TOWN +GOWN: NYC

URR.10: Urban Mining and the CDW Circular Economy: Port Authority Case Study in Action

DYCD, 2 Lafayette, 14th Floor

May 11, 2023, 9:00 a.m. to Noon

AGENDA

9:00-9:15 AM	Opening remarks, Terri Matthews, Director Town + Gown
9:15-10:15 AM	Construction Waste Recycling and Reuse at PANYNJ. Miriam Voss, Resilience and Sustainable Design Unit and Amy Cole. Clean Construction Unit, Engineering Department, PANYNJ
10:15-10:45 AM	Open discussion, Q+A
10:45-11:00 AM	Short break, networking (remember that?!)
11:00-11:30 AM	Presentations on Three Spring 2023 NYU/Tandon-Management of Technology Capstone Projects for the URR Working Group
11:30 AM-Noon	Open discussion, Q+A

Introduction. This event brings the Town+Gown community and the Urban Resource Recovery Working Group together to learn about the Port Authority's Construction Waste Recycling and Reuse program, which inspired the Working Group's Closing Loops City Program Initiative (CLCPI) (see https://www1.nyc.gov/assets/ddc/downloads/town-and-gown/AgendaandPrecis.Final10-12-21.pdf). At this event, we will also hear brief presentations on the three NYU/Tandon-Management of Technology capstone projects for the URR Working Group, which will support the CLCPI.

CLCPI Recap. The CLCPI focuses on the ability of New York State local governments, such as NYC, to leverage their construction activities to activate and drive the potential of the NYS DEC BUD regulations and the State's local government SWMP requirement, which assume and rely on an efficient and functioning "market" to generate sufficient private investment to expand and build new facilities in or near localities generating significant amounts of CDW. The roadmap for local government action links public capital programs to the BUD regulations and SWMP requirement to change the market "calculus" so that contractors' failure to recover and re-use CDW is no longer the economically rational choice. The CLCPI's policy development roadmap, within the authority of any New York local government for adaptation to address local conditions, begins with a **local CDW material flow analysis, including data from public capital projects**; identifying the CDW materials for a pilot initiative; **cost-benefit analyses, where possible due to a dearth of usable CDW data, to estimate the potential for public capital cost savings**; assess the impact of local law, if any, that would operate as an impediment to direct re-use, permitted by the BUD regulations, among a local government's capital project portfolio; develop public construction contract specifications to support recovered CDW material supply and demand for construction materials made with recovered CDW materials; and, local government private market support mechanisms beyond supply and demand contract specifications. These additional market support mechanisms, which do not include any new government subsidies to make the private circular CDW economics work, include the, **creation of a virtual CDW matching digital platform to optimize efficient public capital project operations in a CDW waste-to-resource environment**.

The City's high rate of construction and demolition activities presents a significant opportunity to increase the recovery of CDW materials, with their high embodied carbon content, and thus **reduce GHG emissions associated with the production and transportation of virgin elements for new construction materials.** NYC DEC BUD regulations cover interim processing of BUD CDW, which is not considered as solid waste,[1] and such facilities are governed by NYS DEC regulations on exempt, registered and permitted facilities, including construction and

[1] See pp. 13-18 of 2022 Analysis of Proposed Changes to Part 360 Regulations (Brooklyn Law School) Update.

demolition debris handling and recovery facilities.[2] Under NYS DEC proposed BUD regulation amendments, however, concrete and other masonry products will not be considered waste when received at a ready-mix plant for incorporation into a concrete product.[3] Concrete production is a local industrial manufacturing use because concrete must be made to be available for use within 20 minutes of production.

Two Minimally Viable Products (MVP) and One Off-the-Shelf Technology App (and not for what you'd expect): NYU/Tandon-Management of Technology Spring 2023 Capstone Projects.

- Machine Reading of NYS DEC Part 360 Waste Tracking Documents—Construction & Demolition Debris. For some time now, T+G has been working with the City's construction agencies to identify CDW material and volume data in order to develop the cost-benefit analysis for the CLCPI. This effort definitively confirmed what we had suspected from the beginning, which was that there is no city agency CDW material and volume data to inform policy analysis and implementation. Two of NYS DEC Part 360 reports (transfer station/interim processing facilities and landfills) are publicly available on NYS DEC's website as scanned non-digitized documents. The NYS DEC Part 360 reports from the construction project level for NYC construction projects are also in scanned non-digitized format but they are not available on NYS DEC's website. Being able to machine-read all of these forms to extract the CDW data for analysis has been a critical focus of the Working Group to support the CLCPI.

  A 2022 CUSP project team that focused on visualizing CDW material and volume flows from the first two reports described above (see https://www.nyc.gov/assets/ddc/downloads/town-and-gown/MappingCDWFlowsforAssessingRecoveryandReusePotentialinNYCCapitalProgramNYU-CUSP.pdf and https://accomplishedcode.github.io/NYU-CUSP-Capstone-Mapping-CDW/) made a valiant effort to develop machine reading code, but they were unable to use it for their map tool due to the nature of many of the reports and the time constraints of their engagement, which required them to manually enter the data for the map tool.

  This MOT capstone team was tasked with developing machine-reading code to "read" the third report described above, which contains NYC-based CDW material and volume data, and which Town+Gown was able to obtain for this capstone project from NYS DEC for 2018

[2] See pp. 24-42 of See pp. 13-18 of 2022 Analysis of Proposed Changes to Part 360 Regulations (Brooklyn Law School) Update.

[3] See NYS DEC regulations § 360.12(c)(3)(xi); proposed parts 360-366, 369, 371, 377 from p. 24 of See pp. 13-18 of 2022 Analysis of Proposed Changes to Part 360 Regulations (Brooklyn Law School) Update..

and 2019, and producing CDW material and volume data from NYC construction projects as the deliverable along with the code the team developed for re-use on forms for subsequent years.

NYS DEC Form	Data in Form	Portion of CDW Journey	Capstone Project
Part 360 Waste Tracking Document-C&D Debris	Types of C&D Debris and quantities from NYC location of C&D Debris Generator to Receiving Facility; includes information about Transporter and Receiving Facility	From project site to initial receiving facility	MOT
Annual Permitted C&D Debris Handling and Recovery Facility	Facility name and location; solid waste received by type and quantities; information about entities transferring solid waste, including service area and NYS Planning Unit; types, quantities and destination of materials sent to another facility for transfer or processing prior to disposal or to a landfill or combuster (excludes recycling amounts); type, quantities and destination of material recovered for reuse/recycling	From initial receiving facility to other receiving facilities for processing or to landfills	CUSP
Annual Active C&D Debris Landfill Report	Facility name and location; types, quantities and source (facility and address) of beneficial use designation materials received; also includes related NYS Planning Unit and service area data and other facility operational data	From various handling and recovery facilities to landfill	CUSP

The team researched the necessary steps to develop a traditional programming approach for a handwritten text recognition (HRT) along the lines of the prior CUSP project to transcribe scanned text in the reports into digital text. At the same time, the team researched various cloud-based systems with machine-learning image analysis tools as an alternative to traditional programming for HRT and compared the two options. The team concluded that a cloud-based approach was superior to a traditional programming approach. The traditional approach of developing and training an HRT system is time-consuming and requires significant computational and labor resources to develop and train an initial dataset and add new datasets acquired in subsequent years. Among the commercially available options, the team chose the Google Cloud Platform and with its Vision API machine-learning based image analysis tool, using Python code to extract text from images from Vision API, as the best option based on criteria that included risks and costs.

The team pooled their credentials for Google Cloud Platform provided to them by NYU/Tandon to read the NYS DEC forms, first, as a proof of concept to support the eventual purchase of such a tool for city agencies to unlock data in their paper-based reports for analytical purposes and, second, to generate a csv file of the material and volume data from these reports to support the Working Group's cost benefit analysis as well as other agencies' analyses.

- CDW Materials "Dating" Website Prototype. As noted in the CLCPI (https://www.nyc.gov/assets/ddc/downloads/town-and-gown/AgendaandPrecis.Final10-12-21.pdf), local government efforts at CDW recovery and reuse directly and indirectly require technology for real-time local CDW materials exchange to increase market efficiency, minimize construction schedule disruption, and minimize the costs associated with stockpiling materials. Land prices are high in a dense urban setting and developable industrial and manufacturing site are scarce, which makes materials exchange technology critical for local CDW circular economies in dense urban settings.

  The team researched commercially available materials exchange technology services and interviewed local actors involved currently involved in some aspect of CDW materials exchange to analyze all options that would be available to the City for the CLCPI. They developed a CDW materials exchange "wire frame" prototype, taking into account the information they received from their interviews, that the City could easily replicate, modify and scale to support the CLCPI effort, if it chose not to purchase a commercially available option.

- Transportation Cost and GHG Cost/Benefit "Calculator" for Concrete. A Fall 2022 MOT capstone began to develop a cost benefit analysis of re-using CDW materials, using recycled concrete aggregate generated by NYC Department of Transportation's concrete crusher operations as the case study. Since the cost to the City for the concrete crusher investment and operations are embedded in NYC DOT's operations, the cost benefit analysis had to assume $0 costs for those and the students focused instead on transportation costs savings using transportation cost data they obtained from research and conversations with carting firms and various social benefits. While a good first stab at developing a cost benefit analysis, at the team's presentation at the URR.9 in December event (https://www.nyc.gov/assets/ddc/downloads/town-and-gown/TandonMOTCapstonepresentation-Dec132022.pdf), industry attendees provided comments on how to look at the transportation cost issue because it was fact specific. It requires the location of CDW recovery and its volume to create distances for sending the

material to a landfill to compare sending it to a local processing facility to generate material for local re-use in concrete.

One of the industry participants at the event operates an excavated soil wash plant on Long Island that washes excavated soil to produce washed sand that is suitable as a replacement for virgin sand in new concrete produced at a local batch plant and he agreed to help the students on this spring follow-up capstone project. The team met with the industry expert to understand the fact specific nature for this analysis and obtain data to model a case study excavation project and compare the transportation costs and GHC emissions of taking the excavated soil to Hazelton, PA, a location of many landfills that accept NYC CDW, with the transportation costs and GCH emissions of taking the excavated soil to the Long Island wash plant and the reuse of the sand it washes in new concrete produced by a local batch plant, which is a real-life example of a circular CDW economy.

The student team was able to compare trucking costs and GHG emissions of sending the case study excavated soil volume from a hypothetical project to a landfill in Pennsylvania and sending it to the wash plant on Long Island with local reuse by a Long Island batch plant, using actual costs for trucking and dumping (including tipping fees) and diesel fuel, miles/gallon fuel metrics, various applicable truck weight limits. With this new data and their model, making various assumptions such as empty return trips, the students were able to create a transportation cost/GHG emissions “calculator” estimate transportation cost and GHG emissions savings from re-using CDW sand in new concrete. This calculator could be used to for other parts of the concrete “recipe” in the future, such as glass pozzolan generated by the City’s municipal solid waste processor in Brooklyn that a Connecticut firm uses in its cement product, which contractors have used on NYC capital projects.

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Presenters

Amy Cole is the Environmental Data Scientist of the Clean Construction Unit. She began her career in the Materials Engineering Unit evaluating air monitoring reports. Most recently, Amy has been heading up data management for the embodied carbon dioxide impacts from construction materials and exploring this data with the Agency's overall carbon footprint. Amy has a Bachelor's Degree in Biology and is pursuing her Master's in Environmental Engineering and Science from Johns Hopkins University.

Miriam Voss is a Sustainable Design Specialist in the Resilience and Sustainable Design group within Engineering Design at PANYNJ. With over 10 years of experience in the public sector, she specializes in waste reduction, resource recover, life cycle assessment and circular economy. In addition to integrating resilience and sustainable design best practices, Miriam is leading efforts to incorporate embodied carbon optimization in Engineering's design process. Miriam has a Master's degree in Architecture from Columbia University and a Master's degree in Science in Sustainability in the Urban Environment from CCNY.

Spring 2023 NYU/Tandon-Management of Technology Capstone Students

Machine Reading of NYS DEC Part 360 Waste Tracking Documents—Construction & Demolition Debris Team

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CDW Materials "Dating" Website Prototype Team

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