CLAIMS

1. A method comprising:

exposing, within a pyrolysis chamber, a hydrocarbon feed stream comprising a hydrocarbon and hydrogen to heat in an absence of oxygen to convert the hydrocarbon feed stream into a solids stream and a gas stream, the solids stream comprising carbon, the gas stream comprising hydrogen;

separating the gas stream into an exhaust gas stream and a first hydrogen stream comprising at least a portion of the hydrogen from the gas stream;

separating the carbon from the solids stream to produce a carbon stream;

performing electrolysis on a water stream comprising water to produce an oxygen stream and a second hydrogen stream, the oxygen stream comprising oxygen, the second hydrogen stream comprising hydrogen;

combining at least a portion of the oxygen of the oxygen stream and at least a portion of the carbon of the carbon stream to generate power and a carbon dioxide stream comprising carbon dioxide, wherein a first portion of the generated power is used to perform electrolysis on the water stream; and

providing a second portion of the generated power to a heater of the pyrolysis chamber to generate the heat within the pyrolysis chamber.

2. The method of claim 1, wherein the hydrocarbon feed stream comprises a plurality of hydrocarbons selected from C1-C22 alkanes.

3. The method of claim 1, wherein the oxygen and the carbon are combined by a direct carbon fuel cell comprising a solid oxide, and the oxygen and the carbon are combined by the direct carbon fuel cell at an operating temperature in a range of from about 800 degrees Celsius (°C) to about 1000 °C.

4. The method of claim 3, comprising transferring, by a first waste heat recovery heat exchanger, heat from the gas stream to a buffer fluid.

5. The method of claim 4, comprising transferring, by a second waste heat recovery heat exchanger, heat from the buffer fluid to the hydrocarbon feed stream prior to exposing the hydrocarbon feed stream to heat in the absence of oxygen.

6. The method of claim 4, comprising generating power by a Rankine cycle using the heat transferred from the gas stream to the buffer stream, wherein generating power by the Rankine cycle comprises:

transferring heat from the buffer fluid to a working fluid in a boiler to vaporize the working fluid into a vaporized working fluid;

flowing and expanding the vaporized working fluid through a turbine to generate power;

condensing the vaporized working fluid into a condensed working fluid; and

circulating the condensed working fluid to the boiler.

7. The method of claim 3, comprising transferring, by a first waste heat recovery heat exchanger, heat from the carbon dioxide stream to a buffer fluid.

8. The method of claim 7, comprising transferring, by a second waste heat recovery heat exchanger, heat from the buffer fluid to the hydrocarbon feed stream prior to exposing the hydrocarbon feed stream to heat in the absence of oxygen.

9. The method of claim 3, comprising sequestering, within a subterranean formation, the carbon dioxide stream generated by the direct carbon fuel cell, such that the carbon dioxide stream is not released to the atmosphere.

10. The method of claim 1, wherein providing the second portion of the generated power to the heater of the pyrolysis chamber comprises providing the second portion of the generated power to electrodes of the heater, wherein the method comprises flowing an inert gas along with the hydrocarbon feed stream to the pyrolysis chamber, wherein providing the second portion of the generated power to the electrodes of the heater causes generation of plasma from the inert gas to pyrolyze the hydrocarbon feed stream.