Curing our Concrete Footprint

Concrete is the most ubiquitous man-made material representing over 50% of global materials usage. Unfortunately, the manufacturing of cement, which is the glue that gives concrete its strength, is a major source of carbon dioxide emissions. Emissions occur through both the release of carbon dioxide from calcium carbonate molecules as they form calcium oxide, as well as the heating process required to achieve this reaction. A rule of thumb is that one ton of cement production results in one ton of carbon dioxide production. Given that current global cement production is estimated at 4.4 GT, the carbon footprint of this industry is massive. Industrialization of countries such as China has resulted in rapid growth of this emission source over the last few decades and the same study estimated that two thirds of cumulative emissions have occurred since 1990.

CarbonCure Technologies has developed a process that reduces the carbon footprint of concrete by injecting CO\textsubscript{2} that can be captured from emitters such as ethanol and fertilizer plants, and most recently, cement plants. The schematic shown below describes how the process can be integrated into a CO\textsubscript{2} supply where CO\textsubscript{2} is injected into the process during concrete production.
Counterintuitively, CO\textsubscript{2} is a solution for the industry’s large carbon footprint. By injecting the CO\textsubscript{2} at the precise time and in a precise method during the concrete mixing, the process causes In situ growth of calcium carbonate nanocrystals within the concrete. This has the impact of improving the compressive strength of the concrete typically by at least 10%, and sometimes up to 20%.

**But How Much Does it Cost?**
CarbonCure has implemented an Infrastructure as a Service (IAAS) business model where it provides the necessary equipment and support services to its customers, which in turn pay CarbonCure a fixed monthly license fee. Carbon dioxide tanks are typically provided by one of the major industrial gas companies. While the CarbonCure fee is a cost to the customer, they are able to monetize the technology by reducing the cement content (the most expensive part of the mix) within the concrete. As cement is both the most expensive and carbon intensive component of concrete, the technology can significantly improve the economics and environmental footprint of the concrete.

**Will This Every Fly?**
By improving the material performance and carbon intensity of concrete; CarbonCure offers its customers two competitive advantages of cement cost savings and a differentiated green sales advantage without charging any initial CAPEX. Innovation in the concrete sector is usually slow to safeguard the safety and longevity of structures. Fortunately the CarbonCure technology does not change any of the properties of concrete beyond improving its underlying strength and complies with codes and standards that normally stall innovation within the construction material industry. Once the technology’s performance is validated at a single plant, adoption tends to be rapid across a customer’s fleet of plants.
Since first introducing its ready-mix technology to the market in 2015, CarbonCure has signed licenses at over 90 locations, including with some of the most influential concrete producers in North America.

**Measuring Impact**
CarbonCure’s technology integrates with the control system of ready-mix plants, thus providing CarbonCure the data required to help its customers optimize the performance of their concrete mixes. This data stream, which is sent remotely to CarbonCure’s headquarters, also allows the company to precisely track the number of concrete batches that have been produced, and the resulting carbon reductions. Already thousands of tons of carbon dioxide emissions have been mitigated by CarbonCure’s customers. Once deployed globally, we estimate the technology could reduce carbon emissions by up to 500 Megatons annually.

**Carbon Utilization Pioneer**
CarbonCure is a pioneer in the nascent CO₂ utilization industry. A report by McKinsey, commissioned by the Global CO₂ Initiative has calculated that the carbon-based products industry as a whole, has the potential to consume seven billion metric tonnes of CO₂ annually by 2030. This report also ranked CarbonCure as the top rated technology among 200 of the most promising technologies. The company also leads the world as a Finalist in the $20M Carbon XPRIZE - a competition to demonstrate the greatest wealth creation and climate benefit from converting CO₂ into value-added products. The products that can be produced from CO₂ include chemicals, fuels, building aggregates and more. But there is a lot of work to be done to achieve this result. To be viable, most of these technologies are dependent upon sourcing significant quantities of CO₂ feedstock at very low cost. This requires new CO₂ capture technologies and subsequent scaling to very large volumes. CarbonCure is working with partners to develop new alternate CO₂ supply chains but in the meantime, their process is economic by integrating with the existing industrial gas industry which already serves the food and beverage industry. Any reductions in the cost of CO₂ capture and deeper integration within the cement value chain would further benefit the technology economics and accelerating the company’s growth. By proving that CO₂ utilization technologies can provide value to customers today, CarbonCure is paving the way for the investments that will allow this nascent industry to flourish over the next few decades.

**Pangaea IMPACT Target: Carbon Dioxide Reduction**
With global carbon dioxide concentrations exceeding 400ppm and high impact consequences such as coastal flooding, droughts, reduced glacial water flows becoming a more and more common occurrence, there is a major opportunity for companies that can lower carbon footprint. Often major cost savings are the immediate driver adoption.