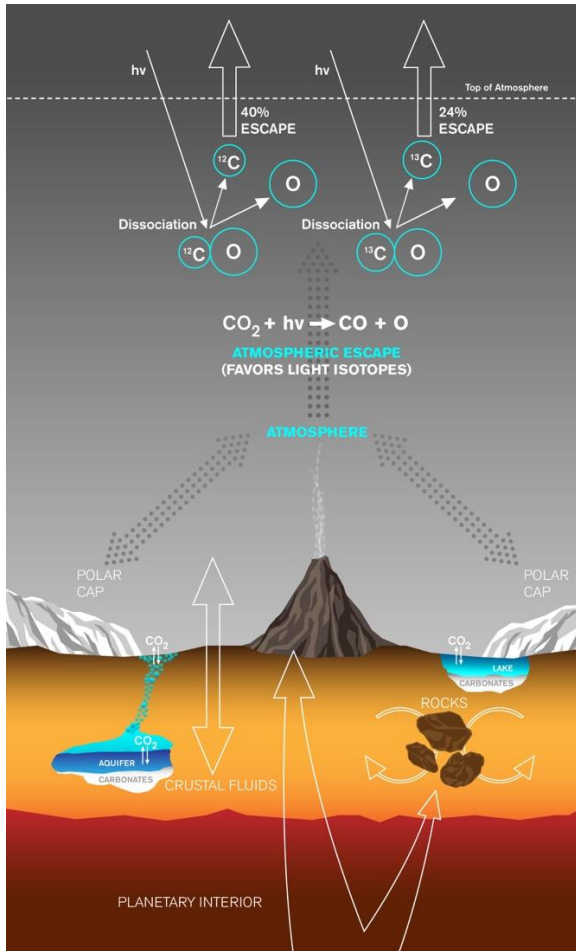


# Converting Mars CO<sub>2</sub> Atmosphere to O<sub>2</sub>



## Name of Technology:

Mars Atmosphere CO<sub>2</sub> Processing into Oxygen

## Participating NASA Centers:

JSC (Lead); ARC, GRC, JPL, KSC, LaRC, MSFC

## Technological Area:

H1.01 Mars Atmosphere Acquisition, Separation, and Conditioning for ISRU

## Vision for the Technology:

Mars missions will require the production of Oxygen (O<sub>2</sub>) from the Martian atmosphere containing Carbon Dioxide (CO<sub>2</sub>). Oxygen is a primary propellant for propulsion systems. Oxygen production for fuel will be a critical for return flights to Earth as it is not feasible to transport fuel to Mars.

## Challenges:

NASA has a small experiment on Mars called the Mars Oxygen In-Situ Resource Utilization Experiment (MOXIE). The following are initial performance factors:

- MOXIE Solid Oxide Electrolyzer (SOE) with 10's of hours of operating life qualified
- 10's of start/shutdown cycles
- MOXIE flow rate is ~1/200th of what is needed for human mission

MOXIE will require scale up for large production. See the Reference section below for MOXIE's recent press releases of accomplishments on Mars.

NASA is also interested in alternative techniques/technologies to accomplish large scale production of Oxygen. One such technology of interest is Reverse Water Gas Shift/Water Electrolysis.

## NASA Seeks to Meet the Following Specs:

- ❖ Large-scale production of oxygen propellant
- ❖ Environmental compatibility and processing at almost any location on Mars, throughout the year and day/night cycle
- ❖ Operation >435 days continuously
- ❖ Time average production of O<sub>2</sub> at 2.2 kg/hr
- ❖ Oxygen purity and dryness to propellant grade specifications (or agreed upon with propulsion)

## Overview of Student Project:

NASA seeks innovative technologies that can mass produce Oxygen (O<sub>2</sub>) from the Mars atmosphere that contains Carbon Dioxide (CO<sub>2</sub>). Technologies need to collect CO<sub>2</sub> from the atmosphere and produce highly pure O<sub>2</sub> for fuel propellant.

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## **Innovative Areas Student Projects Can Address:**

- Improve upon the MOXIE experiment for large scale production
- Develop alternative technologies to accomplish NASA's goals

## **Project Phases**

- I. Conceptual and feasibility study with characteristics
- II. Proof of Concept/Prototype in lab environment

## **Research Funded by NASA on this Topic:**

Proposal Number: 18-1- H1.01-3023  
[Room Temperature Electrolyzers For Oxygen Generation On Mars](#)

Proposal Number: 14-1 H1.01-9966  
[Plasma Extraction of Oxygen from Martian Atmosphere](#)

Proposal Number: 10-1 X1.02-9266  
[Novel CO<sub>2</sub> Separation and Methanation for Oxygen and Fuel Production](#)

## **References:**

[H1.01Mars Atmosphere Acquisition, Separation, and Conditioning for ISRU](#)

[H1.01In-Situ Resource Utilization - Mars Atmosphere/Gas Chemical Processing](#)

[X1.02Gas, Liquid, and Solid Processing to Produce Oxygen and Fuels from In-Situ Resources](#)

[Mars Oxygen In-Situ Resource Utilization Experiment \(MOXIE\)](#)

[Mars Oxygen ISRU Experiment \(MOXIE\)—Preparing for human Mars exploration](#)

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