CLAIMS

1. A ternary or higher composition comprising from 1 to 70 weight % trifluoroiodomethane (CF_3I), from 1 to 40 weight % 1,1-difluoroethylene (R-1132a), and at least one additional compound of lower volatility than 1,1-difluoroethylene selected from the group consisting of 1,1,2-trifluoroethylene (R-1123), difluoromethane (R-32), propane (R-290), propylene (R-1270), fluoroethane (R-161), pentafluoroethane (R-125), 1,1,1,2-tetrafluoroethane (R-134a), 2,3,3,3-tetrafluopropene (R-1234yf), isobutane (R-600a), n-butane (R-600), trans-1,3,3,3-tetrafluopropene (R-1234ze(E)), 3,3,3-trifluoropropene (R-1243zf), 1,2,3,3,3-pentafluoropropene (R-1225ye), 1,1,1,2,3,3,3-heptafluoropropane (R-227ea), 1,1-difluoroethane (R-152a), cis-1,3,3,3-tetrafluopropene (R-1234ze(Z)), 1-chloro-3,3,3-trifluoropropene (R-1233zd(E/Z)) and 1,1,1,4,4,4-hexafluoro-2-butene (R-1336mzz(E/Z)).

2. The composition of claim 1 wherein the R-1132a is present in an amount of from 1 to 30 weight %, based on the total weight of the composition.

3. The composition of claim 2, wherein the R-1132a is present in an amount of from 1 to 20 weight %, based on the total weight of the composition.

4. The composition of claim 3, wherein the R-1132a is present in an amount of from 1 to 10 weight %, based on the total weight of the composition.

5. The composition of any of claims 1 to 4 wherein the CF_3I is present in an amount of from 1 to 60 weight %, based on the total weight of the composition.

6. The composition of claim 5, wherein the CF_3I is present in an amount of from 1 to 50 weight %, based on the total weight of composition.

7. The composition of claim 6, wherein the CF_3I is present in an amount of from 1 to 40 weight %, based on the total weight of composition.

8. The composition of claim 7, wherein the CF_3I is present in an amount of from 1 to 30 weight %, based on the total weight of composition.

9. The composition of any of claims 1 to 8 wherein the composition comprises:

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I and from 1 to 30 weight % R-1123;

from 1 to 40 weight % R-1132a, from 1 to 70 weight % CF_3I and from 1 to 50 weight % R-32;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I and from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-290;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I and from 1 to 20 weight % R-125;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I and from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-1270;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I and from 1 to 40 weight % R-134a;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I and from 1 to 40 weight % R-1234yf;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I and from 1 to 40 weight % R-1234ze(E);

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I and from 1 to 20 weight % R-227ea; or

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I and from 1 to 40 weight % R-152a.

10. The composition of any of claims 1 to 9 wherein the composition further comprises carbon dioxide (CO_2; R-744).

11. The composition of claim 10, wherein the CO_2 is present in an amount of from 1 to 40 weight %, based on the total weight of the composition.

12. The composition of claim 11, wherein the CO_2 is present in an amount of from 1 to 30 weight %, based on the total weight of the composition.

13. The composition of claim 12, wherein the CO_2 is present in an amount of from 1 to 20 weight %, based on the total weight of the composition.

14. The composition of claim 13, wherein the CO_2 is present in an amount of from 1 to 10 weight %, based on the total weight of the composition.

15. The composition of any of claims 10 to 14 wherein the composition comprises:

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, and from 1 to 40 weight % CO_2;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 40 weight % R-1123 and from 1 to 40 weight % CO_2;

from 1 to 40 weight % R-1132a, from 1 to 70 weight % CF_3I, from 1 to 50 weight % R-32 and from 1 to 40 weight % CO_2;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-290 and from 1 to 40 weight % CO_2;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight % R-125 and from 1 to 40 weight % CO_2;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-1270 and from 1 to 40 weight % CO_2;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 40 weight % R-134a and from 1 to 40 weight % CO_2;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 50 weight % R-1234yf and from 1 to 40 weight % CO_2;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight % R-227ea and from 1 to 40 weight % CO_2;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 50 weight % R-152a and from 1 to 40 weight % CO_2;

from 1 to 40 weight % R-1132a, from 1 to 40 weight % CF_3I, from 1 to 40 weight % R-32 and from 1 to 20 weight % CO_2 and from 1 to 40 weight % R-1234yf;

from 1 to 40 weight % R-1132a, from 1 to 40 weight % CF_3I, from 1 to 40 weight % R-32 and from 1 to 20 weight % CO_2 and from 1 to 40 weight % R-1234ze(E); or

from 1 to 40 weight % R-1132a, from 1 to 40 weight % CF_3I, from 1 to 40 weight % R-32 and from 1 to 20 weight % CO_2 and from 1 to 40 weight % R-152a.

16. The composition of any of claims 1 to 8 wherein the composition comprises:

from 1 to 40 weight % R-1132a, from 1 to 70 weight % CF_3I, from 1 to 30 weight % R-1123 and from 1 to 60 weight % R-32;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 30 weight % R-1123 and from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-290;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 40 weight % R-1123 and from 1 to 20 weight % R-125;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 30 weight % R-1123 and from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-1270;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 40 weight % R-1123 and from 1 to 40 weight % R-134a;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 40 weight % R-1123 and from 1 to 50 weight % R-1234yf;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 40 weight % R-1123 and from 1 to 20 weight % R-227ea;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 40 weight % R-1123 and from 1 to 40 weight % R-152a;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 50 weight % R-32 and from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-290;

from 1 to 40 weight % R-1132a, from 1 to 70 weight % CF_3I, from 1 to 50 weight % R-32 and from 1 to 20 weight % R-125;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 50 weight % R-32 and from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-1270;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 50 weight % R-32 and from 1 to 40 weight % R-134a;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 50 weight % R-32 and from 1 to 40 weight % R-1234yf;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 50 weight % R-32 and from 1 to 20 weight % R-227ea;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 50 weight % R-32 and from 1 to 40 weight % R-152a;

from 1 to to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-290 and from 1 to 20 weight % R-125;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-290 and from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-1270;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-290 and from 1 to 40 weight % R-134a;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-290 and from 1 to 50 weight % R-1234yf;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-290 and from 1 to 20 weight % R-227ea;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-290 and from 1 to 50 weight % R-152a;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight % R-125 and from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-1270;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight % R-125 and from 1 to 40 weight % R-134a;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight % R-125 and from 1 to 40 weight % R-1234yf;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight % R-125 and from 1 to 20 weight % R-227ea;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight % R-125 and from 1 to 50 weight % R-152a;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-1270 and from 1 to 40 weight % R-134a;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-1270 and from 1 to 50 weight % R-1234yf;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-1270 and from 1 to 50 weight % R-227ea;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight %, preferably from 1 to 10 weight %, such as from 1 to 5 weight % R-1270 and from 1 to 50 weight % R-152a;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 50 weight % R-134a and from 1 to 40 weight % R-1234yf;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 40 weight % R-134a and from 1 to 20 weight % R-227ea;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 40 weight % R-134a and from 1 to 50 weight % R-152a;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 50 weight % R-1234yf and from 1 to 20 weight % R-227ea;

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 50 weight % R-1234yf and from 1 to 50 weight % R-152a; or

from 1 to 40 weight % R-1132a, from 1 to 50 weight % CF_3I, from 1 to 20 weight % R-227ea and from 1 to 40 weight % R-152a;

17. The composition according to any of claims 1 to 8, wherein the composition comprises from 1 to 70 weight % CF_3I, from 1 to 40 weight % R-1132a and R-1234yf, based on the total weight of the composition.

18. The composition according to any of claims 1 to 8 comprising from 1 to 70 weight % CF_3I, from 1 to 40 weight % R-1132a, R-32 and R-1234yf, based on the total weight of the composition.

19. The composition of any one of the preceding claims further comprising a stabilizer, preferably wherein the stabiliser is selected from the group consisting of diene-based compounds, phosphates, phenol compounds and epoxides, and mixtures thereof.

20. A composition of any one of the preceding claims consisting essentially of the stated components.

21. A composition of any one of the preceding claims, wherein the refrigerant composition is less flammable than R-1132a alone, preferably wherein the refrigerant composition has:

a. a higher flammable limit'
b. a higher ignition energy; and/or
c. a lower flame velocity

compared to R-1132a alone.

22. A composition of any one of the preceding claims wherein the composition is non-flammable, preferably wherein the refrigerant composition is non-flammable at ambient temperature, or wherein the composition is non-flammable at 60 °C.

23. The composition of any one of the preceding claims which has a Global Warming Potential (GWP) below 150.

24. The composition of any one of the preceding claims wherein the refrigerant composition has a temperature glide in an evaporator or condenser of less than about 10K.

25. The composition of claim 24, wherein the refrigerant composition has a temperature glide in an evaporator or condenser of less than about 5K.

26. The use of a composition as claimed in any one of the preceding claims as a refrigerant in a vapour compression heat transfer system.

27. A vapour compression heat transfer system comprising a composition as claimed in any one of claims 1 to 25.

28. The vapour compression heat transfer system of claim 27 which further comprises a lubricant.

29. The vapour compression heat transfer system of claim 28, wherein the lubricant is a polyolester (POE) or polyalkylene glycol (PAG) lubricant.

30. A method of producing cooling which comprises evaporating a composition as claimed in any one of claims 1 to 25 in the vicinity of a body to be cooled.

31. A method of producing heating which comprises condensing a refrigerant composition as claimed in any one of claims 1 to 25 in the vicinity of a body to be heated.

32. A sprayable composition comprising material to be sprayed and a propellant comprising a composition as defined in any of claims 1 to 25.

33. A method for extracting a substance from biomass comprising contacting biomass with a solvent comprising a composition as defined in any of claims 1 to 25 and separating the substance from the solvent.

34. A method of cleaning an article comprising contacting the article with a solvent comprising a composition as defined in any of claims 1 to 25.

35. A method of extracting a material from an aqueous solution or from a particulate solid matrix comprising contacting the aqueous solution or the particulate solid matrix with a solvent comprising a composition as defined in any of claims 1 to 25 and separating the material from the solvent.

36. A mechanical power generation device containing a composition as defined in any of claims 1 to 25.

37. A mechanical power generating device according to claim 36 which is adapted to use a Rankine Cycle or modification thereof to generate work from heat.

38. A method of retrofitting a heat transfer device comprising the step of removing an existing heat transfer composition, and introducing a composition as defined in any one of claims 1 to 25.

39. A method of claim 38 wherein the heat transfer device is a commercial or industrial refrigeration device, a heat pump, or a residential or commercial air conditioning system.

40. A method for reducing the environmental impact arising from the operation of a product comprising an existing compound or composition, the method comprising replacing at least partially the existing compound or composition with a composition as defined in any one of claims 1 to 25.

41. A method of claim 40 wherein the use of the composition of the invention results in a lower Total Equivalent Warming Impact, and/or a lower Life-Cycle Carbon Production than is attained by use of the existing compound or composition.

42. A method of claim 40 or 41 carried out on a product from the fields of air-conditioning, refrigeration, heat transfer, aerosols or sprayable propellants, gaseous dielectrics, flame suppression, solvents, cleaners, topical anaesthetics, and expansion applications.

43. A method according to claim 40 or 41 wherein the product is selected from a heat transfer device, a sprayable composition, a solvent or a mechanical power generation device, preferably a heat transfer device.

44. A method according to claim 43 wherein the product is a heat transfer device, preferably a residential or commercial air conditioning system, a heat pump or a commercial or industrial refrigeration system.

45. A method according to any of claims 38 to 44 wherein the existing compound or composition is a heat transfer composition.

46. A method according to claim 45, wherein the heat transfer composition is a refrigerant selected from R-410A, R-454B, R-452B and R-32