Researchers develop rapid method to measure carbon footprints

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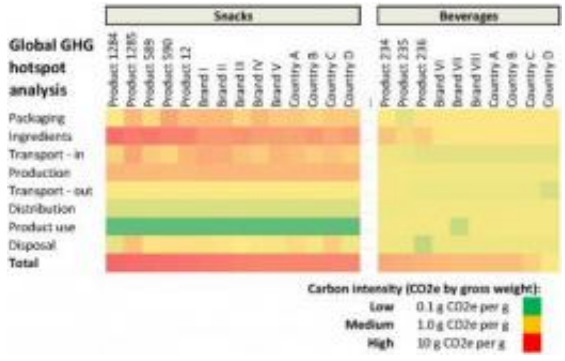
A photo of a factory district outside Dhaka, Bangladesh. Credit: Kevin Krajick, Earth Institute

Researchers have developed new software that can rapidly calculate the carbon footprints of thousands of products simultaneously, a process that up to now has been time consuming and expensive. The methodology should help companies to accurately label products, and to design ways to reduce their environmental impacts, said Christoph Meinrenken, the project's leader and associate research scientist at Columbia University's Earth Institute and Columbia Engineering. A new study, published online in the *Journal of Industrial Ecology*, describes the methodology.

The project is the result of a collaboration between the institute's Lenfest Center for Sustainable Energy and PepsiCo, Inc. Its original aim was to

evaluate and help standardize PepsiCo's calculations ofthe amount of carbon dioxide emitted when a product is made, packaged, distributed and disposed of. Started in 2007, it resulted in the first U.S. carbon footprint label certified by an impartial third party, for Tropicana orange juice. PepsiCo has been pilot-testing the methodology for other uses since 2011.

Meinrenken and his team used a life-cycle-analysis database—a tool used to assess the environmental impact of a product—that covered 1,137 PepsiCo products. They then developed three new techniques that work together, enabling them to calculate thousands of footprints within minutes, with minimal user input. The key component was a model that generates estimated emission factors for materials, eliminating manual mapping of a product's ingredients and packaging materials. Meinrenken said the automatically generated factors enable non-experts "to calculate approximate carbon footprints and alleviate resource constraints for companies embarking on large-scale product carbon footprinting." He said the software complies with guidelines sponsored by the nonprofit World Resources Institute, which provides standards against which carbon footprints can be audited.



A new methodology allows companies to determine carbon footprints and 'hotspots' where impacts are particularly high, across thousands of products simultaneously. Shown here, examples of carbon emissions by weight, broken

down by stages of the supply chain for individual products as well as by brands and countries. Credit: Christoph Meinrenken, Earth Institute

Up until now, life-cycle-analysis has mostly been performed one product at a time. This imposes large requirements for personnel, expertise, and time, and few companies have enough employees with specialized expertise. Meinrenken said that some have tried to overcome this bottleneck by reverting to aggregate data and calculations, but they usually miss out on the microscopic level of detail that a proper analysis requires.

The researchers' approach was inspired by fields outside environmental science, Meinrenken said. "At companies like Facebook or Netflix, engineers employ statistical wizardry to mine vast datasets and essentially teach computers to predict, for instance, who will like a particular movie," he said. He used similar methods to mine detailed product and supply chain data. "For an environmental engineer, using such data to estimate how much the environment will 'like' certain products and services is especially rewarding," he said. "Consumers will be able to make more informed choices." The information can also help companies design and assess ways to lessen products' impacts, he said.

Al Halvorsen, senior director of sustainability at PepsiCo, said, "The newly developed software promises to not only save time and money for companies like PepsiCo, but also to provide fresh insights into how companies measure, manage, and reduce their carbon footprint in the future."

Klaus Lackner, director of the Lenfest Center for Sustainable Energy, said, "Fast carbon footprinting is a great example of how academic methodologies [coupled] with modern data processing and statistical

tools can be brought to life and unlock their power in the real world." Meinrenken's team is now looking at transferring the methodology from carbon to other arenas, such as water use.

More information: onlinelibrary.wiley.com/doi/10 … 012.00463.x/abstract

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