Supporting information

High pressure separation of greenhouse gases from air with 1-ethyl-3-methylimidazolium methyl-phosphonate

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Table S. Bubble point data of the system CO_2 + $[C_2mim][CH_3OHPO_2]$ and temperature dependent binary parameters (ξ) used in the soft-SAFT EoS.

x_{CO_2}	***T* (K)**	***p* (MPa)**	x_{CO_2}	***T* (K)**	***p* (MPa)**	x_{CO_2}	***T* (K)**	***p* (MPa)**
m_{CO_2}	**=0.423 $mol_{CO2}.Kg_{IL}^{-1}$**		m_{CO_2}	**=0.795 $mol_{CO2}.Kg_{IL}^{-1}$**		m_{CO_2}	**=1.861 $mol_{CO2}.Kg_{IL}^{-1}$**	
0.080	293.21	1.16	0.141	293.29	1.88	0.277	293.16	3.42
	303.41	1.46		303.15	2.24		303.41	4.19
	313.45	1.76		313.46	2.45		313.52	5.08
	323.40	1.99		323.43	3.05		323.39	6.08
	333.29	2.31		333.46	3.56		333.32	7.21
	343.28	2.56		343.35	4.17		343.18	8.41
	353.50	2.85		353.31	4.75		353.33	9.80
	363.45	3.12		363.38	5.36		363.38	11.11
m_{CO_2}	**=2.607 $mol_{CO2}.Kg_{IL}^{-1}$**		m_{CO_2}	**=3.353 $mol_{CO2}.Kg_{IL}^{-1}$**		m_{CO_2}	**=3.997 $mol_{CO2}.Kg_{IL}^{-1}$**	
0.350	293.17	5.21	0.409	293.28	6.45	0.452	293.32	11.00
	302.90	6.38		303.18	8.45		303.25	17.26
	313.23	7.54		313.18	11.48		313.29	23.51
	323.37	9.32		323.30	15.91		323.49	29.82
	333.23	11.27		333.24	20.47		333.53	34.67
	343.34	13.61		343.31	25.13		343.55	40.64
	353.32	16.20		353.46	29.45		353.46	45.99
	363.28	18.92		363.17	33.68		363.43	51.09
m_{CO_2}	**=4.932 $mol_{CO2}.Kg_{IL}^{-1}$**						**T_a^* (K)**	ξ
0.504	293.18	31.91					293.23	1.022
	303.26	40.79					303.22	1.021
	313.41	49.64					313.36	1.020
	323.31	58.70					323.38	1.017
	333.35	66.69					333.36	1.014
	343.31	73.43					343.33	1.010
	353.34	80.89					353.39	1.005
	363.32	87.65					363.34	1.000

*Calculated average temperature.

Table S. Bubble point data of the system N_2O + $[C_2mim][CH_3OHPO_2]$ and temperature dependent binary parameters (ξ) used in the soft-SAFT EoS.

x_{N_2O}	T (K)	p (MPa)	x_{N_2O}	T (K)	p (MPa)	x_{N_2O}	T (K)	p (MPa)
m_{N_2O}	**=0.569 $mol_{N2O}.Kg_{IL}^{-1}$**		m_{N_2O}	**=0.769 $mol_{N2O}.Kg_{IL}^{-1}$**		m_{N_2O}	**=1.110 $mol_{N2O}.Kg_{IL}^{-1}$**	
	293.35	1.71		293.42	2.30		293.40	3.58
	303.37	2.13		303.30	2.88		303.22	4.39
	313.30	2.67		313.30	3.55		313.20	5.35
	323.32	3.22		323.13	4.23		323.34	6.42
0.105	333.14	3.80	0.137	333.23	5.00	0.186	333.28	7.81
	343.25	4.45		343.25	5.71		343.23	9.04
	353.27	5.25		353.14	6.47		353.29	10.24
	363.40	5.75		363.39	7.32		363.47	11.47
m_{N_2O}	**=1.450 $mol_{N2O}.Kg_{IL}^{-1}$**		m_{N_2O}	**=1.606 $mol_{N2O}.Kg_{IL}^{-1}$**		m_{N_2O}	**=1.716 $mol_{N2O}.Kg_{IL}^{-1}$**	
	293.12	4.73		293.16	5.40		293.27	6.01
	303.26	5.93		303.41	6.88		303.19	9.31
	313.26	7.21		313.28	9.10		313.33	12.98
	323.28	8.76		323.23	11.93		323.14	15.95
0.230	333.42	10.54	0.249	333.14	14.56	0.261	333.16	18.67
	343.18	12.36		343.10	17.08		343.25	21.30
	353.45	14.36		353.28	19.53		353.28	23.73
	363.37	16.23		363.29	21.74		363.24	25.87
m_{N_2O}	**=1.819 $mol_{N2O}.Kg_{IL}^{-1}$**		m_{N_2O}	**=1.897 $mol_{N2O}.Kg_{IL}^{-1}$**		m_{N_2O}	**=1.946 $mol_{N2O}.Kg_{IL}^{-1}$**	
	293.17	11.68		293.30	17.06		293.30	21.52
	303.22	15.15		303.26	19.78		303.11	24.18
	313.27	18.11		313.21	22.56		313.27	26.72
	323.30	20.98		323.16	25.15		323.25	29.25
0.273	333.15	23.50	0.281	333.14	27.66	0.286	333.15	31.06
	343.22	25.95		343.19	30.05		343.16	33.07
	353.22	28.17		353.15	32.21		353.29	35.12
	363.25	30.19		363.11	34.13		363.14	36.99
m_{N_2O}	**=2.196 $mol_{N2O}.Kg_{IL}^{-1}$**						T_a^* (K)	ξ
0.312	293.25	46.28						

303.31	48.66	293.27	0.9800
313.37	51.26	303.27	0.9820
323.49	52.47	313.28	0.9820
333.24	53.85	323.28	0.9805
343.29	54.85	333.21	0.9782
353.18	56.07	343.21	0.9753
363.40	56.75	353.26	0.9720
		363.31	0.9685

*Calculated average temperature.

Table S. Bubble point data of the system CH_4 + $[C_2mim][CH_3OHPO_2]$ temperature dependent binary parameters (η) used in the soft-SAFT EoS.

x_{CH_4}	**T (K)**	**P (MPa)**	x_{CH_4}	**T (K)**	**p (MPa)**	x_{CH_4}	**T (K)**	**p (MPa)**
m_{CH_4}	**=0.087 $mol_{CH4}.Kg_{IL}^{-1}$**		m_{CH_4}	**=0.142 $mol_{CH4}.Kg_{IL}^{-1}$**		m_{CH_4}	**=0.220 $mol_{CH4}.Kg_{IL}^{-1}$**	
	293.27	2.67		293.27	6.57		293.30	12.54
	303.25	2.93		303.32	6.84		303.38	12.76
	313.25	3.14		313.20	7.22		313.34	13.00
	323.29	3.36		323.22	7.55		323.31	13.12
0.018	333.32	3.51	0.028	333.29	7.71	0.043	333.18	13.32
	343.25	3.66		343.08	7.94		343.19	13.42
	353.29	3.81		353.30	8.12		353.44	13.59
	363.31	3.86		363.21	8.23		363.43	13.78
m_{CH_4}	**=0.274 $mol_{CH4}.Kg_{IL}^{-1}$**						T_a^* **(K)**	η
	293.24	17.79						
	303.28	17.81					293.27	1.0505
	313.22	17.99					303.31	1.0457
	323.21	17.90					313.25	1.0435
0.054	333.24	17.79					323.26	1.0430
	343.31	17.80					333.26	1.0438
	353.36	17.98					343.21	1.0455
	363.34	18.02					353.35	1.0475
							363.32	1.0500

*Calculated average temperature.

Table S. Bubble point data of the system N_2 + $[C_2mim][CH_3OHPO_2]$ temperature dependent binary parameters (ξ) used in the soft-SAFT EoS.

x_{N_2}	T (K)	p (MPa)	x_{N_2}	T (K)	p (MPa)	x_{N_2}	T (K)	p (MPa)
m_{N_2}	**=0.084 $mol_{N2}.Kg_{IL}^{-1}$**		m_{N_2}	**0.107 $mol_{N2}.Kg_{IL}^{-1}$**		m_{N_2}	**=0.132 $mol_{N2}.Kg_{IL}^{-1}$**	
	293.13	18.89		293.34	33.17		293.25	51.32
	303.13	16.99		303.50	31.12		303.14	46.93
	313.23	16.20		313.26	28.77		313.42	42.77
0.017	323.48	15.67	0.022	323.16	27.54	0.027	323.34	39.80
	333.38	15.29		333.38	26.35		333.26	37.57
	343.46	15.14		343.38	25.10		343.22	35.79
	353.37	14.79		353.32	24.23		353.18	34.54
	363.33	14.33		363.53	23.41		363.19	33.38
m_{N_2}	**=0.155 $mol_{N2}.Kg_{IL}^{-1}$**		m_{N_2}	**=0.177 $mol_{N2}.Kg_{IL}^{-1}$**		m_{N_2}	**=0.200 $mol_{N2}.Kg_{IL}^{-1}$**	
	293.36	61.89		293.18	72.34		293.31	80.51
	303.37	55.20		303.32	64.21		303.24	72.11
	313.26	51.58		313.45	58.11		313.45	65.53
0.031	323.30	48.12	0.035	323.35	53.55	0.040	323.18	60.50
	333.31	45.23		333.32	50.93		333.35	57.12
	343.23	42.72		343.21	47.78		343.32	53.37
	353.34	40.87		353.31	45.32		353.21	50.51
	363.38	38.76		363.35	43.14		363.30	47.96
m_{N_2}	**=0.222 $mol_{N2}.Kg_{IL}^{-1}$**					T_a^* (K)	ξ	
	293.31	89.43						
	303.38	79.25				293.31	0.829	
	313.30	71.79				303.32	0.852	
0.044	323.22	66.09				313.30	0.867	
	333.16	61.41				323.30	0.872	
	343.49	57.98				333.32	0.872	
	353.22	55.26				343.32	0.870	
	363.28	52.18				353.31	0.865	
						363.33	0.859	

*Calculated average temperature.

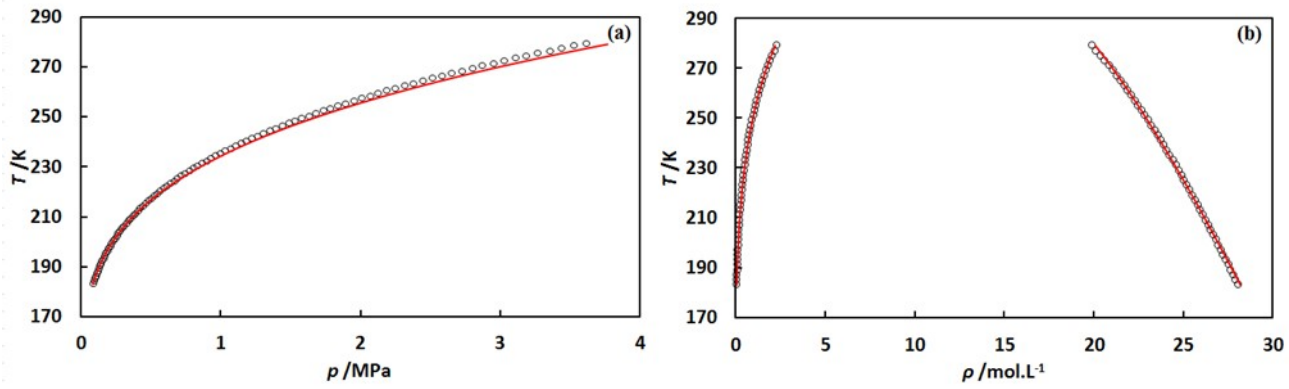

Figure S. (a) Temperature-vapor pressure and **(b)** temperature-density diagrams for N_2O. Symbols represent experimental data (Linstrom and Mallard, 2005) and the solid lines represent the soft-SAFT EoS fit.

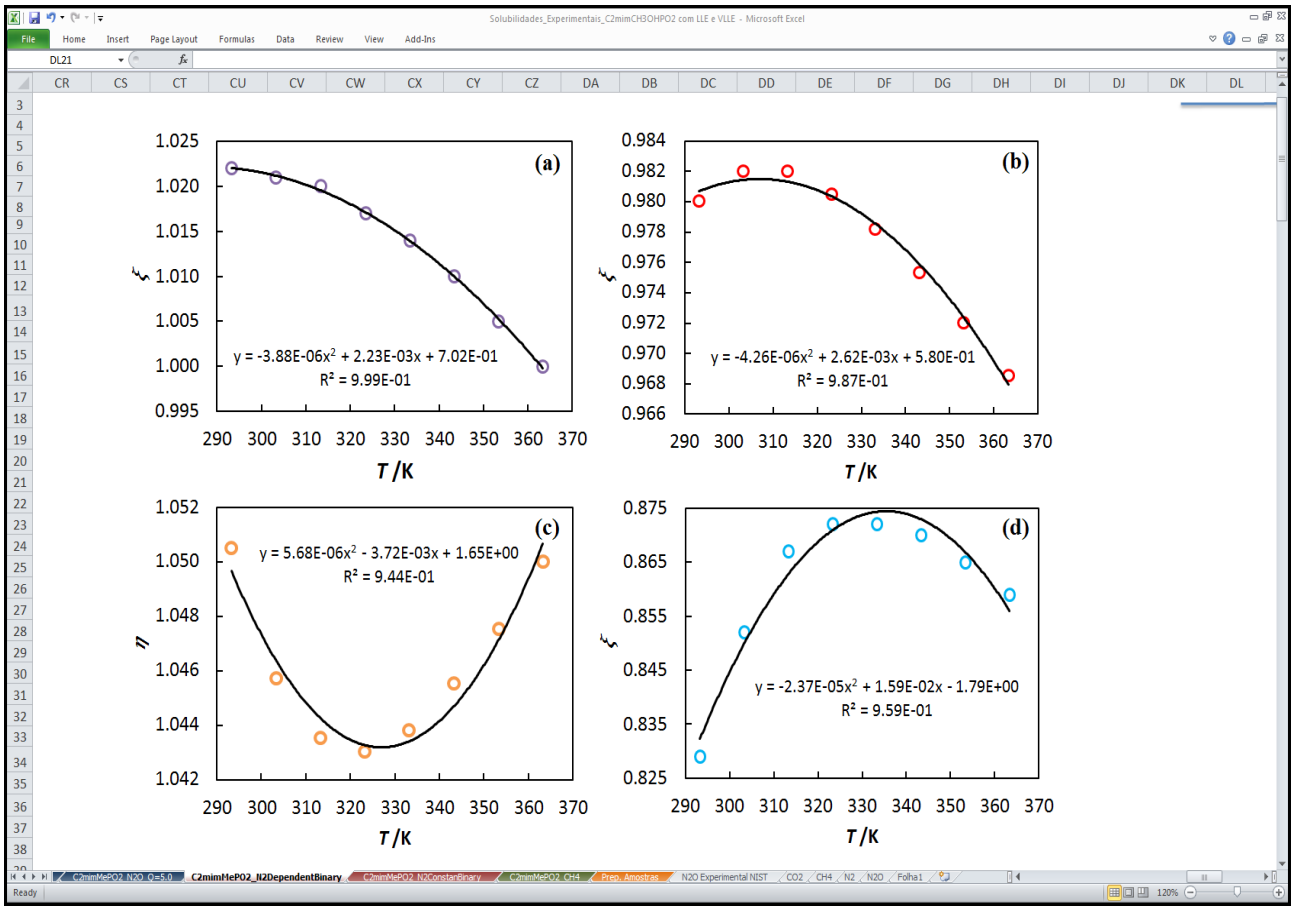

Figure S2. Soft-SAFT EoS binary parameter-temperature diagrams for the systems with the selected IL and the gases **(a)** CO_2, **(b)** N_2O, **(c)** CH_4 and **(d)** N_2. Solid lines represent the adjusted second order polynomial.

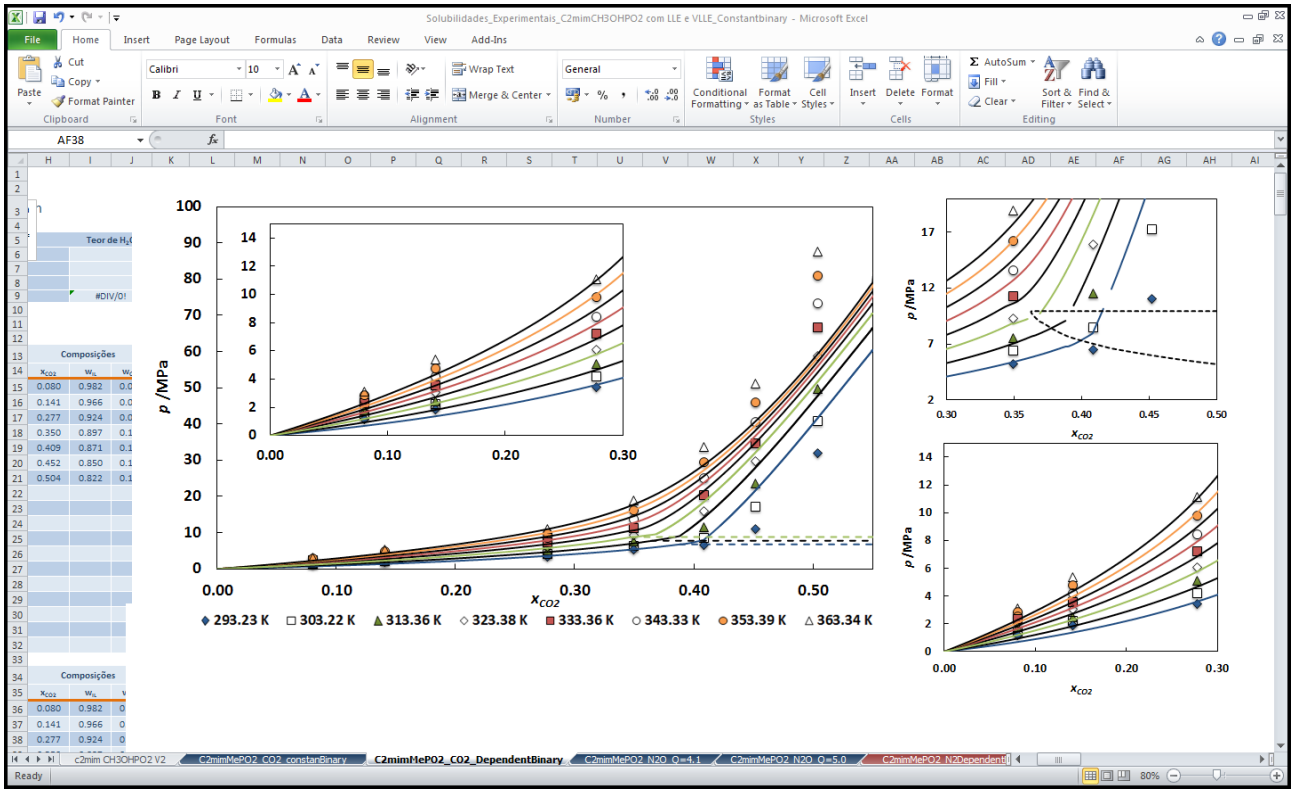

Figure S3. Pressure-composition diagram of the binary system CO_2 + $[C_2mim][CH_3OHPO_2]$. The solid lines represent the soft-SAFT EoS GLE predictions and the dashed lines the VLLE predictions, using one temperature independent binary parameter (ξ =1.0136).