What is claimed is

1. A genetically modified microorganism capable of converting a C1 carbon to 2,3-BDO, wherein the microorganism is from the species *Methylococcus capsulatus* and comprises heterologous genes encoding:

(a) an acetolactate synthase comprising an amino acid sequence at least 95% identical to any one of SEQ ID NO: 1, 3, or 19;

(b) an alpha-acetolactate decarboxylase comprising an amino acid sequence at least 95% identical to SEQ ID NO: 5 or 7; and

(c) an acetoin reductase comprising an amino acid sequence at least 95% identical to any one of SEQ ID NO: 9, 11, or 13;

wherein:

the heterologous acetolactate synthase is non-constitutively expressed; and

when the acetolactate synthase comprises an amino acid sequence at least 95% identical to SEQ ID NO: 3, the acetoin reductase comprises an amino acid sequence at least 95% identical to SEQ ID NO: 9 or 11.

2. The microorganism of claim 1, wherein the heterologous genes are integrated by an integration vector into the genome of said microorganism.

3. The microorganism of claim 1, wherein the heterologous genes are expressed on an episomal vector.

4. The microorganism of claim 1, wherein:

(a) the heterologous gene encoding acetolactate synthase is 5' in relation to any other heterologous gene;

(b) the heterologous gene encoding acetoin reductase is 3' in relation to any other

heterologous gene; and

(c) the heterologous gene encoding alpha-acetolactate decarboxylase is neither 5' or 3' in relation to any other heterologous gene.

5. The microorganism of claim 1, wherein the heterologous genes are under the control of a switch.

6. The microorganism of claim 1, wherein: (a) the acetolactate synthase comprises the amino acid sequence of any one of SEQ ID NOs: 1, 3, or 19, or differs therefrom by conservative substitutions; (b) the alpha-acetolactate decarboxylase comprises the amino acid sequence of SEQ ID NO: 5 or 7, or differs therefrom by conservative substitutions; and (c) the acetoin reductase comprises the amino acid sequence of any one of SEQ ID NO: 9, 11, or 13, or differs therefrom by conservative substitutions.

7. The microorganism of claim 1, wherein: (a) the acetolactate synthase comprises the amino acid sequence of any one of SEQ ID NOs: 1, 3, or 19; (b) the alpha-acetolactate decarboxylase comprises the amino acid sequence of SEQ ID NO: 5 or 7; and (c) the acetoin reductase comprises the amino acid sequence of any one of SEQ ID NO: 9, 11, or 13.

8. The microorganism of claim 1, wherein the heterologous gene encoding acetolactate synthase is under the control of a pBAD promoter or a pMxaF promoter.

9. The microorganism of claim 1, wherein: (a) the acetolactate synthase comprises an amino acid sequence that is at least 95% identical to SEQ ID NO: 1 or 19; (b) the alpha-acetolactate decarboxylase comprises an amino acid sequence that is at least 95% identical to SEQ ID NO: 7; and (c) the acetoin reductase comprises an amino acid sequence that is at least 95% identical to SEQ ID NO: 9.

10. The microorganism of claim 7, wherein the acetoin reductase is NADPH-dependent.

11. A method of making the microorganism of claim 1, the method comprising transforming the microorganism with a heterologous genes encoding an acetoin reductase, an alpha-acetolactate decarboxylase, and an acetolactate synthase.

12. A method of making 2,3-BDO, the method comprising:

(a) contacting the microorganism of claim 1 with a C1 carbon; and

(b) growing the microorganism to produce 2,3-BDO.

13. The method of claim 12, wherein the C1 carbon is methane.

14. The method of claim 12, wherein the microorganism is grown at a temperature between 32 °C and 49 °C.

15. The method of claim 12, further comprising contacting the microorganism with media containing at least 1 μM lanthanum before growing the microorganism to produce 2,3-BDO.

16. The method of claim 15, further comprising diluting the lanthanum in media before growing the microorganism to produce 2,3-BDO.

17. The method of claim 12, wherein the microorganism is grown to produce acetoin.

18. The method of claim 12, further comprising contacting the 2,3-BDO with a catalyst to produce butadiene or methyl ethyl ketone.