Motivation and Background
Increasing CO₂ emissions have led to climate change, which causes the heating of the globe, leading to drastic weather events causing political unrest, war, or famine.

Biochar can be used as a catalyst support for the methanation reaction. CO₂ can be captured and stored or converted into useful chemicals. CO₂ storage can be expensive, has limited storage, and can leak into local ecosystems. CO₂ can be converted into methane through the Sabatier reaction, by reacting it with hydrogen. Methane can be used in existing natural gas infrastructure.

Objectives
The main objective of the research is to observe the impact of biochar catalyst synthesis processes on its ability to catalyze CO₂ methanation. The following synthesis parameters will be examined:

1. Pyrolysis Temperature
2. Pyrolysis Heating Rate
3. Biochar Feedstock
4. Nickel Loading

Research Methodology
- Douglas-fir and wheat straw were used to make biochar.
- Pyrolysis temperature was either 400 °C or 500 °C.
- Heating rate varied from 5 °C/min to 20 °C/min.
- Nickel loading varied from 5 wt.% to 10 wt.%

All biochar specific surface areas were measured before and after activation and Ni-loaded biochars were tested as a catalyst for CO₂ methanation.

Equipment
A fixed-bed, flow through reactor was used for pyrolysis, activation, and calcination.

Research is required to determine the impact of biochar-based catalyst synthesis processes on their ability to catalyze the methanation reaction.

Key Results
- Methane yield increases as the heating rate during pyrolysis decreases.
- Methane yield increases as pyrolysis temperature increases.

Key Conclusions
- Methane yield is higher at lower heating rates because the specific surface area is higher and mesopores are more abundant than micropores.
- Methane yield is higher at greater pyrolysis temperatures because the specific surface area is higher, and the porous network is better developed.
- Methane yield is higher over Douglas-fir biochar-based catalysts because the ash content is lower, and the specific surface area is higher.
- Methane yield is higher over 7 wt.% Ni compared to 10 wt.% Ni because Ni particles can agglomerate and block pores in higher loading sample. Methane yield is unchanged at 5 wt.% Ni because there are less Ni particles for catalysis, but also less blockage of pores.
- Decreasing pyrolysis temperature and heating rate will allow higher recovery of biochar but may lead to lower methane yield.
- Dougs-fir has a higher biochar yield than wheat straw because its lignin content, and hence fixed-carbon content, is greater.
- Biochar-based catalysts have the potential to outperform popular metal oxide-supported catalysts such as alumina for methanation.