CLAIMS

1. A geothermal hydrogen production system, comprising;

a primary liquid circuit circulating a liquid into a geothermal well and returning heated liquid from a well head of the geothermal well, the primary liquid circuit passing through a desalination plant;

a first turbine driven by the heated liquid to produce a first mechanical output; and

a second turbine driven by the heated liquid to produce a second mechanical output,

wherein the first mechanical output drives an electrical generator configured to power an electrolyser generating hydrogen via electrolysis of fresh water, and the second mechanical output drives a compressor to provide at least one of a first, a second and a third compressed air supply,

wherein the first compressed air supply drives a supply pump to supply salt water to the desalination plant, the second compressed air supply drives a start-up pump to initiate the primary liquid circuit, and the third compressed air supply drives a fresh water pump to deliver fresh water from the desalination plant to the electrolyser.

2. The geothermal hydrogen production system of claim 1, wherein a portion of the heated liquid is subject to pressure change in a separator to produce a vapour to drive the first turbine and the second turbine.

3. The geothermal hydrogen production system of claim 1 or claim 2, wherein residual heated liquid from a first separator is mixed with an exhaust from the first turbine liquid in the primary circuit to increase the temperature of the liquid in the primary liquid circuit.

4. The geothermal hydrogen production system of claim 3, wherein residual heated liquid from a second separator is mixed with an exhaust from the second turbine in the primary circuit to increase the temperature of the liquid in the primary liquid circuit.

5. The geothermal hydrogen production system of any one of claims 1-4, further comprising a second compressor driven by the second mechanical output from the second turbine and configured to compress the hydrogen generated by the electrolyser.

6. The geothermal hydrogen production system of any one of claims 1-4, further comprising:

a third turbine driven by the heated liquid of the primary liquid circuit to produce a third mechanical output,

wherein the third mechanical output is configured to drive a second compressor to compress the hydrogen generated by the electrolyser.

7. A geothermal hydrogen production system comprising a primary circuit and a secondary circuit, the primary liquid circuit circulating a liquid into a geothermal well and returning heated liquid from a well head of the geothermal well, the heated liquid of the primary circuit being fed to a heat exchanger to heat a working medium of the secondary circuit, the heated working medium passing through a desalination plant,

the heated working medium of the secondary circuit driving a first turbine to produce a first mechanical output and the heated liquid of the primary circuit driving a second turbine to produce a second mechanical output,

wherein the first mechanical output drives an electrical generator configured to power an electrolyser generating hydrogen via electrolysis of fresh water, and the second mechanical output drives a compressor to provide at least one of a first, a second and a third compressed air supply,

wherein the first compressed air supply drives a supply pump to supply salt water to the desalination plant, the second compressed air supply drives a start-up pump to initiate the primary liquid circuit, and the third compressed air supply drives a fresh water pump to deliver fresh water from the desalination plant to the electrolyser.

8. The geothermal hydrogen production system of claim 7, further comprising a second compressor driven by the second mechanical output from the second turbine and configured to compress the hydrogen generated by the electrolyser.

9. The geothermal hydrogen production system of claim 7, further comprising:

a third turbine driven by either of:

(i) the heated liquid of the primary liquid circuit; or

(ii) the heated working medium of the secondary circuit,

to produce a third mechanical output,

wherein the third mechanical output is configured to drive a second compressor to compress the hydrogen generated by the electrolyser.

10. A geothermal hydrogen production system comprising a primary circuit and a secondary circuit, the primary liquid circuit circulating a liquid into a geothermal well and returning heated liquid from a well head of the geothermal well, the heated liquid passing through a desalination plant within the primary liquid circuit,

the heated liquid of the primary circuit passing a heat exchanger to heat a working medium of the secondary circuit, wherein the heated working medium of the secondary circuit drives a first turbine to produce a first mechanical output and the heated liquid of the primary circuit drives a second turbine to produce a second mechanical output;

wherein the first mechanical output drives an electrical generator configured to power an electrolyser generating hydrogen via electrolysis of fresh water, and the second mechanical output drives a compressor to provide at least one of a first, a second and a third compressed air supply,

wherein the first compressed air supply drives a supply pump to supply salt water to the desalination plant, the second compressed air supply drives a start-up pump to initiate the primary liquid circuit, and the third compressed air supply drives a fresh water pump to deliver fresh water from the desalination plant to the electrolyser.

11. The geothermal hydrogen production system of claim 10, further comprising a second compressor driven by the second mechanical output from the second turbine and configured to compress the hydrogen generated by the electrolyser.

12. The geothermal hydrogen production system of claim 10, further comprising:

a third turbine driven by either of:

(i) the heated liquid of the primary liquid circuit; or

(ii) the heated working medium of the secondary circuit,

to produce a third mechanical output,

wherein the third mechanical output is configured to drive a second compressor to compress the hydrogen generated by the electrolyser.

13. The system of any one of claims 7-12 wherein, the secondary circuit comprises at least one of:

a fresh water condenser configured to draw heat from the secondary circuit to heat the fresh water from the desalination plant before being delivered to the electrolyser; and

a salt water condenser configured to draw heat from the secondary circuit to heat the salt water prior to supplying the desalination plant.

14. The system of any one of claims 7-13, wherein the working medium in the secondary circuit is a binary fluid having a low-boiling point.

15. The system of any one of claims 7-14, wherein the working medium is N-Pentane.

16. The system of any one of claims 7-15, wherein the compressor further provides a fourth compressed air supply to drive a circuit pump to circulate the working medium in the secondary circuit.

17. The system of any one of claims 1-16, wherein the fresh water from the desalination plant is pumped directly to the electrolyser to be disassociated into oxygen and hydrogen.

18. The geothermal hydrogen production system of any one of claims 1-17, wherein the hydrogen is collected from the electrolyser and stored in liquid form at about 1000 Bar.

19. The system of any one of claims 1-18, wherein either the heated liquid of the primary liquid circuit or the heated working medium of the secondary circuit passes through the desalination plant divesting thermal energy to distil the salt water in the desalination plant to produce fresh water and brine.

20. The system of any one of claims 1-19, wherein the compressor further provides a fifth compressed air supply to drive a brine pump, to pump brine from the desalination plant.

21. The system of any one of claims 1-20, wherein the compressor further provides a sixth compressed air supply to drive a waste water pump, to pump waste water from the electrolyser.

22. The geothermal hydrogen production system of any one of claims 1-21, wherein at least one of the supply pump, the start-up pump, the fresh water pump, the circuit pump, the brine pump, and the waste water pump is configured to be powered by the electrical generator.

23. The system of any one of claims 1-22, wherein at least one of the first turbine, the second turbine and the third turbine is substituted for any one of: a screw expander, an ORC turbine, an engine, a steam engine or a water wheel.

24. The system of any one of claims 1-23, wherein the supply pump is configured to drive salt water from a salt water source to a first chamber of the desalination plant.

25. The system of claim 24, wherein the salt water is sprayed into the first chamber of the desalination plant, the first chamber heated by either of the heated working medium of the secondary circuit or the heated liquid of the primary liquid circuit passing therethrough.

26. The system of any one of claims 1-25, wherein a storage tank is incorporated within at least one of the first, second, and third air supplies to store compressed air.

27. The system of any one of claims 1-26, wherein an air vacuum pump is connected upstream of the compressor, such that the air vacuum pump is driven by a flow of ambient air drawn into the compressor.

28. The system of claim 27, wherein a vacuum line is connected to the vacuum pump to drawn air from at least one chamber of the desalination plant.

29. The system of any one of claims 1-28, wherein circulation of the primary liquid circuit once initiated by the start-up pump is sustained by a thermal syphoning effect drawing liquid into the geothermal well at a first temperature as heated liquid is forced out of the well head at a second temperature, greater than the first temperature.

30. The system of claim 29, wherein the start-up pump of the primary liquid circuit is deactivated once the liquid of the primary liquid circuit is circulating predominantly under the thermal syphoning effect.

31. The system of any one of claims 1-30, wherein the liquid in the primary liquid circuit is water or distilled water.

32. A method of generating and feeding fresh water to an electrolyser to produce hydrogen, powered by geothermal energy, comprising the steps:

feeding a liquid into a geothermal well and drawing heated liquid from the well head of the geothermal well to form a primary liquid circuit, the primary liquid conveying heat energy to a desalination plant;

communicating the heated liquid from the primary liquid circuit to a first turbine and a second turbine to produce a first mechanical output and a second mechanical output respectively;

directing the first mechanical output to an electrical generator to power the electrolyser configured to generate hydrogen via electrolysis of fresh water, and directing the second mechanical output to a compressor to produce at least one of a first, a second and a third compressed air supply,

wherein the first compressed air supply drives a supply pump configured to drive salt water to the desalination plant, the second compressed air supply drives a start-up pump to initiate the primary liquid circuit, and the third compressed air supply drives a fresh water pump to pump fresh water from the desalination plant to the electrolyser to be decomposed into hydrogen and oxygen.

33. The method of claim 32, further comprising the step of:

driving a second compressor from the second mechanical output of the second turbine, the second compressor configured to compress the hydrogen generated by the electrolyser.

34. The method of claim 32, further comprising the step of:

communicating the heated liquid from the primary liquid circuit to a third turbine to produce a third mechanical output, and

directing the third mechanical output to a second compressor configured to compress the hydrogen produced by the electrolyser.

35. The method of any one of claims 32-34, comprising the step of converting a portion of the liquid in the primary liquid circuit to vapour in a separator to drive at least one of the first turbine and the second turbine.

36. The method of claim 35, comprising the step of combining residual heated liquid from the separator with an exhaust from the first turbine to increase the temperature of the liquid in the primary liquid circuit.

37. A method of generating and feeding fresh water to an electrolyser to produce hydrogen, powered by geothermal energy, comprising the steps:

feeding a liquid into a geothermal well and drawing heated liquid from the well head of the geothermal well, the heated liquid of the primary circuit being fed to a heat exchanger to

heat a working medium of the secondary circuit, the heated working medium passing through a desalination plant,

wherein the heated working medium of the secondary circuit drives a first turbine and a second turbine to produce a first mechanical output and a second mechanical output respectively;

directing the first mechanical output to an electrical generator to power the electrolyser configured to generate hydrogen via electrolysis of fresh water, and directing the second mechanical output to a first compressor to produce at least one of a first, a second and a third compressed air supply,

wherein the first compressed air supply is configured to drive a supply pump to drive salt water to the desalination plant, the second compressed air supply drives a start-up pump to initiate the primary liquid circuit, and the third compressed air supply drives a fresh water pump to pump fresh water from the desalination plant to the electrolyser to be decomposed into hydrogen and oxygen.

38. The method of claim 37, further comprising the step of:

driving a second compressor from the second mechanical output of the second turbine, the second compressor configured to compress the hydrogen generated by the electrolyser

39. The method of claim 37, further comprising the step of:

communicating the heated liquid from the primary liquid circuit to a third turbine to produce a third mechanical output, and

directing the third mechanical output to a second compressor configured to compress the hydrogen produced by the electrolyser.

40. A method of generating and feeding fresh water to an electrolyser to produce hydrogen, powered by geothermal energy, comprising the steps:

feeding a liquid into a geothermal well and drawing heated liquid from the well head of the geothermal well to form a primary liquid circuit, the primary liquid conveying heat energy to a desalination plant;

feeding the heated liquid of the primary circuit to a heat exchanger to heat a working medium of a secondary circuit, wherein the heated working medium of the secondary circuit drives a first turbine to produce a first mechanical output and the heated liquid of the primary liquid circuit drives a second turbine to produce a second mechanical output respectively;

directing the first mechanical output to an electrical generator to power the electrolyser configured to generate hydrogen via electrolysis of fresh water, and directing the second mechanical output to a compressor to produce at least one of a first, a second and a third compressed air supply,

wherein the first compressed air supply is configured to drive a supply pump to drive salt water to the desalination plant, the second compressed air supply drives a start-up pump to initiate the primary liquid circuit, and the third compressed air supply drives a fresh water pump to pump fresh water from the desalination plant to the electrolyser to be decomposed into hydrogen and oxygen.

41. The method of claim 40, further comprising the step of:

driving a second compressor from the second mechanical output of the second turbine, the second compressor configured to compress the hydrogen generated by the electrolyser

42. The method of claim 40, further comprising the step of:

communicating the heated liquid from the primary liquid circuit to a third turbine to produce a third mechanical output, and

directing the third mechanical output to a second compressor configured to compress the hydrogen produced by the electrolyser.

43. The method of any one of claims 37-42, further comprising the step of:

drawing heat from the working medium of the secondary circuit via a fresh water condenser to heat the fresh water from the desalination plant before delivering the fresh water to the electrolyser.

44. The method of any one of claims 37-43, further comprising the step of:

drawing heat from the working medium of the secondary circuit via a salt water condenser to heat the salt water before delivering the salt water to the desalination plant.

45. The method of any one of claims 37-44, further comprising the step of driving a circuit pump from a fourth compressed air supply from the first compressor to circulate the working medium in the secondary circuit

46. The method of any one of claims 37-45, wherein the working medium in the secondary circuit is a binary fluid having a low-boiling point.

47. The method of claim 46, wherein the working medium is N-Pentane.

48. The method of any one of claims 32-47, further comprising the step of driving a brine pump from a fifth compressed air supply from the first compressor to pump brine from the desalination plant

49. The method of any one of claims 32-48, further comprising the step of driving a waste water pump from a sixth compressed air supply from the first compressor to pump waste water from the electrolyser.

50. The method of any one of claims 32-49, further comprising the step of powering at least one of the supply pump, the start-up pump, the fresh water pump, the circuit pump, the brine pump, and the waste water pump from the electrical generator.

51. The method of any one of claims 32-50, wherein the liquid in the primary liquid circuit is water or distilled water.

52. The method of any one of claims 32-51, further comprising the step of drawing ambient air through the compressor via a vacuum pump.

53. The method of claim 52, further comprising the step of drawing air from at least one chamber of the desalination plant to create a vacuum therein via a vacuum line off the vacuum pump.

54. The method of any one of claims 32-53, wherein at least one of the first, second and third turbine is substituted for a screw expander, a steam engine, an ORC turbine, an engine, a steam engine or a water wheel.

55. The method of any one of claims 32-53, wherein at least one of the first, second and third turbines comprises a series of turbines.

56. The method of any one of claims 32-55, further comprising the step of pumping saltwater from a saltwater source using the supply pump, to deliver salt water to the desalination plant, wherein the supply pump is an air-pump.