

INQUIRY CHAPTER SIX

A Low Carbon Future: Economic risks, transitions and impacts



EMPOWERING LEARNERS IN A WARMING WORLD

A Climate Change Inquiry Guide for Secondary Educators

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6. A Low Carbon Future: Economic Transitions, Risks and Impacts

This inquiry explores the connection between the economy and the environment. This relationship may be somewhat less intuitive for students than some of the other dimensions (environmental, social, and health). However, through research opportunities, case studies, current events and news, discussion and debate, students will come to grasp economic risks and opportunities for businesses to be leaders in addressing climate change, both locally and globally. Students will explore how personal consumption contributes to climate change, and what personal changes as well as changes in consumer culture must be made in order to mitigate climate effects.



Photo by James Anderson, World Research Institute

Before you Begin: Background Information for Educators

Economic activity and environmental changes are closely intertwined. Looking ahead, there are many ways in which Canadian citizens may pay a price for the effects of climate change. A recent report released by the Bank of Canada in May 2019 acknowledged that Climate Change poses a threat to Canada's economy and financial system. As one very clear example, the Canadian economy is heavily reliant on natural resources, comprising almost 50% of exports ([Natural Resources Canada, 2019](#)) and so the future of Canada's export economy is heavily defined by the natural environment. Canada's economy and job market will look very different

due to the changing climate and national efforts to mitigate it. Many jobs that are central to our economy now may be obsolete in 10 years, and new jobs and careers are emerging by the day. Therefore, it is important for educators to consider how best to prepare students to work and live in a world that has felt the effects of climate change and shifted in many ways because of it.

Regional Variation in Economic Impact

A recurring theme throughout this guide is the variation that exists across such a diverse country like Canada, and the same can be said for prediction of economic impact. Some of the differences that may emerge across the country are: large cities will feel the effects of poor air quality and rising temperatures more heavily due to the large population, leading to an increasing health care costs treating associated illnesses (Paying the Price, Economic Impacts of Climate Change for Canada); the timber supply in Western Canada will be impacted significantly by issues such as pests and forest fires, costing the Canadian economy upwards of \$2 billion dollars per year; and coastal regions will feel the impact most heavily in terms of rebuilding infrastructure to adapt to erosion, flooding and rising sea levels. Mitigating threats to these coastal communities will cost the country a huge amount in capital investment to prevent large scale damage. For instance, the estimated cost of setting up protective measures along the Vancouver coast is \$9.5 million (Global News). Alternatively, looking at projected losses for two distinct locations in Canada, according to the Insurance Bureau of Canada in 2015, Halifax's projected losses due to ice storms and extreme wind events is \$18 million by the year 2040, whereas Mississauga projects an annual loss of \$9 million because of ice storms.

Insurance: Infrastructure damage due to extreme weather events could contribute to an increase in insurance premiums. Over the past five years, insurance premiums have risen 20-25%, in large part due to flooding and water levels rising, according to the head of Intact Centre on Climate Change Adaptation at the University of Waterloo. According to Peter Janson, a principal lecturer at the London School of Business and Finance and a specialist in sustainable business development, "The insurance industry is expected to be most affected, as they have to pay for the damage occurring in other sectors."

Food costs: In Canada, extreme weather events and unexpected weather changes are driving food costs higher. According to [Simon Somogyi, a lead researcher from the University of Guelph](#), "Canadian farmers will face challenges in the future dealing with unpredictable crop yields, heat-wave livestock threats, pasture availability, and pest and disease outbreaks". For instance, e-coli outbreaks in Romaine lettuce are likely connected to a warming climate. Many of these extreme weather events can be attributed directly to climate change.

Consumption: The earth's resources are being used and consumed at a faster rate than possible to replenish. In large part, this has to do with overconsumption but also the linear nature of our economy. A linear economy exists when the raw materials that were used to make a product are thrown out at the end of its use, and thus become waste. On the other hand, a circular economy recycles and re-introduces used materials back into production, and materials/services are produced with sustainability, longevity, and repairability in mind.

In Canada, goods and services are consumed without considering the environmental impact. For instance, according to a recent report by [Second Harvest](#), 58% of all food produced in Canada is thrown away. Additionally, according to [Elisa Tonda](#) (Head of the Consumption and Production Unit at the UN Environment Programme) fast fashion and irresponsible purchasing of clothing are a large contributor to the climate crisis; apparel and footwear industries account for more than 8% of global climate impacts.

The Future of Careers in Climate Change: The Green Economy & Climate Opportunities

The environmental impacts of climate change have a [direct effect on the working world](#). Many jobs that rely on ecosystem services, and therefore also on sustainable environmental management (e.g. farming, fishing, forestry, air and water purification, soil fertilization etc.) are immediately threatened by climate change as it deteriorates these natural ecosystems and processes. As well, the rising temperatures are increasing the risks and hazards associated with labour-intensive work. These risks being felt in many sectors of work can be contrasted with a progressive shift to a green economy in many other sectors around the world. Green industries have grown exponentially over the past decades, and according to an InfoDev report in 2014, green industries have evolved from “a niche 1970s environmental aspiration into a competitive force motivating many of the world’s most progressive business planners and boardroom strategists”.

According to National Geographic, the [top eleven growing green jobs](#) include: urban growers, water quality technicians, clean car engineers, recyclers, natural scientists (measuring and monitoring our impacts on the world around us), green builders (including those using ecologically friendly materials), solar cell technicians, green design professionals, wave energy production workers, wind energy workers, and biofuel jobs (increasing, constructing, and producing renewable fuel). In many ways, it is productive and beneficial for students to conceptualize economic changes in the context of the many emerging careers and climate opportunities that accompany these changes. Throughout the upcoming years, there will be an increasing demand for skilled professionals in not only the green jobs mentioned by National Geographic, but also in sectors like urban planning, health care, architecture and information technology just to name a few. By educating and informing students on the subject of green careers, green energy and the green economy, possibly sparking interest in these fields students will enter the workforce more prepared and more capable of being successful in an economy and workforce that will likely look very different from how it does now.

Climate change is a current reality, but the future remains to be determined by the actions that we take now to stop the impacts from intensifying. The current economic impacts exist and are a part of a much larger interconnected story involving the environment, health, cultural dimensions, infrastructure etc. There is an inevitable level of uncertainty that accompanies any climate forecasting; however, there are concrete adaptation measures that can help prevent job losses and negative effects on workers and income. Governments and citizens can contribute to economic protection measures against climate change by investing in infrastructure, the

conservation of treatment water, reforestation, moving to a new energy future (renewables) and skills development to help displaced workers transition to relevant, growing professions.



A. Provocations: Low Carbon Economic Impacts

To hook student interest, chose one or more of the provocation ideas to initiate student thinking.

Idea 1) Videos

[Climate change impact on business](#) [Blair Feltmate on Bloomberg]: 4:07 minutes
Feltmate (Head of the Intact Centre on Climate Adaptation at the University of Waterloo) talks about the possibilities for businesses to adapt planning to take extreme weather and climate change into consideration.

[Is Fighting Climate Change Bad for the Economy](#) [The Year's Project]: 1:44 minutes
Hal Harvey argues that fighting climate change is not bad for the economy.

[Interview with IKEA CEO on being a company that is 'carbon positive'](#) [CNBC]: 3:21 minutes
Ikea's CEO: Jesper Brodin discusses climate change as their largest concern, and speaks to the company's growth in Asia

[Moving to a low-carbon economy](#) [Bank of Canada] 0:47 seconds
This video provides a short explanation on how policies that increase the price of pollution and how changes in consumer habits will impact our economy.

[Why are banks thinking about climate change](#) [Bank of Canada]: 0:52 seconds
Economists considering how climate change will impact the economy in general

[Business case for a sustainable world](#) [Bob Willard] 10:49 minutes
Bob Willard discusses "the big three" justifications for a sustainable global society: do the right thing, capture opportunities, and mitigate risk.

Idea 2) Articles

[Investing in climate change adaptation will pay off big - report says](#) [CBC Article]

[America's 'Green Economy' Is Now Worth \\$1.3 Trillion](#) [Bloomberg News]



B. Question Generation

Below are some guiding questions with a few references to help frame inquiry questions into economic transitions, the economic risk of not transitioning to a low carbon future, and the economic costs of climate impacts. If students are interested in drafting their own questions, then [affinity mapping](#) or [QFT technique](#) or other question-generating methods will work here too

Guiding questions:

1) What are the costs of climate change-induced natural disasters? What is the costliest climate impact for Canadians?

- [Climate Change is making wildfires in Canada bigger, hotter, and more dangerous.](#) *Macleans.*
- [Climate Change and poor planning are fueling more floods. Here's what we can do about it.](#) *CBC.*
- [Climate Change, Floods, and Municipal Risk Sharing in Canada.](#) *Munk School of Global Affairs.*
- Working with data from the Insurance Bureau of Canada, look at the overview graph of Catastrophic losses on pg. 17 and the following tables (pp 18-26) which break down catastrophic losses per year. With this data determine, whether the cost of climate change impacts are increasing and what kind of impacts are the most costly. [Facts of the Property and Casualty Insurance Industry in Insurance.](#) Insurance Bureau of Canada

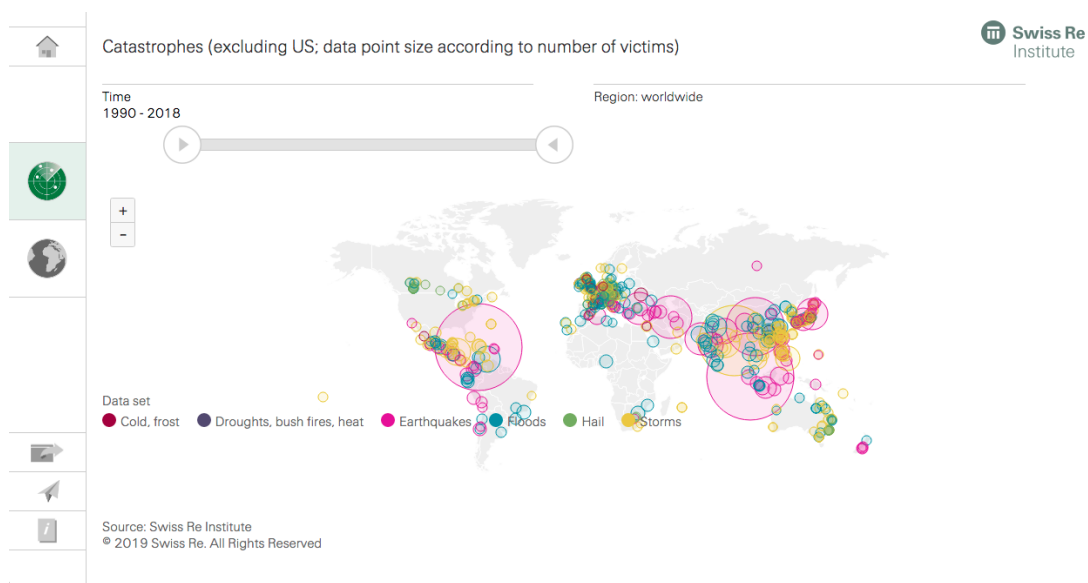
2a) What climate impacts has your community already experienced? What climate impacts should your community be planning for?

- To investigate the climate impacts that your community has already experienced, first begin with students sharing what they know through a [Knowledge Building Circle](#), [think-pair-share](#), or other conversation methods.
- Review local newspaper articles for examples of extreme weather and climate-change-induced natural disasters.
- Then students can explore the historical weather data for your community through the [Climate Atlas of Canada](#). Students can also explore projected climate change impacts

according to numerous variables by selecting two different emission pathways for your community on the Climate Atlas. Refer to Activity 1: Climate Atlas Open Exploration in the Monitoring for Change inquiry for instructions on using this tool.

2b) In terms of climate impacts, how much has your community been affected compared to other locations in the world?

- With students, explore the Swiss Re Institute's [Sigma explorer](#) to review where different climate-change-induced natural disaster events have occurred compared to other regions.



After reviewing, consider a discussion around climate justice (can include researching countries per capita emission rates). Refer to Ethical Dimensions inquiry.

3) What types of investments and businesses face the biggest opportunities for growth as economies shift to low carbon? What are the economic benefits of transitioning to a low-carbon economy? What are some risks? What are stranded assets?

- [Climate change poses risk to financial system](#), Bank of Canada
- [The heat is on: Insurability and Resilience in a Changing Climate. Emerging Risk Initiative - position paper](#). CRO Forum. (2019). Retrieved from: See section 1.4 & 1.5: pp. 13 & 14

4) How will different sectors transition or be impacted either positively or negatively by a low carbon economy?

- [Oil & gas](#)
- [Heavy industry](#)
- [Electricity sector](#)
- [Transportation](#)

5) How could your own personal choices or actions related to consumption either contribute positively (mitigate), or contribute negatively (worsen) to the effects of climate change?

- What choices can you make to contribute to a more sustainable future when it comes to food, goods, and services?
 - It is important to consider four aspects of a purchase: production, transport and retailing, usage, and end of life



C. Knowledge Building

- Students can form a [Learning Circle](#) – based on collective interest after exploring several provocations. For instance, groups could choose to focus on a certain industry or geographic region's economic impacts, mitigation or adaptation strategies, opportunities for green careers, or any other relevant subject that has a collective interest. A good way to begin this process is for each group to agree on a focus question. This stage of inquiry invites the students to actively work to contribute to the collective knowledge of the group, rather than just learning on their own. Small groups of 3-4 students can help ensure that each student has a voice.

Time should be built aside for groups to continue to meet intermittently to build knowledge, refresh understanding with different perspectives, and work together.
 - Groups can be formed using different strategies – knowing your students you will know how to make this process work best.
- **Invite a local community expert** to learn more about the future of the green economy and climate change.

Places to look for a local community expert:

- Environmental non-profit
- Faculty of Economics at a local university or college
- Faculty of Environment at a local university or college
- Economist
- Sustainable Enterprise entrepreneurs

- Sustainable Impact Departments at local businesses or companies
- Research Institutions focused on the Green Economy



D. Determining Understanding

De Bono's Plus Minus Interesting (PMI) Tool

A formative assessment is a useful way to get a sense of students' level of understanding of a subject, and then use the information to help shape the learning environment or process. At this point in the inquiry you may decide to use a tool such as 'Plus, Minus, Interesting.'

The PMI strategy is a critical thinking tool developed by Edward de Bono that allows teachers to determine student understanding of a concept. Students are instructed to write down the positives, negatives and interesting features of a topic, question or situation. This can be done in groups, individually and reviewed, or as a whole class approach to determine future directions of the learning process. For more information on the PMI strategy, check the strategy bank or check [here](#).



E. Pursuing Learning: Impacts and Green Opportunities

At this stage, students will undertake activities to investigate the following:

- Planning for flooding
- How much does carbon cost?
- Green sector careers
- Sustainability Products, Consumer Responsibility

Activity 1: Planning for Flooding

Flooding is the single most costly climate impact in communities across Canada. Being prepared is a proactive and cost-saving adaptation measure that all Canadians living in flood risk areas can do.

Review the Flood Ready guide to determine if your jurisdiction has flood maps available or information on how to access flood resources:

<https://www.canada.ca/en/campaign/flood-ready/first-steps.html>

Here are some provincial flood maps:

- [Ontario Flood Map](#)
- [New Brunswick Flood Map](#)
- [Alberta Flood Map](#)
- [Google Maps](#) may also help you

Many municipalities and conservation authorities are currently developing flood maps to help prepare communities. Check for the availability of these resources for your community

Consider these guiding questions:

1. Locate your school community on a flood map or use Google Maps. Is your school community in a flood risk area?
2. Are there any rivers or streams, and what course do they take? Would they have an effect on the watershed system?
3. Who or what is in the flood risk areas? Would this affect the economy? Using Google Maps as a comparison, see what is currently in the flood risk area.
4. Examine: Does the flood risk area have any artificial flood controls (e.g. dams, channels, sea walls)
5. Using the [IBC report](#)'s section on Catastrophic Losses (pp. 18-26) what has been the cost of flooding in your province since 2016?
6. What preventative measures can individuals take to flood-proof their homes? [Here](#) is a guide for how to flood-proof a home. In your view is it more cost effective to flood-proof a home or pay for damages after a flood?

Note: With flooding being the number one national economic cost of climate change, as well as a huge risk to the safety and health of many Canadians, a key preventative step is the existence of up-to-date, accurate flood maps. Currently, these do not exist for many areas of Canada. Flood maps provide a “cartographic depiction of an area likely to flood in certain situations.” ([Globe and Mail, 2019](#))

Activity 2: How much does carbon cost?

Through a cap & trade game simulation, students will compare two structural solutions aimed to reduce carbon emissions. Through this activity students will think critically about the benefits and drawbacks of several different types of environmental regulations. Specifically: which type of regulation will reduce carbon dioxide emissions most efficiently?

This resource provides clear instructions for the simulation, guiding discussion questions,

consideration of alternate perspectives, and encourages critical thinking.

You can access the full resource [here](#); refer to Chapter 7: pages 67-80, or **jump straight to the activity** [here](#).

Activity 3: Research Green Sector Careers

This research activity invites students to think practically about the job market in the face of climate change. We live in a time of constantly evolving mitigation and adaptation measures and a rapidly changing economic market. As the green sector economy grows and expands, both green skills and green jobs will continue to be embedded throughout the job market. So, we are asking today's students to consider the question: what do future careers look like in a more efficient, sustainable, and renewable world?

Consider these guiding questions as a starting point:

- Where in the economic market do you predict there are opportunities as the economy transitions?
- What careers will make a positive difference for the future of the environment?
- Are there careers now that are central to our economy but may be obsolete in 10 years in a more renewable, sustainable world?

Here are a few case studies of Canadian companies that are looking forward to a low carbon economy:

- [Carboncure](#)
- [Veriform](#) (carbon-neutral since 2015)
- [Sustane Technologies](#)
- [Carbon Engineering](#)

Activity 4: Sustainability Products, Consumer Responsibility

From: *R4R: [Lesson - Sustainability Products, Consumer Responsibility](#)* (Education World, 2012)

This resource focuses on responsible purchasing and sustainable consumption. The aim is for students to make connections between what they choose to purchase, and the various impacts the product is having on society, the economy and the environment.

Students have a chance to examine the life cycle of several products including: a soccer ball, a DVD, a cell phone and walk through the production, consumption and disposal of each item. The students share their findings in groups and examine these products' impacts on the economy, society and the environment. This lesson is intended to help students think critically about their consumption habits, and acknowledge the wide-reaching effects that consumption has. Specific statistics relevant to place and time may need to be updated by the educator.



F. Consolidation

This step is designed to encourage students to integrate and synthesize key ideas. When students make connections and see relationships within and across lessons, it helps them to solidify knowledge and deepen their understanding.

Student Created Questions

For this consolidation exercise, students will work in pairs. Each person will generate several thought-provoking consolidation questions for their partner. The questions should be based on the learning from this inquiry and could address their own personal gaps in understanding or aim to deepen understanding. Each partner will have an opportunity to write full responses to their questions, and then share their thinking with their partner.



Assessment Idea

Teachers will assess learning at different points throughout the inquiry using multiple methods. The following assessment provides an alternative evaluation method to standard quizzes and tests, that can be used after consolidation or at any point in the lesson to check for understanding.

< One-Minute Paper

The [One-minute paper](#) is a classroom assessment technique that uses a focused question that can be answered within a minute or two. The activity asks students to reflect on their understanding of a concept and provides the teacher with rapid feedback on students' perceptions on key learnings. Questions can probe different dimensions, such as interest, relevance, attitudes, or analysis. Check [here](#) for more information on this strategy.



G. Take Action:

Allowing time for students to take action is an essential part of the learning process on climate change, as it empowers students and eases their eco anxiety.

Ideas for Taking Action:

- Encourage innovation and creative use of technology to explore solutions to climate change challenges
- Research local adaptive measures in place to prepare for natural disasters and severe environmental effects and persuade improvements or expansion
- Educate the local community about the existing and future economic risks of climate change
- Reach out to a business climate leader for an informational interview to learn about what they do and opportunities they see in a low-carbon economy

Action Project Examples

- Mission Roots Cafe - Okanagan Mission Secondary High School – Kelowna, BC (2017)
 - Students came up with an innovative entrepreneurial project to promote sustainability: Mission Roots Cafe. This in-school cafe is run and staffed by a team of 25 volunteers from grades 7-12, and it combines sustainable operations with a social enterprise structure. All proceeds from the cafe are donated to charities selected by the students. The students raised over \$3,400 for their chosen charities in their first year! [See their project here.](#)
- Green Industries - Guelph Collegiate Vocational Institute - Guelph ON (2019)
 - In a multifaceted, large scale project students engaged in gaining hands-on experience for students to learn how to create their own sustainable future, and learn about the value of self-sustaining food systems. This project offered students opportunities to learn fundamental skills for a future, and career in a world with a rapidly changing climate. For instance, recirculating ecosystem education, importance of innovation and learning how to make technological innovations more productive and efficient. [See their project here.](#)
- Solar Energy - Saint Mary's Academy - Edmundston, NB (2019)
 - The high school Eco-Committee at St. Mary's Academy in Edmundston, NB is committed to educating their entire K-12 school about solar energy. They have a long-term goal of converting St. Mary's into a clean-energy school. Students began by educating their peers (and themselves!) about solar energy and the function of solar panels. They visited other schools that had already installed solar panels, interviewed their local power generation company, and toured local solar panel providers. They also partnered with The 3% Project to learn about cost-efficiency and cost-impact analysis to strengthen their case! This year they purchased and installed solar panels in their school greenhouse and designed a self-watering system using a rain barrel and a timer. [See their project here.](#)
- Hip Threads - Evergreen Heights Education Centre - Elmsdale, ON (2015)
 - Students started the Hip Threads used clothing store to tackle overconsumption in their community. They collected donations of used clothing, made their own eco-friendly laundry soap to wash the clothing, then held store hours every week

during lunch. They held a successful fashion show to promote the store and encourage more people to donate their old clothes instead of throwing them out. Clothing was sold by donation and proceeds were donated to charity. [See their project here.](#)