

CLAIMS:

1. A method for optimizing the characteristic potential thermal output capacity of a well system including a working fluid capable of thermal charging from said
5 formation, said system having an inlet well and an outlet well and disposed within a formation, comprising:

modulating circulation of said working fluid within said well system to oscillate thermal output from thermally charged working fluid about the characteristic predetermined potential thermal output capacity, where the averaged oscillated
10 thermal output substantially equates with said predetermined potential thermal output capacity of said formation.
2. The method as set forth in claim. 1, wherein said thermal output is inconstant.
- 15 3. The method as set forth in claims 1 or 2, wherein said thermal output is cycled between a charging operation where said working fluid is thermally charged through conductive heat transfer from said formation and a discharging operation where the thermal energy is removed for processing.
- 20 4. The method as set forth in claim 3, wherein processing comprises conversion to at least one of electrical energy, heat energy and combinations thereof.
5. The method as set forth in claim 3, wherein modulating includes at least one of variation in flow rate of said working fluid, residency time in said system, oscillation
25 duration, thermal charging duration, thermal discharging and combinations thereof.

6. The method as set forth in any one of claims 1 through 5, further including the step of generating on demand energy to an end user through interaction between said charged working fluid and a power generation device.
- 5 7. The method as set forth in any one of claims 1 through 6, wherein said thermally charged working fluid is circulated above said characteristic potential thermal output capacity in a discharging cycle to produce on demand power.
8. The method as set forth in any one of claims 1 through 7, wherein said
10 geologic formation is selected from the group comprising: a geothermal formation, a low permeability formation, a sedimentary formation, a volcanic formation, a high temperature formation, a variable permeability formation and combinations thereof.
9. The method as set forth in any one of claims 1 through 8, wherein said
15 geologic formation contains no substantial cracks, fissures, voids and or fractures.
10. The method as set forth in any one of claims 1 through 9, wherein cracks, fissures, voids and or fractures are induced in said formation.
- 20 11. The method as set forth in claim 10, further including the step of sealing said cracks, fissures, voids and or fractures is coincident with drilling said wells.
12. The method as set forth in claim 10, further including the step of sealing said cracks, fissures, voids and or fractures occurring subsequent to drilling said wells.

25

13. The method as set forth in any one of claims 1 through 12, wherein said working fluid includes a drag reducing additive, a surfactant, a polymeric compound, a suspension, a biological additive, a stabilizing agent, anti-scaling agents, anti-corrosion agents, friction reducers, anti-freezing chemicals, biocides, hydrocarbons, 5 alcohols, refrigerants, phase change materials, organic fluids and combinations thereof.
14. The method as set forth in claim 6, wherein said interaction between said charged working fluid and said power generation device includes minimizing said 10 residency time by increasing the flow rate of said charged working fluid.
15. The method as set forth in any one of claims 1 through 14, further including the step of storing thermal energy from said charged working fluid in said formation.
- 15 16. The method as set forth in any one of claims 1 through 15, further including the step of supplementing said working fluid with energy charged working fluid from adjacent wells in said formation.
17. The method as set forth in claim 16, wherein supplementing includes rerouting 20 working fluid from adjacent wells to a well and a power generation device under user demand.
18. The method as set forth in any one of claims 1 through 17, wherein circulation of said working fluid is effected by the induced thermosiphon.

25

19. The method as set forth in claim 18, wherein hydraulic pressure loss in operation is less than 1.5 times the quantity of the thermosiphon pressure.

20. The method as set forth in claim 18, wherein hydraulic pressure loss in
5 operation is less than 1.0 times the quantity of the thermosiphon pressure.

21. The method as set forth in any one of claims 1 through 20, further including the step of amalgamating intermittent renewable energy generating methods with the method of claim 1.

10

22. The method as set forth in claim 21, wherein said intermittent renewable energy generating methods include wind, solar and electrochemical methods.

23. A method for providing on demand power to an end user with a well system
15 having an inlet well, an outlet well in a thermally productive geologic formation, comprising:

forming a closed loop with a power generation device operatively connecting said inlet and said outlet;

20 circulating a working fluid in said loop with a predetermined residency time to thermally load circulating working fluid through conduction from said formation; and

modulating the flow rate of thermally loaded working fluid within said loop for power generation based on user demand.

24. The method as set forth in claim 23, further including interconnecting said inlet
25 well and said outlet well with an interconnecting section in fluid communication, at

least part of said interconnecting section being disposed for conduction in said thermally productive geologic formation.

25. The method as set forth in claim 24, further including the step of
5 interconnecting said inlet well and said outlet well with a plurality of interconnecting sections in a predetermined pattern within said formation.

26. The method as set forth in claim 25, further including the step of selectively
modulating circulation of said working fluid within predetermined sections of said
10 plurality of interconnecting sections of said well system to oscillate thermal output from thermally charged working fluid about a characteristic predetermined potential thermal output capacity of said formation, where the averaged oscillated thermal output substantially equates with said predetermined potential thermal output capacity of said formation.

15

27. The method as set forth in any one of claims 23 through 26, wherein said geologic formation is selected from the group comprising:

a geothermal formation, a low permeability formation, a sedimentary
formation, a volcanic formation, a high temperature formation, a variable permeability
20 formation and combinations thereof.

28. The method as set forth in any one of claims 23 through 27, wherein said geothermal mechanism includes pre-existing wells.

25 29. The method as set forth in claim 28, wherein said geothermal formation includes at least one of hot dry impermeable rock, naturally fissured, fractured or

cracked rock, synthetically fissured, fractured or cracked rock and combinations thereof.

30. The method as set forth in claim 24, wherein said interconnecting section is
5 cased, uncased, lined, chemically treated, chemically sealed, thermally sealed,
includes single pipe, coaxial pipe and combinations thereof in a continuous or
discontinuous configuration.

31. The method as set forth in any one of claims 23 through 30, wherein said inlet
10 well and said outlet well are co-located.

32. The method as set forth in claim 25, wherein said interconnecting sections are
arranged:
symmetrically relative to adjacent interconnecting sections;
15 asymmetrically relative to adjacent interconnecting sections;
in interdigital relation to adjacent interconnecting sections;
in coplanar relation to adjacent interconnecting sections;
in parallel planar relation to adjacent interconnecting sections;
in isolated or grouped networks; and
20 combinations thereof.

33. The method as set forth in claim 25, further including the step of providing at
least one of a plurality of closed loops with outlet wells of adjacent loops selectively
connected to inlet wells of additional wells, inlet wells of adjacent wells commonly

connected, outlet wells of adjacent wells commonly connected and combinations thereof.

34. The method as set forth in claim 33, further including the step selectively
5 modulating circulation of said working fluid within predetermined loops of said plurality of loops of said well system to oscillate thermal output from thermally charged working fluid about a characteristic predetermined potential thermal output capacity, where the averaged oscillated thermal output substantially equates with said predetermined potential thermal output capacity.

10

35. The method as set forth in claim 33, wherein selective connection comprises valved connection with temperature monitoring.

36. The method as set forth in claim 33, wherein the selective connection
15 comprises a daisy chain connection.

37. The method as set forth in claim 36, wherein said daisy chain connection is at least one of continuous, intermittent and combinations thereof.

20 38. The method as set forth in any one of claims 23 through 37, further including the step of amalgamating said method with intermittent renewable energy generating methods.

39. The method as set forth in claim 38, wherein said intermittent renewable
25 energy generating methods include wind, solar and electrochemical methods.

40. A method for delivering on demand power to an end user, comprising:
- providing an inlet well, an outlet well and a well interconnecting section between said inlet well and said outlet well and being disposed within a geologic formation having a temperature of at least 90°C, said formation having a predetermined potential thermal capacity;
- implementing a closed loop arrangement within said formation through connecting said outlet well to a power generation device to recover energy from the well arrangement in a closed loop between the wells and the power generation device, said closed loop arrangement having a predetermined energy output within available potential thermal capacity;
- circulating a working fluid within said loop with predetermined residency time at least within the interconnecting section to form an energy charged working fluid through heat transfer from said formation; and
- generating on demand energy to an end user through interaction between said charged working fluid and said power generation device.
41. The method as set forth in claim 40, wherein said residency time is sufficient to facilitate power generation for the duration of a user's demand.
42. The method as set forth in claims 40 or 41, wherein said interaction between said charged working fluid and said power generation device includes minimizing said residency time by increasing the flow rate of said charged working fluid.
43. The method as set forth in any one of claims 40 through 42, further including the step of storing thermal energy from said charged working fluid in said geothermal formation.

44. The method as set forth in any one of claims 40 through 43, further including the step of supplementing said working fluid with energy charged working fluid from adjacent wells in said formation.

5

45. The method as set forth in claim 44, wherein supplementing includes rerouting working fluid from adjacent wells to a well and power generation device under user demand.

10 46. The method as set forth in any one of claims 40 through 45, wherein circulation of said working fluid is effected by the induced thermosiphon.

47. The method as set forth in any one of claims 40 through 46, wherein hydraulic pressure loss in operation is less than 1.5 times the quantity of the thermosiphon pressure.

15

48. The method as set forth in any one of claims 40 through 47, wherein hydraulic pressure loss in operation is less than 1.0 times the quantity of the thermosiphon pressure.

20

49. The method as set forth in any one of claims 40 through 48, wherein said formation has an available potential thermal capacity and said closed loop is positioned in a configuration within said formation to produce a predetermined energy output recoverable from said predetermined potential thermal capacity.

25

50. The method as set forth in claim 49, including facilitating energy delivery on demand through thermal discharge of said working fluid in said power production apparatus to an end user which intermittently exceeds said predetermined energy output, while maintaining a delivered energy output average of said predetermined energy output over a predetermined timeframe.

5

51. The method as set forth in claim 49, wherein energy delivery for an intermittent duration is a timeframe during which user demand is high relative to the entire predetermined timeframe.

10

52. The method as set forth in claim 1, further including a turbine driven by cryogenic air storage with said power generation device.

53. The method as set forth in claim 23, further including a turbine driven by cryogenic air storage with said power generation device.

15

54. The method as set forth in claim 40, further including a turbine driven by cryogenic air storage with said power generation device.

20 55. A method for optimizing power distribution on a pre-existing grid, comprising:

providing an intermittent power production arrangement having a designed maximum power production quantity and a second effective power production quantity on said pre-existing grid;

positioning an energy recovering and producing closed loop within a thermal bearing geologic formation adjacent said intermittent power production arrangement, said loop including an inlet well, outlet well, interconnecting segment between said

25

inlet well and said outlet well, said interconnecting segment positioned in said formation to facilitate thermal recovery in said formation, said formation having an available potential thermal capacity;

5 positioning said closed loop in a configuration within said formation to produce a predetermined energy output from said available potential thermal capacity;

circulating a working fluid within said loop with a predetermined residency time to thermally charge circulating working fluid through conduction from said formation; and

10 selectively thermally discharging said working fluid through said intermittent power production arrangement to increase power production to a quantity above said second effective power production quantity and below said designed maximum power production quantity, whereby overall power production is optimized using said pre-existing grid.

15 56. The method as set forth in claim 55, wherein said intermittent power production arrangement and said energy recovering and producing closed loop are positioned on a common geographic footprint.

20 57. The method as set forth in claim 56, wherein said energy recovering and producing closed loop produces on demand energy.

25 58. The method as set forth in claims 56 or 57, wherein selective thermal discharging of said working fluid through said intermittent power production arrangement is effected during periods of significant user power demand.

59. The method as set forth in any one of claims 56, through 58, wherein increased power production is transmitted using the transmission capacity and infrastructure of said pre-existing grid of said intermittent power production arrangement.

5

60. A power production method, comprising:

providing a power transmission grid for transmitting produced power to an end user, said grid having an output capacity;

providing a power production arrangement having a designed maximum
10 power production quantity and a second effective power production quantity on said grid;

positioning an energy recovering and producing closed loop within a thermal bearing geologic formation adjacent said intermittent power production arrangement, said loop including an inlet well, outlet well, interconnecting segment between said
15 inlet well and said outlet well, said interconnecting segment positioned in said formation to facilitate thermal recovery in said formation, said formation having an available potential thermal capacity;

positioning said closed loop in a configuration within said formation to produce a predetermined energy output from said available potential thermal capacity;

20 circulating a working fluid within said loop with a predetermined residency time to thermally charge circulating working fluid through conduction from said formation;
and

selectively thermally discharging said working fluid through said power production arrangement to maintain power production to said capacity throughout
25 said power transmission grid.

61. The method a set forth in claim 60, wherein said power transmission grid includes a plurality of separate distribution zones for distribution of power over a geographic area, at least some of the zones including an energy recovering and producing closed loop.

5

62. The method a set forth in claims 60 or 61, wherein said power production arrangement comprises an intermittent power source.

63. The method a set forth in any one of claims 60 through 62, wherein said
10 power production arrangement comprises a baseload power source.

64. A method for providing on demand power to an end user, comprising:
providing an inlet well, an outlet well and an interconnecting section between
said inlet well and said outlet well and being disposed within a geologic formation
15 having a predetermined potential thermal output capacity, said formation having a
temperature of at least 90°C;
connecting said outlet well to a power generation device to recover energy
from the well arrangement in a closed loop between the wells and the power
generation device; and
20 circulating a working fluid within said loop at varying flow rates to oscillate
thermal output about the predetermined potential thermal output capacity, to produce
on demand power where the average thermal output may equal the predetermined
potential thermal output capacity.

25 65. A geothermal power output system having baseload distribution substantially
equivalent with oscillated discontinuous output cycles averaged over a distribution
period.

66. A power plant for providing user predetermined power distribution, comprising:
- a thermal energy recovery apparatus configured to modulate the circulation of a working fluid in a thermally productive formation whereby thermal energy is
 - 5 transferred into said working fluid, said apparatus for oscillating discontinuous output cycles averaged over a distribution period; and
 - distribution apparatus for distributing averaged power output as a user predetermined power output.