GLOSSARY

GENERAL TERMS

**Climate Change**: Changes in average weather conditions that persist over multiple decades or longer. Climate change encompasses both increases and decreases in temperature, as well as shifts in precipitation, changing risk of certain types of severe weather events, and changes to other features of the climate system. Source: [https://www.globalchange.gov/climate-change](https://www.globalchange.gov/climate-change)

**Climate Action Plan**: Climate action plans are comprehensive roadmaps that outline the specific activities that an agency will undertake to reduce greenhouse gas emissions. Climate action plans build upon the information gathered by greenhouse gas inventories and generally focus on those activities that can achieve the relatively greatest emission reductions in the most cost effective manner. Source: [http://www.ca-ilg.org/climate-action-plans](http://www.ca-ilg.org/climate-action-plans)

**Sustainability**: Sustainability is based on a simple principle: Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. To pursue sustainability is to create and maintain the conditions under which humans and nature can exist in productive harmony to support present and future generations. Source: [https://www.epa.gov/sustainability/learn-about-sustainability#what](https://www.epa.gov/sustainability/learn-about-sustainability#what)

**Renewable**: A source of energy that is not depleted by use, such as water, wind, or solar power; a source of energy that can be used repeatedly and can be replaced naturally. Source: Google Dictionary

ELECTRICITY

**Resilience**: Extreme weather and other natural disasters can threaten lives, disable communities, and devastate electric utilities’ generation, transmission, and distribution systems. EPRI is continuing to work with electricity industry stakeholders in developing innovative technologies that can help ensure the resiliency of the electricity distribution system during such events. Efforts to “harden” the electricity grid must focus on three elements: prevention, recovery and survivability. Source: [https://www.epri.com/#/pages/sa/grid-resiliency?lang=en-US](https://www.epri.com/#/pages/sa/grid-resiliency?lang=en-US)

**Carbon Dioxide**: A naturally occurring gas, and also a by-product of burning fossil fuels and biomass, as well as land-use changes and other industrial processes. It is the principal anthropogenic greenhouse gas that affects the Earth’s radiative balance. It is the reference gas against which other greenhouse gases are measured and therefore has a Global Warming Potential of 1. Source: [https://www.fs.fed.us/climatechange/documents/glossary.pdf](https://www.fs.fed.us/climatechange/documents/glossary.pdf)

**Carbon Free**: Not producing any carbon compounds such as carbon dioxide that might contribute to pollution; not associated with net emission of carbon dioxide to the atmosphere. Source: [https://www.lexico.com/en/definition/carbon-free](https://www.lexico.com/en/definition/carbon-free)

**Carbon Neutral**: Being carbon neutral involves calculating your total climate-damaging carbon emissions, reducing them where possible, and then balancing your remaining emissions, often by purchasing a carbon offset. Source: [https://www.fs.fed.us/climatechange/documents/glossary.pdf](https://www.fs.fed.us/climatechange/documents/glossary.pdf)
Decarbonization: Decarbonization is the process by which the average amount of carbon in primary energy reduces over a period. This effect is caused by the increased use of fuels with low carbon content as compared to the reduced use of fuels with high carbon content. The decarbonization in the electricity sector means reducing the carbon intensity of the emissions per each unit of electricity which is generated. It is merely the removal or extraction of carbon dioxide from the energy sources. In addition, decarbonization can be defined as the process of reducing GHG gas (greenhouse gas) emissions which occur as a result of activities such as transport (due to fuels used in transportation services), production of electricity, emissions coming from manufacturing plants, recycling or disposal of some products and vehicles. Source: https://greencoast.org/terms/decarbonization-definition/

Embodied carbon: Making building materials and products cause greenhouse gas emissions. Activities such as mining, driving trucks, running factories, and combining chemicals result in emissions to the air, earth, and water. Embodied carbon is the sum impact of all the greenhouse gas emissions attributed to the materials throughout their life cycle (extracting from the ground, manufacturing, construction, maintenance and end of life/disposal). Source: http://www.carbonleadershipforum.org/about/why/

ZERO Code: ZERO Code is a national and international building energy standard for new building construction that integrates cost-effective energy efficiency standards with on-site and/or off-site renewable energy resulting in zero-net-carbon buildings. The ZERO Code includes prescriptive and performance paths for building energy efficiency compliance based on current standards that are widely used by municipalities and building professionals worldwide. The ZERO code for California is a building energy standard for new nonresidential, high-rise residential and hotel/motel buildings, the prevalent building types being constructed in cities today. The ZERO Code for California is based on the 2019 California Building Energy Efficiency Standards (BEES). The ZERO Code offers code adaptable language and a flexible approach for incorporating renewable energy, both through on-site generation and/or off-site procurement. Source: https://zero-code.org/ABOUT/

AIA2030: The mission of the AIA 2030 Commitment is to support the 2030 Challenge and transform the practice of architecture in a way that is holistic, firm-wide, project based, and data-driven. By prioritizing energy performance, participating firms can more easily work toward carbon neutral buildings, developments and major renovations by 2030. Joining the 2030 Commitment gives you access to the Design Data Exchange (DDx), a national framework created by AIA with simple metrics and a standardized reporting format for measuring progress. The confidential, easy-to-use DDx lets you pinpoint best practices and anonymously compare project performance in your firm and beyond. The research tool allows you to compare projects of similar type, size, climate, and a host of other attributes across the 2030 portfolio.

Sources:
AIA 2030: https://www.aia.org/resources/202041-the-2030-commitment
Design Data Exchange: https://2030ddx.aia.org/users/sign_in

CA SB 100 2045: On September 10, 2018, Governor Jerry Brown signed California’s most ambitious energy bill into law: Senate Bill 100 (SB100). This environmental measure sets a world-leading precedent by committing 100% clean energy in California by 2045, speeding up the state’s timeline for moving to carbon-free power sources. Source: https://www.bloomenergy.com/blog/sb-100-californias-commitment-100-clean-energy
Electrical Grid: The electrical grid is the electrical power system network comprised of the generating plant, the transmission lines, the substation, transformers, the distribution lines and the consumer.

The electrical grid is divided into three main components:

- **Generation**: There are two types of generation – centralized and decentralized. Centralized generations refers to large-scale generation far from consumption. This includes coal, nuclear, natural gas, hydro, wind farms and large solar arrays. The grid connects centralized power to consumers. Decentralized generation occurs close to consumption, for example rooftop solar.

- **Transmission and Distribution**: Transmission includes transformers, substations and power lines that transport electricity from where it is generated to points of consumption. When electricity is at high voltages, transmission losses are minimized over long distances and resistive transmission lines. Therefore, at the point of generation, substations contain transformers that step-up the voltage of electricity so that it can be transmitted. Transmission is achieved via powerlines and can occur either overhead or underground. When it arrives at points of consumption, another substation is found to step-down the voltage for end-use consumption.

- **Consumption**: There are various types of consumers; namely industrial, commercial and residential consumers. Each of these consumers has different needs but in general electricity delivers important energy services like light and power for appliances.

Source: [https://www.studentenergy.org/topics/electrical-grid](https://www.studentenergy.org/topics/electrical-grid)

**Off-grid or Stand-Alone**: The term “off the grid” refers to living autonomously without reliance on a utility for power. When a building is off the grid, it means it has no connection or relationship with a utility. All power used is generated directly by the consumer for use. Source: [https://news.energysage.com/what-does-it-mean-to-go-off-the-grid/](https://news.energysage.com/what-does-it-mean-to-go-off-the-grid/)

**Battery Energy Storage System**: Battery Energy Storage System (BESS) is a system that stores energy, using a battery technology, to be used at a later time. The energy storage system is used to ensure that there is a steady flow of power even the main grid is down. Source: [https://greencoast.org/terms/battery-energy-storage-system/](https://greencoast.org/terms/battery-energy-storage-system/)


**CARBON**

**GHG: Green House Gas** – CO2 and other heat trapping gases such as methane SOX, NOX and HCFC’s

**Carbon or carbon emissions**: used interchangeably with GHG emissions
**Embodied carbon**: the carbon emissions from constructing a building – including the materials, construction equipment, and transport directly related to construction. This should also include the sitework and utilities necessary to build the building.

**Operating emissions**: the carbon emissions from operating a building – heating, cooling, ventilation, lights, equipment, appliances, etc. These include direct emissions (on-site fossil fuel combustion) and indirect emissions from electric power generation.

**ZNE - Zero Net Energy**: a building that produces the same amount of energy from renewable sources as it consumes on an annual basis, (typically it over produces in the summer and under produces in the winter)

**Zero Operating Emissions**: no emissions from building operations (all electric building, powered by renewable sources)

**Zero emissions**: no emissions from building operations and zero or offset emissions from construction (same as above and + of materials that sequester atmospheric carbon)

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**Time Value of Carbon**

*When you save matters, what you build matters: Build well, Rebuild better*

A 2018 special report of the International Panel on Climate Change (IPCC) made it clear that to avoid catastrophic, irreversible climate change, we need to keep global temperature rise below 1.5°C above pre-industrial levels. To meet that goal, GHG emissions will need to peak by 2020 and we need to be carbon neutral in about 12 years.

Given those goals, there are three critical things we need to consider when we evaluate carbon reduction strategies: The first is the amount of potential savings a strategy offers, and the second is the time frame of those savings - we need strategies that can produce large savings quickly, and finally we need strategies that reduce current emissions, (drawdown) not just reduce or avoid new emissions.

The built environment - as an end user of fossil fuels, accounts for more emissions than any other end use sector – about 40% of global emissions according to the IPCC. The current gold standard for reducing emissions from buildings is to build new, zero net energy (ZNE) buildings – super efficient, buildings powered by renewable energy sources. Given that we are on target to double our building stock by 2060, this is an critical component of getting to a carbon neutral built environment – we can’t keep adding new buildings with new emissions. But there is a problem with this strategy: building those new, ZNE buildings will generate a lot of emissions.

Two other sources of emissions may be even more important to address in the short term:
- Embodied emissions from building materials, construction activities
- Operating emissions from existing buildings.

**Embodied Emissions (eCO2) – New Buildings**

Embodied emissions are the first emissions a building generates.

In the U.S. we are currently building about 6 billion sq. ft. a year and the embodied emissions from building those new buildings is somewhere between **300 to 400** million metric tons per year. If they are new, relatively efficient buildings, operating them will generate **30 to 40** million metric tons per year. If we manage to make them ZNE, then the only emissions will be the embodied emissions. So, while new buildings need be ZNE, we also need to reduce embodied emissions. We know we can reduce embodied emissions by around 30%, relatively easily with existing materials and technology by using lower carbon
materials and employing more efficient design and construction processes. We can also reuse the buildings we already have. Building renovation generates significantly lower emissions than a new construction does and creates an opportunity to reduce the operating emission from existing inefficient buildings as well. Ultimately, we need to develop and use carbon sequestering materials and turn buildings into carbon sinks rather than carbon emitters.

**Operating Emissions \( (oCO_2) \) - Existing Buildings**

Operating emissions from existing buildings are an even bigger source of emissions. In 2012 we had about 310 billion sq. ft. of buildings in the United States and operating them generates about **2.3 billion metric tons** of GHG emissions every year – about 1/3 of total U.S. GHG emissions. The majority of the buildings in use today will still be in use in twelve years, so these are the buildings we need to improve.

So, one critical piece of getting to a carbon neutral built environment include renovating and upgrading existing buildings and buildings and building fewer new buildings. When the renovations include deep energy upgrades - even making them net zero, we address two sources of GHG missions at the same time – we reduce embodied emissions compared to new buildings, and we reduce operating emissions from existing buildings. And the good news is, we already know how to do this.

− Improve efficiency - upgrade the lighting, HVAC systems, equipment, controls, etc.
− Improve the building envelope – insulation, windows, shading, air sealing, daylighting
− Convert to all electric, eliminate direct emissions from fossil fuels
− Power them with renewable energy.

ZNE remolds are not as hard as we might think. We co-authored a post occupancy study of a 20,000 sf, two-story office remodel and upgrade that is now generating more energy that it consumes - a net positive building. This interior remodel upgraded equipment and lighting, added skylights and PV’s, with only minimal upgrades to the envelope, (roof insulation). The remodel generated about 1/3 of the embodied emissions that a new building would have and will save about 5,000 tons of CO2 over the next 20 years.

Given the urgency of climate change, for deep green retrofits, we also need to evaluate the initial embodied CO2 investment against the carbon savings from that upgrade. How much carbon was invested to get to zero and how long will it take the savings from increased efficiency to offset that investment? When you do this analysis, the answers may surprise you. Blowing in insulation or re-commissioning existing HVAC and lighting systems are likely good investments of embodied CO2; re-skinning an existing building with a high-performance aluminum / glass curtain wall may not recoup the carbon emitted in the time frame we have. We need to start evaluating all of our reduction strategies in light of how much carbon they save within the next 12 years.

It’s time to rethink our goals for reducing emissions from the built environment:

− **Prioritize early savings over long term savings**
− **Reduce embodied emissions from new buildings to zero by 2050**
  Convert existing buildings to all electric, by 2030, and zero emissions by 2050
− **Make all new buildings net zero by 2030**