Cost savings potential of DLT based capital market infrastructures – a quantitative analysis

A joint study by Cashlink Technologies GmbH, FinPlanet GmbH and Marius Bauer, CFA (Porsche Consulting GmbH)

December 2023

Table of content

1. Authors

Marius Bauer, CFA
Porsche Consulting GmbH

Dr. Dirk Sturz
FinPlanet GmbH

Benedikt Scheungraber
Cashlink Technologies GmbH

Sebastian Liebscher
FinPlanet GmbH

Simon Censkowsky
Cashlink Technologies GmbH

Maximilian Ludwig, CFA
FinPlanet GmbH

2. Executive summary

The following paper outlines the results of a cost impact analysis in case bonds' existing capital market infrastructure processes will be replaced with capital market infrastructure processes which are built on a distributed ledger technology (hereinafter "*DLT*"). For the cost impact assessment, the authors have gathered relevant information through expert interviews and estimates, price lists, aggregated data sets of market participants, and research in order to conduct an independent "bottom-up" analysis, and created two different scenarios with differing assumptions. In addition, the cost impact and especially the saving potential are analyzed for different points in time – today, in 2026, and in 2028 in order to account for future market adoption, new processual features, and increasing economies of scale. The authors concluded that DLT based capital market infrastructures offer cost saving potentials of up to 120.4 basis points (hereinafter "*bps*") in 2028 for bonds with a maturity of eight years, representing a decrease in costs of more than 85% within the middle and back office processes compared to the existing capital market infrastructures without the usage of DLT. In addition, even today, there are cost saving potentials of up to 31.5 bps or 22.3%, respectively, depending on underlying scenario assumptions.

The conditional framework for a switch to DLT based capital market infrastructures is given, as in the EU and especially in Germany, the required solid regulatory and legal framework is implemented (or already decided to become implemented), and market adoption enabling scalability can be expected.

The analysis has shown that saving potentials are located within the middle office and back office processes, but rather unlikely in the front office processes. Especially if processes involve external settlement instructions of the TARGET2-Securities system (hereinafter "*Target 2*") and foreign investors, the existing costs of non-DLT capital market infrastructures are much higher compared to e.g., internal Target 2 settlement instructions and domestic investors only (141.4 bps vs. 73.1 bps over the lifetime of the bond) – and consequently, the saving potential amplifies as DLT is independent of such settlement instructions and investors' domiciles. Regarding the processes, the authors concluded the highest cost impact to lie in the processes of corporate actions and asset servicing, showing saving potentials of 75.1 bps. In addition, the processes of clearing and settlement, trade flow monitoring, depositary business, as well as security accounts offer significant saving potentials.

From a monetary perspective, this means the following: Putting aside all change costs incurred e.g., due to implementation efforts on the IT and business side, this would translate into significant cost savings and therefore an increase of profits before taxes for most affected market participants. For instance, the cost savings of 120.4 bps mentioned earlier (i.e., on average 15.1 bps per year) would create average savings for a bank of up to EUR 15 million per year[1] for every EUR 10 billion in assets under custody (hereinafter "*AuC*") assuming the bank provides all processes and captures the full cost potential. In fact, even in the very conservative first scenario that assumes highly desirable circumstances for the existing non-DLT capital market infrastructure processes, savings of 52.1 bps over the maturity of the bond or in average 6.5 bps per year could be achieved, creating higher profits before tax of EUR 6.5 million per year. Moreover, saving potentials are not limited to banks but expand to other market participants such as asset managers or large non-financial corporations using capital markets for refinancing purposes. For instance, taking advantage of DLT for their fund structures (asset managers) or bond issuances (corporations) allows for several direct and indirect costs savings, e.g., through the avoidance of certain intermediaries or through involved banks that pass on their own cost savings to their clients.

However, full potentials can only be captured with economies of scale as well as the complete utilization of DLT's possibilities. Especially a settlement of both sides, securities and fiat money, and the use stable coins (also for corporate actions), are crucial to create desired efficiency gains.

[1] Average savings per year based on the analyzed scenarios involving bonds' capital market infrastructures and bonds with a maturity of 8 years.

3. Motivation

The goal of this study is to deepen the understanding of the oftentimes promised, but so far rather vague efficiency advantages of DLT that are debated among asset managers, banks and treasury departments of large non-financial corporations.

Since the first appearance of the Bitcoin, DLT – and particularly the blockchain technology – became more and more used for different purposes. Especially the launch of the Ethereum blockchain in 2015[2] can be seen as the decisive event, when the foundation for a technical infrastructure for tokenized securities was created and smart contracts were introduced for the first time. Due to this technological innovation, also the financial industry is observing the DLT closely so that nowadays the DLT is one of the dominating topics in the capital markets. Therefore, not only the German legislator and German financial supervisory authority (hereinafter "*BaFin*") have taken steps to address the new technology (e.g. with the addition of "crypto assets" as financial instruments in the German Banking Act (*Kreditwesengesetz*) and the introduction of the German Electronic Securities Act (*Gesetz über elektronische Wertpapiere)* (hereinafter "*eWpG*")), but also beyond Germany's borders, different national and international regulatory frameworks were created. The most prominent steps recently taken are most likely the introduction of the Markets in Crypto Assets Regulation (hereinafter "*MiCAR*"), as a harmonized EU-wide regulation for various types of digital assets and the DLT pilot regime (hereinafter also "*DLTR*"), as a regulatory sandbox to evaluate risks and opportunities for trading and settlement of securities with the help of DLT. Not surprisingly, the use of DLT in capital markets is currently a prominent topic to conduct different studies.

Throughout the years, several papers have been published examining potential market expectations of digital assets, business cases for DLT, as well as efficiency gains in capital markets and potential cost savings when using DLT. Although these papers provide valuable information about expectations and potential efficiency gains, the papers appear to be exclusively based on a "top-down" approach. In the authors' opinion, in order to reasonably quantify the real impact of DLT usage within the capital markets, existing processes and foreseen future processes with DLT need to be analyzed using a "bottom-up" approach, otherwise it is hardly possible for involved parties to reliably assess business opportunities and strategic positioning.

Therefore, and as an increasing number of financial institutions, FinTech's, and other market participants are investing in DLT based infrastructure projects presumably without a profound cost basis, it is the authors' motivation to provide information about real cost impacts along the complete value chain of capital market infrastructure which can be expected when taking advantage of DLT and the provided regulatory framework for front, middle, and back office processes.

While the eWpG and DLTR provide a regulatory framework for a wide range of financial instruments (e.g., bonds, investment fund units[3], shares[4]), this paper outlines foreseeable cost impacts within bonds' capital market infrastructure as value chains highly differentiate between the different types of securities.

[2] Ethereum foundation blog, "Ethereum Launches", June 2015: https://blog.ethereum.org/2015/07/30/ethereum-launches (link as of October 16th, 2023); Additional information: For the first time Ethereum was described by Mr. Vitalik Buterin in his whitepaper in the end of 2013 before being initially launched in July 2015.
[3] Regarding the eWpG, investment funds units were introduced with its addendum "Verordnung über Kryptofondsanteile" („*KryptoFAV*") in July 2022.
[4] Regarding the eWpG, shares are supposed be added to the eWpG within its next addendum based on the current version of the German Future Financing Act (*Zukunftsfinanzierungsgesetz*).

4. Framework conditions

4.1. Regulatory environment

To efficiently assess the impact on cost structures using DLT for capital market infrastructure processes, the current regulatory environment needs to be considered. In the authors' opinion, for an integration of DLT within the processes, in particular the German eWpG as well as the EU-wide DLTR and the MiCAR need to be taken into account. Therefore, the most important aspects, and why they are relevant for the assumptions of the paper's cost analysis, will be outlined below.

It is important to note that the naming of DLT based securities (i.e. tokenized securities) differ between the different legal or regulatory frameworks. In addition, further definitions can be found in regulations not being addressed in the paper. For instance, the eWpG defines the term "crypto securities", whereas the DLTR only covers "DLT financial instruments". Moreover, there are also "security token sui generis" which are another form of digital assets being addressed by MiFID II[5]. The authors assume that a harmonization of terms will take place eventually. Therefore, in the following, the paper will generally address tokenized securities as a whole with the term "crypto securities". However, security token sui generis are excluded from the analysis, as in the authors' opinion, their scalability is currently not given due to security token sui generis' supposed lack of standardization and suitability for institutional investors.

4.1.1. eWpG

The eWpG is a German law that came into effect in June 2021[6]. The eWpG provides a legal framework for "electronic securities". According to the eWpG, an electronic security is a security that is entered into an electronic securities register instead of issuing a physical security certificate. The eWpG initially covered bearer bonds but was extended with certain types of funds with the introduction of the German regulation on crypto fund shares (*Verordnung über Kryptofondsanteile*) (hereinafter "*KryptoFAV*")[7]. In addition, it is planned that shares will also be covered in the eWpG as part of legal adjustments in the course of the German Future Financing Act (*Zukunftsfinanzierungsgesetz*)[8].

Besides different types of securities, the eWpG also distinguishes between the forms of electronic securities. The framework allows the following forms:

a) Electronic securities in form of central register securities (*Zentralregisterwertpapiere*) in accordance with §4 (2) which need to be registered in a central register in accordance with §12 eWpG. The Registrar of central register securities is either a central security depositary (hereinafter "*CSD*") or a custodian bank.

b) Electronic securities in form of crypto securities (*Kryptowertpapiere*) in accordance with §4 (3) eWpG which need to be registered in a crypto security register in accordance with §16 eWpG. The Registrar of crypto securities needs to be a crypto securities registrar.

Due to the eWpG's legal requirements of crypto security registers to be maintained on a forgery-proof recording system in which data is logged chronologically and stored protected against unauthorized deletion and subsequent changes, DLT is prone to be used as underlying technology.

[5] Markets in Financial Instruments Directive.
[6] German Federal Ministry of Justice (*Bundesministerium der Justiz*), "Gesetz über elektronische Wertpapiere (eWpG)", June 2021: https://www.gesetze-im-internet.de/ewpg/BJNR142310021.html#BJNR142310021BJNG000100000 (link as of October 16th, 2023).
[7] German Federal Ministry of Justice (*Bundesministerium der Justiz*), "Verordnung über Kryptofondsanteile* (KryptoFAV)", June 2022: https://www.gesetze-im-internet.de/kryptofav/KryptoFAV.pdf (link as of October 16th, 2023).
[8] German Federal Government (*Deutsche Bundesregierung*), "Entwurf eines Gesetzes zur Finanzierung von zukunftssichernden Investitionen", page 123, August 2023.

The eWpG is to be considered particularly relevant for the assumptions of the cost impact analysis due to the fact that the law provides a dedicated framework for bonds' capital market infrastructure processes using DLT and therefore provides clarity for financial institutions on how to use DLT in the capital markets so that cost derivations are possible.

4.1.2. DLTR

The DLTR, also known as DLT pilot regime, is a pilot regulation for DLT based capital market infrastructures. It is an EU-wide regulation that came into force in March 2023 and is intended to serve as a temporary "regulatory sandbox" for the trading and settlement of financial instruments based on DLT in order to evaluate potential risks and opportunities.[9] Within the framework of the DLTR, stocks, bonds and other approved debt instruments, as well as UCITS[10] fund units, can be traded and settled directly via the DLT within specified limits and exemptions from existing regulatory requirements[11].

Although the DLTR comes with limits in regard to volumes within the trading and settlement infrastructure, the DLTR is nevertheless relevant for the assumptions of the cost impact analysis, as it provides, as the first European-wide DLT based capital market trading and settlement infrastructure framework, the possibility to create DLT based capital market infrastructure processes with new opportunities (e.g., atomic settlement to address counterparty risk).

As outlined, the DLTR is on purpose a sandbox environment. However, the authors expect that after successful testing, the regulators will provide a final framework for trading and settlement based on DLT (including a harmonization of German and EU-wide differences such as the existence of a crypto security registrar) or will adjust existing frameworks accordingly (e.g., the CSDR[12] of CSDs regarding settlement requirements).

4.1.3. MiCAR

The MiCAR (sometimes also called "MiCA") is an EU-wide regulation for crypto assets that was approved by the European Parliament in April 2023 as part of the "Digital Finance Package"[13]. As the MiCAR is an EU-wide regulation, it is directly legally effective for all market participants in accordance with the Treaty on the Functioning of the European Union (*Vertrag über die Arbeitsweise der Europäischen Union*). It does not have to be converted into national law in contrast to an EU-wide directive.

The MiCAR differentiates between the following types of crypto assets[14]:

a) Electronic money tokens;

b) Asset-referenced tokens;

c) Utility tokens;

d) Other tokens that are not classified as asset-referenced tokens or e-money tokens.

Despite the fact that the MiCAR does not cover securities but rather foresees to establish a solid legal framework for crypto assets which are not yet covered by existing financial legislations, the MiCAR is

[9] European Securities and Markets Authority, "ESMA publishes report on DLT Pilot Regime", September 2022: https://www.esma.europa.eu/press-news/esma-news/esma-publishes-report-dlt-pilot-regime (link as of October 16th, 2023).
[10] Undertakings for Collective Investments in Transferable Securities.
[11] Information based on content of the regulation to the DLT Pilot Regime.
[12] Central securities depositories regulation.
[13] German Bundesbank (*Deutsche Bundesbank*), "MiCAR – Markets in Crypto-Assets Regulation", June 2023: https://www.bundesbank.de/de/aufgaben/bankenaufsicht/einzelaspekte/micar-markets-in-crypto-assets-regulation-799398#:~:text=Das%20Europ%C3%A4ische%20Parlament%20hat%20am,Mai%202023 (link as of October 16th, 2023).
[14] Information based on the Regulation (EU) 2023/1114 of the European Parliament and of the Council of 31 May 2023 on markets in crypto-assets, and amending Regulations (EU) No 1093/2010 and (EU) No 1095/2010 and Directives 2013/36/EU and (EU) 2019/1937.

nevertheless relevant for the assumptions of the cost impact analysis due to the fact that electronic money tokens are subject to the MiCAR. One of the key aspects for the creation of efficient DLT based capital market infrastructures is a DLT based settlement of both, crypto securities and fiat money. Currently, for the payments' side, electronic money tokens subject to the MiCAR are indispensable within the present regulatory environment. However, it is expected that a form of central bank digital currency will be an alternative for the payments' side in the future. As the time until introduction can currently not be reasonably estimated, the use of electronic money token in accordance with MiCAR is assumed for the cost impact analysis rather than the use of central bank digital currency.

4.2. Market potential

Even if there is an appropriate legal and regulatory framework, potential cost benefits cannot be achieved without participants willing to enter the respective market and an institutional-grade infrastructure which allows secure scalability. This also applies for DLT based capital market infrastructures. Therefore, in order to assess the reliability of the assumptions taken for the cost impact analysis, it needs to be evaluated if there is an appropriate market potential for crypto securities in form of bonds. It is important to note that the market potential is analyzed for bonds only due to the scope of the cost impact analysis. It is not taking into account other types of crypto securities which could be issued or traded within in the existing legal and regulatory frameworks. For instance, considering the market potential of shares, fund units, or structured products, the overall market potential of crypto securities would be tremendously amplified.

4.2.1. European market potential

For the European market, an increasing market interest can be recognized due to outstanding bond issuances such as the CHF 375 million bond by UBS AG[15] or the EUR 100 million bond by the European Investment Bank[16].

One approach for estimating the market potential is to derive the market by applying the assumed market adoption rate of crypto securities to the traditional European bond market. Taking a look at this market, one can find that the market for non-financial and financial corporate debt in the euro area amounted to EUR 10.1 trillion in the end of 2022 and was steadily increasing with an average growth rate of 3.7% per year over the last years since 2018[17]. Forecasting the historical average growth rate of 3.7% until 2030, the total bond market in the euro area would amount to EUR 13,592 billion[18]. The development is displayed in the figure below.

[15] UBS AG, "UBS AG lanciert die weltweit erste digitale Anleihe, die sowohl an Blockchain-basierten als auch an traditionellen Börsen öffentlich gehandelt und abgewickelt werden kann", November 2022: https://www.ubs.com/global/de/media/display-page-ndp/de-20221103-digital-bond.html (link as of October 16th, 2023).
[16] European Investment Bank, "EIB innovates further with Project Venus, the first euro-denominated digital bond on a private blockchain", November 2022: https://www.eib.org/en/press/all/2022-448-eib-innovates-further-with-project-venus-the-first-euro-denominated-digital-bond-on-a-private-blockchain (link as of October 16th, 2023).
[17] Bank for International Settlements, "Debt securities amounts outstanding, Euro area 20 – 2023": https://data.bis.org/topics/TDDS/tables-and-dashboards/BIS,SEC_C5_LOCAL,1.0?dimensions=REF_AREA%3A7L&time_period=2022-Q4 (link as of October 16th, 2023).
[18] The euro area serves as a conservative approximation for the European market.

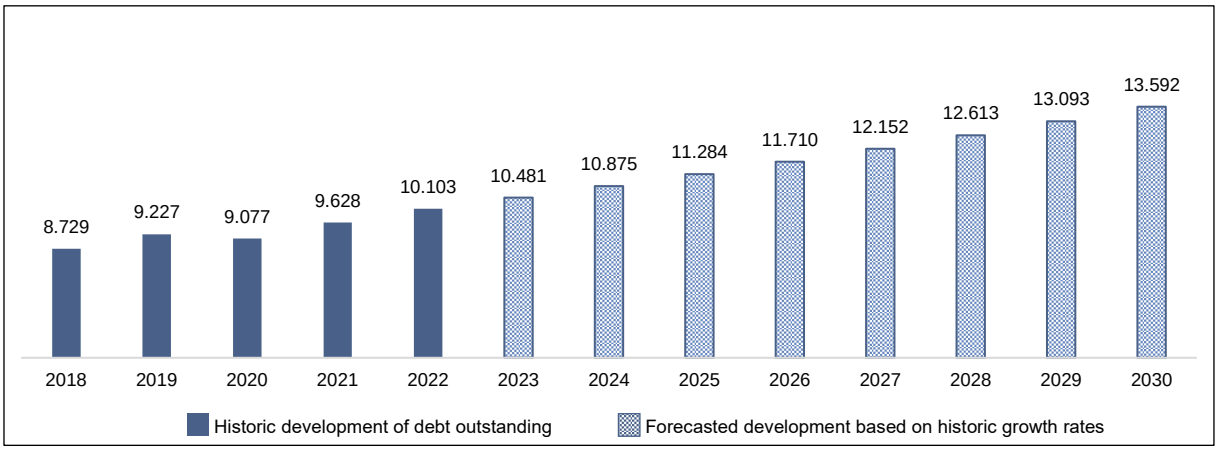

Figure 1: Outstanding amount of non-financial corporate and financial corporate debt in the Euro area (in billion euros)

The market adoption rate of crypto securities can be derived based on the current market expectations. HSBC and Northern Trust expect 5% to 10% of assets to be tokenized in 2030[19]. As these expectations are on a global scale, they, however, do not yet account for the current "competitive advantage" of the EU-wide regulatory environment, especially due to the MiCAR and the DLTR. Therefore, the authors assume the current potential of the European market adoption to even exceed the global market's potential. However, estimating the European market of crypto securities based on the provided expectations, one derives the potential to lie within the range of the scenarios displayed in the following figure.

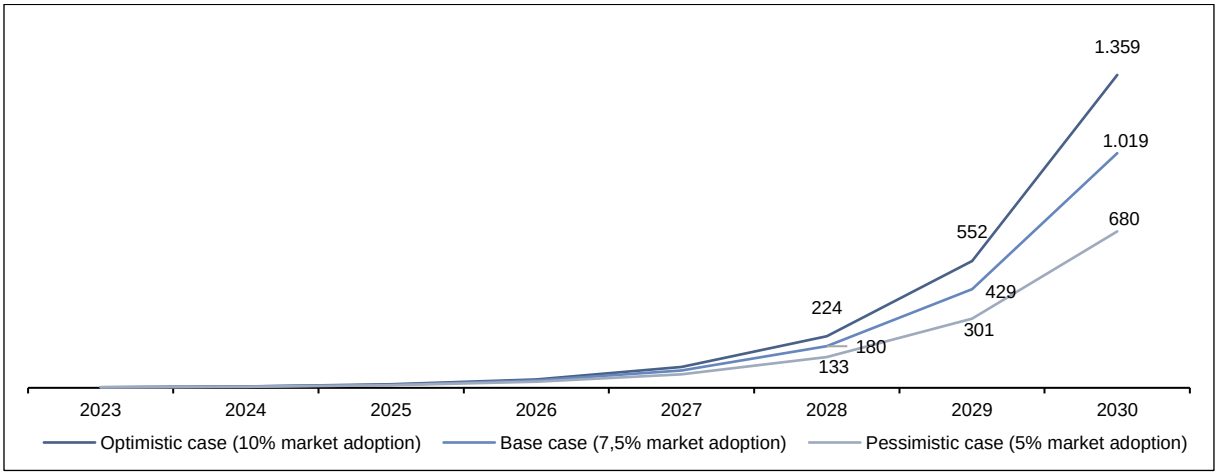

Figure 2: European market potential of bonds in form of crypto securities (in billion euros)

As displayed above, the authors assume the European market potential for non-financial corporate and financial corporate debt to lie within a range of EUR 680 and EUR 1,359 billion in 2030.

[19] Northern Trust Corporation & HSBC Bank Plc., "Beyond asset tokenization", page 11, January 2023.

4.2.2. German market potential

Similar to the European market, one can also recognize an increasing interest in crypto securities in Germany. This is, among others, underpinned by the issuances of the EUR 60 million bond of Siemens AG[20] and the first tokenized fund units by Bankhaus Metzler[21]. Once again, taking a look at the traditional bond market, one can find that the German market for non-financial and financial corporate debt amounted to EUR 1,873 billion in the end of 2022 and was steadily increasing with an average growth rate of 5.4% per year over the past few years since 2018[22]. Using the same approach of applying the historical average growth rate, one can forecast a market size for bonds in Germany of EUR 2,903 billion in 2030. The development is displayed in the figure below.

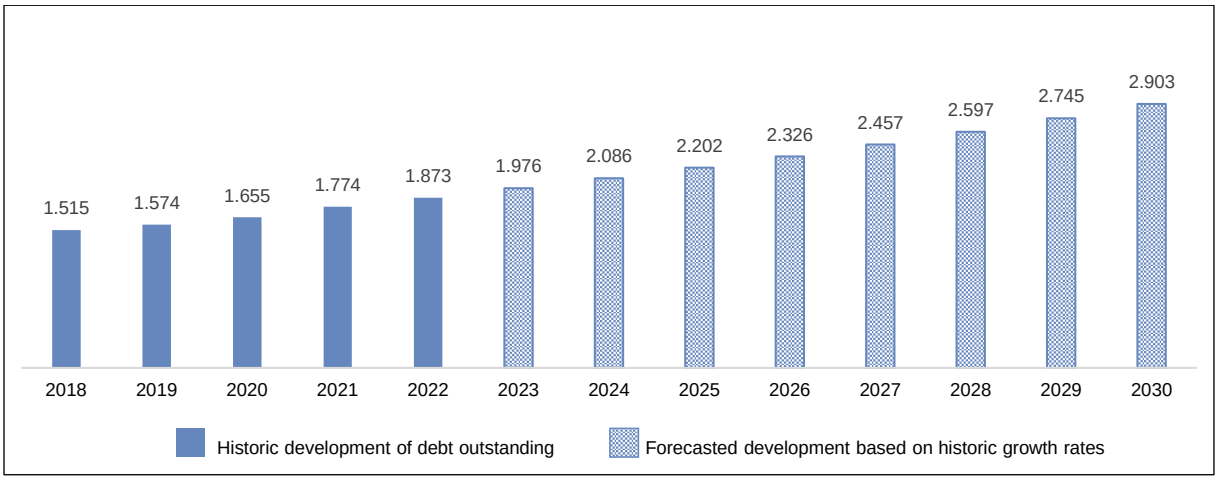

Figure 3: Outstanding amount of non-financial corporate and financial corporate debt in Germany (in billion euros)

Due to the even more advanced regulatory environment in Germany compared to the EU (Europe, respectively) and globally (especially due to the eWpG), one can expect the market adoption rate in Germany to be at least as high as the global and European adoption rate. For instance, DekaBank expects an adoption rate of 20% by 2027[23]. Estimating the German market of crypto securities based on the provided expectations of market adoption to be reached in 2030, one derives a potential of up to EUR 581 billion as displayed in the following figure.

[20] Siemens AG, "Siemens issues first digital bond on blockchain", February 2023: https://press.siemens.com/global/en/pressrelease/siemens-issues-first-digital-bond-blockchain (link as of October 16th, 2023).
[21] Bankhaus Metzler, "Metzler Asset Management begibt als erster Kryptofondsanteile in Deutschland", September 2023: https://www.metzler.com/de/metzler/asset-management/artikel-am/news/Metzler/MAM/Presse/230905-MAM-Kryptofonds (link as of October 16th, 2023).
[22] Bank for International Settlements, "Debt securities amounts outstanding", Germany: https://data.bis.org/topics/TDDS/tables-and-dashboards/BIS,SEC_C5_LOCAL,1.0?dimensions=REF_AREA%3ADE (link as of October 16th, 2023).
[23] Finanzbusiness, "DekaBank erwartet 20-Prozent-Anteil für Kryptowertpapiere binnen fünf Jahren", January 2022: https://finanzbusiness.de/nachrichten/sparkassen/article13677372.ece (link as of October 16th, 2023).

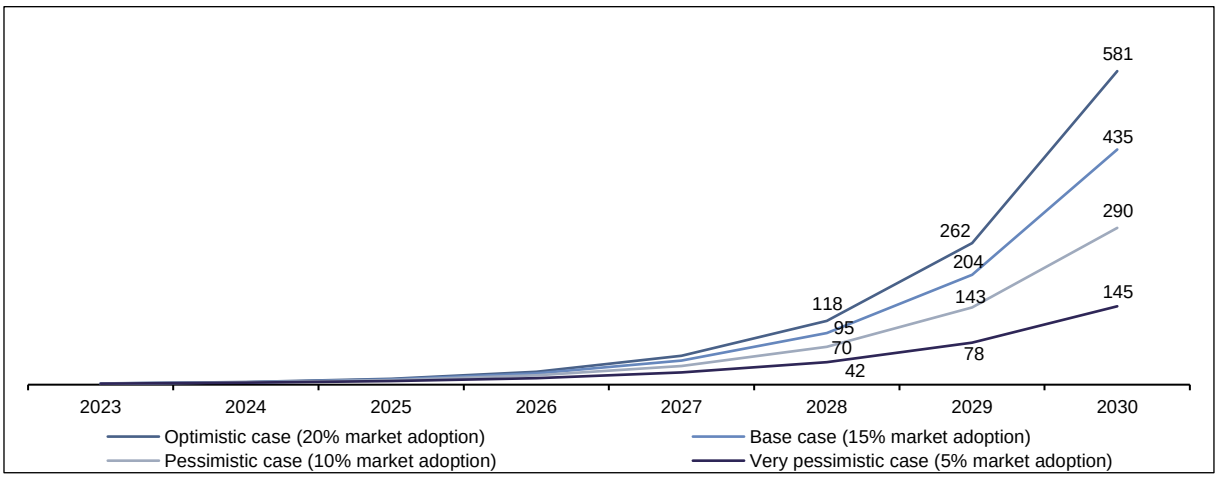

Figure 4: German market potential of bonds in form of crypto securities (in billion euros)

4.2.3. Conclusion of market potential

Based on market studies and expectations, sizes of existing bond markets, and the recent demonstrated interest of market participants, the authors conclude the required market potential and economies of scale for bonds in form of crypto securities to be sufficiently present. Therefore, the assumptions taken in the cost impact analysis are seen to be reliable. In fact, in the authors' opinion, the assumed market adoption rates for the European and German market might even be too conservative due to the existing regulatory and legal frameworks. The authors rather assume the regulatory and legal environment in the EU and Germany to accelerate the market adoption even more, magnifying the respective market potential and driving economies of scale. This assumption is also underpinned by the authors' personal experience. As part of their business activities and in the context of the expert interviews for this study, the authors observe a high level of dynamism, particularly among issuers of financial products. In the authors' opinion, industrial adoption will be driven by these players (because they provide the necessary volume structures) and that market growth can occur erratically in the next few years.

5. Quantitative cost impact analysis of DLT based capital market infrastructures

The following chapter will outline the paper's cost impact analysis which quantifies potential cost savings due to the influence of DLT in capital market infrastructures. For the purpose of the analysis, the relevant processes of a typical non-DLT capital market bond transaction were assessed and their involving costs are compared with a DLT based capital market infrastructure process in different points in time. In addition, since the processes' specific costs for non-DLT based capital market infrastructures depend on the underlying assumptions, different scenarios with differing assumptions were defined.

5.1. Assumptions

For a clear understanding of the results, it is crucial to know the authors' understanding of non-DLT based and DLT-based capital market infrastructures, respectively, the general assumptions taken for the analysis, and the scenarios the analysis is based on.

5.1.1. Non-DLT and DLT based capital market infrastructures and analyzed points in time

Timing of analysis

The authors analyze three different points in time for the DLT based capital market infrastructure – today, 2026, and 2028. The differentiation between shorter term and longer term evaluation is indispensable since the DLT based capital market infrastructure is still relatively young, with currently limited economies of scale due to comparatively low issuance volume. However, as the authors conduct the assessment of the cost impacts in different points in time, a presumably increasing market adoption over time and different levels of scalability of DLT based capital market infrastructures, including new processual possibilities, can be taken into account.

Non-DLT based capital market infrastructures

For the purpose of the analysis, a non-DLT based capital market infrastructure defines an infrastructure environment where no impact of DLT has entered into the financial market, yet. All processes are built in the current non-DLT setup, involving all relevant transaction parties and without any use of DLT. However, the current state-of-the art technology is assumed to be used. This includes, for example, application programming interface ("API") driven IT architectures, cloud technology, and central register securities which are electronic securities in accordance with the eWpG but not recorded with DLT. Nonetheless, non-DLT based capital market infrastructures still involve a central clearing system.

DLT based capital market infrastructures

A DLT based capital market infrastructure defines an infrastructure environment where capital market infrastructure processes are built with the help of DLT in the existing legal and regulatory frameworks (such as the eWpG). The degree of DLT usage is dependent on the analyzed point in time. Regarding technical and processual features, the following features are assumed for DLT based capital market infrastructure for the given times:

Feature	Feature feasible as of today	Feature feasible by 2026	Feature feasible by 2028
Technical features			
Full usage of smart contracts	X	X	X
Seamless blockchain bridging	X	X	X
Widely accepted, global standard protocols and token interface standards	X	X	X
Processual features			
Delivery vs. payment (hereinafter "*DvP*") via atomic settlement using stable coins (e-money token in accordance with MiCAR)		X	X
OTC trading in terms of private markets	X	X	X
Secondary market trading and settlement within the DLT Pilot Regime[24]		X	X
Provision of regulatory reporting information (e.g., MiFIR[25] reporting) to supervisory authorities directly via DLT			X
Securities' redemptions through token burning and the use of smart contracts	X	X	X
Automated interest calculation and interest payments in form of stable coins		X	X
Segregated accounts without the need of custodians are widely accepted by institutional investors			X

5.1.2. Further general assumptions

Solid regulatory and legal environment

The regulatory and legal environment is solid, meaning current legislations and regulations will be persistent and legal and regulatory extensions will come into force as currently intended (e.g., the DLTR will persist after the sandbox testing phase without the given restrictions). This is important in order to assume processes to be built within the current regulatory and legal framework without the need of further cost intensive adjustments later on.

Market adoption

Costs of specific processes in a DLT based capital market infrastructures are highly dependent on the market adaption of crypto securities so that corresponding service providers can take advantage of economies of scale. The authors assume the required market potential to be sufficiently given[26], and adoption can successively be achieved.

Technical infrastructure is available

For all scenarios, the authors assume required infrastructures to be already built. This means setup costs to build the necessary IT infrastructure for DLT based capital markets as, well as additional costs for changing the existing infrastructure, are not taken into account.

Negligible blockchain fees

It is assumed that DLT infrastructures are efficient and blockchain settlement costs are negligible low.

[24] The authors are aware of the multiple license applications being submitted to provide trading and/or settlement services under the DLT Pilot Regime. However, as so far there is no license granted yet, conservatively the authors assume secondary market trading fully functioning in 2026 rather than as of today.
[25] Markets in Financial Instruments Regulation.
[26] Please also see chapter 4.2.

No consideration of costs for custody of fiat money

The internal costs for the custody of fiat money are not taken into account for the analysis, for both the non DLT-based status quo as well as the DLT based capital market infrastructures, due to the complexity of reasonably quantifying existing costs as well as costs for the fiat reserves of the stable coins.

5.1.3. Scenarios' assumptions

Due to the fact that differing assumptions can have large effects on costs in the non-DLT based capital market infrastructure, the authors have evaluated two different scenarios with slightly differing characteristics. The scenarios' assumptions are displayed in the table below. The relevant differences are highlighted.

Scenarios' assumptions	Scenario 1	Scenario 2
Type of bond	Corporate bond	Corporate bond
Origin of issuer	Germany	Germany
Bond currency	EUR	EUR
Issuance volume	EUR 50 million	EUR 50 million
Tradability	Tradable on stock exchanges	Tradable on stock exchanges
Maturity[27]	8 years	8 years
Interest payment frequency	Annual interest payments	Annual interest payments
Type of interest rate	Fixed interest rate	Fixed interest rate
Number of investors	3,000	3,000
Origin of investors	100% investors domiciled in Germany	100% investors domiciled in Austria
Trading turnover[28] **in %**	10.0%	10.0%
Custodian's AuC[29]	EUR 85 billion, thereof German bonds: EUR 1.7 billion	EUR 85 billion, thereof German bonds: EUR 1.7 billion
Type of settlement money	Central bank money	Commercial bank money
Type of settlement instruction	Internal instruction in Target 2	External instruction against counterparties in Target 2

[27] In order to account for the impact of the bonds' maturity within the cost analyses, the maturity was derived by an analysis of outstanding German corporate bonds with fixed annual interest payments and an issuance volume of EUR 40 to 60 million based on information of Onvista media GmbH: https://www.onvista.de/anleihen/finder (information as of October 27th, 2023).
[28] Represents the share of issuance volume to be traded in average per year.
[29] Investors' custodian which is connected to the clearing system.

5.2. Methodology

The analysis was conducted using the methodology as displayed in the following figure.

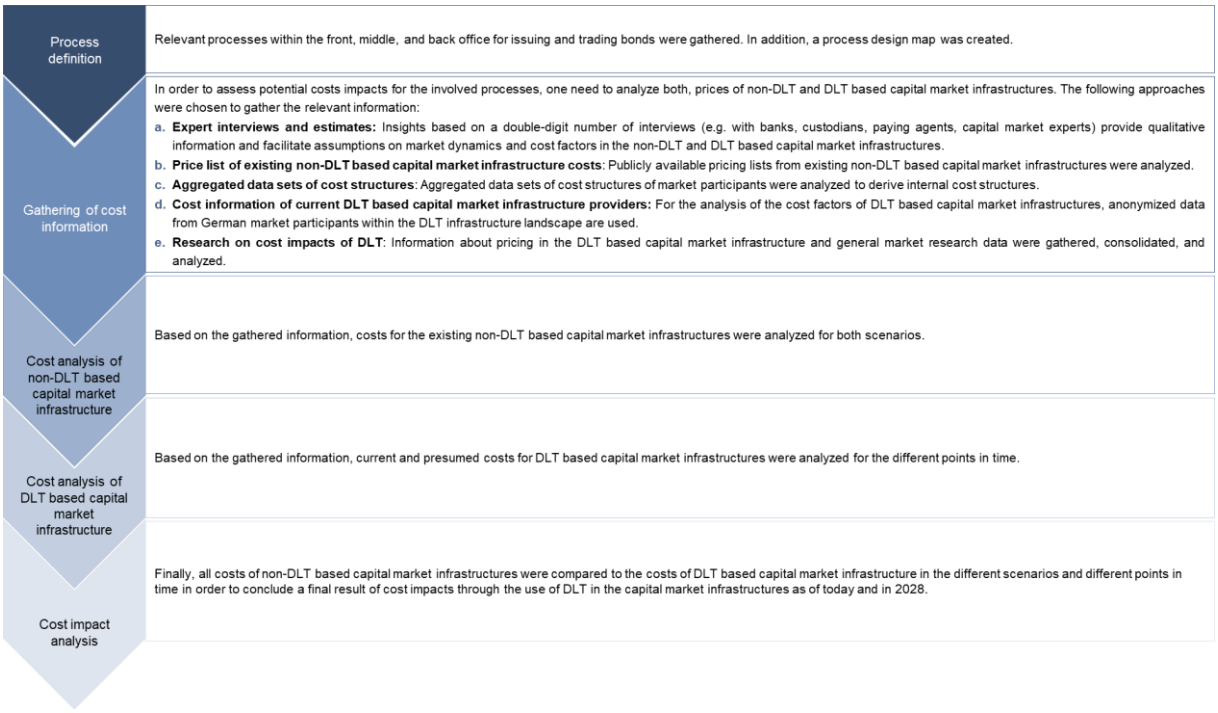

Figure 5: Methodology of cost impact analysis

The processes outlined in more detail in the subsequent chapters are based on their degree of cost impact. Processes with high cost impact (i.e. with high cost saving potential) will be outlined in more depth than processes with medium cost impact. Business processes with low or no/negligible cost impact are not described any further due to the marginal difference between non-DLT and DLT based capital market infrastructures.

5.3. Cost impact analysis

5.3.1. Processes

As already mentioned, the cost impact analysis was conducted based on the relevant involved processes of the front, middle, and back office for bonds' capital market infrastructures. The analyzed processes are displayed in form of a simplified process map in the following figure.

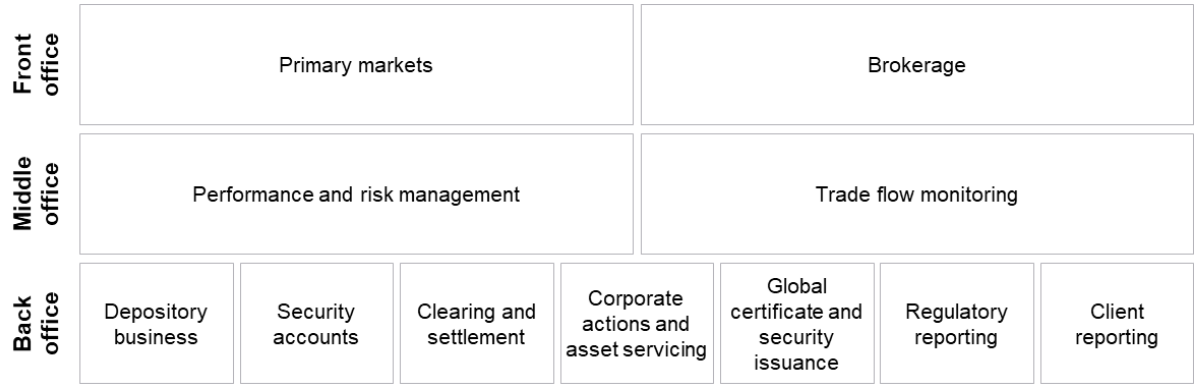

Figure 6: Simplified process map

In order to reasonably assess cost impacts, one needs to have a good understanding of how the processes look like in a non-DLT and a DLT capital market infrastructure. To provide a better comprehension of derived cost impacts, the following subchapters outline the authors' understanding of the processes in both the non-DLT and the DLT based capital market infrastructure on a high level.

5.3.1.1. Front office processes

Primary Market	
Current processes in non-DLT based capital market infrastructures	**Potentially implemented processes in a DLT based capital market infrastructure if reasonable from cost perspective[30]**
Primary markets services involve, among others, the cost positions origination, syndication, and placement which comprise the identification, assessment, and processing of newly issued bond securities. These processes are primarily conducted by investment banks as well as specialized law firms and include e.g., product structuring, guaranteed placement, sale of the bond and the assurance of both regulatory compliance, and water-proof contract clauses. In contrary to other costs, primary market costs only apply once (around inception and subscription of the security).	As primary market services involve highly discretionary processes whose success is still dependent upon human interaction, networking, and personal trust, the authors observe DLT to be difficult to be applied. While DLT certainly makes it technically possible to circumvent placement agents (through issuers directly placing their securities), in the foreseeable future, the authors doubt issuing clients permanently wanting to build the necessary know-how, relationships to investors, and take additional risk (both legally and in terms of sales coverage).

Brokerage	
Current processes in non-DLT based capital market infrastructures	**Potentially implemented processes in a DLT based capital market infrastructure if reasonable from cost perspective**
Brokerage services comprise trading in the secondary market (in contrast to bonds' sale in the primary market). Brokerage is mostly done in form of the financial commission business (*Finanzkommissionsgeschäft*) and involves among others pre-order analytics, order initiation (single, bulk), order maintenance, order routing (manual, automated, smart), and order execution.	As for the brokerage services, the authors see a greater applicability of DLT, but the reaping of significant cost advantages is prevented simply because of the fact that today's non-DLT brokerage services are already highly automated and efficient. Therefore, capturing additional cost advantages is complicated and most likely marginal.

5.3.1.2. Middle office processes

Performance and risk management	
Current processes in non-DLT based capital market infrastructures	**Potentially implemented processes in a DLT based capital market infrastructure if reasonable from cost perspective**
Performance and risk management comprises, among others, the following tasks: Risk parameter maintenance, daily revaluation of positions, profit and loss monitoring, as well as the management of market and other risks.	Existing processes can be replicated in the way they exist but with the use of DLT. However, risk management always involves human interaction even if processes are highly automized. In the authors' opinion, cost savings can most likely be captured indirectly by taking a look into the overall risk reduction (e.g., counterparty risks), corresponding risk weighted assets and costs related to required own funds. However, a risk analysis is not in scope of the analysis. Therefore, the related indirect benefits are consequently not taken into account.

[30] Reasonable means that in the authors' opinion cost advantages are predominant to implementation costs and risk of switching to DLT bases capital infrastructure processes. Outlined processes represent the assumed setup in 2028.

Trade flow monitoring	
Current processes in non-DLT based capital market infrastructures	**Potentially implemented processes in a DLT based capital market infrastructure if reasonable from cost perspective**
Trade flow monitoring comprises, among others, the following tasks: Deal confirmation, reconciliation and investigations. This includes in particular the assurance that the trade is properly carried out within the agreed terms (incl. price, dispute resolution, payment, and delivery oversight). In non-DLT based capital market infrastructures, trade flow monitoring is carried out on different ledgers for assets and fiat money and therefore has to be reconciled on different systems.	Using DLT, assets and fiat money are brought to the same ledger and have trade participants querying data from the same single source of truth (the distributed ledger). In addition, the success of deals is visible for all participants directly form the ledger.

5.3.1.3. Back office processes

Depository business	
Current processes in non-DLT based capital market infrastructures	**Potentially implemented processes in a DLT based capital market infrastructure if reasonable from cost perspective**
Fees for safekeeping and storing deposits (stand alone, does not contain fee for security accounts or the global certificate and issuance that the custodian pays to the clearing system as well as other fees that the custodian pays to the clearing system for clearing and settling). Represents costs that only the custodian bears (internal costs).	In DLT based capital market infrastructures costs comprise internal fees of a crypto custodian including e.g., personnel overhead costs as well as costs for relevant custody systems.

Security accounts	
Current processes in non-DLT based capital market infrastructures	**Potentially implemented processes in a DLT based capital market infrastructure if reasonable from cost perspective**
Fees borne by the custodian for safekeeping and maintenance of the security accounts at the clearing system.	As security accounts are not required anymore, the clearing systems (and its fees) will be replaced with a service provider being in charge of the securities' registers (e.g., crypto security registrar in accordance with German Banking Act or a DLT-SS/DLT-TSS[31], respectively, in accordance with the DLTR).

Clearing and settlement	
Current processes in non-DLT based capital market infrastructures	**Potentially implemented processes in a DLT based capital market infrastructure if reasonable from cost perspective**
Process of clearing and settling the bonds and the fiat money in form of DvP with the clearing system. Costs that are borne by the custodian.	Clearing and settlement is directly done on the DLT based capital market infrastructure without the need of a certain clearing system, as DvP can be ensured by dedicated smart contracts and stable coins within an appropriate regulatory framework (e.g., DLTR).

[31] A DLT-SS is a settlement system in accordance with the DLTR. A DLT-TSS is a trading and settlement system in accordance with the DLTR.

Corporate actions and asset servicing	
Current processes in non-DLT based capital market infrastructures	**Potentially implemented processes in a DLT based capital market infrastructure if reasonable from cost perspective**
The process of corporate actions and asset servicing includes, among others (e.g. bondholder meetings, bond increases, structural changes of the issuer, etc.), coupon payments to investors under the bonds as well as redemption of the bonds under involvement of the paying agent and the clearing system.	Corporate actions and asset servicing such as coupon payments and redemptions will be automatically executed by smart contracts and paid in stable coins without the involvement of paying agents or clearing systems. In addition, costs involve costs of the crypto registrar for e.g., ad-hoc corporate actions.

Global certificate and security issuance	
Current processes in non-DLT based capital market infrastructures	**Potentially implemented processes in a DLT based capital market infrastructure if reasonable from cost perspective**
The process of "global certificate and security issuance" comprises costs related to the custody of the global certificate in regards to the bond's issuance as well as ongoing fees (even if there is no physical global certificate).	Many cost positions of the non-DLT based capital market infrastructures are no longer relevant in DLT based capital market infrastructures. Only required cost positions such as costs for ISINs[32] persist.

Regulatory reporting	
Current processes in non-DLT based capital market infrastructures	**Potentially implemented processes in a DLT based capital market infrastructure if reasonable from cost perspective**
Regulatory reporting comprises reporting requirements such as in accordance with MiFID II or MiFIR. Costs are generated by required systems (e.g., ARMs[33]) and personnel overhead.	The process of regulatory reporting can eventually be digitized in a way that regulators can be connected to distributed ledgers and automatically read information out of these systems so that an additional reporting system is unnecessary, and personnel overhead can be reduced.

Client reporting	
Current processes in non-DLT based capital market infrastructures	**Potentially implemented processes in a DLT based capital market infrastructure if reasonable from cost perspective**
Client reporting consists, among others, of processes like tax reporting or client statement reporting. Costs are primarily generated by required systems and personnel overhead (e.g., for ad-hoc requests from clients or due to controlling functions).	Existing processes can be replicated in the way they exist but with the use of DLT. However, in the authors' opinion, as processes are already very automated, cost saving potentials are limited and existing overhead costs most likely will not be replaced on a significant scale.

5.3.2. Cost analysis of existing non-DLT based capital market infrastructures

After having created the respective process map for relevant bonds' capital market infrastructure processes, and after gathering cost information, the authors analyzed costs of the existing non-DLT based infrastructures for both scenarios. The results of the overall costs over the lifetime of the bonds are displayed in the following figure[34].

[32] International Securities Identification Number.
[33] ARM stands for "Approved Reporting Mechanism". ARMs are entities providing the service of reporting details of transactions to competent authorities or the European Securities and Market Authority on behalf of investment firms.
[34] Primary market costs represent a one-time fee. All other costs represent recurring costs and are aggregated over the lifetime of the bonds (8 years).

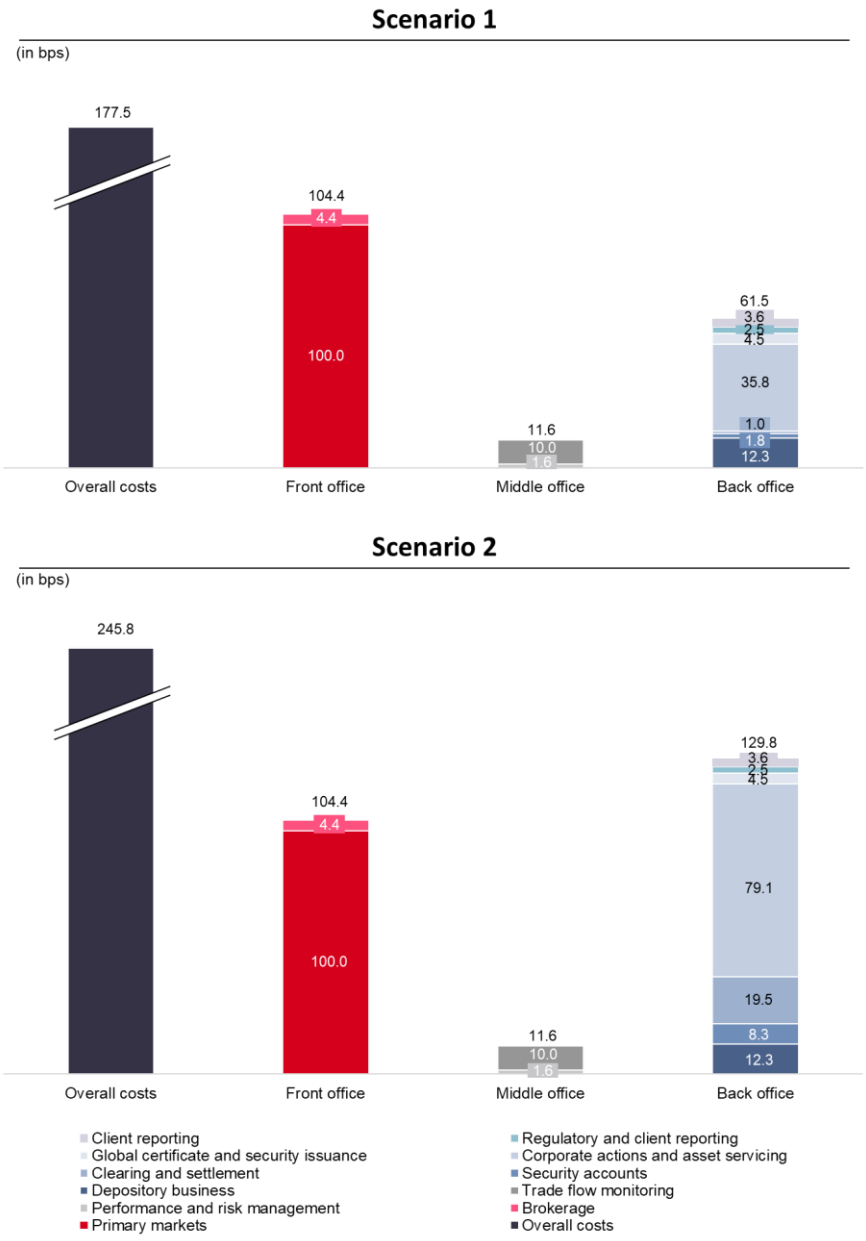

Figure 7: Costs of existing non-DLT capital market infrastructure processes in scenario 1 and scenario 2 (in bps)

As it can be observed from above, the split of costs between front office versus middle and back office is roughly split but sightly tilted to the front office in scenario 1 (58.8% vs. 41.2%). In scenario 2, however, the costs of middle office and back office exceed the front office's costs (42.5% vs. 57.5%). This is due to significantly higher costs within the processes "corporate actions and asset servicing", "clearing and settlement" and "security accounts". Especially corporate actions and asset servicing costs have a tremendous impact as for bonds involving external instructions against counterparties in the Target 2 system, costs are more than double compared to bonds involving internal instructions in Target 2. In addition, also clearing and settlement as well as security accounts are priced differently by existing market participants.

Although front office costs account for approximately 40 – 60% of all costs, they will not be considered for the cost impact analysis further on. This decision is due to the authors' opinion that it is highly unlikely for the front office processes "primary market" and "brokerage" to be replaced by DLT based processes.

This limitation arises from the limited applicability within primary market processes and the degree of given efficiency within non-DLT based brokerage processes. In contrast, middle and back office processes are often still set up inefficiently, offering significant potential for improvement. In addition, current processes involve oligopolistic market structures where the use of DLT is far more compelling as it can be applied to a great extent and intermediaries can be replaced.

5.3.3. Cost analysis of DLT based capital market infrastructures

After having analyzed the current costs of non-DLT based capital market infrastructures, the costs of DLT based capital market infrastructure were assessed for different points in time. A distinction between the different scenarios is not required, as two of the large advantages of DLT are the irrelevance of geographical borders and a uniform technology which is independent of limitations in regard to the type of settlement money and instructions. Consequently, the costs of DLT based capital market infrastructure in both scenarios are the same and the only difference is given by the point in time. The assumed costs (in bps) are displayed in following figure.

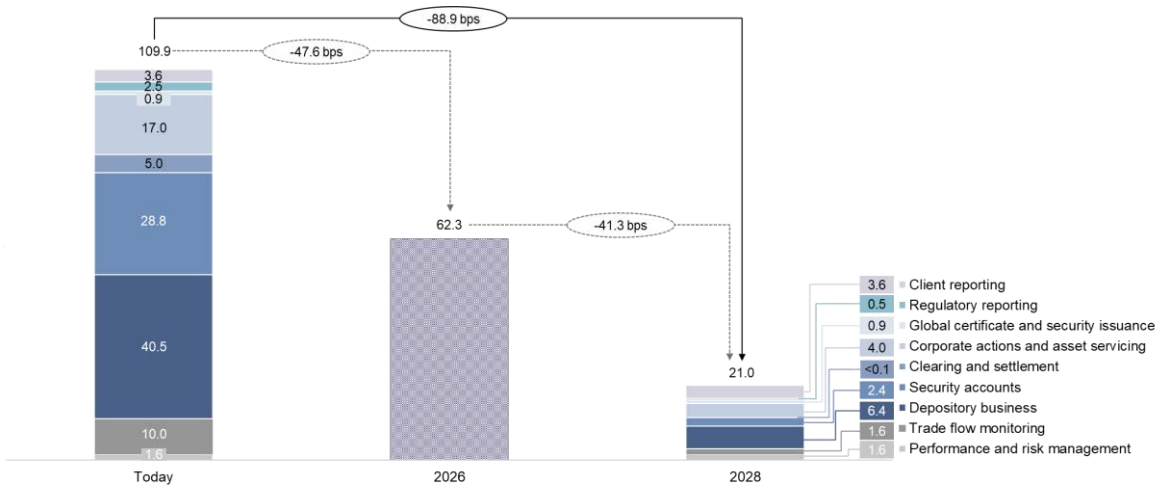

Figure 8: Costs of DLT based capital market infrastructures in 2026, in 2028, and as of today (in bps)

As it can be observed, there is a huge reduction in costs from today to 2028 by 88.9 bps or 80.9%, respectively. However, more than half of these cost benefits can already be captured in the short term by 2026 due to new processual features[35].

The largest reduction between the DLT based capital market infrastructures of today and 2028 can be recognized in the processes of depositary business and security accounts, primarily driven by the fact that the positions are currently still more expensive than the existing non-DLT based processes due to the missing economies of scale of crypto securities as of today.

5.3.4. Result of the cost impact analysis

Having analyzed the costs of non-DLT and DLT based capital market infrastructures, one is able to compare the results and assess the given impacts. The results are displayed (in bps) in the following two figures for both, scenario 1 and scenario 2.

[35] Please also see chapter 5.1.1

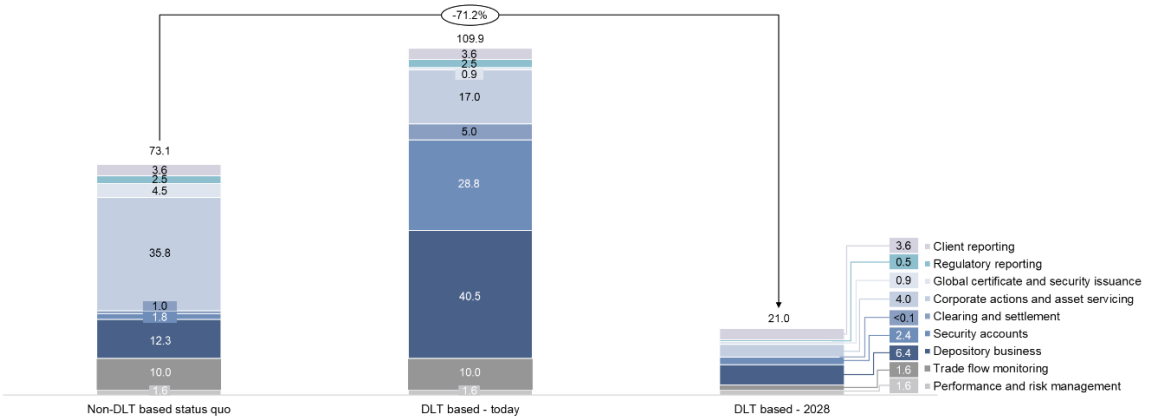

Figure 9: Cost impact analysis of scenario 1 (in bps)

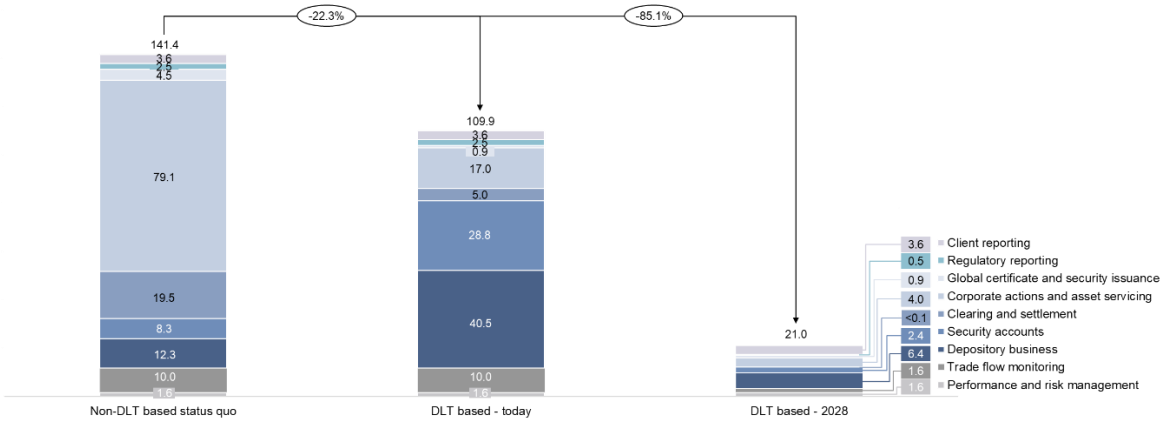

Figure 10: Cost impact analysis of scenario 2 (in bps)

As one can observe from the above figures, using DLT amounts to total cost savings of roughly 71.2% in 2028 for scenario 1. These findings of cost saving potential are further confirmed – and amplified – in scenario 2, which incorporates a bond issuance involving external instructions against counterparties in the Target 2 system and foreign investors. In scenario 2, total cost can be reduced by 85.1% in 2028 and even today the use of DLT already shows a savings potential of 22.3%. This is a large increase compared to the bond of scenario 1. This increase in savings potential is based on the significantly higher cost base of scenario 2 in today's non-DLT based capital market infrastructures[36], as due to the technological characteristics of DLT based transactions, transfers between different countries – regardless of their settlement characteristics – impose in contrast to non-DLT based capital market infrastructures no differences in terms of both costs and processes.

One result to be furthermore highlighted is the impact of corporate actions and servicing. Results have shown that even in scenario 1, the costs can be reduced by more than 50% already today. This finding is especially valuable due to the size of the process' share of total costs.

5.3.5. Drivers of the cost impact analysis

For a better understanding of the cost impacts, the drivers behind them are outlined below. As mentioned, processes with high cost impact will be outlined in more depth than processes with medium cost

[36] Please also see chapter 5.3.2.

impact. Business processes with low or no/negligible impact are not described any further due to the marginal difference between non-DLT and DLT based capital market infrastructures.

5.3.5.1. Processes' degree of cost impacts

In the first place, the degrees of cost impact levels need to be defined by using thresholds. The authors have set the thresholds for low, medium and high cost impacts to show cost savings in the DLT-based capital market infrastructure in 2028 compared to at least one of the scenarios' non-DLT based status quo as follows:

- Low cost impact: More than 2.0 bps compared to the status quo
- Medium cost impact: More than 5.0 bps compared to the status quo
- High cost impact: More than 15.0 bps compared to the status quo

The following figure displays the simplified process map as shown above including the processes' degree of cost impact and the table below summarizes the saving potential.

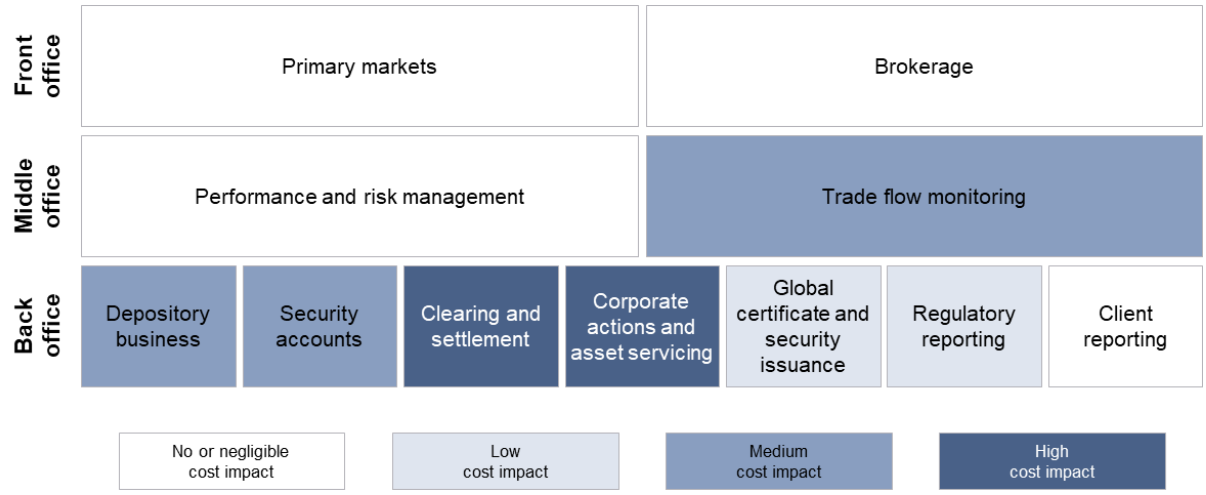

Figure 11: Simplified process map including degree of cost impacts

Process	Degree of cost impact	Cost saving potential (in bps)
Front office		
Primary markets	No or negligible impact	-
Brokerage	No or negligible impact	-
Middle office		
Performance and risk management	No or negligible impact	-
Trade flow monitoring	Medium cost impact	8.4
Back office		
Depository business	Medium cost impact	5.9
Security accounts	Medium cost impact	5.9
Clearing and settlement	**High cost impact**	**19.5**
Corporate actions and asset servicing	**High cost impact**	**75.1**
Global certificate and security issuance	Low cost impact	3.6
Regulatory Reporting	Low cost impact	2.0
Client Reporting	No or negligible impact	-

5.3.5.2. Processes with high cost impact

Corporate actions and asset servicing

The highest cost impact is given in the process of corporate actions and asset servicing. This is due to the fact that existing pricing tables of CSD´s and expert interviews have shown quite significant fees for corporate actions and asset servicing (e.g., costs for redemption or coupon payments). Using DLT, especially through smart contracts, certain servicing tasks can be fully automated as the security itself conducts the required task. For instance, coupon payments can automatically be distributed to investors' wallets in form of stable coins when they are due without service providers to be involved. Moreover, smart contracts even expand into more sophisticated corporate actions such as the handling of call and put options (automatically redeeming or selling the bond once certain pre-defined conditions are met), the conversion of convertible bonds or automatically carrying out a pre-defined processes in connection to the unexpected downgrade of a bond (e.g., imposing additional margin requirements, automatic redemption, risk model adaptations etc.). Tasks which cannot be automized, create costs on the crypto registrar's side.

In numbers, the cost can presumably be reduced from 35.8 bps to 4.0 bps in scenario 1 and even 79.1 bps to 4.0 bps in scenario 2. Therefore, the overall cost structure can be reduced significantly. However, to completely capture the full savings advantage, it is indispensable to provide payments for interest and redemptions with DLT. That means, not only the securities but also the fiat money side need to be processed with DLT. This can be done with the use of stable coins.

Clearing and settlement

Clearing and settlement is one of the processes with the highest cost difference between scenario 1 and scenario 2. Although costs are only marginal in clearing and settlement structures with internal Target 2 instructions and only involving domestic investors (1.0 bps), the costs significantly increase if settlements involve external Target 2 instructions as well as if they involve foreign investors (19.5 bps). Using DLT based capital market infrastructures, the entire clearing and settlement process chain will change significantly and will be independent of Target 2 instruction types and investors' domicile. On the one hand, clearing will not be required at all anymore if settlement of both legs is done using DLT, as settlement contracts will only execute when transaction requirements (e.g., sufficient assets or funds) are fulfilled[37]. On the other hand, DvP settlement processes are fully automated through smart contracts and the usage of stable coins.

Through the radical change and redundancy for clearing (if not explicitly desired), the costs can almost be fully erased (less than 0.1 bps) but not completely due to blockchain fees leading to a reduction of costs by more than 99%[38].

5.3.5.3. Processes with medium cost impact

Trade flow monitoring

Trade flow monitoring mainly covers deal confirmation, reconciliation and investigations. Thus, it is predestined for DLT. The reason is mainly due to omitted coordination processes that ensure that trades are carried out properly within the agreed terms (incl. price, dispute resolution, payment and delivery oversight).

In non-DLT based capital market infrastructures, the process needs to be done on different ledgers for the securities' and fiat money's side. As the ledgers usually involve different systems, the information needs therefore be reconciled between the different banking systems. Through the harmonization of the

[37] In DLT based capital market infrastructures, a clearing can also be involved, if desired.
[38] The cost reduction assumes the usage of efficient blockchains with correspondingly low blockchain transaction fees.

data source by bringing the securities and the fiat money to the same ledger in DLT-based capital market infrastructures, and consequently enabling trade participants query data from the same single source of truth (the distributed ledger), the impact on costs and efficiency is significant. For instance, the authors want to highlight information provided by one of the interviewed parties that completely outsources these activities and currently has high costs of up to 2 bps per year. These costs can be reduced to 0.2 bps per year offering a savings potential of 1.8 bps per year and a total savings potential of 14.4 bps over the lifetime of the bond – even in scenario 1. The remaining costs comprise costs for personnel overhead for controlling functions or ad-hoc monitoring controls.

Depositary business

Costs of the depositary business comprise internal costs of the custodian, excluding the fees charged by the clearing system to the custodian. In the DLT-based capital market infrastructures, new costs of a crypto custodian for e.g., personnel overhead costs as well as costs for relevant custody systems need to be taken into account. In addition, the costs of the custodian persist as long as segregated accounts are not widely accepted. In 2028, when it is assumed that this is the case, only the costs of the crypto custodian persist which furthermore are highly reduced due to economies of scale. In numbers, the costs can be reduced from up to 12.3 bps to 6.4 bps, offering a cost reduction potential of approx. 48%. However, due to the still low issuance volumes and the costs of the crypto custodian in addition to the costs of the regular custodian, the processes are still more expensive than in non-DLT based capital markets as of today.

Security accounts

Security accounts comprise fees borne by the custodian for safekeeping and maintenance of the security accounts at the clearing system. The amount of fees highly depends on several characteristics such as the size of the custodian and amount of up to 8.3 bps. As security accounts are not required anymore in DLT based capital market infrastructures, the clearing systems (and its fees) will be replaced with the costs of service providers being in charge of the securities' registers (e.g., crypto security registrar in accordance with German Banking Act or a DLT-SS/DLT-TSS, respectively, in accordance with the DLTR). These costs are estimated by market participants to only amount to 2.4 bps in 2028 offering a cost reduction potential of 5.9 bps or 71% respectively. However, due to the still low issuance volumes, the processes are still more expensive than in non-DLT based capital markets as of today.

5.3.6. Sensitivity analysis of scenarios' assumptions

Naturally as demonstrated by the two different scenarios, the cost saving potential per bond is highly dependent on the circumstances. In order to account for this aspect, a sensitivity analysis for euro-dominated German corporate bonds with fixed interest payments was conducted. The analysis highlights the impact if single assumptions are changed while everything else remains the same. The results are summarized in the figure below.

Issuance volume	The **higher** the bond's **issuance volume,** the **higher** the cost savings due to larger economies of scale as cost reductions in the non-DLT world are outweighed.
Maturity	The **longer** the bond's **maturity**, the **higher** the total cost savings potential due to higher recurring cost within the middle, and back office.
Interest payment frequency	The **higher** the **interest payment frequency**, the **higher** the savings potential due to higher cost savings within the process of corporate actions and asset servicing.
Number of investor	The **higher** the **number of investors**, the **higher** the savings potential due to higher costs savings in particular within the processes of clearing and settlement as well as corporate actions and asset servicing.
Origin of investor	Costs differ based on the origin of investors. In general, the **more investors with foreign domiciles**, the **higher** the cost savings potential in particular within the processes of corporate actions and asset servicing.
Trading turnover	The **higher** the **trading turnover**, the **higher** the savings potential due to higher costs savings within the processes of clearing and settlement.
Custodian's AuC	The **less** the **custodian's AuC**, the higher the savings potential due to **higher** cost savings in particular within the processes of security accounts.
Type of settlement money	The **higher** the **share of settlements with commercial bank money**, the **higher** the cost savings in particular within the processes of clearing and settlement.
Type of settlement instruction	The **more external instructions against counterparties in Target 2**, the **higher** the cost savings in particular within the processes of clearing and settlement.

Figure 12: Sensitivity analysis of scenarios' assumptions

6. Conclusion

We conclude in our cost impact analysis on bonds that DLT based capital market infrastructures provide significant cost savings potential for market participants. This conclusion is based on information gathered through expert interviews, existing price lists, aggregated data sets of market participants, current cost information on DLT based capital market infrastructure providers, and research. The conditional framework for a switch to DLT based capital market infrastructures is also given, as in the EU and especially in Germany, the required solid regulatory and legal framework is implemented (or already decided to become implemented), and increasing market adoption enabling scalability can be expected.

The cost Impact analysis has shown that saving potentials are located within the middle office and back office processes, but rather unlikely in the front office processes. The potential in front office processes is limited due to the nature of primary market processes and only little applicability of DLT, as well as the degree of given efficiency within non-DLT based brokerage processes. In contrast, middle and back office processes are often still set up inefficiently offering a lot of room for improvement when using DLT. Especially if external Target 2 settlement instructions and foreign investors are involved, processes can be set up more efficiently and saving potentials can be captured.

The authors conclude the highest cost saving potential to lie in the corporate actions and asset servicing processes. In addition, the processes of clearing and settlement, trade flow monitoring, depositary business, as well as security accounts offer significant saving potentials. However, full potentials can only be captured with economies of scale as well as the complete utilization of DLT's possibilities. Especially a settlement using DLT of both sides, securities and fiat money using stable coins, are crucial to create the desired efficiency gains. In the authors' opinion, by latest in 2028 the market should sufficiently take advantage of these features so that efficiency gains can be achieved, and economies of scale can release its full potential with increasing market adoption. However, also until 2026, several required features are expected to become available so that large efficiency gains can be captured. In addition, even already today using DLT can save costs depending on the circumstances and especially for certain processes such as corporate actions and asset servicing, DLT is prone to reduce organizations' existing costs significantly already in the short term.

In light of these results, we believe that market participants should evaluate appropriate actions at an early stage to move towards capturing the demonstrated potential:

1) **Impact analysis:** Assessment of the potential impact of DLT on the company's current and future operating model and strategic positioning
2) **Use Case identification:** Defining a set of possible revenue and/or efficiency use cases
    a. Revenue Use Cases: Are there new revenue streams to be captured with DLT (e.g. tapping into new customer segments, implementing a new pricing strategy)?
    b. Efficiency Use Cases: Are there viable opportunities to improve the P&L through the usage of DLT in production / within the operating model?
3) **Market-entry scenario analysis:** Defining various market entry scenarios and subsequent evaluation of these, based on the greatest possible added value for the company
4) **POC:** Conduct a POC to gather experience and gain insights
5) **Target-Operating-Model:** Adaption of the operational and organizational structure of the company (e.g. IT-architecture, regulatory framework, organizational structure, business processes etc.) in order to achieves its intended added value
6) **Decision to scale:** Prepare the necessary strategic decisions to use DLT at scale – including a compelling investment and product roadmap

7. List of abbreviations

Abbreviation	Meaning
API	Application programming interface
ARM	Approved Reporting Mechanism
AuC	Assets under custody
BaFin	German Federal Financial Supervisory Authority (*Bundesanstalt für Finanzdienst-leistungsaufsicht*)
bps	Basis points
CSD	Central security depositary
CSDR	Central security depositary regulation
DvP	Delivery vs. payment
GDP	Gross domestic product
DLT	Distributed ledger technology
DLT-SS	Settlement system in accordance with the DLTR
DLT-TSS	Trading and settlement system in accordance with the DLTR
DLTR	Regulation on the DLT Pilot Regime
eWpG	German Electronic Securities Act (*Gesetz über elektronische Wertpapiere)*
EU	European Union
EUR	Euros
ISIN	International Security Identification Number
KryptoFAV	German regulation on crypto fund shares (*Verordnung über Kryptofondsanteile*)
MiCAR	Markets in Crypto-Assets Regulation
MiFID II	Markets in Financial Instruments Directive
MiFIR	Markets in Financial Instruments Regulation
P&L	Profit and Loss
POC	Proof of Concept
UCITS	Undertakings for Collective Investments in Transferable Securities
USD	US dollars

8. Sources

Bank for International Settlements, “Debt securities amounts outstanding, Euro area 20 – 2023”: https://data.bis.org/topics/TDDS/tables-and-dashboards/BIS,SEC_C5_LOCAL,1.0?dimensions=REF_AREA%3A7L&time_period=2022-Q4 (link as of October 16th, 2023)

Bank for International Settlements, “Debt securities amounts outstanding, Germany”: https://data.bis.org/topics/TDDS/tables-and-dashboards/BIS,SEC_C5_LOCAL,1.0?dimensions=REF_AREA%3ADE (link as of October 16th, 2023)

Bankhaus Metzler, “Metzler Asset Management begibt als erster Kryptofondsanteile in Deutschland“, September 2023: https://www.metzler.com/de/metzler/asset-management/artikel-am/news/Metzler/MAM/Presse/230905-MAM-Kryptofonds (link as of October 16th, 2023)

Clearstream Banking S.A., Clearstream Banking AG, “Clearstream Banking Preisverzeichnis für Kunden der Clearstream Banking”, August 2023

Ethereum foundation blog, “Ethereum Launces”, June 2015: https://blog.ethereum.org/2015/07/30/ethereum-launches (link as of October 16th, 2023)

European Investment Bank, “EIB innovates further with Project Venus, the first euro-denominated digital bond on a private blockchain”, November 2022: https://www.eib.org/en/press/all/2022-448-eib-innovates-further-with-project-venus-the-first-euro-denominated-digital-bond-on-a-private-blockchain (link as of October 16th, 2023).

European Securities and Markets Authority, “ESMA publishes report on DLT Pilot Regime”, September 2022: https://www.esma.europa.eu/press-news/esma-news/esma-publishes-report-dlt-pilot-regime (link as of October 16th, 2023)

European Parliament, “Regulation (EU) 2022/858 of the European Parliament and of the council of 30 May 2022 on a pilot regime for market infrastructures based on distributed ledger technology, and amending Regulations (EU) No 600/2014 and (EU) No 909/2014 and Directive 2014/65/EU”, March 2022

European Parliament, “Regulation (EU) 2023/1114 of the European Parliament and of the Council of 31 May 2023 on markets in crypto-assets, and amending Regulations (EU) No 1093/2010 and (EU) No 1095/2010 and Directives 2013/36/EU and (EU) 2019/1937”, May 2023

Finanzbusiness, “Dekabank erwartet 20-Prozent-Anteil für Kryptowertpapiere binnen fünf Jahren“, January 2022: https://finanz-business.de/nachrichten/sparkassen/article13677372.ece (link as of October 16th, 2023)

German Bundesbank (*Deutsche Bundesbank*), “MiCAR – Markets in Crypto-Assets Regulation”, June 2023: https://www.bundesbank.de/de/aufgaben/bankenaufsicht/einzelaspekte/micar-markets-in-crypto-assets-regulation-799398#:~:text=Das%20Europ%C3%A4ische%20Parlament%20hat%20am,Mai%202023 (link as of October 16th, 2023)

German Federal Ministry of Justice (*Bundesministerium der Justiz*), ”Gesetz über elektronische Wertpapiere (eWpG)”, June 2021: https://www.gesetze-im-internet.de/ewpg/BJNR142310021.html#BJNR142310021BJNG000100000 (link as of October 16th, 2023)

German Federal Ministry of Justice (*Bundesministerium der Justiz*), ”Verordnung über Kryptofondsanteile* (KryptoFAV)”, June 2022: https://www.gesetze-im-internet.de/kryptofav/KryptoFAV.pdf (link as of October 16th, 2023)

German Federal Government (*Deutsche Bundesregierung*), “Entwurf eines Gesetzes zur Finanzierung von zukunftssichernden Investitionen“, August 2023

Northern Trust Corporation & HSBC Bank Plc., “Beyond asset tokenization”, January 2023

Onvista media AG, “Anleihen-Finder”, October 2023: https://www.onvista.de/anleihen/finder (information as of October 27th, 2023)

Siemens AG, “Siemens issues first digital bond on blockchain”, February 2023: https://press.siemens.com/global/en/pressrelease/siemens-issues-first-digital-bond-blockchain (link as of October 16th, 2023)

UBS AG, “UBS AG lanciert die weltweit erste digitale Anleihe, die sowohl an Blockchain-basierten als auch an traditionellen Börsen öffentlich gehandelt und abgewickelt werden kann“, November 2022: https://www.ubs.com/global/de/media/display-page-ndp/de-20221103-digital-bond.html (link as of October 16th, 2023)