**Pushing the CDW Recycling and Re-use Envelope: Waste2Resources (CDW.5)**
**@ NYC ACS 150 William Street, 19th floor (Manhattan Conference Room)**
**February 24, 2020, 9:00 a.m. to Noon**

## AGENDA

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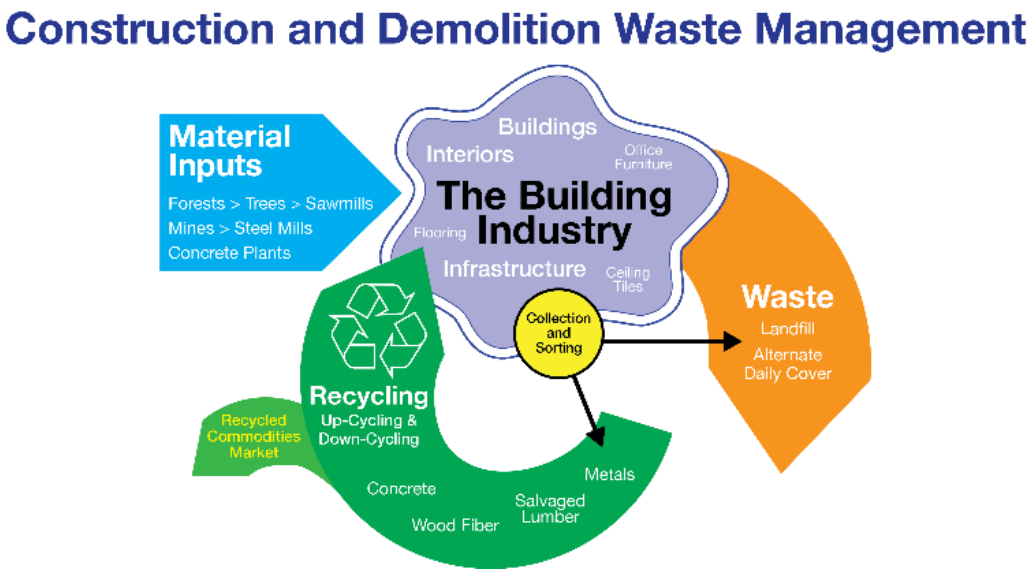
| 9:00 a.m. – 9:15 a.m. | **Sign-in and Welcome** |
| 9:15 a.m. – 10:15 a.m. | **NYC Case Study on Glass Pozzolan in Concrete**<br>Julio Davalos, Professor, Department of Civil Engineering, CUNY-CCNY |
| 10:15 a.m. – 11:15 a.m. | **Up-Cycling CDW for New Construction Materials**<br>Weihua Jin, Director of Applied Research, Sustainable Building Materials, Institute of Design & Construction Innovation Hub, NYU/Tandon |
| 11:15 a.m. – Noon | **Discussion** |

***This Event.*** This event marks the fifth Symposium event in the Construction and Demolition Waste (CDW) series, which aims at pushing the recycling and re-use envelope for construction and demolition waste (CDW), this time focusing on how innovations in technology and materials science can help support the increased re-use of recycled CDW elements in new construction materials.

The City's solid waste management and long-term sustainability plans have few specific references to the presence of CDW in the City's waste stream or policies related to recycling and re-using CDW. Most of green-house gas (GHG) generation from the construction materials occurs at production sites *outside* the city and from the transportation of construction materials to project sites and CDW to transfer stations, recycling firms, and processing firms or landfills. The lack of a City focus on CDW is due to the fact that the City's capacity to act with respect to CDW is significantly less than its capacity to act with respect to municipal solid waste—which is true for all local governments in New York—because regulatory control for CDW recycling and re-use rests with the New York State Department of Environmental Conservation (NYSDEC). Thus, at the local level, CDW recycling and re-use is dependent on broader market conditions, which NYSDEC's recent regulations are intended to support. Moreover, Local Law 86 of 2005 requiring LEED on City public building construction projects, with its prescribed holistic guidelines and credits that include CDW recycling and re-use, has muted earlier policy efforts at the City that explicitly focused on CDW recycling and re-use.

Thus, expanding the re-use of recycled CDW elements in new construction materials is not directly within the City's span of control and is further subject to materials and technological innovations and market forces that the City also does not control. While the City generates a significant amount of CDW through its capital projects, the management of its CDW, as a potential resource, is delegated to contractors under capital construction contracts, again subject to market conditions, with less oversight than required to close material loops effectively or efficiently. In order to explore the development of policies to increase the use of recycled CDW in new construction materials and reduce amounts sent to landfills, wide-ranging coordinated applied research efforts are necessary as a first step.



***Recap of Prior Events.*** **CDW.1**, on November 30, 2017, was a general exploration of the state of academic research, practical considerations and impediments, and ideas for future research to advance the recycling and reuse of CDW.[1] CDW.1 was inspired by a 2015-2016 research project involving a partial comparative life cycle assessment (LCA) to compare the environmental impacts of two concrete product systems—concrete with coarse natural aggregate and concrete with coarse recycled aggregate—that was conducted by a visiting graduate student Meryl Lagouin working with Professor Ardavan Yazdanbaksh of CUNY/CCNY and the New York City Department of Sanitation.

**CDW.2**, on October 30, 2018, followed up from CDW.1 by forming working groups to explore ways to close concrete, gypsum, carpet and soil material loops within the City.[2] These CDW Working Groups continued to meet after the event and they generated several research project ideas to support CDW policy development, some of which have been completed or are underway. These research projects summarized below are intended to provide research results for this overall effort to push the recycling and re-use envelope for CDW.

- New Jersey Institute of Technology (NJIT)and the New York City Department of Transportation (NYCDOT) have developed a 4-stage research plan to promote the use of recycled concrete aggregate (RCA) in new concrete at NYCDOT. Stage-1 (completed) was an analysis of aggregate properties of RCA produced by the NYCDOT Recycling Facility, and Stage-2 (underway) is a long-term field trial of sidewalk concrete slabs using NYCDOT RCA, at replacement levels ranging from 0%-100%. Stage-3 (beginning in 2020) is a durability research program examining performance of concrete made with NYCDOT RCA under accelerated durability testing at NJIT's Materials and Structures Laboratory. Stage-4 will provide the results of Stages 1-3 for NYCDOT to consider modifying specifications to allow for the use of RCA in particular applications.
- A student team from Pratt/Communication Design created, for the CDW Working Group, a communication campaign, including designed collateral (website, brochures, subway ads and construction hoardings), to support developing an initiative to close the soil loop using the City's capital program. This communications campaign focused on two audiences—the general public and the professional designer/contractor community—to communicate re-using soil excavated from one project on another project is not only safe but also environmentally and financially sustainable.
- A student team from CUNY/Brooklyn College preliminarily analyzed CDW material flows in the New York City region using NYSDEC data. Developing a fuller data visualization of CDW waste flows from generation to recycling is critical for the CDW Working Group as it moves ahead to explore policy options to increase recycling and re-use of CDW to close material loops, which may become the subject of a capstone project with NYU/CUSP in the spring and summer semesters. CUNY/Brooklyn College has also conducted research primarily on gypsum chemical transparency and safety, which is a key issue in the recycling of the gypsum wallboard materials with the Building Product Ecosystem Closed Loop Wallboard Collaborative Working Group, some of whose members are also in the CDW Working Group.

**CDW.3**, on August 1, 2019, focused specifically on life cycle cost benefit analysis (LCCBA) modeling applied to recycled concrete aggregate that would be used as a basis for providing a LCCBA model template for all Working Group material loops. Professor Yazdanbaksh ran through the mechanics of LCCBA modeling. The

[1] See https://www1.nyc.gov/assets/ddc/downloads/town-and-gown/Precis_Final.pdf.
[2] See https://www1.nyc.gov/assets/ddc/downloads/town-and-gown/CDW.2%20Precis.Final.pdf.

ultimate question to be answered with LCCBA for RCA in new concrete is whether it is worth the additional costs, which have a financial component and an environmental component. Prof. Yazdanbaksh suggested a publicly-supported research project to research, from the perspective of industry, and possibly with case-study plants and government subsidies, what is needed to drive down production of costs to use of RCA in new concrete, in order to get a sense of whether such use can become profitable without subsidies over time. Kate Mikuliak of NYCDOT and Professor Matthew Adams of NJIT also provided the group with an update of research begun after CDW.2 with respect to testing uses of concrete using RCA generated by the NYCDOT crusher for potential NYCDOT uses.

**CDW.4**, on October 23, 2019, was a directed exploration resulting from discussions at the CDW.3 event. Since LCCBA modeling quantifies environmental impacts from reuse of recycled materials, CDW.3 presentations raised questions among participants about how a public owner wishing to qualify its infrastructure projects within the Envision framework should assess the environmental impact of reusing recycled materials on its infrastructure projects. Professor Spiro Pollalis from Harvard/GSD, which was involved, through its Zofnass Program for Sustainable Infrastructure, in the development of the Envision framework, presented in great detail about the goals and mechanics of the Envision framework. Prof. Pollalis did indeed confirm that, unlike LEED, which prescribes the TRACI methodology to measure the impact of using recycled CDW on new building construction projects, Envision does not because its framework permits owners to use the best methodology, which may allow owners to use locally-derived parameters and data, to conduct a life cycle environmental assessment and provide the project examiner with sufficient quantitative analysis to evaluate the credits sought. Professor Christoph Meinrenken of Columbia presented on available life cycle assessment (LCA) tools that can evaluate system-wide climate change-related impacts of green technologies, including the re-use of recycled CDW elements. Prof. Meinrenken conducted a "101" on LCA, providing an overview of the world of standards, protocols and rules; the role of recycling in carbon "foot-printing" (also known as GHG accounting) frameworks consisting of the recycled content method and closed-loop method; and, a high-level roadmap for how RCA would be treated in Envision-required calculations, excluding, however, considerations of other important environmental and financial costs. Of three available methodologies—TRACI, ISO standards and the GHG Protocol, developed by the World Resources Institute in collaboration with the World Business Council for Sustainable Development—the GHG Protocol would seem to be an optimum methodology for public owners to use because it can be executed without proprietary software and is appropriately detailed with regard to GHG attribution for recycling for both recycled content and closed loop methods, it has a high level of detail, and it also permits owners to use locally-derived parameters and data. Prof. Meinrenken ended his presentation with the open question about other alternatives for low carbon cement, such as using slag cement and fly ash, which has led to this event, CDW.5, that begins to explore how innovations in technology and materials science can help support the increased re-use of recycled CDW elements in new construction materials and innovative materials technology.

*Working Group Information Update.* Building Transparency just launched an embodied carbon tool calculator called Embodied Carbon in Construction Calculator, or EC3, which may be helpful in Envision guideline calculations.[3] EC3 is a free and open-source software intended to help owners and their designers and engineers assess and reduce upfront emissions. EC3, unlike other tools, focuses on the

[3] See https://www.architecturalrecord.com/articles/14359-embodied-carbon-tool-launches-at-greenbuild-2019 and https://www.buildingtransparency.org/en/.

specification and procurement phases of projects and permits comparisons of similar materials from several suppliers. This tool is based on environmental product declarations (EPDs) within a searchable digitized database and currently includes EPDs for concrete, steel, wood, aluminum, building enclosure products, and carpet; and, it can link to BIM 360, Autodesk's cloud-based construction management platform.