

# Incorporating TerraFixing's DAC into the Allam Cycle

## Summary

TerraFixing's DAC technology can be incorporated neatly into the Allam cycle. Our technology can replace the front-end purification unit while being able to capture and concentrate 9.7 metric tons of CO<sub>2</sub>/day from the air (for a 300MW power plant). This will cost approximately 0.4 MW to run. Another opportunity for our technology lies in using the Allam cycle to power our DAC process. With energies as low as 1 MWh/metric-tonCO<sub>2</sub>, a 300 MW Allam Cycle power plant could power 7200 metric tons of CO<sub>2</sub> being capture per day using TerraFixing's technology. This would equate to 2.6 million metric tons of CO<sub>2</sub> being capture per year.

## Overview

The Allam Cycle first separates the O<sub>2</sub> from the air then combusts the biomaterial/natural gas/oil/biogas/coal to produce a stream of CO<sub>2</sub> and H<sub>2</sub>O. This can be seen below:

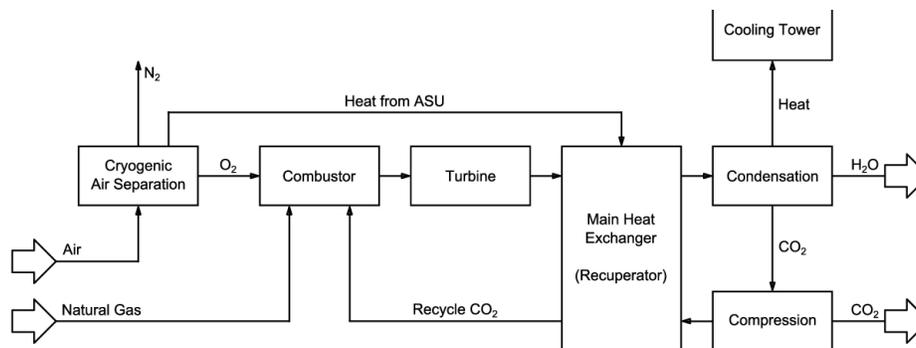


Figure 1 - PFD of the Allam Cycle

The initial step of separating the O<sub>2</sub> from the air is where the opportunity lies for TerraFixings DAC technology. Before I explain the opportunity, let me give you an overview of the O<sub>2</sub> air separation process. For a 300MW facility, approximately 3500 metric tons of oxygen are required per day (<https://doi.org/10.3390/cleantechnol1010022>). To do this, a cryogenic air separations unit is required such as that offered by Air Liquide which is shown in Figure 2. This unit first separates the water and CO<sub>2</sub> from the air in the front-end purification, before sending the inert gases of N<sub>2</sub>, O<sub>2</sub>, and Ar to be separated in the distillation column. So, this process already captures the CO<sub>2</sub> from the air. However, they do not concentrate it but release it back into the air. TerraFixings technology can be incorporated into the process and capture this CO<sub>2</sub> that passes through the column. Our DAC technology allows this CO<sub>2</sub> to be capture from the air and concentrated more than 95% to meet pipeline specification for sequestration.

# Large Air Separation Unit

**Application**

Steel making (basic oxygen furnaces, blast furnaces, electric arc furnaces), gas monetization (gas-to-methanol, -propylene, -liquids), coal gasification, chemicals (ethylene and propylene oxide, etc), clean power (IGCC, oxycombustion)

**Feedstock**

Air + Energy (electrical or steam)

**Product**

Oxygen up to 99.8% purity and 100 bara

**Co-product**

Nitrogen, rare gases (Kr, Xe, He, Ne), liquid oxygen, nitrogen and argon, compressed dry air

**Capacity**

Up to 6,000 tpd

**Economics**

Specific energy: 160 to 500 kWh/t

Capex: 40 to 300 mm USD

Several processes are available to optimize economics depending on product requirements, energy cost and process integration.

**Description**

Large air separation units are based on adsorption purification, cryogenic distillation of main components and internal compression of high pressure products. From the small standard of a few hundred tonnes per day to Mega ASU complexes (multi-train) of more than 15,000 tonnes per day, Air Liquide Engineering & Construction offers optimized solutions in terms of construction strategy, operating philosophy and reliability.

**References**

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**Contact**

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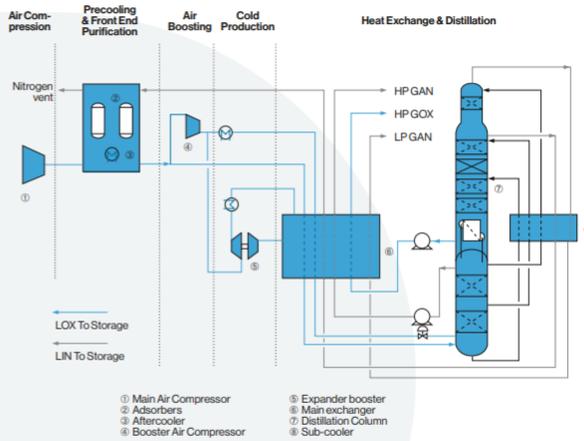


Figure 2 - Air Liquides air separation unit

By incorporating our technology into a 300MW Allam Cycle power plant, we can capture and concentrate the 9.7 metric tons of CO<sub>2</sub>/day that pass through the air separation unit. This will require 0.4 MW of power from the 300MW power plant to be able to capture the CO<sub>2</sub>. This was incorporated into the PFD of the Allam Cycle from before (Figure 3). It should be noted that a large portion of this energy penalty is already paid with normal front end purification but without capturing the CO<sub>2</sub>.

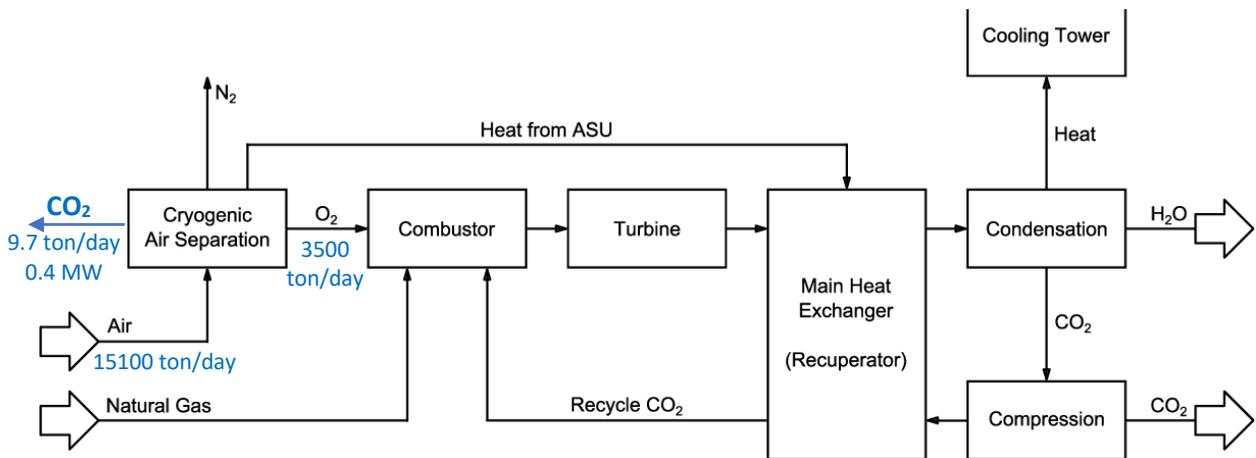


Figure 3 - PFD of the Allam Cycle including TerraFixing's technology

The Allam cycle can also be used to power TerraFixing's DAC technology. This technology thrives in cold and dry conditions in places like Canada, Alaska, Greenland, Norway, Antarctica, Russia, Finland, Iceland, Svalbard, and the Tibetan Plateau. In these cold conditions, energies as low as 1MWh/metric-tonCO<sub>2</sub> are achieved. For a 300 MW facility, this would mean being able to capture 7200 metric-tons of CO<sub>2</sub> per day. Over the course of a year, this would equate to capturing 2.6 million metric-tons of CO<sub>2</sub> per year.