What is claimed is:

1. An improved hydrogen generation system comprising:

one or more hydrodesulfurization (HDS) units configured to desulfurize a hydrocarbon gas stream to produce a process gas stream and a desulfurized fuel gas stream;

a pre-reformer configured to receive the process gas stream and convert heavy hydrocarbons within the process gas stream to methane to produce a pre-reformed process gas, wherein the amount of methane within the pre-reformed process gas as compared to the process gas stream is increased;

a reformer having a combustion zone and a reaction zone, wherein the combustion zone is in fluid communication with the HDS unit and configured to receive the desulfurized fuel gas stream originating from the HDS, wherein the reaction zone is in fluid communication with the pre-reformer and configured to receive the pre-reformed process gas originating from the pre-reformer, wherein the reformer is configured to produce a syngas stream within the reaction zone and a flue gas within the combustion zone;

a pressure swing adsorption (PSA) unit configured to receive the syngas stream and produce a product hydrogen stream and a PSA off-gas stream; and

means for cooling the flue gas against a combustion air and the PSA off-gas stream to a temperature below the dew point of sulfuric acid.

2. The system of claim 1, wherein the means for cooling the flue gas comprises an air pre-heater configured to exchange heat between the flue gas and a combustion air, such that the flue gas is cooled and the combustion air is heated.

3. The system of claim 2, wherein the means for cooling the flue gas comprises a first PSA off-gas pre-heater configured to exchange heat between the flue gas and the PSA off-gas, such that the flue gas is cooled and the PSA off-gas is heated.

4. The system of claim 3, wherein the first PSA off-gas pre-heater is installed upstream of the air pre-heater.

5. The system of claim 3, wherein the first PSA off-gas pre-heater is installed downstream of the air pre-heater.

6. The system of claim 3, wherein the first PSA off-gas pre-heater is installed in parallel with the air pre-heater such that the first PSA off-gas pre-heater is configured to neither receive nor send a flow directly to the air pre-heater.

7. The system of claim 3, further comprising a second PSA off-gas pre-heater, wherein the first PSA off-gas pre-heater is installed upstream of the air pre-heater and the second PSA off-gas pre-heater is installed downstream of the air pre-heater.

8. The system of claim 3, further comprising a second PSA off-gas pre-heater, wherein the first PSA off-gas pre-heater is installed upstream of the air pre-heater and the second PSA off-gas pre-heater is installed in parallel with the air pre-heater and downstream of the first PSA off-gas pre-heater.

9. The system of claim 3, further comprising a second PSA off-gas pre-heater, wherein the first PSA off-gas pre-heater is installed downstream of the air pre-heater and the second PSA off-gas pre-heater is installed in parallel with the air pre-heater and upstream of the first PSA off-gas pre-heater.

10. The system of claim 1, further comprising a hydrocarbon source comprising a natural gas pipeline.

11. A method for improving thermodynamic efficiency in a hydrogen generation system, the method comprising the steps of:

desulfurizing a hydrocarbon gas stream in one or more hydrodesulfurization (HDS) units to form a process gas stream and a desulfurized fuel gas stream;

pre-reforming the process gas stream in a pre-reformer in the presence of steam under conditions effective to form a pre-reformed process gas stream;

reacting the pre-performed process gas stream in the presence of steam in a reaction zone of a reformer under conditions effective to produce a syngas stream, wherein heat for reacting the pre-performed process gas stream is provided by combusting the desulfurized fuel gas stream in the presence of a combustion oxidant in a combustion zone of the reformer thereby producing a flue gas, wherein the combustion zone is configured to exchange heat with the reaction zone;

introducing the syngas stream into a pressure swing adsorption (PSA) unit under conditions effective for producing a product hydrogen stream and a PSA off-gas stream; and

cooling the flue gas against the combustion oxidant and the PSA off-gas stream to a temperature below the dew point of sulfuric acid to produce a cooled flue gas, wherein the cooled flue gas comprises an absence of sulfuric acid.

12. The method of claim 11, wherein the step of cooling the flue gas against the combustion oxidant and the PSA off-gas stream further comprises the step of cooling the flue gas by exchanging heat between the flue gas and the combustion oxidant in an oxidant pre-heater.

13. The method of claim 12, wherein the step of cooling the flue gas against the combustion oxidant and the PSA off-gas stream further comprises the step of cooling the flue gas by exchanging heat between the flue gas and the PSA off-gas stream in at least one PSA off gas pre-heater to form a pre-heated PSA off-gas stream, wherein the pre-heated PSA off-gas stream is introduced to the combustion zone for combustion therein.

14. The method of claim 13, wherein the PSA off-gas pre-heater is installed upstream of the oxidant pre-heater, such that the flue gas exiting the PSA off-gas pre-heater is at a higher temperature than the flue gas exiting the oxidant pre-heater.

15. The method of claim 13, wherein the PSA off-gas pre-heater is installed downstream of the oxidant pre-heater, such that the flue gas exiting the PSA off-gas pre-heater is at a lower temperature than the flue gas exiting the oxidant pre-heater.

16. The method of claim 13, wherein the PSA off-gas pre-heater is installed in parallel with the oxidant pre-heater such that the PSA off-gas pre-heater is configured to neither receive nor send a flow of flue gas to the oxidant pre-heater.

17. The method of claim 13, wherein a first PSA off-gas pre-heater is installed upstream of the oxidant pre-heater and a second PSA off-gas pre-heater is installed downstream of the oxidant pre-heater.

18. The method of claim 13, wherein a first PSA off-gas pre-heater is installed upstream of the oxidant pre-heater and a second PSA off-gas pre-heater is installed in parallel with the oxidant pre-heater and downstream of the first PSA off-gas pre-heater.

19. The method of claim 11, wherein a first PSA off-gas pre-heater is installed downstream of the oxidant pre-heater and a second PSA off-gas pre-heater is installed in parallel with the oxidant pre-heater and upstream of the first PSA off-gas pre-heater.

20. The method of claim 11, wherein the hydrocarbon is natural gas and the combustion oxidant is air.