

The Case of the Life Cycle Analysis

[Slide 1: Title Slide]

Characters:

Lucius Charles Anderson, Private Eye (Luke)

Luke's Voice Over: 1st person narration of what Luke is thinking (performed by different student)

Pine Plantation Manager

Lumber Mill Manager

Hank

Waste Manager

Student 1

Student 2

Student 3

Student 4

Student 5

Student 6

Scene 1: Luke's Office

[Slide 2: Detective Office]

[Lucius Charles Anderson sits, reading a newspaper, with his feet propped up on a desk. Luke continues reading or looking lost in thought while his "Voice Over" is read.]

Luke's Voice Over: It was a cold, rainy night, and I was happy to be inside. I'd just finished a case, and I was looking forward to catching up on the local news. My name's Lucius Charles Anderson, but most people call me Luke. They also say I'm a private eye, but I don't care for that term myself. Let's just say, I find things for people. Finding out what most people don't know is sort of a gift of mine. I was just getting into an article on the effects of global warming when they showed up.

[Student 1 and Student 2 enter.]

Luke's Voice Over: They had a look of fear and expectation—the kind you get when you are running behind on a major assignment and are about to ask for help. You know the kind.

Luke: You two look a little out of your element. The daycare is up the street a ways.

Student 1: We're here to hire you.

Luke: I'm not really looking for a job right now, kid.

Student 2: But it's important. We need your help tracking the life cycle of outdoor furniture.

Life Cycle Assessment Play (One-Act Version)

Luke: The what?

Student 1: It's called Life Cycle Assessment or LCA for short. Have you heard of it?

Luke's Voice Over: Life Cycle Assessment? Nobody's heard of that.

Luke: Maybe.

Student 2: It's when you evaluate the impact of a product or service by analyzing its entire life cycle from cradle to grave.

Student 1: From raw materials through production, use, and then disposal. We're picking out furniture for the senior-sponsored outdoor eating areas, and we need to figure out which set of outdoor furniture results in the least amount of greenhouse gas emission during the course of its life cycle.

Luke: Greenhouse gases, huh? I was just reading about those.

Student 2: We're comparing three different types of furniture: plastic, aluminum, and wood.

Luke: All right, show me what you have so far.

Student 1: Well, so far, we've come to you to ask for help.

Luke: You mean you don't have anything yet?

Student 2: We're just supposed to get the wood part. We're focusing on the three main greenhouse gases: carbon dioxide, methane, and nitrous oxide.

Student 1: If we spend any more time on this, we'll end up failing our English test. We have about twelve hours to figure out who Lady Macbeth is and why she kept washing her hands.

Luke: You kids look pretty desperate. All right, I'll take the case while you develop your theories about Lady MacBeth. I've got a buddy down at the pine plantation who should be able to get me started on this.

Scene 2: Pine Plantation

[Slide 3: Pine Plantation]

Luke's Voice Over: It had been a while since I'd seen my buddy at the pine plantation, but I'd gotten him/her out of a jam a while back and figured I'd cash in the favor.

Pine Plantation Manager: Luke Anderson. It's been a long time. What brings you out to the forest?

Luke: I'm working on a case, and I'm betting that you can help me out.

Pine Plantation Manager: This isn't the best time, Luke.

Life Cycle Assessment Play (One-Act Version)

Luke: I didn't want to have to mention that thing I helped you with.

Pine Plantation Manager: What thing? Do you mean the pencil you loaned me when we were in high school? Are you still stuck on that?

Luke: You could have never taken that test without a number two pencil.

Pine Plantation Manager: Are you kidding me? You know what, never mind. But after today, I don't want to hear about that pencil again.

Luke: It was my only spare.

Pine Plantation Manager: What can I help you with, Luke?

Luke: Ever heard of life cycle assessment?

Pine Plantation Manager: Of course, that's where you evaluate the impact of a product or service by analyzing its entire life cycle from cradle to grave.

Luke: Wow, that's it exactly. All right, well that's what I'm working on now, and I'm looking into the greenhouse gas emissions associated with the life cycle of a wooden set of outdoor dining furniture. I need to find out about your operations here, and the greenhouse gas emissions that result from them.

Pine Plantation Manager: So, I imagine you're focusing on carbon dioxide, methane, and nitrous oxide.

Luke: You're really good at this.

Pine Plantation Manger: Pardon?

Luke: I said, obviously, yes.

Pine Plantation Manager: Well, the first thing you should understand about our emissions numbers is that they depend on what kind of carbon dioxide you are talking about.

Luke: I don't want any tricks here. Carbon dioxide is carbon dioxide. C-O-2. Slap a couple of oxygen atoms onto a carbon one, and you've got yourself a greenhouse gas. That's what we're talking about.

Pine Plantation Manager: The molecule may be the same, but where it comes from matters a lot. Do you know about the carbon cycle in an ecosystem?

Luke: [Covering his ignorance] I know things.

Pine Plantation Manager: Plants use carbon dioxide from the atmosphere during photosynthesis and store carbon as cellulose or starch. Then the carbon dioxide goes back to the atmosphere when it is oxidized in respiration or decomposition.

Life Cycle Assessment Play (One-Act Version)

Luke: Yes, that's what I was going to say.

Pine Plantation Manager: We can think of it in terms of one tree. As the tree grows, it's converting atmospheric carbon dioxide into wood. Then, when it dies and decomposes, that carbon is converted back into carbon dioxide. Of course, when a tree dies, others grow to take its place. As long as there is no net loss of trees—or deforestation—then the carbon taken up by the growing trees will balance with the carbon dioxide released by a decomposing tree.

Luke: So individual trees come and go, but the forest, as a whole, stores the same amount of carbon?

Pine Plantation Manager: Exactly! Assuming there's no net loss of trees. That's how I manage this pine plantation. I make sure that we are growing trees as fast as we are harvesting them. This way, I know I'll be able to keep supplying trees to my customers, but also, it means that the carbon released when these wood products are thrown away and the wood decomposes is balanced by the carbon dioxide that the new trees are using to grow. That's why we think of the carbon dioxide from the decomposing wood as different from the carbon dioxide that result from using fossil fuels, and why wood is called a “carbon neutral” energy source.

Luke: You mean as opposed to fossil fuels, which come from plants and animals that lived hundreds of millions of years ago.

Pine Plantation Manager: That's right. When we burn fossil fuels, we're making carbon dioxide out of ancient carbon. Fossilized carbon.

Luke: So the carbon that comes from trees goes back into trees, but the carbon that comes from fossil fuels won't go back into fossil fuels—at least not for millions of years.

Pine Plantation Manager: Now you've got it.

Luke: So you're telling me that you have no greenhouse gas emissions at all?

Pine Plantation Manager: I'm not saying that. We use fossil fuels here too—fuels for cutting and trimming the trees and transporting them to the lumber mill. Even the fertilizer we use, once or twice in the trees growth cycle to give the trees a boost, is made from fossil fuels. All of these things have to be counted when considering the greenhouse gas emissions associated with growing trees and preparing them for processing.

Luke: So do you know what the emission numbers are to run a pine plantation?

Pine Plantation Manager: Sure. [Takes a piece of paper from his pocket and pats his pockets looking for something to write with. Finds a number 2 pencil]

[The manager scribbles something down on a sheet of paper and hands it to Luke] Here are the emissions based on all of these things that we need to run a pine plantation.

[Slide 4: Emissions from Sustainable Forestry]

Luke [looking at the paper]: Transport the trees to a lumber mill, huh? Looks like that's my next stop.

Life Cycle Assessment Play (One-Act Version)

Pine Plantation Manager: You could also catch a ride with one of our truck drivers. It's not far from here. [Hands Luke a number 2 pencil] And Luke, why don't you keep the pencil too.

[Luke accepts the pencil with a nod]

Scene 3: Lumber Mill

[Slide 5: Lumber Mill]

[Luke walks and observes the area.]

Luke Voice Over: Calling in a favor was one thing, but this lumber mill would be a different story. Sometimes in my line of work, people don't want to answer your questions, but I'm pretty good at getting people to talk. It's best if you let'em know right away that you mean business.

[The Lumber Mill Manager is facing away from him watching operations. Luke walks up behind him.]

Luke: You the manager of this place?

Lumber Mill Manager: Sure am. Name's—

Luke: Didn't ask for your name. I'm working on a life cycle assessment. It's when you—

Lumber Mill Manager: —evaluate the impact of a product or service by analyzing its entire life cycle from cradle to grave. I know what an LCA is.

Luke Voice Over: How does everyone know this but me?

Luke: All right, smart guy. Start telling me about the greenhouse gas emissions from this place, and I mean right now. That furnace over there must produce a lot of them.

Lumber Mill Manager: There's no reason for that tone. I'd be happy to give you a tour of the place.

Luke: You'd do that?

Lumber Mill Manager: Sure. First of all, that isn't a furnace. It's a kiln, and it doesn't produce nearly as much greenhouse gas emissions as you'd think. After the wood is cut, we dry it in that kiln, but the heat is produced from the bark chips and sawdust produced during the earlier steps. Scientists typically don't count the carbon from burning wood as greenhouse gas emissions—

Luke: Because the carbon from that wood would go into the atmosphere anyway when the tree decomposed.

Lumber Mill Manager: Exactly. In fact, it's better than that, because we're avoiding the emission of ancient carbon that would happen if we burned fossil fuel like oil or natural gas to heat the kiln.

Luke: So what happens after the kiln? And don't be skimpy with the details.

Life Cycle Assessment Play (One-Act Version)

Lumber Mill Manager: The wood is planed to make sure that each piece is straight and sized correctly. We mark it, sort it, and let it sit in that pile until we sell it.

Luke: And that's it? That's the whole story?

Lumber Mill Manager: Yes, sir, that about sums it up. You got a pencil I could borrow? I could write down the greenhouse gas emissions associated with that process right now.

Luke: Yes I do. [Luke hands the Lumber Mill Manager the pencil he got from the Pine Plantation Manager]

Lumber Mill Manager: [The Lumber Mill Manager scribbles something on a slip of paper] Wait a second. I understand that you're interested in wood for outdoor furniture.

Luke: That's right. What's that mean to you?

Lumber Mill Manager: It means you'd need pressure-treated wood. Wood for outdoor use is treated to protect it from insects, fungus, and moisture. Here, these numbers include the pressure treatment too. [Lumber Mill Manager scribbles something down on a slip of paper and hands it to Luke, but does not return the pencil.]

[Slide 6: Emissions from Lumber Production and Pressure Treatment Process]

Luke: Ah, thanks. Are there any places around here that make outdoor furniture out of wood?

Lumber Mill Manager: Hank's place is just up the road. Look for the sign.

Luke: All right. Thanks for your help. [Luke begins to walk away and then suddenly remembers something. He runs back over to the Lumber Mill Manager and takes the pencil back with an apologetic nod.]

Scene 4: Hank's Outdoor Furniture

[Slide 7: Hank's Outdoor Furniture Sign]

[Hank, a woman, is sanding a chair down when Luke and the students approach.]

Luke Voice Over: The place really was just down the road from the lumber mill. A woman was outside sanding a chair. She was my key to finding Hank. I just needed to win her over with some of my tough-on-the-outside-but-good-guy-at-heart charm. You know the kind.

Hank: Were you just talking to yourself?

Luke: No

Hank: I heard you talking when you walked up, and you're all alone.

Life Cycle Assessment Play (One-Act Version)

Luke: I'm a private detective. We have to do a lot of our own narration.

Hank: Is that something like an invisible friend?

Luke: Not exactly. Never mind. I'm looking for Hank. I'm not going to hurt him. I just need to talk.

Hank: Why would you want to hurt Hank?

Luke: I don't want to. I'm just trying to put you at ease.

Hank: If that's what you're trying to do, then you need to quit talking to your invisible friend.

Luke: Do you have any idea where I can find Hank?

Hank: I've got a pretty good idea. You're looking at her.

Luke: I don't have times for games here, lady. I need to find how much greenhouse gas is emitted to make this furniture.

Hank: Name's Henrietta, but people around here have been calling me Hank ever since I was a kid. I can tell you that information, but to look at the true impacts of making this furniture, you really need to include the whole lifecycle.

Luke Voice Over: Am I really the only one who hasn't heard of life cycle assessment?

Luke: I've been tracking the pine set from the pine plantation, to the mill and the pressure treating, and it's all led me here to you.

Hank: I see. Well, most of the emissions at this step come from the use of power tools—saws and sanders and such. Then, there's the emissions that result from making the stain and finish that I put on the wood.

Luke: Stain and finish?

Hank: To give the wood the desired color and protect it from the elements. Here's the emissions numbers [Hands Luke a piece of paper].

[Slide 8: Emissions from Furniture Manufacturing]

Luke: Thanks, uh, Hank. I think that is pretty much the last piece of the puzzle.

Hank: Not quite.

Luke: What do you mean?

Hank: If you're doing a life cycle assessment, you need to include impacts from use and disposal of your product as well.

Life Cycle Assessment Play (One-Act Version)

Luke: Hmm, that makes sense, but how do I do that?

Hank: You have to consider how long the product will be used. Let's assume the usable life of this furniture will be fifteen years. To keep the surface looking good, the pine would need to be sealed at least twice during its lifetime.

Luke: So waxing seven times would take us through the fifteen years?

Hank: Exactly, here are the maintenance emissions to account for those [Hands Hank a slip of paper.]

[Slide 9: Emissions from Use and Maintenance]

Hank: Now, for the disposal, you should probably go to the landfill.

Luke: Couldn't we just toss the wood aside once we were done with it, and let it decompose naturally?

Hank: Not after that high-pressure treatment. Because of the chemicals involved there, we'd need to dispose of it in a landfill, and that means more emissions. You see, when wood decomposes in a forest, it does so aerobically, which means that oxygen is present. The product of that aerobic decomposition is carbon dioxide. But when it decomposes in a landfill, no oxygen is present. That means it goes through what is called "anaerobic decomposition." One of the products of anaerobic decomposition is methane, which is a much more potent greenhouse gas.

Luke: How do you know so much about this stuff?

Hank: When I was in school my teacher made us perform a play about it. It was corny, but the ideas stuck.

Scene 5: Landfill

[Slide 10: Landfill]

[The Waste Manager is sitting and staring off into space when Luke arrives at the landfill.]

Luke's Voice Over: Sometimes a case brings me to places I'd rather not be. A crime scene, a morgue, or school on a Saturday. But none of those places smell worse than a landfill.

Waste Manager: Welcome, welcome! It's always so good to have visitors. Nobody ever comes out here to the landfill. Most people don't even like to admit that "here" exists. They simply throw things away and never think about them again. Are you here to throw something away?

Luke: I'm interested in the greenhouse gas emissions associated with disposing of outdoor wood furniture. You know, with the anaerobic decomposition and all that.

Waste Manager: Ah, so you know that because the wood must decompose without oxygen in a landfill, some of the carbon in the wood becomes methane instead of carbon dioxide?

Luke: Yes, and I know that methane traps more heat per mass than carbon dioxide does.

Life Cycle Assessment Play (One-Act Version)

Waste Manager: Yes, exactly. Some of that methane is recaptured at the landfill before it ever reaches the atmosphere, but the rest must be included in your calculations. And then there are also the emissions associated with the general production and management of the landfill. Here are the numbers that include both the methane emitted from decomposition and the other emissions from running the landfill [Hands Hank a slip of paper.]

[Slide 11: Emissions from Disposal]

Luke: That's it. The last piece! Now I have the entire life cycle, from cradle to grave.

[Slide 12: Life Cycle Diagram]

Luke: And I have the greenhouse gas emissions associated with each step.

[Slide 13: Total Emissions]

Luke: I'll take these back to those students.

Scene 6: Luke's Office

[Slide 14: Luke's Office]

[Luke, Student 1, and Student 2 are looking at all the information they have found.]

Student 1: Nice work, Luke. This will allow us to compare the greenhouse gas impacts of the three types of furniture once we have the other groups' findings for plastic and aluminum.

[Students 3 and 4 enter.]

Student 3: Did somebody say "plastic"?

Student 4: We tracked the entire life cycle for plastic furniture..

[Slide 15: Life Cycle Diagram: Plastic Set]

Student 1: You two are done already?

Luke: (Looking at the life cycle diagram) What in the world is poly-propi-whatever?

Student 3: Who are you?

Student 2: He's Luke, the private detective we hired to do the life cycle assessment for the wood furniture.

Student 3: You hired a detective? That's kind of lazy, isn't it?

Student 4: Luke, you mean polypropylene. It's the kind of plastic that furniture is made out of.

Life Cycle Assessment Play (One-Act Version)

Student 3: That's right, and it comes from oil. Look. Here are the carbon emissions from each step.

[Slide 16: Total Emissions: Plastic Set]

Student 1: You finished that part already too?

Student 3: Yes, and without a detective.

[Students 5 and 6 enter.]

Student 5: Someone hired a detective?

Student 3: The wood group hired a detective.

Student 5: That's kind of lazy, isn't it?

Student 3: That's what I said.

Student 1: The aluminum group finished also?

Student 6: Of course, here's the life cycle for the aluminum furniture.

[Slide 17: Life Cycle Diagram: Aluminum Set]

Luke: And bauxite would be...?

Student 6: Who are you?

Student 3: That's the detective.

Student 5: Bauxite is aluminum ore that they mine out of the ground, but it has to go through a whole lot of processing before it can be made into aluminum. Check out the figures.

[Slide 18: Total Emissions: Aluminum Set]

Student 2: Ok, so we have the totals for all three, but now we have to convert them to carbon dioxide equivalents.

Luke: Carbon dioxide whats?

Student 3: (To Luke) You ask a lot of questions.

Luke: I'm a detective.

Student 1: Both methane and nitrous oxide are more potent greenhouse gases. One pound of methane traps about 25 times as much heat as a pound of carbon dioxide.

Life Cycle Assessment Play (One-Act Version)

Student 2: And a pound of nitrous oxide is 300 times more potent. We can fill in this sheet to get a true comparison.

Luke: I suppose that finishes things up for me.

Student 1: How much do we owe you, Luke?

Luke: Don't worry about that. I've gotten something much more valuable by working on this case.

Student 1: You mean your new insight into life cycle assessment? I know that I'll never be able to look at a product again without thinking about the raw materials and energy requirements for making it, using it, and getting rid of it.

Student 2: Yea, I never realized that something as boring as outdoor dining furniture could involve so many different people and places.

Luke: That's all true, but that's not what I was referring to. [Luke takes out the pencil that the Pine Plantation Manager gave him.]

Student 1: A pencil?

Luke: It's a long story. So what type of furniture do you think you'll choose?

[Slide 19: The End]

[Slide 20: Comparison of Emissions]