

Links in the chain: Global carbon emissions and consumption

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It is difficult to measure accurately each nation's contribution of carbon dioxide to the Earth's atmosphere. Carbon is extracted out of the ground as coal, gas, and oil, and these fuels are often exported to other countries where they are burned to generate the energy that is used to make products. In turn, these products may be traded to still other countries where they are consumed. A team led by Carnegie's Steven Davis, and including Ken Caldeira, tracked and quantified this supply chain of global carbon dioxide emissions. Their work will be published online by *Proceedings of the National Academy of Sciences* during the week of October 17.

Traditionally, the carbon dioxide emitted by [burning fossil fuels](#) is attributed to the country where the fuels were burned. But until now, there has not yet been a full accounting of emissions taking into consideration the entire supply chain, from where fuels originate all the way to where products made using the fuels are ultimately consumed.

"Policies seeking to regulate emissions will affect not only the parties burning fuels but also those who extract fuels and consume products. No emissions exist in isolation, and everyone along the supply chain benefits from carbon-based fuels," Davis said.

He and Caldeira, along with Glen Peters from the Center for International Climate and Environmental Research in Oslo, Norway, based their analysis on fossil energy resources of coal, oil, [natural gas](#), and secondary fuels traded among 58 industrial sectors and 112 countries in 2004.

They found that fossil resources are highly concentrated and that the majority of fuel that is exported winds up in [developed countries](#). Most of the countries that import a lot of fossil fuels also tend to import a lot of products. China is a notable exception to this trend.

Davis and Caldeira say that their results show that enacting carbon pricing mechanisms at the point of extraction could be efficient and avoid the relocation of industries that could result from regulation at the point of combustion. Manufacturing of goods may shift from one country to another, but fossil [fuel](#) resources are geographically fixed.

They found that regulating the fossil fuels extracted in China, the US, the Middle East, Russia, Canada, Australia, India, and Norway would cover 67% of global [carbon dioxide emissions](#). The incentive to participate would be the threat of missing out on revenues from carbon-linked tariffs imposed further down the [supply chain](#).

Incorporating gross domestic product into these analyses highlights which countries' economies are most reliant on domestic resources of fossil energy and which economies are most dependent on traded fuels.

"The country of extraction gets to sell their products and earn foreign exchange. The country of production gets to buy less-expensive fuels and therefore sell less-expensive products. The country of consumption gets to buy products at lower cost." Caldeira said. "However, we all have an interest in preventing the climate risk that the use of these fuels entails."

More information: To look at the data, please visit: supplychainco2.stanford.edu/

Provided by Carnegie Institution

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