

# The Global Market for Carbon Capture, Utilization and Storage (CCUS) 2023-2040

<https://marketpublishers.com/r/G57E68FD05A1EN.html>

Date: June 2023

Pages: 435

Price: US\$ 1,250.00 (Single User License)

ID: G57E68FD05A1EN

## Abstracts

Carbon capture, utilization, and storage (CCUS) refers to technologies that capture CO<sub>2</sub> emissions and use or store them, leading to permanent sequestration. CCUS technologies capture carbon dioxide emissions from large power sources, including power generation or industrial facilities that use either fossil fuels or biomass for fuel. CO<sub>2</sub> can also be captured directly from the atmosphere. If not utilized onsite, captured CO<sub>2</sub> is compressed and transported by pipeline, ship, rail or truck to be used in a range of applications, or injected into deep geological formations (including depleted oil and gas reservoirs or saline formations) which trap th CO<sub>2</sub> for permanent storage.

Carbon removal technologies include direct air capture (DAC) or bioenergy with carbon capture and storage (BECCS). This fast growing market is being driven by government climate initiatives and increased public and private investments. In 2022 there was over \$1 billion in private investment in CCUS companies. Climeworks, a Swiss start-up developing direct air capture (DAC) raised a \$650m round in April 2022. In December 2022, Svante raised US\$318 million in a Series E fundraising round. Funding has dipped in 2023, but investment remains robust.

The market for CO<sub>2</sub> use is expected to remain relatively small in the near term (

## Contents

### 1 ABBREVIATIONS

### 2 RESEARCH METHODOLOGY

- 2.1 Definition of Carbon Capture, Utilisation and Storage (CCUS)
- 2.2 Technology Readiness Level (TRL)

### 3 EXECUTIVE SUMMARY

- 3.1 Main sources of carbon dioxide emissions
- 3.2 CO<sub>2</sub> as a commodity
- 3.3 Meeting climate targets
- 3.4 Market drivers and trends
- 3.5 The current market and future outlook
- 3.6 CCUS Industry developments 2020-2023
- 3.7 CCUS investments
  - 3.7.1 Venture Capital Funding
- 3.8 Government CCUS initiatives
  - 3.8.1 North America
  - 3.8.2 Europe
  - 3.8.3 China
- 3.9 Market map
- 3.10 Commercial CCUS facilities and projects
  - 3.10.1 Facilities
    - 3.10.1.1 Operational
    - 3.10.1.2 Under development/construction
- 3.11 CCUS Value Chain
- 3.12 Key market barriers for CCUS

### 4 INTRODUCTION

- 4.1 What is CCUS?
  - 4.1.1 Carbon Capture
    - 4.1.1.1 Source Characterization
    - 4.1.1.2 Purification
    - 4.1.1.3 CO<sub>2</sub> capture technologies
  - 4.1.2 Carbon Utilization

- 4.1.2.1 CO<sub>2</sub> utilization pathways
- 4.1.3 Carbon storage
  - 4.1.3.1 Passive storage
  - 4.1.3.2 Enhanced oil recovery
- 4.2 Transporting CO<sub>2</sub>
  - 4.2.1 Methods of CO<sub>2</sub> transport
    - 4.2.1.1 Pipeline
    - 4.2.1.2 Ship
    - 4.2.1.3 Road
    - 4.2.1.4 Rail
  - 4.2.2 Safety
- 4.3 Costs
  - 4.3.1 Cost of CO<sub>2</sub> transport
- 4.4 Carbon credits

## **5 CARBON CAPTURE**

- 5.1 CO<sub>2</sub> capture from point sources
  - 5.1.1 Transportation
  - 5.1.2 Global point source CO<sub>2</sub> capture capacities
  - 5.1.3 By source
  - 5.1.4 By endpoint
- 5.2 Main carbon capture processes
  - 5.2.1 Materials
  - 5.2.2 Post-combustion
  - 5.2.3 Oxy-fuel combustion
  - 5.2.4 Liquid or supercritical CO<sub>2</sub>: Allam-Fetvedt Cycle
  - 5.2.5 Pre-combustion
- 5.3 Carbon separation technologies
  - 5.3.1 Absorption capture
  - 5.3.2 Adsorption capture
  - 5.3.3 Membranes
  - 5.3.4 Liquid or supercritical CO<sub>2</sub> (Cryogenic) capture
  - 5.3.5 Chemical Looping-Based Capture
  - 5.3.6 Calix Advanced Calciner
  - 5.3.7 Other technologies
    - 5.3.7.1 Solid Oxide Fuel Cells (SOFCs)
    - 5.3.7.2 Microalgae Carbon Capture
  - 5.3.8 Comparison of key separation technologies

- 5.3.9 Technology readiness level (TRL) of gas separation technologies
- 5.4 Opportunities and barriers
- 5.5 Costs of CO<sub>2</sub> capture
- 5.6 CO<sub>2</sub> capture capacity
- 5.7 Bioenergy with carbon capture and storage (BECCS)
  - 5.7.1 Overview of technology
  - 5.7.2 Biomass conversion
  - 5.7.3 BECCS facilities
  - 5.7.4 Challenges
- 5.8 Direct air capture (DAC)
  - 5.8.1 Description
  - 5.8.2 Deployment
  - 5.8.3 Point source carbon capture versus Direct Air Capture
  - 5.8.4 Technologies
    - 5.8.4.1 Solid sorbents
    - 5.8.4.2 Liquid sorbents
    - 5.8.4.3 Liquid solvents
    - 5.8.4.4 Airflow equipment integration
    - 5.8.4.5 Passive Direct Air Capture (PDAC)
    - 5.8.4.6 Direct conversion
    - 5.8.4.7 Co-product generation
    - 5.8.4.8 Low Temperature DAC
    - 5.8.4.9 Regeneration methods
  - 5.8.5 Commercialization and plants
  - 5.8.6 Metal-organic frameworks (MOFs) in DAC
  - 5.8.7 DAC plants and projects-current and planned
  - 5.8.8 Markets for DAC
  - 5.8.9 Costs
  - 5.8.10 Challenges
  - 5.8.11 Players and production
- 5.9 Other technologies
  - 5.9.1 Enhanced weathering
  - 5.9.2 Afforestation and reforestation
  - 5.9.3 Soil carbon sequestration (SCS)
  - 5.9.4 Biochar
  - 5.9.5 Ocean Carbon Capture
    - 5.9.5.1 Ocean fertilisation
    - 5.9.5.2 Ocean alkalinisation

## 6 CARBON UTILIZATION

### 6.1 Overview

- 6.1.1 Current market status
- 6.1.2 Benefits of carbon utilization
- 6.1.3 Market challenges

### 6.2 Co<sub>2</sub> utilization pathways

### 6.3 Conversion processes

- 6.3.1 Thermochemical
  - 6.3.1.1 Process overview
  - 6.3.1.2 Plasma-assisted CO<sub>2</sub> conversion
- 6.3.2 Electrochemical conversion of CO<sub>2</sub>
  - 6.3.2.1 Process overview
- 6.3.3 Photocatalytic and photothermal catalytic conversion of CO<sub>2</sub>
- 6.3.4 Catalytic conversion of CO<sub>2</sub>
- 6.3.5 Biological conversion of CO<sub>2</sub>
- 6.3.6 Copolymerization of CO<sub>2</sub>
- 6.3.7 Mineral carbonation

### 6.4 CO<sub>2</sub>-derived products

#### 6.4.1 Fuels

- 6.4.1.1 Overview
- 6.4.1.2 Production routes
- 6.4.1.3 Methanol
- 6.4.1.4 Algae based biofuels
- 6.4.1.5 CO<sub>2</sub>-fuels from solar
- 6.4.1.6 Companies
- 6.4.1.7 Challenges

#### 6.4.2 Chemicals

- 6.4.2.1 Overview
- 6.4.2.2 Scalability
- 6.4.2.3 Applications
- 6.4.2.4 Companies

#### 6.4.3 Construction materials

- 6.4.3.1 Overview
- 6.4.3.2 CCUS technologies
- 6.4.3.3 Carbonated aggregates
- 6.4.3.4 Additives during mixing
- 6.4.3.5 Concrete curing
- 6.4.3.6 Costs

- 6.4.3.7 Companies
- 6.4.3.8 Challenges
- 6.4.4 CO<sub>2</sub> Utilization in Biological Yield-Boosting
  - 6.4.4.1 Overview
  - 6.4.4.2 Applications
  - 6.4.4.3 Companies
- 6.5 CO<sub>2</sub> Utilization in Enhanced Oil Recovery
  - 6.5.1 Overview
    - 6.5.1.1 Process
    - 6.5.1.2 CO<sub>2</sub> sources
  - 6.5.2 CO<sub>2</sub>-EOR facilities and projects
  - 6.5.3 Challenges
- 6.6 Enhanced mineralization
  - 6.6.1 Advantages
  - 6.6.2 In situ and ex-situ mineralization
  - 6.6.3 Enhanced mineralization pathways
  - 6.6.4 Challenges

## **7 CARBON STORAGE**

- 7.1 CO<sub>2</sub> storage sites
  - 7.1.1 Storage types for geologic CO<sub>2</sub> storage
  - 7.1.2 Oil and gas fields
  - 7.1.3 Saline formations
- 7.2 Global CO<sub>2</sub> storage capacity
- 7.3 Costs
- 7.4 Challenges

## **8 COMPANY PROFILES**

- 8.1 Aeroborn B.V.
- 8.2 AirCapture
- 8.3 Air Company
- 8.4 Air Liquide S.A.
- 8.5 Air Products and Chemicals, Inc.
- 8.6 Air Protein
- 8.7 Air Quality Solutions Worldwide DAC
- 8.8 Airovation Technologies
- 8.9 Aker Carbon Capture

- 8.10 Algal Bio Co., Ltd.
- 8.11 Algenol
- 8.12 Algiecel ApS
- 8.13 Andes
- 8.14 Aqualung Carbon Capture
- 8.15 Arca
- 8.16 Arkeon Biotechnologies
- 8.17 Asahi Kasei
- 8.18 AspiraDAC Pty Ltd.
- 8.19 Aspiring Materials
- 8.20 Avantium N.V.
- 8.21 Avnos, Inc.
- 8.22 Aymium
- 8.23 Axens SA
- 8.24 Azolla
- 8.25 Barton Blakeley Technologies Ltd.
- 8.26 BASF Group
- 8.27 BP PLC
- 8.28 Blue Planet Systems Corporation
- 8.29 BluSky, Inc.
- 8.30 Breathe Applied Sciences
- 8.31 Brilliant Planet
- 8.32 bse Methanol GmbH
- 8.33 C-Capture
- 8.34 C4X Technologies Inc.
- 8.35 C2CNT LLC
- 8.36 Cambridge Carbon Capture Ltd.
- 8.37 Captura Corporation
- 8.38 Capture6
- 8.39 Carba
- 8.40 CarbiCrete
- 8.41 Carbfix
- 8.42 Carboclave
- 8.43 Carbo Culture
- 8.44 Carbofex Oy
- 8.45 Carbominer
- 8.46 Carbonade
- 8.47 Carbonaught Pty Ltd.
- 8.48 Carbonova

- 8.49 CarbonScape Ltd.
- 8.50 Carbon8 Systems
- 8.51 Carbon Blade
- 8.52 Carbon Blue
- 8.53 CarbonBuilt
- 8.54 Carbon CANTONNE
- 8.55 Carbon Capture, Inc. (CarbonCapture)
- 8.56 Carbon Capture Machine (UK)
- 8.57 Carbon Centric
- 8.58 Carbon Clean Solutions Limited
- 8.59 Carbon Collect Limited
- 8.60 CarbonCure Technologies Inc.
- 8.61 Carbon Geocapture Corp
- 8.62 Carbon Engineering Ltd.
- 8.63 Carbon Infinity Limited
- 8.64 Carbon Limit
- 8.65 Carbon Recycling International
- 8.66 Carbon Reform, Inc.
- 8.67 Carbon Ridge, Inc.
- 8.68 Carbon Sink LLC
- 8.69 CarbonStar Systems
- 8.70 Carbon Upcycling Technologies
- 8.71 Carbonfree Chemicals
- 8.72 CarbonMeta Research Ltd
- 8.73 CarbonOrO Products B.V.
- 8.74 CarbonQuest
- 8.75 Carbon-Zero US LLC
- 8.76 Carbyon BV
- 8.77 Cemvita Factory Inc.
- 8.78 CERT Systems, Inc.
- 8.79 CFOAM Limited
- 8.80 Charm Industrial
- 8.81 Chevron Corporation
- 8.82 Chiyoda Corporation
- 8.83 China Energy Investment Corporation (CHN Energy)
- 8.84 Climeworks
- 8.85 CO2 Capsol
- 8.86 CO2Rail Company
- 8.87 CO2CirculAir B.V.



- 8.88 Compact Carbon Capture AS (Baker Hughes)
- 8.89 Coval Energy B.V.
- 8.90 Covestro AG
- 8.91 Cquestr8 Limited
- 8.92 CyanoCapture
- 8.93 D-CRBN
- 8.94 Decarbontek LLC
- 8.95 Deep Branch Biotechnology
- 8.96 Denbury Inc.
- 8.97 Dimensional Energy
- 8.98 Dioxide Materials
- 8.99 Dioxycle
- 8.100 8Rivers
- 8.101 Ebb Carbon
- 8.102 Ecocera
- 8.103 ecoLocked GmbH
- 8.104 Eion Carbon
- 8.105 Eonic Technologies Ltd
- 8.106 EcoClosure LLC
- 8.107 Electrochaea GmbH
- 8.108 Emerging Fuels Technology (EFT)
- 8.109 Empower Materials, Inc.
- 8.110 Enerkem, Inc.
- 8.111 enaDyne GmbH
- 8.112 Entropy Inc.
- 8.113 E-Quester
- 8.114 Equatic
- 8.115 Equinor ASA
- 8.116 Evonik Industries AG
- 8.117 ExxonMobil
- 8.118 44.01
- 8.119 Fairbrics
- 8.120 Fervo Energy
- 8.121 Fluor Corporation
- 8.122 Fortera Corporation
- 8.123 Framergy, Inc.
- 8.124 FuelCell Energy, Inc.
- 8.125 GE Gas Power (General Electric)
- 8.126 Giner, Inc.

- 8.127 Global Algae Innovations
- 8.128 Global Thermostat LLC
- 8.129 Graviky Labs
- 8.130 Gulf Coast Sequestration
- 8.131 Greenlyte Carbon Technologies
- 8.132 greenSand
- 8.133 Hago Energetics
- 8.134 Haldor Topsoe
- 8.135 Heimdal CCU
- 8.136 Heirloom Carbon Technologies
- 8.137 High Hopes Labs
- 8.138 Holcim Group
- 8.139 Holy Grail, Inc.
- 8.140 Honeywell
- 8.141 Oy Hydrocell Ltd.
- 8.142 1point8
- 8.143 IHI Corporation
- 8.144 Immaterial Ltd
- 8.145 Ineratec GmbH
- 8.146 Infinitree LLC
- 8.147 Innovator Energy
- 8.148 InnoSeptra LLC
- 8.149 InterEarth
- 8.150 ION Clean Energy, Inc.
- 8.151 Japan CCS Co., Ltd.
- 8.152 Jupiter Oxygen Corporation
- 8.153 Kawasaki Heavy Industries, Ltd.
- 8.154 Krajete GmbH
- 8.155 LanzaJet, Inc.
- 8.156 Lanzatech
- 8.157 Lectrolyst LLC
- 8.158 Levidian Nanosystems
- 8.159 The Linde Group
- 8.160 Liquid Wind AB
- 8.161 Lithos Carbon
- 8.162 Living Carbon
- 8.163 Loam Bio
- 8.164 Low Carbon Korea
- 8.165 Low Carbon Materials

- 8.166 Made of Air GmbH
- 8.167 Mango Materials, Inc.
- 8.168 Mars Materials
- 8.169 Mattershift
- 8.170 Mercurius Biorefining
- 8.171 Minera Systems
- 8.172 Mineral Carbonation International (MCi) Carbon
- 8.173 Mission Zero Technologies
- 8.174 Mitsui Chemicals, Inc.
- 8.175 Mitsubishi Heavy Industries Ltd.
- 8.176 MOFWORX
- 8.177 Molten Industries, Inc.
- 8.178 Mosaic Materials, Inc. (Baker Hughes)
- 8.179 Myno Carbon
- 8.180 Nanyang Zhongju Tianguan Low Carbon Technology Company
- 8.181 Net Power, LLC
- 8.182 NetZero
- 8.183 Neustark AG
- 8.184 Newlight Technologies LLC
- 8.185 New Sky Energy
- 8.186 Norsk e-Fuel AS
- 8.187 Novocarbo GmbH
- 8.188 Novo Nutrients
- 8.189 Noya
- 8.190 Nuada
- 8.191 1PointFive
- 8.192 Oakbio
- 8.193 Obrist Group
- 8.194 Occidental Petroleum Corp.
- 8.195 OCOchem
- 8.196 Orchestra Scientific S.L.
- 8.197 Origen Carbon Solutions
- 8.198 Osaki CoolGen Corporation
- 8.199 OXCCU Tech Ltd.
- 8.200 OxEon Energy, LLC
- 8.201 Oxylum
- 8.202 Paebbl AB
- 8.203 Parallel Carbon Limited
- 8.204 Perpetual Next Technologies

- 8.205 Photanol B.V.
- 8.206 Phytionix Corporation
- 8.207 Pond Technologies
- 8.208 Planetary Technologies
- 8.209 Prometheus Fuels, Inc.
- 8.210 Prometheus Materials
- 8.211 PTTEP
- 8.212 Proton Power, Inc.
- 8.213 PYREG
- 8.214 RedoxNRG
- 8.215 Remora
- 8.216 Removr
- 8.217 RepAir Carbon DAC Ltd.
- 8.218 Rubi Laboratories, Inc.
- 8.219 Running Tide Technologies, Inc.
- 8.220 Saipem S.p.A.
- 8.221 Seabound
- 8.222 Seachange Technologies
- 8.223 Sekisui Chemical
- 8.224 SeaO2 Netherlands
- 8.225 Seeo2 Energy, Inc.
- 8.226 Shell plc
- 8.227 Silicate Carbon
- 8.228 SkyMining AB
- 8.229 SkyNano Technologies
- 8.230 Skyrenu Technologies
- 8.231 Skytree
- 8.232 Solar Foods Oy
- 8.233 Soletair Power Oy
- 8.234 Solidia Technologies
- 8.235 South Ocean Air
- 8.236 Southern Green Gas
- 8.237 Steeper Energy
- 8.238 Stockholm Exergi AB
- 8.239 Storegga Geotechnologies Limited
- 8.240 Sublime Systems
- 8.241 Sunfire GmbH
- 8.242 Sustaera
- 8.243 Svante, Inc.

- 8.244 Synhelion
- 8.245 Quantiam Technologies Inc.
- 8.246 Tandem Technical
- 8.247 TerraCOH, Inc.
- 8.248 TerraFixing, Inc.
- 8.249 Terra CO2 Technologies Ltd.
- 8.250 TierraSpec Ltd.
- 8.251 TotalEnergies SE
- 8.252 Travertine Technologies, Inc.
- 8.253 Twelve
- 8.254 UNDO
- 8.255 UP Catalyst
- 8.256 Validun Inc
- 8.257 Vertus Energy Ltd.
- 8.258 Verdox
- 8.259 Vortis Carbon Co.
- 8.260 YuanChu Technology Corp.
- 8.261 ZoraMat Solutions
- 8.262 ZS2 Technologies

## **9 REFERENCES**

## List Of Tables

### LIST OF TABLES

- Table 1. Technology Readiness Level (TRL) Examples.
- Table 2. Carbon Capture, Utilisation and Storage (CCUS) market drivers and trends.
- Table 3. Carbon capture, usage, and storage (CCUS) industry developments 2020-2023.
- Table 4. CCUS VC deals 2020-2023.
- Table 5. Demonstration and commercial CCUS facilities in China.
- Table 6. Global commercial CCUS facilities-in operation.
- Table 7. Global commercial CCUS facilities-under development/construction.
- Table 8. Key market barriers for CCUS.
- Table 9. CO<sub>2</sub> utilization and removal pathways
- Table 10. Approaches for capturing carbon dioxide (CO<sub>2</sub>) from point sources.
- Table 11. CO<sub>2</sub> capture technologies.
- Table 12. Advantages and challenges of carbon capture technologies.
- Table 13. Overview of commercial materials and processes utilized in carbon capture.
- Table 14. Methods of CO<sub>2</sub> transport.
- Table 15. Carbon capture, transport, and storage cost per unit of CO<sub>2</sub>
- Table 16. Estimated capital costs for commercial-scale carbon capture.
- Table 17. Point source examples.
- Table 18. Assessment of carbon capture materials
- Table 19. Chemical solvents used in post-combustion.
- Table 20. Commercially available physical solvents for pre-combustion carbon capture.
- Table 21. Main capture processes and their separation technologies.
- Table 22. Absorption methods for CO<sub>2</sub> capture overview.
- Table 23. Commercially available physical solvents used in CO<sub>2</sub> absorption.
- Table 24. Adsorption methods for CO<sub>2</sub> capture overview.
- Table 25. Membrane-based methods for CO<sub>2</sub> capture overview.
- Table 26. Benefits and drawbacks of microalgae carbon capture.
- Table 27. Comparison of main separation technologies.
- Table 28. Technology readiness level (TRL) of gas separation technologies
- Table 29. Opportunities and Barriers by sector.
- Table 30. Existing and planned capacity for sequestration of biogenic carbon.
- Table 31. Existing facilities with capture and/or geologic sequestration of biogenic CO<sub>2</sub>.
- Table 32. Advantages and disadvantages of DAC.
- Table 33. Companies developing airflow equipment integration with DAC.
- Table 34. Companies developing Passive Direct Air Capture (PDAC) technologies.

Table 35. Companies developing regeneration methods for DAC technologies.

Table 36. DAC companies and technologies.

Table 37. DAC technology developers and production.

Table 38. DAC projects in development.

Table 39. Markets for DAC.

Table 40. Costs summary for DAC.

Table 41. Cost estimates of DAC.

Table 42. Challenges for DAC technology.

Table 43. DAC companies and technologies.

Table 44. Biological CCS technologies.

Table 45. Biochar in carbon capture overview.

Table 46. Carbon utilization revenue forecast by product (US\$).

Table 47. CO<sub>2</sub> utilization and removal pathways.

Table 48. Market challenges for CO<sub>2</sub> utilization.

Table 49. Example CO<sub>2</sub> utilization pathways.

Table 50. CO<sub>2</sub> derived products via Thermochemical conversion-applications, advantages and disadvantages.

Table 51. Electrochemical CO<sub>2</sub> reduction products.

Table 52. CO<sub>2</sub> derived products via electrochemical conversion-applications, advantages and disadvantages.

Table 53. CO<sub>2</sub> derived products via biological conversion-applications, advantages and disadvantages.

Table 54. Companies developing and producing CO<sub>2</sub>-based polymers.

Table 55. Companies developing mineral carbonation technologies.

Table 56. Market overview for CO<sub>2</sub> derived fuels.

Table 57. Microalgae products and prices.

Table 58. Main Solar-Driven CO<sub>2</sub> Conversion Approaches.

Table 59. Companies in CO<sub>2</sub>-derived fuel products.

Table 60. Commodity chemicals and fuels manufactured from CO<sub>2</sub>.

Table 61. Companies in CO<sub>2</sub>-derived chemicals products.

Table 62. Carbon capture technologies and projects in the cement sector

Table 63. Companies in CO<sub>2</sub> derived building materials.

Table 64. Market challenges for CO<sub>2</sub> utilization in construction materials.

Table 65. Companies in CO<sub>2</sub> Utilization in Biological Yield-Boosting.

Table 66. Applications of CCS in oil and gas production.

Table 67. CO<sub>2</sub> EOR/Storage Challenges.

Table 68. Storage and utilization of CO<sub>2</sub>.

Table 69. Global depleted reservoir storage projects.

Table 70. Global CO<sub>2</sub> ECBM storage projects.

Table 71. CO2 EOR/storage projects.

Table 72. Global storage sites-saline aquifer projects.

Table 73. Global storage capacity estimates, by region.



## List Of Figures

### LIST OF FIGURES

- Figure 1. Carbon emissions by sector.
- Figure 2. Overview of CCUS market
- Figure 3. Pathways for CO<sub>2</sub> use.
- Figure 4. Regional capacity share 2022-2030.
- Figure 5. Global investment in carbon capture 2010-2022, millions USD.
- Figure 6. Carbon Capture, Utilization, & Storage (CCUS) Market Map.
- Figure 7. CCS deployment projects, historical and to 2035.
- Figure 8. Existing and planned CCS projects.
- Figure 9. CCUS Value Chain.
- Figure 10. Schematic of CCUS process.
- Figure 11. Pathways for CO<sub>2</sub> utilization and removal.
- Figure 12. A pre-combustion capture system.
- Figure 13. Carbon dioxide utilization and removal cycle.
- Figure 14. Various pathways for CO<sub>2</sub> utilization.
- Figure 15. Example of underground carbon dioxide storage.
- Figure 16. Transport of CCS technologies.
- Figure 17. Railroad car for liquid CO<sub>2</sub> transport
- Figure 18. Estimated costs of capture of one metric ton of carbon dioxide (Co<sub>2</sub>) by sector.
- Figure 19. Cost of CO<sub>2</sub> transported at different flowrates
- Figure 20. Cost estimates for long-distance CO<sub>2</sub> transport.
- Figure 21. CO<sub>2</sub> capture and separation technology.
- Figure 22. Global capacity of point-source carbon capture and storage facilities.
- Figure 23. Global carbon capture capacity by CO<sub>2</sub> source, 2021.
- Figure 24. Global carbon capture capacity by CO<sub>2</sub> source, 2030.
- Figure 25. Global carbon capture capacity by CO<sub>2</sub> endpoint, 2021 and 2030.
- Figure 26. Post-combustion carbon capture process.
- Figure 27. Postcombustion CO<sub>2</sub> Capture in a Coal-Fired Power Plant.
- Figure 28. Oxy-combustion carbon capture process.
- Figure 29. Liquid or supercritical CO<sub>2</sub> carbon capture process.
- Figure 30. Pre-combustion carbon capture process.
- Figure 31. Amine-based absorption technology.
- Figure 32. Pressure swing absorption technology.
- Figure 33. Membrane separation technology.
- Figure 34. Liquid or supercritical CO<sub>2</sub> (cryogenic) distillation.

- Figure 35. Process schematic of chemical looping.
- Figure 36. Calix advanced calcination reactor.
- Figure 37. Fuel Cell CO<sub>2</sub> Capture diagram.
- Figure 38. Microalgal carbon capture.
- Figure 39. Cost of carbon capture.
- Figure 40. CO<sub>2</sub> capture capacity to 2030, MtCO<sub>2</sub>.
- Figure 41. Capacity of large-scale CO<sub>2</sub> capture projects, current and planned vs. the Net Zero Scenario, 2020-2030.
- Figure 42. Bioenergy with carbon capture and storage (BECCS) process.
- Figure 43. CO<sub>2</sub> captured from air using liquid and solid sorbent DAC plants, storage, and reuse.
- Figure 44. Global CO<sub>2</sub> capture from biomass and DAC in the Net Zero Scenario.
- Figure 45. DAC technologies.
- Figure 46. Schematic of Climeworks DAC system.
- Figure 47. Climeworks' first commercial direct air capture (DAC) plant, based in Hinwil, Switzerland.
- Figure 48. Flow diagram for solid sorbent DAC.
- Figure 49. Direct air capture based on high temperature liquid sorbent by Carbon Engineering.
- Figure 50. Global capacity of direct air capture facilities.
- Figure 51. Global map of DAC and CCS plants.
- Figure 52. Schematic of costs of DAC technologies.
- Figure 53. DAC cost breakdown and comparison.
- Figure 54. Operating costs of generic liquid and solid-based DAC systems.
- Figure 55. Schematic of biochar production.
- Figure 56. CO<sub>2</sub> non-conversion and conversion technology, advantages and disadvantages.
- Figure 57. Applications for CO<sub>2</sub>.
- Figure 58. Cost to capture one metric ton of carbon, by sector.
- Figure 59. Life cycle of CO<sub>2</sub>-derived products and services.
- Figure 60. CO<sub>2</sub> utilization pathways and products.
- Figure 61. Plasma technology configurations and their advantages and disadvantages for CO<sub>2</sub> conversion.
- Figure 62. LanzaTech gas-fermentation process.
- Figure 63. Schematic of biological CO<sub>2</sub> conversion into e-fuels.
- Figure 64. Eonic catalyst systems.
- Figure 65. Mineral carbonation processes.
- Figure 66. Conversion route for CO<sub>2</sub>-derived fuels and chemical intermediates.
- Figure 67. Conversion pathways for CO<sub>2</sub>-derived methane, methanol and diesel.

- Figure 68. CO<sub>2</sub> feedstock for the production of e-methanol.
- Figure 69. Schematic illustration of (a) biophotosynthetic, (b) photothermal, (c) microbial-photoelectrochemical, (d) photosynthetic and photocatalytic (PS/PC), (e) photoelectrochemical (PEC), and (f) photovoltaic plus electrochemical (PV+EC) approaches for CO<sub>2</sub> c
- Figure 70. Audi synthetic fuels.
- Figure 71. Conversion of CO<sub>2</sub> into chemicals and fuels via different pathways.
- Figure 72. Conversion pathways for CO<sub>2</sub>-derived polymeric materials
- Figure 73. Conversion pathway for CO<sub>2</sub>-derived building materials.
- Figure 74. Schematic of CCUS in cement sector.
- Figure 75. Carbon8 Systems' ACT process.
- Figure 76. CO<sub>2</sub> utilization in the Carbon Cure process.
- Figure 77. Algal cultivation in the desert.
- Figure 78. Example pathways for products from cyanobacteria.
- Figure 79. Typical Flow Diagram for CO<sub>2</sub> EOR.
- Figure 80. Large CO<sub>2</sub>-EOR projects in different project stages by industry.
- Figure 81. Carbon mineralization pathways.
- Figure 82. CO<sub>2</sub> Storage Overview - Site Options
- Figure 83. CO<sub>2</sub> injection into a saline formation while producing brine for beneficial use.
- Figure 84. Subsurface storage cost estimation.
- Figure 85. Air Products production process.
- Figure 86. Aker carbon capture system.
- Figure 87. ALGIECEL PhotoBioReactor.
- Figure 88. Schematic of carbon capture solar project.
- Figure 89. Aspiring Materials method.
- Figure 90. Aymium's Biocarbon production.
- Figure 91. Carbonminer technology.
- Figure 92. Carbon Blade system.
- Figure 93. CarbonCure Technology.
- Figure 94. Direct Air Capture Process.
- Figure 95. CRI process.
- Figure 96. PCCSD Project in China.
- Figure 97. Orca facility.
- Figure 98. Process flow scheme of Compact Carbon Capture Plant.
- Figure 99. Colyser process.
- Figure 100. ECFORM electrolysis reactor schematic.
- Figure 101. Dioxycle modular electrolyzer.
- Figure 102. Fuel Cell Carbon Capture.
- Figure 103. Topsoe's SynCORTM autothermal reforming technology.

Figure 104. Carbon Capture balloon.

Figure 105. Holy Grail DAC system.

Figure 106. INERATEC unit.

Figure 107. Infinitree swing method.

Figure 108. Audi/Krajete unit.

Figure 109. Made of Air's HexChar panels.

Figure 110. Mosaic Materials MOFs.

Figure 111. Neustark modular plant.

Figure 112. OCOchem's Carbon Flux Electrolyzer.

Figure 113. ZerCaL™ process.

Figure 114. CCS project at Arthit offshore gas field.

Figure 115. RepAir technology.

Figure 116. Soletair Power unit.

Figure 117. Sunfire process for Blue Crude production.

Figure 118. CALF-20 has been integrated into a rotating CO<sub>2</sub> capture machine (left), which operates inside a CO<sub>2</sub> plant module (right).

Figure 119. O12 Reactor.

Figure 120. Sunglasses with lenses made from CO<sub>2</sub>-derived materials.

Figure 121. CO<sub>2</sub> made car part.

## I would like to order

Product name: The Global Market for Carbon Capture, Utilization and Storage (CCUS) 2023-2040

Product link: <https://marketpublishers.com/r/G57E68FD05A1EN.html>

Price: US\$ 1,250.00 (Single User License / Electronic Delivery)

If you want to order Corporate License or Hard Copy, please, contact our Customer Service:

[info@marketpublishers.com](mailto:info@marketpublishers.com)

## Payment

To pay by Credit Card (Visa, MasterCard, American Express, PayPal), please, click button on product page <https://marketpublishers.com/r/G57E68FD05A1EN.html>

To pay by Wire Transfer, please, fill in your contact details in the form below:

First name:  
Last name:  
Email:  
Company:  
Address:  
City:  
Zip code:  
Country:  
Tel:  
Fax:  
Your message:

**\*\*All fields are required**

Customer signature \_\_\_\_\_

Please, note that by ordering from marketpublishers.com you are agreeing to our Terms & Conditions at <https://marketpublishers.com/docs/terms.html>

To place an order via fax simply print this form, fill in the information below and fax the completed form to +44 20 7900 3970