CLAIMS:

What is claimed is:

1. A process for quenching an effluent, comprising:

(I) contacting a pyrolysis effluent and a first quench medium to produce a first quenched effluent, wherein the pyrolysis effluent and the first quench medium flow through an indirect heat exchanger, and wherein the first quench medium in the liquid phase flows along a surface of an inner wall of the indirect heat exchanger; and

(II) obtaining from the first quenched effluent a bottoms stream comprising tar and an overhead stream comprising ethylene and propylene, wherein the first quench medium comprises a first portion of the bottoms stream comprising a first portion of the tar.

2. The process of claim 1, further comprising:

(III) hydroprocessing a second portion of the bottoms stream comprising a second portion of the tar to produce a hydroprocessed product;

(IV) obtaining a hydroprocessed bottoms stream from the hydroprocessed product; and

(IV) contacting at least a portion of the hydroprocessed bottoms stream and the first portion of the bottoms stream to produce the first quench medium.

3. The process of claim 1 or 2, wherein at least 3 wt% of the first quench medium remains in a liquid phase when mixed with the pyrolysis effluent.

4. The process of claim 1, wherein the indirect heat exchanger comprises a transfer line exchanger, and wherein the pyrolysis effluent and the first quench medium flow through the indirect heat exchanger in a downward direction, an upward direction, or both.

5. The process of any of claims 2 to 4, wherein the first quench medium comprises about 10 wt% to about 90 wt% of the hydroprocessed bottoms stream, based on the combined weight of the hydroprocessed bottoms stream and the first portion of the bottoms stream.

6. The process of any of claims 1 to 5, wherein:

the pyrolysis effluent and the first quench medium are contacted within a quench header or within an inlet of an indirect heat exchanger,

the pyrolysis effluent has a temperature of at least 750°C,

at least 3 wt% of the first quench medium remains in a liquid phase when contacted with the pyrolysis effluent, and

at least a portion of the first quench medium in the liquid phase flows along a surface of an inner wall of the quench header or a surface of an inner wall of the indirect heat exchanger.

7. The process of any of claims 1 to 6, wherein step (I) further comprises indirectly transferring heat from the first quenched effluent to a second quench medium to produce a second quenched effluent and a heated second quench medium, wherein the bottoms stream is obtained from the second quenched effluent.

8. The process of claim 7, wherein:

the pyrolysis effluent has a temperature of at least 750°C,

the first quenched effluent has a temperature of 475°C to 550°C, and

the second quenched effluent has a temperature of less than 450°C.

9. The process of claim 7 or 8, wherein an amount of heat transferred to the second quench medium is sufficient to generate at least 150 MW of power via a turbine.

10. The process of claim 8 or 9, wherein step (I) further comprises contacting the second quenched effluent with a third quench medium to produce a third quenched effluent, wherein the bottoms stream is obtained from the third quenched effluent.

11. The process of claim 10, wherein:

the pyrolysis effluent has a temperature of at least 750°C,

the first quenched effluent has a temperature of 475°C to 550°C,

the second quenched effluent has a temperature of 350°C to 450°C, and

the third quenched effluent has a temperature of 250°C to 350°C.

12. The process of claim 11, wherein the overhead stream further comprises a quench oil, wherein step (II) further comprises obtaining a process gas stream comprising the ethylene and the propylene and a quench oil stream comprising the quench oil, and wherein the third quench medium comprises at least a portion of the quench oil stream.

13. The process of any of claims 2 to 12, wherein the hydroprocessing in step (III) comprises:

hydroprocessing the second portion of the bottoms stream in a first hydroprocessing zone by contacting the second portion of the bottoms steam with at least one first hydroprocessing catalyst and molecular hydrogen under first catalytic hydroprocessing conditions to convert the second portion of the bottoms steam to a hydroprocessed product;

obtaining from the first hydroprocessed product:

(i) a hydroprocessed overhead stream comprising at least 1 wt% of the first hydroprocessed product;

(ii) a hydroprocessed mid-cut stream comprising at least 20 wt% of the first hydroprocessed product; and

(iii) the hydroprocessed bottoms stream, wherein the hydroprocessed bottoms stream comprises at least 20 wt% of the first hydroprocessed product, wherein a first portion of the hydroprocessed bottoms stream is contacted with the first portion of the bottoms stream to produce the first quench medium.

14. The process of claim 13, wherein the hydroprocessed bottoms stream comprises at least 0.5 wt% of donatable hydrogen, based on the total weight of the hydroprocessed bottoms stream.

15. The process of any of claims 2 to 14, wherein the first portion of the bottoms stream comprising the first portion of the tar comprises at least 2.5 wt% of sulfur, has a density of at least 1.05 g/cm^3, an API gravity at 15.6°C of less than 0, and a 25/75 solubility number of 0.8 wt% to 10 wt%, and wherein the hydroprocessed bottoms stream comprises less than 1.5 wt% of sulfur and has a density of at least 1 g/cm^3, an API gravity at 15.6°C of less than 5, and a 25/75 solubility number of 0 wt% to 2 wt%.

16. The process of any of claims 1 to 15, wherein the pyrolysis effluent is produced by:

(a) steam cracking a hydrocarbon-containing feed, or

(b) contacting a hydrocarbon-containing feed with a plurality of heated particles having a temperature sufficiently high to enable pyrolysis of at least a portion of the hydrocarbon-containing feed; or

(c) subjecting a hydrocarbon-containing feed to a coking process; or

(d) a combination thereof.

17. A process for quenching an effluent, comprising:

(I) obtaining a vapor phase product and a liquid phase product from a heated mixture comprising steam and a hydrocarbon-containing feed;

(II) steam cracking the vapor phase product to produce a pyrolysis effluent;

(III) contacting the pyrolysis effluent having a first temperature and a first quench medium to produce a first quenched effluent having a second temperature;

(IV) indirectly transferring heat from the first quenched effluent to a second quench medium to produce a second quenched effluent having a third temperature and a heated second quench medium;

(V) indirectly transferring heat from the second quenched effluent to a third quench medium or contacting the second quenched effluent with a third quench medium to produce a third quenched effluent having a fourth temperature;

(VI) obtaining a bottoms stream comprising tar and an overhead stream comprising ethylene, propylene, and a quench oil from the third quenched effluent; and

(VI) recycling a first portion of the bottoms stream comprising the tar as the first quench medium.

18. The process of claim 17, further comprising:

(VII) hydroprocessing a second portion of the bottoms stream comprising a second portion of the tar to produce a hydroprocessed product; and

(VIII) recycling a first portion of the hydroprocessed product to provide a portion of the first quench medium.

19. The process of claim 18, wherein the first portion of the bottoms stream and the first portion of the hydroprocessed product are contacted with one another to produce a mixture prior to contacting the pyrolysis effluent.

20. The process of claim 18 or 19, wherein the first quench medium comprises about 10 wt% to about 90 wt% of the first portion of the hydroprocessed product, based on the combined weight of the first portion of the bottoms stream and the first portion of the hydroprocessed product.

21. The process of any of claims 18 to 20, wherein the hydroprocessing in step (VII) comprises:

hydroprocessing the second portion of the bottoms stream in a first hydroprocessing zone by contacting the second portion of the bottoms steam with at least one first hydroprocessing catalyst and molecular hydrogen under first catalytic hydroprocessing conditions to convert the second portion of the bottoms steam to a hydroprocessed product;

obtaining from the first hydroprocessed product:

(i) a hydroprocessed overhead stream comprising at least 1 wt% of the first hydroprocessed product;

(ii) a hydroprocessed mid-cut stream comprising at least 20 wt% of the first hydroprocessed product; and

(iii) a hydroprocessed bottoms stream, wherein the hydroprocessed bottoms stream comprises at least 20 wt% of the first hydroprocessed product, wherein the first portion of the hydroprocessed product recycled as the first quench medium comprises a first portion of the hydroprocessed bottoms stream.

22. The process of any of claims 17 to 21, wherein at least 3 wt% of the first quench medium remains in a liquid phase when contacted with the pyrolysis effluent.

23. The process of claim 22, wherein in step (IV) the first quenched effluent flows through an indirect heat exchanger to indirectly transfer the heat therefrom, and wherein the first quench medium in the liquid phase flows along a surface of an inner wall of the indirect heat exchanger,

and wherein the first quenched effluent flows through the indirect heat exchanger in a downward direction, an upward direction, or both.

24. The process of any of claims 17 to 23, wherein the first quench medium comprises about 40 wt% to about 60 wt% of the hydroprocessed product, based on the combined weight of the hydroprocessed product and the bottoms stream.