PARYS™: a Stable and Transparent Carbon Collateral for the Regenerative Finance (ReFi) Ecosystem by Jason R. Cooner – June 2023

In Honor of Nik

Abstract. The $130T Climate Finance gap needed to implement Paris Agreement through 2050 will not be addressed by historical Financial Institution based stock and bond issuance and investment alone. It will require a bridging of existing financial mechanisms with what is called Web3, the financial mechanism that has created $2.5T in new value over the last 4 years.

Web3, otherwise called Decentralized Finance, now including Regenerative Finance, is the pavement by which we can build a financial highway to NetZero by 2050. No other financial means will deliver these results. One most promising bridge to map the existing financial infrastructure to Paris goals is the Parisii™ blockchain-based platform, and more specifically a patent-pending ReFi instrumentation known as the PARYS™ Protocol.

PARYS™ is the world's first and only stable carbon synthetic that can act as a stablecoin for settlement and wealth preservation. PARYS™ price pegs 1:1 with the EURO, and fully asset backs with EU-ETS Carbon Allowances (EUAs), which have delivered 28.27% APY returns over the past decade. PARYS™ is backed by EUAs (government issued certificates) from a $700B annual trading market with over $200M in daily liquidity, and can be redeemed in crypto, EUAs, or EUROs as needed. Due to the new MiCA legalization of crypto in the European Union (EU), PARYS™ is the world's first totally legal stablecoin under the EU regulatory framework. PARYS™ is currently the only fully regulated financial mechanism in Web3 that plans to quantify, track and assist in real-world facilitation of this $130T global investment expected over the next 27 years to implement the Paris Agreement in achieving NetZero.

PARYS™ is governance minimized as a decentralized protocol that automatically reacts to market forces in order to modify the target value of its native collateralized asset, carbon. The PARYS™ Protocol allows anyone to leverage their fiat, crypto or carbon deposits as native carbon instruments, and issue a “carbon reflex index” which is a dampened version of its underlying carbon collateral. The PARYS™ Protocol includes a governance token, AGREE™, to allow the community to determine carbon collateral types and other governance measures.

This whitepaper describes how carbon reflex indexes can be useful as universal, low volatility collateral which can protect its holders, as well as enable other decentralized finance protocols, from sudden market shifts. The contents should serve as a blueprint to help other teams launch their own decentralized finance (DeFi)/ regenerative finance (ReFi) protocols and instruments based on carbon by leveraging our Parisii™ infrastructure as a means of settlement and extended functionality. Finally, this whitepaper details an alternative on-ledger source direct and transparent carbon-based pricing solution as an improvement to current oracle and governance structures found in Dai, Rai, as well as many other DeFi/ReFi protocols.

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Introduction

Money is one of the most powerful coordination mechanisms humanity leverages in order to thrive. The privilege of managing the money supply has historically been kept in the hands of sovereign leadership and the financial elite while being imposed upon an unwitting general public. Where Bitcoin has demonstrated the potential for a grassroots protest to manifest a store-of-value commodity asset, Ethereum gives us a platform to build carbon asset-backed synthetic instruments that can be protected from volatility and used as carbon collateral, or pegged to a reference price and used as a medium-of-exchange for daily transactions, all enforced by the same principles of decentralized consensus.

Permissionless access to Bitcoin for storing wealth and properly decentralized synthetic instruments on Ethereum will lay the foundation for the upcoming financial revolution, providing those at the fringes of the modern financial system the means to coordinate around building the new one.

In this paper, we introduce a framework for building carbon reflex indexes, a new asset type which will help other carbon synthetics flourish and will establish a key building block for the entire decentralized finance / regenerative finance industries.

We start by describing overall benefits of the PARYS™ ReFi ecosystem. We then detail Carbon Allowances as Emissions Trading Schemes, as well as benefits of utilizing the European Union Emissions Trading Scheme (EU-ETS) as the carbon collateral of choice for initial PARYS™ implementation. By leveraging existing European Union Allowances (EUAs) as Carbon Futures for collateralization, coupled with the Intercontinental Exchange European Union Allowance (ICEEUA) index for price discovery and fungibility, PARYS™ can achieve optimal results as a ReFi protocol.

We then discuss the PARYS™ blockchain mechanics. We describe the carbon reflex indexes as a non-pegging to carbon collateral, then monetary policy and related global governance. We conclude by summarizing our product roadmap, the addressable market, as well as providing detailed diagrams for system visualization.

How PARYS™ Benefits Planet Earth

1. PARYS™ minting is Proof-of-Stake, which doesn't require digital mining to produce (designed to not "burn up" the planet).
2. PARYS™ is fully 1:1 fungible with a Carbon Allowance (designed to save the planet), which can be utilized in the future for Paris Agreement compliance – both “firsts” in the digital currency industry.
3. PARYS™ is expected to outpace every other commodity (gold, silver, etc.) on the planet in price over the next 30+ years. In fact, if current World Bank estimates hold, PARYS™ is expected to outpace all other major stock indexes, including the NASDAQ and S&P 500 year over year through 2050.
4. PARYS™ is designed to drive the price of carbon up naturally, to set a new/higher floor for carbon pricing worldwide incrementally over time.
5. PARYS™ is designed to reward higher quality GHG Projects with better compensation and higher liquidity throughout their decades-long lifetime.
6. PARYS™ commits over 50% of proceeds towards re-investment into new Sustainable, as well as truly "Additional" GHG Project development during the protocol’s operation, creating a truly circular economy at scale for global carbon emissions reduction/sequestration.
7. PARYS™ is the first Carbon Synthetic designed to increase in value over time, in fact adjusting for inflation and profits per government climate change policies in the pricing model itself.
8. PARYS™ is the world's first and only carbon-collateralized "green Carbon Synthetic" allowing the crypto exchanges to perform 100% of their global settlement with a truly green financing mechanism.

Carbon Allowances and Emissions Trading Schemes (ETS)

Climate change policies are becoming more prevalent around the world as governments and companies scramble to meet net-zero by 2050. Carbon allowances have come to the fore as one of the most effective measures to reach this goal. This once obscure asset class is now accessible through ETFs which invest in carbon futures. It may appear to be an abstract investment opportunity but fear not, we’ve stepped out the four key concepts you need to understand about carbon allowances and their growth potential for your portfolio.

What Are Carbon Allowances?

Carbon allowances – also called “emissions trading schemes”, or “cap and trade” – are sometimes described as the economist’s solution to greenhouse gas emissions. They are tradeable government permits that allow polluters to pump carbon dioxide (CO2) into the atmosphere. Under these programs, polluters must surrender enough

allowances to cover their pollution upon inspection. Governments ensure compliance, with large fines issued for non-compliance.

Carbon Allowances Are NOT Carbon Offsets

It should be noted at the outset that carbon allowances are NOT the same thing as carbon offsets. Carbon offsets, like the Australian Carbon Credit Units (ACCUs) issued by Australia's Clean Energy Regulator, are unregulated voluntary programs, where polluters do things like rent forests that theoretically offset their pollution. Offsets are sometimes marketed by companies to create "carbon neutral" products, like beef or plane flights. They have been criticized by academics. Carbon allowances by contrast are mandatory and heavily regulated programs that require emission to fall over time. Australia does not run a mandatory carbon allowance program.

How Do Emissions Trading Schemes Work?

Emission trading schemes are the issuers of and marketplace for carbon allowances. They were introduced to help address climate change concerns and became more widely known after the Paris Agreement in 2015 when governments from around the world agreed to reach net-zero carbon emissions by 2050 to prevent global warming increasing by more than two degrees Celsius. According to the Organization for Economic Co-operation and Development (OECD), "broader use of emission trading systems (or of environmental taxation) would be one of the most efficient and effective ways of promoting green growth" – making them a vital tool in accomplishing these targets.

The most regulated and enforceable type of emission trading scheme is the 'cap-and-trade' model. 'Cap-and-trade' schemes auction off carbon allowances to put a strict "cap" on the overall number of emissions which can be pumped into the atmosphere each year and incrementally lower the "cap" to work towards net-zero goals. The largest and most established trading schemes in the world follow this model. Each scheme has its nuances; however, the basic principles are similar across the board.

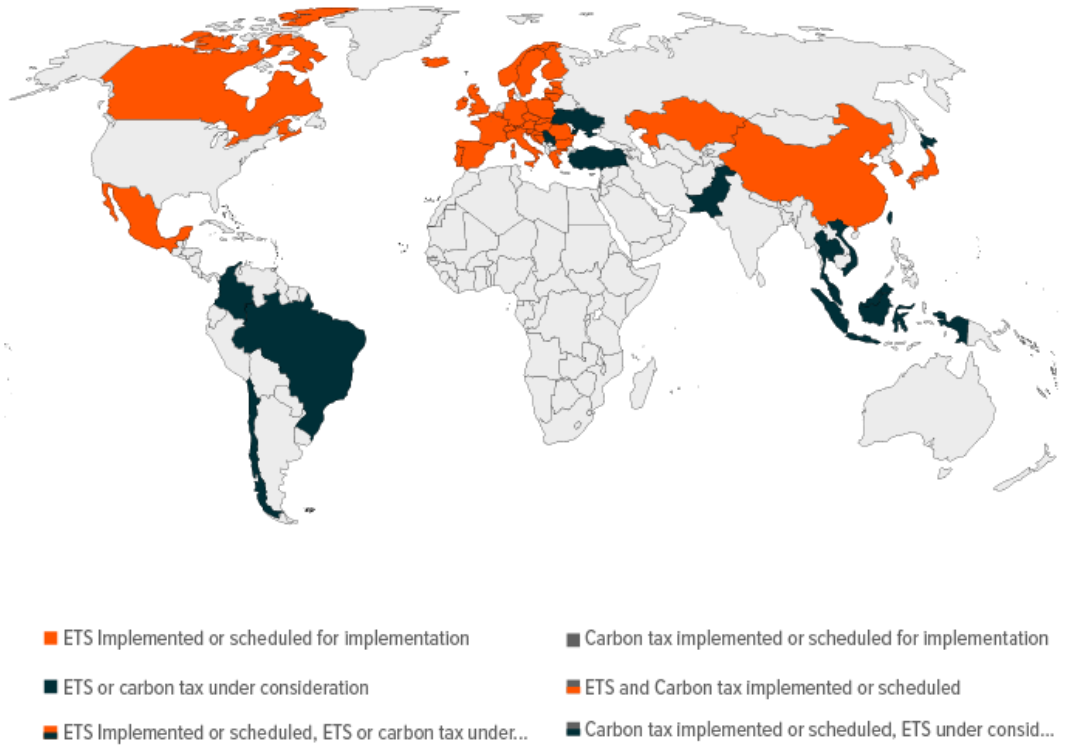
Emission trading scheme authorities hold an annual auction where polluters bid to purchase enough carbon allowances to see them through the year. The number of new allowances issued is reduced each year – creating a more competitive market, pushing up the price of CO2 and encouraging the adoption of clean energy. Participating organizations can also auction off their leftover allowances from the previous year. To ensure allowance limits are adhered to, trading scheme authorities conduct audits and enforce hefty fines.

Where Are the Biggest Emission Trading Schemes?

The first emission trading scheme was started by the European Union in 2005. Other jurisdictions including the United Kingdom and areas of America have since followed suit and now there are more than 20 carbon markets around the world. The four most robust and regulated schemes are the European Union Emissions Trading Scheme, Regional Greenhouse Gas Initiative, Western Climate Initiative and the UK Emissions Trading Scheme.

SUMMARY MAP OF REGIONAL CARBON PRICING INITIATIVES

Source: World Bank. Data as of October 2022.



The European Union Emissions Trading Scheme requires every country in the region to participate, plus Iceland, Liechtenstein and Norway.

The Regional Greenhouse Gas Initiative is comprised of eleven east coast states in the US – including New York – which has established a regional cap on carbon emissions by specifically targeting power plants in each state.

The Western Climate Initiative operates in the US states of California and Washington, as well as the Canadian provinces of Québec and Nova Scotia. Heavy polluters including power plants and refineries were required to participate from 2013, while other emitters like suppliers of transportation fuels had to comply by 2015.

UK Emissions Trading Scheme is governed by the UK, Scottish and Welsh Governments and Northern Ireland Department of Agriculture, Environment and Rural Affairs. The scheme applies to energy intensive industries, the power generation sector and aviation as well as smaller emitters such as hospitals.

Why Are Carbon Prices Rising?

The investment case for carbon allowances is growing thanks to favorable supply and demand dynamics, political pressures and international investment in decarbonization. These factors should multiply the growth potential of carbon allowances, particularly if climate change targets become more ambitious than current net-zero goals.

Now that you understand how emission trading schemes work, it is easier to understand how supply and demand could affect the price of carbon over time. With supply shrinking each year, all things being equal, prices should rise. This also works to help cut emissions by making pollution more expensive.

Political pressures from global entities such as the United Nations – notably policies like the Paris Agreement – are seeing governments and companies alike reduce their carbon footprint. More broadly, climate change awareness from the broader public is also contributing to mounting pressure for polluters to address their environmental impact. This may lead to more jurisdictions around the world implementing emission trading schemes to ensure climate change goals are being met.

Carbon Allowances: Fighting the Good Fight

Carbon allowances and emission trading schemes are becoming a leading method to meet net-zero goals and limit global warming. As existing schemes in the European Union, the United Kingdom and US continue to crack down on emissions and more countries enact similar policies, the overall cost of carbon is set to increase – making carbon allowances a valuable tool in the fight against climate change and a cleaner way to incorporate growth potential into your portfolio.

Investment Thesis: Why are Carbon Allowances an Investment Opportunity?

The clean energy transition is a huge investment opportunity. Yet investors naturally wonder why carbon allowances are a good bet, rather than alternatives like battery technology, clean energy utilities or green bonds. Such curiosity is elevated by the strangeness of carbon allowances to many, and their common confusion with carbon offsets.

From our perspective, there are three major reasons for investing in carbon allowances: price appreciation, diversification, and environmental investing. We discuss each below.

Reason #1 – Potential Price Appreciation

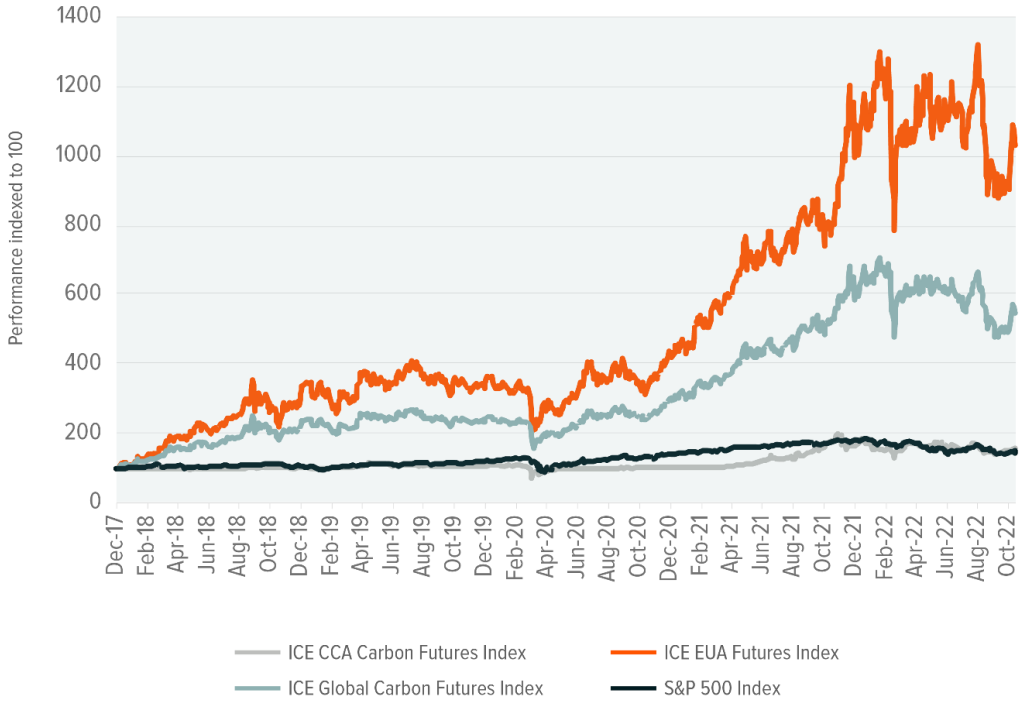
Carbon allowances have performed strongly in recent years, especially in Europe, the largest market. The ICE Global Carbon Futures Index delivered a 38.46% annualized return over five years from November 2017 – November 2022 in US dollars. While past performance does not guarantee future returns, the drivers of carbon's historical return remain in place: supply, demand and government-mandated price increases.

The supply of carbon allowances in markets like the EU, UK, California and RGGI is designed to fall over time, with the shrinkage rate differing between regions. The European Union recently increased the speed at which supply shrank from 1.7% in 2020 to 2.2% in July 2021 under 'Fit for 55' legislation. While the UK knocked an additional 5% of supply out of its market in 2021 as well. Economics textbooks teach us that, all things being equal, a commodity with a steadily diminishing supply should see its price increase.

Demand for carbon allowances is also, perhaps regrettably, rising. As of December 2022, rising demand owes to sanctions on Russia straining global supplies of oil and gas. The absence of Russian fuel is causing the EU in particular to burn more coal. Coal produces more carbon dioxide per kilowatt hour of electricity produced. Thus, substituting coal for gas translates into greater demand for carbon allowances.

CARBON ALLOWANCES HAVE PERFORMED STRONGLY

Source: Bloomberg. Data as of 30 October 2022.



Governments are also engineering higher carbon prices in some markets. In the RGGI states and California, governments dial up auction reserve prices every year. In California, the auction reserve price increases by the rate of inflation + 5% each year. While in RGGI it rises by 2.5% per year. (While the EU and UK lack a price floor, regulators can intervene if the market is oversupplied).

Beyond auction reserve prices, there is a sense in which higher carbon prices are existentially necessary. That is, if the world is to respond adequately to global warming, the price of carbon *must* rise to force down demand—in rich countries especially.

COUNTRIES BY CO2 EMISSIONS PER CAPITA
Source: World Bank. Data as of 2019.

Countries by CO2 emissions	Metric tonnes
High income	9.8
Middle income	3.8
Low income	0.3

Richer countries have the highest greenhouse gas emissions per capita—and it is per capita emissions that ultimately matter most. Richer countries are also most able to afford clean energy alternatives, thereby 'freeing up' poorer countries to use cheaper fossil fuels.

It is perhaps worth noting how far carbon prices must rise if international agreements – like the Paris Agreement – are to be honored. According to the Real Carbon Index, the global weighted average price per ton for countries with mandatory carbon markets is roughly US$23.70 as of 30 November 2022. Yet academics suggest that global carbon prices need to rise to over $50 globally if we are to have a realistic chance of meeting climate targets.

Reason #2 – Diversification

Diversification is another potential benefit. Theory would lead us to expect that carbon allowances are poor diversifiers. This is because they are underpinned largely by energy demand—as discussed above in relation to Russia. And other assets – like utilities companies and oil – have similar underpinnings. But contrary to expectation, carbon allowances exhibit low correlations with other assets, including, crucially, the oil price.

5-YEAR CORRELATIONS (OCT 2017 - OCT 2022)

Source: Bloomberg. Data as of 31 Oct 2022.
Correlations measured weekly in US dollars on a price return basis. Source: Bloomberg.
Global shares index = MSCI World. Bonds = Bloomberg Barclays Global Aggregate Bond Index.
Commodities = S&P GSCI. Oil = Bloomberg WTI Crude Oil Index. Real Estate = FTSE EPRA Nareit Global REITs Net Total Return Index. Clean Energy Equities = S&P Global Clean Energy Index. Data as of 4 July 2022.

	ICE Carbon Futures Index
Global shares	0.43
Australian shares	0.29
Global bonds	0.19
Commodities	0.15
Oil	0.15
Global property	0.33
Clean energy equities	0.31

There are logical reasons for these low correlations. These include the fact that carbon allowances are a unique asset class, and exist only as digital entries in government ledgers. The fact that carbon markets are more centrally controlled by regulators than other financial markets, and regulations effecting carbon markets are much more idiosyncratic. And the presence of non-economic players – like governments – in carbon markets, which can give allowances away freely. Stock, bond, and commodity markets do not have such participants.

Reinforcing these diversification benefits for many is the fact that carbon allowances are issued in few regions worldwide and not a regular feature in many existing investment portfolios, meaning their prices should not be directly tied to a nation's economic outlook if the allowances were produced by a foreign ETS.

Reason #3 – Environmental Investing without Greenwash

Investors increasingly want to invest in positive environmental causes. After the 2020 bushfires in Australia, there was a proliferation of environmentally marketed investment products in country. But amidst the scrum, investors have struggled to determine how environmentally friendly funds truly are. While ASIC has raised concerns that some investment products being peddled as environmentally friendly are not true to label.

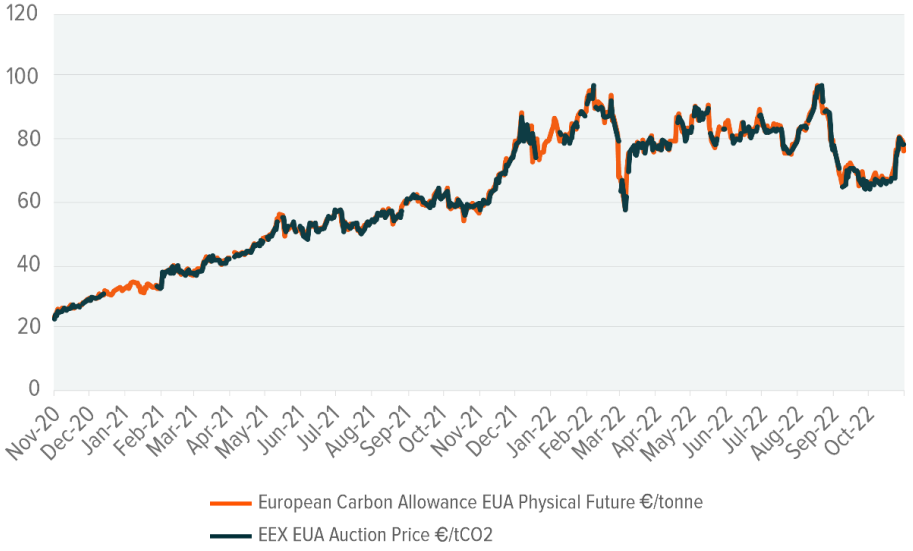
An advantage of investing in carbon allowances is that its environmental credentials are clear-cut. They are expressly designed to reduce carbon dioxide emissions. And in this respect, they are perhaps the only instruments of their kind.

Carbon Futures: Invest in Carbon Allowances

Investors looking to invest in carbon need a way to do so. While the obvious choice would be buying carbon allowances outright, carbon allowances do not trade on exchanges or on any single venue. Instead, carbon allowances are traded in different places and different ways, often bilaterally between institutions. They can only be traded by registered participants, which have accounts within government registers.

In this setting, futures are common way investors access the carbon market. Carbon futures – unlike allowances – are traded on exchanges. These futures are often more liquid than allowances, and some of them trade hundreds of millions of dollars a day. They are primarily used by polluters looking to hedge, but they can also be used by investors wanting long term exposure or speculators. Exchange traded funds use them to invest in the carbon market.

EU CARBON FUTURES HAVE CLOSELY TRACKED AUCTION PRICES
Source: Bloomberg. Data as of 30 October 2022.



Carbon allowances are growing in popularity around the world, as governments explore policies for bringing down greenhouse gas emissions. Thanks to futures markets, these carbon allowances are highly investible. Investment benefits can include diversification, potential price return, and the ability to have an environmental impact. We expect:

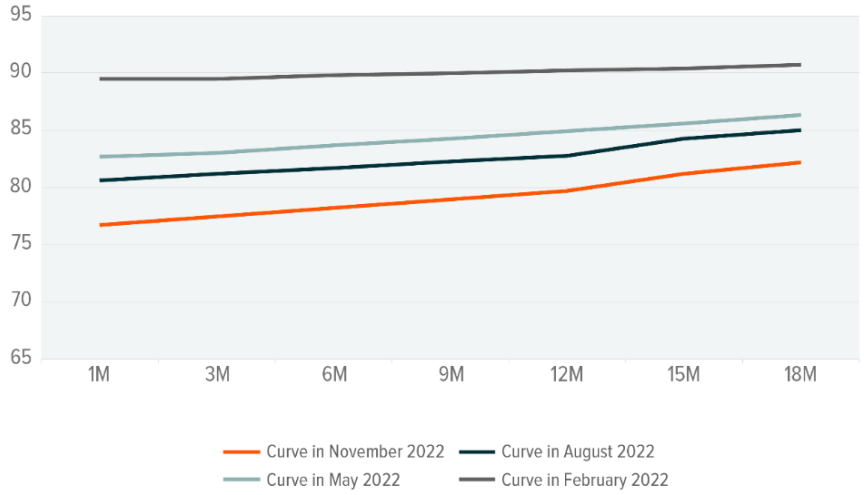
1. The scope of the EU-ETS to expand
2. The supply of allowances (or permits) to emit carbon to shrink
3. The price of allowances to rise and thus help policy makers deliver on their promises to decarbonize and become emissions net neutral by 2050

Potential Limitations and Risks

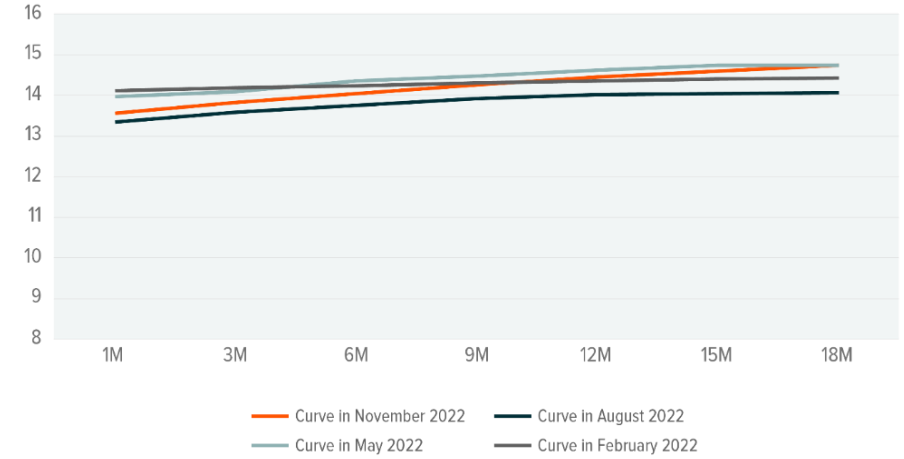
1) Contango

Investing in futures comes with the risk of contango. Contango is where futures trade above the spot prices of a commodity, and fall in value (relative to the spot price) as they come closer to maturity. Contango can reduce returns, as it requires investors to "sell low, buy high" when rolling futures contracts. Contango is common in many commodities futures markets – such as gold futures – as logistical and storage costs get priced in.

EUA FUTURES PRICE CURVE IN 2022
Source: ICE. Data as of 30 October 2022.



RGGI FUTURES PRICE CURVE IN 2022
Source: ICE. Data as of 30 October 2022.



However, carbon allowances are digital entries in governments' ledgers. As such, they do not carry the same logistical or storage costs as other commodities. Meaning that

while there is often a small amount of contango in carbon futures markets, there is never a lot. The futures curves in carbon allowances have historically remained flat. This is particularly true in Europe, the largest market (pictured above, which shows the shape of the futures curve at various points in time).

2) Environmental Inadequacy

Critics also question the environmental credentials of carbon allowances. They claim that current allowances are too generous to polluters, and insufficient to meet international agreements. Meanwhile others point to the opposite problem of "carbon leakage": as only some countries and regions participate in emissions trading schemes, polluters can simply shop between jurisdictions to avoid the restrictions.

On these points, there are no easy answers. We would only note that evidence suggests that carbon allowances, in markets where they are used, are having their desired effect and bringing greenhouse gas emissions down. Evidence also suggests that carbon leakage is minimal, as carbon allowances mostly target utilities companies with immobile infrastructure and allowances are not prohibitively expensive for polluters.

PARYS™ as a Stable Carbon Synthetic

According to the International Financial Reporting Standards (IFRS), a Synthetic Instrument is a financial product designed, acquired, and held to emulate the characteristics of another instrument.

As the popularity of Decentralized Finance (DeFi) proliferates, Parisii™ seeks to provide new opportunities for investors using a novel structure of finance. Carbon Synthetic Instruments, which grant users exposure to numerous carbon assets and/or financial derivatives (carbon futures and carbon options) while eliminating traditional barriers to entry, are among the latest forms of such innovation. In essence, Carbon Synthetics refer to the tokenized clone of traditional carbon-based financial assets. This 'clone' rests solely on a blockchain, however. Since they are blockchain-based, DeFi has become a home to these assets. In fact, the integration of blockchain technology which brings automation and removes the need for intermediaries is what makes Carbon Synthetics so innovative. Courtesy of the blockchain, traders can enjoy exposure to traditional carbon allowances and offsets without the need to worry about the drawbacks a centralized platform brings. In addition, the decentralized nature of DeFi largely removes the troubles commonly emanated from regulatory bodies.

Similar to derivatives in traditional finance, Carbon Synthetics are digital assets with their price pegged to other real-world carbon assets—such as EUAs and CCAs. Also referred to as “synths,” these assets track and provide the returns of traditional assets without requiring access to the real-world carbon asset.

Since PARYS™ Stable Carbon Synthetics are derivatives, their value is derived from an underlying asset through smart contracts. Therefore, one can use these assets to trade the movement of price and value of traditional carbon assets. PARYS™ tokens are created in the form of ERC-20 smart contracts that run initially on the Ethereum blockchain. They are different from options and other forms of traditional derivatives in that they tokenize the relationship between the derivative product and the underlying asset.

On the other hand, traditional derivatives are financial contracts that create terms for a carbon asset and its price. This allows DeFi users to leverage Carbon Synthetic assets in the use of various trading strategies. For instance, hedging, which is a popular strategy in binary options trading, allows users to offset losses and manage risks by taking positions in derivatives. Such strategies are also used in the PARYS™ Protocol world of Carbon Synthetic assets.

Benefits of the PARYS™ Stable Carbon Synthetic

PARYS™ Stable Carbon Synthetic assets carry a number of unique advantages. While there are no specific citizenship requirements to participate in the stock market, there are certain needs that investors must satisfy. Non-US persons must provide identification documents, pass Know Your Customer (KYC) screening, and comply with a number of laws that are intended to protect US interests.

However, Carbon Synthetic assets feasibly provide investors of any location or jurisdiction exposure to the price action of stocks, commodities, and currencies. To trade these tokens, users would hardly need any of the requirements to enter the US equities market. This makes Carbon Synthetic assets a favorable alternative for foreign investors experiencing barriers to entry. Moreover, Carbon Synthetic assets are openly tradeable and transferable, meaning anyone can send and receive them using standard crypto wallets. The only need is access to the internet and a bit of technical know-how. Since DeFi is always on, synthetic tokens can be traded 24/7. This is in great contrast to traditional markets, where trading is limited to specific days and specific hours.

In addition, with Carbon Synthetic assets, there are no central party restrictions or risks. This is in stark contrast to the recent reddit-fueled GME drama when thousands of retail investors were unable to sell select securities due to restrictions imposed by stock brokers such as Robinhood. In such cases, these controlling parties can halt or

even execute trades—keeping their primary interest in mind, without prioritizing the trader.

The ethos of Carbon Synthetic assets and decentralized finance (DeFi) lies in openness and transparency. Unlike traditional finance, DeFi does not rely on centralized authorities like banks or brokerages functioning as the intermediaries between transacting parties. Instead, a public ledger records and verifies transactions directly on a digital blockchain for all to reference, eliminating opacity and cumbersome bureaucracy. Since a centralized authority does not exist, investors are empowered with the autonomy to instantly access, trade, and transfer Carbon Synthetic assets with ease.

DeFi works through smart contracts, which are automated, self-executed programs that cannot be altered. Once a certain set of requirements is met, the smart contract is automatically activated without the need for institutional intermediaries, thus removing any ambiguity in its terms. For example, a smart contract can be programmed to release salary funds for a bi-weekly payday or automatically issue payments to the winning party of a bet once the terms are met. By removing third parties, there is less room for missteps since issues of subjectivity and dishonesty are eliminated. The objective nature of smart contracts ensures that transactions are reliably fulfilled. By transitioning the concept of derivatives to DeFi in the form of Carbon Synthetic assets, the possibility of global, borderless transactions becomes a reality, allowing anyone from anywhere to participate.

Carbon Synthetic assets also allow investors to invest in new, emerging carbon commodity classes. Take European Allowance Units (EUAs) for instance. Historically, EUAs have been only accessible by a handful of EU registered carbon brokers, but the PARYS™ Carbon Synthetics are innovating to bridge this gap. Through the tokenization of EUAs, anyone can buy into the token and reap the rewards of EU-ETS carbon allowance investing without ever personally needing to physically own or custody the EUAs directly.

Unlike derivatives, one unique selling point of Carbon Synthetics have the potential to earn rewards or yield by staking or holding on to a carbon asset for an extended period of time. The only such example to date, PARYS™, is a Carbon Synthetic asset whereby a token mimics the value of an underlying real-world carbon asset, in this case EUAs. By staking these Carbon Synthetics as collateral for projects, investors have the potential to earn interest. This flexible trait makes Carbon Synthetic assets attractive for more savvy investors.

A Carbon Synthetic equity strategy can help investors who wish to maintain passive equity exposure while seeking one or more of the following:

- Liquidity pool. Generate an additional source of funds to enhance portfolio liquidity.
- Reduce foreign exchange risk. Passive equity futures contracts minimize the foreign exchange risk associated with foreign equity holdings.
- Low transaction costs. These contracts provide "cheap beta," with low transaction costs and without the management fees and expenses associated with cash equity products.
- Generate higher portfolio yield. Fixed income products can provide an additional and predictable source of portfolio income.
- Improve portfolio duration matching. Extending portfolio duration by adding carbon futures is especially useful for key rate duration matching for liability driven investors.

Flexibility in Risk Exposure

PARYS™ Stable Carbon Synthetic products are covered carbon allowances and carbon offsets, including derivatives such as futures and options, characterized by identical or similar profit and loss structures when compared with traditional carbon-based financial instruments.

Parisii™ carbon investment services allow investors to decide on how much exposure they have to different forms of carbon assets, thereby allowing investors the ability to hedge risk associated with investing in carbon derivatives such as carbon futures and options. By investing in diversified portfolios containing weighted percentages of EUAs with EUA Futures, investors can achieve greater potential return-on-investment. Of course, this comes with potential additional risk as well. Investors seeking the safest carbon investment strategy in a Parisii portfolio may want to consider investing in 100% EUA holding as part of their PARYS™ Carbon Synthetic investment.

It is the price of novelty, customization, and flexibility offered by PARYS™ Carbon Synthetics as Structured Financial Instruments that can be expressed in one four-letter word: risk. Risk taking is welcome when one knows how to manage their exposure, but it can be a disaster when one doesn't – hence, the wisdom of learning ahead of investing the challenges posed by carbon derivatives and how to be in charge of risk control.

Carbon Pricing Mechanisms are a Central Part of the Global Emission Reduction Policy Toolkit

Carbon pricing mechanisms are becoming a ubiquitous part of the toolkit to tackle climate change. The higher the cost of a 'permit' or 'allowance' to produce carbon, the greater the incentive to implement abatement technology to reduce carbon output. There are several methods of achieving lower emissions, but the 'cap and trade'

strategy is one of the most favored today. According to the World Bank, a total of 64 carbon pricing instruments are now in operation around the world, covering over 20% of global greenhouse gas (GHG) emissions and generating $53 billion in revenue. The World Bank data reveals the market is heavily fragmented and that represents some challenges. Firstly, there is no global price for carbon. That could incentivize some carbon emitters to change location of production to places where the cost of carbon cheaper (carbon leakage). Secondly, the less mature and less liquid carbon markets carry a lower carbon price. The social cost of underpriced carbon mechanism is the overproduction of carbon. Carbon Market Year in Review 2020, January 2021. Includes futures but excludes options. The majority of carbon prices remain far below the High-Level Commission on Carbon Pricing's recommended range of $40-80/ton CO2 equivalent (tCO2e) for 2020 to meet the 'well below 2°C' temperature goal of the Paris Agreement. At this point, carbon prices in the recommended range cover less than 5% of global emissions.

The EU-ETS is the Largest Carbon Market, Offering Unrivaled Liquidity

The permits to produce greenhouse gases that are traded under the ETS are called Allowances (EUAs). The volume of trading in EUAs and futures based on EUAs is considerably larger than any other carbon market (see table below). The size and liquidity of this market offers investors and users the best trading experience. With the global carbon market being so fragmented, we believe EUAs are leading the blueprint for a well-functioning cap and trade emission system. The EU-ETS is aided by a sizeable futures market which promotes the price discovery process so that carbon is correctly priced to reflect current policy ambitions.

GLOBAL CARBON MARKET SIZE 2018-2020 (INCLUDING FUTURES WHERE AVAILABLE)

MILLION TONNES CO2 EQUIVALENT (MT) AND MILLION EUROS									
	2018		2019		2020		Volume change	Value change	Share of total value
	Mt	€ million	Mt	€ million	Mt	€ million	2019-2020	2019-2020	
Europe (EUAs, aviation EUAs)[a]	7,754	129,736	6777	168,966	8,096	201,357	19%	19%	88%
CERs[b] (primary and secondary)	15	32	12	40	16	61	33%	53%	
North America (CCAs[c], RGGIs[d])	1,126	12,871	1,673	22,365	2,010	26,028	20%	16%	12%
South Korea	51	809	38	744	44	870	16%	17%	
Chinese pilot schemes (allowances and offsets)[e]	103	194	130	249	134	257	3%	3%	
New Zealand	23	299	30	433	30	516	0%	19%	
Total	9,062	14,3847	8,660	192,797	10,330	229,089	19%	19%	

A Brief History of the EU-ETS

The EU-ETS was set up in 2005 and therefore is the world's oldest emissions trading system. The EU-ETS works on the 'cap and trade' principle. A cap is set on the total amount of certain greenhouse gases that can be emitted by the installations (or companies) covered by the system. The cap is reduced over time so that total emissions fall. Within the cap, companies buy or receive emissions allowances, which they can trade with one another as needed. Each allowance permits the holder to produce 1 ton of carbon equivalent greenhouse gases (tCO2e). The limit on the total number of allowances available ensures that they have a value. After each year, a company must surrender enough allowances to cover fully its emissions, otherwise heavy fines are imposed. The companies covered the scheme have a legal obligation to participate. If a company reduces its emissions, it can keep the spare allowances to cover its future needs or else sell them to another installation that is short of allowances. Trading brings flexibility that ensures emissions are cut where it costs least to do so. A robust carbon price also promotes investment in innovative, low-carbon technologies. Energy utilities, industrial emitters and intra-EU aircraft operators are the main types of companies covered today. Allowances are either auctioned or given to the emitters (known as free allocation). Historically, utilities have generally had to go through auction, while industrial emitters were largely given free allowances. More heavily emitting industrial companies may have to also go through auction to receive enough allowances to cover their activities. Aviation has had a separate track after its inclusion in 2012 and most of the allowances for this sector have historically been free allocation. Given the international nature of flights there is ongoing work to develop more global parameters here.

An Incomplete System Ripe for Further Growth

The current EU-ETS only covers energy utilities, some industrial emitters and intra-EU flights. Despite covering two of the largest carbon emitting sectors, at best only half the EU-wide emissions are covered. We expect more sectors to come under the scope of the EU-ETS. The latest round of legislative changes announced on 14th July 2021 have indicated some movement in this direction.

The Art of Calibrating Supply and Demand

The EU-ETS has gone through several phases of implementation and it is currently in its fourth phase. Various correction mechanisms have been implemented to address the issue of oversupply which has haunted this market in early phases. These correction mechanisms, while complicating the system, are essential to address the oversupply and thus for the success of EU-ETS market.

Phase 4 of the EU-ETS Program

The EU has implemented into law a target to reduce greenhouse gas emissions by 55% by 2030 from 1990 levels and eliminate them by 2050. The Commission estimates that in the absence of any changes, emissions would only decline by 40% by 2030 and 60% by 2050 (relative to 1990 levels). To achieve the EU's overall greenhouse gas emissions reduction target for 2030, the current sectors covered by the EU Emissions Trading System (EU-ETS) must reduce their emissions by 61% compared to 2005 levels. And more sectors need to be included. The revised EU-ETS Directive, which will apply for the period 2021-2030, will enable this through a mix of interlinked measures:

1. Overall number of allowances will decrease at a faster rate than prior to 2021.
2. The number of allowances put into reserve rather than in circulation will increase.
3. Number of allowances in reserve will be limited to the auction volume of the previous year (allowances above that level will become void).
4. Free allocations will be phased out for some sectors.
5. A carbon border tax will be implemented to reduce the risk of 'carbon leakage'
6. More sectors will be added to the system.

Who are Carbon Speculators, and What is Their Role in ETS Markets?

The underlying EUA market is designed for firms with a compliance obligation to meet on the emissions of their installations. Looking at the breakdown of who owns allowances in circulation (based on 2020 data), it is overwhelmingly energy utility companies and industry. But there is a presence of 'speculators. Speculators either invest in EUAs as they expect the price to rise or are buying EUAs to restrict supply and help tighten the market (as they won't need to surrender them to meet compliance obligations). Based on the mechanics of the Market Stability Reserve, unused allowances can reduce auction volumes and thus further tighten the market.

There is an active futures market based on these EUAs, that can be used for hedging purposes for these firms with a compliance obligation or futures can be used by investors to express their views on price. As highlighted above, speculative activity can remove some of the underlying EUAs from inventory in circulation. So, speculators in the underlying can help tighten the market to a degree. EUA futures are a deliverable futures market, so investors holding contracts to maturity (and have a registry account) can take delivery and remove the allowances from circulation. We suspect more investors are likely to roll their contracts before expiry, and therefore the inventory of older contracts can come back into the market (even though inventory of the newer contracts rolled into). We believe, as with most futures markets, the presence of speculators helps to enhance liquidity and aid the price discovery process i.e., help prices reach the 'correct' level. For a market that has arguably been underpriced for a large part of its history, an improved price discovery process is a

welcome development. The cost of an underpriced carbon market would be the overproduction of carbon and hence futures market speculators play a vital role in this market. The liquidity of EUA futures is concentrated in the first December contract. There is markedly lower liquidity in the second December contract and very little liquidity in most other months. EUA futures have historically been in contango. But between the two most liquid contracts there is not a large negative roll yield. As EUA prices rise, we typically see parallel shifts in the curve.

The EU initially pledged to reduce GHG emissions by at least 40% by 2030 compared to 1990. All key EU legislation for implementing this target was adopted by the end of 2018. But that has recently been upgraded. A European Green Deal to further cut emissions by at least 55% by 2030 compared to 1990 has been enshrined into law. By 2050 Europe aims to become the world's first climate-neutral continent.

Prior to July 2021 reform, the following changes were already in place in phase 4:

1. More aggressive reduction rate. The cap on emissions continues to decrease annually at an increased annual linear reduction factor of 2.2% (compared to 1.74% before).
2. More allowances put in reserves. Between 2019 and 2023, the number of allowances put in the reserve will double to 24% of the allowances in circulation. The intention was to restore the regular feed rate of 12% in 2024.
3. Cancelling allowances in reserve so that they don't re-enter market. From 2023 onwards the number of allowances held in the reserve will be limited to the auction volume of the previous year. Allowances above that level become void, thus restricting supply further.
4. Restricting free allowances. For some sectors covered by the program, free allocations will remain to reduce the risk of those industries leaving the EU to jurisdictions with less stringent carbon policies (i.e., carbon leakage). But for other sectors free allocations will be phased out after 2026 from a maximum of 30% to 0% at the end of phase 4.
5. Promoting clean technology. Various innovation and modernization funds have been set up. They are expected to reduce the demand for newly issued allowances in auction, and thus accelerate the pace at which the reserve declines (linked to point 3 above).

On 14 July 2021, the European Commission adopted a series of legislative proposals setting out how it intends to achieve climate neutrality in the EU by 2050, including the intermediate target of an at least 55% net reduction in greenhouse gas emissions by 2030. This includes a raft of measures to strengthen the EU-ETS.

The EU-ETS of the Future: Fit for 55

In line with the European Green Deal, to achieve carbon neutrality by 2050 and have tangible legal limits on carbon at 55% below 1990 levels by 2030, the following changes will come into play after new legislation was announced on 14 July 2021:

1. The EU will create a carbon border adjustment mechanism (CBAM) to impose a CO2 tariff on imports. It will be the first of its kind in the world and initially focus on cement, iron and steel, aluminum and fertilizers. That will allow the European Commission to reduce free allowances to those sectors without the fear of carbon leakage.
2. The linear reduction factor will likely increase from current 2.2% in 2023-2024.
3. The EU-ETS will expand to shipping, buildings and road transportation. Shipping will receive a cap in 2026 with a phase-in period between 2023-2025. The scheme for buildings and transport would be set-up from 2025.
4. The MSR feed rate will remain at 24% beyond 2023. Aviation allowances will also fall into scope of the MSR. The Commission also wants to cap the MSR to 400 million allowances.

EU Carbon Allowance Price Stability and Overall Performance

EU-ETS Carbon Allowances (EUA) priced by the Intercontinental Exchange EU Allowance index make for an excellent carbon collateral for PARYS™ due to several reasons:

1. EUAs are fungible in that the underlying collateral can be fully redeemed at the price of their index at any time.
2. EUAs are highly liquid as they have multiple regulated secondary markets to trade into; ICE Exchanges (including the NYSE and Endex), CME Group, Nasdaq, EEX, Nodal Exchange, and others.
3. EUAs are bound by EU Government policy, which is designed to hedge inflation, as well as gain in price, long term.
4. Carbon Allowances become more scarce every year, and are intended to not be issued past 2050 when the EU becomes Net-Zero, making EUAs the most limited of any tradable listed commodity.
5. The ICE Global Carbon Futures Index (ICECRBNT) makes for a good indicator of the ICEEUA index, as the ICECRBNT is weighted mostly by the EU-ETS based on volume. Please reference the charts below as they are reflective of long-term performance of the ICEEUA Futures as well.

Correlation matrix

	ICECRBNT	ICEUST5T	US00	MLCXENTR	MLCXPMTR
ICECRBNT	1.00				
ICEUST5T	0.19	1.00			
US00	(0.05)	(0.18)	1.00		
MLCXENTR	0.19	0.33	(0.16)	1.00	
MLCXPMTR	0.07	(0.00)	0.29	0.12	1.00

The ICE Global Carbon Futures Index is uncorrelated to other major asset classes such as equities, fixed income, energy and precious metals.

Annual returns

YEAR	ICECRBNT	ICEUST5T	US00	MLCXENTR	MLCXPMTR
2014	23.18	13.75	6.27	(45.42)	(4.28)
2015	3.49	1.60	0.60	(37.52)	(11.08)
2016	(18.70)	12.09	2.61	23.20	8.62
2017	31.65	22.26	3.61	11.30	12.20
2018	121.27	(4.48)	0.06	(16.04)	(3.57)
2019	0.75	31.92	8.88	32.14	17.73
2020	29.39	21.65	7.56	(35.34)	24.29
2021	109.10	27.01	(1.58)	63.02	(4.95)
2022	0.70	(21.27)	(10.33)	65.28	(2.57)

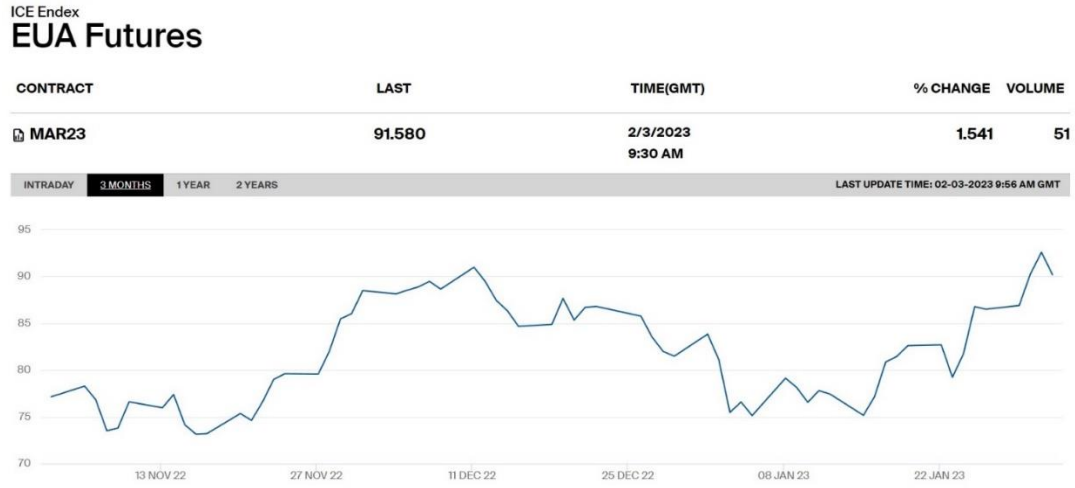
The ICE Global Carbon Futures Index has had only one negative return year in 2016. Five of the last eight years have had returns of over 20%.

Performance over various time horizons

	1 Month	1 Quarter	YTD	1 Year	3 Year	5 Year	Since 12/31/2013
ICECRBNT	1.50	7.24	0.70	40.41	37.16	53.85	28.27
ICEUST5T	(8.16)	(16.76)	(21.27)	(12.81)	10.50	11.36	11.01
US00	(1.34)	(4.56)	(10.33)	(10.27)	(0.90)	0.92	1.92
MLCXENTR	(5.79)	13.87	65.28	82.77	23.04	21.29	(1.18)
MLCXPMTR	(2.43)	(8.72)	(2.57)	(1.00)	7.59	6.49	3.65

The ICE Global Carbon Futures Index has consistently outperformed other major asset classes over longer time horizons.

6. As seen below, the ICEEUA Futures Index has very low volatility as an asset class.



Compare the 3-month ICEEUA index chart above to the 3-month Ethereum pricing chart below. The ICEEUA index is significantly more stable on intraday pricing, making EUAs a far better collateral to asset back a Carbon Synthetic over the long term than ETH.

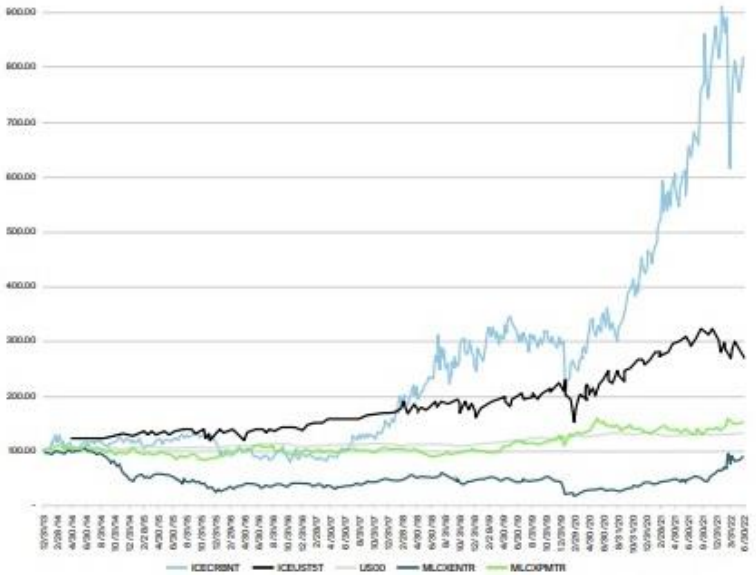
7. The ICECRBNT index has produced a higher return than indexes representing U.S. equities, U.S. bonds, energy futures and precious metals futures. It compares favorably to these other asset classes on the basis of risk/return metrics such as the Sharpe and Sortino Ratios. With an annualized return of 28.27%, the ICECRBNT clearly outperforms other asset classes.

Historical performance

Risk & return

	Ann Ret	Ann Std Dev	Sharpe Ratio	Sortino Ratio
ICECRBNT ICE Global Carbon Futures Index (TR)	28.27	30.85	0.89	1.27
ICEUST5T ICE U.S. 500 Index (TR)	11.01	17.97	0.57	0.79
US00 ICE BofA U.S. Broad Market Index (TR)	1.92	3.73	0.32	0.44
MLCXENTR ICE BofA Commodity index eXtra (ENergy) (TR)	(1.18)	34.00	(0.06)	(0.08)
MLCXPMTR ICE BofA Commodity index eXtra (Precious Metals) (TR)	3.65	15.53	0.19	0.27

The ICE Global Carbon Futures Index has produced a higher return than indices representing U.S. equities, U.S. bonds, energy futures and precious metals futures. While it has a standard deviation (volatility) that is second highest to traditional energy, it still compares favorably to these other asset classes on the basis of risk/return metrics such as the Sharpe and Sortino Ratios.



The ICECRBNT has had an annualized return of 28.27% from 12/31/13 to 6/30/22, as compared to 11.01% for the ICEUST5T, 1.92% for the US00, -1.18% for the MLCXENTR and 3.65% for the MLCXPMTR.

PARYS™ as a Pigouvian Subsidy

A Pigouvian Subsidy is a subsidy that is used to encourage behavior that have positive effects on others who are not involved or society at large. Behaviors or actions that are a benefit to others who are not involved in the transaction are called positive externalities. This is closely related to the idea of a pigouvian tax. A positive externality is something that enhances society as a whole. It results from an economic transaction that has positive external effects on others not party to the transaction.

One example of a positive externality is the market for education. The more education a person receives, the greater the social benefit since more educated people tend to be more enterprising, meaning they bring greater economic value to their community. Another example is behavior that reduces pollution that imposes a negative effect on society. Assume a government wants to reduce the dependence of their country on fossil fuels, the government might give a subsidy to homeowners who buy solar panels for their house to reduce the amount of electricity they draw from the grid that is powered by coal.

If the government offers a 20% subsidy on residential solar systems and the cost of installing a system of panels that can power the house is $20,000 then the cost to the homeowner will be $16,000. The subsidy both encourages the consumer to buy the cheaper product and encourages the seller to continue producing and selling the product as they still receive the full price of the product. In short, a consumer subsidy increases demand and lowers price for the consumer.

PARYS™ is intended to reward network participants as a pigouvian subsidy in that it rewards PARYS™ holders with benefits for helping implement and facilitate the Paris Agreement goal of Climate Change Abatement.

Effect of a Consumer Subsidy on the Market for Solar Panels

- At **Point A** the market is in equilibrium, the price **(P_1)** is equal to the quantity supplied **(Q_1)**.
- When the government introduces a subsidy to the consumers, the demand for the panels increases overall, there is a shift in the demand curve, denoted by the **Green Arrows**.
- Producers respond to the increased demand with a increased supply (**(Q_1)** to **(Q_2)**, the price rises as a response to the increased demand (**(P_1)** to **(P_2)**)[5]
- The price to the consumer stays low however as the subsidy negates the normal market forces that would make the consumer pay the higher price..
- The subsidy encourages consumers to buy more solar panels but keeps the price the same for the producer.
- The **Red Triangle** represents the deadweight loss (DWT) that results form the subsidy, the cost of the subsidy decreases the competitiveness of the market. However, the economic inefficiency is offset by the social benefit of reducing pollution from reliance on fossil fuel electricity generation methods.

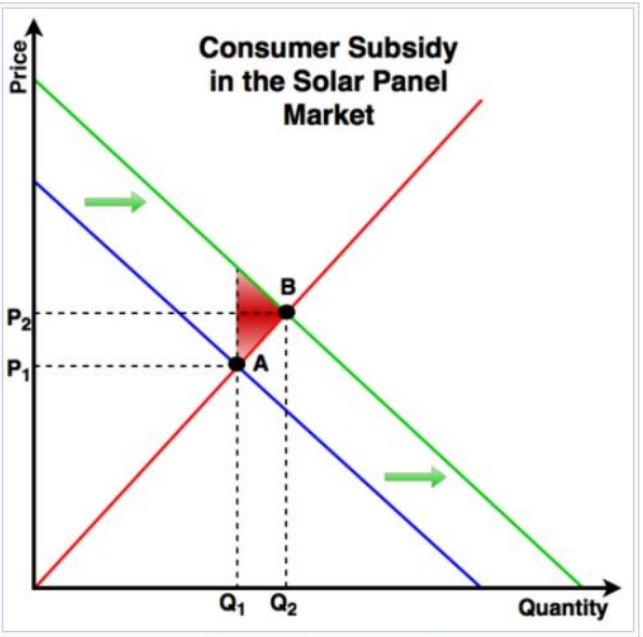


Figure 1. The effect of a consumer subsidy in the market for solar planes, which increases demand and lowers the price the consumer pays while maintaining producer reveneue.[4]

Overview of Carbon Reflex Indexes

A carbon reflex index's purpose is not to maintain a specific peg, but to dampen the volatility of its native carbon collateral. Indexes allow anyone to gain exposure to the cryptocurrency market without the same scale of risk as holding actual carbon assets. We believe PARYS™, our first carbon reflex index, will have immediate utility for other teams issuing carbon synthetics on Ethereum because it gives their systems a lower exposure to volatility of carbon assets and offers users more time to exit their positions in case of a significant market shift.

In order to understand carbon reflex indexes, we can compare the behavior of their redemption price to that of a stablecoin's price.

The redemption price is the value of one debt unit (or coin) in the system. It is meant to be used only as an internal accounting tool and it is different from the market price (the value that the market is trading the coin at). In the case of fiat-backed stablecoins such as USDC, the system operators declare that anyone can redeem one coin for one US dollar and thus the redemption price for these coins is always one. There are also cases of crypto-backed stablecoins such as MakerDAO's Multi Collateral DAI (MCD) where the system targets a fixed peg of one US dollar and thus the redemption price is also fixed at one.

In most cases, there will be a difference between the market price of a stablecoin and its redemption price. These scenarios create arbitrage opportunities where traders will create more coins if the market price is higher than redemption and they will redeem their stablecoins for collateral (e.g., US dollars in the case of USDC) in case the market price is lower than the redemption price.

Carbon reflex indexes are similar to stablecoins because they also have a redemption price that the system targets. The main difference in their case is that their redemption will not remain fixed, but is designed to change while being influenced by market forces. In Section 10 we explain how an index's redemption price floats and creates new arbitrage opportunities for its users.

Design Philosophy and Go-to-market Strategy

Our design philosophy is to prioritize security, stability and speed of delivery.

DAI/RAI was the natural place to start iterating on PARYS™'s design. The DAI system has been heavily audited and formally verified, it has minimal external dependencies and it gathered an active community of experts. To minimize development and communications effort, PARYS™ chose to make only the simplest changes to the original DAI/RAI codebase in order to achieve their implementation.

Our most important modifications include the addition of an autonomous rate setter,

a Carbon Allowance Index (CAI) Network Medianizer which is integrated with many independent transparent from source price feeds implemented as a smart contract on ledger, as well as a governance minimization layer beyond RAI meant to isolate the system as much as possible from human intervention.

The very first version of the protocol (Stage 1) will only include the rate setter and other minor improvements in the core architecture. Once we prove that the setter works as expected, we can more safely add the CAI Network Medianizer (Stage 2) and the governance minimization layer (Stage 3).

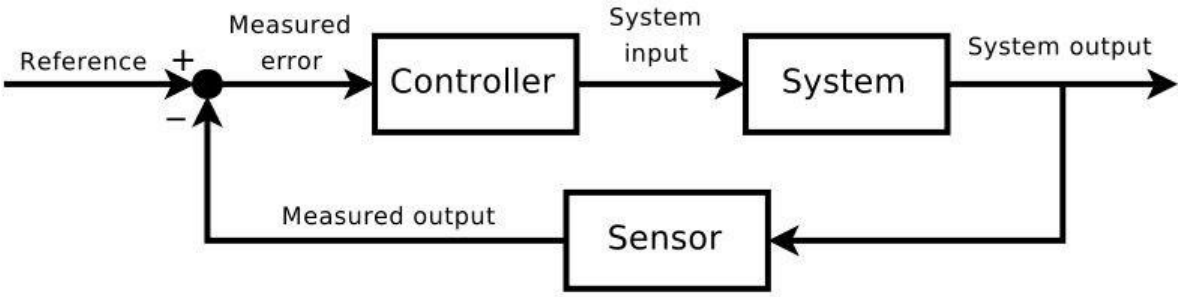
Monetary Policy Mechanisms

Introduction to Control Theory

One common control system that most people are familiar with is the shower. When someone starts a shower, they have a desired water temperature in mind which, in control theory, is called the *reference set point*. The person, acting as the *controller*, continuously measures the water flow temperature (which is called the system *output*) and modifies the speed at which they turn the shower's knob based on the *deviation* (or *error*) between the desired and the current temperature. The speed at which the knob is turned is called the system *input.* The objective is to turn the knob fast enough as to reach the reference set point quickly, but not so fast that the temperature *overshoots*. If there are system *shocks* where the water flow temperature suddenly changes, the person should be able to maintain the current temperature by knowing how fast to turn the knob in response to the disturbance.

The scientific discipline of maintaining stability in dynamic systems is called control theory and it has found broad application in cruise control for cars, flight navigation, chemical reactors, robotic arms, and industrial processes of all kinds. The Bitcoin difficulty adjustment algorithm which maintains the ten-minute average block time, despite a variable hash rate, is an example of a mission critical control system.

In most modern control systems, an *algorithmic controller* is typically embedded in the process and it is given control over a system input (e.g., a car's gas pedal) in order to automatically update it based on deviations between the system output (e.g., a car's speed) and the setpoint (e.g., the cruise control speed).



The most common type of algorithmic controller is the *PID controller*. Over 95% of industrial applications and a wide range of biological systems employ elements of PID control [4]. A PID controller uses a mathematical formula with three parts to determine its output:

Controller Output = Proportional Term + Integral Term + Derivative Term

The Proportional Term is the part of the controller which is directly *proportional* to the deviation. If the deviation is large and positive (e.g., the cruise control speed setpoint is far higher than the car's current speed) the proportional response will be large and positive (e.g., floor the gas pedal).

The Integral Term is the part of the controller which takes into account how long a deviation has persisted. It is determined by taking the *integral* of the deviation over time and it is primarily used to eliminate *steady state error*. It accumulates in order to respond to small, albeit persistent deviations from the setpoint (e.g., the cruise control setpoint has been 1 mph higher than the car's speed for a few minutes).

The Derivative Term is the part of the controller which takes into account how fast the deviation is growing or shrinking. It is determined by taking the *derivative* of the deviation and serves to accelerate the controller response when the deviation is growing (e.g., speed up if the cruise control setpoint is higher than the car's speed and the car starts to slow down). It also helps reduce overshoot by decelerating the controller response when the deviation is shrinking (e.g., ease up on the gas as the car's speed starts to approach the cruise control setpoint).

The combination of these three parts, each of which can be independently tuned, gives PID controllers great flexibility at managing a wide variety of control system applications.

PID controllers work best in systems that allow some degree of lag in the response time as well as the possibility of overshoot and oscillation around the setpoint as the system attempts to stabilize itself. Carbon reflex index systems like PARYS™ are well suited for this type of scenario where their redemption prices can be changed by PID

controllers.

More generally, it has recently been discovered that many of the current central bank monetary policy rules (e.g., the Taylor Rule) are actually approximations of PID controllers.

Carbon Redemption Rate Feedback Mechanism

The Carbon Redemption Rate Feedback Mechanism is the system component in charge of changing a carbon reflex index's redemption price. In order to understand how it works, we first need to describe why the system needs a feedback mechanism as opposed to using manual control and what the mechanism's output is.

Feedback Mechanism Components

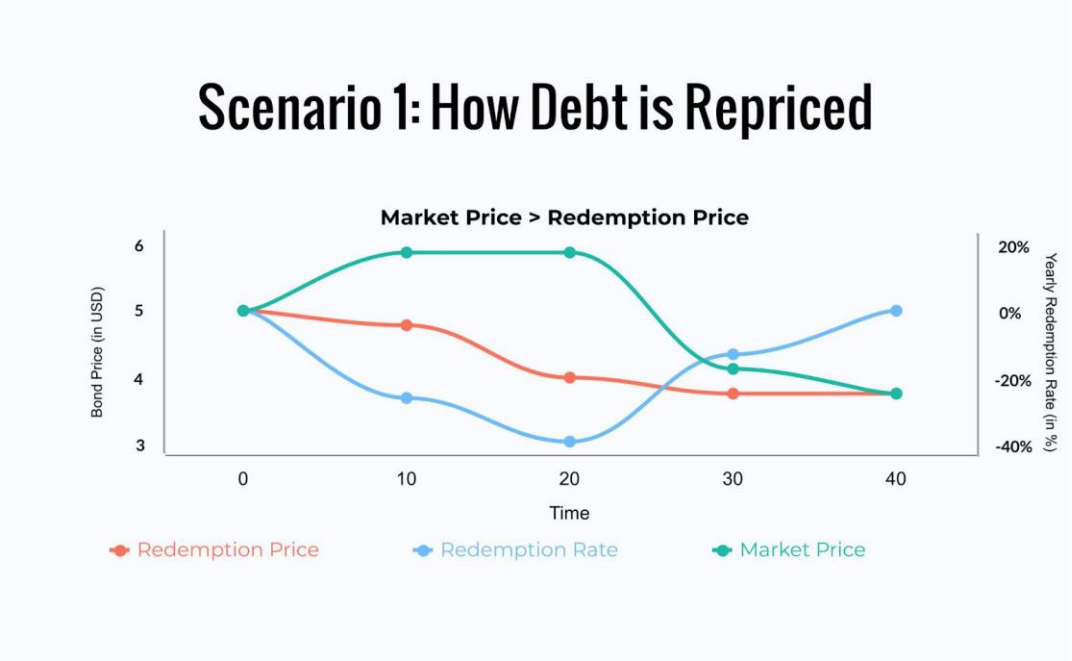
In theory, it would be possible to directly manipulate the carbon reflex index's redemption price (described in Section 10) in order to influence index users and ultimately change the index's market price. In practice, this method would not have the desired effect on system participants. From the perspective of a SAFE holder, if the redemption price is increased only once, they might accept a higher price per debt unit, absorb the loss from a decreased collateralization ratio and maintain their position. If, however, they expect the redemption price to continue to increase over time, they would likely be more inclined to avoid expected future loss and thus choose to pay back their debt and close their positions.

We expect carbon reflex index system participants not to respond directly to changes in the redemption price, but instead respond to the *rate of change of the redemption price* which we call the *redemption rate*. The redemption rate is set by a *feedback mechanism* that governance can fine-tune or allow to be fully automated.

Feedback Mechanism Scenarios

Recall that the feedback mechanism aims to maintain equilibrium between the redemption price and the market price by using the redemption rate to counter shifts in market forces. To achieve this, the redemption rate is calculated so that it opposes the deviation between market and redemption prices.

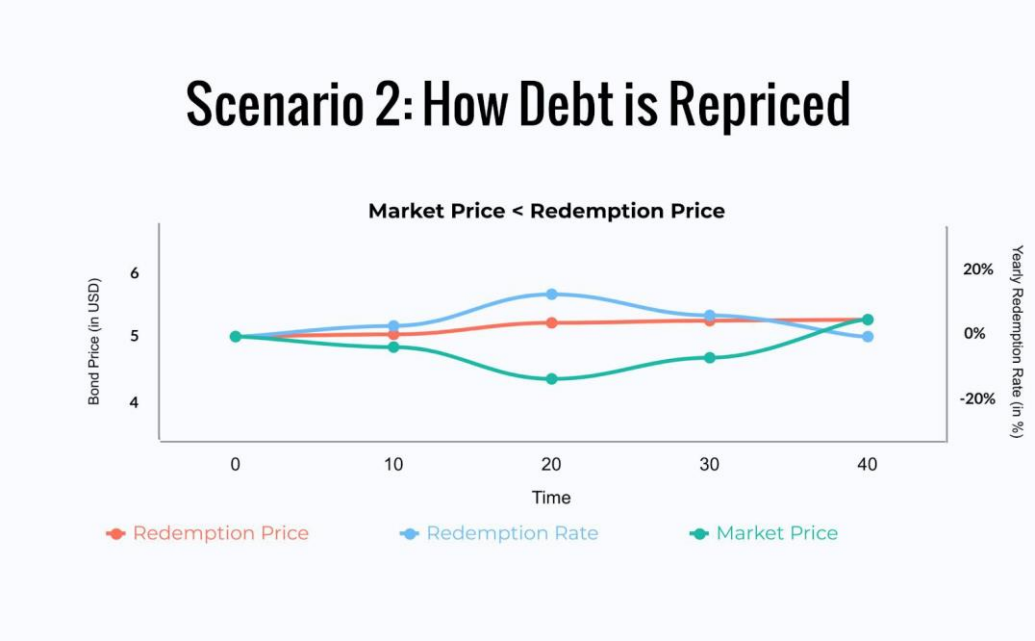
In the first scenario below, if the carbon index's market price is higher than its redemption price, the mechanism will calculate a negative rate which will start to decrease the redemption price, thus making the system's debt cheaper.



The expectation of a decreasing redemption price will likely discourage people from holding indexes and encourage SAFE holders to generate more debt (even if the collateral price does not change) which is then sold on the market, thus balancing out supply and demand. Note that this is the ideal scenario where carbon index holders react quickly in response to the feedback mechanism. In practice (and especially in the early days post launch) we expect a lag between the mechanism's kickoff and actual results seen in the amount of debt issued and subsequently in the market price.

On the other hand, in scenario two, if the carbon index's market price is lower than the redemption price, the rate becomes positive and starts to reprice all the debt so that it becomes more expensive.

As debt becomes more expensive, the collateralization ratios of all SAFEs go down (thus SAFE creators are incentivized to pay back their debt) and users start to hoard carbon indexes with the expectation that they will increase in value.



Feedback Mechanism Algorithm

In the following scenario, we assume that the protocol uses a proportional-integral controller to calculate the redemption rate:

- The carbon reflex index is launched with an arbitrary redemption price ‘rand’
- At some point, the carbon index’s market price rises from ‘rand’ to ’rand’ + x. After the feedback mechanism reads the new market price, it calculates a proportional term *p*, which in this case is -1 * ((‘rand’ + x) / ‘rand’). The proportional is negative in order to decrease the redemption price and in turn reprice the carbon indexes so that they become cheaper
- After calculating the proportional, the mechanism will determine the integral term *i* by adding all the past deviations from the last *deviationInterval* seconds
- The mechanism sums the proportional and the integral and calculates a per-second redemption rate *r* that slowly starts to decrease the redemption price. As SAFE creators realize they can generate more debt, they will flood the market with more carbon indexes
- After *n* seconds, the mechanism detects that the deviation between the market and redemption prices is negligible (under a specified parameter *noise*). At this point, the algorithm sets r to zero and keeps the redemption price where it is

In practice, the algorithm will be more robust and we will either make some variables immutable (e.g., the *noise* parameter, *deviationInterval*) or there will be strict bounds

over what governance can change.

Feedback Mechanism Tuning

Of the utmost importance to the proper functioning of the carbon reflex index system is the tuning of the algorithmic controller parameters. Improper parameterization could result in the system being too slow to achieve stability, massively overshooting, or being generally unstable in the face of external shocks.

The tuning process for a PID controller typically involves running the live system, tweaking the tuning parameters, and observing the system's response, often purposefully introducing shocks along the way. Given the difficulty and financial risk of tweaking the parameters of a live carbon reflex index system, we plan to leverage computer modeling and simulation as much as possible to set the initial parameters, but will also allow governance to update the tuning parameters if additional data from production shows them to be sub-optimal.

Money Market Setter

In PARYS™, we plan to keep the borrowing rate (interest rate applied when generating indexes) fixed or capped and only modify the redemption price, thus minimizing the complexity involved in modelling the feedback mechanism. The borrowing rate in our case is equal to the spread between the stability fee and DSR in Multi-Collateral DAI.

Even though we plan to keep the borrowing rate fixed, it is possible to change it alongside the redemption price using a money market setter. The money market changes the borrowing rate and the redemption price in a way that incentivizes SAFE creators to generate more or less debt. If a carbon index's market price is above redemption, both rates will start to decrease, whereas if it is below redemption, the rates will increase.

Global Settlement

Global settlement is a method of last resort used to guarantee the redemption price to all carbon reflex index holders. It is meant to allow both carbon reflex index holders and SAFE creators to redeem system collateral at its net value (amount according to the latest redemption price). Anyone can trigger settlement with a majority PARYS™ holder vote.

Settlement has three main phases:

- **Trigger**: settlement is triggered, users cannot create SAFEs anymore, all collateral price feeds and the redemption price are frozen and recorded

- **Process**: process all outstanding auctions

- **Claim**: every carbon reflex index holder and SAFE creator can claim a fixed amount of any system collateral based on the index's last recorded redemption price

Towards Organic Governance

The vast majority of parameters are immutable and the inner smart contract mechanics are not upgradeable unless a majority of AGREE™ holders vote to have the Parisii Advisory Panel address a certain aspect of the PARYS™ Protocol. If a simple majority vote determines an aspect of the protocol should be addressed, then the Parisii Advisory Panel must review, report to the community in a timely fashion, and respond with an actionable item that requires majority vote of AGREE™ holders to enact. We chose this strategy because we can eliminate the meta-game where people try to influence the governance process for their own benefit, thus damaging trust in the system. We establish the proper operation of the protocol without putting too much faith in humans (the "bitcoin effect") so that we maximize social scalability and minimize the risks for other developers who will want to use PARYS™ as core infrastructure in their own projects.

For the few parameters that can be changed, we propose the addition of a Restricted Governance Module meant to delay or bound all possible system modifications. Moreover, we present Governance Ice Age, a permissions registry that can lock some parts of the system from outside control after certain deadlines have passed.

Time Bounded Governance

Time Bounded Governance is the first component of the Restricted Governance Module. It imposes time delays between changes applied to the same parameter. An example is the possibility to change the CAI smart contract inputs used as the overall carbon redemption price after at least *T* seconds have passed since the last CAI modification.

Action Bounded Governance

The second component in the Restricted Governance Module is Action Bounded Governance. Every governable parameter has limits on what values it can be set to and how much it can change over a certain period of time. Notable examples are the initial versions of the Carbon Redemption Rate Feedback Mechanism (Section 12.2) which governance token holders will be able fine-tune.

Governance Ice Age

The Ice Age is an immutable smart contract that imposes deadlines on changing specific system parameters and on upgrading the protocol. It can be used in the case where governance wants to make sure they can fix bugs before the protocol locks itself and denies outside intervention. Ice Age will verify if a change is permitted by checking the parameter's name and the affected contract's address against a registry of deadlines. If the deadline has passed, the call will revert.

Governance may be able to delay Ice Age a fixed number of times if bugs are found close to the date when the protocol should start to lock itself. For example, Ice Age can only be delayed three times, each time for one month, so that the newly implemented bug fixes are tested properly.

Core Areas Where Governance Is Needed

We envision four areas where governance might be needed, especially in the early versions of this framework:

- **Adding new collateral diversification**: PARYS™ will be backed only by native carbon instruments, and diversification will be achieved by adoption of new GHG Methodologies and GHG Projects approved for carbon collateral use to diversify risk over time

- **Changing external dependencies**: carbon indexes and DEXs that the system depends on can be upgraded. Governance can point the system to newer dependencies in order for it to continue functioning properly

- **Fine-tuning rate setters**: early monetary policy controllers will have parameters that can be changed within reasonable bounds (as described by Action and Time Bounded Governance)

- **Migrating between system versions**: in some cases, governance can deploy a new system, give it permission to print PARYS™ tokens and withdraw this permission from an old system. This migration is performed with the help of the Restricted Migration Module outlined below

Restricted Migration Module

The following is a simple mechanism for migrating between system versions:

- There is a migration registry that keeps track of how many different systems the same AGREE™ token covers and which systems can be denied the permission to print PARYS™ tokens in a debt auction

- Every time governance deploys a new system version, they submit the address of the system's debt auction contract in the migration registry. Governance also needs to specify if they will ever be able to stop the system from printing PARYS™ tokens. Also, governance can, at any time, say that one system will always be able to print PARYS™ tokens and thus it will never be migrated from

- There is a cooldown period between proposing a new system and withdrawing permissions from an old one

- An optional contract can be set up so that it automatically shuts down an old system after it is denied printing permissions

The migration module can be combined with an Ice Age that automatically gives specific systems the permission to always be able to print PARYS™ tokens.

Automatic System Shutdown

There are cases that the system can automatically detect and as a result trigger settlement by itself, without the need to burn PARYS™ tokens:

- **Severe Price Feed Delays**: the system detects that one or more of the collateral or index price feeds have not been updated in a long time

- **System Migration**: this is an optional contract that can shut down the protocol after a cooldown period passes from the moment when governance withdraws the ability of the debt auction mechanism to print PARYS™ tokens (Restricted Migration Module, Section 13.4.1)

- **Consistent Market Price Deviation**: the system detects that the index's market price has been *x%* deviated for a long time compared to the redemption price

Governance will be able to upgrade these autonomous shutdown modules while still being bounded or until the Ice Age starts to lock some parts of the system.

Carbon Allowance Index (CAI)

There are three main asset types that the system needs to read price feeds for: the

CAI, the PARYS™ token and the collateralized assets (Carbon Allowances / Futures / FIAT). In limited cases, the price feeds can be provided by governance led CAIs or by already established CAI providers like the EU-ETS, the Intercontinental Exchange and IHS Markit.

Governance Led CAI

AGREE™ token holders or the core team that launched the protocol can partner with other entities who gather multiple CAI price feeds off-chain and then submit a single transaction to a smart contract that medianizes all data points.

This approach allows for more flexibility on upgrading and changing the CAI infrastructure, although it comes at the expense of trustlessness.

CAI Network Medianizer

A Carbon Allowance Index Network Medianizer (CAINM) is a smart contract that reads price indexes from multiple sources which are not directly controlled by governance (e.g., IceWeb, IHS Markit, and/or Uniswap V3 pool between an index collateral type and other PARYS™ tokens) and then medianizes all the results. CAINM works as follows:

- Our contract keeps track of approved index feeds from networks it can call in order to request CAI prices. The contract is funded by part of the surplus the system accrues (using the Surplus Treasury, Section 18). Each CAI network accepts payment so our contract also keeps track of the minimum amount and the type of tokens needed for each request

- In order to push a new price feed in the system, the CAI need to be called beforehand. When calling a CAI, the contract first swaps some stability fees with one of the CAI's accepted tokens. After a CAI is called, the contract tags the call as "valid" or "invalid". If a call is invalid, the specific faulty CAI price feed network cannot be called again until all the other ones are called and the contract checks if there is a valid majority. A valid CAI call must not revert and it must retrieve a price that has been posted on-chain sometime in the last *m* seconds. "Retrieve" means different things depending on each CAI type:

- For a pull-based CAI, from which we can get a result right away, our contract needs to pay a fee and directly fetch the price

- For a push-based CAI, our contract pays the fee, calls the CAI and needs to wait a specific period of time *n* before calling the CAI again in order to get the

requested price

- Every CAI result is saved in an array. After every approved CAI is called and if the array has enough valid data points to form a majority (e.g., the contract received valid data from 3/5 CAI input networks), the results are sorted and the contract chooses the median

- Whether the contract finds a majority or not, the array with CAI results is cleared and the contract will need to wait *p* seconds before starting the entire process all over again

CAI Redundancy / Network Backup

Governance can add a backup CAI option that starts to push prices in the system if the CAI Medianizer cannot find a majority of valid approved networks several times in a row.

The backup option must be set when the CAI Medianizer is deployed as it cannot be changed afterwards. Furthermore, a separate contract can monitor if the backup has been replacing the medianization mechanism for too long and automatically shut down the protocol.

SAFEs

In order to generate indexes, anyone can deposit and leverage their carbon collateral inside SAFEs. While a SAFE is opened, it will continue accruing debt according to the deposited collateral's borrowing rate. As the SAFE creator pays back their debt, they will be able to withdraw more and more of their locked collateral.

SAFE Lifecycle

There are four main steps needed for creating carbon reflex indexes and subsequently paying back a SAFE's debt:

- Deposit collateral in the SAFE. The user first needs to create a new SAFE and deposit collateral in it.

- Generate indexes backed by the SAFE's collateral. The user specifies how many indexes they want to generate. The system creates an equal amount of debt that starts to accrue according to the collateral's borrowing rate.

- Pay back the SAFE debt. When the SAFE creator wants to withdraw their collateral, they have to pay back their initial debt plus the accrued interest.

- Withdraw collateral. After the user pays back some or all of their debt, they are allowed to withdraw their collateral.

SAFE Liquidation

In order to keep the system solvent and cover the value of the entire outstanding debt, each SAFE can be liquidated in case its collateralization ratio falls under a certain threshold. Anyone can trigger a liquidation; in which case the system will confiscate the SAFE's collateral and sell it off in a *collateral auction*.

Liquidation Insurance

In one version of the system, SAFE creators can have the option to choose a *trigger* for when their SAFEs get liquidated. Triggers are smart contracts that automatically add more collateral in a SAFE and potentially save it from liquidation. Examples of triggers are contracts that sell short positions or contracts that communicate with insurance protocols such as Nexus Mutual, or carbon specific insurance programs like the Global Carbon Trust.

Another method to protect SAFEs is the addition of two different collateralization thresholds: *safe* and *risk*. SAFE users can generate debt until they hit the safe threshold (which is higher than risk) and they only get liquidated when the SAFE's collateralization goes below the risk threshold.

Carbon Collateral Auctions

To start a collateral auction, the system needs to use a variable called *liquidationQuantity* in order to determine the amount of debt to be covered by every auction and the corresponding amount of collateral to be sold. A *liquidation penalty* will be applied to every auctioned SAFE.

Collateral Auction Parameters

Parameter Name	Description
minimumBid	Minimum number of coins that need to be offered in one bid
Discount	Discount at which collateral is being sold
lowerCollateralMedianDeviation	Max lower bound deviation that the collateral median can have compared to the CAI price

upperCollateralMedianDeviation	Max upper bound deviation that the collateral median can have compared to the CAI price
lowerSystemCoinMedianDeviation	Max lower bound deviation that the system coin CAI price feed can have compared to the system coin CAI price
upperSystemCoinMedianDeviation	Max upper bound deviation that the collateral median can have compared to the system coin CAI price
minSystemCoinMedianDeviation	Min deviation for the system coin median result compared to the redemption price in order to take the median into account

Collateral Auction Mechanism

The fixed discount auction is a straightforward way (compared to English auctions) to put collateral up for sale in exchange for system coins used to settle bad debt. Bidders are only required to allow the auction house to transfer their safeEngine.coinBalance and can then call buyCollateral in order to exchange their system coins for collateral which is sold at a discount compared to its latest recorded market price.

Bidders can also review the amount of collateral they can get from a specific auction by calling getCollateralBought or getApproximateCollateralBought. Note that getCollateralBought is not marked as view because it reads (and also updates) the redemptionPrice from the CAI relayer whereas getApproximateCollateralBought uses the lastReadRedemptionPrice.

Debt Auctions

In the scenario where a collateral auction cannot cover all the bad debt in a SAFE and if the system does not have any surplus reserves, anyone can trigger a debt auction.

Debt auctions are meant to mint more PARYS™ tokens (Section 17) and sell them for indexes that can nullify the system's remaining bad debt.

In order to start a debt auction, the system needs to use two parameters:

- initialDebtAuctionAmount: the initial amount of PARYS™ tokens to mint post-auction

- debtAuctionBidSize: the initial bid size (how many indexes must be offered in exchange for *initialDebtAuctionAmount* PARYS™ tokens)

Autonomous Debt Auction Parameter Setting

The initial amount of PARYS™ tokens minted in a debt auction can either be set through a governance vote or it can be automatically adjusted by the system. An automated version would need to be integrated with CAIs (Section 15) from which the system would read the PARYS™ token and carbon reflex index market prices. The system would then set the initial amount of PARYS™ tokens (*initialDebtAuctionAmount*) that will be minted for *debtAuctionBidSize* indexes. *initialDebtAuctionAmount* can be set at a discount compared to the actual PROTOCOL/INDEX market price in order to incentivize bidding.

Debt Auction Parameters

Parameter Name	Description
amountSoldIncrease	Increase in the amount of PARYS™ tokens to be minted for the same number of indexes
bidDecrease	Next bid's minimum decrease in the accepted amount of PARYS™ tokens for the same number of indexes
bidDuration	How long the bidding lasts after a new bid is submitted (in seconds)
totalAuctionLength	Total length of the auction (in seconds)
auctionsStarted	How many auctions have started until now

Debt Auction Mechanism

As opposed to collateral auctions, debt auctions only have one stage:

decreaseSoldAmount (uint id, uint amountToBuy, uint bid): decrease the amount of PARYS™ tokens accepted in exchange for a fixed number of indexes.

The auction will be restarted if it has no bids placed. Every time it restarts, the system will offer more PARYS™ tokens for the same number of indexes. The new PARYS™

token amount is calculated as *lastTokenAmount * amountSoldIncrease / 100*. After the auction settles, the system will mint tokens for the highest bidder.

AGREE™ (PARYS Protocol Governance) Tokens

As described in earlier sections, each protocol will need to be protected by a token that is minted through debt auctions. Apart from protection, the token will be used to govern a few system components. Also, the AGREE™ token supply will gradually be reduced with the use of surplus auctions. The amount of surplus that needs to accrue in the system before extra funds are auctioned is called the *surplusBuffer* and it is automatically adjusted as a percentage of the total debt issued.

Insurance Fund

Apart from the AGREE™ token, governance can create an insurance fund that holds a wide array of uncorrelated assets and which can be used as a backstop for debt auctions. This fund can optionally facilitate purchase of carbon insurance through the Global Carbon Trust program.

Surplus Auctions

Surplus auctions sell stability fees accrued in the system for PARYS™ tokens that are then burned.

Surplus Auction Parameters

Parameter Name	Description
bidIncrease	Minimum increase in the next bid
bidDuration	How long the auction lasts after a new bid is submitted (in seconds)
totalAuctionLength	Total length of the auction (in seconds)
auctionsStarted	How many auctions have started until now

Surplus Auction Mechanism

Surplus auctions have a single stage:

`increaseBidSize(uint id, uint amountToBuy, uint bid)`: anyone can bid a higher amount

of PARYS™ tokens for the same number of indexes (surplus). Every new bid needs to be higher than or equal to *lastBid* * *bidIncrease* / 100. The auction will end after maximum *totalAuctionLength* seconds or after *bidDuration* seconds have passed since the latest bid and no new bids have been submitted in the meantime.

An auction will restart if it has no bids. On the other hand, if the auction has at least different smart contracts:

- The *accounting engine* used to trigger debt (Section 17.2) and surplus (Section 18.1) auctions

- The *surplus treasury* used to fund core infrastructure components and incentivize external actors to maintain the system

The surplus treasury is in charge of funding three core system components:

- CAI module (Section 15). Depending on how a CAI is structured, the treasury either pays governance whitelisted, off-chain CAIs or it pays for calls toward approved CAI networks. The treasury can also be set up to pay the addresses that spent gas to call a CAI and update it

- In some cases, independent teams that maintain the system. Examples are teams who whitelist new collateral types or fine tune the system's rate setter (Section 15.2)

The treasury can be set up so that some surplus recipients will automatically be denied funding in the future and others can take their place.

External Actors

The system depends on external actors in order to function properly. These actors are economically incentivized to participate in areas such as auctions, global settlement processing, market making and updating price feeds in order to maintain the system's health.

We will provide initial user interfaces and automated scripts to enable as many people as possible to keep the protocol secure.

Regulatory Compliance

Proof of Reserves

PARYS™ and all additional tokenized carbon offerings defined in our Product Roadmap (section 22) including PCCA, PRGA, and PUKA, and potentially more to come. We will work with 3rd party accounting firms to provide monthly attestations to confirm the carbon reserves collateralizing each PARYS™ token. From launch, Parisii, LLC will work with a major accounting firm to verify that the carbon backing PARYS™ is always held at a fully asset-backed level, and that Parisii has made no material changes to the 'terms of service' that protects users.

In addition to attestations on a set schedule, Parisii LLC will build a 'live attestation' dashboard. PARYS™ holders will be able to view a real-time dashboard of Parisii LLC Carbon Reserves, advancing transparency from months to minutes. The real-time dashboard will provide third-party confirmation, with Parisii LLC as an exclusive client. The dashboard will be viewable via the Parisii LLC website. Eventually, the real-time confirmation dashboard will replace the monthly attestations.

Creation and Redemption

One of the most important aspects of a collateralized Carbon Synthetic is the ability to be able to freely purchase and redeem the digital token back into the underlying carbon and/or fiat currency consistently, without hassle, and in an inexpensive manner. With these facts in mind, Parisii LLC has strived to make the PARYS™ redemption process as smooth and inexpensive as possible while complying with all necessary compliance measures.

Carbon Synthetic Code of Ethics

Stablecoins are a foundational pillar for the blockchain-based financial system. A stable Carbon Synthetic, when properly implemented, can serve as a medium of exchange for a new ecosystem of financial contracts, applications, and businesses.

But until recently, cryptocurrency markets have been hurt by a lack of carbon-backed stable instruments. While there has been a surge of new stablecoin projects, there has not yet been an industry-wide dialogue about what it will take for a stable Carbon Synthetic to be trusted as an integral part of the industry's infrastructure.

In the future, regulators may establish clearer policies for digitized currencies. In the meantime, PARYS™ can take the initiative and hold ourselves to a high standard of ethics. While specific approaches may vary, there are at least a few lessons from the past that PARYS™ should not repeat.

In short, the core pillars of this code of ethics include:

1. Fully Backed - Every token will have the equivalent carbon value stored in the

PARYS™ Reserve to back it.
2. Stable - The market should recognize the inherent value of PARYS™ as being equal to the price of the underlying carbon.
3. Redeemable - We will never prevent or discourage legitimate redemptions from verified customers.
4. Compliant - We will ensure the long-term survival of PARYS™ through regulatory compliance.

Planned Compliance Policy

PARYS™ plans to register as a regulated Money Service Business with the Financial Crimes Enforcement Network ("FinCEN"), Parisii LLC is fully compliant with Bank Secrecy Act (BSA) / Office of Foreign Assets Control (OFAC) and Know Your Customer (KYC) / Anti-Money Laundering (AML) laws. A risk-based compliance program has been implemented that is designed to comply with these applicable requirements.

Parisii LLC requests personal identification information and documentation from persons or entities and contracts with multiple third parties to verify and validate customer information including screening the names against various sanctions lists. Once all KYC/AML checks have been completed, the person or entity's account is created on the platform.

A third-party vendor performs fund origination verification on all persons or entities. This includes ensuring wires or checks submitted by the customer are in the name of the account holder, should the names and address not match, the wires are returned. From time to time, Parisii LLC might reach out to an existing customer for additional information or documentation. Should this additional information or documentation not be sufficient, Parisii LLC will not allow the customer to continue transacting on the platform.

In addition to identity verification and source-of funds validation, Parisii LLC utilizes a third party to perform OFAC and other sanctions watch-list checks on all persons or entities. Parisii LLC will not be doing business with any person or entity appearing on such a watch-list.

Product Roadmap

The initial PARYS™ token launch utilizing EUAs along with the ICEEUA index is scheduled for Q2, 2023. However, we plan to diversify rapidly as follows:

PARYS™: our flagship stable Carbon Synthetic offering, dedicated to the EU-ETS to fully collateralize with EUAs and EU Carbon Futures, non-pegged to ICEEUA for redemption rate while brokering Carbon Allowances and Carbon Futures contracts through

multiple secondary markets for liquidity/redemption.

PCCA™: stable Carbon Synthetic dedicated to California Cap-and-Trade to fully collateralize with CCAs and CCA Futures, non-pegged to ICECCA for redemption rate while brokering Carbon Allowances and Carbon Futures contracts through multiple secondary markets for liquidity/redemption.

PRGA™: stable Carbon Synthetic dedicated to the New York Regional Greenhouse Gas Initiative (RGGI) to fully collateralize with RGAs and RGA Futures, non-pegged to ICERGGI for redemption rate while brokering Carbon Allowances and Carbon Futures contracts through multiple secondary markets for liquidity/redemption.

PUKA™: stable Carbon Synthetic dedicated to the United Kingdom ETS (UKA) to fully collateralize with UKAs and UKA Futures, non-pegged to ICEUKA for redemption rate while brokering Carbon Allowances and Carbon Futures contracts through multiple secondary markets for liquidity/redemption.

In development to deliver these products in the future:

PSKA™: stable Carbon Synthetic dedicated to the South Korean ETS (KETS) to fully collateralize with SKAs and SKA Futures, non-pegged to ICESKA for redemption rate while brokering Carbon Allowances and Carbon Futures contracts through multiple secondary markets for liquidity/redemption.

PCCER™: stable Carbon Synthetic dedicated to China's ETS (CH-ETS) to fully collateralize with CCERs and CCER Futures, non-pegged to ICECCER for redemption rate while brokering Carbon Allowances and Carbon Futures contracts through multiple secondary markets for liquidity/redemption.

PACCU™: stable Carbon Synthetic dedicated to the Australian voluntary emissions reduction program to fully collateralize with ACCUs and ACCU Futures, non-pegged to ICEACCU or IHS Markit for redemption rate while brokering Carbon Allowances and Carbon Futures contracts through multiple secondary markets for liquidity/redemption.

PNZA™: stable Carbon Synthetic dedicated to New Zealand's ETS (NZ-ETS) to fully collateralize with NZAs and NZA Futures, non-pegged to ICENZA or IHS Markit equivalent for redemption rate while brokering Carbon Allowances and Carbon Futures contracts through multiple secondary markets for liquidity/redemption.

Other PARYS™ derived ETS stable Carbon Synthetics will follow for new ETS markets like Canada, who is in the process of building their own nationwide ETS. We also plan to work with voluntary carbon markets including the worldwide leader Xpansiv/CBL Markets, as well as EEX, and EEX US through Nodal Exchange to deliver dedicated

PARYS™ derived Carbon Synthetics for their markets.

Addressable Market

We see PARYS™ as being useful in several significant use cases:

- **Portfolio Diversification**: Investors use PARYS™ to get dampened exposure to an asset like carbon without the whole risk of actually holding carbon.

- **Collateral for Synthetic Assets**: PARYS™ can offer protocols such as UMA, MakerDAO and Synthetix a lower exposure to the crypto market and give users more time to exit their positions in the case of scenarios such as Black Thursday from March 2020 when millions of dollars' worth of crypto assets was liquidated.

- **Long-term Institution-Grade Investment Vehicle for Carbon**: PARYS™ provides a safe and fully regulated environment to invest in carbon as an asset class with immediate liquidity and solid performance metrics.

- **A Climate Positive Structured Financial Instrument for Payment Systems:** PARYS™ provides the world's first and only "green Carbon Synthetic", which can serve as the basis for future climate mitigating payment systems.

- **Trading**: At present, the majority of cryptocurrency trading on exchanges is done using stablecoin pairings. For example, on the largest cryptocurrency exchange, Binance, PARYS™ could be traded against many cryptoassets including Bitcoin and Ethereum. Prior to stablecoins, on cryptocurrency exchanges, you were only able to trade 1 crypto asset (e.g., Bitcoin) for other cryptoassets (e.g., Ethereum). This means that a trader is taking on double price risk. With stable instruments like PARYS™, this price risk is mitigated.

- **Moving Money**: stable digital instruments have proven to be transformational for moving money around the world. For <$1 USD, you are now able to send millions (or billions) of dollars in a single transaction. This use case has yet to be fully taken advantage of, but is happening on a small scale right now.

- **A Trusted Store of Value**: Individuals in some countries face high barriers to entry to opening a simple bank account. Through PARYS™, individuals and businesses around the world can access the economic security of the U.S. dollar and custody the value themselves.

- **Remittances**: As PARYS™ continues to tokenize additional carbon synthetics alongside fiat currencies (e.g., USD, EURO, British Pound, Hong Kong Dollar, Philippine Peso, Argentine Peso, etc.) this will enable the fast and inexpensive ability to remit money around the world. At present, the costs associated with sending money from one country to another can be prohibitively high with fees eating up to 10% of the transferred asset's value. PARYS™ eliminates many of the fees charged by middlemen and allow for more assets to arrive back in the local countries. This is a net positive for governments as it allows for funds to be transferred back into local economies and not taken by foreign money remitters.

- **B2B and International Trade:** The market for companies sending money between each other, and hedging between the currencies of their home market and markets they are doing business in, is well over $1T. It is antiquated that in 2019, companies still need to pay high fees to intermediaries to simply send funds between companies. Large companies (e.g., Apple) get bank-grade rates for transfers, but small-and-medium-sized businesses face high fees and friction.

- **Blockchain-based FX markets**: Advanced traders may find additional use cases for FX Marketplaces composed of tokenized carbon collateral, e.g., PARYS™ / PCCA™ or PARYS™ / PCCER™.

Future Research

To push the boundaries of decentralized money and bring further innovation in decentralized / regenerative finance, we will continue to look for alternatives in core areas such as governance minimization and liquidation mechanisms.

We first want to lay the groundwork for future standards around protocols that lock themselves from outside control and for true "money robots" which adapt in response to market forces. Afterwards, we invite the Ethereum community as well as ETS and voluntary carbon markets to debate and design improvements around our proposals with a specific focus on collateral and debt auctions.

Risks and Mitigation

There are several risks involved in developing and launching a carbon reflex index, as well as subsequent systems that are built on top:

- **Smart contract bugs**: the greatest risk posed to the system is the possibility of a bug that allows anyone to extract all the collateral or locks the protocol in a

state it cannot recover from. We plan to have our code reviewed by multiple security researchers and launch the system on a testnet before we commit to deploying it in production

- **CAI failure**: we will aggregate feeds from multiple CAI approved carbon pricing networks and there will be strict rules in place for upgrading only one carbon pricing input at a time so that malicious governance cannot easily introduce false prices

- **Collateral black swan events**: there is the risk of a black swan event in the underlying collateral which can result in a high number of liquidated SAFEs. Liquidations may not be able to cover the entire outstanding bad debt and so the system will continuously change its surplus buffer in order to cover a decent amount of issued debt and withstand market shocks

- **Improper rate setter parameters**: autonomous feedback mechanisms are highly experimental and may not behave exactly like we predict during simulations. We plan to allow governance to fine-tune this component (while still being bounded) in order to avoid unexpected scenarios

- **Failure to bootstrap a healthy liquidator market**: liquidators are vital actors that make sure all issued debt is covered by collateral. We plan to create interfaces and automated scripts so that as many people as possible can participate in keeping the system secure.

Summary

We have proposed a protocol that progressively locks itself from human control and issues a low volatility, collateralized asset called a carbon reflex index. We first presented the autonomous mechanism meant to influence the index's market price and then described how several smart contracts can limit the power that token holders have over the system. We outlined a self-sustaining scheme for medianizing price feeds from multiple independent approved carbon pricing networks and then finished by presenting the general mechanism for minting indexes and liquidating SAFEs.

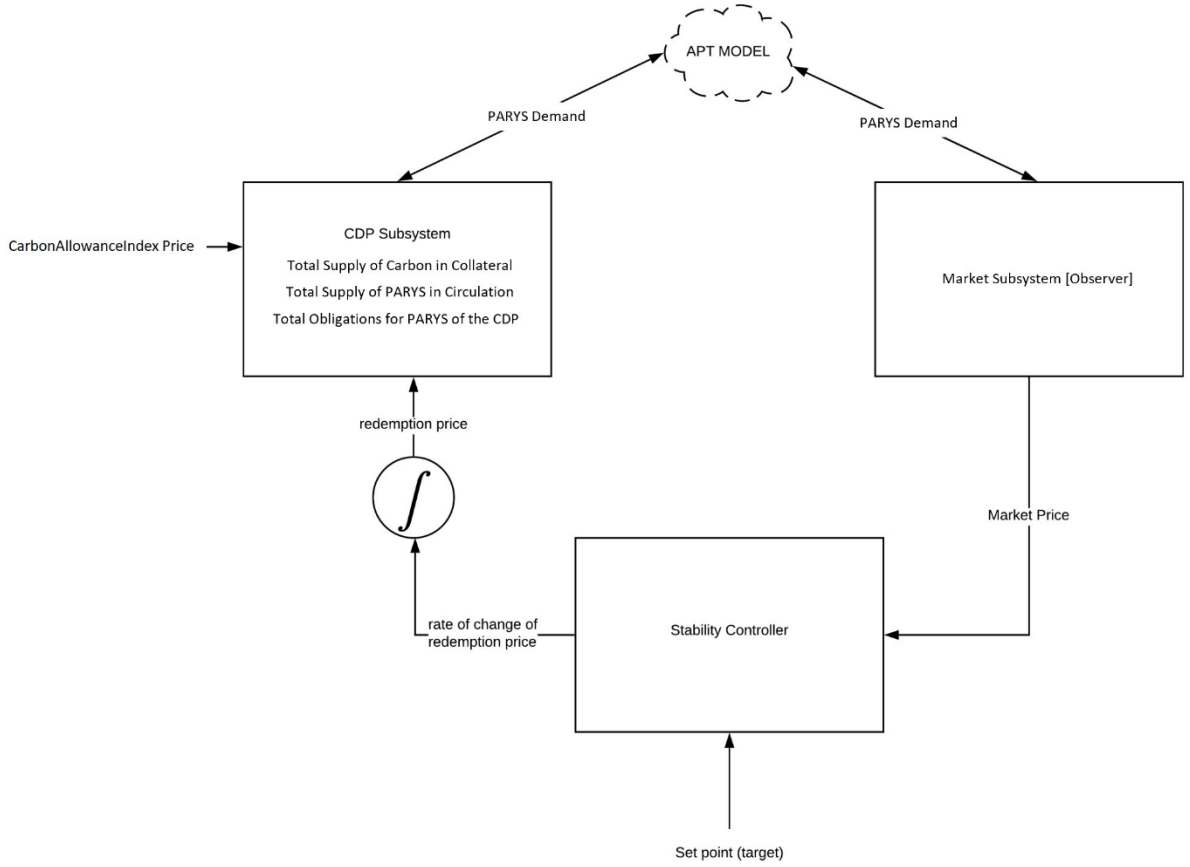
We discussed how the PARYS™ ReFi platform is leveraging existing European Union Allowances (EUAs) as Carbon Futures for collateralization, coupled with the Intercontinental Exchange European Union Allowance (ICEEUA) index for price discovery and fungibility, to achieve best overall performance as the world's first "green stable Carbon Synthetic". We have provided our product roadmap to give participants some insight into the PARYS™ development effort as it exists today. We conclude by summarizing the addressable market, as well as providing system

diagrams for consideration.

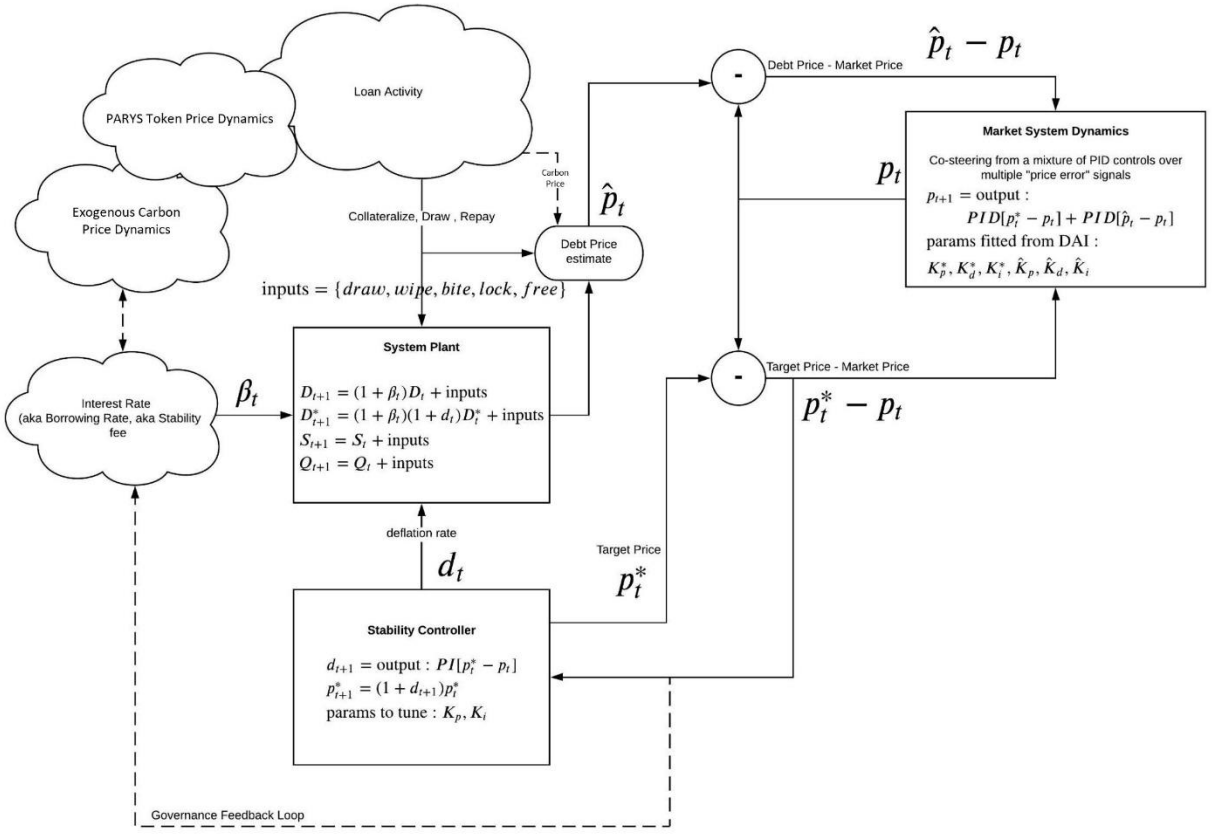
Our goal is to provide Paris Agreement aligned Web3 financial models as carbon-based synthetics; Pigouvian Subsidy while reducing pollution worldwide! We are working relentlessly to preserve a Sustainable Planet Earth for generations and centuries to come. We hope you join our PARYS™ ReFi community!

System Design Graphs

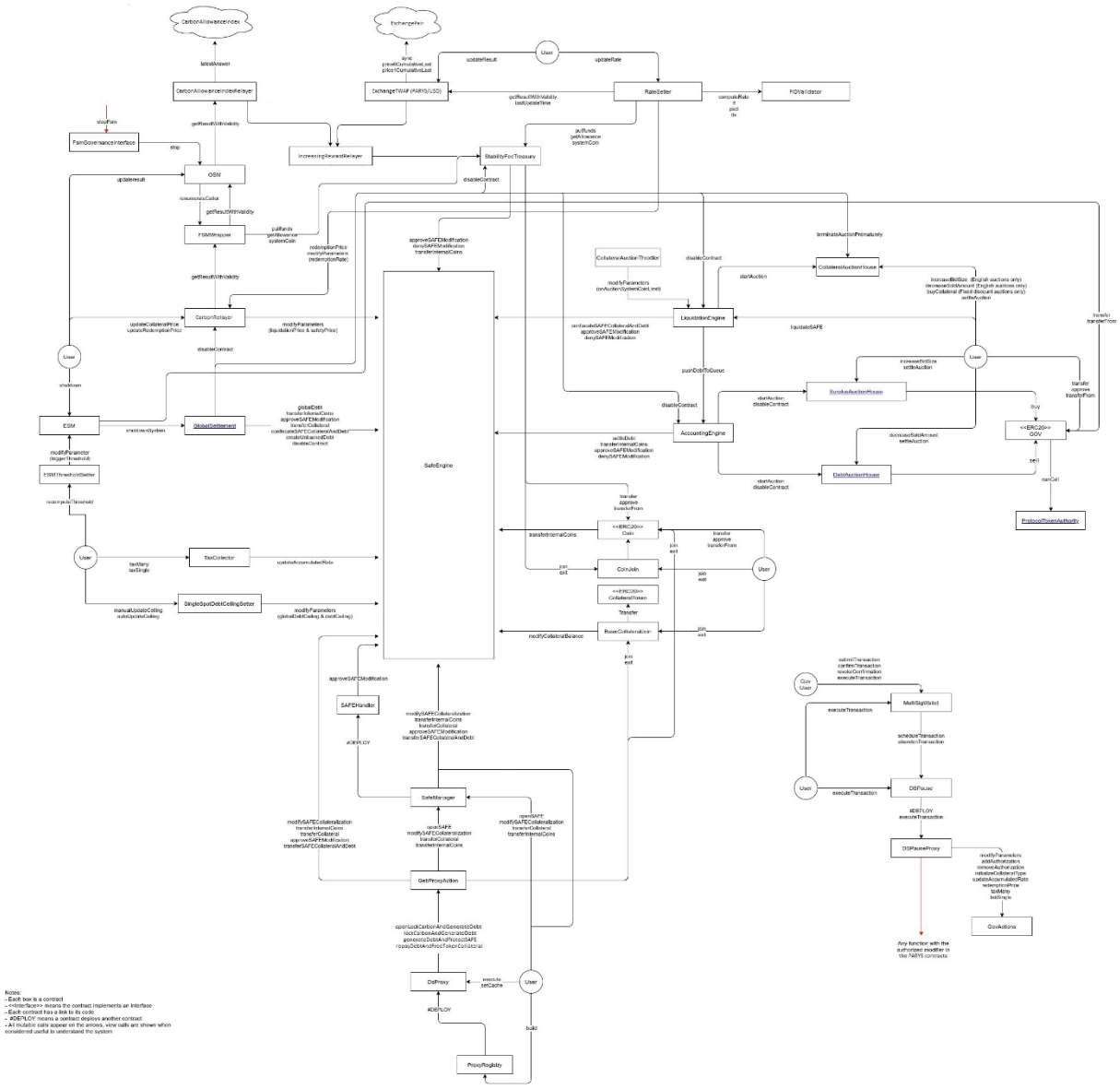
Arbitrage Pricing Model Flow Chart:



PARYS™ Laws of Motion State Diagram:



PARYS™ System Diagram:



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Glossary

Accounting Engine: system component which triggers debt and surplus auctions. It also keeps track of the amount of currently auctioned debt, unactioned bad debt and the surplus buffer.

AGREE™ Token: The PARYS™ Protocol governance token.

Borrowing Rate: annual interest rate applied to all SAFEs that have outstanding debt.

Carbon Allowances – also called "emissions trading schemes", or "cap and trade" – are sometimes described as the economist's solution to greenhouse gas emissions. They are tradeable government permits that allow polluters to pump carbon dioxide (CO2) into the atmosphere. Under these programs, polluters must surrender enough allowances to cover their pollution upon inspection. Governments ensure compliance, with large fines issued for non-compliance.

Carbon Allowance Index (CAI): the external carbon futures contract index used for price discovery, fungibility, and redemption price in the PARYS™ protocol. This index should map to the carbon market PARYS™ is bound to for price discovery, fungibility and collateral redemption, initially the EU-ETS market with the ICEEUA carbon index. Other versions of PARYS™ may bind to other carbon markets in a similar capacity.

Carbon Allowance Index Network Medianizer (CAINM): a smart contract that pulls prices from multiple approved carbon pricing sources, and medianizes them if a majority (e.g., 3 out of 5) returned a result without throwing, or on-network redundancy.

Carbon Futures: are derivative financial contracts that obligate parties to buy or sell a carbon allowance at a predetermined future date and price. The buyer must purchase or the seller must sell the underlying carbon allowance at the set price, regardless of the current market price at the expiration date.

Carbon Reflex index: a collateralized asset that dampens the volatility of its underlying carbon collateral.

Carbon Synthetic: a Synthetic Instrument as defined by the International Financial Reporting Standards (IFRS) herein, utilizing carbon allowances, carbon offsets, carbon futures, carbon options, or any form of carbon asset or derivative available in any manner as a structured financial instrument.

Emissions Trading Scheme (ETS): an Emissions Trading Scheme works on the 'cap and trade' principle. A cap is set on the total amount of certain greenhouse gases that can be emitted by the installations covered by the system. The cap is reduced over time so that total emissions fall. Within the cap, installations buy or receive emissions allowances, which they can trade with one another as needed. The limit on the total number of allowances available ensures that they have a value. After each year, an installation must surrender enough allowances to cover fully its emissions, otherwise heavy fines are imposed. If an installation reduces its emissions, it can keep the spare allowances to cover its future needs or else sell them to another installation that is short of allowances. Trading brings flexibility that ensures emissions are cut where it costs least to do so. A robust carbon price also promotes investment in innovative, low-carbon technologies.

European Union-Emissions Trading Scheme (EU-ETS): the European Union's cap and trade carbon market implementation.

Governance Ice Age: immutable contract that locks most components of a protocol from outside intervention after a certain deadline has passed.

Money Market Setter (MMS): a mechanism similar to RRFM which pulls multiple monetary levers at once. In the case of carbon reflex indexes, it modifies both the borrowing rate and the redemption price.

PARYS™: the first carbon reflex index as a stable Carbon Synthetic.

Pigouvian Subsidy: a subsidy that is used to encourage behavior that have positive effects on others who are not involved or society at large. Behaviors or actions that are a benefit to others who are not involved in the transaction are called positive externalities. This is closely related to the idea of a pigouvian tax.

RAI: the first reflex index.

Redemption Price: the price that the system wants the index to have. It changes, influenced by a redemption rate (computed by RRFM), in case the market price is not close to it. Meant to influence SAFE creators to generate more or pay back some of their debt.

Redemption Rate Feedback Mechanism (RRFM): an autonomous mechanism which compares the market and redemption prices of a carbon reflex index and then computes

a redemption rate that slowly influences SAFE creators to generate more or less debt (and implicitly tries to minimize the market/redemption price deviation).

Restricted Governance Module (RGM): a set of smart contracts that bound the power that governance tokens holders have over the system. It either enforces time delays or limits the possibilities that governance has to set certain parameters.

Stablecoin: a digital asset, on a blockchain, that is designed to maintain a consistent value, typically by linkage to the value of another asset. Presently, there are 4 ways to design a stablecoin:

1. Algorithmic (derives value from a separate token specific to the stablecoin)
2. Commodity Collateralized (derives value from a commodity, e.g., Gold)
3. Cryptocurrency Collateralized (derives value from other cryptocurrencies, e.g., ETH, BTC)
4. Fiat Collateralized (derives value from a fiat currency, e.g., USD, EUR)

PARYS™ can act as a stablecoin in current crypto exchanges consistent with the 2nd category, carbon (commodity) collateralized.

Structured Financial Instrument: comprises of a range of products designed to repackage and redistribute risk. They are pre-packaged investments based on a single security, a basket of securities, options, commodities, debt issuance or foreign currencies, and to a lesser extent, derivatives. They include asset-backed securities (ABS) and collateralized debt obligations (CDOs).

Surplus Buffer: amount of interest to accrue and keep in the system. Any interest accrued above this threshold gets sold in surplus auctions that burn AGREE™ tokens.

Surplus Treasury: contract that gives permission to different system modules to withdraw accrued interest (e.g., CAINM for carbon pricing index calls).

Synthetic Instrument: According to the International Financial Reporting Standards (IFRS), a synthetic instrument is a financial product designed, acquired, and held to emulate the characteristics of another instrument. For example, such is the case of a floating-rate long-term debt combined with an interest rate swap. This involves receiving floating payments, or making fixed payments, thereby synthesizing a fixed-rate long-term debt. Another example of a synthetic is the output of an option strategy followed by dealers who are selling synthetic futures for a commodity that they hold by using a combination of put and call options. By simultaneously buying a put option in a given commodity, say, gold, and selling the corresponding call option, a trader can construct a position analogous to a short sale in the commodity's futures market.