"natural" refrigerants such as CO_2. Many of these suggested replacements are toxic, flammable, and/or have low energy efficiency. Therefore, new alternative refrigerants are being sought.

The object of the present invention is to provide novel refrigerant compositions and heat transfer fluid compositions that provide unique characteristics to meet the demands of low or zero ozone depletion potential and lower global warming potential as compared to current refrigerants.

BRIEF SUMMARY OF THE INVENTION

The present ~~invention~~disclosure relates to a refrigerant or heat transfer fluid composition comprising at least one compound selected from the group consisting of:

(i) fluoroolefins of the formula *E*- or *Z*-$R^1CH=CHR^2$, wherein R^1 and R^2 are, independently, C_1 to C_6 perfluoroalkyl groups, and wherein the total number of carbons in the compound is at least 5;

(ii) cyclic fluoroolefins of the formula cyclo-[$CX=CY(CZW)_n$-], wherein X, Y, Z, and W, independently, are H or F, and n is an integer from 2 to 5; and

(iii) fluoroolefins selected from the group consisting of: 2,3,3-trifluoro-1-propene ($CHF_2CF=CH_2$); 1,1,2-trifluoro-1-propene ($CH_3CF=CF_2$); 1,2,3-trifluoro-1-propene ($CH_2FCF=CF_2$); 1,1,3-trifluoro-1-propene ($CH_2FCH=CF_2$); 1,3,3-trifluoro-1-propene ($CHF_2CH=CHF$); 1,1,1,2,3,4,4,4-octafluoro-2-butene ($CF_3CF=CFCF_3$); 1,1,2,3,3,4,4,4-octafluoro-1-butene ($CF_3CF_2CF=CF_2$); 1,1,1,2,4,4,4-heptafluoro-2-butene ($CF_3CF=CHCF_3$); 1,2,3,3,4,4,4-heptafluoro-1-butene ($CHF=CFCF_2CF_3$); 1,1,1,2,3,4,4-heptafluoro-2-butene ($CHF_2CF=CFCF_3$); 1,3,3,3-tetrafluoro-2-(trifluoromethyl)-1-propene ($(CF_3)_2C=CHF$); 1,1,3,3,4,4,4-heptafluoro-1-butene ($CF_2=CHCF_2CF_3$); 1,1,2,3,4,4,4-heptafluoro-1-butene ($CF_2=CFCHFCF_3$); 1,1,2,3,3,4,4-heptafluoro-1-butene ($CF_2=CFCF_2CHF_2$); 2,3,3,4,4,4-hexafluoro-1-butene ($CF_3CF_2CF=CH_2$); 1,3,3,4,4,4-hexafluoro-1-butene ($CHF=CHCF_2CF_3$); 1,2,3,4,4,4-

($CF_3CH=CFCF_2CF_2C_2F_5$); 1,1,1,2,4,4,5,5,6,6,7,7,7-tridecafluoro-2-heptene ($CF_3CF=CHCF_2CF_2C_2F_5$); 1,1,1,2,2,4,5,5,6,6,7,7,7-tridecafluoro-3-heptene ($CF_3CF_2CH=CFCF_2C_2F_5$); 1,1,1,2,2,3,5,5,6,6,7,7,7-tridecafluoro-3-heptene ($CF_3CF_2CF=CHCF_2C_2F_5$); $CF_2=CFOCF_2CF_3$ (PEVE) and $CF_2=CFOCF_3$ (PMVE).

The present ~~invention~~disclosure further relates to a composition comprising: (i) at least one fluoroolefin compound; and (ii) at least one flammable refrigerant; wherein said fluoroolefin is selected from the group consisting of:

(a) fluoroolefins of the formula *E*- or *Z*-$R^1CH=CHR^2$, wherein R^1 and R^2 are, independently, C_1 to C_6 perfluoroalkyl groups;

(b) cyclic fluoroolefins of the formula cyclo-[$CX=CY(CZW)_n$-], wherein X, Y, Z, and W, independently, are H or F, and n is an integer from 2 to 5; and

(c) fluoroolefins selected from the group consisting of: 1,2,3,3,3-pentafluoro-1-propene ($CF_3CF=CHF$); 1,1,3,3,3-pentafluoro-1-propene ($CF_3CH=CF_2$); 1,1,2,3,3-pentafluoro-1-propene ($CHF_2CF=CF_2$); 1,1,1,2,3,4,4,4-octafluoro-2-butene ($CF_3CF=CFCF_3$); 1,1,2,3,3,4,4,4-octafluoro-1-butene ($CF_3CF_2CF=CF_2$); 1,1,1,2,4,4,4-heptafluoro-2-butene ($CF_3CF=CHCF_3$); 1,2,3,3,4,4,4-heptafluoro-1-butene ($CHF=CFCF_2CF_3$); 1,1,1,2,3,4,4-heptafluoro-2-butene ($CHF_2CF=CFCF_3$); 1,3,3,3-tetrafluoro-2-(trifluoromethyl)-1-propene (($CF_3)_2C=CHF$); 1,1,3,3,4,4,4-heptafluoro-1-butene ($CF_2=CHCF_2CF_3$); 1,1,2,3,4,4,4-heptafluoro-1-butene ($CF_2=CFCHFCF_3$); 1,1,2,3,3,4,4-heptafluoro-1-butene ($CF_2=CFCF_2CHF_2$); 2,3,3,4,4,4-hexafluoro-1-butene ($CF_3CF_2CF=CH_2$); 1,3,3,4,4,4-hexafluoro-1-butene ($CHF=CHCF_2CF_3$); 1,2,3,4,4,4-hexafluoro-1-butene ($CHF=CFCHFCF_3$); 1,2,3,3,4,4-hexafluoro-1-butene ($CHF=CFCF_2CHF_2$); 1,1,2,3,4,4-hexafluoro-2-butene ($CHF_2CF=CFCHF_2$); 1,1,1,2,3,4-hexafluoro-2-butene ($CH_2FCF=CFCF_3$); 1,1,1,2,4,4-hexafluoro-2-butene ($CHF_2CH=CFCF_3$); 1,1,1,3,4,4-hexafluoro-2-butene ($CF_3CH=CFCHF_2$); 1,1,2,3,3,4-hexafluoro-1-butene

hexene ($CF_3CF_2CF=CFCF_2CF_3$); 1,1,1,4,4,4-hexafluoro-2,3-bis(trifluoromethyl)-2-butene ($(CF_3)_2C=C(CF_3)_2$); 1,1,1,2,3,4,5,5,5-nonafluoro-4-(trifluoromethyl)-2-pentene ($(CF_3)_2CFCF=CFCF_3$); 1,1,1,4,4,5,5,5-octafluoro-2-(trifluoromethyl)-2-pentene ($(CF_3)_2C=CHC_2F_5$); 1,1,1,3,4,5,5,5-octafluoro-4-(trifluoromethyl)-2-pentene ($(CF_3)_2CFCF=CHCF_3$); 3,3,4,4,5,5,6,6,6-nonafluoro-1-hexene ($CF_3CF_2CF_2CF_2CH=CH_2$); 4,4,4-trifluoro-3,3-bis(trifluoromethyl)-1-butene ($CH_2=CHC(CF_3)_3$); 1,1,1,4,4,4-hexafluoro-2-(trifluoromethyl)-3-methyl-2-butene ($(CF_3)_2C=C(CH_3)(CF_3)$); 2,3,3,5,5,5-hexafluoro-4-(trifluoromethyl)-1-pentene ($CH_2=CFCF_2CH(CF_3)_2$); 1,1,1,2,4,4,5,5,5-nonafluoro-3-methyl-2-pentene ($CF_3CF=C(CH_3)CF_2CF_3$); 1,1,1,5,5,5-hexafluoro-4-(trifluoromethyl)-2-pentene ($CF_3CH=CHCH(CF_3)_2$); 1,1,1,2,3,4,4,5,5,6,6,7,7,7-tetradecafluoro-2-heptene ($CF_3CF=CFCF_2CF_2C_2F_5$); 1,1,1,2,2,3,4,5,5,6,6,7,7,7-tetradecafluoro-3-heptene ($CF_3CF_2CF=CFCF_2C_2F_5$); 1,1,1,3,4,4,5,5,6,6,7,7,7-tridecafluoro-2-heptene ($CF_3CH=CFCF_2CF_2C_2F_5$); 1,1,1,2,4,4,5,5,6,6,7,7,7-tridecafluoro-2-heptene ($CF_3CF=CHCF_2CF_2C_2F_5$); 1,1,1,2,2,4,5,5,6,6,7,7,7-tridecafluoro-3-heptene ($CF_3CF_2CH=CFCF_2C_2F_5$); and 1,1,1,2,2,3,5,5,6,6,7,7,7-tridecafluoro-3-heptene ($CF_3CF_2CF=CHCF_2C_2F_5$).

The present ~~invention~~disclosure further relates to a method of using a refrigerant or heat transfer fluid composition in refrigeration, air-conditioning, or heat pump apparatus, said method comprising introducing said composition into said apparatus having (a) centrifugal compressor; (b) multi-stage centrifugal compressor, or (c) single slab/single pass heat exchanger; wherein said refrigerant or heat transfer composition is employed in said apparatus to result in heating or cooling; and wherein said refrigerant or heat transfer composition comprises at least one fluoroolefin selected from the group consisting of:

(i) fluoroolefins of the formula *E*- or *Z*-$R^1CH=CHR^2$, wherein R^1 and R^2 are, independently, C_1 to C_6 perfluoroalkyl groups,;

(ii) cyclic fluoroolefins of the formula cyclo-[$CX=CY(CZW)_n$-], wherein X, Y, Z, and W, independently, are H or F, and n is an integer from 2 to 5; or

CF_2=$CFOCF_2CF_3$ (PEVE); CF_2=$CFOCF_3$ (PMVE) and combinations thereof.

In a first aspect, there is provided a refrigerant or heat transfer fluid composition comprising at least one compound selected from the group consisting of:

fluoroolefins selected from the group consisting of:

1,1,2,3,3,4,4,4-octafluoro-1-butene (CF_3CF_2CF=CF_2);

1,1,1,2,4,4,4-heptafluoro-2-butene (CF_3CF=$CHCF_3$);

1,2,3,3,4,4,4-heptafluoro-1-butene (CHF=$CFCF_2CF_3$);

1,1,1,2,3,4,4-heptafluoro-2-butene (CHF_2CF=$CFCF_3$);

1,3,3,3-tetrafluoro-2-(trifluoromethyl)-1-propene

((CF_3)$_2$C=CHF); 1,1,3,3,4,4,4-heptafluoro-1-butene

(CF_2=$CHCF_2CF_3$); 1,1,2,3,4,4,4-heptafluoro-1-butene

(CF_2=$CFCHFCF_3$); 1,1,2,3,3,4,4-heptafluoro-1-butene

(CF_2=$CFCF_2CHF_2$); 2,3,3,4,4,4-hexafluoro-1-butene

(CF_3CF_2CF=CH_2); 1,3,3,4,4,4-hexafluoro-1-butene

(CHF=$CHCF_2CF_3$); 1,2,3,4,4,4-hexafluoro-1-butene

(CHF=$CFCHFCF_3$); 1,2,3,3,4,4-hexafluoro-1-butene

(CHF=$CFCF_2CHF_2$); 1,1,2,3,4,4-hexafluoro-2-butene

(CHF_2CF=$CFCHF_2$); 1,1,1,2,3,4-hexafluoro-2-butene

(CH_2FCF=$CFCF_3$); 1,1,1,2,4,4-hexafluoro-2-butene

(CHF_2CH=$CFCF_3$); 1,1,1,3,4,4-hexafluoro-2-butene

(CF_3CH=$CFCHF_2$); 1,1,2,3,3,4-hexafluoro-1-butene

(CF_2=$CFCF_2CH_2F$); 1,1,2,3,4,4-hexafluoro-1-butene

(CF_2=$CFCHFCHF_2$); 1,1,1,2,4-

pentafluoro-2-butene (CH_2FCH=$CFCF_3$); 1,1,1,3,4-

pentafluoro-2-butene (CF_3CH=$CFCH_2F$); 3,3,4,4,4-

pentafluoro-1-butene (CF_3CF_2CH=CH_2); 1,1,1,4,4-

pentafluoro-2-butene (CHF_2CH=$CHCF_3$); 1,1,1,2,3-

pentafluoro-2-butene (CH_3CF=$CFCF_3$); 2,3,3,4,4-

pentafluoro-1-butene (CH_2=$CFCF_2CHF_2$); 1,1,2,4,4-

pentafluoro-2-butene (CHF_2CF=$CHCHF_2$); 1,1,2,3,3-

pentafluoro-1-butene (CH_3CF_2CF=CF_2); 1,1,2,3,4-

pentafluoro-2-butene (CH_2FCF=$CFCHF_2$); 1,1,3,3,3-

pentafluoro-2-methyl-1-propene (CF_2=$C(CF_3)(CH_3)$); 2-

(difluoromethyl)-3,3,3-trifluoro-1-propene ($CH_2=C(CHF_2)(CF_3)$); 2,3,4,4,4-pentafluoro-1-butene ($CH_2=CFCHFCF_3$); 1,2,4,4,4-pentafluoro-1-butene ($CHF=CFCH_2CF_3$); 1,3,4,4,4-pentafluoro-1-butene ($CHF=CHCHFCF_3$); 1,3,3,4,4-pentafluoro-1-butene ($CHF=CHCF_2CHF_2$); 1,2,3,4,4-pentafluoro-1-butene ($CHF=CFCHFCHF_2$); 3,3,4,4-tetrafluoro-1-butene ($CH_2=CHCF_2CHF_2$); 1,1-difluoro-2-(difluoromethyl)-1-propene ($CF_2=C(CHF_2)(CH_3)$); 1,3,3,3-tetrafluoro-2-methyl-1-propene ($CHF=C(CF_3)(CH_3)$); 3,3-difluoro-2-(difluoromethyl)-1-propene ($CH_2=C(CHF_2)_2$); 1,1,1,2-tetrafluoro-2-butene ($CF_3CF=CHCH_3$); 1,1,1,3-tetrafluoro-2-butene ($CH_3CF=CHCF_3$); 1,1,1,2,3,4,4,5,5,5-decafluoro-2-pentene ($CF_3CF=CFCF_2CF_3$); 1,1,2,3,3,4,4,5,5,5-decafluoro-1-pentene ($CF_2=CFCF_2CF_2CF_3$); 1,1,1,4,4,4-hexafluoro-2-(trifluoromethyl)-2-butene ($(CF_3)_2C=CHCF_3$); 1,1,1,2,4,4,5,5,5-nonafluoro-2-pentene ($CF_3CF=CHCF_2CF_3$); 1,1,1,3,4,4,5,5,5-nonafluoro-2-pentene ($CF_3CH=CFCF_2CF_3$); 1,2,3,3,4,4,5,5,5-nonafluoro-1-pentene ($CHF=CFCF_2CF_2CF_3$); 1,1,3,3,4,4,5,5,5-nonafluoro-1-pentene ($CF_2=CHCF_2CF_2CF_3$); 1,1,2,3,3,4,4,5,5-nonafluoro-1-pentene ($CF_2=CFCF_2CF_2CHF_2$); 1,1,2,3,4,4,5,5,5-nonafluoro-2-pentene ($CHF_2CF=CFCF_2CF_3$); 1,1,1,2,3,4,4,5,5-nonafluoro-2-pentene ($CF_3CF=CFCF_2CHF_2$); 1,1,1,2,3,4,5,5,5-nonafluoro-2-pentene ($CF_3CF=CFCHFCF_3$); 1,2,3,4,4,4-hexafluoro-3-(trifluoromethyl)-1-butene ($CHF=CFCF(CF_3)_2$); 1,1,2,4,4,4-hexafluoro-3-(trifluoromethyl)-1-butene ($CF_2=CFCH(CF_3)_2$); 1,1,1,4,4,4-hexafluoro-2-(trifluoromethyl)-2-butene ($CF_3CH=C(CF_3)_2$); 1,1,3,4,4,4-hexafluoro-3-(trifluoromethyl)-1-butene ($CF_2=CHCF(CF_3)_2$); 2,3,3,4,4,5,5,5-octafluoro-1-pentene ($CH_2=CFCF_2CF_2CF_3$); 1,2,3,3,4,4,5,5-octafluoro-1-pentene ($CHF=CFCF_2CF_2CHF_2$); 3,3,4,4,4-pentafluoro-2-(trifluoromethyl)-1-butene ($CH_2=C(CF_3)CF_2CF_3$); 1,1,4,4,4-pentafluoro-3-(trifluoromethyl)-1-butene ($CF_2=CHCH(CF_3)_2$);

1,3,4,4,4-pentafluoro-3-(trifluoromethyl)-1-butene ($CHF=CHCF(CF_3)_2$); 1,1,4,4,4-pentafluoro-2-(trifluoromethyl)-1-butene ($CF_2=C(CF_3)CH_2CF_3$); 3,4,4,4-tetrafluoro-3-(trifluoromethyl)-1-butene ($(CF_3)_2CFCH=CH_2$); 3,3,4,4,5,5,5-heptafluoro-1-pentene ($CF_3CF_2CF_2CH=CH_2$); 2,3,3,4,4,5,5-heptafluoro-1-pentene ($CH_2=CFCF_2CF_2CHF_2$); 1,1,3,3,5,5,5-heptafluoro-1-butene ($CF_2=CHCF_2CH_2CF_3$); 1,1,1,2,4,4,4-heptafluoro-3-methyl-2-butene ($CF_3CF=C(CF_3)(CH_3)$); 2,4,4,4-tetrafluoro-3-(trifluoromethyl)-1-butene ($CH_2=CFCH(CF_3)_2$); 1,4,4,4-tetrafluoro-3-(trifluoromethyl)-1-butene ($CHF=CHCH(CF_3)_2$); 1,1,1,4-tetrafluoro-2-(trifluoromethyl)-2-butene ($CH_2FCH=C(CF_3)_2$); 1,1,1,3-tetrafluoro-2-(trifluoromethyl)-2-butene ($CH_3CF=C(CF_3)_2$); 1,1,1-trifluoro-2-(trifluoromethyl)-2-butene ($(CF_3)_2C=CHCH_3$); 3,4,4,5,5,5-hexafluoro-2-pentene ($CF_3CF_2CF=CHCH_3$); 1,1,1,4,4,4-hexafluoro-2-methyl-2-butene ($CF_3C(CH_3)=CHCF_3$); 3,3,4,5,5,5-hexafluoro-1-pentene ($CH_2=CHCF_2CHFCF_3$); 4,4,4-trifluoro-3-(trifluoromethyl)-1-butene ($CH_2=C(CF_3)CH_2CF_3$); 1,1,2,3,3,4,4,5,5,6,6,6-dodecafluoro-1-hexene ($CF_3(CF_2)_3CF=CF_2$); 1,1,1,2,2,3,4,5,5,6,6,6-dodecafluoro-3-hexene ($CF_3CF_2CF=CFCF_2CF_3$); 1,1,1,4,4,4-hexafluoro-2,3-bis(trifluoromethyl)-2-butene ($(CF_3)_2C=C(CF_3)_2$); 1,1,1,2,3,4,5,5,5-nonafluoro-4-(trifluoromethyl)-2-pentene ($(CF_3)_2CFCF=CFCF_3$); 1,1,1,4,4,5,5,5-octafluoro-2-(trifluoromethyl)-2-pentene ($(CF_3)_2C=CHC_2F_5$); 1,1,1,3,4,5,5,5-octafluoro-4-(trifluoromethyl)-2-pentene ($(CF_3)_2CFCF=CHCF_3$); 4,4,4-trifluoro-3,3-bis(trifluoromethyl)-1-butene ($CH_2=CHC(CF_3)_3$); 1,1,1,4,4,4-hexafluoro-2-(trifluoromethyl)-3-methyl-2-butene ($(CF_3)_2C=C(CH_3)(CF_3)$); 2,3,3,5,5,5-hexafluoro-4-(trifluoromethyl)-1-pentene ($CH_2=CFCF_2CH(CF_3)_2$); 1,1,1,2,4,4,5,5,5-nonafluoro-3-methyl-2-pentene ($CF_3CF=C(CH_3)CF_2CF_3$); 1,1,1,5,5,5-hexafluoro-4-(trifluoromethyl)-2-pentene ($CF_3CH=CHCH(CF_3)_2$);

3,4,4,5,5,6,6,6-octafluoro-2-hexene ($CF_3CF_2CF_2CF=CHCH_3$); 3,3,4,4,5,5,6,6-octafluoro1-hexene ($CH_2=CHCF_2CF_2CF_2CHF_2$); 1,1,1,4,4-pentafluoro-2-(trifluoromethyl)-2-pentene ($(CF_3)_2C=CHCF_2CH_3$); 4,4,5,5,5-pentafluoro-2-(trifluoromethyl)-1-pentene ($CH_2=C(CF_3)CH_2C_2F_5$); 3,3,4,4,5,5,5-heptafluoro-2-methyl-1-pentene ($CF_3CF_2CF_2C(CH_3)=CH_2$); 4,4,5,5,6,6,6-heptafluoro-2-hexene ($CF_3CF_2CF_2CH=CHCH_3$); 4,4,5,5,6,6,6-heptafluoro-1-hexene ($CH_2=CHCH_2CF_2C_2F_5$); 1,1,1,2,2,3,4-heptafluoro-3-hexene ($CF_3CF_2CF=CFC_2H_5$); 4,5,5,5-tetrafluoro-4-(trifluoromethyl)-1-pentene ($CH_2=CHCH_2CF(CF_3)_2$); 1,1,1,2,5,5,5-heptafluoro-4-methyl-2-pentene ($CF_3CF=CHCH(CF_3)(CH_3)$); 1,1,1,3-tetrafluoro-2-(trifluoromethyl)-2-pentene ($(CF_3)_2C=CFC_2H_5$); 1,1,1,2,3,4,4,5,5,6,6,7,7,7-tetradecafluoro-2-heptene ($CF_3CF=CFCF_2CF_2C_2F_5$); 1,1,1,2,2,3,4,5,5,6,6,7,7,7-tetradecafluoro-3-heptene ($CF_3CF_2CF=CFCF_2C_2F_5$); 1,1,1,3,4,4,5,5,6,6,7,7,7-tridecafluoro-2-heptene ($CF_3CH=CFCF_2CF_2C_2F_5$); 1,1,1,2,4,4,5,5,6,6,7,7,7-tridecafluoro-2-heptene ($CF_3CF=CHCF_2CF_2C_2F_5$); 1,1,1,2,2,4,5,5,6,6,7,7,7-tridecafluoro-3-heptene ($CF_3CF_2CH=CFCF_2C_2F_5$); 1,1,1,2,2,3,5,5,6,6,7,7,7-tridecafluoro-3-heptene ($CF_3CF_2CF=CHCF_2C_2F_5$); $CF_2=CFOCF_2CF_3$ (PEVE) and $CF_2=CFOCF_3$ (PMVE).

In a second aspect, there is provided a composition comprising: (i) at least one fluoroolefin compound; and (ii) at least one flammable refrigerant; wherein said fluoroolefin is selected from the group consisting of:

1,1,2,3,3,4,4,4-octafluoro-1-butene ($CF_3CF_2CF=CF_2$); 1,1,1,2,4,4,4-heptafluoro-2-butene ($CF_3CF=CHCF_3$); 1,2,3,3,4,4,4-heptafluoro-1-butene ($CHF=CFCF_2CF_3$); 1,1,1,2,3,4,4-heptafluoro-2-butene ($CHF_2CF=CFCF_3$); 1,3,3,3-tetrafluoro-2-(trifluoromethyl)-1-propene ($(CF_3)_2C=CHF$); 1,1,3,3,4,4,4-heptafluoro-1-butene ($CF_2=CHCF_2CF_3$); 1,1,2,3,4,4,4-heptafluoro-1-butene ($CF_2=CFCHFCF_3$); 1,1,2,3,3,4,4-heptafluoro-1-butene

(CF_2=$CFCF_2CHF_2$); 2,3,3,4,4,4-hexafluoro-1-butene
(CF_3CF_2CF=CH_2); 1,3,3,4,4,4-hexafluoro-1-butene
(CHF=$CHCF_2CF_3$); 1,2,3,4,4,4-hexafluoro-1-butene
(CHF=$CFCHFCF_3$); 1,2,3,3,4,4-hexafluoro-1-butene
(CHF=$CFCF_2CHF_2$); 1,1,2,3,4,4-hexafluoro-2-butene
(CHF_2CF=$CFCHF_2$); 1,1,1,2,3,4-hexafluoro-2-butene
(CH_2FCF=$CFCF_3$); 1,1,1,2,4,4-hexafluoro-2-butene
(CHF_2CH=$CFCF_3$); 1,1,1,3,4,4-hexafluoro-2-butene
(CF_3CH=$CFCHF_2$); 1,1,2,3,3,4-hexafluoro-1-butene
(CF_2=$CFCF_2CH_2F$); 1,1,2,3,4,4-hexafluoro-1-butene
(CF_2=$CFCHFCHF_2$); 1,1,1,2,3,4,4,5,5,5-decafluoro-2-pentene
(CF_3CF=$CFCF_2CF_3$); 1,1,2,3,3,4,4,5,5,5-decafluoro-1-pentene
(CF_2=$CFCF_2CF_2CF_3$); 1,1,1,4,4,4-hexafluoro-2-(trifluoromethyl)-2-butene ((CF_3)$_2$C=$CHCF_3$); 1,1,1,2,4,4,5,5,5-nonafluoro-2-pentene
(CF_3CF=$CHCF_2CF_3$); 1,1,1,3,4,4,5,5,5-nonafluoro-2-pentene
(CF_3CH=$CFCF_2CF_3$); 1,2,3,3,4,4,5,5,5-nonafluoro-1-pentene
(CHF=$CFCF_2CF_2CF_3$); 1,1,3,3,4,4,5,5,5-nonafluoro-1-pentene
(CF_2=$CHCF_2CF_2CF_3$); 1,1,2,3,3,4,4,5,5-nonafluoro-1-pentene
(CF_2=$CFCF_2CF_2CHF_2$); 1,1,2,3,4,4,5,5,5-nonafluoro-2-pentene
(CHF_2CF=$CFCF_2CF_3$); 1,1,1,2,3,4,4,5,5-nonafluoro-2-pentene
(CF_3CF=$CFCF_2CHF_2$); 1,1,1,2,3,4,5,5,5-nonafluoro-2-pentene
(CF_3CF=$CFCHFCF_3$); 1,2,3,4,4,4-hexafluoro-3-(trifluoromethyl)-1-butene (CHF=$CFCF(CF_3)_2$); 1,1,2,4,4,4-hexafluoro-3-(trifluoromethyl)-1-butene (CF_2=$CFCH(CF_3)_2$); 1,1,1,4,4,4-hexafluoro-2-(trifluoromethyl)-2-butene (CF_3CH=$C(CF_3)_2$); 1,1,3,4,4,4-hexafluoro-3-(trifluoromethyl)-1-butene (CF_2=$CHCF(CF_3)_2$); 2,3,3,4,4,5,5,5-octafluoro-1-pentene
(CH_2=$CFCF_2CF_2CF_3$); 1,2,3,3,4,4,5,5-octafluoro-1-pentene
(CHF=$CFCF_2CF_2CHF_2$); 3,3,4,4,4-pentafluoro-2-(trifluoromethyl)-1-butene (CH_2=$C(CF_3)CF_2CF_3$); 1,1,4,4,4-pentafluoro-3-(trifluoromethyl)-1-butene (CF_2=$CHCH(CF_3)_2$); 1,3,4,4,4-pentafluoro-3-(trifluoromethyl)-1-butene (CHF=$CHCF(CF_3)_2$); 1,1,4,4,4-pentafluoro-2-(trifluoromethyl)-1-butene (CF_2=$C(CF_3)CH_2CF_3$); 3,4,4,4-tetrafluoro-3-(trifluoromethyl)-1-butene ((CF_3)$_2$CFCH=CH_2); 3,3,4,4,5,5,5-heptafluoro-1-pentene

($CF_3CF_2CF_2CH=CH_2$); 2,3,3,4,4,5,5-heptafluoro-1-pentene ($CH_2=CFCF_2CF_2CHF_2$); 1,1,3,3,5,5,5-heptafluoro-1-butene ($CF_2=CHCF_2CH_2CF_3$); 1,1,1,2,4,4,4-heptafluoro-3-methyl-2-butene ($CF_3CF=C(CF_3)(CH_3)$); 2,4,4,4-tetrafluoro-3-(trifluoromethyl)-1-butene ($CH_2=CFCH(CF_3)_2$); 1,4,4,4-tetrafluoro-3-(trifluoromethyl)-1-butene ($CHF=CHCH(CF_3)_2$); 1,1,1,4-tetrafluoro-2-(trifluoromethyl)-2-butene ($CH_2FCH=C(CF_3)_2$); 1,1,1,3-tetrafluoro-2-(trifluoromethyl)-2-butene ($CH_3CF=C(CF_3)_2$); 1,1,2,3,3,4,4,5,5,6,6,6-dodecafluoro-1-hexene ($CF_3(CF_2)_3CF=CF_2$); 1,1,1,2,2,3,4,5,5,6,6,6-dodecafluoro-3-hexene ($CF_3CF_2CF=CFCF_2CF_3$); 1,1,1,4,4,4-hexafluoro-2,3-bis(trifluoromethyl)-2-butene ($(CF_3)_2C=C(CF_3)_2$); 1,1,1,2,3,4,5,5,5-nonafluoro-4-(trifluoromethyl)-2-pentene ($(CF_3)_2CFCF=CFCF_3$); 1,1,1,4,4,5,5,5-octafluoro-2-(trifluoromethyl)-2-pentene ($(CF_3)_2C=CHC_2F_5$); 1,1,1,3,4,5,5,5-octafluoro-4-(trifluoromethyl)-2-pentene ($(CF_3)_2CFCF=CHCF_3$); 4,4,4-trifluoro-3,3-bis(trifluoromethyl)-1-butene ($CH_2=CHC(CF_3)_3$); 1,1,1,4,4,4-hexafluoro-2-(trifluoromethyl)-3-methyl-2-butene ($(CF_3)_2C=C(CH_3)(CF_3)$); 2,3,3,5,5,5-hexafluoro-4-(trifluoromethyl)-1-pentene ($CH_2=CFCF_2CH(CF_3)_2$); 1,1,1,2,4,4,5,5,5-nonafluoro-3-methyl-2-pentene ($CF_3CF=C(CH_3)CF_2CF_3$); 1,1,1,5,5,5-hexafluoro-4-(trifluoromethyl)-2-pentene ($CF_3CH=CHCH(CF_3)_2$); 1,1,1,2,3,4,4,5,5,6,6,7,7,7-tetradecafluoro-2-heptene ($CF_3CF=CFCF_2CF_2C_2F_5$); 1,1,1,2,2,3,4,5,5,6,6,7,7,7-tetradecafluoro-3-heptene ($CF_3CF_2CF=CFCF_2C_2F_5$); 1,1,1,3,4,4,5,5,6,6,7,7,7-tridecafluoro-2-heptene ($CF_3CH=CFCF_2CF_2C_2F_5$); 1,1,1,2,4,4,5,5,6,6,7,7,7-tridecafluoro-2-heptene ($CF_3CF=CHCF_2CF_2C_2F_5$); 1,1,1,2,2,4,5,5,6,6,7,7,7-tridecafluoro-3-heptene ($CF_3CF_2CH=CFCF_2C_2F_5$); and 1,1,1,2,2,3,5,5,6,6,7,7,7-tridecafluoro-3-heptene ($CF_3CF_2CF=CHCF_2C_2F_5$).

In a third aspect, there is provided a process for cooling, said process comprising condensing the composition as defined above and thereafter evaporating said composition in the vicinity of a body to be cooled.

In a fourth aspect, there is provided a process for heating said process comprising evaporating the composition as defined above and thereafter condensing said composition in the vicinity of a body to be heated.

In a fifth aspect, there is provided a method for producing heating or cooling in a refrigeration, air-conditioning, or heat pump apparatus, said method comprising introducing a refrigerant or heat transfer fluid composition into said apparatus having (a) a centrifugal compressor; (b) a multi-stage centrifugal compressor, or (c) a single slab/single pass heat exchanger; wherein said refrigerant or heat transfer fluid composition comprises at least one fluoroolefin selected from the group consisting of:

(i) fluoroolefins of the formula *E*- or *Z*-$R^1CH=CHR^2$, wherein R^1 and R^2 are, independently, C_1 to C_6 perfluoroalkyl groups,;

(ii) cyclic fluoroolefins of the formula cyclo-[$CX=CY(CZW)_n$-], wherein X, Y, Z, and W, independently, are H or F, and n is an integer from 2 to 5; or

(iii) fluoroolefins selected from the group consisting of: 1,1,1,2,3,4,4,4-octafluoro-2-butene($CF_3CF=CFCF_3$); 1,1,2,3,3,4,4,4-octafluoro-1-butene ($CF_3CF_2CF=CF_2$); 1,1,1,2,4,4,4-heptafluoro-2-butene ($CF_3CF=CHCF_3$); 1,2,3,3,4,4,4-heptafluoro-1-butene ($CHF=CFCF_2CF_3$); 1,1,1,2,3,4,4-heptafluoro-2-butene ($CHF_2CF=CFCF_3$); 1,3,3,3-tetrafluoro-2-(trifluoromethyl)-1-propene (($CF_3)_2C=CHF$); 1,1,3,3,4,4,4-heptafluoro-1-butene ($CF_2=CHCF_2CF_3$); 1,1,2,3,4,4,4-heptafluoro-1-butene ($CF_2=CFCHFCF_3$); 1,1,2,3,3,4,4-heptafluoro-1-butene ($CF_2=CFCF_2CHF_2$); 2,3,3,4,4,4-hexafluoro-1-butene ($CF_3CF_2CF=CH_2$); 1,3,3,4,4,4-hexafluoro-1-butene ($CHF=CHCF_2CF_3$); 1,2,3,4,4,4-hexafluoro-1-butene ($CHF=CFCHFCF_3$); 1,2,3,3,4,4-hexafluoro-1-butene ($CHF=CFCF_2CHF_2$); 1,1,2,3,4,4-hexafluoro-2-butene ($CHF_2CF=CFCHF_2$); 1,1,1,2,3,4-hexafluoro-2-butene ($CH_2FCF=CFCF_3$); 1,1,1,2,4,4-hexafluoro-2-butene ($CHF_2CH=CFCF_3$); 1,1,1,3,4,4-hexafluoro-2-butene ($CF_3CH=CFCHF_2$); 1,1,2,3,3,4-hexafluoro-1-butene ($CF_2=CFCF_2CH_2F$); 1,1,2,3,4,4-hexafluoro-1-butene ($CF_2=CFCHFCHF_2$); 3,3,3-trifluoro-2-(trifluoromethyl)-1-propene ($CH_2=C(CF_3)_2$); 1,1,1,2,4-pentafluoro-2-butene ($CH_2FCH=CFCF_3$); 1,1,1,3,4-pentafluoro-2-butene ($CF_3CH=CFCH_2F$);

3,3,4,4,4-pentafluoro-1-butene ($CF_3CF_2CH=CH_2$); 1,1,1,4,4-pentafluoro-2-butene ($CHF_2CH=CHCF_3$); 1,1,1,2,3-pentafluoro-2-butene ($CH_3CF=CFCF_3$); 2,3,3,4,4-pentafluoro-1-butene ($CH_2=CFCF_2CHF_2$); 1,1,2,4,4-pentafluoro-2-butene ($CHF_2CF=CHCHF_2$); 1,1,2,3,3-pentafluoro-1-butene ($CH_3CF_2CF=CF_2$); 1,1,2,3,4-pentafluoro-2-butene ($CH_2FCF=CFCHF_2$); 1,1,3,3,3-pentafluoro-2-methyl-1-propene ($CF_2=C(CF_3)(CH_3)$); 2-(difluoromethyl)-3,3,3-trifluoro-1-propene ($CH_2=C(CHF_2)(CF_3)$); 2,3,4,4,4-pentafluoro-1-butene ($CH_2=CFCHFCF_3$); 1,2,4,4,4-pentafluoro-1-butene ($CHF=CFCH_2CF_3$); 1,3,4,4,4-pentafluoro-1-butene ($CHF=CHCHFCF_3$); 1,3,3,4,4-pentafluoro-1-butene ($CHF=CHCF_2CHF_2$); 1,2,3,4,4-pentafluoro-1-butene ($CHF=CFCHFCHF_2$); 3,3,4,4-tetrafluoro-1-butene ($CH_2=CHCF_2CHF_2$); 1,1-difluoro-2-(difluoromethyl)-1-propene ($CF_2=C(CHF_2)(CH_3)$); 1,3,3,3-tetrafluoro-2-methyl-1-propene ($CHF=C(CF_3)(CH_3)$); 2-difluoromethyl-3,3-difluoro-1-propene ($CH_2=C(CHF_2)_2$); 1,1,1,2-tetrafluoro-2-butene ($CF_3CF=CHCH_3$); 1,1,1,3-tetrafluoro-2-butene ($CH_3CF=CHCF_3$); 1,1,1,2,3,4,4,5,5,5-decafluoro-2-pentene ($CF_3CF=CFCF_2CF_3$); 1,1,2,3,3,4,4,5,5,5-decafluoro-1-pentene ($CF_2=CFCF_2CF_2CF_3$); 1,1,1,4,4,4-hexafluoro-2-(trifluoromethyl)-2-butene ($(CF_3)_2C=CHCF_3$); 1,1,1,2,4,4,5,5,5-nonafluoro-2-pentene ($CF_3CF=CHCF_2CF_3$); 1,1,1,3,4,4,5,5,5-nonafluoro-2-pentene ($CF_3CH=CFCF_2CF_3$); 1,2,3,3,4,4,5,5,5-nonafluoro-1-pentene ($CHF=CFCF_2CF_2CF_3$); 1,1,3,3,4,4,5,5,5-nonafluoro-1-pentene ($CF_2=CHCF_2CF_2CF_3$); 1,1,2,3,3,4,4,5,5-nonafluoro-1-pentene ($CF_2=CFCF_2CF_2CHF_2$); 1,1,2,3,4,4,5,5,5-nonafluoro-2-pentene ($CHF_2CF=CFCF_2CF_3$); 1,1,1,2,3,4,4,5,5-nonafluoro-2-pentene ($CF_3CF=CFCF_2CHF_2$); 1,1,1,2,3,4,5,5,5-nonafluoro-2-pentene ($CF_3CF=CFCHFCF_3$); 1,2,3,4,4,4-hexafluoro-3-(trifluoromethyl)-1-butene ($CHF=CFCF(CF_3)_2$); 1,1,2,4,4,4-hexafluoro-3-(trifluoromethyl)-1-butene ($CF_2=CFCH(CF_3)_2$); 1,1,1,4,4,4-hexafluoro-2-(trifluoromethyl)-2-butene ($CF_3CH=C(CF_3)_2$); 1,1,3,4,4,4-hexafluoro-3-(trifluoromethyl)-1-butene ($CF_2=CHCF(CF_3)_2$); 2,3,3,4,4,5,5,5-octafluoro-1-pentene ($CH_2=CFCF_2CF_2CF_3$); 1,2,3,3,4,4,5,5-octafluoro-1-pentene ($CHF=CFCF_2CF_2CHF_2$); 3,3,4,4,4-pentafluoro-2-(trifluoromethyl)-1-butene ($CH_2=C(CF_3)CF_2CF_3$); 1,1,4,4,4-pentafluoro-3-(trifluoromethyl)-1-butene ($CF_2=CHCH(CF_3)_2$); 1,3,4,4,4-pentafluoro-3-(trifluoromethyl)-1-butene

($CHF=CHCF(CF_3)_2$); 1,1,4,4,4-pentafluoro-2-(trifluoromethyl)-1-butene ($CF_2=C(CF_3)CH_2CF_3$); 3,4,4,4-tetrafluoro-3-(trifluoromethyl)-1-butene ($(CF_3)_2CFCH=CH_2$); 3,3,4,4,5,5,5-heptafluoro-1-pentene ($CF_3CF_2CF_2CH=CH_2$); 2,3,3,4,4,5,5-heptafluoro-1-pentene ($CH_2=CFCF_2CF_2CHF_2$); 1,1,3,3,5,5,5-heptafluoro-1-butene ($CF_2=CHCF_2CH_2CF_3$); 1,1,1,2,4,4,4-heptafluoro-3-methyl-2-butene ($CF_3CF=C(CF_3)(CH_3)$); 2,4,4,4-tetrafluoro-3-(trifluoromethyl)-1-butene ($CH_2=CFCH(CF_3)_2$); 1,4,4,4-tetrafluoro-3-(trifluoromethyl)-1-butene ($CHF=CHCH(CF_3)_2$); 1,1,1,4-tetrafluoro-2-(trifluoromethyl)-2-butene ($CH_2FCH=C(CF_3)_2$); 1,1,1,3-tetrafluoro-2-(trifluoromethyl)-2-butene ($CH_3CF=C(CF_3)_2$); 1,1,1-trifluoro-2-(trifluoromethyl)-2-butene ($(CF_3)_2C=CHCH_3$); 3,4,4,5,5,5-hexafluoro-2-pentene ($CF_3CF_2CF=CHCH_3$); 1,1,1,4,4,4-hexafluoro-2-methyl-2-butene ($CF_3C(CH_3)=CHCF_3$); 3,3,4,5,5,5-hexafluoro-1-pentene ($CH_2=CHCF_2CHFCF_3$); 3-(trifluoromethyl)-4,4,4-trifluoro-1-butene ($CH_2=C(CF_3)CH_2CF_3$); 1,1,2,3,3,4,4,5,5,6,6,6-dodecafluoro-1-hexene ($CF_3(CF_2)_3CF=CF_2$); 1,1,1,2,2,3,4,5,5,6,6,6-dodecafluoro-3-hexene ($CF_3CF_2CF=CFCF_2CF_3$); 1,1,1,4,4,4-hexafluoro-2,3-bis(trifluoromethyl)-2-butene ($(CF_3)_2C=C(CF_3)_2$); 1,1,1,2,3,4,5,5,5-nonafluoro-4-(trifluoromethyl)-2-pentene ($(CF_3)_2CFCF=CFCF_3$); 1,1,1,4,4,5,5,5-octafluoro-2-(trifluoromethyl)-2-pentene ($(CF_3)_2C=CHC_2F_5$); 1,1,1,3,4,5,5,5-octafluoro-4-(trifluoromethyl)-2-pentene ($(CF_3)_2CFCF=CHCF_3$); 3,3,4,4,5,5,6,6,6-nonafluoro-1-hexene ($CF_3CF_2CF_2CF_2CH=CH_2$); 4,4,4-trifluoro-3,3-bis(trifluoromethyl)-1-butene ($CH_2=CHC(CF_3)_3$); 1,1,1,4,4,4-hexafluoro-3-methyl-2-(trifluoromethyl)-2-butene ($(CF_3)_2C=C(CH_3)(CF_3)$); 2,3,3,5,5,5-hexafluoro-4-(trifluoromethyl)-1-pentene ($CH_2=CFCF_2CH(CF_3)_2$); 1,1,1,2,4,4,5,5,5-nonafluoro-3-methyl-2-pentene ($CF_3CF=C(CH_3)CF_2CF_3$); 1,1,1,5,5,5-hexafluoro-4-(trifluoromethyl)-2-pentene ($CF_3CH=CHCH(CF_3)_2$); 3,4,4,5,5,6,6,6-octafluoro-2-hexene ($CF_3CF_2CF_2CF=CHCH_3$); 3,3,4,4,5,5,6,6-octafluoro-1-hexene ($CH_2=CHCF_2CF_2CF_2CHF_2$); 1,1,1,4,4-pentafluoro-2-(trifluoromethyl)-2-pentene ($(CF_3)_2C=CHCF_2CH_3$); 4,4,5,5,5-pentafluoro-2-(trifluoromethyl)-1-pentene ($CH_2=C(CF_3)CH_2C_2F_5$); 3,3,4,4,5,5,5-heptafluoro-2-methyl-1-pentene ($CF_3CF_2CF_2C(CH_3)=CH_2$); 4,4,5,5,6,6,6-heptafluoro-2-hexene ($CF_3CF_2CF_2CH=CHCH_3$); 4,4,5,5,6,6,6-heptafluoro-1-hexene

(CH_2=$CHCH_2CF_2C_2F_5$); 1,1,1,2,2,3,4-heptafluoro-3-hexene (CF_3CF_2CF=CFC_2H_5); 4,5,5,5-tetrafluoro-4-trifluoromethyl-1-pentene (CH_2=$CHCH_2CF(CF_3)_2$); 1,1,1,2,5,5,5-heptafluoro-4-methyl-2-pentene (CF_3CF=$CHCH(CF_3)(CH_3)$); 1,1,1,3-tetrafluoro-2-trifluoromethyl-2-pentene ($(CF_3)_2C$=CFC_2H_5); 1,1,1,2,3,4,4,5,5,6,6,7,7,7-tetradecafluoro-2-heptene (CF_3CF=$CFCF_2CF_2C_2F_5$); 1,1,1,2,2,3,4,5,5,6,6,7,7,7-tetradecafluoro-3-heptene (CF_3CF_2CF=$CFCF_2C_2F_5$); 1,1,1,3,4,4,5,5,6,6,7,7,7-tridecafluoro-2-heptene (CF_3CH=$CFCF_2CF_2C_2F_5$); 1,1,1,2,4,4,5,5,6,6,7,7,7-tridecafluoro-2-heptene (CF_3CF=$CHCF_2CF_2C_2F_5$); 1,1,1,2,2,4,5,5,6,6,7,7,7-tridecafluoro-3-heptene (CF_3CF_2CH=$CFCF_2C_2F_5$); 1,1,1,2,2,3,5,5,6,6,7,7,7-tridecafluoro-3-heptene (CF_3CF_2CF=$CHCF_2C_2F_5$); CF_2=$CFOCF_2CF_3$ (PEVE); CF_2=$CFOCF_3$ (PMVE) and combinations thereof.

In a sixth aspect, there is provided a method of using the refrigerant or heat transfer fluid composition as defined above for reducing the flammability of a flammable refrigerant, said method comprising: combining said flammable refrigerant with said composition.

In a seventh aspect, there is provided a method for replacing the use of a high global warming potential refrigerant, said method comprising: providing the composition as defined above in refrigeration, air conditioning, or heat pump apparatus in place of, or in combination with, a high global warming potential refrigerant in said apparatus.

In an eighth aspect, there is provided a method of using the composition as defined above to lower global warming potential of an original refrigerant or heat transfer fluid composition, said method comprising combining said original refrigerant or heat transfer fluid composition with the composition as defined above, to produce a second refrigerant or heat transfer fluid composition wherein said second refrigerant or heat transfer fluid composition has a lower global warming potential than said original refrigerant or heat transfer fluid composition.

In a ninth aspect, there is provided a method for reducing the GWP of an original refrigerant or heat transfer fluid composition in a refrigeration, air-conditioning or heat pump apparatus, wherein said original refrigerant or heat transfer fluid has a GWP of about 150 or higher; said method comprising introducing a second, lower GWP refrigerant or heat transfer fluid composition as defined above into said refrigeration, air-conditioning or heat pump apparatus.

In a tenth aspect, there is provided a method for replacing an original refrigerant or heat transfer fluid composition with a second refrigerant or heat transfer fluid composition comprising providing a composition as defined above as the second refrigerant or heat transfer fluid composition.

In an eleventh aspect, there is provided a method of using the composition as defined above as a heat transfer fluid composition, said process comprising comprises transporting said composition from a heat source to a heat sink.

In a twelfth aspect, there is provided a refrigeration, air-conditioning or heat pump apparatus containing a composition as defined above.

In a thirteenth aspect, there is provided a mobile refrigeration or air-conditioning apparatus containing the composition as defined above.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to compositions comprising at least one fluoroolefin. By fluoroolefin is meant any compound containing carbon, fluorine and optionally, hydrogen or oxygen that also contains at least one double bond. These fluoroolefins may be linear, branched or cyclic.

These compositions have a variety of utilities in working fluids, which include use as foaming agents, blowing agents, fire extinguishing agents, heat transfer mediums (such as heat transfer fluids and refrigerants for use in refrigeration systems, refrigerators, air-conditioning systems, heat pumps, chillers, and the like), to name a few.

A heat transfer fluid (also referred to herein as a heat transfer composition or heat transfer fluid composition) is a working fluid used to carry heat from a heat source to a heat sink.

A refrigerant is a compound or mixture of compounds that function as a heat transfer fluid in a cycle wherein the fluid undergoes a phase change from a liquid to a gas and back.

The present invention provides fluoroolefins having the formula *E*- or *Z*-$R^1CH{=}CHR^2$ (Formula I), wherein R^1 and R^2 are, independently, C_1 to C_6 perfluoroalkyl groups. Examples of R^1 and R^2 groups include, but are not limited to, CF_3, C_2F_5, $CF_2CF_2CF_3$, $CF(CF_3)_2$, $CF_2CF_2CF_2CF_3$, $CF(CF_3)CF_2CF_3$, $CF_2CF(CF_3)_2$, $C(CF_3)_3$, $CF_2CF_2CF_2CF_2CF_3$, $CF_2CF_2CF(CF_3)_2$, $C(CF_3)_2C_2F_5$, $CF_2CF_2CF_2CF_2CF_2CF_3$, $CF(CF_3)CF_2CF_2C_2F_5$, and $C(CF_3)_2CF_2C_2F_5$. In one embodiment the fluoroolefins of Formula I, have at least about 3 carbon atoms in the molecule. In another embodiment, the fluoroolefins of Formula I have at least about 4 carbon atoms in the molecule. In yet another embodiment, the fluoroolefins of Formula I have at least about 5 carbon atoms in the molecule. Exemplary, non-limiting Formula I compounds are presented in Table 1.

TABLE 1