CLAIMS

What is claimed is:

1. A method of producing at least one organic compound in a subterranean environment comprising:

providing a carbon dioxide feedstock, a microbial culture, and a microbial growth medium; and

converting a portion of the carbon dioxide feedstock into the at least one organic compound by adding the carbon dioxide feedstock, the microbial culture, and the microbial growth medium to the subterranean environment,

wherein the carbon dioxide feedstock contains from 1.0 volume percent to 100 volume percent carbon dioxide based on a total volume of the carbon dioxide feedstock; and further comprising the steps of:

collecting a first sample from the subterranean environment at a first time point;

analyzing the first sample to obtain a first sample microbiome information; and

selecting the microbial culture and the microbial growth medium based on the microbiome information of the first sample.

2. The method of claim 1, wherein the subterranean environment includes a wellbore, a well formation containing a hydrocarbon, a natural cavern, a subterranean formation, an underground storage tank, or a combination thereof.

3. The method of claim 1, wherein the microbial culture includes at least one bacterial population native to the subterranean formation, at least one exogenous bacterial population, at least one anaerobic bacterial population, at least one genetically modified bacterial population, or a combination thereof.

4. The method of claim 1, wherein the microbial culture includes a *Geobacter* bacterium, a *Clostridium* bacterium, a *Bacillus* bacterium, a *Geobacillus* bacterium, a *Petrobacter* bacterium, a *Desulfotomaculum* bacterium, a *Bacteroides* bacterium, a *Thermoanaerobacter* bacterium, a *Thermococcus* bacterium, a *Thermotogales* bacterium, a *Petrotoga* bacterium, a *Thermotoga* bacterium, a *Caminicella* bacterium, a *Geosporobacter* bacterium, or a combination thereof; or the microbial culture includes a methanotrophic bacterium, a methanogenic bacterium, an archaebacterium, a

chemotrophic bacterium, an iron oxidizing bacterium, a sulfur oxidizing bacterium, an extremophile bacterium, a thermophilic bacterium, a halophilic bacterium, a hydrogen producing bacterium, a surfactant producing bacterium, an acetogenic bacterium, or a combination thereof.

5. The method of claim 1, wherein the microbial growth medium is an aqueous liquid including from 1 weight percent to 50 weight percent of at least one bio-based material, based on a total weight of the microbial growth medium.

6. The method of claim 5, wherein the at least one bio-based material includes glucose, fructose, glycerol, sucrose, maltodextrin, sodium chloride, a yeast extract, a malt extract, a casein peptone, sodium acetate, sodium lactate, a corn steep liquor, a watermelon rind, a corn cob, molasses, a dry bio-based material, or combinations thereof.

7. The method of claim 1, wherein the at least one organic compound includes a C_1 to C_{12} alkane, a C_1 to C_4 alcohol, a C_1 to C_3 organic acid, a C_1 to C_{120} hydrocarbon, or a combination thereof.

8. The method of claim 1, wherein the at least one organic compound includes an alkane, methane, butane, pentane, hexane, heptane, octane nonane, decane, dodecane, tetradecane, octadecane, an alkene, an alcohol, methanol, ethanol, propanol, butanediol, an organic acid, acetic acid, oxalic acid, an olefin, ethylene, a bio-surfactant, or a combination thereof.

9. The method of claim 1, further comprising,

harvesting the at least one organic compound from the subterranean environment after a time period sufficient for the microbial culture to convert the portion of the carbon dioxide feedstock into the at least one organic compound; or

adding a second portion of carbon dioxide feedstock to the subterranean environment.

10. The method of claim 1, further comprising,

selecting the microbial culture and the microbial growth medium based on at least one property of the subterranean environment, wherein the at least one property includes temperature, pressure, permeability, porosity, salinity, acidity, or combinations thereof.

11. The method of claim 1, further comprising,

collecting a second sample from the subterranean environment at a second time point; analyzing the second sample to obtain a second sample microbiome information;

selecting an adjustment dose based on the second sample microbiome information, wherein the adjustment dose includes a second microbial culture, a second microbial growth medium, or a combination thereof; and

injecting the adjustment dose into the subterranean environment.

12. The method of claim 11, further comprising,

measuring an amount of the at least one organic compound produced by at least one of the first microbial culture and the second microbial culture.

13. The method of claim 1, further comprising,

adding the carbon dioxide feedstock, the microbial culture, and the microbial growth medium to the subterranean environment, simultaneously, or in any order; or

injecting or pumping at least one of the carbon dioxide feedstock, the microbial culture and the microbial growth medium into the subterranean environment, simultaneously or in any order.

14. The method of claim 1, further comprising,

forming a culture mixture by mixing the microbial culture and the microbial growth medium together; and

adding the culture mixture and the carbon dioxide feedstock to the subterranean environment, simultaneously or in any order.

15. The method of claim 1, wherein the carbon dioxide feedstock is added to a first subterranean environment, wherein the microbial culture and the microbial growth medium are added to a second subterranean environment, and wherein the first subterranean environment is connected to the second subterranean environment.

16. The method of claim 1, further comprising,

injecting the microbial culture and the microbial growth medium together into the subterranean environment in a combined volume at an injection rate and an injection pressure sufficient to convert the portion of carbon dioxide feedstock into the at least one organic compound.

17. The method of claim 1, further comprising,

introducing at least one of an electrolysis apparatus and a hydrogen feedstock into the subterranean environment, wherein the hydrogen feedstock contains from 1 volume percent to 80 volume percent based on a total volume of the gas feedstock.

18. A system for producing at least one organic compound in a subterranean environment according to the method of claim 1, the system comprising:

a microbial culture vessel connected to a microbe injection port and a microbial growth medium vessel connected to a microbial growth medium injection port, or a culture mixture vessel connected to a culture mixture port;

a supply pipeline connected to at least one of the microbe injection port, the microbial growth medium injection port, the culture mixture port, and to a pumping station; and

an injection pipeline connected to the pumping station, wherein a portion of the injection pipeline is connected to the subterranean environment.

19. The method of claim 1, wherein the at least one organic compound is a hydrocarbon; and the subterranean environment is a well bore; and

wherein the sample microbiome information comprises an adaptation of the microbial culture to at least one property of the well bore environment, a resistance of the microbial culture to at least one property of the well bore environment, at least one property of the well bore environment, or a combination thereof;

wherein the at least one property includes temperature, pressure, permeability, porosity, salinity, acidity, or combinations thereof; and

wherein the method further comprises the steps of:

providing a biosurfactant feedstock;

converting a portion of the biosurfactant feedstock into at least one biosurfactant and degrading at least one petroleum hydrocarbon, at least one paraffin, or combination thereof present in the well bore environment by adding the biosurfactant feedstock, the microbial culture, and the microbial growth medium to the well bore environment;

wherein the microbial culture comprises a surfactant producing bacterium, a petroleum hydrocarbon degrading bacterium, a paraffin degrading bacterium, *Gordina sp.*, *Pseudomonas sp.*, *Bacillus sp.*, *Bacillus subtilis*, a rock degrading bacterium, *Rhodothermus marinus*, or combinations thereof; and

increasing production of the hydrocarbon from the well bore.