CLAIMS:

What is claimed is:

1. A process comprising:

(I) supplying a hydrocarbon feed and a steam feed into a syngas producing unit comprising a reforming reactor under syngas producing conditions to produce a reformed stream exiting the reforming reactor, wherein the syngas producing conditions include the presence of a reforming catalyst, and the reformed stream comprises H_2, CO, and steam;

(II) cooling the reformed stream by using a waste heat recovery unit ("WHRU") to produce a cooled reformed stream and to generate a high-pressure steam ("HPS") stream;

(III) contacting the cooled reformed stream with a first shifting catalyst in a first shift reactor under a first set of shifting conditions to produce a first shifted stream exiting the first shift reactor, wherein the first shifted stream has a lower CO concentration and a higher CO_2 concentration than the cooled reformed stream;

(IV) cooling the first shifted stream to obtain a cooled first shifted stream;

(V) contacting the cooled first shifted stream with a second shifting catalyst in a second shift reactor under a second set of shifting conditions to produce a second shifted stream exiting the second shift reactor, wherein the second shifted stream has a lower CO concentration and a higher CO_2 concentration than the cooled first shifted stream;

(VI) abating steam present in the second shifted stream to produce a crude gas mixture stream comprising CO_2 and H_2;

(VII) recovering at least a portion of the CO_2 present in the crude gas mixture stream to produce a CO_2 stream and a H_2-rich stream, wherein the H_2-rich stream comprises H_2 at a concentration of at least 80 mol%, based on the total moles of molecules in the H_2-rich stream;

(VIII) combusting a portion of the H_2-rich stream in the presence of an oxidant to generate thermal energy and to produce a flue gas stream;

(IX) operating a steam cracker located in an olefins production plant under steam cracking conditions to convert a steam cracker feed into a steam cracker effluent comprising olefins;

(X) producing a CH_4-rich stream from the steam cracker effluent; and

(XI) providing the CH_4-rich stream as at least a portion of the hydrocarbon feed in step (I);

wherein the H_2-rich stream is supplied to at least one combustion device used in the process for producing the H_2-rich stream.

2. The process of claim 1, wherein the cooled reformed stream produced in step (II) has a temperature from 285 °C to 400 °C.

3. The process of any of the preceding claims, wherein in step (III), the first shifted stream has at least one of the following: a temperature from 335 °C to 500 °C; and an absolute pressure from 700 kPa to 5,000 kPa or wherein the cooled first shifted stream has at least one of the following: a temperature from 150 °C to 250 °C, and an absolute pressure from 700 kPa to 5,000 kPa.

4. The process of any of the preceding claims, wherein the syngas producing unit comprises a pre-reformer including a furnace heated by one or more burners combusting a fuel gas and a portion of the H2-rich stream is supplied as at least a portion of the fuel gas to such burners.

5. The process of any of the preceding claims, wherein H2-rich stream production process uses an additional boiler or auxiliary furnace combusting a fuel gas and a portion of the H2-rich stream is supplied as at least a portion of the fuel gas to the additional boiler or auxiliary furnace.

6. The process of any of the preceding claims, wherein in step (V), the second shifted stream has at least one of the following: a temperature from 150 °C to 300 °C; an absolute pressure from 700 kPa to 3500 kPa; and a CO concentration no greater than 5.0 mol%, based on the total moles of molecules in the second shifted stream.

7. The process of any of the preceding claims, wherein:

the syngas producing unit comprises a steam-methane-reformer ("SMR");

the SMR comprises: one or more SMR burners where a SMR fuel combusts to supply thermal energy to the SMR;

a radiant section heated by the thermal energy in which the hydrocarbon feed and steam react under the syngas producing conditions;

a convection section heated by the thermal energy in which the hydrocarbon feed and steam are preheated before entering the radiant section; and

in step (VII), a portion of the H_2-rich stream is supplied to the plurality of SMR burners as at least a portion of the SMR fuel.

8. The process of claim 7, further comprising:

(XIIa) heating the HPS stream generated in step (II) in the convection section of the SMR and/or an auxiliary furnace to obtain a super-heated HPS ("SH-HPS") stream having at least one of the following: a temperature from 350 °C to 550 °C, and a pressure from 4,000 kPa to 14,000 kPa.

9. The process of any of claims 1 to 16, wherein:

the syngas producing unit comprises an autothermal reformer ("ATR");

an O_2 stream is fed into the ATR;

the ATR comprises a reaction vessel into which the hydrocarbon feed, the steam feed, and the O_2 stream are supplied;

the syngas producing conditions comprises the presence of an ATR catalyst in the reaction vessel; and

the reformed stream has at least one of the following: a temperature from 800 °C to 1200 °C; and an absolute pressure from 700 kPa to 5,000 kPa.

10. The process of claim 9, further comprising:

(XIIb) heating the HPS stream generated in step (II) in an auxiliary furnace to obtain a super-heated HPS ("SH-HPS") stream having at least one of the following: a temperature from 350 °C to 550 °C, and a pressure from 4,000 kPa to 14,000 kPa.

11. The process of any of the preceding claims, wherein step (VIII) comprises combusting a portion of the H_2-rich stream in the steam cracker, the olefins production plant optionally produces a steam-cracker H_2 stream, and the process further comprises optionally combining a portion of the H_2-rich stream with a portion of the steam-cracker H_2 stream to form a joint H_2-rich stream.

12. The process of claim 11, wherein the process comprises combusting a portion of the H_2-rich stream, and/or a portion of the steam-cracker H_2 stream, and/or a portion of the joint H_2-rich stream in an SMR, a boiler, and/or an auxiliary furnace.

13. The process of claim 11 or claim 12, wherein the olefins production plant comprises a combined-cycle power plant, the combined-cycle power plant comprises one or more duct burners combusting a duct burner fuel to generate thermal energy, and the process further

comprises combusting a portion of the H_2-rich stream and/or a portion of the steam-cracker H_2 stream and/or a portion of the joint H_2-rich stream as at least a portion of the duct burner fuel.

14. The process of any of the preceding claims, wherein the CH_4-rich stream has an absolute pressure higher than that of the hydrocarbon feed supplied into the syngas producing unit in step (I), and the process further comprises:

(XIV) expanding the CH_4-rich stream through a turbo-expander and/or a Joule-Thompson valve to produce a cooled CH_4-rich stream having a pressure in the vicinity of the pressure of the hydrocarbon feed; and

(XV) heating the cooled CH_4-rich stream by using a stream in the olefins production plant via a heat exchanger.

15. The process of claim 14, wherein the H_2-rich stream and the steam-cracker H_2 stream together provides at least 60%, on a BTU basis, of the total combustion fuel needed by the operation of the olefins production plant.