

Saving Sand to Save the Planet 2.0

**Roundtable on Industry, Government, Academic, and NGO
Perspectives on Sand as a Critical Resource**

CONFERENCE PROCEEDINGS

Northeastern University
Arlington, Virginia, USA

February 18, 2025

In collaboration with
The University of Plymouth, UK
UNEP/GRID-Geneva, Switzerland

Funded by a grant from the Academy of Medical Sciences (UK)



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Saving Sand to Save the Planet 2.0: Proceedings of the International Roundtable held at Northeastern University, February 18, 2025. Sheila M. Puffer, Antonio Garcia-Amate, and Fedor Bentsa, Eds. 2025. Arlington, VA: Northeastern University.

Conference institutional partners:





Northeastern University Arlington, VA campus

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Conference Agenda and Speakers

Tuesday February 18th	Description
Venue: Arlington Tower, Suite 1500 1300, 17th Street North, Arlington, VA 22209	
9:00-10:00 a.m.	Registration and light breakfast
Welcome and Introduction to the Roundtable	
10:00-10:15 a.m.	Welcome by: - Sheila M. Puffer, University Distinguished Professor, Northeastern University, Boston - Jamie Jones Miller, CEO and Dean, Northeastern University, Arlington - Pascal Peduzzi, Director, UNEP/GRID-Geneva
Session 1: Presentations	
10:15-10:40 a.m.	<i>The Sand Paradox: Why We Need to be More Efficient With a Seemingly Infinite Resource.</i> Dr. Arnaud Vander Velpen, Sand Industry and Data Analytics Officer, UNEP/GRID- Geneva
10:40-11:00 a.m.	<i>Age of Sand: How long will it last.</i> Dr. Jonathan Moizer, Associate Professor, University of Plymouth Dr. Minchul Sohn, Lecturer, University of Plymouth Dr. Boksun Kim, Associate Professor, University of Plymouth
11:00-11:20 a.m.	<i>From Crisis to Opportunity: Addressing the Global Sand Shortage in the US and Canada.</i> Dr. Adel A. Zadeh, Teaching Professor and Campus Director, Northeastern University, Toronto Dr. Yunxin Peng, Part Time Lecturer, Northeastern University, Arlington Dr. Sheila M. Puffer, University Distinguished Professor, Northeastern University, Boston
11:20-11:30 a.m.	Break
11:30-11:50 a.m.	<i>Sand and Sustainability in North America: Policy and Practice.</i> Charles Di Leva, Former CEO, Environmental & Social Standards, World Bank
11:50-12:10 p.m.	<i>Accelerating green building to improve lives and livelihoods.</i> Ryan P. Snow, Regional Director, US Market Transformation & Dev, US Green Building Council
12:10-12:30 p.m.	<i>Addressing U.S. Coastal Sediment Needs.</i> Dr. Ashley Long, Geologist, US Bureau of Ocean Energy Management
12:30-01:30 p.m.	Lunch
Session 2: Roundtable breakout sessions	
01:30-02:30 p.m.	Stakeholder Supply Chain Analysis – led by Northeastern University and University of Plymouth

02:30-03:40 p.m.	<i>Sustainable Substitutes and Solutions</i> Dr. Hadi Rashidi, Director, Engineering and Technical Policy, National Stone, Sand and Gravel Association Michael Nesbitt, Research – Project Lead Sustainability, CDE Global Ltd Dr. Nick Brown, Coastal Scientist, HDR
03:40-04:00 p.m.	Closing remarks and next steps

Proceedings

Welcome and Introduction to the Roundtable

February 18th

10:00-10:15 a.m. Welcome by Dr. Sheila M. Puffer, University Distinguished Professor, Northeastern University, Boston

The roundtable opened with a warm welcome from Professor Sheila Puffer of Northeastern University, who greeted participants both in person at the Arlington, VA campus and online. Those online included participants from around the world, including The Maldives, North and South America, Africa, Europe, Canada, and the UK. She introduced the event, “Saving Sand to Save the Planet 2.0,” as a follow-up to a prior conference held in Boston in June 2024, which was supported by the UK’s Academy of Medical Sciences in collaboration with the University of Plymouth, UK. She emphasized that this event brings together a diverse group of speakers and stakeholders—spanning the entire sand supply chain from extraction to construction—to explore sand as a critical yet often overlooked material. The roundtable aimed to expand global dialogue and foster collaboration, particularly as sand plays a crucial role not only in infrastructure but also in climate protection and environmental services.

Dr. Puffer acknowledged the support from the Arlington campus team, particularly Kalen James (IT support) and Will Matthews (Operations Manager), and thanked the associate dean and campus staff for their hospitality. Dr. Ronna Halbgewachs, Associate Dean of Northeastern's Arlington Campus, on behalf of CEO and Dean Jamie Jones Miller, then offered a brief overview of the campus, which focuses on innovation, technology, security, and policy. She noted that the campus hosts graduate programs from various Northeastern colleges and provided practical information for in-person attendees.

Following this introduction, a pre-recorded welcome address was presented by Pascal Peduzzi, Director of UNEP/GRID-Geneva. He emphasized the global dependence on sand—not just for buildings and roads, but also for its vital ecosystem services such as water filtration, shoreline protection, and support for renewable energy infrastructure. Dr. Peduzzi stressed that despite sand being the most consumed solid material on the planet (with 50 billion tons used annually), it remains largely unregulated and under-monitored. He called for the recognition of sand as a critical resource, the implementation of sustainable extraction practices, and greater efforts to collect data and reduce consumption through recycling and innovation.



Dr. Puffer concluded the welcome session by reiterating the importance of interdisciplinary and international cooperation. She highlighted Northeastern’s collaboration with UNEP/GRID-Geneva and the University of Plymouth, to contribute to the 2025 United Nations report on sand. The opening session ended with brief introductions from participants in the room, including researchers from environmental NGOs and academia, as well as Northeastern faculty involved in sand-related research. The tone was set for a day of cross-sector dialogue aimed at reshaping how we understand and manage sand as a strategic global material.

Highlights

Dr. Sheila Puffer (Northeastern University, Boston): *“Sand is taken for granted because of the fallacy that it is unlimited.”*

Dr. Pascal Peduzzi (UNEP/GRID-Geneva): *“Sand is literally everywhere... the unrecognized hero of our planet.”*

Dr. Pascal Peduzzi (UNEP/GRID-Geneva): *“We are using 50 billion tons of sand per year... enough to build a 27 meter-high wall around the equator annually.”*

Session 1: Presentations

10:15-10:40 a.m. *The Sand Paradox: Why We Need to be More Efficient With a Seemingly Infinite Resource.*

**Dr. Arnaud Vander Velpen, Sand Industry and Data Analytics Officer,
UNEP/GRID- Geneva.**

Arnaud Vander Velpen, who joined the roundtable remotely, opened his presentation by expanding on the urgent need for efficiency in how we use sand—a resource that appears abundant but is, in fact, finite and formed over thousands of years through slow geological processes. While most people associate sand with beaches, its presence in everyday life is far more widespread. It forms the backbone of modern infrastructure, used in buildings, roads, and hydropower dams. In its purer forms, sand is essential in the production of glass, semiconductors, and even cosmetics. However, humanity's dependence on sand is not matched by responsible usage or regulation.



In 2020, the global volume of human-made building materials surpassed the total mass of all living biomass, with sand and gravel making up the majority. Today, we extract around 50 billion tons of sand annually—enough to build a wall 27 meters high and wide around the Earth's equator every year. The scale and intensity of extraction are particularly alarming in coastal and marine environments, where UNEP's Marine Sand Watch program recently reported that 6 billion tons of sediment are extracted annually. This far exceeds natural replenishment rates in many regions, especially in Europe, West Africa, and the U.S., where extraction disrupts ecosystems and sediment flow.

Dr. Vander Velpen highlighted that the primary drivers of this escalating demand are population growth, urbanization, and infrastructure expansion, with climate change adding new pressures through coastal resilience and land reclamation efforts. He noted that in places like Singapore, land mass has grown by 23% since the 1970s due to large-scale sand importation. Similarly, projects like Dubai's Palm Jumeirah required hundreds of millions of tons of sand. These activities, often carried out with little oversight, damage marine biodiversity, erode coastlines, and contribute to water and land degradation.

One particularly concerning trend is the extraction of sand from Marine Protected Areas (MPAs), where 20–30% of dredging in regions such as Western Europe and the Americas now takes place. Without responsible procurement frameworks, extraction is likely to continue in ecologically sensitive zones. Sand's lack of inclusion in stock markets or centralized trade systems makes its supply chain highly opaque, preventing proper monitoring or governance.

UNEP's response has been multifaceted. Dr. Vander Velpen discussed the Sand and Sustainability report released in 2022, which offered ten strategic recommendations for responsible sand use. The report has since informed ministries and institutions globally. UNEP/GRID-Geneva has also led coordination efforts among UN agencies and stakeholders, including member states, civil society, extractive industries, end users, and financial institutions. A growing expert group is now working on the next Sand and Sustainability report, with a focus on biodiversity impacts and sand as a critical resource.



One of UNEP's major technical tools, the Global Marine Sand Watch, uses AI to monitor approximately two million vessels, distinguishing dredgers from other types of ships. This tool helps identify where marine sand extraction is occurring, particularly within Exclusive Economic Zones (EEZs), and flags unauthorized or excessive dredging activity.

Dr. Vander Velpen concluded by emphasizing the urgent need to close global data gaps, promote circularity, and recognize sand as a strategic resource. He called for countries to establish responsible sourcing frameworks, assess replenishment rates, track environmental impacts, and plan long-term sustainable supply chains. Without a coordinated global effort, sand extraction will continue to degrade vital ecosystems, undermine coastal resilience, and threaten future infrastructure development. The session ended on a clear note: action on sand must become a global priority before the damage becomes irreversible.

Highlights

Dr. Arnaud Vander Velpen (UNEP/GRID-Geneva):

- *"In 2020, man-made building materials outweighed all global living biomass — most of it being sand and gravel."*
- *"We're extracting more sand from coasts and rivers than nature can replenish — this is unsustainable."*
- *"20–30% of marine sand extraction in regions like Western Europe happens inside Marine Protected Areas."*
- *"We must close the data gap, recognize sand as a strategic resource, and promote responsible sourcing and circularity."*

10:40-11:00 a.m.

Age of Sand: How Long Will it Last.

Dr. Jonathan Moizer, Associate Professor, University of Plymouth

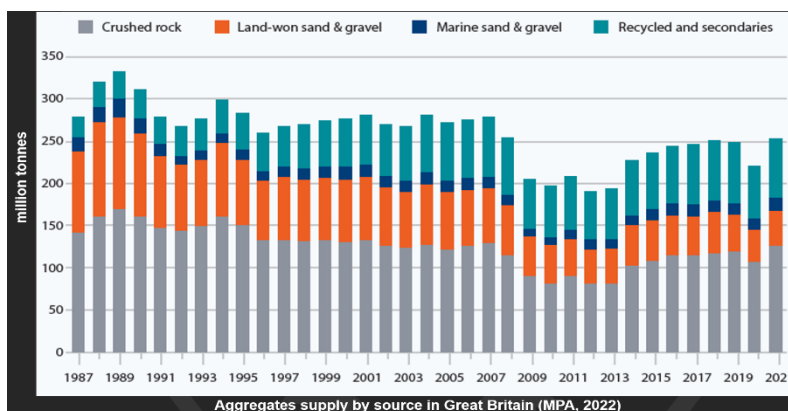
Dr. Minchul Sohn, Lecturer, University of Plymouth

Dr. Boksun Kim, Associate Professor, University of Plymouth

Dr. Jonathan Moizer, joined by Dr. Minchul Sohn and speaking on behalf of their colleague Dr. Boksun Kim, presented a detailed overview of sand and gravel usage in the United Kingdom. The presentation focused on national trends in sand demand, the challenges in estimating reserves, and policy efforts aimed at developing a sustainable supply. Dr. Moizer opened by noting the UK government's aggressive infrastructure agenda, including a goal to build 1.5 million new homes by 2030 and major expansions in renewable energy. This initiative will significantly raise demand for sand, as infrastructure projects heavily rely on sand-based materials like concrete.

Currently, the UK consumes about 270 million tonnes of aggregate per year, 90% of which is used in construction. Notably, 30% of these materials are sourced from recycled or secondary aggregates. However, Dr. Moizer pointed out that recycled aggregates alone cannot satisfy future demand, especially given a policy emphasis on extending the lifespan of existing buildings rather than demolishing them. Moreover, national statistics often combine sand and gravel under one category, which creates data gaps and makes it difficult to plan specifically for sand-related needs.

The presentation highlighted that a third of the UK's sand and gravel supply comes from marine dredging, while two-thirds is land-based. About 7% is silica sand, which is essential for glass production. The UK imports only about 1% of its sand, primarily from EU countries, but exports 7%, with marine-dredged sand comprising a large portion. Challenges also exist in replenishment: between 2011 and 2020, the UK replaced only 63% of the sand and gravel it extracted, through new planning approvals, raising concerns about long-term sustainability.



A critical policy issue lies in the expiration of extraction permits. Under the Town and Country Planning Minerals Act (1981), all existing extraction permits will expire by 2042. Currently, 85% of UK reserves fall under permits that will expire by or before this date, yet plans for replacing those permits remain unclear. The presentation concluded with a call for improved data collection, proactive policy development, and long-term strategic planning to ensure sustainable aggregate supply in the UK.

Dr. Puffer thanked the University of Plymouth team for offering a national lens to complement the previous global overview and then transitioned to the next presentation.

Highlights

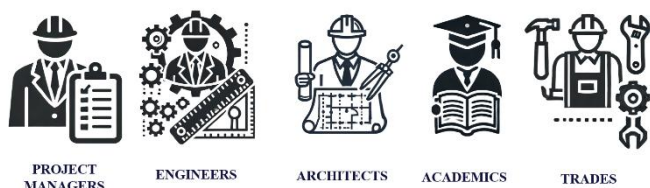
Dr. Jonathan Moizer (University of Plymouth):

- *"Sand is the largest material flow in the [UK] economy."*
- *"For every 100 tonnes of sand extracted in the UK, only 63 tonnes are replenished."*
- *"85% of the UK's current reserves will expire by 2042, with no clear plan for replacement."*

11:00-11:20 a.m. ***From Crisis to Opportunity: Addressing the Global Sand Shortage in the US and Canada.***
Dr. Adel A. Zadeh, Teaching Professor and Campus Director, Northeastern University, Toronto
Dr. Yunxin Peng, Part Time Lecturer, Northeastern University, Arlington
Dr. Sheila M. Puffer, University Distinguished Professor, Northeastern University, Boston

The Northeastern University research team, led in person by Dr. Yunxin Peng based at the Arlington campus and joined remotely by Dr. Adel Zadeh due to severe weather in Toronto, began their discussion of the sand crisis in North America. This session focused on the low awareness of sand shortages in the U.S. and Canada, the current availability of sand alternatives, and the barriers and incentives associated with their adoption. Dr. Peng introduced the team's research, which began in 2019 with a construction industry survey with over 350 responses and 75 interviews.

KEY STAKEHOLDERS



Dr. Peng emphasized that sand is the second most consumed natural resource after water, yet its unsustainable extraction causes serious environmental damage such as erosion, habitat loss, and flooding. The construction industry's dependence on sand, coupled with limited regulatory frameworks, makes it vulnerable to scarcity. In the U.S., where 130 million metric tons of sand were extracted in 2023, demand remains high due to major construction projects. Canada, meanwhile, has been a leading exporter of sand and gravel to the U.S., with Ontario, Alberta, and British Columbia driving most of the domestic production.

The team explained that while alternative materials such as slag, recycled construction waste, and manufactured sand show promise, widespread adoption remains limited due to cost, regulatory uncertainty, and supply chain barriers. Pie chart and bar graph visuals were used to demonstrate the primary uses of sand: 43% for Portland cement concrete, 24% for road bases, and smaller portions for construction fill and filtration. These figures reinforced the urgent need for sustainable sand management and innovation in alternative materials.

Dr. Zadeh then elaborated on key findings, including industry awareness of the crisis and regional differences in how sand shortages are addressed across North America. The session transitioned into a deeper look at the U.S. and Canadian responses to the global sand shortage and potential policy solutions moving forward. Dr. Zadeh, a civil engineer with a background in concrete sustainability, reflected on how the issue of sand scarcity had initially been absent from mainstream construction discourse, which often focuses more heavily on cement sustainability. The Northeastern research team, led by Professors Zadeh, Puffer, and Peng, structured their study around four central research questions: awareness of the sand crisis, the availability of viable substitutes, barriers to adoption, and incentives for stakeholders.

The team began by assessing the level of awareness within the construction industry. Surveys and interviews revealed that knowledge about the sand crisis was generally low, particularly outside academic circles. Academics showed the highest awareness levels, likely due to their exposure to recent literature and attendance at conferences. The study surveyed professionals across stakeholder groups, including engineers, project managers, architects, academics, and tradespeople. Approximately 69% of responses came from the U.S. and 31% from Canada, with engineers representing the largest group.

A critical part of the research focused on identifying and evaluating potential sand substitutes. The team compiled a list of 27 alternatives, including slag, recycled construction waste, and manufactured sand. They assessed stakeholders' familiarity with and acceptance of these options, and the results indicated a broad range of knowledge and skepticism across roles. Stakeholders frequently expressed concern about the substitutes' availability, performance, and environmental legitimacy, highlighting the importance of lifecycle assessments to verify long-term sustainability.

The research also explored perceived barriers and incentives to adopting sustainable substitutes. Performance concerns were especially important to structural engineers, while cost and availability were top priorities for architects and managers. To encourage adoption, the study identified three major categories of incentives: general, governmental, and financial. General incentives included environmental protection and ease of access to materials. Governmental incentives centered on mandatory regulations and increased investment in R&D, while financial incentives focused on rebates, tax credits, and grant funding.

Dr. Zadeh emphasized the importance of understanding stakeholder influence through an interest-power matrix. Engaging low-interest but high-power stakeholders was identified as essential for driving change. The study recommended tailored strategies to mobilize key decision-makers and called for stronger involvement from policymakers, environmental scientists, and industry leaders. The research team's findings were published in academic journals in 2022 and 2023 and presented at multiple international forums.

The session concluded with a call to action for deeper engagement across the construction ecosystem. The team introduced their Global Sand Sustainability Network and encouraged attendees to join their ongoing knowledge-sharing efforts via LinkedIn. Professor Puffer thanked Dr. Zadeh for the presentation, and the group paused for a short break before transitioning to the next speaker.

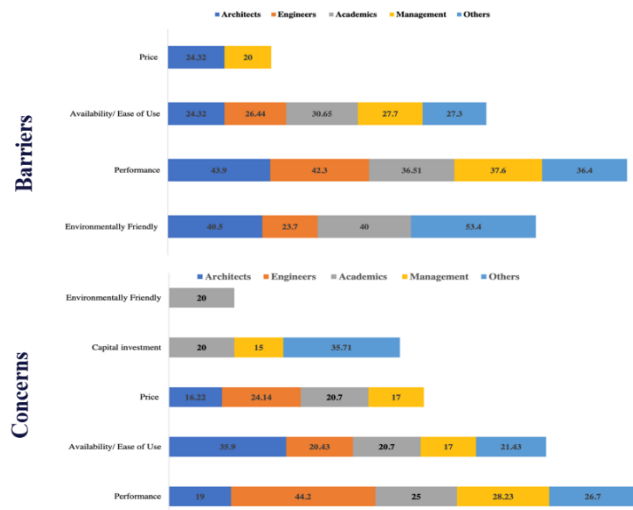
Highlights

Dr. Adel Zadeh (Northeastern University, Toronto):

- *"Much of the research on concrete sustainability ignores sand—yet sand is critical."*
- *"Awareness of the sand crisis remains low across engineers, managers, and industry professionals."*
- *"Twenty-seven sand substitutes were identified, but adoption is limited by performance concerns and regulatory gaps."*
- *"If we remove more sand than we replenish—without substitutes or planning—we jeopardize long-term sustainability."*

Dr. Yunxin Peng (Northeastern University, Arlington):

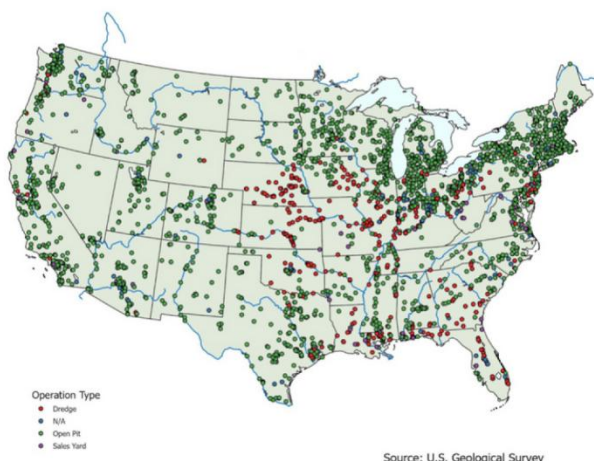
- *"Sand is the second most consumed natural resource after water."*
- *"Recycled and manufactured alternatives exist, but adoption is limited by regulatory and economic barriers."*



11:30-11:50 a.m. **Sand and Sustainability in North America: Policy and Practice.** **Charles Di Leva, Former CEO, Environmental & Social Standards, World**

Dr. Charles Di Leva shared findings from a student-led research project at American University that examined sand and sustainability across North America, with a focus on regulatory gaps and opportunities for circularity in the construction industry. The study was initiated during Dr. Di Leva's tenure at the World Bank and further developed through a practicum with students at the School of International Service at American University. The research sought to understand both the fragmented legal landscape of sand extraction and the potential to integrate sustainable practices such as recycling and reuse of construction materials.

Sand and Gravel Operations in the Continental U.S.



The research began by mapping sand extraction sites across the United States, revealing that most production is localized and comes from open-pit operations—especially near major river systems like the Elkhorn, Platte, and Missouri Rivers. Due to the weight and volume of sand, cross-border trade remains limited, with domestic extraction exceeding 1.5 million metric tons annually. A significant portion of this activity occurs with limited oversight, as many regulatory agencies depend on self-reporting for compliance. The fragmented jurisdictional structure—where oversight varies between federal, state, and local governments depending on whether sand is extracted from land, rivers, or the outer continental shelf—further complicates enforcement. The Supreme Court's recent narrowing of the definition of "waters of the United States" has shifted more authority to state-level regulators, weakening federal control.

A key challenge identified in the study was the inconsistency of building codes across states. Only 12 states and Washington, D.C. have adopted green building codes, and most do not enforce uniform standards related to sourcing or recycling sand-based materials. The research also noted the near absence of third-party monitoring and the lack of a centralized legal framework for sand sourcing. Parallel issues were identified in Canada and Mexico, where regulations exist but are often not transparent or effectively enforced.

Dr. Di Leva's presentation also highlighted the impact of sand mining on Indigenous communities, particularly in Hawaii and parts of Mexico. In one high-profile case, improper use of tribal lands for sand extraction led to legal challenges and a United Nations investigation into environmental racism. The intersection of resource rights, environmental degradation, and Indigenous sovereignty remains a deeply under-addressed concern in North America's sand economy.

Regarding circularity, the study reviewed opportunities to reduce reliance on newly extracted sand through recycling and sustainable construction practices. Students involved in the research found that although technical standards allow for up to 70% of aggregate in demolished buildings to be reused, practical adoption remains low due to weak financial incentives and minimal regulatory support. Procurement contracts typically exclude recycling requirements, landfill facilities offer little motivation to sort reusable materials, and waste haulers rarely promote circularity. The lack of robust incentive systems—such as tax credits, mandatory recycling provisions, or procurement guidelines—has stalled progress in this area.

The students conducted a case study on American University's LEED-certified graduate school building to explore circular building design in action. The architect, who engaged directly with the class, shared practical approaches to low-emission construction and sustainable material use. They also investigated the broader implications of sand extraction on vulnerable ecosystems and economic costs. In Rhode Island, for example, the cost of protecting just 12 miles of shoreline from erosion was estimated to range between \$26 million and \$120 million.

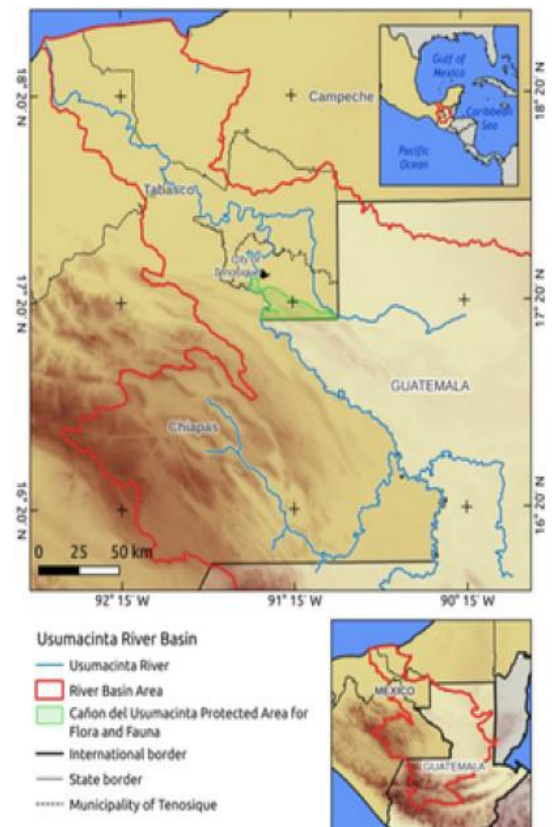
Looking at policy, the research examined how recent developments like the Inflation Reduction Act and the establishment of the Federal Permitting Council might influence sand and gravel extraction through changes in permitting processes. Dr. Di Leva emphasized the importance of continuing to monitor how regulatory shifts under different U.S. administrations affect environmental reviews and extraction practices.

Finally, the study explored alternative materials, including laminated timber and recycled glass. One compelling case involved a stadium in Idaho constructed entirely from laminated timber, illustrating how innovation can help reduce demand for sand-based concrete. Dr. Di Leva closed by sharing that the full report includes detailed recommendations and is available upon request. He also called for deeper exploration of how environmental risks related to sand are currently being assessed by financial and insurance sectors—an area he believes will grow in importance as climate risks become more visible.

Highlights

Dr. Charles Di Leva (American University):

- *"Many extraction sites operate with little oversight—self-reporting is common, and third-party monitoring is rare."*
- *"Only a minority of U.S. states have adopted green construction codes. Policy uniformity is urgently needed."*
- *"Tribal land disputes in Hawaii and Mexico show how sand extraction can clash with Indigenous rights."*
- *"Recycled glass and laminated timber are promising alternatives, but adoption requires financial and regulatory support."*
- *"Protecting just 12 miles of Rhode Island coastline from erosion could cost up to \$120 million."*



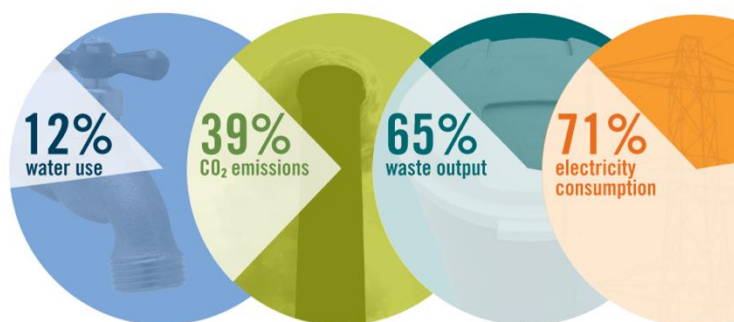
11:50-12:10 p.m.

Accelerating Green Building to Improve Lives and Livelihoods.

Ryan P. Snow, Regional Director, US Market Transformation & Dev, US Green Building Council

Ryan Snow from the U.S. Green Building Council (USGBC) opened his presentation by acknowledging that sand sustainability is not widely discussed within the green building industry, making the morning's sessions particularly eye-opening. He introduced USGBC and its global reach through its sister organization, GBCI (Green Business Certification Inc.), and framed the discussion around how buildings significantly impact environmental systems. Buildings account for a large portion of water use, carbon emissions, waste generation, and electricity consumption, which place the construction and design sectors in a unique position to influence sustainable material use, including sand.

Impact of buildings...



Mr. Snow explained how the LEED (Leadership in Energy and Environmental Design) rating system serves as a tool for guiding sustainable practices in buildings. LEED is a globally recognized certification system that awards points across various categories such as site use, energy efficiency, water conservation, materials and resources, and indoor environmental quality. Projects earn levels of certification—Certified, Silver, Gold, or Platinum—based on the number of points achieved. He described LEED as a “nutrition label” for buildings that helps owners and developers make informed, sustainability-minded decisions.

He noted that LEED is constantly evolving, and with the release of LEED v5 expected soon, there will be a heightened focus on materials and resource conservation. The updated system prioritizes three core themes: decarbonization, quality of life, and ecological conservation. While earlier LEED versions focused primarily on operational carbon from energy use, LEED v5 introduces stronger incentives to address embodied carbon—the emissions associated with material production. Because sand is a critical component of concrete, addressing embodied carbon also creates an opportunity to rethink sand sourcing and consumption in the building industry.

Mr. Snow cited a recent report produced in collaboration with RMI (Rocky Mountain Institute), which outlines low-cost ways to reduce embodied carbon in buildings by up to 30 percent. He also emphasized that ecological conservation in LEED includes efforts to manage erosion, improve stormwater runoff, and support biodiversity—all of which relate directly to how sand is used and managed on construction sites. Additionally, LEED supports circularity through building lifecycle assessments and the reuse of materials. Mr. Snow gave the example of a large convention center project where 90 percent of the concrete was recycled and reused on site, demonstrating that responsible material use is already achievable with the right planning.

Mr. Snow discussed the importance of leadership and policy. While many sustainable options exist, the will to implement them is often lacking. LEED aims to help push the industry forward through pilot credits, which allow for the early testing of new sustainability ideas before they become part of the core rating system. This approach has introduced innovations such as bird-safe building design and social impact credits. Mr. Snow suggested that responsible sand sourcing could follow a similar pathway toward eventual integration into LEED.

He also pointed to the role of local governments, noting that although green building codes are not yet universal, many cities and states now require LEED certification for public buildings or offer incentives for sustainable construction. He encouraged attendees to explore USGBC's policy library, which provides a useful overview of current green building policies across jurisdictions.



In closing, Mr. Snow welcomed collaboration with researchers and institutions like Northeastern University. Professor Puffer thanked him for the presentation and noted the potential for Northeastern's newly relaunched Research and Innovation Team to support joint projects. The session provided a hopeful outlook on how the building industry could play a meaningful role in more sustainable sand use going forward.

Highlights

Ryan Snow (USGBC):

- *"Buildings account for nearly 40% of carbon emissions and 65% of waste output. Sustainable materials matter."*
- *"Sand hasn't been widely discussed in the green building industry, but it should be."*
- *"LEED v5 will emphasize embodied carbon, ecological restoration, and resource conservation—including materials like sand."*
- *"We can integrate responsible sand sourcing into LEED through pilot credits, just like we did with bird collision prevention."*
- *"A convention center reused 90% of its concrete on-site, proving sustainable reuse is possible when there's industry will."*

12:10-12:30 p.m.

Addressing U.S. Coastal Sediment Needs.

Dr. Ashley Long, Geologist, US Bureau of Ocean Energy Management

Dr. Ashley Long of the U.S. Bureau of Ocean Energy Management (BOEM) delivered an overview of sediment-related challenges in coastal resilience planning, focusing on the role of offshore sand and gravel resources. She began by identifying the growing demand for sediment in coastal protection strategies, including beach nourishment, dune restoration, marsh building, and gray infrastructure such as jetties. All these solutions depend on access to sand, yet Dr. Long emphasized that resource availability is increasingly constrained—not because sand doesn't exist, but because development, regulation, and accessibility issues have limited extraction options.



She referenced a UNEP report and a 2021 study titled "A Century of U.S. Beach Nourishment," which showed a significant upward trend in sand use over time. If the trajectory continues, demand for sediment will likely reach unsustainable levels. Simultaneously, supply is being strained as nearby offshore sand sources have been depleted, requiring extraction from farther offshore, which significantly increases project costs. As resilience plans expand across the country, more sediment is needed for shoreline stabilization, habitat restoration, and storm protection, all while climate change accelerates coastal pressures.

BOEM, a regulatory agency within the U.S. Department of the Interior, plays a unique role in stewarding offshore sand and gravel resources on the Outer Continental Shelf. Although the agency does not implement resilience projects directly, it supports federal, state, and local partners by identifying and leasing offshore sediment sources, tracking supply and demand trends, conducting environmental assessments, and managing competing interests.

Dr. Long noted that historically, sediment management has been reactive, responding to individual project needs as they arise. BOEM now advocates for a more strategic, long-term approach. A centerpiece of this strategy is BOEM's National Offshore Sand Inventory (NOSI), a tool that consolidates geological, operational, and environmental data into a centralized platform. Accessible through the Marine Minerals Information System (MMIS), NOSI supports decision-makers across multiple levels of government by providing essential data for planning and coordination. Dr. Long described NOSI as a first step toward building a Regional Sediment Management Framework, which would organize the U.S. coastline and adjacent continental shelf into scientifically grounded districts. This framework would enable more cohesive, data-driven planning across jurisdictions, moving away from the current fragmented, project-by-project approach.

To develop this model, BOEM collaborated with academic institutions, NGOs, and multiple agencies to compare the current state of sediment management to an idealized, optimized system. The envisioned framework aims to reduce resource conflicts, enhance equity, and improve overall efficiency. Dr. Long explained that BOEM's work aligns with seven core management themes, including resource identification, extraction optimization, environmental risk mitigation, and long-term supply tracking.

She also highlighted that while BOEM has traditionally focused on sediment for beach nourishment, there is growing interest in offshore resources for broader construction purposes. Offshore sand deposits may mirror those found onshore, and the possibility of commercial extraction remains open, particularly given trends seen in Europe. In Alaska, for example, where overland transport infrastructure is limited, the costs of material movement are particularly high, making offshore resources even more strategic.

In addition to construction uses, marine minerals play a role in energy infrastructure and may contain critical minerals. BOEM is currently sponsoring research into extracting valuable elements from sand used in beach nourishment projects. Dr. Long emphasized that sediment has environmental value both when left undisturbed—supporting habitats and water quality—and when redeployed to build new coastal features. The challenge lies in balancing these ecological and economic priorities through responsible, science-based planning.

Outlook for the Future



- Challenges and Opportunities
 - Spatial and temporal scales
 - Valuation
 - Resource matches to all possible end-use types
 - Engagement
- BOEM MMP Long-term Priorities:
 - Promote recognition of sediment as a finite resource that needs to be considered during coastal resilience adaptation planning
 - Maintain balance of resource and environmental stewardship in an increasingly crowded ocean


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In closing, Dr. Long stressed that offshore sediment must be recognized as a finite and vital resource. As coastal communities contend with increasing demands and mounting climate risks, strategic sediment management is essential. BOEM remains committed to supporting coastal resilience through long-term planning, stakeholder collaboration, and research that integrates environmental protection with sustainable resource use.

Highlights

Dr Ashley Long (BOEM):

- *"We're not out of sand but we've built over it, sequestered it, or made it inaccessible."*
- *"Beach nourishment needs are rising exponentially; future demand may reach billions of cubic yards."*
- *"BOEM is the only U.S. agency federally mandated to manage offshore sand and gravel resources."*
- *"Project-by-project sediment management is no longer sustainable. We need a regional, data-driven framework."*
- *"We must balance resource extraction with environmental preservation: sand is finite, and its role is critical."*

Session 2: Roundtable breakout sessions

01:30-02:30 p.m. *Stakeholder Supply Chain Analysis* Led by Northeastern University and University of Plymouth

Following the lunch break, participants reconvened for an interactive session focused on mapping stakeholders within the sustainable sand supply chain. Led by Dr. Kate Ashley of Northeastern University, Boston, the activity aimed to build on the morning's presentations by engaging participants in real-time analysis of stakeholder roles, barriers, and incentives related to sustainable sand adoption. Dr. Ashley introduced a shared spreadsheet template to guide the exercise, which divided participants—both in person and online—into breakout groups tasked with evaluating power, interest, and influence across various stakeholder categories.



Each breakout group contributed to identifying key actors, rating their relative influence, and outlining the specific challenges and drivers that shape their decision-making. End users, including the construction industry, cement and concrete producers, and government agencies such as the U.S. Department of Transportation, were identified as powerful players with significant leverage in the supply chain. These stakeholders, participants noted, often possess high bargaining power due to the competitive landscape among extractive suppliers. However, the adoption of sand substitutes is hindered by concerns over availability, costs, lack of scale, and the limited familiarity with or acceptance of alternative materials.

Dr. Jonathan Moizer summarized his group's findings on end users, emphasizing the importance of policy and regulation—such as low-carbon material mandates or polluter-pays systems—as potential incentives. The group also highlighted the need for research, technical standards, and industry training to improve confidence in sand alternatives. Michael Nesbitt contributed examples of influential companies, including Cemex, Heidelberg, and CRH, and suggested that trade associations, academic institutions, and agencies like the U.S. Geological Survey could serve as valuable educational resources.

The next breakout group, represented by Dr. Stephen Childe and supported by Dr. Adel Zadeh, examined academics and researchers. They noted that while academics demonstrate high interest in sustainable sand solutions, their institutional power is relatively limited. Their primary contributions lie in raising awareness, producing technical research, and advising on policy. Barriers such as a lack of access to real-world industry processes and limited influence in policymaking were flagged as key challenges. The group emphasized that research funding, professional recognition, and opportunities for interdisciplinary collaboration serve as primary incentives for academics. Additionally, academics require better access to high-quality data and more effective methods for disseminating research findings beyond traditional academic journals.

Dr. Zadeh added a critical perspective by drawing attention to a frequently overlooked stakeholder group: those less supportive of sustainability transitions. These include traditional extractive companies and suppliers whose current business models are directly threatened by the introduction of sand substitutes and environmentally motivated policies. These actors often possess high power but low interest, making them especially challenging to engage. Their potential misperception of sand being a limitless resource can further deepen resistance, highlighting the need for targeted awareness campaigns and inclusive policy discussions.

Throughout the session, participants refined and expanded the stakeholder list, suggested ways to segment large categories into meaningful subgroups, and proposed a range of tools—including regulatory incentives, awareness-building strategies, and technical standards—to promote collaboration and accelerate sustainable adoption. The session concluded with plans to synthesize the shared insights into a visual power-interest grid and develop a more comprehensive stakeholder strategy for future sand sustainability initiatives.

Highlights

Dr. Kate Ashley (Northeastern University, Boston): *"We want to identify not just who the stakeholders are, but what drives or blocks their engagement with sustainable sand."*

Dr. Jonathan Moizer (University of Plymouth): *"End users have significant power—especially in the U.S.—but low awareness of viable sand substitutes."*

Dr. Stephen Childe (University of Plymouth): *"Academics have high interest, but often lack authority. Their strength lies in ideas, evidence, and advocacy."*

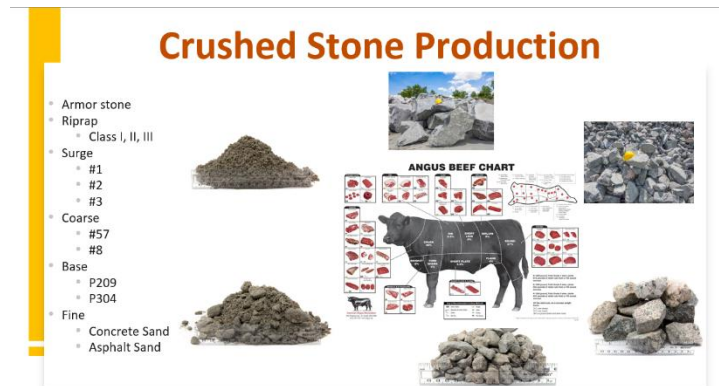
Dr. Adel Zadeh (Northeastern University, Toronto):

- *"We must account for 'negative stakeholders'—groups who see sustainability as a threat to their current business model."*
- *"Economies of scale, industry standards, and regulatory incentives are key to shifting sand substitute adoption."*
- *"Stronger data, funding, and collaboration channels are essential to connect research with real-world impact."*

**02:30-03:00 p.m. *Sand. The Construction Material Perspective.*
Dr. Hadi Rashidi, Director, Engineering and Technical Policy, National
Stone, Sand and Gravel Association**

Dr. Hadi Rashidi, Director of Engineering and Technical Policy at the National Stone, Sand & Gravel Association, began the session by offering an industry-centered view on the sand discussion. Speaking specifically about the U.S. mainland, he clarified that while the industry acknowledges certain challenges, it does not currently view sand scarcity as a crisis. Dr. Rashidi emphasized the importance of precise definitions, noting that the term "sand" can vary across disciplines. In construction, sand is classified according to ASTM standards and is considered a fine aggregate. He highlighted that not all sand—especially marine or dredged material—is suitable for use in concrete, as specific physical and chemical specifications must be met for durability and performance.

Dr. Rashidi explained the distinction between naturally occurring sand and gravel, typically formed by glacial or water processes, and manufactured aggregates like crushed stone, which are produced through mechanical processes. He noted that in many U.S. quarries there is an oversupply of fine crushed materials, including sand, which are underutilized due to lower market demand. From an industry standpoint, the issue is not the absence of sand but the limited market for construction-grade sand that meets engineering requirements. Some quarries have millions of tons of fine materials stockpiled, and efforts are underway to find productive uses for them.



The presentation included discussion of sustainability efforts within the aggregates industry. Dr. Rashidi pointed out that quarry operators are increasingly focused on reducing waste, extending quarry lifespans, and contributing positively to local communities. He also explained differences in aggregate shape—natural sand is rounded, while crushed stone is angular—and how this affects its use in concrete and asphalt. In regions lacking natural sand, engineered mixes using angular materials and admixtures are commonly used. Recycling plays an important role, particularly in asphalt, which retains structural integrity more easily than concrete during reuse.

Dr. Rashidi closed by discussing the long-term planning underway in the aggregates industry, including post-use land redevelopment such as creating stormwater reservoirs or recreational lakes from depleted quarry sites. He emphasized the industry's interest in new technologies and research, such as 3D printing with aggregates and rock weathering processes to absorb carbon.

Highlights

Dr. Hadi Rashidi (NSSGA):

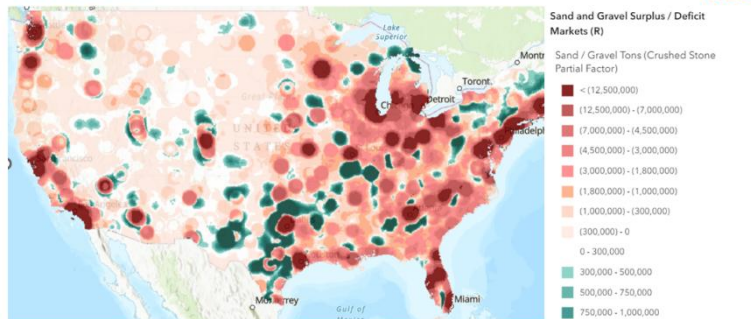
- *"There's no sand crisis—there's an abundance of material that simply doesn't meet spec."*
- *"Not all sand is suitable for construction. Marine sand, for example, often fails to meet concrete-use standards."*
- *"Crushed stone and manufactured sand are already enabling construction in regions lacking natural resources."*

03:00-03:30 p.m.

Muck and Dirt: The Untapped Potential of Discarded Soils in the US
Michael Nesbitt, Research – Project Lead Sustainability, CDE Global Ltd

Following Dr. Rashidi, Michael Nesbitt from CDE Group gave his presentation remotely from his company's headquarters in Northern Ireland. He discussed innovative approaches to processing waste materials—especially excavated soils, quarry byproducts, and dredged sediments—for use in construction. He clarified that CDE's focus is not on promoting products but on elevating the value of discarded materials. These materials, often sent to landfills or left in massive stockpiles, have significant potential to reduce pressure on natural sand sources, minimize landfill use, and decrease emissions tied to long-distance sand transport.

US Sand Deficit



Mr. Nesbitt presented data showing that cities across the U.S. experience sand and gravel deficits, resulting in higher prices and increased transport-related emissions. He noted that over 750 million tonnes of excavation soil are landfilled annually, despite containing valuable materials like sand and gravel. CDE's wet processing technology can convert heavy, contaminated soils into high-quality construction materials using closed-loop water systems, which is especially important in water-scarce areas.

He shared real-world case studies from New York, Maryland, and Canada, where treated soils were

successfully reintroduced into the construction supply chain. He emphasized that early adopters tend to be those willing to invest in new technologies, and that policy lags remain a significant barrier. Most U.S. Department of Transportation (DOT) standards currently recognize only recycled concrete and asphalt, excluding excavated soils. State regulations often require uniform material sourcing, which further restricts recycled sand adoption.

Mr. Nesbitt argued that overcoming these challenges will require updating technical standards, educating regulators and industry professionals, and integrating soil reuse into construction planning. He concluded by linking recycled soil use to broader sustainability goals, including reducing landfill stress, lowering project costs, and improving the circular economy of materials. The session highlighted the importance of aligning policy, innovation, and infrastructure investment to promote alternative sand sources as viable, sustainable solutions.

Highlights

Michael Nesbitt (CDE):

- "90% of U.S. cities with 200K+ people face sand deficits over 12.5M tons annually."
- "Excavated soil and quarry fines are a 'goldmine.' If properly processed, they can replace virgin sand."
- "Soil washing tech can recover 40%+ usable sand and aggregate from waste, helping ease landfill and supply pressure."
- "Policy shifts are key; DOT standards must evolve to include recycled soils and processed materials."

03:30-03:40 p.m.

Sediment Re-connection
Dr. Nick Brown, Coastal Scientist, HDR

Dr. Nick Brown, a coastal scientist at HDR Inc., who was unable to join due to illness, provided written remarks that were read by Dr. Puffer. Dr. Brown's remarks focused on the sediment cycle, the extensive inland and coastal waterway systems in the U.S., and the vast quantities of dredged sediment that are rarely reused despite mandates for beneficial use. He noted that the natural system has sediments eroding from inland and moving seaward, and emphasized the need for reconnecting sediment with the systems it is passing through. He specified that the USACE (U.S. Army Corps of Engineers) maintains 12,000 miles of inland and intracoastal waterways and 13,000 miles of coastal and deep draft navigable channels. Additionally, states maintain more navigational waterways before getting to the local level. He emphasized the opportunity for improved coordination between dredgers, transportation departments, and private stakeholders to return sediment to the system, reduce costs, and support resilience and construction needs. He also noted concerns about who can accept sediment due to possible contamination, quality of materials, and grain size.

Highlights

Dr. Nick Brown (HDR Inc.): *“Many beneficial uses of dredge material mandates exist. However, much of this sediment ends up in large storage facilities that hold millions of cubic yards of sediment and make it challenging for that sediment to ever be put back into the system.”*

Sediment Re-connection

- Sediment continuously fills thousands of miles of navigational waterways domestically
 - USACE, State, and Locally owned
 - Some BUDM mandates exist, but much of the sediment is “disposed” of
- Large quantities of sediment are stored in upland containment facilities
 - What other uses or partnerships can be established?
 - What additional economics can be included to keep sediments moving in the system if not within the natural system?
 - What partners are available to accept sediment?



03:40-04:00 p.m. Closing remarks and next steps by Dr. Sheila M. Puffer, University Distinguished Professor, Northeastern University, Boston

Dr. Puffer led the closing session by expressing her appreciation to all presenters and participants for a full day of rich dialogue around the sustainability of sand. She then opened the floor for final reflections and discussion. To start, she offered a visual interlude featuring a series of images from a recent exhibit she viewed at the National Building Museum in Washington, D.C., showcasing creative uses of concrete, sand substitutes, and sustainable construction materials from around the world. Projects included Brutalist architecture, a school made from mass timber, glass structures, green façades made from plant matter, and various buildings made from locally sourced volcanic stone, cardboard tubes, and shipping containers. This visual tour highlighted the artistic and functional potential of alternative materials and creative design approaches.

Returning to the discussion, Dr. Puffer reiterated the central goal of the roundtable: fostering cross-sector collaboration and knowledge-sharing along the entire sand supply chain. She noted the clear consensus that more granular, transparent, and region-specific data is needed to effectively plan for sustainable sand management and use.

Dr. Zadeh continued the discussion by revisiting the earlier debate about whether the sand issue constitutes a “crisis.” He referenced Dr. Rashidi’s view that there is no sand crisis in the U.S. mainland and asked for clarification about whether that perspective applies globally. Dr. Zadeh also raised the point that, regardless of current supply levels, long-term projections are needed. Reliable data on where sand is being sourced, particularly from riverbeds, remains limited, making it difficult to evaluate environmental impact or forecast availability.



In response, Dr. Rashidi clarified that his remarks applied specifically to the U.S. construction industry, particularly on the mainland. He explained that while natural sand supplies are indeed constrained in some regions, there are ample reserves of manufactured sand that are underutilized. The real challenge is not absolute scarcity but limited adoption of available alternatives. He emphasized that using manufactured sand requires contractors to make adjustments. These include altering mix designs and adding admixtures, which can introduce risk and reduce workability, deterring widespread use. He added that most construction sand in the U.S. does not come from dredged riverbeds but rather from regulated pits and quarries, with stringent permitting requirements in place.

Dr. Zadeh followed up by citing a scientific paper estimating that 60% of construction sand globally is sourced from riverbeds, underscoring the importance of data clarity. He stressed that understanding the current supply is not enough; we need to forecast 50 to 100 years into the future to ensure long-term sustainability as demand increases.

Michael Nesbitt echoed the need for more detailed global data. He explained that the frequently cited figure of 50 billion tonnes of sand used annually encompasses a wide range of materials—natural sand, gravel, crushed rock, marine sand, silica, mineral sands, and manufactured sand—with different sources and applications. Without disaggregating this number, it's difficult to understand where actual shortages lie or how to target solutions effectively. Mr. Nesbitt suggested that breaking down sand use by material type and region would improve understanding, facilitate more focused interventions, and support smarter policymaking and investment.

As the session concluded, Dr. Puffer highlighted the importance of continuing this collaborative effort, particularly in addressing data gaps and scaling sustainable practices. She invited participants to stay involved, share additional insights, and engage with upcoming publications or initiatives. With that, she thanked everyone once more for their valuable contributions and officially closed the roundtable.

Highlights

Michael Nesbitt (CDE):

- *"Millions of cubic yards of dredged sediment sit unused in storage—missed opportunities for nature-based resilience and construction."*
- *"Sediment moves through inland systems. Why not reconnect it back where it's needed? Better partnerships could close this loop."*
- *"Every time sediment is handled, costs increase. Reuse strategies must account for timing and logistics."*
- *"Contamination, grain size, and spec compliance are barriers to reusing dredged material."*

Dr. Hadi Rashidi (National Stone, Sand & Gravel Association):

- *"There is no sand crisis in the U.S.—there is underutilized material available, especially manufactured sand from quarries."*
- *"The problem isn't absence of material—it's that alternatives require concrete mix changes, admixtures, and added care during placement."*
- *"Permitting new quarries can take decades—industry is managing existing reserves carefully under tight regulation."*
- *"Fill material and construction-grade sand are not interchangeable—specs matter for structural uses."*

Dr. Adel Zadeh (Northeastern University, Toronto):

- *"Stakeholders resistant to change have high power but low interest—data and dialogue are key to engagement."*
- *"Globally, 60% of construction sand may come from riverbeds—yet we lack precise U.S. data on extraction sources."*
- *"Today's supply may seem stable, but we need forecasts for 50–100 years to ensure sustainability."*

Northeastern University *Arlington*



Report Creators



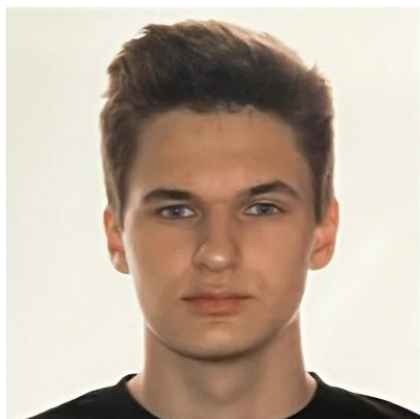
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University Distinguished Professor International Business and Strategy Group D'Amore-McKim School of Business Northeastern University, Boston, USA



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Acknowledgment. The authors are grateful for the editing of these Proceedings by Dr. Kate Ashley, Associate Teaching Professor of Supply Chain and Information Management at Northeastern University, Boston.

Appendix Conference Registrants

First Name	Last Name	Organization/Affiliation	Location
Humay	Abdulghafoor	Save Maldives Campaign (non-profit)	Malé, Maldives
Felix	Akello	County Government of Kisumu	Kisumu, Kenya
Mahym	Alekberova	Northeastern University	Arlington, VA
Faisal	Alfadi	Saudi Green Building Forum	Riyadh, Saudi Arabia
Katherine (Kate)	Ashley	Northeastern University	Boston, MA
Fedor	Bentsa	Northeastern University	Boston, MA
Manthan	Bhatt	Project Management Institute	Washington DC
Carlos	Bohorquez	Medellin City Hall	Medellin, Colombia
Henry	Bokuniewicz	Stony Brook University	Stony Brook NY
Laura	Brothers	USGS	Woods Hole, MA
Jennifer	Bucatar	BOEM	Sterling, VA
J. Alfonso	Carrillo S.	Cámara Mexicana de la Industria de la Construcción	Ciudad de Mexico, Mexico
Stephen	Childe	University of Plymouth	Plymouth, UK
Stephanie	Chuah	UNEP/GRID-Geneva	Geneva, Switzerland
Philip	Coonley	350 Mass for a Better Future, MetroNorth	Winchester, MA
Charles	Di Leva	Sustainability Frameworks, LLP	Washington, DC
Susan	Doubler	Winchester Unitarian Society	Winchester, MA
Michael	Dow	BBH	Boston, MA
Antonio	Garcia	Public University of Navarre	Pamplona, Spain
Eric	Golban	CDE	Houston, TX
Michael	Gryniuk	CORA Structural	Boston, MA
Halil	Gulnar	Northeastern University	Boston, MA
Ginger	Hanson	Intersystems	Boston, MA
Agron	Haxhimali	Institute for Albanian Municipalities	Tirane, Albania
Maria	Ivanova	Northeastern University	Boston, MA
Aleksandra	Jaeschke	University of Texas at Austin	Austin, TX
Kalen	James	Northeastern University	Arlington, VA
Shyam	K	Habitat for Humanity International	Chennai, India
John	Keller	Weather Analytics, Inc.	Canton, MA
Jae Hong	Kim	KAIST/UCSD	San Diego, CA
Boksun	Kim	University of Plymouth	Plymouth, UK
Venkat	Kuppuswamy	Northeastern University	Boston, MA
Ashley	Long	Bureau of Ocean Energy Management	Sterling, VA
Theresa	Loux	Aero Aggregates	Eddystone, PA
Maria	Loyola	Universidad San Francisco de Quito	Guayaquil, Ecuador
Alana	MacMahon	Harvard University	Boston, MA
Kennedy	Matheka	State Department for Public Works	Nairobi, Nigeria
Ruth	May	Retired Professor	Dallas, TX
Collin	McDade	Northeastern University	Boston, TX
Michael	Miner	The Water Institute	New Orleans, LA
Jonathan	Moizer	University of Plymouth	Plymouth, UK
Eddie	Mutebi	Union of Community Development Volunteers	Kampala, Uganda
David	Mutesasira	Brick by Brick Construction Company Ltd	Masaka, Uganda
Antonio	Nanni	University of Miami	Coral Gables, FL
Alexander	Narh	GRIDCO	Ghana
Mike	Nesbitt	CDE Group	Northern Ireland
Steve	Nolan	Florida DOT	Tallahassee, FL
Helenka	Nolan	Northeastern University	Boston, MA
Anna	Ostrander	American Wood Council	Washington, D.C.

Yunxin	Peng	Northeastern University	Arlington, VA
Brian	Peterson	Brian Peterson Photography	Freeport, ME
Vincent	Petit	Schneider Electric	Boston, MA
Sheila	Puffer	Northeastern University	Boston, MA
Munira	Raji	University of Plymouth	Plymouth, UK
Hadi	Rashidi	National Stone Sand and Gravel Association	Alexandria, VA
Brent	Rollins	Spray-Lock Concrete Protection	Chattanooga, TN
Anna	Rossi	Kearns & West	Washington, DC
Youngbok	Ryu	Northeastern University	Boston, MA
Daniel	Satinsky	Independent Researcher	Boston, MA
Oluwasegun	Seriki	Technological University Dublin	Dublin, Ireland
Raji	Sivaraman	PMI	Philadelphia, PA
Ryan	Snow	U.S. Green Building Council	Washington, DC
Minchul	Sohn	University of Plymouth	Plymouth, UK
Randall	States	Retired	New Haven, CT
Natalia	Stieglitz	Northeastern University	Boston, MA
Ayla	Stover	Brown Brothers Harriman	Boston, MA
John	Swartz	The Water Institute	New Orleans, LA
Kazuhiro	Teranishi	Sekisui House, Ltd.	Osaka, Japan
Robert	Triest	Northeastern University	Boston, MA
Vera	Van Lancker	Institute of Natural Sciences	Brussels, Belgium
Arnaud	Vander Velpen	UNEP/GRID-Geneva	Geneva, Switzerland
Kyle	Vint	Kearns & West	Washington DC
Don	Ward	CIB	London, UK
Adel	Zadeh	Northeastern University	Toronto, Canada
Batjargal	Zamba	IRIMHE	Ulaanbaatar, Mongolia