In-use NOx emissions from diesel and liquefied natural gas refuse trucks equipped with SCR and TWC respectively

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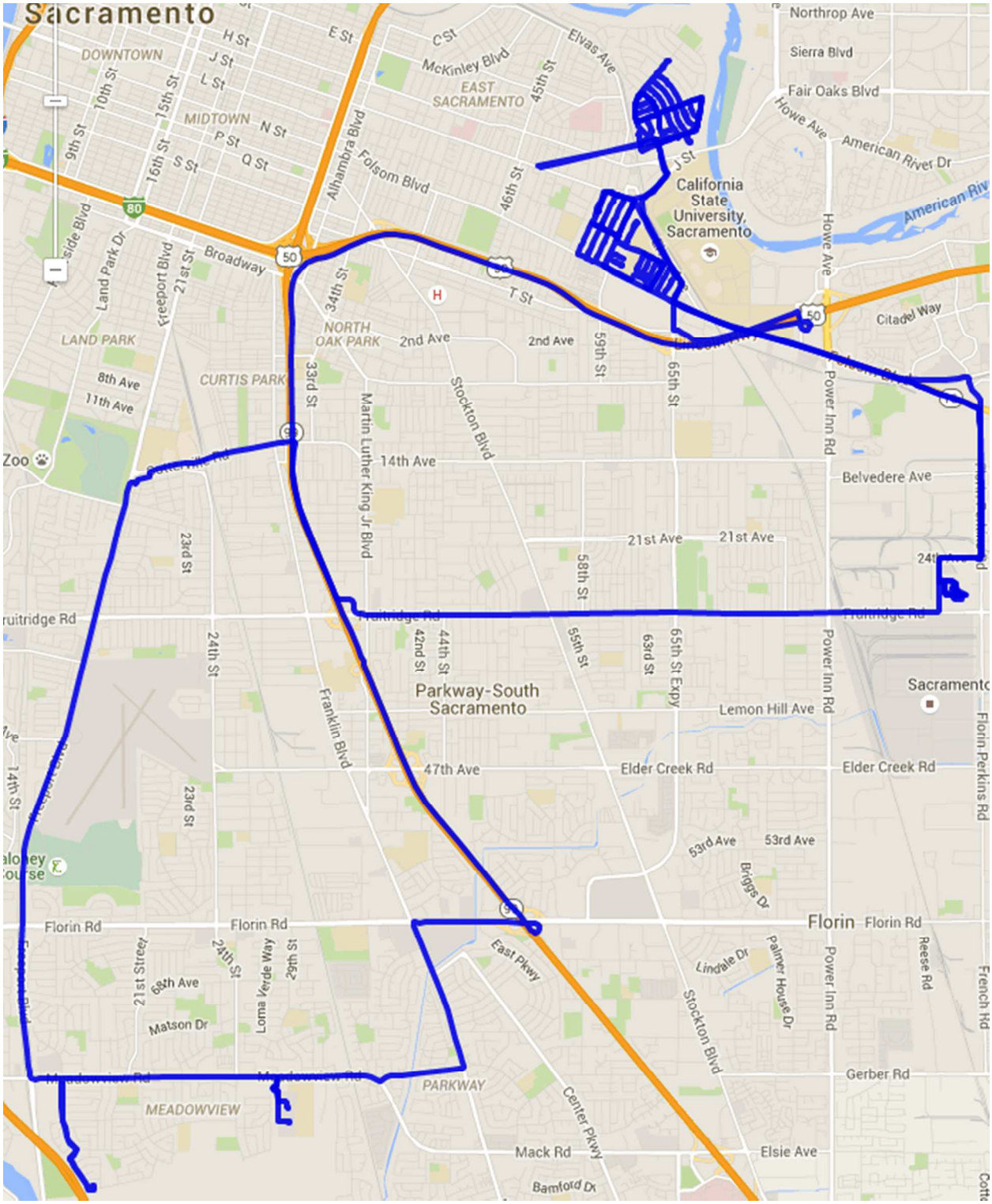


Figure S1: Route of 12/19/2013 corresponding to Figure 1 in manuscript

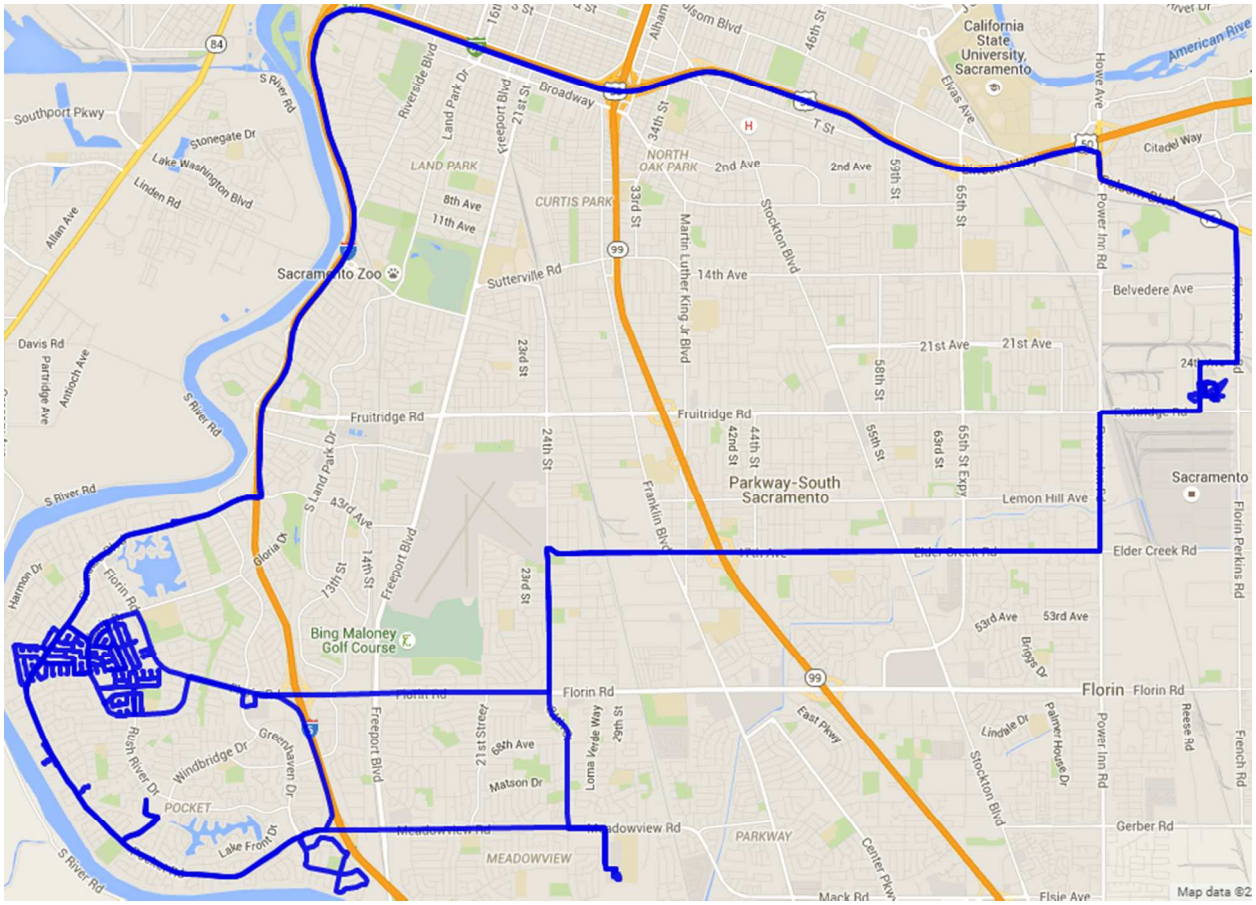


Figure S2: Route of 12/23/2013 corresponding to Figure 4 in manuscript

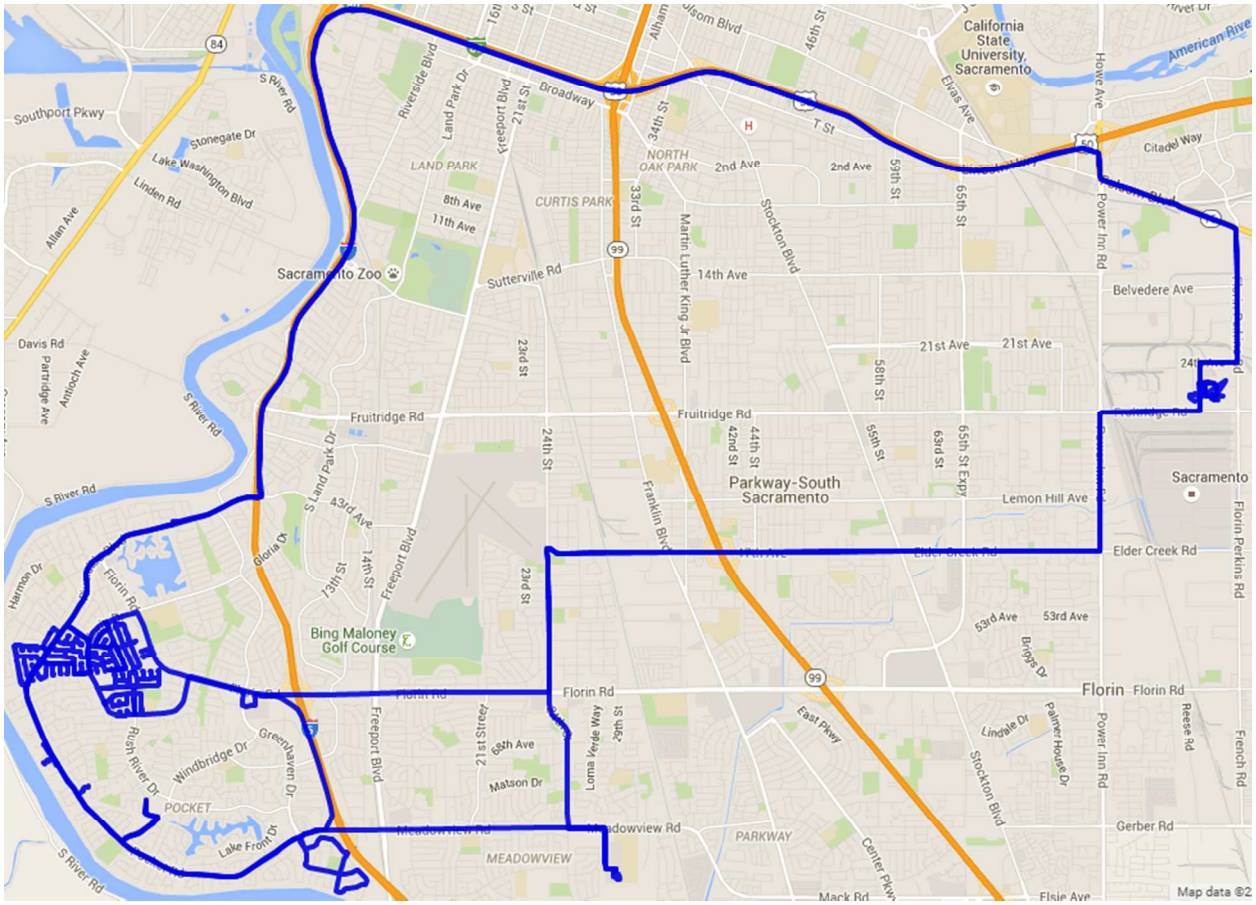
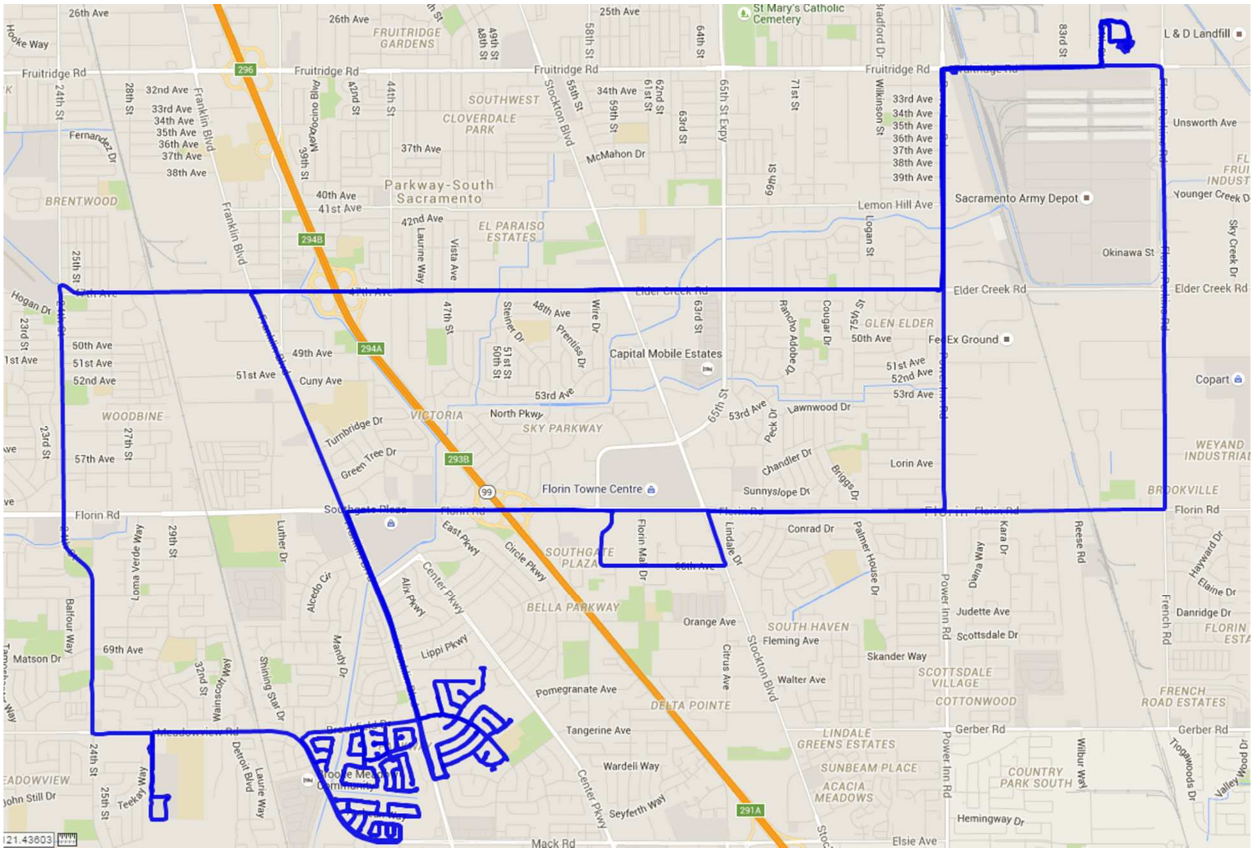


Figure S3: Route of 1/14/2014 corresponding to Figure 5 in manuscript



<u>Figure S4:</u> Route of 3/3/2014 corresponding to Figure 6 in manuscript

Table S1: PEMS engine and emissions parameters

Parameter	Units
Engine speed	rpm
Engine torque	lb-ft
Fuel flow rate	gal/s
Exhaust mass flow rate	kg/hr
Percent engine load	%
Vehicle speed	mph
Oil temperature	deg C
Coolant temperature	deg C
Exhaust temperature	deg C
Pre and post SCR temperatures	deg C
Pre and Post DPF temperature and pressure*	deg C mbar
NO_2 emission rate	g/s
NO emission rate	g/s
CO emission rate	g/s
CO_2 emission rate	g/s
HC emission rate	g/s

*where feasible

Table S2: Summary of emissions

	Diesel 1						
Date	12/10/2013	12/11/2013	12/12/2013	12/16/2013	12/17/2013	12/18/2013	12/19/2013
Total Distance Traveled (mi)	31.425	40.947	42.301	51.01	51.716	81.526	56.645
Total Fuel Consumed (gal)	21.423	25.583	30.374	27.549	29.752	45.995	32.147
Overall Fuel Economy (mpg)	1.466	1.601	1.393	1.852	1.738	1.772	1.762
CO2 Mass Emissions (g/bhp-h)	608.518	614.008057	623.881593	605.102	613.139	620.443	604.367
CO Mass Emissions (g/bhp-h)	0.737	0.80769338	0.83434961	0.827	0.913	0.856	0.912
NOx Mass Emissions (g/bhp-h)	1.315	1.05691379	1.16750143	1.152	1.2	1.317	1.405
kNOx Mass (corrected g/bhp-h)	1.227	0.99109935	1.09921829	1.094	1.153	1.271	1.349
THC (g/bhp-h)	0.001	0.00148694	0.00148602	0.001	0.005	0	0
Thermal Efficiency	31%	31%	30%	31%	31%	31%	31%

	Diesel 2						
Date	12/23/2013	12/24/2013	12/25/2013	12/26/2013	12/31/2013	1/1/2014	1/6/2014
Total Distance Traveled (mi)	60.064	49.86	35.742	45.562	56.529	75.148	31.5777222
Total Fuel Consumed (gal)	30.573	26.85	18.449	26.247	28.54	35.47	18.954915
Overall Fuel Economy (mpg)	1.965	1.857	1.937	1.736	1.981	2.119	1.66593848
CO2 Mass Emissions (g/bhp-h)	607.64	606.202	602.935	611.504	597.417	596.296	594.227901
CO Mass Emissions (g/bhp-h)	1.261	1.457	1.298	1.912	1.262	1.387	1.26333229
NOx Mass Emissions (g/bhp-h)	0.699	0.692	0.663	0.741	0.618	0.656	0
kNOx Mass (corrected g/bhp-h)	0.666	0.662	0.63	0.706	0.591	0.621	0.77232544
THC (g/bhp-h)	0.001	0	0.007	0.011	0	0	0.00660458
Thermal Efficiency	31%	31%	31%	31%	32%	32%	33%

	LNG 1					
Date	1/13/2014	1/14/2014	1/15/2014	1/16/2014	1/20/2014	1/21/2014
Total Distance Traveled (mi)	53.702	78.238	53.903	61.233	44.774	51.175
Diesel (in lieu of LNG) (gal)	31.1961181	35.1572118	29.89438	31.1537151	23.7748458	21.8345559
Overall Fuel Economy (mpg)	1.72143213	2.22537556	1.80311483	1.96551197	1.88325091	1.91973708
CO2 Mass Emissions (g/bhp-h)	403.413	405.021	400.488	400.057	403.801	395.817
CO Mass Emissions (g/bhp-h)	3.27	3.325	3.277	3.152	3.335	3.064
NOx Mass Emissions (g/bhp-h)	0.136	0.132	0.126	0.146	0.136	0.138
kNOx Mass (corrected g/bhp-h)	0.13	0.126	0.121	0.139	0.128	0.13
THC (g/bhp-h)	0.213	0.239	0.233	0.164	0.116	0.155
Thermal Efficiency	34%	33%	34%	34%	34%	34%

	LNG 2	
Date	1/27/2014	1/28/2014
Total Distance Traveled (mi)	60.097	82.331
Diesel (in lieu of LNG) (gal)	32.1627328	34.4638845
Overall Fuel Economy (mpg)	1.86852904	2.38890657
CO2 Mass Emissions (g/bhp-h)	415.091	399.888
CO Mass Emissions (g/bhp-h)	2.725	2.764
NOx Mass Emissions (g/bhp-h)	0.085	0.105
kNOx Mass (corrected g/bhp-h)	0.081	0.103
THC (g/bhp-h)	0.139	0.16
Thermal Efficiency	32%	33%

	Hydraulic Hybrid			
Date	3/3/2014	3/4/2014	3/5/2014	3/6/2014
Total Distance Traveled (mi)	46.768	53.508	44.898	30.474
Total Fuel Consumed (gal)	14.328	15.428	12.141	10.163
Overall Fuel Economy (mpg)	3.264	3.468	3.698	2.999
CO2 Mass Emissions (g/bhp-h)	465.500787	479.520815	461.7805	473.119958
CO Mass Emissions (g/bhp-h)	4.03194622	2.52043093	1.97116129	6.78891149
NOx Mass Emissions (g/bhp-h)	0.46321063	0.50305976	0.49676756	0.38305986
kNOx Mass (corrected g/bhp-h)	0.46268566	0.50305976	0.49676756	0.38265773
THC (g/bhp-h)	0.00010563	0.00239234	0.00220461	0.00036053
Thermal Efficiency	40%	39%	41%	39%