

Embodied Carbon Workshop: Market Transformation for Cement and Concrete

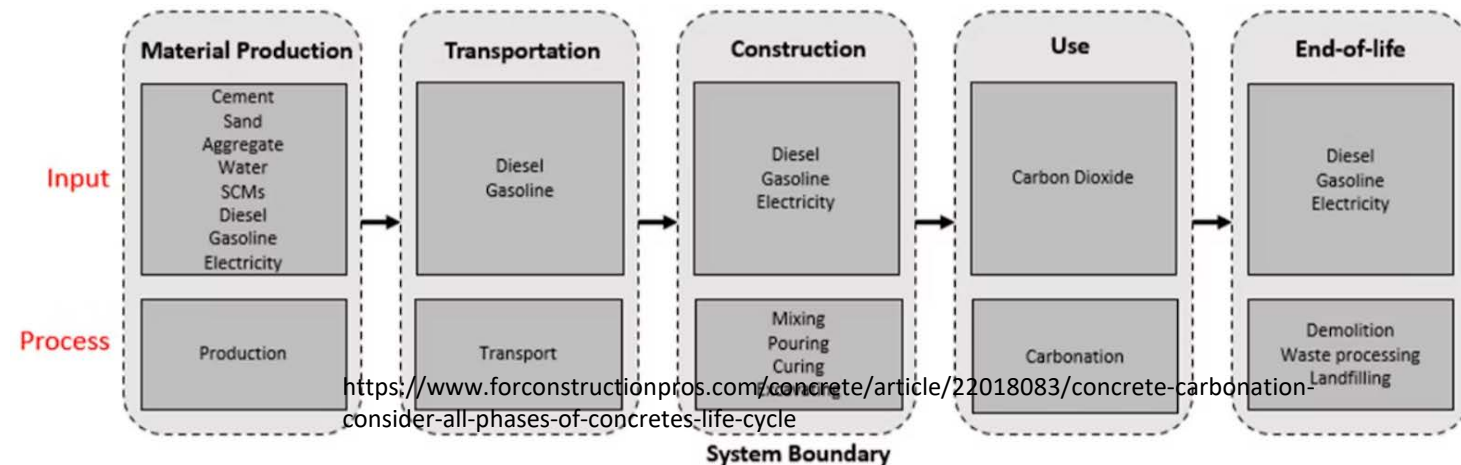
Aron Newman
Group Leader, Infrastructure Materials Group, Engineering Laboratory

7/11/2023, Detroit, MI

Life Cycle of Concrete

Use:

- IPCC recognized that carbonation is a significant component of the carbon cycle for concrete.
- Challenges to include in LCA due to difficulty in quantifying – factors include: different covers, porosity of concrete, moisture content, cement type and additives, the actual lifetime, etc



Intergovernmental Panel on Climate Change (IPCC), May 2021 Board Meeting, https://www.ipcc-nggip.iges.or.jp/EFDB/otherdata/Note_on_Cement_Carbonation.pdf

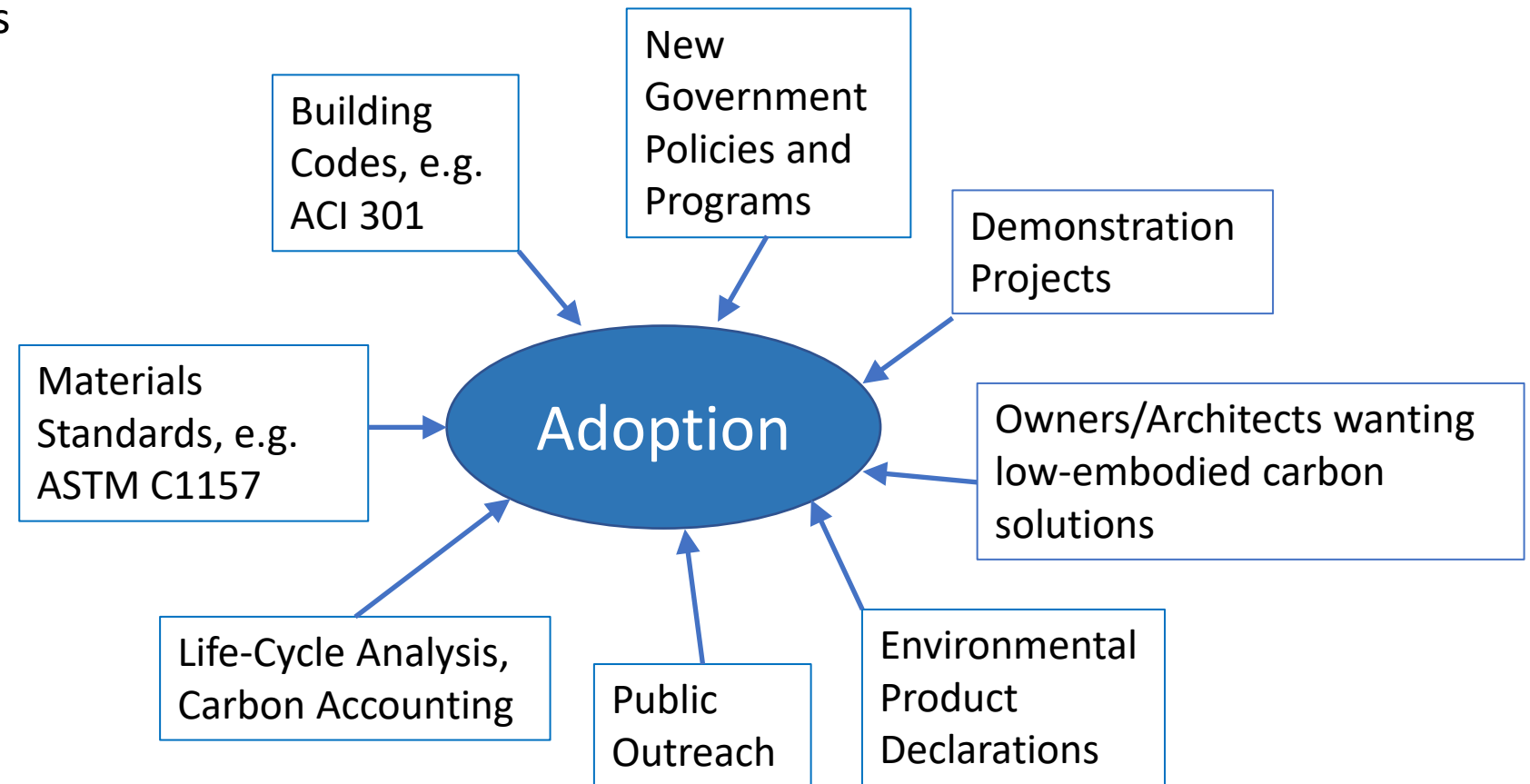
- Optimizing clinker substitutes (e.g. portland limestone cement, limestone calcined clay cement, calcium sulfoaluminate, carbonatable calcium silicate cement)
- Switching from coal to lower-carbon fossil fuels for clinker production
- Increasing use of recycled materials in cement (down cycling or circular)
- Promoting market uptake of low-carbon cements and concretes
- Maximizing efficiency in concrete design and construction (less cement in concrete & less concrete in structures)

- Deploy clinker substitutes and alternative clinker technologies while optimizing for durability (e.g. alkali-activated binders, geopolymers, and magnesium-based cements, alternative rebar)
- Harnessing new energy sources, including clean hydrogen, electricity, and alternative fuels (e.g. biobutanol, dimethyl ether, methanol, renewable diesel, NH₃)
- Maximizing concrete's ability to sequester carbon via a variety of carbon mineralization approaches
- Expand the application space of precast concrete and to leverage new binder chemistries (e.g. design for disassembly)
- Decarbonization of the transport of precursor and final products
- Carbon capture utilization and storage (CCUS)

Multipronged Approach Towards Adoption

Standards Needs:

- Be actively involved in standards committee work, including interlaboratory studies.
- Must include representation from producers, owners, and academia. Long term investment.
- Performance-Based Standards instead of Prescriptive-Based Standards



Low Carbon Cements and Concrete Consortium **NIST**

Accelerate adoption of innovative low-carbon building materials Cements & Concretes

Consortium

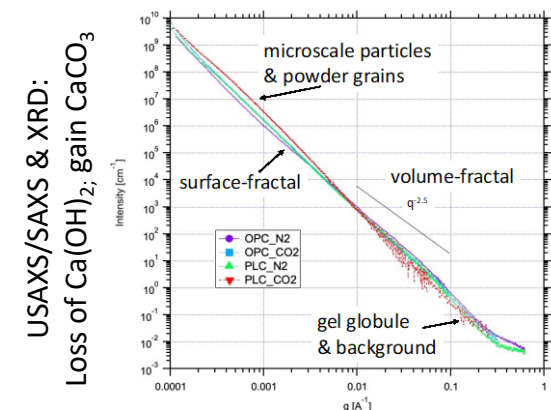
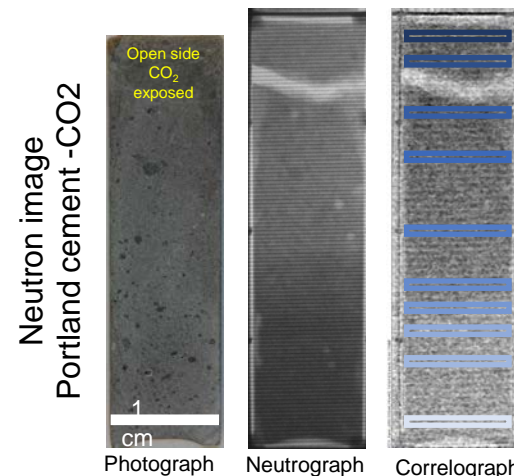
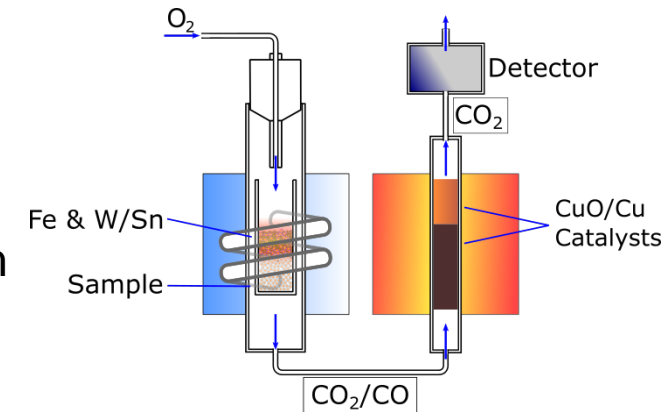
- 35 member organizations – industry, academics, other agencies
- Coordinate with voluntary consensus standards organizations, e.g. ASTM, ACI
- Coordinate with other agencies EOP/CEQ, DOE, EPA, DOT
- Facilitate standards development, interlaboratory comparisons and research grade test materials
- Performance specifications

Kinetics of CO₂ uptake

- Neutron imaging, USAX, SAX, XRD

Fostering a Circular Economy and Carbon Sequestration for Construction Materials:
A Focus on Concrete - workshop 2022

Combustion Analysis





Extra

Roadmaps

<https://gccassociation.org/concretefuture/>

https://thisisukconcrete.co.uk/TIC/media/root/Perspectives/MPA-UKC-Roadmap-to-Beyond-Net-Zero_October-2020.pdf

<https://www.cement.org/sustainability/roadmap-to-carbon-neutrality>

<https://ised-isde.canada.ca/site/clean-growth-hub/en/roadmap-net-zero-carbon-concrete-2050>

<https://www.iea.org/reports/technology-roadmap-low-carbon-transition-in-the-cement-industry>

<https://www.third-derivative.org/blog/low-carbon-cement-2>

<https://www.aceee.org/sites/default/files/pdfs/u2202.pdf>

<https://rmi.org/insight/roadmap-to-reaching-zero-embodied-carbon-in-federal-building-projects/>

<https://par.nsf.gov/servlets/purl/10301626>

