



What is a “Carbon Neutral” Building?

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Globe and Mail, May 10, 2013: “Carbon dioxide hits levels not seen for three million years”¹

For the past 20 years, governments worldwide have attempted to curtail carbon emissions by introducing policies and regulations; contrary to the expected reduction, there is an alarmingly unprecedented rise in carbon.

With growing pressure from the public on governments and organizations to address climate change, the term ‘carbon neutral’ has become increasingly used in recent years. Carbon neutral is an emerging definition that relates to measuring, reducing and offsetting carbon energy used by either a building or an organization as a whole. To provide a little background, a popular approach for designing a carbon neutral building is as follows:

1. Integrating passive design strategies
2. Designing a high performance building envelope
3. Specifying energy efficient HVAC systems, lighting and appliances
4. Installing on-site renewable energy
5. Offsetting

To help BC municipalities develop policies and regulations relating to carbon neutral building design and construction, Light House published: *Towards*

¹ Globe and Mail Published May 10, 2013
<http://www.theglobeandmail.com/news/world/carbon-dioxide-hits-levels-not-seen-for-three-million-years/article11874930/#dashboard/follows/>

Carbon Neutral Buildings in BC: Framework for High-Rise Multi-Unit Residential Buildings, in July 2012. The framework consists of defensible, actionable and measurable targets to assist municipalities in the development of policy goals relating specifically to carbon neutral multi-residential buildings.

The report’s definition for carbon neutral building follows the common theme of the various definitions attached to carbon-based building policies that have emerged worldwide. A carbon neutral building is defined as one with significantly reduced energy consumption combined with the increased use of low carbon energy sources to meet the remaining demand. This definition is also consistent with existing BC provincial and municipal regulations, e.g. City of Vancouver has already established a goal for all new construction to be carbon neutral by 2030.

There is often a lack of transparency regarding what is meant by different organizations’ usage of the term. Even when it is well defined, there are discrepancies between definitions such as the scope of emissions sources included, the targets for reductions of emissions, and the quality of offsets used. A carbon neutral definition should include specific information/requirements relating to the following:

- System boundary – includes within it all areas associated with the buildings where energy is used or produced; i.e. operational energy, embodied energy of the materials used, energy used for the construction process and travel for occupants.
- Renewable energy and carbon offset 3rd party certification.
- Verification or certification of the calculated carbon emissions.

This paper presents and discusses some of the key international definitions of carbon neutrality worldwide and how they relate to buildings in particular.

UK Department of Energy and Climate Change

The UK's Department of Energy and Climate Change (DECC) has developed a series of guidelines surrounding the use of the term carbon neutrality, to discourage "greenwashing" and provide greater clarity around the concept. According to their definition, "*Carbon neutral means that – through a transparent process of calculating emissions, reducing those emissions and offsetting residual emissions – net carbon emissions equal zero.*"²

At a minimum, Scope 1 and Scope 2 emissions should be included in any calculation of emissions. Scope 1 emissions (direct emissions) are those from equipment that is owned or controlled at a building scale and that releases emissions straight into the atmosphere, such as those from combustion in boilers or furnaces on site. Scope 2 emissions (energy indirect) are emissions associated with consumption of *purchased* electricity, heat, steam and cooling. While these emissions are released directly into the atmosphere, they are indirect emissions from the perspective of an individual building as they are produced by sources not owned or controlled at the building scale.

In addition, the DECC recommends that significant Scope 3 emissions are also included in calculations. These include all other associated activities that release emissions from sources that are not owned or controlled at the building scale, and which are not classed as Scope 2 emissions. Scope 3 emissions would reflect sources such as business travel in vehicles owned by others.

The DECC also provides clarity around the role of emissions reduction versus emissions offsetting to claim carbon neutrality. Projects should always seek to reduce emissions first, thereby minimizing the emissions that need to be offset. Therefore, a carbon neutral claim consisting only of calculating emissions and offsetting should not be made. Carbon neutrality should only be claimed after verified genuine carbon savings have been achieved, and the claim should clearly report the remaining amount of emissions required to be offset. The DECC's quality criteria for carbon offsets include: avoiding leakage, permanence, validation and verification, additionality, timing, avoiding double counting, and transparency.

The DECC recommends that results are verified by PAS2050 (Specification for the assessment of the life cycle greenhouse gas emissions of goods and services) or ISO 14064 (Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals) standards. Finally, a claim of carbon neutrality should always be linked to a particular and specified period of time, because doing so will ensure the claim is understandable and transparent.

EU Energy Performance of Buildings Directive 2010/31/EU³

Rather than carbon neutral buildings, the Energy Performance of Building Directive (EPBD) focuses on nearly zero energy buildings, requiring that all new buildings must be nearly zero energy by 2020. A nearly zero building is defined as one that "...has a very high energy performance ... [the] very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site". The quantitative value of "nearly zero" is left to each member state to define, but is to be tied to primary energy demand. However, there is much collaboration between member states, namely through the Concerted Action EPBD mechanism.⁴

²UK Department of Energy and Climate Change, "Guidance on carbon neutrality", <http://www.decc.gov.uk/en/content/cms/emissions/neutrality/neutralty.aspx>

³ Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32012R0244:EN:NOT>

⁴ <http://www.epbd-ca.eu/>

Even though this is technically not a definition for carbon neutral building, the intent is similar to many of the other carbon neutral building definitions.

Carbon Neutral Design Project (AIA and SBSE)

The Carbon Neutral Design Project, a partnership of the American Institute of Architects (AIA), the AIA Committee on the Environment (COTE), and the Society of Building Science Educators (SBSE) was developed in part as a response to the Architecture 2030 Challenge, which targets carbon neutral architecture by 2030. The Carbon Neutral Design Project goes one step further than the DCEE, adding embodied energy to the scope of their 3-component definition:

- **“Carbon Neutral - Operating Energy:** The base definition for Carbon Neutral Design is taken from www.architecture2030.org. Carbon neutral with respect to Operating Energy means using no fossil fuel GHG emitting energy to operate the building. Building operation includes heating, cooling and lighting. These targets may be accomplished by implementing innovative sustainable design strategies, generating on-site renewable power and/or purchasing (20% maximum) renewable energy and/or certified renewable energy credits. According to the Carbon Neutral Design Protocol Tool developed for this project, this includes Scope 1: Carbon due to Direct Emissions, as well as Scope 2: Carbon due to Indirect Emissions. It is felt that at the present time, Operating Energy accounts for approximately 70% of the carbon emissions associated with a building.
- **Carbon Neutral - Operating Energy + Embodied Energy:** This definition for Carbon Neutrality builds upon the definition above and also adds the carbon emissions associated with energy embodied in the materials used to construct the building. A tool such as Athena Institute's Impact Estimator for Buildings⁵ is very useful to determine the associated carbon emissions with building material choices.

- **Carbon Neutral - Operating Energy + Site Energy + Occupant Travel:** This definition of carbon neutrality builds upon the inclusion of operating energy and embodied energy, and also reflects the carbon costs associated with a building's location. This requires a calculation of the personal carbon emissions associated with the means and distance of travel of all employees and visitors to the building. This is referred to as Scope 3 Carbon due to Indirect Emissions (organizational travel).⁶

In addition to the requirement of first reducing emissions associated with building operations, the Carbon Neutral Design Project also places a maximum on the amount of renewable energy that can be purchased to offset emissions. Unlike the UK DECC, no specific criteria are provided for carbon credits, and no specific standard or program is recommended for quantification, reporting and verification. There is no link to a specific period of time for measurement.

ASHRAE Vision 2020

Similar to the Architecture 2030 Challenge, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) have a vision that the building community will produce market-viable net zero energy buildings by 2030. ASHRAE defines a net zero energy building as one that produces as much energy as it uses when measured at the site. They further break down the definition using different metrics as follows:

1. Net zero site energy building – verification through on-site metering and does not distinguish between fuel types.
2. Net zero source energy building – uses site-to-source conversions to account for source energy.
3. Net zero energy cost buildings – based on utility bills
4. Net zero energy emissions building – calculates emissions produced by the energy needs of the building

⁵ Athena Sustainable Materials Institute
<http://www.athenasmi.org/our-software-data/impact-estimator/>

⁶ The Carbon Neutral Design (CND) Project,
http://www.tboake.com/carbon-aia/carbon_definition.html

Part of the work accomplished to date by ASHRAE was the development of the Building Energy Quotient building energy-labeling program. The final building energy performance label is based on a letter grade; a building owner receives A+ for a Zero Net Energy building.

Canada Green Building Council

While it has not developed an official definition for or protocols for verifying carbon neutral building, the Canada Green Building Council's 2012 Strategic Plan has set a goal for carbon neutral buildings and communities by 2030, consistent with Architecture 2030.⁷ Based on a workshop offered by the CaGBC at their national conference⁸, which postulated that definitions of carbon neutral building can be extended to include construction and temporary energy supplies, it is assumed that such factors are being weighed as the CaGBC works internally on carbon neutrality.

Canadian Standards Association (CSA) Group

In an attempt to standardize claims of carbon neutrality, the CSA Group has developed its Registered Carbon Neutral™ Program, defining carbon neutrality as “the achievement of zero net greenhouse gas (GHG) emissions from a specified organization or building. This is achieved by measuring GHG emissions and then (for all emissions identified) offsetting them through the retirement of an equivalent amount of qualifying verified emissions reductions or removals. Carbon neutral is not the same as having zero emissions.”⁹ The program does not define any specific scope for calculation of emissions, nor is it linked to a specified period of time.

As part of the Program, CSA requires that offsets have been independently third-party validated and verified, and have been purchased from recognized sources, and refers to ISO 14064 GHG standards for quantification, reporting and verification.

CarbonNeutral®

A global firm that provides a gamut of carbon management services defines carbon neutrality, or having a net zero carbon footprint, as achieving net zero carbon emissions by balancing a measured amount of carbon released with an equivalent amount sequestered, avoided or offset. They offer 3rd party certification of carbon neutrality claims for a variety of business activities including construction and use of buildings. For more information, go to <http://www.carbonneutral.com/>.

City of Vancouver

As part of its ambitious Greenest City 2020 initiative, the City of Vancouver has created targets involving carbon neutrality, including the achievement of carbon neutral operations by 2012 and all new buildings to be carbon neutral by 2030¹⁰. There is no publicly available information on the City's definition of a carbon neutral building, the boundaries within which carbon neutrality will be defined, or a specific standard or program to be used for quantification, reporting and verification. However, based on the City's participation in the Towards Carbon Neutral Buildings in BC: Framework for High-Rise Multi-Unit Residential Buildings, we do know the City is working off an assumption that carbon neutrality is achieved by reducing building operating emissions by 50%, and then meeting the remaining demand with low carbon sources, and that the City is considering more aggressive targets for 2050, as well as the inclusion of embodied energy and occupant travel.

Province of British Columbia

The Province of British Columbia has set a goal of carbon neutral operations by 2012 and as early as of June 2011, BC's public sector achieved carbon neutrality. According to the Province, “carbon neutrality involves measuring operational

⁷ Canada Green Building Council. 2012 Strategic Plan: Second Year of the CaGBC Strategic Plan 2011-2013

⁸ Canada Green Building Council, “Cutting Through the Hot Air: Carbon Neutral Buildings”, <http://www.caqbc.org/source/Events/Event.cfm?EVENT=CN12TO0611§ion=unknown>

⁹ The CSA Group, “CSA Launches Carbon Neutral Program to Help Organizations and Building Owners Demonstrate Carbon Neutrality”, <http://www.csa.ca/cm/ca/en/news/article/csa-launches-carbon-neutral-program>

¹⁰ City of Vancouver, Home, Property, and Development: Green building and renovating, <http://vancouver.ca/home-property-development/green-building-and-renovating.aspx>

greenhouse gas emissions, reducing those where possible, offsetting the remainder and demonstrating leadership through public reporting.”¹¹ According to the Methodology for Reporting 2011 BC Public Sector Greenhouse Gas Emissions, scope 1 and 2 emissions must be included in calculations. Scope 3 is partially addressed through the inclusion of business travel, however travel of employees and visitors to the building is not included. Emissions from embodied energy or the construction process are not considered.

Consistent with the UK DECC guidelines, the Province reports on the emissions reduced internally versus the amount of carbon offsets that have been purchased in their “Carbon Neutral B.C. – Transforming B.C.’s Public Sector” report¹². For quantification, reporting, and verification, the Province has developed its own standard, SMARTTool that meets international standards such as those of The Climate Registry.¹³

The Province has also created a crown corporation, Pacific Carbon Trust, from which to acquire all its carbon offsets. These are sourced from projects in communities across BC that meet specific eligibility criteria as defined by the Ministry of Environment’s Offset Emissions Regulation, which align with the DECC’s quality criteria¹⁴. Project documentation and an offset registry are publicly available on the Pacific Carbon Trust website at: www.pacificcarbontrust.com.

Conclusion

The existing variations in the definitions of carbon neutral building make it clear that there is a need for a more universal third-party standard for the concept.

In the absence of an international accepted definition, we recommend that any organization defining carbon neutral building consider the following:

System Boundaries

Is it merely operations that are being targeted? Embodied energy? Occupant travel? Construction activities? With respect to the Framework mentioned at the beginning of this white paper, the system boundaries were set to be operational, with recommendations to shift longer-term to include embodied energy and occupant travel. Such a shift is consistent with the Carbon Neutral Design Project and the UK’s DECC. It will be interesting to consider the inclusion of construction activities in future.

“Pinch Point”

One common thread is the recognition that energy must be conserved to a pinch point, beyond which the remaining demand would be met with renewable energy and/or carbon offsets. Defining that pinch point should be based on primary energy demand; identifying the quantitative values seems to be both an art and a science. For example, each EU member state is developing its own targets, even though in some cases, common building typologies and climates exist. The Framework proposes some targets for south coastal BC, based on the City of Vancouver’s informal goal of a 50% reduction in building energy, but also acknowledges that remaining demand is likely to be met with some low carbon versus no carbon sources for some time.

Verification / Certification

Before the advent of certification systems such as LEED®, it was difficult to verify the validity of claims for ‘green building’. The same situation now exists in the realm of ‘carbon neutral’ building. Being clear about system boundaries and having quantitative measures of energy performance, as well as renewable energy and offset use, will be critical. In addition, standard protocols for quantification, reporting and verification need to be developed and referenced that are specific to buildings.

¹¹ LiveSmart BC, Understanding Carbon Neutrality, http://www.livesmartbc.ca/government/carbon_neutral/cng_backround.html

¹² LiveSmart BC, “Carbon Neutral B.C. – Transforming B.C.’s Public Sector”, http://www.livesmartbc.ca/attachments/carbon_neutral_action_reports/CarbonNeutralBC-transformingBCpublicsector.pdf

¹³ BC Ministry of Environment, “Methodology for Reporting 2011 BC Public Sector Greenhouse Gas Emissions”, http://www.env.gov.bc.ca/cas/mitigation/pdfs/Methodology_for_Reporting_BC_Public_Sector_GHG_Emissions.pdf

¹⁴ Ministry of Environment, “Offset Emissions Regulation”, <http://www.env.gov.bc.ca/cas/mitigation/ggrrta/pdf/offsets-reg.pdf>

Organizations such as the AIA, ASHRAE and the CaGBC have targeted 2030 for designing market-ready carbon neutral buildings. Given the CO2 levels we are seeing today, is that good enough?

For more information on developing policies and regulations for carbon neutral buildings, go to <http://www.sustainablebuildingcentre.com/research/> and download our report: *Towards Carbon Neutral Buildings in BC: Framework for High-Rise Multi-Unit Residential Buildings*:



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