What is claimed is:

1. A genetically modified microorganism from the genus *Methylcoccus*, wherein said microorganism comprises an overexpressed heterologous gene encoding isocitrate dehydrogenase (icdA); and converts a C1 carbon source to 1,4-butanediol.

2. A method of making a genetically modified microorganism of claim 1, the method comprising contacting a microorganism with a nucleic acid expressing isocitrate dehydrogenase (icdA).

3. A method of making 1,4-butanediol, the method comprising:

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

b) growing the microorganism to produce 1,4-butanediol.

4. The method of claim 3, wherein the C1 carbon is CH_4.

5. The method of claim 3, wherein growing the microorganism is performed in the presence of exogenous gamma-hydroxybutyrate (GHB), exogenous α-ketoglutarate, or exogenous succinate.

6. The method of claim 5, further comprising recovering the 1,4-butanediol.

7. The method of claim 3, further comprising contacting the 1,4-butanediol with a catalyst, wherein said catalyst is an acid catalyst, an alumina catalyst, a silica-alumina catalyst, an alumina-supported tungsten oxide catalyst, a heteropolyacid catalyst, or a zirconium sulfate catalyst.

8. The method of claim 7, wherein tetrahydrofuran (THF) is formed after 1,4-butanediol is contacted with the catalyst.

9. The method of claim 3, further comprising contacting the 1,4-butanediol with a dicarboxylic acid/anhydride.

10. The method of claim 9, wherein a polyurethane is formed after the 1,4-butanediol is contacted with the dicarboxylic acid/anhydride.

11. The method of claim 7, further comprising transesterifying the 1,4-butanediol.

12. The method of claim 11, wherein polybutylene terephthalate (PBT) is formed after the 1,4-butanediol is transesterified.

13. The genetically-modified microorganism of claim 1, further comprising a heterologous gene encoding α-ketoglutarate decarboxylase (kgd), 4-hydroxybutyrate dehydrogenase (4hbD), 4-hydroxybutyryl-CoA transferase (Cat2), aldehyde dehydrogenase (Ald), or alcohol dehydrogenase (Adh).

14. The genetically-modified microorganism of claim 1, further comprising a heterologous gene encoding succinyl-CoA synthetase (SucC), CoA-dependent succinate semialdehyde dehydrogenase (SucD), 4-hydroxybutyrate dehydrogenase (4hbD), 4-hydroxybutyryl-CoA transferase (Cat2), aldehyde dehydrogenase (Ald), or alcohol dehydrogenase (Adh).

15. The genetically-modified microorganism of claim 1, further comprising a heterologous gene encoding pyruvate dehydrogenase (aceEF), citrate synthase (gltA), and/or aconitate hydratase 1 (acnA).