

Special Report (sample)

Front Runners in Sustainable Fuel Technologies



INTRODUCTION

About this report:

- ❖ This report provides a comprehensive overview of the leading players active in developing sustainable fuels globally.
- ❖ Scope of sustainable fuel technologies:
 - **Transesterification** of microalgal lipids or disposed waste oils (biodiesel, etc.)
 - **Electrochemical conversion** of carbon dioxide (CO₂) emitted from various industries (alcohols, etc.)
 - **Microbial fermentation** of biodegradable waste (biogas, bioethanol, etc.)
 - **Thermo-catalytic conversion** of solid waste materials (syngas, etc.)

Note: Conventional processes utilising 2nd generation biomass (wood biomass or agricultural waste) with no significant process novelty have not been considered.

- ❖ Companies covered can be start-ups or mid-sized companies having focused on their proprietary sustainable fuel technology. Established players, conglomerates, research institutions and laboratories have not been captured.
- ❖ Each company has been profiled separately by outlining details around its technology, financials, relevant markets and intellectual property. Further, a 20-point assessment within Aranca 5 Factor Assessment Framework has been provided for each player.

Relevant audience:

- ✓ Established companies and conglomerates willing to explore and acquire start-ups
- ✓ Venture capitalists (VCs), institutional and individual investors

Customization:

- Report contents can be customized based on user requirements. Accordingly, report coverage shall be reduced or expanded to the specific areas of interest.

SUMMARY



Sustainable Fuel Technologies

- Oil- & gas-based fuels are currently the major sources behind meeting the global energy demand, which is ever increasing as we witness growth in urbanization and industrial development.
- However, this growth is marred with volatility in oil & gas prices, depleting fossil fuel sources and greenhouse gas emissions associated with burning of fossil fuel.
- The rising global average temperature due to burning of fossil fuel is a major concern and many governments are imposing stringent regulations in order to curtail the use of fossil fuels.
- With growing pressure both from government and environmentalists, energy producers as well as consumers are looking for potential sustainable fossil fuel substitutes.
- Sustainable fuels range from biofuels derived from biomass to fuels produced using flue gases or industrial wastes as feedstocks.
- Sustainable fuels provide a unique opportunity to reduce our dependency on fossil fuels, increase CO₂ utilization, and thereby assist in reducing global warming.
- However, large scale adoption of such fuels is hurdled due to food chain conflicts, crop yield, low energy output, scalability, and high costs. Many sustainable fuel producers are providing novel technologies to overcome these challenges.

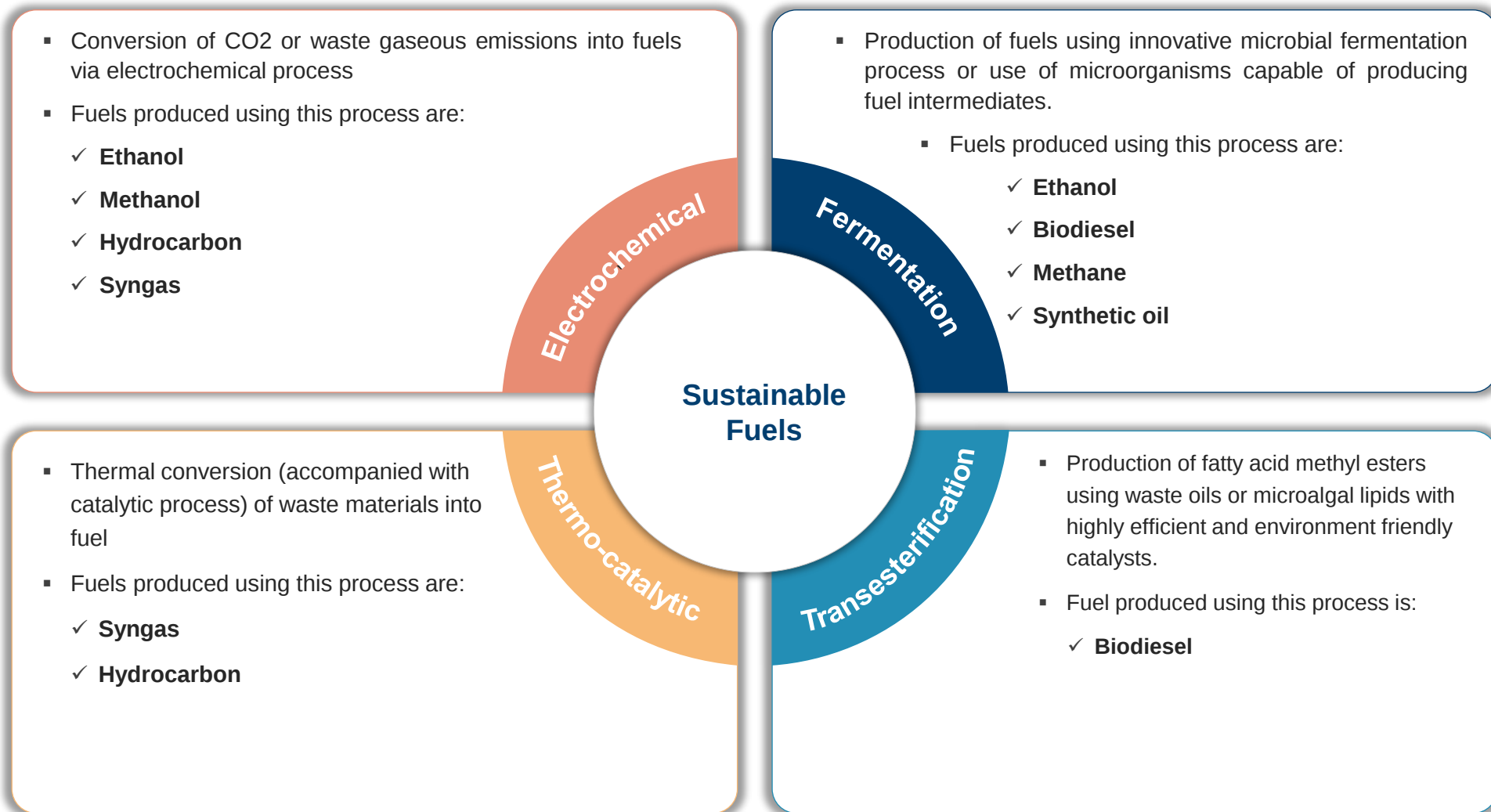


Aranca Report Overview

- In this report, Aranca has captured innovative and scalable technologies from the most promising entities in the domain of sustainable fuel production.
- Identified front runners in sustainable fuel technologies were evaluated using Aranca's 5 factor framework namely comprising of:
 - ✓ Intellectual property
 - ✓ Technology
 - ✓ Financial and market
 - ✓ Organization
 - ✓ Ecosystem
- The report covers innovative players providing technologies such as fuel production using CO₂ capture, fermentation, waste valorization, etc. which have ability to be scaled up in the future and has potential to disrupt fossil fuel market.
- For any broader customized requirements, Aranca can also extend the study scope to provide support in:
 - ✓ Competition assessment
 - ✓ Market assessment and outlook
 - ✓ IP and commercial product landscapes
 - ✓ Route-to-market intelligence, e.g., key technologies, potential M&A targets, regulatory aspects, etc.

Note: This is one in the series of reports published on sustainability theme. Other reports such as Front Runners in **CO₂ Utilization Technologies**, **Sustainable Materials**, **Sustainable Polymeric Composites** are also available.

SUSTAINABLE FUEL TECHNOLOGIES



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Sample Report Contents

Fuel Clusters and Sample Company Profile

REPORT OVERVIEW

50 companies actively working in sustainable fuel technologies



Inclusion of biological, electrochemical and thermochemical process in a single platform



Holistic assessment in terms of IP, technology, financial, ecosystem and organization



Entities range from start-ups to potential disruptors*



In depth analysis and key observations for each entity

Information covered on each company

Company information

- Website, year of establishment, headquarters, key personnel, etc.
- Size (employee count, revenue, funding, etc.)
- Awards and recognition

Technology

- Technology readiness level (TRL)
- Feedstock, conversion process and output
- Patents and research collaborations

Commercialization

- Applications and markets
- Product details (form, chemistry, trade name, etc.)
- Business partnerships, investments

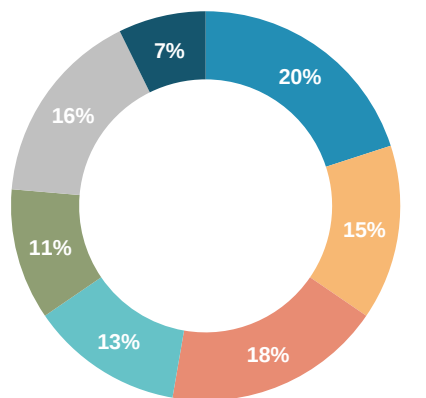
**Players with diversified business portfolio are excluded; Joint Venture and Partnerships, Established Players and Conglomerates shall be provided in a list format*

HIGHLIGHTS

Summary

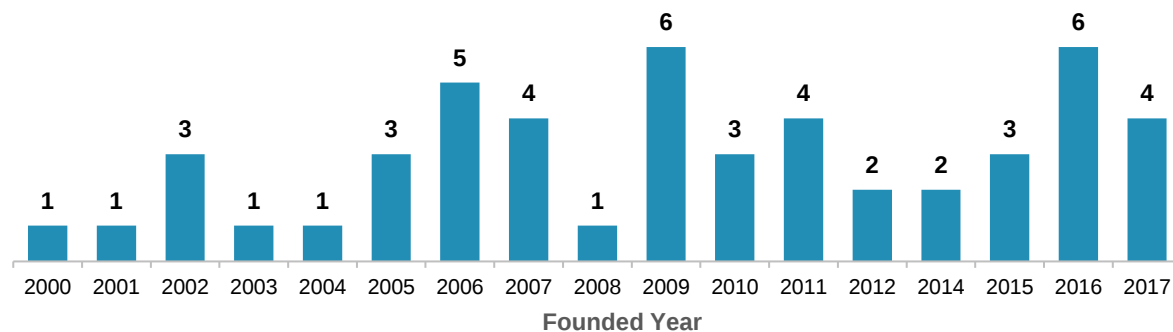
Companies covered	50
Geographic focus	Global
Year of establishment	2000 onwards
Fuel	Ethanol, biodiesel, methane, syngas, alcohols (except ethanol), hydrocarbons, others

Fuel

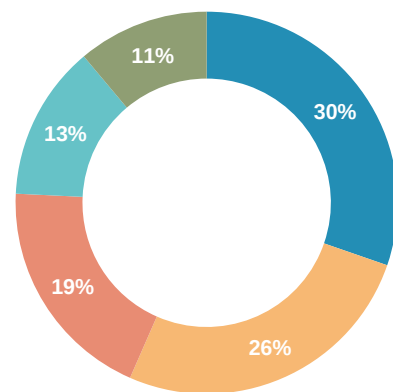


■ Ethanol
 ■ Biodiesel
 ■ Methane
 ■ Miscellaneous
 ■ Other Alcohol
 ■ Syngas
 ■ Other Hydrocarbon

Companies By Maturity

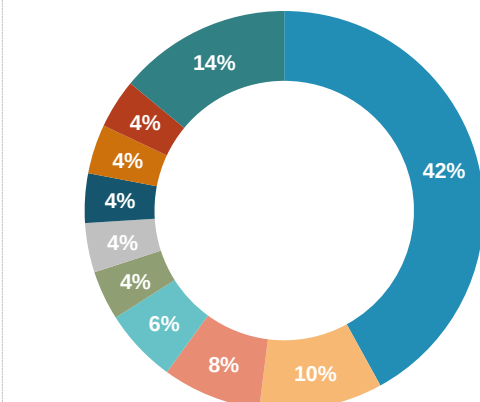


Process Technology



■ Fermentation
 ■ Thermochemical process
 ■ Others
 ■ Electrochemical process
 ■ Transesterification

Regional Coverage



■ USA
 ■ Israel
 ■ Germany
 ■ Others
 ■ UK
 ■ Switzerland
 ■ Netherlands
 ■ Canada
 ■ Spain
 ■ India

RESEARCH METHODOLOGY

Methodology

- A comprehensive search was performed on various platforms to map the relevant technology developers. Mapped entities were scrutinized for relevancy based on technology and product offerings.
- Focused secondary research was conducted for the relevant players in order to capture relevant information. In order to fill the gaps existing after this, primary research was conducted wherever necessary.
- Entities with establishment year 2000 onwards have been considered, however, this has not been considered strictly in order to capture all significant players.
- Corporate players and entities with diversified portfolios having partial focus on sustainable fuel technology were excluded.
- Each relevant player was evaluated on five important factors- intellectual property, technology, financials, ecosystem and organization (refer Aranca 5 Factor Framework on the next slide for more details).

Information Sources

Following paid and public sources of information were referred (not exhaustive):

- Commercial databases such as Factiva, Crunchbase, Pitchbook, Bloomberg, Euromonitor and EMIS
- Company websites, product brochures and news/media sections
- Industry associations and Government sources such as European Commission, Bioenergy Europe, Renewable fuel association and International renewable energy association
- Specific publications/magazines on fuels and biofuels
- Patents on databases such as Thomson Innovation and Questel Orbit
- Scientific literature published on databases such as ScienceDirect, Google scholar, RSC, ResearchGate, Scopus, SpringerLink and Wiley Online
- Aranca internal knowledgebases and industry experts

ARANCA 5 FACTOR ASSESSMENT FRAMEWORK

Factor	Parameter	Score (1–5); higher is better					Min	Max
 Intellectual Property	No. of Patents						3	15
	Forward Citations							
	Patent Status							
 Technology	Novelty						5	25
	Scope							
	Scalability							
	Competitiveness							
	TRL							
 Financials	Total Funding						5	25
	Funding Rounds							
	Type of Investor							
	No. of Investors							
	Revenues							
 Ecosystem	Target Industry Size						3	15
	Policies & Regulations							
	Environmental Impact							
 Organization	Global Presence						4	20
	Employee Size							
	Active Years							
	Awards/Recognition							

Notes:

- Total score is obtained by adding the individual factor scores.
- For uniform representation, final score is normalized on a 0-100 scale and factor scores are adjusted accordingly.

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Fuel Clusters and Sample Company Profile

List of companies by fuel product type

Ethanol

Example:



LanzaTech
capturing carbon, fueling growth.

Biodiesel

Example:



REG
Renewable Energy Group

Methane

Example:



KRAJETE
Learning From Nature.

Syngas

Example:



Fulcrum
BIOENERGY

Other Hydrocarbon

Example:



Carbon
Engineering

Miscellaneous

Example:



c16
BIOSCIENCES

Website: [Link](#)

Est.: 2009

HQ: Canada

Carbon Engineering's (CE) has developed a groundbreaking **Direct Air Capture technology**, that can be used to remove large-scale **carbon dioxide (CO2)** from the atmosphere and convert it further into **fuels** or use it for enhanced crude oil recovery.



Technology

- Feedstock: CO2
- Process: CO2 capture, electrochemical process
- Key products: Hydrocarbon fuel
- TRL: Commercial demonstration system



Financials

- Total revenue: \$ 10 to 50 m
- Total invested amount: \$ 107.4 m
- Investors: Private Equity/Grants



Operations

- Pilot plant in Canada
- Innovation lab in Canada
- Planning for commercial plant in USA



Applications

- Transportation
- Oil and Gas



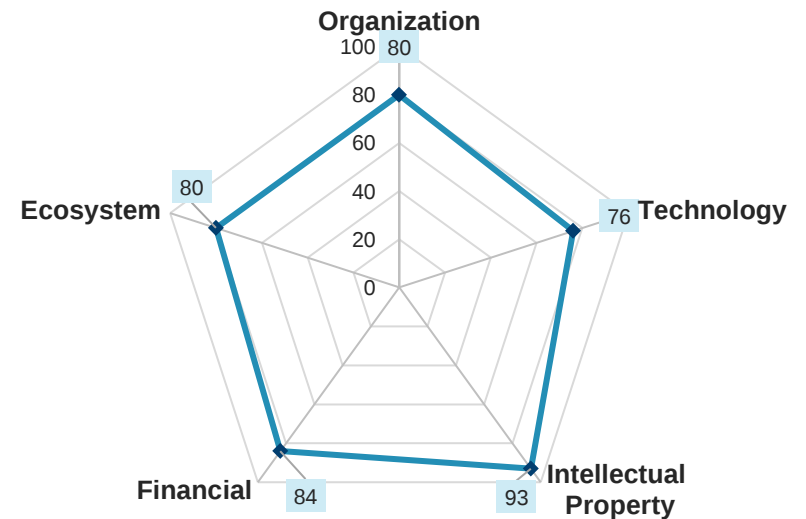
Aranca Observations

- Carbon engineering has been extensively working in the area of CO2 capture and is in the final stage of developing an industrial scale plant
- It is one of the most advanced companies in the domain of direct CO2 capture and utilization



Aranca 5 Factor Assessment

82/100



Note: Scores have been normalized on a 0-100 scale. Detailed analysis has been provided in the next slide.

Overall Rating



Aranca 5 Factor Assessment


Total Score
82

		Criteria	Low 1	2	Score 3	4	High 5	Total
 Intellectual Property	Strong IP portfolio of 11 patents, out of which seven (7) are granted	No. of Patents						14
		Citations/Year						
		Patent Status						
 Technology	- Electrochemical process to combine CO₂ and hydrogen into fuel - Process leads to circular system of carbon emission and capture	Novelty						19
		Scope						
		Scalability						
		Competitiveness						
		TRL						
 Financial	Ample funding available from Private investors and government funds	Total Funding						21
		Funding Rounds						
		Type of Investor						
		No. of Investors						
		Revenues						
 Ecosystem	Renewable electricity is used in the electrochemical process	Target Industry Size						12
		Policies & Regulations						
		Environmental Impact						
 Organization	- CE has a employee count of 79 members - Innovation lab and office located in Canada - Exploring project opportunities in new markets	Global Presence						16
		Employee Size						
		Active Years						
		Awards/Recognition						



With extensive R&D, strong IP portfolio and excellent funding, CE is in good position to lead the market of sustainable fuel production from CO₂

Patents



- Total of **11 patents**, with 7 patents granted
- Patents mainly disclose **the process and equipment involved in capture of CO₂**
- Some patents also disclose regarding further conversion of purified CO₂ into **fuel or material**

Financial



- In **2019**, **CE** completed an investment round of **\$68 m** from global energy companies and top venture capital firms
- Private investors include **Bill Gates, Murray Edwards, BHP, Chevron Technology Ventures, Oxy Low Carbon Ventures, LLC** and many others

Research and Development



- CE is developing an innovation center to integrate current facility operations
- It is also focusing on development of industrial scale plant, with construction planned in 2021

Collaborations and Partners



- CE has a collaboration with **Oxy Low Carbon Ventures, LLC** subsidiary of American petroleum company, **Occidental** to setup a commercial plant.
- It has a partnership with **Greyrock Energy** to develop air to fuel systems



BUSINESS RESEARCH
& ADVISORY



INVESTMENT RESEARCH
& ANALYTICS



VALUATION
ADVISORY



TECHNOLOGY
INTELLIGENCE &
IP RESEARCH



PROCUREMENT & SUPPLY
CHAIN INTELLIGENCE

