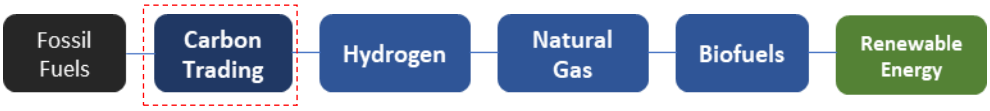
OCBC TREASURY RESEARCH

Clean Energy Series: Carbon Trading

2 August 2021

Carbon Trading Primer



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In the first part of our clean energy series, we look at carbon trading.

This paper serves as an elementary primer for understanding the concept of carbon trading.

It is structured in the following manner:

Part 1: What is carbon trading?

Basic questions on what it is, why it is important and the history of both the Kyoto Protocol and Paris Agreement are addressed here. It sets the backdrop for understanding the motivations behind the creation of a carbon market.

Part 2: The two main types of carbon market.

This section becomes more technical. There are two main types of carbon markets: the cap-and-trade market, and the offset mechanism market. They are very different markets and serve almost entirely different purposes. Since the world is still largely utilising the carbon offset market at present, we take a deeper look at understanding the offset market.

Part 3: Carbon credit purchasing options for buyers.

Understanding how the offset market works in part 2 prepares us for this section. Here we look at the 5 stages of a carbon credit lifecycle in an offset market and how a buyer may, in theory, buy credits at any time during its lifecycle. However, there are different considerations, pros and cons for purchasing credits at each stage. We list them in this section and what a buyer should consider before purchasing.

Part 4: Singapore's role as a carbon trading hub.

We explore Singapore's unique position in Southeast Asia and how it is primed to be a carbon trading hub for the region. While it is unlikely to originate sizeable credits domestically, Singapore's technological infrastructure and financial market maturity allows it to provide credit quality certification and the provision of a well-functioning carbon market for the region.

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Part 1: What is carbon trading?

Answering basic questions on carbon trading.

What is carbon trading?
Carbon trading is similar to all other forms of financial instrument trading – in this case, the instrument of interest is a carbon credit. A buyer and seller exchanges a sum of money for a carbon credit in a marketplace.

What is a carbon credit?
A carbon credit is a certificate or permit which represents the right to emit one tonne of carbon dioxide (CO2) or its equivalents (CO2e). For context, that's the equivalent of what a commercial airplane will produce in a 7 ½ hour flight, from London to New York.

Why is carbon trading important?
The world is increasingly looking to rein in carbon emissions through abatement efforts. The switch to cleaner energy sources, however, cannot be made in a single leap. It is highly challenging for the world to transit from coals and fossil fuels to renewable energy overnight. In between, there is a fair degree of energy mix, including the use of biofuels, natural gas and hydrogen.

To wean the world off carbon, a carbon market is first needed to put a price on carbon and creating a liquid market for trading carbon credits. This will be the first step towards a low-carbon future.

What is a carbon market?
This is where it gets a bit complicated. Although the issue of carbon emissions and its impact on the climate is global, there is no one global carbon market. There are, in fact, several carbon markets. Carbon credits bought in one market may or may not be traded in another.

Generally speaking, there are two kinds of carbon markets: the cap-and-trade scheme, which is largely a compliance market; and the offset market, which may be voluntary or compliance. More on this in part 2.

The most established carbon trading market is the European Union Emissions Trading Scheme (EU ETS). At 90% of global value, the EU ETS is the biggest source of demand for international carbon credits, making it the main driver of the international carbon market.

Carbon emission history – Montreal, Kyoto, Paris.

30 years in the making.
The Montreal Protocol in 1987 was the first inspiration for global cooperation on climate preservation. It was an international treaty ratified by 196 nations and the European Union to protect the ozone layer. The first treaty in the history of the United Nations to achieve universal ratification, its success was the motivation for the Kyoto Protocol ten years later.

The Kyoto Protocol in 1997 is an international agreement birthed by the United Nations Framework Convention on Climate Change (UNFCCC) to reduce CO2 and other greenhouse gases (GHGs), where developed countries were assigned maximum carbon emission levels for specific periods. The Kyoto Protocol turned out to be a colossal failure.

Learning the mistakes from Kyoto, the Paris Agreement in 2015 mandates all countries – not just developing economies – to adopt climate targets.

Paris Agreement tries to learn from the Kyoto Protocol mistakes.
Simply speaking, the Kyoto Protocol failed on two main reasons:

1)Only developed countries were mandated to adopt legally binding targets.
2) Kyoto targets were very weak to begin with.

Kyoto Failure 1: *Failure to incorporate developing economies in the plan.*
The Kyoto Protocol only imposed legally binding targets on developed economies; developing economies were given a pass. That proved a fatal flaw on two fronts: firstly, the BRIC boom in the 2000's meant most of the increase in GHG emissions were from developing countries. Secondly, developed countries' factories constrained by these targets simply shifted to developing countries. That led to the US pulling out of the Kyoto Protocol in 2001 under President George W Bush.

Paris Agreement: all countries are now encouraged to set climate targets.

Kyoto Failure 2: *Initial targets were too weak.*
Targets from both developed and developing economies were too weak. This was particularly evident when the Soviet Union collapsed, resulting in an economic malaise in the Eastern European bloc. With poor economic activity, there were an abundant amount of carbon Assigned Amount Units (AAUs) which these countries sold to other developed countries. Developed countries and companies ended up polluting more, creating what is known as the "hot air" problem.

Paris Agreement: Buyers are encouraged to only buy credits from countries which have ambitious climate targets and also to limit the total quantity of credits that can be used in each country.

Part 2: The two main types of carbon markets

Cap-and-trade vs offset carbon markets.

There are two main types of carbon markets: cap-and-trade, and offset.

These two markets are very different – their only similarity is their underlying, which is a ton of CO2e. Their objectives and the way they work, however, are vastly different.

Cap-and-trade: Also called emissions trading systems (ETS), companies trade permits that allow them to emit one ton of CO2e. A central authority, typically the government, assigns a company a set amount of permits. The company surrenders a permit each time it releases one ton of CO2e.

Offset: Parties trade emission reduction credits, which have already happened. These credits are produced by projects that reduce GHGs emission, for example reforestation programmes. The buyer retires a credit on emission of one tonne CO2e. There is no theoretical limit to how much a company may emit CO2e as long as it purchases the appropriate amount of offset credits, subjected to the country's laws.

Differences between cap-and-trade vs offset mechanism.

1) In an offset mechanism, parties seek credits for emissions that have taken place in the *past*. A cap-and-trade trades permits for *future* emissions.

2) Offsets largely lead to a zero-sum game – one ton of CO2e emission from a factory, for example, has been offset by a reforestation project somewhere. The number of permits in a cap-and-trade, however, can be gradually lowered over time to meet climate goals.

3) There is no theoretical limit on the amount of emissions an offset market will impose on a company, unless otherwise decreed by the government. In a cap-and-trade market, the government dictates the total amount of CO2e emissions in a time period.

Legacy issues from the Kyoto Protocol mean the global carbon market are dominated by offset mechanisms. Specifically, the Clean Development Mechanism and Joint Implementation from the Kyoto Protocol account for almost 75% of credits issued to date. As of 31 Dec 2019, there are 14,550 carbon crediting projects globally.

While the cap-and-trade market remains the best chance for lowering CO2e emissions globally, its difficulty in implementation on a universal scale is much higher than the offset market. The costs of emission reduction also vary widely across economies.

Cap-and-trade is the future; but offsets dominate the present market.
What is clear, however, is that to attain the climate goals set in the Paris Agreement, zero emissions are insufficient. Negative emissions are needed as emissions from some processes are unavoidable (for eg, agriculture). Cap-and-trade is the way forward to achieve these goals, despite its inherent difficulties. The offset market, in theory, should only be largely utilised for unavoidable emissions.

At present, however, the offset market remains the key mechanism for carbon markets across the globe.

A deeper look at the carbon offset market.

A carbon offset credit represents the reduction of one tonne of CO2e. This credit is normally certified by governments (for compliance markets) or independent certification bodies (for voluntary offset markets). It is eventually "retired" when the buyer uses this credit to offset an equivalent amount of CO2e emission.

The offset market allows firms to 'outsource' their emission compliance.
Offset credits need not originate from the same buyer country, nor does it even have to be remotely connected with the buyer's line of business. As greenhouse gases are non-localized once released into the atmosphere, it does not matter where they are emitted nor reduced. A steel company in Europe, for example, could theoretically purchase a recognised offset credit from a project in Brazil.

Simply put, the offset mechanism allows firms to pay others to reduce emissions on their behalf. This flexibility, on paper, creates a market for companies to seek the most efficient method for enabling an equivalent emission-reduction activity in a different part of the globe.

How are carbon offset credits produced?
Carbon offset credits can be produced via activities that reduce greenhouse gas emissions. These are normally in the form of projects and can be divided into two main categories: nature-based (avoid deforestation or encouraging reforestation) or technology-based (building windfarms or investing in energy efficient measures).

The role of carbon offset programmes.
To provide assurance on the authenticity and quality of carbon credits, standard-setting organizations have been established to smoothen the friction between offset buyers and sellers. These organizations are known as "carbon offset programmes".

The importance of offset programs cannot be understated.

1) They develop and approve frameworks for potential and existing offset projects to follow, allowing these developers to securitise their projects into offset credits.
2) They conduct regular reviews on offset projects to ensure they meet prior environmental standards and fulfil evolving requirements.
3) They operate registry systems that provide origination and retirement of offset credits.

Carbon offset programs have been traditionally split into two camps since the Kyoto Protocol:

- international and/or government bodies certify credits for compliance markets;
- independent non-governmental organizations (NGOs) serve the voluntary offset market.

Voluntary offset markets are increasingly important despite its comparatively smaller market size vis-à-vis the offset compliance market. The voluntary market allows firms not mandated by regulation to also participate in reducing their carbon footprint, since the compliance market typically only legislates large companies. The entrance of these players also provide much needed market liquidity, as they typically trade in smaller sizes compared to the larger companies.

Examples of carbon offset programs.

Type	Carbon Offset Program	Geography	Offset Label
Compliance	Clean Development Mechanism (CDM)	Developing Countries	Certified Emission Reduction (CER)
	Regional Greenhouse Gas Initiative (RGGI)	United States	RGGI CO2 Offset Allowance (ROA)
	Alberta Emission Offset Program (AEOP)	Canada	Alberta Emissions Offset Credit (AEOC)
Voluntary	American Carbon Registry	United States	Emission Reduction Tonne (ERT)
	Gold Standard	International	Verified Emission Reduction (VER)
	Plan Vivo	International	Plan Vivo Certificate (PVC)

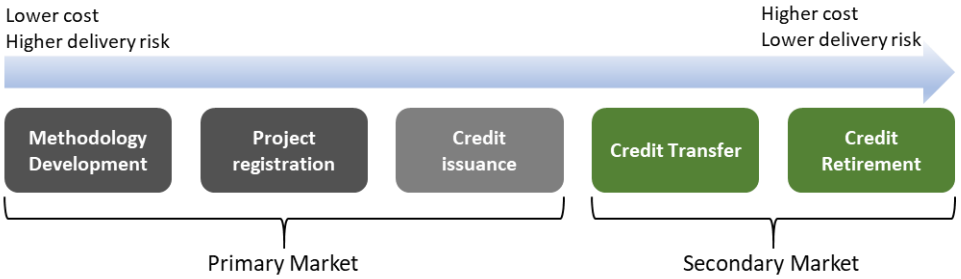
Source: Carbon offset guide, OCBC

Part 3: Carbon credit purchasing options for buyers

When can a buyer purchase offset credits?

The lifecycle of a carbon offset credit.
To understand the numerous purchasing options of a carbon offset credit, it is crucial to first understand the lifecycle of a typical carbon offset credit.

Lifecycle of a carbon offset credit.



Source: Carbon offset guide, OCBC

1. **Methodology development**: project developers present their framework to qualify their GHG reductions as meeting the criteria for offset credits.
2. **Project validation and registration**: An offset program officially indicates the offset project has been accepted into their registry.
3. **Project offset credit issuance:** The carbon offset program approves third-party verification reports on the project's GHGs reductions and issues the equivalent carbon offset credits.
4. **Offset credit transfer:** Credits begin to exchange hands from the program to the secondary market, or if needed, within the secondary market.
5. **Offset credit retirement:** A company then uses the credit to offset its prior CO2e emission. The "retired" credit returns to the offset program's depository and can no longer be used.

At which stage can a buyer purchase offset credits?
In theory, there is no restriction on when a buyer may choose to purchase an offset credit within the credit's lifecycle.

As a rule of thumb, the earlier the buyer purchases the credit in the lifecycle, the larger the discount. A purchase in the primary market, however, comes with higher delivery and liquidity risk. The buyer will also have to contend with a longer wait time before the official issuance of the carbon credit by the offset programme.

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Purchasing methods for buyers.

Stage of purchase	Description	Pros	Cons
New methodology development.	Few buyers are involved at this stage. Buyers who invest at this stage see traits of a development that are specifically attractive – for eg fits their climate protection ideology or business goals.	1.Able to shape entire project from the outset. 2.Allow "at cost" purchase of credits.	1.Significant resources required. 2. Long lead time. 3.Implementation risk. 4.Highly illiquid market.
Direct investment in ongoing project.	A buyer invests directly in an offset project (post methodology development) and becomes a key investor or stakeholder.	1.Allow "at cost" purchase of credits. 2.Considerable stakeholder influence on project development.	1.Significant resources required. 2.Long lead time. 3.Highly illiquid market.
Purchase directly from project developer.	A buyer goes to a project developer directly to purchase credits. This may be in the form of a forward agreement or unsold issued credits for prompt delivery.	1.Lower cost than purchasing from secondary market. 2.Immediate delivery of credits (for unsold issued credits).	1.Buyers will have to enter a long-term purchase agreement and typically purchase in bulk.
Purchase from offset credit broker.	Buyers go to offset brokers to purchase offset credits.	1.Brokers can offer a mix of offset credits. 2.Able to cater to different volume needs. 3.Liquid market. 4.Prompt access to credits.	1.Higher cost than direct purchase from project developers.
Purchase from exchange.	Several commodity exchanges, especially in North America and Europe, offer carbon credits for sale.	1.Liquid market. 2.Immediate access to credits. 3.Lower cost than brokers.	1.Lower ability to customise sizing need. 2.Higher risk of poor quality credit offsets compared to brokers.
Purchase from retailer.	Retailers are non-brokers who maintain accounts with offset programs. They look to serve buyers who require only a small amount of offset credits, although they do transact with organizations as well.	1.Immediate access to credits. 2.Able to deal in small volumes.	1.Likely the highest priced option.

Source: Carbon offset guide, OCBC

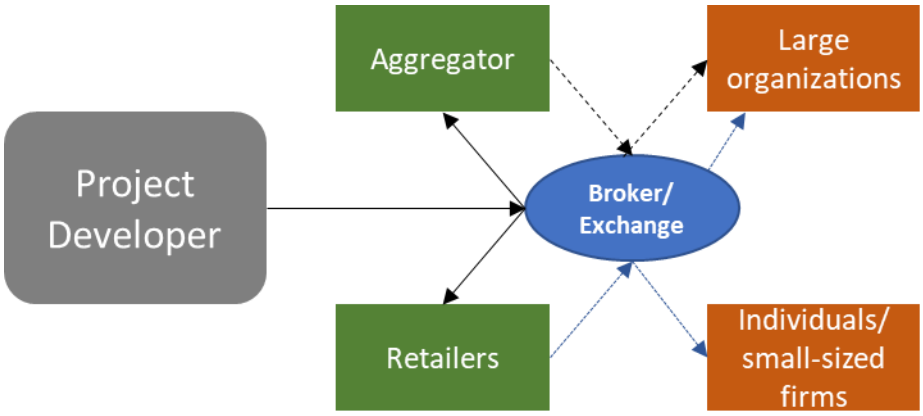
Considerations when purchasing carbon credits.

1) **Timing –** when is actual delivery of these credits required? It may take 3-5 years from project implementation to credit issuance.
2) **Cost –** the earlier the credit purchase, the larger the discount. But the buyer will have to deal with higher delivery/liquidity risk and a longer wait time to issuance.
3) **Size –** how many credits does the buyer need? Early purchase of credits may come in a larger bulk while smaller traded lots may only be found towards the end of the credit lifecycle, typically with retailers.
4) **Label –** does the firm or its country have a mandated offset credit label (for eg, the Certified Emission Reduction label by the CDM) or credit program (for eg the RGGI) that requires adherence?
5) **Any direct interest in the offset project?** – a sizeable, early purchase of credits allows a substantial stakeholder influence on how the project may run during implementation.

Financial intermediaries play an important role for credit flows.

In particular, brokers play a crucial role in providing liquidity in the secondary market, offering solutions on the buyer's specific needs and advising on the relevant credit for purchase from their inventory of offset credits.

Theoretical flow of a carbon offset credit and the central role of a broker/exchange.



Part 4: Singapore's role as a carbon trading hub

Asia remains behind North America and the EU in carbon market maturity.

While the carbon trading markets in the likes of North America and the EU are relatively matured, a well-functioning carbon trading market in Asia is still lacking. Asia's predominantly developing economies, continue to rely more on fossil fuels than their counterparts in North America and the EU. As Asia transits from fossil fuels into a low carbon future, a regional carbon trading marketplace to serve Asia's needs is needed.

Singapore's geographical position and advanced infrastructure makes it a natural choice to be a carbon trading hub.

Southeast Asia is home to many natural carbon sponges, such as mangroves and tropical rainforests, and offer a ready source of carbon credit origination. Singapore's geographical position within Southeast Asia makes it ideal for the creation of a carbon trading hub for trading these credits.

Riding on Singapore's developed financial market infrastructure, Singapore's role as a carbon trading hub will likely focus on two fronts:

1) **Verification of regional carbon credits**, utilising state-of-the-art technologies such as satellite monitoring, AI and blockchain to verify carbon credit quality.
2) **Offering financial services within the regional carbon trade**, such as provision of carbon credit liquidity, the creation of a carbon credit secondary market, the facilitation of credit issuance and regulatory supervision on actors.

Singapore is one of the leading countries in the region on tackling climate change. From introducing a carbon tax to the MAS Green Plan, the country's ambition to be a carbon trading hub further anchors its climate sustainability plans. Its developed infrastructure suggests it will be the leading actor for climate sustainability efforts in the short to medium term for regional efforts. Plans for an onshore carbon trading hub will unlikely be the last in the country's ambition to further pursue its climate goals.

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Summary

Even as the world attempts to transit to a low-carbon future, the move from fossil fuels to renewable energy is unlikely to happen overnight. The phasing out of carbon emissions requires a well-functioning carbon ecosystem and a price on carbon. To that end, a deep and liquid carbon trading market is needed.

While cap-and-trade remains the way forward in bringing down total global carbon emissions, the dominant carbon market presently remains that of the offset mechanism market. Voluntary offset markets are expected to grow increasingly in importance.

In practice, potential buyers may purchase offset credits at any stage of a carbon credit's lifecycle, but will have to balance costs with delivery risks. Buying the credits in the primary market is typically associated with lower costs but higher delivery risks, while purchasing the credits in the secondary market normally results in higher costs but lower delivery risks. A broker/exchange is typically central to the flow of these credits among the project developer, aggregators, retailers and end-users.

Finally, Singapore's position as a key financial market in Southeast Asia primes it for a key role as a carbon trading hub. The country will likely focus its carbon trading efforts on two fronts. First, the leverage of its existing technological infrastructure to provide credible verification of regional carbon credits. Secondly, its status as a global financial hub allows it to provide liquidity and the creation of a secondary trading market in the region.

Appendix 1: Notable References

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