

CLAIMS:

1. A composition comprising trifluoroiodomethane (CF₃I) and 1,1-difluoroethylene (R-1132a), preferably a binary composition of CF₃I and R-1132a.
2. The composition of claim 1 which comprises from 1 to 95 weight % of CF₃I and from 99 to 5 weight % of R-1132a, preferably from 1 to 50 weight % of CF₃I and from 99 to 50 weight %, of R-1132a, based on the total weight of the composition.
3. The composition of claim 2 which comprises from 1 to 40 weight % of CF₃I and from 99 to 60 weight % of R-1132a, preferably from 1 to 30 weight % of CF₃I and from 99 to 70 weight % of R-1132a and particularly from 1 to 20 weight % of CF₃I and from 99 to 80 weight % of R-1132a, based on the total weight of the composition.
4. The composition of claim 1 or 2 which comprises from 99 to 70 weight % of CF₃I and from 1 to 30 weight % of R-1132a, preferably from 99 to 80 weight % of CF₃I and from 1 to 20 weight % of R-1132a, for example from 97 to 85 weight % of CF₃I and from 3 to 15 weight % of R-1132a, based on the total weight of the composition.
5. The composition of any one of claims 1 to 4 which is non-flammable or only weakly flammable as determined by the test method of ASHRAE Standard 34:2016.
6. A ternary or higher composition comprising trifluoroiodomethane (CF₃I), 1,1-difluoroethylene (R-1132a) and at least one additional compound selected from the group consisting of carbon dioxide (CO₂; R-744), tetrafluoromethane (R-14), trifluoromethane (R-23) and perfluoroethane (R-116).
7. The composition of claim 6 which comprises from 1 to 95 weight % (preferably from 1 to 50 weight %) of CF₃I and from 99 to 5 weight % (from 99 to 50 weight %) of R-1132a and the at least one additional compound selected from the group consisting of CO₂, R-14, R-23 and R-116 based on the total weight of the composition.
8. The composition of claim 7 which comprises from 1 to 40 weight % of CF₃I and from 99 to 60 weight % of R-1132a and the at least one additional compound selected from the group consisting of CO₂, R-14, R-23 and R-116, preferably from 1 to 30 weight % of CF₃I and from 99 to 70 weight % of R-1132a and the at least one additional compound and particularly from

1 to 20 weight % of CF₃I and from 99 to 80 weight % of R-1132a and the at least one additional compound based on the total weight of the composition.

9. The composition of claim 6 which comprises from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I and from about 1 to about 40 weight % CO₂ based on the total weight of the composition, optionally wherein the CO₂ is present in an amount of from about 1 to about 30 weight %, preferably from about 1 to about 20 weight %, such as from about 1 to about 10 weight %.

10. The composition of any one of claims 6 to 9, wherein the amount of the at least one additional compound selected from the group consisting of CO₂, R-14, R-23 and R-116 in the composition is selected so that (i) the composition is only weakly flammable and preferably non-flammable as determined by the test method of ASHRAE Standard 34:2016; or (ii) the overall composition is held at two phase equilibrium the vapour phase composition will remain non-flammable as determined by the test method of ASHRAE Standard 34:2016.

11. A ternary or higher composition comprising trifluoroiodomethane (CF₃I), 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-tetrafluoropropene (R-1234yf), isobutane (R-600a), n-butane (R-600), trans-1,3,3,3-tetrafluoropropene (R-1234ze(E)), 3,3,3-trifluoropropene (R-1243zf), 1,2,3,3,3-pentafluoropropene (R-1225ye), 1,1,1,2,3,3,3-heptafluoropropene (R-227ea), 1,1-difluoroethane (R-152a), cis-1,3,3,3-tetrafluoropropene (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)).

12. The composition of claim 11 which comprises from 1 to 95 weight % (preferably from 1 to 50 weight %) of CF₃I and from 99 to 5 weight % (preferably from 99 to 50 weight %) of R-1132a and the at least one additional compound of lower volatility than R-1132a.

13. The composition of claim 11 which comprises from 1 to 40 weight % of CF₃I and from 99 to 60 weight % of R-1132a and the at least one additional compound of lower volatility than R-1132a, preferably from 1 to 30 weight % of CF₃I and from 99 to 70 weight % of R-1132a and the at least one additional compound of lower volatility than R-1132a and particularly from 1 to 20 weight % of CF₃I and from 99 to 80 weight % of R-1132a and the at least one

additional compound of lower volatility than R-1132a, based on the total weight of the composition.

14. The composition of claim 11 wherein the R-1132a is present in an amount of from about 1 to about 40 weight %, preferably from about 1 to about 30 weight %, such as from about 1 to about 20 weight %, for example from about 1 to about 10 weight %, based on the total weight of the composition.

15. The composition of claim 11 or 14 wherein the CF₃I is present in an amount of from about 1 to about 70 weight %, preferably from about 1 to about 60 weight %, such as from about 1 to about 50 or 40 weight %, for example from about 1 to about 30 weight %, based on the total weight of the composition.

16. The composition of claim 11, 14 or 15 wherein the composition comprises:

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I and from about 1 to about 30 weight % R-1123;

from about 1 to about 40 weight % R-1132a, from about 1 to about 70 weight % CF₃I and from about 1 to about 50 weight % R-32;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I and from about 1 to about 20 weight %, preferably from about 1 to about 10 weight %, such as from about 1 to about 5 weight % R-290;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I and from about 1 to about 20 weight % R-125;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I and from about 1 to about 20 weight %, preferably from about 1 to about 10 weight %, such as from about 1 to about 5 weight % R-1270;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I and from about 1 to about 40 weight % R-134a;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I and from about 1 to about 40 weight % R-1234yf;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I and from about 1 to about 40 weight % R-1234ze(E);

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I and from about 1 to about 20 weight % R-227ea; or

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I and from about 1 to about 40 weight % R-152a.

17. The composition of any of claims 11 to 16 wherein the composition further comprises carbon dioxide (CO₂; R-744), optionally wherein the CO₂ is present in an amount of from about 1 to about 40 weight %, preferably from about 1 to about 30 weight %, such as from about 1 to about 20 weight %, for example from about 1 to about 10 weight %, based on the total weight of the composition.

18. The composition of claim 17 wherein the composition comprises:

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, and from about 1 to about 40 weight % CO₂;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 40 weight % R-1123 and from about 1 to about 40 weight % CO₂;

from about 1 to about 40 weight % R-1132a, from about 1 to about 70 weight % CF₃I, from about 1 to about 50 weight % R-32 and from about 1 to about 40 weight % CO₂;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 20 weight %, preferably from about 1 to about 10 weight %, such as from about 1 to about 5 weight % R-290 and from about 1 to about 40 weight % CO₂;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 20 weight % R-125 and from about 1 to about 40 weight % CO₂;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 20 weight %, preferably from about 1 to about 10 weight %, such as from about 1 to about 5 weight % R-1270 and from about 1 to about 40 weight % CO₂;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 40 weight % R-134a and from about 1 to about 40 weight % CO₂;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 50 weight % R-1234yf and from about 1 to about 40 weight % CO₂;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 20 weight % R-227ea and from about 1 to about 40 weight % CO₂;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 50 weight % R-152a and from about 1 to about 40 weight % CO₂;

from about 1 to about 40 weight % R-1132a, from about 1 to about 40 weight % CF₃I, from about 1 to about 40 weight % R-32 and from about 1 to about 20 weight % CO₂ and from about 1 to about 40 weight % R-1234yf;

from about 1 to about 40 weight % R-1132a, from about 1 to about 40 weight % CF₃I, from about 1 to about 40 weight % R-32 and from about 1 to about 20 weight % CO₂ and from about 1 to about 40 weight % R-1234ze(E); or

from about 1 to about 40 weight % R-1132a, from about 1 to about 40 weight % CF₃I, from about 1 to about 40 weight % R-32 and from about 1 to about 20 weight % CO₂ and from about 1 to about 40 weight % R-152a.

19. The composition of claim 11, 14 or 15 wherein the composition comprises:

from about 1 to about 40 weight % R-1132a, from about 1 to about 70 weight % CF₃I, from about 1 to about 30 weight % R-1123 and from about 1 to about 60 weight % R-32;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 30 weight % R-1123 and from about 1 to about 20 weight %, preferably from about 1 to about 10 weight %, such as from about 1 to about 5 weight % R-290;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 40 weight % R-1123 and from about 1 to about 20 weight % R-125;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 30 weight % R-1123 and from about 1 to about 20 weight %, preferably from about 1 to about 10 weight %, such as from about 1 to about 5 weight % R-1270;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 40 weight % R-1123 and from about 1 to about 40 weight % R-134a;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 40 weight % R-1123 and from about 1 to about 50 weight % R-1234yf;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 40 weight % R-1123 and from about 1 to about 20 weight % R-227ea;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 40 weight % R-1123 and from about 1 to about 40 weight % R-152a;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 50 weight % R-32 and from about 1 to about 20 weight %, preferably from about 1 to about 10 weight %, such as from about 1 to about 5 weight % R-290;

from about 1 to about 40 weight % R-1132a, from about 1 to about 70 weight % CF₃I, from about 1 to about 50 weight % R-32 and from about 1 to about 20 weight % R-125;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 50 weight % R-32 and from about 1 to about 20 weight %, preferably from about 1 to about 10 weight %, such as from about 1 to about 5 weight % R-1270;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 50 weight % R-32 and from about 1 to about 40 weight % R-134a;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 50 weight % R-32 and from about 1 to about 40 weight % R-1234yf;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 50 weight % R-32 and from about 1 to about 20 weight % R-227ea;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 20 weight %, preferably from about 1 to about 10 weight %, such as from about 1 to about 5 weight % R-1270 and from about 1 to about 50 weight % R-1234yf;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 20 weight %, preferably from about 1 to about 10 weight %, such as from about 1 to about 5 weight % R-1270 and from about 1 to about 50 weight % R-227ea;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 20 weight %, preferably from about 1 to about 10 weight %, such as from about 1 to about 5 weight % R-1270 and from about 1 to about 50 weight % R-152a;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 50 weight % R-134a and from about 1 to about 40 weight % R-1234yf;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 40 weight % R-134a and from about 1 to about 20 weight % R-227ea;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 40 weight % R-134a and from about 1 to about 50 weight % R-152a;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 50 weight % R-1234yf and from about 1 to about 20 weight % R-227ea;

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 50 weight % R-1234yf and from about 1 to about 50 weight % R-152a;
or

from about 1 to about 40 weight % R-1132a, from about 1 to about 50 weight % CF₃I, from about 1 to about 20 weight % R-227ea and from about 1 to about 40 weight % R-152a;

20. The composition according to claim 11 or 14, wherein the composition comprises CF₃I, R-1132a and R-1234yf, preferably from 15 to 98 weight % of CF₃I, from 1 to 15 weight % of R-1132a and from 1 to 80 weight % of R-1234yf, such as from 25 to 87 weight % of CF₃I, from 3 to 11 weight % of R-1132a and from 5 to 75 weight % of R-1234yf based on the total weight of the composition.

21. The composition according to claim 11 or 14 comprising CF₃I, R-1132a, R-32 and R-1234yf, preferably from 15 to 97 weight % of CF₃I, from 1 to 15 weight % of R-1132a, from 1 to 20 weight % of R-32 and from 1 to 70 weight % of R-1234yf, such as from 28 to 82 weight % of CF₃I, from 3 to 10 weight % of R-1132a, from 5 to 12 weight % of R-32 and from 5 to 60 weight % of R-1234yf based on the total weight of the composition.

22. 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.
23. A composition of any of the preceding claims consisting essentially of the stated components.
24. A composition of any of claims 4 to 23, wherein the refrigerant composition is less flammable than R-1132a alone, preferably wherein the refrigerant composition has:
- a higher flammable limit'
 - a higher ignition energy; and/or
 - a lower flame velocity
- compared to R-1132a alone.
25. A composition of any of any of claims 4 to 23 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.
26. The composition of any one of the preceding claims which has a Global Warming Potential (GWP) below 150.
27. The composition of any of the preceding claims wherein the refrigeration composition has a temperature glide in an evaporator or condenser of less than about 10K, preferably less than about 5K.
28. The use of a composition as claimed in any one of the preceding claims as a refrigerant in a vapour compression heat transfer system.
29. A vapour compression heat transfer system comprising a composition as claimed in any one of claims 1 to 24.
30. The vapour compression heat transfer system of claim 29 which further comprises a lubricant, preferably a polyolester (POE) or polyalkylene glycol (PAG) lubricant.
31. A method of producing cooling which comprises evaporating a composition as claimed in any one of claims 1 to 27 in the vicinity of a body to be cooled.

32. A method of producing heating which comprises condensing a refrigerant composition as claimed in any one of claims 1 to 27 in the vicinity of a body to be heated.
33. A sprayable composition comprising material to be sprayed and a propellant comprising a composition as defined in any of claims 1 to 27.
34. 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 27 and separating the substance from the solvent.
35. A method of cleaning an article comprising contacting the article with a solvent comprising a composition as defined in any of claims 1 to 27.
36. 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 27 and separating the material from the solvent.
37. A mechanical power generation device containing a composition as defined in any of claims 1 to 27.
38. A mechanical power generating device according to claim 37 which is adapted to use a Rankine Cycle or modification thereof to generate work from heat.
39. 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 27.
40. A method of claim 39 wherein the heat transfer device is a commercial or industrial refrigeration device, a heat pump, or a residential or commercial air conditioning system.
41. 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 27.

42. A method of claim 41 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.
43. A method of claim 41 or 42 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.
44. A method according to claim 41 or 42 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.
45. A method according to claim 44 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.
46. A method according to any of claims 39 to 45 wherein the existing compound or composition is a heat transfer composition, preferably wherein the heat transfer composition is a refrigerant selected from R-410A, R-454B, R-452B and R-32.