



Charm Industrial: Bio-oil + Injection

Provider: Charm Industrial

Location: San Francisco, CA and other sites in the US Midwest

Mechanism: Bio-oil Injection (Biomass)

Website: <https://charmindustrial.com/>

Date evaluated: Mar-Apr 2021, Sept-Oct 2021

About

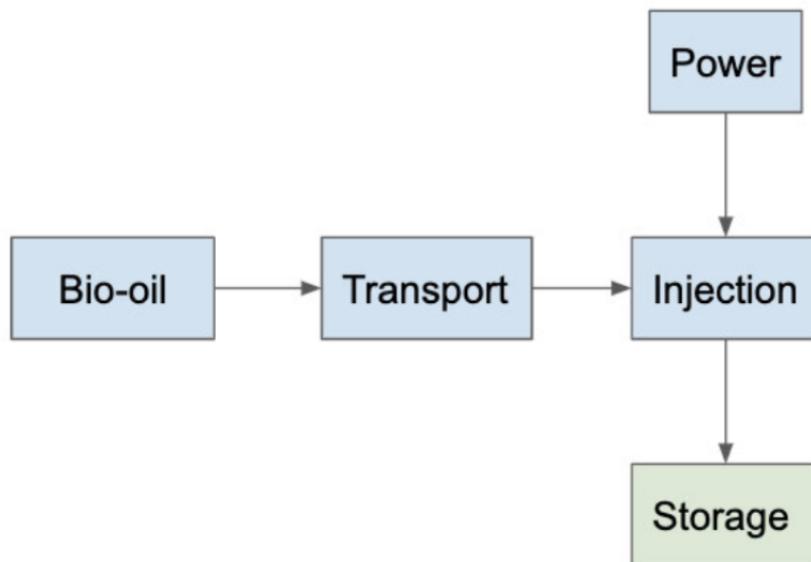
By injecting biogenic liquids like bio-oil into deep geological formations, Charm permanently puts carbon back underground. Dense liquids like bio-oil naturally remain underground for millions of years. Bio-oil is produced using a process called “fast pyrolysis” where biomass that has removed CO₂ from the atmosphere is heated up to high temperatures without oxygen, producing a high-carbon liquid mixture called bio-oil. Instead of the biomass rotting or being digested and returning as CO₂ to the atmosphere, the carbon is injected deep underground via EPA Class I and Class V wells where it safely remains for thousands, or even millions of years.

Do you consider this project to be avoided emissions or emissions removed? Why?

What can you tell us about the carbon life cycle of the average tCO₂e that your solution removes or reduces?

This project removes carbon from the atmosphere. Plants draw down CO₂ from the atmosphere as they grow. Charm converts this biomass (typically agricultural and forest residues) to bio-oil and similar biogenic liquids then injects it underground for long-term storage. New biomass grows where existing biomass was converted to bio-oil, continuing the cycle of carbon removal. Charm Industrial's life cycle analyses fully account for emissions in transport, conversion, injection and any other replacement emission impacts along the way.

Every ton of bio-oil procured contains 1.55 tons of CO₂e. In Charm's process, they emit 0.36 tons of CO₂e for transport and power usage for a 1.19 tons of CO₂e per 1.55 tons of bio-oil (76.7% negativity). The process flow can be found below:



Do you offer a direct-to-consumer purchasing option for your offsets?

Yes

What is your minimum order quantity, if any?

None

Are there additional benefits that your company offers?

Charm Industrial focuses narrowly on carbon removal. Once its bio-oil supply chain comes down the cost curve, we plan to apply bio-oil to the decarbonization of various industrial products like steel, concrete, acetic acid, methanol, ammonia and more.

How much supply do you have still available for purchase in 2021?

Charm has 9,000 tons available for sale in 2023.

When does carbon reduction or removal occur? How is it distributed over time?

Carbon removal will largely take place in 2023 and 2024.

Integrity

First, projects must cross the hurdle of actually reducing or removing the carbon they claim to. To evaluate a provider's integrity, Joro considers verifiability, enforceability, additionality, permanence, and transparency.

Verifiability

How will you measure, report, and verify the emissions you are reducing or removing?

What third party verifiers or other evaluators have evaluated this offset project? What verification standard or evaluation process did they use?

This project has been evaluated by third party non-profit evaluator Carbon Plan. As well, this project has been heavily vetted and selected by competitive corporate negative emissions programs, such as those by Microsoft, Shopify, and Stripe.

If none, what plans do you have in place to get verified or evaluated?

Charm is currently working with providers who will offer third-party verification for additional fee for removals purchased at over 1,000 tons.

Enforceability

Do you provide proof of retirement upon purchase of an offset?

Charm Industrial provides an accessible ledger to customers to see when purchase has been retired and provides timely updates on order fulfillment progress. This ledger is being enhanced (see Transparency), and the company is working with marketplaces for a verification service that can be applied to prove sequestration took place for an additional fee.

Additionality

Did the project require financial capital from offsets to make the project a reality? How will the project result in carbon reduction or removal that would not have otherwise happened without our purchase?

Charm Industrial's business model relies exclusively on revenues from carbon removals, meaning that the biomass would rot or be digested by default and return carbon to the atmosphere unless the project is executed. Charm has also confirmed that the biomass it uses was not destined for fossil-fuel replacing activity. Removals purchased result in additional biomass conversion and ultimately injection underground that would not have otherwise occurred without our purchase.

Permanence

What is the duration in years over which the carbon storage or reduction represented by this project's offsets can be reasonably assured? What supporting research would you point to?

Given the deep injection of biogenic carbon into the Earth, the duration of carbon storage is 1000+ years.

Transparency

Charm Industrial has established robust systems and practices for transparency. The company conducts regular customer calls to update its customers on the sequestration progress, challenges

the company faces, and how customers can support their efforts. The current ledger is being updated and will be public facing on the company's website in the coming months. Any individual, not just customers, can see how much bio-oil was sequestered and at what time frame. This will provide a view of sequestration progress in real time to customers, further enhancing the company's already strong customer transparency processes.

Transformative Potential

Creating a just and sustainable future will require fundamentally transforming our society. We prioritize carbon removal projects that contribute to a world for all life to thrive, considering efficiency, scalability, catalytic potential, ecosystem benefits, and community benefits.

Efficiency

What is the cost per carbon credit (tCO2e) for this project? Tell us more about your fee structure. Specifically, what percentage of an offset purchase goes towards your company, the project owner, and any other parties involved in the offset project?

The cost per carbon credit for this project is \$600/ton. Since Charm Industrial is the project owner, it receives 100% of the purchase.

Scalability

Does this offset project represent a solution from Project Drawdown? If so, which one(s)? Can this solution theoretically be scaled up to reduce or remove at least 1 gigaton of carbon dioxide by 2050?

This solution is most closely aligned to [Biochar Production](#) in the Project Drawdown solution list with an estimated 2.22 to 4.39 gigatons of CO₂e reduced or sequestered by 2050.

Catalytic Potential

Does this project use a novel approach or a well-tested solution? Does this project help demonstrate replicability and inspire similar future projects? How does your project lead to greater innovation in the broader carbon removal field?

Charm Industrial's overall method to inject biogenic carbon-containing liquids deep underground for carbon removal is patent-pending. Bio-oil is produced through a method known as fast pyrolysis. While pyrolysis has been used for biochar production for many years, the use of pyrolysis to produce bio-oil for deep underground injection is novel. Bio-oil's low energy density has made it an unattractive fuel. But recent shifts towards biomass for carbon removal and storage (BiCRS) have made bio-oil an attractive negative emissions pathway.

The Net Zero America Project and California's Getting to Neutral reports both project a significant role for biomass to play in either energy production, hydrogen fuel production, or sequestration necessary for negative emissions. Charm's technology demonstrates a pathway for scaling up biomass technology and could lead to greater innovation in the carbon removal field.

Ecosystem Benefits

Does this offset project address any Sustainable Development Goals beyond Climate Action? If so, which three is your solution most closely aligned with? Are these co-benefits tracked and/or measured? If so, how?

Proven ecosystem impacts (positive or negative) are minimal. Charm Industrial is exploring potential ecosystem benefits but does not have conclusive evidence at this point to make public claims about them. The company will continue to explore the ecosystem impacts of its work. The company does have broader benefits, aligned with the Sustainable Development Goals, however. They include:

- **Goal 8:** Promote sustained, inclusive, and sustainable economic growth, full and productive employment and decent work for all.
- **Goal 10:** Reduce inequality within and among countries

Charm Industrial primarily operates and employs workers in parts of the country (eg. Kansas, Oklahoma, etc.) that don't currently see a future for themselves in a green economy, particularly where fossil fuel industries face disruption from the transition to the green economy. Charm is seeing excitement from these workers as they begin to "benefit from going green". By working in parts of the country that are potentially negatively economically impacted by the transition to a green economy, Charm is addressing inclusive economic growth (Goal 8) and reducing inequality within the United States (Goal 10).

Community Benefits

Who are your community stakeholders? How are local communities involved or consulted in this project?

Consultation and inclusion of local communities in Charm Industrial's work has not yet been established, as well as potential risks that these communities face.

What potential risks do these communities face directly or indirectly related to your work? What steps have you taken to address these risks?

Environmental risks include the potential to slightly increase particulate and NOx from the pyrolysis process and increasing road traffic by transporting biomass from field to local bio-oil conversion and injection sites. The company is working on air quality control mechanisms to reduce any impacts on air quality. The company commits to conducting an environmental review prior to building a permanent conversion and injection plant.

The company has engaged with regulatory bodies to mitigate some of these risks. Regulatory agencies like the Kansas Department of Health and Environment handle reporting requirements, can visit injection sites, observe how operations proceed, and monitor what the company is doing.

What non-carbon benefits from this project accrue to local communities?

Non-carbon benefits include the employment of workers not typically included in the green economy. Specifically, workers left behind from a fossil fuel to green economy transition.

What are the land use implications on local communities as a result of your projects?

Further, changes in land use have not been established, but the focus on using agricultural residues suggests no changes to the land from their existing primary purpose.

Risks: What are the primary risks to the success of this offset project?

While Charm has gained experience in bio-oil injection since our last purchase, there are still risks associated with injecting bio-oil into injection wells. The company continues to refine and learn from its process of sequestering bio-oil, gathering evermore data about how bio-oil behaves in the sub-surface. The company has done core testing and confirmed that bio-oil solidifies in core space and doesn't affect surrounding rock. Nonetheless, the company plans to continue doing these core tests. The company also indicates the need to bring farmers on board in order to continue scaling up, and securing new demand as critical to their success and failure to do so represents a key operational risk.

Images

Additional photos, shared by the provider





