Research will allow architects, building professionals, to measure greenhouse gases in construction

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If you can't measure it, you can't manage it – especially if "it" is greenhouse gases, such as carbon dioxide, produced by building construction and operations.

Data from the U.S. Department of Energy's Energy Information Agency shows that the built environment produces about 50 percent of the nation's manmade carbon dioxide emissions; motor vehicles are responsible for less than 30 percent. While scientists have learned much about the carbon footprint generated by buildings over their lifecycle, this knowledge has yet to find its way into the hands of the architects, engineers, facility managers and builders who can modify that footprint.

Researchers at Colorado State University have been awarded a $600,000 grant from the National Science Foundation to develop measurement and assessment tools to be integrated with existing architectural design software and building material databases to provide real-time, "on-the-fly" carbon footprint metrics.

The concept for a Carbon Footprint Metric (CFM) system for the built environment was developed as part of a Global Challenges Research Team in the interdisciplinary School of Global Environmental Sustainability, or SoGES, at CSU. Peter Means, a graduate student, first suggested the CFM effort as a cross-disciplinary activity, based on his research on modular construction conducted under the supervision of

Mary Nobe in the CSU Department of Construction Management.

Several faculty members participated in the SoGES team and developed the proposal submitted to NSF, including Keith Paustian, Department of Soil and Crop Sciences; Chuck Anderson and Robert France, Department of Computer Science; Angela Guggemos, Department of Construction Management; Thomas Bradley, Department of Mechanical Engineering; Carol Dollard, CSU Facilities Management; Brian Dunbar, Department of Construction Management and the Institute for the Built Environment; and Alberta Carpenter and Luigi Polese of the National Renewal Energy Laboratory.

The CFM research will involve students and faculty in various departments in the CSU Colleges of Agricultural Sciences, Engineering, Health and Human Sciences and Natural Sciences over the two-year life of the grant.

"When it comes to reducing greenhouse gas emissions, a key element to changing behavior on the part of both building professionals and consumers is better environmental impact measurement systems," explained Paustian, the project director. "Our ultimate goal is to develop a system that measures emissions for the entire building lifecycle, from design to decommissioning. The system will need to be readily accessible to architects and builders, easy to understand and use, and conforming to existing environmental management systems."

From research to design tool

In the built environment, emission sources include all the steps in producing and transporting building materials; building construction; building operation and maintenance, such as HVAC systems and landscaping; and activities involved in building turnover, disposal and recycling.

The CSU research will consist of comprehensive Life Cycle Assessments from design through construction of three progressively more complex buildings: a cutting-edge modular residential building designed by Living Homes in Los Angeles; a CSU university classroom and laboratory building in Fort Collins designed by Neenan Co.; and an industrial building – the New Belgium brewery in Asheville, N.C.

"From this research, we will create a CFM system prototype," Paustian said. "Once validated for each class of building, the CFM system will permit design and construction practitioners to evaluate and alter building designs in order to reduce greenhouse gas emissions over the life of the building."

The CFM system will allow those working in the Architecture, Engineering and Construction (AEC) industry to create an integrated design for a "net zero" greenhouse-gas built environment. The project has been endorsed by the American Institute of Architects, the U.S. Green Building Council, the National Institute for Building Science, the Rocky Mountain Institute and Architecture 2030.

"Less attention has been given to buildings as a major source of greenhouse gases, partially because it requires multiple disciplines to synthesize knowledge and develop a useful tool," said Diana Wall, director of SoGES and a CSU University Distinguished Professor. "Congratulations to this research team for addressing this challenge – we look forward to helping achieve this goal."

Provided by Colorado State University