CLAIMS

What is claimed is:

1. A system for producing hydrogen and carbon monoxide, the system comprising:

a pyrolyzer operably coupled to a feed supply of a methane-containing gas, wherein the pyrolyzer is configured to convert methane from the methane-containing gas into hydrogen and elemental carbon via pyrolysis;

an electrolyzer configured to produce hydrogen and oxygen; and

an oxidation unit configured to produce one or more of carbon monoxide or carbon dioxide from the elemental carbon produced from the pyrolyzer and the oxygen produced from the electrolyzer.

2. The system of claim 1 wherein the pyrolyzer is configured to be heated using one or more of:

electrical heating including one or more of inductive heating, microwave heating, plasma heating, or joule heating;

heat from the oxidation unit; or

heat from burning hydrogen.

3. The system of claim 2 wherein the oxidation unit is configured to provide one or more of heat for operation of the pyrolyzer or to produce electricity for operation of the pyrolyzer and the oxidation unit includes a steam turbine, reciprocating gas engine, or gas turbine.

4. The system of claim 1 wherein at least one of the pyrolyzer or electrolyzer is electrically connected to one or more of a wind power or solar power source to provide electricity for producing heat in the pyrolyzer or electrolysis in the electrolyzer.

5. The system of claim 1 wherein a hydrogen output of the pyrolyzer is connected to a first outlet from the system and a hydrogen output of the electrolyzer is connected to a second outlet from the system.

6. The system of claim 1, further comprising a water-gas shift reactor connected to the hydrogen and carbon monoxide output of the pyrolyzer, wherein the water-gas shift reactor is configured to produce hydrogen and carbon dioxide.

7. The system of claim 6, wherein a hydrogen outlet of the water-gas shift reactor is connected to a gas engine configured to use the hydrogen produced from the water-gas shift reactor as fuel.

8. The system of claim 1 wherein the oxidation unit is coupled to a carbon dioxide source to feed carbon dioxide into the oxidation unit to increase production of carbon monoxide therein.

9. A liquid fuel manufacturing system, the system comprising:

a pyrolyzer operably coupled to a feed supply of a methane-containing gas, wherein the pyrolyzer is configured to convert methane from the methane-containing gas into hydrogen and elemental carbon via pyrolysis;

an electrolyzer configured to produce hydrogen and oxygen;

an oxidation unit operably coupled to an oxygen output of the electrolyzer and an elemental carbon output of the pyrolyzer, the oxidation unit being configured to at least partially oxidize the elemental carbon from the pyrolyzer with the oxygen from the electrolyzer to produce carbon monoxide; and

a liquid fuel manufacturing system configured to produce a liquid fuel using carbon monoxide from the oxidation unit and hydrogen from the electrolyzer.

10. The system of claim 9 wherein the liquid fuel manufacturing system includes one or more of a Fischer-Tropsch reactor, a methanol synthesis unit, an ethanol synthesis unit, a gasoline refining system, or a bioreactor.

11. The system of claim 9 wherein a hydrogen output of the electrolyzer is directed outside of the system.

12. The system of claim 9 wherein the feed supply of methane-containing gas includes natural gas or landfill gas.

13. The system of claim 9 wherein:

the oxidation unit includes a thermal oxidizer; and

the liquid fuel manufacturing system includes a bioreactor configured to produce ethanol.

14. The system of claim 13 wherein the feed supply of methane-containing gas includes natural gas or landfill gas.

15. A method for producing hydrogen, carbon monoxide, and carbon dioxide, the method comprising:

pyrolyzing a methane-containing gas to produce hydrogen and elemental carbon from pyrolysis;

electrolyzing water to produce hydrogen gas and oxygen from electrolysis; and

oxidizing the elemental carbon using the oxygen from the electrolyzer, carbon dioxide, or a combination thereof to produce carbon dioxide.

16. The method of claim 15 wherein electricity is used to provide heat for pyrolyzing the methane-containing gas via one or more of inductive heating, microwave heating, plasma heating, or joule heating.

17. The method of claim 16 wherein the electricity is supplied by one or more of solar power or wind power.

18. The method of claim 15, further comprising outputting hydrogen gas from pyrolysis and electrolysis as a mixture or separately for sale.

19. The method of claim 15 wherein the methane-containing gas includes natural gas or renewable natural gas.

20. A method for producing hydrogen and liquid fuel, the method comprising:

electrolyzing water to produce hydrogen gas and oxygen from electrolysis;

pyrolyzing a methane-containing gas to produce hydrogen and elemental carbon from pyrolysis;

oxidizing the elemental carbon from pyrolysis with oxygen from electrolysis to produce carbon monoxide; and

creating a liquid fuel or chemical using carbon monoxide and hydrogen gas.

21. The method of claim 20 wherein the creating a liquid fuel or chemical using the carbon monoxide and hydrogen gas includes using hydrogen gas from one or more of pyrolysis or electrolysis.

22. The method of claim 20 wherein the methane-containing gas includes natural gas or renewable natural gas.

23. The method of claim 20, further comprising:

gasifying an organic feedstock in the presence of oxygen from electrolysis to produce carbon monoxide and water from gasification; and

separating the carbon monoxide from the water.

24. The method of claim 23 wherein creating a liquid fuel using carbon monoxide and hydrogen gas includes using carbon monoxide from gasification and oxidation and using hydrogen from pyrolysis and electrolysis.

25. The method of claim 23 wherein the organic feedstock includes one or more of municipal solid waste or biomass.

26. The method of claim 20 further comprising outputting hydrogen from electrolysis for storage or sale.

27. The method of claim 20 wherein the liquid fuel includes one or more of diesel fuel, gasoline, methanol, or ethanol.

28. The method of claim 20 wherein:

oxidizing the elemental carbon from pyrolysis with oxygen from electrolysis to produce carbon monoxide from oxidation includes thermally oxidizing the elemental carbon; and

creating a liquid fuel or chemical using carbon monoxide and hydrogen gas includes using a bioreactor to create ethanol from the carbon monoxide and hydrogen gas.