Supporting information

Assessing the viability of K-Mo₂C for reverse water-gas shift scale-up: Molecular to laboratory to pilot scale

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Figure S11. Deconvoluted Mo3d spectra (solid line) of P-K-Mo₂C/ γ -Al₂O₃, as-synthesized. Contributions include Mo⁶⁺, Mo⁴⁺, Mo²⁺, and Mo⁰.

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Figure S14. Binding configurations of a) CO_2 ; and b) CO on the C-terminated surface of Mo_2C . Neither adsorbate binds strongly (BE_{CO}= -1.28 kcal mol⁻¹, BE_{CO2}= -1.06 kcal mol⁻¹) and are moving away from the surface.

Figure S15. CO TPD for as-synthesized (red) and spent P-K-Mo₂C/ γ -Al₂O₃ after 12 h on stream at 300 °C (green), 450 °C (teal) and 600 °C (blue) from 100 °C to 650 °C with a ramp rate of 5 °C min⁻¹.

Figure S16. Temperature-programmed desorption data with as-synthesized P-K-Mo₂C following no pretreatment (red), CO₂-TPD (blue) and CO-TPD (green) from 50 °C to 850 °C with a ramp rate of 5 °C min⁻¹.

Figure S17. Mo K-edge XANES energy space spectra of the P-K-Mo₂C catalyst: a) as-synthesized and after reduction; and b) after reduction and after reaction at 450 °C and 600 °C.

Figure S18. X-ray diffraction patterns of K-Mo₂C/Al₂O₃ synthesized on the laboratory scale (L-K-Mo₂C), pilot scale (P-K-Mo₂C) and pilot scale catalyst resynthesized on the laboratory scale (LC-P-Mo₂C). Symbols correspond to: γ -Al₂O₃ (+), MoO₂ (#), β -Mo₂C (*), and MoC (!).

Figure S19. XPS spectra of LC-P-Mo₂C resynthesized under laboratory carburization conditions. a) Deconvoluted Mo3d spectra of LC-P-Mo₂C with contributions from Mo⁶⁺, Mo⁴⁺, Mo²⁺, and Mo⁰; b) O1s spectra; and c) C1s spectra.

Figure S20. Arrhenius plot of P-K-Mo₂C/ γ -Al₂O₃ and L-K-Mo₂C/ γ -Al₂O₃ showing ln(CO Yield) versus 1000/T. The values of CO yield are calculated by averaging 18 steady-state data points, taken between 7 - 12 h on stream. The dashed line represents the natural log of the maximum thermodynamic CO yield for RWGS. Experimental conditions for P-K-Mo₂C: 30 mg catalyst, 25 sccm CO₂, 75 sccm H₂, 10 sccm Ar, GHSV = 61.1 L kg⁻¹ s⁻¹; L-K-Mo₂C: 25 mg catalyst, 10 sccm CO₂, 30 sccm H₂, 10 sccm N₂, GHSV = 33.3 L kg⁻¹ s⁻¹.

Table S4. Detailed distribution of C_2 + products detected in selected RWGS experiments.

Table S5. Full list of selected catalysts for benchmarking catalytic performance of P-K-Mo₂C/ γ -Al₂O₃. The asterisk (*) indicates this work. The P-K-Mo₂C/ γ -Al₂O₃ trial marked with (†) has been conducted with the pilot-scale reactor. All other reaction trials marked with an asterisk (*) have been performed using the laboratory-scale reactor.

Sample Calculations. Methodology for calculating CO STY, CO cost and CO production rates for Figure 1, Table 4 and Table S5.

CO STY (µmol CO gcat⁻¹ s⁻¹):

$$CO STY\left(\frac{\mu mol CO}{g_{cat} * s}\right) = \frac{\left(\frac{CO Yield(\%)}{100}\right) * CO_2 Flow Rate\left(\frac{mL}{min}\right) * 44.643 \frac{\mu mol}{mL}}{\left(\frac{60 s}{1 min}\right) * Catalyst Mass(g)}$$

Where µmol CO is the moles of CO produced.

CO Production Rate (kg CO kg metal⁻¹ day⁻¹):

 $CO Rate\left(\frac{kg CO}{kg metal * day}\right) = CO STY\left(\frac{\mu mol CO}{g_{cat} * s}\right) * 10^{-6} \frac{mol}{\mu mol} * \frac{0.028 kg CO}{mol CO} * \frac{100}{metal loading (wt\%)} * \frac{1000 g}{1 kg} * \frac{86400 s}{1 day}$

Where µmol CO is the moles of CO produced and kg metal is the mass of metal present in the catalyst.

CO Cost (\$ metal kg CO⁻¹):

$$CO\ Cost\left(\frac{\$\ metal}{kg\ CO}\right) = \frac{1}{CO\ Daily\ Production}\left(\frac{kg\ metal}{kg\ CO}\right) * \frac{1000\ g}{1\ kg} * Metal\ Price\ (\frac{\$\ USD}{g_{Metal}})$$

Where CO Daily Production is the kg of CO produced per kg metal in one day (CO Rate times one day), metal prices ($\$ USD g_{metal}^{-1}) are sourced from Argus Metals.¹

Pilot-Scale Catalyst Synthesis (at OxEon Energy): The P-K-Mo₂C catalyst (target final form P-K-Mo₂C/ γ -Al₂O₃) was synthesized via a three-step incipient wetness impregnation process with target molar ratios of 1/4/15 K/Mo/ γ -Al₂O₃. Aqueous solutions of KNO₃ and ammonium heptamolybdate (AHM) precursors (Alfa Aesar, ACS grade) were prepared separately and molar concentrations determined by loss-on-ignition (LOI) measurements. Precursor solutions were mixed just prior to each impregnation step to avoid reaction between the solutions (e.g. formation of insoluble molybdic acid).

The incipient wetness (IW) volume of the St. Gobain tri-lobe support was measured by slowly adding DI water to a small sample until wetness was observed via water beading on the surface and clumping of the tri-lobes, then comparing the dry and saturated weights (prior to beading ensured support flowed freely with no clumping). The measured IW volume was 0.88 cc g^{-1} . The total solution volume (KNO₃ + AHM solutions) used for the initial impregnation of the support was 90% of the IW volume. Due to pore volume reduction with each loading the 2nd and 3rd impregnation steps used solution volumes significantly lower than the previous step as can be seen in Table S1 below.

K-Mo Catalyst: 3-Step Impregnation										
Impreg. Step #	% Total Solution (to achieve target molar ratios)	% IW Volume (of bare support)								
1	46.7%	90.0%								
2	32.0%	61.7%								
3	21.3%	41.1%								

Table S1. Breakdown of solution amounts used for the 3-step impregnation of K-Mo₂C/γ-Al₂O₃.

Solution impregnation into the support was conducted at room temperature in a 10 L capacity rotary evaporator (rotating at 10 rpm) using a pressure-driven dispense apparatus to slowly drip the mixed solution onto a cascading wall of the circulating support. Support bulk volume was kept below 3.3 L (1/3 of flask capacity) for each sub-batch for proper circulation of support in the rotary evaporator. The drip dispense was moved back and forth in the horizontal direction as the rotary evaporator kept the support circulating vertically in an attempt to achieve homogenous loading.

Drying after each impregnation was done by partially submerging the rotary evaporator flask (still at 10 rpm) in a water bath set to 60 °C with an air nozzle to circulate air within the flask. This set-up was left overnight to achieve drying prior to calcination. Calcinations between each impregnation step were done in alumina saggars (multiple saggars used/stacked so that support depth did not exceed half an inch) in a stagnant air furnace. Calcination temperature profile used was 6 h at 350 °C.

Figure S1 below displays the weight gain with each impregnation/calcination for the three sub-batches processed to produce the total 5.5 kg of calcined catalyst. The alumina support fully loaded with K-Mo had a mass 39.6% greater than the bare support while the predicted weight gain was 44.3% (assuming all KNO₃ remains and all AHM is converted to MoO₃ after calcination). It should be noted that small amounts of powder/dust left behind after rotary evaporation and calcination were discarded, therefore the gain in weight with each impregnation/calcination is practically all due to K-Mo loading into the pores of the tri-lobe support. The discarded powder, at least in part, also explains the discrepancy between the actual final weight (3rd calcine) and the predicted final weight.



K-Me	K-Mo Catalyst - Batching Weights (g)											
	CAT-002	CAT-003	CAT-004	Total (CAT-005)								
Bare Support:	1391.53	1367.25	1200.24	3959.02								
1st Calcine:	1623.78	1606.35	1396.64	4626.77								
2nd Calcine:	1809.53	1785.27	1558.72	5153.52								
3rd Calcine:	1934.89	1913.49	1677.61	5525.99								
Predicted*:	2007.36	1972.34	1731.42	5711.12								
%Predicted*:	96.4%	97.0%	96.9%	96.8%								

*Assuming all KNO3 and MoO3 after calcination

Figure S1. Catalyst batching weight data represented in both graphical and tabular form. "3rd Calcine" represents the final (fully loaded) calcined weight and is compared to a predicted weight which assumes K and Mo is entirely in the forms KNO₃ and MoO₃ after calcination.

Theoretical and actual weight percentages for K and Mo are displayed in Table S2 below. Weight percent calculations are made based on calcined state with the assumptions that added weight is

entirely due to KNO₃ and MoO₃, molar ratio of 4/1 Mo/K is preserved, and without considering loss of weight due to discarded powder/dust during processing.

Table S2. Calculated theoretical versus actual weight and weight percentage data for Mo and K

 (based on calcined state).

CAT-005 Theoretical vs. Actual (g)									
	Theo.	Actual							
Added Wt.:	1752.10	1566.97							
MoO3 Wt.:	1490.39	1332.91							
KNO3 Wt.:	261.71	234.06							
Mo Wt.:	993.40	888.44							
Mo Wt.%:	17.4%	16.1%							
K Wt.:	101.21	90.52							
K Wt.%:	1.8%	1.6%							

The catalyst was then carburized in a 21% CH₄ (1 SLPM) in H₂ (3.76 SLPM) gas mixture at 600 °C for 4 hours. After carburization, the catalyst was passivated in 5% O₂ (0.45 SLPM air) in N₂ (9.5 SLPM). The catalyst was then recarburized under the same conditions, but at 660 °C because of the lack of carbide phase observed after 600 °C carburization.



Figure S2. Temperature and gas flow profile for the horizontal quartz tube furnace used for catalyst carburization-passivation at OxEon Energy.

Pilot-Scale Catalyst Initial Characterization (at OxEon Energy): Qualitative XRD analysis was conducted on powder (ground down tri-lobes) samples of bare alumina support, calcined catalyst, carburized (carburization profile: Figure S2) and passivated catalyst. Peak shifts were allowed during peak matching in XRD software for scans shown below due to imperfect alignment of the sample plane. Figure S3 below displays XRD results of all four samples with 660 °C carburization (dark blue) alongside PDF (Powder Diffraction File) references of the likely phases present in the different samples.

The bare St. Gobain tri-lobe support exhibits significant amorphous phase, but appears to be primarily in the gamma-Al₂O₃ phase (Fd-3m phase group), as expected. The fully loaded and calcined sample had the best peak matching with a combined Al-Mo phase [Al₂(MoO₄)₃ – PDF: 00-023-0764] suggesting significant reaction between the alumina support and molybdenum during calcination. The peaks present in the calcined sample also match reasonably well with expected KNO₃ and MoO₃ species, and the primary peaks of γ -Al₂O₃ are still clearly present.



Figure S3. XRD results (blue) of various samples representing different stages of K-Mo catalyst processing with 660 °C carburization, along with PDF reference scans (black) for qualitative comparisons.

After carburization at 660 °C, the carburized and passivated catalyst contains a higher amount of Mo_2C , but looks to be mostly MoO_2 phase with Mo (metal) peaks. The $Al_2(MoO_4)_3$ peaks prevalent in the calcined sample are completely gone in the carburized sample, however the primary γ - Al_2O_3 peaks can still be seen but are broadened and somewhat washed out by the high counts for the MoO_2 peaks. Peaks are not detected for the high temperature phase α -alumina (formation of which would result in significant loss of porosity and durability).





Figure S4. Literature reference illustrating expected peaks for the various phases of alumina.²



Figure S5. Rotary kiln setup with rotating quartz tube to keep consistent temperature around perimeter.



Figure S6. Piping and instrumentation diagram for the pilot-scale reactor studies at OxEon Energy.



Figure S7. Performance of P-K-Mo₂C/ γ -Al₂O₃ during laboratory-scale RWGS. CO₂ conversion (×) and CO selectivity (Δ) are plotted versus GHSV, with the thermodynamically limited equilibrium conversion of RWGS plotted as the red solid line. All reactor studies are using a 3:1 H₂:CO₂ reactant ratio at 300 °C and 2.1 MPa.



Figure S8. Performance of P-K-Mo₂C/ γ -Al₂O₃ during laboratory-scale RWGS. CO₂ conversion (×) and CO selectivity (Δ) are plotted versus GHSV, with the thermodynamically limited equilibrium conversion of RWGS plotted as the red solid line. All reactor studies are using a 3:1 H₂:CO₂ reactant ratio at 450 °C and 2.1 MPa.



Figure S9. Performance of P-K-Mo₂C/ γ -Al₂O₃ during laboratory-scale RWGS. CO₂ conversion (×) and CO selectivity (Δ) are plotted versus GHSV, with the thermodynamically limited equilibrium conversion of RWGS plotted as the red solid line. All reactor studies are using a 3:1 H₂:CO₂ reactant ratio at 600 °C and 2.1 MPa.



Figure S10. Relaxed structural configurations of clean and oxidized Mo_2C (001) surfaces at 0.25 ML of adsorbate coverage: a) CO on clean Mo_2C ; b) CO₂ on clean Mo_2C ; c) CO on oxidized Mo_2C ; and d) CO₂ on oxidized Mo_2C . The oxidized Mo_2C has 0.25 ML oxygen coverage.



Figure S11. Deconvoluted Mo3d spectra (solid line) of P-K-Mo₂C/ γ -Al₂O₃, as-synthesized. Contributions include Mo⁶⁺, Mo⁴⁺, Mo²⁺, and Mo⁰.



Figure S12. Deconvoluted Mo3d spectra (solid line) of L-K-Mo₂C/ γ -Al₂O₃, as-synthesized. Contributions include Mo⁶⁺, Mo⁴⁺, Mo²⁺, and Mo⁰.

Table S3. Composition of deconvoluted Mo3d XPS spectra for K-Mo₂C/ γ -Al₂O₃, as-synthesized. The composition of deconvoluted Mo3d XPS spectra for calcined and recarburized P-K-Mo₂C/ γ -Al₂O₃ under laboratory conditions, LC-P-Mo₂C, is included as a reference.

Catalyst	Mo ⁰	Mo ²⁺	Mo ⁴⁺	Mo⁶⁺
L-K-Mo ₂ C	13.8	14.9	56.9	14.5
P-K-Mo ₂ C	6.6	14.8	39.5	39.0
LC-P-Mo ₂ C	9.8	36.4	23.4	30.4



Figure S13. O1s spectra for as-synthesized a) P-K-Mo₂C/ γ -Al₂O₃; b) L-K-Mo₂C/ γ -Al₂O₃; and P-K-Mo₂C/ γ -Al₂O₃ after laboratory-scale reaction at c) 300 °C; and d) 600 °C.



Figure S14. Binding configurations of a) CO_2 ; and b) CO on the C-terminated surface of Mo_2C . Neither adsorbate binds strongly (BE_{CO} = -1.28 kcal mol⁻¹, BE_{CO2} = -1.06 kcal mol⁻¹) and are moving away from the surface.



Figure S15. CO TPD for as-synthesized (red) and spent P-K-Mo₂C/ γ -Al₂O₃ after 12 h on stream at 300 °C (green), 450°C (teal) and 600 °C (blue) from 100 °C to 800 °C with a ramp rate of 5 °C min⁻¹.



Figure S16. Temperature-programmed desorption of as-synthesized P-K-Mo₂C following no pretreatment (red), CO₂-TPD (blue) and CO-TPD (green) from 50 °C to 850 °C with a ramp rate of 5 °C min⁻¹.



Figure S17. Mo K-edge XANES energy space spectra of the P-K-Mo₂C catalyst: a) as-synthesized and after reduction; and b) after reduction and after reaction at 450 °C and 600 °C.



Figure S18. X-ray diffraction patterns of K-Mo₂C/Al₂O₃ synthesized on the laboratory scale (L-K-Mo₂C), pilot scale (P-K-Mo₂C) and pilot scale catalyst resynthesized on the laboratory scale (LC-P-Mo₂C). Symbols correspond to: γ -Al₂O₃ (+), MoO₂ (#), β -Mo₂C (*), and MoC (!).



Figure S19. XPS spectra of LC-P-Mo₂C resynthesized under laboratory carburization conditions. a) Deconvoluted Mo3d spectra of LC-P-Mo₂C with contributions from Mo⁶⁺, Mo⁴⁺, Mo²⁺, and Mo⁰; b) O1s spectra; and c) C1s spectra.



Figure S20. Arrhenius plot of P-K-Mo₂C/ γ -Al₂O₃ and L-K-Mo₂C/ γ -Al₂O₃ showing ln(CO Yield) versus 1000/T. The values of CO yield are calculated by averaging 18 steady-state data points, taken between 7 - 12 h on stream. The dashed line represents the natural log of the maximum thermodynamic CO yield for RWGS. Experimental conditions for P-K-Mo₂C: 30 mg catalyst, 25 sccm CO₂, 75 sccm H₂, 10 sccm Ar, GHSV = 61.1 L kg⁻¹ s⁻¹; L-K-Mo₂C: 25 mg catalyst, 10 sccm CO₂, 30 sccm H₂, 10 sccm N₂, GHSV = 33.3 L kg⁻¹ s⁻¹.

													Carbon-bas	ed Selectivi	ty (%)				
Catalyst	т (°С)	P (MPa)	H ₂ :CO ₂ Ratio	GHSV (L kg ⁻¹ s ⁻¹)	Conversion (%)	со	СН₄	C₂H ₆	C₂H₄	C₃H ₈	C₃H ₆	C₄H ₁₀	Isobutane	1-Butene	Trans- 2- Butene	Cis-2- Butene	Pentane	Isopentane	Hexane
Revitalized P-K- Mo ₂ C/ γ -Al ₂ O ₃	600	2.1	3	3.7	58.7	43.2	52.1	3.9	0.1	0.7	0.04	0.04	0.02	0	0	0	0	0	0
Cu-ZnO/Al ₂ O ₃	300	2.1	3	36.7	23.3	92.6	4.6	2.2	0.6	0	0	0	0	0	0	0	0	0	0
FeCrO _x	450	2.1	3	36.7	47.5	48.6	37.3	6.3	0.9	2.6	2.6	0.6	0.2	0.1	0.3	0.2	0.16	0.1	0.04

Table S4. Detailed distribution of C_2 + products detected in selected RWGS experiments.

Table S5. Full list of selected catalysts for benchmarking catalytic performance of P-K-Mo₂C/ γ -Al₂O₃. The asterisk (*) indicates this work. The P-K-Mo₂C/ γ -Al₂O₃ trial marked with (†) has been conducted with the pilot-scale reactor. All other reaction trials marked with an asterisk (*) have been performed using the laboratory-scale reactor.

	т	D	нсо.		Conversion	Carbon	-based	Selectivity	со	CO STY	CO Production Rate	CO Cost (\$
Catalyst	(°n)	(MPa)	Ratio	kσ ⁻¹ s ⁻¹)	(%)		(%)		Yield	(μmol CO	(kg CO produced	metal
	19	(ivii a)	Natio	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	(70)	СО	CH₄	C ₂ +	(%)	gcat ⁻¹ s ⁻¹)	day ⁻¹ kg metal ⁻¹)	kg CO⁻¹)
L-K-Mo ₂ C/γ- Al ₂ O ₃ *	450	2.1	3	36.7	22.1	97.3	2.0	0.7	21.5	80.0	984.2	0.02
P-K-Mo ₂ C/γ- Al ₂ O ₃ *	450	2.1	3	36.7	26.8	99.3	0.3	0.4	26.6	99.1	1219.0	0.02
LC-P-Mo ₂ C/γ- Al ₂ O ₃ *	450	2.1	3	36.7	42.7	99.1	0.6	0.3	42.4	157.7	1940.1	0.01
P-K-Mo ₂ C/γ- Al ₂ O ₃ *	450	2.1	3	18.3	33.05	99.88	0.09	0.03	33.0	61.4	755.6	0.03
P-K-Mo ₂ C/γ- Al ₂ O ₃ *	450	2.1	3	1.8	42.1	99.1	0.8	0.2	41.7	7.8	95.5	0.22
P-K-Mo ₂ C/γ- Al ₂ O ₃ [†]	450	2.1	3	1.7	48	98.9	1.1	0.0	47.5	8.8	97.8	0.20
P-K-Mo ₂ C/γ- Al ₂ O ₃ *	450	0.1	3	1.8	21.1	93.3	6.0	0.7	19.7	3.7	45.1	0.47
P-K-Mo ₂ C/γ- Al ₂ O ₃ *	600	2.1	3	3.7	59.0	98.1	1.8	0.1	57.9	21.5	265.0	0.08
Revitalized P-K- Mo ₂ C/ γ -Al ₂ O ₃ *	600	2.1	3	3.7	58.7	43.2	52.1	4.0	25.4	9.4	116.2	0.18
P-K-Mo ₂ C/γ- Al ₂ O ₃ *	300	2.1	3	36.7	1.2	99.2	0.8	0.0	1.2	4.3	52.9	0.40
Cu-ZnO/Al ₂ O ₃ *	300	2.1	3	36.7	23.3	92.6	4.6	2.8	21.6	80.2	194.0	0.03
FeCrO _x *	450	2.1	3	36.7	47.5	48.6	37.3	7.3	23.1	85.8	207.7	0.0001
Pt/TiO ₂ ³	400	0.1	1	1.7	14.9	100.0	0.0	N/A	14.9	5.0	1231.5	22.74
Ni/CeO ₂ ⁴	400	0.1	4	16.7	69.2	28.0	72.0	N/A	19.4	14.4	444.4	0.06
Co/CeO ₂ ⁴	400	0.1	4	16.7	34.9	63.0	37.0	N/A	22.0	16.4	501.7	0.06
Fe/CeO ₂ ⁴	400	0.1	4	16.7	8.7	100.0	0.0	N/A	8.7	6.5	208.6	0.00009
Mn/CeO ₂ ⁴	400	0.1	4	16.7	8.1	100.0	0.0	N/A	8.1	6.0	197.8	0.008
Cu/CeO ₂ ⁴	400	0.1	4	16.7	31.3	100.0	0.0	N/A	31.3	23.3	667.6	0.008
Rh @ S-1 5	450	1	3	3.3	34.4	84.5	15.5	N/A	29.1	3.2	1744.1	40.14
Rh/S-1 ⁵	450	1	3	3.3	38.0	71.3	28.7	N/A	27.1	3.0	1828.8	38.28

Table S5. Continued.

Catalyst T P		Р	H ₂ :CO ₂	GHSV	Conversion	Carbo	n-based So (%)	electivity	CO Yield	CO STY (µmol CO	CO Production Rate (kg CO produced	CO Cost (\$ metal kg
	(°C)	(MPa)	Ratio	(L kg ⁻¹ s ⁻¹)	(%)	со	CH₄	C ₂ +	(%)	gcat ⁻¹ s ⁻¹)	day ⁻¹ kg metal ⁻¹)	CO ⁻¹)
Rh@H-ZSM-5 ⁵	450	1	3	3.3	70.8	0.8	99.2	N/A	0.6	0.1	36.4	1922.47
Rh/K-ZSM-5 ⁵	450	1	3	3.3	42.1	59.5	40.5	N/A	25.0	2.8	1610.3	43.47
Rh/SiO ₂ (Acetate Precursor) ⁶	200	5	3	3.3	0.5	88.1	5.1	6.8	0.5	0.22	54.4	1286.18
Rh/SiO ₂ (Chloride Precursor) ⁶	200	5	3	3.3	0.2	29.1	70.9	0.0	0.1	0.03	6.9	10124.15
Rh/SiO ₂ (Nitrate Precursor) ⁶	200	5	3	3.3	0.5	85.1	11.0	3.9	0.4	0.19	46.5	1505.20
Rh/TiO ₂ ⁷	270	2.02	1	2.2	7.9	14.5	72.7	12.8	1.1	0.57	68.6	1019.77
2%Rh- 2.5%Fe/TiO ₂ ⁷	270	2.02	2	2.2	9.2	28.4	57.2	14.4	2.6	1.29	62.4	560.59
Fe/TiO ₂ ⁷	270	2.02	3	2.2	2.7	73.0	11.6	15.4	1.9	0.96	92.9	0.0002
WC/γ-Al ₂ O ₃ ⁸	300	2	3	1.0	8.8	89.9	10.1	0	7.9	1.18	8.9	0.02
WC/γ-Al ₂ O ₃ ⁸	350	2	3	1.0	24.3	88.0	12.0	0	21.4	3.18	24.1	0.01
K-WC/γ-Al ₂ O ₃ ⁸	300	2	3	1.0	4.8	100.0	0.0	0	4.8	0.71	5.4	0.04
K-WC/γ-Al ₂ O ₃ ⁸	350	2	3	1.0	20.3	98.1	1.9	0	19.9	2.96	22.4	0.01
Na-WC/γ-Al ₂ O ₃ ⁸	300	2	3	1.0	1.9	100.0	0.0	0	1.9	0.28	2.1	0.10
Na-WC/γ-Al ₂ O ₃ ⁸	350	2	3	1.0	13.6	100.0	0.0	0	13.6	2.02	15.3	0.01
Rh/Y ⁹	250	3	3	1.7	24.1	0.3	99.7	0.0	0.1	0.02	0.9	81497.32
1.0 wt% Li-Rh/Y ⁹	250	3	3	1.7	12.0	3.7	95.7	0.6	0.4	0.11	5.3	13270.85
2.4 wt% Li-Rh/Y ⁹	250	3	3	1.7	11.1	27.6	67.9	4.5	3.1	0.75	36.4	1923.31
3.4 wt% Li-Rh/Y ⁹	250	3	3	1.7	13.1	86.6	8.4	5.0	11.3	2.79	134.8	519.39
InNi ₃ C _{0.5} /Al ₂ O ₃ ¹⁰	360	1	3	6.0	18.5	63.5	0.5	36.0	11.7	3.85	11.5	18.61
InNi ₃ C _{0.5} /Al ₂ O ₃ ¹⁰	420	1	3	6.0	35.6	88.8	1.0	10.2	31.6	10.35	30.9	6.91
InNi ₃ C _{0.5} /Al ₂ O ₃ ¹⁰	480	1	3	6.0	45.2	94.0	2.6	3.4	42.5	13.91	41.5	5.14
InNi ₃ C _{0.5} /Al ₂ O ₃ ¹⁰	540	1	3	6.0	51.6	95.3	4.2	0.5	49.2	16.10	48.1	4.45

Table 55. Commucu.	Table	S5 .	Continued.
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Catalyst	Т	Р	H ₂ :CO ₂	GHSV (L	Conversion	Carbo	n-based (%)	Selectivity	CO Yield	CO STY (µmol CO	CO Production Rate (kg CO produced	CO Cost (\$ metal kg
	(°C)	(MPa)	Ratio	kg-1 s-1)	(%)	со	CH4	C ₂ +	(%)	gcat ⁻¹ s ⁻¹)	day ⁻¹ kg metal ⁻¹)	CO ⁻¹)
Cu-ZnO ¹¹	270	3	3	5.6	5.3	93.2	0.0	6.8	4.9	2.45	59.3	0.09
Cu/Mo ₂ C ¹²	300	2	5	2.5	19.0	38.0	32.0	30.0	7.2	1.21	5.8	2.23
Ni/Mo ₂ C ¹²	300	2	5	2.5	29.0	29.0	64.0	7.0	8.4	1.41	6.8	1.92
Co/Mo ₂ C ¹²	300	2	5	2.5	31.0	19.0	37.0	44.0	5.9	0.99	4.8	2.74
Cu/Al ₂ O ₃ ¹³	280	3	3.8	8.9	21.3	86.2	0.0	3.6	18.4	4.82	64.8	0.08
K-Cu/Al ₂ O ₃ ¹³	280	3	3.8	8.9	13.7	99.0	0.0	1.0	13.6	3.56	47.9	0.11
Ba-Cu/Al ₂ O ₃ ¹³	280	3	3.8	8.9	18.2	93.4	0.0	6.6	17.0	4.46	60.0	0.09
CuZnGaAlO ₁ ¹¹	270	3	3	5.6	2.6	76.7	1.4	21.9	2.0	0.99	23.9	0.12
CuZnGaAlO ₂ ¹¹	270	3	3	5.6	7.5	95.8	0.0	4.2	7.2	3.56	86.2	0.03
CuZnGaZrO ₁ ¹¹	270	3	3	5.6	11.2	93.0	0.1	6.9	10.4	5.17	125.0	0.02
CuZnGaZrO ₂ ¹¹	270	3	3	5.6	9.5	91.8	0.0	8.2	8.7	4.32	104.6	0.03
ZnGaAlO ¹¹	270	3	3	5.6	0.2	79.9	1.4	18.7	0.2	0.08	0.3	6.74
ZnGaZrO ¹¹	270	3	3	5.6	0.2	68.7	3.5	27.8	0.1	0.07	0.3	7.65

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