TOWN +GOWN: NYC

New York City's and New York State's Advances in
Urban Resource Recovery and Re-use toward a Circular Economy (URR.11)

Introduction. New York City—and New York State—have made great strides with various policies that advance the city and the state, which regulates the city in this area, toward a circular economy for construction + demolition materials (CDM) coming from both vertical/building and horizontal/infrastructure projects. A systemic approach to move over time toward a CDM circular economy—and one that is sized and located in a way to maximize GHG reductions from reusing the embedded carbon in CDM—requires understanding the **context** for the "baseline" problem and various possible interventions (in all their economic, social, environmental and political glory), with knowledge of **interdependencies** with other systems and all **actors** capable of influencing the intended change. It requires understanding how the **outcomes** of intervention would improve the baseline problem, who would ultimately **benefit** from them, and **sequencing a process** of change over time.[1]

To begin the circular CDM economy transition, we need to think about answers to these questions:

1. What can New York State and New York City do to support a local construction and demolition material (CDM) circular economy to maximize GHG reductions from construction activity over the next four years?

2. Since construction is a private-sector activity, what can private sector actors do to support a local CDM circular economy to maximize GHG reductions from construction activity over the next four years?

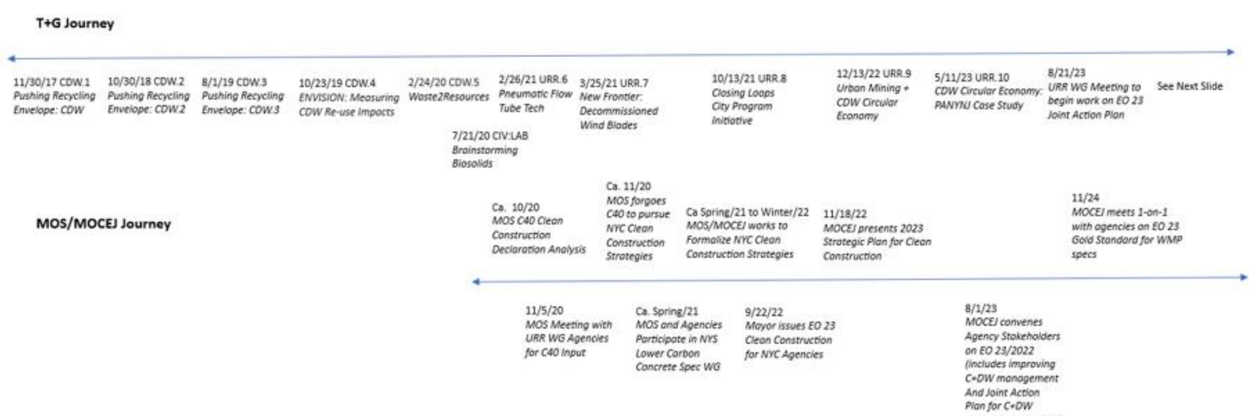
3. What specific CDMs should be the focus of initial efforts because they are "ripe" for recovery leading to reuse over the next four years?

[1] Chris Rogers, Lewis Markana, Joanne Leach and the UKCRIC Community, *The Little Book of Theory of Change for infrastructure and Cities*, pp. 6-7 (Theory of Change for Infrastructure and Cities.pdf, accessed 04/28/25, 6:27 PM).

Background. In 2011, a Columbia/GSAPP thesis project on Gypsum Recycling in PlaNYC 2030: Spaces for Government Intervention[2] serendipitously introduced Town+Gown to the world of construction and demolition waste (CDW). In 2017, a serendipitous meeting with two CUNY/CCNY-Grove professors who wanted to do projects studying the reuse of recycled concrete aggregate and decommissioned wind turbine blades, kicked off Town+Gown's official entry in the world of CDW and its reuse.

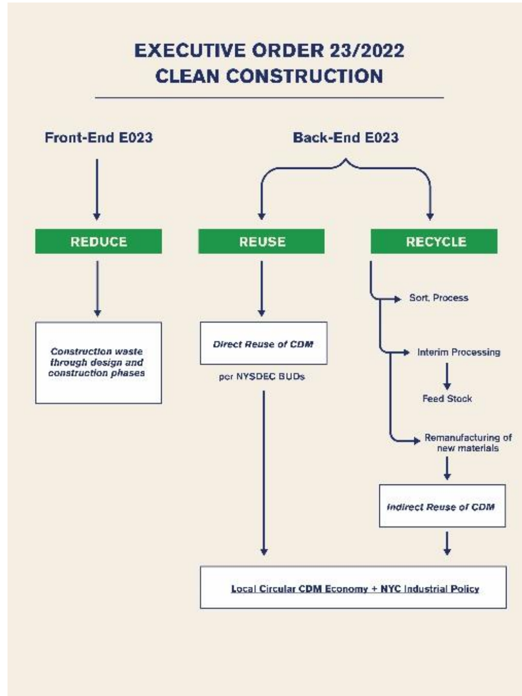
Our first event on November 30, 2017, *Pushing the Recycling Envelope: Construction and Demolition Waste*, has led to ten other symposium events including this one.[3] We have collectively learned much through these events, creating a CDW Working Group in 2018 that morphed in 2020 into an *Urban Resource Recovery* (URR) Working Group to bring in wastewater treatment resources into the equation.[4] Since 2018, much student-led research has been done to support the work of the URR Working Group.[5]

At *Pushing the Urban Resource Recovery and Re-use Envelope: Closing Loops City Program Initiative (URR.8) or You Can't Have Zero Waste without CDW*, on October 13, 2021, we revealed what we were calling then the "Closing Loops City Program Initiative" (CLCPI). The CLCPI was essentially a map for local governments to support a circular CDW economy, and much student-led work from 2021 focused on specific aspects of the circular economy. While the work within Town+Gown proceeded, NYC Mayor's Office of Climate and Environmental Justice (MOCEJ) was proceeding on its own track, and in 2020 the separate efforts began to intersect.



[2] building-ideas-3.pdf, pp. 14-15.
[3] Symposia Archive and Symposia.
[4] Town+Gown Working Groups
[5] Town+Gown Working Groups: Urban Resource Recovery (URR)

EO 23 and Town+Gown. As part of City's ongoing efforts to reduce carbon emissions and create sustainable, resilient public buildings and infrastructure, MOCEJ has been advancing the city's embodied carbon strategy under Executive Order 23 of 2022, the Clean Construction Executive Order (EO 23). The nature of the construction process begins with planning and design activities and ends with construction activities, that include the generation and reuse/recycling/disposal of CDMs. EO 23 specifically focuses on "front end" aspects of the design and construction process with incorporation of low-carbon concrete specifications, submission of environmental product declarations, using low-emission vehicles and equipment, and submission of life cycle assessments, with agency plans. EO 23 also permitted *joint action plans* to achieve EO 23, and one joint action plan focused on waste management planning, with elements beginning with the design process but actioned during the construction process, making the waste management plan a "back end" aspect of EO 23. The "back end" of EO 23 is where MOCEJ's and Town+Gown's efforts moved forward together.



In addition to developing and supporting student-led research related to the "back end"[6] for the URR Working Group, Town+Gown focused its efforts on NYC construction agencies' waste management planning practices. The keys to local government activities to support a local CDM circular economy are embedded in public works design and construction contracts because construction is a private-sector activity, involving private firms[7] that are involved in the entire process—from design and construction of projects that generate CDM to recovery and processing of CDMs. To support the joint action plan, Town+Gown analyzed all covered agency and other agency waste management plan contract and specification provisions, which provide the levers to generate a supply of CDM for a circular

[6] Town+Gown Working Groups: Urban Resource Recovery (URR), see for example FinalReportCapstonePrintSpread.pdf, North Brooklyn Urban Study and East Williamsburg Revitalization FINAL.
[7] Private firms include for profit and nonprofit entities.

CDM economy,[8] that turns construction demolition waste (CDW) into increasing amounts of recovered CDM for direct reuse and recycling/processing/remanufacturing (indirect reuse) within a circular framework. This approach, already in place at the city agencies with their waste management plan specifications, takes advantage of embodied carbon in CDM throughout the life cycle of public capital projects, which will contribute to the city's climate goals of carbon neutrality by 2050 by reducing GHG emissions compared to virgin material extraction and transportation and increasing diversion from landfills.

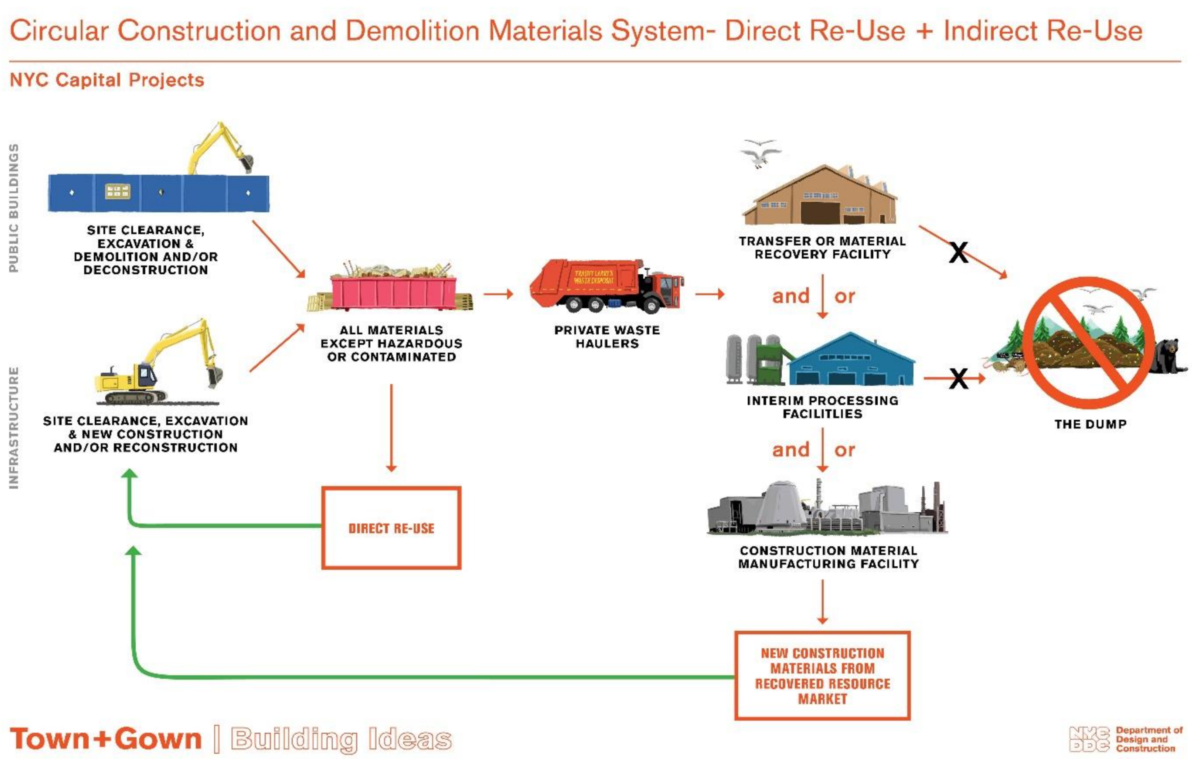
The existence of robust waste management plans in NYC public construction is the result of agencies' practices. On the public building side, agencies must build their projects to LEED green building standards as required by Local Laws 31 and 32/2016, which amended Local Law 86/2005, and is codified in the New York City Charter, Chapter 9, Capital Projects and Budget, Section 224.1: Green Building Standards (the Green Building Law). LEED already requires a certain level of construction material reduction, reuse and recycling, which is the reason that many existing waste management plan provisions in public building design and construction contracts and specifications already embed these requirements. The Green Building Law anticipates new versions of LEED to apply to new projects on a rolling basis as they are released, so the most recent version of the LEED standards, LEED v5, will apply to new public building projects. On the public infrastructure side, Envision provides a consistent, consensus-based framework for construction agencies to assess the sustainability, resiliency, and equity of their civil infrastructure projects. Unlike LEED, at present, NYC construction agencies voluntarily apply Envision to their infrastructure projects, which is the reason that many existing waste management plan provisions in public infrastructure construction contracts and specifications already embed requirements emanating from agencies seeking Envision credits. Envision supports higher infrastructure performance through better choices in infrastructure development which includes waste management planning. With respect to sustainability features such as CDM reuse and recycling, Envision provides agencies with more flexibility than does LEED in obtaining credits.

As a result of NYC agencies having applied LEED standards to public building projects under the Green Building Law for over a decade and having applied the Envision on infrastructure projects voluntarily, NYC agencies have evolved their materials management practices during design and, with their existing waste management plan specifications, during construction. MOCEJ's work on the joint action plan under EO 23, which focused

[8] See ComparativeWasteManagementPlanSpecChart.pdf, ComparativeFeatures.pdf and ComparativeDiversionRates.pdf. Increasing demand on the supply/demand economic equation is what EO 23 "front end" aims at.

on NYC construction agencies' waste management planning practices has revealed a good baseline foundation upon which NYC construction agencies working together and with MOCEJ can evolve and expand their practices.

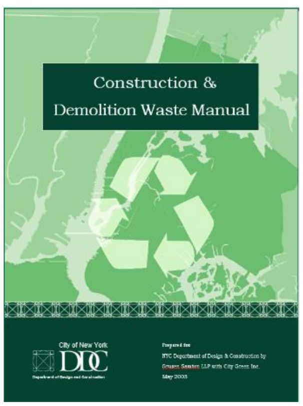
Basic Technical Stuff. Waste management planning activities on capital projects first seek to **reduce** construction-related waste. After reduction, these activities can turn CDW into CDM, by embedding *circular economy* principles into the public design and construction process—specifically, by using design and construction contract provisions and specifications. These provisions and specifications can increase CDM recovery to optimize **direct reuse** of CDM on the generating project or other projects, as permitted under NYS DEC beneficial use designation (BUD) rules.[9] They can also increase effective and efficient **recycling** of CDM, which leads to an **indirect reuse** of CDM elements in new construction materials, which, in circular fashion, can lead back to the front end of EO 23. EO 23 both supports and depends on a local circular CDM economy, ultimately to reduce carbon emissions from the city's capital program, while creating sustainable, resilient public



buildings and infrastructure across the city.

[9] 6 NYCRR Parts 360-366 and 369, NYS Dept. of Environmental Conservation at https://www.dec.ny.gov/regulations/.

Embodied carbon in CDM is present throughout the entire life cycle of a project. It begins with emissions from the original extraction and processing of raw materials into construction materials used on a project and it includes the emissions from the construction and eventual demolition of that project. Embodied carbon emission calculations include emissions from entire life cycle of a project. Building and infrastructure CDM with embodied carbon include from materials such as concrete, steel, glass, excavated soil, asphalt, stone and wood. The circular economy concept provides a means to address these emissions by encouraging the reuse and recycling of these materials to reduce the need for new material extraction and processing. Reusing CDM directly or indirectly as a substitute for newly excavated materials avoids additional carbon emissions from extraction. Within a local circular CDM economy, further carbon emission reductions can be achieved from increasing local place-based efforts, while avoiding carbon emissions associated with CDM treated as waste at the landfills themselves.



Applying the "Reduce, Reuse and Recycle" principles to the City's public building and infrastructure design and construction process requires a level of commitment and attention by all parties to a project to view construction materials, not as waste but as resources to be conserved, reused and recycled for reuse to leverage the embodied carbon present in them and maximize diversion of these resources from landfills. While the design and construction process may seem at first complicated, this effort needed to embed circular economy principles into this process is not complicated. Small but necessary steps taken by all participants throughout the process can achieve much in the way of reducing carbon emissions from the city's capital program.[10]

Reducing construction waste provides the best opportunity for environmental benefits and, thus, should be a priority in any agency's waste management plan, involving actors during the design phase and the construction phase.[11] During design, the agency and its design consultants can minimize construction waste by ensuring the construction contract includes waste management plan specifications that contain aggressive goals consistent with the design. The design process should identify opportunities for salvage for reuse and for recycling on the project and discuss waste management goals as part of the design team's progress meetings.[12] The agency and its contractor should develop the aggressive waste management plan and specifications envisioned during the design phase with various

[10] Construction & Demolition Waste Manual, NYC DDC, 2003, p. 11
[11] *Idem*
[12] *Ibid.,* p. 12

required actions on the part of the agency and contractor throughout the construction process.[13]

Reusing construction materials on the project that generated them or other projects, consistent with the NYS DEC BUD rules extends the life of existing materials, which generated emissions in their creation and represent embodied carbon, and by decreasing the need for new materials, reduces emissions from construction and increases diversion from landfills.[14] **Recycling** these materials[15] within a circular economy that processes them for feedstock into new manufactured materials to be used on new capital projects also takes advantage of embodied carbon and increases diversion from landfills.[16]

As with the reduce strategy, during design, the agency and its design consultants can maximize the direct reuse of materials and the effective recycling of materials by surveying the existing structure, during the schematic design phase, for items that can be salvaged and reused, such as furnishings and equipment, systems components and equipment, and architectural components. Agencies' waste management plan specifications requiring the contractors to reuse materials and recycle those that cannot be reused have evolved over time, beginning with public building projects subject to LEED requirements under the Green Buildings local law. But all require the ongoing collaboration of the agency and the contractor in developing processes during the job that are necessary for effective and efficient reuse and recycling, identifying diversion goals and documentation of all waste management plan activities, including volumes of materials recovered, reused, recycled and diverted from landfills.[17]

<u>Basic Economics Stuff.</u> Most of the world's population lives in cities where, not surprisingly, "the large bulk of resource consumption takes place."[18] Economic production and consumption—including consumption of resources—are concentrated in cites.[19] While urban centers have been growing, the average household size has been decreasing, as a function of income growth due to urbanization.[20] The decreasing trend in household size

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[13] *Ibid.,* pp. 12-13

[14] *Ibid.,* p. 11

[15] Recyclable materials by definition and law excludes hazardous and contaminated materials, which must, under state law, be properly disposed of and are specifically excluded in agency waste management plan specifications.

[16] *Ibid.,* p. 11

[17] *Ibid.,* pp. 14-15

[18] Mike Hodson, Simon Marvin, Blake Robinson, and Mark Swilling, "Reshaping Urban Infrastructure: Material Flow Analysis and Transitions Analysis in an Urban Context," *Journal of Industrial Ecology,* Vol. 26, No. 6 (New Haven, 2012) p. 789. See also Benjamin Sadlek, Ruben Bibas and Jean Chateau, *The Future of Materials Use: Environmental Impacts and Policy Implications*, Organization for Economic Co-operation and Development, , May 2020, pp. 6-11.

[19] *Ibid.*, pp. 789-790.

[20] *Ibid.,* p. 790.

translates into an increasing demand for housing that increases demand for land and building materials and reduces resource use efficiency.[21] Increasing population growth and number of smaller households further increase demands on public infrastructure and buildings through and in which government delivers its services increasing resource demand. The increase in construction occurs within a global construction industry that "consumes approximately 50% of resources, 40% of water, 70% of timber products, and 45% of energy" and it is "likely to have a major impact on resources."[22]

Looking at the built environment system at the "macro-level landscape" perspective, "pressures and potentials to find ways to reconcile economic growth, wellbeing and the sustainable use of resources" also happen in cities.[23] In all economic sectors, these macro-level landscape pressures push "systemic change in infrastructure through low-carbon transitions" to create increase sustainability, which becomes an "infrastructure transition."[24] The construction and maintenance of these urban infrastructure systems[25] "are often the largest expenditures at the city government level,"[26] and the design, construction and operation these built artifacts "create a sociotechnical environment that plays an important role in shaping, and potentially reshaping, how resources are procured, used, and disposed of by the city."[27]

From the transition analysis "meso level sociotechnical regime," stakeholder interrelationships in the regime, "through regulations, policy priorities, consumption patterns, and investment decisions, . . . hold together to stabilize sociotechnical regimes and their existing trajectories."[28] This stabilization function leads to institutionalization and entrenchment of practices, processes and relationships within construction industry and its CDM systems within a complex and fractured regulatory environment.[29] Reconfiguration the regime will "depend on the decoupling of this economic growth from escalating

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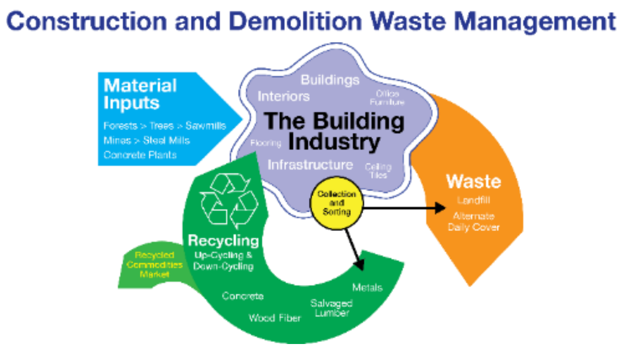
[21] *Idem*
[22] *Idem* See also Sadlek *et al., op, cit.,* pp. 13, 18-19
[23] *Ibid*., p. 789. "The landscape operates at the macro level, focusing on issues such as political cultures, economic growth, macroeconomic trends, land use, utility infrastructures, and so on, and applies to pressures on existing sociotechnical regimes, creating windows of opportunities for responses. Landscapes are characterized as being 'external' pressures that have the potential to impinge upon—but do not determine—the constitution of regimes (meso) and niches (micro)." *Ibid*., p. 794
[24] *Ibid*., p. 791.
[25] Includes energy, waste, water, sanitation and transport infrastructures; should also theoretically include the private and public building systems.
[26] *Ibid*. p. 790.
[27] *Ibid*., p. 790.
[28] *Ibid*., p. 794.
[29] Tineke Egyedi and Jaroslav Sprico, Standards in transitions: Catalyzing infrastructure change, Futures 43 (20110), p. 947-960; at https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1057.906&rep=rep1&type=pdf (accessed 10-08-21 @ 5:07 p.m.), p. 1.

resource use."[30] Decoupling urban economic growth from the resulting increased demand for resources, many of which are finite resources, requires analysis of resource flows through the urban space, which "are conducted by complex networked infrastructures which, in turn, have been designed, built, and operated in accordance with a particular set of technical modalities and governance routines that for the most part assume a continuous supply of resources," followed by developing innovative ways to reshape these flows.[31] The first decoupling mode is "[r]esource decoupling or 'dematerialization' involve[ing] reducing the rate at which primary resources are used per unit of economic output," and the second is "[i]mpact decoupling . . . seek[ing] to increase economic activity while decreasing negative environmental impacts like CO2 emissions or the destruction of biodiversity."[32]



Achieving a level of decoupling within a city requires solving the challenges of identifying a transition methodology with leadership and governance aspects.[33] Uniting material flow analysis (MFA) with transitions analysis (TA) at the city scale, because it is a spatial node of consumption with a capacity for innovation, can provide the analytical tools to help a city to "structure systemic changes in resource use."[34] While the capacity for innovation is important, "absolute reductions in the use of nonrenewable resources are unlikely to happen without deliberative intervention to stimulate broad, systemic (including behavioral) changes."[35] MFA analysis can suggest directions in improving resource efficiency as a "'first step' toward sustainable resource management" through "engineering and/or institutional solutions to fine tune the components of existing systems to reduce" resource use.[36] MFA linked to TA, however, is necessary "to achieve resource productivity, [with] a 'whole system' design perspective that can facilitate more radical system changes is necessary."[37]

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30 *Idem*.
31 *Idem*
32 Hodson *et al., op. cit.,* p. 798, Footnote 4.
33 *Ibid.,* p. 791.
34 *Ibid.*, pp. 790-791.
35 *Ibid.,* p. 791.
36 *Ibid.*, pp. 791-792.
37 *Idem*

The idea of using previously deemed "waste" as a resource via direct and indirect (via recycling and remanufacturing) reuse emerges from moving toward "more circular, location-based urban metabolism [that] is now considered to be a necessity if cities are to survive a future of resource and climate uncertainty," now that earlier urban assumptions of "an endless supply of resource inputs for consumption and nature's unlimited capacity to absorb the concentrated wastes it produces" may no longer be true.[38] The idea of recycling has moved beyond "the separation and collection of household packaging wastes [to] include consideration of all 'waste' streams generated by urban production and consumption activities in terms of how they might be used as valuable inputs. Even the built fabric of the city has the potential to be reused as buildings are retrofitted instead of being replaced, salvaged bricks and other materials from demolitions are reused as inputs into construction, and rubble is processed for use in road surfacing and other projects."[39] Reconfiguring the local infrastructure and building construction regime to recover and re-use what has been considered construction "waste" is larger than a single infrastructure system transition. It is a transcending *meta* urban recovery and re-use transition that crosses all infrastructure and building sectors operating in City, amplifying the need for locality-based research and analysis because "generalized knowledge simply will not do."[40] To paraphrase Tip O'Neill, all politics *and urban resource recovery and re-use* is local. Urban practitioners in the construction "macro-level" regime[41] experience the recovery and re-use of CDM as exogenous and uncontrollable phenomena, while those in the "micro-level niche"[42] have been pursuing the route of agitating for innovative solutions.

In the absence of a landscape level event to galvanize the meta transition,[43] facts on the ground point to a reform process at the regime level, based on localized applied research and with technical actors from the niche level, outlining the required governance to support change within the regime. In public economics terms, government is only actor in the construction regime that can correct negative externalities emanating from private arrangements and decisions in a market that it regulates and contracts with "to change the calculus of each, such that certain erstwhile individually rational decisions that aggregate

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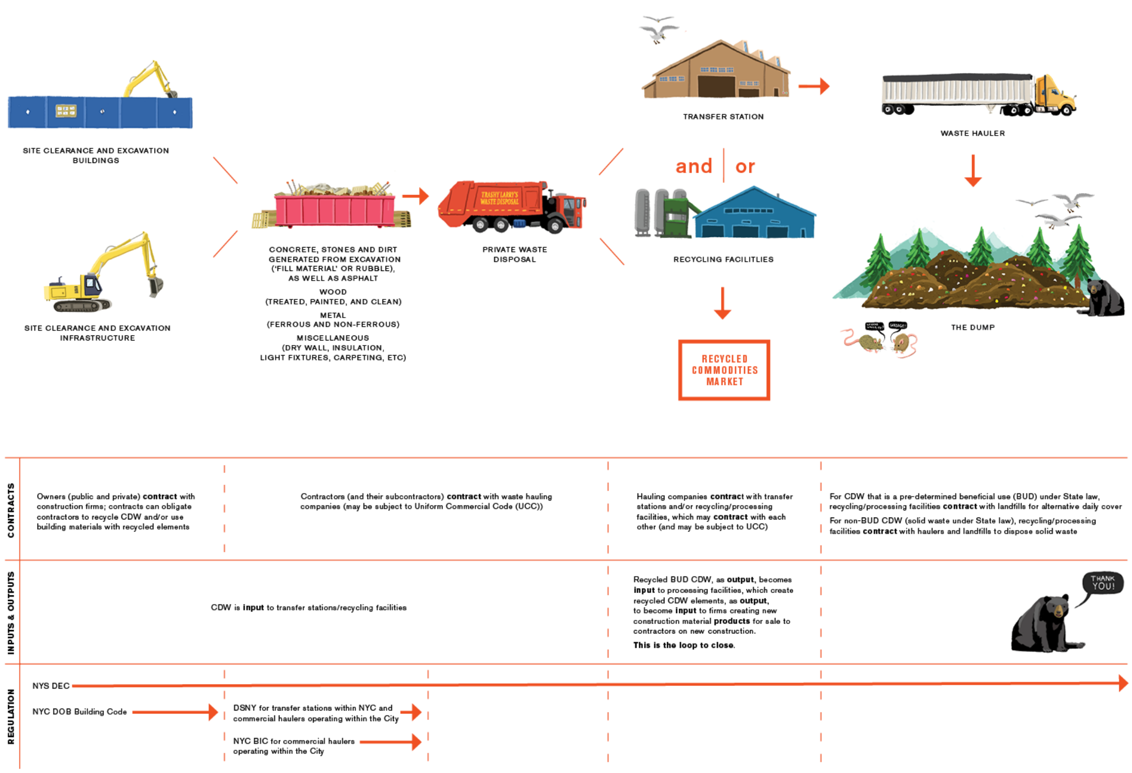
[38] *Ibid.*, p. 792.
[39] *Ibid.,* p. 793.
[40] Samuel Tabory, Terri Matthews, Richard Feiock and Anu Ramaswami, "What Cities Want to Know: A Practitioner-Derived Research Agenda for Sustainable Urban Infrastructure Transitions" (unpublished paper conducted through Sustainable Healthy Cities sustainable research network supported by the U.S. National Science Foundation's Sustainability Research Network (SRN) program [Award No.1444745]), p. 7.
[41] Hodson *et al., op. cit.*, p. 794.
[42] Hodson, p. 794.
[43] Landfill capacity issues and resulting fee increases are likely to be insufficient, on their own, as landscape pressures to cause this meta transition.

into collectively irrational outcomes cease to be individually rational."[44] NYC, leveraging the State's BUD regulations and its capital program spend that functions as a market-maker in the local construction economy, can begin to change the individual actors' calculus so that the failure to recover, reuse and recycle for remanufacturing is no longer individually rational. In addition to landscape pressures operating on a regime from without, micro-level sociotechnical niches that "agitate to get new technologies onto the 'agenda' and promote innovation by trying to keep alive novel technological developments" can operate on a regime from within.[45]

Finally, since construction is a private sector activity and the concept of circular economy has the word "economy" in it, all of the above needs to be considered at the micro-economic level of the private sector firms that are related via discrete transactions and related contracts. It is not simply stating the obvious to highlight that private firms need to make a profit to remain in business and that they are employers of actual people working

Construction and Demolition Waste System: TCE Elements



[44] Robert Hockett, "Recursive Collection Action Problems: The Structure of Procyclicality in Financial and Monetary Markets, Macroeconomics and Formally Similar Contexts," *Journal of Financial Perspectives*, Vol. 3, No. 2, 2015, p. 24.
[45] Hodson *et al., op. cit.*, p. 794.

there. These facts require analyzing the transaction costs of this meta transition throughout the entire local construction industry and will help size and locate the boundaries of a necessary local CDM economy. This transaction costs analysis requires a particular focus on the supply chain aspect of a circular CDM economy, in addition to the necessary material flow analysis, which requires data that is not exactly plentiful. But developing a systems-based transaction cost economics analysis model would help to define and support a local circular CDM economy that works to maximize GHG emission reductions, which is one main objective of this effort.