To: California Air Resources Board
From: Dan Lashof, U.S. Director, World Resources Institute
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The World Resources Institute appreciates the opportunity to submit this informal comment in response to the California Air Resources Board's public meeting on "The Role of the Industrial Sector in Meeting California's Carbon Neutrality Goals." We would like to take this opportunity to urge CARB to consider developing a Low Carbon Cement Standard.

CARB's presentation at the public meeting notes that the industrial sector is responsible for 23 percent of California's greenhouse gas emissions (slide 8) and that cement is responsible for 12 percent of the industrial sector's emissions (slide 10), or 7.6 $MMTCO_2e$ (calculated from the data on slide 10: 63.3 x 0.12 = 7.6). This makes cement the third largest source of industrial emissions following petroleum refining and oil and gas production.

In addition to being covered by CARB's cap-and-trade program, greenhouse gas emissions from the petroleum refining and oil and gas production sectors are directly or indirectly regulated by a number of other programs, including the Low Carbon Fuel Standard (LCFS), Zero-Emission Vehicles program, and the Oil and Gas methane regulations. CARB appropriately recognizes that these programs are needed as complements to the cap-and-trade program in order to stimulate innovation beyond the level induced by the very modest price signal currently created by the cap-and-trade program, or to address other specific characteristics of the covered sectors. No similar program currently covers the cement sector.

The LCFS, in particular, is perhaps the strongest policy driver of decarbonization innovation anywhere in the world and is an excellent model for a Low Carbon Cement Standard. Key features of the LCFS that could be incorporated into a Low Carbon Cement Standard include:

a) Tradeable performance standard
b) Lifecycle emissions based
c) Technology agnostic
d) Recognition of Direct Air Capture of carbon dioxide in any location

I elaborate on each of these characteristics and how it could apply to a Low Carbon Cement Standard briefly below:

Tradeable performance standard. The LCFS is expressed as a percentage reduction in greenhouse gas emissions per gallon of gasoline equivalent supplied to the California market. Credits or deficits are assigned to each transportation fuel supplier in the California market based on the emissions characteristics of their fuel relative to this emission reduction benchmark, which becomes more stringent over time. Credits are tradeable and each supplier is responsible for acquiring enough credits to compensate for any emission reduction deficits generated by their fuel supply. This structure can send a powerful signal to induce innovation among fuel suppliers while having a relatively modest impact on consumers. For example, the most recent data from the LCFS program shows that LCFS credits traded at an average of $190 per ton in June 2019, which is the marginal value of emission reductions to fuel providers. The

average cost of emission reductions seen by consumers, however, is about $12 per ton or 14 cents per gallon because the average emission reduction requirement for 2019 is 6.25 percent. The LCFS has a price ceiling of $200 per ton for credits to avoid an unexpected consumer price shock.

An equivalent approach could be used in a Low Carbon Cement Standard by expressing the requirement as a percentage reduction in greenhouse gas emissions per ton of cement supplied to the California market. This requirement could become gradually more stringent over time similarly to the LCFS. Credits could also be tradeable within the cement sector and subject to a price ceiling. In principle, Low Carbon Cement Standard credits could be tradeable with LCFS credits because they are both denominated in tons. CARB should carefully consider whether allowing such trading would be desirable, and under what circumstances (e.g., only above a threshold price close to the price ceiling), given that a key goal of the program would be to promote innovation within the cement sector).

Lifecycle emissions based. The LCFS uses an open-source lifecycle assessment model to assign a carbon intensity value to each batch of fuel supplied to the California market. This helps ensure that emission reductions in one part of the supply chain are not offset by emission increases elsewhere, including through indirect effects. CARB could adopt an equivalent approach to determining the carbon intensity (tons of CO2-equivalent per ton of cement) for each batch of cement supplied to the California market.

Technology agnostic. The LCFS provides credit to any transportation fuel pathway that contributes to reducing the greenhouse gas emissions intensity of the transportation fuel supply, recognizing that some fuels (such as electricity) are inherently more efficient at converting energy into miles driven. A Low Carbon Cement Standard could similarly recognize any technology that reduces emissions from supply cement for California infrastructure and other construction needs. In addition to producing cement more efficiently, using lower carbon fuels, and capture carbon emissions from the process, CARB could consider crediting reformulations that reduce the mass of cement required and substitution of lower carbon materials for specific purposes.

Recognition of Direct Air Capture of carbon dioxide in any location. In the most recent LCFS regulations CARB recognized the strategic importance of commercializing direct air capture technology for carbon dioxide (DAC) by allowing DAC facilities in any location to potentially generate LCFS credits, provided that they adhere to CARB guidelines for ensuring that the captured CO2 is safely and permanently sequestered. CARB could incorporate equivalent provisions in a Low Carbon Cement Standard.