NTX Future City Junior, 2023

PART 1
RESEARCH ESSAY: CLIMATE CHANGE

Students write a 1,000-word essay that introduces their city and provides a solution to this year's challenge—Climate Change. Develop an innovative solution to answer the challenge of climate change on your future city.

Suggestions and Resources for Completing the Essay Assignments
See the Research Essay Outline (attached). Go over the outline with the students and have them list what they want to say in each section. Then suggest that they divide the sections so that everyone writes at least one part of the draft. When it's time to write the final version, they'll have plenty of material to work with. Also remind students that they can include up to four graphics in their essay.

Research Essay Resources:

- Climate Change Research Questions: This resource provides background information and questions for guiding student research (attached).
- Future City Design: Questions to Consider: Students in the Junior Competition are not required to design a complete city – just focus on the solution to the waste problem in one selected area. The questions in this handout cover a wide range of city issues but will help guide students to consider all the related aspects of their city solution (attached).
- Climate Change: Real World Case Studies: Students will find these real-life examples of technological advances both inspiring and instructive (attached).
- City Essay Suggested Outline: This outline explains what students should include in each section of their essay and how to organize their essay (attached).
- Climate Change Resources: pre-selected set of references and resources and more ideas and information on citing sources in the bibliography (attached).
- Review the Research Essay Rubric (attached) to make sure you understand what the judges will be looking for in your paper.
- Analyze Essays from past NTX Junior winners to give the students a strong sense of what they are aiming for in their own essays. Go to Junior Team Center (http://www.dfwfuturecity.org/team_junior.html).

Research Essay Assignment
Students research and write a 1,000-word essay that describes the unique attributes of their city and provides a solution to this year's challenge: Climate Change.

Climate Change Overview
Today's cities are designed for the long-term average temperatures and weather patterns specific to their region. For instance, Bangor, Maine, has a fleet of snowplows to keep the city's roads clear, while Phoenix, Arizona, requires landlords to supply working air conditioners to their tenants. But climates around the world are not following past weather patterns; they are changing. Researchers have found that the global average temperature has increased by about 1.8°F from 1901 to 2016.1

As hard as it might be to imagine how a one- or two-degree average increase can make a difference, we are seeing shifts in our climate and weather due to rising temperatures. These noticeable changes are called **climate change impacts**. Some climate impacts include sea level rise, more frequent and severe heat waves, and changes in rainfall that cause more floods or longer droughts. As these changes continue, what challenges will our cities, society, and environment face in 100 years?

Engineers, scientists, and city planners are helping cities prepare for climate change through adaptation and mitigation. They are designing ways we can adapt to climate change such as making sure a city's buildings and roads can withstand more extreme weather and redesigning or moving neighborhoods to reduce their risk of flooding from sea-level rise and increased floods. Engineers are also working on mitigation strategies to reduce or prevent the emission of greenhouse gases. They are replacing fossil fuels with renewable energy, using environmentally sound farming methods, and developing materials that don't pollute or degrade the environment. What will future cities look like if today's cities begin to adapt to climate change and install mitigation strategies to combat climate change?

Research Essay Requirements

- In their essay, students will present their future city – at least 100 years in the future, describe its location, and share its innovative features.
- The students will explain what their city was like in the past and the impacts of climate change.
- They will choose the most significant climate change impact on the city and describe one (each) innovative and futuristic
    1. Mitigation strategy to reduce greenhouse gases and
    2. Adaptation technique to deal with climate change.
- The essay cannot exceed 1,000 words and should be free of grammatical and spelling errors.
- The essay can include a maximum of four graphics.
- The essay must cite at least three sources of information used during the idea development process. MLA style is preferred (see Research Strategies for more detail).
- Students should use a variety of sources of information, such as interviews with experts, reference books, periodicals, and websites. (Note: Wikipedia is not accepted as a source of research.)

Research Essay Deliverable

- The essay must be submitted as a Word document via the NTX Junior Team Center (http://www.dfwfuturecity.org/team_junior.html).

Competition Scoring

Teams can earn up to 60 points for their Research Essay. Make sure they have thoroughly covered these categories in the rubric to maximize points:

- Introduce City 15 points
- Problem and Solution 18 points
- Judge Assessment of Solution 15 points
- Writing Skills 12 points

Total 60 points

Scoring Deductions
5 points – Late submissions are accepted with a small point deduction (see online schedule)
10 points – For essays that exceed the 1,000-word limit.

SUGGESTED ESSAY OUTLINE

In the Research Essay, you will share your vision of your future city and your strategies to deal with climate change through adaptation and mitigation.

You can use the following outline as a guide to help you organize and draft your essay.

Introduction
Briefly describe your future city. Include the location, geographic features, climate, population, etc. Include any unique, futuristic features of your city.

Climate Change
Define the Problem:

- Describe what your city was like in the past and the impact of climate change on your city – the residents, environment, and economy – before your city implemented any strategies to deal with climate change.
- Select one of the most significant climate change impacts on the city and
    1. Describe one adaptation technique to lessen the impact
    2. Describe one mitigation strategy to reduce greenhouse gases

Describe the Solution:

- Describe the technology involved in your strategies to deal with climate change.
    - Describe how it works to reduce (or not reduce) the effects of climate change.
    - Highlight the futuristic and innovative aspects of this technology and solution.
    - Describe some of the risks and tradeoffs associated with the technology.
    - Explain what types of engineering were involved and what types of engineers or technicians were most helpful.

Conclusion
Share why people want to live in your city. Summarize how your strategies for dealing with climate change make it a healthy, safe and satisfying place to live.

Climate Change: Research Questions

Picture a city of today. How is climate change affecting it? Are the storms worse than usual, are the summers hotter and drier than they used to be, or are there other changes?

Now picture that same city at least 100 years in the future. What might the effects of climate change be? What actions will the city need to take today to withstand and lessen the impact of climate change in the future?

For the competition, your team will choose a climate change impact facing a city today and design a futuristic climate change adaptation and mitigation to keep your future city residents healthy and safe. Below you will find some information and questions to help start your research.

Climate Change and Its Impact

The term "climate change" describes the long-term shifts in weather patterns that are occurring all over the world. The main cause of climate change is global warming, a phenomenon in which greenhouse gas emissions trap the sun's heat and cause temperatures to rise. Burning fossil fuels—oil, coal, gas—is the main source of greenhouse gas emissions but not the only one. Cutting down forests, landfills, and conventional farming methods are other contributors.

Climate change is causing a wide range of impacts beyond warming the planet: flooding, mass extinctions, freshwater scarcity, severe storms and fires, and more pandemics are all a result of climate change.

What is Climate Change Adaptation and Mitigation?

While climate change is unavoidable, there are many things we can do to ensure our future cities are livable, and their residents are healthy and safe. Two approaches are:

1. **Climate Change Mitigation**–Mitigation focuses on lowering the amount of heat-trapping greenhouse gases in the atmosphere, by:

- Reducing carbon sources. Sources include burning fossil fuels for cars, trucks, planes, electricity, heat, and more.
- Enhancing and protecting carbon sinks. Sinks are anything that absorbs more carbon from the atmosphere than it releases. Our biggest natural sinks are oc eans, forests, and soil.

  Mitigation can be achieved by using new technologies and renewable energy sources, improving energy efficiencies, designing and scaling effective carbon capture technology, and changing how we produce goods and services.

2. **Climate Change Adaptation**–Adaptation is about adjusting to climate impacts by reducing our vulnerability to its harmful impacts, like developing green infrastructure projects such as rain gardens and doing regular storm drain cleaning to protect against flooding from more intense storms.

   Adaptative solutions vary from place to place and involve many trade-offs including cost, cultural and historic significance, balancing the needs of other pressing problems, and addressing competing demands for action from many different groups (businesses, tourism, and vulnerable populations). No matter what challenges a city faces, adapting to climate change also presents new opportunities to design solutions that address more than one problem.

   An example of this is the city of Alcaldía de Medellín in Colombia. It has both high temperatures and very high rates of unemployment. The city hired and trained people from disadvantaged backgrounds to plant and tend 358,000 shrubs and trees. This program cooled the city by up to 3°Celsius, reduced crime, and improved public health.

Watch this video: Adaptation and Mitigation | Climate Wisconsin https://www.youtube.com/watch?v=fmBDZKOdbkY

Climate Change Research Questions

Before you start to design your future city, it is important to gain an understanding of climate change's impact on the cities of today.

- What is climate change?
- What are the causes of climate change?
- What problems is climate change causing in cities today?
- If a city made no changes to address climate change what might life be like in this city 100 years from now?
- What climate change impact is most important for your city to manage?
- What infrastructure is vulnerable to changing weather patterns?
- Does climate change impact a city equally or are different areas of the city affected in different ways?
- Which populations are the most vulnerable to climate change in the city?
- How are today's cities adapting to climate change? What solutions are innovative or futuristic?
- Who is leading the efforts to implement climate change adaptation (for example politicians, environmentalists, business leaders, and/or insurance companies)? How are they making it happen in their city, including getting the resources to make the necessary changes?
- Cities face a lot of issues in addition to climate change. Are there opportunities to design climate change solutions that address other issues in a city?
- What mitigation strategies are today's cities exploring or using? How are they reducing carbon emissions? What are they doing to capture carbon?
- What mitigation strategies are being used in the city's infrastructure (beyond energy production) like in transportation, housing, parks, etc?
- What trade-offs do today's adaptation and mitigation strategies require?

What other questions do you have about climate change and how to adapt and mitigate its effects? Do some research on climate change, there are lots of good places to start on Future City's list of suggested research resources.

Future City Design: Questions to Consider

Your challenge is to choose one climate change impact affecting your city and design one innovative and futuristic climate change adaptation and one mitigation to keep your residents healthy and safe.

How has your city adapted and mitigated your climate change impact 100 years in the future? What design and planning decisions made your city's adaptation and mitigation strategies possible?

As you and your teammates begin to design your future city, use the topics and questions below to guide your research, brainstorming, and design sessions. Remember, no city can provide everything. What are the most important features in your city? What tradeoffs do you have to make? How might a climate change adaptation address more than one problem your city is facing?

City Features

- Where is your city located?
- How has climate change impacted your city, its residents, and the local environment?
- Who lives in your city? Are some populations more vulnerable than others to climate change?
- What are your city's distinctive natural features (e.g., mountains, oceans, rivers)?
- What makes your city futuristic and innovative?

Zoning, Government & Budget

- How is your city zoned? Are the zones separate or are there mixed-use zones (e.g., commercial and residential or commercial and industrial) in your city?
- How has your city used zoning to achieve its goals around climate change?
- How is your city governed? Who makes the laws and regulations?
- What regulations or incentives does your city impose on manufacturers and businesses to ensure they are working to halt or reverse climate change?
- How does your city fund its operations (i.e., utilities, infrastructure, and public services)?

Environment & Energy

- What energy source(s) powers your future city?
- What are the costs and tradeoffs of different power sources?
- What innovative and futuristic technologies is your city using in the production of its power and how has this reduced or eliminated carbon emissions?
- What solutions has your city incorporated to halt or reverse climate change?
- How have your city's practices had a positive impact on the environment?

Food & Agriculture

- Where does your city's food supply come from?
- How has your city's food supply been impacted by climate change? What changes have local and regional farmers made to adapt to climate change impacts facing your city?

Industry, Manufacturing & Jobs

- What drives the economy in your city (e.g., tourism, manufacturing, education, agriculture, sports, medicine, the arts)?
- How has adapting to a risk related to climate change affected your city's economy? What tradeoffs did your city or local industries make?
- What innovative approaches and industry practices are being used to keep products or resources in use?
- What types of jobs are available to your residents?

Structures & Housing

- How has climate change impacted where your city's residents live, work, and go to school?
- How have construction practices changed to achieve your city's climate change-related goal?
- What materials are used in your city's buildings? What makes them innovative? How are materials produced, used, and potentially re-used?

Transportation

- What transportation options are available to your residents? Is there more than one way to get around?
- How are goods and materials moved around your city for use and reuse?
- How has your city reduced or eliminated transportation emissions?
- How is your city designed to be accessible for people with mobility issues related to aging or a physical disability?

Utilities & Services

- What services does your future city provide to its residents (e.g., medical, education)?
- How does your city address the needs of vulnerable populations, including the poor, the sick, the unhoused, and the elderly?
- What impact has your city's approach to climate change had on its utilities - such as water, sewer, waste management and recycling, electricity, Internet, etc.?

Health & Recreation

- How does your city support a healthy lifestyle for its residents throughout every stage of life?
- What does your city offer for entertainment, recreation, and cultural enrichment?
- How have hospitals and healthcare adapted to the risk from climate change? Have any new medicines or treatments been created from your city's approach?
- What types of public spaces does your city have? What do people do there?

Climate Change: Real-World Case Studies

Buildings that Clean the Air

Urban Sequoia was one of the innovations presented at the 2021 UN Climate Change Summit in Glasgow, Scotland. This concept envisions cities as urban forests, where every building captures carbon, purifies the air, and regenerates the environment.

The Urban Sequoia team built a prototype building to prove the viability of this approach. The high-rise is made from nature-based materials like biobrick, hempcrete, timber and biocrete. Its façade, made of biomass (carbon-based material from plants and animals) and algae, actually produces biofuel for heating systems, cars, and airplanes. This one building can sequester 1,000 tons of carbon every year. The captured carbon can be used by various industries.

Turning Carbon Dioxide into Rock

Most factories emit carbon dioxide. But in 2021 a giant plant near Reykjavik, Iceland opened that pulls carbon dioxide out of the air and funnels it deep underground, where it turns into rock. Orca—named after the Icelandic word for "energy"—draws 4,000 tons of carbon dioxide out of the air every year, about the same amount as 870 cars.

Orca works by using fans to draw air into a collector with a filter. When the filter is full of carbon dioxide, the collector closes, the temperature rises, and the carbon dioxide is released as a highly concentrated gas. The gas is mixed with water and injected into basalt rock nearby, where it is mineralized. It turns to stone in about two years. Orca is the first and biggest installation for the "direct air capture" industry.

Ecosystem Engineering Oysters

New York Harbor was once home to 220,000 acres of oyster reefs, which supported one of the most diverse ecosystems on the planet. Oyster reefs are like the trees of the forest and create habitat for hundreds of species. Oysters clean the water and remove pollutants such as nitrogen. One oyster can filter 50 gallons of water a day!

Oyster reefs are also a powerful natural defense against increased and severe storms due to climate change. They reduce flooding, prevent erosion, and soften the impact of large waves. They do this by absorbing wave energy and slowing the water before it hits the shore.

The Billion Oyster Project was launched in 2014 to restore oyster reefs in New York Harbor. Engineers figured out where to place the reefs and how big to make them by creating an exact replica of the restoration area and subjecting it to a mini hurricane. To date 15 oyster reefs have been restored, with many more to go. Oysters are thriving better at some reefs than others; engineers and scientists are always learning.

City Essay: Suggested Outline

This is a suggested outline to follow. Use this outline and the city essay rubric to make sure you address everything the judges will be evaluating.

Part 1: The Introduction

Briefly introduce your future city by sharing basic information about it.

- Include your city's name, how old it is, where it is (and any relevant natural features, like mountains or rivers), and how many people live there.

Part 2: A Closer Look

Paint a picture of life in your future city, as if you are describing it to someone who has never been there. Share details about:

- Who lives in your city? What makes your city appealing to different types of people?
- What is daily life like for your residents?
  - What do they do for fun?
  - Where do they live? Work? Go to school?
- What is the climate like in your city?
- What services does your city provide (such as education, hospitals, fire stations, public transportation)?
- What are some innovative or futuristic elements of your city's infrastructure (such as housing, transportation, energy, agriculture, etc.)?

Part 3: Define the Problem

Describe one climate change impact your city chose to manage. Include:

- What effect the climate change impact had on your city–the residents, environment, and economy–*before* your city made any adaptions or implemented any mitigation strategies.

Part 4: Describe Your Solution

Here is where you get to describe your city's futuristic and innovative climate change solutions. Be sure to describe:

- One climate change adaptation
- One climate change mitigation

For each example, include:

- What issue or issues does the solution address?
- What design and planning decisions made the solution possible?
- How does it work? And what makes it innovative and/or futuristic?
- What were the risks, tradeoffs, and compromises involved in implementing your solution?
- What impact–both positive and negative–did your solution produce?
- Explain what types of engineering are involved in making your city a model for halting or reversing climate change and what kinds of engineers were most helpful.

Part 5: Conclusion

Share why people want to live in your city and what makes it a great place to live. Summarize how the adaptation and mitigation strategies your city is employing keep the people of your city healthy and safe.

Research Strategies

Many students are not aware of the time and effort that effective research requires. Similar to the engineering design process, researching is an iterative process with many steps involved. Teaching your students effective research strategies is a worthwhile endeavor that will benefit your students throughout their academic and professional lives.

Research Tips and Strategies

- **Be sure that students are aware of the purpose of their research**. It helps if they form a focused question related to their research. For example, "What is infrastructure?" or "What types of crops can grow in dry, arid climates?"

- **Stress the importance of drawing information from multiple resources** and formats (books, brochures, journals, interviews, surveys, magazines, newspapers, and electronic sources). Although the Internet may be the most convenient place for students to begin their research, they should not overlook their school or local library.

- **Encourage students to use a process for finding and recording data** so they aren't overwhelmed by information**.** For example, they could use a Read-Think-Select process when finding information. Students should read the information presented, think about the important points presented, sort the data, and then select key facts. Have students repeat this process until they find the answer to their questions.

- **Have students make a plan for how they will collect and organize their notes**. Will they keep all of their notes on index cards, in their Learning Log, or will they use an online tool or app? How will they divide up the task of researching? Who will be responsible for finding what information?

- **Encourage students to share their findings** with others.

- **Make sure that every quote and fact is connected to its source**. Students must always write the full bibliographic reference for information that they draw from.

Internet-Specific Research Strategies

Although the Internet is wonderful tool, students may need help using it effectively. Share the following steps with students as they begin their Internet research process.

1. Make sure that students understand exactly what information they are searching for.

2. Work with your students to create a list of key words and search terms. If they are not finding what they want, alter the key words to make a more (or less) specific search. Point out that sometimes it is a matter of trial and error to discover what keyword combination yields the best results.

3. Preview websites that may be helpful and prepare a list of sites students can start their research with. Have students use search engines like Google, Bing, and/or Sweet Search (a search engine that searches sites that have been found appropriate for students) to test out their key words.

4. Teach students how to evaluate sources. (Choose a site to evaluate and model what you mean by answering the following questions.)

    - Look at the actual URL address? Is it a well-known site? Is it an educational, government, commercial, or opinion-based site?

    - Who published the source?

    - Is the information current?

    - What is the purpose of the source and who wrote it? (Why was it written and whom was it written for?)

    - Is the information supported by evidence?

    - In what ways is the information relevant to your topic?

    - Whose perspective is represented in the source?

Works Cited

A works cited page, or bibliography, is a list of works that you used for researching your essay. It is useful for two reasons: (1) to give proper credit to your sources and (2) to help your reader to find your sources.

General Tips

- The Works Cited is always the last page of your essay.
- Type the title "Works Cited" and center it on the page.
- List sources alphabetically by the first word or name of the source.
- If an entry goes beyond one line always indent the next line(s) five spaces or one-half inch.
- Dates are written as: Day Month Year. For example: 14 May 2004 and 22 Feb. 2010
- Abbreviate all months except for May, June, and July.

The information below shows how to format commonly used sources in MLA style.

Book by One Author
Author (Last name, First name MI). *Title*. City of Publication: Publisher, Year of Publication. Print.

Book by Two or More Authors
Author (Last name, First name and First Name Last Name). *Title*. City of Publication: Publisher, Year of Publication. Print.

Encyclopedia Article
Author of Specific Article (Last name, First name MI). "Title of Article." *Title of Encyclopedia.* Edition. Year of Publication. Print.
Note: If there is no author listed, begin the entry with the article title.

Magazine Article
Author (Last name, First name MI). "Title of the Article." *Title of the Magazine* Date of Issue (Day Month Year): Page Numbers (XX – XX). Print.
Note: If there is no author listed, begin the entry with the article title.

Newspaper Article
Author (Last, First MI). "Title of Article." *Title of Newspaper* Date of Publication (Day Month Year): Page Numbers (XX – XX): Section Number. Print.

Interview Conducted by Researcher
Name of person (Last name, First name MI). Personal interview. Date of interview (Day Month Year).

Article on a Website
Author (Last name, First name MI). "Title of Internet Article." *Title of Website*, Year posted or last updated. Web. Date viewed (Day Month Year). <Web address (optional)>

Online Encyclopedia Article
Author (Last name, First name MI). "Article Title." *Title of Encyclopedia*. Publisher, Date of publication. Web. Date viewed (Day Month Year).

Personal E-mail
Author (Last name, First name MI) of e-mail. "Subject line from posting." Message to recipient. Date of message (Day Month Year). E-mail.

References:

Modern Language Association of America. *MLA Handbook for Writers of Research Papers.* 7th ed. New York: Modern Language Association of America, 2009. Print.

The Purdue Online Writing Lab Website. The Writing Lab and OWL at Purdue and Purdue University, 2015. Web. 7 July 2015. < https://owl.english.purdue.edu>

Essay Rubric (FC Jr.)

	0 **No Points** Requirements missing	1 **POOR** Poor-Fair quality. Fulfills less than 50% of requirements.	2 **GOOD** Average-Above average quality. Fulfills at least 90% of requirements.	3 **EXCELLENT** Excellent quality. Fulfills 100% of requirements with additional distinctive features.
I. INTRODUCE CITY (15 points)				
1. City overview ● Introduce city and basic features ● Location, geography, climate, development, etc.	No description of city	Underdeveloped description of city.	Clear and developed description of the city and unique features.	Clear and thoroughly developed description of city and unique features.
2. Features and innovations • Attributes that make this city unique.	No description of unique features.	Underdeveloped description of unique features.	Clear and developed description of unique features.	Clear and thoroughly developed description of unique features.
3. City innovation and futuristic elements	No description of innovative or futuristic elements.	Underdeveloped description of futuristic elements.	Clear and developed description of innovative and futuristic elements.	Clear and thoroughly developed description of futuristic elements.
4. Describe past behaviors or causes of climate change problems • Causes of climate change	No description of causes.	Underdeveloped description of causes	Clear and developed description of causes of climate change problems.	Clear and thoroughly developed description of causes of climate change problems.
5. Select one climate change impact and describe effect on health, safety • Impact on the city (environment, economy, etc.) • Impact on health of citizens	No identification of system or description of impact on city or citizens.	Underdeveloped description of selected system and effects on city and citizens	Clear and developed description of selected system and its effects on city and citizens.	Clear and thoroughly developed description of selected system and its effects on city and citizens.
II. PROBLEM AND SOLUTION (18 points)				
6. Describe one adaptation strategy for selected climate change problem. ● Description of how solution works ● Technology involved ● Innovative and futuristic	No description of adaptation strategy.	Underdeveloped description of adaptation strategy and technology.	Clearly outlines the adaptation strategy and somewhat futuristic technology involved. Could be more detailed.	Clear and thorough description of adaptation strategy. Innovative and futuristic technology.
7. Describe one mitigation strategy for selected climate change problem. ● Description of how solution works ● Technology involved ● Innovative and futuristic	No description of mitigation strategy.	Underdeveloped description of mitigation strategy and technology.	Clearly outlines the mitigation strategy and somewhat futuristic technology involved. Could be more detailed.	Clear and thorough description of mitigation strategy. Innovative and futuristic technology.
8. Risks, tradeoffs, and compromises ● Benefits, drawbacks, risks ● Tradeoffs & compromises	No discussion of benefits, risks or tradeoffs	Description of one risk and/or tradeoff.	Description of more than one benefit, risk, or tradeoffs.	Description of more than two benefits, risks, or tradeoffs.
9. Describe benefits to citizens ● How does lessening climate change impacts benefit the residents	No description	Underdeveloped description	Clear and developed description of benefits	Clear and thoroughly developed description of benefits
10. Engineering disciplines involved	Engineering disciplines are not identified or not relevant to solution	Discusses one relevant Engineering discipline.	Clear description of more than one relevant engineering discipline	Clear and detailed description of more than one relevant engineering discipline.

Essay Rubric (FC Jr.)

	0 **No Points** Requirements missing	1 **POOR** Poor-Fair quality. Fulfills less than 50% of requirements.	2 **GOOD** Average-Above average quality. Fulfills at least 90% of requirements.	3 **EXCELLENT** Excellent quality. Fulfills 100% of requirements with additional distinctive features.
II. PROBLEM AND SOLUTION (Cont'd)				
11. Role of 1-2 engineers	Role of engineers are not identified	Underdeveloped discussion of role of one engineer	Clear description of role of 1-2 engineers involved in system and solution	Clear and detailed description of role of 1-2 engineers involved in system and solution
III. JUDGE ASSESSMENT OF SOLUTION (15 points)				
12. Effectiveness and Quality of adaptation strategy ● Effective strategy for adapting to selected climate change impact ● Appropriate design and application of technology	Not effective	Solution is somewhat effective. Technology and design need improvement.	Solution is effective, but technology and design could be improved.	Solution is a highly effective, with excellent technology application.
13. Effectiveness and Quality of mitigation strategy ● Effective strategy for mitigating effects of selected climate change impact. ● Appropriate design and application of technology	Not effective	Solution is somewhat effective. Technology and design need improvement.	Solution is effective, but technology and design could be improved.	Solution is a highly effective, with excellent technology application.
14. Innovative & futuristic technologies ● Futuristic, but reasonable extrapolation and application of technology	Not innovative or original	Overall concept is somewhat original or innovative. Not futuristic.	Overall concept is moderately innovative, original or futuristic.	Overall concept is highly innovative, original and futuristic.
15. Plausibility of solution ● Plausible. Based on sound scientific principles.	Implausible or not scientifically sound	Solution is not very plausible (science fiction)	Solution is plausible	Solution is highly plausible and scientifically sound
16. Tradeoffs & compromises ● Accounting for risks, benefits ● Assessing consequences and making logical decisions	Does not explore tradeoffs	Some consideration of tradeoffs, but ignores major issues.	Adequate assessment of tradeoffs, but analysis and decisions could be improved.	Excellent assessment of risks, benefits, tradeoffs in the decision-making process.
IV. WRITING SKILLS (12 points)				
17. Organization	Poorly organized	Fair organization	Good organization	
18. Writing skills	Poor writing	Fair writing	Good writing	
19. Grammar & spelling	Many errors	Some errors	Few, if any, errors	
20. Maximum number of Graphics ● If used, max of 4 (does not include tables)	Exceeds maximum of 4 graphics, illustrations		Does not exceed maximum of 4 graphics and/or illustrations	
21. List of references ● At least three acceptable references ● Wikipedia not recognized as an acceptable reference	No references	Less than three acceptable references	At least three acceptable references	
22. Word count ● Does not include title, references ● Includes all captions and words in graphics, illustrations and tables.	No word count at end of document or inaccurate count		Accurate word count at end of document	