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POLITÈCNICA  
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Facultad de Administración  
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UNIVERSITAT POLITÈCNICA DE VALÈNCIA

Faculty of Business Administration and Management

Development and Impact of the Collateralized Loan  
Obligations on Renewable Energy Generation Project  
Financing

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Bachelor's Degree in Business Administration and Management

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## **UNIVERSITAT POLITÈCNICA DE VALÈNCIA**

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### **Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing**

Trabajo Fin de Grado

Grado en Administración y Dirección de Empresas

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Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

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Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

## 1 Abstract

The present bachelor thesis has as a main objective to develop a new financial product that could have major global implications in the banking industry and that is an iteration of a recently developed product in the Securitization sector.

In the introduction there is an explanation of the objectives, SDG goals that this bachelor thesis is linked to, methodology developed, etc.

In the conceptual framework developed, and to achieve the main goal, there are several secondary objectives put in place to help understand Collateralized products structure, lifecycle, types, parties involved, market and regulation. In addition, to understand the evolution of the product and how Loans have become the center of gravity of Collateralized products there is an explanation of the development of Collateralized Loan Obligations throughout their history, followed by their specific lifecycle, structure, composition and market characteristics.

In the final part of the conceptual framework there is a brief explanation of what is project finance and why it is important to the development of renewable energy generation facilities as well as to other ESG friendly infrastructure projects. It also includes a description of what would be considered Green Project Finance.

Moving forward, there is an extensive analysis, based on comparable precedent transactions and on the conceptual framework, on how a Green Project Finance based CLO could be structured, both in its capital structure as well as in its deal structure including some parties that could be interested.

To finalize the last section of the bachelor thesis there is a benefit and risk analysis on how the proposed product could impact the industries that would be included in the deal.

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El presente trabajo de fin de grado tiene como objetivo principal desarrollar un nuevo producto financiero que podría tener grandes implicaciones globales en la industria bancaria y que es una iteración de un producto recientemente desarrollado en el sector de securización.

En la introducción se explica los objetivos, los objetivos de desarrollo sostenible (SDG, por sus siglas en inglés) a los que está vinculada esta tesis de licenciatura, la metodología desarrollada, etc.

En el marco conceptual desarrollado, y para lograr el objetivo principal, se establecen varios objetivos secundarios para ayudar a comprender la estructura, el ciclo de vida, los tipos, las partes involucradas, el mercado y la regulación de los productos con respaldo. Además, para comprender la evolución del producto y cómo los préstamos se han convertido en el centro de gravedad de los productos con respaldo, se explica el desarrollo de las Obligaciones Colaterales de Préstamos a lo largo de su historia, seguido de su ciclo de vida específico, estructura, composición y características de mercado.

En la parte final del marco conceptual, se brinda una breve explicación de lo que es la financiación de proyectos y por qué es importante para el desarrollo de instalaciones de generación de energía renovable, así como para otros proyectos de infraestructura amigables con el medio ambiente y la sostenibilidad



(ESG, por sus siglas en inglés). También se incluye una descripción de lo que se consideraría Financiamiento de Proyectos Verdes.

Avanzando, se realiza un análisis exhaustivo, basado en transacciones precedentes comparables y en el marco conceptual, sobre cómo se podría estructurar un CLO basado en Financiamiento de Proyectos Verdes, tanto en su estructura de capital como en su estructura de transacción, incluyendo algunas partes interesadas que podrían estar interesadas.

Para finalizar la última sección de la tesis de licenciatura, se realiza un análisis de beneficios y riesgos sobre cómo el producto propuesto podría impactar a las industrias que se incluirían en la transacción.

## 2 Introduction

In recent years, financial markets have witnessed the emergence of complex financial instruments designed to optimize risk and return profiles for investors. Collateralized Debt Obligations (“CDO”s) and Collateralized Loan Obligations (“CLO”s) are prime examples of such instruments, playing a crucial role in shaping the landscape of modern finance. While CDOs gained notoriety during the 2008 financial crisis, CLOs have shown resilience and even growth in the aftermath.

This bachelor's thesis aims to explore the potential application of CLOs in boosting project finance, with a specific focus on projects related to Environmental, Social, and Governance (“ESG”) considerations. The integration of ESG factors into investment decisions has gained traction globally as investors increasingly recognize the importance of sustainability and responsible investing.

By investigating the structure and functioning of CLOs, as well as analyzing the characteristics of ESG-related projects, this research seeks to shed light on how CLOs can be utilized as an effective funding mechanism for such projects. The bachelor thesis will delve into the potential benefits and challenges associated with using CLOs to finance ESG projects.

Overall, this bachelor thesis seeks to bridge the gap between traditional project finance and emerging sustainable investment practices, showcasing how CLOs can serve as a catalyst to unlock capital for ESG-related projects, ultimately fostering a more sustainable and inclusive future.

### 2.1 Objective

The main objective of this bachelor thesis consists of proposing the creation and adoption of an iteration of an existing but new financial product.

In order to achieve this objective, a set of several secondary objectives:

- Describe how Collateralized Debt Obligations function and what are their main characteristics: In order to understand the basis of how the proposed could work and which basic characteristics might encompass.
- Analyze how the Collateralized Debt Obligations evolved after the Global Financial Crisis: To visualize how the crisis brought new regulation to the

- CDO space, how it changed the market and why the new product has gained popularity.
- Evaluate the specific traits and characteristics of Collateralized Loan Obligations: In order to showcase what are the specific traits that the proposed product would need to have in order to be commercially viable and attractive to investors, by complying with regulation.
  - Analyze the Collateralized Loan Obligations market evolution, trends, actors, and characteristics: With the finality of understanding how market dynamics have moved and why to adapt the proposed product.
  - Understand the Project Finance industry and the rationale behind using loans in that space: In order to consolidate the hypothesis that loan generation will be sustained in the future and that the industry growth is linked directly to the loan generation.

## 2.2 Sustainable Development Goals (“SDG”)

The SDGs, or Sustainable Development Goals, are a set of 17 global goals established by the United Nations (“UN”) in 2015. They were adopted by world leaders as part of the 2030 Agenda for Sustainable Development, with the aim of addressing various social, economic, and environmental challenges facing the world.

This bachelor’s thesis can help address three main objectives that are included in the SDG list.

Firstly, the objective of Decent Employment and Economic Growth (SDG 8), the proposed product included in this bachelor’s thesis would significantly increase the funding available for infrastructure projects that are in line with ESG matters. The new funded projects would bring good paying jobs to several regions in the world and help develop economic growth wherever the new projects were placed.

Secondly, the objective of having Affordable and Non-contaminant Energy (SDG 7), since the proposed product could spur new investments into projects that generate renewable energy. By helping achieve the net zero resolutions across the globe, the proposed product would help increase energy supply, thus reduce energy prices and do so in an environmental manner.

Finally, the last objective that this project has a relationship with is Industry, Innovation and Infrastructure (SDG 9). In order for institutions to take advantage of the benefits of the proposed product, they would be forced to invest the liberated funds in projects that would tackle energy infrastructure to be able to have a loan pool large enough to create new products. Also, it would be sensible to assume that with a larger pool of funds it would be easier for companies to innovate in the project finance and infrastructure industry.

## 2.3 Relationship with Undergraduate Courses

Regarding the justification for the utilization of the subjects' contents in the Degree in Business Management and Administration, related to this work, first and foremost, it is important to highlight the following subjects:

- Derivatives: All the products that are described in the bachelor's thesis are derivatives and it is important to have a basis of understanding of these types of financial products in order to fully understand the importance and scope of what is discussed.
- Infrastructure and Development Finance: The proposed product links the derivatives market with the Infrastructure Finance; thus, it is helpful to have a meaningful understanding on how the financial services industry participates in the infrastructure industry.
- Corporate Finance: Many of the concepts needed to understand the rationale behind why and how all types of corporations seek funding in order to develop projects are needed to fully integrate the concepts laid out in this bachelor's thesis.

## 2.4 Methodology

The primary approach employed in the production of this bachelor's thesis is analytical and centered around conducting extensive literature research. The main sources utilized for gathering information include Google Scholar and Google with a particular emphasis on highly cited theses, books, and articles.

In conducting the information search, preference was given to English-written documents, primarily focusing on publications from the past two decades (2000-2020). Keywords such as collateralized debt obligations ("CDO"), collateralized loan obligations ("CLO"), leveraged loans, spread, project finance, etc., were employed to refine the search. The search process spanned from August 2022 to April 2023.

Firstly, extensive research on the description, structure, lifecycle and parties involved in the creation of CDOs has been conducted. To achieve this, bibliographic research through Google and Google Scholar has been necessary. Industry reports and public professional statements have also been utilized in order to define and analyze CDO characteristics according to past and present market trends.

Additionally, as a connection with the main product analyzed in this bachelor's thesis the financial history transition between CDOs and CLOs has been exposed. The same bibliographical methodology has been used to perform said analysis.

In order to explain the specific characteristics of CLOs, its development as a financial product throughout history, and the recent market trends that helped it gain popularity in the industry, a significant number of reports from US public financial institutions, rating agencies and professional investors websites have been researched.

Finally, and to achieve the bachelor's thesis objective to propose an innovative product in line with the 2030 goals a product proposal has been done by developing a precedent transaction approach. This approach is a market standard in the finance industry and it has also been based on several books on project finance and publicly available investor information memorandum from comparable products.

### 3 Collateralized Debt Obligation (“CDO”)

#### 3.1 CDO’s Description

A collateralized debt obligation (“CDO”) is a type of structured asset back security (“ABS”) that pools together a diverse portfolio of debt instruments such as bonds, loans, and other securities, and then repackages them into a new security, usually in the form of bonds that can be sold to investors. The securities issued by a CDO are backed by the cash flows generated by the underlying pool of debt instruments and/or the increase in value of said pool.

#### 3.2 CDO’s Basic Structure and Lifecycle

##### 3.2.1 Debt Origination

As depicted in *Figure 1* CDO deals always start with the debt origination. In this stage, one or several financial institutions create a large array of debt instruments from financing their clients.

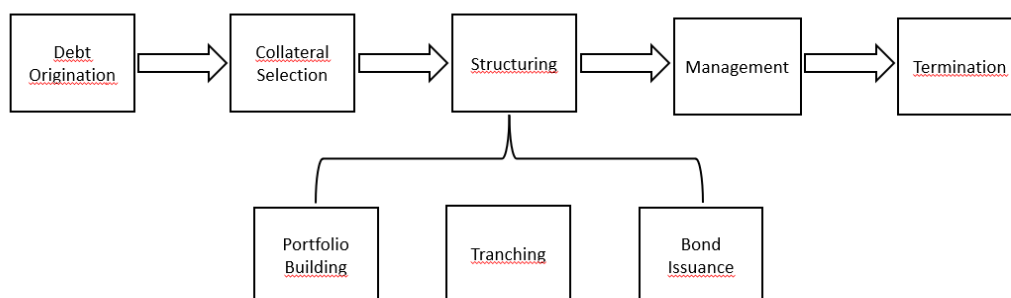


Figure 1 CDO Lifecycle

Source: Own elaboration from *Capital Access Index, Securitization in Financing Economic Activities* (Barth, Li, McCarthy, Phumiwasana, & Yago, 2005).

As it can be seen in *Figure 2* the financial institutions act as an asset seller to a Special Purpose Vehicle (“SPV”) to be securitized. CDOs are usually structured via an SPV, which is a separate subsidiary created by a parent company. The specific roles of all the parties involved are analyzed in depth later.

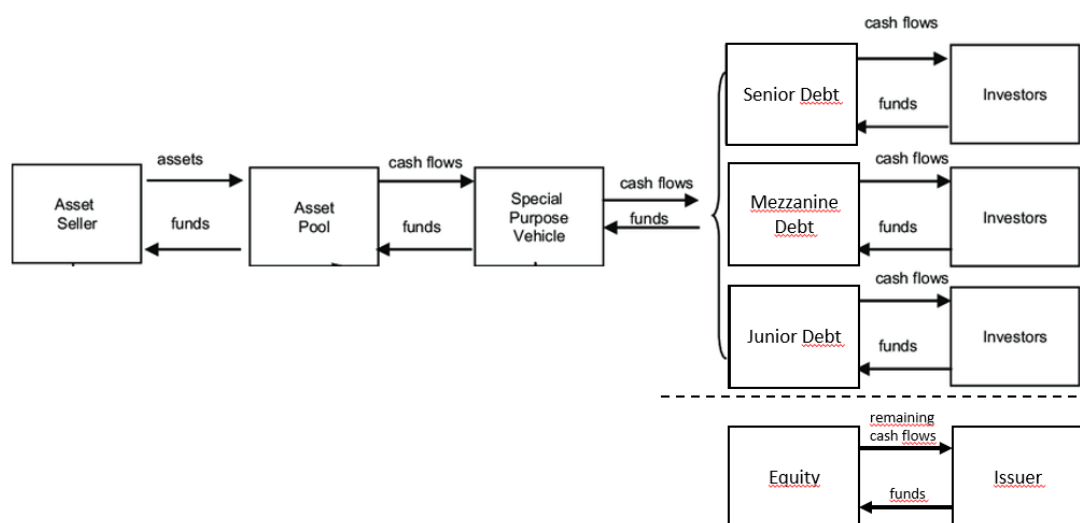


Figure 2 CDO Balance Sheet and SPV Structure

Source: Own elaboration from *Capital Access Index, Securitization in Financing Economic Activities* (Barth, Li, McCarthy, Phumiwasana, & Yago, 2005).

### 3.2.2 Collateral Selection

During the second phase, the collateral selection phase, the SPV builds the portfolio of securities. The SPV acts as a passive holding where the CDO assets can be independently managed by selecting, acquiring, and selling securities in order to build and manage the aforementioned portfolio (Hayes, *What Is a Special Purpose Vehicle (SPV) and Why Companies Form Them*, 2022). This method is selected to structure the CDOs in order to better balance the underlying cash inflows received from the assets held in the SPV balance sheet and cash outflows paid to the CDO bond investors. The SPV is set up in order to limit risks, since the CDO benefits from limited liability, allowing investors to make better assessments about the financial health of the CDO and improving the financial modeling process' efficiency and effectiveness, thus enhancing the instrument's predictability (CFI, 2023).

### 3.2.3 Structuring

In order to kickstart the next phase, the structuring phase, the first mandate executed on the SPV is to purchase the different types of collateral which will compose the asset side of the CDO's balance sheet to then issue bonds backed by the assets.

#### Assets

According to a report by the Financial Stability Oversight Council (FSOC), which is a U.S. government agency, some common types of assets that are included in CDOs include mortgage-backed securities, asset-backed securities, corporate bonds, and leveraged loans. The report also notes that CDOs can be backed by

a variety of other assets, including commercial real estate debt, aircraft leases, and structured finance securities such as project finance (“PF”) debt (FSCO, 2020).

Depending on which type of asset the CDO is mainly formed of it will receive a different name (New York Public Library, 2023):

- Structured finance CDOs (“SFCDOs”): CDOs backed primarily by MBS and CMBS.
- Collateralized loan obligations (“CLOs”): CDOs backed primarily by leveraged bank loans and project finance debt.
- Collateralized bond obligations (“CBOs”): CDOs backed primarily by leveraged fixed income securities.
- Collateralized synthetic obligations (“CSOs”): CDOs backed primarily by credit derivatives, such as SWAPS and other CDOs.

Later in the bachelor thesis, a more in-depth analysis of the Collateralized Loan Obligations and on the assets that are used to create the portfolios can be found since it is the main product discussed.

Once the securities portfolio is built, the CDO is structured into several tiers or tranches using the waterfall payment system to subordinate them and create seniorities. In a CDO the waterfall payment mechanism follows a set of pre-defined rules that determine the order and priority of payments to each tranche. The rules are designed to ensure that each tranche receives its promised cash flows, while also protecting the more senior tranches from default risk.

In a waterfall payment mechanism, there is a subordination in the payment mechanism that works in the following way as exemplified in [Figure 3](#).

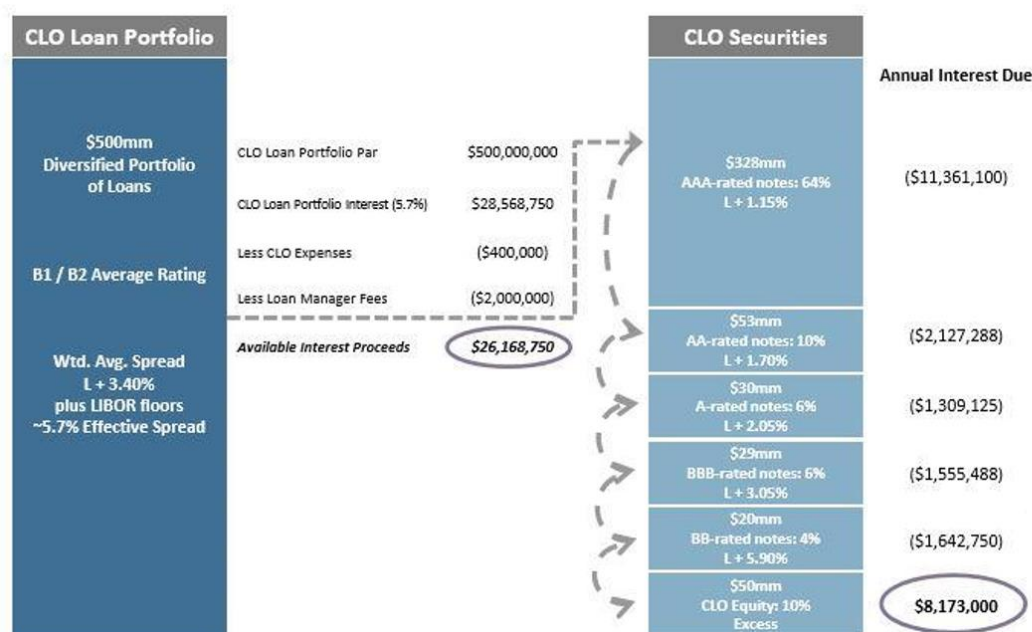


Figure 3 CDO/CLO Cash Flow distribution

Source: Understanding CLOs and the Makeup Of Their Distribution, (Holloway, 2019)

The cash flows generated by the underlying assets are first used to pay fees and

costs, to then pay the senior-most tranche interests. Once that tranche has received its full payment, the remaining cash flows are used to pay the next-most senior tranche, and so on, until all tranches have received their full payment or there are no more cash flows remaining (Barbican Consulting, s.f.).

Thanks to the subordination created by the waterfall each tranche has a different risk profile, which translates into different risk ratings depending on the preference of payment. There is a wide variety of tranche granularity level on different CDOs, however the four main tranche levels are:

- Senior Tranches: These tranches are considered to carry low levels of risk in a CDO. The Senior Tranches are the first ones to receive the payments and the last ones to absorb losses. They are given the highest credit ratings (AAA-AA) and account for up to 80%-90% of the portfolio (Barbican Consulting, s.f.).
- Mezzanine Tranches: These tranches are considered to carry moderate to low levels of risk in a CDO. The Mezzanine Tranches are the second ones to receive the payments and the second ones to absorb losses. They are given the high credit ratings (A-BBB) and account for up to 5%-10% of the portfolio (Barbican Consulting, s.f.).
- Junior or Subordinated Tranches: These tranches are considered to carry moderate to high levels of risk in a CDO. The Junior Tranches are the third ones to receive the payments and absorb losses. They are given the non-investment grade credit ratings ( $\leq$ BBB) and account for up to 5%-10% of the portfolio (Barbican Consulting, s.f.).
- Equity Tranches: These tranches are considered to carry high levels of risk in a CDO. The Equity Tranches are the last ones to receive the payments and the first ones to absorb losses. They do not have a credit rating and account for up to 5%-10% of the portfolio (Barbican Consulting, s.f.).

## Liabilities

Having completed the asset side during the structuring phase, the liabilities side of the balance sheet is created during the distribution phase. A series of Bonds are issued using each of the tranches as collateral and later in this phase of the lifecycle, these bonds are sold to investors in a public offering or in a private placement and are often marketed to institutional investors. In addition, there are no bonds issued against the equity tranche and usually the final owner of this part of the SPV is the originator or the manager of the CDO.

Reasonably, the more senior tranches will offer lower coupons than the more junior ones. A more in-depth analysis of the returns investors could expect and the respective spreads to similarly rated assets can be found later in this bachelor thesis.

### 3.2.4 Management

In the management phase, the SPV or an external asset manager monitors the performance of the underlying debt and manages the cash flows generated by the securities. The manager may also make decisions about how to allocate any excess cash flows, such as paying down the debt or distributing dividends to investors. This phase is not as important as the prior ones, that is why there is not such a level of analysis included in this bachelor thesis.

### 3.2.5 Termination

Finally, the CDO reaches the end of its life in the termination phase, either through the expiration of the underlying debt or through the redemption of the bonds. At this point, the remaining assets in the SPV are distributed to investors, and the SPV is typically dissolved. As with the management phase, it is not critical to analyze this phase in depth in order to further elaborate in this bachelor thesis.

### 3.3 CDOs Types and Purposes

Now that it has been explained what a CDO is and how it is structured in a superficial manner, it is important to further develop the different types of products that exist and what are their uses. This explanation will allow us to understand why CDOs are attractive to all the different parties that are involved in the deal.

There are several methodologies used to categorize CDOs, however this bachelor thesis will be focusing on three of them, since they are the most critical ones to completely understand the differences among the types of CDOs that exist. In *Figure 4* there is a graphical synthesis of the concepts explained in this section in detail.

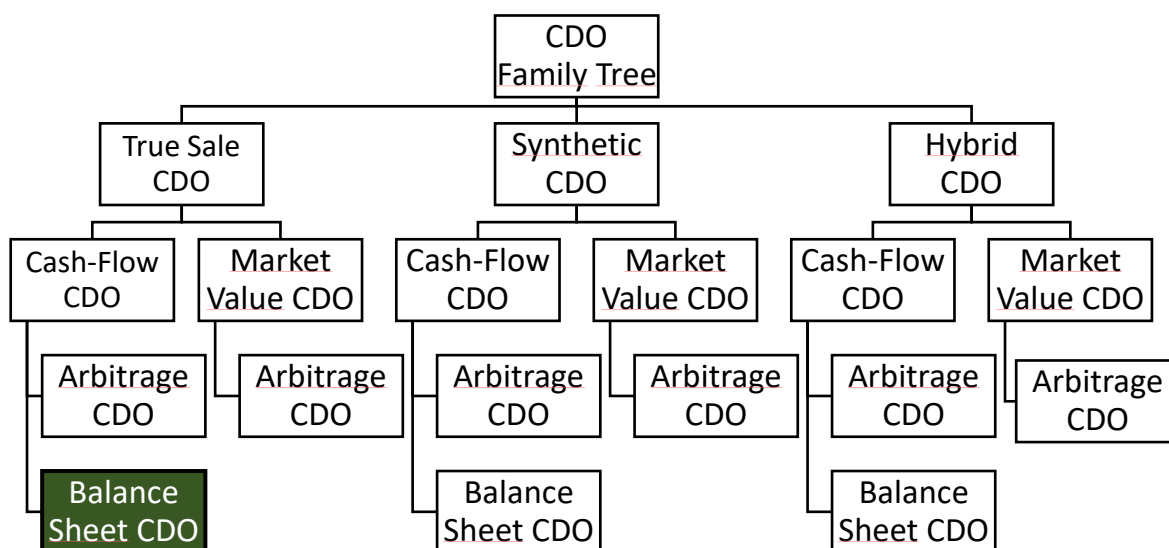


Figure 4 CDO Classification Tree

Source: Own elaboration from Collateralized Debt Obligations Structures and Analysis (Douglas, Fabozzi, & Goodman, 2006).

#### 3.3.1 CDO Types by Asset Acquisition Methodology

The first approach to characterize the CDO typology is based on the mode of asset acquisition, using these distinctions there are three types of CDOs.



## True Sale CDO

The basic CDO structure corresponds to a True Sale CDO, where the issuer sells a portion of its loan or bond portfolio to a SPV, which issues the CDO securities to investors. The SPV is responsible for managing the portfolio and distributing the cash flows to the CDO investors.

## Synthetic CDO

Additionally, there are Synthetic CDOs which are a type of CDO that are constructed using credit derivatives instead of actual bonds or loans as collateral. Instead of owning the actual underlying assets, investors in a synthetic CDO own credit derivatives that reference the performance of those assets. These derivatives often include credit default swaps (CDS), and other financial instruments.

In synthetic CDOs, the issuer creates tranches of securities and issues bonds similar to those found in traditional Cash CDOs. However, the issuer also buys credit default swaps or total return swaps on a portfolio of underlying assets, which can include corporate bonds, residential mortgage-backed securities, or other types of debt.

The cash flows from the swaps are then used to pay the interest and principal on the synthetic CDO tranches. In a synthetic CDO, the issuer does not actually own the underlying assets, so the risk of default is shifted from the issuer to the counterparty of the credit derivative (Dinca, 2015).

Synthetic CDOs gained popularity in the early 2000s, particularly in the market for collateralized debt obligations based on mortgage-backed securities. However, they also played a significant role in the financial crisis of 2008, as many of these securities were backed by subprime mortgages that defaulted in masse, leading to significant losses for investors.

## Hybrid CDOs

Lastly there are Hybrid CDOs, that combine both cash assets and synthetic securities as collateral. Hybrid CDOs are designed to provide investors with exposure to a diversified pool of assets, including bonds, loans, and other fixed-income securities, as well as credit derivatives such as credit default swaps (CDS) and total return swaps (TRS). The exact composition of assets in a hybrid CDO can vary depending on the specific structure of the transaction (Standard & Poor's Ratings Services, 2007).

### 3.3.2 CDO Types by Found Sourcing

Moving forward and characterizing the CDOs based on the source of funds for the investor's repayment there exist Cash Flow CDOs and Market Value CDOs.

#### Cash-Flow CDOs

Cash-flow CDOs are structured in such a way that the repayments are based on the ability of the underlying assets' cash flows to fully service the principal and

interest payments of the bonds issued, as well as the ability to cover the fees and other expenses. It's worth noting that cash-flow CDOs can also fall under the categories of True Sale CDOs, Synthetic CDOs, or Hybrid CDOs (Dinca, 2015).

### Market Value CDOs

Market Value CDOs generate returns based on changes in the market value of the underlying collateral and allow investors to profit from the appreciation in the market value of the assets in the underlying pool. Market Value CDOs were a popular type of CDO prior to the 2008 financial crisis, but their complexity and lack of transparency contributed to the GFC and subsequent regulatory reforms. As a result, the market for Market Value CDOs has declined significantly in popularity in recent years.

In addition, it is important to mention that Market Value CDOs can be both True Sale CDOs and Synthetic CDOs.

### 3.3.3 CDO Types by Deal Purpose

Lastly focusing on the purposes of the deal there are Balance Sheet and Arbitrage CDOS.

#### Balance Sheet CDOs

There are several key regulations and concepts related to how balance sheet CDOs work and why they make sense that would be beneficial to introduce in this section in order to understand their uses and implications later.

The first one would be that there are international regulations followed by all major banks in the world that require them to have a certain amount of cash or cash-like items in their balance sheet in order to back all their other assets. This type of capital is called CET I capital and is basically cash and liquid safe bonds and cash certificates. The regulation states that banks must maintain at least an amount of CET I capital equivalent to 6% of their Risk Weighted Assets ("RWA") (Basel Committee on Banking Supervision, 2017).

The RWA is a way to count how much assets a bank has, it basically works like a weighted aggregate, where riskier assets have larger weights. For example, certain government bonds have 0% weight, thus banks can hold as many as they want. However, other assets, such as low rated bonds or MBS have a 150% or even 200% weight, so for every dollar they hold of those assets they will have 1.5 or even 2 dollars on RWA that must be backed by a 6% in CET I capital (Basel Committee on Banking Supervision, 2020).

In order to avoid having to increase too much their cash reserves banks usually tend to originate loans, increasing their RWA to them sell them somehow to reduce their RWA and capital required to finally generate another loan.

Now, after having understood this it is easy to see how in balance sheet CDOs, the issuer (usually a bank) desires to shrink its balance sheet to reduce their required regulatory capital, and/or achieve cheaper funding costs (Douglas, Fabozzi, & Goodman, 2006). After having issued a certain amount of loans, banks can find it hard to continue financing their current and new clients since

they need to back these loans with capital and they have a limited amount of funds.

They can thus repackage these loans and sell them to the CDO SPV, significantly reducing the asset side of their balance sheet, thus reducing the regulatory capital required to back their balance sheet (Opler, Pinkowitz, stulz, & Williamson, 1998). Banks act as issuers and usually hold the equity tranche which does require capital backing. Nevertheless, they can still benefit from the aforementioned reduction and continue issuing loans to their clients and financing ventures. They can be both True Sale CDOs, and synthetic based CDOs, however they usually only appear in the Cash-Flow form (Armstrong & Kiff, 2006).

### Arbitrage CDOs

Moreover, in terms of purposes, arbitrage CDOs, which is a type of CDO where the manager acquires undervalued or mispriced securities and combines them with other securities to create a portfolio. This strategy is commonly used by investors, such as hedge funds, to generate alpha or excess returns by taking advantage of pricing discrepancies in the market. However, arbitrage CDOs are also considered to be relatively risky investments, as they rely on the accuracy of pricing models used to identify mispricing. These CDOs are a way for asset management firms to offer their services to investors, but with a difference. Instead of all investors sharing the fund's returns proportionally, investor returns are also determined by the seniority of the CDO tranches they purchase (Coval, Juerk, & Stafford, 2008). They are cash-flow CDOs and market-value CDOs based on both True Sale and Synthetic structures.

### 3.3.4 Chosen Structure to Analyze

This bachelor thesis will be focusing only on Balance Sheet CDOs with a Cash-flow source of funds and a True Sale mode of asset acquisition because as seen later in the project, CDOs structured this way are the right fit for the niche market of Project Finance in terms of demand from investors. In addition, these types of CDOs are the ones that provide a level of investor protection enough to be issued in the current markets. It would not be possible to structure and sell Synthetic and Hybrid CDOs as well as Market Value CDOs in the current market. There has not been a significant Synthetic CDO issuance since 2008, up until 2020 when three banks tried to sell a synthetic CDO, indicating the low levels of interest for the product (Christopher Whittall, 2020). However, it is uncertain whether the level of interest will increase with time and under the current credit hardening circumstances.

## 3.4 Parties Involved in the Chosen CDO Structuring Process

In this section of the bachelor thesis, there will be an expansion on one of the five steps in a CDO lifecycle, the CDO's structuring process and the parties involved on it to complete the picture in a more granular level of how a True Sale, Cash-Flow, Balance Sheet CDO works and who is interested in these types of products. As can be seen in *Figure 5* below, the deal has a large level of complexity and moving parts and a visual summary is necessary.

## Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

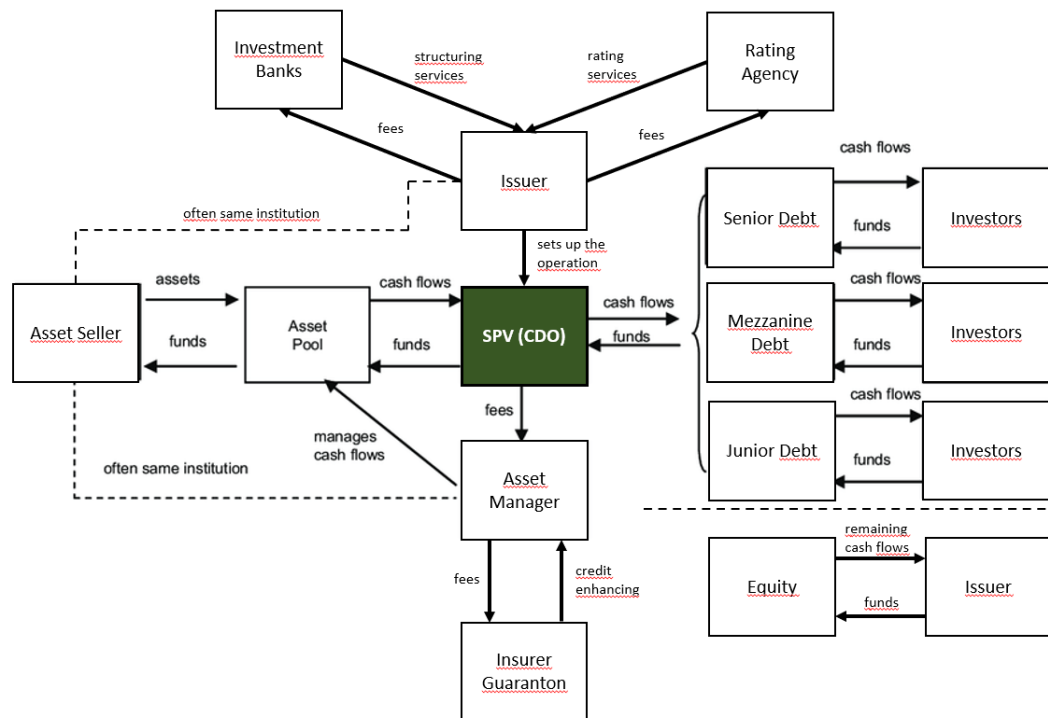


Figure 5 CDO Deal Structure and Parties Relationship

Source: Own elaboration from *Capital Access Index, Securization in Financing Economic Activities* (Barth, Li, McCarthy, Phumiwasana, & Yago, 2005).

### 3.4.1 Issuers

When structuring a CDO, it's the responsibility of the issuer to establish the SPV, even though the SPV has a passive role, provides protection to the parent company, as previously discussed.

SPVs are typically incorporated in offshore locations like the Cayman Islands or Ireland (Douglas, Fabozzi, & Goodman, 2006). As an example, in 2021 62.5% of all newly listed US CDOs used the Cayman Islands as an incorporating country and 37% used Ireland (Maples Group, 2021).

The use of offshore incorporation offers the advantage of easier sale of CDO obligations to international investors, including those in the United States and EU. This is due to the fact that The Cayman Islands is a well-established and widely recognized international financial center and institutional investors, are comfortable investing in Cayman Islands structures. The familiarity of the jurisdiction can enhance the credibility and appeal of a CDO to potential investors. Additionally, it allows the CDO to avoid taxation at the corporate entity level.

In particular, incorporating the SPVs in Ireland results attractive since they are granted an "onshore" status, meaning that the Irish SPVs will be part of the EU company ecosystem, which is key for certain investors that only can buy bonds from SPVs located in EU or OECD countries (Matheson LLP, 2011). In addition, CLOs incorporated in Ireland take advantage of the EU's passporting regime, which enables the marketing and distribution of financial products across EU member states.

Issuers are usually large global banks CDOs that have access to large pools of assets and have great relationships with the rest of the parties involved in order to arrange and lead the deal. During the peak of the CDO market in terms of issuance in 2006 the most active issuers in the market were the banks listed in Table 1.

Table 1 2006 US CDO Top Issuers

Financial Institution Name	Total Amount Issued in Billions of US Dollars
Merill Lynch	55
Deutsche Bank	37
Citigroup	35
Goldman Sachs	34
Credit Suisse	25
Bear Steams	25
UBS	20
Bank Of America	20
J.P.Morgan Chase	19
Wells Fargo	18

Source: Own elaboration from *Collateralized Debt Obligations' Valuation Using the One Factor Gaussian Copula Model* (Teply, 2012).

It is worth mentioning that there are several banks that went bankrupt during the 2008 global financial crisis ("GFC") and the 2023 credit crunch. They do not continue to issue any CDOs in the current market or at least they do not do so under the same name, since they have been bought by other financial institutions. Credit Suisse was bought by UBS in 2023, and Bear Steams was acquired by J.P.Morgan Chase in 2008.

During most of the CDO transaction processes, the issuers, the asset sellers, and the asset managers are the same organization enacting different roles especially when it comes to balance sheet deals. However, the parties are analyzed in different sections since their roles are different independently of the entity that carries out the task. In addition, the fact that the issuer, the asset seller and the asset manager is the same institution should not pose any extra risk for the investors or the public at large, since the intention of the deal is to sell some assets and not produce extra income for the financial institution.

### 3.4.2 Asset Seller

The responsibility of supplying the assets for the CDO portfolio and retaining its equity lies with the asset sellers, they are just suppliers to the asset manager, who picks out the right asset mix. Typically, the assets consist of smaller-sized loans that are issued to small borrowers. In the United States, these loans are referred to as "middle market," while in Europe, they are known as "Small and medium enterprise" ("SME") loans. The portfolio may also include loans to individuals, such as credit card debt, mortgages, student debt, auto debt, and so on (Douglas, Fabozzi, & Goodman, 2006).

Since the goal of the CDO is to reduce the issuing banks' balance sheet, then

there will only be one asset provider to the facility and it will usually be the same as the issuer and most probably the same as the asset manager. Thus, the global banks previously mentioned as the largest issuers are also the largest asset sellers.

According to a report by the Financial Stability Board (FSB) published in 2017, the largest asset providers to CDOs before the 2008 financial crisis were commercial banks, accounting for about 55% of the underlying assets. Other financial institutions, such as investment banks, insurance companies, and pension funds, accounted for the remaining 45% of the assets. The large concentration of asset sellers in the commercial banks was due to the fact that it was these institutions who originated and held the largest number of loans, and that the main use of the CDOs was to reduce the balance sheet of these banks. In addition, the report also noted that the market for CDOs had become less concentrated in the years following the financial crisis.

### 3.4.3 Asset Managers

The role of an asset manager in a CDO is to select, purchase, and manage the underlying assets that make up the CDO's portfolio. The asset manager is responsible for ensuring that the assets meet the criteria specified in the CDO's investment guidelines, which typically include factors such as credit rating, duration, and yield. (Dechert LLP, 2018) The asset manager is also responsible for monitoring the performance of the assets and making adjustments to the portfolio as necessary to ensure that the CDO's investment objectives are met. The asset manager may also be involved in marketing the CDO to potential investors and providing ongoing reports on the performance of the CDO to its investors (Moody's Investors Service , 2018).

When the CDO is a balance sheet CDO, the asset manager is usually the same institution as the issuer and the asset seller. It is thus responsible for determining the tranches of securities and allocating the assets to each tranche based on the desired risk and return characteristics of the bonds. Nevertheless, the asset manager can also be an independent firm.

The largest independent CDO managers based on assets under management are:

1. Blackstone/GSO Capital Partners
2. Ares Management
3. Golub Capital
4. Carlyle Group
5. Oaktree Capital Management
6. Apollo Global Management
7. Bain Capital Credit
8. HPS Investment Partners
9. Sixth Street Partners
10. Intermediate Capital Group

It's worth noting that this list may not be comprehensive and that rankings can change over time as assets under management and market conditions fluctuate (Institutional Investor, 2021).

The CDO asset manager charges a certain amount of fees to the investors who buy the CDOs tranches for their services. The fees charged by CDO managers can vary depending on a number of factors, such as the size of the CDO, the complexity of the underlying assets, and the competitive landscape.

However, some common fees typically used by CDO managers are the Management Fees, which are an annual fee paid by the SPV to the manager for managing the portfolio. The management fees are usually a percentage of the assets under management, ranging from 0.50% to 1.50% depending on the size of the CDO (Fitch Ratings, 2020).

In addition, there are Incentive Fees. These are performance-based fees that are paid to the manager if the CDO meets certain performance targets, such as a specified level of excess returns or spreads. The incentive fees are usually a percentage of the excess spreads, which are the difference between the yield on the CDO's assets and the interest rate paid to investors on the CDO's liabilities. The incentive fee typically ranges from 15% to 20% of the excess spread, although it can be higher in some cases (International Capital Market Association (ICMA), 2011). These fees only occur if the party holding the equity, usually the asset seller, is not the same institution as the asset manager, otherwise the excess spread is captured entirely by the asset seller/asset manager.

In addition to the management fees and incentive fees, CDO managers may charge other fees, such as transaction fees for buying and selling assets, legal and accounting fees, and other expenses related to managing the CDO.

All the fees are deducted from the underlying loans cash flows before the SPV can start the interest payments to the investors in the tranches as it was depicted in the waterfall payment scheme example in *Figure 3*.

Overall, the asset manager plays a critical role in the CDO process, as the success of the CDO depends largely on the quality of the assets selected and the management of the portfolio over time. Also, because in many cases the same institution that is in charge of managing the CDO is in charge of issuing it and selling the assets to the SPV.

#### 3.4.4 Investment Banks

Investment banks and structurers collaborate with the asset managers and/or asset sellers to facilitate the creation of the CDO. Their primary responsibilities include establishing corporate entities, guiding the CDO through the debt rating process, placing the CDO's debt with investors, and managing other organizational details (Douglas, Fabozzi, & Goodman, 2006). They are tasked with executing the designs of the other parties involved in the structure.

Their primary role is to structure the CDO's liabilities, including size and coupons, in coordination with the CDO manager's requirements. Additionally, they are responsible for obtaining the cheapest funding for the CDO and assisting with the asset purchasing process. This requires balancing the demands of the asset manager and/or seller, the rating agencies, and the debt and/or equity investors (Mentorme, 2022).

Investment banks also promote the CDO to prospective investors and may help

distribute the bonds issued. They may also provide other services such as underwriting the bonds, providing liquidity facilities such as warehousing and revolving credit facilities to support the CDO's operations, and advising on risk management and hedging strategies.

In a CDO transaction, the fees for the investment banks involved in structuring the deal are typically paid by the issuer of the CDO. The issuer can either pay the fees directly or include them in the transaction expenses that are passed on to the investors. The specific arrangement may vary depending on the terms of the deal and the negotiations between the issuer and the investment banks.

The largest investment banks that participated on the structuring process according to the Reuters League Tables in 2007 and as stated in Table 2.

*Table 2 Top Investment Banks in Structuring Processes*

Financial Institution Name	Participation in Structuring Processes
J.P.Morgan Chase	>20%
Morgan Stanley	20%
Barclays	14%

Source: Own elaboration from the Reuters League Tables in 2007 (Reuters Staff, 2007).

It's important to state that these rankings are previous to the GFC since the CDO market liquidity has significantly decreased and market shares may vary nowadays. (Reuters Staff, 2007).

### 3.4.5 Insurers/Guarantors

The CDO insurers are tasked with the mandate of providing credit enhancement facilities to the structured product. Credit enhancement serves as a cushion that absorbs potential losses from defaults on the underlying loans and is frequently used only on the most senior tranches (Chen, 2020).

One of the main types of credit enhancement techniques used in the CDO is the subordination process which has already been discussed in this bachelor thesis. The second most popular modern credit enhancement technique is called over-collateralization.

Over-collateralization is a technique that involves ensuring that the total value of the assets in the underlying pool exceeds the total value of the bonds issued. This helps to protect investors from defaults and late payments on the underlying loans, as the excess collateral can be used to cover missed payments and ensure timely principal and interest payments. In order to improve the credit profile and thus improve the credit rating of the CDO there must be around a 10% to 20% of over-collateralization (Will, 2023). Insurers can provide this much needed extra collateral in exchange for a recurring fee.

Another popular credit enhancement facility is a third-party letter of credit, which is a commitment granted by the insurer that offers a limited protection against losses on the underlying assets (FDIC, 2007)



Lastly, another credit enhancement technique utilized by guarantors is the Cash Collateral Account (CCA). This is a distinct account created to cover any deficiencies in interest or principal payments. Typically, an insurer funds the account through a loan, and its interests are paid back only after all bondholders have received their full repayment.

Guarantors are usually only used if the CDO's is using new types of assets in the structure or if the CDO manager has a short track record (Mandel, Morgan, & Wei, 2012). CDO insurers are typically large insurance companies with strong credit ratings that are willing to take on the risk of insuring the CDO's underlying assets (Fitch Ratings, 2006). Some of the largest CDO insurers include:

1. MBIA Inc.
2. Assured Guaranty Ltd.
3. Syncora Guarantee Inc.
4. Financial Security Assurance Holdings Ltd.
5. Ambac Financial Group Inc.

### 3.4.6 Rating Agencies

Rating agencies play a crucial role in CDOs by evaluating and assigning credit ratings to the various tranches of the CDO based on the underlying assets. The rating agencies assess the creditworthiness of the underlying loans and securities and assign ratings based on the probability of default and the expected loss in the event of a default. These ratings are important as they determine the risk and return profile of the CDO and help investors make informed investment decisions. The rating agencies also provide ongoing monitoring and surveillance of the CDO's credit quality and may adjust the ratings if there are changes in the underlying assets or other factors affecting the credit risk of the CDO (Financial Stability Board, 2010).

Additionally, the rating agencies assess and approve the legal of the CDO and conduct thorough due diligence analysis on the asset manager. Typically, two or three of the major rating agencies such as Moody's, S&P, and Fitch, are involved in rating the debt of CDOs.

Rating agencies are paid by the issuers of CDOs. This has been criticized as a potential conflict of interest, as the rating agencies may be motivated to provide higher ratings in order to secure more business from issuers. During the GFC the rating agencies played a role in generating misinformation to investor giving high ratings to the bonds issued against the senior tranches while there were clear indications that the risk profile of said tranches was more similar to sub investment grade products. During the GFC The rating agencies initially assigned an AAA rating to approximately \$4.3 trillion worth of bonds. However, within a span of 18 months, these very same agencies subsequently downgraded these bonds to a level below investment grade (Mullard, 2012).

However, rating agencies have implemented measures to address this concern, such as increased transparency in their rating methodologies and independent oversight committees.

### 3.4.7 CDO Investors

Investors play a crucial role in a CDO as they provide the necessary capital to purchase the underlying assets and issue the CDO. They can also actively engage in the structuring process of a CDO in several ways.

Firstly, they can collaborate with the CDO manager to develop the investment strategy, which involves selecting the types of assets that will be included in the pool of collateral. Secondly, investors can negotiate the terms and conditions of the CDO, such as the size of the equity tranche, fee structure, and credit enhancement mechanisms. They can also participate in the due diligence process, evaluating the creditworthiness of the asset manager, analyzing the risk of the transaction, and assessing the quality of the assets that will be included in the CDO.

Moreover, investors play a role in the ongoing management of the CDO, they can monitor the performance of the CDO by reviewing periodic reports and disclosures from the CDO manager and then may choose to sell their investments or reinvest in other tranches based on their risk tolerance and investment goals. They may also have the right to vote on changes to the CDO's legal and structural documents.

CDO investors are frequently institutional investors such as pension funds, insurance companies, and hedge funds. It is rarer to find individual investors among their institutional peers in CDOs due to their very limited access to these sophisticated products. Some of the largest institutional investors in the world, such as BlackRock, Vanguard, and State Street, are likely to have significant exposure to CDOs and other structured finance products, either through direct investments or through investments in funds that hold these securities.

## 4 From CDO to CLO

In this section will briefly explain why the CDO market transformed and why the CLOs now dominate the structured finance sector.

CDOs and CLOs are both types of structured financial products that gained popularity in the early 2000s. However, their popularity took different paths during and after the global financial crisis of 2008. Despite its major popularity prior to the GFC, currently, the CDO is seen as a toxic product and this has meant that no party wants to get involved in the issuance, management, or purchase of CDOs (Tuckman, 2016).

The downfall of CDOs can be attributed to the Subprime Mortgage Crisis. The CDO market, especially synthetic and hybrid ones, were heavily exposed to subprime mortgages, which were loans given to borrowers with poor creditworthiness. As the U.S. housing market collapsed and the default rates on subprime mortgages surged, the value of CDOs plummeted (Jarrow, 2011). This triggered a chain reaction across the financial system, causing significant losses for investors and financial institutions. After the housing and financial markets recovered it was clear to issuers, investors, managers and regulators that the CDO financial model induced too much leverage and exposure to mortgage

defaults.

In addition, the lack of transparency and complexity of CDOs made it challenging to assess the true risks associated with these instruments. Many investors, including large financial institutions, were not fully aware of the underlying assets within CDOs and their vulnerability to a housing market downturn. The lack of transparency contributed to the widespread underestimation of risk and magnified the impact of the crisis.

Moreover, regulatory changes following the financial crisis were implemented to enhance the oversight and stability of the financial system. The Dodd-Frank Act was the reform that affected the most to the CDO, it imposed stricter regulations, which are discussed in more detail later, on all types of structured finance products. However, CDOs model of subprime collateralization became impossible to sustain but CLOs model did not become obsolete. These reforms, coupled with the negative reputation of CDOs, led to a decline in their issuance and a shift towards other structured products like CLOs (Bord, 2012).

CLOs have experienced a different trajectory since the financial crisis and by the 2010s it became a trillion-dollar industry (Jonathan Beaverstock, 2021). This success can be attributed to several factors like a stronger underwriting standard. Compared to the subprime mortgage market, corporate loan underwriting standards have generally been stricter. As a result, the default rates on corporate loans have been low as this project will analyze after. This relative stability has made CLOs more attractive to investors seeking higher yields with lower risks.

It's important to note that while CLOs have experienced a rise in popularity, they are not without risks. As with any investment, CLOs carry their own set of challenges, including credit risk, liquidity risk, and potential market volatility.

## **5 Collateralized Loan Obligations (“CLO”)**

### **5.1 CLO’s Description**

A CLO is a type of CDO that pools together a group of loans and uses them as collateral to issue bonds to investors. CLOs are typically created by banks or other financial institutions, which gather together a portfolio of loans, often leveraged loans or high-yield bonds, it does not use any other type of security as cash-flow generating asset (Segal, 2023).

CLOs are usually used for both balance sheet reduction and arbitration, and there are usually True Sale and Cash-Flow CLOs. It is rare to find Market Value CLOs since the mark to market approach was proven to be highly rigid and risky during the GFC. In addition, Synthetic and Hybrid CLOs were never structured for their lack of transparency, levels of leverage and complicated exposure to the global economy and other financial instruments.

CLOs have become increasingly popular in recent years as a way for investors to gain exposure to the leveraged loan market, which is a segment of the debt market that provides financing to companies with high levels of debt or lower credit ratings (Trant, 2023).

## 5.2 CLO Specific Lifecycle

In this section the specific characteristics that have made the CLO a viable product in modern markets will be analyzed. Even though CLOs are a subcategory of CDOs they have specific traits and characteristics in the product's structuring process and lifecycle as depicted in *Figure 6* by the boxes with a different background color. In contrast to other CDOs, CLO's lifecycle has four different additional phases. The Warehousing, the Ramp Up and the Management phase which splits in two.

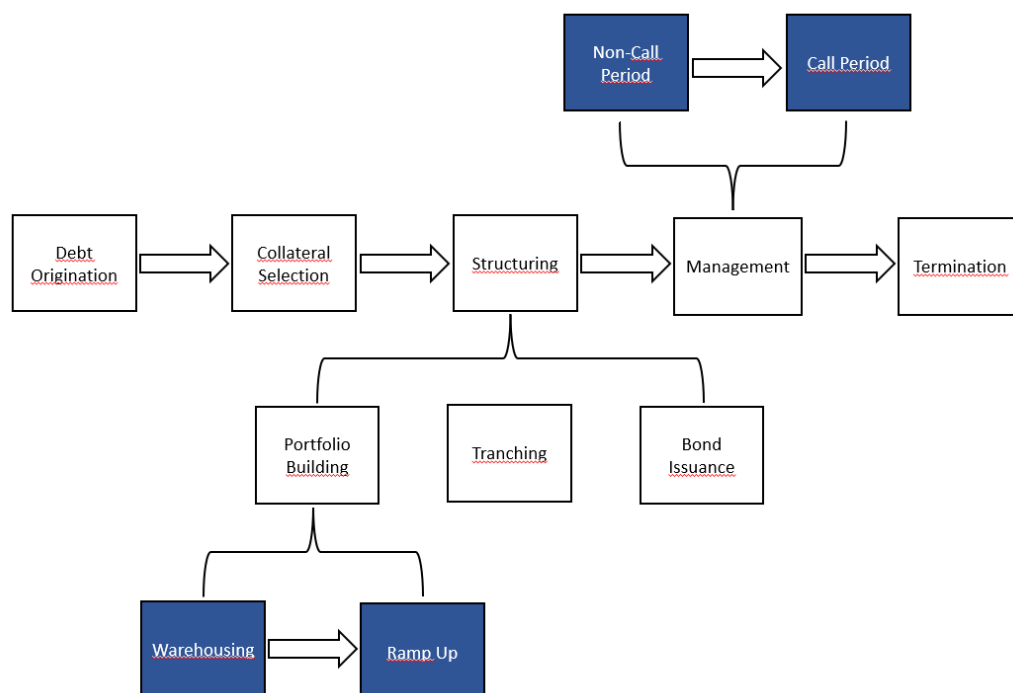


Figure 6 CLO Specific Lifecycle

Source: Own elaboration from CLOI: Question and Answer, VanEck, 2022 (Sokol, 2022)

The Warehousing phase occurs because most of the CLOs are not fully financed when the asset acquisition phase begins. This extra phase happens only when the asset seller is not the same financial institution as the CLO manager and the CLO issuer and it usually starts at the same time as the origination phase begins.

During the warehousing phase the manager need to obtain short-term financing for acquiring the corporate loans prior to the launch of a CLO, it is common for the CLO manager to arrange a credit facility with a bank, typically the underwriter for the upcoming CLO (Cho, 2013). This process length is very deal specific depending on the loan availability and market liquidity. Afterwards, the CLO manager starts purchasing the assets, which are typically held in a warehouse account until the desired amount is accumulated, following which they are moved to the corporation or trust formed for the CDO. The warehouse facility is normally paid back with the proceeds from the CLO's bond issuance.

After the warehousing process and the structuring phase have ended (closing date), in a CLO, the Ramp Up phase begins. In this phase the CLO manager has

the ability to continue purchasing assets with the extra proceeds from the bond issuance. The Ramp Up period usually lasts six months, the deadline after which the CLO will “go effective” and the CLO manager will focus from building the portfolio to monitoring it and making the due adjustments (Guggenheim Investments, 2022).

This phase will only occur if the manager has not achieved the portfolio characteristics it desired (maturity, return, size, credit rating, etc.) or if the CLO has not reached a target nominal size. It is worth noting that by the closing date, most CLOs have been able to structure a complete portfolio. In addition, Ramp Up periods can also be included if the targets are reached but just in case the CLO manager desires to increase the CLO size during that period to attract more investors or to furtherly reduce the balance sheet of the asset seller.

Lastly, during the management phase of the CLO there is a reinvestment period which is not common in other types of CDOs. At this stage the manager is permitted to trade the portfolio of loans actively and reinvest principal cash flows into other assets that they see fit to enter the portfolio. This phase usually lasts five years and it has two stages. The non-call period lasts from 6 to 24 months and the call period lasts until the end of the phase (Johnson, 2013).

During the non-call period the CLO manager is prohibited from redeeming or refinancing the CLO securities. This means that the manager cannot call back or retire the securities during this period.

The non-call period is typically designed to provide investors with a stable source of income and to ensure that the CLO remains fully invested in the underlying loans. During this period, the collateral manager is focused on managing the portfolio of loans and generating cash flows to pay interest and principal on the CLO securities.

Once the non-call period expires, the CLO issuer may have the option to refinance the CLO or call back the securities during the second stage of the reinvestment period, subject to certain conditions and limitations outlined in the offering documents (Corporate Finance Institute, 2022)

Following the end of the reinvestment period, the CLO moves into the amortization phase, during which the collateral manager is prohibited from reinvesting principal cash flows. Instead, the manager must use the cash flows to reduce the outstanding CLO notes. However, there are certain exceptions, as most CLO transactions allow the reinvestment of proceeds from unscheduled prepayments and sales of certain at-risk assets. It's worth noting that there are additional restrictions on the types of assets that can be purchased during the amortization period (Katzenstein, 2020).

### 5.3 CLO Development (CLO 1.0, 2.0 and 3.0)

The terms CLO 1.0, CLO 2.0, and CLO 3.0 are used to describe different generations or versions of CLOs that have evolved over time in response to changes in the market environment, regulations, and investor preferences. The ages in CLO terminology are called “vintages”.

### 5.3.1 The CLO 1.0 (1990-2010)

The CLO 1.0 era refers to the period when CLOs were issued prior to the GFC in 2008. CLO 1.0 is the traditional version of CLO that originated in the 1990s. These structures usually consisted of only one tranche of debt and were mainly invested in loans issued by corporations with significantly low credit ratings. Collateral managers had few limitations on the type of loans they could include in the portfolio, and the documentation was less stringent. This resulted in over exposure to a certain type of loans, companies, and sectors with very thin risk management. The overall principal amounts were also relatively low compared to CDOs that were backed by subprime mortgages. (Credit Suisse, Credit Investments Group, 2021) Although CLO 1.0s faced losses during the GFC, tighter regulations and greater transparency requirements were introduced. However, despite the high default rates in CLO portfolios, the vast majority of CLOs not only survived the crisis but also performed well.

### 5.3.2 The CLO 2.0 (2010-2014)

After the financial crisis a newer version of CLOs emerged called CLO 2.0. All the CLOs that were issued between 2010 and 2014 adhered to the new regulation imposed after the GFC are grouped as CLO 2.0. This second vintage of CLOs is more complex and has more stringent documentation and investor protections. CLO 2.0s typically have several tranches of debt with different levels of risk and return and are more diversified across a range of loan types and industries. CLO 2.0 also has shorter non-call periods and reinvestment periods (Deloitte UK, 2013).

CLO 2.0 employs advanced risk management techniques such as stress testing, overcollateralization testing, and conservative assumptions. The CLo2.0 structure contains several internal tests that are conducted for all tranches before any payment is made to noteholders. These tests aim to improve the alignment between assets and liabilities and test the structure's ability to meet its commitments to interest payment and principal repayment.

The two main types of tests are distinguishable based on their impact on the waterfall of payments. The coverage tests, including Overcollateralization (“OC”) and Interest Coverage (“IC”) tests, are typically conducted for all tranches. The Interest Diversion (“ID”) test is generally done only for the most junior rated tranche. If coverage tests are breached, the priority of payments is adjusted, and available cash is used to pay down the rated tranches sequentially. (Lu, 2021) When the IDT is breached, a portion of the excess interest that was supposed to be paid to the equity tranche is redirected to reinvest in collateral or repay the rated tranches until the test is satisfied.

The OC Ratio test is the amount by which the collateral's par amount must exceed the total par amount of the issued notes. Overcollateralization is usually expressed as the following ratio:

$$OC\ Ratio = \frac{Par\ Amount\ of\ Assets}{\sum\ Outstanding\ amount\ of\ related\ tranche\ and\ all\ tranches\ senior\ to\ it}$$

The IC Ratio is the ratio of the total interest payments collected from the pool of

assets to the interest due on each tranche and all tranches senior to it in the priority of payments.

$$IC\ Ratio = \frac{Interest\ Collected - Fees - Expenses}{\sum Interest\ due\ on\ related\ tranche\ and\ all\ tranches\ senior\ to\ it}$$

The Interest Diversion Ratio Test (“ID Ratio”) is calculated only for the most junior rated tranche with the same formula as the OC. However, the IDT trigger is lower than the one used for the OC test on the same tranche.

$$ID\ Ratio = OC\ Ratio$$

The *Figure 7* depicts the most commonly applied triggers values in the CLO 2.0

Rating	Euro CLO 2.0				US CLO 2.0			
	% of total	OC Trigger	IDT Trigger	IC Trigger	% of total	OC Trigger	IDT Trigger	IC Trigger
AAA	57	128.00%	-	120.00%	62	121.60%	-	120.00%
AA	13	128.00%	-	120.00%	14	121.60%	-	120.00%
A	6	119.60%	-	115.00%	7	113.50%	-	115.00%
BBB	5	112.80%	-	110.00%	5	108.60%	-	110.00%
BB	5,5	106.70%	-	105.00%	4	104.70%	105.70%	105.00%
B	2	103.61%	104.11%	-	0	-	-	-
Equity	11	-	-	-	8	-	-	-

Figure 7 Euro and US Coverage and Interest Diversion Test Triggers

Source CLO 2.0 Mechanism, modelling and management, NATIXIS Asset Management, (Pistre)

Rating agencies are also more skeptical when evaluating the portfolio tranches and assessing the default probabilities, making CLO 2.0 much safer than CLO 1.0 without decrementing the financial instrument’s attractiveness to investors. CLO 2.0s are designed to be more resilient in the face of market downturns and to provide investors with greater transparency and protection.

### 5.3.3 The CLO 3.0 (2014 Onwards)

The CLO 3.0 vintage represents the latest generation of CLOs, that date from 2014 to the current year 2023. CLO 3.0 aims to address some of the remaining concerns around transparency and risk management (Bennett, 2020). They have more conservative leverage ratios, stricter concentration limits, and more frequent testing and reporting requirements.

The Volcker rule is a specific measure that was passed after the GFC and entered into effect in the US, the largest CLO market, on April 1<sup>st</sup>, 2014, and that had a great impact on CLOs requirements. “The Volcker rule generally prohibits banking entities from engaging in proprietary trading or investing in or sponsoring hedge funds or private equity funds” (Office of the Comptroller of the Currency (“OCC”), 2020). Proprietary trading is the practice of banks using their own funds to trade securities, derivatives, or other financial instruments for their own profit, rather than on behalf of their clients. However, banks can still engage in trading activities that are conducted on behalf of their clients, such as market-making

(selling and buying securities and providing liquidity for their clients) and underwriting (issuing securities to the market) (Duffle, 2012).

The Volker rule affects CLOs since restricts banks investing in CLOs. These products can be considered potentially proprietary positions and hedge funds. For example, if a bank acts as asset seller, issuer and CLO manager, taking large positions in the CLOs tranches and it trades with the CLO in order to increase their return, this can be considered proprietary trading (Nabilou, 2017). Also, if a CLO invests in certain risky assets with low diversification, it can be considered a hedge fund.

Thus, in order to remain in the market, banks had to limit their ownership of the equity and tranches of the CLOs. Specifically, banks cannot own more than 3% of the total equity in a CLO, or more than 3% of the total outstanding principal amount of any individual tranche of a CLO (Alison, 2011).

In addition, CLOs asset mix had to be adapted to a more conservative portfolio of leveraged loans, with larger diversification across regions and industries in order to not be considered as hedge funds and banks could sponsor and invest on them. Specifically, the eligibility criteria that the loans must meet are:

- They must be made to non-affiliates of the bank.
- They must be senior, secured loans that are not subordinate to any other loans.
- They must not be in default or 30 days past due of payments.
- The issuer of the loans must have made all required payments of principal and interest on the loans for the previous six months.

The result is that CLO 3.0s are also more likely to invest in middle-market loans, banks only invest in the more senior tranches and CLO 3.0 structurers require managers to retain a minimum of 5% of the value of some tranches of the CLO on their balance sheet (Kollmorgen, 2022).

It is important to state that many reliable sources of information used in this project do not differentiate between CLO 2.0 and 3.0 since there have been amendments to the Volcker rule and its implementation is not fully complete. Thus, for now onwards if there is no differentiation between the CLO 2.0 and 3.0 in the analysis is because of that reason. This project will work under the assumption that when CLO 2.0 is mentioned it also includes the 3.0 vintage unless explicitly stated.



## 5.4 CLO 2.0/3.0 Specific Debt Composition

Since one of the main differences between a standard CDO and a CLO, and the major reason why the CLO not only survived the GFC, but has become popular in recent years, is the fact that the underlying collateral are leveraged loans rather than subprime mortgages it is worth making an analysis of the CLOs specific debt composition.

CLOs are composed of senior secured corporate loans from small and medium sized companies, that usually have a large level of debt or leverage compared to their assets and/or profit-making ability.

A loan is considered a senior secured loan, or a first-lien loan if it is granted two specific characteristics. First, if it has to have a first priority claim on the assets of a borrower in the event of default or bankruptcy. Second, it has a higher priority of repayment compared to other types of debt in the capital structure (Hayes, Senior Debt: What It Is, Why It's Less Risky, 2020).

A company is considered a leveraged company if its level of debt compared to other companies in the industry is high, this will vary depending on the industry, and size of the company. Investor professionals guide themselves by the credit risk rating issued by the credit agencies to determine if a company is leveraged or not. It is usually considered that a company that has under investment grade rate is a leveraged company.

### 5.4.1 Asset Composition by Credit Risk Rating

Since CLO's assets are comprised of leveraged loans emitted by leveraged companies, the loans have credit risk ratings under the investment grade of  $\leq$ BBB. It is important to note that as seen in *Table 3* there is a clear correlation between the default probability and the credit risk rating.

*Table 3 Relationship Between Default Rate and Credit Risk Rating*

<b>Global corporate average cumulative default rates by rating modifier (1981 - 2017)</b>										
Credit rating	Time horizon									
	1	2	3	4	5	6	7	8	9	10
AAA	0.00	0.03	0.13	0.24	0.35	0.46	0.51	0.60	0.65	0.71
AA+	0.00	0.05	0.05	0.10	0.16	0.21	0.27	0.33	0.39	0.45
AA	0.02	0.03	0.08	0.22	0.36	0.48	0.61	0.72	0.81	0.91
AA-	0.03	0.09	0.18	0.25	0.33	0.45	0.52	0.57	0.63	0.69
A+	0.05	0.09	0.20	0.34	0.45	0.55	0.66	0.79	0.93	1.08
A	0.06	0.15	0.24	0.36	0.49	0.68	0.86	1.03	1.23	1.47
A-	0.07	0.17	0.28	0.40	0.57	0.74	0.98	1.16	1.30	1.42
BBB+	0.11	0.31	0.53	0.77	1.03	1.32	1.54	1.78	2.04	2.30
BBB	0.17	0.43	0.68	1.05	1.42	1.80	2.15	2.49	2.85	3.23
BBB-	0.25	0.77	1.39	2.11	2.84	3.50	4.09	4.65	5.11	5.53
BB+	0.34	1.11	2.02	2.94	3.86	4.74	5.50	6.05	6.70	7.33
BB	0.56	1.71	3.38	4.94	6.52	7.77	8.89	9.85	10.75	11.53
BB-	1.00	3.13	5.37	7.66	9.66	11.62	13.24	14.80	16.04	17.12
B+	2.08	5.71	9.23	12.21	14.53	16.33	17.98	19.43	20.77	21.97
B	3.60	8.29	12.29	15.46	17.89	20.15	21.66	22.76	23.77	24.81
B-	7.15	14.28	19.62	23.37	26.18	28.31	29.99	31.13	31.84	32.40
CCC/C	26.82	36.03	41.03	43.97	46.22	47.13	48.33	49.23	50.08	50.71
Investment grade	0.10	0.26	0.45	0.68	0.92	1.17	1.40	1.61	1.82	2.03
Speculative grade	3.75	7.31	10.39	12.90	14.95	16.64	18.05	19.23	20.27	21.21
All rated	1.50	2.95	4.22	5.29	6.18	6.94	7.57	8.12	8.60	9.05

## Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

Source: *SPGI Investor Fact Book Ratings*, (S&P Global Ratings, 2021)

As it can be seen in [Figure 8](#) CLOs are comprised mainly of B and B- rated companies which form 30% and 29% of the CLOs balance sheet respectively.

### Rating Distribution For Assets In Reinvesting U.S. BSL CLOs (2017-Q3 2022)

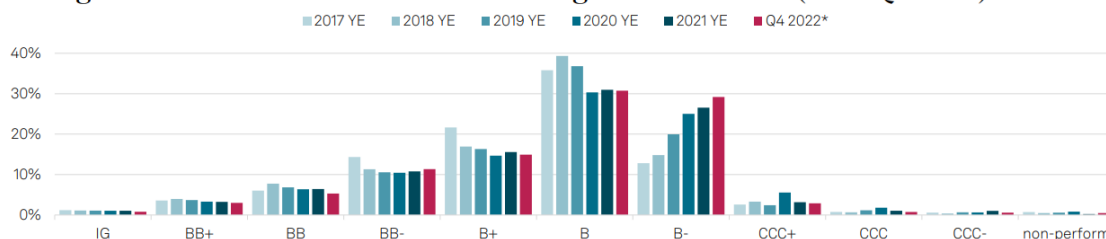


Figure 8 Rating Distributions in CLOs

Source: U.S. BSL CLO And Leveraged Finance Quarterly: Is Winter Coming? By S&P Global Ratings (S&P Global Rating, 2022)

It can also be seen a clear trend of an increase in the amount of B- rated companies since 2017 from barely 12% to 29% at the expense of BB- loan representation from 15% to 10%, B+ loans that have gone from 22% to 15% and B loans that have reduced their weight in 5% in the last 5 years.

This could result in an increase of defaults and larger loses in some CLO tranches, which is an increased risk that must be compensated with extra returns somehow if the product wants to remain popular.

## 5.4.2 Asset Composition By Sector

When it comes to asset composition per sector CLOs have great exposure to Industrials (22%), Information Technology (17%), Consumer Discretionary (14%), Healthcare (12%) and Communication Services (12%) as depicted in [Figure 9](#).

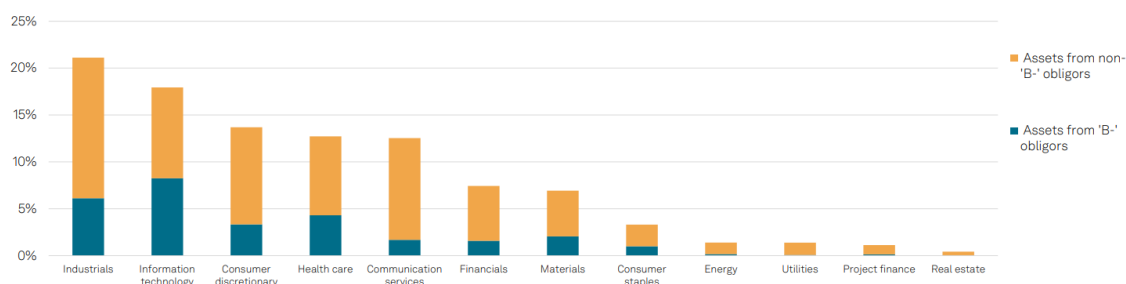


Figure 9 CLO Exposure to Different Industries

Source: U.S. BSL CLO And Leveraged Finance Quarterly: Is Winter Coming? By S&P Global Ratings (S&P Global Rating, 2022)

Since there is not enough information about leveraged loan universe distribution per industry it is also possible to use the US S&P small cap index to compare it to the distribution of the CLOs assets. The distribution of companies in the major sectors is depicted in [Figure 10](#) in the yellow color for the small caps, which are medium companies that trade on the US stock market and are comparable to leveraged companies.

## Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

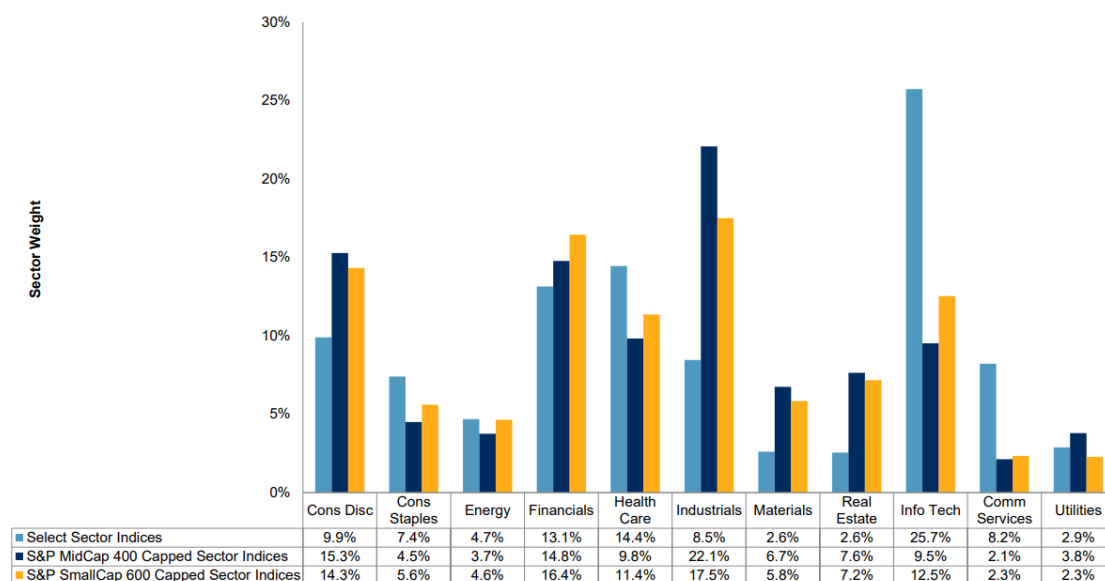


Figure 10 S&P Industry Distribution

Source: Key Highlights for 11 Select Sectors (Cboe, 2019)

As is observable the Industrials and Information Technology sector are overrepresented in the CLO assets compared to the broader medium sized companies in the US by a 5% and a 3% respectively. In addition, Communication Services is overrepresented by 10%. On the other hand, Energy and Financials are the ones that are more underrepresented in CLOs compared to the broader market by -3% and -10% respectively.

These discrepancies can be due to either the preference of CLO issuers for some industries against others or, the most probable one, small leveraged companies are concentrated in Communication Services, Information technology, and Industrials while it is more difficult to find leveraged companies in the Energy and Financial industries.

Regardless of the reasons of this slight over or under representation of certain industries it is important to mention that the top 5 industries by weight represent over 70% of all CLO assets, and they are these specific industries the ones with the lowest credit ratings. In conclusion, it is observable that there is an acceptable level of diversification, but that there is a concentration in the industries that are riskier. CLOs might benefit from including loans from companies in the Energy, Utilities, Project Finance and or REIT sectors to further improve diversification and lower the average credit risk rating.

### 5.5 CLO Market Development and Characteristics

In this section of the bachelor's thesis and to finalize the CLO exposition it is convenient to perform an in-depth analysis of the different traits the CLO market has and how it has evolved in recent years.

#### 5.5.1 Market Size

Starting with the market size of the CLO will clarify the relevance that the product

## Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

has gained an will allow for a better understanding of why CLOs can be a significant tool in the future of the financial industry.

In *Figure 11* and *Figure 12* it can be seen the evolution of the aggregated principal between CLO 1.0, 2.0 and 3.0 in the USA from the third quarter of 2012 until the last quarter of 2022.

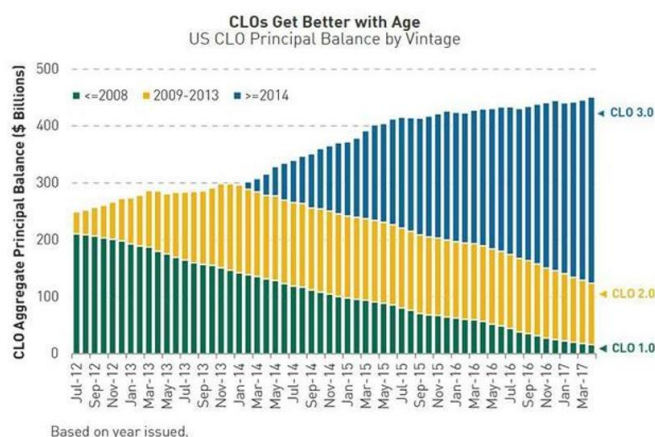


Figure 11 US CLO Principal Balance Amounts by Vintage (2012-2017)

Source: Thompson Reuters LPC Collateral as of 30 April 2017

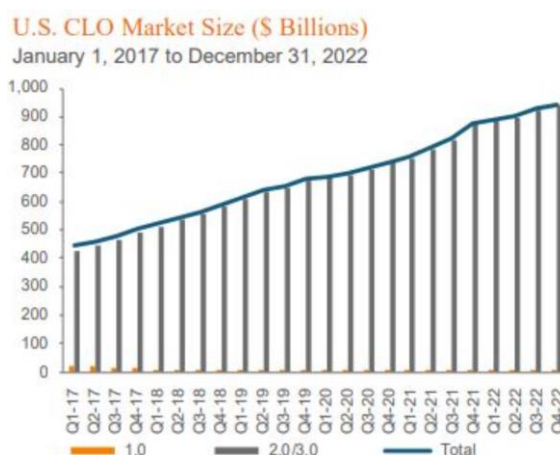


Figure 12 US CLO Principal Balance Amounts by Vintage (2017-2022)

Source: CLO and Loan Market Commentary – 4Q 2022 (VOYA, 2023)

In the last 10 years the US CLO market has grown from 250 billion (“BN) dollars to 900BN dollars, which represents a 13.67% Compound Annual Growth Rate (“CAGR”). CLO global market has surpassed the 1 trillion dollars in aggregated principal, split 80% US and 20% European CLOs. Focusing on the US market, it is posed to keep growing at this rate for the foreseeable future, meaning that it will double its size every 5 years and a quarter. At this size CLOs cannot be ignored by investors who must learn how to better utilize them to maximize returns, also, asset sellers must enter the market to profit from this trend (Cshie, 2021).

US CLO 1.0 weight in the market was negligible by 2017 and by Q4 2022 represents less than 0.1% of the total market value of the asset class. CLO 2.0

market share stagnated by 2014 and since then it has been reduced over time, due to assets amortization in the CLO 2.0 structures (Cordell, Roberts, & Schwert, 2021). Meanwhile, CLO 3.0 has gained weight in the market, by 2017 CLO 3.0 represented over 55% of the total US CLO market share. It has increased to dominate 2022 current market with the most significant influence over the new issuance.

### 5.5.2 New Issuance

The rapid growth of CLOs as an asset class has only been possible thanks to a large issuance rate as depicted in *Figure 13*. That is why it is sensible to study how and why new issuance rates have worked in the last years.

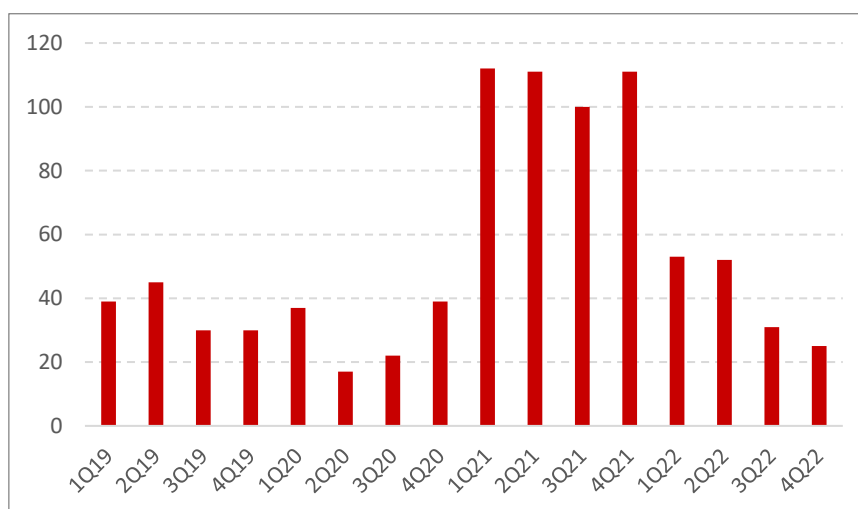


Figure 13 Quarterly US CLO Issuance

Source: Own elaboration from U.S. BSL CLO And Leveraged Finance Quarterly: Is Winter Coming? (Anderberg, 2022)

In the last four years there are two trends, prior to 2021 and during and after 202. Prior to 2021 as depicted in *Figure 13* there is a normalized issuance of around 35BN dollars and a decreasing trend coming into 2020 due to covid. Afterwards, in 2021 issuances per quarter multiply by 2.5 times to a 100BN per quarter level followed by a rapid decrease.

During 2022 quarterly CLO issuance has remained well above the series median of 39 BN dollars per quarter in the last two years. However, it has come down to a more standard level in the last half of 2022 due to a tighter credit and macroeconomic environment. Despite this, 2022 was the second largest year in the historical series of US CLO issuance.

The resilience shown by the market to harsh macroeconomic events like Covid and the tightening of the credit environment shows that there is a high demand for the product due to attractive spreads backed by a large supply of leveraged loans.

### 5.5.3 Leveraged Loans

In this section there is an explanation of what are leveraged loans and how its

market has grown and developed, which in turn has helped boost CLO new issuance rate.

The distinguishing feature of a leveraged loan is the high level of leverage, which refers to the borrower's substantial debt relative to their assets or cash flow. The borrower's creditworthiness and credit rating is typically assessed based on factors such as their debt-to-equity ratio, cash flow generation, and overall financial health. In addition, leveraged loans are typically senior secured debt, meaning they have a higher priority in the repayment hierarchy in the event of default. They are often backed by specific collateral or assets of the borrower (Corporate Finance Institute, 2023). As seen in *Figure 14* leveraged loans are issued to companies with high levels of debt or a poor credit rating.

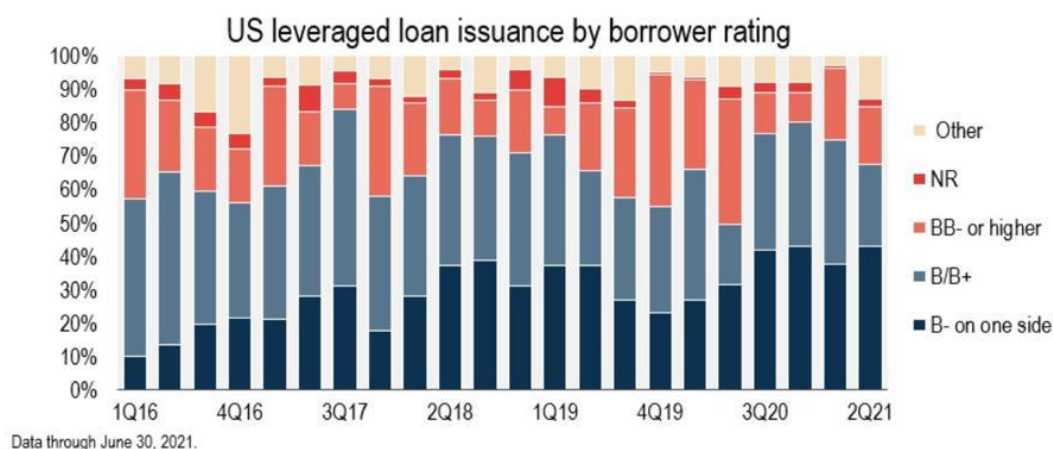


Figure 14 US Leveraged Loans Issuance

Source: The U.S. Leveraged Finance Market Is At A Record \$3 Trillion, Forbes (Valladares, 2021)

It can be appreciated that the leveraged loan market has evolved over the last few years and more companies rated on the lower spectrum of the credit rating are accessing the capital markets.

Leveraged loans are typically used to finance mergers and acquisitions, leveraged buyouts, corporate activities that involve significant debt, refinancing other debt, dividends recapitalizations and project finance. They are often provided by banks or institutional investors and are usually secured by the borrower's assets or collateral (Kenton, 2022). M&A activity has grown in the last decades and the trend is posed to continue in the foreseeable future as seen in *Figure 15* As long as M&A activity keeps growing the leveraged loan market will continue to grow in order to support the ever-increasing number of deals.

## Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

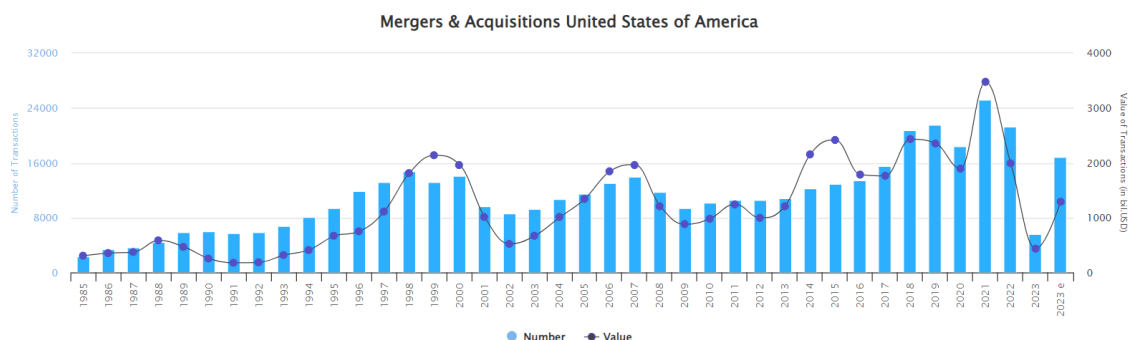


Figure 15 M&A Activity in the USA

Source: United States - M&A Statistics by Institute for Mergers Acquisitions & Alliances (IMMA, 2023)

As shown in *Figure 16* leveraged loans market has grown exponentially in recent years. This growth has helped fuel the CLO market with loans to supply the structuring of the products.



Figure 16 US Leveraged Loans Market

Source: Old-School Leveraged Loan Market Is Bigger Than Ever by Bloomberg (Bloomberg, 2022)

### 5.5.7 Investors

The second lever that has boosted the CLO market comes from an increasing level of demand from investors. In this section it is explained who are the investors that have become interested in the CLO market, lured by high spreads in relationship with default rates and recovery rates which are analyzed in the following sections.

As studied in *Figure 22* the large majority of CLO investors are insurance companies, commercial banks and mutual funds in terms of total holdings.

## Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

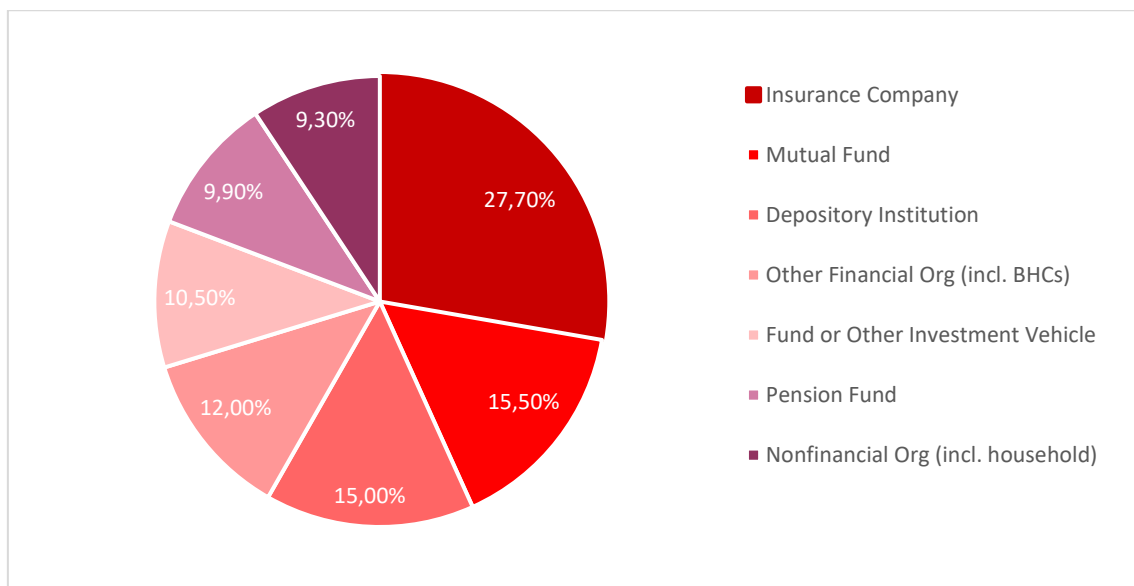


Figure 17 CLO Total Holdings By Investor type

Source: Own Elaboration from Board of Governors of the Federal Reserve System Who Owns U.S. CLO Securities? An Update by Tranche (Liu & Schmidt-Eisenlohr, 2019)

Institutional investors and banks, represented in the different shades of red and pink, hold 80.8% of the U.S. CLO securities outstanding. The largest investors in this market are Insurance Companies (27.7%), Mutual Funds (15.5%) Commercial Banks & Credit Unions (Depository Institutions) (15%). However, Pension Funds and the Other investors play a key role in the CLO market since they tend to take riskier positions in the CLO structure.

As depicted in [Figure 23](#) different CLO investors vary significantly in their preferences when it comes to investing in different tranches.

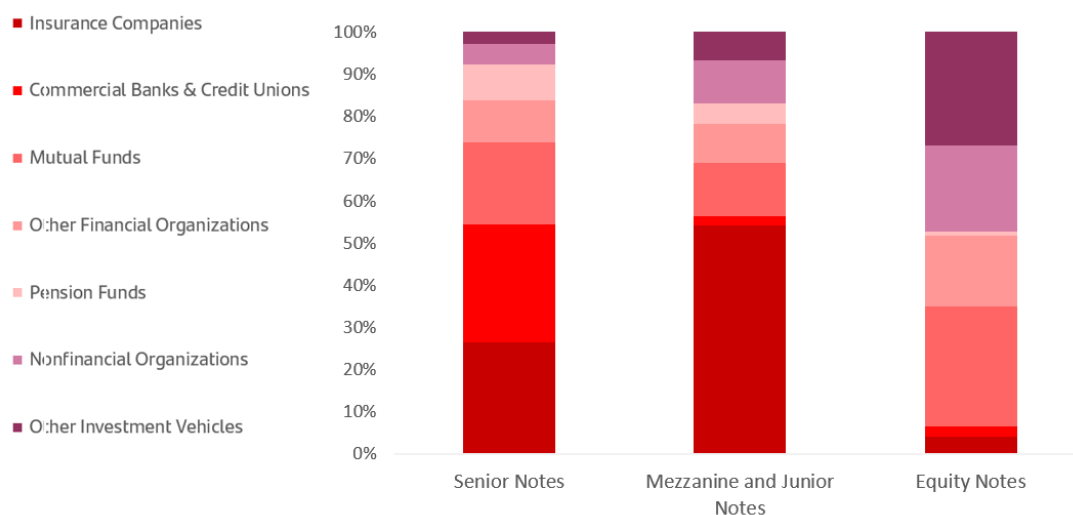


Figure 18 CLO Investors By Tranches

Source: Own Elaboration from Board of Governors of the Federal Reserve System Who Owns U.S. CLO Securities? An Update by Tranche (Liu & Schmidt-Eisenlohr, 2019)



Senior notes are highly attractive for institutional investors. That is the reason why over 70% of U.S CLO's Senior Notes outstanding are owned by these type of investors.

A surprising number of institutional investors hold large portions of the riskier tranches. Over 30% of the CLO Mezzanine and Junior Tranches are held by Mutual Funds and 50% are held by Insurance Companies.

Over 45% of the Equity Tranche is owned by NonFi. and smaller Inv. Vehicles (PE, HF, CLO Managers). As analyzed later a higher spread with a relative low default rate makes this CLO tranche fit with their risk appetite.

#### 5.5.4 Spreads

Seeking to profit from attractive spreads on the tranches investors have been attracted to the CLO as a relevant new asset class. In this section there is an explanation of what spreads are and how they compare in CLOs versus other financial products.

In financial terms, the spread refers to the difference between two prices, rates, or yields. It is commonly used to indicate the difference between the interest rate or yield on a particular security and the benchmark rate or yield. When issuing loans banks usually use the spread terminology in order to more clearly identify the extra net return that the investor is getting from the extra risk exposure compared to a risk-free investment.

Since the end of 2021 the most commonly used benchmark rate is called Secured Overnight Financing Rate ("SOFR"). SOFR is based on overnight transactions in the U.S. Treasury repurchase market, commonly known as the repo market. In this market, financial institutions and banks borrow or lend U.S. Treasury securities overnight, using these highly secure collateralized loans. They buy or sell U.S. Treasury securities for a period of time smaller than 24h in order to access or provide liquidity and the cost or premium of the transaction is introduced into the SOFR calculation.

The calculation of SOFR involves taking the volume-weighted median of overnight Treasury repurchase transactions cost. It reflects the cost of borrowing cash overnight, collateralized by U.S. Treasuries. This number is then regarded as the risk-free rate for the rest of the transactions during the day.

As seen in *Figure 17*, CLOs offer attractive spreads compared to other debt securities.

## Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

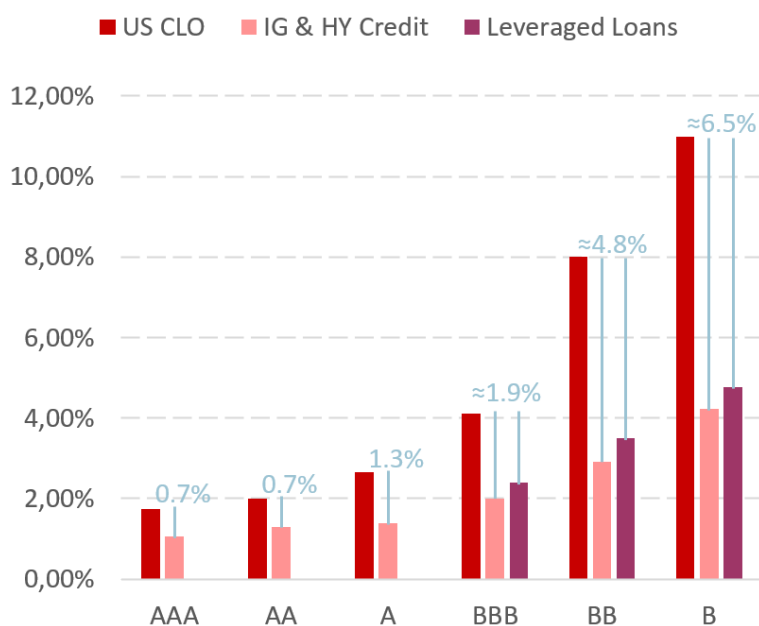


Figure 19 US CLO Spread Comparison

Source: Own elaboration from Cordell, L., Roberts, M. R., & Schwert, M. (2021). *CLO performance* (No. w29410). National Bureau of Economic Research.

This attractive spread level between the CLO tranches and other assets with similar risk rating level, is achieved thanks to the structuring process that has been explained in previous chapters, in addition with the high spread that leveraged loans that are rated lower than B offer. That is to say that the loan mix that is rated <B is enhancing the spread of all rated CLO tranches. The spread distribution from loans rated <B to the rated tranches is significant to an extent that all rated tranches have a larger spread than similarly rated debt products. This is achieved with no extra risk attached to them thanks to the subordination process and the inherent diversification found in the CLOS.

### 5.5.5 CLO Default Rates / Credit Risk

It is important to study the default rates in the CLO market, since it is the main factor that determines spreads and it allow investors to compare different assets based on the spread/default rate possibility relationship. The default rates are also key when it comes to the long term survivability of any type of asset.

As discussed in previous chapters, credit risk (default rate) is one of the main exposures that CDOs and CLOs face. This is due to the fact that fees and investor payment depend on the underlying loan repayment. However, defaults as shown in Table 4 are rare in CLOs as of the end of Q3 2022.

Table 4 US CLO Default Rate by Tanches

### U.S. CLO 1.0 And 2.0 Default Summary By Original Rating

	CLO 1.0 Transactions (2009 and prior)			CLO 2.0 Transactions (2010 and later)		
	Original rating(i)	Defaults(ii)	Currently rated(i)	Original rating(i)	Defaults(ii)	Currently rated(i)
AAA (sf)	1,540	0	0	3,463	0	1,508
AA (sf)	616	1	0	2,773	0	1,224
A (sf)	790	5	0	2,315	0	1,088
BBB (sf)	783	9	0	2,101	0	1,070
BB (sf)	565	22	0	1,710	3	879
B (sf)	28	3	0	378	8	180
Total	4,322	40	0	12,740	11	5,949

Source: U.S. BSL CLO And Leveraged Finance Quarterly: Is Winter Coming? By S&P Global Ratings (S&P Global Rating, 2022)

S&P Global Ratings has provided ratings for more than 16,000 U.S. CLO tranches since the mid-1990s. Their CLO ratings history encompasses the three recessions that have taken place in the 21<sup>st</sup> century. The dotcom bubble (2000-2001), the GFC, and the COVID-19 recession in 2020. However, the ongoing 2023 credit crunch is not yet considered and this might change the data in some significant level (S&P Global Rating, 2022).

During the period studied by S&P there have been no AAA tranches defaults and only 6 A and AA tranches default, and none since 2010. The more senior CLO tranches have proven to be a safe investment with less than 0.10% of them defaulting through three financial crises as show in Figure 18.

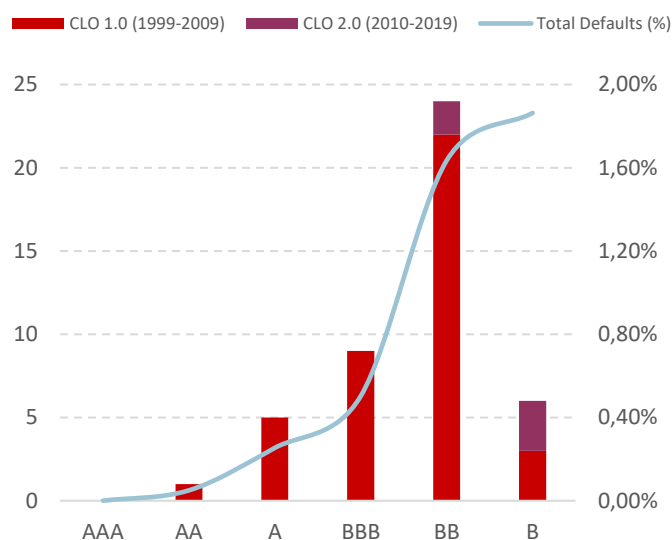


Figure 20 US CLO Default Rates Aggregated

Source: Own elaboration from U.S. BSL CLO And Leveraged Finance Quarterly: Is Winter Coming? By S&P Global Ratings (S&P Global Rating, 2022)

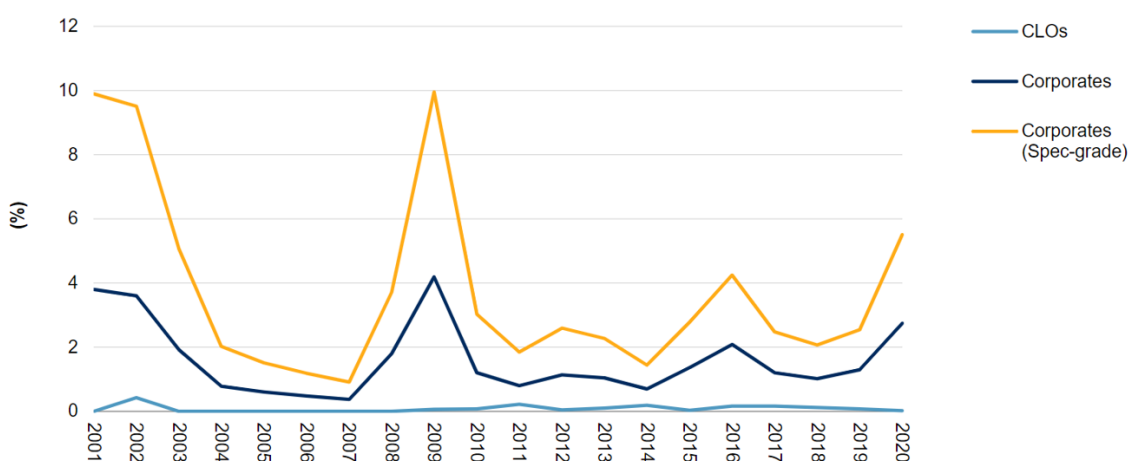
During the mentioned period, a total of 51 U.S. CLO tranches experienced defaults. Among them, 40 tranches were from CLO 1.0 transactions originated in 2009 or earlier, while the remaining 11 tranches were from CLO 2.0/3.0 transactions. This is a sign that the studied changes conducted to the CLOs after

the GFC have been effective in protecting investors from defaults in the tranches.

Furthermore, among five other CLO 2.0/3.0, there are four tranches rated CC that are likely to default, along with an additional two tranches rated CCC-. Additionally, there are 23 tranches currently rated CCC+ and four tranches rated CCC that have the potential to default if the companies economic outlook continues to worsen based on their assigned ratings (S&P Global Rating, 2022).

Overall CLOs, especially CLO 2.0/3.0 have been resilient product thanks to the subordination and diversification of the underlying loans. Even when compared to products that theoretically have the same risk profile, and ones like investment grade corporate bonds and loans, CLOs have had significantly lower default rates as per *Figure 19*.

**Annual Global Default Rates**  
CLOs versus corporates



*Figure 21 Default Rate Comparison Between CLOs and Corporate Debt*

Source: Understanding Collateralized Loan Obligations (CLOs) (Guggenheim Investments, 2022)

CLOs not only have had lower default rates through the 21<sup>st</sup> century but the product is much less sensitive to market conditions since the volatility in defaults is less severe than in investment grade corporate and sub investment grade corporate debt.

### 5.5.6 Recovery rate

In order to finalize with the investors perspective on how the CLO market has grown significantly it is important to understand what would happen if a CLO tranche defaulted. This is, what would the actual losses be for the tranche and how much could be recovered.

In the case of default on a loan or bond, the debt holders of a company and of the CLO tranches will take ownership of the assets that collateralized said loans in order to liquidate them and recover the maximum amount of their investments (Fitch Ratings, 2023).

When an investor decides to put money on an asset, the recovery rate is usually

expressed as a percentage of the principal or value of said investment or loan that is expected to be recovered in the event of default or loss. It represents the amount that creditors or investors can expect to receive from the borrower or issuer after the default or loss has occurred.

As shown in *Figure 20* in recent years, there has been a notable rise in loans categorized with a recovery rating of '3' and point estimates of either 50% or 55% recovery rate. Presently, these loans constitute approximately 37% of the overall CLO asset par, which is an increase from around 30% observed before the COVID-19 pandemic and up from about a 25% 5 years ago.

Recovery Ratings Distribution For Assets In Reinvesting U.S. BSL CLOs (2017-Q3 2022)\*

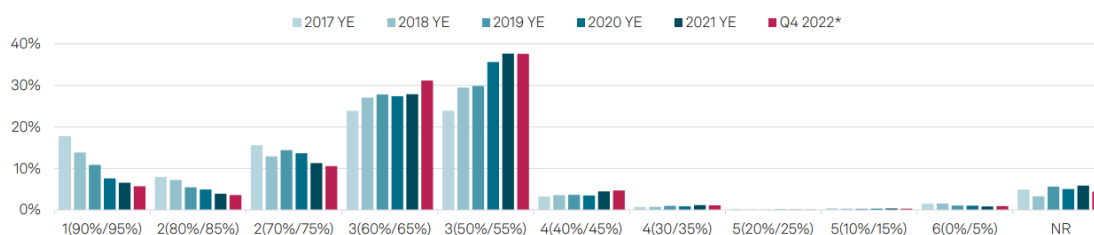


Figure 22 US CLOs Expected Recovery Rates

Source: U.S. BSL CLO And Leveraged Finance Quarterly: Is Winter Coming? By S&P Global Ratings (S&P Global Rating, 2022)

This trend is only natural since the asset mix in the CLOs has moved to riskier assets thus increasing the risk of larger or total losses in the event of default on either the CLO tranches or the underlying leveraged loans that comprise them.

Compared to recovery rates from similarly rated investments CLOs have a lower expected recovery rate. This means that even though the event of default in the CLO tranches is less likely it can be more severe than in other securities that have a similar risk profile.

As show in *Figure 21* leveraged loans (First Lien Loans) tend to have an average expected recovery rate of 70% and High yield bonds tend to have a recovery rate more on par with CLOs of 50%. It is also important to note that in more senior tranches CLOs recovery rates can be higher.

## Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

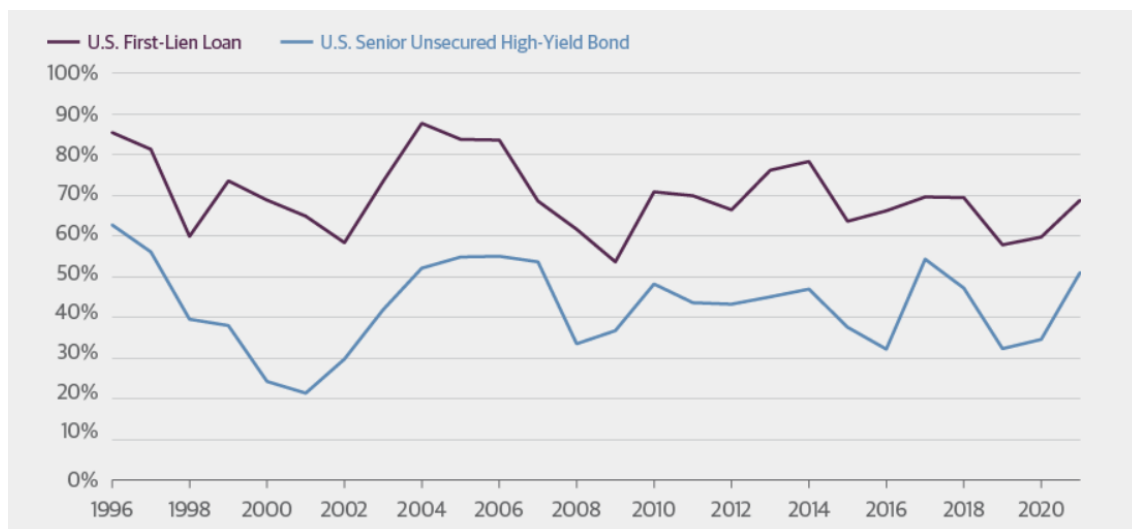


Figure 23 Leveraged Loans and High Yield Bonds Recovery Rates

Source: Understanding Collateralized Loan Obligations (CLOs) (Guggenheim Investments, 2022)

This recovery rate discrepancies between leveraged loans and the CLOs tranches can be attributed to the loan mix that composes the CLOs. A loan to a company with a sub investment grade rating is considered a leveraged loan, this can be the case with a loan extended to a company rated B or BB. Whoever, as seen previously, CLOs hold loans that have worst credit ratings, mainly in the B-range. Riskier loans have worst recovery rates on average thus giving the CLOs a worst recovery rate than leveraged loans on average.

### 5.5.8 ESG

The last factor from the CLO market that is significant to analyze is the ESG exposure that the products have since it has been a factor that has gained importance and popularity in recent years. In addition, the improvement of the environmental side of the ESG characteristics is one of the main issues this project aims to address (Attig, 2013).

#### *ESG Credit Indicators*

Before commenting on the current state of the CLO market in relation to ESG it is important to understand how the rating agencies classify companies and thus the loans granted to them. There is a large number of different methodologies ESG rating agencies have developed but this project will focus on the S&P grading system since it is one of the most renowned and respected. This is due to the fact that S&P rating does not solely rely on publicly available information, the scores are derived from a combination of verified company disclosures, media and stakeholder analysis, and comprehensive company engagement. Finally, it will focus on the S&P rating since the institution is one of the only that assesses and publishes CLOs ESG ratings.

S&P has developed a proprietary system that consists of 12 general qualitative factors that can be seen in [Figure 24](#) which can be modified and adapted for each industry. These are relevant factors that are considered to have a material impact on the companies' risk profiles, thus the ESG scores have a weight in the final

## Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

credit risk rating.

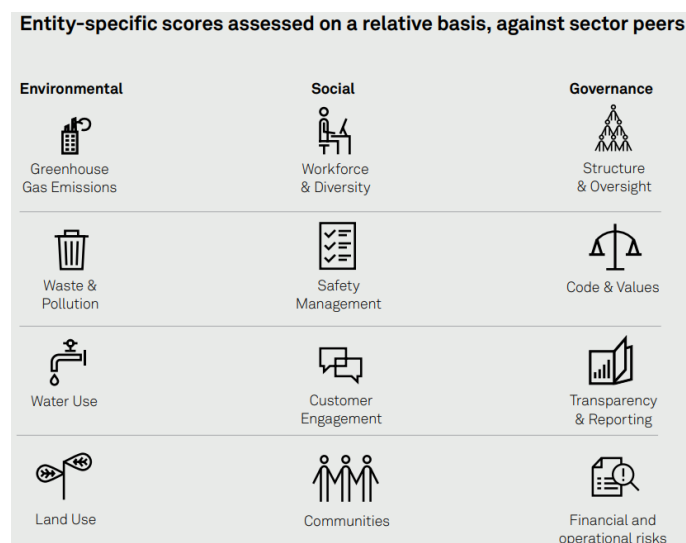


Figure 24 S&P ESG Rating Factors

Source: ESG Evaluation by S&P Global Ratings (S&P Global Ratings, 2021)

Afterwards, the score on each of these factors is weighted and then compared on a relative basis against industry peers to reach a final ESG rating on each of the component factors as can be seen in [Table 5](#).

Table 5 S&P ESG Ratings

Influence on credit rating analysis	Environmental Credit Indicator	Social Credit Indicator	Governance Credit Indicator
Positive	E-1	S-1	G-1
Neutral	E-2	S-2	G-2
Moderately negative	E-3	S-3	G-3
Negative	E-4	S-4	G-4
Very negative	E-5	S-5	G-5

Source: ESG Evaluation by S&P Global Ratings (S&P Global Ratings, 2021)

It is important to mention, that the scale has a deliberate negative skewness, since S&P considers that the effects and exposures of each of the aforementioned factors impacts in the risk profile of the company more often negatively than positively (S&P Global Ratings, 2021).

The ratings translate into the reality of a company's operations as seen in [Table 6](#).

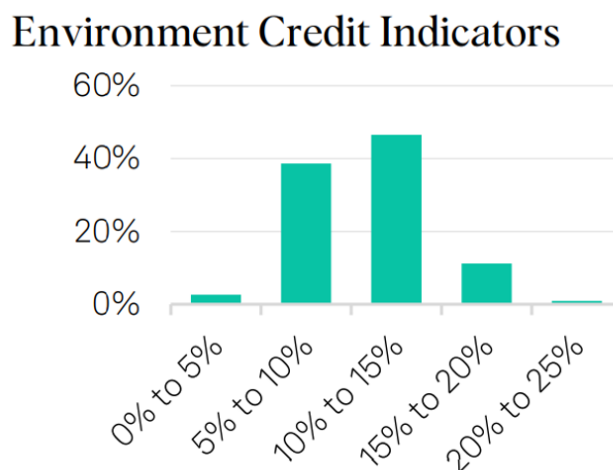
Table 6 ESG Rating Definitions

Credit Indicator Rating	Definition
Positive	The environmental factors analyzed have a net positive impact on at least one component of the credit risk rating
Neutral	The environmental factors analyzed do not have any impact of the credit risk rating
Moderately Negative	The environmental factors analyzed have a net moderately negative impact on at least one component of the credit risk rating
Negative	The environmental factors analyzed have a net negative impact on more than one component of the credit risk rating
Very Negative	The environmental factors analyzed have a net very negative impact on more than one component of the credit risk rating

Source: Own Elaboration from ESG Evaluation by S&P Global Ratings (S&P Global Ratings, 2021)

## Environmental Factor

Beginning with the environmental factor in *Figure 25* the Y axis represents the percentage of CLOs that have exposure to companies with a negative Environmental Rating (E-3 to E-5), and the X axis represents the percentage of their portfolio that is exposed to a negative Environmental Factor.



*Figure 25 US CLOs Exposure to Companies with Low Environmental Credit Ratings*

Source: U.S. BSL CLO And Leveraged Finance Quarterly: Is Winter Coming? By S&P Global Ratings (S&P Global Rating, 2022)

It is clear that a large majority of CLOs have between 5% to 15% exposure to loans from companies with a negative Environmental rating. Moreover, it is worrisome that 12% of rated U.S. BSL CLOs have greater than 15% portfolio exposure to issuers with a negative E credit indicator. Finally, it is important to mention that the primary driver of negative environmental credit indicators in a significant is attributed to climate transition risk factors (S&P Global Rating, 2022). This credit score could be improved by changing the mix on the loan portfolio to greener industries or to companies that have better E scores in more traditional industries like Oil & Gas.

## Social Factor

Following with the social factor, *Figure 26* the Y axis represents the percentage of CLOs that have exposure to companies with a negative Social Rating (S-3 to S-5), and the X axis represents the percentage of their portfolio that is exposed to a negative Environmental Factor.



### Social Credit Indicators

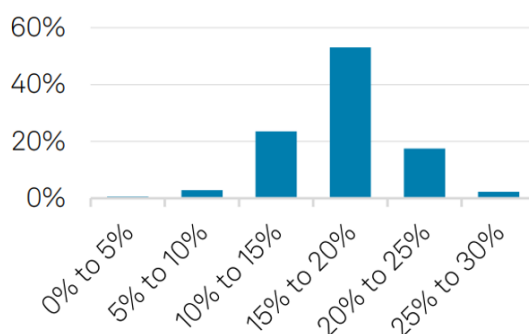


Figure 26 US CLOs Exposure to Companies with Low Social Credit Ratings

Source: U.S. BSL CLO And Leveraged Finance Quarterly: Is Winter Coming? By S&P Global Ratings (S&P Global Rating, 2022)

Analyzing the Social factor, a significant percentage of CLOs have between 15% to 20% exposure to loans from companies with a negative Social rating. Moreover, almost 20% of US CLOs have greater than 20% portfolio exposure to issuers with a negative S credit indicator.

Comparatively to the Environmental factor, that there is a larger exposure to negatively S rated companies. This might indicate that companies with riskier profiles have taken more actions to address the environmental issues than the social issues, and/or that CLOs are investing in younger companies, which tend to have riskier profiles, and those are more concerned with environmental issues, and/or that CLOs have larger exposures to industries where the environmental factors are more regarded. There can be multiple explanations for these comparative discrepancies, which could be a good topic to study in further projects.

Finally, it is important to mention the majority of CLO exposures that have a negative Social indicator are due to health and safety and social capital factors (S&P Global Rating, 2022).

### Governance Factor

Analyzing the Governance Factor, in Figure 27 the Y axis represents the percentage of CLOs that have exposure to companies with a negative Governance Rating (G-3 to G-5), and the X axis represents the percentage of their portfolio that is exposed to a negative Environmental Factor.

## Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

### Governance Credit Indicators

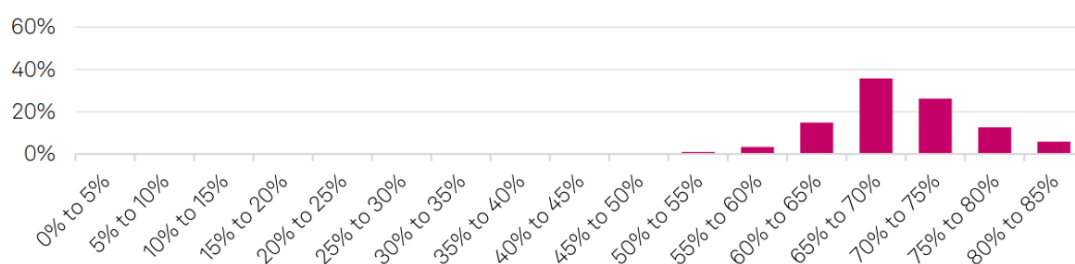


Figure 27 US CLOs Exposure to Companies With Low Governance Credit Ratings

Source: U.S. BSL CLO And Leveraged Finance Quarterly: Is Winter Coming? By S&P Global Ratings (S&P Global Rating, 2022)

When it comes to the Governance factor, the distribution is more spread out, however a significant percentage of CLOs have between 65% to 75% exposure to loans from companies with a negative Governance rating. Moreover, almost 20% of US CLOs have greater than 75% portfolio exposure to issuers with a negative G credit indicator.

Compared to the Environmental and Social factor, there is a significantly larger exposure to negatively G rated companies than to ones with negative E or S ratings. This is because there are many B- rated companies which are controlled by financial sponsors and there is a large exposure to B- rated companies in CLOs (S&P Global Rating, 2022). This factor alone can explain the low Governance ratings exposure seen in CLOs.

## 6 Project Finance

Once established and explained in detail how CLOs are structured, who are the main parties involved in the product lifecycle and its market characteristics now the project will be focused on introducing a new class of CLO that bases its cash flow in renewable energy project finance assets. However, it is important first to understand what project finance is and where do the renewable energy projects fit inside the industry.

Before diving down into how Renewable Energy Project Finance Based CLOs might work and which characteristics they might have, it is important to have a basic level of understanding of the Project Finance industry. In this section there will be an analysis of what is project finance, its characteristics, and types, followed by a commentary on the specificities of the market of the assets this bachelor thesis focuses on.

### 6.1 Project Finance Definition

Project finance is a specialized form of financing used for large-scale infrastructure, energy, and industrial projects. It involves the creation of an SPV, to finance and manage the project. Project finance is commonly employed for ventures that require significant upfront capital investments and have long-term revenue-generating potential but that would be too costly or uncertain to be

directly funded by a company. Debt and Equity are issued according to the expected capacity of the project to generate cash flows (Hayes, Project Finance: How It Works, Definition, and Types of Loans, 2021).

## 6.2 Project Finance Characteristics

Project finance ventures have the following characteristics:

- It is used in large infrastructure projects with long construction timelines and a long operating life. Thus, financing must be long term (15-25 years)
- Debt holders only rely on projected cash flow generation of the project. Thus, the project must be done under an SPV.
- The projects have large levels of debt-to-equity ratio usually covering 70-90% of total capital deployed in the project to reduce cost of capital and increase returns.
- The assets of the project are likely to have an insignificant value than the total debt issued, so the main risk mitigators for debt holders are contracts to secure the cash flows.
- The project has a finite life unlike corporations which theoretically can exist indefinitely.

Ventures must have then very specific characteristics to be considered for project financing (Yescombe, 2014).

## 6.3 Type of Projects that use Project Financing

There are two main types of projects that require and use project financing but this project will only be focusing mainly on Process Plant Projects, since it is the type that includes Renewable Energy Generation, LNG and Water Treatment Facilities.

It is interesting to note that three quarters of infrastructure projects globally are sponsored and financed by public entities (Deblina, 2020), in contrast to renewable energy generating facilities in which the private sector accounts for around 75% of the 500BN\$ committed annually to financing these projects. This is one of the main reasons why this bachelor thesis mainly focuses on process plants financing and more specifically in renewable energy generation facilities. (International Renewable Energy Agency, 2022)

### 6.3.1 Process Plant Projects

These projects involve a clear input-output process, where a specific input undergoes a process within the project and results in a corresponding output as can be seen in *Table 7*. One of the most common projects nowadays are the Liquefied Natural Gas (“LNG”) Terminals

## Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

Table 7 Examples of Projects that Use Project Financing

Project	Input	Process	Output
Thermal Power Generation Plant	Coal/Natural Gas	Burning/Conversion to steam	Electricity & Heat
Water Treatment Facility	Untreated Water	Water Treatment	Potable Water
Waste Incineration Plant	Household/Commercial waste	Incineration	Electricity & Residue
LNG Terminal	Liquid Natural Gas	Re-gasification	Natural Gas
Renewable Energy Generation Facility	Wind/Sun	Power Generation	Electricity

Source: Own Elaboration from Principles of Project Finance (Yescombe, 2014)

These types of projects typically involve several key elements and parties, as exemplified in *Figure 28*.

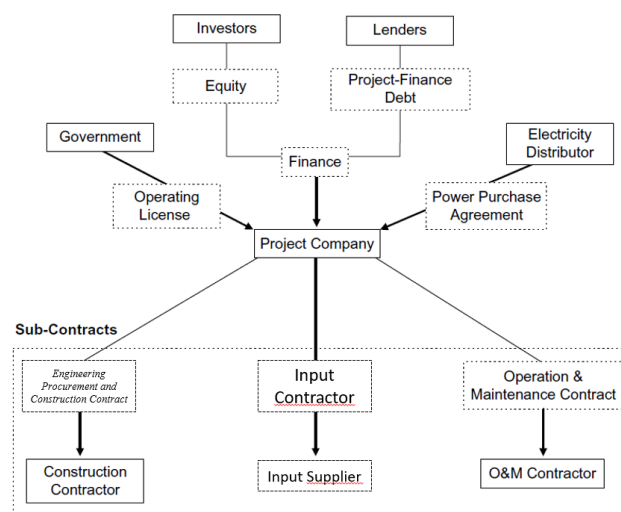


Figure 28 Project Finance Deal Structure

Source: Principles of Project Finance (Yescombe, 2014)

This project only focuses on the lenders who are the same institutions as the issuers previously studied. Lenders play a key role in financing the project and they are in charge of making sure to bring it to fruition. In order to secure their expected returns, lenders perform in-depth risk analysis on how much output will be generated under several scenarios and take part and advise on the several agreement and contract processes. Thus, lenders minimize project costs and the probability of failure while making sure that the required quality standards are met (Ficht, 2006).

The main contract lenders advise on takes the form of an Offtake Contract, specifically a Power Purchase Agreement (“PPA”). Under the PPA, an electricity-distribution company, natural gas plant or municipality agrees to purchase the project's output, at a predetermined tariff. This agreement is key for the lenders in order to calculate the potential cash flows of the project that will be available to service the debt, since the projects revenue depends on the amount of output they can generate times the price the Off-taker pays for said output (Yescombe, 2014).

### 6.3.2 Infrastructure Projects

There are two kinds of infrastructure projects, the private or privatized ones, such

as certain ports and airports, and the public-private partnerships, that usually work under the concession model to build roads, bridges, tunnels and railways. The basic structure can be understood using the example of a Toll-road concession in *Figure 29*.

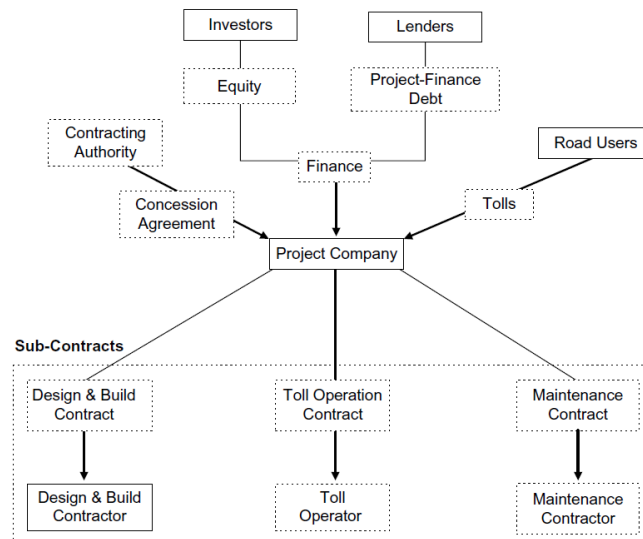


Figure 29 Infrastructure Project

Source: Principles of Project Finance (Yescombe, 2014)

The main contract in this kind of project are the concessions and the revenue generating contract and it is there where lenders tend to advise and analyze the most.

## 6.4 Loans Usage in Project Finance Rationale

It is important to understand why project financing is performed through loans in order to assess the long-term viability of a CLO composed of these assets. Since one of the variables of the success of the product will depend on a continuous flow of loan issuance and this would not be possible if PF would start to be financed with another type of product such as bonds, thus in this section there is a commentary on the topic.

Project finance typically involves securing committed term loans with structured repayment schedules due to the long-term nature of investments. This approach is preferred over revolving credits, where funds are borrowed and repaid within short periods. Infrastructure projects often take time to generate sufficient cash flows to cover interest and principal payments, making revolving credits less suitable.

In certain instances, short-term bridge loans may be used for construction financing. These bridge loans are intended to be refinanced with longer-term debt once the project is completed.

Loans are also preferred over bonds since loans offer greater flexibility in terms of structuring and customization compared to bonds. Project finance loans can be tailored to meet the specific needs of the project, such as cash flow

requirements, repayment schedules, and collateral arrangements. This flexibility allows lenders and borrowers to align the loan terms with the unique characteristics and risks of the project (Estache & Strong, 2000).

In addition, loan agreements are typically negotiated directly between the lender and the borrower. This allows for more efficient and timely decision-making, as negotiations can be conducted on a bilateral basis. On the other hand, bond issuances involve more complex processes, including underwriting, rating agencies, and syndication, which can be more time-consuming.

Finally, loans often have lower issuance costs compared to bonds. Bond issuances involve various expenses, such as underwriting fees, legal fees, rating agency fees, and marketing costs. These costs can be significant, especially for smaller projects where the economies of scale may not be as favorable. Loans may offer a more cost-effective financing solution, especially for projects with moderate financing needs (Yescombe, 2014).

In conclusion, loans are the main way to finance large scale projects which secures the supply to make feasible Green Project Finance based CLOs.

## 6.5 Green Project Finance Definition

As a summary of this section, it is sensible to underline that the proposed financial product (Green Project Finance CLO) will mainly include loans issued to projects that have some impact on ESG matters, especially Renewable Energy projects.

Facilities that can be considered ESG, thus making their loans suitable investments to include in the asset pool of the CLO are those that desalinate, purify and treat water, renewable energy generation facilities such as offshore and onshore wind farms and solar farms and other facilities that can also be considered as such in certain occasions.

Starting from 2022, there are specific circumstances where LNG and nuclear projects can be classified as green energy. Generally, the sustainable use of natural gas for electricity generation or as a collective heating or cooling source for multiple households will be considered environmentally friendly. However, certain other uses may be excluded from this classification. These projects must adhere to specific emissions thresholds and have an approval period only until 2030 or 2035, depending on the particular situation. For new nuclear plants that employ cutting-edge technologies and modifications to extend the lifespan of existing plants, approvals may be granted until 2040 or 2045. (Clifford, 2022).

Thus, the CLOs might also be able to hold loans issued to projects that either generate electricity using the aforementioned fuels or that impact the supply chain of the fuels. Especially referring to the construction and expansion of LNG regasification facilities and nuclear plant expansion and rework projects.

Finally other projects that might become popular in the future and are essential in the electrification of industries and economies could also be prospects to be included in the CLO, especially large charging stations, green hydrogen facilities, etc...

## 7 Green Project Finance Based CLOs

In this final part of the bachelor thesis there will be a proposal of a new CLO that will help with reaching net zero emission targets.

In order to reach net zero emissions by 2050 as agreed in the Paris agreements an estimated 6 to 10 trillion dollars in investments are needed in the next decade (Florence Jaumotte, 2021). Out of this amount 1.7 trillion dollars needs to be deployed to renewables.

From the loan originator's perspective, the large financing necessities means that RWA will increase by \$2.210BN, since project finance loans are weighted at a 130% of the exposure (Basel Committee on Banking Supervision, 2020). The increased RWA will need to be backed by liquid capital considered TIER I in order for banks to maintain a healthy level of capital adequacy. The current average for all the banks supervised by the European Central Bank is 14.74€ of liquid capital per 100€ of RWA exposure (European Central Bank, 2023). Thus, banks most likely will have to increase their liquid capital by around \$300BN.

In 2022 total world's TIER I capital reached 10 trillion dollars, meaning that banks' required capital will likely have to increase their capital by 3% in the next decade to fund the projects required to be on track with the Paris agreement.

A Green PF based CLO would help banks reduce the necessity of increasing their capital reserves which therefore would increase the project funding.

On the other hand, from an investors' perspective it could be an attractive product since CLOs at large have proven to generate excellent returns with low risk as studied in the previous chapter.

### 7.1 Green Project Finance CLO Structure

At this stage it is clear the function and mechanism of CLOs and it has been established the most basic functions of Project Finance, specifically of green projects. Now it is possible to explain how CLOs can be structured to help with the energy transition.

#### 7.1.1 Capital and Deal Structure Based on Precedent Transactions

In order to propose a structure for the new CLO it is necessary to look into how institutions around the globe have created their own PF CLOs and understand the essential characteristics and parties of said transactions. This section will perform an analysis on the capital and deals structure of comparable CLOs that occurred in the past years and can be used as precedent transactions to base the Green Project Finance CLO of.

Since 2017 there have been at least 8 different deals that have been marked as PF CLO or CDO. In 2021 alone there were 3 deals (Starwood, RIN IV and Bayfront Infra II), followed by one in 2022 (Bayfront Infra III), and another one in 2023 (Bauhinia ILBS1).

In order for Moody's, which is the only rating agency servicing PF CLOs, to assign

a rating to the tranches, thus allowing for the commercialization of the product, all PF CLOs must meet certain requirements and recommendations. This is done to make the product comply with the law and make it a relatively safe investment for the investors. As is common in the finance industry there can be some exceptions in the requirements, where CLOs can still be structured under law compliance and can attract investors.

### Qualitative Capital Structure Characteristics

In the qualitative characteristics it has been included all relevant information related to the diversification of the asset mix achieved by the aforementioned CLOs.

There is the possibility that a PF CLO includes loans from other types of leveraged financing. However, Moody's requires that a minimum of 60% of the loans forming the CLO asset pool come from PF. In order to adjust the proposed product to market while still improving its ESG profile it is recommended to have at least 85% of loans coming only from suitable PF. Moreover, it is also proposed that the remaining 15% of loans come from corporate loans in the utilities and telecommunications industries where infrastructure plays a predominant role and it could be put to in service of the energy transition or other ESG friendly tasks.

When it comes to industry diversification, the top 3 industries that form the asset pool cannot exceed 65% of loans. (Moody's Investors Service, 2023). These requirements would need to be modified Green PF CLOs since the number of industries that would be suitable to include in the product would be smaller than in normal PF CLOs. The industry concentration of the proposed product would be larger with a maximum of 85% sector concentration among the top 3 industries included in the portfolio.

In addition, loans issued to companies in the Oil and Gas industry can only form a maximum of 15% of the asset pool. However, there would need to be a due diligence assessment of the loans coming from the oil and gas industry, only including those coming from LNG related facilities.

Finally, according to Moody's recommendations, the exposure to individual obligors cannot exceed 5%, meaning that no more than 5% of all PF CLO assets can be issued against one single company. Moreover, the minimum number of obligors must be at least 30 (Moody's Investors Service, 2022). The Green PF CLO would aim to follow these guidelines.

### Quantitative Capital Structure Characteristics

In the quantitative characteristics it has been included all relevant information related to the performance of the asset mix achieved by the aforementioned CLOs.

The starting notional that PF CLO commonly have is \$500MM, this is done in order to have a large enough asset pool to not be considered too concentrated and have a size enough to cover some possible losses that the lowest rated tranches might suffer. In addition, PF CLOs are usually not fully funded, the trend seen in the analyzed CLOs is that the initial ramp up of \$500MM is between 50%



to 85% of the total amount that the CLO holds in the future. Thus, the typical total notional amount of a PF CLO is between \$600MM to \$1.000MM. Once more, the Green PF CLO would be in line with this market commonality and would aim to achieve the \$1BN size with a first issuance of half that size followed by a ramp up period.

Despite the fact that Moody's does not have a requirement for the tranches weighing it is important to have a good level of comprehension on how tranches are distributed in order to understand what the market trends and what investors deem viable. As it can be seen in *Table 8* there is a slight level of variance between PF CLOs tranches weight distribution but in this project, it is appropriate to use the average weights in order to propose a capital structure.

Table 8 PF CLO Tranches Distribution

	Credit Risk Rating					
	AAA	AA	A	BBB	SBBB	Equity
Starwood Infra	300,0	52,5	22,5	35,0	0,0	90,0
RIN I	273,3	51,8	0,0	57,4	0,0	65,0
RIN II	256,0	41,0	21,0	35,0	0,0	48,0
RIN IV	248,0	56,0	24,0	31,0	0,0	41,0
BIC I	320,6	72,6	0,0	19,0	0,0	46,0
BIC II	296,9	33,3	22,1	8,8	0,0	40,1
BIC III	297,9	33,4	0,0	43,0	0,0	30,2
Bauhina	299,6	36,5	18,3	10,0	0,0	40,4

	Credit Risk Rating						Total
	AAA	AA	A	BBB	SBBB	Equity	
Aggregated Notional	2292,3	377,1	107,9	239,2	0,0	400,8	3417,2
Weighting	67,08%	11,04%	3,16%	7,00%	0,00%	11,73%	100,00%

Source: Own Elaboration from PF CLOs Rating Documents (Moody's Investors Service, 2007)

Following this rationale, a Green PF CLO would have four tranches following the market trend. The AAA tranche would be around 67% of the total notional, AA around 11%, A close to 3% and BBB close to 7% with a 12% equity tranche. These figures could have some ranges as the Green PF CLO would start the ramp-up period and total notional would change, but the CLO manager should aim to maintain these weightings in order to remain in line with the market. In addition, the issuing bank would need to hold at least 5% of the equity tranche, while the rest is held by the CLO manager.

While Moody's does not have any requirements on the Weighted Average Maturity ("WAM") of the PF CLO loans, all issued CLOs tend to share the same characteristics. The guideline for WAM is usually between 5 to 10 years (Moody's Investors Service, 2019), the Green PF CLO would follow this.

The loans must be somewhat mature to lower the Green PF CLO risk, thus it would be recommendable to use the same limits as other PF CLOs. A maximum of 25% of PF loans that compose the product can come from projects that are still under construction (Moody's Investors Service, 2018). Also, 60% of loans issued 24 months before their acquisition and 15% of the loans bought after 24 months. This is relevant since it seems a decision made by the CLO managers considering investors' preferences to include a significant number of loans from projects that have entered COD and that the proposed product would need to follow.

In addition, Moody's does not require a minimum or maximum Weighted Average Rating Factor ("WARF") of the PF CLOs. However, it is interesting to see the guidelines on how other products have been structured to apply it to a Renewable Energy CLO.

Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

WARF is a calculation that considers the credit ratings assigned to each loan in the portfolio, along with their respective weights or proportions within the CLO. It is commonly used to summarize the overall credit quality of the loans in the CLO. In order to do so, it determines a numeric risk factor to each grade as seen in Table 9.

Table 9 Moody's Credit Risk Rating to Rating Factor Conversion table.

Moody's Rating	Moody's Rating Factor
Aaa	1
Aa1	10
Aa2	20
Aa3	40
A1	70
A2	120
A3	180
Baa1	260
Baa2	360
Baa3	610
Ba1	940
Ba2	1350
Ba3	1766
B1	2220
B2	2720
B3	3490
Caa1	4770
Caa2	6500
Caa3	8070
Ca-C	10000

Source: CDO Research Data Feed Glossary of Terms (Moody's Investors Service, 2007)

Analyzed PF CLOs rating factor range between 936 to 2305 as shown in Table 10 with an average rating factor of 1592 and a mean of 1465.

Table 10 PF CLOs WARF

	WARF
BIC I	975
BIC II	937
BIC III	1041
Bauhinia ILBS1	936
Starwood Infra	2251
RIN IV	2305
RIN II	2207
RIN I	2085
AVG	1592
MEAN	1465

Source: Own Elaboration from Moody's Rating Reports of PF CLOs

Using the conversion table seen before the most normal credit rating observed in PF CLOs asset pool corresponds to a BBB which is higher than the ones seen in other vanilla CLOs with a higher mixture of assets. Those CLOs that have the lower WARF are closer to a BB to a BBB but altogether PF CLOs seem to have a more conservative credit profile. This shows that PF CLOs have lower risk than other CLOs because the assets have stronger credit profiles and the selection is more meticulous. It is significantly harder to issue a recommendation on the Green PF CLO WARF since it is a Moody's internal calculation and it is not possible to build an asset portfolio taking this exact calculation into account. However, it seems that if the assets chosen are rated from BB to BBB the WARF

should fall to a market acceptable level.

The fourth and probably most important characteristic of the PF CLOs is the Weighted Average Spread (“WAS”). The WAS in the studied transactions ranges from 2.3% to 3.7%. This spread might seem low compared to the previously studied but it is important to consider that AAA tranches are the ones that weight the most and they also have the lowest spreads, higher spreads can be found in the most junior tranches of this product (Moody's Investors Service, 2022). The Green PF CLO WAS will probably need to be slightly higher to compensate for a lower industry diversification and a concentration of risks, probably falling closer to 4%. This also depends on investors' appetite and can be modified after the assets selection with the increase or decrease of the tranche's sizes and coupons payments.

The next characteristic to check would be the Weighted Average Recovery Rate (“WARR”) of the analyzed PF CLOs ranges between 63.5% to 69.9% which is higher than the 50-55% that is common in other CLOs as previously seen. It could be interesting for a Green PF CLO to make assessments of the expected recovery rate of the selected loans and include this parameter into the selection model.

The last quantitative characteristics should be focused on analyzing the level of subordination and credit enhancement that the market and Moody's are asking to the PF CLOs. However, there is no public information concerning these matters, thus the most commonly applied figures seen before will be proposed as risk mitigation structure. Note that due to the relatively high concentration of these portfolios of assets the triggers and subordination levels could vary significantly in reality from what is commonly applied in other CLOs. To issue an exact recommendation on this parameter for the Green PF CLO there would need to be a more transparent information flow in the industry.

### 7.1.2 Green PF CLO Deal Structure

After getting to know what are the characteristics that a Green Project Finance CLO must have to be rated and commercialized, it is important to understand which parties could be involved in this transaction. Moreover, in order to issue a recommendation on how to structure the deal the diagram used in the explanation of the CDO structure can be used.

Loan originators such as Sumitomo Mitsui Banking Corporation (“SMBC”), Mitsubishi UFJ Financial Group (“MUFG”), Natixis, Santander, Société Générale, and Credit Agricole, are the largest renewables project financiers in the world, and would definitely be interested in issuing a Green Project Finance CLO in the future (IJ Global, 2021).

There are many more banks that could also be interested in forming the proposed deals as seen in Table 11

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Table 11 Banks Ranked by Total PF Investment in Renewable Projects

Rank	Company		Value (\$m)	
	FY 2021	FY 2020	FY 2021	FY 2020
1	4	SMBC	6,188	3,977
2	3	MUFG	5,094	4,301
3	8	Natixis	4,787	2,580
4	1	Santander	4,413	4,605
5	2	Societe Generale	3,726	4,569
6	6	Credit Agricole	3,344	3,254
7	12	CIBC	3,082	1,804
8	7	BNP Paribas	2,732	3,067
9	11	KeyBank	2,655	1,819
10	9	Mizuho	2,525	2,539
11	15	ING	2,414	1,416
12	5	Rabobank	1,966	3,648
13	21	Nomura	1,655	833
14	10	HSBC	1,583	2,083
15	43	NAB	1,571	431
16	19	National Bank of Canada	1,539	984
17	17	NordLB	1,500	1,219
18	13	CaixaBank	1,479	1,680
19	34	UniCredit	1,394	572
20	38	Intesa Sanpaolo	1,391	472

Source: Infrastructure and Project Finance League Table Report (IJ Global, 2021)

These financial institutions would act as the Asset Seller while hiring or creating an external organization to act as Issuer and Asset Manager. This would be done in this way in order to create a true asset sale thus complying with regulations such as the Volcker Rule.

Several banks such as MUFG and Deutsche Bank that have already issued PF CLOs used external CLO managers. MUFG partnered with Starwood Infrastructure in order to create their CLO. Also, Deutsche Bank RIN CLOs have been structured through a series of intermediaries such as their Asset Management branch and a subsidiary called Rreef America. Other PF CLOs have been issued by Bayfront Infrastructure, an independent player in the industry owned by Clifford Capital Holdings and the Asian Infrastructure Investment Bank. This shows that not all PF CLOs are arranged by banks thus a Green PF CLO could also be attractive to other institutions apart from the main ones previously stated.

Moving forward, the external institutions that would be hired or created by the banks and the banks would follow the structure and lifecycle studied in previous chapters to create and manage the CLO, without making any significant changes to the market standards and always complying with the law.

### 7.2 Green Project Finance CLO Specific Benefits and Risks

This section summarizes, into benefits and risks, all the previous analysis performed on CDOs and CLOs 2.0/3.0 applied to Green Project Finance deals. The benefits and risks are analyzed through the lens of the four main stakeholders that would take part and/or be affected by the creation and adoption of the Green PF CLO.

## 7.2.1 Benefits

Starting with the benefits section, the four main stakeholders will be organized according to their significance and potential impact on the creation and adoption of the proposed product. Since banks and loan originators would be the institutions that would be in charge of starting and commanding the deals, they are the first to benefit and expose themselves to the product. Followed by the institutions that would invest in the product, and finally the two main stakeholders that would not directly participate on the creation but would feel an impact, the project sponsors and the society at large.

### Banks and Green PF Loan Originators Benefits

The financial institutions that fund project finance that are in line with the net zero goals and help improve other ESG matters could benefit from the balance sheet reduction effects of the proposed product.

For every \$100 that they sold to the CLO SPV they would decrease their RWA by \$130 thus their required liquid capital by \$16.9. In addition, and considering that if they were to arrange a Green PF CLO they would have to hold at least a 5% of the total amount raised, their RWA would also have a increase of 7.5\$ and the required capital by around 97.5 cents (Basel Committee on Banking Supervision, 2020).

Taking all this into consideration, banks could reduce the capital requirements derived from lending mainly to projects aimed at generating renewable energy by \$15.93 for every \$100 allowing them to fund extra projects and generate more fees and interests. This effect could be bootstrapped almost in perpetuity since with the freed capital they could fund \$94.23 worth of projects.

A Green PF CLO could in fact allow banks to increase their ability to fund projects by 16.33x as can be seen in Table 12.

Table 12 CLO Multiplying Factor Calculation

Levers													
Project Finance Weight	130%												
Capital Requirement	13%												
Equity Tranche RWA	150%												
CLO Exposure	5%												
	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5	CLO 6	CLO 7	CLO 8	CLO 9	CLO 10	CLO 11	CLO 137	
Initial Exposure	100,00	94,23	88,79	83,67	78,84	74,30	70,01	65,97	62,16	58,58	55,20	0,50	
Initial RWA	130,00	122,50	115,43	108,77	102,50	96,58	91,01	85,76	80,81	76,15	71,76	0,66	
Initial Capital Requirements	16,90	15,93	15,01	14,14	13,32	12,56	11,83	11,15	10,51	9,90	9,33	0,09	
CLO Exposure	5,00	4,71	4,44	4,18	3,94	3,71	3,50	3,30	3,11	2,93	2,76	0,03	
RWA	7,50	7,07	6,66	6,28	5,91	5,57	5,25	4,95	4,66	4,39	4,14	0,04	
CLO Capital Requirements	0,98	0,92	0,87	0,82	0,77	0,72	0,68	0,64	0,61	0,57	0,54	0,00	
Capital Savings	15,93	15,01	14,14	13,32	12,56	11,83	11,15	10,51	9,90	9,33	8,79	0,00	
Multiplying Factor	16,33												

Source: Own Elaboration

In order to calculate the multiplying factor, it has been taken as an example a

100\$ CLO deal in which the levers were used to calculate the total capital savings. Afterwards the capital savings were divided by the capital requirement in order to find the maximum amount of RWA that could be sustained with the capital savings from the previous deal. These operations were then repeated until the capital savings equaled 0. All initial exposures were added back, this figure would be the total amount that the CLO arranger could fund with an initial 100\$ if they used the CLO under a perfect market, without considering commissions or taxes. Finally, the total amount of exposure is divided by the initial amount giving back the multiplying factor.

In order to put the utility of the product for the banks it in a global perspective, the top 20 project financing banks would be able to increase their funding capacity targeted to renewable projects and other green PF from \$55BN to \$898BN dollars annually. It is true that many of these banks would not opt to use the CLO and banks having the financing capability does not mean that there will be demand for it thus these numbers might in fact be much lower in reality.

### Investors Benefits

From the investors' perspective a Green PF CLO would be highly beneficial in order to improve their ESG investing metric first and foremost. As seen in previous chapters CLOs do not have significantly high ESG metrics this makes investors who own CLO bonds decrease their ESG metrics. A Green PF CLO could help improve CLO investor's ESG ratings.

In addition, ESG investor would be able to increase their product diversification, a Green PF CLO would most probably fit into their investing philosophy and be approved for purchase by the investment committee of ESG investment funds. By increasing their diversification levels, they could reduce risks and improve their risk/return ratios, increasing their attractiveness for capital inflows.

On the other hand, a Green PF CLO would be a great product for less ESG concerned investors, such as mainstream Hedge Funds or Pension Funds who just look for maximizing returns. These institutional investors, that are the ones more likely to buy the lower rated tranches, could find highly lucrative deals and new exposures to markets in different industries in which they usually do not invest due to the low expected returns of said industries.

### Project Sponsors Benefits

The companies that sponsor projects that would be eligible for the CLO would highly benefit from it.

First, there would be a higher level of funds available for projects, especially renewable projects. With an increase in the funds availability, project sponsors would have a larger leverage for negotiating critical funding characteristics, such as cost (interests), repayment timing, covenants, maximum leverage level, etc.

This phenomenon could improve the returns from projects making it more attractive for current players in the industry to increase their operations. It would also attract new companies into the industry that might have the technical capabilities to create a project but not enough financial capabilities.

Secondly, a lower cost of funding could make feasible a larger number of projects that did not cut the bar previously, which would definitely help project sponsors increase their revenues and profits.

Finally, the Green PF industry could see a large rate of innovation generation growth thanks to the increase of funding availability. For example, the Green PF CLO could allow a bank to fund companies that are investigating cutting edge technology to develop and improve projects. New sources of energy or other innovative ideas could be developed by project sponsors to tackle ESG related issues in their projects.

### Society Benefits

As the final stakeholder it has been decided to include society at large. It is estimated that one of the benefits that a Green PF CLO could have is increasing the chances of reaching the net zero goal. It is clear that to reach the goals there are many moving parts and that the financial service industry must be one of the levers of change taking the active approach.

By introducing the Green PF CLO society could benefit from an enhanced PF industry which would be aimed at developing ESG friendly and renewable energy projects across the globe. It is clear how by accelerating the energy transition and reducing the impact of global warming society will benefit.

The other benefit of a Green PF CLO for society could be that the energy change could be accelerated in a business-friendly manner. By improving the financial perspective and returns from lenders and project sponsors there would be an increase in tax payments, employment created and several other macroeconomic factors improved.

In addition, by decreasing the aforementioned institutional investors' risks by helping them diversify, pension funds and mutual funds returns would be more stable and safer for the ultimate owners which are real people, workers and retirees mainly.

With an increase in clean energy sources and enhancement of their returns by lowering costs, energy prices should come down. This benefit would be possible since the supply of energy would increase quicker than if the Green PF CLO did not exist thus outpacing the growth of demand and making prices shift downwards. In addition, if the energy is cheaper to produce there are greater chances that companies can charge less for it to increase their competitiveness, thus further lowering energy prices.

Lastly, there is a potential benefit that could derive from a widespread adoption of Green PF CLOs regarding other ESG matters, such as tackling the water scarcity problem that many regions of the world are facing. If the costs of funding a project lowered and new projects could then cut the return bar maybe it would be possible to see a faster adoption of water desalination and treatment plants in locations that currently do not make financial sense.

### 7.2.2 Risks

There are several clearly identifiable risks that would be new in the PF industry if

the Green PF CLO were to be widely introduced. The risks once more, have been analyzed through the stakeholders perspective and the order of appearance in the analysis as well as the rationale for their appearance is the same as for the benefit section.

### Banks and Loan Originators Risks

If banks were to use the full potential of the Green PF CLO, they could materially increase their leverage levels. This can be considered a risk if a large part of projects were to default at the same time. The probability of this is very low since projects must be developed on a contract basis, where the revenues and costs are highly controlled.

However, if a major number of projects defaulted at the same time due to catastrophic events, force majeure reasons or any other socioeconomical reason, banks with highly leveraged positions, low capital and a high exposure to Green PF CLO equity tranches could take large losses.

### Investors Risks

The main risks for investors are the fact that there is a chance that the bonds they purchase default. If the actual default probability is significantly higher than what it was expected due to an over rating matter, investors could find themselves with large exposures to what it seemed to be safe low paying investments but in reality, were highly risky assets.

Credit rating agencies would in fact have a lot of responsibility and power when deciding the rating of the bonds issued against Green PF CLOs. Investors should do their due diligence when checking which projects loans are owned by the CLO, they are investing at to minimize the risk. However, there is always the possibility of finding false or bad information coming from the CLO managers in order to lure investment, but this is not expected to be a large problem as it is not in other financial products with similar characteristics, such as traditional CLOS.

### Project Sponsors Risks

When it comes to the extra risks that project sponsors could intake if the Green PF CLO was fully introduced it is important to state that they would not take many more risks inherently. The only one that is clearly identifiable is that they might take on riskier ventures and projects that do not make economic sense or are not well funded by the contract basis and which fail, leading to bad returns and economic performance.

### Society Risks

The risks that society might expose itself to if the Green PF CLO is adopted would mainly derive from the possibility that the negligent use of the product, without due supervision and controls would impact the economy. If the CLOs become the new CDOs and collapse the world economy, society would clearly suffer and this is a low but real possibility.

Finally, if the strict quality standards of projects loosen in order to increase the



deal flow of Green PF CLOS, then society might suffer socioeconomic losses related to the use of low-quality infrastructure that requires excessive maintenance. It could also be the case that the PF industry starts developing projects that are not really met with the demand and society ends up burdened with massive infrastructure projects that are not used and that money could have been used for better initiatives.

## Conclusions

In conclusion, this bachelor's thesis has explored the potential of utilizing Collateralized Loan Obligations (CLOs) as a means to boost project finance, with a specific focus on renewable energy generation and Environmental, Social, and Governance (ESG)-related projects. The bachelor thesis has proposed a novel financial product, the Green Project Finance CLO, which leverages the existing market standards for CDOs and CLOs, offering a structured approach to fund sustainable initiatives.

The research has highlighted that the lifecycle and structural components of CDOs can be adapted to create the Green Project Finance CLO. By incorporating features such as balance sheet, true sale, and cash flow CDOs, this new financial product can effectively pool and securitize project financing, attracting a broader range of investors interested in supporting green and socially responsible initiatives.

Moreover, the bachelor thesis has emphasized that the parties involved in structuring traditional CDOs, including originators, underwriters, trustees, and rating agencies, would also play key roles in developing the Green Project Finance CLO. Their expertise in risk assessment, due diligence, and market evaluation can be applied to ensure the viability and success of this innovative financial instrument.

The Green Project Finance CLO offers several benefits. Firstly, it can help address the funding gap for renewable energy and ESG-related projects by attracting a wider pool of investors seeking sustainable investment opportunities. Secondly, by securitizing and diversifying the underlying assets, the CLO structure can provide risk mitigation and enhanced liquidity, making it an attractive option for both investors and project developers. Lastly, this financial product aligns with the growing global focus on ESG considerations, fostering the transition towards a greener and more sustainable future.

However, it is important to acknowledge that the Green Project Finance CLO also carries certain risks. Market volatility, regulatory changes, and potential defaults within the underlying projects can pose challenges to investors and the overall performance of the CLO. Therefore, comprehensive risk assessment, ongoing monitoring, and transparent reporting frameworks are crucial to mitigate these risks and ensure the long-term success of the Green Project Finance CLO.

Additionally, it is important to mention that it would be beneficial for the success of the product to perform further investigation in topics such as portfolio building models and risk management models.

In conclusion, the Green Project Finance CLO presents an innovative approach to mobilize capital for renewable energy generation and ESG-related projects. By leveraging the structural elements and expertise of CDOs, this financial product has the potential to drive sustainable development, attract diverse investors, and contribute to the achievement of environmental and social objectives. However, careful risk management and regulatory oversight are vital to safeguard investor interests and maintain the integrity of the market. The Green Project Finance CLO represents a step forward in bridging the gap between finance and sustainability,

offering a promising avenue for the advancement of green initiatives on a global scale.

## **SDG Annex**

In recent years, the urgency to address climate change and promote sustainable development has gained significant momentum. SDGs provide a comprehensive framework for tackling various global challenges. This bachelor thesis has a clear link on how the creation of Green Project Finance CLOs can have a positive impact on three key SDGs: Goal 8 (Decent Work and Economic Growth), Goal 7 (Affordable and Clean Energy), and Goal 9 (Industry, Innovation, and Infrastructure).

SDG 8 focuses on promoting inclusive and sustainable economic growth, full and productive employment, and decent work for all. Green Project Finance CLOs can contribute to job creation. Green project financing supports environmentally friendly projects, such as renewable energy installations, sustainable infrastructure, and clean technology initiatives. By investing in these projects, Green Project Finance CLOs can generate employment opportunities, thereby promoting decent work and economic growth.

SDG 7 aims to ensure access to affordable, reliable, sustainable, and modern energy for all. Green Project Finance CLOs can support the development and expansion of renewable energy projects, such as solar and wind farms, hydroelectric plants, and geothermal energy installations. By providing financing options to these projects, CLOs facilitate the transition to clean and sustainable energy sources, promoting affordable and clean energy access.

SDG 9 emphasizes the need for resilient infrastructure, inclusive and sustainable industrialization, and fostering innovation. By directing funds towards sustainable infrastructure projects, eco-friendly transportation systems, etc. Green Project Finance CLOs contribute to the development of sustainable cities and communities.

Furthermore, Green Project Finance CLOs can help finance innovative projects that focus on developing and deploying clean technologies and solutions. Investments in research and development of green innovations can drive progress towards sustainable industrialization and foster environmentally conscious practices.

Green Project Finance CLOs provide an avenue to align financial investments with sustainable development objectives. By linking to SDGs 8, 7, and 9, these CLOs can promote decent work and economic growth, affordable and clean energy access, and sustainable industry, innovation, and infrastructure.

## Bibliography

- Alison, G. (2011). *Creating a future economic crisis: political failure and the loopholes of the volcker rule*. Or. L. Rev.
- Anderberg, S. (2022). *U.S. BSL CLO And Leveraged*.
- Armstrong, J., & Kiff, J. (2006). *Understanding the Benefits and Risks of*. Financial System Review.
- Attig, N. (2013). *Corporate social responsibility and credit ratings*. Journal of business ethics.
- Barbican Consulting. (n.d.). *Collateralized Debt Obligations*. Retrieved from Barbican Consulting: [https://www.barbicanconsulting.co.uk/collateralised\\_debt\\_obligations](https://www.barbicanconsulting.co.uk/collateralised_debt_obligations)
- Barth, J. R., Li, T., McCarthy, D., Phumiwasana, t., & Yago, G. (2005). *Capital Access Index, Securization in Financing Economic Activities*. New York City: Milken Institute.
- Basel Committee. (2009). *Report on Special Purpose*.
- Basel Committee on Banking Supervision. (2017). *Basel III: Finalising post-crisis reforms*.
- Basel Committee on Banking Supervision. (2020). *Calculation of minimum risk-based capital requirements*.
- Basel Committee on Banking Supervision. (2020). *Calculation of RWA for credit risk*.
- Bayfront Infrastructure. (2021). *Platforms*. Retrieved from Bayfront Infrastrucutre: <https://www.bayfront.sg/platforms>
- Bennett, M. (2020, September 21). *What will CLO 3.0 look like?* Retrieved from S&P Global Intelligence: <https://www.spglobal.com/marketintelligence/en/mi/research-analysis/what-will-clo-30-look-like.html>
- Bloomberg. (2022). *Old-School Leveraged Loan Market Is Bigger Than Ever*.
- Bord, V. (2012). *The Rise of the Originate-to-Distribute Model and the Role of Banks in Financial Intermediation*. SSRN.
- Cboe. (2019, February). *Key Highlights for 11 Select Sectors*. Retrieved from Cboe: <https://www.cboe.com/insights/posts/key-highlights-for-11-select-sectors/>
- CFI. (2023, March 14). *Special Purpose Vehicle (SPV)*. Retrieved from CFI : <https://corporatefinanceinstitute.com/resources/management/special-purpose-vehicle-spv/>
- Chen, J. (2020, October 31). *Credit Enhancement: Definition, Benefits, Techniques*. Retrieved from Investopedia: <https://www.investopedia.com/terms/c/creditenhancement.asp>
- Cho, J. (2013). *WAREHOUSE FINANCING—RAMP-UP FUNDING FOR CLOS*. Blank Rome LLP.
- Christopher Whittall. (2020). *Banks race to sell first post-crisis managed synthetic CDO*. Retrieved from Reuters: <https://www.reuters.com/article/banks-race-to-sell-first-post-crisis-man-idUSL8N29T3NP>

Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

Clifford, C. (2022, July 6). *Europe will count natural gas and nuclear as green energy in some circumstances*. Retrieved from CNBC: <https://www.cnn.com/2022/07/06/europe-natural-gas-nuclear-are-green-energy-in-some-circumstances-.html>

Cordell, L., Roberts, M. R., & Schwert, M. (2021). *CLO performance*. National Bureau of Economic Research.

Corporate Finance Institute. (2022, December 19). *Collateralized Loan Obligations (CLO)*. Retrieved from CFI: <https://corporatefinanceinstitute.com/resources/fixed-income/collateralized-loan-obligations-clo/>

Corporate Finance Institute. (2023). *Leveraged Loan*. Retrieved from CFI: <https://corporatefinanceinstitute.com/resources/fixed-income/leveraged-loan/>

Coval, J. D., Juerk, J., & Stafford, E. (2008). *The economics of structured finance*. Harvard Business School Working Paper.

Credit Suisse, Credit Investments Group. (2021). *Introduction to Collateralized Loan Obligations*. Credit Suisse,.

Cshie, P. v. (2021, August). *Global CLO Market Hits \$1 Trillion Milestone*. Retrieved from Neuberger Berman: [https://www.nb.com/en/global/insights/nb-blog-global-clo-market-hits-\\$1-trillion-milestone](https://www.nb.com/en/global/insights/nb-blog-global-clo-market-hits-$1-trillion-milestone)

Deblina, S. (2020, January 15). *Who finances infrastructure, really? Disentangling public and private contributions*. Retrieved from World Bank Blogs: <https://blogs.worldbank.org/ppps/who-finances-infrastructure-really-disentangling-public-and-private-contributions>

Dechert LLP. (2018). *Asset Manager's Guide to CDOs*. Dechert LLP.

Deloitte UK. (2013). *CLO Structures An evolution*. Deloitte UK.

Dinca, S. E. (2015). *CASH vs. SYNTHETIC CDOs*. University of Craiova.

Douglas, L. J., Fabozzi, F. J., & Goodman, L. S. (2006). *Collateralized Debt Obligations: Structures and Analysis*.

Duffie, D. (2012). *Market making under the proposed Volcker rule*. Rock Center for Corporate Governance at Stanford University Working Paper.

Estache, A., & Strong, J. (2000). *The Rise, the Fall, and ...the Emerging Recovery of Project Finance in Transport*. World Bank Publications.

European Central Bank. (2023, January 11). *ECB publishes supervisory banking statistics for the third quarter of 2022*. Retrieved from ECB: <https://www.bankingsupervision.europa.eu/press/pr/date/2023/html/ssm.pr230111~4cb4953fd6.en.html#:~:text=The%20aggregate%20capital%20ratios%20of,capital%20ratio%20stood%20at%2018.68%25.>

FDIC. (2007). *Risk Management Securitization Manual: CREDIT ENHANCEMENT FACILITIES*. FDIC.

Fight, A. (2006). *Introduction to Project Finance*.

Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

Financial Stability Board. (2010). *The Role of Credit Rating Agencies in Structured Finance Markets*. The Role of Credit Rating Agencies in Structured Finance Markets.

Fitch Ratings. (2006). *The Changing World of CDOs*. Fitch Ratings.

Fitch Ratings. (2020). *Collateralized Debt Obligations: An Introduction*. Fitch Ratings.

Fitch Ratings. (2023). *Rating Definitions*. Fitch Ratings.

Florence Jaumotte, G. S. (2021, July 22). *Reaching Net Zero Emissions*. Retrieved from IMF: <https://www.imf.org/en/Blogs/Articles/2021/07/22/blog-reaching-net-zero-emissions#:~:text=An%20estimated%20additional%20%24%20to,percent%20of%20a%20annual%20global%20GDP.>

FSCO. (2020). *Annual Report*. U.S Treasury Department.

Guggenheim Investments. (2022, December 8). *Understanding Collateralized Loan Obligations (CLOs)*. Retrieved from Guggenheim Investments: <https://www.guggenheiminvestments.com/perspectives/portfolio-strategy/understanding-collateralized-loan-obligations-clo#:~:text=Warehouse%20Period%3A%20A%20warehouse%20provider,proceeds%20from%20the%20CLO's%20issuance.>

Hayes, A. (2020, November 30). *Senior Debt: What It Is, Why It's Less Risky*. Retrieved from Investopedia: <https://www.investopedia.com/terms/s/seniordebt.asp#:~:text=Secured%20senior%20debt%20is%20backed,an%20asset%20pledged%20as%20collateral.>

Hayes, A. (2021, August 20). *Project Finance: How It Works, Definition, and Types of Loans*. Retrieved from Investopedia: <https://www.investopedia.com/terms/p/projectfinance.asp>

Hayes, A. (2022, August 23). *What Is a Special Purpose Vehicle (SPV) and Why Companies Form Them*. Retrieved from Investopedia: <https://www.investopedia.com/terms/s/spv.asp>

Holloway, T. (2019). *Understanding CLOs and the Makeup Of Their Distribution*. Seeking Alpha.

IJ Global. (2021). *Infrastructure and Project Finance League Table Report*.

IJ Global. (2021). *Infrastructure and Project Finance League table Report*.

IMMA. (2023). *Announced M&A in the United States by Numbers and Value by Years*. Retrieved from IMMA : <https://imaa-institute.org/mergers-and-acquisitions-statistics/united-states-ma-statistics/>

Infrastructure, B. (n.d.).

Institutional Investor. (2021, Q2). *Institutional Investor ranking of the largest CLO/CDO*. Retrieved from Institutional Investor: <https://www.institutionalinvestor.com/article/b1sm2d1tbsz1c9/The-Largest-CLO-CDO-Managers>

International Capital Market Association (ICMA). (2011). *An Introduction to Collateralized Debt Obligations (CDOs)*. International Capital Market Association (ICMA).

## Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

International Renewable Energy Agency. (2022). *Investment Trends*. Retrieved from IRENA: <https://www.irena.org/Energy-Transition/Finance-and-investment/Investment#:~:text=The%20private%20sector%20provides%20the,in%20the%20period%202013%2D2020>.

Jarrow, R. A. (2011). *The Role of ABS, CDS and CDOs in the Credit*.

Johnson, S. (2013). *An Introduction to Warehouse Funding*. Fidelity Bank.

Jonathan Beaverstock. (2021). *How Financial Products Organize Spatial Networks: Analyzing CDOs and CLOs*.

Katzenstein, S. (2020). *An Introduction to Collateralized Loan Obligations (CLOs)*. Intermediate Capital Group.

Kenton, W. (2022). *What Is a Leveraged Loan? How Financing Works, and Example*. Retrieved from Investopedia: <https://www.investopedia.com/terms/l/leveragedloan.asp>

Kollmorgen, L. (2022, January 19). *Seeing Beyond the Complexity: An Introduction to Collateralized Loan Obligations*. Retrieved from PineBridge Investments: <https://www.pinebridge.com/en/insights/clo-beyond-the-complexity>

Liu, E., & Schmidt-Eisenlohr, T. (2019). *Who Owns U.S. CLO Securities?* Board of Governors of the Federal Reserve System .

Lu, L. (2021). *An introduction to CLOs*. Yield Book.

Mandel, B., Morgan, D., & Wei, C. (2012). *The Role of Bank Credit Enhancements In Securitization*. Federal Reserve Bank of New York.

Maples Group. (2021). *The CLOser*. Maples Group.

Matheson LLP. (2011, September 30). *The SPV location of choice for us structured finance transactions*. Retrieved from Lexology: <https://www.lexology.com/library/detail.aspx?g=6e7aa3fd-17f4-42eb-879e-40763e93ca9c>

Mentorme. (2022, June 13). *How does a CDO work?* Retrieved from Mentorme: <https://mentormecareers.com/what-is-collateralized-debt-obligation-and-its-different-aspects/>

Moody's Investors Service. (2007). *CDO Research Data Feed*.

Moody's Investors Service . (2018). *A Guide to Understanding CDOs*. Moody's.

Moody's Investors Service. (2018). *Moody's assigns definitive ratings to three classes of notes issued by Bayfront Infrastructure*. Hong Kong.

Moody's Investors Service. (2019). *RatingAction: Moody's assigns definitive ratings to five classes of notes issued byRINII Ltd*. New York.

Moody's Investors Service. (2022). *RatingAction: Moody's assigns definitive ratings to four classes of notes issued by Bayfront InfrastructureCapital*. Hong Kong.

Moody's Investors Service. (2022). *RatingAction: Moody's assigns ratings to five classes of notes issued by STWD2021-SIF2, Ltd*. New York.

Development and Impact of the Collateralized Loan Obligations on Renewable Energy Generation Project Financing

Moody's Investors Service. (2023). *RatingAction: Moody's assigns definitive ratings to five classes of notes issued by Bauhinia ILBS1 Limited*. Hong Kong.

Mullard, M. (2012). *The Credit Rating Agencies and Their Contribution to the Financial Crisis*. The Political Quarterly.

Nabilou, H. (2017). *Bank proprietary trading and investment in private funds: is the Volcker Rule a panacea or yet another Maginot Line?* Banking and Finance Law Review.

New York Public Library. (2023, January 26). *Fixed Income Securities (Bonds): Collateralized Debt Obligations*. Retrieved from New York Public Library: <https://libguides.nypl.org/c.php?g=1043575&p=7660195>

Office of the Comptroller of the Currency ("OCC"). (2020). *Volcker Rule Implementation*. Retrieved from OCC: <https://www.occ.treas.gov/topics/supervision-and-examination/capital-markets/financial-markets/trading-volcker-rule/volcker-rule-implementation.html#:~:text=The%20final%20regulations%20were%20published,effective%20on%20April%201%2C%202014>.

Opler, T., Pinkowitz, L., stulz, R., & Williamson, R. (1998). *The determinants and implications of corporate*. Journal of Financial Economics .

Pistre, N. (n.d.). *CLO 2.0 Mechanism, modelling and management*. NATIXIS Asset Management.

Reuters. (2014). *JPMorgan tops investment bank league table in first half*. Retrieved from Reuters: <https://www.reuters.com/article/investmentbank-ranking-idUKL6N0RP43Y20140925>

Reuters Staff. (2007, May 3). *JP Morgan was top CDO arranger in Q1 -Creditflux*. Retrieved from Reuters: <https://www.reuters.com/article/credit-derivatives-tables-idUSL0355831820070503>

S&P Global Rating. (2022). *U.S. BSL CLO And Leveraged Finance Quarterly: Is Winter Coming?*

S&P Global Ratings. (2021). *ESG Credit Indicator Definitions And Application*.

S&P Global Ratings. (2021). *ESG Evaluation*.

S&P Global Ratings. (2021). *SPGI Investor Fact Book Ratings*. S&P Global.

Segal, T. (2023, April 21). *Collateralized Loan Obligation (CLO) Structure, Benefits, and Risks*. Retrieved from Investopedia: <https://www.investopedia.com/terms/c/clo.asp>

Sokol, W. (2022, June 22). *CLOI: Question and Answer*. Retrieved from VanEck: <https://www.vaneck.com/us/en/blogs/income-investing/clos-question-and-answer/>

Standard & Poor's Ratings Services. (2007). *An Introduction to CDOs and Standard & Poor's Global CDO Ratings*. Standard & Poor's.

Teplý, P. (2012). *Collateralized Debt Obligations' Valuation Using the One Factor Gaussian Copula Model*. Prague Economic Papers.

Trant, B. (2023, January). *What is a CLO?* Retrieved from Barings: <https://www.barings.com/en-us/guest/perspectives/viewpoints/what-is-a-clo>



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Tuckman, B. (2016). *Derivatives: Understanding Their Usefulness and Their Role in the Financial Crisis*. Columbia Business School.

Valladares, M. R. (2021, August). *The U.S. Leveraged Finance Market Is At A Record \$3 Trillion*. Retrieved from Forbes: <https://www.forbes.com/sites/mayrarodriguezvalladares/2021/08/10/the-us-leveraged-finance-market-is-at-a-record-3-trillion/>

VOYA. (2023, February 13). *CLO and Loan Market Commentary – 4Q 2022*. Retrieved from VOYA: <https://institutional.voya.com/insights/market-outlook/clo-and-loan-market-commentary-4q-2022#:~:text=CLO%20issuance%20hit%20%24132%20billion,%24187%20billion%20issued%20in%202022.>

Will, K. (2023, March 23). *Over-Collateralization (OC): Definition, Benefits, and Examples* . Retrieved from Investopedia: <https://www.investopedia.com/terms/o/overcollateralization.asp#:~:text=insurance%20and%20annuities.-,What%20is%20Over%2DCollateralization%3F,than%20the%20amount%20being%20borrowed.>

Yescombe, E. (2014). *Principles of Project Finance*. Elsevier.