MTFC Project Proposal 2025-26

Team Name	PRiNceSSes
Team ID #	23916
Short Title for Proposal	CO2 Capture and Reuse for Emission Reduction
Topic Category	Climate Change/Environment ▾

MTFC Project Proposal Template Use Notes:
- *Note that the topic for the Project Proposal is the **team's choice** (i.e., it is <u>NOT</u> intended that you use the 2025-26 Scenario Quest corn farming for your project proposal topic)*
- *Refer to the official MTFC Project Proposal Prompts 2025-26 for the 15 prompts and scoring instructions.*
- *The use of this template is <u>OPTIONAL</u>.*
  - *It is provided as an optional resource for teams to keep their Project Proposal response organized. Teams who wish to use this template should make a copy in order to edit.*
- *The final version of the team's MTFC Project Proposal should be downloaded as a PDF or Word document to submit on the ICS Dashboard. A single file will be submitted.*
- *Additional resources (including the Actuarial Process Guide) can be found on the Modeling the Future Challenge website: https://www.mtfchallenge.org/resources/*
- *Please direct any questions to challenge@mtfchallenge.org.*

Part 1: Project Definition *(Team's Topic)*

These prompts can be found on page 3 of the MTFC Project Proposal Prompts 2025-26. Additional information on Project Definition can be found in ***Step 1: Project Definition*** in the Actuarial Process Guide.

Team Responses:

#1: Identify the topic
- Response: Our atmosphere is facing constantly increasing carbon dioxide levels which causes a variety of risks and problems. Now, more than ever, we have been experiencing the effects of rising CO_2 levels in the atmosphere, such as extreme weather, global warming, rising sea levels, and more. Rising CO_2 levels affect everyone, from people who live in polluted areas and have to face respiratory health risks, to people who live in coastal areas and are facing extreme weather and flooding due to rising sea levels. Animals are being affected, such as polar bears who are losing their homes, the icebergs, every day. It is not too late to reverse some of these effects and save our planet, but only if we take action now.

#2: Identify potential risks
- Response: Some risks of increasing CO_2 levels are ocean acidification, unpredictable weather events, and coastal flooding due to rising sea levels. This majorly affects governments globally since they have to deal with the outcomes of destroyed infrastructure and citizen grievances. Additionally, industries like agriculture, seafood, and pharmaceuticals have problems as ocean acidification destroys one of our main food and medicine sources and extreme weather could lead to lower yield in agriculture. Also, businesses face the risk of losing money and assets because of their physical aspects like buildings due to extreme weather or flooding that is caused by increased levels of CO_2.

#3: Identify a behavior change risk mitigation strategy
- Response: One behavior change risk mitigation strategy is to use more renewable energy rather than fossil fuel energy like coal burning which will release less CO_2 into the atmosphere.

#4: Identify a modifying outcomes risk mitigation strategy
- Response: One modifying outcomes risk mitigation strategy is to recycle carbon dioxide from the atmosphere to reuse it which not only prevents more release, it also reduces the amount that exists.

#5: Identify an insurance risk mitigation strategy
- Response: One insurance risk mitigation strategy is using property insurance for houses and small businesses to protect against unpredictable weather events caused by climate change and global warming.

#6: Identify driving research questions for your topic
- Response:
    - How can we achieve carbon neutrality in the manufacturing process? And once the carbon is captured, how can we effectively reuse it?
    - How is the air quality affected by CO_2 emissions, and how does it affect the environment?
    - How can we identify higher-risk environments, and how could we focus on mitigating the risk in these areas?

Part 2: Data Identification & Assessment *(Team's Topic)*

These prompts can be found on page 4 of the MTFC Project Proposal Prompts 2025-26. Additional information on Data Identification and Assessment can be found in **Step 2: Data Identification & Assessment** in the Actuarial Process Guide.

Team Responses:

#7: Identifying the type of data you hope to find
- Response: Our ideal dataset would have multiple sheets for the data across different time periods and intervals, for example, one sheet for every 5 years from the last 50 years. In each sheet, the rows would be regions. The columns will be the different characters that we want to track across the location and times. It is important that we are able to track the data across both location and time to find the different relationships of the varying CO_2 levels and the effects it has. Some examples of characteristics we would track are the levels of CO_2 in the atmosphere, the weather or number of extreme weather events, the sea levels, the health reports of cardiovascular diseases, ocean acidification levels, property damage amounts in the region, and the amount of use of CO_2 recycling.

#8: Identify potential data sources for your topic
- Response:
  - [US Environemnt Information Agency](#)
  - [US Environment Protection Agency](#)
  - [Data.gov](#)
  - [Data.mass.gov](#)
  - [Yale Environment Data](#)
  - [Open Environment Data](#)
  - [nasa](#)
  - [UN Environment Program](#)
  - [Environment Data and Governance Inititiative](#)
  - https://ourworldindata.org/co2-and-greenhouse-gas-emissions
  - https://ourworldindata.org/explorers/co2
  - https://ourworldindata.org/grapher/per-capita-ghg-emissions
  - https://ourworldindata.org/grapher/annual-co2-gas
  - https://gml.noaa.gov/ccgg/trends/data.html (Monthly /annual CO2 production)
  - https://ourworldindata.org/grapher/annual-co-emissions-by-region (Annual CO2 emissions by world region)
  - https://www.iea.org/data-and-statistics/data-product/ccus-projects-database?utm_source=chatgpt.com (Usage of CO2 recycling)

Part 3: Mathematical Modeling *(Team's Topic)*

These prompts can be found on page 5 of the MTFC Project Proposal Prompts 2025-26. Additional information on Mathematical Modeling can be found in *Step 3: Mathematical Modeling* in the Actuarial Process Guide.

Team Responses:

#9: Modeling research on your topic

Conduct some online searches with your topic + "math models", "math modeling" or "modeling."
In 3-5 sentences, summarize and describe the results of your online searches by answering the following questions:

What kind of results, published papers, and credible literature does this yield? Include links from your findings in your response so you can reference them later.
What is helpful in what you found? What was unfamiliar or beyond the math you are familiar with?

- Response:
    - https://onlinelibrary.wiley.com/doi/full/10.1002/env.2837 – This paper proposes a math formula to calculate the air quality index from the levels of multiple pollutants.
    - https://www.sciencedirect.com/science/article/pii/S2405844024000070 – This is a model to analyze carbon dioxide pollution system in relation to human population.
    - https://www.ncbi.nlm.nih.gov/books/NBK218138/ – This is a model to characterize emissions.
    - https://www.intechopen.com/chapters/68928 — This model is designed specifically to help guide UN policy making with smooth patterns of CO2 emissions.

So far, the field has generally models that help predict the emissions or quantify what pollution effects will be over time. This is helpful for us so we don't have to recreate the models and can use trusted credible models to quantify emissions over time among other factors. The math was almost all multiplication, division, and sum of series that we are familiar with.

#10: Goals of a mathematical model in the project phase

Note: You won't actually create a mathematical model until Phase 2: Project Phase. For now, you need to identify what you hope that your mathematical model will be able to accomplish. Your mentor in the Project Phase will work with you to actually create a mathematical model.
In 3-5 sentences:
Describe what – ideally – you hope that a mathematical model would be able to do for you?
    -   How could it help you identify the likelihood & severity of risk and the changes over time or other elements that will help you characterize risk?
    -   What kind of mathematical analysis seems to be fruitful to pursue in the Project Phase for your proposed topic?

- Response:

    For this project, we aim to develop a mathematical model that can track historical CO2 emissions and predict future emission levels based on factors such as energy usage, industrial activity, and population trends. This mode will also estimate the current carbon capture and reuse ratio and see how deducting this ratio can

affect the overall emission rate. Additionally, it should be able to predict the environmental conditions surrounding it based on the effects of CO2 emissions. This will allow for methods to mitigate this to be made and implemented. This will also let the models be tested prior to making any changes to see what the outcome will be. Sensitivity analysis will also help identify which variables have the greatest impact based on the model's predictions.

#11: Assumption development

In this stage of the proposal process, you are still operating at a very "high level" of project overview and you will tackle your project at a deeper level in the Project Phase. Even at this stage, however, you have conducted enough initial background research to be able to begin formulating assumptions that will allow you to formulate recommendations you have suggested in your problem statement.

In 1-2 sentences each, address some initial assumptions that you anticipate that need to be made in order to provide a framework for your model.

What is the appropriate future time period for your analysis? That is, how far out into the future do you anticipate needing to consider for the risk and the mitigation strategy to take effect? What leads you to consider this a rational and logical assumption?

How do you expect your data to change over that time period? Will the rate of change be the same or different from the historical rate of change or trend? What leads you to consider this a rational and logical assumption?

- Response:

Initial assumptions:
- All measurements will be over longer periods of time due to the need for a clear trend
- Data is going to change over the years, such as new technologies and other types of implementations, but those will not be considered so we don't have interruptions in our data and we don't even know what they are going to be since it would take place in the future
- Assume current conditions (climate, environments) and generalize conditions over an area (country, region)
- Assuming the current rate of change will stay constant
- Anything that is going to be enacted, like bills and all the effect the climate, will be implemented so we know how those will work in the next few years, will aid in seeing if these actually work

      The appropriate future time period should be the next 5 years, 10 years, 20 years, etc. We can run our mitigation strategies through these time periods to get comparable data. This will allow us to clearly see where our strategies will lead us.

      As for one of our assumptions, we do not expect our data to change. There are some obvious things like stuff that already has a trend like global warming and acidity levels, but we are not considering any change in these rates or additional factors being implemented from now unless they are already in place.

Part 4: Risk Analysis *(Team's Topic)*

These prompts can be found on page 6 of the MTFC Project Proposal Prompts 2025-26. Additional information on conducting a Risk Analysis can be found in **Step 4: Risk Analysis** in the Actuarial Process Guide.

Team Responses:

In 2-3 sentences, consider potential outcome scenarios for the risk(s) you identified in Step 1: Project Definition.

Based on your background research, what does the current trajectory and forecast of the risks for your topic lead to if no interventions are made?

What would be the goal and hope for the impact that the risk mitigation strategy would have?

#12: Goals for mitigation strategy
- Response:

One modifying outcome risk mitigation strategy is to recycle carbon dioxide from the atmosphere to reuse it which not only prevents more release, it also reduces the amount that exists.

A potential outcome scenario for the risks of the increasing CO_2 levels are ocean acidification, unpredictable weather events, and coastal flooding due to rising sea levels. If no action is taken and everything stays how it is currently, the ocean acidification will intensify, the unpredictable and extreme weather will escalate, and there will be an even more accelerated rise in sea levels which also implying more frequent coastal flooding. The goal for our mitigation strategy is to significantly reduce the amount of carbon emissions in the world and allow for the CO_2 concentration in the atmosphere to decrease. We hope to take proactive action so the world can avoid irreversible climate change and have a guaranteed future.

Part 5: Recommendations *(Team's Topic)*

These prompts can be found on page 7 of the MTFC Project Proposal Prompts 2025-26. Additional information on making Recommendations can be found in **Step 5: Recommendations** in the Actuarial Process Guide.

Team Responses:

#13: Recommendation differences between mitigation strategies
In the Project Phase, you will ultimately select one risk mitigation strategy to characterize and recommend. The strategy you choose will depend on a variety of factors (and you'll need to justify why you pursue one risk mitigation strategy over another).

For now, revisit the risk mitigation strategies identified for your topic in #3-5 from Step 1: Project Definition responses of this Project Proposal.

In 2-3 sentences, what metrics do you anticipate being helpful to prioritize which one of the three risk mitigation strategies to pursue when you fully model your project in the Project Phase of the MTFC (e.g., cost, effectiveness, ethics, complexity, timeframe, etc.)? What rationale leads you to your response?

- Response:

    To understand what metrics will be helpful to prioritize which one of the risk mitigation strategies to pursue, we will need to consider cost, time frame, and impact. Cost and time frame matter because the carbon recycling approach is a huge time commitment and the funding for this is crucial. The scale of the impact is just as important since we need to know how fast we need to act on the situation and plan accordingly.

#14: Audience for recommendations

There may be two different groups to consider when formulating a recommendation for action: those who actually are facing the risks and those who are in a position to do something about mitigating those risks. It's possible that those at risk are the same who may be in a position to enact change, but it is possible that they will not be.

In 1-2 sentences, identify one potential target audience for your recommendations who may be in a position to make decisions based on your recommendations (e.g., based on financial investment or authority to enact change). What rationale leads you to identify this audience? Explain.

- Response:
    The government is one potential target audience for our recommendations. They are the ones who would have the money to support funding for large scale strategies that mitigate climate change. They also have a lot of pressure to support environmentally friendly actions from the public and environmental groups.

#15: Goals for situation improvement

Ultimately, the goal of your MTFC project is to model the future and recommend a strategy to improve the outlook for the future for your project topic.

In 3-5 sentences, summarize what improvements would you hope your recommendations would lead to for your project topic (ie, what is your best case scenario outcome)? Explain.

- Response: find way to recycle carbon emissions effectively, be on the course to achieve a carbon neutral environment,

In our MTFC project, we hope to model a way to find the best recycling strategies for carbon immersion and move toward a carbon neutral environment. This model will hopefully aid the people in terms of health, quality of life, and living in a less wasteful way. This will also lead to improved habitats for animals and maintain biodiversity in the various ecosystems on Earth.