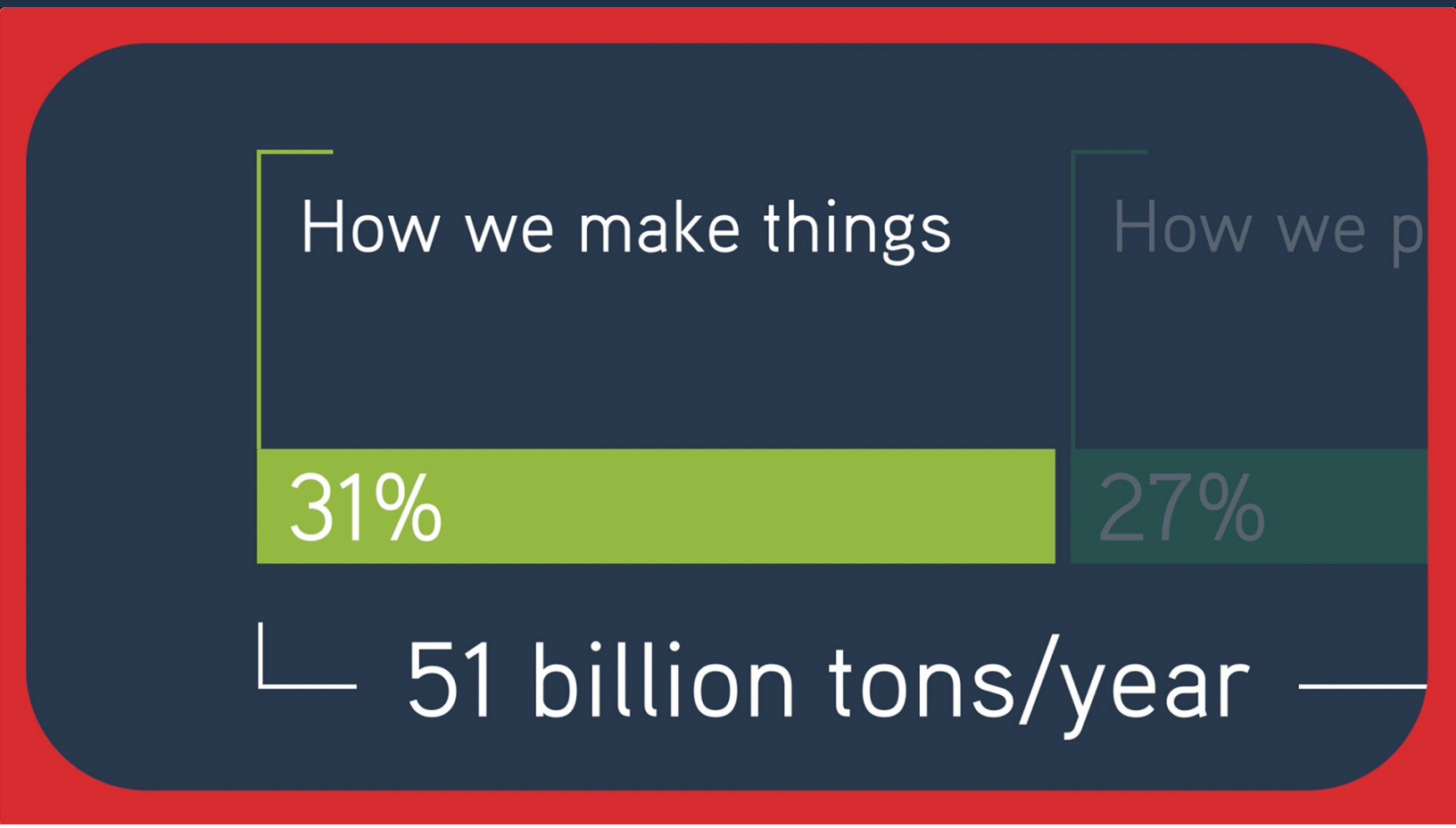

Grand Challenge 2: How We Make Things | The Climate Project

As cities and populations around the world grow, society will need to find alternatives to major climate health offenders like cement that produce dangerous levels of greenhouse gas. It will take scientists, educators, politicians, and so much more to find long-term solutions. What will you do?

0:10

Narrator speaking; photos of infrastructure

Humans are making a lot of stuff, and I don't just mean plastic straws and plush Pokemon toys—I mean big stuff.

The global population is growing (I mean you probably knew that). But did you know that by 2060 we'll have doubled the number of buildings on Earth?

Photo of New York City; text box: x 480!

Here's what that means: on a global scale, we're going to be building the equivalent of New York City every month for the next 40 years. That's 480 additional New York's!

Photos of workers in China, India, and Nigeria

Most of that growth will be concentrated in places like China, India, and Nigeria, where millions of people are pulling themselves out of poverty and migrating to cities.

That's not a problem, it's a good thing. But you know what is a big problem? Almost all the stuff we humans make produces some greenhouse gas. But concrete and steel produce a lot of it.

Photos of construction sites using cement; text box: Cement is the ingredient...

Cement, the main ingredient in concrete, is probably the biggest offender.

1:06

Text description

Cement production alone accounts for 8 percent of the carbon we put into the atmosphere each year. Building 480 new New York cities in the next 40 years is going to require a lot of concrete.

Finding carbon-free methods to make the cement needed for all that concrete is going to be very important.

Grand Challenges infographic; zooms up on "How we make things"

And that effort is a big part of Grand Challenge #2: How We Make Things. Altogether, making things is responsible for 31 percent of greenhouse gas emissions—almost a third of all global emissions. That's the largest percentage of any of the Five Grand Challenges.

Text box: Three sources of greenhouse gas from manufacturing; text box: It takes a lot of electricity to make stuff; photo of a factory

How does making things generate greenhouse gases? There are three main ways: first, it takes a lot of electricity to make stuff. Using electrical power in and of itself isn't a problem. But how that power is generated matters a great deal. If electricity used to make materials comes from renewable sources, that's fine.

2:01

Text description

But today, most of it comes from burning fossil fuels, which produces lots of greenhouse gas.

Text box: Making steel and concrete takes a lot of heat; photo of steel being made; photo of chemical reactions; text box: Chemical reactions produce greenhouse gases

Second, we need extreme heat to make cement and steel: for example, steel production requires melting iron at 3,000 degrees Fahrenheit. That produces a lot of carbon. Finally, the chemical reactions that turn raw ingredients into steel or glass or cement, also directly produce carbon dioxide.

Text: Why don't we just stop making stuff?; transition music

So if making stuff emits so much greenhouse gas, why don't we just stop making stuff?

Photos of plastic bags and plastic straws

Sure, we can make less stuff, but even that drastic step wouldn't be enough. Remember, we're not just talking about consumer goods like single-use plastic bags or plastic straws.

2:50

Photos of houses and bridges and cables being attached

The big emitters, especially concrete and steel, are used for things people need; that includes buildings to live and work in, bridges and roads to get to places, and internet cables to connect us to each other. So making less stuff isn't really the solution.

Text: We can do this; transition musici

We also need innovations that let us make the big stuff without putting as much greenhouse gas into the atmosphere.

Text box: Low-carbon concrete; clip of a scientist working; text: How We Make Things Solutions; photos of steel and a construction site; text: Low-carbon steel and Low-carbon concrete

Most of this video is going to focus on low carbon concrete. But that's just one of the pathways you can explore as you seek solutions to the Grand Challenge of how we make things. We'll also need solutions for other materials, like steel. Super tall resilient buildings and infrastructure are possible thanks to the combination of concrete and steel, and we're going to need a lot more steel.

By 2050, our steel production will be emitting 2.8 billion tons of CO2 each year.

3:46

Text: Alternative building materials

Another set of solutions is to find alternative building materials to replace cement and steel. For example, some companies are developing technologies to make a cement-like material from naturally growing substances like mushrooms.

Our fourth innovation is all about finding something to do with the carbon that's being produced by the chemical reactions that happen when we make cement and steel.

Photo of a worker storing carbon; text: How can we drive… ; transition music

Maybe, for example, we can find ways to capture, store, and reuse all the carbon produced through manufacturing.

But, let's get back to cement for a moment.

Image: U.S. flag (upper right); text: U.S. Cement Production + cement production stats underneath; clip of cement being made

We use a lot of cement: in the United States we make more than 96 million tons of cement a year. That's 600 pounds for every person.

4:34

Clip of construction sites; text: more statistics on cement

In the 20th century, the United States built a lot of new stuff as its population grew, constructing new cities and massive infrastructure projects. Concrete was a big part of that expansion: from 1901 to 2000, the United States made 4.3 billion tons of cement.

Chinese flag (upper left); text: cement statistics; photo of building constructions; U.S. flag appears below; bar graph on cement production

That sounds like a lot, right? Well, now in the 21st century, China is undertaking its own expansion, building new power plants and urban infrastructure. In the 15 years from 2001 to 2016, China made 25.8 billion tons of cement—six times more than the United States made in the entire 20th century.

Text: Low-carbon concrete; text: equation

We need to find concrete solutions, but that will be hard. The challenge starts with a simple equation: limestone plus heat equals calcium oxide plus carbon dioxide.

Photo of cement production

The calcium oxide in this equation is the cement we need. The carbon dioxide is a byproduct that's released into the atmosphere when you make that cement.

5:33

If you make one ton of cement, you produce one ton of carbon dioxide.

This simple fact is what makes this innovation pathway so daunting. Right now, there's not much we can do to change this chemical reaction. If we want to make cement, we're going to get carbon dioxide as a byproduct.

So, if we're going to get to zero in how we make things, we'll need to make our cement production as efficient as possible.

Text: Could we just use cleaner energy?; transition music

And, we'll need to find ways to stop the carbon produced in that chemical reaction from entering the atmosphere.

One way to do this is to use cleaner energy. The chemical reaction that produces cement takes a lot of power.

Photos: renewable energy sources

So, using renewables to power factories and to produce the heat needed for manufacturing would help. But adopting renewable energy costs more than burning fossil fuels for now.

Photo: cement manufacturer site

Cement manufacturers will need incentives to make these changes and we'll need to produce renewable energy at much larger scales.

6:32

And that will only help a little bit.

Text: Can we use cleaner methods of production?; transition music

There are also some possible ways we could make cement that would release less carbon. For example, some researchers are trying to find methods to inject carbon back into the cement while it's being made.

But they need to do more research to make this technology work, and to make it cheap enough for people to use.

Photo: woman doing research

Other researchers are looking for ways to make cement using waste materials, like ash from coal plants, byproducts from steel manufacturing, or even corn husks. This might also reduce the carbon footprint of the final product.

Text: possible government policy

And of course, it's possible for governments to require cement manufacturers to capture some of the carbon they produce, using carbon capture and sequestration.

Text: Green Premium; text Green premium for cement = 140%

But these technologies are still expensive: for cement, clean manufacturing would cost up to 140 percent more.

7:24

Text: Green premium for steel = 29%; text: Obstacles; transition music

And since we're manufacturing these materials on such large scales, those premiums make it unlikely that manufacturers will adopt low-carbon methods without government policies and subsidies.

Text: Demand...; photos of people enjoying their lifestyle

You might have noticed that we didn't suggest just making less cement; it's a nice idea, but the truth is that global populations are growing, and as countries like Nigeria, Vietnam, and Indonesia grow wealthier and larger, they will need to build a lot more.

In other words, there's no single solution to the problem of concrete-related greenhouse gas emissions.

Text: Action Opportunities: transition music

But, maybe a million little changes can all work together.

Text box: How can I help....;

Now, making a million little changes is really complicated stuff, and you may be asking yourself, "What can I do to help?" And again, there are a lot of possible answers.

8:18

Obviously, we desperately need more innovations that will help us produce cleaner cement or replace it with low carbon alternatives.

Text: action opportunity ideas; photo: person's hands working in lab; photo of renewable energy resource; photo of man delivering a speech

Maybe you could study to become a chemical engineer, joining the search for alternative materials and new processes for making cement; you could also advocate for replacing fossil fuels with renewable energy sources and cement manufacture; and of course, you can lobby your local state or federal government to incentivize and fund innovations in making cleaner cement and mandating carbon capture.

In each case, you'll have to consider what innovations might be most suitable to your community.

Are there any large factories in your town? Does your town depend on tax revenue from a manufacturer? Do you live in a place that's expanding and will be using a lot of concrete and steel?

Your activism might convince people in your town to support better policies that will prevent more carbon emissions from how we make things. But only if you listen to and think about the people around you. So, what's your plan for getting to zero?