Climate Change
our forests our future

Dear Teachers,

Our climate is changing and we know that we must work together to mitigate its effects in any way we can. Our forests and the wood products that are produced from our forests can play a key role in modifying the effects of climate change.

This teacher resource, developed by Forestry Innovation Investment and the Council of Forest Industries Forest Education Program, provides material that helps explain how our forest can help lessen the impact of climate change. It provides classroom project ideas to stimulate discussion and activities that students can undertake in school and at home.

This binder includes a lesson plan and supplementary teaching material keyed to the B.C. Ministry of Education learning outcomes of various subjects in grades ten through twelve, extension activities, activity sheets, posters and a DVD containing a slide presentation.

Forestry Innovation Investment is a British Columbia government agency that delivers the facts about British Columbia's forests and how they are managed. The Council of Forest Industries is the voice of the B.C. interior forest industry. For more information, visit **www.cofi.org** or **www.naturallywood.com** or **www.bcfii.ca**.

We welcome your feedback on this resource and have included an evaluation form for this purpose.

K. Baker

Ken Baker
Chief Executive Officer
Forestry Innovation Investment Ltd.

Forestry Innovation Investment

Chris Lear
Manager, Forest Education
Council of Forest Industries
Northern Operations

Council of
Forest Industries

Climate Change
our forests our future

# Evaluation

Please fax this form to 604 685-5373 or e-mail your comments to **info@bcfii.ca**

| | | |
|---|---|---|
| Is this an effective resource for use in your classroom? | Yes | No |
| Is this of value in helping you meet the learning outcomes in the curriculum? | Yes | No |
| Have you used similar forest resource kits in the classroom? | Yes | No |
| Will you use this resource again? | Yes | No |
| Are there other tools/resources related to our forests that would assist you? | Yes | No |

Please rate the following components of the Climate Change Our Forests Our Future resource binder based on usability.

1 = poor 2 = below average 3 = average 4 = good 5 = excellent

| | | | | | |
|---|---|---|---|---|---|
| Lesson plan, glossary and background notes | 1 | 2 | 3 | 4 | 5 |
| Extension activities | 1 | 2 | 3 | 4 | 5 |
| Poster | 1 | 2 | 3 | 4 | 5 |
| Slide presentation | 1 | 2 | 3 | 4 | 5 |
| Web links | 1 | 2 | 3 | 4 | 5 |

Additional comments (please use additional pages, if needed):

_____

_____

_____

Name:_____ Date: _____ Grade: _____

School: _____ School district: _____

# Table of Contents

# Curriculum Connections

## Curriculum Connections

### Science 10: Earth and Space Sciences

- Describe how climate can be influenced by human activities.
- Describe how climate change affects natural systems.

### Science 10: Life Sciences - Sustainability of Ecosystems

- Illustrate the cycling of matter through abiotic and biotic components of an ecosystem by tracking carbon (with reference to carbon dioxide, carbonate, oxygen, photosynthesis, respiration, decomposition, volcanic activity, carbonate formation, greenhouse gases from human activity, combustion).

### Earth Science 11

- Explain the characteristics and significance of the atmosphere.

### Social Studies 11

- Assess environmental challenges facing Canadians, including: global warming, ozone layer depletion, fresh water quality and supply.

### Geography 12

- Analyse interactions between human activity and the atmosphere, with reference to global climate change, ozone depletion, acid precipitation.
- Explain how climate affects human activity.
- Analyse the interactions between human activity and biomes, with reference to deforestation, desertification, soil degradation, species depletion.

### Sustainable Resources 11 (Forestry)

- Assess current practices related to the management of sustainable forest resources in British Columbia.
- Analyse challenges and opportunities faced by forest industries in British Columbia.

### Sustainable Resources 12 (Forestry)

- Assess the impact of environmental components and changes on a forest ecosystem.
- Outline the challenges impacting the health and sustainability of forest resources in British Columbia.

# Lesson Plan

## Climate Change, Our Forests, Our Future

### Secondary Lesson Plan

### Main Idea

***Forests and the wood products produced from forests are key elements in mitigating the affects of climate change.***

### Learning Outcomes

Students will be able to:

- Describe the carbon cycle.
- Explain how climate change impacts forests.
- Demonstrate how forests can mitigate the effects of climate change.
- Describe how wood products help mitigate climate change.
- Compare different building materials in terms of their impacts on the environment and mitigating the effects of climate change.
- Describe what actions are being taken locally and provincially to fight climate change.

# Materials

## Materials

- Lesson plan
- Teacher background
- Suggested activities
- Curriculum connections
- Web links
- Slide presentation on DVD
- Slide presentation script and note pages
- Glossary
- Posters

### Recommended time:

- One to three class periods. Extra time will be required for extension activities.

### Classroom Instruction

**Teacher note:**

Prior to starting this lesson, review the Teacher Background information provided in the binder.

# Introduction

## Introduction (10 to 15 minutes)

### Discussion

- **Introduce** the topic of climate change by asking students what they have heard or read about climate change in the media or other classes. At this time the purpose is to determine what prior knowledge they may have of climate change. Answers may vary.

  **Possible answers:**

  - Climate change may be caused by increased greenhouse gas levels in the atmosphere.
  - Climate change may be causing the melting of the polar ice caps and glaciers around the world resulting in rising ocean levels.
  - Climate change may be affecting weather patterns - increased temperatures, droughts, wildfires, etc.
  - Climate change may be affecting the natural habitat of wildlife such as that of the polar bear and other species.
  - Climate change may be considered a contributing factor in the mountain pine beetle outbreak in western Canada and the United States.
  - Climate change may be a contributing factor in the spread of tropical diseases such a West Nile virus, dengue fever and malaria into temperate regions of the world.

  In Canada, climate change could increase crop yields and/or variety of foods that could be grown or reduce our dependency on fossil fuels to heat our greenhouses, homes and offices etc.

- **Discuss** points students come up with to gauge just how serious they think climate change really is. Do they think that climate change is something that will affect them in their lifetime? Do they think that climate change and its effects will be a trend that lasts for a long time, or is this a short term phenomenon? Are they concerned enough to take action? Have any of them taken any action?

  **Possible statement to start off the discussion:**

  *"Climate change is the most pressing issue facing the planet right now."*
  Source: World Wildlife Fund (Canada)

# Introduction

## Introduction continued

- **Ask** students what theories they have heard as to the possible causes of climate change.

  **Possible answers:**
  - o Increased carbon dioxide in the atmosphere
  - o Increased solar output from the sun
  - o Catastrophic events such as volcanic eruptions
  - o Changes in the Earth's tilt and orbit around the sun
  - o Ocean currents
  - o Human activity such as burning fossil fuels resulting in carbon dioxide emission

- **Ask** students whether there is any way in which humans can help mitigate or slow down climate change. (Answers may vary)

  **Possible answers:**
  - o Use biofuels, solar or hydro to produce electricity rather than burning fossil fuels.
  - o Drive hybrid or electric cars.
  - o Increase energy efficiency in buildings thus reducing energy consumption.

- **Ask** students what effects, if any, climate change has on forests. (Answers may vary)

  **Possible answers:**
  - o Warmer temperatures may result in an increased risk of forest fires, disease and insect epidemics.
  - o Increased carbon dioxide may increase tree growth.
  - o Climate change may alter the boundaries of current biogeoclimatic zones resulting in tree species migrating northward and to higher elevations.

# Part 1

## Part 1 – Climate Change and our Forests: slide presentation

- **Discuss with students** that while it is difficult to determine any one cause of climate change, one thing scientists do seem to agree on is that increased greenhouse gases, in particular increased carbon dioxide emissions, are a main contributing factor. Every year, human activity adds 3.3 billion tonnes of carbon into the atmosphere.

  While it is difficult to predict the specific effects of climate change due to the complexities of the interactions with the Earth's ecosystems, scientists are observing and reporting some significant trends:

  - Changes in natural habitats may result in the loss of plant and animal species.
  - Continued melting of Arctic and Antarctic ice sheets may result in rising ocean levels threatening coastal communities and island nations.
  - Drought, loss of agricultural lands and hunger in tropical areas may increase.

  There may also be an impact on the world's forests. They may face risk from disease, fire and insect infestations like the mountain pine beetle epidemic. Increase carbon dioxide levels may result in an increase in tree growth.

  Many scientists around the world believe that a key to mitigating the effects of climate change is to reduce the amount of carbon dioxide in the atmosphere. Two possible ways to do this:

  - Removing carbon dioxide from the atmosphere and storing it, and
  - Reducing carbon dioxide emissions.

- **Tell students** that they are now going to watch a short slide presentation on climate change and our forests. The slide presentation will review some of the possible causes and possible effects of climate change, outline how our forests absorb and sequester carbon and identify how managing our forest resources and using wood can mitigate the effects of climate change.

  At this time you may want to hand out the blank **Slide Presentation Note Pages** so the students can make notes on each slide **or** hand out the **Slide Presentation Question Sheet**.

- **After viewing** the slide show discuss with students what they think of using wood to help mitigate climate change? Should it be used? What, if any, concerns do they have about using wood? Do they think our forests are being managed in a sustainable manner?

# Part 1

## Part 1 continued

### Slide Presentation – Using the narrated presentation

The narrated slide presentation runs on a PC or Mac computer.

This is a slide presentation – which runs like a PowerPoint™ presentation except that a narrated sound track has been added.

Double click the presentation icon to launch the slide presentation. You may see a "Microsoft Office Security Options" pop-up window. The slide presentation contains interactive elements that will require you to enable the content. Select "enable this content" and click "OK". The slide presentation will then launch.

Arrow keys on your keyboard allow you to advance to the NEXT page, or to go back to the PREVIOUS slide. Or if you prefer to use your mouse, arrows appear as the cursor hovers over the bottom left corner of the screen. Just click ESC at the end of the presentation to close the PowerPoint™ window.

- To START – The sound track for the first slide will automatically start once a viewing mode is selected. At the end of each sound clip is an audible tone indicating that the narration for this slide is over. You can now advance to the next slide.
- Click the NEXT button to advance the slides. Narration will automatically run for each slide. A tone indicates the end of the narration.

**Note:**

Do not advance until the narration of the current slide finishes and you hear the tone.

# Part 2 / 3 / 4

## Part 2 – Using Wood to Fight Climate Change

Now more than ever before, we must find ways to reduce pressure on our environment and our finite resources. Choosing products that are made from renewable resources with a light carbon footprint and reducing waste can have a real impact on climate change now and into the future.

- Hand out the **Climate Change, Our Forests, Our Future Information Sheets** and accompanying chart and ask students to complete the chart identifying various attributes of forests and forest products and how they can help mitigate the effects of climate change.

## Part 3 – Climate Change, Our Forests, Our Future: $CO_2$ Emissions and Carbon Sequestration

Carbon sequestration in forests is a very complex process, but understanding it is an integral part of finding solutions to mitigating the rapid effects of climate change. While this exercise is simplistic, it exposes students to the idea of removing carbon dioxide from the atmosphere.

- **Explain** to students that they are going to investigate passenger car $CO_2$ emissions and then determine what it would take in terms of seedlings planted and houses constructed to absorb and sequester the amount of $CO_2$ emissions each year in British Columbia.
- To complete this activity, students will need access to computers.
- Hand out **Activity Sheet: Motor Vehicle Emissions**

## Part 4 – Suggested Activities and Extension Activities

- Review the **Suggested Activities and Extension Activities** and choose one or more activities for students to complete.

# Suggested Activities

## Suggested Activities

### 1. In the headlines

Over a couple weeks, a month or even a semester, have students review news articles from newspapers, TV and/or internet news links.

As a class or with students working in groups, select one or more articles and have students summarize them in terms of what the climate change news is about – what issue and point of view is being reported. What seems to be the 'mood' of the news item – optimistic, positive, concerned, overly pessimistic, call to action, wait and see, overblown? Is the news coverage changing? Is the news item presented with any known fact or is it mostly hypothetical? Are there any counter arguments to the information? Ask students to comment on what they think about the issue and whether or not they care and why. With your help or on their own, have them identify what is at stake for them personally.

Wrap-up with an open class discussion on how to view information on climate change.

> Suggested website **http://www.treefrogcreative.ca/Welcome.html** hosts a free daily news service featuring local, provincial, national and international news on forestry, forest products, carbon, climate change and bioenergy, wood products and building green. There are archives on the website so students could research and review recent clippings.

### 2. Carbon footprint: comparing building materials

- Have students do a carbon footprint calculation of a large building (school gymnasium, farm building, medial center, industrial building) to determine how much carbon dioxide emissions could be saved if the building was built by using wood. Direct students to the website NZWood Carbon Calculator at **www.nzwood.co.nz/carbon-calculator**. Have students discuss their results and make recommendations as to what changes in the building's construction they would implement to reduce carbon emissions.
- Have students do a carbon footprint calculation of their home to determine the contributions the choice of building materials makes to their carbon footprint. Direct students to NZWood House Carbon Calculator at **www.nzwood.co.nz/house-calculator**. As a class, discuss the various results.
- Have students work in groups to research on the web their local city hall, the provincial government and their school board to see what they are doing to help reduce their carbon footprint.

# Suggested Activities

## Suggested Activities continued

### 3. Effects of climate change locally

To initiate a discussion on the effects of climate change on forest ecosystems, have students contact their local B.C. Ministry of Forests and Range and/or Ministry of Environment and/or a local forest products company and ask what changes they are experiencing locally as a result of climate change – i.e. increased wildfires, storms, changes in weather patterns, insect infestations, plant succession, etc.

Ministry of Forest branches **www.for.gov.bc.ca/mof/branches.htm**, or

Ministry of Environment regions **www.env.gov.bc.ca/main/regions.html**

- British Columbia is currently in the midst the Mountain Pine Beetle Epidemic, one of the largest and most devastating insect epidemics in Canadian history. In large part, the epidemic is attributed to climate change. Have students research the causes of the epidemic, outline the extent of the epidemic and its impact on our forests, communities and economy of British Columbia.

**Note:**

Each school in British Columbia has received one or more teaching resource kits 'B.C.'s Mountain Pine Beetle – Today and Tomorrow'. If you would like to order one of these kits, please go to: **www.forest-education.info/teaching/ordering.html**

Website: B.C. Ministry of Forests and Range, Mountain Pine Beetle
**http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/**

- Have students make a visual presentation (video, photos, slide presentation, or poster) on the impacts of climate change on their community.
- Have students work individually or in teams to develop questions and survey other students and/or people in their community to determine what they think are the short term and long term effects of climate change as well as any steps they will themselves be taking to reduce their personal carbon footprint.
- Invite students to contact a local forest company or B.C. Ministry of Forests and Range office to determine how climate change may be affecting forest planning for the future.

# Suggested Activities

## Suggested Activities continued

- Over the past few years, British Columbia has experienced some severe forest fires and predictions are that they will continue to get worse as a consequence of climate change. Encourage students to contact the local Ministry of Forests and Range Fire Protection Branch to inquire if climate change is increasing the frequency and severity of forest fires in the province and what, if any, steps are being taken and need to be taken to reduce the risks of fires attributed to climate change.

  Website **http://bcwildfire.ca/**

### 4. Going green

- **European action:** We are not alone in looking at our forests and wood products as 'natural' ways to help fight climate change. In Europe, there is a new and invigorating program designed to expand the use of wood and maintain and grow sustainably managed forests.

  With the class as a whole, or individually, have students view the **Wood and the low carbon economy film** at **http://www.woodforgood.com/general/media-resources/wood-and-the-low-carbon-economy-film/** The film promotes the low carbon revolution and the part wood has to play for construction and energy generation. It shows how using more wood is a simple way of helping to build the low carbon economy that is vital to the fight against climate change. After viewing the video, have students summarize why Europeans are turning to wood to help fight climate change.

- '**Bioenergy**' is being touted by many as being absolutely critical in achieving British Columbia's climate goals and economic objectives. Have students research the British Columbia government's Bioenergy Strategy (**www.energyplan.gov.bc.ca/bioenergy/**) and report on what opportunities and benefits there are for British Columbians and how the new bioenergy industry will be developed. Then have students do an internet search for any British Columbia bioenergy company and write a short report on the company. For information, go to **www.pellet.org**

- '**Green building**' is a terminology being used by many building contractors to claim that their buildings are good for the environment. British Columbia's provincial government is implementing changes for residential and industrial buildings. Have your students go to **www.housing.gov.bc.ca/building/green/greenbuildingoverview.htm** and make a list of the changes that the British Columbia government is recommending, why they are promoting 'building green', and what other provinces and countries are doing.

## Suggested Activities continued

### 5. Deforestation and illegal logging

Without responsible forestry practices, deforestation and illegal logging can devastate forests around the world. As a class watch the World Wildlife Federation video clip WWW- Global Forest and Trade Network on YouTube. Go to **http://www.worldwildlife.org/climate/** then scroll down the left column and click on **Forest Carbon**. Then scroll down the right hand column to multimedia and then click on **"See why responsible forestry management is key to a healthy forest"**. After viewing the video clip with your students, discuss with them how serious a problem they think this is and ask them how this can be stopped.

# Extension Activities

## Extension Activities

### 1. Motor vehicle $CO_2$ emissions – my personal $CO_2$ emissions

Have students calculate the $CO_2$ emissions from their own or family car and compare their findings with the results for a typical passenger car.

> Canadian vehicle fuel consumption and $CO_2$ emissions website:
> Natural Resources Canada: Office of Energy Efficiency
> **http://oee.nrcan.gc.ca/transportation/tools/fuelratings/ratings-search.cfm**

### 2. Taking action

Ask students to think of some strategies for raising awareness in their school or community about the affects of climate change on our forests and how our forests and forest products can help mitigate the effects of climate change. This might be through a bulletin display, field trip to a local forest, visits from invited guests or a student-produced video. As a group or class project, allow time for students to present their project to other classes, set up a noon-hour display or provide information at a parent night.

### 3. Taking action

Trees absorb carbon dioxide and store it long-term. About 15 trees need to be planted to absorb every 4,500 kg of carbon dioxide emitted. After calculating the carbon emissions from your school using the carbon calculator at **http://www.nzwood.co.nz/carbon-calculator**, have your students create an action plan to offset the carbon emissions by planting trees. Contact the school board, city hall or a forest company to see where students could plant their trees.

### 4. Taking action

Brainstorm with the class ideas how individuals could make small changes to help mitigate the effects of climate change. Now challenge your students to commit to making a personal change. Students could commit to an action plan for a period of time and then discuss what challenges they faced in keeping to their plan.

## Extension Activities continued

### 5. Video production

Challenge students to make their own video on how their community and/or school are or could be going 'green'. Students could, for example, focus on the use of wood and other measures such as installing low volume toilets to cut water consumption, walking and riding bikes to cut carbon emissions or recycling wood and paper products.

### 6. Guest speaker

Building with wood, rather than using other building materials may seem like a responsible thing to do to help mitigate the effects of climate change. However, many buildings continue to be built using steel and concrete even when wood could be used.

Invite a building contractor, architect or engineer into class to discuss the current challenges they face in using wood.

### 7. Field trip

In almost every community in British Columbia, there are buildings that highlight the use of wood in their construction. Arrange a field trip to one of these buildings and, if possible, arrange for the architect, building contractor or building manager to give a guided tour outlining the use of wood in the building.

Have students prepare questions beforehand focusing on the benefits of using wood products to help fight climate change.

Climate Change
our forests our future

# Extension Activities

Some suggested sites:

- 2010 Olympic Commerce Center, Vancouver, B.C.
- Abbotsford Recreation Centre, Abbotsford, B.C.
- B.C. Visitor's Centre, Osoyoos, B.C.
- Brentwood Skytrain Station, Burnaby, B.C.
- Castlegar City Hall, Castlegar, B.C.
- Cypresss Creek Lodge, West Vancouver, B.C.
- FPInnovations, Forintek Division, Vancouver, B.C.
- Fort St. James Library and City Hall, Fort St. James B.C.
- Gordon Head School, Victoria, B.C.
- Gleneagles Community Centre, West Vancouver, B.C.
- Grandstand at Macleod Athletic Park, Langley, B.C.
- Jericho Tennis Club, Vancouver, B.C.
- Kelowna Rotary Arts Center, Kelowna, B.C.
- Killarney Community Pool, Vancouver, B.C.
- Kwantlen Polytechnic University, Vancouver, B.C.
- Ladysmith RCMP Station, Ladysmith, B.C.
- Langley Municipal Hall, Langley, B.C.
- Michael Smith Building, UBC, Vancouver, B.C.
- Mt Washington X-Country Ski Lodge, Comox, B.C.
- Nicola Institute of Technology, Merritt, B.C.
- Nita Lake Lodge, Whistler, B.C.
- NK' MIP Desert Cultural Center, Osoyoos, B.C.
- North Shore Film Studios, North Vancouver, B.C.
- Richmond Oval, Richmond, B.C.
- South Surrey Ice Arena, Surrey, B.C.
- Southridge Senior School, White Rock, B.C.
- Squamish Adventure Centre, Squamish, B.C.
- Squamish Lil' Wat Cultural Centre, Squamish, B.C.
- Surrey Central City, Surrey, B.C
- Surrey City Central, Surrey, B.C.
- Sutherland School, North Vancouver, B.C.
- The Cove Lakeside Resort, Westbank, B.C.
- Trout Lake Ice Arena, Vancouver, B.C.
- Vancouver Olympic/Paralympic Center and Percy Norman Pool, Vancouver, B.C.
- UBC Boathouse, Vancouver, B.C.
- UBC's Forest Science Centre, Vancouver, B.C
- University of Northern B.C., Prince George, B.C.
- UNBC/CNC Quesnel Campus, Quesnel, B.C.
- Vancouver Convention Centre, Vancouver, B.C.
- Visitor's Center, Williams Lake, B.C.
- West Vancouver Aquatic Center, West Vancouver, B.C.
- Wickaninnis Lodge, Tofino, B.C.
- Whistler Day Lodge, Whistler, B.C.
- Whistler Library, Whistler, B.C.
- Whistler Olympic Park, Whistler, B.C.

# Extension Activities

## 8. Field trip

Throughout British Columbia, bioenergy is fast becoming a new industry and new source of energy in many communities. For example, the University of Northern British Columbia is now calling itself Canada's Green University and recently announced that it is installing a biomass gasification system that will provide heat to core campus buildings and offset an estimate 85% of current natural gas consumption.

If a bioenergy system or manufacturing facility (wood pellet plant) exists in your community, arrange a tour of the facility. Students can see first hand how bioenergy can help reduce dependence on fossil fuels and help in the fight against climate change.

- Armstrong Pellets, Armstrong B.C.
- Pacific BioEnergy, Prince George, B.C.
- Pinnacle Pellet, Quesnel, Houston, Armstrong, Williams Lake and Strathnaver, B.C.
- Premium Pellet, Vanderhoof, B.C.

UNBC's website for bioenergy **www.unBC.ca/green/energy.html**

# Teacher Background

## Teacher Background

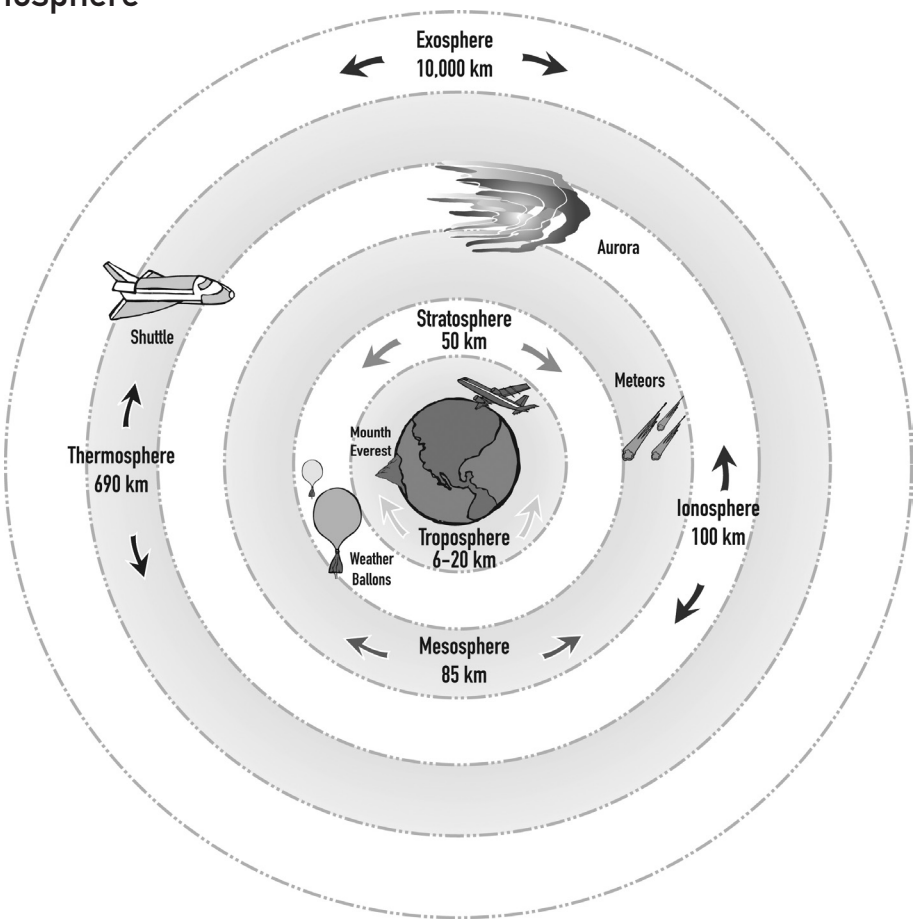
### Background to Climate Change

- The Earth's climate is always changing. The different factors that can cause climate change operate on very different time scales. For example, continental drift – the crucial movement of Earth's tectonic plates – has changed the position of land masses on Earth over timescales of hundreds of millions of years, influencing ocean circulation and the formation of major ice sheets.
- Between 15,000 and 30,000 years ago, great sheets of ice covered much of North America. Some 14,000 years ago, the last ice sheet began to melt and by 7,000 years ago, the ice was gone. This end to the ice age caused big changes on the Earth - many kinds of plants and animals died.
- Starting in the 14th century, Europeans lived through the Little Ice Age when the advance of glaciers along with hard winters and famines caused some people to starve and others to leave their homes.
- The Earth has warmed about 0.6 degrees centigrade in the last 100 years. The eight warmest years on record (since 1850) have all occurred since 1998, with the warmest year being 2005.
- Periods of increased heat from the sun may have helped make the Earth warmer. But many of the world's leading climatologists think that the greenhouse gases people produce are making the Earth warmer, too.

# Teacher Background

## Teacher Background continued

### Earth's Atmosphere




**Exosphere**

- From 500 up to 10,000 km above Earth's surface, the exosphere contains free-moving particles that may migrate into and out of the solar wind.

**Ionosphere**

- The part of the atmosphere that is ionized by solar radiation stretches from 50 to 1,000 km above Earth's surface and is very thin, typically overlapping both the exosphere and the thermosphere. Because of its charged particles, it absorbs the most energetic photons from the sun, and reflects radio waves, thereby making long-distance radio communication possible. It is also responsible for auroras.

# Teacher Background

## Teacher Background continued

### Thermosphere

- From 80 to over 640 km above Earth's surface. Although the temperature can rise to 1,500 °C in this sphere, a person would not feel warm because of the extremely low pressure. The International Space Station orbits in this layer, between 320 and 380 km above earth's surface.

### Mesosphere

- The mesosphere extends from about 50 km to the range of 80 to 85 km above Earth's surface. This is where most meteors burn up when entering the atmosphere.

### Stratosphere

- The stratosphere extends from the troposphere's 7 km range to about 51 km above Earth's surface. A thin layer in the upper stratosphere has a high concentration of ozone, a particularly reactive form of oxygen. The stratosphere is primarily responsible for absorbing the ultraviolet radiation from the sun. The formation of this layer is a delicate matter, since only when oxygen is produced in the atmosphere can an ozone layer form and prevent an intense flux of ultraviolet radiation from reaching the surface.

  Ozone Layer - Though part of the Stratosphere, the ozone layer can be considered as a layer of the Earth's atmosphere in itself because its physical and chemical composition is far different from the Stratosphere. The ozone layer is the region from about 10 to 50 km above Earth's surface. About 90% of the ozone in our atmosphere is contained in the stratosphere. Ozone concentrations are greatest between about 20 and 40 km where they range from about two to eight parts per million.

### Troposphere

- The lowest layer of the atmosphere, it begins at the Earth's surface and extends to between 7 km at the poles and 17 km at the equator. The troposphere contains roughly 80% of the total mass of the atmosphere. Fifty percent of the total mass of the atmosphere is located in the lower 5.6 km of the troposphere. The troposphere is where all weather takes place; it is the region of rising and falling packets of air. The air pressure at the top of the troposphere is only 10% of that at sea level.

# Teacher Background

## Teacher Background continued

### The Natural Greenhouse Effect

- The Earth's atmosphere acts similarly to the glass in a greenhouse. About 31% of the incoming radiation from the sun is reflected directly back to space by Earth's atmosphere and surface (particularly by snow and ice), and another 20% is absorbed by the atmosphere. The rest of the incoming radiation is absorbed by the Earth's oceans and land, where it is converted into heat, warming the surface of the Earth and the air above it. Some of the heat energy – infrared radiation - is radiated back into space, but some of it is kept in by our atmosphere.
- The warmth of our climate is crucial because on Earth and in the atmosphere, water can exist in all three of its phases – frozen as snow or ice, liquid as water, and gaseous as water vapour. The cycling of water from one phase to another is critical to sustaining life since it is this cycling of water through the land-ocean-atmosphere system that replenishes the water available for life on Earth. The water cycle is also an important part of what drives our weather and the climate system generally.

### The Climate System

The average temperature on Earth is but one feature of Earth's climate. In a simple way, Earth's climate system can be thought of as a giant heat engine, driven by energy from the sun. The job of Earth's climate system is to redistribute heat around the globe. Because of how the Earth is exposed to the Sun, the heating of the Earth by the sun is not uniform. Heating around the equator is greater than it is at the poles. This is why the equatorial regions are hot and the polar regions are cold. This temperature difference is what drives weather.

### Climate Change

Climate change may result from:

- natural factors, such as changes in the sun's intensity or slow changes in Earth's orbit around the sun;
- natural processes within the climate system (e.g. changes in ocean circulation);
- human activities that change the atmosphere's composition (e.g. through burning fossil fuels) and the land surface (e.g. deforestation, urbanization, desertification, etc.)

# Teacher Background

## Teacher Background continued

### The Greenhouse Gases

1. **Water vapour** is the most common greenhouse gas and is responsible for about 2/3 of the natural greenhouse effect. The amount of water vapour stored in the atmosphere increases as surface temperatures rise, because higher temperatures increase both evaporation and the capacity of air to hold water vapour. Changes in atmospheric water vapour are therefore considered a feedback in the climate system; human activity is not a direct influence to any significant degree.
2. **Carbon dioxide** is released to the atmosphere through the natural processes of plant and animal life, decay, and the burning of fossil fuels and other materials. It is removed from the atmosphere by the photosynthesis of plants and absorption by the oceans. Over 90% of the carbon lost from conversion of forest to other land uses is released to the atmosphere as carbon dioxide, immediately through burning, and over time through decay of dead vegetation in the soil.
3. **Methane** is not as common in volume as water vapour and carbon dioxide, but is more effective at trapping heat, making it a very powerful greenhouse gas. It is primarily created when matter decays in an oxygen-free environment including rice paddies, cattle and other livestock whose digestive systems rely on enteric fermentation, termites (present in huge quantities in tropical forest systems, especially on disturbed sites), biomass burning, landfills and wetlands. Methane from landfills has 23 times the global warming potential of carbon dioxide. Forest fires emit one unit of methane for every 100 units of carbon dioxide.
4. **Nitrous oxide** comes mostly from soils and the oceans. Some is released by deforestation, biomass burning, nitrogenous fertilizers, and fossil fuel combustion.
5. **Ozone** exists naturally in the upper atmosphere where it plays an important role in shielding the Earth from the sun's harmful ultraviolet rays. However, only small traces of ozone occur naturally in the lower atmosphere. In fact, most of the ozone now found at ground level is the result of chemical reactions involving pollutants produced by human activities.
6. **Halocarbons** are a group of human-made chemicals containing a halogen (bromine, chlorine, and fluorine) and carbon. They are extremely powerful greenhouse gases.

The six greenhouse gases included under the international Kyoto Protocol are: carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, hydrofluorocarbons and perfluorocarbons. Scientists lump these six gases together under the simple name "carbon" by figuring out their carbon dioxide equivalent. So when they talk about "carbon footprint" and "carbon neutral", they are referring to all the major greenhouse gases, not just carbon dioxide.

# Teacher Background

## Teacher Background continued

### What We Should Know about Greenhouse Gases

- For the past 150 years or so, we have burned huge amounts of fossil fuels like oil, natural gas and coal that contain large amounts of carbon. Combustion of these fossil fuels releases carbon dioxide into the atmosphere, increasing the atmospheric concentration of carbon, a potent greenhouse gas.
- Nearly eight billion tonnes of carbon dioxide are emitted every year – most of this through fossil fuel combustion and deforestation in tropical regions. Carbon dioxide accounts for more than 75% of total greenhouse gas emissions.
- Fossil fuel combustion, deforestation in the tropics and other human activities are also causing increases in other atmospheric greenhouse gases, such as methane and nitrous oxide.
- As the atmosphere becomes more concentrated with greenhouse gases, the Earth's average surface temperatures become higher than they would otherwise be. The consequence is global warming and long-term changes in climate.
- Sometimes the increasing temperature is referred to as 'global warming'. However, many scientists believe the increasing amounts of greenhouse gases will have an impact on the Earth's climate that far exceeds just a change in temperature. A change in one part of the climate system can lead to a series of greenhouse reactions that can disrupt normal weather patterns around the world. 'Global climate change' more clearly describes what is happening.

### What Might Happen?

- Scientists don't know exactly what will happen in the future, but they can use computer modeling programs to find out how the climate may change in the years ahead. And the computer models tell us that the Earth may continue to get warmer.
- Together, the melting glaciers, rising seas, and computer models tell us that the Earth's temperature will probably continue to rise as long as we or nature continue increasing the amount of greenhouse gases in the atmosphere.
- Days and nights could be more comfortable and people in the area may be able to grow different and better crops than they could before. But it is also true that changes in some places will not be very good at all.
- Rising temperatures will lead to changes in other aspects of the Earth's climate, which may change weather patterns around the world.

# Teacher Background

## Teacher Background continued

### Ecological Systems

- Climate change may alter the world's habitats and ecosystems –many of which depend on a delicate balance of rainfall, temperature, and soil type. A rapid change in climate could upset this balance and seriously endanger many living things.
- Most past climate changes occurred slowly, allowing plants and animals to adapt to the new environment or move somewhere else. If future climate changes occur as rapidly as some scientists predict, plants and animals may not be able to react quickly enough to survive.

### Possible Impacts of Climate Change on our Forest Ecosystems

- Over time, some tree species could become poorly adapted to their environment, reducing their productivity and increasing their susceptibility to diseases and insect infestations such as the mountain pine beetle.
- Climate change may result in more frequent and intense wildfires, droughts, floods and storms. This may increase landslides, debris flow, wind throw, and changes to water quality and quantity.
- Grasslands may encroach into forest ecosystems, and forests into northern and alpine areas.
- Laboratory studies of the effects of elevated carbon dioxide levels on plants have documented increased rates of photosynthesis, lowered plant water use requirements, increased carbon sequestering and increased soil microbial activity fixing nitrogen for fertilizer, thereby stimulating growth. Therefore, carbon dioxide increases could theoretically provide significant benefits for plants and trees undergoing water stress in drier climates.
- In theory then, the increasing levels of carbon dioxide should increase forest growth and expand forest distribution northward. This is true in Canada. However, other variables such as drought may limit these effects and some forests may in the near term be more vulnerable to fire, insects and diseases.
- Studies show that concentrations of ground level ozone pollution are decreasing the growth of trees in the northern and temperate mid-latitudes. Ozone pollution is four times greater now than prior to the Industrial Revolution in the mid-1700s. Future ozone concentrations will be at least double current levels by the end of this century with the capacity to further decrease the growth of trees. It has the potential to leave more carbon dioxide in the atmosphere by decreasing carbon assimilation in trees.

# Teacher Background

## Teacher Background continued

### Climate Change, Water and Our Forests

- Some scientists predict that increased heating of the surface will lead to increased evaporation and, as a result, to greater global mean precipitation. However, some individual regions may experience decreases in rainfall.
- They expect high latitudes will experience increased penetration of warm, moist air, leading to increased annual precipitation and river runoff.
- Mitigation measures can reduce the magnitude of impacts of global warming on water resources, in turn reducing adaptation needs. However, they can have considerable negative side effects, such as increased water requirements for forestation/reforestation activities or bio-energy crops, if projects are not sustainably located, designed and managed.
- Stopping or slowing deforestation and forest degradation (loss of carbon density) and sustainable management of forests may significantly contribute to avoided emissions, may conserve water resources and prevent flooding, reduce runoff, control erosion, reduce siltation of rivers, and protect fisheries and investments in hydro-electric power facilities; and at the same time preserve biodiversity.

### Our Forests - mitigating climate change

- By reducing the amount of greenhouse gases in the atmosphere, forests can help address climate change. Young and growing trees absorb carbon dioxide, which is a main driver of climate change. Trees use the carbon dioxide to produce sugars for tree growth then release oxygen back into the air.
- As a tree grows, the carbon is stored in its leaves, twigs and solid woody stem, and in the soil around it. Because forests can absorb and store carbon over an extended period of time, they are considered "carbon sinks."
- In scientific terms, every molecule of carbon that is here now was present millions of years ago—a basic law of nature meaning that matter can be changed, but not created or destroyed.
- Key mitigation technologies and practices currently commercially available include afforestation, reforestation, forest management, reduced deforestation, harvested wood product management, use of forestry products for bioenergy to replace fossil fuel use.

# Teacher Background

## Teacher Background continued

- Forest-related mitigation options can be designed and implemented to be compatible with adaptation, and can have substantial co-benefits in terms of employment, income generation, biodiversity and watershed conservation, renewable energy supply and poverty alleviation.
- Managed forests are efficient carbon sinks as long as they are regenerated, and Canadian law requires prompt reforestation after public lands are harvested. Half a billion seedlings are planted in Canadian forests each year, the key reason why the country has virtually no deforestation even after more than 100 years of forestry.
- Globally, we also have the capacity to increase the amount of carbon that forests store by reducing the amount of deforestation in developing countries, and by converting non-forested areas to forest. About 65% of the total mitigation potential is located in the tropics and about 50% of the total could be achieved by reducing emissions from deforestation.
- Studies show producing and using wood products are associated with far less greenhouse gas emissions over their lifetime than building materials such as steel, concrete, aluminum or plastic. Using wood products that take less carbon emissions to produce and that store carbon instead of building materials that require more fossil fuel to manufacture and don't store carbon can help slow climate change.

### Embodied Energy

Although operating energy is the majority of energy consumed by buildings, embodied energy is also important. Embodied energy is the energy used in production and distribution of a product or material. Presently the embodied energy of building materials contributes anywhere from 15 to 20% of the energy used by a building over a 50 year period. As the operating energy is reduced through efficient design and technology, embodied energy will become more and more important in reducing a building's carbon footprint. **www.architecture2030.org/regional_solutions/materials.html**

# Teacher Background

## Teacher Background continued

- Wood First Policy - The British Columbia government now encourages all new public buildings in the province to include British Columbia wood in their construction whenever possible.
- Paper manufacturing has long played an important role in national emission reductions by using fibre left over from the sawmilling process that once was burned and sent to landfills.
- Sequestration doesn't work the same for paper as it does for wood. Paper in North America is generally made with residual material from wood processing. Paper can't be recycled indefinitely so recovery of paper is the best thing that people can do to make sure that paper they use isn't contributing to climate change. i.e. use the recycle bin.

### Our Forests - adapting to climate change

- Forest managers must work to maintain and increase forest resiliency.
- Long-term forest planning that considers climate change can minimize potential problems of species and climate and weather changes.
- Planned adaptation - Resource managers are taking climate change into account in their forest planning activities, selecting species that increase the resilience of the forest and are more likely to survive in future climate.

### The Future

Canada's forest products industry aims to be carbon neutral by 2015 by:

- Reducing direct and indirect emissions by switching to a renewable energy source, adopting energy-efficient technologies and finding ways to divert forest products from landfills such as recycling them.
- Increasing sequestration (carbon storage) in forests through landscape planning and innovative silviculture practices.
- Promoting an understanding of the carbon implication of wood-based materials in relation to available substitutes.

# Note Page

# Glossary

## Glossary

**Abiotic –** Nonliving. The abiotic factors of the environment include light, temperature, and atmospheric gases.

**Adaptation –** The adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

**Afforestation –** The planting of new forests on lands that historically have not contained forests or have not been recently forested because the land was used for other purposes.

**Atmosphere –** The mixture of gases surrounding the Earth, held in place by gravity. It forms distinct layers at different heights. The atmosphere is composed primarily of nitrogen (78%) and oxygen (21%). All the Earth's weather takes place in the lowest part of the atmosphere, which is called the troposphere. This extends upwards from ground level to about 8km at the poles and about 16km at the equator.

**Biofuel –** Any fuel that is obtained from a renewable biological resource, especially from biomass.

**Bioenergy –** Useful, renewable energy produced from organic matter. The conversion of complex carbohydrates in organic matter to energy. Organic matter may either be used directly as a fuel or processed into liquids and gasses.

**Biomass –** Organic matter such as plants, grasses and trees including mill and wood wastes, agricultural wastes, municipal and industrial waste and dedicated energy crops. Biomass can be used as a fuel and therefore be regarded as a potential energy source.

**Biome –** A major ecological community type (as tropical rain forest, grassland, or desert).

**Biotic –** Consisting of living organisms. An ecosystem is made up of a biotic community (all of the naturally occurring organisms within the system) together with the physical environment.

**Carbon cycle –** The forest carbon cycle refers to the flow of carbon through a forest ecosystem. The global carbon cycle refers to the flow of carbon through the Earth's atmosphere, oceans, forests, and other land-based ecosystems.

**Carbon dioxide ($CO_2$) –** A colorless, odorless, incombustible (non-burning) gas formed during respiration, burning of fossil fuels and decomposition of organic (biomass) material.

# Glossary

## Glossary continued

**Carbon neutral –** When the amount of carbon released is equal to the amount of carbon absorbed. Trees for example are considered carbon neutral because the amount of carbon they release when they decompose or burn is equal to the amount of carbon they absorbed from the atmosphere. Being carbon neutral as an industry, building or city means calculating a total carbon footprint, and balancing emission with sequestration to achieve a zero net carbon impact.

**Carbon sequestration –** Projects that capture and store carbon in a manner that prevents it from being released into the atmosphere.

**Carbon sink –** Those elements in the environment able to absorb or take in carbon from the atmosphere thus reducing the amount of carbon in the atmosphere. Trees, for example, are a carbon sink – they take in carbon dioxide and convert it to wood, leaves and roots.

**Climate change –** Any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer).

**Computer modeling –** A computer simulation, a computer model or a computational model in a computer program, or network of computers, that attempts to simulate an abstract model of a particular system in order to predict future events.

**Desertification –** The process of becoming desert (as from land mismanagement or climate change).

**Deforestation –** The removal of trees from forested land so that the land can be used for purposes other than growing trees. For example, trees are often removed from land in order to build cities, highways, farms, airports, golf courses, etc.

**Embodied energy –** The sum total of the energy - from raw material extraction, transport, manufacturing, assembly, installation plus the capital, environmental and other costs - used to produce a service or product from its beginning through its disassembly, deconstruction and/or decomposition.

**Ecosystem –** A system that includes all living organisms (biotic factors) in an area as well as its physical environment (abiotic factors) functioning together as a unit.

**Finger-joint lumber –** Boards made through a process of bonding shorter pieces of wood together with an interlocking 'finger-joint' to form a longer piece of lumber.

**Geological carbon –** Carbon derived from burning fossil fuels such as oil, natural gas and coal.

# Glossary

## Glossary continued

**Global warming –** An average increase in the temperature of the atmosphere near the Earth's surface and in the troposphere, which can contribute to changes in global climate patterns. Global warming can occur from a variety of causes, both natural and human induced. In common usage, "global warming" often refers to the warming that can occur as a result of increased emissions of greenhouse gases from human activities

**Green building –** The outcome of a design which focuses on the efficiency of resource use – energy, water and materials, while reducing the building's impact on humans and the environment during the life cycle of the building.

**Greenhouse effect –** The trapping and build-up of heat in the atmosphere (troposphere) near the Earth's surface. Some of the heat flowing back toward space from the Earth's surface is absorbed by water vapor, carbon dioxide, ozone, and several other gases in the atmosphere and then reradiated back toward the Earth's surface. If the atmospheric concentrations of these greenhouse gases rise, the average temperature of the lower atmosphere will gradually increase.

**Greenhouse gas (GHG) –** Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, but are not limited to, water vapor, carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), ozone ($O_3$ ), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride ($SF_6$).

**Infrared radiation –** The heat energy that is emitted from all solids, liquids, and gases. In the context of the greenhouse issue, the term refers to the heat energy emitted by the Earth's surface and its atmosphere. Greenhouse gases strongly absorb this radiation in the Earth's atmosphere, and radiate some back towards the surface, creating the greenhouse effect.

**Intergovernmental Panel of Climate Change (IPCC) –** The IPCC is a scientific intergovernmental body set up by the World Meteorological Organization (WMO) and by the United Nations Environment Programme (UNEP). Hundreds of scientists all over the world contribute to the work of the IPCC as authors, contributors and reviewers.

**Kenaf –** A fibrous plant from the Hibiscus family that is commercially grown in warm regions for paper production. The stalk of this plant varies in height from 8 to 12 feet and is about half an inch in diameter. Kenaf is mostly produced in India and Pakistan but also grows in Africa, South East Asia, Indonesia, Russia, Mexico, the Philippines, Cuba and the United States.

# Glossary

## Glossary continued

**Life-cycle assessment –** A way to calculate the environmental impact of a product over the lifespan of the product. This assessment usually requires the assessment of raw material extraction, manufacture, transportation, use and disposal of the product.

**Lignin –** A natural glue that binds the cellulose fibres of plants together.

**Medium density fiberboard (MDF) –** A panel board made from combining fine wood sawdust with glue and wax.

**Mitigate –** A long term measure or process of trying to reduce or eliminate risk or prevent hazards from becoming disasters.

**Natural regeneration –** The process of allowing forests to regrow on their own as opposed to replanting the forest.

**Ozone –** The gas found in the stratosphere that protects us from the Sun's harmful ultra-violet (UV) radiation.

**Ozone layer –** A layer of air in the atmosphere that contains a relatively high concentration of the gas ozone.

**Photosynthesis –** The process by which plants take carbon dioxide from the air to build carbohydrates, releasing oxygen in the process.

**Public land –** Sometimes called 'crown land', any land owned and managed by the federal or provincial government.

**Reforestation –** Planting of forests on lands that have previously contained forests.

**Sequestered –** The storage of carbon dioxide so that it cannot be readily released to the atmosphere and contribute to the greenhouse effect.

**Sustainable forest management –** Management that maintains and enhances the long-term health of forest ecosystems for the benefit of all living things while providing environmental, economic, social and cultural opportunities for present and future generations.

**Windthrow –** trees uprooted or broken by wind.

# Web Links

## Web Links

Natural Resources Canada, *Climate change in southwestern British Columbia Forests in Transition*
**http://adaptation.rncan.gc.ca/posters/B.C./B.C._09_e.php**

Environment Canada. Climate Change
**http://www.ec.gc.ca/cc/default.asp?lang=En&n=E584B5CF-1**

B.C. Ministry of Forests and Range, Preparing for Climate Change
**http://www.for.gov.BC.ca/mof/Climate_Change/preparing.htm**

B.C. Ministry of Environment, Climate Change
**http://www.env.gov.BC.ca/epd/climate/index.htm**

BC Bioenergy Network
**http://bcbioenergy.ca/home/index.html**

B.C. Climate Action Secretariat
**http://www.climateactionsecretariat.gov.BC.ca/**

Naturally Wood: British Columbia
**http://www.naturallywood.com/**

B.C. Forestry Climate Change Working Group
**http://www.BCclimatechange.ca/**

Forests and Wood Products Australia: Wood Naturally Better
**http://www.naturallybetter.com.au/**

NZWood
**http://nzwood.co.nz/**

Intergovernmental Panel on Climate Change
**http://www.ipcc.ch/index.htm**

B.C. Forestry Innovation Investment
**http://www.bcfii.ca**

# Web Links

## Web Links continued

Tree Frog Daily Forestry News
**http://www.treefrogcreative.ca/Welcome.html**

B.C. Wildfire Management Branch
**http://bcwildfire.ca/**

B.C. Ministry of Forests and Range Mountain Pine Beetle
**http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/**

University of Northern B.C. Green Energy
**http://www.unbc.ca/green/energy.html**

B.C. Ministry of Energy, Mines and Petroleum Resources: B.C. Bioenergy Strategy
**http://www.energyplan.gov.bc.ca/bioenergy/**

B.C. Stats: Construction and Housing
**http://www.bcstats.gov.bc.ca/data/bus_stat/econ_stat.asp**

B.C. Taking Action for the Environment
**http://www.env.gov.bc.ca/main/docs/bc_an_environmental_leader.pdf**

Wood for Good: Wood and the Low Carbon Economy Film
**http://www.woodforgood.com/general/media-resources/wood-and-the-low-carbon-economy-film/**

B.C. Ministry of Education Green Schools website
**http://www.bced.gov.bc.ca/greenschools/**

World Wildlife Fund: Climate Curriculum For Teachers
**http://www.worldwildlife.org/what/globalmarkets/Climate%20Change/Climate%20Cirriculum/item5944.html**

City of Vancouver: One day…small steps towards a cleaner, greener and healthier city
**http://vancouver.ca/oneday/takeAction/atSchool/tools.htm**

# Slide Presentation
## Question Sheet

Name: _____

1. Which layer of the atmosphere is primarily responsible for absorbing the ultraviolet radiation from the sun? _____
2. In which layer of the atmosphere does all weather take place? _____
3. Why is the atmosphere important? _____
4. What is the most common greenhouse gas? _____
5. Identify the source of the following greenhouse gases
   a) Carbon dioxide: _____
   b) Methane: _____
   c) Nitrous oxide: _____
   d) Ozone: _____
   e) Halocarbons: _____
6. What natural indicators have scientists identified as signs that climate change is occurring? _____
7. How do trees remove carbon dioxide from the atmosphere? _____
   _____
8. How many tonnes of oxygen do trees return to the atmosphere for every tonne of carbon dioxide they absorb? _____
9. What percentage of the weight of wood is carbon? _____
10. When does a tree release its stored carbon? _____
    _____
11. What is the key element to ensure that our forests are efficient carbon sinks?
    _____
12. What can be done in developing countries to help reduce the effects of climate change? _____
    _____

# Slide Presentation
## Question Sheet

13. What factors does a Life Cycle Assessment measure to determine the environmental impact of a building product?

    a) _____
    b) _____
    c) _____
    d) _____
    e) _____
    f) _____
    g) _____

14. Why would choosing to build with wood rather than concrete or steel be a better choice in the fight again climate change? _____
    _____

15. What is bioenergy? _____

16. What are the advantages of using wood biomass rather than other sources of biomass?

    a) _____
    b) _____
    c) _____
    d) _____
    e) _____

17. How can managing our forests help us adapt to climate change? _____
    _____

18. What does Canada's forest industry hope to achieve by 2015? _____
    _____

19. Identify three ways in which individuals can help fight climate change.

    a) _____
    b) _____
    c) _____

# Slide Presentation
## Question Sheet – Answers

1. Which layer of the atmosphere is primarily responsible for absorbing the ultraviolet radiation from the sun?

   **Stratosphere**

2. In which layer of the atmosphere does all weather take place?

   **Troposphere**

3. Why is the atmosphere important?

   **By absorbing some of the sun's radiation it prevents us from burning up during the day and by absorbing the earth's heat prevents heat loss at night so we don't freeze**

4. What is the most common greenhouse gas?

   **Water vapour**

5. Identify the source of the following greenhouse gases

   a) Carbon dioxide: **plant and animal respiration, biomass decay and burning, burning of fossil fuels**
   b) Methane: **livestock, decaying biomass in oxygen free environments**
   c) Nitrous oxide: **soils and oceans**
   d) Ozone: **appears naturally in atmosphere**
   e) Halocarbons: **manmade chemicals**

6. What natural indicators have scientists identified as signs that climate change is occurring?

   **Melting glaciers, rising sea levels**

7. How do trees remove carbon dioxide from the atmosphere?

   **Through photosynthesis**

8. How many tonnes of oxygen do trees return to the atmosphere for every tonne of carbon dioxide they absorb?

   **0.7 tonnes of oxygen**

9. What percentage of the weight of wood is carbon?

   **50% or half their weight**

10. When does a tree release its stored carbon?

    **When they decompose or burn**

# Slide Presentation
## Question Sheet – Answers

11. What is the key element to ensure that our forests are efficient carbon sinks?

    **Managing our forests to reduce deforestation and ensure reforestation**

12. What can be done in developing countries to help reduce the effects of climate change?

    **Reduce deforestation and convert non-forested land to forests (plant trees)**

13. What factors does a Life Cycle Assessment measure to determine the environmental impact of a building product?

    **Resource extraction**
    **Processing of raw materials**
    **Production**
    **Distribution**
    **Use of the product**
    **Reuse and recycling**
    **Disposal**

14. Why would choosing to build with wood rather than concrete or steel be a better choice in the fight again climate change?

    **Wood requires less energy to extract, process, and transport, and less energy to construct and operate a home than using either concrete or steel**

15. What is bioenergy?

    **A clean renewable energy**

16. What are the advantages of using wood biomass rather than other sources of biomass?

    **Longer storage life**
    **Lower storage costs**
    **Lower transport costs**
    **Less intensive use of water and fertilizers**
    **Established collection system**

17. How can managing our forests help us adapt to climate change?

    **New forests may be more resilient to effects of climate change and through landscape planning and silviculture increasing carbon sequestration**

18. What does Canada's forest industry hope to achieve by 2015?

    **To become carbon neutral**

19. Identify three ways in which individuals can help fight climate change.

    **Use less fossil fuels**
    **Plant trees**
    **Reuse and recycle**

# Motor Vehicle $CO_2$ Emissions
## Question Sheet

Name: _____

The burning of fossil fuels such as gasoline is one of several ways in which carbon dioxide is added to the atmosphere. In this activity, you will calculate the amount of carbon dioxide emitted into the atmosphere by passenger vehicles in British Columbia. You will need to do some research on the internet to find some of the answers. A list of websites is provided at the end of this activity sheet.

### Part 1: Research

1. What is the total number of passenger vehicles registered in British Columbia? _____
2. What is the current cost of gasoline (regular) per litre? _____
3. What is the average gas mileage of a vehicle? _____
4. What is the average length of passenger vehicle in metres? _____
5. What is the average kilometres driven per vehicle per year? _____
6. How much carbon dioxide is produced per litre of gasoline? _____

### Part 2: Calculations

1. Calculate how long a line of cars would be (in kilometres) if all cars in British Columbia were lined up 'bumper to bumper' on a highway at the same time. _____ km long.
2. Using an atlas or web distance calculator, see how far this line would stretch across Canada. _____ km long.
3. If each car is driven 10,400 km per year, how much gasoline is used per year? _____
   _____
4. What is the total cost of all the gasoline used? _____
5. How much carbon dioxide is produced by these vehicles? _____

### Part 3: Analysis

1. Did any of the calculations in part 2 surprise you? Why? _____
   _____
2. If the government of British Columbia decided to reduce carbon dioxide emissions from motor vehicles by 25%, how could this be accomplished? _____
   _____
   _____

# Motor Vehicle $CO_2$ Emissions
## Question Sheet

3. Trees absorb carbon dioxide in the atmosphere and store or sequester it for many years in their organic tissues. About 15 trees need to be planted to absorb every 4,500 kilograms of $CO_2$ emitted. How many trees need to be planted to absorb the carbon dioxide emitted from motor vehicles in British Columbia? _____

   _____

4. Forest products such as lumber can store carbon for decades. A typical 2,400-square-foot wood-frame house contains 29 metric tonnes of stored carbon or the equivalent of the carbon dioxide produced by driving a passenger car over five years. How many 2,400 square-foot wood-framed houses would need to be built each year in British Columbia to offset the amount of carbon dioxide emitted from passenger cars? _____

5. How many trees on average are planted annually in British Columbia to regenerate areas impacted by logging, wildfire and insect infestations? _____

   _____

6. What recommendations would you give to people concerned about climate change and carbon dioxide emissions? _____

   _____

   _____

### Motor Vehicle $CO_2$ Emissions research websites:

B.C. Stats Licensed Vehicles in B.C. 2008
**http://www.bcstats.gov.bc.ca/data/dd/handout/mvlic.pdf**

Naturally Wood: British Columbia
**http://www.naturallywood.com/links.aspx?id=448**

Ford Canada
**http://www.fordvehicles.com/cars/fusion/features/specs/**

Canada Distance Calculator
**http://distancecalculator.globefeed.com/Canada_Distance_Calculator.asp**

Natural Resources Canada: Personal Transportation:
**http://oee.nrcan.gc.ca/publications/transportation/fuel-calculator/index.cfm**

Wikipedia Fuel Efficiency
**http://en.wikipedia.org/wiki/Fuel_efficiency#Fuel_economy**

# Motor Vehicle $CO_2$ Emissions
## Question Sheet - Answers

The burning of fossil fuels such as gasoline is one of several ways in which carbon dioxide is added to the atmosphere. How much carbon dioxide is emitted from cars in British Columbia each year?

## Part 1: Research

1. What was the total number of passenger vehicles registered in British Columbia for 2008?

   **2,022,397 (B.C. Stats for 2008 )**

2. What is the current cost of gasoline (regular) per litre?

   **(Check with your local gas service station for this answer)**

3. What is the average gas mileage of a passenger vehicle?

   **11 litres / 100 km Answers may vary: (Wikipedia fuel efficiency: 11L/100KM)**

4. What is the average length of passenger vehicle in metres?

   **4.8 metres**

5. What is the average kilometres driver per passenger vehicle per year?

   **10,400 km (B.C. Ecological footprint calculator: 200 km/week: 10,400 km per year)**

6. How much carbon dioxide is produced per litre of gasoline?

   **1.4 kg of $C0_2$ (NRCAN)**

## Part 2: Calculations

1. Calculate how long a line of cars would be (in kilometres) if all cars in British Columbia were lined up 'bumper to bumper' on a highway at the same time.

   **9,707.5 km long (2,022,397 X 4.8 = 9,707,505.6 m) (9,707,505 / 1,000 = 9,707.5 km)**

2. Using an atlas or web distance calculator, see how far this line would stretch across Canada using Vancouver as the starting point.

   **Answers may vary - Based on kilometres, approximately Vancouver to Halifax return plus Vancouver to Dawson Creek**

3. If each car is driven 10,400 km per year how much gasoline is used per year?

   **2,313,622,168 litres of gasoline per year (10,400 x .11=1144) (1144 x 2022,397=2,313,622,168)**

# Motor Vehicle $CO_2$ Emissions
## Question Sheet - Answers

4. What is the total cost of all the gasoline used?

   **Answers may vary (current cost of gasoline times 2,313,622,168 litres of gasoline)**

5. How much carbon dioxide is produced by these vehicles?

   **5,552,693,203 kg of $CO_2$ (2.4kg of $CO_2$ X 2,313,622,168 = 5,552,693,203)**

## Part 3: Analysis

1. Did any of the calculations in Part 2 surprise you? Why?
2. If the government of British Columbia decided to reduce carbon dioxide emissions from motor vehicles by 25%, how could this be accomplished?

   **Answers will vary. Possible answers:**
   - **Increase use of rapid transit in urban areas**
   - **Increase incentives for use of alternative transportation such as bicycles**
   - **Require all vehicles to lower carbon emissions by 25%**

3. Trees absorb carbon dioxide in the atmosphere and store or sequester it for many years in their organic tissues. About 15 trees need to be planted to absorb every 4500 kilograms of $CO_2$ emitted. How many trees need to be planted to absorb the carbon dioxide emitted by motor vehicles in British Columbia?

   **1,808,977 trees (5,552,693,203 / 4,500 = 1233931 X 15 = 1,808,977)**

4. How many trees on average are planted annually in British Columbia to regenerate areas impacted by logging, wildfire and insect infestations?

   **200 million per year (B.C. Forestry Innovation Investment, Forest Facts)**

5. Forest products such as lumber and furniture can store carbon for decades. A typical 2,400-square-foot wood-frame house contains 29 metric tonnes of stored carbon or the equivalent of the carbon dioxide produced by driving a passenger car over five years. How many 2,400 square-foot wood-framed houses would need to be built each year in British Columbia to offset the amount of carbon dioxide emitted from passenger cars?

   **191,742 houses 5,552,693,203 kg of $CO_2$ / 29,000 kg =191,742**

6. What recommendations would you give to people concerned over climate change and carbon dioxide emissions?

   **Answers will vary**

# Information Sheet

Climate Change our forests our future

## Forest Products – A sound environmental choice

Forests are a global treasure; and a source of beauty, inspiration, recreation and outstanding products. They also play a key role in mitigating climate change by absorbing and storing carbon in trees, soil and biomass. Just as there is no longer any doubt that the climate is changing, there can be no doubt that well-managed forests yield immense environmental and economic benefits.

Healthy growing forests recycle carbon naturally. When biomass is used instead of fossil fuels, it can reduce the build-up of carbon dioxide in the atmosphere. When trees are used for forest products, 50% of the carbon remains stored in the products for decades, or longer.

This is recognized by the Intergovernmental Panel on Climate Change (IPCC), a scientific body set up by the World Meteorological Organization and United Nations Environment Program. A 2007 report by IPCC Working Group III says forests remove carbon from the atmosphere, and at the same time, provide products that meet society's needs for timber, fibre and energy. A stable market for forest products encourages landowners to manage forests sustainably rather than converting them to other uses such as agriculture or urban development.

Canada's vast forests deliver diverse, high-quality products, backed by some of the toughest environmental laws on earth. Canadian wood products are an excellent environmental choice for construction.

Governments and organizations can improve their corporate social responsibility and lighten their environmental footprint through policies and procurement processes that encourage the use of wood and paper products from well managed forests.

## Forests and the Carbon Cycle

Understanding the substantial role forests play as carbon stores, as sources of carbon emissions and as carbon sinks has become one of the keys to understanding how forests can act to modify the global carbon cycle.

# Information Sheet

## Carbon in Wood and Paper

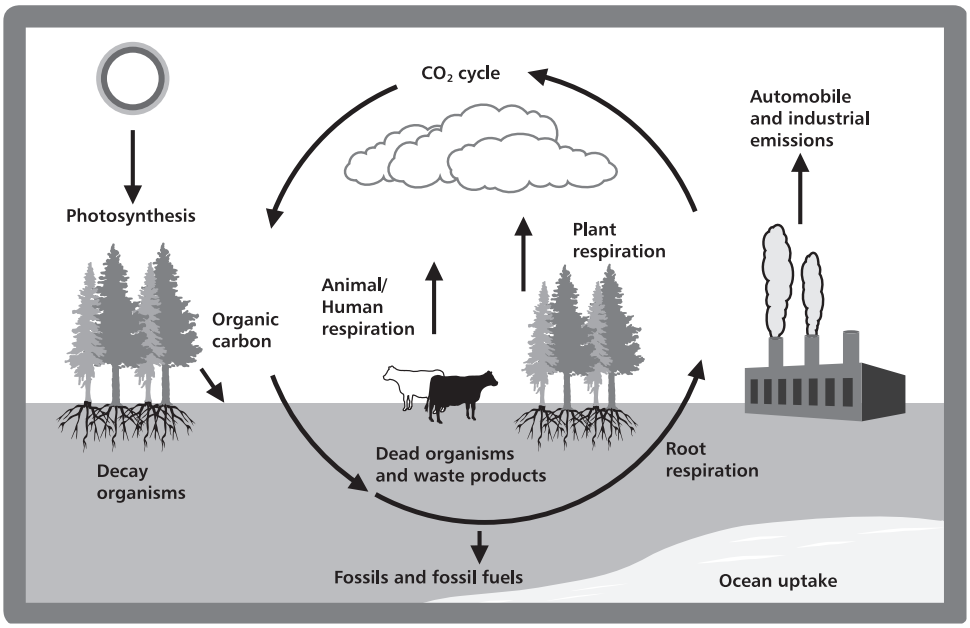
As trees grow, they absorb carbon dioxide and store it. Photosynthesis is a chemical process that takes place in the green leaves and needles of trees and plants. During the day trees take in carbon dioxide and release oxygen.

A chemical reaction converts the carbon into glucose, which is a sugar the tree uses to grow. Growing trees add a new ring of wood every year made up of cellulose, hemicellulose and lignin. Wood is a complex chemical compound that is about half carbon by dry mass.

The carbon stored in trees remains in the wood, even after the tree is harvested. It is released only if the tree or wood or paper product produced from that tree burns or decomposes.

When trees decompose or burn, much of the stored carbon is released back into the atmosphere, mainly as carbon dioxide, and some of the carbon remains in the forest debris and soils.

In its Global Forest Resources Assessment 2005, the United Nations Food and Agriculture Organization says the total carbon content of forest ecosystems for the year 2005 was more than the amount of carbon in the entire atmosphere. Roughly half of total carbon is found in forest biomass and dead wood combined, and half in soils and forest debris combined.



# Information Sheet

## How Forests Can Mitigate Climate Change

- Forests absorb and store carbon.
- Reforestation maintains this carbon reservoir.
- Carbon remains stored in wood and some paper products.

To mitigate or lessen the impact of climate change, it is necessary to reduce greenhouse gas emissions, remove carbon dioxide from the atmosphere and store more carbon. A healthy forest can do all three.

Because Canada's vast abundant forests absorb carbon dioxide from the atmosphere and store it in their fibre, they represent a significant carbon reservoir. Canada's world leadership in sustainable forest management practices ensures these forests will continue to play an important role in responding to climate change.

Managed forests are efficient carbon reservoirs or sinks as long as they are regenerated. Deforestation is the permanent conversion or change over of forested land to other uses, such as agriculture, urban development or transportation networks such as roads and railways. Harvesting trees is not considered deforestation if the area harvested is replanted or allowed to regenerate naturally. Harvesting and reforesting are part of sustainable forest management practices.

Two hundred million seedlings are planted annually in British Columbia while half a billion seedlings are planted annually across Canada. This is a key reason why Canada has virtually no deforestation even after more than 100 years as one of the world's leading forestry nations. And Canadian law requires forest companies to undertake prompt reforestation after public lands are harvested ensuring our forests are regenerated as soon as possible.

The carbon stored in trees remains sequestered even after the tree has been harvested and manufactured into forest products. Forest products such as structural lumber, furniture and some paper products store carbon for decades lessening the impact of climate change. A typical 2,400 square foot wood-frame house contains 29 metric tonnes of carbon, or the equivalent of offsetting the greenhouse gas emissions produced by driving a passenger car over five years (about 12,500 litres of gasoline).

The Intergovernmental Panel on Climate Change says many climate change impacts can be reduced, delayed or avoided through mitigation, and that efforts and investments in the next 20 to 30 years will have a large impact. If action is delayed, it increases the risk of more severe climate change impacts.

# Information Sheet

## How Forests Can Mitigate Climate Change continued

Many forest-related activities can help to mitigate climate change. They include reducing deforestation globally particularly in tropical areas and converting non-forested areas to forest (afforestation); replacing fossil fuels with bioenergy; using more wood products instead of energy-intensive building materials; and managing forests so they absorb and store more carbon.

## Forest Adaptation: A Response to Climate Change

A general trend towards warmer conditions, combined with increasing levels of carbon dioxide, could increase forest distribution and growth in Canada. However, it could take decades, or even centuries, before forests adjust to new climatic conditions. During this period of adjustment, the forests could be more vulnerable to insect infestations, such as the mountain pine beetle infestation, diseases, forest fires, and competition from unwanted species.

Due to uncertainties in climate models and the incomplete understanding of ecosystem processes and the complexities of forest ecosystems, precise predictions of climate change impacts are not likely. This emphasizes the need to maintain or increase forest resiliency.

Long-term forest planning that considers climate change can minimize potential mismatches between species and future climatic conditions and disturbance events. A strong case can be made for planned adaptation, in which future changes are anticipated and forestry practices (e.g. silviculture, harvesting, and fire protection) are adjusted accordingly.

Although many of the impacts of climate change are decades away, Canada's resource managers are exploring possible adaptation strategies to reduce the potential vulnerability of forests.

# Information Sheet

Climate Change our forests our future

## Managing Forests to Mitigate Climate Change

- Sustainable forest management lowers $CO_2$ emissions.
- Harvesting in Canada releases less $CO_2$ than natural disturbances.
- Deforestation increases greenhouse gas emissions.

*"Over the long term, active and sustainable management of forests, including their use as a source of wood products and biofuels, allows the greatest potential for reducing net carbon emissions."*
Integrated Carbon Analysis of Forest Management Practices and Wood Substitution 2007

When a tree is cut down, 40 to 60% of the carbon stays in the forest, and the rest is removed in the logs, which are converted into forest products. Some carbon is released when the forest soil is disturbed during harvesting, and the roots, branches and leaves left behind release carbon as they decompose.

The amount of carbon dioxide released through harvesting is small compared to what is typically experienced through forest fires and other natural disturbances such as insect infestations or disease. In extreme fire years, emissions from wildfires have represented up to 45% of Canada's total greenhouse gas emissions.

Once the harvested area is regenerated, either naturally or by planting seedlings, the forest begins to store carbon again. This combination of harvest and regrowth, along with the fact that most wood products have a lighter environmental footprint and store carbon for long periods of time, means that sustainable forest management practices can lower greenhouse gas emissions.

It is far better for the environment if the world's growing demand for building and paper products relies on fibre from sustainably managed forests rather than turning to products that require more fossil fuels to extract, manufacture and transport or are from less reliable sources.

# Information Sheet

## Solid Wood and Climate Change

- Wood building products are an excellent environmental choice.
- Life cycle assessment confirms the benefits of wood.
- Wood buildings are energy efficient, durable, adaptable.

Using wood building products that store carbon instead of building materials that require more fossil fuel to manufacture, such as concrete or steel, can help slow climate change. Trees grow with solar energy, and the little waste generated during processing is often used as biofuel to generate energy to meet the energy needs of the mill. And at the end of a building's life, the wood products used to construct the building can be easily reused, recycled or used as a carbon neutral source of energy.

As environmental awareness grows, building professionals are finding wood is an excellent choice for green construction designs, which minimize the use of energy, water and materials, and reduce impacts on human health and the environment. Wood is a high-performance and versatile choice for any new construction or renovation.

Wood is light in weight, yet strong. It has excellent load-bearing (ability to withstand weight) and thermal (insulating) properties, is easy to work with, and is well suited for large or small projects. Wood adds warmth and beauty to any building, enhancing the well being of occupants.

## Lighter Footprint

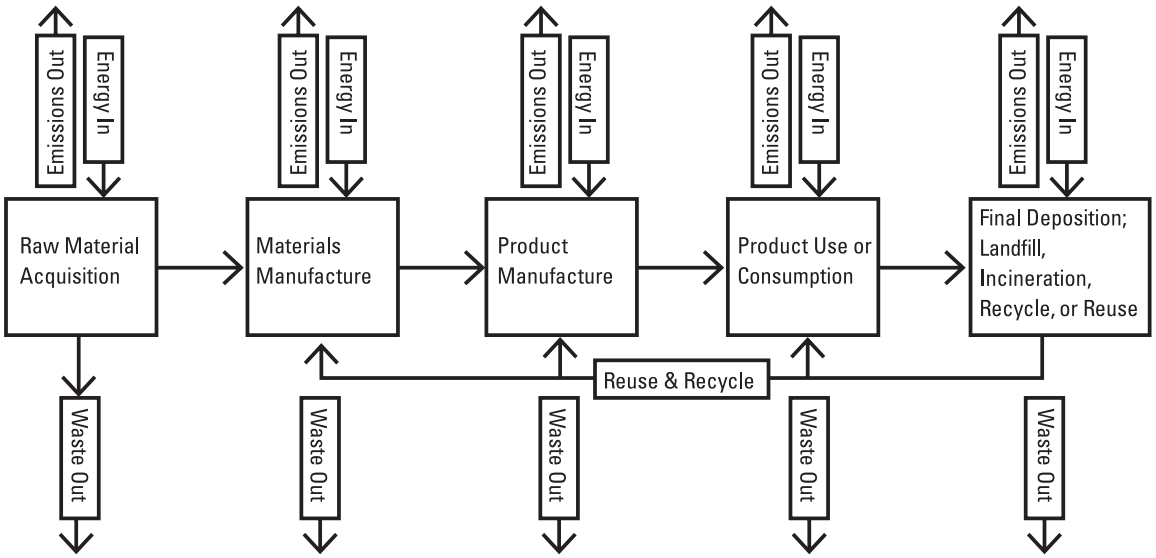
Studies show wood products are associated with far less greenhouse gas emissions over their lifetime than building materials such as steel, concrete, aluminum or plastic. For example, substituting a cubic meter of wood for concrete blocks or bricks results in a significant saving of 0.75 to one tonne of carbon dioxide.

# Information Sheet

## Lighter Footprint continued

Numerous international scientific studies demonstrate the environmental benefits of wood. A recent life cycle assessment, which looks at the environmental impact of the building materials from extraction, manufacture, construction, use to disposal, compared the environmental impacts of homes framed with wood, steel and concrete. The assessment found that the production of steel-framed homes generated 26% more greenhouse gas emissions and concrete-framed homes generated 31% more greenhouse gas emissions than their wood-framed counterparts.

The same study found that the production of the steel-framed homes consumed 17% more embodied energy (the total amount of energy used to manufacture and transport to point of use) and released 14% more air pollution than a wood-framed home. The same study found that the production of concrete framed homes consumed 16% more embodied energy and released 23% more air pollutants than a wood-framed home.



# Information Sheet

## Energy Efficient

As much as one third of the energy produced in North America is used to heat, cool and operate buildings.

Compared with other building products, wood products require less energy to extract, process and transport, and wood buildings can require less energy to construct and operate over time. If less fossil fuel energy is consumed, fewer greenhouse gases are emitted.

Wood's cellular structure, with lots of tiny air pockets, improves its natural thermal efficiency, making it 400 times better than steel and 15 times better than concrete in resisting the flow of heat. Steel and concrete are solid throughout and, as a result, they allow a greater amount of heat loss in many climates, increasing energy consumption. To achieve the same thermal performance as wood structures, steel and concrete structures need more insulation.

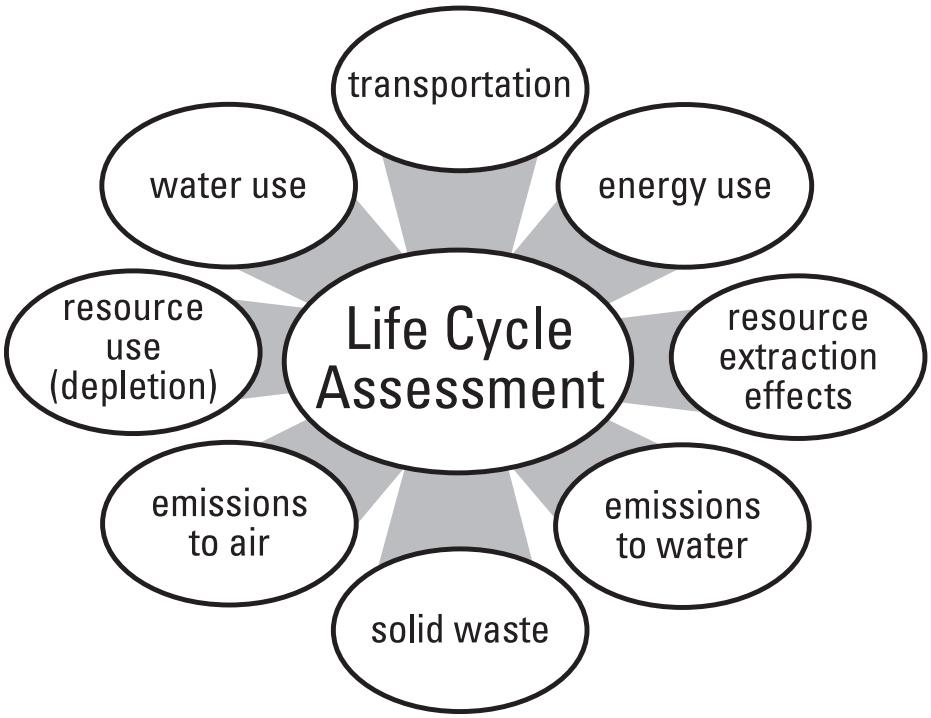
## Durable and Adaptable

Products that last longer reduce environmental demands. Wood is durable, and wood-frame buildings can be easily adapted to meet new needs and extend their life. After decades or even centuries of use, wood can be re-used in new buildings – and this requires little or no energy.

Wood residue from the production of lumber can be re-manufactured into high-value products like medium density fiberboard (MDF), finger-jointed lumber and other wood-hybrid composite lumber. Wood waste is also chipped into mulch for landscaping and agricultural uses.

# Information Sheet

## Life Cycle Assessment – Looking at the complete picture

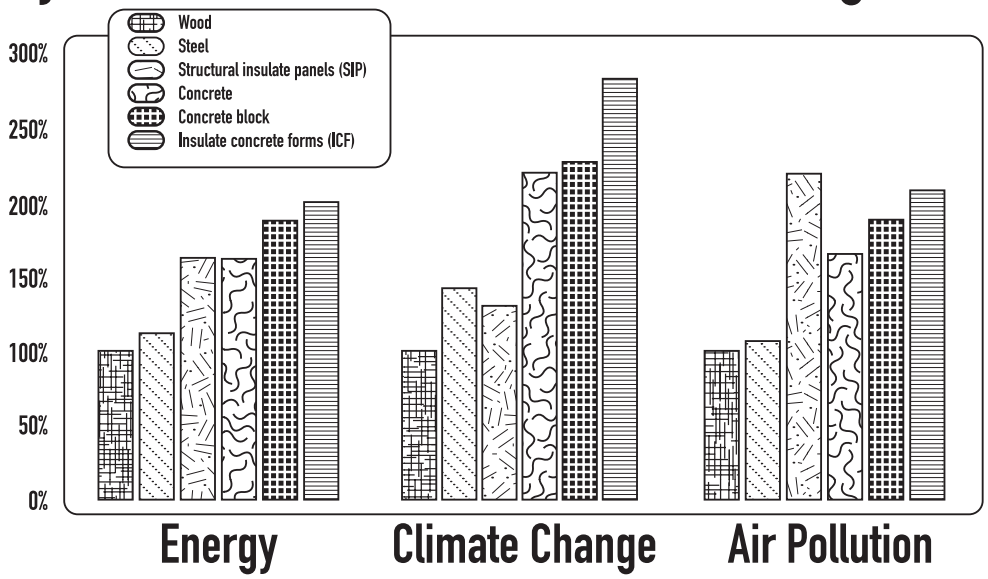



Life cycle assessment is an internationally accepted, science-based method of quantifying a product's environmental input and output from cradle to grave. It delivers a scientific measure of the environmental impact from resource extraction and processing of the raw materials through production, distribution, and use of the product to reuse or recycling, and eventual disposal.

Life cycle assessment studies show that wood building products have a lighter environmental footprint compared with alternative materials and offer clear environmental advantages at every stage.

# Information Sheet

## Life cycle assessment shows wood is a good choice




Embodied environmental impacts of various exterior wall assemblies

# Information Sheet

## Paper – Efficient Use of Fibre and Energy

- Today, Canada's paper industry uses less fossil fuel, emits fewer greenhouse gases, and uses wood fibre more efficiently.
- New paper is primarily recovered wood fibre and sawmill residues.
- The paper cycle needs recycled and fresh new wood fibre.

Paper manufacturing has long played an important role in national emission reductions by using wood fibre left over from the sawmilling process that once was burned or sent to landfills. Today, B.C.'s pulp and paper industry has improved its environmental performance by shifting its energy needs away from fossil fuels to wood chips and wood residues (biomass), and by using wood fibre more efficiently.

Using wood biomass fuels recycles carbon stored in wood instead of using fossil fuels which introduce geologic carbon to the atmosphere – helping to reduce the build-up of carbon dioxide.

As a result, 60% of the paper industry's energy requirements are met by renewable resources. Today, the paper industry emits 45% fewer greenhouse gases now than it did 15 years ago. And by using its waste material to generate energy, it also reduced its landfill wastes by nearly 40% between 1996 and 2001.

## Recycled Content

Used paper and paperboard products make up the largest single category of material disposed of in North American municipal landfills, and when these materials decay they can release methane, an even more potent greenhouse gas than carbon dioxide. Canada's paper industry has invested significantly in paper recovery, diverting used paper from landfills.

Today, almost one third of Canada's fibre supply for new paper comes from recovered paper, and about 85% of the fibre used to make new paper and paperboard comes from a combination of sawmill waste and recycled paper. Many Canadian companies deliver new paper to customers in the United States, and bring back waste paper in the same trucks.

# Information Sheet

## The Need for Fresh Fibre

North America's paper fibre cycle depends on fresh fibre from well-managed forests and a strong recovery (recycling) network that values and collects discarded paper products for reuse.

A project conducted by Metafore, a non-profit group that works with business, government and other leaders to advance environmental goals, found that without fresh fibre from sawmill residues and harvesting, paper supplies for magazines would disappear in weeks, and supplies for newspapers and cardboard boxes would disappear in months.

In part, that's because recycled fibre breaks down with each use and 15% of paper products, such as tissues and books or documents stored for extended periods, simply cannot be recycled. On top of this, some paper that could be recycled still escapes recovery.

While recycled paper is generally an excellent environmental choice, buyers need to consider how far the waste paper was transported and the type of processing needed – and compare this with requirements to harvest and process fresh wood fibre. Transporting recycled paper long distances may use more biofuels than harvesting new wood fibre and thus have a greater environmental impact.

Recovered paper used for products such as newsprint and brown paper bags that do not need to be bright has a lower environmental impact because it requires less processing and cleaning. With brighter paper grades, there is a point where using more recovered fibre can actually diminish environmental returns because of the additional processing required.

## Lighter Weight Papers

A new trend in "light-weighted" paper is helping to reduce production and delivery costs, transportation emissions and the amount of fibre needed. If paper for products such as newspapers weighs less without losing any printing quality, the result is an end product that costs less to ship and takes less space to transport and store – which in turn lightens its environmental impact.

Innovations in paper and cardboard production have resulted in creative, flexible and environmentally sensitive options for everything from furniture to consumer packaging.

# Information Sheet

## Non-wood Fibres

It is technically possible to make paper from almost any kind of fibre. In some cases, especially when fibre comes from dedicated fibre crops, the environmental impacts are often greater than harvesting trees. Research results from around the world show products such as kenaf and hemp require regular application of fertilizer and various chemicals, and sometimes irrigation, similar to other forms of high-yield agriculture.

Non-wood fibres are not commonly used to make paper in Canada because wood is plentiful and agricultural waste has higher-value uses such as livestock fodder. There are environmental issues related to the use of straw pulps, and they are inferior to wood pulps for strength.

## Bioenergy and Climate Change

- Bioenergy has no net greenhouse gas emissions.
- Wood is a clean, renewable energy source.
- Canada's forest sector uses biomass energy.

Wood was the world's main source of energy until the mid-1800s, and continues to be a major source of energy in much of the developing world. More recently, industrialized nations are again viewing wood as a source of bioenergy.

# Information Sheet

## Bioenergy and Climate Change continued

Bioenergy is clean renewable energy which comes from the burning of biomass that can include forest harvesting and sawmill residues (branches, tree tops, sawdust, bark, etc.), agricultural residues (plant stocks), urban and industrial organic waste, or dedicated energy crops. It is an environmentally friendly and sustainable alternative to traditional fossil fuel energy. Bioenergy has no added greenhouse gas emission because the carbon dioxide produced is recycled by plants, which absorb it for photosynthesis and cellular respiration.

Biomass can be used to produce heat and electricity, liquid and gaseous fuels (such as ethanol from grain and cellulose, biodiesel from oilseed and waste greases and biogas from anaerobic digestion), solid fuels (pellets and briquettes), and other products.

Cellulose fibres are an excellent choice for heat and electricity because they have higher energy efficiency than conventional agricultural feedstocks. The advantages of wood over other sources of biomass include a longer storage life and lower storage costs; higher bulk density (lower transport costs); less intensive use of water and fertilizers; and an established collection system.

# Information Sheet

## Bioenergy and Climate Change continued

Using biomass from wood and forest residues is a better choice for biomass than using agricultural crops for fuel. A declaration issued after the United Nations Food and Agriculture Organization summit on soaring food prices in 2008 said it is essential to address the challenges and opportunities posed by biofuels, in view of the world's food security, energy and sustainable development needs.

Canada's pulp and paper sector currently meets 60% of its energy demands with biomass derived from forest industry byproducts such as bark, wood shavings and sawdust.

## Canada's Forests and Climate Change

- Canada enforces its tough forest laws.
- Canada is a world leader in third-party forest certification.
- Canada has 91% of its original forest area.

Canada has 10% of the world's total forest cover, which means the country plays an important role in mitigating climate change.

The Canadian forest industry operates under some of the toughest environmental laws and regulations in the world, backed by comprehensive compliance and enforcement. An independent study by an associate professor from Yale University in 2004 found that Canada's forest practice regulations are among the most stringent in the world.

Canada has more forestland protected from harvesting than any other country. Less than 1% of Canada's managed forest is harvested each year, and areas that are logged must be promptly regenerated.

Deforestation in developing countries accounts for about 18% of annual global greenhouse gas emissions, or almost eight billion tonnes of carbon dioxide a year. Canada has 91% of its original forest cover, more than any other country, and its rate of deforestation has been virtually zero for more than 20 years.

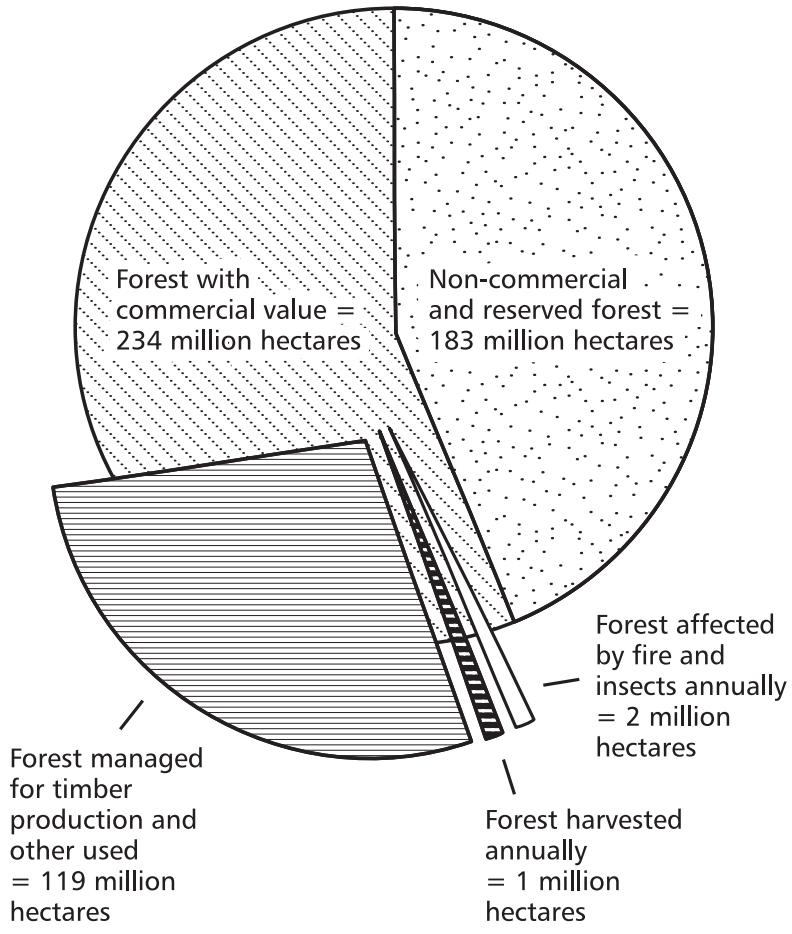
# Information Sheet

## Canada's Forests and Climate Change continued

Third-party forest certification is an excellent tool to verify that forest products are from legal, sustainable sources. Canada is a world leader in the independent certification of forest management and practices, and has more certified lands than any other country. At a time when just 10% of the world's forests are certified, Canada is home to more than 40% of all certified lands.

In Canada, 97% of the wood fibre removed from the forest is used for the highest-value products possible. The first choice is lumber and other wood products; however, wood fibre is also used as chips to make composite products (such as oriented strand board) and paper, and as sawdust for bioenergy.

### Canada's 401 million hectares of forest



# Using Wood to Fight Climate Change

Using the information sheets provided, complete the chart by providing the attributes and climate change mitigation potential for each item on the left.

| | Attributes | Mitigation Potential |
|---|---|---|
| Forests | | |
| Solid Wood | | |
| Paper | | |
| Bioenergy | | |
| Canada's Forests | | |

# Slide Presentation Script

## Slide Presentation

### Slide 1: Climate Change, Our Forests, Our Future

*Audio:* Climate Change, Our Forests, Our Future.

### Slide 2: Earth's climate

*Audio:* For the past several million years, the earth's climate and the biosphere has been in constant change, dominated by ice ages and glaciers. Since the last ice age some 18,000 years ago, our climate has been warming melting the ice sheets that covered most of north America, Asia and Europe giving way to grasslands, deserts and forests. Today our climate continues to change having warmed 0.6 Celsius over the past 100 years.

### Slide 3: The atmosphere

*Audio:* To better understand climate change, we first should know about the atmosphere. Earth's atmosphere is made up of the exosphere which extends to 10,000 kilometres above the earth. The thermosphere is below that and this is the area where the International Space Station orbits. Below it is the ionosphere where auroras form due to solar radiation. The mesosphere which extends from 50 to 80 kilometres above the earth is the part of the atmosphere where meteors burn up. Below that is the stratosphere which is primarily responsible for absorbing the ultraviolet radiation from the sun. The lowest part of the atmosphere is the troposphere and it is where all weather takes place.

### Slide 4: Protective shield

*Audio:* The atmosphere acts as a protective shield for the earth, allowing life to exist. Without it, we would be burned by the intense heat of the sun during the day or frozen by the very low temperatures at night, similar to conditions on the moon. Certain gases in the atmosphere absorb heat from the sun and radiate some of it back to the earth's surface. We call them greenhouse gases.

### Slide 5: Greenhouse gases

*Audio:* Water vapour is the most common greenhouse gas and is responsible for about 2/3 of the natural greenhouse effect. Carbon dioxide is released to the atmosphere through the natural processes of plant and animal life, decay, and the burning of fossil fuels and other materials. Methane is not as common in the atmosphere and is primarily created when matter decays

in an oxygen-free environment including rice paddies, cattle and other livestock, termites, biomass burning, landfills and wetlands. Nitrous oxide comes mostly from the soils and oceans but some is also released by deforestation, biomass burning, nitrogenous fertilizers, and fossil fuel combustion. Ozone exists naturally in the upper atmosphere where it shields the earth from the sun's harmful ultraviolet rays. Halocarbons are a group of man-made chemicals that are powerful greenhouse gases. As the atmosphere becomes more concentrated with greenhouse gases, Earth's average surface temperatures become higher than they would otherwise be. Scientists tell us the consequence is long-term changes in the earth's climate including temperature, precipitation, soil moisture, and sea level.

### Slide 6: Rising temperature

*Audio:* Many scientists point to melting glaciers and rising ocean levels as signs that Earth's temperature is rising and predict that the Earth's temperature will continue to rise as the amount of greenhouse gases in our atmosphere increases.

### Slide 7: Carbon Cycle

*Audio:* Many scientists identify carbon dioxide as one of the greenhouse gases that we contribute to the atmosphere and one which we may be able to reduce. Each year approximately 7.9 billion tonnes of carbon dioxide is emitted into the atmosphere through the combustion of fossil fuels and deforestation mainly in the tropics. 4.6 billion tonnes of the carbon emitted into the atmosphere is absorbed by oceans, lakes, rivers and biomass leaving some 3.3 billion tonnes in the atmosphere annually.

### Slide 8: Growing trees

*Audio:* What can we do to reduce the build up of carbon dioxide in the atmosphere and lessen predicted impacts of climate change? One natural way is to grow trees. Through a process called photosynthesis, trees remove carbon dioxide from the air and through a chemical process convert the carbon into glucose, which is a sugar the tree uses to grow. As a tree grows, the carbon is stored in its leaves, twigs and solid woody stem, and in the soil around it. Trees replace the carbon dioxide they take from the air with oxygen which is released through their leaves or needles. For every cubic meter of tree growth, about the size of a large telephone pole, a tree absorbs one tonne of carbon and returns 0.7 tonnes of oxygen to the atmosphere.

# Slide Presentation Script

### Slide 9: Carbon storage

*Audio:* Wood is a complex chemical compound that is about half carbon by dry weight. When a tree is harvested, about 40 to 60 percent of the carbon stays in the forest in the roots, leaves and branches and is released into the atmosphere as they decompose. The other 40 to 60 percent of the carbon is removed with the log. It is released only if the wood or paper product produced from that log burns or decomposes. Once the harvested area is regenerated, either naturally or by planting seedlings, the forest again begins to absorb and store carbon. The activities of harvesting and forest regeneration combined with the sequestering of carbon in wood products for long periods of time, means that our forests can help mitigate the impact of climate change.

### Slide 10: Mitigating climate change

*Audio:* Managed forests are efficient at absorbing carbon as long as they are regenerated. In Canada we harvest less than one percent of the forested land annually and by law all harvested public lands must be promptly reforested. Half a billion seedlings are planted in Canadian forests each year and over 200 million seedlings are planted in B.C., the main reason why the country has virtually no deforestation even after more than 100 years of forestry.

### Slide 11: Reduce deforestation. Convert non-forested areas to forests.

*Audio:* Globally, decreasing carbon emissions may be achieved by reducing deforestation in developing countries in particular in the tropics where forests are converted to agriculture, and by converting non-forested areas to forests.

### Slide 12: Life Cycle Assessment factors of building products

*Audio:* In our own communities, we can also help slow climate change by using wood building products that store carbon. We can compare the environmental impact of building products through an internationally accepted, science-based method of assessment. It delivers a scientific measure of the environmental impact from resource extraction and processing of the raw materials through production, distribution, and use of the product to reuse or recycling, and eventual disposal.

# Slide Presentation Script

### Slide 13: Less energy

*Audio:* Life cycle assessment studies show wood products require less energy to extract, process and transport, and wood buildings can require less energy to construct and operate over time than those built with steel or concrete.

### Slide 14: Wood and wood products

*Audio:* Wood is light in weight, yet strong. And at the end of a building's life, the wood products used to construct the building can be easily reused, recycled or used as a carbon neutral source of energy.

### Slide 15: Bioenergy from wood

*Audio:* Wood also helps reduce carbon emissions by providing bioenergy – a clean, renewable energy which comes from the burning of biomass that can include forest harvesting and sawmill residues like branches, tree tops, sawdust and bark. For example, paper manufacturing uses wood fibre left over from the sawmilling process that once was burned or sent to landfills. And wood residue from the production of lumber is re-manufactured into high-value products like medium density fiberboard, finger-jointed lumber and other wood hybrid composite lumber. Wood waste is also chipped into mulch for landscaping and agricultural uses.

### Slide 16: Bioenergy from wood

*Audio:* Bioenergy has no added greenhouse gas emissions because the carbon dioxide produced is recycled by plants, which absorb it for photosynthesis and cellular respiration. Using wood biomass fuels recycles carbon stored in wood instead of using fossil fuels which introduce carbon to the atmosphere – helping to reduce the build-up of carbon dioxide.

### Slide 17: Wood residue as bioenergy source

*Audio:* Compared to other sources of biomass, wood has a longer storage life and lower storage costs; lower transport costs; less intensive use of water and fertilizers; and an established collection system.

# Slide Presentation Script

### Slide 18: Adapting to climate change

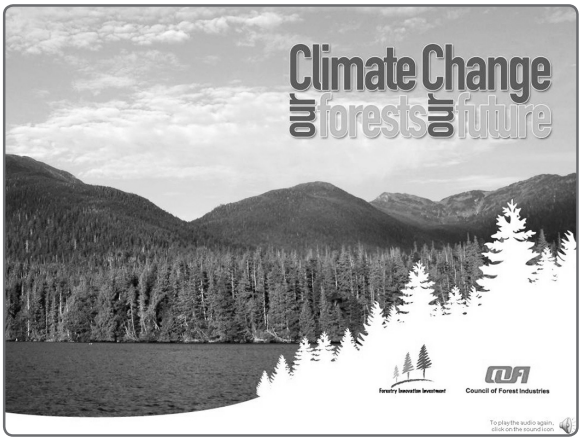
*Audio:* To help our forests help us, forest managers are selecting species that increase the resilience of the forest and are more likely to survive in future climates. They are increasing sequestration or carbon storage in forests through landscape planning and innovative silvicultural practices. With these and other strategies, the Canadian forest products industry aims to be carbon neutral by 2015.

### Slide 19: The Future

*Audio:* Some changes brought about by climate change would be good. If you live in a very cool climate, you might enjoy warmer temperatures. Days and nights could be more comfortable and people in the area may be able to grow different and better crops than they could before. Of course, changes in some places would not be very good at all. We can all help lessen climate change by using fewer fossil fuels – that means reducing our use of electricity that comes from burning fossil fuels and by walking or biking rather than driving vehicles that run on fossil fuels. We can plan tree planting programs through school, home and community activities. We can use wood for building houses and other structures. And we can reuse and recycle as much as possible.

# Slide Presentation Notes

Notes

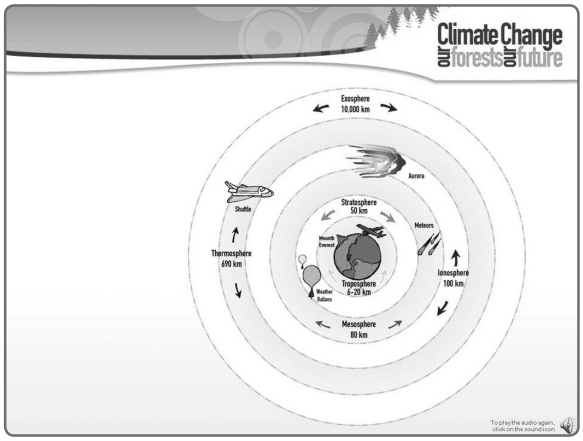



Slide 1

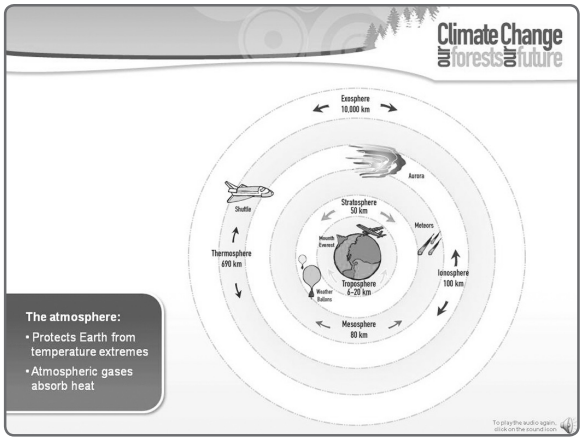

Slide 2

# Slide Presentation Notes

## Notes



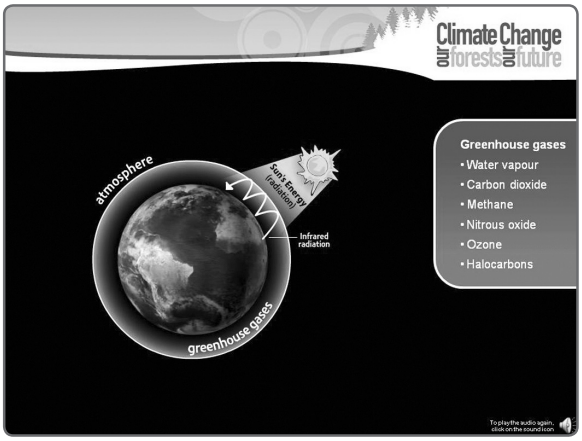

Slide 3




Slide 4

# Slide Presentation Notes

Notes

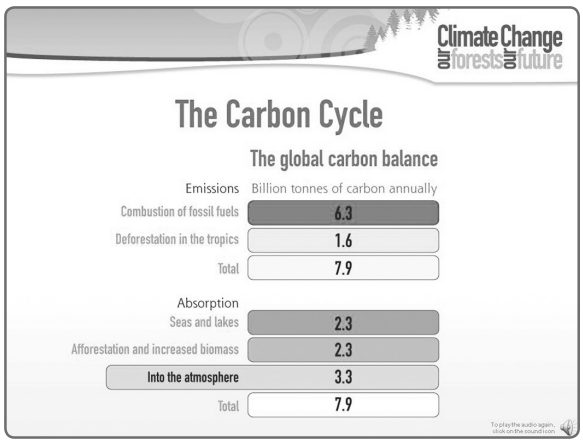



Slide 5

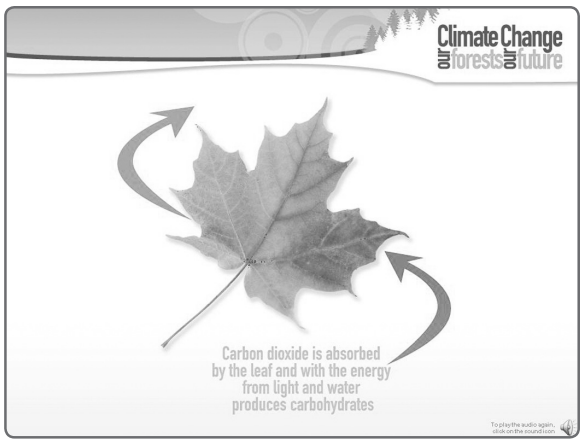

Slide 6

# Slide Presentation Notes

## Notes




Slide 7




Slide 8

# Slide Presentation Notes

Notes

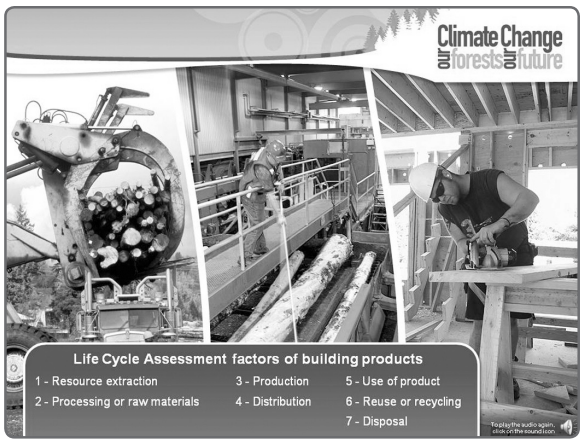

Slide 9


Slide 10

# Slide Presentation Notes

## Notes

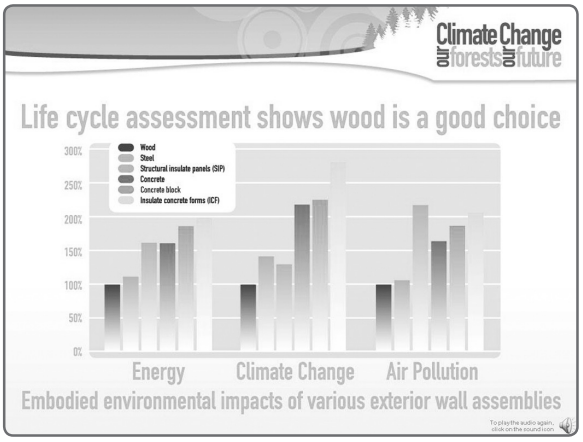

Slide 11



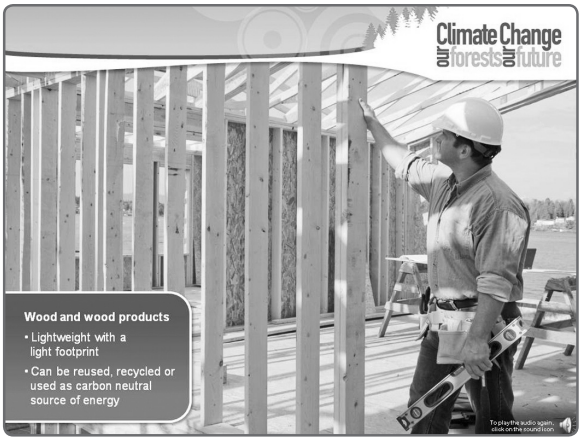

Slide 12

# Slide Presentation Notes

Notes



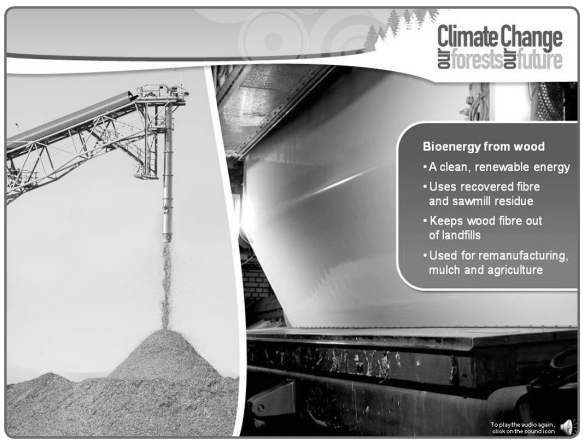

Slide 13



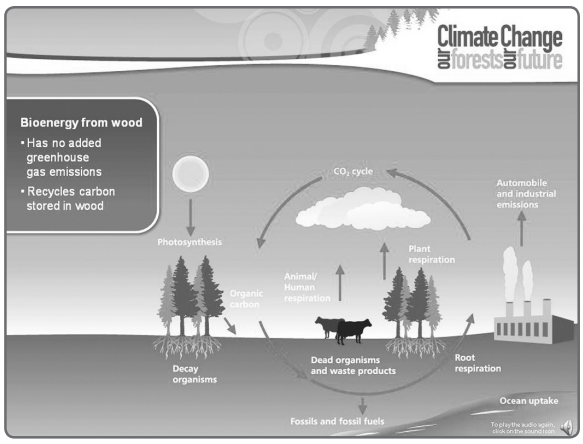

Slide 14

# Slide Presentation Notes

## Notes



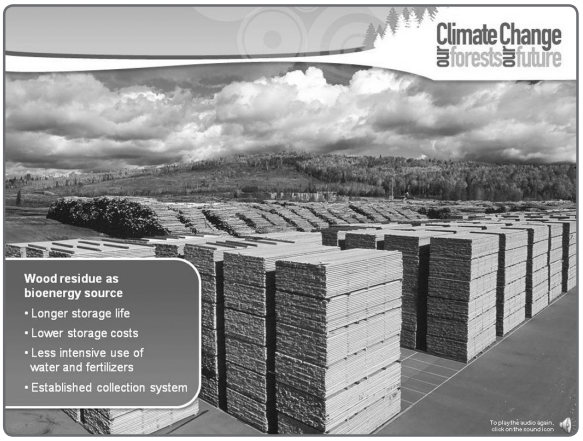

Slide 15



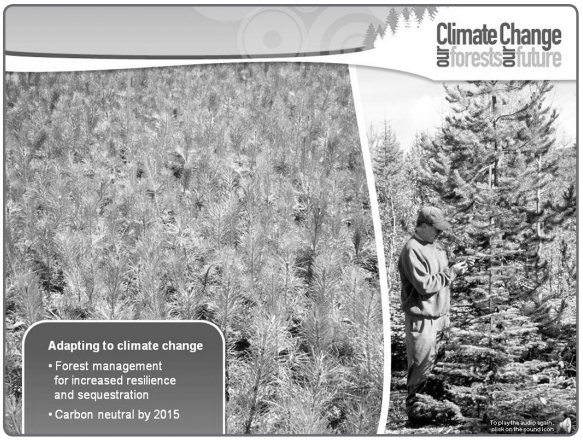

Slide 16

# Slide Presentation Notes

Notes




Slide 17




Slide 18

# Slide Presentation Notes

## Notes


Slide 19