Delta Brick &
Climate Company

PO Box 280 Paonia, CO 81428 deltabrick.com

Christopher Caskey
Founder
Delta Brick & Climate Company
720-421-2633

Matthew Stearns
Colorado Water Conservation Board
1313 Sherman Street, Room 718
Denver, CO 80203

Periodic Report
Water Supply Reserve Fund - Gunnison Basin Account - POGG1 2019-2929
October 8th, 2020

This project is to design and build a condensation apparatus to produce liquid water from steam. The steam originates from the intentional destruction--for climate benefit--of waste methane leaking from old coal mines in the Somerset mining district. Millions of cubic feet of methane leak from this area every day producing climate pollution equivalent to hundreds of thousands of passenger cars.

Methane destruction proceeds according to the following reaction:

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + \text{Energy}$ (Reaction 1)

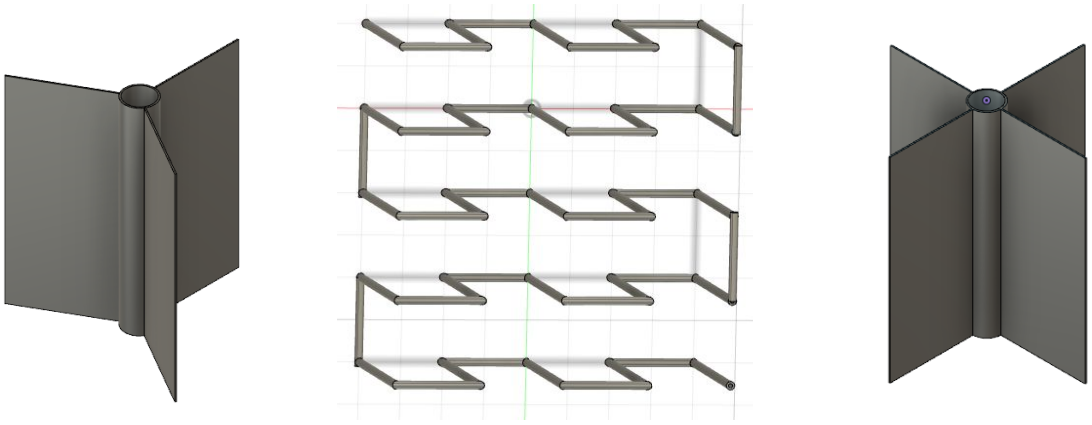
This reaction is carried out by project partners Vessels Carbon Solutions in electrical generators. Reaction 1 is entirely in the gas phase, but if the products can be cooled sufficiently, water will condense.

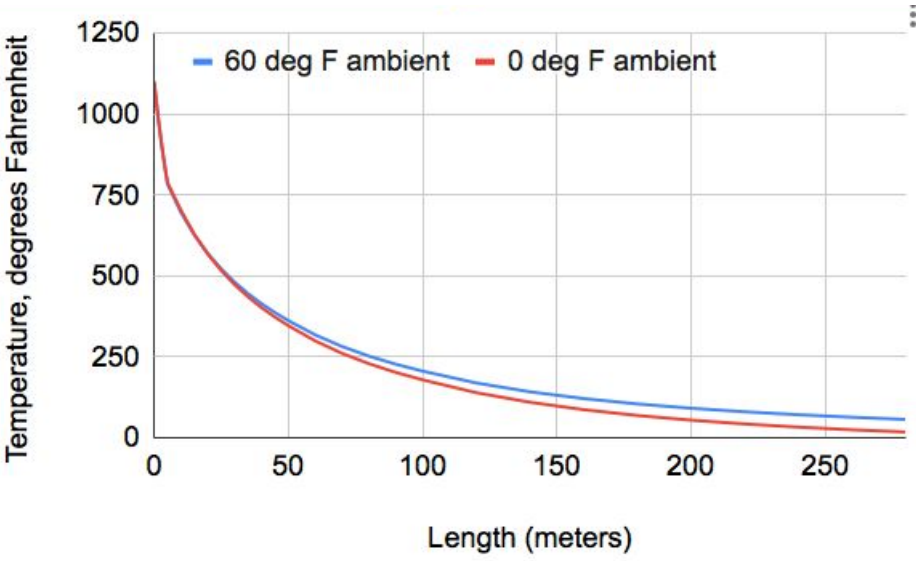
Exhibit A Task 1 is the engineering and design of a water condensation apparatus. Several concepts have been considered and constraints have been identified.

Constraints include:
Need to be inexpensive
Need to be safe

Need to operate with minimal intervention in remote areas in all weather conditions
Power requirements must be minimal

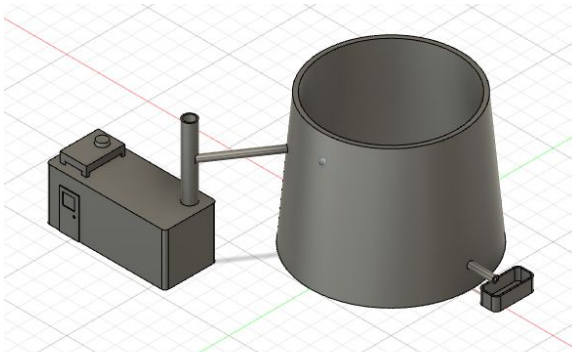
Based on these considerations, passive cooling from a long network of pipe has been selected for installation. The figures below show the estimated temperature of the pipe on a 60 ℉ day and a 0 ℉ day, as well as several pipe configurations.





Top: Possible configurations of condenser pipes. Bottom: Thermal model for pipe temperature along its length.

Incorporation of a dry-draft cooling tower was also considered (shown below). This setup will be too expensive for this grant, but will be reconsidered in the future.



Above: Dry draft cooling tower connected to methane destruction generator.

Based on our thermal models and the constraints above, we selected a condenser design consisting of an un-finned pipe to pull about 5% of the steam out of one methane-destroying generator. This apparatus is expected to produce about 100 gallons of water per day.

Next Steps:

Full design of condenser including site considerations and installation plan
Procurement of materials
Installation of condenser
Commissioning and verification
Water discharge permitting as needed.

Thanks for your support of this project, and let me know if you have any questions.

Sincerely,

Christopher Caskey

Delta Brick &
Climate Company

PO Box 280 Paonia, CO 81428 deltabrick.com

Christopher Caskey
chris@deltabrick.com
720-421-2633

June 24th, 2021

Project Update
Chemical Production of Water *via* Waste Methane Destruction
2019-2929 WSRF

Matt Stearns
Colorado Water Conservation Board
1313 Sherman St, Suite 718
Denver, CO

Dear Mr Stearns,

Here are a few updates on the water production project.

We have purchased some of the equipment we need and are working on getting it assembled for a field test.

Task 1, Engineering and design of Condensation Apparatus, is largely complete.

Task 2, Component purchase and construction, is in progress. Here is a picture of a box containing made-in-the-USA components! Now I just need to make time to open it and put the device together...

Task 3, Installation of a Pilot Apparatus, is planned for late this summer.

Task 4, Monitoring and reporting, will proceed thereafter. In this task, we hope to understand other methane sources where the technology is relevant.

To that end, we have identified and are participating in a stakeholder process for other methane sources. While this is in some ways putting the cart in front of the horse, the progress is promising. Delta Brick is in talks with stakeholders in Pitkin County to capture and create water

from methane leaking from the mines in Coal Basin, the historic mining district above Redstone. These are some of the gassiest mines in the state, and their remote location precludes other uses of the gas.

Table of Mines in Coal Basin

Mine Name	2) Estimated 2021 Emissions (cf)	3) Tons Methane per year	4) Tons CO2e per year	5)Water Available, gallons/year
Dutch Creek #1 Mine	188,730,300	3,926	329,750	566,191
Dutch Creek #2 Mine	152,855,700	3,179	267,069	458,567
LS Wood Mine	83,777,700	1,743	146,376	251,333
Coal Basin Mine	52,120,200	1,084	91,064	156,361
Total	477,483,900		**834,260**	1,432,452

2) Adapted from "Group A" page 20 2016 Colorado Energy Office report
3) Using 1 cf methane weighs 0.0416 lbs and 2000 lbs is a ton.
4) Using 1 ton methane = 84 tons CO2 on a 20 year time horizon
5) Assuming 50% methane capture efficiency and 50% condensation efficiency

The locations of mines in Coal Basin can be viewed at this link: https://caltopo.com/m/3H99
And a video of methane detection can be seen here:
https://photos.app.goo.gl/ZLA2MAJJCGi1dFDW8

Delta Brick &
Climate Company

PO Box 280 Paonia, CO 81428 deltabrick.com

Christopher Caskey
chris@deltabrick.com
720-421-2633

January 4th, 2022

Update Report
Chemical Production of Water *via* Waste Methane Destruction
2019-2929 WSRF

Matt Stearns
Colorado Water Conservation Board
1313 Sherman St, Suite 718
Denver, CO

Dear Mr Stearns,

The project is successful and almost complete. Outstanding items are applying for a water discharge permit and continued monitoring.

Task 1, Engineering and design of Condensation Apparatus, is complete.

The selected design is a passive radiator through which the water-rich exhaust is routed. We considered other designs including radiators with active cooling and radiators employing a physical water-absorbing material.

Task 2, Component purchase and construction, is complete.

The radiator is constructed from silencers (mufflers) and 12" diameter steel pipe. 160 feet of 12" diameter pipe was purchased from Gunnison Energy. Western Maintenance Enterprises was the construction subcontractor.

Task 3, Installation of a Pilot Apparatus, is complete.

3MW LLC agreed to host the Pilot Apparatus. 3MW is an electric generating company burning waste methane leaking from the abandoned Elk Creek Mine. It is operated by Vessels Carbon Solutions (VCS) and majority owned by Aspen Ski Co. More information on 3MW can be found here. Disclosure: As of August 2021, Delta Brick is the contract manager of VCS.

Task 4, Monitoring and reporting, is ongoing. In spring 2022, we plan to upgrade the condenser to increase water recovery and build a tiny wetland using the water.

This will require a water discharge permit, and we are in contact with CDPHE for this purpose.

Water production was several ounces per minute, with exhaust cooled from ~1100° F to 90° F over the length of the radiator. 3MW consists of three separate generators. Approximately 5% of the exhaust from one generator was routed through the pilot condenser. Of the 5% routed to the condenser, we estimate 10% of the available water vapor was captured as liquid, with 90% escaping. Dropping the final temperature from 90° F to 70° F would increase the capture efficiency.

Delta Brick is in talks with stakeholders in Pitkin County to capture and use methane leaking from the mines in Coal Basin, the historic mining district above Redstone. These are some of the gassiest mines in the state, and stakeholders are interested in a variety of use schemes including electricity generation and water production.

Table of Redstone-area Mines

Mine Name	2) Estimated 2021 Emissions (cf)	3) Tons Methane per year	4) Tons CO2e per year	5)Water Available, gallons/year
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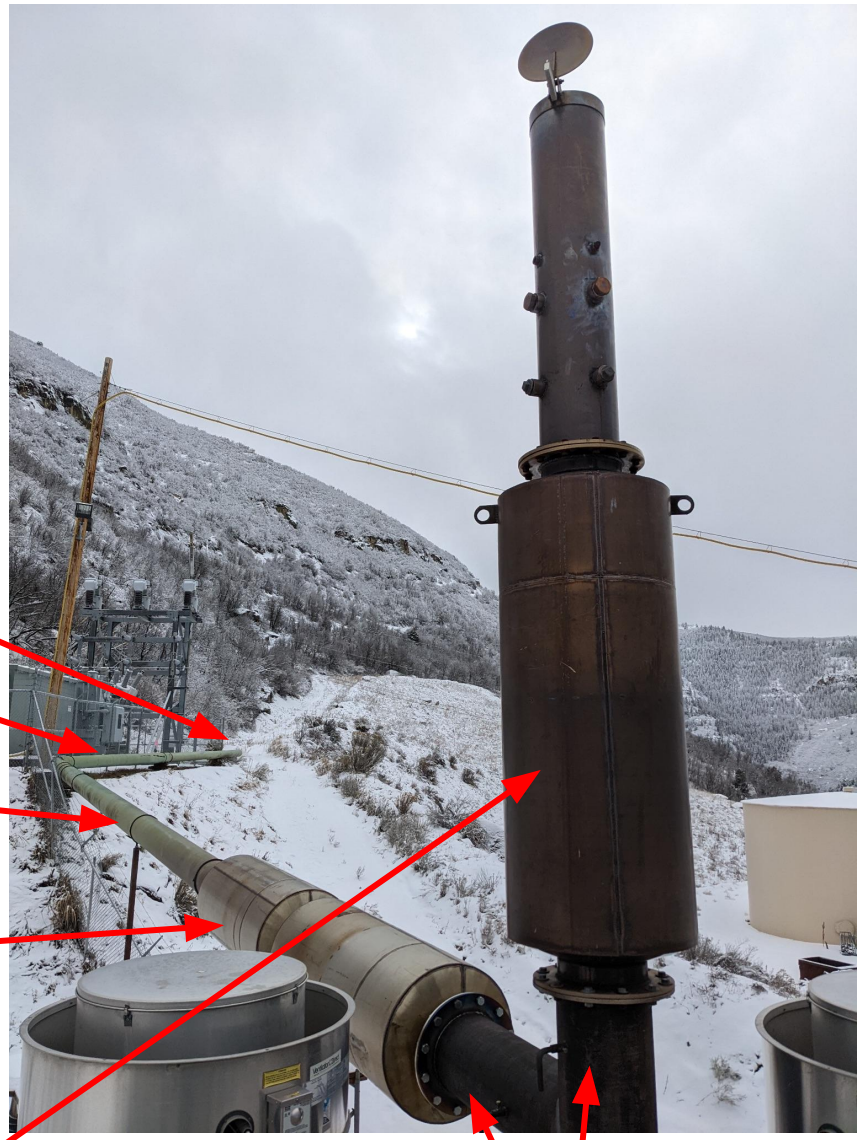
This effort is supported by the Community Office for Resource Efficiency (CORE), and press about the effort can be found here:
https://aspenjournalism.org/in-coal-basin-a-hidden-source-of-climate-pollution/

Construction of water production apparatus

Geometry of water production apparatus

Photo taken from the top of the electric generator



Condenser exhaust

Water collection point

12” steel pipe radiator

Twin silencers serving double-duty as radiators

Primary exhaust stack with silencer

Valves for directing exhaust to condenser or primary stack

Testing of water production apparatus

Testing of water production apparatus