
nrg | cosia
CARBON XPRIZE
FINALIST
BOOKLET
2020
REIMAGINE CO_2

nrg | cosia CARBON XPRIZE®

THE CARBON OPPORTUNITY

CARBON-TO-VALUE

Carbon is the backbone of the modern economy, but CO_2 emissions have become a serious liability. Today, there is a new opportunity to make productive use of excess CO_2 emissions. The current global total addressable market for products made from CO_2 is estimated to be over $6 trillion per year by Carbon180. Analysis from Global CO_2 Initiative in 2016 and a 2019 review article in Nature both estimate that CO_2 products could scale to remove or avoid several gigatons of CO_2 annually in the coming decades. Products and materials like concrete, carbon fiber, polymers, food, fertilizer, liquid fuels, graphene, and many others have the potential to offer superior performance, lower cost, and lower carbon footprint when made from CO_2. This emerging industry is known variously as "carbon-to-value", "carbontech", and "carbon capture utilization and storage (CCUS)". The long term vision is a new low-carbon economy built around recycling CO_2 emissions, producing superior products, and supporting a stable global climate.

INVESTMENT LANDSCAPE

Market activity in the space is accelerating, and the structural elements of a capital ecosystem have begun to form. Groups like Breakthrough Energy Ventures, Oil and Gas Climate Initiative, Y-Combinator, Carbontech Labs, Circular Carbon Network, CO_2 Value Europe, and Lawrence Livermore National Laboratory are supporting and driving innovation, private investment, corporate engagement, and policy. A new $35 per ton U.S. federal tax credit ("45Q") for capturing and utilizing CO_2 is anticipated to support the development of new large commercial projects. Working with partners, XPRIZE's Circular Carbon Network initiative created the first ever Company Index and Deal Hub – the most comprehensive database of companies in this sector to date. Initial analysis shows that the entire sector has garnered a total investment of just over $2 billion to date, despite the estimated $6 trillion market opportunity.

CARBON XPRIZE

The companies profiled here are Finalists in the NRG COSIA Carbon XPRIZE, a $20 million global prize competition for conversion of CO_2 into products. Over the past four years each company has been vetted by independent engineering auditors and a panel of expert judges against the following performance metrics: CO_2 uptake, economic value of product, product market size, and environmental footprint. Now they are scaling their systems by 10X as they prepare to build and operate pilot-scale demonstration projects at either the Wyoming Integrated Test Center or the Alberta Carbon Conversion Technology Centre.

The Finalists are currently engaging investors to fund their demonstration projects and beyond. Investors and prospective partners interested in further information are encouraged to contact the founders directly for specific inquiries, or for general information, **carbon@xprize.org**.

TABLE OF CONTENTS

Carbon Upcycling Technologies demonstrating their technology in Calgary, Canada. November 2017

CARBON UPCYCLING TECHNOLOGIES

AT A GLANCE

One-Liner:
Carbon Upcycling Technologies is using the pollution of today to build the materials of tomorrow

Location:
Calgary, Alberta, Canada

Vertical:
CO_2-to-Advanced Materials

Corporate Status:
Alberta Corporation

Funding Needs:
Strategic partnership in infrastructure, polymers, and advanced materials

Funding Stage:
Late Seed/Series A

Customers:
OldCastle Infrastructures, CRH, Florida Lemark

Tech Stage:
Early Commercial

XPRIZE Test Site:
Alberta Carbon Conversion Technology Centre

Contact:
Apoorv Sinha, Founder and CEO,
a.poorv@cutco2.com

OVERVIEW

Carbon Upcycling Technologies ("CUT") was formed to use the pollution of today to build the materials of tomorrow by converting CO_2 gas into solid products. CUT sells advanced solid products derived from greenhouse emissions and cheaply available solids. Since 2014, CUT has scaled its ability to capture CO_2 emissions from point sources, such as power plants, by over a million times and has technically validated the performance of its end products in over 10 different industrial markets. Through its portfolio of CO_2-derived solid nanoparticles, CUT has technically validated its solutions for use in the plastics, coatings, epoxy, adhesives, concrete, lithium-ion battery, and pharmaceutical industries.

MARKET

CUT's nanoparticles have applications in various industries, particularly in concrete, construction, and plastics. Target markets include additives for concrete mixes, asphalt mixes, adhesives; polymer reinforcement additives for polyethylene, polypropylene, polyurethane, epoxies, rubbers & nylons; solid lubricants or air filtration media; additives for lithium-battery systems; membranes for water filtration membranes.

SOLUTION AND ADVANTAGE

CUT chemically adsorbs CO_2 emissions into exfoliated solid feedstock to create a portfolio of fine nanoparticles, such as graphitic nanoplatelets (GNPs), graphene oxide (GO), graphene quantum dots (GQDs), and enhanced fly ash (EFA). CUT's solution is unique in its broad portfolio of products with identified and validated technical use in a range of different areas ranging from high-volume, commoditized industries such as plastics and concrete, to advanced sectors such as photovoltaics, energy storage, and pharmaceuticals.

BUSINESS MODEL

CUT commercialized a corrosion-resistant coating, utilizing its nanoparticles, in 2017, becoming the youngest CO_2 utilization company to generate commercial revenue (<2.5 years since inception) to date. CUT is in a commercialization phase for its concrete additive and nucleation agent which include licensing and direct-sales models.

TEAM

CUT is led by Founder and CEO, Apoorv Sinha. CUT's management team has more than 30 years in advanced materials startups focused on coatings and composites. Current advisors and directors include a renowned plastics composite engineer, an ex-VP of marketing for North America's largest precast concrete company, and an ex-BP Ventures MD globally recognized as a thought leader in the field of CO_2 utilization.

C2CNT setting up their demonstration for the
Finals at the ACCTC in Calgary, Canada. October 2019

C2CNT

AT A GLANCE

One-Liner:
C2CNT's unique process uses CO_2 to create carbon nanotubes at significantly lower cost

Location:
Calgary, Alberta, Canada

Vertical:
CO_2-to-Advanced Materials

Corporate Status:
Incorporated in USA, 2017
Incorporated in CA, 2018

Partnership Needs:
No venture funding needed at this time, but interested in non-dilutive philanthropic capital and strategic commercial relationships

Funding Stage:
Series A

Customers:
Steel, aluminum, textiles, ceramics and cement producers, manufacturing, packaging, and construction industries (packaging, batteries, electronics, non-metal construction)

Tech Stage:
Demonstration Plant

XPRIZE Test Site:
Alberta Carbon Conversion Technology Centre

Contact:
Dr. Stuart Licht, Founder,
SL@c2cnt.com

OVERVIEW

C2CNT has developed an inexpensive means of transforming CO_2 into carbon nanotubes (CNTs), which have remarkable properties of flexibility, high conductivity, and are lightweight and have strength greater than steel. Carbon nanotubes can be used as: lightweight, ultra-strong and cost- effective replacements for metals; new bullet- and taser-proof textiles; stronger cement-composite building materials; and expanding applications in industrial catalysis, batteries, and nanoelectronics.

MARKET

C2CNT addresses the growing market need for stronger materials with a lower carbon footprint. The unique properties of CNTs, including the highest tensile strength of any known material, allow the company to target several markets, including the carbon nanotube ($250k/tonne, 25k tonne annual global market), carbon fiber ($40k/tonne, 125k tonnes), aluminum ($32k/ tonne, 58M tonnes), and steel ($25k/tonne, 1.6B tonnes) markets. The CNT market alone has expanded rapidly, constrained only by the current high cost of manufacturing, and is projected to grow to $8.7B by 2022. CNTs are also expected to find applications in new products for the textile, building, medical, aerospace, transportation, battery, and electronics industries.

SOLUTION AND ADVANTAGE

C2CNT produces nanotubes 100x more cheaply than the current industry standard. Its process can use cheap and abundant flue gas input without separating or concentrating the CO_2, and produces a highly pure and compact material whose stable molecular structure sequesters carbon over the long term. Those nanotubes are valued at over $100,000 per ton, resulting in high revenue potential and a strong economic driver for greenhouse gas mitigation. Another advantage of C2CNT's product over metals is its relative strength and lower carbon footprint. Because fewer CNT's can be used to replace aluminum or steel, the realized cost if even lower. For example, at current prices, CNT's can be 17 times less costly than steel while remaining just as strong. Furthermore, 6.3 tons of CO_2 are emitted per ton of steel produced through current methods, resulting in significant emission reductions when replaced by CNTs.

BUSINESS MODEL

C2CNT's revenue model is based on direct sales of CNTs, licensing of C2CNT technology by industrial customers, and greenhouse gas reductions. Licensing includes ownership of the produced CNT product along with incentivized sales commissions back to licensee plants by C2CNT for their sales or use of the CNTs. C2CNT will design, build, and demonstrate variously sized plants for specialized applications, including integrated units for gas, coal, cement, fertilizer, and corn-to-ethanol plants. Over the long term, C2CNT plans to incorporate direct CO_2 air capture technology, and is also designing off-grid ovens, which, when driven by biomass, will heat and cook without CO_2 emissions while generating CNTs for sale.

TEAM

C2CNT is led by Dr. Stuart Licht, Professor of Chemistry at George Washington University and former Program Director at the US National Science Foundation; he has been developing C2CNT's core technology for 30 years. The core team consists of innovative researchers and industry professionals located at ACCTC Calgary, Alberta, in Canada together with the C2CNT research team at GWU.

C4X demonstrating their technology in Suzhou, China. November 2017

C4X

AT A GLANCE

One-Liner:
C4X converts CO_2 into high-value chemicals and bio-composite foamed plastics

Location:
Suzhou, China and Toronto, Canada

Verticals:
CO_2-to-Chemicals, CO_2-to-Plastics

Corporate Status:
Incorporated in China and Canada

Funding Needs:
$2M

Funding Stage:
Late Seed/Series A

Customers:
Manufacturers of textiles, plastics, lithium-ion batteries, packaging and automotive interior parts

Tech Stage:
Commercial Pilot

XPRIZE Test Site:
Wyoming Integrated Test Center

Contact:
Dr. Wayne Song, Founder,
waynesong@ccccx.net

OVERVIEW

C4X's unique process converts waste CO_2 into a variety of chemicals and plastics, including ethylene carbonate, an essential material used in lithium-ion batteries, and ethylene glycol, a key ingredient in the packaging of textiles. C4X also produces microscopic CO_2 foamed plastics for use in applications such as car and aircraft interiors, packaging, and beverages. The process is powered using excess energy from coal and renewable generation in China that would otherwise be discarded.

MARKET

C4X is focused on the production of ethylene carbonate for the lithium-ion battery market, which is valued at $2B, and is expanding globally due to the increasing demand for electric vehicles. The global market for ethylene glycol is valued at $1.2B and the foamed plastics market is valued at $4.5B.

SOLUTION AND ADVANTAGE

C4X's conversion process is simple, efficient, mature, economical, and requires much less energy than current processes. Their process captures CO_2 at 90% efficiency, and converts it into ethylene carbonate and ethylene glycol at a conversion rate greater than 90%. C4X is also able to uniquely extract and purify hydrogen, a key ingredient for their process, from industrial flue gas to a purity of 99.9% at half the cost of traditional water electrolysis systems.

BUSINESS MODEL

C4X is pursuing a combination of licensing and strategic corporate investment to scale and deploy their systems. In China, C4X has partnered with CONCH, the largest cement maker in China, as well as SinoChem, Huaneng Power, Jinhong Gas, Wanli Group. In Canada, C4X has partnered with Ford Motor Company of Canada, Walkerville Brewery, and others to produce automotive interior parts, ethylene carbonate for Li-Ion batteries, and ethylene glycol for polyester.

TEAM

C4X's 18-person core team has over 30 years of R&D and industrial experience in eight industrial fields, with technology commercialization expertise inside China, Canada and other parts in the world. They are associated with six universities in Canada and China, and have the support of four key Chinese national labs. The management team is led by an experienced group with a combined over 50 years in global real estate and construction development, corporate engineering R&D leadership, technical sales, logistics, and technology development in the bio and

Newlight demonstrating their technology in Huntington Beach, USA. December 2017

NEWLIGHT

AT A GLANCE

One-Liner:
Newlight converts greenhouse gases into biodegradable plastics

Location:
Huntington Beach, CA, USA

Vertical:
Greenhouse Gas-to-Bioplastic

Corporate Status:
Delaware C-Corporation

Funding Needs:
$10M

Funding Stage:
Series E

Customers:
IKEA, Dell, Hewlett-Packard

Tech Stage:
Early Commercial

XPRIZE Test Site:
Alberta Carbon Conversion Tecnology Centre

Contact:
Mark Herrema, Founder and CEO,
mdh@newlight.com

OVERVIEW

Newlight converts greenhouse gases into a high-performance biodegradable plastic material called AirCarbon, a material that is estimated to have the ability to out-compete various fossil-fuel based plastics on price and sustainability. The company is commercializing its product with brand-name customers and supply agreements, including agreements amounting to 74 billion pounds of AirCarbon over the next 20 years.

MARKET

Fossil fuel-based plastics face increasing public backlash due to carbon intensity and ocean plastic pollution. The market for a cost-effective, high-performance, biodegradable, sustainable plastic material within the 900 billion pound global plastics market is vast and growing rapidly.

SOLUTION AND ADVANTAGE

Newlight converts greenhouse gas into bioplastic materials that are cost-competitive, biodegradable, high performance, and can be carbon-negative if made with renewable power.

BUSINESS MODEL

Since scale-up in 2013, Newlight has contracted over 74 billion pounds of direct supply or licensed production.

TEAM

Newlight was founded in 2003 and the team currently consists of over 50 full-time team members. Newlight has been honored to receive a number of industry awards, including Innovation of the Year from Popular Science and Technology Pioneer from the World Economic Forum.

Air Co. at their new distillery in Brooklyn, USA. October 2019

AIR CO.

AT A GLANCE

One-Liner:
Air Co. is the world's most sustainable alcohol company, transforming atmospheric CO_2 into ultra-high purity ethanol, all renewably powered.

Location:
New York, NY, USA

Vertical:
CO_2-to-Alcohol(s)

Corporate Status:
Delaware C Corp

Funding Needs:
$10 Million

Funding Stage:
Series A

Customers:
Spirit consumers and companies, Fragrance and cosmetics companies, flavoring providers, fine chemical companies, pharmaceutical and solvent manufacturers.

Tech Stage:
Commercial Pilot

XPRIZE Test Site:
Alberta Carbon Conversion Technology Centre

Contact:
Stafford Sheehan, CTO
staff@aircompany.com
Gregory Constantine, CEO,
greg@aircompany.com

OVERVIEW

Air Co. has developed ground-breaking, proprietary technology to transform carbon dioxide into the highest quality, most sustainable alcohol on the planet. With core inputs of only of carbon dioxide, water and renewable electricity, our production method actively helps combat climate change by removing the most abundant greenhouse gas from our planet (CO_2) and turning it into ultra-high purity ethanol, with oxygen as the sole byproduct. We are targeting consumer products with our ultra-high purity ethanol in the near-term, and in the long-term plan to tackle commodity markets and fuels.

MARKET

Our total addressable market in the near-term is $290B, the total revenue from consumer ethanol products. Our end user and target market for our products in the near term are millennials aged 21-40 who are concerned for the environment and want to do something to help. We enable our target market to do something good for the world by providing products that contain the same consumer alcohols in spirits, fragrances, cleaners, medicines, and other products that use ethanol, but produced in a more climate-friendly manner.

SOLUTION AND ADVANTAGE

Our technology uses only air, water, and sunlight as inputs. Solar panels power our patented electrochemical reactor, which is our technological advantage over incumbent technologies. This system breaks apart captured carbon dioxide along with water over our proprietary catalysts, and reforms them to produce alcohol, with pure oxygen as the only byproduct. This process has net negative carbon emissions, removing one pound of carbon dioxide from the atmosphere per kilogram of alcohol produced in a complete lifecycle analysis. The more alcohol we create, the more CO_2 we remove from the atmosphere, actively helping prevent climate change.

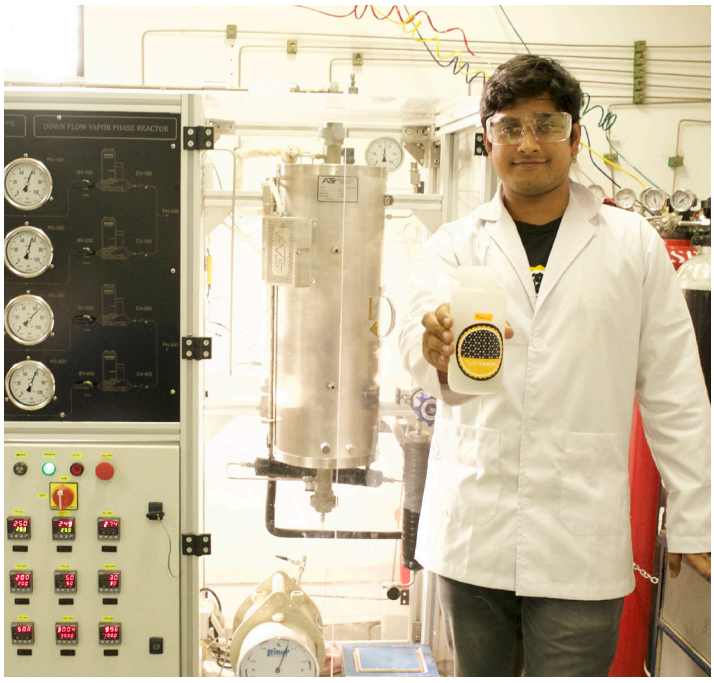
BUSINESS MODEL

B2C: Air Co. will be releasing consumer products in every industry vertical that utilizes high purity alcohols such spirits, fragrances, cosmetics and household cleaning. Our first product is a carbon negative, ultra-premium sipping vodka, launched on Nov. 7, 2019.

B2B: In addition to releasing consumer products, Air Co. is in production of a larger-volume facility for commodity and fuel markets, for which we will employ a licensing model of our technology.

TEAM

Our team was founded by Dr. Stafford Sheehan and Gregory Constantine, who met on the Forbes 30 under 30 list in 2017. Stafford oversees production of Air Co.'s products as Chief Technology Officer and developed the technology that converts carbon dioxide into alcohols. Gregory, a former marketing executive at Diageo, serves as the company's Chief Executive Officer and oversees all business & marketing efforts. Our main office is in Brooklyn, New York where we have created two production spaces; one 2500 sq. ft. plant that houses our pilot CO_2 conversion reactor, and a second 5,000 sq. ft. commercial demonstration facility.



Breathe demonstrating their technology in Bangalore, India. December 2017

BREATHE

AT A GLANCE

One-Liner:
Breathe converts CO_2 into high purity methanol and carbon monoxide

Location:
Bangalore, India

Vertical:
CO_2-to-Chemicals

Corporate Status:
Incorporated in India, 2016

Funding Needs:
$2M

Funding Stage:
Late Seed/Series A

Customers:
Carbon monoxide and methanol customers

Tech Stage:
Lab Pilot

XPRIZE Test Site:
Wyoming Integrated Test Center

Contact:
Dr. Sebastian Peter, Founder,
sebastiancp@gmail.com

OVERVIEW

Breathe Applied Sciences specializes in design and use of novel catalysts for converting CO_2 into high-purity methanol and carbon monoxide, which have a wide range of industrial, manufacturing, and chemical applications.

MARKET

Methanol, which in many countries is blended with gasoline to reduce emissions, presents a $37B worldwide market and $1B in India. Carbon monoxide represents a $380M market. Both chemicals are carbon intensive and expensive to produce. There is currently no commercial-scale, cost-competitive solution to produce these chemicals utilizing waste CO_2. Only 20% of India's growing methanol demand is met using local supply.

SOLUTION AND ADVANTAGE

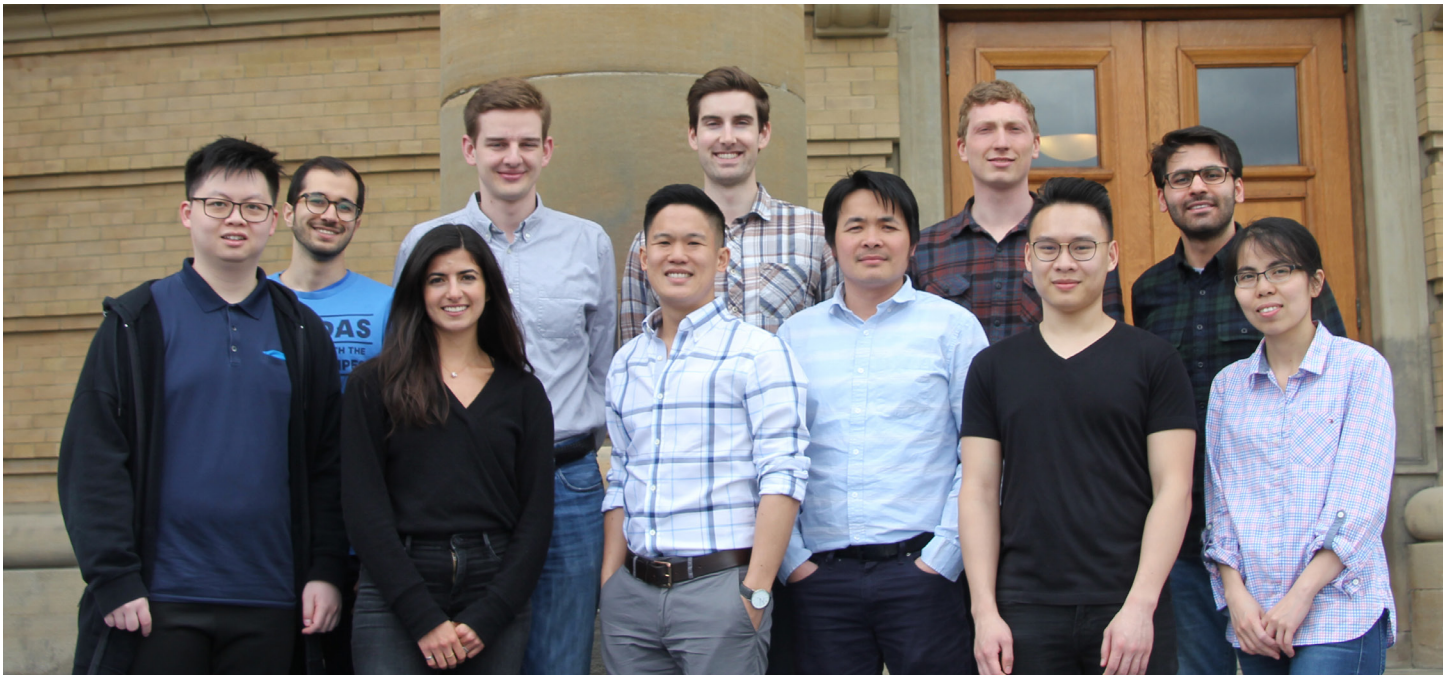
Breathe's reactors pass CO_2 and hydrogen across a range of copper, zinc, aluminium and iron-based catalysts to speed up a variant of the Fischer-Tropsch process, as used in the international space station. Novel and efficient uses of catalysts are Breathe's primary innovation and competitive advantage, which is in the process of being patented. At scale their end-to-end solution in India is projected to reduce methanol production costs by 25%, and carbon monoxide production costs by 50% relative to current industry standards.

BUSINESS MODEL

Breathe's model relies on licensing as a primary source of revenue. Subsidies are not required to make this technology profitable. Their current customers and partners include Tata, Novomer, and Bhuruka gases. Breathe is also targeting domestic methanol production in India.

TEAM

The team is led by Dr. Sebastian Peter, recipient of the Material Research Society of India medal in 2016, and selected as a young research investigator by the American Chemical Society (2014), Royal Society of Chemistry (2016) and Institute of Physics (2016). His team is comprised of scientists and engineers with significant domain and business expertise, backed by the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) in Bangalore, which is well known for material science research.



CERT demonstrating their technology in Toronto, Canada. December 2017

CERT

AT A GLANCE

One-Liner:
CERT converts CO_2 into chemical feedstocks and carbon-based fuels

Location:
Toronto, ON, Canada

Vertical:
CO_2-to-Chemicals

Corporate Status:
Incorporation and technology transfer in process

Funding Needs:
CAD 3.3M ($2.5M)

Funding Stage:
Late Seed/Series A

Customers:
Integrated oil & gas, petrochemicals, electricity generators

Tech Stage:
Lab Pilot

XPRIZE Test Site:
Alberta Carbon Conversion Technology Centre

Contact:
Dr. Alex Ip, Founder,
alex.ip@utoronto.ca

OVERVIEW

CERT has developed a modular system for the electrocatalytic conversion of CO_2 into chemical feedstocks and carbon-based fuels, using only water and electricity. CERT's unique process operates at room temperature and atmospheric pressure, which can dramatically reduce the complexity of the system. CERT will target drop-in applications in chemical processes as well as opportunities for seasonal energy storage of renewable electricity. The first target product will be ethylene, a major petrochemical feedstock.

MARKET

The petrochemicals market for ethylene, ethanol, carbon monoxide, and formic acid will be roughly $250B in 2020. The CO_2-derived fuels market is also expected to reach $250B by 2030. Demand for chemical feedstocks and fuels, particularly those that are sustainably sourced, is growing rapidly as a growing global population demands higher standards of living. While there have been significant advances in renewable electricity generation, current solutions to their intermittency, such as batteries, do not generally provide long-term energy storage.

SOLUTION AND ADVANTAGE

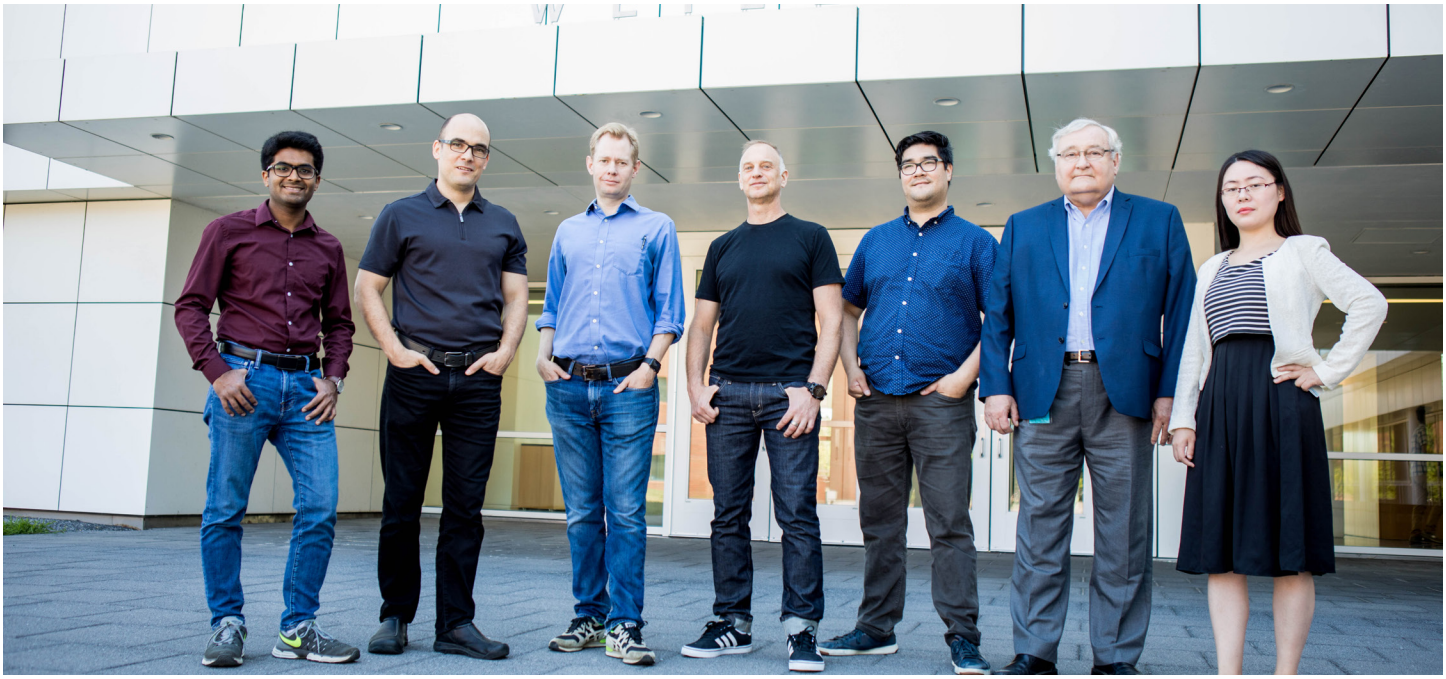
CERT's system uses proprietary catalyst formulations to enable highly efficient, selective, and stable carbon-negative synthesis. They reduce the need for expensive separation processes, since CO_2 contains fewer impurities and generates fewer byproducts than conventional naphtha or natural gas feedstocks. In addition, CERT's modular solution can provide large-scale, long-term energy storage in fuels such as ethanol or methane that can be transported using existing infrastructure.

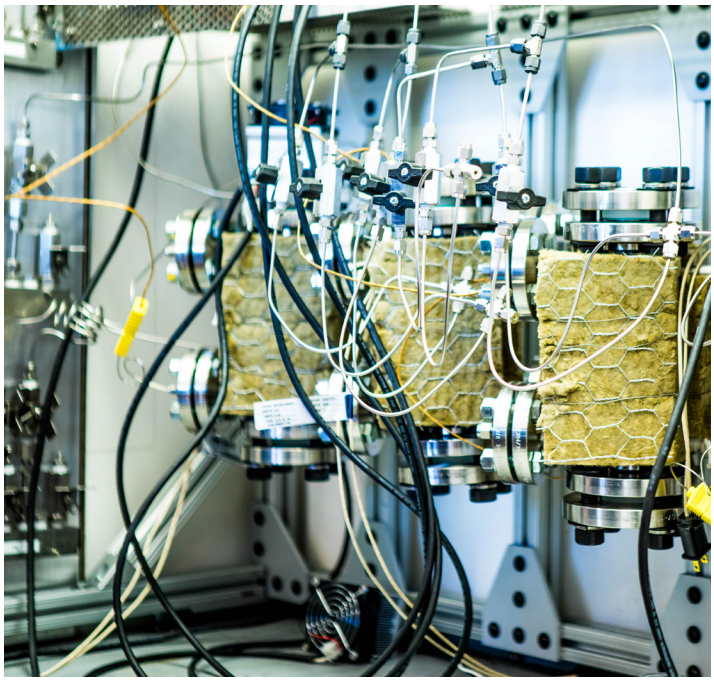
BUSINESS MODEL

CERT will work with strategic partners in petrochemical manufacturing to integrate their technology into existing operations. On-site emissions will be converted into ethylene that can be added to the partner's existing supply chain, resulting in reduced carbon-intensity of the final product. Longer term, CERT will work with a broad spectrum of large emitters to generate new revenue streams by selling low-carbon chemical feedstocks and fuels to other users.

TEAM

The CERT team consists of experts in catalyst design and electrochemical systems engineering, based on technology developed by two University of Toronto Professors, Ted Sargent and Dave Sinton, both Canada Research Chairs. They have previously scaled up tech companies, including Interface Fluidics and InVisage. Dr. Alex Ip and Dr. Christine Gabardo are leading the XPRIZE partnerships and technology development efforts for CERT.





Dimensional Energy demonstrating their technology in Ithaca, USA. December 2017

DIMENSIONAL ENERGY

AT A GLANCE

One-Liner:
Dimensional Energy has developed a solution for harnessing sunlight and transforming CO_2 from waste into fuels that power our economy.

Location:
Ithaca, NY, USA

Vertical:
CO_2-to-Chemicals

Corporate Status:
Delaware C Corp

Funding Needs:
$1 Million

Funding Stage:
Seed

Customers:
Chemical and Fuel Manufacturing

Tech Stage:
Pilot

XPRIZE Test Site:
Wyoming Integrated Test Center

Contact:
Jason Salfi, CEO
jason@dimensionalenergy.net

OVERVIEW

Dimensional Energy is currently scaling their HI-Light™ technology, a modular photocatalytic reactor platform that produces environmentally responsible feedstocks for industrial partners. The scalable reactor platform, a novel variant on the shell and tube reactor, combines advanced optics for homogeneous light distribution with optimized photocatalysts. This high throughput reactor platform optimizes the interplay of reactants, catalysts, and sunlight for maximum conversion. To accelerate the development of light-driven reduction of CO_2, Dimensional Energy is deploying a demonstration reactor for the Carbon XPRIZE finals to prove the concept of light driven syngas production.

MARKET

Dimensional Energy is addressing the global syngas market. Syngas capacity is approximately 115 MWth growing at 9% CAGR. Each year, several billion dollars in capital is deployed for large scale syngas plants upstream from feedstock demand. Dimensional Energy has identified several opportunities that are a good fit for the modularity and cost-effectiveness of our platform for producing syngas upstream from on-site demand for fertilizer and liquid fuel production. Immediate go-to-market plan is to address the $400 mm market for delivered carbon monoxide.

SOLUTION AND ADVANTAGE

Dimensional Energy's HI-Light reactor is powered by direct sunlight. The platform can be designed to run free from grid power where capacity is not available. The HI-Light platform utilizes the full solar spectrum, directing captured photons to drive catalysis and excess thermal energy for upstream and downstream product separation and process heat. The low temperature outputs require no additional cooling, reducing the need for costly output heat management by the customer.

BUSINESS MODEL

Dimensional Energy will license our HI-Light technology to those seeking to produce renewable products from CO_2. We intend to manufacture the most precise components of the system—reactors, catalysts, and optics and ship internationally.

TEAM

The Dimensional Energy team consists of Jason Salfi, CEO with expertise in bringing novel technologies to market and sustainable manufacturing; Brad Brennan, Director of R&D with expertise in photo-driven technologies, electrochemistry, and CO_2 catalysis; Brian Bowman, a mechanical engineer with expertise in reactor design build and instrumentation; Mihir Gada with expertise in chemical and process engineering modeling; and Marcelo Motto with expertise in process optimization. HI-Light combines technology developed at the labs of Dr. Tobias Hanrath and Dr. David Erickson at Cornell University.

CarbonCure demonstrating their technology in Atlanta, USA. October 2017

CARBONCURE

AT A GLANCE

One-Liner:
CarbonCure provides commercial CO_2 utilization technologies for more sustainable and economic concrete production

Location:
Halifax, Nova Scotia, Canada

Vertical:
CO_2-to-Concrete

Corporate Status:
Incorporated in Canada (HQ) and USA

Funding Needs:
None, but seeking innovation and scaling strategic partnerships with corporates and governments

Funding Stage:
Series D (closed May 2018)

Customers:
Ready mix, precast and masonry concrete producers

Tech Stage:
Growth

XPRIZE Test Site:
Alberta Carbon Conversion Technology Centre

Contact:
Jennifer Wagner, EVP Corporate Development,
jwagner@carboncure.com

OVERVIEW

CarbonCure Technologies is the global leader in CO_2 utilization technologies for the world's most abundant man-made material: concrete. The retrofit CarbonCure Technology chemically mineralizes waste CO_2 during production to make greener and stronger concrete. Every day, thousands of cubic yards of concrete made with mineralized CO_2 are delivered to job sites across the globe. CarbonCure enables concrete producers to achieve improved profit margins, gain a competitive sales advantages in the green building market, and reduce the carbon footprint of the built environment.

MARKET

The concrete market is dominated by the $530 billion ready-mix concrete segment, but CarbonCure is uniquely positioned as the only solution compatible with all cement and concrete product segments. The concrete industry emits 7% of global CO_2, emissions; however the global cement industry has set ambitious goals to reduce its emission intensity by 24% by 2050, and needs a pathway to do so.

SOLUTION AND ADVANTAGE

CarbonCure Technologies can help the industry meet those goals while creating concrete material performance improvements, manufacturing cost efficiencies and water-use reduction. Their simple retrofit process uses existing production equipment and Portland cement chemistry to produce, in situ, a nano-sized mineral carbonate embedded within the concrete, all without impacting normal plant operations or supply chains.

BUSINESS MODEL

CarbonCure employs a licensing model with fixed monthly recurring payments and no upfront capital costs. The production efficiencies derived from using the technology exceed both monthly licensing fees and CO_2 supply costs, providing producers with an attractive opportunity to strengthen their bottom line without any capital investment. Moreover, each installed system is tethered to a central network to ensure compliance and monitor performance for optimal value creation.

TEAM

CarbonCure Technologies was founded in 2007 by CEO Rob Niven who recognized concrete's potential to mitigate global carbon emissions. As of 2018, the CarbonCure team consists of 20 full-time members including Jennifer Wagner, Executive Vice President of Corporate Development, who leads the CarbonCure XPRIZE team. CarbonCure has been recognized as a 4-time recipient of the Cleantech Group Global 100 Company, and is a recipient of the Ernest C. Manning Innovation Award. CarbonCure's extended advisory team and board of directors include world-renowned concrete academics, concrete industry veterans and globally recognized clean technology investors.

Carbon Capture Machine demonstrating their technology in Aberdeen, Scotland. December 2017

CARBON CAPTURE MACHINE

AT A GLANCE

One-Liner:
We transform carbon dioxide from a polluting waste to a potentially valuable resource by forming stable solid mineral products containing high concentrations of CO_2 (20-45%), for use in construction materials, plastic and paper fillers, nutritional supplements, and cement replacement admixtures.

Location:
Aberdeen, Scotland

Verticals:
CO_2-to-Carbonates,
CO_2-to-Construction-Materials

Corporate Status:
Incorporated in UK, considering USA

Funding Needs:
$2.5M

Funding Stage:
Series A

Customers:
Paper, plastics, pharma, & construction industries

Tech Stage:
Lab Pilot

XPRIZE Test Site:
Wyoming Integrated Test Center

Contact:
Dr. Zoe Morrison,
Founding Director & COO
z.morrison@ccmuk.com

OVERVIEW

CCM's proprietary mineralization process selectively removes CO_2 from combustion gases, using only mild conditioning, by scrubbing into a dilute solution of sodium hydroxide. The resulting solution is interfaced with brine containing calcium or magnesium, or both, to give phase-pure products with properties optimized for the specific application. The process is safe and the equipment is relatively simple, with low capital costs and modest operating costs. The products score highly in environmental audits because they are made from captured carbon dioxide and displace other products with large carbon footprints.

MARKET

CCM products have two distinct markets. One where product specifications are already known, such as paper making. We supply competitive products with a much lower carbon footprint than the conventional product. The other is for new products, such as lightweight, fireproof building insulation to replace flammable foamed polymeric materials, or an active calcium carbonate product intended to replace Portland cement in concrete.

SOLUTION AND ADVANTAGE

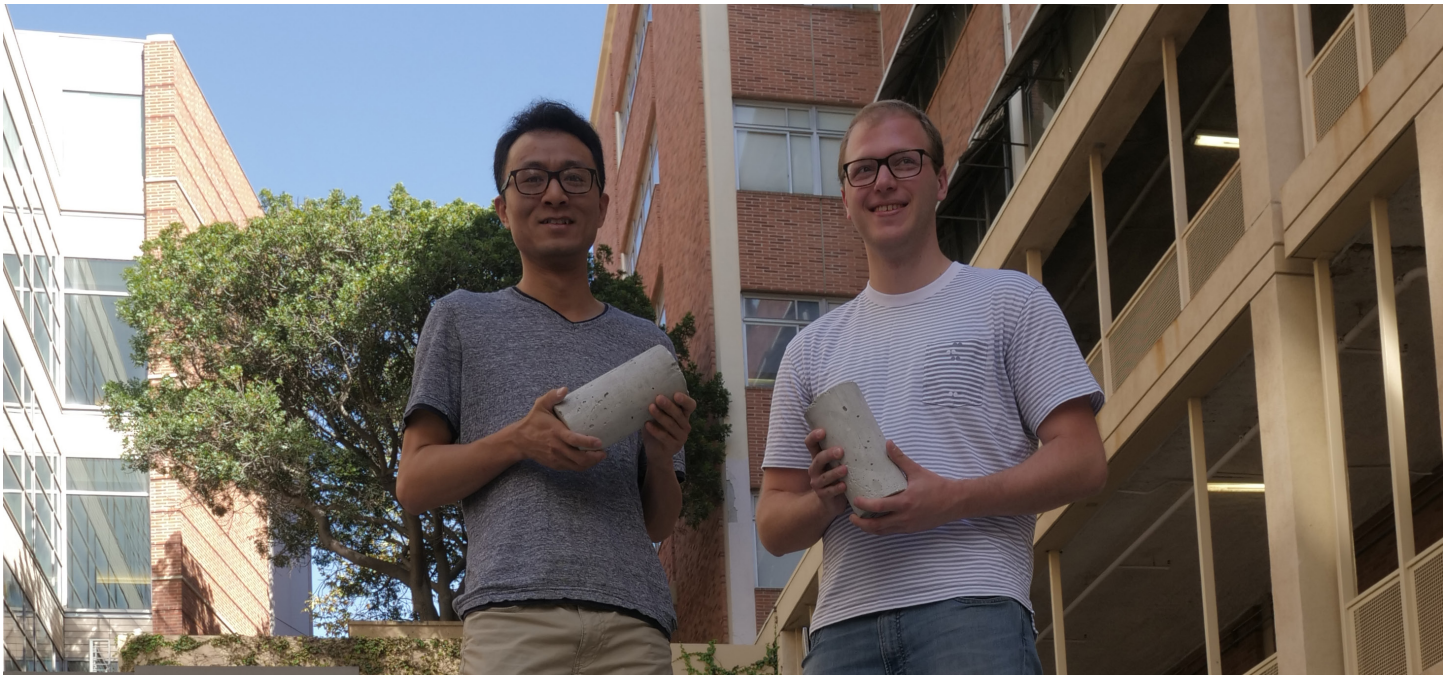
CCM offers a flexible, low-cost method of capturing CO_2 and converting it to useful products, the sale of which will more than pay for capital and running costs. The process is suitable for both new and retrofit applications and can cope with gas streams containing 4% to 100% CO_2. The process does not use elevated temperature or pressure or require solvents other than water. The products are safe, long-lived solid mineral carbonates suitable for existing application and with potential to develop new products with annual sales in the megaton/yr range.

BUSINESS MODEL

During the formative stage, CCM will design, build, and operate capture machines, with an intention to develop partnerships to provide a comprehensive service of design, permitting, installation, and servicing of capture machines and the development and marketing of products. The intention is to operate globally with franchises on a geographic basis. CCM will protect its IP through patenting and development of know-how.

TEAM

The team is led by acting CEO Dr Zoe Morrison and Chairman Professor Fred Glasser.



CO_2CONCRETE demonstrating their technology in Los Angeles, USA. October 2017

CO_2CONCRETE

AT A GLANCE

One-Liner:
CO_2Concrete captures CO_2 in scalable, drop-in construction materials and products

Location:
Los Angeles, CA, USA

Vertical:
CO_2-to-Concrete

Corporate Status:
Incorporated in USA

Funding Needs:
Funding for XPRIZE Finals Closed

Funding Stage:
Series A

Customers:
Construction sector
(Cement and Concrete),
Power Sector
(Coal and Natural gas)

Tech Stage:
Pilot

XPRIZE Test Site:
Wyoming Integrated Test Center

Contact:
Dr. Gaurav Sant, Founder,
gsant@ucla.edu

OVERVIEW

CO_2Concrete (formerly Carbon Upcycling UCLA) uses a breakthrough technology to create CO_2Concrete™ – strong, prefabricated components that directly substitute for standard concrete, but with a CO_2 footprint that is up to 75% smaller. The technology offers unprecedented energy efficiency and scalability, as it uses flue gas CO_2 directly without a carbon capture system and unlocks the potential to use abundant and cheap fly ashes as feedstocks. The core technology lies in the unique knowledge that combines the design of material formulation and processing routes to efficiently and rapidly take up CO_2 while producing products with

MARKET

CO_2Concrete is initially targeting precast concrete and concrete masonry markets, each of which are around $100 billion globally, and are themselves segments of the larger $900 billion global concrete market. Concrete production is responsible for 7-9% of the world's annual CO_2 emissions, and the industry is facing increasing pressure from customers and regulators to reduce them. The team will initially target concrete masonry products, before expanding production into precast concrete components.

SOLUTION AND ADVANTAGE

CO_2Concrete's process locks flue gas CO_2 into limestone within CO_2Concrete™. The process requires minimal CAPEX, since it features simple "stack-tap" integration with limited site utility tie-ins, does not require a carbon capture system, and readily integrates into existing construction supply chains and workflows. Additionally, CO_2Concrete™ mixtures can incorporate low-value fly ashes, including those reclaimed from landfills and ponds, while providing engineering performance equivalent to typical concrete. The low cost of CO_2Concrete™ is a significant advantage in the low margin concrete business.

BUSINESS MODEL

The team will license its technology to emissions-intensive sectors as a profitable method to convert flue gas CO_2 into saleable concrete products. Licensees benefit by securing carbon credits in eligible markets; meeting governmental, social, and corporate pressures to reduce CO_2; and marketing the CO_2-based products as a low-carbon alternative to existing materials. CO_2Concrete™ also presents a unique ability to turn a supply cost (fly ash) into revenue, by unlocking tipping fees for utilizing off-spec coal combustion residuals / fly ashes.

TEAM

The team combines deep technical skills with strong commercialization experience and has assembled an advisory board of leading industry experts. Dr. Gaurav N. Sant is the Founder and CEO, as well as Professor and Henry Samueli Fellow of Civil and Environmental Engineering at UCLA. Dr. Gabriel Falzone and Dr. Iman Mehdipour round out the engineering team. Stephen Raab covers operations and business development, with extensive experience in the coal power sector, and environmental compliance and regulations.

800 Corporate Pointe Drive, Suite 350 | Culver City, CA 90230 | **carbon.xprize.org**