CLAIMS

1. A power system that generates at least one of direct electrical energy and thermal energy comprising:

   at least one vessel;

   a reaction mixture comprising reactants comprising:

   a) at least one source of nascent H_2O;

   b) at least one source of atomic hydrogen;

   c) at least one of a conductor and a conductive matrix to allow a current to permeate the reaction mixture to initiate a reaction to produce reaction products comprising a plasma; and

   at least one set of electrodes to confine the reaction mixture,

   a source of electrical power to deliver a short burst of current electrical energy to the reaction mixture to produce the plasma;

   a reloading system;

   at least one system to regenerate reactants from the reaction products, and

   at least one plasma dynamic converter or at least one photovoltaic converter configured to convert the plasma into electrical energy or thermal energy.

2. The power system of Claim 1 wherein the reactants comprise at least one of bulk H_2O, a compound or compounds that undergo at least one of react to form H_2O and release bound or nascent H_2O.

3. A power system of Claim 2 wherein the bound H_2O is in a state of at least one of absorbed H_2O, bound H_2O, physisorbed H_2O, and waters of hydration.

4. The power system of Claim 1 wherein the reactants O_2, H_2O, HOOH, OOH^-, peroxide ion, superoxide ion, hydride, H_2, a halide, an oxide, an oxyhydroxide, a hydroxide, a compound that comprises oxygen, a hydrated compound, a hydrated compound selected from the group of at least one of a halide, an oxide, an oxyhydroxide, and a hydroxide.

5. A power system of Claim 4 wherein the oxyhydroxide comprises at least one from the group of TiOOH, GdOOH, CoOOH, InOOH, FeOOH, GaOOH, NiOOH, AlOOH, CrOOH, MoOOH, CuOOH, MnOOH, ZnOOH, and SmOOH;

the oxide comprises at least one from the group of CuO, Cu_2O, CoO, Co_2O_3, Co_3O_4, FeO, Fe_2O_3, NiO, and Ni_2O_3;

the hydroxide comprises at least one from the group of $Cu(OH)_2$, $Co(OH)_2$, $Co(OH)_3$, $Fe(OH)_2$, $Fe(OH)_3$, and $Ni(OH)_2$;

the compound that comprises oxygen comprises at least one from the group of a sulfate, phosphate, nitrate, carbonate, hydrogen carbonate, chromate, pyrophosphate, persulfate, perchlorate, perbromate, and periodate, MXO_3, MXO_4 (M = metal such as alkali metal such as Li, Na, K, Rb, Cs; X = F, Br, Cl, I), cobalt magnesium oxide, nickel magnesium oxide, copper magnesium oxide, Li_2O, alkali metal oxide, alkaline earth metal oxide, CuO, CrO_4, ZnO, MgO, CaO, MoO_2, TiO_2, ZrO_2, SiO_2, Al_2O_3, NiO, FeO, Fe_2O_3, TaO_2, Ta_2O_5, VO, VO_2, V_2O_3, V_2O_5, P_2O_3, P_2O_5, B_2O_3, NbO, NbO_2, Nb_2O_5, SeO_2, SeO_3, TeO_2, TeO_3, WO_2, WO_3, Cr_3O_4, Cr_2O_3, CrO_2, CrO_3, CoO, Co_2O_3, Co_3O_4, FeO, Fe_2O_3, NiO, Ni_2O_3, rare earth oxide, CeO_2, La_2O_3, an oxyhydroxide, TiOOH, GdOOH, CoOOH, InOOH, FeOOH, GaOOH, NiOOH, AlOOH, CrOOH, MoOOH, CuOOH, MnOOH, ZnOOH, and SmOOH, and

the conductive matrix comprises at least one from the group of a metal powder, carbon, carbide, boride, nitride, carbonitrile such as TiCN, or nitrile.

6. The power system of Claim 1 wherein the reactants comprise a mixture of a metal, its metal oxide, and H_2O wherein the reaction of the metal with H_2O is not thermodynamically favorable.
7. The power system of Claim 1 wherein the reactants comprise a mixture of a metal, a metal halide, and H_2O wherein the reaction of the metal with H_2O is not thermodynamically favorable.
8. The power system of Claim 1 wherein the reactants comprise a mixture of a transition metal, an alkaline earth metal halide, and H_2O wherein the reaction of the metal with H_2O is not thermodynamically favorable.
9. A power system of Claim 1 wherein the reactants comprise a mixture of a conductor, a hydroscopic material, and H_2O.
10. The power system of Claim 1 or 9 wherein the conductor comprises a metal powder or carbon powder wherein the reaction of the metal or carbon with H_2O is not thermodynamically favorable.

11. The power system of Claim 9 further comprising a hygroscopic material wherein the hygroscopic material comprises at least one of the group of lithium bromide, calcium chloride, magnesium chloride, zinc chloride, potassium carbonate, potassium phosphate, carnallite such as $KMgCl_3 \cdot 6(H_2O)$, ferric ammonium citrate, potassium hydroxide and sodium hydroxide and concentrated sulfuric and phosphoric acids, cellulose fibers, sugar, caramel, honey, glycerol, ethanol, methanol, diesel fuel, methamphetamine, a fertilizer chemical, a salt, a desiccant, silica, activated charcoal, calcium sulfate, calcium chloride, a molecular sieves, a zeolite, a deliquescent material, zinc chloride, calcium chloride, potassium hydroxide, sodium hydroxide and a deliquescent salt.
12. The power system of Claims 6, 7, 8, or 10 wherein the metal having a thermodynamically unfavorable reaction with H_2O is at least one of the group of Cu, Ni, Pb, Sb, Bi, Co, Cd, Ge, Au, Ir, Fe, Hg, Mo, Os, Pd, Re, Rh, Ru, Se, Ag, Tc, Te, Tl, Sn, W, Al, V, Zr, Ti, Mn, Zn, Cr, and In.
13. The power system of Claim 12 wherein reactants are regenerated by addition of H_2O.
14. The power system of Claim 1 wherein the reactants comprise a mixture of a metal, its metal oxide, and H_2O wherein the metal oxide is capable of H_2 reduction at a temperature less than 1000 °C.
15. The power system of Claim 1 wherein the reactants comprise a mixture of

    an oxide that is not easily reduced with H_2 and mild heat;

    a metal having an oxide capable of being reduced to the metal with H_2 at a temperature less than 1000 °C, and

    H_2O.
16. The power system of Claims 14 or 15 wherein the metal having an oxide capable of being reduced to the metal with H_2 at a temperature less than 1000 °C is at least one of the group of Cu, Ni, Pb, Sb, Bi, Co, Cd, Ge, Au, Ir, Fe, Hg, Mo, Os, Pd, Re, Rh, Ru, Se, Ag, Tc, Te, Tl, Sn, W, Al, V, Zr, Ti, Mn, Zn, Cr, and In.
17. The power system of Claim 15 wherein the metal oxide that is not easily reduced with H_2, and mild heat comprises at least one of alumina, an alkaline earth oxide, and a rare earth oxide.
18. The power system of Claim 1 wherein the solid fuel comprises carbon or activated carbon and H_2O wherein the mixture is regenerated by rehydration comprising addition of H_2O.

19. The power system of Claim 1 wherein the reactants comprise at least one of a slurry, solution, emulsion, composite, and a compound.

20. The power system of Claim 1 wherein the H_2O mole % content may be in the range of at least one of about 0.000001% to 100%, 0.00001% to 100%, 0.0001% to 100%, 0.001% to 100%, 0.01% to 100%, 0.1% to 100%, 1% to 100%, 10% to 100%, 0.1% to 50%, 1% to 25%, and 1% to 10%.

21. The power system of Claim 1 wherein the source of electrical power to deliver a short burst of high-current electrical energy comprises at least one of the following:

a voltage selected to cause a high AC, DC, or an AC-DC mixture of current that is in the range of at least one of 100 A to 1,000,000 A, 1 kA to 100,000 A, 10 kA to 50 kA;

a DC or peak AC current density in the range of at least one of 100 A/cm^2 to 1,000,000 A/cm^2, 1000 A/cm^2 to 100,000 A/cm^2, and 2000 A/cm^2 to 50,000 A/cm^2;

the voltage is determined by the conductivity of the solid fuel or energetic material wherein the voltage is given by the desired current times the resistance of the solid fuel or energetic material sample;

the DC or peak AC voltage may be in at least one range chosen from about 0.1 V to 500 kV, 0.1 V to 100 kV, and 1 V to 50 kV, and

the AC frequency may be in the range of about 0.1 Hz to 10 GHz, 1 Hz to 1 MHz, 10 Hz to 100 kHz, and 100 Hz to 10 kHz.

22. The power system of Claim 1 wherein the reaction mixture is in the form of a solid fuel and the resistance of the solid fuel is in at least one range chosen from about 0.001milliohm to 100 Mohm, 0.1 ohm to 1 Mohm, and 10 ohm to 1 kohm, and

the conductivity of a suitable load per electrode area active to induce the reaction is in at least one range chosen from about 10^{-10} ohm^{-1} cm^{-2} to 10^6 ohm^{-1} cm^{-2}, 10^{-5} ohm^{-1} cm^{-2} to 10^6 ohm^{-1} cm^{-2}, 10^{-4} ohm^{-1} cm^{-2} to 10^5 ohm^{-1} cm^{-2}, 10^{-3} ohm^{-1} cm^{-2} to 10^4 ohm^{-1} cm^{-2}, 10^{-2} ohm^{-1} cm^{-2} to 10^3 ohm^{-1} cm^{-2}, 10^{-1} ohm^{-1} cm^{-2} to 10^2 ohm^{-1} cm^{-2}, and 1 ohm^{-1} cm^{-2} to 10 ohm^{-1} cm^{-2}.

23. The power system of Claim 1 wherein the regeneration system comprises at least one of a hydration, thermal, chemical, and electrochemical system.

24. The power system of Claim 1, wherein the photovoltaic power converter includes a photon-to-electric power converter.

25. The method of claim 24, further including a light distribution system.
26. The power system of Claim 25, further comprising a concentrated photovoltaic device.
27. The power system of Claim 1, wherein the photovoltaic power converter includes a photon-to-thermal power converter.
28. The power system of Claim 27, further comprising a thermal-to-electric power converter.
29. The power system of Claim 1, further comprising a concentrated solar power device.
30. The power system of Claim 1, further comprising a tracker.
31. The power system of Claim 1, further comprising an energy storage device.
32. The power system of Claim 1, wherein the power system is operably connected to a power grid.
33. The power system of Claim 1, wherein the power system is a stand-alone system.
34. The power system of Claim 1, wherein the photovoltaic power converter includes a plurality of multi-junction photovoltaic cells.
35. The power system of Claim 34, wherein the multi-junction photovoltaic cells are triple-junction photovoltaic cells.
36. The power system of Claim 1, wherein the photovoltaic power converter is located within a vacuum cell.
37. The power system of Claim 1, wherein the photovoltaic power converter includes at least one of an antireflection coating, an optical impedance matching coating, or a protective coating.
38. The power system of Claim 1, wherein the photovoltaic power converter is operably coupled to a cleaning system configured to clean at least a portion of the photovoltaic power converter.
39. The power system of Claim 1, further comprising an optical filter.
40. The power system of Claim 1, wherein the photovoltaic power converter comprises at least one of a monocrystalline cell, a polycrystalline cell, an amorphous cell, a string/ribbon silicon cell, a multi-junction cell, a homojunction cell, a heterojunction cell, a p-i-n device, a thin-film cell, a dye-sensitized cell, and an organic photovoltaic cell.
41. The power system of Claim 1, wherein the photovoltaic power converter comprises at multi-junction cell, wherein the multi-junction cell comprises at least one of an inverted cell, an upright cell, a lattice-mismatched cell, a lattice-matched cell, and a cell

comprising Group III-V semiconductor materials.

42. A power system of Claim 1, further comprising
an output power conditioner operably coupled to the photovoltaic power converter; and
an output power terminal operably coupled to the output power conditioner.

43. The power system of Claim 1, further comprising an inverter.

44. The power system of claim 1, further comprising an energy storage device.

45. The power system of claim 44, wherein a portion of power output from the output power terminal is directed to the energy storage device.

46. The power system of claim 44, wherein a portion of power output from the output power terminal is directed to a component of the power generation system.

47. The power generation system of claim 44, wherein a portion of power output from the output power terminal is directed to the plurality of electrodes.

48. The power generation system of claim 44, wherein a portion of power output from the output power terminal is directed to an external load.

49. The power generation system of claim 44, wherein a portion of power output from the output power terminal is directed to a power grid.