APPENDIX F

AIR QUALITY

Past planning documents identified a “Chicago to Omaha” corridor, so for the purposes of this appendix, the corridor reference will remain as previously designated; however, the project name includes “Council Bluffs” in the title.

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Chicago to Omaha Intercity Passenger Rail Service Cook County		Estimate of Diverted Trips
Build Alternative	**Quantity**	**Source:**
Total Annual Ridership	1,922,816	AECOM updates (April 2013)
New Trips from induced growth	190,944	AECOM updates (April 2013)
Amount of Diverted Trips	1,731,872	AECOM updates (April 2013)
Auto Diverted Trips	1,366,329	Travel diverted to rail from auto
Bus Diverted Trips	324,680	Travel diverted to rail from bus
Air Diverted Trips	40,864	Travel diverted to rail from air
Auto		
Auto miles one way	16.6	miles - Google Earth Pro
Nationwide % passenger cars	60.3%	Percent[a]
Nationwide % passenger trucks	39.7%	Percent[a]
Average passenger car energy intensity	3,538	Btu/passenger mile
Average passenger truck energy intensity	3,663	Btu/passenger mile
Average passengers per car	1.55	passengers/vehicle[a]
Average passengers per truck	1.84	passengers/vehicle[a]
Total diverted auto passenger miles per year	22,681,000	passenger-miles/year
Annual diverted auto fuel consumption	81,370	MMBtu/yr
Gasoline heating value	130,000	Btu/gal - USEPA AP-42 Appendix A
Annual auto fuel consumption diverted	625,923	gallons per year
Annual auto miles diverted	13,621,915	miles per year
Bus		
Intercity passenger bus energy intensity[a]	4,242	Btu/passenger mile
One-way distance	16.6	miles - Google Earth Pro
Total diverted bus passenger miles per year	5,389,680	passenger-miles/year
Annual diverted bus fuel consumption	22,863	MMBtu/yr
Diesel fuel heating value	137,000	Btu/gal - USEPA AP-42 Appendix A
Annual diverted bus fuel consumption	166,883	gallons per year
Train		
Intercity passenger train energy intensity[a]	2,435	Btu/passenger mile
One-way distance	17	miles
Total new train passenger miles per year	31,918,744	passenger-miles/year
Annual new passenger train fuel consumption	77,722	MMBtu/yr
Diesel fuel heating value	137,000	Btu/gal - USEPA AP-42 Appendix A
Annual new passenger train fuel consumption	567,315	gallons per year
Air		
Air transportation energy intensity[a]	2,826	Btu/passenger mile
One-way distance	17	miles - Google Earth Pro
Total diverted air passenger miles per year	678,335	passenger-miles/year
Jet fuel heating value	135,000	Btu/gal[a]
Jet fuel density	6.60	lb/gal
Annual air fuel consumption diverted	1,917	MMBtu/yr
Annual air fuel consumption diverted	14,200	gal/yr
Annual air fuel consumption diverted	42,548	kg/yr

[a] US Department of Energy Transportation Energy Data Book: Edition 30-2011.

Emission Calculations

	Additional Passenger Train Emissions			Automobile Emissions Diverted			Airline Emissions Diverted			Bus Emissions Diverted			
Pollutant	Emission Factor[1],[4] (g/gal) (lb/gal) CO2	Emissions Added (lb/yr)	Emissions Added (ton/yr)	Emission Factor[2] (g/mile) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	Emission Factor[3],[4] (g/kg) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	Emission Factor[2] (g/mile) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	Net Change (ton/yr)
Hydrocarbons	5.8	7,248	3.62	0.4272	12,817	6.41	0.7	66	0.03	0.1581	4,742	2.37	-5.19
Carbon monoxide (CO)	38.1	47,609	23.80	3.3467	100,415	50.21	4.4	413	0.21	1.2706	38,122	19.06	-45.67
Nitrogen oxides (NO_x)	131	163,697	81.85	3.4469	103,421	51.71	14.1	1,323	0.66	1.2978	38,940	19.47	10.01
PM_{10}	3.4	4,249	2.12	0.1698	5,095	2.55				0.0644	1,931	0.97	-1.39
$PM_{2.5}$	3.298	4,121	2.06	0.1411	4,234	2.12				0.0545	1,637	0.82	-0.87
SO_2[5]	0.096	120	0.06	0.0071	213	0.11	0.4	38	0.02	0.0024	72	0.04	-0.10
Carbon dioxide[4] (CO_2)	22.377	12,694,806	6,347.40	17.681	11,066,946	5,533.47	21.098	299,588	150	22.377	3,734,349	1,867.17	-1,203.04

[1] Except CO2, emission factors from EPA document EPA420-F-09-025; Emission Factors for Locomotives; Dated April 2009. Emission factors are projected calendar year 2015 emission factors for passenger/commuter locomotives (Tier 4).

[2] Emission factors from data output from EPA Moves2010b model run for 2015.

[3] Except CO2, emission factors from US Department of Transportation Federal Highway Administration document "Assessing the Effects of Freight Movement on Air Quality at the National and Regional Level; Final Report; April 2005". Emission factors are projected for 2015.

[4] CO2 Emission factors from US Department of Transportation Energy Information Administration Voluntary Reporting of Greenhouse Gases Program - Coefficients webpage. Emission factors are in units of lb/gal.

[5] Train SO_2 emission factor calculated based on 15 ppm (weight basis) diesel fuel sulfur content:
(15 ppm S/1,000,000) x (7.05 lb/gal) x (454 g/lb) x (2 lb SO2/lb S) = 0.096 g/gal

Note: The Chicago nonattainment area for Hydrocarbons, Nitrogen Oxides, and $PM_{2.5}$ includes the Cook, DuPage, Kane and Kendall Counties.

Chicago to Omaha Intercity Passenger Rail Service Cook County		Estimate of Diverted Trips
Build Alternative	**Quantity**	**Source:**
Total Annual Ridership	1,922,816	AECOM updates (April 2013)
New Trips from induced growth	190,944	AECOM updates (April 2013)
Amount of Diverted Trips	1,731,872	AECOM updates (April 2013)
Auto Diverted Trips	1,366,329	Travel diverted to rail from auto
Bus Diverted Trips	324,680	Travel diverted to rail from bus
Air Diverted Trips	40,864	Travel diverted to rail from air

Auto		
Auto miles one way	4	miles - Google Earth Pro
Nationwide % passenger cars	60.3%	Percent[a]
Nationwide % passenger trucks	39.7%	Percent[a]
Average passenger car energy intensity	3,538	Btu/passenger mile
Average passenger truck energy intensity	3,663	Btu/passenger mile
Average passengers per car	1.55	passengers/vehicle[a]
Average passengers per truck	1.84	passengers/vehicle[a]
Total diverted auto passenger miles per year	5,465,000	passenger-miles/year
Annual diverted auto fuel consumption	19,606	MMBtu/yr
Gasoline heating value	130,000	Btu/gal - USEPA AP-42 Appendix A
Annual auto fuel consumption diverted	150,815	gallons per year
Annual auto miles diverted	3,282,208	miles per year
Bus		
Intercity passenger bus energy intensity[a]	4,242	Btu/passenger mile
One-way distance	4	miles - Google Earth Pro
Total diverted bus passenger miles per year	1,298,718	passenger-miles/year
Annual diverted bus fuel consumption	5,509	MMBtu/yr
Diesel fuel heating value	137,000	Btu/gal - USEPA AP-42 Appendix A
Annual diverted bus fuel consumption	40,213	gallons per year
Train		
Intercity passenger train energy intensity[a]	2,435	Btu/passenger mile
One-way distance	4	miles
Total new train passenger miles per year	7,691,264	passenger-miles/year
Annual new passenger train fuel consumption	18,728	MMBtu/yr
Diesel fuel heating value	137,000	Btu/gal - USEPA AP-42 Appendix A
Annual new passenger train fuel consumption	136,702	gallons per year
Air		
Air transportation energy intensity[a]	2,826	Btu/passenger mile
One-way distance	4	miles - Google Earth Pro
Total diverted air passenger miles per year	163,454	passenger-miles/year
Jet fuel heating value	135,000	Btu/gal[a]
Jet fuel density	6.60	lb/gal
Annual air fuel consumption diverted	462	MMBtu/yr
Annual air fuel consumption diverted	3,422	gal/yr
Annual air fuel consumption diverted	10,253	kg/yr

[a] US Department of Energy Transportation Energy Data Book: Edition 30-2011.

Emission Calculations

	Additional Passenger Train Emissions			Automobile Emissions Diverted			Airline Emissions Diverted			Bus Emissions Diverted			
Pollutant	Emission Factor[1],[4] (g/gal) (lb/gal) CO2	Emissions Added (lb/yr)	Emissions Added (ton/yr)	Emission Factor[2] (g/mile) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	Emission Factor[3],[4] (g/kg) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	Emission Factor[2] (g/mile) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	Net Change (ton/yr)
Hydrocarbons	5.8	1,746	0.87	0.4272	3,088	1.54	0.7	16	0.01	0.1581	14	0.01	-0.69
Carbon monoxide (CO)	38.1	11,472	5.74	3.3467	24,195	12.10	4.4	99	0.05	1.2706	0	-	-6.41
Nitrogen oxides (NO_x)	131	39,445	19.72	3.4469	24,919	12.46	14.1	319	0.16	1.2978	7	0.00	7.10
PM_{10}	3.4	1,024	0.51	0.1698	1,228	0.61		0		0.0644	0	0.00	-0.10
$PM_{2.5}$	3.298	993	0.50	0.1411	1,020	0.51		0		0.0545	924	0.46	-0.48
SO_2[5]	0.096	29	0.01	0.0071	51	0.03	0.4	9	0.00	0.0024	0	0.00	-0.02
Carbon dioxide[4] (CO_2)	22.377	3,058,989	1,529.49	17.681	11,066,946	5,533.47	21.098	72,190	36	22.377	899,843	449.92	-4,489.99

[1] Except CO2, emission factors from EPA document EPA420-F-09-025; Emission Factors for Locomotives; Dated April 2009. Emission factors are projected calendar year 2015 emission factors

[2] Emission factors from data output from EPA Moves2010b model run for 2015.

[3] Except CO2, emission factors from US Department of Transportation Federal Highway Administration document "Assessing the Effects of Freight Movement on Air Quality at the National and

[4] CO2 Emission factors from US Department of Transportation Energy Information Administration Voluntary Reporting of Greenhouse Gases Program - Coefficients webpage. Emission factors

[5] Train SO_2 emission factor calculated based on 15 ppm (weight basis) diesel fuel sulfur content:

Note: The Chicago nonattainment area for PM_{10} includes the Lyons Township only which is located in Cook County.

Chicago to Omaha Intercity Passenger Rail Service DuPage County		Estimate of Diverted Trips
Build Alternative	**Quantity**	**Source:**
Total Annual Ridership	1,922,816	AECOM updates (April 2013)
New Trips from induced growth	190,944	AECOM updates (April 2013)
Amount of Diverted Trips	1,731,872	AECOM updates (April 2013)
Auto Diverted Trips	1,366,329	Travel diverted to rail from auto
Bus Diverted Trips	324,680	Travel diverted to rail from bus
Air Diverted Trips	40,864	Travel diverted to rail from air
Auto		
Auto miles one way	18.3	miles - Google Earth Pro
Nationwide % passenger cars	60.3%	Percent[a]
Nationwide % passenger trucks	39.7%	Percent[a]
Average passenger car energy intensity	3,538	Btu/passenger mile
Average passenger truck energy intensity	3,663	Btu/passenger mile
Average passengers per car	1.55	passengers/vehicle[a]
Average passengers per truck	1.84	passengers/vehicle[a]
Total diverted auto passenger miles per year	25,004,000	passenger-miles/year
Annual diverted auto fuel consumption	89,704	MMBtu/yr
Gasoline heating value	130,000	Btu/gal - USEPA AP-42 Appendix A
Annual auto fuel consumption diverted	690,031	gallons per year
Annual auto miles diverted	15,017,079	miles per year
Bus		
Intercity passenger bus energy intensity[a]	4,242	Btu/passenger mile
One-way distance	18.3	miles - Google Earth Pro
Total diverted bus passenger miles per year	5,941,635	passenger-miles/year
Annual diverted bus fuel consumption	25,204	MMBtu/yr
Diesel fuel heating value	137,000	Btu/gal - USEPA AP-42 Appendix A
Annual diverted bus fuel consumption	183,974	gallons per year
Train		
Intercity passenger train energy intensity[a]	2,435	Btu/passenger mile
One-way distance	18	miles
Total new train passenger miles per year	35,187,532	passenger-miles/year
Annual new passenger train fuel consumption	85,682	MMBtu/yr
Diesel fuel heating value	137,000	Btu/gal - USEPA AP-42 Appendix A
Annual new passenger train fuel consumption	625,413	gallons per year
Air		
Air transportation energy intensity[a]	2,826	Btu/passenger mile
One-way distance	18	miles - Google Earth Pro
Total diverted air passenger miles per year	747,803	passenger-miles/year
Jet fuel heating value	135,000	Btu/gal[a]
Jet fuel density	6.60	lb/gal
Annual air fuel consumption diverted	2,113	MMBtu/yr
Annual air fuel consumption diverted	15,654	gal/yr
Annual air fuel consumption diverted	46,906	kg/yr

[a] US Department of Energy Transportation Energy Data Book: Edition 30-2011.

Emission Calculations

	Additional Passenger Train Emissions			Automobile Emissions Diverted			Airline Emissions Diverted			Bus Emissions Diverted			
Pollutant	Emission Factor[1],[4] (g/gal) (lb/gal) CO2	Emissions Added (lb/yr)	Emissions Added (ton/yr)	Emission Factor[2] (g/mile) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	Emission Factor[3],[4] (g/kg) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	Emission Factor[2] (g/mile) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	Net Change (ton/yr)
Hydrocarbons	5.8	7,990	3.99	0.4272	14,130	7.07	0.7	72	0.04	0.1581	5,228	2.61	-5.72
Carbon monoxide (CO)	38.1	52,485	26.24	3.3467	110,700	55.35	4.4	455	0.23	1.2706	42,027	21.01	-50.35
Nitrogen oxides (NO_x)	131	180,461	90.23	3.4469	114,013	57.01	14.1	1,458	0.73	1.2978	42,928	21.46	11.03
PM_{10}	3.4	4,684	2.34	0.1698	5,617	2.81		0		0.0644	2,129	1.06	-1.53
$PM_{2.5}$	3.298	4,543	2.27	0.1411	4,668	2.33		0		0.0545	1,804	0.90	-0.96
SO_2[5]	0.096	132	0.07	0.0071	235	0.12	0.4	41	0.02	0.0024	79	0.04	-0.11
Carbon dioxide[4] (CO_2)	22.377	13,994,876	6,997.44	17.681	11,066,946	5,533.47	21.098	330,268	165	22.377	4,116,783	2,058.39	-759.56

[1] Except CO2, emission factors from EPA document EPA420-F-09-025; Emission Factors for Locomotives; Dated April 2009. Emission factors are projected calendar year 2015 emission factors for passenger/commuter locomotives (Tier 4).

[2] Emission factors from data output from EPA Moves2010b model run for 2015.

[3] Except CO2, emission factors from US Department of Transportation Federal Highway Administration document "Assessing the Effects of Freight Movement on Air Quality at the National and Regional Level; Final Report; April 2005". Emission factors are projected for 2015.

[4] CO2 Emission factors from US Department of Transportation Energy Information Administration Voluntary Reporting of Greenhouse Gases Program - Coefficients webpage. Emission factors are in units of lb/gal.

[5] Train SO_2 emission factor calculated based on 15 ppm (weight basis) diesel fuel sulfur content:
(15 ppm S/1,000,000) x (7.05 lb/gal) x (454 g/lb) x (2 lb SO2/lb S) = 0.096 g/gal

Note: The Chicago nonattainment area for Hydrocarbons, Nitrogen Oxides, and $PM_{2.5}$ includes the Cook, DuPage, Kane and Kendall Counties.

Chicago to Omaha Intercity Passenger Rail Service Kane County		Estimate of Diverted Trips
Build Alternative	**Quantity**	**Source:**
Total Annual Ridership	1,922,816	AECOM updates (April 2013)
New Trips from induced growth	190,944	AECOM updates (April 2013)
Amount of Diverted Trips	1,731,872	AECOM updates (April 2013)
Auto Diverted Trips	1,366,329	Travel diverted to rail from auto
Bus Diverted Trips	324,680	Travel diverted to rail from bus
Air Diverted Trips	40,864	Travel diverted to rail from air
Auto		
Auto miles one way	6.2	miles - Google Earth Pro
Nationwide % passenger cars	60.3%	Percent[a]
Nationwide % passenger trucks	39.7%	Percent[a]
Average passenger car energy intensity	3,538	Btu/passenger mile
Average passenger truck energy intensity	3,663	Btu/passenger mile
Average passengers per car	1.55	passengers/vehicle[a]
Average passengers per truck	1.84	passengers/vehicle[a]
Total diverted auto passenger miles per year	8,471,000	passenger-miles/year
Annual diverted auto fuel consumption	30,390	MMBtu/yr
Gasoline heating value	130,000	Btu/gal - USEPA AP-42 Appendix A
Annual auto fuel consumption diverted	233,769	gallons per year
Annual auto miles diverted	5,087,573	miles per year
Bus		
Intercity passenger bus energy intensity[a]	4,242	Btu/passenger mile
One-way distance	6.2	miles - Google Earth Pro
Total diverted bus passenger miles per year	2,013,013	passenger-miles/year
Annual diverted bus fuel consumption	8,539	MMBtu/yr
Diesel fuel heating value	137,000	Btu/gal - USEPA AP-42 Appendix A
Annual diverted bus fuel consumption	62,330	gallons per year
Train		
Intercity passenger train energy intensity[a]	2,435	Btu/passenger mile
One-way distance	6	miles
Total new train passenger miles per year	11,921,459	passenger-miles/year
Annual new passenger train fuel consumption	29,029	MMBtu/yr
Diesel fuel heating value	137,000	Btu/gal - USEPA AP-42 Appendix A
Annual new passenger train fuel consumption	211,889	gallons per year
Air		
Air transportation energy intensity[a]	2,826	Btu/passenger mile
One-way distance	6	miles - Google Earth Pro
Total diverted air passenger miles per year	253,354	passenger-miles/year
Jet fuel heating value	135,000	Btu/gal[a]
Jet fuel density	6.60	lb/gal
Annual air fuel consumption diverted	716	MMBtu/yr
Annual air fuel consumption diverted	5,304	gal/yr
Annual air fuel consumption diverted	15,892	kg/yr

[a] US Department of Energy Transportation Energy Data Book: Edition 30-2011.

Emission Calculations

	Additional Passenger Train Emissions			Automobile Emissions Diverted			Airline Emissions Diverted			Bus Emissions Diverted			
Pollutant	Emission Factor[1],[4] (g/gal) (lb/gal) CO2	Emissions Added (lb/yr)	Emissions Added (ton/yr)	Emission Factor[2] (g/mile) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	Emission Factor[3],[4] (g/kg) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	Emission Factor[2] (g/mile) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	Net Change (ton/yr)
Hydrocarbons	5.8	2,707	1.35	0.4272	4,787	2.39	0.7	25	0.01	0.1581	1,771	0.89	-1.94
Carbon monoxide (CO)	38.1	17,782	8.89	3.3467	37,503	18.75	4.4	154	0.08	1.2706	14,238	7.12	-17.06
Nitrogen oxides (NO_x)	131	61,140	30.57	3.4469	38,626	19.31	14.1	494	0.25	1.2978	14,543	7.27	3.74
PM_{10}	3.4	1,587	0.79	0.1698	1,903	0.95		0		0.0644	721	0.36	-0.52
$PM_{2.5}$	3.298	1,539	0.77	0.1411	1,581	0.79		0		0.0545	611	0.31	-0.33
SO_2[5]	0.096	45	0.02	0.0071	80	0.04	0.4	14	0.01	0.0024	27	0.01	-0.04
Carbon dioxide[4] (CO_2)	22.377	4,741,433	2,370.72	17.681	11,066,946	5,533.47	21.098	111,894	56	22.377	1,394,757	697.38	-3,916.08

[1] Except CO2, emission factors from EPA document EPA420-F-09-025; Emission Factors for Locomotives; Dated April 2009. Emission factors are projected calendar year 2015 emission factors for passenger/commuter locomotives (Tier 4).

[2] Emission factors from data output from EPA Moves2010b model run for 2015.

[3] Except CO2, emission factors from US Department of Transportation Federal Highway Administration document "Assessing the Effects of Freight Movement on Air Quality at the National and Regional Level; Final Report; April 2005". Emission factors are projected for 2015.

[4] CO2 Emission factors from US Department of Transportation Energy Information Administration Voluntary Reporting of Greenhouse Gases Program - Coefficients webpage. Emission factors are in units of lb/gal.

[5] Train SO_2 emission factor calculated based on 15 ppm (weight basis) diesel fuel sulfur content:
(15 ppm S/1,000,000) x (7.05 lb/gal) x (454 g/lb) x (2 lb SO2/lb S) = 0.096 g/gal

Note: The Chicago nonattainment area for Hydrocarbons, Nitrogen Oxides, and $PM_{2.5}$ includes the Cook, DuPage, Kane and Kendall Counties.

Chicago to Omaha Intercity Passenger Rail Service Kendall County		Estimate of Diverted Trips
Build Alternative	**Quantity**	**Source:**
Total Annual Ridership	1,922,816	AECOM updates (April 2013)
New Trips from induced growth	190,944	AECOM updates (April 2013)
Amount of Diverted Trips	1,731,872	AECOM updates (April 2013)
Auto Diverted Trips	1,366,329	Travel diverted to rail from auto
Bus Diverted Trips	324,680	Travel diverted to rail from bus
Air Diverted Trips	40,864	Travel diverted to rail from air
Auto		
Auto miles one way	14.5	miles - Google Earth Pro
Nationwide % passenger cars	60.3%	Percent[a]
Nationwide % passenger trucks	39.7%	Percent[a]
Average passenger car energy intensity	3,538	Btu/passenger mile
Average passenger truck energy intensity	3,663	Btu/passenger mile
Average passengers per car	1.55	passengers/vehicle[a]
Average passengers per truck	1.84	passengers/vehicle[a]
Total diverted auto passenger miles per year	19,812,000	passenger-miles/year
Annual diverted auto fuel consumption	71,077	MMBtu/yr
Gasoline heating value	130,000	Btu/gal - USEPA AP-42 Appendix A
Annual auto fuel consumption diverted	546,746	gallons per year
Annual auto miles diverted	11,898,831	miles per year
Bus		
Intercity passenger bus energy intensity[a]	4,242	Btu/passenger mile
One-way distance	14.5	miles - Google Earth Pro
Total diverted bus passenger miles per year	4,707,853	passenger-miles/year
Annual diverted bus fuel consumption	19,971	MMBtu/yr
Diesel fuel heating value	137,000	Btu/gal - USEPA AP-42 Appendix A
Annual diverted bus fuel consumption	145,772	gallons per year
Train		
Intercity passenger train energy intensity[a]	2,435	Btu/passenger mile
One-way distance	15	miles
Total new train passenger miles per year	27,880,831	passenger-miles/year
Annual new passenger train fuel consumption	67,890	MMBtu/yr
Diesel fuel heating value	137,000	Btu/gal - USEPA AP-42 Appendix A
Annual new passenger train fuel consumption	495,546	gallons per year
Air		
Air transportation energy intensity[a]	2,826	Btu/passenger mile
One-way distance	15	miles - Google Earth Pro
Total diverted air passenger miles per year	592,522	passenger-miles/year
Jet fuel heating value	135,000	Btu/gal[a]
Jet fuel density	6.60	lb/gal
Annual air fuel consumption diverted	1,674	MMBtu/yr
Annual air fuel consumption diverted	12,403	gal/yr
Annual air fuel consumption diverted	37,166	kg/yr

[a] US Department of Energy Transportation Energy Data Book: Edition 30-2011.

Emission Calculations

	Additional Passenger Train Emissions			Automobile Emissions Diverted			Airline Emissions Diverted			Bus Emissions Diverted			
Pollutant	Emission Factor[1],[4] (g/gal) (lb/gal) CO2	Emissions Added (lb/yr)	Emissions Added (ton/yr)	Emission Factor[2] (g/mile) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	Emission Factor[3],[4] (g/kg) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	Emission Factor[2] (g/mile) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	Net Change (ton/yr)
Hydrocarbons	5.8	6,331	3.17	0.4272	11,196	5.60	0.7	57	0.03	0.1581	4,142	2.07	-4.53
Carbon monoxide (CO)	38.1	41,587	20.79	3.3467	87,713	43.86	4.4	361	0.18	1.2706	33,300	16.65	-39.89
Nitrogen oxides (NO_x)	131	142,988	71.49	3.4469	90,339	45.17	14.1	1,156	0.58	1.2978	34,014	17.01	8.74
PM_{10}	3.4	3,711	1.86	0.1698	4,451	2.23		0		0.0644	1,687	0.84	-1.21
$PM_{2.5}$	3.298	3,600	1.80	0.1411	3,698	1.85		0		0.0545	1,430	0.71	-0.76
SO_2[5]	0.096	105	0.05	0.0071	186	0.09	0.4	33	0.02	0.0024	63	0.03	-0.09
Carbon dioxide[4] (CO_2)	22.377	11,088,836	5,544.42	17.681	11,066,946	5,533.47	21.098	261,688	131	22.377	3,261,932	1,630.97	-1,750.86

[1] Except CO2, emission factors from EPA document EPA420-F-09-025; Emission Factors for Locomotives; Dated April 2009. Emission factors are projected calendar year 2015 emission factors for passenger/commuter locomotives (Tier 4).

[2] Emission factors from data output from EPA Moves2010b model run for 2015.

[3] Except CO2, emission factors from US Department of Transportation Federal Highway Administration document "Assessing the Effects of Freight Movement on Air Quality at the National and Regional Level; Final Report; April 2005". Emission factors are projected for 2015.

[4] CO2 Emission factors from US Department of Transportation Energy Information Administration Voluntary Reporting of Greenhouse Gases Program - Coefficients webpage. Emission factors are in units of lb/gal.

[5] Train SO_2 emission factor calculated based on 15 ppm (weight basis) diesel fuel sulfur content:
(15 ppm S/1,000,000) x (7.05 lb/gal) x (454 g/lb) x (2 lb SO2/lb S) = 0.096 g/gal

Note: The Chicago nonattainment area for Hydrocarbons, Nitrogen Oxides, and $PM_{2.5}$ includes the Cook, DuPage, Kane and Kendall Counties.

Build Alternative Emission Calculations - 2040

Pollutant	Additional passenger train emissions			Automobile Emissions Diverted			Airline Emissions Diverted			Bus Emissions Diverted			Net Change (ton/yr)
	Emission Factor[1],[4] (g/gal) (lb/gal) CO2	Emissions Added (lb/yr)	Emissions Added (ton/yr)	Emission Factor[2] (g/mile) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	Emission Factor[3],[4] (g/kg) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	Emission Factor[2] (g/mile) (lb/gal) CO2	Emissions Diverted (lb/yr)	Emissions Diverted (ton/yr)	
Hydrocarbons	5.8	218,302	109.15	0.4272	365,219	182.61	0.7	1,677	0.84	0.1581	135,129	67.56	-141.86
Carbon monoxide (CO)	38.1	1,434,020	717.01	3.3467	2,861,230	1,430.62	4.4	10,544	5.27	1.2706	1,086,255	543.13	-1,262.00
Nitrogen oxides (NO_x)	131	4,930,620	2,465.31	3.4469	2,946,874	1,473.44	14.1	33,788	16.89	1.2978	1,109,551	554.78	420.20
PM_{10}	3.4	127,970	63.99	0.1698	145,180	72.59				0.0644	55,034	27.52	-36.12
$PM_{2.5}$	3.298	124,131	62.07	0.1411	120,644	60.32				0.0545	46,635	23.32	-21.57
SO_2[5]	0.096	3,614	1.81	0.0071	6,082	3.04	0.4	959	0.48	0.0024	2,045	1.02	-2.74
Carbon dioxide[4] (CO_2)	22.377	382,373,667	191,186.83	17.681	315,341,859	157,670.93	21.098	7,652,118	3,826	22.377	106,406,455	53,203.23	-23,513.38

[1] Except CO2, emission factors from EPA document EPA420-F-09-025; Emission Factors for Locomotives; Dated April 2009. Emission factors are projected calendar year 2015 emission factors for passenger/commuter locomotives (Tier 4).

[2] Emission factors from data output from EPA Moves2010b model run for 2015.

[3] Except CO2, emission factors from US Department of Transportation Federal Highway Administration document "Assessing the Effects of Freight Movement on Air Quality at the National and Regional Level; Final Report; April 2005". Emission factors are projected for 2015.

[4] CO2 Emission factors from US Department of Transportation Energy Information Administration Voluntary Reporting of Greenhouse Gases Program - Coefficients webpage. Emission factors are in units of lb/gal.

[5] Train SO_2 emission factor calculated based on 15 ppm (weight basis) diesel fuel sulfur content: (15 ppm S/1,000,000) x (7.05 lb/gal) x (454 g/lb) x (2 lb SO2/lb S) = 0.096 g/gal

Chicago to Omaha Intercity Passenger Rail Service - Estmate of Diverted Trips - 2040

Build Alternative		Quantity	Source
Total Annual Ridership		1,922,816	AECOM Ridership Forecast 9/17/12
New Trips from induced growth		190,944	AECOM Ridership Forecast 9/17/12
Amount of Diverted Trips		1,731,900	AECOM Ridership Forecast 9/17/12
Auto Percent of Diverted Trips	78.9%	1,366,329	Passengers diverted to rail from auto
Bus Percent of Diverted Trips	18.7%	324,680	Passengers diverted to rail from bus
Air Percent of Diverted Trips	2.4%	40,864	Passengers diverted to rail from air
Auto			
Auto miles one way		473	miles - Google Earth Pro
Nationwide % passenger cars		60.3%	Percent[a]
Nationwide % passenger trucks		39.7%	Percent[a]
Average passenger car energy intensity		3,538	Btu/passenger mile
Average passenger truck energy intensity		3,663	Btu/passenger mile
Average passengers per car		1.55	passengers/vehicle[a]
Average passengers per truck		1.84	passengers/vehicle[a]
Total diverted auto passenger miles per year		646,273,000	passenger-miles/year
Annual diverted auto fuel consumption		2,318,559	MMBtu/yr
Gasoline heating value		130,000	Btu/gal - USEPA AP-42 Appendix A
Annual auto fuel consumption diverted		17,835,069	gallons per year
Annual auto miles diverted		388,143,198	miles per year
Bus			
Intercity passenger bus energy intensity[a]		4,242	Btu/passenger mile
One-way distance		473	miles - Google Earth Pro
Total diverted bus passenger miles per year		153,573,406	passenger-miles/year
Annual diverted bus fuel consumption		651,458	MMBtu/yr
Diesel fuel heating value		137,000	Btu/gal - USEPA AP-42 Appendix A
Annual diverted bus fuel consumption		4,755,171	gallons per year
Train			
Intercity passenger train energy intensity[a]		2,435	Btu/passenger mile
One-way distance		500	miles
Total new train passenger miles per year		961,407,965	passenger-miles/year
Annual new passenger train fuel consumption		2,341,028	MMBtu/yr
Diesel fuel heating value		137,000	Btu/gal - USEPA AP-42 Appendix A
Annual new passenger train fuel consumption		17,087,799	gallons per year
Air			
Air transportation energy intensity[a]		2,826	Btu/passenger mile
One-way distance		424	miles - Google Earth Pro
Total diverted air passenger miles per year		17,326,147	passenger-miles/year
Jet fuel heating value		135,000	Btu/gal[a]
Jet fuel density		6.60	lb/gal
Annual air fuel consumption diverted		48,964	MMBtu/yr
Annual air fuel consumption diverted		362,694	gal/yr
Annual air fuel consumption diverted		1,086,776	kg/yr

[a] US Department of Energy Transportation Energy Data Book: Edition 30-2011.