Cement Association of Canada

GAPS AND RECOMMENDATIONS TO DECARBONIZING THE CONCRETE SECTOR IN ALBERTA

A recent set of case studies showcasing innovation in Alberta's concrete sector shows the industry has a strong roster of commercially available technologies, as well a healthy pipeline of new technologies for future deployment. A number of these projects also demonstrate collaboration across industries, provinces, and countries and importantly, show progress towards achieving a more circular economy. Based on interviews with cement producers and technology vendors in the concrete sector, below, we discuss some of gaps to reaching net zero for the concrete sector, along with recommendations that emerged from these discussions. Many of these are applicable to other jurisdictions and sectors, and align with the recently published Concrete Zero roadmap.

GAPS

While technology is advancing quickly, policy and regulatory gaps remain. Cement producers and technology vendors face challenges implementing alternative, low carbon cement and concrete mixes due to lack of incentives, the need to update codes and standards in tune with net zero targets, lack of cultural acceptance around novel products, and lack of border adjustment mechanisms to ensure economic competitiveness for internationally traded products, like cement.

Beyond policy and regulatory gaps, some technical and value chain gaps also remain. There is a pressing need to reduce the cost of carbon capture, the biggest near-term lever for emissions reductions, either through improved capture technologies or process innovations that reduce the amount of CO_2 to be captured in the first place. In addition, far more could be done to take advantage of concrete's carbon uptake capabilities and enhance the circular economy for concrete – in certain cases, there is untapped potential for carbon utilization, and in others, significant opportunities for enhanced end of life concrete management. Finally, the need for low carbon electricity, heat, and transportation will increasingly be required to decarbonize the concrete sector.

Below we describe these gaps to achieving Concrete Zero in more detail.

GAP #1: LACK OF GREEN PROCUREMENT STANDARDS IN THE PUBLIC SECTOR

One of the best ways to incentivize adoption of lower emissions cement and concrete in the public sector is to establish green procurement standards that require government projects to demonstrate an emissions reduction. This would incentivize both the industry and those implementing project approvals to seek low carbon pathways in construction projects, while still meeting applicable codes and standards.

Some examples of where this is being done today include New York and the pacific northwestern US. The Canadian Federal Government has also set targets for lowering carbon intensity of federally funded projects, although these changes are still in the early stages of implementation.

GAP #2: TIMELINES TO UPDATE CODES AND STANDARDS ARE INCOMPATIBLE WITH NET ZERO TARGETS

The main body for implementing engineering standards in concrete in Canada is the Canadian Standards Association (CSA), which tends to align with its US counterparts, the American Society for Testing and Materials (ASTM) and the American Association of state Highway and Transportation Officials (AASHTO). These organizations are critical for maintaining safety standards across the industry, but are not structured in a way to keep up with net zero timelines. Updates only occur every few years; for example, the next CSA rewrite is not until 2030.

Once standards have been implemented at a national level, they must trickle down to municipalities before implementation is possible. For example, low carbon cements have been approved by the CSA for over a decade but have yet to be implemented in all provincial transportation specifications.

Of note, smaller producers of cement and concrete products often have only one silo for raw materials storage, and thus do not have the commercial flexibility to make incremental shifts towards lower-carbon operations. These small producers are unlikely to make any transformation until new products are acceptable to the entire market they try and serve. This impacts hundreds of ready-mix producers in Alberta alone, who are commercially unable or unwilling to make the transition to lower carbon cements and concrete, until those materials are fully accepted by all their potential clients.

GAP #3: LACK OF CULTURAL ACCEPTANCE OF NEW PRODUCTS IN PUBLIC SECTOR PROJECTS

Even when regulatory codes and standards allow, cement producers and technology vendors face cultural challenges due to low appetite for change in government and municipal organizations. As a structural material, safety must be paramount, but pathways to adoption of new substitutions must be accelerated. For example, PLC, which uses 5% less clinker (replaced with limestone) has been approved in Canadian Building and Bridge Codes for over a decade, but still faces challenges gaining acceptance in some jurisdictions. Deployment is a challenge even for non-structural materials where the risk of new technologies is much lower, such as sidewalks. A fundamental cultural shift is needed to enable deployment of alternatives in a safe manner that helps the industry achieve its net zero goals.

GAP #4: MANAGING THE COST OF NET ZERO ACROSS BORDERS

Key levers to achieving net zero, like carbon capture, come with a significant added cost. Approximately 50% of Canadian cement is traded, but in North America no border adjustment mechanism exists to prioritize low-carbon products, such as is being done in Europe. Cement and concrete are traditionally low value, bulk products. For these and other reasons, it is challenging for cement and concrete producers to pass additional costs onto the consumer and/or offer products above international commodity price. This creates barriers to implementing high-cost technologies like carbon capture.

GAP #5: CARBON CAPTURE IS EXPENSIVE, ENERGY-INTENSIVE, AND HAS A HIGH FOOTPRINT

Liquid amine is the only carbon capture technology that has been demonstrated at full commercial scale, and for this reason, most near-term commercial-scale CCUS projects are pursuing this pathway. Amine technology has some drawbacks in terms of cost, energy intensity, and performance. New capture technologies, such as Svante's solid sorbent technology, are in the pipeline, but must reach commercial readiness and adoption as soon as possible. Additionally, process innovations are needed to make CO_2 easier to capture and/or reduce the amount of CO_2 produced in the first place. Having more alternative pathways for carbon capture on the market will de-risk supply chain bottlenecks as an increasing number of facilities implement carbon capture.

GAP #6: CARBON UTILIZATION TECHNOLOGIES ARE NOT FULLY SCALABLE AND FACE BARRIERS TO ENTRY

Carbon utilization offers an alternative pathway to geological sequestration that generates new economic value from CO_2, but is more complex, because it typically involves development of an entirely new value chain and suite of novel products. Utilization sequestration will be most applicable in cases where pore space is not available and a significant source of CO_2 end-use exists in proximity to a CO_2 source.

As part of developing new value chains, new products will be developed that may face barriers to entry. In the carbon nanotube example, Carbon Corp is introducing an entirely novel product to the market that is currently undergoing new product certification with Environment and Climate Change Canada's (ECCC) new substance program. This process takes multiple years and iterations to get the product to market, even to implement at the pilot scale.

GAP #7: CONCRETE IS MATERIAL-INTENSIVE AND NOT ALL CONCRETE IS RECYCLED

Concrete is a natural carbon sink, and its carbon uptake potential can be significantly increased by improving the way concrete is handle at the end of its life. Currently, there is no standardized way of recycling concrete, and much of this carbon uptake potential is wasted. Concrete also required raw materials that must be mined and create a significant environmental footprint.

GAP #8: NEED FOR CLEANER TRANSPORTATION, HEAT, AND ELECTRICITY

15% of total concrete emissions come from transportation and concrete mixing facilities. To fully decarbonize this portion of the concrete sector requires access to clean sources of transportation fuel, heat, and electricity. Additionally, some novel technology pathways, including carbon utilization and alternative electrified cement production methods such as Z2S and Carbon Corp, won't be net-zero compatible without access to low carbon power.

RECOMMENDATIONS

While the above gaps are significant, Concrete Zero and other documents have identified pathways to meaningful, staged solutions. Organizations like Emissions Reduction Alberta and its industry partners have also made a meaningful impact towards scaling new technologies, and these efforts should continue. We drew the following recommendations from interviews with cement and concrete producers and technology developers to reflect the Alberta experience. Many of them also align with Concrete Zero.

RECOMMENDATION #1: IMPLEMENT GREEN PROCUREMENT STANDARDS IN THE PUBLIC SECTOR

- Implement clear, consistent definitions of net zero across regional, provincial, and national borders wherever possible.
- Implement green procurement standards at the municipal, provincial, and national level to incentivize procurement of alternative low carbon cement & concrete products. Create incentives at the project level for cities and public jurisdictions to implement change.

RECOMMENDATION #2: ALIGN TIMING OF CODES & STANDARDS UPDATES WITH NET ZERO TARGETS

- Increase alignment between timelines to update national concrete codes and standards with net zero timelines to enable implementation of new emissions reduction technologies.
- Increase education and awareness of new technologies to accelerate adoption within the regulatory bodies responsible for codes & standards updates, by presenting at conferences and conducting targeted knowledge sharing efforts.
- Increase coordination and alignment between US, Canadian, and European regulatory standards.
- Where possible, replace prescriptive limits with performance-based requirements that can be demonstrated in multiple ways. Reduce data requirements and barriers for implementing new technology in non-structural materials, such as sidewalks.

RECOMMENDATION #3: ENHANCE KNOWLEDGE SHARING AND COLLABORATION TO INCREASE CULTURAL ACCEPTANCE OF NOVEL CEMENT AND CONCRETE PRODUCTS

- Implement grant funding mechanisms like ERA to show "virtue signals" for novel cement and concrete approaches, that can improve cultural acceptance in municipal government bodies.
- Leverage mechanisms like the TIER fund and ERA to support pilots in commercial environments – such as repaving a small section of road and testing on non-structural materials like sidewalks – to enhance cultural acceptance without introducing risk.
- When deploying novel cement and concrete chemistries, share & accept data from other jurisdictions and sources, such as Europe, where many new cement and concrete technologies are already in commercial use. Accept data from accelerated tests in a lab environment for pilot-scale projects.

RECOMMENDATION #4: CREATE A BORDER ADJUSTMENT MECHANISM FOR INTERNATIONALLY-TRADED PRODUCTS

- Implement border adjustment mechanisms for traded products to valorize and incentivize lower emissions products.
- Increase certainty around carbon pricing and carbon credit values for different end states of CO_2, including utilization.

RECOMMENDATION #5: INVEST IN HIGH PERFORMING CAPTURE TECHNOLOGIES AND PROCESS INNOVATIONS TO REDUCE THE COST OF CAPTURE

- Accelerate deployment of better, lower cost capture technologies that offer performance, energy use, cost, and land footprint advantages over traditional liquid amine technologies.
- In parallel, continue to scale up process innovations such as Heidelberg's LEILAC technology that can reduce the CO_2 produced and make it easier to capture.
- Offer staged funding for scale-up of new technologies through organizations like ERA.

RECOMMENDATION #6: CONTINUE TO SCALE AND REMOVE MARKET ENTRY BARRIERS FOR CARBON UTILIZATION

- Incentivize pilots of utilization technologies in partnership with existing supply chains. Enhance collaboration between existing and new value chains and different sectors.
- Allow pilot testing of new products, like CNTs, in parallel with the new substance certification process.
- Resolve market gaps for utilization such as transport infrastructure for industrial grade CO_2.

RECOMMENDATION #7: EXPAND AND IMPROVE END-OF-LIFE MANAGEMENT FOR DEMOLISHED CONCRETE AND ENHANCE CIRCULAR ECONOMY OPPORTUNITIES

- Incentivize and improve industry alignment to maximize the potential of end of life concrete management and recycling, both to increase carbon uptake and reduce demand for raw materials. This is an area where technology investment has been more limited, as it's not necessarily "high-tech", but rather, involves improved value coordination, standardization, and incentives.

RECOMMENDATION #8: CONTINUE TO INCENTIVIZE & INVEST IN CLEAN TRANSPORTATION, HEAT, & ELECTRICITY

- Decarbonize concrete sector transport fleets using hydrogen or electric vehicles as soon as possible.
- Continue to incentivize grid decarbonization and clean heat, to pave the way for electrification pathways and reduce emissions from concrete mixing facilities.