



## MEMORANDUM

To: Ann Arbor City Council  
From: Tom Crawford, Interim City Administrator  
Missy Stults, Sustainability and Innovations Manager  
Date: May 27, 2020  
Subject: Responses to Council Questions on A<sup>2</sup>Zero Carbon Neutrality Plan

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This memorandum provides responses to Council and community questions shared with Council and forwarded to City Staff on the A<sup>2</sup>Zero Plan between the dates of May 18<sup>th</sup>, 2020 and May 26<sup>th</sup>, 2020.

**Question:** What changes were made to the Plan?

**Response:** The following changes were made to the A<sup>2</sup>Zero Plan based on the original document sent to Council on March 28<sup>th</sup>, 2020:

- Co-benefits were added to the executive summary table on pages 10-11.
- Cost and total emissions errors were updated for Strategy 3 and Strategy 4 in the executive summary table on pages 10-11.
- Inclusion of the phrase “not calculated” in the executive summary for actions that a greenhouse gas emissions reduction potential was not estimated.
- The Ann Arbor Historic District and 2030 District and Mindful City Ann arbor were added as partners on select actions
- Grammatical corrections
- Updating of GHG reduction potential due to the inclusion of:
  - Updated figures from DTE’s recently approved Integrated Resource Management Plan – which was being administratively challenged when the draft Plan was released
  - The University of Michigan’s power purchase agreement and scheduled upgrades to their natural gas plant
- Correction of an error on the estimated greenhouse gas reduction potential of emissions offsets on page 121
- The inclusion of cost figures in the summary for the following actions: sustainable material use and reuse; circular economy; plant-based diets; and refrigerant recycling

**Question:** Generally, what’s the cost to residents?

**Response:** Costs to residents cannot be projected with a great sense of accuracy because individual actions may or may not be approved at a later date by Council and the funding available from federal/state/philanthropic/other partner entities varies annually. One possible scenario is included in the Investment Plan associated with the report. Were this scenario to occur \$2.0-\$2.6 million of additional funding would be needed per year on average over the next ten years, which is equivalent to \$60 per household per year, assuming the City is unable to offset any of this increased cost with other offsets. These costs would be borne by residents as part of the City’s base plan. In addition, residents may voluntarily incur additional expenditures should they be able to and desire to pursue some of the actions described below to support carbon neutrality.

The specific voluntary costs to each resident will vary depending on many factors (i.e., if they own vs. rent; if they have made improvements to their home; if they are geothermal or solar viable; if they have any electric appliances; if they are eligible for weatherization services). Overall, however, A<sup>2</sup>Zero identified actions that are incentivized and/or pay for themselves over their lifetime, or are structured in a way to either not or minimally impact the energy bills residents see. For example, by participating in a community choice aggregation program, a resident would be using 100% clean and renewable electricity without needing to invest in solar on their property or paying an additional amount for voluntary green solar on their utility bill, which they have to do through DTE's program. As illustration, Vermont has a program that incentivized homeowners to undertake deep retrofits in their homes with energy efficient improvements and electrification.<sup>1</sup> Scaling a program like this to Ann Arbor, residents could pay an average of \$11,000 with a payback of 13 years, or a minimum of \$5,000 with a payback of 7 years.<sup>2</sup> These costs assume the use of an air source heat pump; costs would increase with the addition of onsite solar and/or a ground source heat pump, which have payback periods of 10 years and 5 – 10 years, respectively.<sup>3</sup>

With improvements in active transportation options and public transit, a resident could be incentivized to reduce their vehicle miles traveled by 50%, saving over \$1,000 a year; or, by purchasing an electric vehicle, they could save over \$600 a year in operating costs. If similar electric vehicle ride sharing programs like those in Los Angeles were introduced to Ann Arbor, they could save over \$8,000 a year without needing to pay for and maintain a private vehicle.

For new builds, The Rocky Mountain Institute estimates that net zero energy ready single family homes (highly efficient homes that have low energy consumption and the remaining consumption can be offset by offsite renewable energy) have an incremental cost in Detroit of \$1,574, which meets thresholds of energy savings over the life of a mortgage, resale value, and customer willingness to pay. Retrofitting is more expensive which is why a proposal has been brought forward to support new buildings being all electric.

Lastly, A<sup>2</sup>Zero proposes programs that use economies of scale to significantly reduce the costs to residents and businesses. For example, we have been piloting a solar group buy program which is bringing discounts of up to 15% to residents to invest in solar energy. This 15% is on top of the federal tax incentive (which is 26% this year), meaning that combined, residents can save over 40% off the cost of solar through this program. As the A<sup>2</sup>Zero plan notes, we are looking to scale similar initiatives in regards to other renewable energy technologies, electric appliances, more efficient appliances, electric vehicles, and batteries.

**Question:** I would also recommend that other the other merchant associations be engaged as partners.

**Response:** Invitations to serve as an A<sup>2</sup>Zero partner were extended to the Main Street Area Association, Kerrytown District Association, S. University Area Association, and State Street District. The only one that responded to our invitation was the Main Street Association.

**Question:** In the example provided me, again, I alluded to this Monday night, DTE looked at a 6,000 sq. ft. restaurant with typical equipment. Using this restaurant example, a conversion from natural gas appliances to electric equipment, at today's energy prices, would result in a 44% or \$17,000/yr. increase in energy bills with most of this coming from cooking and water heating. DTE also noted this this cost increase does NOT take into account the upfront cost of purchasing and installing new appliances, and removing the natural gas ones, which would be as much as \$160,000 to retrofit an existing restaurant of this, ~6,000, sq. ft. size and configuration. DTE further clarified that a new restaurant would see the energy cost increase of 44% but not the upfront cost difference. And additionally, this analysis does NOT take into account the premium needed to be at 100% renewables which it was indicated would add to the incremental annual cost of all electric equipment.

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<sup>1</sup> [https://www.aceee.org/files/proceedings/2016/data/papers/10\\_297.pdf](https://www.aceee.org/files/proceedings/2016/data/papers/10_297.pdf)

<sup>2</sup> <https://www.aceee.org/sites/default/files/ultra-low-energy-0717.pdf>, page 11

<sup>3</sup> [www.energysage.com](http://www.energysage.com)

**Response:** We can't speak to the exact numbers DTE provided without understanding their assumptions. The response does seem to negate conversations which have been taking place between the City and the utility about bundling energy efficiency with electrification so that upfront and operational costs are lowered, if not neutralized, for the customer. These figures also don't appear to take into consideration the details of the plan, which focus on voluntary fuel switching or the work we've been discussing with our utility and others about providing incentives that support electrification. Moreover, these figures appear to assume that the customer has to pay the premium DTE charges to participate in their green pricing program for renewables. The city intervened in DTE's Integrated Resource Plan in part, because of the exceptionally high price DTE charges for their voluntary green pricing program. This is why the A<sup>2</sup>Zero plan does not promote asking residents to sign up for DTE's voluntary green pricing program. In summary, these figures don't appear to focus on the A<sup>2</sup>Zero Plan's: 1) bundling of efficiency with electrification to lower upfront and operational costs; 2) investing in renewable energy at scale that is far cheaper than what our utility offers through their programs; 3) efforts to create incentives to help support electrification; and 4) the voluntary nature of electrification programs outlined in the Plan.

Modern electric heating equipment is not a new technology and has achieved high rates of adoption in multiple countries. Expanding demand for heat pumps in the Northeast has resulted in specified cold-climate technologies that maintain adequate efficiency to 5 degrees F. While all-electric solutions will only become more cost effective over time, combining electric heat pumps with natural gas equipment can reduce the amount of natural gas used while reducing any risks of increased electric bills, power outages, or extreme winter weather events, like the polar vortex of 2019. Right now, modern electric appliances do cost more to operate than natural gas, due to the low price of natural gas in Michigan. Natural gas prices are volatile however, and there is currently no long-term pathway to making natural gas carbon neutral. Also, this conversation doesn't look at the public health impacts associated with natural gas combustion,<sup>4</sup> which was part of the effort to ban natural gas in Berkeley.

In addition, a partner shared this real world example: "I am working with the Ypsilanti Food Co-op on an expansion and we are looking at ventless all electric cooking equipment using induction. The kitchen equipment and installation is 22% less and we don't have the added cost of make-up air which has initial equipment cost and long term operational cost of bringing in large quantities of outside air. It is an historic building so this strategy is a perfect fit. There are specific pieces of equipment that are much more efficient with induction such as steam tables (50%) energy savings."

**Question:** Any feedback on design and construction incentives/actions that may have been provided from another partner organization, viz., The American Institute of Architects Huron Valley Chapter, on embodied energy in buildings ([architecture2030.org/new-buildings-embodied/](http://architecture2030.org/new-buildings-embodied/)) since these associated carbon emissions, as many analyses note, play a significant role in new construction would be helpful. I believe our plan is silent on the role of embodied carbon and any associated recommendations.

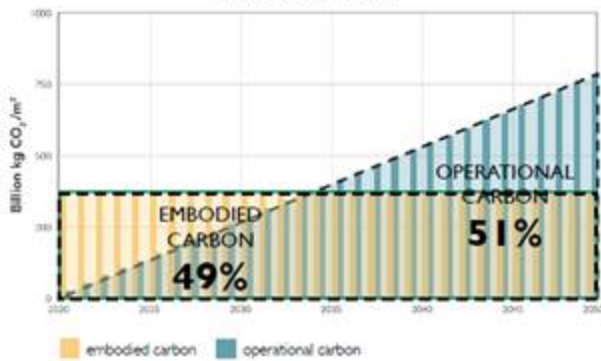
**Response:** Staff reached out to the AIA HV and A2 2030 District and got the following response (and have attached additional **slides**):

AIA HV promoted and A2 2030 circulated a free webinar and its recording prior to the March Carbon Positive Conference (which A2 2030 provided a discount code for our members). Vince Martinez of Architecture 2030 was coming to speak at an October event that the A2 2030 District was planning with AIA HV, but that will now be virtual. We are doing a joint presentation on 7.29 as part of the Yeah, What Lester Said event: <https://www.eventbrite.com/o/detroit-center-for-design-technology-dcdt-19774073319>. This is an emerging strategy for carbon neutrality which is illustrated by this diagram showing that as we continue to reduce our operational CO<sub>2</sub> emissions in buildings, the embodied carbon becomes the big elephant in the room.

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<sup>4</sup> [RMI recently released a report on natural gas' indoor air quality impacts](#)

Total Carbon Emissions of **All Global New Construction**  
**from 2020-2050**  
*Business as Usual Projection*



**Question:** On page 10 of the revised report, a summary of strategies begins that reveals the GHG reduction due to each strategy. By far the largest percentage (35.8%) is due to Community Choice Aggregation (a term indicating that we would essentially purchase carbon credits elsewhere). How is this a local reduction? We are paying to have someone else absorb our carbon cost.

**Response:** Community Choice Aggregation can be designed in many ways to serve many purposes. Through outreach with the public, a clear preference emerged for a Community Choice Aggregation program for Ann Arbor that focuses on: 1) additionality, meaning that whatever we invested in would not have happened without our investment; 2) displacing fossil fuels; 3) an investment, ideally, in communities disproportionately burdened by the fossil fuel extractive economy, and 4) that is 100% renewable energy. The principle of additionality means that the project would reduce greenhouse gas emissions equivalent to whatever our investment is.

If we were to run a request for proposals and ask the market to bid to build new renewable energy for Ann Arbor, we would have the flexibility of determining the criteria associated with that development. Above are four criterion identified through public engagement, but we could always add a geographical preference for the build (i.e., in Michigan or in the Midwest). The specifics around what the community would want to see in a Community Choice Aggregation program would be defined through public engagement before the item went to the ballot.

**Question:** Several of the important components are not, in fact, under control of the City, but of an independent authority, AAATA. Bus electrification (which is still not a well-developed technology) is a high-cost, but relatively low-contribution (0.6%) strategy. Local and regional transit (4.3%) are also responsibilities of AAATA. This agency is currently restructuring under a massive revenue shortfall. They are unlikely to fulfill any of these directives and are struggling to maintain the service they have. We might like to develop recommendations but these items do not belong in our plan.

**Response:** The City simply cannot meet our ambitious carbon neutrality goal without the full participation and engagement from other local public agencies such as UM, the AAATA, the AAPL, and the school district. Transportation is the second largest source of carbon pollution locally (after stationary fuel) and without a robust public transportation system, our strategy related to reducing vehicle miles traveled will not be achievable. For these reasons, the City takes into account the AAATA. Of course, the budgetary impacts of the COVID-19 crisis are and will continue to influence how we support and partner with AAATA.

**Question:** One strategy (see Strategy 4) is a change in land-use planning to permit denser housing and mixed-use zoning. These will yield 0.1% GHG reduction (based on certain assumptions, which are arguable). This is really about a different policy, surrounding our community debate about zoning and housing. It belongs in a Master Plan discussion. We have a proposed Master Plan process that has been temporarily stalled, but the Carbon Neutrality plan should not be employed to achieve that goal.

**Response:** Diverse moderate density housing types and mixed use neighborhoods are included in the A<sup>2</sup>Zero Plan for two reasons: 1) the topic came up repeatedly in public engagement and through the technical advisory committees and 2) because studies are increasingly showing that walkability and attached housing units decrease greenhouse gas emissions compared to more spread out land use patterns.<sup>5</sup> Attached housing units tend to be more energy efficiency, and walkability to goods and services and close access to jobs decreases reliance on single occupancy vehicles. However, quantifying these emissions reductions is highly complex and addresses emissions that are currently not included in our calculated baseline, but are certainly occurring. The emissions include energy consumption from other communities and the portions of commutes outside of City boundaries. Increasing housing density interacts with many goals, including increasing housing choice and affordability, walkability, improved social connections, addressing historical inequalities, reducing urban sprawl, and decreasing greenhouse gas emissions.

For example, a 2014 London School of Economics study determined that a modest blend of pro-density housing and transit policies could cut emissions by nearly a third by 2030.<sup>6</sup> A study in the United States found that urban densification alone could allow the U.S. to achieve half the carbon reductions needed domestically to hold global temperatures to a rise of 2 degrees Celsius.<sup>7</sup> As noted in a 2018 Curbed article: “Increased density means more opportunities for walkable neighborhoods and car-free transit, which would cut pollution. Density means shorter commutes and less driving, leading to less congestion, fewer road fatalities, and improved health outcomes from cleaner air.”<sup>8</sup>

As noted in the land use actions, the A<sup>2</sup>Zero Plan brings attention to the importance of this topic and calls for supporting an open community conversation around land use and density as part of the Master Plan update process (please see the process figure for relevant actions in Strategy 4 of the A<sup>2</sup>Zero Plan). The A<sup>2</sup>Zero Plan does not usurp the master planning process but attempts to draw attention to a topic that is actively being discussed/debated in our community.

**Question:** Many of the calculations are based on assumptions and assertions. As an example, in the Investment Plan, a City expenditure of \$35,000 for emergency kits is balanced by a \$210,000 annual savings. The note says “Estimated savings from a FEMA report showing that for every \$1 invested in prevention, we save \$7 in emergency management and response costs.” This type of extrapolation needs to be examined more closely

**Response:** This assertion is based on recent reports from the Pew Research Center, the National Institute of Building Sciences, and The World Bank. If needed, additional analysis will be performed prior to this particular action coming to City Council for approval.”

**Question:** The Park and Ride strategy (1.3%) (said to be funded mostly by unknown donors) is objectionable on several levels. This again imposes responsibilities on AAATA (it would be their buses that would service the lots). It would consume a great deal of open space just outside the City borders (complicated by land-use plans of other municipalities). And its premise is to invite more automobile traffic (by providing parking) but since it is outside the City, we don’t have to count it!

**Response:** By locating Park and Ride lots just inside and/or just outside city borders, the portion of the vehicular commute in Ann Arbor limits could be shortened, the number of vehicles on city streets could be reduced, helping to lower community-wide VMT. This is not an invitation to drive, as the purpose of these lots would be for use by the nearly 85,000 existing commuters into Ann Arbor.

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<sup>5</sup> See: <https://www.sciencedirect.com/science/article/abs/pii/S2214629616301943>; <https://pennur.upenn.edu/uploads/media/Cohen.pdf>; <https://pubs.acs.org/doi/abs/10.1021/es4034364>; <https://www.pnas.org/content/early/2017/01/03/1606035114.full>; <https://www.researchgate.net/publication/338377261> The Impact of Urban Form and Spatial Structure on per Capita Carbon Footprint in US Larger Metropolitan Areas; <https://www.epa.gov/smartgrowth/location-efficiency-and-housing-type>

<sup>6</sup> Floater, Graham, Philipp Rode, Alexis Robert, Dan Hoornws Roxana Slavcheva, and Nick Godfrey. 2014. “Cities and the New Climate Economy: The Transformative Role of Global Urban Growth. New Climate Economy Cities Paper 01.” LSE Cities

<sup>7</sup> [https://www.springer.com/us/book/9781610910057?utm\\_medium=affiliate&utm\\_source=commission\\_junction&utm\\_campaign=3\\_nsn6445\\_brand\\_PID100032198&utm\\_content=de\\_textlink&countryChanged=true](https://www.springer.com/us/book/9781610910057?utm_medium=affiliate&utm_source=commission_junction&utm_campaign=3_nsn6445_brand_PID100032198&utm_content=de_textlink&countryChanged=true)

<sup>8</sup> <https://www.curbed.com/2018/12/11/18136188/city-density-climate-change-zoning>

**Question:** There are many other issues to be debated here, including the lack of consideration of embodied energy in buildings (manufacturing and construction are the third highest contributors to GHG emissions for energy), the legality under current law of certain strategies, the degree to which individual property owners can be required or incentivized to replace their current technologies. But the point is that more consideration and discussion is needed before this plan is even received, much less adopted. It is simply incomplete.

**Response:** The City adheres to the Local Government Operations Protocol and the Community Protocols, two documents that set the standard for how local governments count emissions. To-date, no standards exist for counting embodied carbon. The City is following work in this area but since a standard does not exist, these emissions were not included in our baseline inventory. We have volunteered to work with peers to help develop standards in this area and will continue to monitor protocols and methodologies for estimating embodied energy across an entire community. To-date however, studies have found that the energy used to operate buildings has long dominated life cycle energy use. As we improve energy efficiency however, embodied energy is an important consideration,<sup>9,10</sup> which is why the City will continue to monitor standards for calculating this emissions source.

In terms of legality, achieving carbon neutrality at the community-level will necessitate changes in policy locally and at the state level. This was factored into the prioritization / decision making framework that was used to determine which actions were considered for inclusion in A<sup>2</sup>Zero. During community engagement, very little interest was expressed in meeting our carbon neutrality goals through a dependence on significant greenhouse gas emissions offsets. Instead, a preference was given for taking as much local and regional action as possible, especially actions that were scalable and transferable throughout the State. Given that, staff looked at actions that provided more local control over our greenhouse gas emissions profile.

**Question:** I am troubled at the outset with several statements in the executive summary and closing sections. At p. 12, the report states: “[the Plan] is iterative, transparent, failure-positive, and grounded in justice and equity.” Choice of words and clarity in writing is important, particularly when many likely readers do not come from academia. What does “iterative” mean as used here? Repetitious (the old dictionary meaning)? Probably not. “Relating to or involving iteration, especially of a mathematical process” (newer dictionary meaning). Maybe. My guess is the meaning intended to be conveyed is that the Plan will go through several versions (iterations). Why not just say that?

**Response:** We expect that the Plan will grow and change as the City implements it. In this context, iterative means that we will learn from the process, projects, outcomes, and integrate that learning into revisions in the Plan. There is a learning component that is not fully conveyed by saying that the Plan will go through many versions.

**Question:** Next, what does “transparent” mean here? The report certainly isn’t transparent in terms of how actions will be funded, or in terms of how the costs might affect residents/taxpayers. Nor is the process of how A2Zero came to be on the agenda tonight “transparent.”

**Response:** Transparent refers to the ability of the public to understand, interact with, and monitor progress in regards to Ann Arbor’s carbon neutrality goals and actions.

**Question:** And “failure-positive” doesn’t even appear in any dictionary.

**Response:** Also referred to as “failing forward,” this concept means accepting all actions may not achieve their intended result but utilizing this learning to improve performance and likelihood of overall success.

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<sup>9</sup> Ramesh, T., Prakash, R., & Shukla, K. (2010). Life cycle energy analysis of buildings: An overview. *Energy and Buildings*, 42(10), 1592–1600. doi: 10.1016/j.enbuild.2010.05.007

<sup>10</sup> Ghattas, R., Gregory, J., Olivetti, E., Greene, S. (2013) Life Cycle Assessment for Residential Buildings: A Literature Review and Gap Analysis

**Question:** Next, at p. 9 the report states: “The more physical staff that are focused on the Plan, the more likely the Plan is to succeed.” Really? If you hired several hundred people you would guarantee success?

**Response:** Success cannot be guaranteed by simply staffing. The goals laid forth will be achieved by the collaboration between city staff, private enterprises, local institutions, and the general public. That said, increased staffing is essential to ensure our capacity to accomplish the actions detailed in the Plan, often in partnership with the aforementioned organizations.

**Question:** Then “[t]ime is of the essence if Ann Arbor is to seriously achieve this goal.” Seriously?

**Response:** There is scientific consensus that, in many ways, the climate is changing even more rapidly than the best scientific models predicted. The longer we wait to drastically curtail our carbon emissions, our actions will become not only more expensive but also less effective compared to robust actions taken earlier. Please see the latest IPCC report<sup>11</sup> for our justification for using the phrase “time is of the essence”.

**Question:** My April 13 email focused, among other things, on the very high cost-benefit ratios of several items, one of which was electric buses. At the April 13 work session, I focused on that issue during my comments. The next speaker, Ken Garber, attempted to rebut my point on the buses by claiming that the \$80M+ cost shown in the report was overstated; that the incremental cost would be much lower. So I thought maybe the revised report or the prioritization analysis would address this point. The prioritization framework does appear to recognize the bad cost-benefit ratio; it ranks electric buses at the bottom of the list of actions. But the report didn’t change at all. So you still can’t really tell for sure whether the intent is to replace diesel buses as they are taken out of service or sooner than that; you can only make an educated guess. Why not provide a paragraph of explanation, or a chart? I do note that, despite the very low prioritization ranking, the report still shows 11 electric buses are to be purchased in the next year, without any explanation of where the funding will come from. And the documents provided re funding do not clearly show where the money would come for the buses either. So, simply put, why should we support “adopting” a Plan with this lack of clarity?

**Response:** Adoption of the Plan adopts the 7 strategies. Nearly all individual actions would be further considered by Council before moving into implementation, which will likely include more specific cost and investment-related quantification. For the A<sup>2</sup>Zero Plan, multiple aspects of the bus electrification model led to conservative cost estimates, including model assumptions that electric busses would be adopted at rates similar to current bus replacement by the AAATA. Around 10% of the bus fleet is replaced annually, so the model examined replacing this 10% with electric busses, rather than diesel. The cost of these replacements is incremental, as it is assumed diesel busses would be purchased each year regardless. This is also why the A<sup>2</sup>Zero Plan has the proposed timeline, to take full advantage of this already occurring fleet update. In addition, the Plan analyzed expanding the frequency, time, and/or routes served by AAATA, and accounted for a purchase of additional electric buses to meet increases in demand. Second, electric buses are eligible for various incentives, including those from VW settlement funding, EPA grants, FTA Low-No Funding, and FTA Bus Funding. None of these incentives were accounted for in the cost analyses. Current electric bus models offer a lower total cost of ownership due to decreased fuel and maintenance costs, resulting in over \$400k in savings over their operational life. These savings do not include the reduction in air pollution, and the social cost of carbon that is avoided. In addition, vehicle battery prices continue to follow a downward trend, and the incremental cost of an electric bus is expected to decrease, meaning that the A<sup>2</sup>Zero funding estimates presents a conservative cost of this action. The cost of the battery of an electric vehicle represents around 80% of the incremental cost compared to a fossil fuel bus. Batteries can be leased, bringing the purchase price of an electric bus much closer to that of a fossil fuel bus and decreasing the upfront capital required. Internationally, China is leading the bus electrification movement with over 400,000 electric busses, but cities worldwide like Lima have also pursued bus fleet electrification and procured a fleet of over 180 electric busses. Cities in the US who have electric busses in operation include Chicago, Portland, and Gulfport, MS, among many others.

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<sup>11</sup> <https://www.ipcc.ch/sr15/>

**Question:** Just a couple (perhaps sarcastic) items to consider: the report shows a \$656M cost for upgrading transit, with a relatively small, in context, 4.3% reduction in emissions. That is a giant amount of money. Why not spend some of it on weatherizing buildings, rather than trying to get cash-strapped residents to borrow money to do that? And the report shows that a 45.3% reduction in emissions is going to be obtained by buying credits for a mere \$9M. So (I'm being deliberately sarcastic here) why not spend \$20M to buy 90+% emission reduction?

**Response:** Much of the reason the transit item has such a large cost is that it includes infrastructure improvements, which can be costly to execute. These improvements, were included in order to create a safer, more accessible, and more connected mobility network. The improved network, in turn, "sets the stage" for other strategies to succeed; including creating the infrastructure to support a significant reduction in vehicle miles traveled (VMT) that are needed in order to meet our goal of carbon neutrality by improving walkability, bike-ability, and mass transit options. In short, these improvements have far more indirect carbon reductions than the indicated 4.3%.

In terms of weatherization, that is already included in the Plan under strategy 3. Finally, in terms of offsets, the community showed a strong desire to minimize their use and focus on reducing local and regional emission first. Moreover, offsets offer no co-benefits, whereas nearly all other actions have a direct local co-benefit associated with its implementation. As such, offsets were integrated into the Plan to help "close the gap" between what could be done locally or regionally and what was needed to achieve the Council goal of carbon neutrality, community-wide, by 2030. Furthermore, staff will be working on a strategy for carbon offsets to ensure that any offsets we buy are additional and that they have community support.

**Question:** The other main point I want to address are the unsupported statements (on p. 78 and 122) that density in the form of duplexes/triplexes/quadplexes will automatically result in more affordable housing for renters and low-income residents. The reports do not contain ANY data or analysis whatsoever to support that view, and I believe objective analysis supports the opposite position. There are few vacant lots, or lots large enough to put an additional significant building on, left in the city. So quadplexes would have to result, for the most part, from teardowns of existing houses. The cost of houses in the city is quite high, as we know, in many neighborhoods, so houses in those neighborhoods would be the least likely to be bought as teardowns, and, if converted to quadplexes, would have to be priced by developers as luxury condos or apartments. That means the quadplexes would be concentrated in the least expensive neighborhoods; for example, my old neighborhood near Haisley school. But even there quadplexes would not result in affordable housing. A teardown would cost say, \$225,000 plus demolition cost. Constructing 4 units of, say, 900 square feet each (2 stories of 2 units each) is a significant cost, which in my view, would result in rents at the upper end of the current market, while removing one of the few remaining affordable houses in town. This is a net negative for affordable housing

**Response:** Concepts related to land use and zoning came up repeatedly in A<sup>2</sup>Zero-related public engagement as well as through our technical advisory committees as there is a connection to land use and greenhouse gas emissions.<sup>12, 13, 14, 15, 16, 17, 18</sup> For these reasons, diverse moderate density housing types and mixed use neighborhoods are included in the A<sup>2</sup>Zero Plan. Additionally, increasing housing density interacts with many goals, including increasing housing choice and affordability, walkability, improved social connections, addressing historical inequalities, reducing urban sprawl, and decreasing greenhouse gas emissions. And, as noted, the A<sup>2</sup>Zero Plan draws attention to this important topic and supports its deeper consideration within the community Master Planning process.

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<sup>12</sup> The Link Between Local Zoning Policy and Housing Affordability in America's Cities. Erdmann, Furth, Hamilton. Mercatus Center, George Mason University, 2019

<sup>13</sup> Understanding Low-Rise, Moderate-Density Housing in Greater Boston, Mich. Massachusetts Institute of Technology, 2017.

<sup>14</sup> Minneapolis 2040, The City's Comprehensive Plan. 2019.

<sup>15</sup> Essays on Housing Supply and House Price Volatility, Paciorek. University of Pennsylvania, 2011. Panel Paper: Redevelopment and Housing Quality, Cosman.

<sup>16</sup> <https://missingmiddlehousing.com/about>

<sup>17</sup> <https://www.vtppi.org/sgcp.pdf>

<sup>18</sup> <https://www.vtppi.org/sgcp.pdf>



**Question:** I would expect a report which advocates significant disruption of neighborhoods via teardowns of currently affordable housing to provide a DETAILED ANALYSIS showing why that strategy would result in affordable housing. This report provides nothing of the sort; instead simply stating in completely conclusory fashion, several times, that the desired result would occur. This is a totally unacceptable abdication of the task of analysis and is yet another reason to send this report back to staff for further work.

**Response:** The task for the A<sup>2</sup>Zero Plan was to present a strategy to achieve comprehensive community-wide carbon neutrality. While land use relates to greenhouse gas emissions, it is a highly complex topic that deserves its own analysis and requires coordination on multiple scales. That is why actions related to land use highlight the importance of engaging with these topics in much greater depth in the Master Plan update. As noted above, it is acknowledged that Ann Arbor is a desirable place to live and our country's housing affordability crisis is in full view here. If housing subsidies are not available, simply adding new housing is no guarantee of affordability. However, workforce housing built by the market presents an opportunity for potentially greater housing access by middle income families.

**Question:** Having had a minor role at life cycle analysis in my job I can say that this involves a maddening number of assumptions and details. A simple observation, though, is that we still use a lot of natural gas and coal for electrical generation. Natural gas is cleaner both in air quality and GHG compared to coal. So if you compare a natural gas fueled electrical generation plant to using the natural gas in a home range, then based on thermodynamics alone you cannot possibly be more efficient than using the natural gas in the stove. (Losses in generating and transmitting the electrical energy are significant.)

**Response:** All future-based plans have assumptions. Those assumptions are outlined for each action in the Plan meaning that they can be adjusted over time as needed.

The A<sup>2</sup>Zero Work Plan proposes a suite of options to shift our electrical generation to 100% renewable energy within the next ten years. This means that equipment that uses natural gas (space and water heating, dryers, and cooking ranges), will receive no benefit in emissions reductions and rely on carbon offsets to achieve neutrality, unless they are switching to electricity. Electric heat pumps, unlike electric resistance heaters, move heat from the air or ground rather than convert energy, and can be 2-5 times more efficient than fuel-fired alternatives. In addition, the A<sup>2</sup>Zero Plan includes maximizing our local solar production, which creates opportunities for homes and businesses to fuel switch to electric HVAC equipment, while reducing high transmission and distribution losses associated with peaks in electrical demand. Finally, natural gas is 28-36 times more potent of a greenhouse gas than carbon dioxide and the more we analyze the natural gas distribution system, the more we find that leakage in that system is greater than previously thought.<sup>19, 20-21, 22</sup>

**Question:** Advocates will argue that we are well along the way in making our electrical grid sustainable. There is some truth to this but the pace is slow (13% of US electrical plant is hydro, solar or wind). If you make the change today from gas to electric at home, you will have a greater carbon footprint today. Better to wait until the grid actually changes to sustainable basis.

**Response:** In addition to the previous response, the A<sup>2</sup>Zero Plan proposes a suite of options to shift our electrical generation to 100% renewable energy within the next ten years. This means that equipment that uses natural gas (space and water heating, dryers, and cooking ranges) will receive no benefit in emissions reductions and rely on carbon offsets to achieve carbon neutrality, unless they are switched to electricity. Many of these appliances have long service lifetimes, which means that there are fewer opportunities to fuel switch. In many cases, any increase in emissions over a fraction of an appliance's service life is outweighed by the total emissions of using 100% natural gas. Natural gas (methane) is a greenhouse gas with a Global Warming Potential between 28-36 times more powerful than carbon dioxide. Researchers from U of M have found that over 80% of detected methane in urban areas arise from leaks in residential and commercial

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<sup>19</sup> <https://theconversation.com/the-us-natural-gas-industry-is-leaking-way-more-methane-than-previously-thought-heres-why-that-matters-98918>

<sup>20</sup> [https://www.usdn.org/uploads/cms/documents/methane-math\\_natural-gas-report\\_final.pdf](https://www.usdn.org/uploads/cms/documents/methane-math_natural-gas-report_final.pdf)

<sup>21</sup> Plant, G., Kort, E. A., Floerchinger, C., Gvakharia, A., Vimont, I., & Sweeney, C. (2019). Large Fugitive Methane Emissions From Urban Centers Along the U.S. East Coast. *Geophysical Research Letters*, 46(14), 8500–8507. doi: 10.1029/2019gl082635 and

<sup>22</sup> <https://www.sciencemag.org/news/2019/07/major-us-cities-are-leaking-methane-twice-rate-previously-believed>

sources, along with gas distribution infrastructure.<sup>23</sup> These fugitive emissions may even be offsetting the CO<sub>2</sub> benefits of natural gas combustion. In addition, natural gas prices are expected to rise in future years, as renewable prices are expected to continue declining. This doesn't include the social cost of carbon, or the detrimental environmental and social effects of natural gas production, such as water use and groundwater pollution or impacts to local air quality and public health.<sup>24</sup> Given the goal set by Council of achieving carbon neutrality, community-wide, by 2030, and the long lifespan of appliances once replaced, the proposal is to begin supporting residents and businesses with fuel switching as soon as possible.

**Question:** Yet another complexity, though, is that natural gas (methane) itself is a GHG, with greater greenhouse properties than CO<sub>2</sub>. Some amount of natural gas is lost to leakage at all stages from the wellhead to final use, and that has its own impact which isn't good.

**Response:** Natural gas (methane) is a greenhouse gas with a Global Warming Potential about 28-36 times more powerful than CO<sub>2</sub>. Researchers from U of M have found that over 80% of detected methane in urban areas arise from leaks in residential and commercial sources, along with gas distribution infrastructure.<sup>25</sup> These fugitive emissions may even be offsetting the CO<sub>2</sub> benefits of natural gas combustion. In addition, natural gas prices are expected to rise in future years, as renewable prices are expected to continue declining. This doesn't include the social cost of carbon, or the detrimental environmental and social effects of natural gas production, such as water use and groundwater pollution or impacts to local air quality and public health.<sup>26</sup>

**Question:** A conservative approach is to focus on improvements that are more energy efficient, regardless of the fuel type. This promises a true net improvement without lots of assumptions. And there are still plenty of these opportunities

**Response:** The A<sup>2</sup>Zero Plan identifies many areas and programs that promote energy efficiency improvements. Indeed, energy efficiency has the lowest levelized cost of electricity.<sup>27</sup> However, City Council set a goal of community-wide carbon neutrality by 2030 and energy efficiency alone will not achieve the aggressive response we need to achieve this goal. We know that we have limited opportunities to connect with residents, landlords, and businesses. Comprehensive energy efficiency retrofits that include electrification and, when appropriate, onsite renewables, can maximize benefits over the lifetime of the equipment, lower costs for residents, and make progress towards carbon neutrality.

**Question:** If you do some back-of-the-envelope calculations, the numbers look like this: Generating 20,000 BTU/hour with natural gas versus electricity: Your gas stove will use 0.1934 CCF to generate the 20,000 BTU's which will cost \$0.24 with current DTE rates and produce 2.34 lbs of Green-House-Gas (GHG). To generate the same number of BTU's with electricity will use 5.86 Kilowatt-Hours (Kwh) and will produce an average of 5.80 lbs of GHG's (assuming grid electricity of 0.99 lbs/kwh) which will cost \$0.99 at current household DTE rates. The A2Zero plan wants to get people to switch from natural gas to electricity for heating (sic--heating)—did you see my numbers? Electricity used for heating can cost up to four times as much and produce twice the GHG emissions; where is the public benefit? This plan needs to spell out its assumptions in detail and explain how basic physics and chemistry are going to be applied to actually reduce carbon emissions. ...please explain, in light of the above calculation, how compelling people to switch from natural gas appliances to electric ones contributes to a reduction in GHG's? I want to be clear that the above calculation is by no means a slam-dunk indictment of the plan to switch to electric appliances! I want to see the assumptions ... use[d] that get us to a GHG savings. Also, I

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<sup>23</sup> Plant, G., Kort, E. A., Floerchinger, C., Gvakharia, A., Vimont, I., & Sweeney, C. (2019). Large Fugitive Methane Emissions From Urban Centers Along the U.S. East Coast. *Geophysical Research Letters*, 46(14), 8500–8507. doi: 10.1029/2019gl082635 and

<sup>23</sup> <https://www.sciencemag.org/news/2019/07/major-us-cities-are-leaking-methane-twice-rate-previously-believed>

<sup>24</sup> [RMI recently released a report on natural gas' indoor air quality impacts](#)

<sup>25</sup> Plant, G., Kort, E. A., Floerchinger, C., Gvakharia, A., Vimont, I., & Sweeney, C. (2019). Large Fugitive Methane Emissions From Urban Centers Along the U.S. East Coast. *Geophysical Research Letters*, 46(14), 8500–8507. doi: 10.1029/2019gl082635 and

<sup>25</sup> <https://www.sciencemag.org/news/2019/07/major-us-cities-are-leaking-methane-twice-rate-previously-believed>

<sup>26</sup> [RMI recently released a report on natural gas' indoor air quality impacts](#)

<sup>27</sup> <https://www.aceee.org/blog/2017/12/new-data-same-results-saving-energy>

want to express my concern that even if a savings in GHG's can be achieved, if it adds costs which are not paid for over time by the switch, it will be difficult to get others to follow the policy. In other words, if the measures proposed by the A2Zero plan do not reduce costs or make money for the people covered by the plan, the plan will not scale & will not be adopted by others. Ann Arbor will sacrifice for next to no benefit.

**Response:** If the goal is community-wide carbon neutrality, then fuel switching away from natural gas will be part of the solution since natural gas is a greenhouse gas and it is impossible to achieve local carbon neutrality while burning it.<sup>28, 29, 30</sup> Electrification is only one step in getting to carbon neutrality, but paired with the greening of the electrical grid, it has the potential to make a significant dent in local greenhouse gas emissions. Moreover, the A<sup>2</sup>Zero initiative calls for the pairing of energy efficiency with electrification to help lower the upfront and operational cost changes associated with electrification, the use of incentives to encourage individuals and businesses to transition to electric, the greening of our electrical grid, and greater energy choice to ensure cost competitive access to renewable energy.

In terms of assumptions, the A<sup>2</sup>Zero Plan assumes that all buildings switching fuels already have natural gas and electricity service, and may maintain natural gas service for back-up emergencies. As such, the plan does not include fixed costs in our analysis. Based on research from the Rocky Mountain Institute for our climate zone, heat pumps have been found to need 60% less electricity than natural gas; therefore, an assumption of a 1:1 conversion of natural gas to electricity is conservative. In addition, our updated models include as a base DTE's projected IRP changes over the next 10 years as well as A<sup>2</sup>Zero's proposed suite of options to achieve 100% renewable energy. Based on DTE's grid becoming 25% less carbon intensive by 2030 and a projection of community choice aggregation being offered to the community in 2027, an electric heat pump generates less greenhouse gas emissions over its lifetime compared to a natural gas equivalent, and that does not factor emissions saved by avoiding natural gas leaks (which are omitted from your calculations but are described in previous responses). The A<sup>2</sup>Zero Plan does not propose mandating a conversion to electricity or an immediate 100% conversion to electric. Instead, the Plan focuses on bundling electrification with energy efficiency and providing incentives to support fuel switching.

**Question:** Could the city buy/sell carbon credits using existing international and national markets? If you want to unleash market forces to compete with DTE, then Cap-And-Trade regulations are one way to accelerate the process.

**Response:** Included in Strategy 6 is an action related to the purchasing of carbon offsets. This action includes public engagement to define what exactly the community is looking for in carbon offsets. The planning process used to create A<sup>2</sup>Zero found strong community preference for minimizing the amount of carbon offsets purchased by focusing on achieving as much local and regional greenhouse gas reduction as possible, and then using offsets to "close the gap." In addition, a preference was given for offsets which are additional, meaning they wouldn't have happened without our investment. Going forward, these assumptions need to be further refined so that appropriate greenhouse gas emissions offsets can be determined.

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<sup>28</sup> [https://www.usdn.org/uploads/cms/documents/methane-math\\_natural-gas-report\\_final.pdf](https://www.usdn.org/uploads/cms/documents/methane-math_natural-gas-report_final.pdf)

<sup>29</sup> <https://rmi.org/insight/gas-stoves-pollution-health>

<sup>30</sup> <https://www.theguardian.com/environment/2020/may/05/gas-stoves-air-pollution-environment>



Vincent Martinez  
Architecture 2030



A hand holding a magnifying glass over a cityscape. The magnifying glass has a red circular lens. The text "CLIMATE EMERGENCY!" is written across the lens and extends to the right. The background is a blurred cityscape with tall buildings.

**CLIMATE EMERGENCY!**

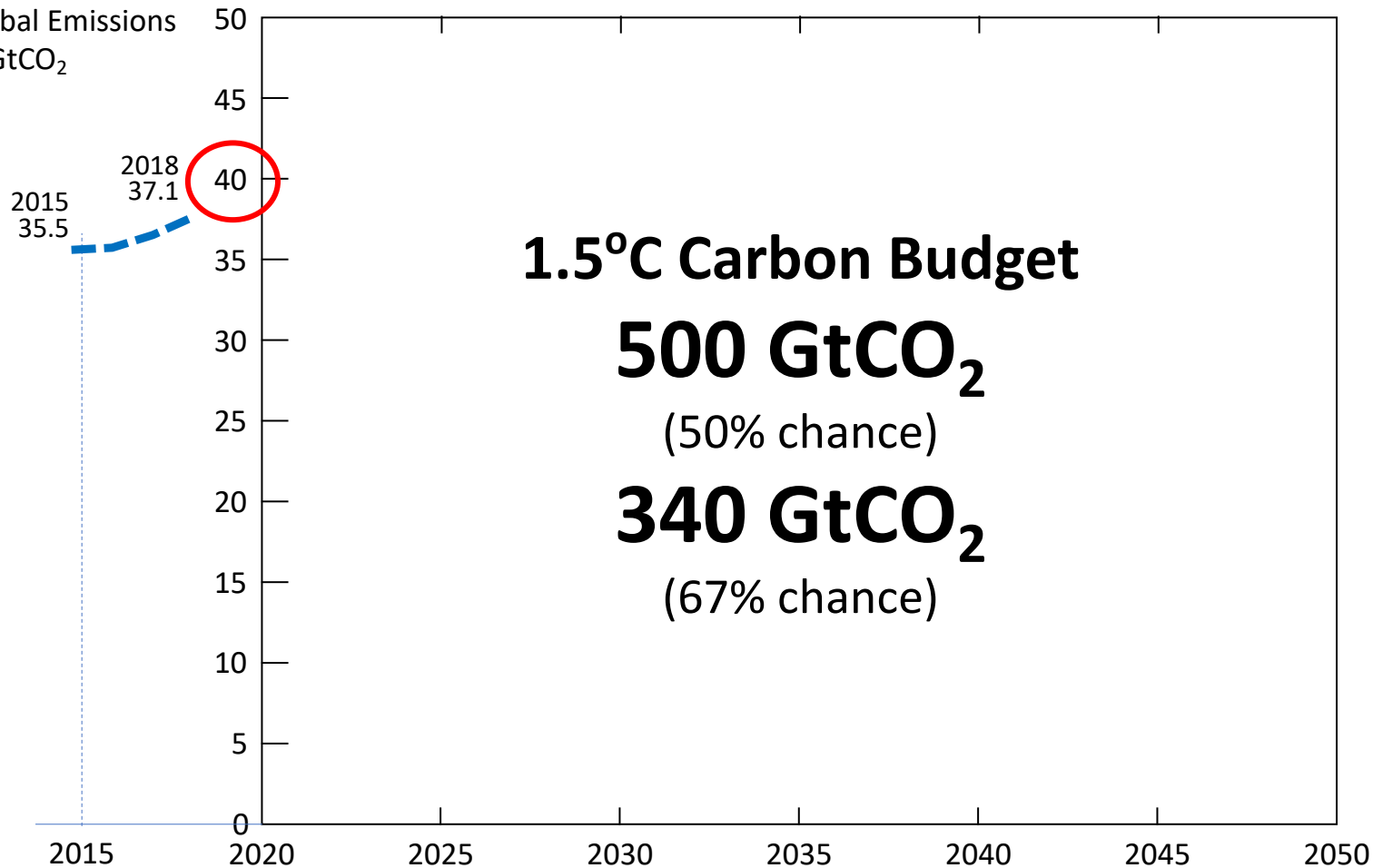
Vincent Martinez  
Architecture 2030



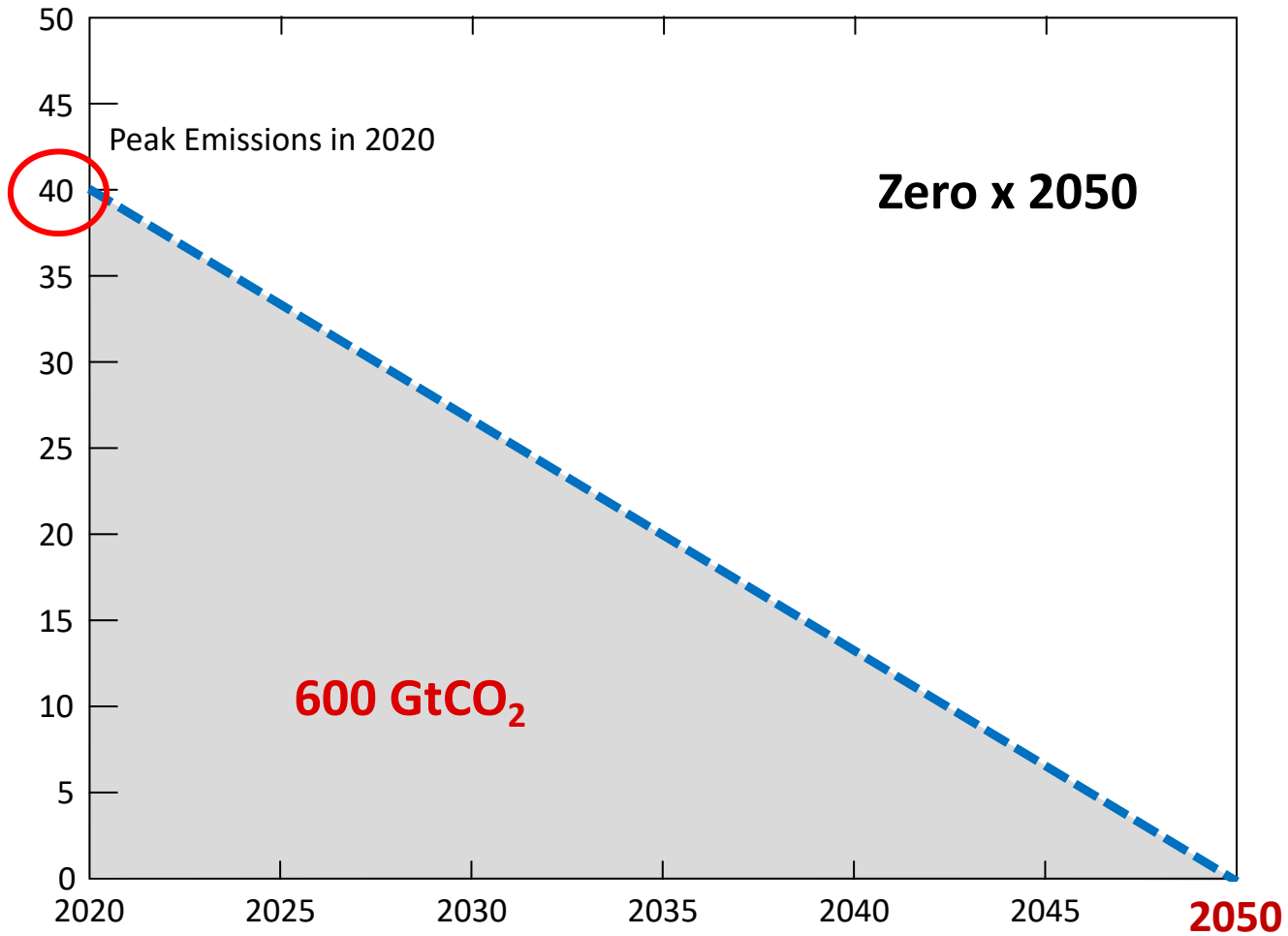


**EMERGENCY!**

Global Emissions  
in GtCO<sub>2</sub>

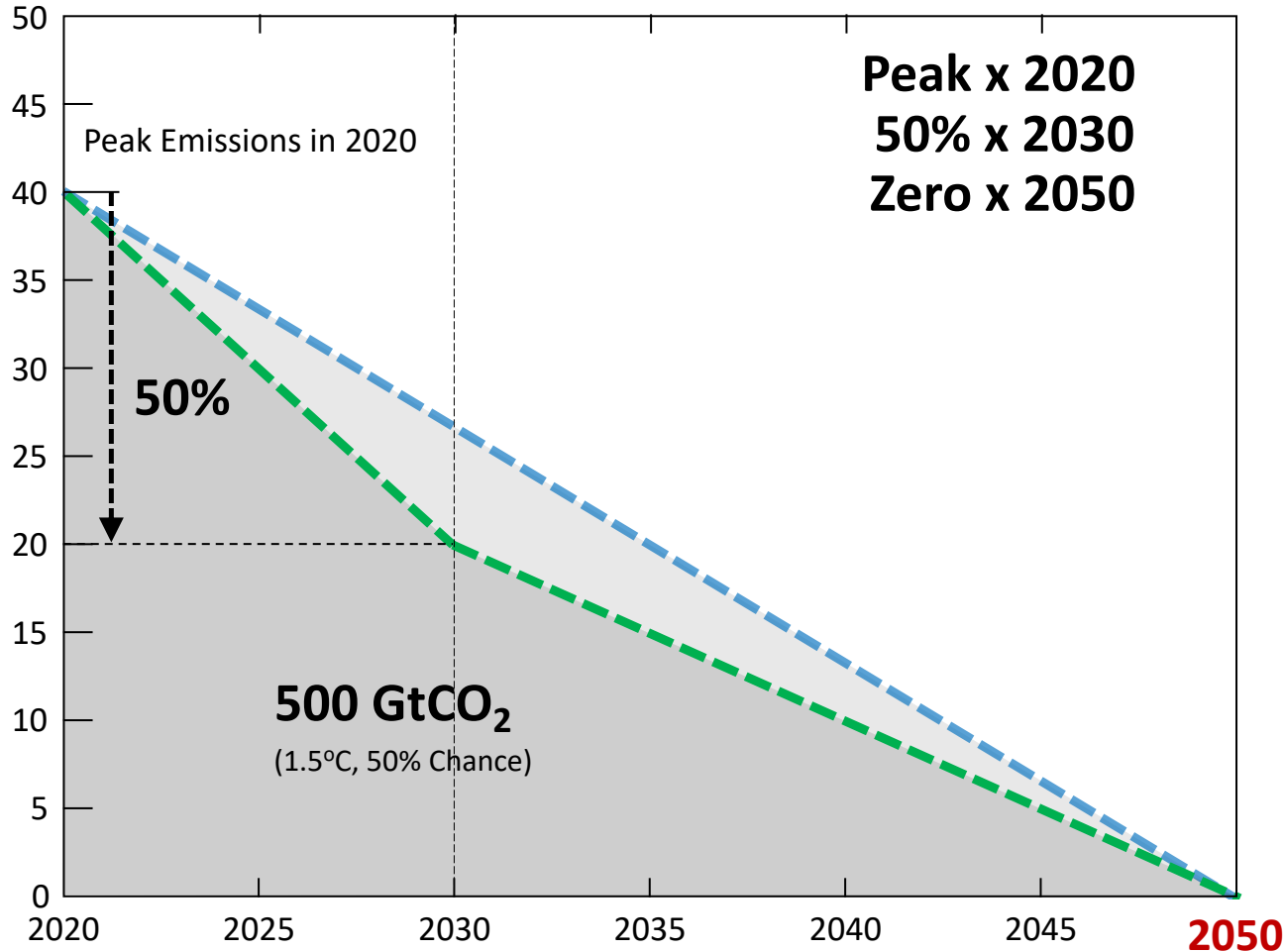


Global Emissions  
in GtCO<sub>2</sub>



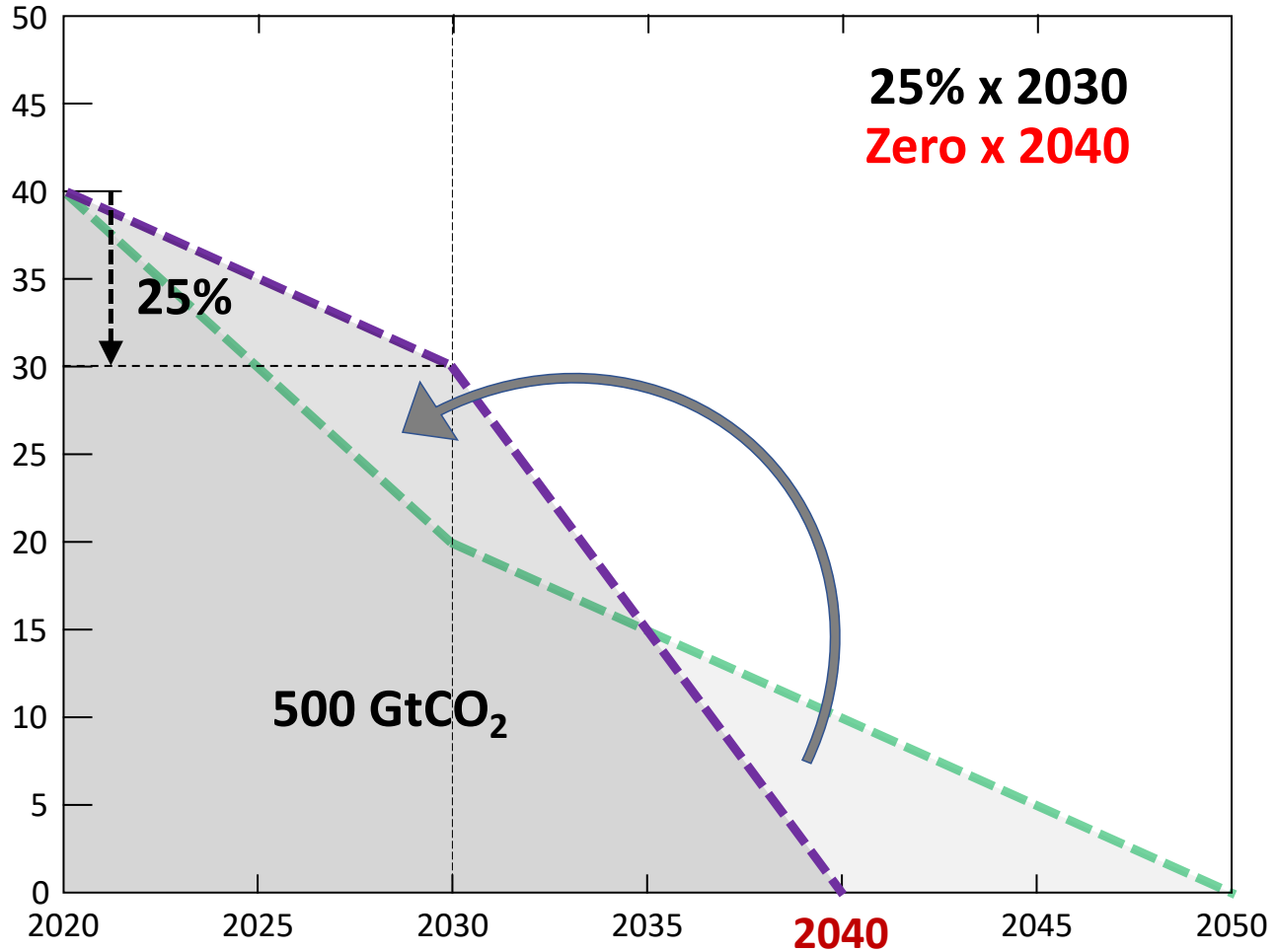


Global Emissions  
in GtCO<sub>2</sub>

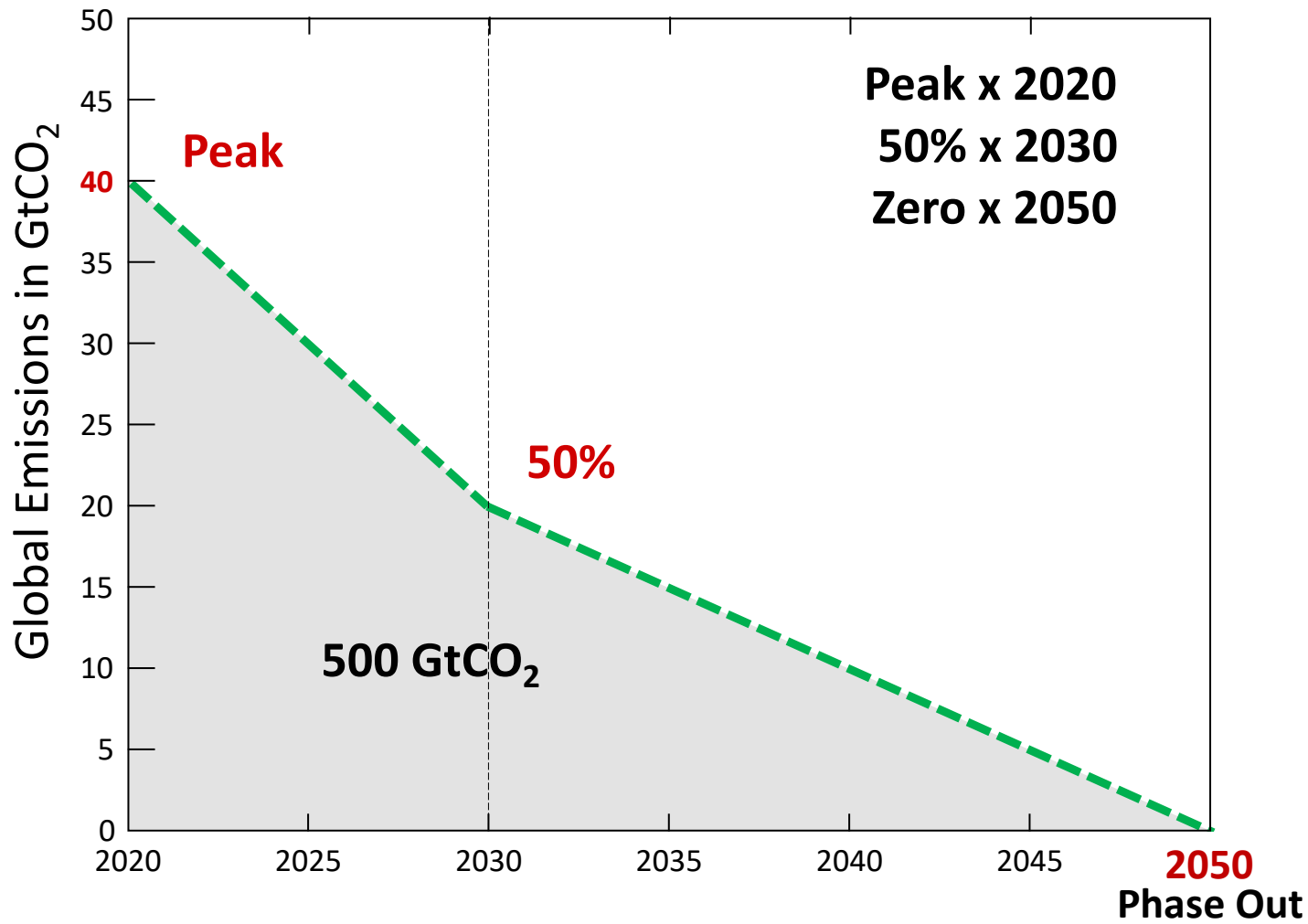


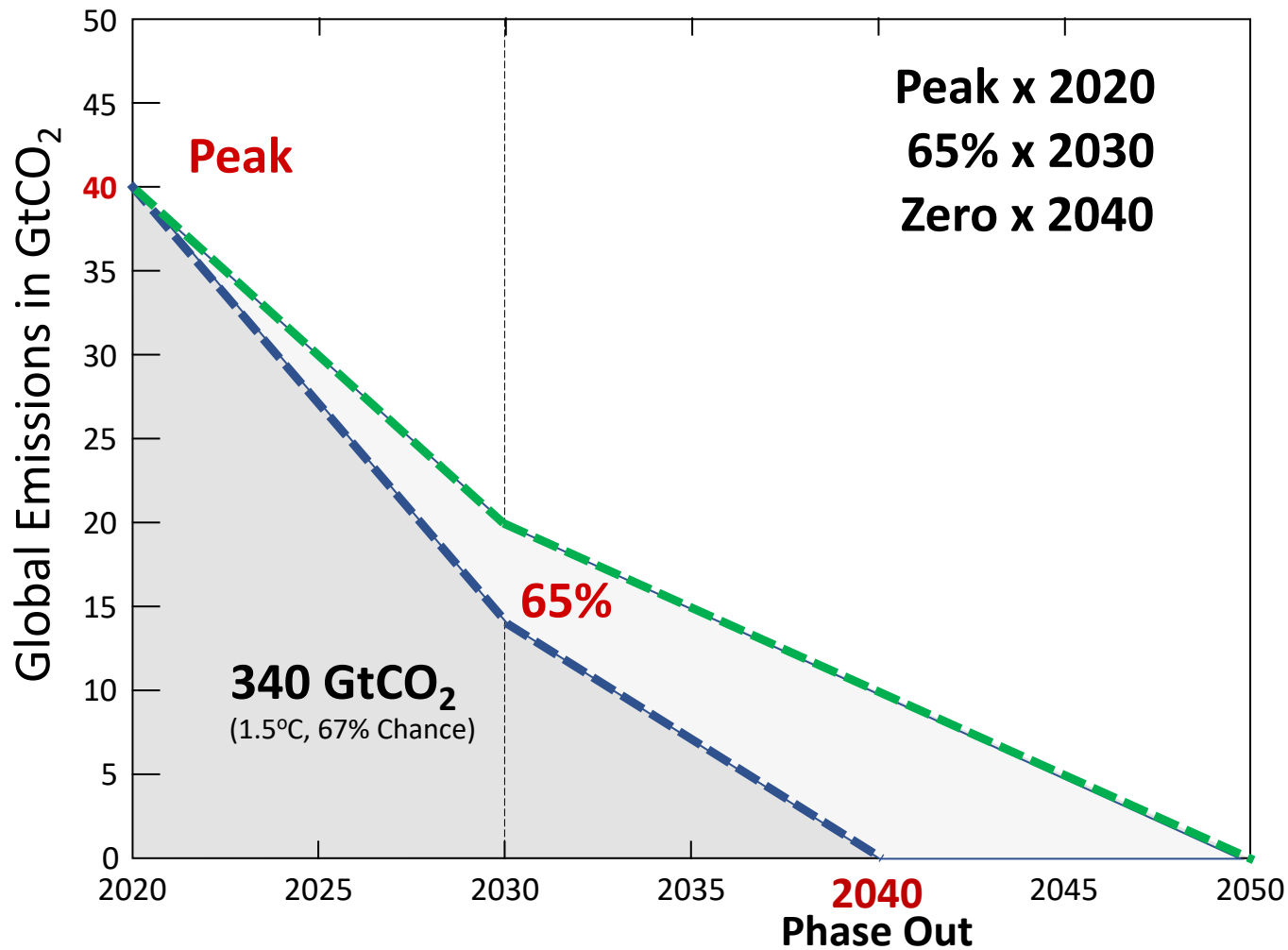
Source: Architecture 2030; Adapted from RealClimate.org “How much CO<sub>2</sub> your country can still emit, in three simple steps”; and IPCC SR15, Table 2.2

Global Emissions  
in GtCO<sub>2</sub>



Source: Architecture 2030; Adapted from RealClimate.org “How much CO<sub>2</sub> your country can still emit, in three simple steps”; and IPCC SR15, Table 2.2

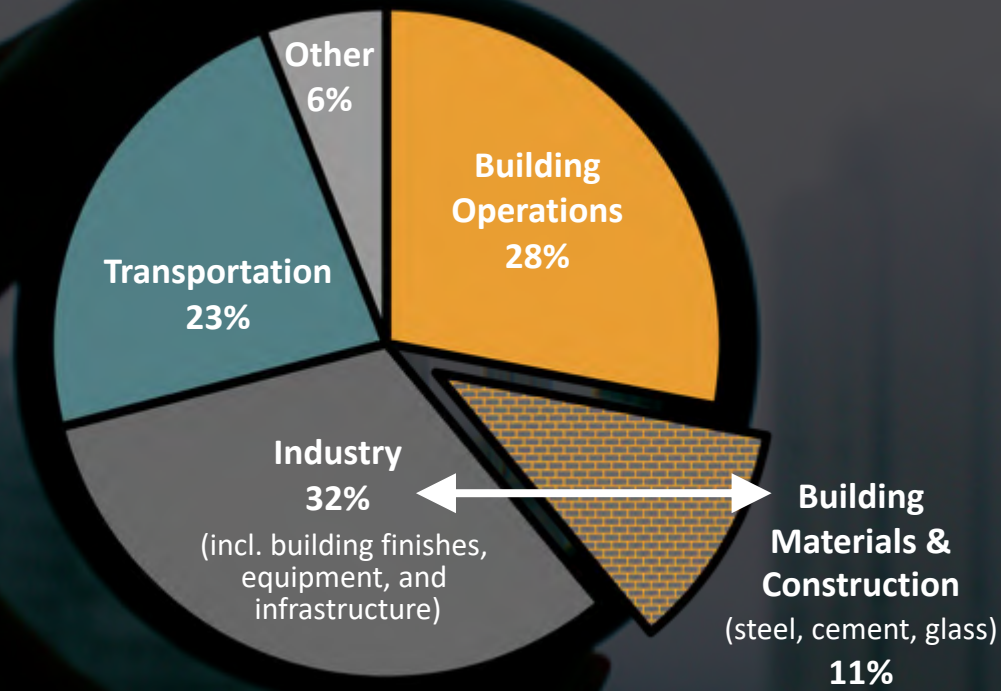




Materials,  
Construction  
& Infrastructure

New  
Buildings

Existing  
Buildings

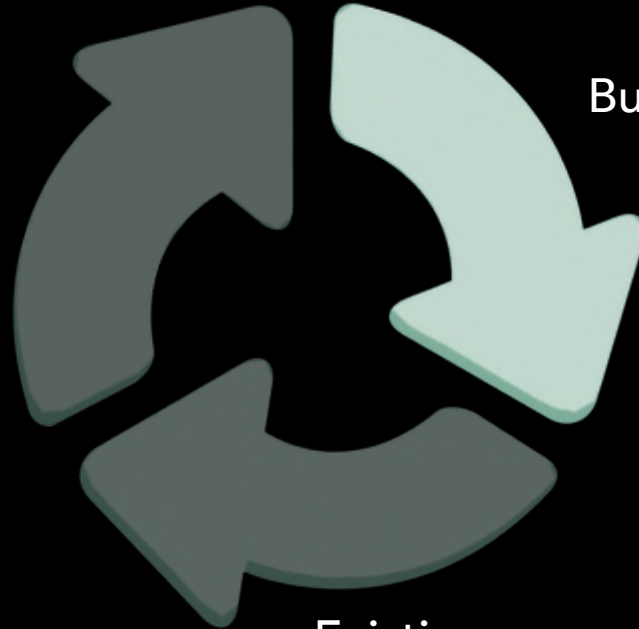


Source:  
2018 Global ABC Report

## Global CO<sub>2</sub> Emissions by Sector



Materials,  
Construction  
& Infrastructure



New  
Buildings

Existing  
Buildings

**Zero Emissions for New Construction**

**NOW!!!**

**2030 at the latest**





# Zero Emissions for New Construction Will Require:

ENERGY-EFFICIENT  
NEW  
CONSTRUCTION

+

CARBON-FREE  
RENEWABLE  
ENERGY

+

ZERO  
ON-SITE  
EMISSIONS



Angie Wang

Source: Architecture 2030  
Graphic adaptations: Sefaira; DOE, Green Ideas

Introducing the **ZERO Code** standard for new commercial, institutional, and mid- to high-rise residential buildings.

[zero-code.org](http://zero-code.org)



# ZERO CODE™

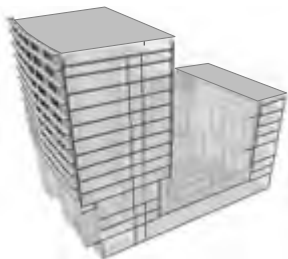
U.S. & International **ZERO Code** Standards



## How it works . . .

1

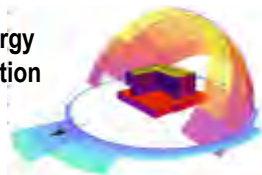
Design an energy efficient building in compliance with the 2021 IECC *or better*.



2

Establish the building's renewable energy requirement from:

an energy simulation



or

default renewable energy table

29

Building Type

Building Area Type	Climate Zone	Climate Zone												
		01	02	03	04	05	06	07	08	09	10	11	12	
Residential (R-2)	A	20	20	20	20	20	20	20	20	20	20	20	20	20
Residential (R-3)	A	20	20	20	20	20	20	20	20	20	20	20	20	20
Healthcare/Hospital (H)	1-10	20	20	20	20	20	20	20	20	20	20	20	20	20
Government (G-1)	1-10	20	20	20	20	20	20	20	20	20	20	20	20	20
Office	1-10	20	20	20	20	20	20	20	20	20	20	20	20	20
Manufacturing (M-2)	1-10	20	20	20	20	20	20	20	20	20	20	20	20	20
Retail (R-1)	1-10	20	20	20	20	20	20	20	20	20	20	20	20	20
School (S)	1-10	20	20	20	20	20	20	20	20	20	20	20	20	20
Warehouse (W)	1-10	20	20	20	20	20	20	20	20	20	20	20	20	20
Others	1-10	20	20	20	20	20	20	20	20	20	20	20	20	20

Source: Architecture 2030  
Graphic adaptations: Sefaira; DOE, Green Ideas

3

Meet the requirement by integrating onsite renewable energy when feasible.



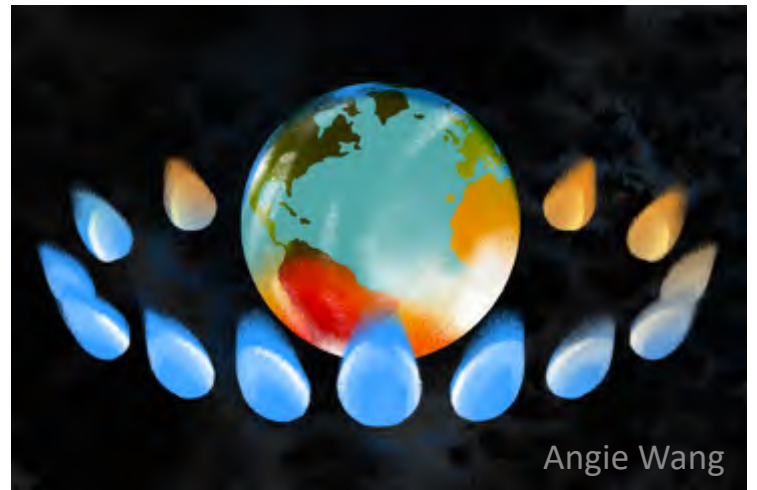
4

If necessary, procure offsite renewable energy.



Opinion **The New York Times**

# Your Gas Stove Is Bad for You and the Planet



Angie Wang

To help solve the climate crisis, we need to electrify everything.

**By Justin Gillis and Bruce Nilles**

Mr. Gillis is a former New York Times environmental reporter and a contributing opinion writer.

Mr. Nilles is a managing director at Rocky Mountain Institute.

May 1, 2019



787



# Berkeley became first US city to ban natural gas. Here's what that may mean for the future

~~Susie Cagle in Oakland~~

Tue 23 Jul 2019 23.34 EDT

The California city on Tuesday voted to **ban natural gas hook-ups** in new buildings, in a historic move



▲ The view of the Bay from the Berkeley Hills. Photograph: Alamy Stock Photo



**MICROGRID  
KNOWLEDGE**

September 20, 2019 by Lisa Cohn

# Another City — San Jose, California — Goes All Electric in a Growing Trend

## San Jose is 8th all electric California city

San Jose is the eighth California city to pass measures to prioritize electricity.

In July, Berkeley became the nation's first city to prohibit natural gas from new construction, and cities including Menlo Park, San Luis Obispo, Santa Monica, San Mateo, Windsor and Carlsbad have all passed codes incentivizing or requiring all electric new construction recently.

# Natural Gas Increasingly ‘Vilified’ and ‘Demonized,’ Says BP’s Dudley

[Carolyn Davis](#)

October 9, 2019

In the UK, gas heating for new houses is set to be banned by 2025. In the United States, “at least 12 big cities have banned or plan to ban gas in new buildings.” A \$500 million campaign led by former New York Mayor [Michael Bloomberg](#) would halt building gas-fired power plants.



[Kim Brinnhuber](#) · CBC News ·

Posted: Oct 16, 2019 4:00 AM ET | Last Updated: October 16

# Climate change's next target: your natural gas range

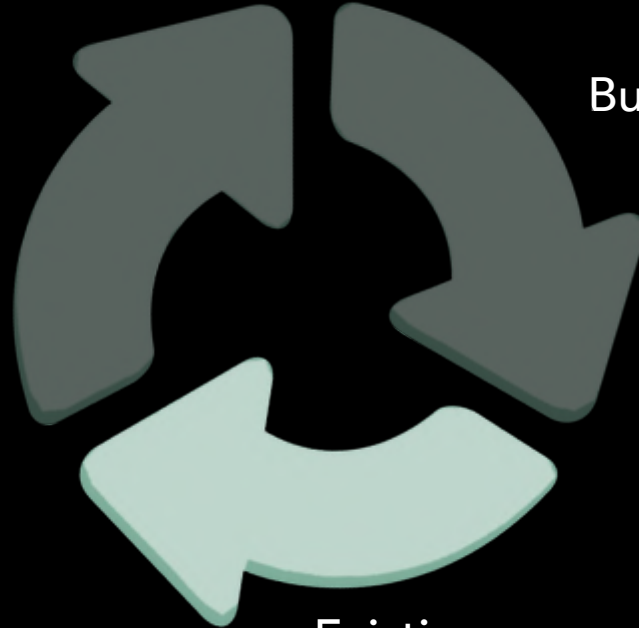
In July, Berkeley became the first city in the U.S. to ban natural gas from all new building construction. And in September, San Jose — the 10th most populous U.S. city — enacted a similar measure. Now, more than 50 other cities and counties are considering following suit.



# THE VALUE PROPOSITION: CO-BENEFITS

- HEALTH – Indoor Air Quality / Outdoor Air Quality
- SAFETY – Burns / Explosions
- RESILIENCY – Downtime of Service
- COMFORT – Heating and Cooling
- TECHNOLOGY – Modern 21<sup>st</sup> Century
- CLIMATE – *Lower Emissions / No Methane Leaks*
- *COST – Single Utility / Cheaper to Operate or Cost Neutral*

Materials,  
Construction  
& Infrastructure



New  
Buildings

Existing  
Buildings

Zero Emissions for Existing Buildings

**50 - 65% REDUCTION  
BY 2030**



# Zero Emissions for Existing Buildings will Require:

BIG BUILDING  
POLICIES

+

SMALL BUILDING  
POLICIES

## NYC Building GHG Emissions Limits (Local Law 97)

This bill establishes  
greenhouse gas emissions  
limits for existing buildings  
and retro-commissioning  
requirements for certain  
buildings over 25,000 square  
feet.

**Targeted  
Longevity  
Consistency**

# Zero Emissions for Existing Buildings will Require:

BIG BUILDING  
POLICIES

+

SMALL BUILDING  
POLICIES

**Burlington Time of Sale  
Energy Efficiency Ordinance**  
Mandated cost-effective  
minimum energy efficiency  
standards enforced when  
rental buildings are sold.

**Equitable**  
**Simple**  
**Prescriptive**



## ACHIEVING ZERO FRAMEWORK

Reaching a 50% carbon emissions reduction in the built environment by 2030, and zero emissions by 2050, is critical if we are to successfully manage climate change. Achieving Zero is a framework and set of tools to help city and sub-national governments (state, provincial, and regional) meet this target.

[LEARN MORE](#)

# POLICY PRECEDENTS

## **Berkeley Prohibition of Natural Gas Infrastructure in New Buildings**

This citywide ordinance bans natural gas infrastructure in new construction.

## **NYC Building GHG Emissions Limits (Local Law 97)**

This bill establishes greenhouse gas emissions limits for existing buildings and retro-commissioning requirements for certain buildings over 25,000 square feet.

## **Burlington Time of Sale Energy Efficiency Ordinance**

Mandated cost-effective minimum energy efficiency standards enforced when rental buildings are sold.

# CITY ANALYSIS

## 0 FRAMEWORK

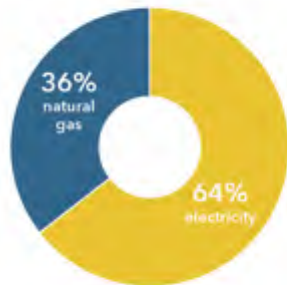
TOTAL BUILDING GHG EMISSIONS BY SIZE\*  
(percentage)



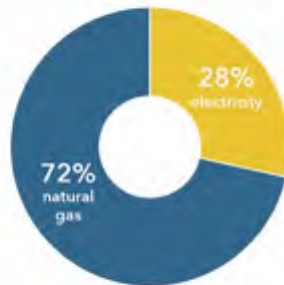
**Grand Rapids**

\*Modeled results based on publicly available data

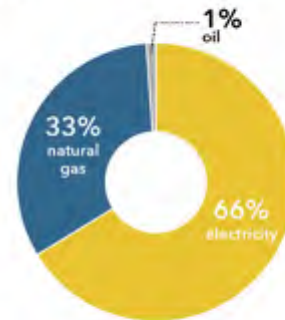
BUILDING SECTOR GHG EMISSIONS BY FUEL TYPE\*  
(percentage)



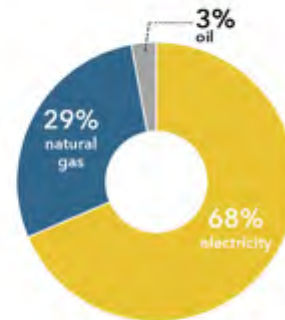
**Grand Rapids**



**San Francisco**



**Cambridge**



**Washington D.C.**

\*Modeled results based on publicly available data - may differ from actual emissions. Does not account for fugitive emissions of natural gas infrastructure and distribution.



*achieving-zero.org*

## ACHIEVING ZERO FRAMEWORK

Reaching a 50% carbon emissions reduction in the built environment by 2030, and zero emissions by 2050, is critical if we are to successfully manage climate change. Achieving Zero is a framework and set of tools to help city and sub-national governments (state, provincial, and regional) meet this target.

LEARN MORE



Materials,  
Construction  
& Infrastructure

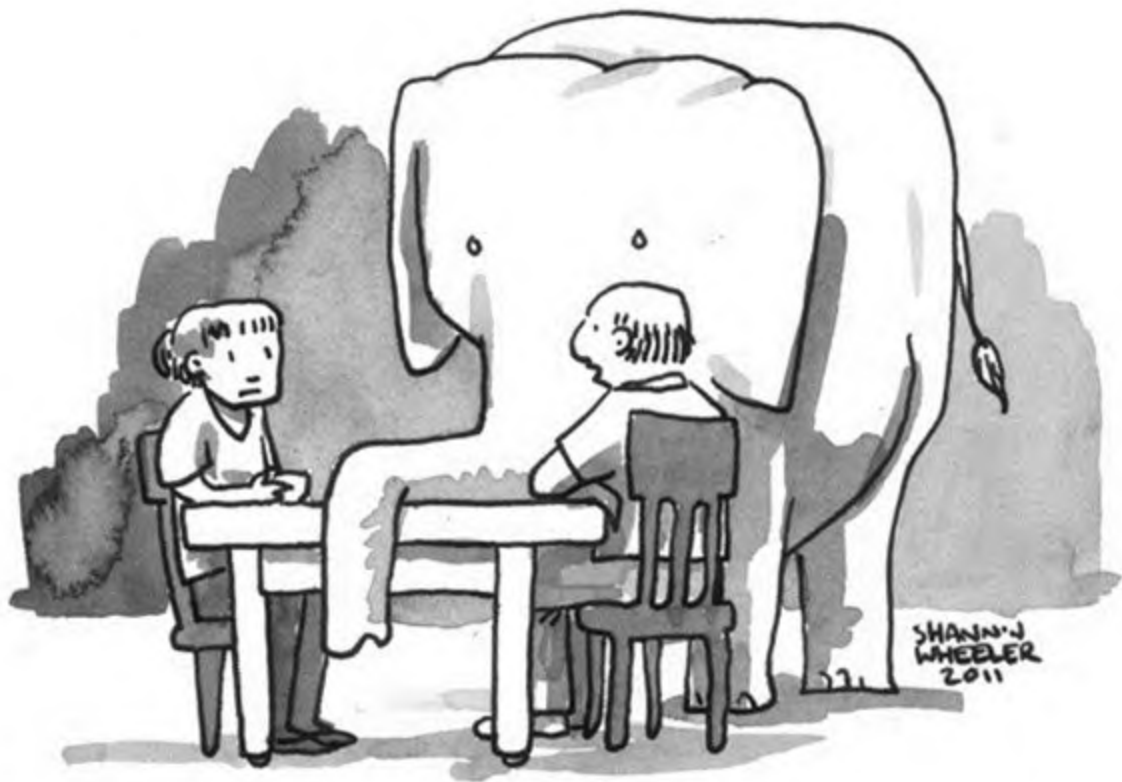


New  
Buildings

Existing  
Buildings

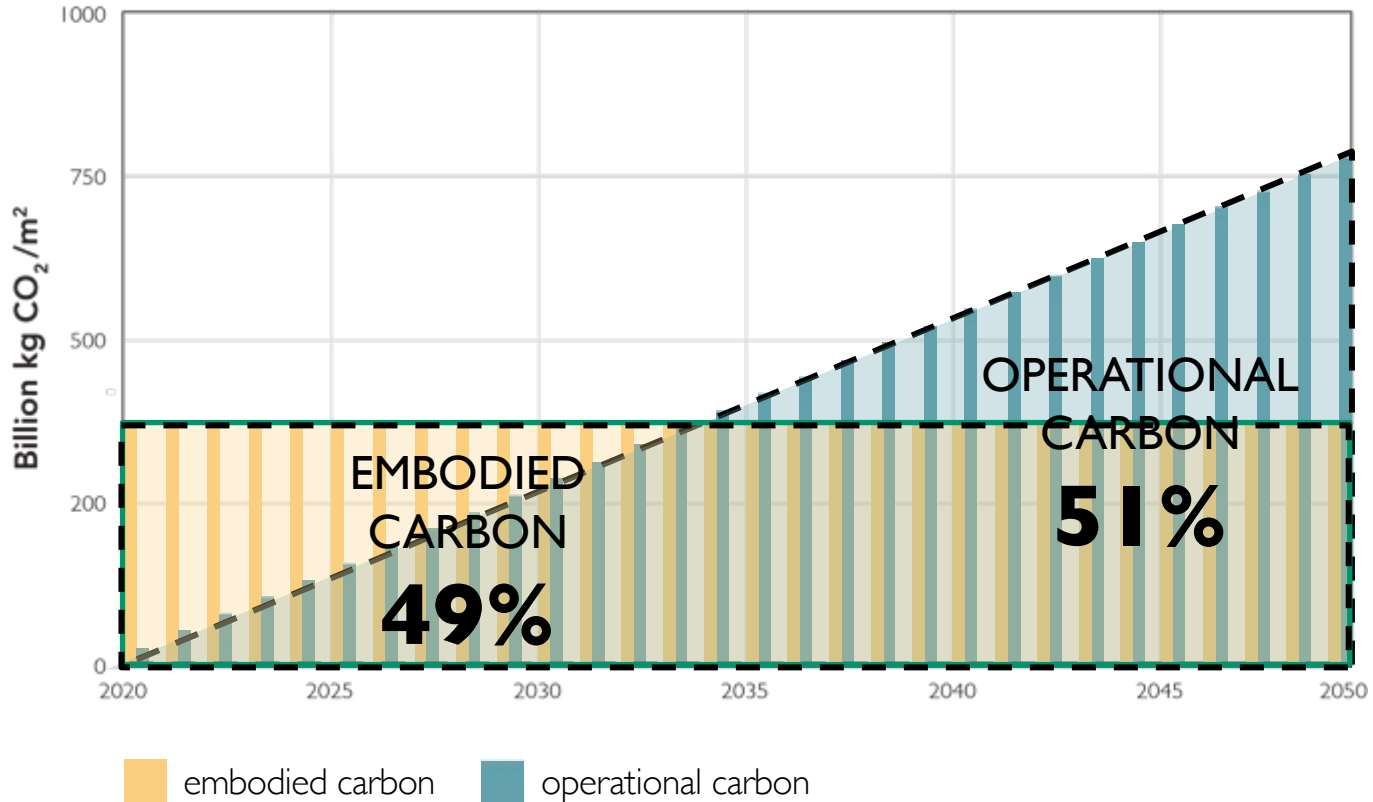
**50 - 65% REDUCTION  
BY 2030**





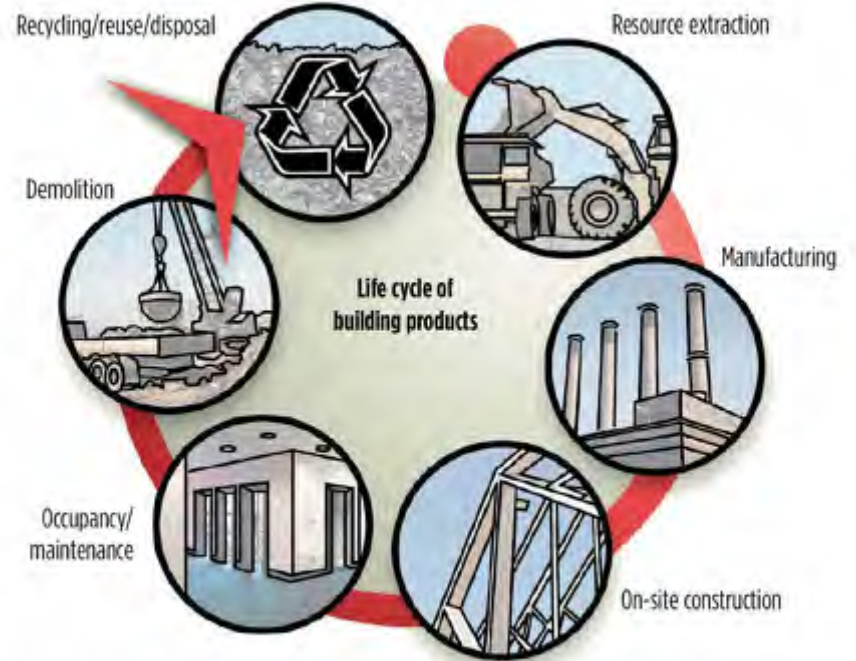
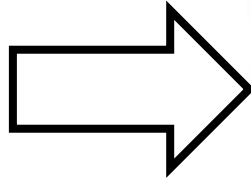
"HONESTLY? I PREFERRED WHEN WE  
DIDN'T TALK ABOUT THE ELEPHANT"

# Total Carbon Emissions of **All Global New Construction** from **2020-2050** *Business as Usual Projection*





# Embodied Carbon

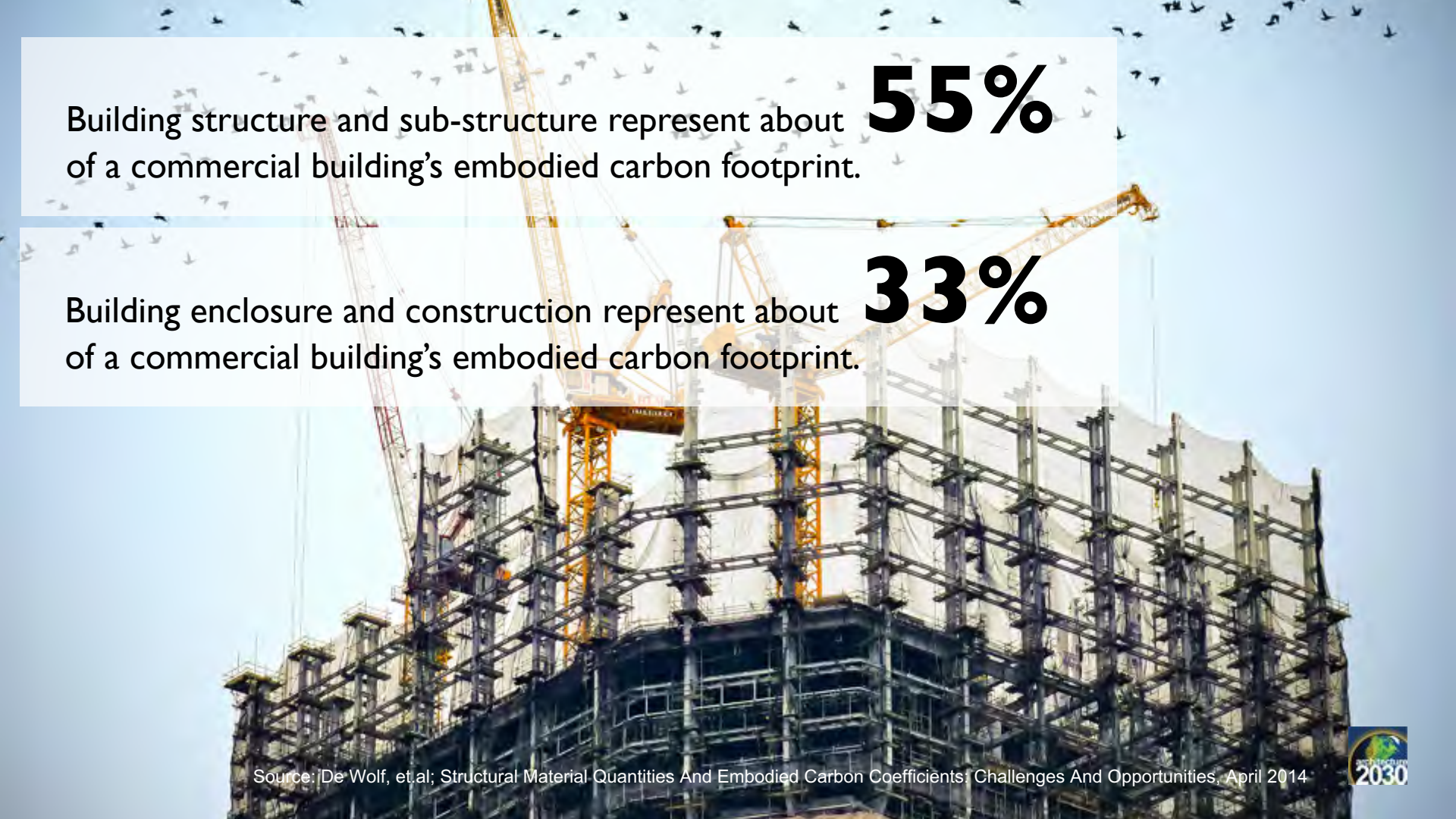


**Life Cycle Assessments**  
Environmental Product Declarations



**HOW DO WE  
REDUCE EMBODIED  
CARBON?**





Building structure and sub-structure represent about  
of a commercial building's embodied carbon footprint.

**55%**

Building enclosure and construction represent about  
of a commercial building's embodied carbon footprint.

**33%**



# Reducing **Operational** Energy/Carbon in Design and Policy



## Prescriptive Path



BUILDING ENVELOPE



HVAC



LIGHTING

## Performance Path



ENERGY MODEL

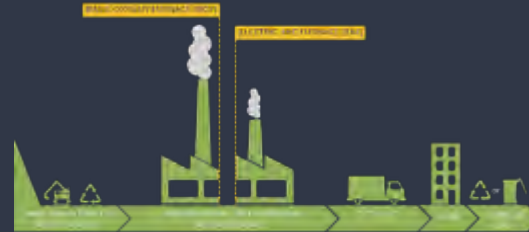
# Reducing **Embodied Carbon** in Design and Policy



## Prescriptive Path

- ELECTRIC ARC FURNACE
- 100% RENEWABLE ENERGY
- 100% RECYCLED STEEL

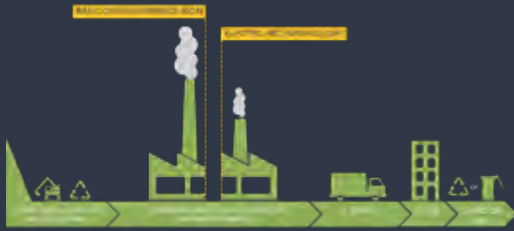
## Performance Path



EPDs & WHOLE BUILDING LCAS

# Reducing **Embodied Carbon** in Design and Policy

## Performance Path



EPDs & WHOLE BUILDING LCAS

EC3  
ATHENA IE  
QUARTZ  
TALLY\*  
ONE CLICK LCA\*  
PRIOPTA\*

\*Requires purchase



# Reducing **Embodied Carbon** in Design and Policy

## Prescriptive Path



ELECTRIC ARC FURNACE



100% RENEWABLE ENERGY



100% RECYCLED STEEL



**CARBON SMART  
MATERIALS  
PALETTE**



# CARBON SMART

## MATERIALS PALETTE™

## HIGH-IMPACT MATERIALS

Predominant building materials with high-impact potential for emissions reductions



CONCRETE



STEEL



WOOD



INSULATION

## CARBON-SMART MATERIALS

Low carbon/carbon sequestering materials





# CARBON SMART MATERIALS PALETTE™

## PALETTE

High Impact Materials Swatches

Carbon Smart Materials Swatches

Whole Building Approaches

## SWATCHES

Carbon Impact Information

Carbon Smart Attributes

Carbon Smart Design & Construction Guidance

Acknowledged Challenges,  
Questions, Unknowns

Resources

⋮  
NEXT STEP



Specifications  
&  
Policy Framework

[materialspalette.org](http://materialspalette.org)



# POLICY PRECEDENTS

## **Bay Area Low-Carbon Concrete Code**

A low-carbon concrete building code slated to be released in late 2019 for inclusion with triennial code updates, as well as model specifications and case studies.

## **AB 262: Buy Clean California Act**

Embodied carbon policy that requires facility-specific EPDs and will establish a maximum acceptable GWP for each category of material.





**CNCA**  
CARBON NEUTRAL CITIES ALLIANCE



PRESS RELEASE – 26 September 2019

## **Policy Framework to Dramatically Reduce Embodied Carbon in Cities Developed to Respond to Climate Goals**

*A policy framework for reducing embodied carbon in infrastructure, buildings and construction is being developed by the Carbon Neutral Cities Alliance and Bionova Ltd, in cooperation with Architecture 2030. The framework will enable cities to adopt and implement policies to reduce embodied carbon, or carbon from materials and construction, a necessity to meet climate goals.*

# CARBON POSITIVE '19 '20

**AIA LFRT • SUMMIT**

April 10, 2019

September 26 – 27, 2019

**CONFERENCE**

March 2 – 4, 2020



# CARBON' POSITIVE 20

INTERNATIONAL CONFERENCE & EXPO

Los Angeles, March 2-4, 2020



# CARBON'20 POSITIVE

## SUMMIT TOPIC AREAS

Materials, Specifications, Policies & Innovation

(low-carbon & carbon positive materials that convert carbon into durable products)

Cities: Planning & Land Use

(explosive urbanization, infill, infrastructure & deforestation)

Building Design

(embodied/operational carbon, structure+enclosure, & adaptive reuse)

Design & Planning Tools

(UrbanFootprint, EC3, Asterik, Tally)

