What is claimed is:

1. A process comprising:

reacting a mixed C_4 metathesis feed stream comprising isobutylene and at least one of 1-butene and 2-pentene in a first metathesis reactor in the presence of a first metathesis catalyst under conditions sufficient to produce an intermediate product stream comprising at least 30 wt. % 2-methyl-2-pentene based upon the olefin content of fresh feed in the mixed C_4 metathesis feed stream, and at least one of ethylene and propylene,

separating the 2-methyl-2-pentene,

subjecting the separated 2-methyl-2-pentene to pyrolysis to produce a reaction product stream comprising isoprene, and

separating the isoprene into an isoprene product stream using fractionation.

2. The process of claim 1, wherein the mixed C_4 metathesis feed stream is formed by obtaining a mixed C_4 stream containing isobutylene, 1-butene and 2-butene and removing at least a portion of the 2-butene, isomerizing the removed portion in an isomerization reactor to obtain additional 1-butene, and combining the additional 1-butene with the mixed C_4 stream to form the mixed C_4 metathesis feed stream.

3. The process of claim 1, wherein the actual yield of 2-methyl-2-pentene prior to pyrolysis is 30-70 wt % based upon the C_4 olefin content of fresh feed.

4. The process of claim 3, wherein at least 50 wt % of the 1-butene in the mixed C_4 metathesis feed stream is obtained by isomerizing 2-butene in the isomerization reactor.

5. The process of claim 2, wherein 2-butene removed from the isomerization reactor is separated from the 1-butene and recycled to the isomerization reactor.

6. The process of claim 1, wherein the mixed C_4 metathesis feed stream is formed by obtaining a mixed C_4 stream containing isobutylene, 1-butene and 2-butene and separating the mixed C_4 stream to form a 2-butene stream and the mixed C_4 metathesis feed stream.

7. The process of claim 6, further comprising reacting the 2-butene stream and ethylene in a second metathesis reactor to produce propylene.

8. The process of claim 7, wherein the ethylene that is reacted with the 2-butene is obtained from the intermediate product stream.

9. The process of claim 7, wherein unreacted ethylene is recovered and recycled.

10. The process of claim 1, wherein the mixed C_4 metathesis feed stream is formed by reacting a mixed C_4 stream and ethylene in a second metathesis reactor to obtain a metathesis product stream comprising ethylene, propylene, isobutylene and 1-butene, and removing at least a portion of the ethylene and propylene to form the mixed C_4 metathesis feed stream.

11. The process of claim 1, wherein the isobutylene for the first metathesis feed stream is obtained by separating a mixed C_4 feed stream to obtain an isobutylene distillate and a bottoms stream comprising 1-butene and 2-butene.

12. The process of claim 11, further comprising reacting the bottoms stream in a second metathesis reactor to form 2-pentene and propylene.

13. The process of claim 12, further comprising separating the 2-pentene and recycling the 2-pentene to the mixed C_4 metathesis feed stream.

14. The process of claim 1, wherein the first metathesis reactor contains a fixed bed catalyst.

15. The process of claim 1, wherein separating the isoprene includes a combination of fractionation and extraction.

16. The process of claim 1, wherein the intermediate product contains at least 40 wt % 2-methyl-2-pentene based upon the olefin content of fresh feed.

17. The process of claim 1, wherein the isoprene is separated using extractive distillation.

18. A process comprising:

reacting a mixed C_4 metathesis feed stream comprising isobutylene and 1-butene in the presence of a first metathesis catalyst under conditions sufficient to produce an intermediate product stream comprising 2-methyl-2-pentene and at least one of ethylene and propylene,

fractionating the intermediate product stream to form a 2-methyl-2-pentene stream and at least one of an ethylene stream and a propylene stream,

subjecting the separated 2-methyl-2-pentene stream to pyrolysis to produce a reaction product stream comprising isoprene, and

separating the isoprene to form an isoprene product stream using fractionation.

19. The process of claim 18, wherein the mixed C_4 metathesis feed stream is formed by obtaining a mixed C_4 stream containing isobutylene, 1-butene and 2-butene and removing at least a portion of the 2-butene, isomerizing the removed portion in an isomerization reactor to obtain additional 1-butene, and combining the additional 1-butene with the mixed C_4 stream to form the mixed C_4 metathesis feed stream.

20. The process of claim 18, wherein the actual yield of 2-methyl-2-pentene prior to pyrolysis is 30-70 wt % based upon the C_4 olefin content of fresh feed.

21. A process comprising:

reacting a mixed C_4 metathesis feed stream comprising isobutylene and 2-pentene in the presence of a first metathesis catalyst under conditions sufficient to produce an intermediate product stream comprising propylene, 2-methyl-2-pentene, ethylene, 2,3-dimethyl-2-butene and 2-butene,

separating the intermediate product stream in a multi-stage fractionation process to form a 2-methyl-2-pentene stream, a distillate stream containing ethylene and propylene, and a 2,3-dimethyl-2-butene stream,

subjecting the separated 2-methyl-2-pentene stream to pyrolysis to produce a reaction product stream comprising isoprene, and

separating the isoprene into an isoprene product stream using fractionation.

22. The process of claim 21, wherein the isobutylene that is reacted with 2-pentene is obtained by fractionating a mixed C_4 feed stream to obtain an isobutylene distillate and a bottoms stream comprising 1-butene and 2-butene.

23. The process of claim 22, further comprising conducting a metathesis reaction of the bottoms stream comprising 1-butene and 2-butene to form the 2-pentene for the mixed C_4 feed stream.

24. The process of claim 21, wherein isoprene is separated using extractive distillation.

25. A system comprising:

a first metathesis reactor configured to react isobutylene with at least one of 1-butene and 2-pentene to produce 2-methyl-2-pentene,

a second reactor comprising at least one of an isomerization reactor configured to isomerize 2-butene to form 1-butene, and a metathesis reactor configured to react 2-butene with at least one of ethylene and 1-butene to produce propylene,

a first multistage fractionation system configured to produce a 2-methyl-2-pentene stream and a 2,3-dimethyl-2-butene stream,

a pyrolysis heater configured to crack the 2-methyl-2-pentene to produce isoprene and other hydrocarbons, and

a second multistage fractionation system configured to separate isoprene from the other hydrocarbons.

26. The apparatus of claim 25, wherein the second reactor is an isomerization reactor and the 1-butene formed therein is fed to the first metathesis reactor.

27. The apparatus of claim 25, wherein the second reactor is a metathesis reactor configured to react 2-butene with ethylene and produce propylene.

28. The apparatus of claim 25, wherein the second reactor is a metathesis reactor configured to react 1-butene with itself and 2-butene to form ethylene, propylene and 2-pentene, and to react a portion of the ethylene produced therein with 2-butene to produce propylene.

29. The apparatus of claim 25, wherein the multistage fractionation section includes at least one extractive distillation column.

What is claimed is:

1. A process comprising:

obtaining a mixed C_4 stream comprising isobutylene, 1-butene and 2-butene,

removing at least a portion of the 2-butene,

isomerizing the removed portion of the 2-butene in an isomerization reactor to obtain additional 1-butene, and combining the additional 1-butene with the remainder of the mixed C_4 stream to form a mixed C_4 metathesis feed stream comprising isobutylene and 1-butene,

reacting the mixed C_4 metathesis feed stream in a first metathesis reactor in the presence of a first metathesis catalyst under conditions sufficient to produce an intermediate product stream comprising at least 30 wt. % 2-methyl-2-pentene based upon the olefin content of fresh feed in the mixed C_4 metathesis feed stream, and at least one of ethylene and propylene,

separating the 2-methyl-2-pentene,

subjecting the separated 2-methyl-2-pentene to pyrolysis to produce a reaction product stream comprising isoprene, and

separating the isoprene into an isoprene product stream using fractionation.

2. The process of claim 1, wherein the actual yield of 2-methyl-2-pentene prior to pyrolysis is 30-70 wt % based upon the C_4 olefin content of fresh feed.

3. The process of claim 2, wherein at least 50 wt % of the 1-butene in the mixed C_4 metathesis feed stream is obtained by isomerizing 2-butene in the isomerization reactor.

4. The process of claim 1, wherein 2-butene removed from the isomerization reactor is separated from the 1-butene and recycled to the isomerization reactor.

5. The process of claim 1, wherein the first metathesis reactor contains a fixed bed catalyst.

6. The process of claim 1, wherein separating the isoprene includes a combination of fractionation and extraction.

7. The process of claim 1, wherein the intermediate product stream contains at least 40 wt % 2-methyl-2-pentene based upon the olefin content of fresh feed.

8. The process of claim 1, wherein the isoprene is separated using extractive distillation.

9. A process comprising:

obtaining a mixed C_4 stream comprising isobutylene, 1-butene and 2-butene,

separating the mixed C_4 stream to form a 2-butene stream and a mixed C_4 metathesis feed stream comprising isobutylene and 1-butene,

reacting the mixed C_4 metathesis feed stream in the presence of a first metathesis catalyst under conditions sufficient to produce an intermediate product stream comprising at least 30 wt. % 2-methyl-2-pentene based upon the olefin content of fresh feed in the mixed C_4 metathesis feed stream and at least one of ethylene and propylene,

fractionating the intermediate product stream to form a 2-methyl-2-pentene stream and at least one of an ethylene stream and a propylene stream,

subjecting the separated 2-methyl-2-pentene stream to pyrolysis to produce a reaction product stream comprising isoprene, and

separating the isoprene to form an isoprene product stream using fractionation.

10. The process of claim 9, further comprising reacting the 2-butene stream and ethylene in a second metathesis reactor to produce propylene.

11. The process of claim 10, wherein the ethylene that is reacted with the 2-butene is obtained from the intermediate product stream.

12. The process of claim 10, wherein unreacted ethylene is recovered and recycled.

13. The process of claim 9, wherein the actual yield of 2-methyl-2-pentene prior to pyrolysis is 30-70 wt % based upon the C_4 olefin content of fresh feed.

14. The process of claim 9, wherein the intermediate product stream contains at least 40 wt % 2-methyl-2-pentene based upon the olefin content of fresh feed.

15. A process comprising:

obtaining a mixed C_4 stream comprising isobutylene, 1-butene and 2-butene,

reacting the mixed C_4 stream and ethylene in a second metathesis reactor to obtain a metathesis product stream comprising ethylene, propylene, isobutylene and 1-butene, and removing at least a portion of the ethylene and propylene to form the mixed C_4 metathesis feed stream,

reacting the mixed C_4 metathesis feed stream in a first metathesis reactor in the presence of a first metathesis catalyst under conditions sufficient to produce an intermediate product stream comprising at least 30 wt. % 2-methyl-2-pentene based upon the olefin content of fresh feed in the mixed C_4 metathesis feed stream, and at least one of ethylene and propylene,

separating the 2-methyl-2-pentene,

subjecting the separated 2-methyl-2-pentene to pyrolysis to produce a reaction product stream comprising isoprene, and

separating the isoprene into an isoprene product stream using fractionation.

16. The process of claim 15, wherein the intermediate product stream contains at least 40 wt % 2-methyl-2-pentene based upon the olefin content of fresh feed.