ACTIVITY 7

Building Initiative

COMPUTER APP

ACTIVITY 7

Building Initiative

ACTIVITY SUMMARY

Students make a recommendation about which initiative related to buildings should be adopted in Vanwick. The decision supports the efforts of Project REV by reducing greenhouse gas emissions. Students make the decision based on weighing facts and values with a computer app. They evaluate three different proposals to evaluate how well each option fulfills the values of the City Council and then make a recommendation.

ACTIVITY TYPE
COMPUTER APP

NUMBER OF
40–50 MINUTE
CLASS PERIODS
1–2

KEY CONCEPTS & PROCESS SKILLS

1. Facts support informed decision-making by leading to more accurate predictions about the likely outcomes of different choices.
2. Values affect people's behaviors, opinions, and decisions. There can be disagreement within a community when people hold a variety of values.
3. Decision analysis is the process of breaking down a decision in a way that can help the decision-maker systematically consider elements related to a choice, such as facts and values.
4. Community decisions are more likely to be accepted if the values of all stakeholders, especially those who are underrepresented, are considered in the decision-making process.

NEXT GENERATION SCIENCE STANDARDS (NGSS) CONNECTION:
Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations. *(Science and Engineering Practice: Constructing Explanations and Designing Solutions)*

CONCEPTUAL TOOLS

WEAVING FACTS & VALUES IN DECISION-MAKING

GROUP DECISION-MAKING

VOCABULARY DEVELOPMENT

decision-analysis tool
a tool that systematically breaks down a decision by mathematically weighing the facts and values related to the decision

MATERIALS & ADVANCE PREPARATION

FOR THE TEACHER

- VISUAL AID, 7.1 "Read, Think, and Take Note Guidelines" (OPTIONAL)
- VISUAL AID 7.2 "Scoring Guide: Decision-Making (DM)" (OPTIONAL)
- ITEM-SPECIFIC SCORING GUIDE: Activity 6, Build Understanding item 1

FOR THE CLASS

- SURVEY RESULTS FROM ACTIVITY 3

FOR EACH GROUP OF FOUR STUDENTS

- BUILDING INITIATIVE FACT SHEETS (A–D)

FOR EACH PAIR OF STUDENTS

- COMPUTER WITH INTERNET ACCESS

FOR EACH STUDENT

- STUDENT SHEET 7.1 "Building Initiative Information"
- STUDENT SHEET 7.2 "Writing Frame: Decision-Making" (OPTIONAL)
- STUDENT SHEET 7.3 "Decision-Analysis Tool: Manual Calculation" (OPTIONAL)
- SCORING GUIDE: Decision-Making (DM) (OPTIONAL)

If you do not have computer accessibility, you can create a printed version of this activity by printing the optional Student Sheet 7.3, "Decision-Analysis Tool: Manual Calculation." Read through the student and teacher instructions to further determine how to modify the activity for use offline with your students.

TEACHING NOTES

Suggestions for **discussion questions** are highlighted in gold.

Strategies for the **equitable inclusion of diverse students** are highlighted in pink.

GETTING STARTED (10 MIN)

1 **Brainstorm day-to-day experiences that are related to greenhouse gas emissions.**

- Before students open their Student Books to the activity, revisit the primary goals of Project REV with the class: *reduce harmful greenhouse gas emissions.* Until now, students have been focused on electricity generation and distribution as a major solution to the problem. Ask, What other activities contribute to greenhouse gases other than electrical energy generation? Expect students to identify transportation and energy to make products.

- Have students read the introduction and review the other areas of significant greenhouse gas emissions identified in the first paragraph. Together, brainstorm examples of how they are part of everyday life.
  - Goods and services: everything bought and used in the built world, includes industrial processes to make those goods
  - Transportation: cars, trucks, trains, buses, planes
  - Buildings and construction: original construction (related to goods and services) and running the building with lights, heat, devices, etc.
  - Agricultural practices: deforestation, cattle farming, monocultures, etc.

- With students, compare their responses to the Global Greenhouse Gas Emissions by Sector diagram in the Student Book. Help students translate the sectors into their everyday experiences and activities. Students may notice that the building emissions quoted in the introduction are higher than in the "Energy use in buildings" section of the diagram. Challenge them to figure out why that is the case. It is because the estimate in the introduction includes large portions of other sectors, such as unallocated fuel combustion, iron and steel production, cement, transportation, petrochemical manufacturing, etc.

  TEACHER'S NOTE: For a detailed description of each sector, see References for the webpage where the chart appears.

- Ask, What does the diagram say about the role of energy in greenhouse gas emissions? Students should be able to see that energy-related activities make up almost three-fourths of all greenhouse gas emissions.

- Recall that the stakeholder @GrannySmithJr in Activity 2 posted about how greenhouse gas emissions from buildings were very high (which was subsequently found to be credible in the activity). @GrannySmithJr wanted to address that problem before developing renewable energy generation. Point out that with enough money to do both, these initiatives could work together.
- Let students know that in this activity, they will make a decision from the perspective of the City Council. They will make a recommendation on the City Council's behalf.

PROCEDURE SUPPORT (40 MIN)

2 Introduce the scenario for the building initiatives.

- As students read the scenario in their Student Books, let them know that this activity does not deal with generation as in the previous activities; however, it explores another way to reduce greenhouse gas emissions. This is only one of several approaches that can support Project REV. Others could include grid upgrades, reusing discarded materials, or reducing greenhouse gas emissions in transportation. This activity exemplifies that greenhouse gas emission reductions can be reduced in many ways. These reductions can be implemented concurrently with the development of renewable energy generation.
- Distribute the Building Initiative Fact Sheets A–D. Provide each group with all four sheets. Have students read all four initiatives and answer any questions related to the initiatives.
- Support students' reading comprehension as they read the Building Initiative Fact Sheets with the literacy strategy of Read, Think, and Take Note. This provides an opportunity for students to record their thoughts, reactions, and questions on sticky notes as they read. The notes serve to make concrete the thoughts arising in their minds and then serve as prompts to generate conversation or write explanations. You can use Visual Aid 7.1, "Read, Think, and Take Note Guidelines," to review this literacy strategy. If your students are unfamiliar with the strategy, it can be helpful to demonstrate with a short passage of simple text, such as the introduction to the activity. For more information about the Read, Think and Take Note strategy, see Appendix 1: Literacy Strategies.

3 Familiarize students with using the Decision-Analysis Tool computer app.

- Before beginning the procedure, introduce the online Decision-Analysis Tool as a thinking tool that can help to weigh facts and values related to a decision when choosing between options. Emphasize that this digital app is a concrete tool that supports decision analysis.
- Review the concept of weighted values introduced earlier in this unit (in Activity 3). Recall how students used points to prioritize a list of values. Students will have to weight values numerically to use the app.

- Introduce the idea of using a fact to evaluate an option, which is done in the bottom part of the app. To illustrate this, provide a simple example: Imagine someone deciding on a snack who has the value of eating nutritious food. The nutritional facts of each snack option shows that a bowl of vegetable chili fulfills the value of nutrition better than the cake. In the app, there is a scale of 0 (the value is not fulfilled at all) to 4 (the value is completely fulfilled). If the app was used to inform the decision for the snack, the cake option might have a rating of 0, and the vegetable chili option a rating of 4.

- Model how to work the app with a simple example to illustrate the principles of weighting the facts and values:

  - Imagine your school club is trying to decide what kind of food to sell at your club's end-of-year fundraiser. You are choosing between candy, muffins, or sandwiches.

  - First, you send out a survey to members of the club (stakeholders) and gather their values. You learn that 40% think that cost is the most important, 35% said the food's popularity was most important, and 25% said ease of transporting was the most important.

  - After putting this information into the app, you need to find out some facts about these three options. These facts can be summarized as follows:

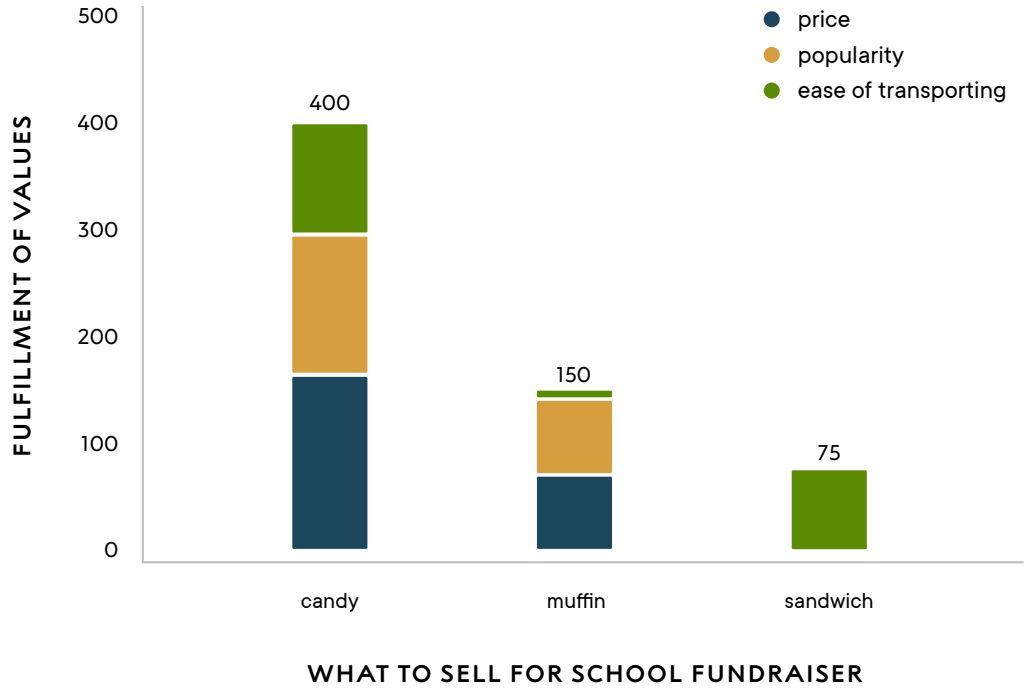
    OPTION 1
    Candy is the least expensive, the most popular, and the easiest to transport.

    OPTION 2
    Muffins are in between the other two in price and popularity, and it is the least easy to transport due to its squishability.

    OPTION 3
    Sandwiches are the most expensive, the least popular, and in between the other two for ease of transporting.

  - Entering these facts and values together in the app shows that the candy is the best choice according to the app, as shown in Figure 7.1 on the following page.

FIGURE 7.1
Decision-Analysis Tool Screenshot



- Discuss with students how the answer would change if the values were different—for example, if nutrition was one of the top values.
- It is important to remind students that the app provides advice but does not make the decision. If students were running the fundraiser, it would be okay to realize that perhaps there were other values not accounted for. They could either run the app again after adjusting the values or reflect on how the app informs the decision.
- Ask, How does the Decision-Analysis Tool integrate the facts and values? If students can't quite figure it out, let them know that it integrates the facts and values by assessing how well each option fulfills a given value based on the facts related to that option. The app takes into account the value weights and option ratings for each option, adds up all (value weight x option rating) for each option, and then displays it on the graph. This allows for a direct comparison of all options.

4 Support students as they use the Decision-Analysis Tool to decide on a building initiative.

- As students begin the procedure, distribute Student Sheet 7.1, "Building Initiative Information." Filling in the tables will help students understand the information they need to input into the app.
- If students do not have individual Internet access and are calculating the results from the Decision-Analysis Tool manually, explain how to use the following formulas. This calculation is supported by optional Student Sheet 7.3, "Decision-Analysis Tool: Manual Calculation."

Value 1 Decision Score = (Value 1 weight x option rating 1)
+ (Value 1 weight x option rating 2)
+ (Value 1 weight x option rating 3)
+... continue

Likewise, the Decision Scores for the other values are:

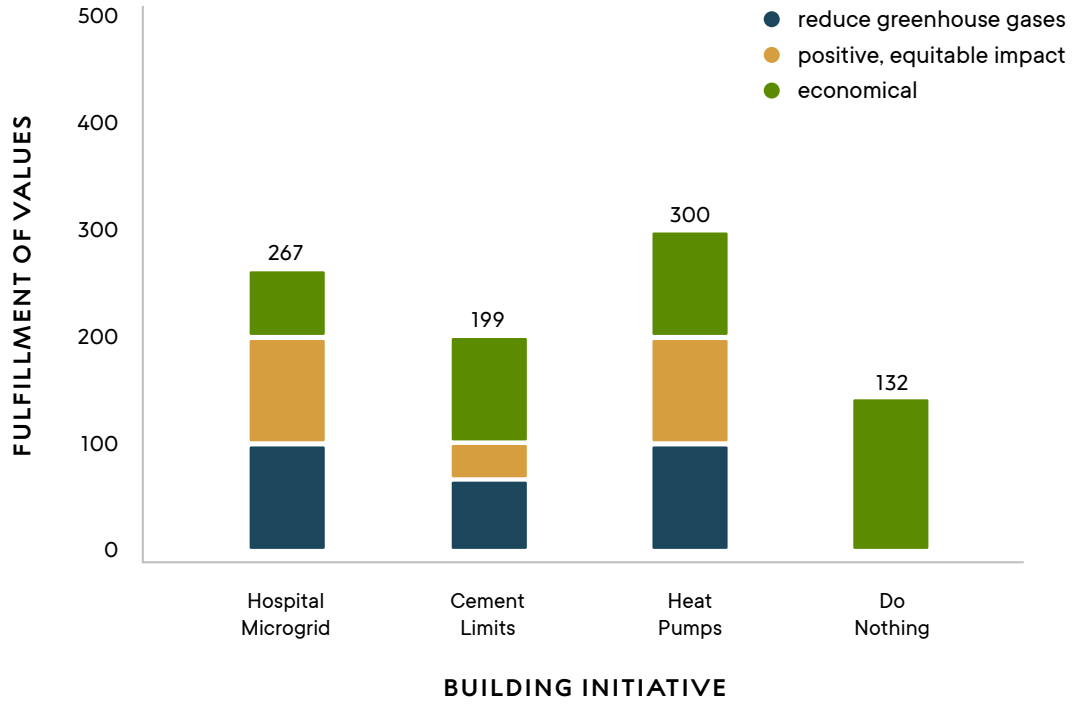
Value 2 Decision Score = (Value 2 weight x option rating 1)
+ (Value 2 weight x option rating 2)
+ (Value 2 weight x option rating 3)
+... continue

and

Value 3 Decision Score = (Value 3 weight x option rating 4)
+ (Value 3 weight x option rating 5)
+ (Value 3 weight x option rating 3)
+... continue

- When students run the Decision-Analysis Tool, they will get a variety of responses based on how they rate the facts. Initiative A: Microgrids and Initiative C: Heat Pumps usually come out with the highest values in the app. Figure 7.2 on the following page shows one sample response.

FIGURE 7.2
Sample Student Response, Procedure Step 6



- In Procedure Step 9, encourage students to be clear in their one-sentence recommendations. Responses will vary. The following shows one sample response.

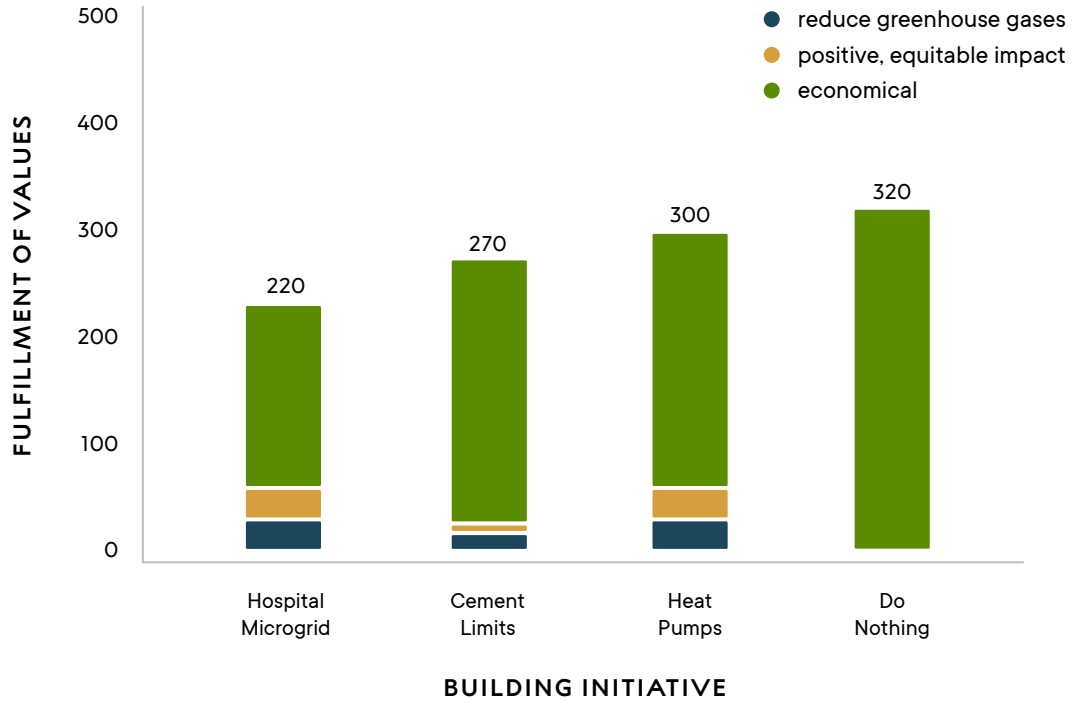
Sample Student Response, Procedure Step 9

The Vanwick City Council announces that it supports Building Initiative C: Heat Pumps! This program will help reduce greenhouse gases, positively impact lots of people in the city, and will be cost-effective compared to other plans.

5 Support students in seeing how values impact decisions.

- In Procedure Steps 11–12, students should first predict and then find that the heavily weighted economic value changes the decision. App responses will vary, but most often the numbers favor Initiative D: Do Nothing, as shown in Figure 7.3 on the following page.

FIGURE 7.3
Sample Student Response, Procedure Steps 11-12



- Through this exercise, students should see clearly that different decisions can be made using the same facts, even when the values are different. One option would help accomplish the Project REV goal of reducing emissions, and the other would not. This also reinforces the role of weighted values introduced in Activity 3.
- If time allows, let students move the three value sliders to show different weights and compare the results.

SYNTHESIS OF IDEAS (20 MIN)

6 Reflect on the process of group decision-making.

- Elicit student ideas about what kind of decisions the Decision-Analysis Tool would be most helpful for and where it has limitations. Students should see, through their experiences, that complicated decisions with multiple choices benefit the most from being broken down into components. Likewise, the app does not capture all the complexities of a decision. There could be missing facts or ideas that are not quantitative that are overlooked. Emphasize again that the tool is for informed consideration, and the highest score from the app does not mandate that decision.
- When finishing the activity, discuss whose ideas were left out of the decision and why they were overlooked. If the values were not weighted highly enough to show up on the survey summary, their values were not included in the app. Ask, If you know some people's values are overlooked, what could you do about it? Responses will vary but some ideas may include adding more values to the app, seeking out what the overlooked values are, giving another survey, or using the app as only part of the decision-making process. Use this discussion to emphasize the important role of values in a complex group decision.

7 Use the Decision-Making Scoring Guide to assess responses to Build Understanding item 1.

- Remind students of the Decision-Making Scoring Guide. You may wish to project a copy of Scoring Guide: Decision-Making (DM) for your students to review each level and clarify your expectations.
- Do not share Item-Specific Scoring Guide: Activity 7, Build Understanding item 1 with students as it provides specific information on how to respond to the question prompt.
- For students who need support organizing and writing their responses, you may wish to provide optional Student Sheet 7.2, "Writing Frame: Decision-Making" to compose their response. Students could also use Student Sheet 7.2 only as a reference or as a checklist as they write their responses. A sample student response for this student sheet is shown at the end of this activity. For more information on a Writing Frame, see Appendix 1: Literacy Strategies.

- Remind students that you expect to see them demonstrate growth in their understanding and explanation of decision-making, and they may want to review their responses to the assessment in Activity 4 (Build Understanding item 1) and/or Activity 6 (Build Understanding item 1). You may also want to let students know that they will have one more opportunity in the unit to be assessed (Activity 10, Build Understanding item 1).
- Depending on your students, you may want to have them provide feedback on one another's work for revision prior to turning in the work to you for scoring. Alternatively, consider having students turn in a rough draft to you for feedback and revision.
- Sample responses for Levels 1–4 are provided in the Build Understanding section that follows. Review these responses to get an idea of what is expected for each level, alongside the Item-Specific Scoring Guide. See Appendix 2: Assessment Resource for more guidance and information on using the Scoring Guides and assessment system with your students.
- Conclude the activity by revisiting the Guiding Question, How can a decision-analysis tool help make group decisions? Use student responses to evaluate if your students are able to identify the essential ideas of the activity.

EXTENSION (10 MIN)

8 **Use the Extension as an opportunity for advanced learning.**

Students can connect the scenario to the issues being decided in their own community. If they are not familiar with an energy decision the town is facing—such as things related to development projects, redistricting, or what to cut when facing a budget deficit—have them speak with their parents or look at a government-sponsored website for information. In most cases, the app could be helpful to bring people together to look for a solution that would satisfy the greatest number of people.

SAMPLE STUDENT RESPONSES

BUILD UNDERSTANDING

① DM Scoring Guide

Consider the initiatives proposed in this activity. If you were a resident of Vanwick making a recommendation for the City Council on Initiatives A–D, which initiative would you recommend? Explain your decision and include the following:

- the relevant facts and stakeholder values and how they affected your decision
- the predicted outcome(s) of your decision
- any trade-offs involved in your decision

The sample responses that follow recommend Initiative C: Heat Pumps, but this does not indicate that C is the correct choice. The response should be assessed based on the student's support of their recommendation with relevant facts and values, predicted outcomes, and inclusion of trade-offs.

Level 4 response

If I were a resident of Vanwick, I would recommend the Vanwick Heat Pump initiative (Initiative C) because I think it is the best choice when all the facts, values, and trade-offs are considered. Heat pumps do not produce greenhouse gases as long as they are run off of electricity from renewable energy sources. They are more efficient than older heating and cooling systems, so they use less energy. These facts support the stakeholder values of reducing overall greenhouse gas emissions and being cost-effective. There is the trade-off of producing some greenhouse gases in making and installing the heat pumps, but long term, there will be an overall reduction of greenhouse gases. Also, city buildings—including elementary schools, the library, and the firehouse—will have air conditioning, and there will be a cooling center at the library for people to use during future heat waves. Overall, this initiative works well with stakeholder values and is the best choice for Vanwick.

Level 3 response

If I were a resident of Vanwick, I would recommend the Heat Pump initiative. Heat pumps do not produce greenhouse gases and are more efficient than older heating systems. These facts support the stakeholder value of reducing greenhouse gas emissions. Installing heat pumps will mean more efficient use of energy and provide air conditioning in some buildings and a cooling center. The trade-off is that there are some emissions produced in making the heat pumps.

Level 2 response

If I were a resident of Vanwick, I would recommend the Heat Pump initiative. They don't produce greenhouse gases, and that's a stakeholder value. There will also be cooling centers.

Level 1 response

I would recommend the Heat Pump initiative because it is the best choice. It will be expensive and still produce some greenhouse gases. It also might be difficult for builders.

② **What factors might lead you to make a group decision that is different from the numerical result from the Decision-Analysis Tool?**

Answers can vary. One sample response is shown here.

Using the number is really helpful, but the app is supposed to inform the decision and not necessarily make the decision. For example, there could be a situation where an important population in Vanwick was not included in the survey. They might hold a minority value that was not represented in the app, but an important one, so that should be considered in the final decision.

CONNECTIONS TO EVERYDAY LIFE

③ **Think about a significant decision that you must make in the near future. Use the Decision-Analysis Tool to evaluate your choices. Did the results of the Decision-Analysis Tool help you make the decision? Explain why or why not.**

The Decision-Analysis Tool said I should definitely get a job at a coffee shop. It helped me because it was not the same decision I arrived at when I was breaking it down in my head. It was good to think about it more before deciding.

REFERENCES

2022 Global Status Report for Buildings and Construction. (November 9, 2022). United Nations Environment Programme. Retrieved from https://www.unep.org/resources/publication/2022-global-status-report-buildings-and-construction

Ritchie, H. (2020). Sector by sector: Where do global greenhouse gas emissions come from? Our World in Data. Retrieved from: https://ourworldindata.org/ghg-emissions-by-sector

STUDENT SHEET 7.1	BUILDING INITIATIVE INFORMATION	NAME

TABLE 1: VALUES

STAKEHOLDER VALUE	DESCRIPTION	WEIGHT
1		
2		
3		
TOTAL		

TABLE 2: EVALUATING FACTS

OPTIONS	VALUE 1		VALUE 2		VALUE 3	
	FACTS	RATING	FACTS	RATING	FACTS	RATING
A: Hospital Microgrid						
B: Cement Limits						
C: Heat Pumps						
D: Do Nothing						

TABLE 1: VALUES

STAKEHOLDER VALUE	DESCRIPTION	WEIGHT
1	*reduce greenhouse gas emissions*	*33*
2	*positive, equitable impact on residents*	*34*
3	*cost-effective*	*33*
TOTAL		*100*

TABLE 2: EVALUATING FACTS

OPTIONS	VALUE 1		VALUE 2		VALUE 3	
	FACTS	RATING	FACTS	RATING	FACTS	RATING
A: Hospital Microgrid	*good, except for building*	*3*	*supports vulnerable, but not everyone*	*3*	*most expensive, but eventually bills are $0*	*2*
B: Cement Limits	*most are elsewhere, small amount*	*2*	*difficult for builders*	*1*	*relatively low cost*	*3*
C: Heat Pumps	*makes a difference*	*3*	*city-only buildings*	*3*	*2nd most expensive, have to keep paying for electricity*	*3*
D: Do Nothing	*emissions keep increasing*	*0*	*doesn't help anyone*	*0*	*no cost*	*4*

I/we/they have decided

The value(s) that I/we/they are weighting most heavily is

One fact related to the value is

A second fact related to the value is

Together, these facts and values affect the decision because

The likely outcome of this decision is

(OPTIONAL) **The trade-offs of this decision were**

(OPTIONAL) **This decision involved compromising about**

I/we/they have decided

that Vanwick should choose the Vanwick Heat Pump Initiative.

The value(s) that I/we/they are weighting most heavily is

of reducing overall greenhouse gas emissions and being cost-effective.

One fact related to the value is

that heat pumps do not produce greenhouse gases if they are powered by renewable energy.

A second fact related to the value is

that they cost less to run because they are more efficient than older heating and cooling systems.

Together, these facts and values affect the decision because

it means that the choice of the Heat Pump Iniative can fulfill both of the city's values.

The likely outcome of this decision is

that the energy costs will be reduced and the city buildings will have air conditioning. There will be a cooling center at the library for people to use during a heat wave.

(OPTIONAL) **The trade-offs of this decision were**

that greenhouse gases are produced when making and installing the heat pumps, so the emissions savings are not immediate.

(OPTIONAL) **This decision involved compromising about**

N/A

DECISION-ANALYSIS TOOL: MANUAL CALCULATION

NAME

Add Option | Subtract Option | Add Value | Subtract Value

What are you deciding?	OPTION 1	OPTION 2	OPTION 3	OPTION 4
Building Initiative	Hospital Microgrid	Cement Limits	Heat Pumps	Do Nothing

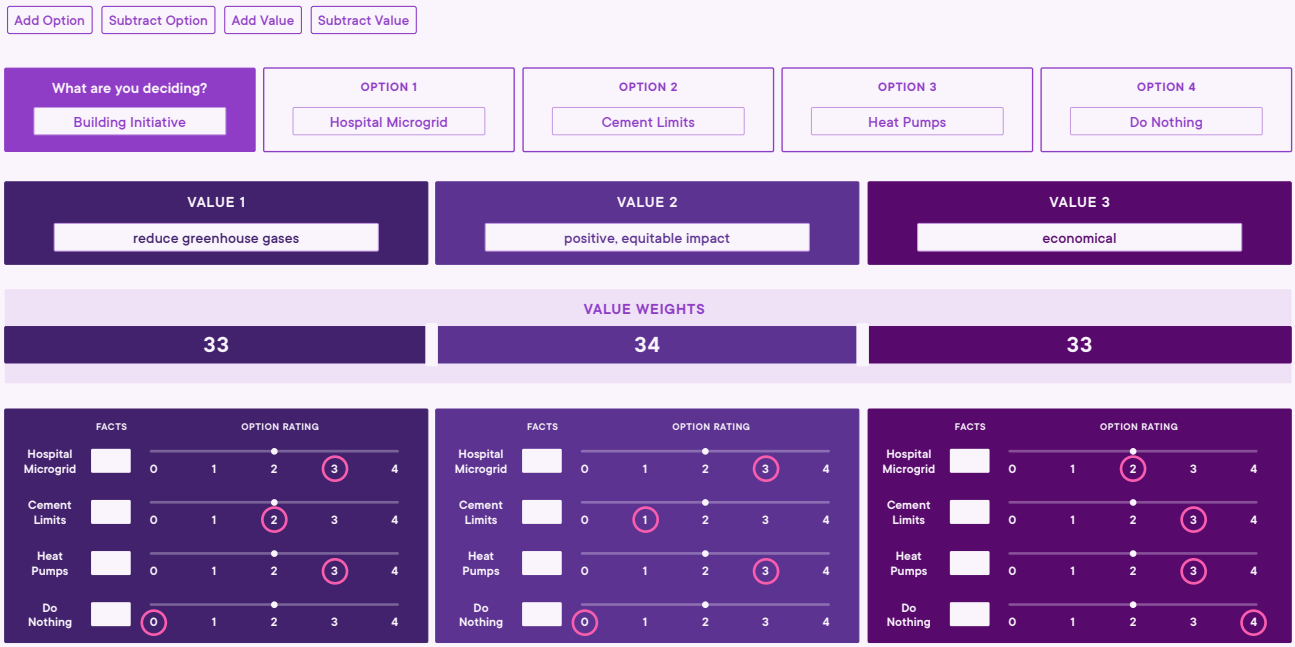
VALUE 1	VALUE 2	VALUE 3
reduce greenhouse gases	positive, equitable impact	economical

VALUE WEIGHTS

33	34	33

FACTS	OPTION RATING	FACTS	OPTION RATING	FACTS	OPTION RATING
Hospital Microgrid	0 1 2 3 4	Hospital Microgrid	0 1 2 3 4	Hospital Microgrid	0 1 2 3 4
Cement Limits	0 1 2 3 4	Cement Limits	0 1 2 3 4	Cement Limits	0 1 2 3 4
Heat Pumps	0 1 2 3 4	Heat Pumps	0 1 2 3 4	Heat Pumps	0 1 2 3 4
Do Nothing	0 1 2 3 4	Do Nothing	0 1 2 3 4	Do Nothing	0 1 2 3 4

OPTION	WEIGHT x OPTION RATING			TOTAL
	VALUE 1	VALUE 2	VALUE 3	
1				
2				
3				
4				



OPTION	WEIGHT x OPTION RATING			TOTAL
	VALUE 1 *reduce greenhouse gases*	VALUE 2 *positive, equitable impact*	VALUE 3 *cost-effective*	
1	*33 x 3 = 99*	*34 x 3 = 102*	*33 x 2 = 66*	*267*
2	*33 x 2 = 66*	*34 x 1 = 34*	*33 x 3 = 99*	*199*
3	*33 x 3 = 99*	*34 x 3 = 102*	*33 x 3 = 99*	*300*
4	*33 x 0 = 0*	*34 x 0 = 0*	*33 x 4 = 132*	*132*

Read, Think, and Take Note Guidelines

Stop at least three times during each section of the reading to mark on a sticky note your thoughts or questions about the reading.

As you read, use a sticky note from time to time to:

- explain a thought or reaction to something you read.
- note something in the reading that is confusing or unfamiliar.
- list a word from the reading that you do not know.
- describe a connection to something you've learned or read previously.
- make a statement about the reading.
- pose a question about the reading.
- draw a diagram or picture of an idea or connection.

After writing a thought or question on a sticky note, place it next to the word, phrase, sentence, diagram, drawing, or paragraph in the reading that prompted your note.

After reading, discuss with your partner the thoughts and questions you had while reading.

VISUAL AID 7.2 | SCORING GUIDE: DECISION-MAKING (DM)

WHEN TO USE THIS SCORING GUIDE:

This Scoring Guide is used when students are explaining a decision (sometimes in the form of a recommendation) that incorporates relevant facts and values and predicts possible outcomes.

WHAT TO LOOK FOR:

- Response incorporates and explains the effects of relevant facts and stakeholder values on the decision.
- Response identifies trade-offs (if appropriate).
- Response describes any compromises made (if appropriate).

LEVEL	GENERAL DESCRIPTION
Level 4 **Complete and correct**	The student explains a decision made from two or more options that incorporates: • one or more relevant stakeholder values. • the facts associated with those values. • how the facts and values affected the decision. • predicted outcome(s) supported by the relevant facts. • pny trade-offs made as a result of weighing the relevant facts and values (if appropriate). • any compromise made by stakeholders (if appropriate).
Level 3 **Almost there**	The student explains a decision made from two or more options that incorporates most of the following, BUT one or more may be insufficiently described: • one or more relevant stakeholder values • the facts associated with those values • how the facts and values affected the decision • predicted outcome(s) supported by the relevant facts • any trade-offs made as a result of weighing the relevant facts and values (if appropriate) • any compromise made by stakeholders (if appropriate)

LEVEL	GENERAL DESCRIPTION
Level 2 **On the way**	The student provides a clear and relevant decision, BUT the explanation of supporting facts and values is incomplete.
Level 1 **Getting started**	The student provides a clear and relevant decision BUT provides inaccurate or unrelated facts, unrelated values, and/or an illogical explanation of the decision.
Level 0 **Missing or off task**	Student response is missing, illegible, or irrelevant.
X	The student had no opportunity to respond.

WHEN TO USE THIS SCORING GUIDE:

This Scoring Guide is used when students are explaining a decision (sometimes in the form of a recommendation) that incorporates relevant facts and values and predicts possible outcomes.

WHAT TO LOOK FOR:

- Response incorporates and explains the effects of relevant facts and stakeholder values on the decision.
- Response identifies trade-offs (if appropriate).
- Response describes any compromises made (if appropriate).

LEVEL	GENERAL DESCRIPTION	ITEM-SPECIFIC DESCRIPTION
Level 4 **Complete and correct**	The student explains a decision made from two or more options that incorporates: • one or more relevant stakeholder values. • the facts associated with those values. • how the facts and values affected the decision. • predicted outcome(s) supported by the relevant facts. • any trade-offs made as a result of weighing the relevant facts and values (if appropriate). • any compromise made by stakeholders (if appropriate).	**The student explains which initiative they would recommend to the City Council, incorporating the following:** • 2–3 relevant facts • relevant stakeholder values (such as reduce emissions, positive equitable access, cost-effective) • how facts support particular options • predicted outcomes • clear description of trade-off(s) **However, specific facts, values, outcomes, and trade-offs will vary depending on the initiative being recommended. There is no correct initiative choice.**

LEVEL	GENERAL DESCRIPTION	ITEM-SPECIFIC DESCRIPTION
Level 3 **Almost there**	The student explains a decision made from two or more options that incorporates most of the following, BUT one or more may be insufficiently described: • one or more relevant stakeholder values • the facts associated with those values • how the facts and values affected the decision • predicted outcome(s) supported by the relevant facts • any trade-offs made as a result of weighing the relevant facts and values (if appropriate) • any compromise made by stakeholders (if appropriate)	**The student explains which initiative they would recommend to the City Council, incorporating the following, BUT one or more may be insufficiently described:** • 2–3 relevant facts • relevant stakeholder values (such as reduce emissions, positive equitable access, cost-effective) • how facts support particular options • predicted outcomes • clear description of trade-off(s) **However, specific facts, values, outcomes, and trade-offs will vary depending on the initiative being recommended. There is no correct initiative choice.**

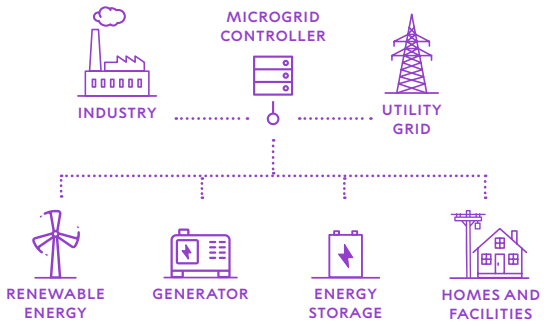
LEVEL	GENERAL DESCRIPTION	ITEM-SPECIFIC DESCRIPTION
Level 2 **On the way**	The student provides a clear and relevant decision, BUT the explanation of supporting facts and values is incomplete.	The student explains which initiative they would recommend to the City Council, but the explanation of supporting facts and values is incomplete (e.g., only one fact, not including values, not stating possible outcomes) and/or is missing trade-offs relevant to their plan.
Level 1 **Getting started**	The student provides a clear and relevant decision BUT provides inaccurate or unrelated facts, unrelated values, and/or an illogical explanation of the decision.	The student explains which initiative they would recommend to the City Council BUT provides inaccurate or unrelated facts, unrelated values, and/or an illogical explanation of the decision.
Level 0 **Missing or off task**	Student response is missing, illegible, or irrelevant.	
X	The student had no opportunity to respond.	

INITIATIVE A

VANWICK COMMUNITY HOSPITAL MICROGRID

BACKGROUND

A microgrid includes one or more energy sources (and a distribution system) located near the end user. It includes the energy generation, a smart grid-controlling system, energy storage, and connected electrical devices. Microgrids work primarily as an independent energy system, but some microgrids are still connected to the local grid so it can draw from it when more power is needed. If the microgrid has excess power, it can give it back to the grid for others to use.



DESCRIPTION

The Vanwick Community Hospital Microgrid Initiative plans to cut down greenhouse gas emissions by building a microgrid at the regional hospital campus. It will provide all the power for all the heating, cooling, lights, and medical devices that are needed for the hospital campus of 10 large buildings. It will depend on renewable generation through solar panels placed on the building roofs and parking garages and in a large field on campus. Less energy will be needed overall due to a complex control system that will respond to the changes in the electricity demand in the buildings and the supply coming in from the solar panels. While the microgrid will stay connected to the grid, a second backup in the form of a diesel generator will be included. This is for the very unlikely, but possible, future scenario in which electricity is completely cut off and medical services become critical.

BENEFITS

- Estimates are that the buildings will rarely need to draw power from the Vanwick grid, thereby reducing, over time, the electricity costs to zero for the hospital.
- Since the power does not have to be transmitted over distances, the typical loss of 5% of the power will be eliminated. This is equal to about 50 MW less generation needed per year.
- Not having to transmit the electricity over long-distance transmission wires also reduces the risk of fire in wildfire-prone areas, such as Vanwick.
- The microgrid does not emit greenhouse gas emissions while in operation. There will be greenhouse gas emissions released while making and installing it.

WHO IT IMPACTS

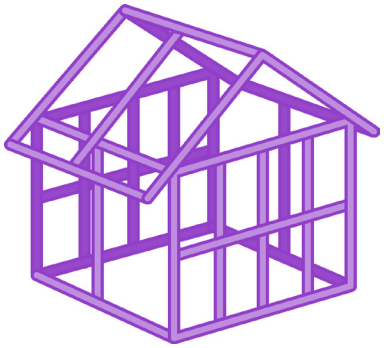
- Everyone working or staying at the hospital buildings.
- Cost: $5 million.
- This option is the most expensive of the initiatives with an initial cost of $5 million. It will take 10 years to recover the costs in savings, and after that, the electricity will be free; the only cost will be for maintenance.

INITIATIVE B

VANWICK CEMENT LIMITATIONS

BACKGROUND

Although the cement industry uses less than 1% of US energy, it is the most energy-intensive of all manufacturing industries. Cement is unique in its heavy reliance on coal and petroleum. Cement is mostly used as a binder in concrete, which is a basic material for all types of construction—including buildings, roads, dams, and ports—and applications such as walls, foundations, patios, and even sculptures.



DESCRIPTION

This proposed initiative aims to place strict limitations on using cement in building projects, both new buildings and renovations in existing buildings. This initiative would place a ban on new cement for buildings in Vanwick, both city-owned and privately owned. As a result, no new concrete building foundations can be built. This initiative requires removal of concrete in asphalt in the building of new roads, driveways, and sidewalks. New construction projects will switch to wheelchair accessible porous materials that take less energy to build and are friendlier to the environment overall. New construction would need to repurpose old buildings instead of building ones with new concrete foundations. In the event that non-concrete materials won't work, there is an exception to the limitations for essential buildings, such as schools and hospitals. This initiative would provide money for contractors that use renewable local timber materials and repurposed building materials. Grants will also be given to universities and companies to support research on energy-friendly alternative cements.

BENEFITS

- This initiative will reduce the amount of greenhouse gases that are emitted in the production of the cement used in Vanwick.
- It will not have a significant impact on the power needs or electric bills in Vanwick, as cement is made outside the city.
- Vanwick could help reduce greenhouse gas emissions to zero by leading significant change in building approaches.

WHO IT IMPACTS

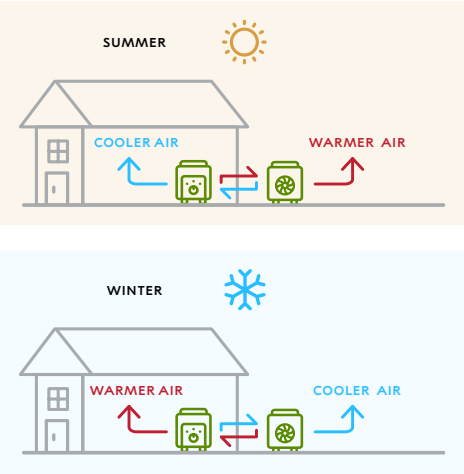
- This new rule will impact those who are building houses now or in the future.
- Cost: $1 million.
- This initiative is relatively low cost because it is made up of new rules and incentives.

INITIATIVE C

VANWICK HEAT PUMPS

BACKGROUND

A heat pump is a single electric device that works as both air conditioning and heating. Unlike conventional systems, heat pumps don't generate heat or cool air; instead, heat pumps transfer heat energy. In warmer months, it pulls heat out of indoor air and transfers it outdoors to cool your home, like air conditioning. In cooler months, a heat pump pulls heat from the cold outdoor air and transfers it indoors. Heat pumps move heat around more efficiently than traditional systems and use one-third the energy of conventional heating systems. Heat pumps have been used in homes since the 1960s, but it is only more recently that the technology has evolved to make them work better. In very cold climates, however, heat pumps may need additional heating technology or a backup furnace. Heat pumps support electrification because they run on electricity and not fossil fuels, as conventional furnaces do.



DESCRIPTION

This initiative would replace all the heating and cooling systems in Vanwick's city-owned buildings with heat pumps. In Vanwick, the winters are not severe, so the heat pumps would rarely use any backup furnaces; natural gas furnaces would be kept for emergencies. In addition to installing the new systems, there will need to be some ductwork improvements in some older buildings. Some of the older city buildings—such as the library, elementary schools, and the firehouse—will now have air conditioning installed where they previously did not. This initiative will also provide money to establish a cooling center at the library for heat waves.

BENEFITS

- In most buildings, about half the energy use is for heating and cooling. This initiative will decrease the total amount of energy used by buildings because the new system will be more efficient than the old systems.
- While the amount of fossil fuels needed will decrease, the amount of electrical energy used will increase since the heating system will now run off electricity.
- The heat pump does not emit greenhouse gas emissions while in operation. (Note: There will be greenhouse gas emissions released while making and installing heat pumps.)
- Vanwick could also consider possible future initiatives that require heat pumps in private buildings, thereby significantly increasing the savings.

WHO IT IMPACTS

- The city won't have to pay as much to heat and cool its buildings. The initiative will benefit those working in the buildings and those who would benefit from being in a cooling center during the next heat wave.
- Cost: $2.5 million.
- While the cost of installing a heat pump is more than a traditional heating and cooling system, the savings on energy expenses will recover the extra cost from installation in 5 years.

INITIATIVE D

DO NOTHING

BACKGROUND

When groups can't decide which course of action to take, sometimes no decision becomes the decision.

DESCRIPTION

No action is to be taken. The status quo of emitting greenhouse gases from buildings would continue into the future.

BENEFITS

- There is no effort or investment.
- Cost: $0
- No jobs would be created or lost as a result of this initiative.

WHO IT IMPACTS

- Greenhouse gas emissions will continue to increase and affect people, animals, and the entire planet.