We Claim:

1. An apparatus for producing a calcium-rich liquid fraction comprising calcium chloride from non-limestone materials comprising calcium, wherein the apparatus comprises a processor configured to treat the non-limestone starting materials to produce the ~~solid~~ calcium-rich liquid fraction comprising calcium chloride.

2. The apparatus of claim 1 wherein the processor comprises

(a) a leacher configured to contact the non-limestone materials with a first acid to produce a first calcium-rich liquid fraction and a calcium-depleted solid fraction, operably connected to

(b) a calcium solid precipitator configured to produce a solid comprising calcium and a calcium-depleted liquid from the calcium-rich fraction.

3. The apparatus of claim 2 wherein the leacher further comprises a first separator, operably connected to the leacher and to the precipitator, configured to separate the calcium-rich liquid fraction and the calcium-depleted solid fraction, and direct the calcium-rich liquid fraction to the precipitator.

4. The apparatus of 2 wherein the precipitator is operably connected to a second separator for separating the solid comprising calcium from the calcium-depleted liquid.

5. A system comprising:

(a) a first processor configured to produce cement from a non-limestone material; and, optionally,

(b) a second processor configured to produce SCM from the non-limestone material.

6. The system of claim 5 further comprising (c) a third processor to produce aggregates from the non-limestone material.

7. The system of claim 5 wherein the first and second processors are the same.

8. A method for producing clinker comprising

(a) dissolving a non-limestone material comprising calcium in acid to produce a calcium-rich liquid fraction comprising calcium chloride and a calcium-depleted solid fraction;

(b) separating the calcium-depleted solid fraction from the calcium-rich liquid fraction;

(c) producing a solid comprising calcium from the calcium-rich liquid; and

(d) treating the solid comprising calcium to form clinker.

9. The method of claim 8 wherein the non-limestone material also comprises silicon.

10. The method of claim 8 wherein the non-limestone material comprises rocks and/or minerals.

11. The method of claim 10, wherein the non-limestone material comprising rocks and/or minerals comprises anorthosite, skarn, gabbro, pyroxenite, mafurite, basalt, copper skarn, tungsten skarn, quarry rock, mafic rock, ultramafic rock, or a combination thereof.

12. The method of claim 8, wherein no more than 40, 30, 20, 15, 10, 5, 4, 3, 2, or 1% of the calcium in the starting material is present as calcium carbonate, preferably no more than 10%, more preferably no more than 5%.

13. The method of claim 8, wherein the starting material further comprises aluminum, iron, and/or magnesium.

14. The method of claim 8, wherein the method produces less than 90, 80, 70, 60, 50, 40, 30, 20, 10, or 5% emitted CO_2 as compared to production of the same quantity of hydraulic cement from limestone by a process that comprises calcining the limestone.

15. The method of claim 8, wherein the method further produces a supplementary cementitious material (SCM), a Mg derivative, and/or an aggregate, wherein the SCM, Mg derivative, and/or aggregate are produced from the same starting material as used for producing the cement.

16. The method of claim 8 wherein the acid comprises HCl.

17. The method of claim 8 wherein the acid is at a concentration of 10-37%.

18. The method of claim 8 wherein producing a solid comprising calcium from the calcium-rich liquid comprises precipitating one or more compounds comprising aluminum, iron, and/or magnesium from the calcium-rich liquid or a derivative thereof.

19. The method of claim 8 wherein producing a solid comprising calcium from the calcium-rich liquid comprises treating the calcium-rich liquid with H_2SO_4 to precipitate $CaSO_4$ from the liquid.

20. The method of claim 8 wherein treating the solid comprising calcium to form clinker comprises heating the solid comprising calcium.

21. The method of claim 20 wherein treating the solid comprising calcium comprises heating the solid comprising calcium in the presence of flux.

22. The method of claim 8 comprising precipitating one or more compounds comprising aluminum from the calcium-rich liquid or a derivative thereof.

23. The method of claim 22 wherein precipitating the one or more compounds comprising aluminum from the calcium-rich liquid or a derivative thereof comprising treating the calcium-rich liquid with H_2SO_4 to precipitate $CaSO_4$ from the liquid, and treating the remaining liquid with HCl to precipitate $AlCl_3$.

24. The apparatus of claim 2 wherein the first acid is HCl and the apparatus further comprises a source of HCl.

25. The apparatus of claim 2 wherein the calcium-solid precipitator is configured to contact the calcium-rich fraction with H_2SO_4 to precipitate $CaSO_4$ from the calcium-rich fraction.

26. The apparatus of claim 2 further comprising a clinkerer operably connected to the calcium solid precipitator, wherein the clinkerer is configured to produce a cement clinker from the solid comprising calcium.

27. The apparatus of claim 2 further comprising an aluminum compound precipitator operably connected to the calcium compound precipitator to precipitate one or more aluminum compounds from the calcium-depleted liquid.

28. The apparatus of claim 27 wherein the aluminum compound precipitator comprises a source of HCl to contact the calcium-depleted liquid, to produce $AlCl_3$.