CLAIMS

What is claimed is:

1. A method for production of hydrocarbons, including:

flowing a stream directly from a hydrocarbon reservoir to a cavern;

performing a phase separation of the stream within the cavern to form an aqueous phase and an organic phase;

flowing at least a portion of the aqueous phase or the organic phase, or both, directly from the cavern to a subsurface location; and

offloading at least a portion of the organic phase from the cavern to a surface.

2. The method of paragraph 1, wherein performing the phase separation of the stream within the cavern includes separating the stream into liquid hydrocarbon, water, gas, or solids, or any combinations thereof.

3. The method of paragraph 1 or 2, including storing at least a portion of the aqueous phase or the organic phase, or both, within the cavern.

4. The method of any of paragraphs 1, 2, or 3, wherein flowing at least a portion of the aqueous phase or the organic phase, or both, directly from the cavern to the subsurface location includes flowing at least a portion of the aqueous phase into an aquifer, a body of water, a sand formation, or a subterranean formation, or any combinations thereof.

5. The method of any of the preceding paragraphs, wherein flowing at least a portion of the aqueous phase or the organic phase, or both, directly from the cavern to the subsurface location includes flowing at least a portion of the organic phase into the hydrocarbon reservoir, a sand formation, or a subterranean formation, or any combinations thereof.

6. The method of any of the preceding paragraphs, wherein offloading at least a portion of the organic phase from the cavern to the surface includes sending at least a portion of the organic phase to a transportation system, wherein the transportation system includes a tanker, a platform, a ship, a pipeline, or any combinations thereof.

7. The method of any of the preceding paragraphs, including flowing at least a portion of the aqueous phase or the organic phase, or both, directly from the cavern to a second cavern, wherein the second cavern includes a storage vessel or a multi-stage separation vessel, or both.

8. The method of any of the preceding paragraphs, including flowing at least a portion of the aqueous phase or the organic phase, or both, directly from the cavern to each of a number of new subsurface locations.

9. A system for production of hydrocarbons, including:

a cavern configured to affect a phase separation;

a hydrocarbon reservoir linked to the cavern directly through a subsurface;

a reinjection system configured to reinject a gas stream into the hydrocarbon reservoir from the cavern directly through the subsurface;

an injection system configured to inject an aqueous stream from the cavern into an aquifer directly through the subsurface; and

a coupling configured to allow offloading of at least a portion of an organic phase from the cavern to a transportation system.

10. The system of paragraph 9, wherein the aquifer is fluidically coupled to the hydrocarbon reservoir.

11. The system of paragraph 9 or 10, wherein the cavern includes a salt cavern, a carbonate cavern, or any other water-soluble or acid-soluble cavern.

12. The system of any of paragraph 9, 10, or 11, wherein the cavern includes an underground phase separator for separating gas, liquid hydrocarbon, water, or solids, or any combinations thereof.

13. The system of any of paragraphs 9-12, wherein the cavern includes any of a number of shapes, including a cylindrical shape, a conical shape, or an irregular shape.

14. The system of any of paragraphs 9-13, wherein the cavern includes active controls for pressure and fluid level.

15. The system of paragraph 14, wherein the active controls for pressure and fluid level include a nucleonic level detector, a differential pressure (DP) cell level transmitter, an

optical level detector, a refractive index level detector, or a diaphragm-based strain gauge, or any combinations thereof.

16. The system of paragraph 14, wherein the active controls for pressure and fluid level include pumps, valves, and check valves, or any combinations thereof.

17. The system of any of paragraphs 9-14, wherein the system is configured to reduce a power requirement for the cavern by increasing or decreasing a pressure level within the cavern.

18. The system of any of paragraphs 9-14 or 17, wherein the system includes multiple connected caverns, and wherein each cavern includes a phase separation vessel or a storage vessel, or both.

19. The system of any of paragraphs 9-14, 17, or 18, wherein the system includes:

a first cavern configured to create a first separated stream; and

a second cavern fluidically coupled to the first cavern, wherein the second cavern accepts the first separated stream and creates a second separated stream.

20. The system of any of paragraphs 9-14 or 17-19, wherein the transportation system includes a pipeline, a platform, a tanker, or a ship, or any combinations thereof.

21. The system of any of paragraphs 9-14 or 17-20, wherein the cavern is configured to store a cushion hydrocarbon within the cavern, wherein the cushion hydrocarbon is a base hydrocarbon volume level for the cavern.

22. The system of any of paragraphs 9-14 or 17-21, wherein the cavern is configured to accept a number of streams directly from a number of hydrocarbon reservoirs.

23. The system of any of paragraphs 9-14 or 17-22, including downhole or in-cavern machinery for compression or reinjection of a stream, wherein the downhole or in-cavern machinery includes compressors or pumps, or any combination thereof.

24. The system of any of paragraphs 9-14 or 17-23, wherein the system includes a continuous power source supplied by a topside source, an episodic power source supplied by a ship or a tanker, a power source supplied by a differential pressure between subsurface locations, or any combinations thereof.

25. A method for harvesting hydrocarbons, including:

flowing a hydrocarbon stream from a hydrocarbon reservoir directly to a cavern;

performing a phase separation of the hydrocarbon stream within the cavern to recover a number of separated streams, wherein the number of separated streams include a liquid hydrocarbon stream, a gas stream, a water stream, and a solids stream; and

injecting an amount of the gas stream directly back into the hydrocarbon reservoir at a first time;

injecting an amount of the water stream directly into an aquifer at a second time; and

sending at least a portion of any of the number of separated streams to a new subsurface location through a subsurface line.

26. The method of paragraph 25, wherein the aquifer is fluidically coupled to the hydrocarbon reservoir.

27. The method of paragraph 25 or 26, including sending at least a portion of the liquid hydrocarbon stream or the gas stream, or both, to a location above surface, wherein the location above surface includes a transportation system.

28. The method of any of paragraphs 25, 26, or 27, wherein sending at least a portion of any of the number of separated streams to the new subsurface location includes sending at least a portion of the water stream or the gas stream, or both, to another cavern for further separation or storage, or any combination thereof.

29. The method of any of paragraphs 25-28, wherein the liquid hydrocarbon stream includes oil or condensate.

CLAIMS

1. A method for production of hydrocarbons, including:

forming a cavern using solution mining;

flowing a stream directly from a hydrocarbon reservoir to the cavern without reaching the surface;

performing a phase separation of the stream within the cavern to form an aqueous phase and an organic phase;

flowing at least a portion of the aqueous phase or the organic phase, or both, directly from the cavern to a separate subsurface location without reaching the surface; and

offloading at least a portion of the organic phase from the cavern to a surface.

2. The method of claim 1, wherein performing the phase separation of the stream within the cavern includes separating the stream into liquid hydrocarbon, water, gas, or solids, or any combinations thereof.

3. The method of claim 1 or 2, including storing at least a portion of the aqueous phase or the organic phase, or both, within the cavern.

4. The method of any of claim 1, 2, or 3, wherein flowing at least a portion of the aqueous phase or the organic phase, or both, directly from the cavern to the subsurface location includes flowing at least a portion of the aqueous phase into an aquifer, a body of water, a sand formation, or a subterranean formation, or any combinations thereof.

5. The method of any of the preceding claims, wherein flowing at least a portion of the aqueous phase or the organic phase, or both, directly from the cavern to the subsurface location includes flowing at least a portion of the organic phase into, a sand formation, or a subterranean formation, or any combinations thereof.

6. The method of any of the preceding claims, wherein offloading at least a portion of the organic phase from the cavern to the surface includes sending at least a portion of the organic phase to a transportation system, wherein the transportation system includes a tanker, a platform, a ship, a pipeline, or any combinations thereof.

7. The method of any of the preceding claims, including flowing at least a portion of the aqueous phase or the organic phase, or both, directly from the cavern to a second cavern without reaching the surface, wherein the second cavern includes a storage vessel or a multi-stage separation vessel, or both.

8. The method of any of the preceding claims, including flowing at least a portion of the aqueous phase or the organic phase, or both, directly from the cavern to each of a number of new subsurface locations without reaching the surface.

9. A system for production of hydrocarbons, including:

a cavern formed by solution mining and configured to affect a phase separation;

a hydrocarbon reservoir linked to the cavern directly through a subsurface without reaching the surface;

a reinjection system configured to reinject a gas stream into the hydrocarbon reservoir from the cavern directly through the subsurface without reaching the surface;

an injection system configured to inject an aqueous stream from the cavern into an aquifer directly through the subsurface without reaching the surface; and

a coupling configured to allow offloading of at least a portion of an organic phase from the cavern to a transportation system.

10. The system of claim 9, wherein the aquifer is fluidically coupled to the hydrocarbon reservoir.

11. The system of claim 9 or 10, wherein the cavern includes a salt cavern, a carbonate cavern, or any other water-soluble or acid-soluble cavern.

12. The system of any of claim 9, 10, or 11, wherein the cavern includes an underground phase separator for separating gas, liquid hydrocarbon, water, or solids, or any combinations thereof.

13. The system of any of claims 9-12, wherein the cavern includes any of a number of shapes, including a cylindrical shape, a conical shape, or an irregular shape.

14. The system of any of claims 9-13, wherein the cavern includes active controls for pressure and fluid level.

15. The system of claim 14, wherein the active controls for pressure and fluid level include a nucleonic level detector, a differential pressure (DP) cell level transmitter, an optical level detector, a refractive index level detector, or a diaphragm-based strain gauge, or any combinations thereof.

16. The system of claim 14, wherein the active controls for pressure and fluid level include pumps, valves, and check valves, or any combinations thereof.

17. The system of any of claims 9-14, wherein the system is configured to reduce a power requirement for the cavern by increasing or decreasing a pressure level within the cavern.

18. The system of any of claims 9-14 or 17, wherein the system includes multiple caverns connected to each other without reaching the surface, and wherein each cavern includes a phase separation vessel or a storage vessel, or both.

19. The system of any of claims 9-14, 17, or 18, wherein the system includes:

a first cavern configured to create a first separated stream; and

a second cavern fluidically coupled to the first cavern without reaching the surface, wherein the second cavern accepts the first separated stream and creates a second separated stream.

20. The system of any of claims 9-14 or 17-19, wherein the transportation system includes a pipeline, a platform, a tanker, or a ship, or any combinations thereof.

21. The system of any of claims 9-14 or 17-20, wherein the cavern is configured to store a cushion hydrocarbon within the cavern, wherein the cushion hydrocarbon is a base hydrocarbon volume level for the cavern.

22. The system of any of claims 9-14 or 17-21, wherein the cavern is configured to accept a number of streams directly from a number of hydrocarbon reservoirs without reaching the surface.

23. The system of any of claims 9-14 or 17-22, including downhole or in-cavern machinery for compression or reinjection of a stream, wherein the downhole or in-cavern machinery includes compressors or pumps, or any combination thereof.

24. The system of any of claims 9-14 or 17-23, wherein the system includes a continuous power source supplied by a topside source, an episodic power source supplied by a ship or a tanker, a power source supplied by a differential pressure between subsurface locations, or any combinations thereof.

25. A method for harvesting hydrocarbons, including:

flowing a hydrocarbon stream from a hydrocarbon reservoir directly to a salt cavern formed by solution mining;

performing a phase separation of the hydrocarbon stream within the cavern to recover a number of separated streams, wherein the number of separated streams include a liquid hydrocarbon stream, a gas stream, a water stream, and a solids stream; and

injecting an amount of the gas stream directly back into the hydrocarbon reservoir at a first time;

injecting an amount of the water stream directly into an aquifer at a second time; and

sending at least a portion of any of the number of separated streams to a new, separate subsurface location through a subsurface line that does not reach surface.

26. The method of claim 25, wherein the aquifer is fluidically coupled to the hydrocarbon reservoir.

27. The method of claim 25 or 26, including sending at least a portion of the liquid hydrocarbon stream or the gas stream, or both, to a location above surface, wherein the location above surface includes a transportation system.

28. The method of any of claim 25, 26, or 27, wherein sending at least a portion of any of the number of separated streams to the new subsurface location includes sending at least a portion of the water stream or the gas stream, or both, to another cavern for further separation or storage, or any combination thereof.

29. The method of any of claims 25-28, wherein the liquid hydrocarbon stream includes oil or condensate.