CLAIMS:

1. A method for performing a reaction in a reverse flow reactor, comprising:

reacting a fuel mixture comprising fuel, 0.1 vol% or more of O_2, and a diluent under combustion conditions in a combustion zone within a reverse flow reactor to form a flue gas and to heat a conversion zone to an average conversion zone temperature of 400°C or more, the conversion zone comprising a catalyst composition; and

exposing a reactant stream comprising 5.0 vol% to 50 vol% CO_2, 20 vol% or more H_2, and a ratio of H_2 to CO_2 of 2.0 or more, to the catalyst composition in the conversion zone under reverse water gas shift reaction conditions to form a product stream comprising H_2O and CO, a direction of flow for the reactant stream within the reaction zone being reversed relative to a direction of flow for the fuel mixture,

wherein the reactant stream further comprises 15 vol% or less of a reformable hydrocarbon.

2. The method of claim 1, wherein the reactant stream comprises a ratio of H_2 to CO_2 of 3.0 or more, or wherein the reactant stream comprises 10 vol% or more CO_2, or a combination thereof.

3. The method of any of the above claims, the method further comprising: mixing a synthesis gas feed comprising 10 vol% or more CO_2 with an H_2-containing stream to form the reactant stream.

4. The method of any of the above claims, wherein the product stream comprises H_2, the product stream comprising a syngas ratio of 2.0 or more.

5. The method of any of the above claims, wherein the conversion zone is heated to an average conversion zone temperature of 500°C or more, or wherein a peak conversion zone temperature at the end of the reacting the fuel mixture is 800°C or more, or a combination thereof.

6. The method of any of the above claims, further comprising: stopping the exposing of the reactant stream; and reacting, after the exposing, the fuel mixture under combustion conditions in the combustion zone to heat the conversion zone to the average conversion zone temperature.

7. The method of any of the above claims, wherein the reactant stream further comprises 0.5 vol% to 15 vol% of a reformable hydrocarbon, the reformable hydrocarbon optionally comprising methane.

8. The method of claim 7, wherein the reactant stream further comprises 5.0 vol% to 50 vol% of H_2O, a ratio of H_2O to reformable hydrocarbon being 3.0 or more.

9. The method of claim 7 or 8, wherein the product stream comprises the reformable

hydrocarbon, a volume percentage of the reformable hydrocarbon in the product stream being less than the volume percentage of the reformable hydrocarbon in the reactant stream during the exposing step.

10. The method of any of the above claims, wherein the reverse water gas shift conditions comprise a pressure of 1.4 MPa-g or more, or wherein the reverse water gas shift conditions comprise a gas hourly space velocity of 10,000 hr^{-1} to 50,000 hr^{-1}, or a combination thereof

11. The method of any of the above claims, wherein the catalyst composition comprises a reforming catalyst.

12. The method of claim 11, wherein the catalyst composition comprises Ni, Co, Fe, Pd, Rh, Ru, Pt, Ir, Cu, Ag, Au, Zr, Cr, Ti, V, W, Mo, Nb, Mn, Sr, La, or a combination thereof.

13. The method of any of the above claims, wherein the fuel comprises H_2.

14. The method of any of the above claims, wherein the reactor comprises a reactor system, the reactor system comprising a recuperator portion and a portion including the conversion zone.

15. The method of any of the above claims, wherein the reverse water gas shift conditions comprise at least one of an average conversion zone temperature and a peak conversion zone temperature at the end of the reacting the fuel mixture.

16. The method of any of the above claims, wherein the reverse water gas shift conditions comprise a pressure of 0 MPa-g to 10.3 MPa-g, or 1.4 MPa-g to 10.3 MPa-g, and a gas hourly space velocity of 1,000 hr^{-1} to 50,000 hr^{-1}, or 10,000 hr^{-1} to 50,000 hr^{-1}.