

Embodied, Emitted and Committed Carbon

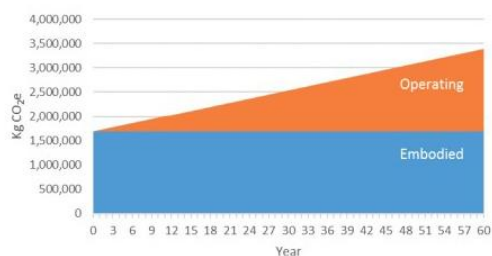
There are 2 classification of Carbon Dioxide Equivalent (CO₂e) emissions: embodied and emitted. There is also committed carbon, which is the carbon that will be released if a project is approved. It's important to distinguish, and measure, the various types in order to develop an effective action plan.

Embodied carbon is usually not included in the CO₂e of imported items which is problematic because it encourages outsourcing manufacturing to countries with poor environmental standards.

Committed carbon means that purchasing decisions made today have a long lasting effect on climate change and efforts to mitigate the effects of CO₂e emissions.

EMBODIED CARBON IN BUILDINGS

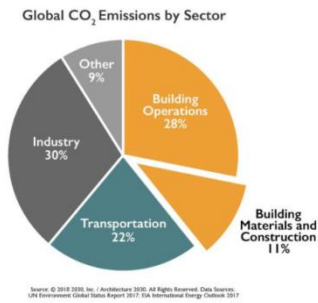
Embodied carbon (also known as upfront carbon) is the CO₂e released during the manufacturing or construction process of an item and includes the production and transportation of the raw materials and sub assemblies, as well as the CO₂e released due to warehousing, marketing and demolition or disposal. This is the carbon footprint before the item becomes operational.



This image from [The Atmospheric Fund](#), shows the carbon in a typical 5 story apartment in Vancouver. It takes 60 years for the carbon emitted by heating and cooling the building to exceed the carbon emitted in the construction of the building ^[1].

It's difficult to measure the actual ratio between embodied and operating CO₂e but embodied carbon will become a larger percentage of total building emissions as the operating emissions decrease.

As operating carbon is reduced because of Net-Zero or Passive House construction, the impact of embodied carbon becomes greater. Embodied carbon from current construction practices are about 50% of the total GHG emissions over a 30 year period. In Net-Zero construction, because the operating carbon emissions are so low, the embodied carbon is about 90% of the total GHG emissions over 30 years ^[2].



About 40% of all carbon emissions come from the building sector [3]. Approximately 50% comes from embodied carbon and the majority of that comes from concrete [4].

A typical house has somewhere between 25 and 60 tonnes of embodied carbon [5].

For reference, using the low estimate of 25 tonnes of CO₂e per unit, a sub-division such as the proposed Cachet Development in Baden would have about 12,500 tonnes of embodied CO₂e just for the residential units. It's difficult to estimate the amount of embedded carbon in the office buildings but one study shows that embodied carbon is about 116 kg per square metre [6]. The proposed office space was 66,426 square meters, therefore the embodied carbon would have been an additional 7,700 tonnes for a total of 20,200 tonnes of CO₂e.

EMITTED CARBON IN BUILDINGS

The average Canadian home heated with natural gas uses 88.4 gigajoules per year [7] and emits 4.9 tonnes of CO₂e annually [8]. If heated with renewable energy and heat pumps, the CO₂e emissions would be essentially zero.

COMMITTED CARON IN BUILDINGS

The embodied carbon in buildings must be reduced significantly. Municipalities must establish a carbon budget and all application for building permits must include both the embodied carbon and the operating carbon.

Embodies carbon in buildings can be reduced by [9]:

- renovating instead of demolition
- use low carbon concrete
- limit carbon intensive materials (aluminum, plastic and foam)
- use carbon sequestered material (wood frame construction)
- use recycled material (steel rebar)
- building design to minimize waste.

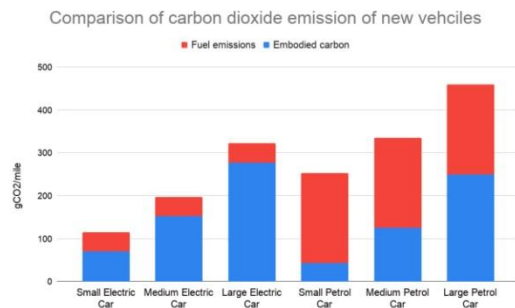
Emitted carbon can be reduced by:

- Net-Zero certification
- Banning of natural gas.

ELECTRIC VEHICLES

Transportation accounts for 25% of Canada's GHG and about half comes from cars and light duty trucks. As of February 4, 2022, the Federal Government has mandated that 100% of all cars and light trucks be electric by 2035 ^[10].

EMBODIED CARBON IN VEHICLES



The manufacturing of a small car releases 6 to 8.5 tonnes of CO₂e, a medium size car releases 17 tonnes of CO₂e, and a large car releases 35 tonnes of CO₂e ^[11].

The manufacturing of a small electric car, including the battery, releases 14 tonnes of CO₂e ^[12].

The embodied carbon of an electric car is almost twice that of a comparable gasoline powered car, however, the operating carbon is significantly less.

EMITTED CARBON IN VEHICLES

The average gasoline powered car in Canada emits about 206 grams of CO₂e per kilometre ^[13].

In Canada, a car is driven on average 15,200 km per year ^[14] and releases about 3.1 tonnes of CO₂e per year. Over the 13 year lifetime of a typical Canadian car, this amounts to 40 tonnes. The total CO₂e, including both the manufacturing and operation of a small car over its life is approximately 50 tonnes. An average sized car will emit about 46 tonnes of CO₂ over its life.

A small electric car has a larger embodied carbon footprint but, if charged with renewable energy, the emitted carbon is essentially zero. However, renewable energy has its own embodied carbon (about 20 to 30 grams CO₂/kWh) ^[15]. A small electric car gets 6.5 km per kWh, and uses 2,340 kWh per year. 0.07 tonnes of CO₂e is released each year and over the 13 year life of an electric car, the total embodied and emitted CO₂e is 14.9 tonnes, 37% of the carbon released by an equivalent gasoline car.

COMMITTED CARBON

If you purchase an average size car today, you are committing to the release of 46 tonnes of CO₂e. If you purchase an electric vehicle today, you are committing to release 15 tonnes of CO₂e.

The Federal Government has *"has set a mandatory target for all new light-duty cars and passenger trucks to be zero-emission by 2035"* ^[16]. Currently, there is a limited supply of electric vehicles but this will improve in the near future. Electric vehicles are also expensive but the price will come down as volumes increase. The Federal Government has a \$5,000 subsidy for the purchase of an electric vehicle. The current Provincial Government has removed its subsidy on electric vehicles.

Bay du Nord

Bay du Nord is an example of why embodied and committed carbon needs to be examined before approving a project. The Federal Government ignored the original forecast that the approval of the oil field would cause the release of 130 MT of carbon in the future ^[17] and claimed that oil would be clean. The extraction may be cleaner than tar sand oil but the problem is the downstream emissions when the oil is burnt.



It is now estimated that 400 MT of carbon will be released from this oil field ^[18].

Committed carbon must be included in any plans to reduce GHG emissions.

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