North American Concrete Alliance

The American Concrete Pavement Association, the American Concrete Pipe Association, the American Concrete Pressure Pipe Association, the American Concrete Pumping Association, the Concrete Reinforcing Steel Institute, the Concrete Foundations Association, the National Concrete Masonry Association, the National Precast Concrete Association, the Portland Cement Association, the Precast/Pre-stressed Concrete Institute, the Tilt-Up Concrete Association.

House Select Committee on The Climate Crisis: Request for Information & Responses

Industry Profile: *Concrete forms when portland cement is mixed water and aggregate (sand and rock), then allowed to harden. Cement holds the concrete together and has a role similar to flour in a cake mix. Concrete is the most used building material in the world for a reason: it is a relatively low-cost and low-environmental footprint material that provides critical functionality for buildings and infrastructure. It is necessary to meet societal goals for sustainable development. The U.S. uses about 260 million cubic yards of concrete each year. It is used to build highways, bridges, runways, water & sewage pipes, high-rise buildings, dams, homes, floors, sidewalks, and driveways.*

Sector-Specific Policies

1. *What policies should Congress adopt to decarbonize the following sectors consistent with meeting or exceeding net-zero emissions by mid-century? Where possible, please provide analytical support that demonstrates that the recommended policies achieve the goal.*
   a. *Transportation*

   Roughness or deflection in the pavements (which leads to additional energy dissipation in the vehicle) cause excess fuel consumption by vehicles.[1] Thus, there is an opportunity to reduce greenhouse gas emissions associated with the transportation sector by changing the way we design and maintain our pavement network.

   Specifically, agencies should adopt pavement design and maintenance practices that provide smooth and stiff pavements that also retain these attributes during the life cycle of the pavement. In addition, agencies should prioritize long lasting and durable highway infrastructure elements (pavements, bridges, pipe, etc.) that reduce the need for frequent energy and resource intensive intervention, rehabilitation and replacement. Similarly, agencies should prioritize the use resilient transportation infrastructure, in order to minimize the need for frequent rehabilitation and replacement (see more on this in section 11 below).

   Given the energy efficiencies demonstrated by design and maintenance practices that utilize smooth and stiff pavements, including the use of concrete in highway roadbeds, we would encourage the U.S. Department of Transportation (DOT or the Department) to provide incentives to State DOTs to mandate the use of such design and maintenance practices. A provision of incentives or grants similar to the Department's current "congestion mitigation" policies may serve as an appropriate precedent.

b. *Electric Power. The Select Committee would like policy ideas across the electricity sector but requests specific comment on two areas:*

[1] Xu, X., Akbarian, M., Gregory, J. & Kirchain, R. Role of the use phase and pavement-vehicle interaction in comparative pavement life cycle assessment as a function of context. *J. Clean. Prod.* **230**, 1156–1164 (2019).

i. *If you recommend a Clean Energy Standard, how should it be designed?*
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ii. *How can Congress expedite the permitting and siting of high-voltage interstate transmission lines to carry renewable energy to load centers.*
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c. *Industry*

There is significant potential to use carbon captured from industrial sources in concrete. Congress can accelerate adoption of these technologies by increasing investment in research and development in this sector.

The process of *mineralization* involves exposing minerals to carbon dioxide to create a carbonate mineral. It is a natural process that took place over millions of years to create the limestone used in the production of cement. More recently it has been proposed as a form of carbon capture and utilization (CCU) to produce materials that can be used in concrete production. Carbon captured from industrial sources, potentially including cement plants themselves, can be used in the production of binders, aggregates, and concrete (i.e. carbon dioxide is used in the mixing process). Several companies have been formed over the past decade to commercialize mineralization for building products.[2]

There is significant variation in the degree to which these companies make use of carbon dioxide. Most of the companies are in a start-up phase with demonstration plants or small production volumes, but several of them have products currently being used in construction projects. In some cases, the technologies can only be used to make concrete in production facilities (as opposed to cast-in-place concrete on job sites) because of the requirements to control the mixing of carbon dioxide with minerals. As such, this limits the application of mineralization to cases where concrete can be used (such as buildings).

Investment in research and development to take these concepts and apply them to additional manufacturing processes and products represents an opportunity to address industry emissions.

d. *Buildings*

Environmental life cycle assessments of several building types have shown that embodied environmental impacts of buildings (associated with material production and building construction) are at most 10% of the total life cycle greenhouse gas emissions; energy use represents the vast majority of environmental impacts[3]. Thus, while we should seek to lower embodied impacts in buildings wherever possible, improving the energy efficiency of buildings should remain a priority. Concrete has a high thermal mass, which means it can act like a thermal sponge. Concrete is able to absorb heat during the summer to keep a building's interior cool, thereby reducing the energy demands on the building's HVAC system.

When evaluating the embodied carbon of building materials and systems, it is important to employ a cradle to grave or even cradle to cradle assessment. The assessment should include emissions from the extraction and transportation of raw materials, manufacturing and transportation of building materials, construction, as well as end of life disposition or

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[2] Collins, C. Recasting Cement: The Race to Decarbonize Concrete. *Medium* (2019).
[3] Ochsendorf, J. *et al.* Methods, Impacts, and Opportunities in the Concrete Building Life Cycle. *Res. Rep. R11-01, Concr. Sustain. Hub, Dep. Civ. Environ. Eng. Massachusetts Inst. Technol.* 119 (2011).

recycling of materials. This should include the lost carbon capture value of naturally sequestering materials like trees.

Federal and state governmental entities should take a material neutral position on building materials. No federal research or demonstration programs should advance or promote one specific building material or design over another. Rather, research and demonstration programs should pursue a standards-based, prescriptive approach to construction materials rather than a material-specific approach, allowing materials to compete on their ability to contribute to reducing embodied and operational carbon in buildings.

In order to preserve the natural absorption of carbon that trees provide, the federal government should prohibit the use of timber in construction unless it can be proven to be harvested in an environmentally responsible matter such that it replaces as much naturally occurring carbon capture as it depletes.

2. *What policies should Congress adopt to ensure that the United States is a leader in innovative manufacturing clean technologies; creating new, family-sustaining jobs in these sectors; and supporting workers during the decarbonization transition?*

   Congress should adopt policies aimed at avoiding leakage by ensuring that imports of cement are subject to same environmental impact standards as American cement. This will also help to retain the U.S. workforce.

   Congress should continue to prioritize bipartisan work supporting career and technical education (CTE) with special emphasis on skills needed for jobs specializing in manufacturing clean technologies.

3. *What policies should Congress adopt to ensure that environmental justice is integral to any plan to decarbonize these sectors?*

   Decide on societal goals first, such as affordable housing, clean air, and disaster-resistant construction, and then use a life cycle approach to evaluate the environmental impacts of these solutions. Concrete plays a critical role in achieving societal goals for sustainable development. It is required for nearly all aspects of our built environment including buildings, pavements, bridges, dams, and other forms of infrastructure. Infrastructure is required to achieve all 17 of the United Nation's sustainable development goals. As growth in urban and suburban areas of the US significantly outpaces growth in rural areas (13%, 16%, and 3%, respectively since 2000), demand for buildings and infrastructure will increase to meet the needs of migration and immigration. Calls for increased housing to address affordable housing shortages and more resilient buildings and infrastructure to mitigate the impacts of natural disasters will also lead to increased construction using concrete. While this development is inevitable, it is possible to make it sustainable.

Cross-Cutting Policies

4. *Carbon Pricing:*

a. *What role should carbon pricing play in any national climate action plan to meet or exceed net zero by mid-century, while also minimizing impacts to low- and middle-income families, creating family-sustaining jobs, and advancing environmental justice? Where possible, please provide analytical support to show that the recommended policies achieve these goals.*

   Congress should consider a meaningful market-based approach to addressing carbon and couple this with policies to accelerate innovation (see below). Congress should also consider how to account for the amount of carbon a product removes from the air. Concrete naturally absorbs carbon dioxide over its lifetime as part of a chemical process called carbonation, which is the reverse of the calcination process that leads to process emissions in the production of cement. A study estimated that 4.5 gigatons of carbon dioxide has been sequestered in carbonating cement materials worldwide from 1930 to 2013, offsetting 43% of process CO2 emissions[4]. Hence, there is significant potential to use cement and concrete as a carbon sink in the future.

5. *Innovation:*

a. *Where should Congress focus an innovation agenda for climate solutions? Please identify specific areas for federal investment and, where possible, recommend the scale of investment needed to achieve results in research, development and deployment.*

As noted above, there is significant opportunity for Congress to support innovation in technologies that use captured carbon in concrete. Legislation such as the Clean Industrial Technologies Act (CIT) and Utilizing Significant Emissions with Innovative Technologies Act (USE IT Act) Act are important steps to support the development of the technology needed to address climate change.

While this investment is critical, it is also important to consider that engineers typically rely on prescriptive-based specifications that detail the types and limits of materials that can be used in concrete mixtures. Following such specifications helps to mitigate risk for them and the concrete producers because they can point to the specifications in case there are unforeseen problems. Engineers also prefer to rely on the use of constituent materials that have been used in the past because of their perceived familiarity with performance. The downside of this practice is that it often limits the use of low-carbon materials, either explicitly or implicitly[5]. As such, prescriptive specifications inhibit opportunities for innovative concrete mixtures that make use of low-carbon materials, including blended cements and supplementary cementitious materials that are available for use today. In addition, there is a significant burden of proof to demonstrate that new low-carbon materials will meet long-term structural and durability requirements.

In contrast to prescriptive-based specifications, performance-based specifications set performance targets for concrete (strength, stiffness, constructability, durability) with minimal limitations on the constituent materials that may be used[6]. This enables significant opportunities to spur innovation in concrete mixtures by enabling use of low-carbon materials[7]. Although performance-based specifications have been proposed for over two decades, there has been limited adoption within the architecture, engineering, and construction community, most likely due to a preference for using materials and practices that have been used in the past. A paradigm shift to performance-based specifications will require encouragement and incentives.

b. *How can Congress incentivize more public-private partnerships and encourage more private investment in clean energy innovation?*
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Agriculture

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[4] Xi, F. *et al.* Substantial global carbon uptake by cement carbonation. *Nat. Geosci.* **9**, 880–883

[5] Obla, K. H. & Lobo, C. L. Prescriptive Specifications: A Reality Check. *Concrete International* 29–31 (2015).

[6] National Ready Mixed Concrete Association. *Guide Performance-Based Specification for Concrete Materials*. (2012).

[7] Lemay, L., Lobo, C. & Obla, K. Sustainable concrete: The role of performance-based specifications. in *Structures Congress 2013: Bridging Your Passion with Your Profession - Proceedings of the 2013 Structures Congress* 2693–2704 (2013).

6. *What policies should Congress adopt to reduce carbon pollution and other greenhouse gas emissions and maximize carbon storage in agriculture?*
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7. *What policies should Congress adopt to help farmers, ranchers, and natural resource managers adapt to the impacts of climate change?*
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Oceans, Forestry and Public Lands

8. *How should Congress update the laws governing management of federal lands, forests, and oceans to accelerate climate adaptation, reduce greenhouse gas emissions and maximize carbon storage?*
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Non-CO2 Greenhouse Gases

9. *What policies should Congress adopt to reduce emissions of non-CO2 greenhouse gases, including methane, nitrous oxide, and fluorinated gases?*
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Carbon Removal

10. *How can Congress accelerate development and deployment of carbon removal technology to help achieve negative emissions?*

    There are several entities that are already pursuing innovative processes of CCU that can enable concrete to achieve negative emissions.

    The federal government should strongly consider policies that encourage and support these sorts of innovation and research, such as competitive grant programs or competitions and expanding existing tax incentives such as 45Q would be beneficial to the industry seeking commercial deployment of CCU.

Resilience and Adaptation

11. *What policies should Congress adopt to help communities become more resilient in response to climate change? The Select Committee welcomes all ideas on resilience and adaptation but requests comments on three specific questions:*

    Research has shown that it is important to take a life cycle perspective when evaluating the costs of owning and operating buildings in hazard-prone areas. The cost of repairing conventional buildings in hazard-prone areas can exceed the initial building cost[8]. Payback periods for hazard mitigation in residential buildings can be five years or less in hazard-prone areas.

    While it is clear that design decisions should be made using this life cycle approach, developers are not incentivized to invest in hazard-resistant construction, and owners are not aware of how to ask for hazard-resistant, resilient construction. Congress can work to incentivize the adoption and expansion of resilience rating systems in hazard-prone areas such as those offered by IBHS and the US Resiliency Council. This will help to educate owners to ask for resilient construction, thereby creating demand in the marketplace.

[8] Noshadravan, A.; Miller, T.R.; and Gregory, J. "A Lifecycle Cost Analysis of Residential Buildings Including Natural Hazard Risk" *Journal of Construction and Engineering Management* (2017).

a. *What adjustments to federal disaster policies should Congress consider to reduce the risks and costs of extreme weather and other effects of climate change that can no longer be avoided?*

Policies that incentivize states and communities to adopt mitigation and sustainability plans. The 2018 Bipartisan Budget Act, Section 20606, allowed the federal cost share for disaster assistance to be increased from 75% to 85% if recipients have invested in various mitigation criteria, including adopting and enforcing strong building codes.[9] Similarly, FEMA has considered a public assistance deductible concept, whereby states and communities can "buy down" their deductible exposure through adoption of stronger building codes, better floodplain management policies and otherwise reducing vulnerability to natural disasters.[10] Congress should build on the passage of the Disaster Recovery Reform Act, which places greater emphasis on pre-disaster mitigation helping communities better withstand future disasters. Placing greater emphasis on pre-disaster mitigation saves taxpayer dollars.

b. *How can Congress better identify and reduce climate risks for front-line communities, including ensuring that low and moderate-income populations and communities that suffer from racial discrimination can effectively grapple with climate change?*

Invest in most cost efficient and resilient structures so these communities are impacted less by natural disasters.

c. *What standards and codes should Congress consider for the built environment to ensure federally-supported buildings and infrastructure are built to withstand the current and projected effects of climate change?*

The federal government should consider possible incentives for adoption by local units of government of resilient rating systems as well as encourage use of such systems for building projects receiving federal funds. Congress can work to incentivize the adoption and expansion of resilience rating systems such as those offered by IBHS and the US Resiliency Council. This will help to educate owners to ask for resilient construction, thereby creating demand in the marketplace.

Increase the adoption of blended or alternative binders will require overcoming the risk aversion of engineers specifying concrete. Engineers typically rely on prescriptive-based specifications that detail the types and limits of materials that can be used in concrete mixtures. In addition, there is a significant burden of proof to demonstrate that new low-carbon materials will meet long-term structural and durability requirements. Supporting a shift to performance-based specifications for concrete would spur innovation in the design of low-carbon concrete mixtures. Sponsoring research on the long-term structural and durability performance of concretes using blended or alternative cements will help to mitigate perceived risk by engineers.

The federal government could encourage procurement standards by asking suppliers of construction materials for government projects to report on the environmental impacts and performance of their products across the full product lifecycle, along with steps being taken by the supplier to improve the product's environmental impact profile over time. If the projects involve buildings that are seeking LEED certification, this can be used to achieve

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[9] https://www.congress.gov/bill/115th-congress/house-bill/1892?q=%7B%22search%22%3A%5B%22bipartisan+budget+act+of+2018%22%5D%7D

[10] https://www.nrdc.org/experts/joel-scata/more-resilient-future-femas-public-assistance-deductible

points in the materials and resources portion of the rating system. Many suppliers do not think to lower the environmental impacts of their products because they do not measure the impacts and are not asked to report them. Changing these practices will likely cause them to lower their environmental impacts as a means of differentiating themselves in the marketplace.

Offices and residential buildings should be graded on energy-efficiency and resiliency. The rating system used for New York City buildings provides an example of these types of metrics.

Climate Information Support

12. *Our understanding and response to the climate crisis has relied on U.S. climate observations, monitoring and research, including regular assessment reports such as the National Climate Assessment. What policies should Congress adopt to maintain and expand these efforts in order to support solutions to the climate crisis and provide decisionmakers – and the American people – with the information they need? Where possible, recommend the scale of investment needed to achieve results.*

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International

13. *The climate crisis requires a global response. U.S. leadership is critical for successful global solutions. What policies should Congress adopt to support international action on the climate crisis?*

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