ZERO CARBON BUILDING TECHNICAL FEASIBILITY STUDY

I. OBJECTIVE

The objective of this project is to provide technical support for the pursuit of low-carbon building in California as part of the state's long-term climate program. Zero carbon buildings were identified in the First Update to the Scoping Plan as the next generation of buildings that can significantly contribute to achieving California's post-2020 climate goals. This research will explore the technical feasibility of net zero or near-zero carbon residential and commercial new buildings which will support the development of state goals and a policy and programmatic path towards transitioning to zero carbon building.

II. BACKGROUND

In 2006, California passed Assembly Bill 32—landmark legislation requiring the state to reduce our greenhouse gas emissions to 1990 levels by 2020. While we are on track to achieving this target, much more must be done long-term to ratchet down emissions to a level needed for climate stabilization. The First Update to the Scoping Plan identifies future actions and policies that can help California achieve our post-2020 climate goals, including advancing zero net energy (ZNE) buildings to be zero net carbon buildings (ZCB). The Scoping Plan Update specifically calls for ARB and stakeholder agencies to "establish target dates and pathways toward transitioning to zero net carbon buildings that expand upon and complement ZNE goals" by 2017. Currently, the state's ZNE goals established by both the California Public Utility Commission and the California Energy Commission are to have all new low-rise residential buildings be ZNE by 2020 and all new commercial buildings to be ZNE by 2030. In addition, the Governor has made a commitment that all new state buildings beginning design in 2025 shall be ZNE.

To build upon these targets, ARB and state agency stakeholders must chart a path for expanding these goals to focus on greenhouse gas emissions, and as a result, consider water, waste, and transportation impacts of a building. A zero or near-zero carbon building would generate nearly no net greenhouse gas emissions over the course of a year from the energy, water, waste and transportation impacts of the building. Essentially, a near-zero carbon building will be a zero net energy building, but will also employ additional strategies to substantially reduce greenhouse gas emissions associated with water, waste, and transportation impacts as well. Zero carbon buildings can utilize high performance design solutions, generate renewable energy on-site, and employ other techniques to eliminate or offset the GHG emissions associated with these impacts. One option for a path forward would be to adopt a carbon budget approach, whereby greenhouse gas emission performance targets are set taking into account building climate zone and other factors and are ratcheted down over time until they reach zero. Ensuring the carbon budget is met for each sector will likely require both demand-side and supply-side strategies. The initial scope of a zero carbon building program can focus on emissions from building operations, and to a limited extent, building construction. As we become more advanced in our understanding of embodied

energy, the definition of zero carbon can be progressed towards one that takes a lifecycle perspective.

III. Scope of Work

This study will provide the technical foundation needed to chart a path for a zero carbon building program and to set aggressive, yet achievable statewide zero carbon building goals. The research will focus on strategies to reduce the carbon associated with building-level water, waste, and transportation impacts, but will consider energy to the extent renewables could be used to offset GHG emissions associated with water, waste, or transportation impacts. Research is needed to evaluate the technical feasibility of achieving zero or near-zero carbon buildings for new residential and commercial buildings *before* the state adopts a ZCB definition and associated metrics. This research will include:

- Assessment of high-performance design solutions, technologies, and building operation strategies most likely to enable zero/near-zero GHG emissions across the water, waste, and transportation impact sectors of a building. This will include 1) the identification of leading-edge GHG reduction strategies and 2) building performance simulations for a set of standard building types utilizing the strategies to determine feasibility of achieving zero/near-zero emissions with known technologies and solutions for both residential and commercial buildings in different regions of the state.
- Evaluation of the extent to which zero-carbon buildings would perform better than those built to meet the latest California Green Building Standards, including both the mandatory and voluntary standards. This comparison can provide a benchmark for progress needed above and beyond current building standards to achieve zero carbon building.
- Discussion of opportunities and challenges in achieving near-zero carbon status on *existing* residential and commercial buildings. As part of this, the identification and prioritization of building types for which retrofitting to zero carbon status is most feasible can inform program strategy.
- Evaluation of feasibility of achieving a range of long-term zero carbon targets for new building. Currently the state has ZNE targets measured in percent of new residential and commercial buildings by a future year that are ZNE buildings.[1] An evaluation to identify feasible ranges of similar targets for zero carbon building can inform future target setting.
- Estimation of construction cost premium and payback period associated with near-zero carbon building, to the extent possible.
- Estimation of potential GHG benefits of zero carbon versus zero net energy buildings, and cost-effectiveness in $/MT CO_2 reduced.
- Assessment of appropriate policy framework needed to support zero carbon building and possible program design and structure, including mandatory versus voluntary pathways. Given the cross-sector nature of zero carbon building, existing and new mechanisms may be needed to successfully transition California's building stock.

[1] California Public Utilities Commission. 2011. California Long Term Energy Efficiency Strategic Plan. http://www.cpuc.ca.gov/NR/rdonlyres/A54B59C2-D571-440D-9477-3363726F573A/0/CAEnergyEfficiencyStrategicPlan_Jan2011.pdf

The results of this study will be used to assess the practicality and appropriate timeframe for a zero or near-zero carbon building state policy or program. It will also be used to inform any program development and quantification protocols.

IV. DELIVERABLES

- Quarterly progress reports and conference calls;
- Draft final report;
- Peer-reviewed publication(s), as appropriate;
- Final report and research seminar in Sacramento;
- All data and analyses generated through the course of this project;
- Additional deliverables to be determined in consultation with ARB staff.

V. TIMELINE AND BUDGET

It is anticipated this project will be completed in 18 months from the start date. This allows 12 months for completion of all work through delivery of a draft final report. The last 6 months are for review of the draft final report by ARB staff and the Research Screening Committee (RSC), modification of the report by the contractor in response to ARB staff and RSC comments, and delivery of a revised final report and data files to the ARB. The estimated budget for this project is $400,000.