

Claims

The invention claimed is:

1. A system integrating a fossil-fueled power plant with
i) a post-combustion, carbon dioxide capture subsystem that carbonizes an acidic, basic or buffer, liquid electrolyte solution, ii) a decarbonizing subsystem that regenerates the carbonized electrolyte solution, iii) a thermal management subsystem that integrates the power plant waste heat and/or external heat sources with the thermal needs of the other subsystems, iv) a power management subsystem that integrates and optimizes all internal electrical needs with external supplies and loads, and, v) a control system to manage all of the above listed subsystems and respond to varying internal and external demands, interruptions and events.
2. A system as in 1 where the carbon dioxide capture is done in one stage of carbonate to bicarbonate.
3. A system as in 1 where carbon capture is done in two stages. The first stage captures 50% in hydroxide to carbonate and the second captures the remainder in the newly formed carbonate to bicarbonate.
4. A system as in 1 where thermal decarbonization using steam regenerates the bicarbonate to carbonate and carbon dioxide, which can be vented, collected, sold and/or sequestered.
5. A system as in 1 where the decarbonization is done in an electrochemical cell using electrical and/or thermal input to strip the bicarbonate of oxygen at one electrode and hydrocarbons and/or oxygenated hydrocarbons at the other. One or both of these species are exported for off-site sale or use.

6. A system as in 1 where the decarbonization is done in an electrochemical cell using electrical and/or thermal input to strip the bicarbonate of oxygen at one electrode and hydrocarbons and/or oxygenated hydrocarbons at the other. One or both of these species are recycled for internal plant use.

7. A system as in Claim 5 where a portion of the hydrocarbons produced are used to make the electricity needed to drive the process and the balance are exported for off-site sale or use.

8. A system as in Claim 5 where a portion of the hydrocarbons produced are used to make the electricity needed to drive the process and the balance are recycled for internal plant use.

9. A system as in Claim 5 where a portion of the power plant output provides the electricity needed to drive the process and the products are exported for off-site sale or use.

10. A system as in Claim 5 where a portion of the power plant output provides the electricity needed to drive the process and the products are recycled for internal plant use.

11. A system as in Claim 5 where imported electricity provides the electricity needed to drive the process and the products are exported for off-site sale or use.

12. A system as in Claim 5 where imported electricity provides the electricity needed to drive the process and the products are recycled for internal plant use.

13. A system integrating a fossil-fueled power plant with i) a pre-combustion, carbon capture subsystem that uses the carbonaceous fossil input to carbonize an acidic, basic or buffer, liquid electrolyte solution in an ECR, producing hydrogen that will be used, instead of the fossil fuel, to generate power, ii) a decarbonizing subsystem that regenerates

the carbonized electrolyte solution, iii) a thermal management subsystem that integrates the power plant waste heat and/or external heat sources with the thermal needs of the other subsystems, iv) a power management subsystem that integrates and optimizes all internal electrical needs with external supplies and loads, and, v) a control system to manage all of the above listed subsystems and respond to varying internal and external demands, interruptions and events.

14. A system as in 13 where the carbon dioxide capture is done in one stage of carbonate to bicarbonate.

15. A system as in 13 where capture is done in two stages. The first stage captures 50% in hydroxide to carbonate and the second captures the remainder in the newly formed carbonate to bicarbonate.

16. A system as in 13 where thermal decarbonization using steam regenerates the bicarbonate to carbonate and carbon dioxide, which can be vented, collected, sold and/or sequestered.

17. A system as in 13 where the decarbonization is done in an electrochemical cell using electrical and/or thermal input to strip the bicarbonate of oxygen at one electrode and hydrocarbons and/or oxygenated hydrocarbons at the other. One or both of these species are exported for off-site sale or use.

18. A system as in 13 where the decarbonization is done in an electrochemical cell using electrical and/or thermal input to strip the bicarbonate of oxygen at one electrode and hydrocarbons and/or oxygenated hydrocarbons at the other. One or both of these species are recycled for internal plant use.

19. A system as in Claim 17 where a portion of the hydrocarbons produced are used to make the electricity needed to

drive the process and the balance are exported for off-site sale or use.

20. A system as in Claim 17 where a portion of the hydrocarbons produced are used to make the electricity needed to drive the process and the balance are recycled for internal plant use.

21. A system as in Claim 17 where a portion of the power plant output provides the electricity needed to drive the process and the products are exported for off-site sale or use.

22. A system as in Claim 17 where a portion of the power plant output provides the electricity needed to drive the process and the products are recycled for internal plant use.

23. A system as in Claim 17 where imported electricity provides the electricity needed to drive the process and the products are exported for off-site sale or use.

24. A system as in Claim 17 where imported electricity provides the electricity needed to drive the process and the products are recycled for internal plant use.

25. A system integrating a fossil-fueled or supplied industrial process plant (i.e, steel, aluminum, cement, paper, fertilizer, petrochemical, hydrogen, etc.) with i) a post-combustion, or use, carbon dioxide capture subsystem that carbonizes an acidic, basic or buffer, liquid electrolyte solution, ii) a decarbonizing subsystem that regenerates the carbonized electrolyte solution, iii) a thermal management subsystem that integrates the power plant waste heat and/or external heat sources with the thermal needs of the other subsystems, iv) a power management subsystem that integrates and optimizes all internal electrical needs with external supplies and loads, and, v) a control system to manage all of the above

listed subsystems and respond to varying internal and external demands, interruptions and events.

26. A system as in 25 where the carbon dioxide capture is done in one stage of carbonate to bicarbonate.

27. A system as in 25 where capture is done in two stages. The first stage captures 50% in hydroxide to carbonate and the second captures the remainder in the newly formed carbonate to bicarbonate.

28. A system as in 25 where thermal decarbonization using steam regenerates the bicarbonate to carbonate and carbon dioxide, which can be vented, collected, sold and/or sequestered.

29. A system as in 25 where the decarbonization is done in an electrochemical cell using electrical and/or thermal input to strip the bicarbonate of oxygen at one electrode and hydrocarbons and/or oxygenated hydrocarbons at the other. One or both of these species are exported for off-site sale or use.

30. A system as in 25 where the decarbonization is done in an electrochemical cell using electrical and/or thermal input to strip the bicarbonate of oxygen at one electrode and hydrocarbons and/or oxygenated hydrocarbons at the other. One or both of these species are recycled for internal plant use.

31. A A system as in Claim 29 where a portion of the hydrocarbons produced are used to make the electricity needed to drive the process and the balance are exported for off-site sale or use.

32. A system as in Claim 29 where a portion of the hydrocarbons produced are used to make the electricity needed to drive the process and the balance are recycled for internal plant use.

33. A system as in Claim 29 where a portion of the power plant output provides the electricity needed to drive the process and the products are exported for off-site sale or use.

34. A system as in Claim 29 where a portion of the power plant output provides the electricity needed to drive the process and the products are recycled for internal plant use.

35. A system as in Claim 29 where imported electricity provides the electricity needed to drive the process and the products are exported for off-site sale or use.

36. A system as in Claim 29 where imported electricity provides the electricity needed to drive the process and the products are recycled for internal plant use.

37. A system integrating a fossil-fueled or supplied industrial process plant (i.e, steel, aluminum, cement, paper, fertilizer, petrochemical, hydrogen, etc.) with i) a pre-combustion, carbon capture subsystem that uses the carbonaceous fossil input to carbonize an acidic, basic or buffer, liquid electrolyte solution in an ECR, producing hydrogen that will be used, instead of the fossil fuel, to generate power, ii) a decarbonizing subsystem that regenerates the carbonized electrolyte solution, iii) a thermal management subsystem that integrates the power plant waste heat and/or external heat sources with the thermal needs of the other subsystems, iv) a power management subsystem that integrates and optimizes all internal electrical needs with external supplies and loads, and, v) a control system to manage all of the above listed subsystems and respond to varying internal and external demands, interruptions and events.

38. A system as in 37 where the carbon dioxide capture is done in one stage of carbonate to bicarbonate.

39. A system as in 37 where capture is done in two stages. The first stage captures 50% in hydroxide to carbonate and the second captures the remainder in the newly formed carbonate to bicarbonate.

40. A system as in 37 where thermal decarbonization using steam regenerates the bicarbonate to carbonate and carbon dioxide, which can be vented, collected, sold and/or sequestered.

41. A system as in 37 where the decarbonization is done in an electrochemical cell using electrical and/or thermal input to strip the bicarbonate of oxygen at one electrode and hydrocarbons and/or oxygenated hydrocarbons at the other. One or both of these species are exported for off-site sale or use.

42. A system as in 37 where the decarbonization is done in an electrochemical cell using electrical and/or thermal input to strip the bicarbonate of oxygen at one electrode and hydrocarbons and/or oxygenated hydrocarbons at the other. One or both of these species are recycled for internal plant use.

43. A system as in Claim 41 where a portion of the hydrocarbons produced are used to make the electricity needed to drive the process and the balance are exported for off-site sale or use.

44. A system as in Claim 41 where a portion of the hydrocarbons produced are used to make the electricity needed to drive the process and the balance are recycled for internal plant use.

45. A system as in Claim 41 where a portion of the power plant output provides the electricity needed to drive the process and the products are exported for off-site sale or use.

46. A system as in Claim 41 where a portion of the power plant output provides the electricity needed to drive the process and the products are recycled for internal plant use.

47. A system as in Claim 41 where imported electricity provides the electricity needed to drive the process and the products are exported for off-site sale or use.

48. A system as in Claim 41 where imported electricity provides the electricity needed to drive the process and the products are recycled for internal plant use.

49. A system as Claims 13-24 & 37-48, where the ECR carbonization subsystem and the decarbonization subsystem are physically separated and the decarbonized electrolyte and hydrocarbons and/or oxygenated hydrocarbons produced are used as a method of energy storage and transportation to provide hydrogen at the remote ECR site. The carbonized electrolyte will then be shipped back to the decarbonizer for regeneration, storage and subsequent reshipment.

50. A system as in Claim 49 that is used to store intermittent, renewable electrical energy for later use.