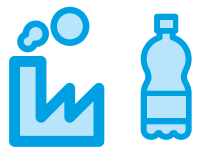
STATE OF THE TECH:

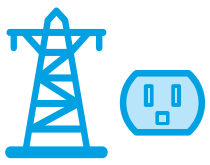
STEEL & CEMENT PRODUCTION

LESSER KNOWN POLLUTERS

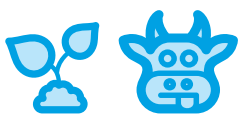
If you're talking about a comprehensive plan for tackling climate change, you need to consider everything that humans do to cause greenhouse gas emissions. Some things, like electricity and cars, get lots of attention, but they're only the beginning argues Bill Gates in his new book "How to Avoid a Climate Disaster." Passenger cars represent less than 8 percent of all emissions worldwide. Meanwhile, making steel and cement alone accounts for around 10 percent of all emissions.



MAKING THINGS
(cement, steel, plastic)
31%

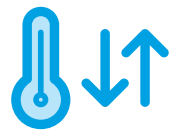


PLUGGING IN
(electricity)
27%



GROWING THINGS
(crops, animals)
19%

GETTING AROUND
(planes, trucks, ships)
16%



KEEPING WARM/COOL
(HVAC, refrigeration)
7%

HARD TRUTH ABOUT STEEL

We like steel because it's both strong and easy to shape when it's hot. To make steel, you need pure iron and carbon; on its own, iron isn't very strong, but add just the right amount of carbon (<1%) and the carbon atoms nestle themselves in between the iron atoms, giving the steel strength. Carbon isn't hard to find – you can get carbon from coal – but pure iron is quite rare, you have to dig up the metal and it's almost always combined with oxygen and called iron ore. To make steel you need to separate the oxygen from the iron and add a tiny bit of carbon. You do this by melting iron ore at very high temperatures (3,000 deg F) in the presence of oxygen and a type of coal called coke. At those temperatures, the iron ore releases oxygen, and the coke releases carbon. A bit of carbon bonds with the iron, forming the steel we want, and the rest of the carbon grabs onto the oxygen, forming a by-product we don't want: carbon dioxide. Quite a bit in fact. Making 1 tonne of steel produces about 1.8 tonnes of carbon dioxide. By 2050, steel production around the world will release 5 billion tonnes of carbon dioxide every year unless we find a new, climate friendly way to do it.

CEMENT'S CHEMICAL REACTION

As challenging as that may sound, concrete is even harder. To make it, you mix together gravel, sand, water and cement. It's the cement that is a problem for the climate. To make cement, you need calcium. To get calcium, you start with limestone – which contains calcium plus carbon and oxygen – and burn it in a furnace along with some other materials. After burning limestone, you're left with what you want (calcium for your cement) and something you don't (carbon dioxide). Nobody knows of a way to make cement without going through this process. It's a chemical reaction, there is no way around it. Make 1 tonne of cement, and you'll get 1 tonne of carbon dioxide. By 2050, cement production around the world will release another 4 billion tonnes of carbon dioxide every year.

WHAT CAN WE DO?

To meet the goal of reducing 51 billion tonnes of emissions a year down to net zero emissions by 2050, innovation is critical. One approach is to take recycled carbon dioxide – possibly point captured during the process of making the cement – and inject it back into the concrete as it's being mixed. Another approach is called molten oxide electrolysis: instead of burning iron ore in a furnace with coke, you pass electricity through a cell that contains a mixture of liquid iron oxide and other ingredients. The electricity causes the iron oxide and other ingredients to break apart, leaving you with the pure iron you need for steel and pure oxygen as a by-product. The ideas are promising but are in their infancy and haven't been proven to work at an industrial scale. Until then, reducing our use of these primary structural materials by using other materials like CLT (more on this tomorrow) is a good start.

EARTH WEEK: APRIL 19 - 23, 2021

Presented by R&S Sustainability Committee