CLAIMS

1. A method for producing renewable gas, renewable naphtha, and renewable jet fuel or components thereto from a renewable feedstock, the method comprising the following steps:
    a) providing the renewable feedstock,
    b) pre-treating the renewable feedstock by reducing the amount of impurities therein not to include: more than 10 w-ppm alkali metal and alkaline earth metal impurities, calculated as elemental alkali metals and alkaline earth metals; more than 10 w-ppm other metals, calculated as elemental metals; more than 1000 w-ppm nitrogen containing impurities, calculated as elemental nitrogen; more than 30 w-ppm phosphorus containing impurities, calculated as elemental phosphorus; more than 5 w-ppm silicon containing impurities, calculated as elemental silicon; to produce a pre-treated feedstock,
    c) subjecting the pre-treated feedstock to hydrodeoxygenation reaction to produce a hydrodeoxygenated stream, wherein the hydrodeoxygenation reaction comprises one or more of:
        a. a temperature in the range from 250 °C to 400 °C,
        b. a pressure in the range from 10 bar to 200 bar,
        c. a WHSV in the range from 0.25 $h^{-1}$ to 3 $h^{-1}$,
        d. a $H_2$ flow from 350 to 1500 N-L $H_2$/L feed, and
        e. a hydrodeoxygenation catalyst selected from Pd, Pt, Ni, Co, Mo, Ru, Rh, and W or any combination thereof, on a support, to produce hydrodeoxygenated stream,
    d) subjecting the hydrodeoxygenated stream to a gas-liquid separation thereby producing a gaseous stream and a hydrodeoxygenated liquid stream,
    e) subjecting the hydrodeoxygenated liquid stream to hydroisomerization reaction comprising
        i. a temperature in the range from 270°C to 340 °C,
        ii. a pressure in the range from 10 bar to 100 bar,
        iii. a hydroisomerization catalyst comprising a metal impregnated ZSM-23 zeolite on a support, wherein

a. the metal is selected from noble metals and Ni and any combinations thereof, and metal content of the catalyst is from 0.1 wt-% to 5.0 wt-%,

b. the ZSM-23 zeolite comprising one or more of the following features:

- $SiO_2/Al_2O_3$ molar ratio is from 10 to 85, preferably from 15 to 85 such as from 40 to 80,
- crystallinity is from 40% to 95%, measured by X-ray diffraction (XRD) according to ASTM D5758-01 (2021),
- BET surface area is from 180 $m^2/g$ to 350 $m^2/g$, such as from 200 $m^2/g$ to 300 $m^2/g$, determined by nitrogen physisorption,
- acidity is from 250 µmol/g to 500 µmol/g, measured with $NH_3$-TPD method, wherein acidity is calculated from the amount of $NH_3$ adsorbed at 200 °C and desorbed between 100 °C and 500 °C,
- ratio of Brønsted acid sites to Lewis acid sites is from 10 to 20, measured by the pyridine FTIR, and
- crystalline zeolite particles are needle-like particles of a size below 2 µm along the needle, and

c. the support comprising alumina, silica, or alumina-silica,

in the presence of hydrogen flow to produce a hydroisomerized stream,

f) optionally subjecting the hydroisomerized stream to stabilization, to obtain a stabilized hydroisomerized stream, and

g) separating the hydroisomerized stream, or optionally the stabilized hydroisomerized stream at least to

i) a fraction rich in C1-C4 hydrocarbons thereby producing the renewable gas,

ii) a fraction rich in C5-C9 hydrocarbons thereby producing the renewable naphtha or components thereto, and

iii) a fraction rich in C10-C16 hydrocarbons thereby producing the renewable jet fuel or components thereto.

2. The method according to claim 1, wherein in step c) temperature is from 260 °C to 380 °C, preferably from 280 °C to 360 °C, such as from 300 °C to 330 °C, pressure is from 20 bar to 100 bar, preferably from 20 bar to 80 bar, a weight hourly space velocity (WHSV) is in the range from 0.5 $h^{-1}$ to 3.0 $h^{-1}$, preferably from 0.7 $h^{-1}$ to 2.5 $h^{-1}$, most preferably from 1.0 $h^{-1}$ to 2.0 $h^{-1}$ and $H_2$ flow is in the range from 350 to 1100 N-L $H_2$/L feed, preferably from 350 to 1000 N-L $H_2$/L feed.

3. The method according to claim 1 or 2, wherein in step e) WHSV is in the range from 0.5 $h^{-1}$ to 3 $h^{-1}$.

4. The method according to any one of claims 1 to 3, wherein in step e) $H_2$ flow of is 100-800 N-L $H_2$/L feed.

5. The method according to any one of claims 1 to 4, wherein the hydroisomerization catalyst is platinum impregnated ZSM-23, and wherein Pt content of the hydroisomerization catalyst is from 0.4 wt-% to 0.6 wt-%, such as about 0.5 wt-% of the catalyst.

6. The method according to any one of claims 1 to 5, wherein the hydrodeoxygenation catalyst is selected from a group consisting of CoMo, NiMo, NiW, and CoNiMo on a support, wherein the support is preferably alumina and/or silica.

7. The method according to any one of claims 1 to 6, wherein the hydrodeoxygenation reaction comprise temperature in the range from 250 °C to 400 °C, pressure in the range from 20 bar to 80 bar, a WHSV in the range from 0.5 $h^{-1}$ to 3 $h^{-1}$, and $H_2$ flow of 350-1500 N-L $H_2$/L feed, and a hydrodeoxygenation catalyst.

8. The method according to any one of claims 1 to 7, wherein the hydrodeoxygenated stream comprises at least 92 wt-%, preferably at least 95 wt-%, more preferably at least 99 wt-% paraffins based on total weight of hydrocarbon products.

9. The method according to any one of claims 1-8, comprising purifying the fraction rich in C10-C16 hydrocarbons until the total content of the C10-C16 hydrocarbons reaches at least 85 wt-%, preferably at least 90 wt-%, more preferably at least 95 wt-%, even more preferably at least 99 wt-% or at least 99.5 wt-%, based on the total weight of the fraction.

10. The method according to any one of claims 1-9, comprising purifying the fraction rich in C5-C9 hydrocarbons until the total content of the C5-C9 hydrocarbons reaches at least 85 wt-%, preferably at least 90 wt-%, more preferably at least 95 wt-%, even more preferably at least 99 wt-% or at least 99.5 wt-%, based on the total weight of the fraction.

11. The method according to any one of claims 1-10, comprising separating C3 hydrocarbons and C4 hydrocarbons from the fraction rich in C1-C4 hydrocarbons.

12. The method according to any one of claims 1-11, wherein the feedstock is selected from waste and residues of animal fat or oil, plant fat or oil, and fish fat or oil, and mixtures

thereof, preferably the feedstock is selected from palm oil residues and wastes, such as palm effluent sludge, palm oil mill effluent, sludge palm oil, palm oil fatty acid, tall oil material, used cooking oil, acid oils, animal fats, such as brown grease, spent bleaching earth oil, technical corn oil.

13. The method according to any one of claims 1-12, wherein the feedstock comprises triglycerides and/or fatty acids.