



Carbon Credits Carbon Offsets Carbon Neutrality



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Carbon Credits vs Carbon Offsets vs Carbon Neutrality

1. Carbon Credits

A carbon credit is a tradable permit that allows the holder to emit one metric ton of CO₂ (or its equivalent in other greenhouse gases). These are typically used in regulated 'cap-and-trade' systems, where entities must hold enough credits to cover their emissions. Credits can be bought or sold among companies or nations. The purpose is to limit overall emissions through a capped and market-driven system.

2. Carbon Offsets

A carbon offset is a reduction or removal of CO₂ from the atmosphere achieved elsewhere (e.g., tree planting, methane capture, renewable energy investment) to compensate for emissions. These are often used voluntarily by individuals or organizations to balance their own emissions. Offsets are verified by third parties to ensure climate benefits.

3. Carbon Neutrality

Carbon neutrality is the status of having a net-zero carbon footprint. This means the amount of CO₂ emitted is balanced by the amount removed or offset. Achieving carbon neutrality involves reducing emissions as much as possible and then offsetting the remainder. It is a goal or status, not a market instrument.

Summary Table

Term	What It Is	Use	Market Type	Purpose
Carbon Credit	Permit to emit 1 ton CO ₂	Compliance with regulations	Regulated (e.g. EU ETS)	Limit and trade emissions
Carbon Offset	Action to reduce CO ₂ elsewhere	Compensate for unavoidable CO ₂	Voluntary or regulated	Balance out emissions
Carbon Neutrality	Net-zero emissions balance	Final goal or status	Not a market instrument	Achieve no net increase in CO ₂ emissions

Carbon Offsets Explained

Carbon offsetting funds projects in communities across the world that reduce greenhouse gas (GHG) emissions beyond what you can achieve through individual action. You can purchase carbon credits to support these projects and offset the climate impact of your own GHG emissions, even though the projects are located elsewhere. Carbon credits make environmental and economic sense. You can fund projects that reduce emissions elsewhere to mitigate your own GHG emissions that are impossible to reduce.



What is a carbon credit?

Carbon credits are the financing mechanism for carbon reduction projects. A project generates a carbon credit for every one metric ton of CO₂e (CO₂ equivalent of GHG) that is reduced and verified by an independent third party. Projects sell their carbon credits every year in order to finance their construction and ongoing operation. When you buy a carbon credit, you purchase the environmental benefits of that carbon reduction.

There are hundreds of different types of carbon reduction projects. For example, a landfill can install a landfill gas system to capture methane that would otherwise leak into the atmosphere. Such landfill gas systems are not required on many landfills around the world, and they are expensive to install and maintain. The construction and operation of a landfill gas project is financed by selling carbon credits every year based on the amount of carbon emissions reduced. By funding emission reductions like this, individuals and organizations can mitigate the climate impact of their own carbon emissions that cannot be reduced.

What are the different types of carbon credits?

Carbon reduction projects reduce greenhouse gases in the atmosphere in two ways:

1. By preventing new greenhouse gases from entering the atmosphere. Examples of these projects include landfill gas capture and industrial gas recycling. These projects generate carbon *avoidance* or carbon *reduction* credits.
2. By removing greenhouse gases from the atmosphere. Examples of these projects include reforestation or direct air capture (DAC). These projects generate carbon *removal* credits.

It is also important to know that many projects create multiple sustainable benefits. For instance, reforestation projects can also restore valuable ecosystems, protect threatened species, and provide jobs and education for surrounding communities.

Carbon offset



Wind turbines near [Aalborg, Denmark](#). Renewable energy projects are the most common source of carbon offsets.

A **carbon offset** is a reduction in emissions of carbon dioxide or [greenhouse gases](#) made in order to compensate for or to offset an emission made elsewhere. [\[1\]\[2\]\[3\]\[4\]](#)

Carbon offsets are measured in metric tons of [carbon dioxide-equivalent](#) (CO₂e) and may represent six primary categories of greenhouse gases. [\[5\]](#) One carbon offset represents the reduction of one metric ton of carbon dioxide or its equivalent in other greenhouse gases.

There are two markets for carbon offsets. In the larger, compliance market, companies, governments, or other entities buy carbon offsets in order to comply with [caps](#) on the total amount of carbon dioxide they are allowed to emit. This market exists in order to achieve compliance with obligations of Annex 1 Parties under the [Kyoto Protocol](#), and of liable entities under the EU Emissions Trading Scheme. In 2006, about \$5.5 billion of carbon offsets were purchased in the compliance market, representing about 1.6 billion metric tons of CO₂e reductions. [\[6\]](#)

In the much smaller, voluntary market, individuals, companies, or governments purchase carbon offsets to mitigate their own greenhouse gas emissions from transportation, electricity use, and other sources. For example, an individual might purchase carbon offsets to compensate for the greenhouse gas emissions caused by personal air travel. Many companies (see list [\[7\]](#)) offer carbon offsets as an up-sell during the sales process so that customers can mitigate the emissions related with their product or service purchase (such as offsetting emissions related to a vacation flight, car rental, hotel stay, consumer good, etc.). In 2008, about \$705 million of carbon offsets were purchased in the voluntary market, representing about 123.4 million metric tons of CO₂e reductions. [\[8\]](#)

Offsets are typically achieved through financial support of projects that reduce the emission of greenhouse gases in the short- or long-term. The most common project type is renewable energy, such as wind farms, biomass energy, or hydroelectric dams. Others include energy efficiency projects, the destruction of industrial pollutants or agricultural byproducts, destruction of landfill methane, and forestry projects. [\[9\]](#) Some of the most popular carbon offset projects from a corporate perspective are energy efficiency and wind turbine projects. [\[10\]](#)

Carbon offsetting has gained some appeal and momentum mainly among consumers in western countries who have become aware and concerned about the potentially negative environmental effects of energy-intensive lifestyles and economies. The [Kyoto Protocol](#) has sanctioned offsets as a way for governments and private companies to earn [carbon credits](#) which can be traded on a marketplace. The protocol established the [Clean Development Mechanism](#) (CDM), which validates and measures projects to ensure they produce authentic benefits and are genuinely "additional" activities that would not otherwise have been undertaken. Organizations that are unable to meet their emissions quota can offset their emissions by buying CDM-approved Certified Emissions Reductions.

Offsets may be cheaper or more convenient alternatives to reducing one's own fossil-fuel consumption. However, some critics object to carbon offsets, and question the benefits of certain types of offsets. [\[11\]](#)

Offsets are viewed as an important policy tool to maintain stable economies. One of the hidden dangers of climate change policy is unequal prices of carbon in the economy, which can cause economic collateral damage if production flows to regions or industries that have a lower price of carbon - unless carbon can be purchased from that area, which offsets effectively permit, equalizing the price. [\[12\]](#)

Definitions

The [World Resources Institute](#) defines a carbon offset as “a unit of carbon dioxide-equivalent (CO₂e) that is reduced, avoided, or sequestered to compensate for emissions occurring elsewhere”.^[1]

The Collins English Dictionary defines a carbon offset as “a compensatory measure made by an individual or company for carbon emissions, usually through sponsoring activities or projects which increase carbon dioxide absorption, such as tree planting.”^[2]

The Environment Protection Authority of Victoria (Australia) defines a carbon offset as: “a monetary investment in a project or activity elsewhere that abates greenhouse gas (GHG) emissions or sequesters carbon from the atmosphere that is used to compensate for GHG emissions from your own activities. Offsets can be bought by a business or individual in the voluntary market (or within a trading scheme), a carbon offset usually represents one tonne of CO₂-e”.^[3]

The Stockholm Environment Institute defines a carbon offset as “a credit for negating or diminishing the impact of emitting a ton of carbon dioxide by paying someone else to absorb or avoid the release of a ton of CO₂ elsewhere”.^[13]

The University of Oxford Environmental Change Institute defines a carbon offset as “mechanism whereby individuals and corporations pay for reductions elsewhere in order to offset their own emissions”.^[4]

Features of carbon offsets

Carbon offsets have several common features:

- *Vintage*. The vintage is the year in which the carbon reduction takes place.^[14]
- *Source*. The source refers to the project or technology used in offsetting the carbon emissions. Projects can include land-use, methane, biomass, renewable energy and industrial energy efficiency. Projects may also have secondary benefits (co-benefits). For example, projects that reduce agricultural greenhouse gas emissions may improve water quality by reducing fertilizer usage.^[15]
- *Certification regime*. The certification regime describes the systems and procedures that are used to certify and register carbon offsets. Different methodologies are used for measuring and verifying emissions reductions, depending on project type, size and location.^[16] For example, the [Chicago Climate Exchange](#) uses one set of protocols,^[17] while the CDM uses another.^[18] In the voluntary market, a variety of industry standards exist. These include the [Voluntary Carbon Standard](#) and the [CDM Gold Standard](#) that are implemented to provide third-party verification of carbon offset projects. There are some additional standards for the validation of co-benefits, including the CCBS, issued by the [Climate, Community & Biodiversity Alliance](#) and the Social Carbon Standard, issued by Ecologica Institute.

Carbon offset markets

Global market

In 2009, 8.2 billion metric tons of carbon dioxide equivalent changed hands worldwide, up 68% from 2008, according to the study by carbon-market research firm Point Carbon, of Washington and Oslo. But at EUR94 billion, or about \$135 billion, the market's value was nearly unchanged compared with 2008, with world carbon prices averaging EUR11.40 a ton, down about 40% from the previous year, according to the study.^[19] The World Bank's "State and Trends of the Carbon Market 2010"^[20] put the overall value of the market at \$144 billion, but found that a significant part of this figure resulted from manipulation of a VAT loophole.^[21]

E.U. market

The global carbon market is dominated by the [European Union](#), where companies that emit greenhouse gases are required to cut their emissions or buy pollution allowances or carbon credits from the market, under the [European Union Emission Trading Scheme](#) (EU ETS). Europe, which has seen volatile carbon prices due to fluctuations in energy prices and supply and demand, will continue to dominate the global carbon market for another few years, as the U.S. and China—the world's top polluters—have yet to establish mandatory emission-reduction policies.

U.S. market

On the whole, the U.S. market remains primarily a voluntary market, but multiple cap and trade regimes are either fully implemented or near-imminent at the regional level. The first mandatory, market-based cap-and-trade program to cut CO₂ in the U.S., called the [Regional Greenhouse Gas Initiative](#) (RGGI), kicked into gear in Northeastern states in 2009, growing nearly tenfold to \$2.5 billion, according to [Point Carbon](#). [Western Climate Initiative](#) (WCI) -- a regional cap-and-trade program including seven western states (California notably among them) and four Canadian provinces—has established a regional target for reducing heat-trapping emissions of 15 percent below 2005 levels by 2020.

Voluntary market

Participants

A wide range of participants are involved in the voluntary market, including providers of different types of offsets, developers of quality assurance mechanisms, third party verifiers, and consumers who purchase offsets from domestic or international providers. Suppliers include for-profit companies, governments, colleges and universities, and other organizations. ^[22]

Motivations

According to industry analyst [Ecosystem Marketplace](#), the voluntary markets present the opportunity for citizen consumer action, as well as an alternative source of carbon finance and an incubator for carbon market innovation. In their survey of voluntary markets, data has shown that “[Corporate Social Responsibility](#)” and “Public Relations/Branding” are clearly in first place among motivations for voluntary offset purchases, with evidence indicating that companies seek to offset emissions “for goodwill, both of the general public and their investors.”

In addition, regarding market composition, research indicates: “Though many analysts perceive pre-compliance buying as a dominant driving force in the voluntary market, the results of our survey have repeatedly indicated that precompliance motives (as indicated by “investment/resale” and “anticipation of regulation”) remain secondary to those of the pure voluntary market (companies/individuals offsetting their emissions).” ^[23]

Pre-compliance & trading

The other main category of buyers on the voluntary markets are those engaged in pre-compliance and/or trading. Those purchasing offsets for pre-compliance purposes are doing so with the expectation, or as a hedge against the possibility, of future mandatory cap and trade regulations. As a mandatory cap would sharply increase the price of offsets, firms—especially those with large carbon footprints and the corresponding financial exposure to regulation—make the decision to acquire offsets in advance at what are expected to be lower prices.

The trading market in offsets in general resembles the trade in other commodities markets, with financial professionals including hedge funds and desks at major investment banks, taking positions in the hopes of buying cheap and selling dear, with their motivation typically short or medium term financial gain.

Retail

Multiple players in the retail market have offerings that enable consumers and businesses to calculate their [carbon footprint](#), most commonly through a web-based interface including a calculator or

questionnaire, and sell them offsets in the amount of that footprint.^[24] In addition many companies selling products and services, especially carbon-intensive ones such as airline travel,^{[25][26]} offer options to bundle a proportional offsetting amount of carbon credits with each transaction. Suppliers of voluntary offsets operate under both [nonprofit](#) and [social enterprise](#) models, or a blended approach sometimes referred to as [triple bottom line](#). Other suppliers include broader environmentally focused organizations with website subsections or initiatives that enable retail voluntary offset purchases by members, and government created projects.

Sources of carbon offsets

The CDM identifies over 200 types of projects suitable for generating carbon offsets, which are grouped into broad categories. These project types include renewable energy, methane abatement, energy efficiency, reforestation and fuel switching.^[9]

Renewable energy

[Renewable energy](#) offsets commonly include [wind power](#), [solar power](#), [hydroelectric power](#) and [biofuel](#). Some of these offsets are used to reduce the cost differential between renewable and conventional energy production, increasing the commercial viability of a choice to use renewable energy sources.

[Renewable Energy Credits](#) (RECs) are also sometimes treated as carbon offsets, although the concepts are distinct. Whereas a carbon offset represents a reduction in greenhouse gas emissions, a REC represents a quantity of energy produced from renewable sources. To convert RECs into offsets, the clean energy must be translated into carbon reductions, typically by assuming that the clean energy is displacing an equivalent amount of conventionally produced electricity from the local grid. This is known as an indirect offset (because the reduction doesn't take place at the project site itself, but rather at an external site), and some controversy surrounds the question of whether they truly lead to "additional" emission reductions and who should get credit for any reductions that may occur.^{[27][28]}

Methane collection and combustion

Some offset projects consist of the combustion or containment of [methane](#) generated by farm animals (by use of an [anaerobic digester](#)),^[29] landfills^[30] or other industrial waste. Methane has a [global warming potential](#) (GWP) 23 times that of CO₂; when combusted, each molecule of methane is converted to one molecule of CO₂, thus reducing the global warming effect by 96%.

An example of a project using a [anaerobic digester](#) can be found in Chile where in December 2000, the largest pork production company in Chile, initiated a voluntary process to implement advanced waste management systems (anaerobic and aerobic digestion of hog manure), in order to reduce greenhouse gas (GHG) emissions.^[31]

Energy efficiency



Chicago Climate Justice activists protesting cap and trade legislation in front of [Chicago Climate Exchange](#) building in Chicago Loop

While carbon offsets which fund renewable energy projects help lower the [carbon intensity](#) of energy *supply*, energy conservation projects seek to reduce the overall *demand* for energy. Carbon offsets in this category fund projects of several types:

1. [Cogeneration](#) plants generate both electricity and heat from the same power source, thus improving upon the energy efficiency of most power plants which waste the energy generated as heat.
2. Fuel efficiency projects replace a combustion device with one which uses less fuel per unit of energy provided. Assuming energy demand does not change, this reduces the carbon dioxide emitted.
3. [Energy-efficient buildings](#) reduce the amount of energy wasted in buildings through efficient heating, cooling or lighting systems. In particular, the replacement of incandescent [light bulbs](#) with [compact fluorescent lamps](#) can have a drastic effect on energy consumption. New buildings can also be constructed using less carbon-intensive input materials.

Destruction of industrial pollutants

Industrial pollutants such as hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) have a [GWP](#) many thousands of times greater than carbon dioxide by volume.^[32] Because these pollutants are easily captured and destroyed at their source, they present a large and low-cost source of carbon offsets. As a category, HFCs, PFCs, and N₂O reductions represent 71% of offsets issued under the CDM.^[9]

Land use, land-use change and forestry

Land use, land-use change and forestry ([LULUCF](#)) projects focus on natural [carbon sinks](#) such as forests and soil. Deforestation, particularly in Brazil, Indonesia and parts of Africa, account for about 20% of greenhouse gas emissions.^[33] Deforestation can be avoided either by paying directly for forest preservation, or by using offset funds to provide substitutes for forest-based products. There is a class of mechanisms referred to as REDD schemes ([Reducing emissions from deforestation and forest degradation](#)), which may be included in a post-Kyoto agreement. REDD credits provide carbon offsets for the protection of forests, and provide a possible mechanism to allow funding from developed nations to assist in the protection of native forests in developing nations.

Almost half of the world's people burn wood (or fiber or [dung](#)) for their cooking and heating needs.^[citation needed] Fuel-efficient cook stoves can reduce fuel wood consumption by 30 to 50%, though the warming of the earth due to decreases in particulate matter (i.e. smoke) from such fuel-efficient stoves has not been addressed. There are a number of different types of LULUCF projects:

- **Avoided [deforestation](#)** is the protection of existing forests.
- **[Reforestation](#)** is the process of restoring forests on land that was once forested.
- **[Afforestation](#)** is the process of creating forests on land that was previously unforested, typically for longer than a generation.
- **[Soil management](#)** projects attempt to preserve or increase the amount of carbon sequestered in soil.

Purchase of carbon allowances from emissions trading schemes

Voluntary purchasers can offset their carbon emissions by purchasing carbon allowances from legally mandated cap-and-trade programs such as the [Regional Greenhouse Gas Initiative](#) or the European [Emissions Trading Scheme](#). By purchasing the allowances that power plants, oil refineries, and industrial facilities need to hold to comply with a cap, voluntary purchases tighten the cap and force additional emissions reductions.

Voluntary purchases can also be made through small-scale and sometimes uncertified schemes such as those offered at South African based Promoting Access to Carbon Equity Centre (PACE),^[34] which nevertheless offer clear services such as poverty alleviation in the form of renewable energy development. Also, as "easy carbon credits are coming to an end",^[35] these projects have the potential to develop projects that are either too small or too complicated to benefit from legally mandated cap-and-trade programs.

Links with emission trading schemes

Once it has been accredited by the [UNFCCC](#) a carbon offset project can be used as [carbon credit](#) and linked with official emission trading schemes, such as the [European Union Emission Trading Scheme](#)^[36] or [Kyoto Protocol](#), as [Certified Emission Reductions](#). European emission allowances for the 2008-2012 second phase were selling for between 21 and 24 Euros per metric ton of CO₂ as of July 2007.

The voluntary [Chicago Climate Exchange](#) also includes a carbon offset scheme that allows offset project developers to sell emissions reductions to CCX members who have voluntarily agreed to meet emissions reduction targets.

The [Western Climate Initiative](#), a regional greenhouse gas reduction initiative by states and provinces along the western rim of North America, includes an offset scheme. Likewise, the [Regional Greenhouse Gas Initiative](#), a similar program in the northeastern U.S., includes an offset program. A credit mechanism that uses offsets may be incorporated in proposed schemes such as the Australian Carbon Exchange.

Other

A UK offset provider set up a carbon offsetting scheme which set up a secondary market for [treadle pumps](#) in developing countries. These pumps are used by farmers, using human power, in place of [diesel](#) pumps.^[37] However, given that treadle pumps are best suited to pumping shallow water, while diesel pumps are usually used to pump water from deep boreholes, it is not clear that the treadle pumps are actually achieving real emissions reductions. Other companies have explored and rejected treadle pumps as a viable carbon offsetting approach due to these concerns.

Carbon Retirement

Carbon retirement involves retiring allowances from [emission trading schemes](#) as a method for offsetting carbon emissions. Under schemes such as the [European Union Emission Trading Scheme](#), EU Emission Allowances (EUA's), which represent the right to release carbon dioxide into the atmosphere, are issued to all the largest polluters. The theory is that by buying these allowances and permanently removing them, the price of EUAs increases and provides an incentive for industrial companies to reduce their emissions.^[38]

Accounting for and verifying reductions

Due to their indirect nature, many types of offset are difficult to verify. Some providers obtain independent certification that their offsets are accurately measured, to distance themselves from potentially fraudulent competitors. The credibility of the various certification providers is often questioned. Certified offsets may be purchased from commercial or non-profit organizations for US\$1–30 per [tonne](#) of CO₂,^[39] due to fluctuations of market price. [Annual carbon dioxide emissions](#) in developed countries range from 6 to 23 tons per capita.

Accounting systems differ on precisely what constitutes a valid offset for voluntary reduction systems and for mandatory reduction systems. However formal standards for quantification exist based on collaboration between emitters, regulators, environmentalists and project developers. These standards include the [Voluntary Carbon Standard](#), Green-e Climate, Chicago Climate Exchange and the [CDM Gold Standard](#), the latter of which expands upon the requirements for the [Clean Development Mechanism](#) of the [Kyoto Protocol](#).

Accounting of offsets may address the following basic areas:

- Baseline and Measurement - What emissions would occur in the absence of a proposed project? And how are the emissions which occur after the project is performed going to be measured?

- **Additionality** - Would the project occur anyway without the investment raised by selling carbon offset credits? There are two common reasons why a project may lack additionality: (a) if it is intrinsically financially worthwhile due to energy cost savings, and (b) if it had to be performed due to environmental laws or regulations.
- **Permanence** - Are some benefits of the reductions reversible? (for example, trees may be harvested to burn the wood, and does growing trees for fuel wood decrease the need for [fossil fuel](#)?) If woodlands are increasing in area or density, then [carbon is being sequestered](#). After roughly 50 years, newly planted forests will reach maturity and [remove carbon dioxide](#) more slowly.
- [Leakage](#) - Does implementing the project cause higher emissions outside the project boundary?

Co-benefits

While the primary goal of carbon offsets is to reduce global carbon emissions, many offset projects also claim to lead to improvements in the quality of life for a local population. These additional improvements are termed *co-benefits*, and may be considered when evaluating and comparing carbon offset projects. Some possible co-benefits from a project which replaces wood burning stoves with ovens which use a less carbon-intensive fuel include:

- Lower non greenhouse gas pollution (smoke, ash, and chemicals), which improves health in the home.
- Better preservation of forests, which are an important habitat for wildlife.

In a recent survey conducted by EcoSecurities, Conservation International, CCBA and ClimateBiz, of the 120 corporates surveyed more than 77% rated community and environmental benefits as the prime motivator for purchasing carbon offsets.^[40]

Carbon offset projects can also negatively affect quality of life. For example, people who earn their livelihoods from collecting firewood and selling it to households could become unemployed if firewood is no longer used. A paper from the [Overseas Development Institute](#) offers some indicators to be used in assessing the potential developmental impacts of voluntary carbon offset schemes^[41]:

- What potential does the project have for income generation?
- What effects might a project have on future changes in land use and could conflicts arise from this?
- Can small-scale producers engage in the scheme?
- What are the 'add on' benefits to the country - for example, will it assist capacity-building in local institutions?^[42]

Quality Assurance Schemes

The UK Government's Quality Assurance Scheme for Carbon Offsetting

In an effort to inform and safeguard business and household consumers purchasing Carbon Offsets, the [UK Government](#) has launched a scheme for regulating Carbon offset products.^[43] [DEFRA](#) have created the "Approved Carbon Offsetting" brand to use as an endorsement on offsets^[44] approved by the UK government. The Scheme sets standards for best practice in offsetting. Approved offsets have to demonstrate the following criteria:

- Accurate calculation of emissions to be offset
- Use of good quality carbon credits i.e. initially those that are Kyoto compliant
- Cancellation of carbon credits within a year of the consumers purchase of the offset
- Clear and transparent pricing of the offset

- Provision of information about the role of offsetting in tackling climate change and advice on how a consumer can reduce his or her carbon footprint

The first company to qualify for the scheme was [Clear](#), followed by Carbon Footprint, Carbon Passport, Pure, [British Airways](#) and Carbon Retirement.

[edit] Australian Government National Carbon Offset Program

The Australian government is currently in a consultation period on the regulation of Carbon Offsets.^[45] The standard will provide guidance on what constitutes a genuine, additional voluntary offset credit, set requirements for the verification and retirement of such credits, and provide principles for calculating the emissions of an organisation, product or service which could be offset.

Controversies

Project-offsetting

Less than 30 pence in every pound spent on some carbon offset schemes goes directly to projects designed to reduce emissions. The figures reported by the BBC^[46] and based on UN data reported that typically 28p goes to the set up and maintenance costs of an environmental project. 34p goes to the company that takes on the risk that the project may fail. The project's investors take 19p, with smaller amounts of money being distributed between organisations involved in brokering and auditing the carbon credits.

Indulgence controversy

Some activists disagree with the principle of carbon offsets, likening them to papal [indulgences](#), a way for the guilty to pay for absolution rather than changing their behavior. [George Monbiot](#), an English environmentalist and writer, says that carbon offsets are an excuse for business as usual with regard to pollution.^{[47][48]} Proponents hold that the indulgence analogy is flawed because they claim carbon offsets actually reduce carbon emissions, changing the business as usual, and therefore address the root cause of climate change.^[49] Proponents of offsets claim that third-party certified carbon offsets are leading to increased investment in renewable energy, energy efficiency, methane biogas and reforestation and avoided deforestation projects^[citation needed], and claim that these alleged effects are the intended goal of carbon offsets. On October 16, 2009 Responsible Travel, once a strong voice in favour of carbon offsetting, announced that it would stop offering carbon offsetting to its clients, stating that "too often offsets are being used by the tourism industry in developed countries to justify growth plans on the basis that money will be donated to projects in developing countries. Global reduction targets will not be met this way".^[50]

On 4 February 2010, travel networking site Vida Loca Travel announced that they would donate 5% of profits to International Medical Corps, as they feel that international aid can be more effective at cutting global warming in the long term than carbon offsetting, citing the work of economist [Jeffrey Sachs](#).^[51]

Effectiveness of tree-planting offsets

Some environmentalists have questioned the effectiveness of [tree-planting projects](#) for carbon offset purposes.^[52] Critics point to the following issues with tree planting projects:

- **Timing.** Trees reach maturity over a course of many decades. Project developers and offset retailers typically pay for the project and sell the promised reductions up-front, a practice known as "forward selling".

- **Permanence.** It is difficult to guarantee the permanence of the forests, which may be susceptible to clearing, burning, or mismanagement. The well-publicized instance of the "Coldplay forest," in which a forestry project supported by the British band [Coldplay](#) resulted in a grove of dead mango trees, illustrates the difficulties of guaranteeing the permanence of tree-planting offsets.^[53] When discussing "tree offsets, forest campaigner Jutta Kill of European environmental group [FERN](#), clarified the physical reality that "Carbon in trees is temporary: Trees can easily release carbon into the atmosphere through fire, disease, climatic changes, natural decay and timber harvesting."^[54]
- **Monocultures and invasive species.** In an effort to cut costs, some tree-planting projects introduce fast-growing invasive species that end up damaging native forests and reducing biodiversity. For example, in Ecuador, the Dutch [FACE Foundation](#) has an offset project in the Andean [Páramo](#) involving 220 square kilometres of [eucalyptus](#) and pine planted. The NGO [Acción Ecológica](#) criticized the project for destroying a valuable Páramo ecosystem by introducing exotic tree species, causing the release of much soil carbon into the atmosphere, and harming local communities who had entered into contracts with the FACE Foundation to plant the trees.^[55] However, some certification standards, such as the Climate Community and Biodiversity Standard require multiple species plantings.
- **Indigenous land rights issues.** Tree-planting projects can cause conflicts with indigenous people who are displaced or otherwise find their use of forest resources curtailed. For example, a [World Rainforest Movement](#) report^[56] documents land disputes and [human rights](#) abuses at [Mount Elgon](#). In March 2002, a few days before receiving Forest Stewardship Council certification for a project near Mount Elgon, the [Uganda Wildlife Authority](#) evicted more than 300 families from the area and destroyed their homes and crops. That the project was taking place in an area of on-going land conflict and alleged human rights abuses did not make it into project report.^[citation needed]
- **Methane.** A recent study has claimed that plants are a significant source of methane, a potent greenhouse gas, raising the possibility that trees and other terrestrial plants may be significant contributors to global methane levels in the atmosphere.^[57] However, this claim has been disputed recently by findings in another study.^[58]
- **The albedo effect.** Another study suggested that "high latitude forests probably have a net warming effect on the Earth's climate", because their absorption of sunlight creates a warming effect that balances out their absorption of carbon dioxide.^[59] This view is however being challenged by other studies showing that despite the negative albedo effects of temperate forests there is a net benefit^[citation needed] and in addition there is weak evidence of a positive albedo effect in the tropics from clouds generated by forests^[60]
- **Necessity.** Corporate tree-planting is not a new idea; farming operations have been used by companies making [paper](#) from trees for a long time. If farmed trees are replanted, and the products made from them are placed into [landfills](#) rather than [recycled](#), a very safe, efficient, economical and time-proven method of [geological sequestration](#) of greenhouse carbon is the result of the paper product use cycle. This only holds if the paper in the land fill is not decomposed. In most landfills, this is the case and leads to the fact that more than half of the [greenhouse gas](#) emissions from the life cycle of paper products occur from landfill [methane](#) emissions.^[citation needed]

Additionality and lack of regulation in the voluntary market

Several certification standards exist, offering variations for measuring emissions baseline, reductions, additionality, and other key criteria. However, no single standard governs the industry, and some offset providers have been criticized on the grounds that carbon reduction claims are exaggerated or misleading. Problems include:^{[61][62]}

- Widespread instances of people and organizations buying worthless credits that do not yield any reductions in carbon emissions.
- Industrial companies profiting from doing very little – or from gaining carbon credits on the basis of efficiency gains from which they have already benefited substantially.
- Brokers providing services of questionable or no value.

- A shortage of verification, making it difficult for buyers to assess the true value of carbon credits.

Perverse incentives

Because offsets provide a revenue stream for the reduction of some types of emissions, they can in some cases provide incentives to emit more, so that emitting entities can later get credit for reducing emissions from an artificially high baseline. This is especially the case for offsets with a high profit margin. For example, one Chinese company generated \$500 million in carbon offsets by installing a \$5 million incinerator to burn the [HFCs](#) produced by the manufacture of refrigerants. The huge profits provided incentive to create new factories or expand existing factories solely for the purpose of increasing production of HFCs and then destroying the resultant pollutants to generate offsets. Not only is this outcome environmentally undesirable, it undermines other offset projects by causing offset prices to collapse.^{[63][64]} The practice had become so common that offset credits are now no longer awarded for new plants to destroy [HFC-23](#).^[65]

In [Nigeria](#) oil companies *flare off* 40% of the [natural gas](#) found. The [Agip Oil Company](#) plans to build plants to generate electricity from this gas and thus claim 1.5 million offset credits a year. United States company [Pan Ocean Oil Corporation](#) has also applied for credits in exchange for processing its own waste gas in Nigeria. Oilwatch.org's Michael Karikpo calls this "outrageous," as flaring is illegal in Nigeria, adding that "*It's like a criminal demanding money to stop committing crimes*".^[65]



Other negative impacts from offset projects

Although many carbon offset projects tout their environmental co-benefits, some are accused of having negative secondary effects. Point Carbon has reported on an inconsistent approach with regard to some [hydro-electric](#) projects as carbon offsets; some countries in the EU are not allowing large projects into the [EU ETS](#), because of their environmental impacts, even though they have been individually approved by the UNFCCC and [World Commission on Dams](#).^[66]

Offset projects may also have negative social impacts, for example when local residents are evicted to enable a National Park to be marketed as a carbon offset.^[67]

Understanding carbon offsets and credits

There is a lot of confusion related to the topic of carbon offsets and carbon credits. Hopefully, this will explain this complicated issue in a way that dispels some of the common misunderstanding. In this example, and to offer an example that is easier to understand, we will refer to the carbon credits as the amount of the home's monthly electric bill. Many people on both sides of this issue tend to use complicated terms or phrases that seem to confuse everyone. Our purpose is to break the details down to a simple description.

			
Home A		Home B	
# of residents	3	# of residents	2
Carbon credits	\$100 per month	Carbon credits	\$100 per month
Actual usage	\$125 per month	Actual usage	\$75 per month
Exceeded credits	\$25 per month	Unused credits	\$25 per month
Credits purchased	\$25 per month	Credits sold	\$25 per month
Actual payments	\$150 per month	Actual payments	\$50 per month

Notice that if you add the two homes together for the following, the total remains the same:

Carbon credits:	\$100 plus \$100 equals \$200
Actual usage:	\$125 plus \$75 equals \$200
Actual payments:	\$150 plus \$50 equals \$200

Many people believe the concept of carbon credits and carbon offset is that if you purchase these unused credits, you are "offsetting" the fact that you are over your allotted or allowed credits. Some people believe that by offsetting this amount, you are actually reducing the amount of carbon that is put into the atmosphere. In truth, and as the example above shows, although the unused credits from House B are being purchased by the owner of House A, the actual amount of carbon being generated remains the same, since the amount of electricity consumed is also the same.

Proponents of carbon offsets often make false claims that the use of these offsets reduces carbon that is put into the atmosphere, but a simple review of the process proves this to be incorrect. The only way to actually reduce the amount of carbon emissions is by physically reducing them at the source.

Unfortunately, this issue has become an emotional and political issue. Anyone that disagrees with the environmentalists, are immediately labeled as being against green energy. This could not be further from the truth. Our goal from the outset was to introduce to the world a new way to look at sustainable energy production. The following information describes how we are proposing to offer that balance in order to reduce the amount of carbon actually being put into the atmosphere.

Consider a typical power utility generation facility producing 100MW of electricity. The image below depicts what such a facility would look like. We refer to these as “behemoths!” Our idea is to reduce the amount of electricity being generated, which will in turn, reduce the amount of carbon emissions. Our smaller, micro power generation facilities can then be deployed to produce the amount of electricity to replace the reduced amount from the behemoth.

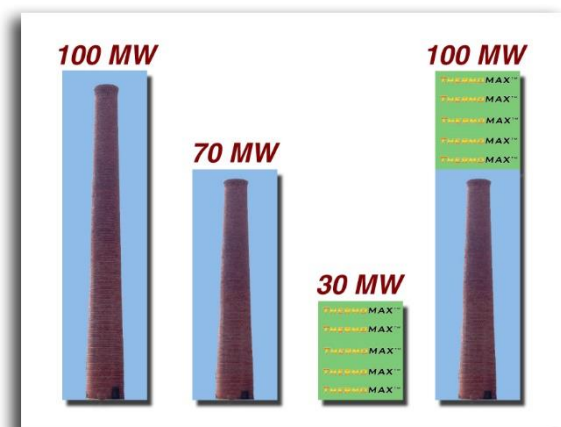


The power plant on the left is producing 100 MW of electricity. If we reduce that same site to producing only 70 MW (note the reduction in the exhaust emissions), less carbon emissions will enter the atmosphere.



This image on the left represents a typical facility producing 6 MW of electricity using our *ThermoMAX3™* Thermal Vortex technology with energy recovery components. Notice that there is no exhaust stack belching exhaust into the atmosphere, due to our unique process and not producing any harmful emissions, including smoke.

With 5 of our micro power generation facilities deployed to strategically reduce any long distance transportation of MSW, the total production will be 30 MW, enough to offset the amount reduced from the larger power plant.



The graphic on the left depicts the only way to truly reduce the amount of carbon emissions put into the atmosphere. By reducing it at the source, we can then replace that energy volume lost with clean, renewable energy with no harmful emissions.

Carbon emissions can't be reduced through deceptive marketing tactics, or false financial schemes. We must demand immediate action in order to properly protect the environment, while maintaining the level of electricity needed and to grow with new demand.

Measurement and Calculation of Diverted CO₂ and Carbon Offsets

I. What Does It Mean to "Divert" CO₂?

"Diverted CO₂" refers to carbon dioxide that would have been emitted into the atmosphere but was avoided through specific actions. This includes carbon capture, emissions avoidance (like using renewable energy), and carbon sequestration (such as afforestation or soil storage).

II. How Is CO₂ Measured When Diverted or Avoided?

1. Direct Measurement (Point-Source Emissions):

- Uses Continuous Emissions Monitoring Systems (CEMS).
- Measures flow rate, CO₂ concentration, and temperature to determine mass.

2. Estimations Based on Fuel Combustion:

- Calculated using fuel usage data and emission factors (e.g., gasoline emits 8.89 kg CO₂ per gallon).

3. Project-Based Estimations:

- Models avoided emissions (e.g., trees absorbing CO₂).
- Requires third-party verification against baselines and standards like Verra or Gold Standard.

III. Converting CO₂ Volume to Mass

At standard temperature and pressure (STP), CO₂ has a density of approximately 1.964 kg/m³. To convert volume to mass:

Example:

$$1,000 \text{ m}^3 \text{ of CO}_2 = 1,000 \times 1.964 \text{ kg} = 1,964 \text{ kg} = 1.96 \text{ metric tons}$$

IV. How Carbon Credits Are Calculated

1 Carbon Credit = 1 Metric Ton of CO₂ reduced or avoided.

Example: A project sequesters 50,000 metric tons of CO₂ → Issues 50,000 carbon credits. Buyers use these to offset their own emissions.

V. Criticisms and Limitations

- Measurement uncertainty in nature-based projects.
- Permanence issues (e.g., forest fires).
- Additionality: Would the project have occurred anyway?
- Potential for fraud or exaggerated claims.

VI. Summary Table

Method	CO ₂ Source	Measurement	Mass Calculation
CEMS (direct)	Industrial stack	Gas analyzer	Volume × Density
Fuel-based Estimation	Transportation, heating	Fuel logs, emission factor	Gallons × kg CO ₂ /gallon
Offsets (indirect)	Solar, forestry	Modeling & verification	Estimated tons avoided
Captured CO ₂	CCS system	Flow sensors & concentration	Measured flow × density