CLAIMS

What is claimed is:

1. A conditioning system comprising:

a liquid-to-air energy exchanger (LAEE) having a plurality of energy exchange (EX) circuits, the LAEE comprising:

a single liquid panel having a plurality of liquid circuits through each of which a liquid is configured to flow, each of the plurality of liquid circuits having a plurality of closed liquid channels through each of which a liquid is configured to flow without mixing with the liquid flowing through other of the plurality of closed liquid channels, and each of the liquid circuits corresponding to each of the plurality of EX circuits;

an air channel adjacent the liquid panel and through which air is configured to flow from an inlet of the LAEE to an outlet of the LAEE, the air channel extending adjacent all of the plurality of liquid circuits; and

a plurality of membranes connected to the liquid panel, at least one of the plurality of membranes corresponding to each of the plurality of liquid circuits, and each one of the plurality of membranes disposed between the respective liquid circuit and the air channel, and

wherein each of the plurality of EX circuits is configured to exchange at least one of latent and sensible energy between a liquid flowing through the respective liquid circuit and the air.

2. The conditioning system of claim 1, wherein:

the plurality of liquid circuits comprises:

a first liquid circuit through which a first liquid is configured to flow; and

a second liquid circuit through which a second liquid is configured to flow, the second liquid circuit arranged downstream of the first liquid circuit in a direction of air flow through the LAEE;

the plurality of membranes comprises:

a first membrane connected to the liquid panel between the first liquid circuit and the air channel and forming a barrier between the first liquid and the air; and

a second membrane connected to the liquid panel between the second liquid circuit and the air channel and forming a barrier between the second liquid and the air; and

the plurality of EX circuits comprises:

a first EX circuit configured to exchange at least one of latent and sensible energy between the first liquid and the air through the first membrane; and

a second EX circuit configured to exchange at least one of latent and sensible energy between the second liquid and the air through the second membrane.

3. The conditioning system of claim 2, wherein:

the first liquid comprises a liquid desiccant and the second liquid comprises water;

each of the first and second membranes comprise a semi-permeable membrane permeable to gases and vapor and impermeable to liquids and solids;

the first EX circuit is configured to circulate the liquid desiccant to absorb water from the air flowing through the first EX circuit, a moisture content of the air exiting the first EX circuit being lower than a moisture content of the air entering the first EX circuit; and

the second EX circuit is configured to evaporatively cool at least one of the water and the air, a temperature of the at least one of the water and the air exiting the second EX circuit being lower than a temperature of the at least one of the water and the air entering the second EX circuit.

4. The conditioning system of claim 3, wherein:

the LAEE defines a process plenum and the air is process air;

the second EX circuit is configured to evaporatively cool the process air entering the second EX circuit and deliver the conditioned process air to an enclosed space, a temperature of the conditioned process air exiting the second EX circuit being lower than a temperature of the process air entering the second EX circuit.

5. The conditioning system of claim 4, wherein the process air entering the LAEE is at least partially return air from the enclosed space.

6. The conditioning system of claim 4, further comprising a first liquid transport circuit connected to a liquid outlet of the first EX circuit and configured to transport the liquid desiccant from the first EX circuit to a regenerator, the regenerator configured to increase a concentration of the liquid desiccant by removing water from the liquid desiccant, the regenerator fluidically connected to the first EX circuit to transport the concentrated liquid desiccant back to the first EX circuit.

7. The conditioning system of claim 6, further comprising a second liquid transport circuit connected to a liquid outlet of the regenerator and configured to transport at least a portion of the water removed from the liquid desiccant to a liquid inlet of the second EX circuit.

8. The conditioning system of claim 6, wherein the regenerator is a thermally driven regenerator.

9. The conditioning system of claim 3, further comprising:

a liquid transport circuit connected to a liquid outlet of the second EX circuit and configured to transport the water to a heat load in an enclosed space, wherein the second EX circuit is configured to evaporatively cool the water, a temperature of the water exiting the second EX circuit via the liquid outlet being lower than a temperature of the water entering the second EX circuit via a liquid inlet.

10. The conditioning system of claim 9, wherein the air is scavenger air and further comprising:

a process plenum configured to direct process air from the enclosed space through a process air inlet and return conditioned process air to the enclosed space through a process air outlet; and

a liquid-to-air heat exchanger (LAHX) arranged inside the process plenum, the LAHX comprising a liquid inlet connected to and configured to receive the water from the liquid transport circuit, the LAHX configured to directly and sensibly cool the process air using the water flowing through the LAHX, a temperature of the conditioned process air exiting the LAHX being lower than a temperature of the air entering the LAHX,

wherein the conditioned process air exiting the process plenum at the process air outlet is returned to the enclosed space.

11. The conditioning system of claim 10, wherein the process air entering the LAHX is at least partially return air from the enclosed space.

12. The conditioning system of claim 10, wherein the liquid transport circuit is a second liquid transport circuit, and further comprising a first liquid transport circuit connected to a liquid outlet of the first EX circuit and configured to transport the liquid desiccant from the first EX circuit to a regenerator, the regenerator configured to increase a concentration of the liquid desiccant by removing water from the liquid desiccant, the regenerator fluidically connected to the first EX circuit to transport the concentrated liquid desiccant back to the first EX circuit.

13. The conditioning system of claim 12, further comprising a third liquid transport circuit connected to a liquid outlet of the regenerator and configured to transport at least a portion of the water removed from the liquid desiccant to a liquid inlet of the second EX circuit.

14. The conditioning system of claim 12, wherein the regenerator is a thermally driven regenerator.

15. The conditioning system of claim 2, wherein:

the first membrane comprises an impermeable membrane;

the second membrane comprises a semi-permeable membrane permeable to gases and vapor and impermeable to liquids and solids;

the first EX circuit is configured to directly and sensibly cool the air using the first liquid, a temperature of the air exiting the first EX circuit being lower than a temperature of the air entering the first EX circuit; and

the second EX circuit is configured to evaporatively cool at least one of the second liquid and the air, a temperature of the at least one of the second liquid and the air exiting the second EX circuit being lower than a temperature of the at least one of the second liquid and the air entering the second EX circuit.

16. The conditioning system of claim 15, wherein:

the LAEE defines a process plenum and the air is process air;

the second EX circuit is configured to evaporatively cool the process air entering the second EX circuit and deliver the conditioned process air to an enclosed space, a temperature of the conditioned process air exiting the second EX circuit being lower than a temperature of the process air entering the second EX circuit.

17. The conditioning system of claim 16, wherein the process air entering the LAEE is at least partially return air from the enclosed space.

18. The conditioning system of claim 15, further comprising:

a liquid transport circuit connected to a liquid outlet of the second EX circuit and configured to transport the water to a heat load in an enclosed space, wherein the second EX circuit is configured to evaporatively cool the water, a temperature of the water exiting the second EX circuit via the liquid outlet being lower than a temperature of the water entering the second EX circuit via a liquid inlet.

19. The conditioning system of claim 18, wherein the air is scavenger air and further comprising:

a process plenum configured to direct process air from the enclosed space through a process air inlet and return conditioned process air to the enclosed space through a process air outlet; and

a liquid-to-air heat exchanger (LAHX) arranged inside the process plenum, the LAHX comprising a liquid inlet connected to and configured to receive the water from the liquid transport circuit, the LAHX configured to directly and sensibly cool the process air using the water flowing through the LAHX, a temperature of the conditioned process air exiting the LAHX being lower than a temperature of the air entering the LAHX,

wherein the conditioned process air exiting the process plenum at the process air outlet is returned to the enclosed space.

20. The conditioning system of claim 19, wherein the process air entering the LAHX is at least partially return air from the enclosed space.

~~21. The conditioning system of claim 1, wherein:~~

~~the plurality of liquid circuits comprises:~~

~~a first liquid circuit through which a first liquid is configured to flow;~~

~~a second liquid circuit through which a second liquid is configured to flow, the second liquid circuit arranged downstream of the first liquid circuit in a direction of air flow through the LAEE; and~~

~~a third liquid circuit through which a third liquid is configured to flow, the third liquid circuit arranged downstream of the second liquid circuit in the direction of air flow;~~

~~the plurality of membranes comprises:~~

~~a first membrane connected to the liquid panel between the first liquid circuit and the air channel and forming a barrier between the first liquid and the air;~~

~~a second membrane connected to the liquid panel between the second liquid circuit and the air channel and forming a barrier between the second liquid and the air; and~~

~~a third membrane connected to the liquid panel between the third liquid circuit and the air channel and forming a barrier between the third liquid and the air; and~~

~~the plurality of EX circuits comprises:~~

~~a first EX circuit is configured to exchange at least one of latent and sensible energy between the first liquid and the air through the first membrane;~~

~~a second EX circuit is configured to exchange at least one of latent and sensible energy between the second liquid and the air through the second membrane; and~~

~~a third EX circuit is configured to exchange at least one of latent and sensible energy between the third liquid and the air through the third membrane.~~

~~22. The conditioning system of claim 21, wherein:~~

~~the first liquid comprises a liquid desiccant and each of the second and third liquids comprises water;~~

~~each of the first and third membranes comprise a semi-permeable membrane permeable to gases and vapor and impermeable to liquids and solids;~~

~~the second membrane comprises an impermeable membrane;~~

the first EX circuit is configured to circulate the liquid desiccant to absorb water from the air flowing through the first EX circuit, a moisture content of the air exiting the first EX circuit being lower than a moisture content of the air entering the first EX circuit;

the second EX circuit is configured to directly and sensibly cool the air using the water flowing through the second EX circuit, a temperature of the air exiting the second EX circuit being lower than a temperature of the air entering the second EX circuit; and

the third EX circuit is configured to evaporatively cool at least one of the water flowing through the third EX circuit and the air, a temperature of the at least one of the water and the air exiting the third EX circuit being lower than a temperature of the at least one of the water and the air entering the third EX circuit.

23. The conditioning system of claim 22, wherein:

the LAEE defines a process plenum and the air is process air;

the third EX circuit is configured to evaporatively cool the process air entering the third EX circuit and deliver the conditioned process air to an enclosed space, a temperature of the conditioned process air exiting the third EX circuit being lower than a temperature of the process air entering the third EX circuit.

24. The conditioning system of claim 23, wherein the process air entering the LAEE is at least partially return air from the enclosed space.

25. The conditioning system of claim 23, further comprising a first liquid transport circuit connected to a liquid outlet of the first EX circuit and configured to transport the liquid desiccant from the first EX circuit to a regenerator, the regenerator configured to increase a concentration of the liquid desiccant by removing water from the liquid desiccant, the regenerator fluidically connected to the first EX circuit to transport the concentrated liquid desiccant back to the first EX circuit.

26. The conditioning system of claim 25, further comprising a second liquid transport circuit connected to a liquid outlet of the regenerator and configured to transport at least a portion of the water removed from the liquid desiccant to a liquid inlet of the third EX circuit.

27. The conditioning system of claim 25, wherein the regenerator is a thermally driven regenerator.

28. The conditioning system of claim 22, further comprising:

a liquid transport circuit connected to a liquid outlet of the third EX circuit and configured to transport the water to a heat load in an enclosed space, wherein the third EX circuit is configured to evaporatively cool the water, a temperature of the water exiting the third EX circuit via the liquid outlet being lower than a temperature of the water entering the third EX circuit via a liquid inlet.

29. The conditioning system of claim 28, wherein the air is scavenger air and further comprising:

a process plenum configured to direct process air from the enclosed space through a process air inlet and return conditioned process air to the enclosed space through a process air outlet; and

a liquid-to-air heat exchanger (LAHX) arranged inside the process plenum, the LAHX comprising a liquid inlet connected to and configured to receive the water from the liquid transport circuit, the LAHX configured to directly and sensibly cool the process air using the water flowing through the LAHX, a temperature of the conditioned process air exiting the LAHX being lower than a temperature of the air entering the LAHX,

wherein the conditioned process air exiting the process plenum at the process air outlet is returned to the enclosed space.

30. The conditioning system of claim 29, wherein the process air entering the LAHX is at least partially return air from the enclosed space.

31. The conditioning system of claim 29, wherein the liquid transport circuit is a first liquid transport circuit, and further comprising a second liquid transport circuit connected to a liquid outlet of the first EX circuit and configured to transport

~~the liquid desiccant from the first EX circuit to a regenerator, the regenerator configured to increase a concentration of the liquid desiccant by removing water from the liquid desiccant, the regenerator fluidically connected to the first EX circuit to transport the concentrated liquid desiccant back to the first EX circuit.~~

~~32. The conditioning system of claim 31, further comprising a third liquid transport circuit connected to a liquid outlet of the regenerator and configured to transport at least a portion of the water removed from the liquid desiccant to a liquid inlet of the third EX circuit.~~

~~33. The conditioning system of claim 31, wherein the regenerator is a thermally driven regenerator.~~

~~34. The conditioning system of claim 21, wherein:~~

~~each of the first and third membranes comprise an impermeable membrane;~~

~~the second membrane comprises a semi-permeable membrane permeable to gases and vapor and impermeable to liquids and solids;~~

~~the first EX circuit is configured to directly and sensibly cool the air using the first liquid, a temperature of the air exiting the first EX circuit being lower than a temperature of the air entering the first EX circuit;~~

~~the second EX circuit is configured to evaporatively cool at least one of the second liquid and the air, a temperature of the at least one of the second liquid and the air exiting the second EX circuit being lower than a temperature of the at least one of the second liquid and the air entering the second EX circuit; and~~

~~the third EX circuit is configured to configured directly and sensibly cool the third liquid using the air, a temperature of the third liquid exiting the third EX circuit being lower than a temperature of the third liquid entering the third EX circuit.~~

~~35. The conditioning system of claim 34, further comprising:~~

~~a liquid transport circuit connected to a liquid outlet of the second EX circuit and configured to transport the water to a heat load in an enclosed space, wherein the second EX circuit is configured to evaporatively cool the water, a temperature of the water exiting the second EX circuit via the liquid outlet being lower than a temperature of the water entering the second EX circuit via a liquid inlet.~~

36. The conditioning system of claim 35, wherein the air is scavenger air and further comprising:

a process plenum configured to direct process air from the enclosed space through a process air inlet and return conditioned process air to the enclosed space through a process air outlet; and

a liquid-to-air heat exchanger (LAHX) arranged inside the process plenum, the LAHX comprising a liquid inlet connected to and configured to receive the water from the liquid transport circuit, the LAHX configured to directly and sensibly cool the process air using the water flowing through the LAHX, a temperature of the conditioned process air exiting the LAHX being lower than a temperature of the air entering the LAHX,

wherein the conditioned process air exiting the process plenum at the process air outlet is returned to the enclosed space.

37. The conditioning system of claim 36, wherein the process air entering the LAHX is at least partially return air from the enclosed space.

38. The conditioning system of claim 35, wherein the liquid transport circuit is a first liquid transport circuit, and further comprising:

a second liquid transport circuit connected to a liquid outlet of the LAHX and configured to transport the water exiting the LAHX to a liquid inlet of the third EX circuit; and

a third liquid transport circuit connected to a liquid outlet of the third EX circuit and configured to transport the water exiting the third EX circuit to a liquid inlet of the second EX circuit.

39. The conditioning system of claim 1, wherein:

the plurality of liquid circuits comprises:

a first liquid circuit through which a first liquid is configured to flow;

a second liquid circuit through which a second liquid is configured to flow, the second liquid circuit arranged downstream of the first liquid circuit in a direction of air flow through the LAEE;

a third liquid circuit through which a third liquid is configured to flow, the third liquid circuit arranged downstream of the second liquid circuit in the direction of air flow; and

~~a fourth liquid circuit through which a fourth liquid is configured to flow, the fourth liquid circuit arranged downstream of the third liquid circuit in the direction of air flow~~

~~the plurality of membranes comprises:~~

~~a first membrane connected to the liquid panel between the first liquid circuit and the air channel and forming a barrier between the first liquid and the air;~~

~~a second membrane connected to the liquid panel between the second liquid circuit and the air channel and forming a barrier between the second liquid and the air;~~

~~a third membrane connected to the liquid panel between the third liquid circuit and the air channel and forming a barrier between the third liquid and the air; and~~

~~a fourth membrane connected to the liquid panel between the fourth liquid circuit and the air channel and forming a barrier between the fourth liquid and the air; and~~

~~the plurality of EX circuits comprises:~~

~~a first EX circuit configured to exchange at least one of latent and sensible energy between the first liquid and the air through the first membrane;~~

~~a second EX circuit configured to exchange at least one of latent and sensible energy between the second liquid and the air through the second membrane;~~

~~a third EX circuit configured to exchange at least one of latent and sensible energy between the third liquid and the air through the third membrane; and~~

~~a fourth EX circuit configured to exchange at least one of latent and sensible energy between the fourth liquid and the air through the fourth membrane.~~

~~40. The conditioning system of claim 39, wherein:~~

~~the first liquid comprises a liquid desiccant and each of the second, third, and fourth liquids comprises water;~~

~~each of the first and third membranes comprise a semi-permeable membrane permeable to gases and vapor and impermeable to liquids and solids;~~

~~each of the second and fourth membranes comprises an impermeable membrane;~~

the first EX circuit is configured to circulate the liquid desiccant to absorb water from the air flowing through the first EX circuit, a moisture content of the air exiting the first EX circuit being lower than a moisture content of the air entering the first EX circuit;

the second EX circuit is configured to directly and sensibly cool the air using the water flowing through the second EX circuit, a temperature of the air exiting the second EX circuit being lower than a temperature of the air entering the second EX circuit;

the third EX circuit is configured to evaporatively cool at least one of the water flowing through the third EX circuit and the air, a temperature of the at least one of the water and the air exiting the second EX circuit being lower than a temperature of the at least one of the water and the air entering the second EX circuit; and

the fourth EX circuit is configured to configured directly and sensibly cool the water flowing through the fourth EX circuit using the air, a temperature of the water exiting the fourth EX circuit being lower than a temperature of the water entering the fourth EX circuit.

41. The conditioning system of claim 40, further comprising:

a liquid transport circuit connected to a liquid outlet of the third EX circuit and configured to transport the water to a heat load in an enclosed space, wherein the third EX circuit is configured to evaporatively cool the water, a temperature of the water exiting the third EX circuit via the liquid outlet being lower than a temperature of the water entering the third EX circuit via a liquid inlet.

42. The conditioning system of claim 41, wherein the air is scavenger air and further comprising:

a process plenum configured to direct process air from the enclosed space through a process air inlet and return conditioned process air to the enclosed space through a process air outlet; and

a liquid-to-air heat exchanger (LAHX) arranged inside the process plenum, the LAHX comprising a liquid inlet connected to and configured to receive the water from the liquid transport circuit, the LAHX configured to directly and sensibly cool the process air using the water flowing through the LAHX, a

temperature of the conditioned process air exiting the LAHX being lower than a temperature of the air entering the LAHX,

wherein the conditioned process air exiting the process plenum at the process air outlet is returned to the enclosed space.

43. The conditioning system of claim 42, wherein the process air entering the LAHX is at least partially return air from the enclosed space.

44. The conditioning system of claim 41, wherein the liquid transport circuit is a first liquid transport circuit, and further comprising a second liquid transport circuit connected to a liquid outlet of the first EX circuit and configured to transport the liquid desiccant from the first EX circuit to a regenerator, the regenerator configured to increase a concentration of the liquid desiccant by removing water from the liquid desiccant, the regenerator fluidically connected to the first EX circuit to transport the concentrated liquid desiccant back to the first EX circuit.

45. The conditioning system of claim 44, further comprising a third liquid transport circuit connected to a liquid outlet of the regenerator and configured to transport at least a portion of the water removed from the liquid desiccant to a liquid inlet of the third EX circuit.

46. The conditioning system of claim 44, wherein the regenerator is a thermally driven regenerator.

47. The conditioning system of claim 44, further comprising:

a fourth liquid transport circuit connected to a liquid outlet of the LAHX and configured to transport the water exiting the LAHX to a liquid inlet of the fourth EX circuit; and

a fifth liquid transport circuit connected to a liquid outlet of the fourth EX circuit and configured to transport the water exiting the fourth EX circuit to a liquid inlet of the third EX circuit.

48. The conditioning system of claim 1, wherein each of the plurality of liquid channels comprises a liquid inlet connected to a liquid outlet through a plurality of flow passages.

~~49. The conditioning system of claim 48, wherein the plurality of liquid inlets of the plurality of liquid channels of each of the plurality of liquid circuits are disposed at a first corner of the respective liquid circuit of the single liquid panel, and wherein the plurality of liquid outlets of the plurality of liquid channels of each of the plurality of liquid circuits are disposed at a second corner of the respective liquid circuit of the single liquid panel, the second corner being diagonally opposed to the first corner.~~

~~50. The conditioning system of claim 49, wherein the first and second corners of each of the plurality of liquid circuits is arranged for counter-flow of a liquid through the respective liquid circuit relative to the direction of air flow.~~

~~51. The conditioning system of claim 48, wherein the liquid inlets and outlets are vertical and the flow passages are horizontal.~~

~~52. The conditioning system of claim 48, wherein the plurality of liquid channels comprises:~~
~~a first plurality of flow passages connected to a first inlet channel and a first outlet channel; and~~
~~a second plurality of flow passages connected to a second inlet channel and a second outlet channel.~~

~~53. The conditioning system of claim 52, wherein the first plurality of flow passages is staggered with respect to the second plurality of flow passages.~~

~~54. The conditioning system of claim 1, wherein each of the plurality of membranes is selected from the group of membranes consisting of semi-permeable and impermeable membranes.~~

~~55. The conditioning system of claim 1, wherein one or more of the plurality of membranes is a semi-permeable membrane.~~

~~56. The conditioning system of claim 55, wherein the one or more of the plurality of membranes is selected from the group of membranes consisting of micro-porous, non-porous ion exchange, and non-porous pervaporation membranes.~~

57. The conditioning system of claim 1, wherein:

the single liquid panel and the plurality of membranes are a first liquid panel assembly and further comprising a plurality of additional liquid panel assemblies, each of the plurality of liquid panel assemblies comprising:

a single liquid panel having a plurality of liquid circuits through each of which a liquid is configured to flow, each of the liquid circuits corresponding to each of the plurality of EX circuits; and

a plurality of membranes connected to the liquid panel, at least one of the plurality of membranes corresponding to each of the plurality of liquid circuits, and each one of the plurality of membranes disposed between the respective liquid circuit and the air channel;

the air channel is a first air channel and further comprising a plurality of additional air channels, each of the plurality of air channels disposed between two of the plurality of liquid panel assemblies and extending adjacent all of the plurality of liquid circuits of the two of the plurality of liquid panel assemblies.

58. The conditioning system of claim 57, wherein:

the plurality of liquid panel assemblies comprises a first plurality of liquid panel assemblies and a second plurality of liquid panel assemblies, the first plurality of liquid panel assemblies arranged adjacent the second plurality of liquid panel assemblies in a direction generally perpendicular to a direction of air flow through the LAEE, each of the first plurality of liquid panel assemblies having a first plurality of liquid circuits and each of the second plurality of liquid panel assemblies having a second plurality of liquid circuits, the first plurality of liquid circuits comprising:

a first liquid circuit through which a first liquid is configured to flow;

a second liquid circuit through which a second liquid is configured to flow, the second liquid circuit arranged downstream of the first liquid circuit in the direction of air flow through the LAEE; and

a third liquid circuit through which a third liquid is configured to flow, the third liquid circuit arranged downstream of the second liquid circuit in the direction of air flow,

the second plurality of liquid circuits comprising:

the first liquid circuit through which the first liquid is configured to flow;

the second liquid circuit through which the second liquid is configured to flow, the second liquid circuit arranged downstream of the first liquid circuit in the direction of air flow through the LAEE; and

a fourth liquid circuit through which a fourth liquid is configured to flow, the fourth liquid circuit arranged downstream of the second liquid circuit in the direction of air flow, the third liquid circuit being fluidically isolated from the fourth liquid circuit;

the plurality of EX circuits comprising a first plurality of EX circuits and a second plurality of EX circuits, each of the first plurality of liquid circuits corresponding to each of the first plurality of EX circuits and each of the second plurality of liquid circuits corresponding to each of the second plurality of EX circuits, the first plurality of EX circuits comprises:

a first EX circuit configured to exchange at least one of latent and sensible energy between the first liquid and the air;

a second EX circuit is configured to exchange at least one of latent and sensible energy between the second liquid and the air; and

a third EX circuit is configured to exchange at least one of latent and sensible energy between the third liquid and the air,

the second plurality of EX circuits comprises:

the first EX circuit configured to exchange at least one of latent and sensible energy between the first liquid and the air;

the second EX circuit is configured to exchange at least one of latent and sensible energy between the second liquid and the air; and

a fourth EX circuit is configured to exchange at least one of latent and sensible energy between the fourth liquid and the air.

59. The conditioning system of claim 58, wherein:

the first liquid comprises a liquid desiccant and each of the second, third, and fourth liquids comprises water;

the first EX circuit is configured to circulate the liquid desiccant to absorb water from the air flowing through the first EX circuit, a moisture content of the air exiting the first EX circuit being lower than a moisture content of the air entering the first EX circuit;

the second EX circuit is configured to directly and sensibly cool the air using the water flowing through the second EX circuit, a temperature of the air exiting

the second EX circuit being lower than a temperature of the air entering the second EX circuit;

the third EX circuit is configured to evaporatively cool the air flowing through the third EX circuit, a temperature of the air exiting the third EX circuit being lower than a temperature of the air entering the third EX circuit; and

the fourth EX circuit is configured to evaporatively cool the water flowing through the fourth EX circuit using the air, a temperature of the water exiting the fourth EX circuit being lower than a temperature of the water entering the fourth EX circuit.

60. The conditioning system of claim 59, wherein the air entering the LAEE through the inlet of the LAEE is at least partially return air from an enclosed space.

61. The conditioning system of claim 59, further comprising a first liquid transport circuit connected to a liquid outlet of the first EX circuit and configured to transport the liquid desiccant from the first EX circuit to a regenerator, the regenerator configured to increase a concentration of the liquid desiccant by removing water from the liquid desiccant, the regenerator fluidically connected to the first EX circuit to transport the concentrated liquid desiccant back to the first EX circuit.

62. The conditioning system of claim 61, further comprising a second liquid transport circuit connected to a liquid outlet of the regenerator and configured to transport at least a portion of the water removed from the liquid desiccant to a liquid inlet of the third EX circuit.

63. The conditioning system of claim 62, further comprising a third liquid transport circuit connected to a liquid outlet of the second EX circuit and configured to transport at least a portion of the water exiting the second EX circuit to a liquid inlet of the fourth EX circuit.

64. The conditioning system of claim 63, further comprising a fourth liquid transport circuit connected to a liquid outlet of the fourth EX circuit and configured to transport at least a portion of the water exiting the fourth EX circuit to a liquid inlet of the second EX circuit.

~~65. The conditioning system of claim 61, wherein the regenerator is a thermally driven regenerator.~~

~~66~~21. A method comprising:

arranging a liquid-to-air energy exchanger (LAEE) having a plurality of energy exchange (EX) circuits within or in proximity to an enclosed space, the LAEE comprising:

a single liquid panel having a plurality of liquid circuits through each of which a liquid is configured to flow, each of the liquid circuits corresponding to each of the plurality of EX circuits;

an air channel adjacent the liquid panel and through which air is configured to flow from an inlet of the LAEE to an outlet of the LAEE, the air channel extending adjacent all of the plurality of liquid circuits; and

a plurality of membranes connected to the liquid panel, each of the plurality of membranes corresponding to each of the plurality of liquid circuits and disposed between the respective liquid circuit and the air channel;

directing air through the air channel from the inlet of the LAEE to the outlet of the LAEE;

directing one or more liquids through each of the plurality of liquid circuits of the single liquid panel; and

in each of the plurality of EX circuits, exchanging at least one of latent and sensible energy between a liquid flowing through the respective liquid circuit and the air flowing through the air channel through the respective membrane.