Supplementary data

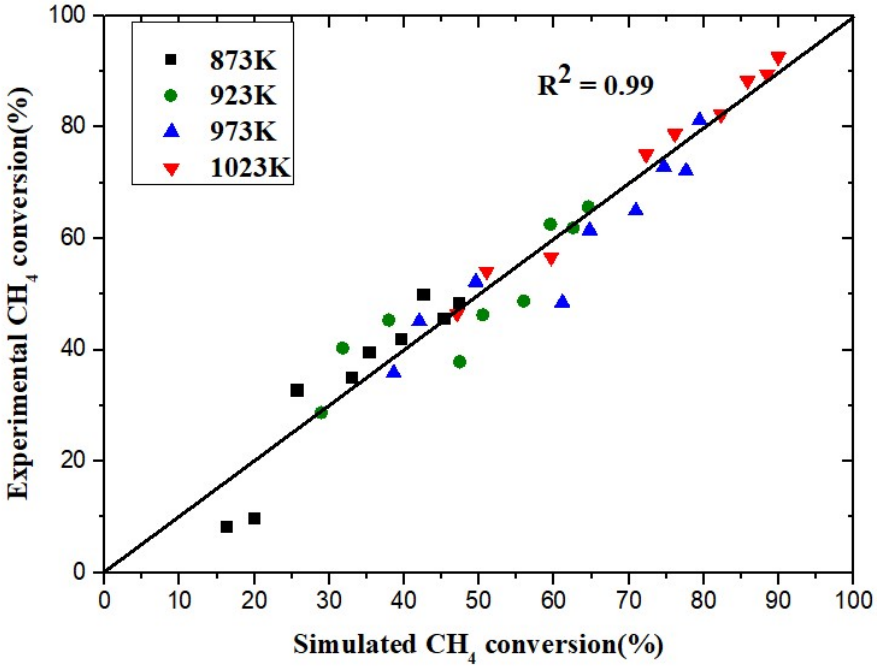

Figure S1 – Comparison of model-predicted CH_4 conversions and experimental data for ODRM; Reaction conditions: Temperature (873K to 1023K), Pressure (1 atm), Molar feed composition (CH_4:0.333, CO_2:0.333, O_2:0.0756, N_2:0.256).

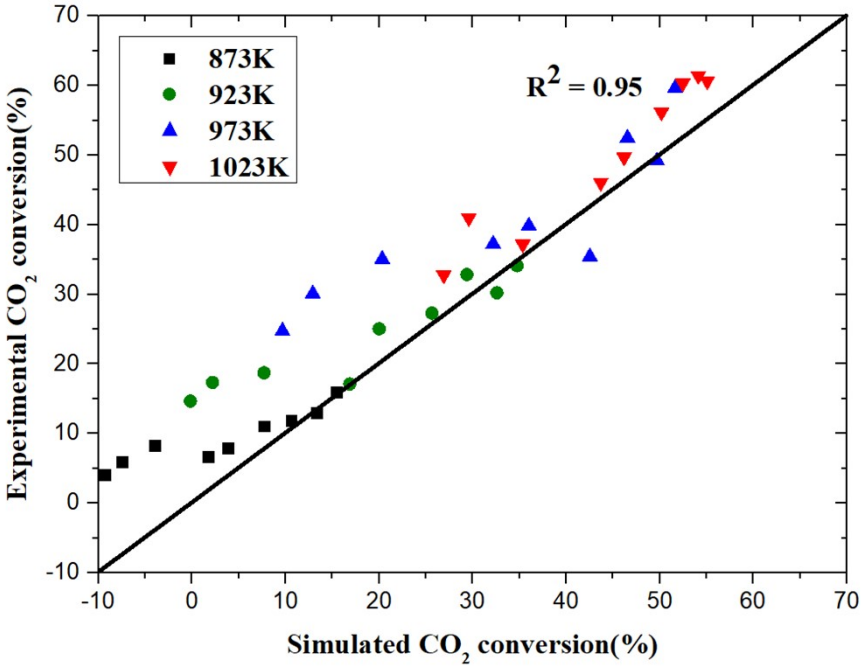

Figure S2 – Comparison of model-predicted CO_2 conversions and experimental data for ODRM; Reaction conditions: Temperature (873K to 1023K), Pressure (1 atm), Molar feed composition (CH_4:0.333, CO_2:0.333, O_2:0.0756, N_2:0.256).

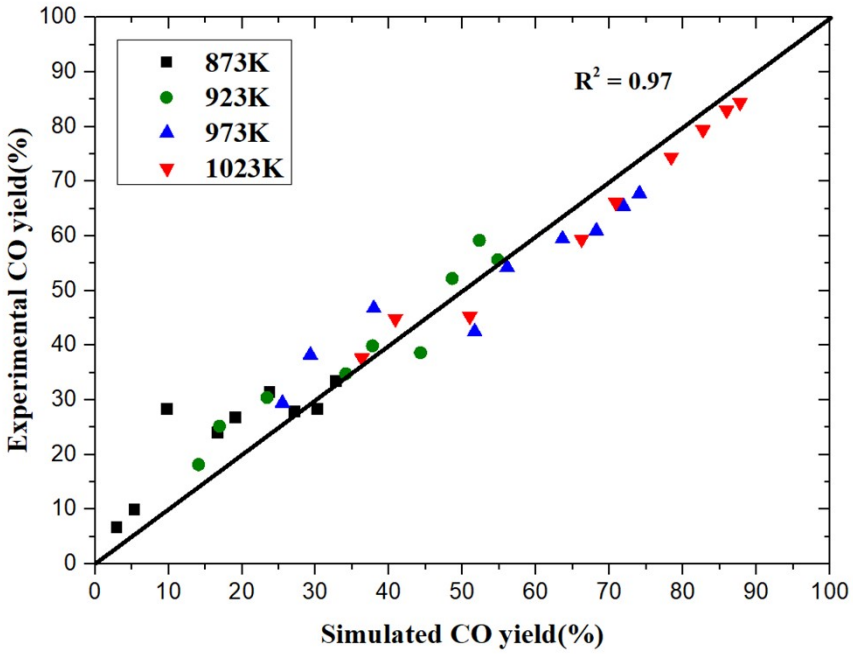

Figure S3 – Comparison of model-predicted CO yields experimental and data for ODRM; Reaction conditions: Temperature (873K to 1023K), Pressure (1 atm), Molar feed composition (CH_4:0.333, CO_2:0.333, O_2:0.0756, N_2:0.256).

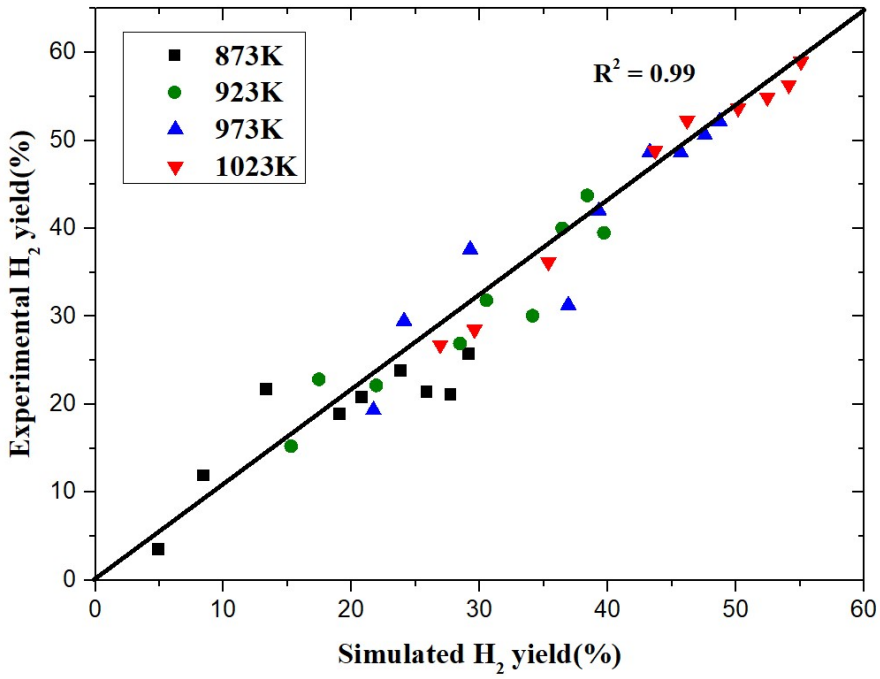

Figure S4 – Comparison of model-predicted H_2 yields experimental and data for ODRM; Reaction conditions: Temperature (873K to 1023K), Pressure (1 atm), Molar feed composition (CH_4:0.333, CO_2:0.333, O_2:0.0756, N_2:0.256).

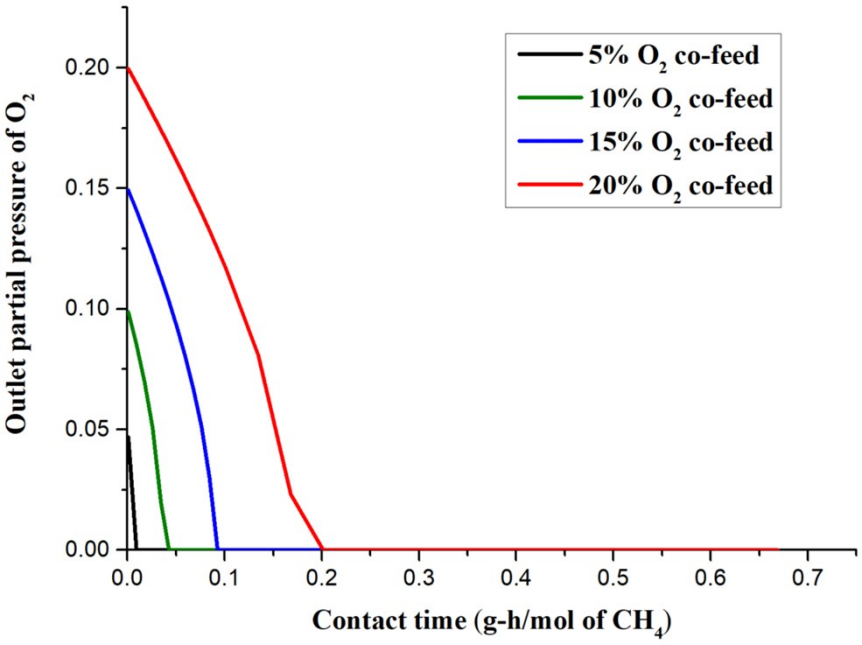

Figure S5 – Outlet partial pressure of O_2 with contact time for ODRM; Reaction conditions: Temperature (873K), Pressure (1 atm), Molar feed composition (CH_4:0.333, CO_2:0.333, O_2:0.05 to 0.20, N_2:balance), contact time (0 to 0.7 g-h/mol of CH_4)

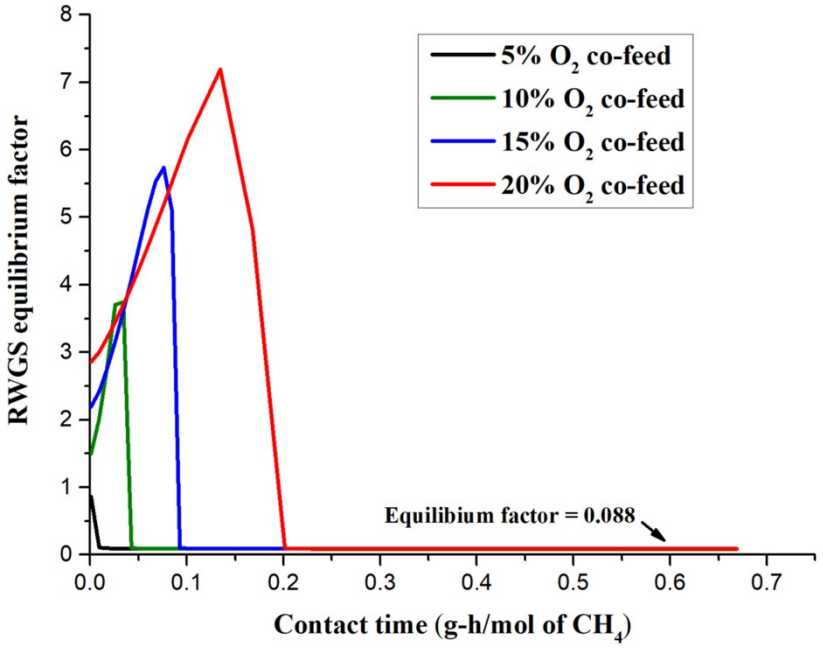

Figure S6 – Equilibrium factor of RWGS reaction with contact time for ODRM; Reaction conditions: Temperature (873K), Pressure (1 atm), Molar feed composition (CH_4:0.333, CO_2:0.333, O_2:0.05 to 0.20, N_2:balance), contact time (0 to 0.7 g-h/mol of CH_4)

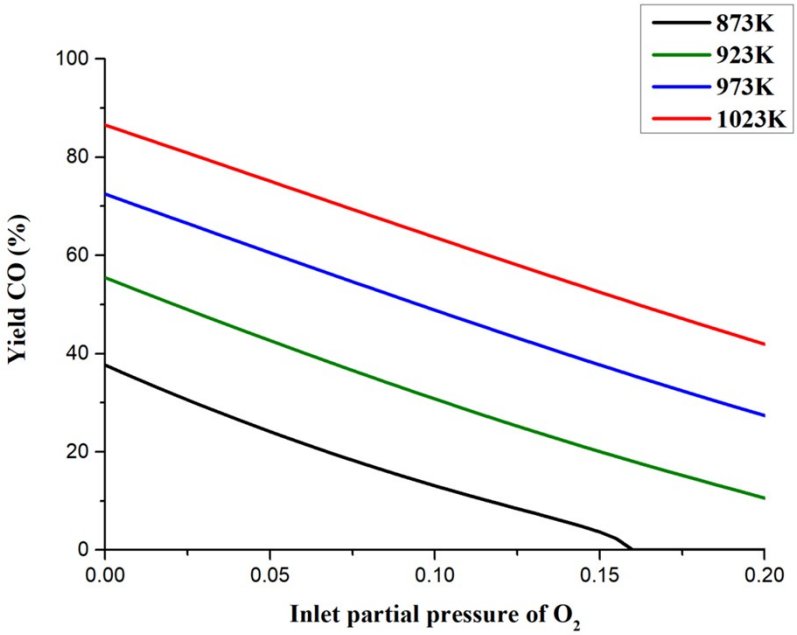

Figure S7 – Model-predicted CO yields as a function of O_2 co-feed for ODRM; Reaction conditions: Temperature (873K), Pressure (1 atm), Molar feed composition (CH_4:0.333, CO_2:0.333, O_2:0 to 0.20, N_2:balance), Contact time (0.6 g-h/mol of CH_4).

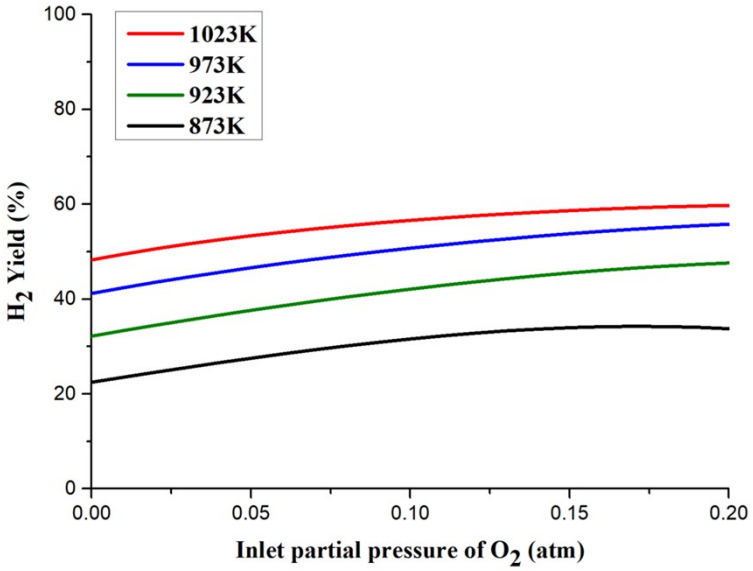

Figure S8 – Model-predicted H_2 yields as a function of O_2 co-feed concentration ODRM; Reaction conditions: Temperature (873K to 1023K), Pressure (1 atm), Molar feed composition (CH_4:0.333, CO_2:0.333, O_2:0 to 0.20, N_2:balance), Contact time (0.6 g-h/mol of CH_4).

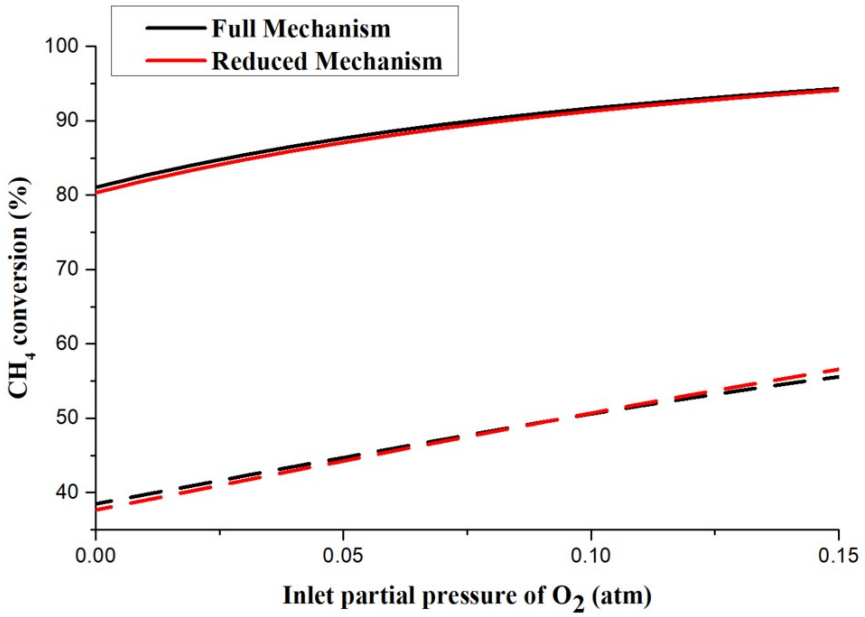

Figure S9 – Comparison of model-predicted CH_4 conversions using full mechanism and reduced mechanism; Reaction conditions: Temperature 873K (dashed lines) and 1023K(lines), Pressure (1 atm), Molar feed composition (CH_4:0.333, CO_2:0.333, O_2:0.0 to 0.15, N_2:balance), Contact time (0.6 g-h/mol of CH_4).

Reaction ID	**Equations**	**A_0 (cm^2, mol, s)/S_0**	**β**	**E_a (J/mol)**	**ε_i/CO* (J/mol)**
1	H_2 + 2 * => 2 H*	3.00E-02	0	5.00E+03	0
2	2 H* => H_2 + 2 *	2.54E+20	0	9.52E+04	0
3	2 * + O_2 => 2 O*	4.36E-02	-0.206	1.51E+03	0
4	2 O* => 2 * + O_2	1.19E+21	0.823	4.69E+05	0
5	H_2O + * => H_2O*	1.00E-01	0	0	0
6	H_2O* => H_2O + *	3.73E+12	0	6.08E+04	0
7	CO_2 + * => CO_2*	7.00E-06	0	0	0
8	CO_2* => CO_2 + *	6.44E+07	0	2.60E+04	0
9	CO + * => CO*	5.00E-01	0	0	0
10	CO* => CO + *	3.57E+11	0	1.11E+05	-5.00E+04
11	CH_4 + * => CH_4*	8.00E-03	0	0	0
12	CH_4* => CH_4 + *	8.71E+15	0	3.76E+04	0
13	CH_4* + * => CH_3* + H*	1.55E+21	0.087	5.58E+04	0
14	CH_3* + H* => CH_4* + *	1.44E+22	-0.087	6.35E+04	0
15	CH_3* + * => CH_2* + H*	1.55E+24	0.087	9.81E+04	0

16	CH_2* + H* => CH_3* + *	3.09E+23	-0.087	5.72E+04	0
17	CH_2* + * => CH* + H*	1.55E+24	0.087	9.52E+04	0
18	CH* + H* => CH_2* + *	9.77E+24	-0.087	8.11E+04	0
19	CH* + * => C* + H*	9.89E+20	0.5	2.20E+04	0
20	C* + H* => CH* + *	1.71E+24	-0.5	1.58E+05	0
21	CH_4* + O* => CH_3* + OH*	5.62E+24	-0.101	8.79E+04	0
22	H_2O* + * => H* + OH*	3.67E+21	-0.086	9.29E+04	0
23	H* + OH* => H_2O* + *	1.85E+20	0.086	4.15E+04	0
24	H* + O* => * + OH*	3.95E+23	-0.188	1.04E+05	0
25	* + OH* => H* + O*	2.25E+20	0.188	2.96E+04	0
26	C* + O* => CO* + *	3.40E+23	0.000	1.48E+05	0
27	CO* + H* => C* + OH*	3.52E+18	-0.188	1.05E+05	-5.00E+04
28	C* + OH* => CO* + H*	3.89E+25	0.188	6.26E+04	0
29	CO_2* + * => CO* + O*	4.64E+23	-1.000	8.93E+04	-5.00E+04
30	CO* + OH* => COOH* + *	6.00E+21	0.213	9.76E+04	-5.00E+04
31	COOH* + * => CO* + OH*	1.46E+24	-0.213	5.44E+04	0
32	CO_2* + H* => COOH* + *	6.25E+24	-0.475	1.17E+05	0
33	COOH* + * => CO_2* + H*	3.74E+20	0.475	3.37E+04	0
34	CO* + H* => HCO* + *	4.01E+20	-1	1.32E+05	-5.00E+04
35	HCO* + * => CO* + H*	3.71E+21	0	0	5.00E+04

Table S1: Reduced mechanism developed for oxidative dry reforming in O_2 enhanced region