming the EMDs were built between 1973 and 1995 and have been overhauled to Tier 0+ standards.

Results

Previous analyses evaluated K LW hybrid's performance in two days of local service. Table 1 and Table 2 below list the results of the calculations described above for each of these scenarios. The tables also list the total fuel consumed in the actual runs so one can compare the impact on fuel consumption of the K LW hybrids.

Comparing the K LW hybrid numbers in Table 2 illustrates the advances the OEM engine manufacturer has made in improving the exhaust emissions between Tier 3 and Tier 4 standards. While the fuel consumed (along with the CO₂) improves 7-8% on the K LW hybrid scenario, the NO_x improves 14% and the PM improves 70%.

¹ * The CO₂ emissions are calculated using gallons consumed rather than g/kWh.

Table 1: Fuel consumption and emission data (Local)

Description	Two GP38's	Two Tier 4 CAT hybrids
Total tractive work (kWh)	3071	3071
Locomotive fuel efficiency (%)	68	86
Total locomotive work (kWh)	4516	3571
Fuel consumption rate (kWh/gal)	9.4	15.1
Total fuel consumed (gallons)	480	236
Total CO ₂ introduced into the atmosphere (tons)	5.4	2.6
Total NOx introduced into the atmosphere (lbs)	127	24
Total PM introduced into the atmosphere (lbs)	8.0	0.2

Table 2: Fuel consumption and emission data (Local)

Description	Three GP38's	Three GP40's	Three Tier 4 CAT hybrids
Total tractive work (kWh)	6877	6877	6877
Locomotive fuel efficiency (%)	67	76	89
Total locomotive work (kWh)	10264	9049	7727
Fuel consumption rate (kWh/gal)	9.4	9.4	15.1
Total fuel consumed (gallons)	1092	963	512
Total CO ₂ introduced into the atmosphere (tons)	12.2	10.8	5.7
Total NOx introduced into the atmosphere (lbs)	288	254	51
Total PM introduced into the atmosphere (lbs)	18.2	16.0	0.5