NON-CONFIDENTIAL FINAL REPORT

CCEMC GRAND CHALLENGE ROUND ONE

CCEMC PROJECT ID:

K130111

TITLE OF PROJECT:

Carbon Capture and Mineralogic Sequestration - Addressing the World Wide Epidemic on a World Wide Scale

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31 May 2016

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31 May 2016

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2. EXECUTIVE SUMMARY

Blue Planet, Ltd. (Blue Planet) has developed technology to capture, permanently sequester, and economically utilize carbon dioxide (CO_2) emissions from power plants, cement plants, steel plants and other stationary sources. The cost effective and highly scalable technology platform permanently converts CO_2 to carbonate mineral products that are sold at a massive global scale. The products potentially include all of the ingredients of concrete, the world's largest selling commodity, thereby transforming it from a GHG-producing material into a carbon neutral and even carbon negative material. The Blue Planet carbon capture and utilization technology is a realistic alternative to conventional carbon capture and storage (CCS) technologies that use gas-separation to produce pure CO_2 for liquefaction, compression and transport, to ultimately be pumped underground at geological storage sites or at enhanced oil recovery sites. The Blue Planet technology instead permanently sequesters CO_2 in its building products, doing so at a lower cost and at a lower energy, all while creating useable materials for which there is enormous global demand.

Formed in 2012, Blue Planet has an extensive intellectual property portfolio dating to 2002 and the company has been proving the efficacy of its technology in a 15,000 square foot facility since 2013. The facility includes over 4,000 square feet of dedicated lab space where bench and pilot scale carbon capture and mineralization processes have been validated, including the third-party validation of products from the process.

3. PROJECT DESCRIPTION

This section describes the project as it was presented to the CCEMC in the initial full project proposal stage and incorporates any changes from the original agreement through to the amended agreement #2. Key outcomes and learnings, overall conclusions, scientific achievements and next steps of the project are summarized in sections 4, 6, 7 and 8, respectively.

➢ *Introduction and background*

With the CCEMC Grand Challenge Round 1 Award, Blue Planet's objectives were to (i) develop its technology platform, (ii) verify the GHG reduction potential of the technology and (iii) deploy a pilot skid unit at an emitter located in Alberta. The Blue Planet technology converts CO_2 into usable products through the permanent sequestration and utilization of CO_2 into high-value green building goods and road-based materials. These include cement and aggregate for concrete, and including pavement and high albedo roofing and highway materials. In a mobile systems configuration, the Blue Planet platform uses established water process membrane operations to combine inputs of various natural and wastewaters with CO_2 to produce solutions that are rich in bicarbonate (HCO_3^-) ion that, when combined with hard water, result in the direct mineralization of calcium carbonate ($CaCO_3$). This is represented in the process flow diagram in Figure 1.

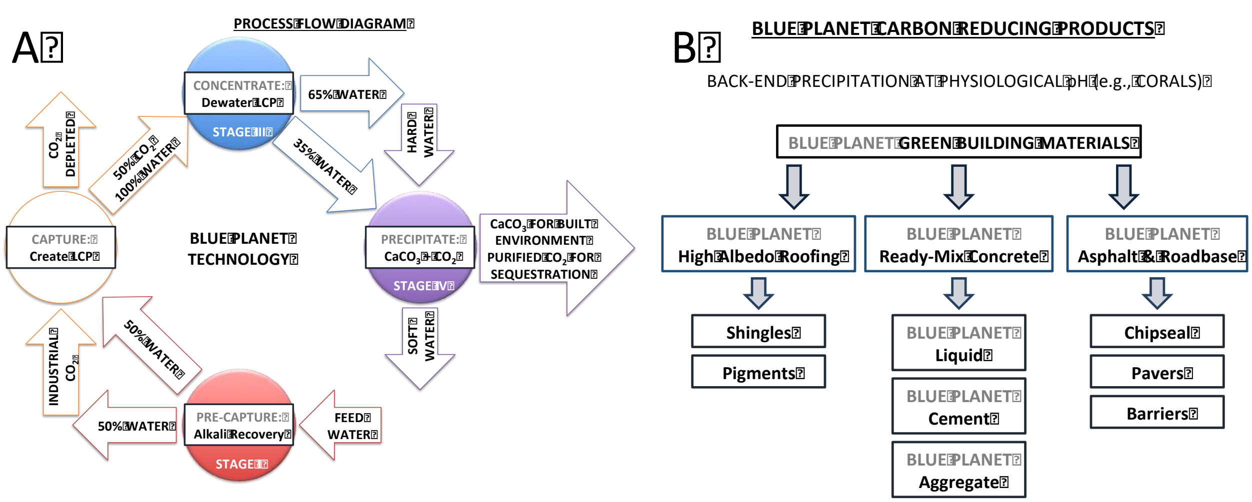

Fig. 1 (**A**) Process flow diagram for the proposed four-stage carbon capture and mineralization process. (**B**) Products of the process in (**A**), stemming from synthetic carbonate precipitation under physiological conditions.

The dissolved inorganic carbon-rich solutions are a gateway to the production of the aforementioned carbon-mitigating goods and materials to be used in the built environment. One of the end products is a novel liquid used in making ready-mix products for concrete. Trade named CarbonMix, the product family is based upon the revolutionary liquid that contains sequestered CO_2, in the form of a HCO_3^- ion microemulsion, a so-called liquid condensed phase or LCP, which is incorporated into the final concrete products as solid $CaCO_3$. One of the principal end products in the product family is CarbonMix $CaCO_3$ aggregate for concrete, roadbase, asphalt and roofing - a realistic product for sequestering gigaton quantities of global anthropogenic CO_2.

The goal of this Project was to have a mobile Blue Planet technology platform in operation, producing $CaCO_3$ aggregate for concrete at the site of an industrial emitter in Alberta. To achieve this goal, Blue Planet developed its technology platform, initially at laboratory scale and using commercial chemicals. The CarbonMix aggregate products were validated by their incorporation into cement, mortar and concrete formulations. Laboratory scale development was then expanded to produce materials using commercially available off-the-shelf technologies.

As CO_2 and water were the two major sources of input, Blue Planet scoped each component individually and in conjunction: (i) commercial gas sources with varying partial pressures of CO_2, to resemble industrial sources such as coal- and natural gas-fired power plants, cement plants and steel plants and (ii) water sources with chemical compositions similar to those in produced, industrial, natural, brine waters, produced waters, etc. Materials produced during these tasks were validated by their incorporation into formulated cement, mortar and concrete.

Using commercially available storage containers, Blue Planet investigated appropriate methods and shelf life of CarbonMix as it related to storage and transportation. With Alberta's extreme climate, it is critical to evaluate storage and transportation parameters, especially as they relate to temperature.

While the R&D progressed, Blue Planet engaged potential partners to discuss their interest, capacity, equipment, location, economics and logistical considerations for introducing $CaCO_3$ aggregate to the ready-mix concrete market in Alberta. One of Blue Planet's ideal scenarios is one where a partner manages a site that has cement and ready-mix plants co-located or locally close, the former as a CO_2 source and the latter as a market for the aggregate. Another ideal situation is co-located steam generation with oil sand extraction, where Blue Planet has process inputs of both CO_2 and abundant industrial produced waters. This involved negotiating agreement(s) with partner(s) to demonstrate Blue Planet's technology, as well as obtaining the required permits for work to be completed in Alberta. Blue Planet had budgeted for at least one representative of the team to travel to Alberta to meet with partners and CCEMC project manager twice per year.

In order to prepare for deployment in Alberta, Blue Planet purchased equipment to fabricate skid components capable of demonstrating its technology at pilot scale. This is a critical milestone of the Project. The deployment of the Blue Planet technology at an emitter site in Alberta was to be via mobile skid. It is useful to know that the industries that make up the components of the proposed technology are well-established and therefore low risk when scaling from laboratory to pilot to commercial scale demonstration.

Prior to deployment in Alberta, Blue Planet worked with third-party firms to verify the carbon life-cycle of the CarbonMix $CaCO_3$ aggregate product of the process. Through these third-party verifications, and with the guidance of its various Board Advisors, Blue Planet established its own rating system for concrete called CarbonStar. The rating allows for a simple life-cycle comparison of the materials, namely water, cement and aggregate, used in conventional ready-mix concrete formulations. The CarbonStar rating guided Blue Planet's every day market assessment of the aggregate to be sold in Alberta and globally.

- *Technology description*

The fundamentals behind the CO_2 sequestration features of the Blue Planet process are based on the findings made by one of the company's founding scientists. First reported and presented to the field in 2012, at the 159th Faraday Discussion on Crystallization - A Biological Perspective, the discovery of the existence of LCP emulsions in aqueous solutions containing bicarbonate ion is a paradigm shift in our understanding of the carbonate mineralization process. The studies demonstrated that, in the absence of additives, and at near neutral pH (emulating the conditions of biomineralization and biomimetic model systems), condensed phases of liquid-like emulsions form at a critical concentration. The addition of certain proprietary additives help to kinetically stabilize the LCP in a distinct and pronounced fashion.

Previous concrete generation technologies use high-energy sources of alkalinity, like electrochemically-produced hydroxide, to capture and drive CO_2 gas all the way to carbonate ion, which then reacts to form solid carbonate material. The parasitic load for the formation of hydroxide is too high to be commercially economical. Blue Planet uses its proprietary membrane-based alkaline separation system goes about this in a different way, by removing protons, i.e., acid, from the system rather than by generating hydroxide for the system. By comparison, the second-generation Blue Planet technology, through the practical application and the efficient use of membranes (as in nature), is what fundamentally differentiates the proposed technology from that of previous generations.

A second-generation technology, the carbon capture and utilization (CCU) platform developed by scientists at Blue Planet offers a unique means of permanently sequestering and utilizing CO_2 in high-value green building products and highway materials. The new system represents four scientific breakthroughs in the commercialization of CCU and makes use of off-the-shelf water process membrane technologies. Combining two types of wastewater with raw flue gas containing CO_2, the process produces solutions that are rich in bicarbonate (HCO_3^-) ions, that, when mixed with an input of hard water or produced hard waters, results in the sequestration of one CO_2 molecule as solid calcium carbonate mineral products ($CaCO_3$) for every two CO_2 molecules from the flue stream. In addition to capturing CO_2 from raw flue gas, the Blue Planet process can capture other emissions, such as mercury and particulate matter. This aspect of the technology can either achieve additional emissions reductions from facilities with controls in place or replace other air pollution control devices at a newly built plant.

In most locations, the process can be optimized to adapt to the local source of wastewater and the constituents thereof. While no potable water is required for the process, available wastewater can be treated existing water-processing technologies to generate the water needed for the alkali recovery step, which creates the CO_2 capture solution. The primary energy demand is for the pumping of the water, since it can be used at ambient temperature and close to ambient pressure.

- *Project goals*

The original Project goal was to have a modular Blue Planet pilot unit in operation at the site of an industrial emitter in Alberta. This goal remained unchanged throughout the course of the project. The scope to get to that goal, however, did change slightly. Initially the operating technology platform was to produce CarbonMix liquid for use in ready-mix concrete. Instead it was decided to feed the CarbonMix liquid into the back-end of the process to produce solid $CaCO_3$ coatings on a substrate material. The CarbonMix $CaCO_3$-coated substrate was then used as the aggregate component, replacing conventional aggregate, in ready-mix concrete.

Progressions made throughout the course of the project helped us to determine that solid CarbonMix $CaCO_3$-coated aggregate for use in concrete has a significantly greater impact on sequestering CO_2 than does the CarbonMix liquid alone. Ultimately this positively impacts the overall Project goal as well as the GHG benefits to the end market user, primarily the construction industry.

- *Work scope overview*

Table 1 provides an overview of the project work plan, including tasks, milestones and deliverables.

Table 1. Project work plan.

TASK 1 – ADMINISTRATION
1.1 Attend kick-off meeting or conference call
1.2 Quarterly progress reports
1.3 Identify and obtain required permits
1.4 Final report
1.5 Final meeting or conference call
TASK 1 Deliverables: Progress reports, final reports, permits
TASK 2 - DEVELOP LCP TECHNOLOGY PLATFORM
2.1 At laboratory scale, use commercial chemicals to optimize CarbonMix
2.2 At laboratory scale, develop LCP technology platform to create CarbonMix
2.3 At laboratory scale, develop LCP technology coating process
2.4 Optimize LCP technology
2.5 Upgrade equipment to develop LCP technology on larger scale
2.6 Contact potential demonstration partners in Alberta
TASK 2 Deliverables: CarbonMix product reports, evidence of CO_2 capture, evidence of $CaCO_3$ coating process for CO_2 sequestration, updated equipment description, summary of demonstration sites, project partner letter(s) of support

TASK 3 - VERIFY GHG REDUCTION
3.1 Verify the amount of CO_2 sequestered into end product(s)
TASK 3 Deliverables: Carbon life-cycle analysis from third-party firm
TASK 4 - DEPLOYMENT IN ALBERTA
4.1 Upgrade skid to mobile deployment in Alberta
4.2 Secure a CO_2 emitter to demonstrate technology in Alberta
4.3 Obtain a professional market assessment
4.4 Bring CarbonMix for concrete to commercialization readiness stage in Alberta
TASK 4 Deliverables: Equipment installation summary, partner site agreement, market study of aggregate for concrete, field study results

4. OUTCOMES & LEARNINGS

This section is a summary of the progress of the Round 1 project by task, including the explanation of any variances from the original project plan.

TASK 1 - ADMINISTRATION STATUS: **COMPLETE**

1.1. Attend Kick-off Meeting or Conference Call (Subtask Completed)

Communication and procedures for the project were established.

1.2. Quarterly Progress Reports (Subtask Completed)

An interim project report was submitted after the project was 50% complete; the interim, Q3 & Q4 reports are rolled up into this final report.

1.3. Identify and obtain required permits (Subtask Completed)

It was determined through discussions with potential demonstration partners in Alberta and elsewhere that a Blue Planet mobile demonstration unit would not require operating permits, e.g., air, waste disposal, water, etc., as the pilot-sized unit falls under existing permits held by emitter sites. However, looking ahead to Rounds 2 and 3 of the Grand Challenge, and keeping in mind the objective that is to demonstrate a clear path to 1 Mt net reduction of GHG emissions, the permitting requirements will be re-evaluated as necessary in the course of technology commercialization in Alberta.

1.4. Final report (Subtask Completed)

The final report, the final financial report and the technology transfer plan have been submitted to the project advisor and will also be submitted through the CCEMC Information Management System for final processing. The reports were submitted May 31, 2016 in order for the CCEMC to complete the final audit and for entry to Round 2, Phase 2 ahead of the July 26, 2016 full project proposal deadline.

1.5. Final meeting or conference call (Subtask Completed)

In addition to phone conversations with the project manager, the Blue Planet team met to discuss the project's success in achieving its goals, the preparation of the final report, and near-term milestones needed to successfully meet the Round 2 full project proposal submission deadline.

TASK 2 - DEVELOP LCP TECHNOLOGY PLATFORM STATUS: **COMPLETE**

2.1. At laboratory scale, use commercial chemicals to optimize CarbonMix (Subtask Completed)

Production of CarbonMix with synthetic solutions and commercial limestone aggregates was verified in the Blue Planet process, as was its validation as a water replacement product in mortar and in concrete.

One of the products of the Blue Planet technology platform is CarbonMix liquid, a liquid that has sequestered carbon (or CO_2) in it and can be used as a water replacement in mortar and concrete formulations to permanently sequester CO_2 in the built environment. For example, Figure 2 shows the analysis of the dissolved inorganic carbon (DIC) content in a CarbonMix liquid that was then used as a water replacement to make concrete. In terms of flow and compressive strength, the CarbonMix showed no detrimental effects to the concrete. What's more, the CarbonMix was roughly 0.36 weight percent CO_2 (wt% CO_2) and so there were 20 g CO_2 sequestered in the batch of concrete (5.3 kg CarbonMix liquid, 11.9 kg cement, 29.2 kg coarse aggregate and 21.2 kg fine aggregate = 67.6 kg concrete), from the CarbonMix alone (5.3 kg CarbonMix used in concrete testing batch)!

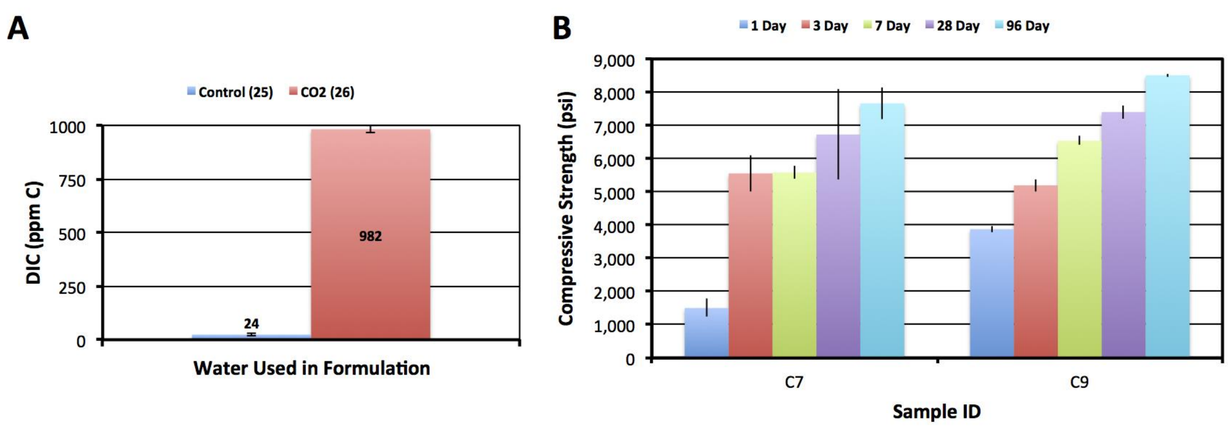

Fig. 2 (**A**) DIC content of a CarbonMix liquid. The "Control (25)" is the liquid prior to contact with CO_2 gas and the "CO2 (26)" is the liquid post contact with 100% CO_2 gas. DIC is reported in ppm C; 982 ppm C equates to roughly 0.36 wt% CO_2. (**B**) Compressive strength of concrete cylinders made with CarbonMix as the liquid component; C7 is the control liquid and C9 is concrete made with CarbonMix, "Control (25)" and "CO2 (26)" from (**A**), respectively.

The performance measurement for wt% CO_2 in CarbonMix was in the range of 0.1 to 10 wt% CO_2 and was optimized in the range of 0.7 to 1.8 wt%. Looking ahead, because the water component per m^3 concrete is typically less than 10 wt% itself, CarbonMix alone will not have a significant effect on the GHG baseline per m^3 concrete (roughly 360 kg CO_2 per m^3). Another way in which CarbonMix liquid may be used, however, is in formulations that replace high percentages of cement, the major contributing component to concrete's GHG life cycle. Figure 3 represents some of our efforts to address offsetting of CO_2 cement replacement. The data suggest that CarbonMix liquid can be used as a water replacement in mixes with lower cement content and still maintain desirable compressive strength.

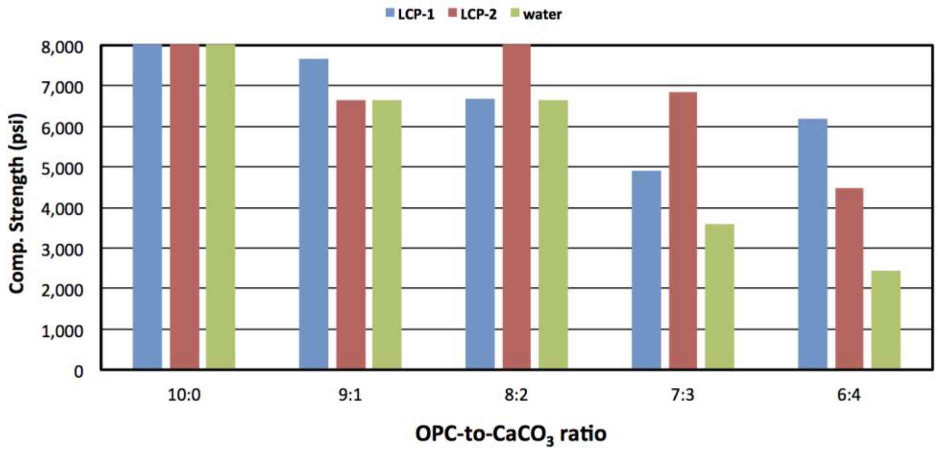

Fig. 3 Screening of cement pastes, where the cement (OPC) was replaced by limestone ($CaCO_3$), wetted with either water or CarbonMix liquid (LCP-1 and LCP-2) and left to cure in mini-cube molds. Compressive strength was determined with a penetrometer having 1/40 in^2 surface area; values are qualitative and intended for comparison within the study.

2.2. At laboratory scale, develop LCP technology platform to create CarbonMix (Subtask Completed)

Production of CarbonMix with lab, bench and multi-batch scale membrane systems was verified in the Blue Planet process, as was its validation as a water replacement product in mortar and in concrete.

The primary objective of this task was to produce CarbonMix liquid by an industrial process, namely using low-energy water processing (WP) technology. Whereas in Task 2.1 the CarbonMix liquids were made with commercial chemicals in a beaker, Task 2.2 used lab and pilot scale WP systems to reproduce synthetic CarbonMix liquids at higher volumes and in shorter time periods. Recall that the carbon-sequestering capacity of CarbonMix liquids is due the existence of so-called liquid condensed phase (LCP) droplets, a fundamental phenomenon that was discovered by one of Blue Planet's founding scientists and applies generally, across many disciplines, to liquids that contain bicarbonate ion (HCO_3^-). As it turns out, existing WP technologies promote the concentration of LCP droplets, and therefore CarbonMix liquid, all while using minimal energy. There are two parameters that we evaluated during WP system verification: (i) the isolation/separation of LCPs and (ii) the operating pressure of the system. Through our in-house verification protocols, we were able to identify two manufacturers of WP equipment suited to the LCP technology platform, both of which are promising candidates to scale the process with.

Performance measurement for wt% CO_2 in CarbonMix liquid was optimized in the range of roughly 0.7 to 1.8 wt% CO_2. We verified that CarbonMix liquid stored for up to two months at either room temperature or frozen retains both its carbon content and its performance as a water replacement in mortar mixes. These results are shown in Figure 4.

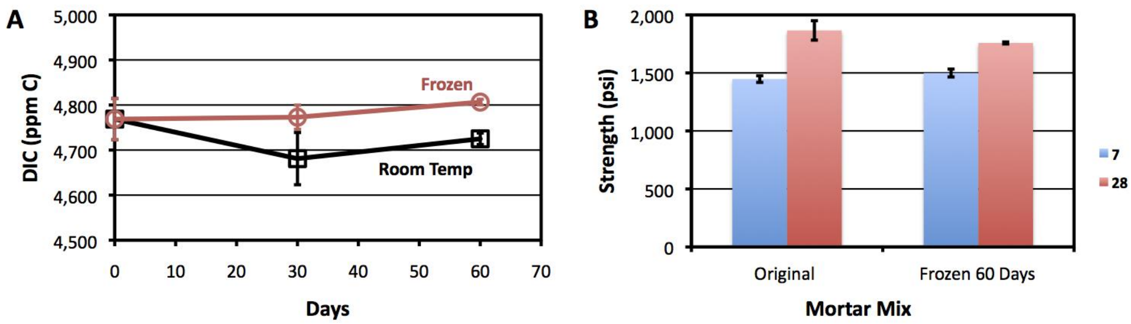

Fig. 4 Shelf-life validation of CarbonMix liquid, which was stored in high-density polyethylene bottles, separately, at both room temperature (22 °C) and in the freezer (-20 °C). (**A**) Analysis of the dissolved inorganic carbon (DIC), in ppm carbon, present in CarbonMix liquid stored at room temperature and stored frozen. (**B**) Compressive strength tests for mortar cubes made with CarbonMix liquid that was 1.8 wt% CO_2. Here, the cubes have a CarbonStar rating of 95 kg CO_2 per m^3 mortar, lower by 532 kg CO_2 compared to the baseline of 627 kg CO_2 per m^3 mortar.

By the end of this task, we were operating in both batch and multi-batch processes. CarbonMix liquid was used in a number of mortar and concrete formulations but ultimately, its production specification is geared toward direct mineralization of $CaCO_3$ in the presence of a hard water source.

2.3. At laboratory scale, develop LCP technology coating process (Subtask Completed)

Synthetic $CaCO_3$ coating process for CO_2 sequestration was verified as a component of the Blue Planet process.

Our efforts in Task 2.3 have led to a major technological breakthrough for the company's $CaCO_3$ aggregate products. Using CarbonMix liquid and hard water, our R&D team has developed a coating process for the direct mineralization of $CaCO_3$ onto various substrate materials. In short, the important discovery allows $CaCO_3$ aggregate to be produced and isolated at a price point that is at least an order of magnitude lower than conventional processes. To top it off, for every ton of $CaCO_3$ produce, there will be 0.44 tons of CO_2 sequestered in the built environment.

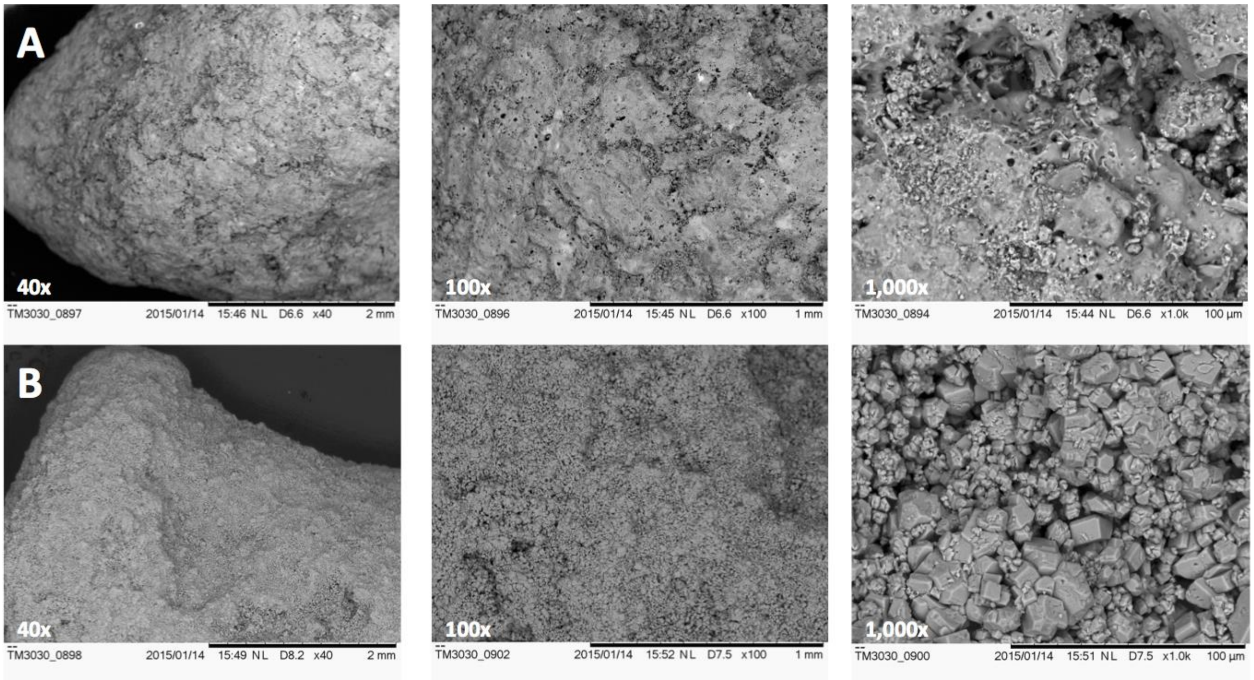

Fig. 5 Scanning electron microscopy (SEM) images of lightweight aggregate. (**A**) Images of the aggregate before coating with $CaCO_3$, at 40, 100 and 1,000x magnified. (**B**) Images of the aggregate after coating by direct mineralization of $CaCO_3$, at 40, 100 and 1,000x magnified.

In addition to the lightweight aggregate coatings in Figure 5, we also coated five different sands with $CaCO_3$ (Table 2), which were then used in mortar formulations in place of conventional sand/aggregate. The performance measurement for the sands of at least 20 wt% $CaCO_3$ was achieved, that is, every 1 mass unit of substrate input (sand) produces at least 1.2 mass units of substrate output ($CaCO_3$ coated sand). Some compressive strength data for the mortar cubes are shown in Table 2 and in Figure 6. It's important to note that the $CaCO_3$ aggregate does not have a detrimental effect on the compressive strength of the mortar. While in some instances, the compressive strength is lower for the sand replacement relative to the control, the strength is still higher than what is required for, e.g., bagged concrete, which needs to meet 3,500 psi after 28-days according to ASTM 387. In addition, chemical admixtures can always be added to a mix in order to obtain a desired compressive strength, and though the admixtures themselves have their own GHG footprint, it is miniscule relative to the effect of replacing large percentages of a concrete formulation with $CaCO_3$ aggregate. The key here is that the CO_2 is now permanently sequestered in the form of a valuable building material.

Table 2. 28-day compressive strength data for mortar cubes that used $CaCO_3$ aggregate, listed in the Sand Replacement column, in place of standard aggregate, listed in the Control column. Flows and compressive strength of mortars tested according to ASTMs C1437 and C109, respectively.

Type of Sand	Control (sample ID)	Sand Replacement (sample ID)
Sand Type I	6,134 psi (168)	3,914 psi (170)
Sand Type II	6,130 psi (169)	5,399 psi (172)
Sand Type III	5,641 psi (163)	3,664 psi (171), 5,270 psi (173)
Sand Type IV	3,946 psi (164)	4,311 psi (174)
Sand Type V	6,026 psi (166)	5,954 psi (175)

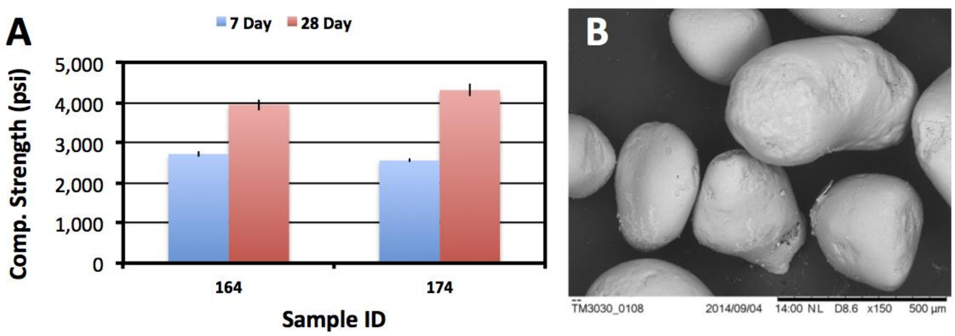

Fig. 6 (**A**) Compressive strength data for mortar cubes formulated with Sand Type IV in place of standard aggregate for mortar; Sample ID 164 is the control and Sample ID 174 is the sample made with $CaCO_3$ aggregate. (**B**) SEM image of aggregate substrate for coating.

2.4. Optimize LCP technology (Subtask Completed)

The components of the Blue Planet technology that make up the CO_2 gas absorption process and the solid $CaCO_3$ coating process were verified.

In conventional carbon capture technologies, the capture step uses an absorber tower to contact the flue gas with a liquid capture solution. Gaseous CO_2 preferentially dissolves in the capture solution, which is then sent to a stripper to remove pure CO_2 and regenerate the liquid capture solution. The capture step in the Blue Planet process differs in two ways: (i) gas and liquid are contacted through a commercial hollow fiber membrane contactor that maximizes surface area of contact and (ii) the output liquid from the membrane contactor, i.e. CarbonMix liquid, is consumed in the back-end of the process to produce solid $CaCO_3$ aggregate.

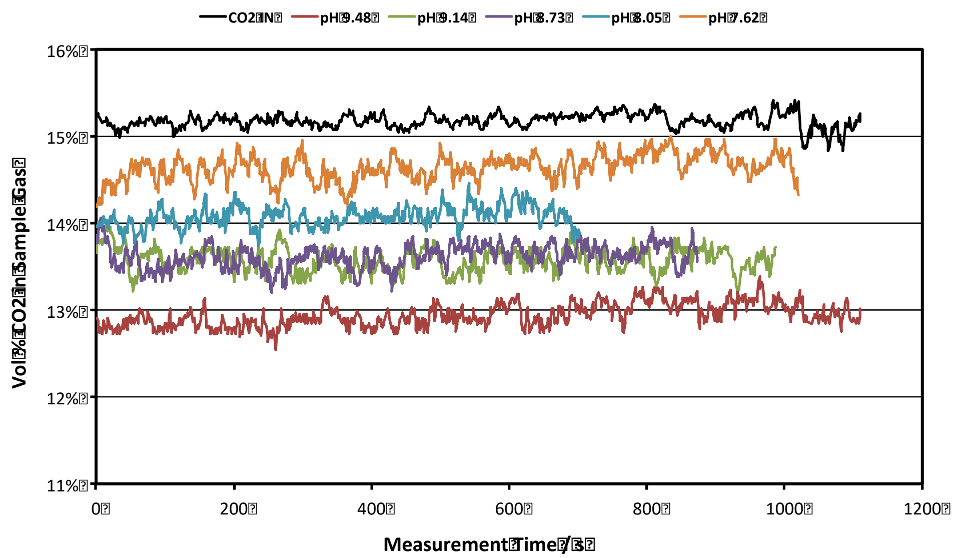

Fig. 7 Representative data set for the lab testing unit which plots the vol% CO_2 going into ('CO2 IN', black line) or out of the system at various pHs versus time. In this example, the input gas is 15 vol% CO_2/85 vol% N_2 and the capture liquids range in pH from pH 7.6 to pH 9.5.

From Figure 7, while it may seem like the CO_2 capture is low, at least relative to conventional technologies, it is noteworthy that the capture liquids are in the range of pH 7.6-9.5, yet they are still capturing CO_2 in large enough quantities to feed the back-end of the Blue Planet technology. For example, the pH 9.5 solution captures roughly 15% of the CO_2, while the pH 7.6 solution captures roughly 4% of the CO_2. While the lab testing unit has been verified with industrial gases including 100 vol% CO_2, 15 vol% CO_2 (N_2 make-up) and 5 vol% CO_2 (N_2 make-up), it remains to be optimized for those systems. Using capture solutions such as these is critical to making the Blue Planet technology a scalable process. Earlier generations use capture solutions with pH > 10 are not scalable in terms of an overall GHG life cycle analysis. Here, the technology is focused on scaling a process that resembles natural biomineralization. In doing so, CarbonMix liquids (the bicarbonate-rich LCPs) were used in combination with calcium chloride ($CaCl_2$) solutions, so-called hard water, to coat various substrates in the direct $CaCO_3$ mineralization reactors. Optimization of the coating process involved screening a scope of concentrations for both HCO_3^- in the LCPs as well as Ca^{2+} in the hard water. Once coated, scanning electron microscopy (SEM) was used as a quantification and quality control technique for the mineralized $CaCO_3$ aggregate materials.

2.5. Upgrade equipment to develop LCP technology on larger scale (Subtask Completed)

Equipment was upgraded from laboratory scale to verify the Blue Planet process components at a larger pilot scale.

Two components of the process needed upgrading to pilot scale in order to treat larger volumes of gas and to produce greater quantities of $CaCO_3$ coated aggregate for product validation with our partners, especially with regard to using the aggregate in demonstration projects. Figures 8 and 9 highlight the progress made during the completion of this task, specifically related to gas absorption, water processing and $CaCO_3$-coated aggregate product.

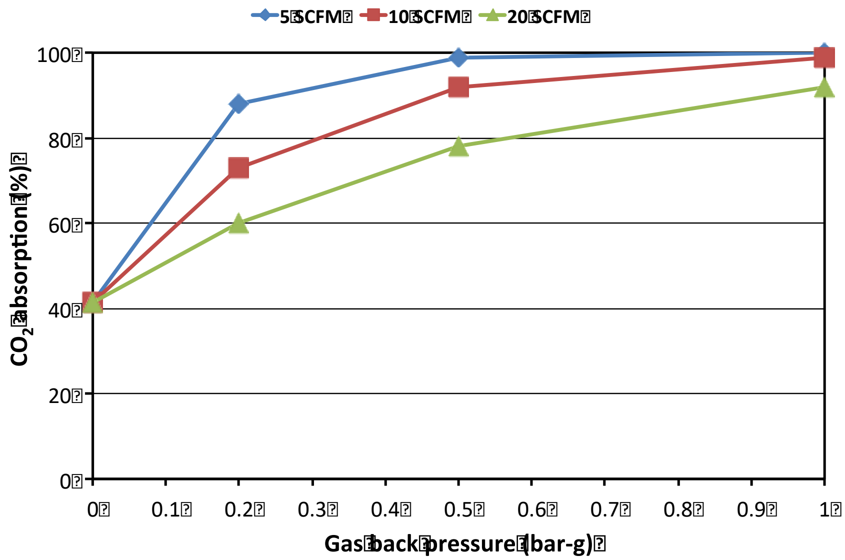

Fig. 8 A model showing the CO_2 absorption capacity as it relates to gas back pressure and volumetric flow of gas for the membrane contactors in the pilot system.

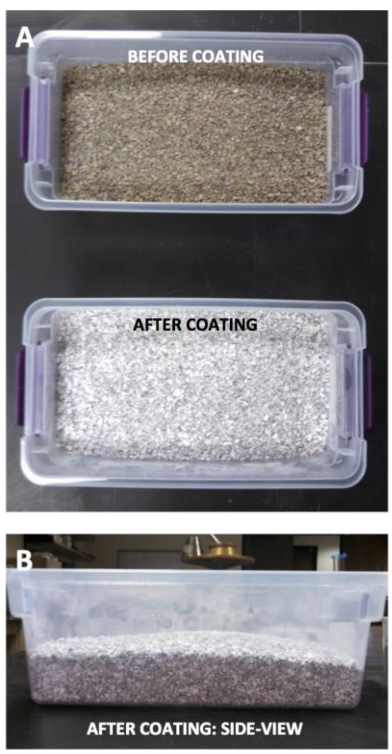

Fig. 9 Examples of fine, lightweight $CaCO_3$-coated aggregate produced in Blue Planet's pilot plant. (**A**) Shows the difference in aggregate before and after coating. (**B**) A side-view of the coated aggregate in (**A**).

2.6. Contact potential demonstration partners in Alberta (Subtask Completed)

Throughout the length of the project, we made contact and established lines of communication with a number of potential demonstration partners in Alberta and elsewhere. As of this final report, we continue to develop new relationships but also strengthen existing ones through communication about the Round 1 project findings and how they have impacted the path ahead toward a commercial installation at a project site in Alberta. Table 3 summarizes our efforts thus far to contact an emitter partner. It includes (i) three project sites in Alberta with necessary inputs for the Blue Planet technology, (ii) a fourth project site in Quebec, (iii) additional project sites in the USA and Mexico, and (iv) a variety of point source emitters that include coal- and natural gas-fired power stations, cement plants, a steel plant and a chemical industry plant.

Table 3. Summary of contact with potential emitter partners and respective project sites for Rounds 2 and 3 of the Grand Challenge, as well as alternative sites outside of the scope of the Grand Challenge competition.

Location	Plant Type	Initial CO_2 Reduction	Commercial CO_2 Reduction	Progress
Alberta	Coal	18,250 tpy [a]	1.37 M tpy [b]	Early phase discussions
Florida	Coal	13,870 tpy	1.04 M tpy	Tie-in completed, FEED under review
Alberta	Cement	18,250 tpy	1.00 M tpy	Early phase discussions
Alberta	Cement	18,250 tpy	0.80 M tpy	Technical due diligence
California	Natural Gas	9,125 tpy	0.68 M tpy	Tie-in completed, FEED underway
Mexico	Steel	4,380 tpy	0.29 M tpy	Technical due diligence
Quebec	Industrial	3,650 tpy	0.20 M tpy	Technical due diligence

[a] tpy = metric tons CO_2 per year ; [b] M tpy = million metric tons CO_2 per year.

Note that the list in Table 3 is exclusive of emitter sites and their corresponding partner company. It does not include corporate development efforts with product off-takers, of which we have also made significant progress throughout the course of this project.

Finally, Blue Planet has appointed a new VP of Corporate Development, Rodney Schmidt, whose full-time focus is on communications in Alberta, Quebec and Canada in general. Rodney, an Alberta native, joined the team in Q1 2016 and will continue to support the development of relationships and negotiations, including helping to secure letter(s) of interest, MOUs or letter(s) of support from potential partners. A brief bio of Rodney is below.

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Rodney Schmidt, VP Corporate Development, has held a number of executive and leadership positions in finance, strategic advisory, and economic and market research. He is Founder and

CEO of Northrise Energy LLC (Northrise), a privately-held energy investment and advisory firm that provides strategic, investment and business development advisory to companies and to governments. His experience includes strategic advisor to the inner cabinet of the executive branch of a North American government; senior advisor to a sovereign investment agency on M&A transactions; and energy industry expert on a government's strategy committee.

From 2007 to 2012, Mr. Schmidt served as Managing Director, at Standard Chartered Bank (SC), in charge of wholesale energy banking to SC's largest energy clients in the Americas. He led the Americas relationship banking, deal origination, and oversaw delivery of SC's structured finance, lending, and M&A banking products, managed the America's energy team, and oversaw SC's Washington-based banking and brokerage office. In 2011, Mr. Schmidt represented SC in an initiative with *The Climate Group* which interfaced with both energy industry participants and environmental stakeholders to identify critical risk factors in the global natural gas shales industry. The result was a new set of guidelines for financiers, building off of the Equator Principles, entitled "*Shale gas exploration and production: Key issues and responsible business practices - Guidance note for financiers".* Prior to SC, Mr. Schmidt was with Harrison Lovegrove & Co (HLC), an international M&A advisory firm - HLC was acquired by SC in December of 2007. Before HLC, Mr. Schmidt was a Partner for 17 years with PFC Energy, a global energy advisory firm (acquired by IHS Inc.), and before PFC he was with the Bank of Canada in Ottawa (the Central Bank).

Mr. Schmidt holds a M.A. in International Relations from the School of Advanced International Studies (SAIS) of The Johns Hopkins University in Washington D.C., a M.A. in Economics from Queen's University at Kingston, Canada, and a Bachelor's in Economics (with Honours) from the University of Alberta, Canada.

TASK 3 - VERIFY GHG REDUCTION STATUS: **COMPLETE**

3.1. Verify the amount of CO_2 sequestered into end product(s) (Subtask Complete)

The R&D team at Blue Planet has developed a process that makes possible the coating of solid $CaCO_3$ on to the surface and in the pores of various substrate materials. Considering the primary product of the Blue Planet process is $CaCO_3$-coated aggregate or $CaCO_3$-coated lightweight aggregate for concrete, the process effectively sequesters 0.44 tons of CO_2 in the built environment for every ton of $CaCO_3$ produced. This has major implications should Blue Planet aggregate replace conventional aggregate in concrete formulations. For example, by mass, the aggregate, including both fine and coarse, typically makes up over 70% of a concrete formulation, with water and cement as the remaining balance. The effects of replacing Blue Planet aggregate with conventional aggregate are detailed further in Section 5 and illustrated in Figure 14.

We did consult Blue Source Canada (www.bluesourcecan.com) to provide a third-party GHG validation report for this project, and opted to consider their services as part of the Round 2 Grand Challenge project. Instead we completed product performance verification processes through working with Capital-E (www.cap-e.com) in a scope of work involved securing third-party GHG evaluations, product validation and product demonstration in real world applications, and included regular communications with Sustainability Advisors at local Silicon Valley firms regarding CO_2 mitigation in concrete. Considering the development of a carbon life cycle rating standard for concrete made with Blue Planet aggregate, Capital-E facilitated that by way of global research organizations like World Resources Institute (www.wri.org) and thinkstep (www.thinkstep.com). Our starting point has been the CarbonStar rating, a performance rating for concrete that has been developed by the Blue Planet R&D team; it is explained further in Section 5 and in Figure 14.

Arguably the most significant GHG verification comes from a recent demonstration project with Central Concrete (www.centralconcrete.com), an industry leader with a proactive approach to environmental stewardship in building construction. Central Concrete is a supporting partner to Blue Planet's method of sequestering carbon in the built environment as an additional method of formulating sustainable concrete. The demo project used Blue Planet $CaCO_3$-coated lightweight aggregate in a concrete pour at the San Francisco International Airport (SFO). As part of SFO's initiative to be the world's most sustainable airport, starting with the construction of their new terminal, the concrete pour by Central Concrete in May 2016 specifically called for carbon sequestered lightweight aggregate produced by Blue Planet. Not only that, but the Concrete Materials specification for the job called out the Blue Planet lightweight product as "no known equal". An excerpt from the Concrete Materials specification for the job is detailed in Figure 10. The pour itself, including details around the production of the Blue Planet aggregate and the size of the pour is highlighted under Subtask 4.4.

2.6 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type II/V.

B. Fly Ash: ASTM C 618, Class F with maximum loss on ignition of 1 percent.

C. Ground Granulated Blast Furnace Slag (GGBFS): ASTM C 989, Grade 100 or 120.

D. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:
1. Class: Negligible weathering region.
2. Nominal Maximum Aggregate Size: 3/4 inch, typical. Where congestion and embedded structural steel elements restricts concrete flow and for self-consolidating concrete, ½ inch nominal maximum aggregate size.

E. Light-Weight Aggregate: ASTM C 330, nominal size designation 12.5 mm to 4.75 mm.
1. A minimum of 5 percent of the total lightweight coarse aggregate shall be carbon sequestered aggregate by Blue Planet, LTD, 100 Cooper Ct., Suite A, Los Gatos, CA 95032, *t* 408.458 3900, no known equal.

F. Water: ASTM C 1602.

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SP04 90% Construction Documents – Shell and Core Interim Boarding Area B & SSCP

Fig. 10 Excerpt from the Shell and Core Construction Documents for the Interim Boarding Area B & SSCP section of SFO's new Terminal 1, which is currently under construction. The Concrete Materials Section 2.6.E. specifies carbon sequestered lightweight coarse aggregate by Blue Planet, *no known equal*.

In addition to all of the above, we established the Blue Planet Built Environment Advisory Board during the course of this project. It is an outstanding cast of Advisors that are intimately involved with various USA and international GHG green building standards efforts. The Advisors are listed below.

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Greg Kats, Chair, is President of Capital-E, a national clean energy advisory and venture investment firm. Kats previously served as a Managing Director at Good Energies, a multi-billion dollar global clean energy investor, and served for 5 years as the Director of Financing for Energy Efficiency and Renewable Energy at the U.S. Department of Energy. He Chairs the Congressionally appointed advisory board guiding the greening of 500,000 federal buildings. Kats is author of *Greening Our Built World*, earned a MBA from Stanford University, is a Certified Energy Manager, and was the first recipient of the US Green Building Council's (USGBC) Lifetime Achievement Award.

David Gottfried is known as the father of the global green building movement, founding the USGBC and the World Green Building Councils (World GBC, with GBCs in 100 countries). The GBC movement has likely reduced global warming and ecological footprint more than any other organizations in the world. Gottfried's work started a global industry with hundreds of thousands of green buildings in most of the world's countries. USGBC alone has 15,000 organizational members representing 10 million employees. Over 200,000 professionals have passed its LEED Accredited Professional and Green Associate exams.

Denis Hayes is the National Coordinator of the first Earth Day and has been at the core of the modern environmental movement since its launch as a foundation president, attorney, lobbyist, Stanford professor, grassroots organizer, and the youngest director of a national laboratory in the nation's history. Selected by Time magazine as one of its 100 "Heroes for the Planet," Denis Hayes has been awarded the highest honors offered by the Sierra Club, National Wildlife Federation, Natural Resources Council of America, American Solar Energy Society, and the Humane Society of the United States.

Kevin Hydes is CEO and President of Integral Group, which guides a global team of driven and committed leaders transforming the industry through engineering excellence. Bringing over 30 years of experience to the engineering profession, Kevin has spent the past 15 years focusing on green design and advancing its cause. Kevin leads the Integral team to explicitly deliver on the current needs of the profession across the globe. He is Former Chair of the World GBC, Past Chair of the USGBC, Cascadia Chapter and a Cofounder of its Canadian counterpart, the Canada Green Building Council (CaGBC), and also serves as a faculty member to the USGBC and CaGBC.

Mary Ann Lazarus, FAIA, LEED AP BD+C served as HOK's firm-wide sustainable design director for over a decade where she led the implementation of sustainable strategies in all of HOK's work. HOK, a global design, architecture, engineering and planning firm, is one of the largest U.S. architectural practices working globally with a strong sustainability reputation. She is now on leave from HOK and consulting with the American Institute of Architects as the Resident

Fellow on sustainability where she was the prime author of the AIA Sustainability Leadership Opportunity Scan.

Roger Platt, President of the USGBC, is responsible for overseeing the policy aspects of the increasingly global adoption of green building and urban development practices, including those recognized by the LEED green building program. He served previously as USGBC's SVP for Global Policy and Law. Before joining USGBC, Roger spent 15 years as senior vice president and counsel with the Real Estate Roundtable.

TASK 4 - DEPLOYMENT IN ALBERTA STATUS: **COMPLETE**

Ultimately, we were unable to bring the mobile pilot equipment to an emitter in Alberta for process validation. Considering the short term and relatively limited budget of the Round 1 project, however, we feel that the technology has progressed ahead of schedule and if we had had a partner and project site in mind at the commencement of the project, we would have full-filled the testing. As a consolation to testing at an emitter site, our mobile pilot gas absorption unit is routinely validated with synthetic gas mixtures at our facility. In parallel, we have come a long way in discussions with partners in Alberta and we are confident that continued communication will result in at least one, but likely multiple partner and project site opportunities for Round 2 full project proposals leading toward 1 Mt net reduction of GHG emissions. As it happens, we have also made significant progress in developing parallel projects at sites outside of Alberta. Our progress to the end of this project are explained in this section of the final report.

4.1. Upgrade skid to mobile deployment in Alberta (Subtask Complete)

Equipment skid components were upgraded for mobile deployment to an emitter site. Arguably the most critical component of the skid system is the gas absorption unit. The membrane contactors are designed to treat 20 scfm (standard cubic feet per minute) of flue gas if operated in series or, when operated in parallel, designed to treat roughly 60 scfm gas. For liquids, the contactors are designed to treat up to 50 gpm if operated in series or, when operated in parallel, designed to treat roughly 150 gpm liquid. Because the gas absorption unit is most sensitive to the volume of gas being treated and not to the volume of liquid, it is expected that a commercial system will have gas flowing in parallel and have liquid flowing in series. This mode of operation minimizes cost at commercial scale. The pilot gas absorption unit for mobile deployment to an emitter site is routinely operated at the Blue Planet facility using mixtures of compressed air and CO_2 to mimic the flue gas to be treated at an emitter site.

Though the objective of this Subtask was to only configure the mobile gas absorption unit, we also upgraded the so-called back-end or coating equipment so as to be able to produce large enough quantities of $CaCO_3$-coated aggregate for use in third-party product validation projects. We validated over five different design bases for the coating process equipment. Through these validations, we were able to identify the types of equipment that are best suited to scale to a commercial facility.

4.2. Secure a CO_2 emitter to demonstrate technology in Alberta (Subtask Complete)

Though we do not have an agreement in place with an emitter in Alberta, we have made significant progress throughout the course of the project to communicate information about the project, the project findings and how the underlying Blue Planet technology can have a major impact on reduction to annual GHG emissions. Table 3 under Subtask 2.6 in Section 4 summarizes the progress of our corporate development to secure a CO_2 emitter project site in Alberta. The two frontrunners are host to a coal plant and to a cement plant. We continue to worth with them toward site demonstrations.

In light of the challenges in getting a pilot to Alberta within the time frame of the Round 1 project, we worked in parallel to get to other pilot projects online. One was a roughly 5,000 acfm slip-stream from a coal-fired power plant in Florida (USA). The other was a roughly 20,000 scfm slip-stream from a natural gas-fired power plant in California (USA). The former is designed to capture 9,000 tons CO_2 per year while producing over 21,000 tons aggregate product per year at 50% CO_2 removal from the flue gas slip-stream. The latter is designed to capture over 18,000 tons CO_2 per year while producing nearly 68,000 tons aggregate product per year at 80% CO_2 removal from the flue gas slip-stream.

4.3. Obtain a professional market assessment (Subtask Complete)

The value proposition of the $CaCO_3$-coated aggregate product from the Blue Planet process is evident through our own research and through the expertise of outside professionals familiar with our targeted markets. Because one of the high volume product opportunities for Blue Planet $CaCO_3$-coated aggregate lies in the bagged concrete industry, we have worked closely with the Home Improvement Retail Advisors group (HIRA, www.hiraadvisors.com), of which all of the partners were executives for Lowe's Companies, Inc. and played critical roles in the development and evolution of home improvement retail in the USA and across the globe. Their own market assessment of the Blue Planet CarbonMix bagged concrete product validated the market opportunities. Examples of what the Blue Planet CarbonMix product might look like inside the bags and on the shelves in home improvement stores are shown Figures 11 and 12, respectively.

Fig. 11 Images of what the CarbonMix $CaCO_3$-coated aggregate might look like inside its bag (Figure 12) on the shelves at home improvement stores anywhere in the world. This particular product was made in a pilot reactor and is ASTM C330 specifiable aggregate.

Fig. 12 Template of a bag dye design for Blue Planet CarbonMix $CaCO_3$-coated aggregate, such as that shown in Figure 11. Notice the performance characteristics that the bag design emphasizes; high strength, carbon negative concrete, better finish, excellent workability, proven ASTM testing and a CarbonStar rating consistent with offsetting the amount of CO_2 equal to driving an average car about 60 miles.

4.4. Bring CarbonMix for concrete to commercialization readiness stage in Alberta (Subtask Complete)

With the concrete industry being a conservative one, we've gotten a tremendous head start on the commercial readiness of the CarbonMix product. Considering the size of the mobile pilot unit outlined in this project, it is unreasonable to assume commercial scale production of Blue Planet aggregate. Within the scope of this project we have been developing concrete mixes with Blue Planet aggregate to replace conventional aggregate in existing products manufactured by leading concrete producers in North America. For over a year and during this developmental stage, Blue Planet has been working with leading manufacturers and local market leaders to validate CarbonMix aggregate at their corporate concrete testing laboratories. In fact, the CarbonMix aggregates like those made in Figure 11 are materials used in the recurring concrete formulation testing protocol with our collaborators in the industry. The concrete demonstration pour with Central Concrete at the new SFO terminal (see content under TASK 3) demanded over three tons of Blue Planet lightweight aggregate, as part of about a 60 total cubic yard pour, shown in action in Figure 13. Looking ahead to Round 2 of the Grand Challenge, we are poised to have a demonstration unit capable of producing over 21,000 tons per year Blue Planet aggregate product within the next year, allowing us to better evaluate the year-round market in Alberta.

Fig. 13 Images of concrete demonstration pour by Central Concrete and using Blue Planet CarbonMix aggregate in the concrete formulation. Job summary: on the morning of May 18, 2016, Blue Planet CarbonMix lightweight aggregates (LWA) were used as a 5% LWA replacement in a mix design; materials were batched using normal methods of gravimetric feeding and discharged into ready mix trucks. The Central Concrete QA/QC lab had previously externally validated CarbonMix in Mar 2016.

5. GREENHOUSE GAS & NON-GREENHOUSE GAS IMPACTS

Due to the technology readiness level and scale of the Round 1 project, there were no immediate performance measurements around the GHG benefits from the completed project. The potential future impacts to GHG benefits are significant and very realistic going forward into Rounds 2 and 3 of the Grand Challenge.

Early on in the project, CarbonMix liquids were validated extensively as a complete water replacement in mortar formulations. The most significant performance measurement for CarbonMix was specific to its weight percent (wt%) CO_2, a measurement that can be extrapolated to estimate the mass of embodied CO_2 per cubic meter (m^3) mortar or concrete. As the project continued, Blue Planet proposed a higher standard performance measurement, a so-called CarbonStar rating, that included a combination of: (i) wt% CO_2 in the CarbonMix liquid, (ii) CO_2 offset by replacement of cement, and (iii) CO_2 sequestered by replacement of conventional aggregate with Blue Planet $CaCO_3$-coated aggregate. Because the wt% CO_2 in CarbonMix liquid had been optimized in the range of 0.7 to 1.8 wt%, and because the water component per m^3 concrete is typically less than 10 wt%, CarbonMix liquid alone does not have a significant effect on the GHG baseline per m^3 concrete (estimated to be 356 kg CO_2 per m^3; see section below). On the other hand, replacing conventional aggregate with carbon sequestered aggregate, at roughly 70-80 wt% of concrete, has major implications on reducing the GHG baseline (or CarbonStar rating) per m^3 concrete. And while mortar and concrete formulations need to meet the requirements of specific jobs, e.g., compressive strength and workability, the CarbonStar rating per m^3 concrete will be the focal point toward 1 Mt net reduction of GHG emissions during the development to commercialization of the technology.

Using Blue Planet's proposed technology, the GHG reduction potential of a cubic meter (m^3) of ready-mix concrete, the major volume product of the process, is significant. Concrete formulations contain three components: water, cement and aggregate (fine and coarse), with aggregate being nearly 80% of the mass of the concrete. For example, each m^3 of moderate-strength concrete typically uses 178 kg water (7 wt%), 356 kg cement (15 wt%) and 1,880 kg total aggregate (78 wt%).[1] Now consider that an average of 927 kg CO_2 is emitted for every 1,000 kg of ordinary Portland cement (OPC),[2] or roughly 1 kg CO_2 for every 1 kg OPC. Assuming there are minimal GHG contributions from the water and aggregate components of the concrete, the *GHG baseline per m^3 concrete is therefore estimated to be 356 kg or 0.356 tonnes CO_2*.

With the baseline identified, the GHG reduction potential per m^3 concrete can be estimated by a simple carbon life cycle analysis, the CarbonStar rating. Figure 14 exemplifies that replacement of conventional components in a concrete formulation by novel, carbon-offsetting and carbon-sequestering components, can lead to a massive reduction in the GHG per m^3 concrete. For example, complete replacement of the water CarbonMix liquid, which might be,

[1] Mehta, P. K. and Monteiro, P. J. M., "Concrete: Microstructure, Properties and Materials," Third Edition, The McGraw-Hill Companies, Inc., 2006, New York, USA

[2] "Concrete CO_2 Fact Sheet", NRMCA (2012), based on the most recent survey of PCA members and depending on fuel type, raw ingredients and energy efficiency of cement plant.

e.g., 5% by weight CO_2, will reduce the CO_2 per m^3 concrete by 9 kg CO_2. When CarbonMix liquid is used in combination with, e.g., 70% replacement of OPC by fly ash, a hazardous by-product of coal combustion that functions as a supplementary cementitious material, the kg CO_2/m^3 concrete is reduced to a mere 98 kg CO_2/m^3 from the baseline of 356 kg CO_2/m^3. This is due to the 5% by weight CO_2 in the liquid and the 70% *offset* of CO_2 that would have otherwise come from the OPC. The most dramatic example includes the replacement of conventional aggregate by CarbonMix aggregate, which contains *sequestered* CO_2.[3] This case reduces the kg CO_2/m^3 to -471, a *net negative* unit of concrete! As individual units, -471 kg CO_2/m^3 might not seem that impactful. Table 4 puts it into perspective for Albertans.

Table 4. Projected annual GHG benefits of using CarbonMix aggregate in place of conventional aggregate in ready-mix concrete formulations.

(i)	Ready-Mix Concrete Used in Alberta (2012)[4]	203,300 m^3
(ii)	Baseline CO_2/m^3 Concrete	0.356 tCO_2
(iii)	Annual Alberta GHG Baseline (2012)	72,400 tCO_2
(iv)	**Annual GHG Reduction w/ 100% Aggregate Replacement by $CaCO_3$**	**168,100 tCO_2**

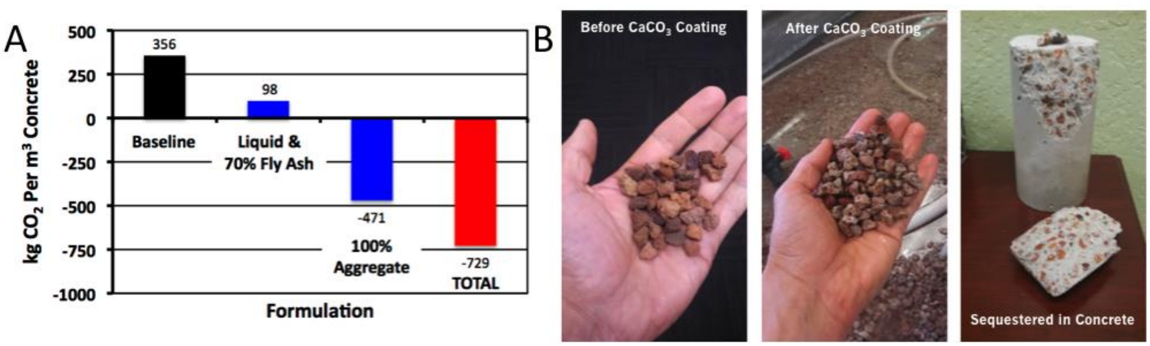

Fig. 14 (**A**) Graphical representation of the CarbonStar rating or GHG reduction potential, in kg CO_2/m^3 concrete, for replacement of conventional components by Blue Planet's carbon-reducing components. *Baseline* is the ordinary concrete formulation; *Liquid & 70% Fly Ash* replaces water and 70% OPC with CarbonMix liquid, where the liquid is 5% by weight CO_2, and fly ash, respectively; *100% Aggregate* replaces conventional aggregate with CarbonMix aggregate; *TOTAL* is the combined reduction of *Liquid & 70% Fly Ash* and *100% Aggregate*. (**B**) Pictures of the substrate before and after coating and in a concrete formulation, whereby the captured CO_2 is now permanently sequestered. Here, the $CaCO_3$ makes up roughly 1/3 of the mass of the coated material, e.g., 1 ton unit weight substrate in to the Blue Planet process produces 1.5 tons unit weight product out of the Blue Planet process (net 0.5 tons unit weight $CaCO_3$).

[3] Assuming each equivalent of $CaCO_3$ sequesters one equivalent of CO_2.

[4] Assumptions: (i) Heidelberg Cement, a leader in global cement and ready-mix markets, had a 2012 global market demand for ready-mix concrete of 39.1 M m^3; (ii) N. America demands 26% of Heidelberg's ready-mix concrete market share => Canada demands 10% of N. America's market share: 2.6% => Alberta demands 20% of Canada's market share: 0.52% => 39.1 M m^3 x 0.52% = 203,300 m^3.

6. OVERALL CONCLUSIONS

- The two-year Round 1 project was a success.
- The team discovered early on that the initial product, CarbonMix liquid, would not have the necessary impact toward 1 Mt net reduction of GHG emissions on its own.
- The shift toward a different, impactful CarbonMix aggregate product led to significant process developments in both the gas absorption and coating process components, and helped the team make major strides toward a technology capable of 1 Mt net reduction of GHG emissions.
- The shift in products led to the team developing a simplified carbon life-cycle rating system for concrete, CarbonStar, which we see as a long-term initiative to sustainability in the green-building industry and beyond.
- Communicating information about the project, the CCEMC Grand Challenge and its link to the underlying Blue Planet technology led to tremendous strides in corporate development, specifically our understanding of the ideal opportunities to demonstrate the technology in Alberta.
- Considering where the level of technology was at the start of the project to where it is now, and through the help of the CCEMC Grand Challenge, we feel the company is poised to construct our initial demonstrations plants producing commercial quantities of aggregate for sale to the concrete industry, validating our technology in the marketplace.

7. SCIENTIFIC ACHIEVEMENTS

Based on work conducted during the course of this project, the Blue Planet team has:

- Filed 11 patent applications, adding to Blue Planet's overall intellectual property umbrella which includes:
    - 13 pending patent applications
    - 5 WO patent applications, including protection in Canada
    - 6 trademarks
    - One licensed patent family from a fortune 100 company

- Given oral presentation at the following conferences:
    - 6th CO_2 Utilization Summit, 24-25 February 2016, Newark, NJ, USA (Brent Constantz)
    - Banff Venture Forum, 24-25 September, 2015, Banff, AB, Canada (Brent Constantz)
    - 13th International Symposium on Biomineralization, 16-19 September 2015, Granada, Spain (Mark Bewernitz)
    - 4th Carbon Dioxide Utilization Summit, 25-26 February 2015, San Antonio, TX, USA (Brent Constantz)

- Published the following papers in peer-reviewed journals:
    - "Bioinspired Concrete," Constantz, B. R., Bewernitz, M. A., Camire, C. L., Kang, S.-H., Schneider, J.; Wade II, R. R. *Biotechnologies and Biomimetics for Civil Engineering* **2015**, 297-308.
    - "The Discovery of a Fundamental Bicarbonate-Rich Liquid Condensed Phase," Bewernitz, M. A., Ginder-Vogel, M., Schneider, J., Camiré, C. L., Kang, S.-H., Bourcier, W. B., Wade II, R. R., Constantz, B. R., *Manuscript in preparation*.

8. NEXT STEPS

The immediate next step for this completed Round 1 project is to prepare for the submission of the Round 2 full project proposal. As mentioned throughout this final report, we are in the middle of a number of discussions with Round 2 project partners and project sites. Table 3 under Subtask 2.6 in Section 4 summarizes the details around those discussions.

Regardless of project site, the initial Blue Planet system roll out is designed to capture and sequester at least 9,000 tons per year CO_2 from an emitter and produce over 21,000 tons per year CarbonMix aggregate product for off take and validation in the marketplace. From 9,000 tons per year CO_2 captured and sequestered we envisage scaling up to 45,000 tons per year CO_2 and eventually to over 1 Mt per year CO_2. The three front-runners at this stage for a commercial demonstration site are at a coal plant and at one of two cement plants. At the scale of over 1 Mt per year CO_2, this would treat roughly 115 MW power at the coal plant or all of the CO_2 at either cement plant.

Blue Planet is conducting a proactive reconnaissance effort to identify large CO_2 emitters in regions were a carbon law exists, with several other ideal characteristics, such as waste geomass mitigation, construction market access, and transportation logistics. Blue Planet's modular approach will allow for rapid deployment because of shortened permit times, construction periods, lack of site disruption, and re-deployment options. As a result, the modules can be deployed to different emitter sites, while being manufactured in a regionally centralized location for rapid deployment. Blue Planet will provide marketing services to the different project emitter sites and make specifiers of concrete aware of the carbon sequestered aggregate and the CarbonStar rating. The required ASTM testing and ACI specifications, as well as local building project specifications met by Blue Planet's aggregate, will be developed into marketing information for individual project sites to obtain the necessary off-take agreements.

9. COMMUNICATIONS PLAN

Table 5 lists third parties that we communicate to through various channels with regard to the underlying Blue Planet carbon capture and mineralization technology, information about the CCEMC Grand Challenge project, the CCEMC itself, as well as our interest to be operational in Alberta.

Table 5. Matrix of channels for communicating information about the Grand Challenge, the project outcomes and the underlying Blue Planet technology.

Third Parties	Communication Channels							
	Conference Calls	Face-to-Face	Email	Website	Media Release	Public Relations	Conferences	Powerpoint
Investors, e.g., venture, corporate	X	X	X	X	X	X		X
Partners, e.g., manufacturer, vendor	X	X	X	X	X	X	X	X
Manufacturers, e.g., equipment	X	X	X	X	X	X		X
Governments, e.g., provincial/state, federal	X	X	X	X	X	X	X	X
Emitters, e.g., coal, cement, steel	X	X	X	X	X	X	X	X
Off-Takers, e.g., construction, governments	X	X	X	X	X	X		X