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Energy Traders Europe Manual on Liquidity Risk Management

(Issued by Energy Traders Europe Credit & Collateral Working Group)

Abstract:

The purpose of this manual is to provide a clear and actionable framework for managing cash liquidity risk stemming from margin requirements in the energy sector. It aims to consolidate industry insights, enhance transparency, and promote leading industry practices that align with market needs. The document outlines the steps necessary for EMPs to establish robust liquidity management systems that can withstand market fluctuations and ensure continued operational resilience.

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CAPEX:	Capital Expenditure
CCP:	Central Counterparty
CSA:	Credit Support Annex
EFP:	Exchange for Physical
EMIR:	European Market Infrastructure Regulation
EMP(s):	Energy Market Participant(s)
ESMA	European Securities and Markets Authority
ETD:	Exchange-Traded Derivatives
EOD:	End of Day
EU:	European Union
FVA:	Funding Valuation Adjustment
KPI:	Key Performance Indicator
KRI:	Key Risk Indicator
MaR:	Margin at Risk
OPEX:	Operating Expenses
OTC:	Over-The-Counter
PnL:	Profit and Loss
SBLC:	Stand-by Letter of Credit
SRLM:	Single Liquidity Risk Metric
SPAN:	Standardized Portfolio Analysis of Risk
STB:	Short Term Buffer
VaR:	Value-at-Risk

1 Introduction

1.1 General considerations

The recent energy crisis in 2022 has highlighted the essential role of effective liquidity risk management in ensuring the stability and resilience of Energy Market Participants (EMPs). With unprecedented volatility and escalating prices during this period, proper functioning liquidity risk management became increasingly important due to immediate high cash demand. This crisis showed how EMPs successfully navigated significant challenges by employing efficient liquidity risk management strategies across both cleared exchange and Over-the-Counter (OTC) energy markets. Their ability to maintain operational continuity and secure energy supplies for consumers underscores the importance of sound liquidity practices.

Organizational setups and governance frameworks within EMPs have been instrumental in ensuring market stability and facilitating effective liquidity risk management. The diverse range of structures within EMPs allows for innovative and flexible adjustments to standard business operations, ensuring security of supply while fostering competition for efficient solutions. This has also led to the development of different methodologies for risk measurement and risk management. This manual therefore presents a variety of tools that EMPs can select to best suit their business models. This adaptability has proven vital during times of crisis and continues to be an anchor of resilience for the energy market in future market stress conditions.

Key elements that contributed to the stability of the energy market during the recent crisis include:

- **Sector-specific expertise:** EMPs possess tailored risk management frameworks designed to address the unique characteristics of the energy sector.
- **Dynamic response capability:** The capacity to respond swiftly to changing market conditions is essential for maintaining liquidity and preventing disruptions.

In the energy crisis in particular, regular interactions and clear communication with lenders such as banks and counterparties helped EMPs to navigate through the challenging market environment and secure additional liquidity. In addition, EMPs have proactive discussions with rating agencies, their banks, and counterparties to provide confidence and reassurance to the market.

The imperative for robust liquidity risk management could not be clearer. The successful management of cash liquidity risk during the crisis through a combination of tools not only safeguarded individual companies but also contributed to the overall stability of the energy market. However, the lessons learned highlight the necessity for continuous improvement and a sound liquidity risk framework. The urgency for this manual arises from the recognition that while EMPs navigated the recent challenges effectively, establishing a comprehensive liquidity risk framework will be crucial for sustaining performance amidst future market fluctuations. With proactive measures and strategic foresight, EMPs are prepared for the next wave of volatility, safeguarding their operational integrity, and the energy security of consumers. Now is the time for EMPs to fortify their liquidity practices and ensure they are equipped to withstand the uncertainties of the future.

1.2 About this manual

The purpose of this Energy Traders Europe Liquidity Risk Management Manual, drafted by the Credit & Collateral Working Group, is to provide a clear and actionable framework for managing cash liquidity risk stemming from margin requirements in the energy sector. It aims to consolidate industry insights, enhance transparency, and promote leading industry practices that align with regulatory standards and market needs. The document outlines the steps necessary for EMPs to establish robust liquidity management systems that can withstand market fluctuations and ensure continued operational resilience.

This manual is specifically designed to address pure cash liquidity risk arising from margins and collaterals related to cleared positions and collateralized OTC transactions, distinguishing it from other liquidity-related concerns. It focuses solely on the mechanisms necessary to manage cash flow adequacy and avoid liquidity shortfalls from margin requirements, as these are more volatile in frequency and magnitude, and only predictable in a statistical sense compared to other cash flows (e.g., Operating Expenses (OPEX) and Capital Expenditure (CAPEX) or payments for physically delivered commodities). These other cash flows are managed via standard corporate planning processes.

While leading market practices are discussed, it is essential to clarify that the manual takes a ‘fit for purpose’ approach, ensuring that recommendations are practical and adaptable to the distinct challenges faced by EMPs of different sizes and kinds. As the manual focuses solely on the cash liquidity risk in the context of margining, the following areas are explicitly out of scope:

- **Investment and divestment strategies:** This manual does not cover how EMPs should allocate their capital for long-term growth or determine the optimal timing for selling off assets. These strategies require comprehensive financial analysis and market insights that are outside the immediate focus of liquidity risk management related to margin requirements.
- **Physical cash flows and corporate liquidity planning:** The manual does not address the management of day-to-day cash flows that are integral to operational sustainability, such as the timing of overall company income and expenses (e.g., including salary payments, etc.). These are typically managed through established corporate liquidity planning processes that encompass a broader financial strategy beyond just liquidity risk associated with margins. For the avoidance of doubt, settlement exposure resulting from physical deliveries is in scope of the manual only when it is covered by an OTC CSA agreement, as it will affect margining.
- **Other liquidity risks such as operational risks, funding liquidity risks, and market liquidity risks:** The manual explicitly excludes discussions on various liquidity risks that could affect an organization's overall financial health, including risks arising from operational inefficiencies, funding shortfalls, or fluctuations in market liquidity. These areas require distinct risk management approaches that go beyond the scope of cash liquidity risk management in the context of margining.

Readers of this manual are expected to have a foundational understanding of general liquidity management principles, as well as being familiar with the energy industry. This background knowledge will enable readers to fully grasp the methodologies and practices presented. The primary audience for this manual includes industry representatives from EMPs who are responsible for liquidity management.

This manual is organized as follows: Chapter 2 delves into the liquidity risk concept, introducing the risk triangle (i.e., interplay between liquidity risk, market risk and credit risk, and strategies for its management). Thereafter, Chapter 3 focuses on measuring and stress testing liquidity risk. Chapter 4 addresses governance, detailing the roles of stakeholders, organizational structures, and key processes for managing liquidity risk, with an emphasis on reporting. Chapter 5 explores strategies to steer and optimize liquidity risk and usage, including funding and contingency planning, liquidity sources, and the impact of liquidity charges. The manual concludes with the Annex: Case study, which features a practical example designed to demonstrate the theory and concepts outlined in the manual through a real-world application.

2 The concept of liquidity risk[1]

This chapter introduces the general principles of the risk triangle which describes the balance between the three main types of financial risk: market, credit, and cash liquidity risk. Moreover, leading industry practices on how to manage and optimize this risk triangle in different market situations are explained.

2.1 Introduction to risk triangle

In their financial risk management strategy, EMPs need to balance three main types of risks: market, cash liquidity, and credit risk (see Figure 1).

- **Market risk:** the potential of financial losses from unhedged positions following price and volatility movements on the market. Market risk can be reduced through entering hedges with products offered on exchanges or OTC markets.
- **Credit risk:** the "potential that a [...] counterparty will fail to meet its obligations in accordance with agreed terms."[2] On centrally cleared markets (e.g., exchanges), credit risks for EMPs relate to the default of their clearing bank[3] or in case of direct clearing membership it also relates to the default of the Central Counterparty (CCP). OTC bilateral credit risks by EMPs are more diversified and subject to the respective credit risk profile assigned by the EMP to each individual counterparty (e.g., based on internal rating methodologies, and credit risk mitigation measures agreed).[4]
- **Cash liquidity risk**: the potential of insufficient cash reserves, for example, to timely meet collateral requirements. On the one hand, these collateral requirements relate to daily (and sometimes intraday) margin calls for existing cleared transactions caused by adverse market price and volatility trends. This creates a dynamic environment where entities must be prepared to respond to daily or even intraday margin calls. Failure to

[1] This chapter is an adjusted excerpt from "Principles of Energy Market Regulation – Securing Efficient & Resilient Energy Trading"; Frontier Economics & Luther Lawfirm (2024).

[2] "Principles for the Management of Credit Risk"; Basel Committee on Banking Supervision (1999).

[3] EMPs typically fulfil clearing obligations (IM and VM requirements) with CCPs via their clearing banks. The clearing banks act as intermediaries rather than EMPs interacting directly with CCPs.

[4] For details on best practice of managing Credit Risk please refer to the EFET Credit Risk Manual which is available from energy traders europe upon request.

meet these demands can lead to severe consequences, including forced liquidation of positions, financial penalties, or increased borrowing costs and potentially to insolvency. On the other hand, they relate to collateralized OTC transactions.[5] The nature of collateralized OTC transactions adds another layer of complexity to cash liquidity risk. These transactions often require collateral as a safeguard against losses from counterparty default.

The repercussions of cash liquidity risk stemming from margining and collateral requirements can be significant. Organizations may face operational disruptions, increased costs of capital, and challenges in maintaining financial stability. Considering these risks, effective liquidity management is crucial. By implementing robust risk management practices, regularly monitoring market conditions and maintaining liquidity buffers, EMPs can prepare for potential margin calls and collateral demands, ultimately ensuring that they can meet their obligations and sustain operational integrity in fluctuating market environments.

The three different risk types depend on each other. When hedging market risk, EMPs simultaneously face credit risk to varying degrees and, in the case of collateralized transactions, a corresponding cash liquidity risk. This situation is presented in the risk triangle, see Figure 1. This risk triangle represents a constant trilemma in which EMPs manage and balance their risks.

[5] A standard approach for EMPs to mitigate credit risk in OTC trading is to trade under a master agreement enhanced by a credit support annex (CSA). The CSA stipulates that if Party A's exposure towards Party B exceeds a defined threshold, Party B is required to provide collateral to Party A according to prescribed terms.

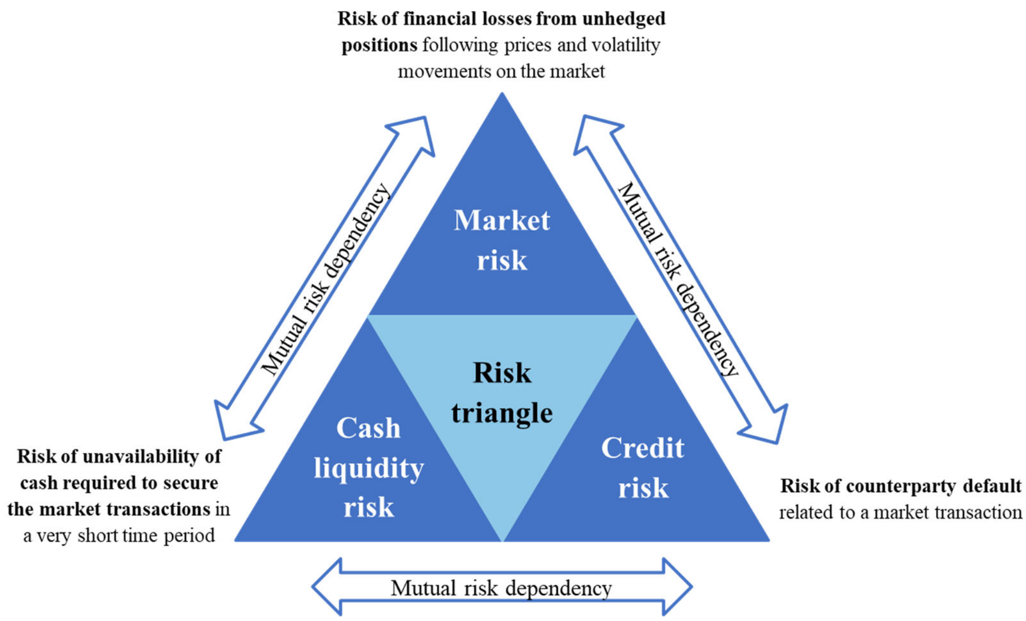

Figure 1: Risk Triangle – EMPs balance market, liquidity, and credit risk

2.2 Managing the risk triangle

As an introduction into the topic, consider an EMP that manages a fleet of power producing assets. These assets represent a highly complex real option, whose value can only be approximately hedged in praxis. As a result, fluctuations in market prices lead to changes in the combined value of the asset fleet and its associated proxy hedges. Therefore, changes in the market price lead to shifts in the market risk of the EMP.

If the EMP does not react to the changed situation, its market risk would remain elevated, while its credit risk and cash liquidity risk positions would remain unchanged.[6] Alternatively, adjusting the hedge position to reduce the market risk would alter the EMPs credit risk and potentially its cash liquidity risk.

To simplify, consider a scenario where an existing hedge position had to be increased in size. If the additional hedge is done with an OTC counterparty, the credit risk would increase. This increase may be partially mitigated if transacted under a CSA, though at the cost of increasing the cash liquidity risk. Conversely, if the hedge is done at an exchange, the increase in credit

[6] Credit risk and cash liquidity risk metrics are typically a function – among others – of positions and associated market prices. Therefore, with changing underlying market prices the risk metrices change accordingly.

risk would be negligible due to the low default risk of the EMP's clearing bank (or the clearing house if the EMP is a clearing member itself), as well as the associated margining. The latter, however, increases the cash liquidity risk.

With variation margin ("VM") and initial margin ("IM") requirements for cleared positions and typically only an OTC collateralization of the current exposure – VM look-a-like – the cash liquidity risk of cleared positions is comparably larger than the one in the OTC case. A summary of this discussion is presented in Figure 2. Here it is assumed that the size of an existing hedge position had to be increased.

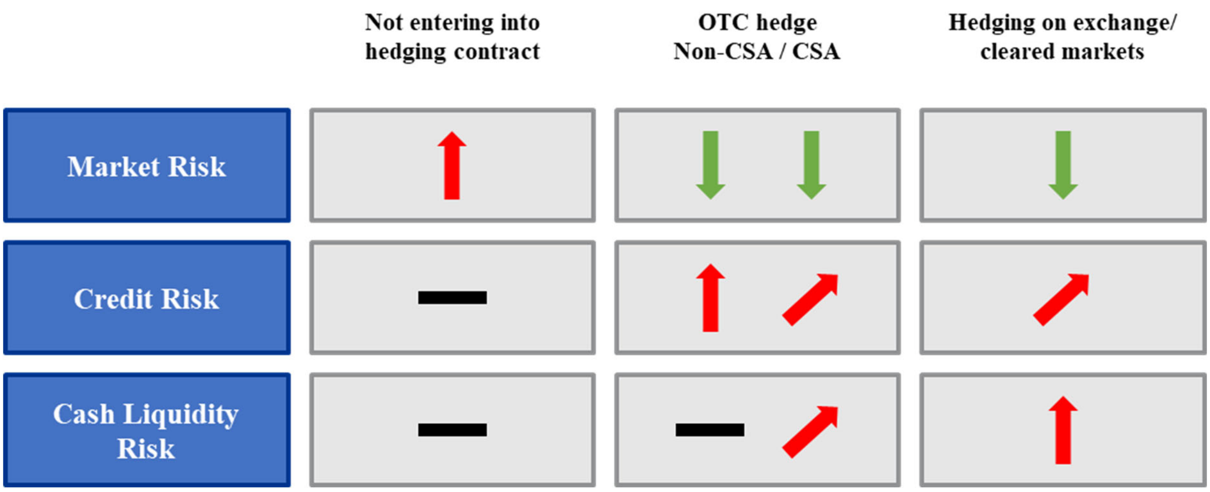

Figure 2: Schematic presentation of changing risks caused by a change in an underlying market risk position, e.g., from production assets

Although management of all three risks is required, their relative importance is not equal from an insolvency perspective. Losses related to market and/or credit risk are covered by the equity of the company. Even if the equity of a company is negative, an insolvency is not an immediate consequence. In contrast, however, if a company has a negative liquidity balance and cannot meet its next financial obligation, an insolvency is the direct consequence.

When hedging through a centrally cleared market, EMPs need to post IM, and deposit or receive VM, with the clearing bank over the course of the transaction. Both IM and VM are covered by cash or highly liquid non-cash assets. IM is a refundable collateral that covers potential Mark-to-Market (MtM) losses incurred by a CCP when it replaces positions of a defaulted counterparty. The IM is posted when entering a contract and remains subject to further adaptations driven by market volatility and price levels (margin parameters). Its size is typically proportional to the transaction volume and the underlying's price and its volatility.

VM is a payment that the EMP either makes or receives to settle the MtM change on open positions resulting from market price changes. VM therefore reflects the commercial situation of the EMP (MtM gain or loss) regarding its positions per clearing account. While typically IM and VM are updated and called (or posted back) daily, intraday margin calls may occur during volatile times.

Hedging via a regulated exchange reduces the EMP's market risk while increasing its cash liquidity risk from margin calls. As previously stated, credit risk from trading on centrally cleared markets (such as energy exchanges) is low due to the sound credit quality of clearing banks.

In contrast, when hedging through bilateral OTC trades, EMPs must manage their exposure individually. For this, EMPs assess their counterparties' creditworthiness (default risk) prior to individually setting a credit limit for the respective counterparty. This is based on their specific risk preference and credit risk policy. Hedging through a bilateral OTC trade therefore reduces the EMP's market risk, while simultaneously increasing its credit risk. Entering a trade under a CSA reduces the credit risk due to collateralization, but at the same time collateralization increases cash liquidity risk.

It is 'industry-standard' for EMPs to undertake a combination of the options outlined above, following their individual risk management policies and company preferences. Furthermore, EMPs may change their approach in managing the risk triangle, depending on the evolving micro and macro environment. Amongst others, this can include:

- **Long-term strategic approach:** For example, EMPs may choose to hedge less than 100% of the market risk of an investment or asset. This could be due to retaining exposure to potential upside, or practical considerations such as hedging costs and market liquidity. Typically, the first few liquidly traded years are hedged via an exchange, with the remainder managed on the OTC market.
- **Short-term strategy adjustment:** EMPs may decide to adapt their remaining market risk exposure via new hedges, dissolve existing hedges, or move their existing position between the CCP and OTC markets. This is subject to market conditions allowing them

to trade-off and adjust the risk type faced (e.g., adaption of positions in response to changing supply and demand patterns, changes in market prices, or the availability of liquidly traded derivatives with a shorter tenor, including those with higher granularity such as day, week or weekend products).

It is a common 'industry-standard' for EMPs to manage and optimize their individual cash liquidity position to safeguard the company's financial solvency. Consequently, managing the cash liquidity risk becomes an integral part of daily EMP risk mitigating procedures. To achieve this, EMPs rely on a combination of tools (Figure 3).

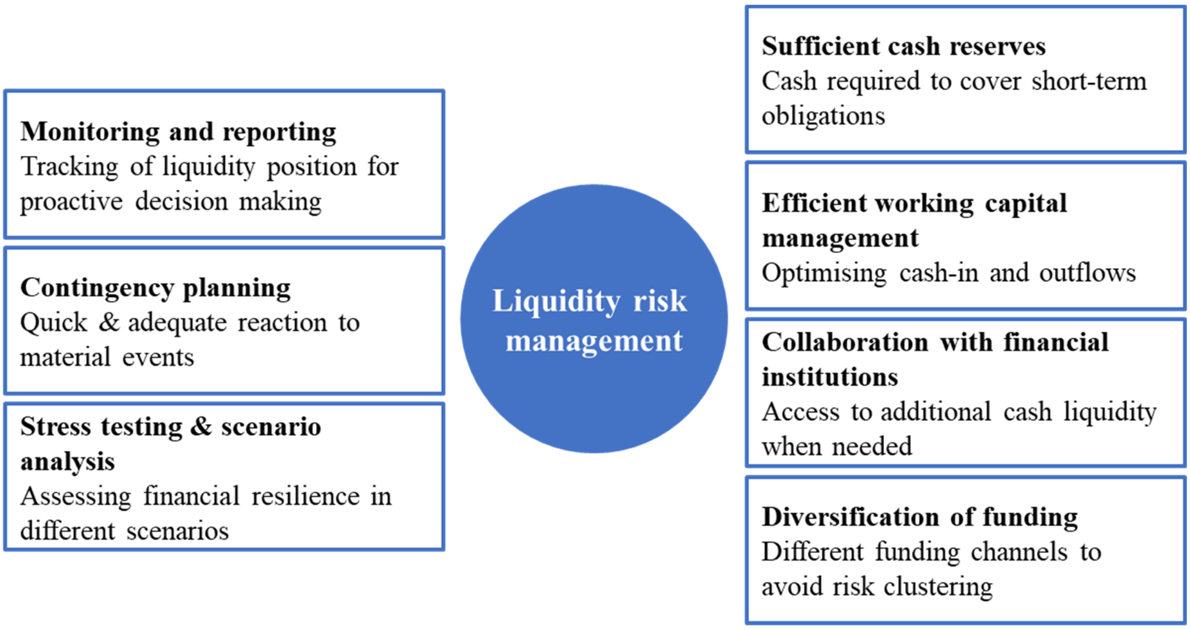

Figure 3: EMPs rely on a combination of tools to manage cash liquidity risk

The optimal usage of liquidity management tools is dependent on an EMPs individual risk profile and business activities on the wholesale market. These tools can be grouped into two broader categories: "Transparency tools" and "Management tools." Both serve different yet complementary purposes in safeguarding an EMPs financial health.

On one hand, transparency tools focus on providing clear visibility into an EMPs liquidity position and the risks it faces, enabling proactive decision-making. Such tools facilitate the continuous monitoring of liquidity metrics and the development of strategic responses to potential liquidity strains. On the other hand, management tools focus on the operational strategies and actions an EMPs takes to ensure that it has sufficient liquidity to meet its obligations, optimize cash flow, and maintain financial stability. Below is a (non-exhaustive) list of liquidity tools:

- **Transparency tools:**
  - **Monitoring and reporting**: Implementing robust monitoring and reporting systems helps EMPs track their liquidity position in (close to) real-time. This enables proactive decision-making and timely adjustments to respond to changing market conditions.
  - **Contingency planning:** Developing comprehensive contingency plans for cash liquidity is essential for EMPs to swiftly respond to material market events. This includes having access to emergency funding or negotiating standby credit lines with financial institutions, as well as establishing clear protocols for the internal management.
  - **Stress testing and scenario analysis:** Conducting stress tests assists EMPs in assessing personal financial resilience under adverse scenarios. By simulating potential liquidity challenges that may arise under increased market price and volatility levels going forward, they can identify vulnerabilities, set aside cash liquidity buffers (e.g., based on Value-at-Risk analysis) and develop contingency plans addressing these.
- **Management tools:**
  - **Sufficient cash reserves:** Maintaining sufficient cash reserves is a primary method of mitigating cash liquidity risk. In particular, EMPs set aside cash funds to cover short-term obligations (e.g., for collaterals), ensuring their ability to meet financial commitments towards counterparties.
  - **Efficient working capital management:** Optimizing working capital by efficiently managing receivables, payables, and inventory is crucial for EMPs. This includes streamlining internal processes to adequately manage cash inflows and outflows (e.g., receiving/paying collaterals).
  - **Collaboration with financial institutions:** Building strong relationships with financial institutions facilitates access to additional cash liquidity when needed. Particularly during the energy crisis, regular interactions with lenders such as

banks helped EMPs to navigate through the challenging market environment and secure additional liquidity.

- **Diversification of funding:** EMPs typically diversify their funding sources to avoid risk clustering through a single channel. This entails obtaining credit lines from multiple financial institutions such as banks and insurance companies, as well as issuing company bonds.

3 Measuring the liquidity risk

This chapter describes the importance of having a transparent view of cash inflows and outflows, in order to understand their causes and illustrate ways of determining future cash needs. To create a picture of an EMPs current liquidity risk, it is crucial to understand the composition of the portfolio. From a liquidity risk perspective, the portfolio can be divided into Exchange-Traded Derivatives (ETDs) and OTC transactions traded under CSAs. Together, these form what is referred to in this chapter as the margined position.

3.1 The margined position

The overall margined position offers valuable insights into potential margin requirements. It is important to analyze the portfolio in more detail, considering specific factors such as the portfolio composition, with offsetting positions in a walk forward view, for example. Determining the expiry profile provides insights into the realization of positions and the resulting cash flows.

EMPs may trade on exchanges as a direct member or through a clearing bank as an indirect member. For centrally cleared contracts, it is important to know the position for each clearing account, as IM requirements are calculated per account, and netting credits are not granted across accounts.

The liquidity risk associated with OTC CSA contracts is similar to the VM requirement in centrally cleared contracts. However, there is added complexity, as thresholds and the collateralization of settlement exposures stemming from physical deliveries must also be considered. Therefore, it is important to know the OTC CSA positions per agreement with the associated current exposure and CSA parameters.

For EMPs active in markets across different time zones, they may choose to add the time zone as a reporting dimension, as cash flows across time zones will not net intraday. The same applies to engaging on exchanges or in CSA agreements with different cut-off times.

These reporting dimensions are sufficient to gain a meaningful overview of the margined position. Additionally, the position can be further broken down into the desks that entered into the margined positions. This breakdown is a prerequisite for liquidity risk charging and is also necessary information when it comes to closing positions, should it be required (see Figure 4).

Furthermore, visualization tools with drill-down and filter capabilities are valuable for providing a general overview, as well as understanding which desks hold specific positions and for gaining insight into how those positions are likely to evolve over time.

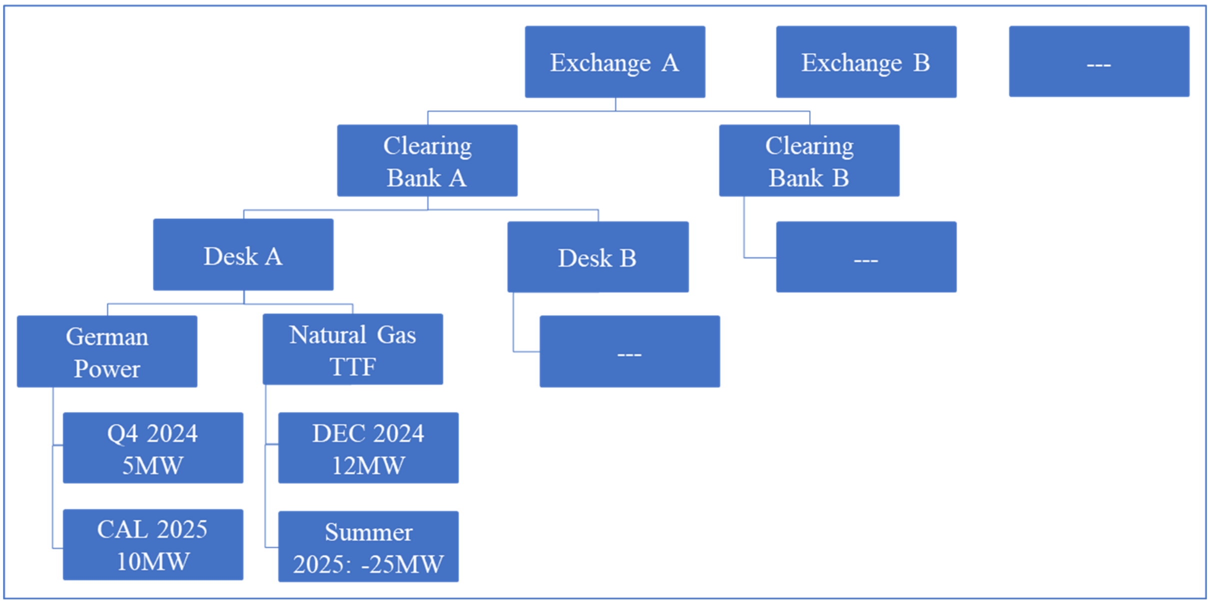

Figure 4: Schematic position breakdown

3.2 Margin contributions and reconciliation

Understanding and reconciling margin calls is crucial for the EMP. It is important to check and challenge the validity of clearing bank statements. Moreover, an EMP that is unable to reliably reconcile margin calls will struggle to forecast margin calls.

Reconciling VM and OTC margin calls is straightforward, as these mirror the daily change in MtM of the position and settlement exposure in case of physically settled transactions covered by the respective agreement. For OTC margin agreements, the specific margin parameters must be considered. However, for liquidity risk purposes, parameters such as rounding and minimum transfer amounts can typically be excluded, as they do not alter the overall picture. By contrast, thresholds and margining frequency must be considered.

Accurate reconciliation of IM entails replicating clearing house models, which is often more challenging. This can be achieved by either internally replicating the IM calculation or purchasing and implementing one of the externally available solutions. If the EMP opts to charge the IM liquidity costs at desk level, an allocation method must be established. One solution for the standardized portfolio analysis of risk IM model would be to allocate the actual

IM by the gross IM. The gross IM is calculated by multiplying the positions by the single margin parameters provided by the exchanges. For VaR-based IM models, one way of allocating IM would be to look at the historical simulations in or around the chosen quantile and determine the average contribution of each desk in each of those simulations.

In addition to MtM margins and IM, it is important to reconcile and understand contributions of other margining elements such as spot IM, delivery margin, or options credits. Furthermore, it is a good practice to save the margined positions and realized margin calls, as this is valuable information for liquidity risk modelling and back testing.

3.3 Margin-at-Risk (MaR) and the Single Liquidity Risk Metric (SLRM)

The EMP can gain an overview of the magnitude of the short-term liquidity risk by employing a Margin-at-Risk (MaR) model. In addition, existing VaR models in place for market risk analysis can be amended for liquidity risk purposes. This can be achieved by filtering on the margined position only and taking OTC CSA margin parameters into account.

With this approach, VM and cash flows for collateralized OTC contracts are covered. However, predicting the development of IM parameters under a specific price scenario is not possible, as the margin parameters are based on each CCP's own VaR and stress test models, as well as their risk management frameworks and processes. Since IM is intended to be a buffer to cover for the VM of defaulting clearing members (see Figure 5), an EMP can estimate IM changes using its own VaR models. Such assessments should be tested back against actual IM changes observed historically.

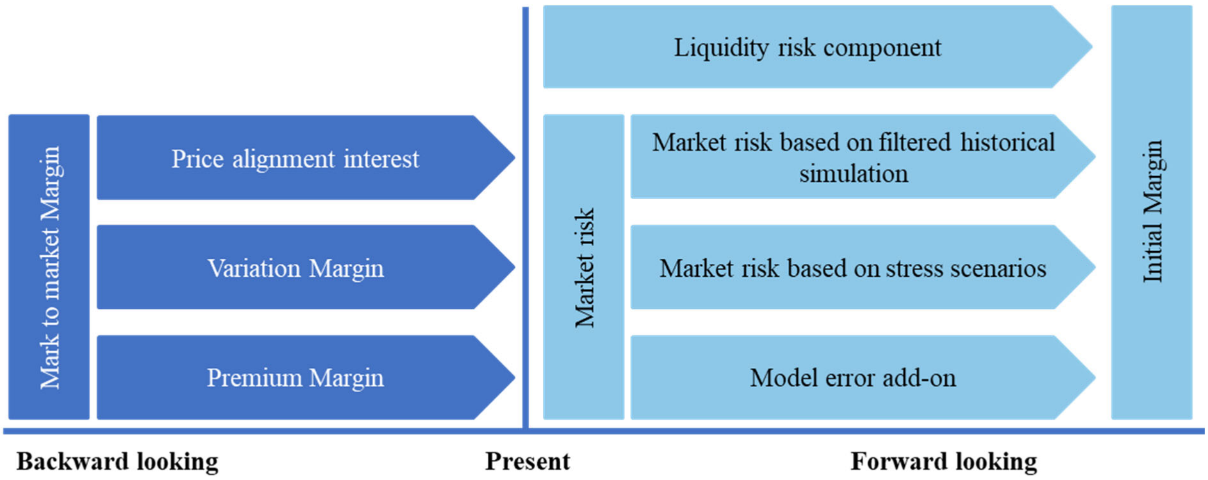

Figure 5: CCP's perspective on margin components[7]

However, there may be limitations to the applicability of market risk VaR scenarios for liquidity risk purposes, as these scenarios are typically calibrated only on recent history. Due to the severe consequences of incurring negative cash balances, it is therefore considered leading practice to enhance the MaR model. Possible enhancements may include:

- Choosing a different lookback period,
- Choosing different confidence level,
- Correlation break assumptions,
- Assuming one or more CSA counterparties to dispute bilateral margin calls,
- Combining multiple metrics,
- Looking at multiple forecast time horizons.

Choosing a different lookback period and confidence level are one way of adjusting the market risk VaR to account for a different risk appetite toward liquidity risk compared to market risk. Furthermore, EMPs may consider the introduction of correlation break assumptions to reflect that historically observed correlations may not hold in the future, particularly when only looking on a very short forecast horizon. Often, EMPs also have these assumptions embedded in their market risk VaR models.

A liquidity risk specific adjustment involves the introduction of the assumption that one or more OTC CSA counterparties dispute their margin calls, which can create a substantial drain

[7] "Eurex Clearing Prisma" Eurex: https://www.eurex.com/ec-en/services/margining/eurex-clearing-prisma.

on liquidity. This enhancement to the MaR metric is particularly important for EMPs that hold significant positions with opposing signs across different OTC CSA counterparties or between OTC CSAs and exchanges.

On one hand, it is difficult to adequately capture all facets of liquidity risk with at a single MaR metric. However, on the other hand, for communicating and managing liquidity risk, having a single metric to refer to is desirable. To overcome this, EMPs can combine multiple risk metrics into one Single Liquidity Risk Metric (SLRM). The composition of the SLRM will look different for each EMP, as it is tailored to their specific liquidity risk exposure. One example of a SLRM can be found in the Annex: Case study. Another example is the following:

$$SLRM = Max\left(MaR_{1\,day,\,\rho=0,\,dis=1},\ MaR_{10\,day,\,dis=2},\ MaR_{20\,day,\,dis=1}\right),$$

where:

n day: time horizon covered by MaR metric,

ρ=0: correlation break assumption, setting all commodity correlations to zero,

dis: number of n-th biggest incoming margin calls being disputed.

Importantly, even the most elaborate SLRM may not cover every possible scenario, and by design the MaR concept will allow for breaches of the chosen quantile. To identify potential shortcomings of the chosen SLRM, it is a leading practice to conduct regular stress testing exercises. These exercises are complementary to the SLRM, and EMPs may choose to include certain enhancements into either the SLRM or the stress testing exercises, depending on their firm's specific liquidity risk exposure.

3.4 Stress testing

Liquidity stress testing allows the comparison of the term structure of funding needs (caused by exceptional but plausible spikes in margin and collateral calls) with the term structure of available funding.

Where possible, the liquidity risk stress testing methodology should include both historical and hypothetical scenarios. In addition, reverse stress tests should be considered, starting with the identification of a pre-defined outcome (e.g., complete depletion of available funding), followed by exploring and narrating scenarios leading to that fixed outcome.

EMPs can enhance their stress tests by looking at specific, relevant periods of stress. For each historical day and for each contract, price differences can be determined from the historical prices, which allows EMPs to create hypothetical price changes scaled to the current price levels.

For instance, an EMP with a substantial cleared gas position, may look at the gas price and volatility that were stressed for the 2021-2023 period and infer its cash liquidity needs from such conditions (Figure 6).

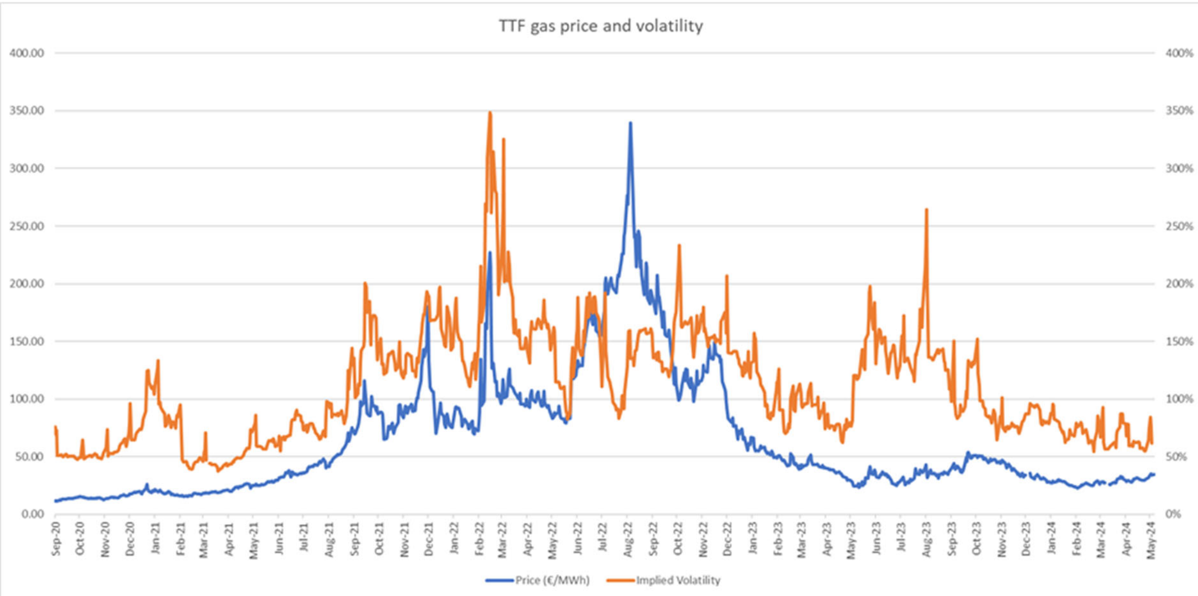

Figure 6: Gas price and its implied volatility in Europe (TTF)

Figure 7 depicts the Brent price for the first half of 2020, which represents an example of a stressed period with low prices.

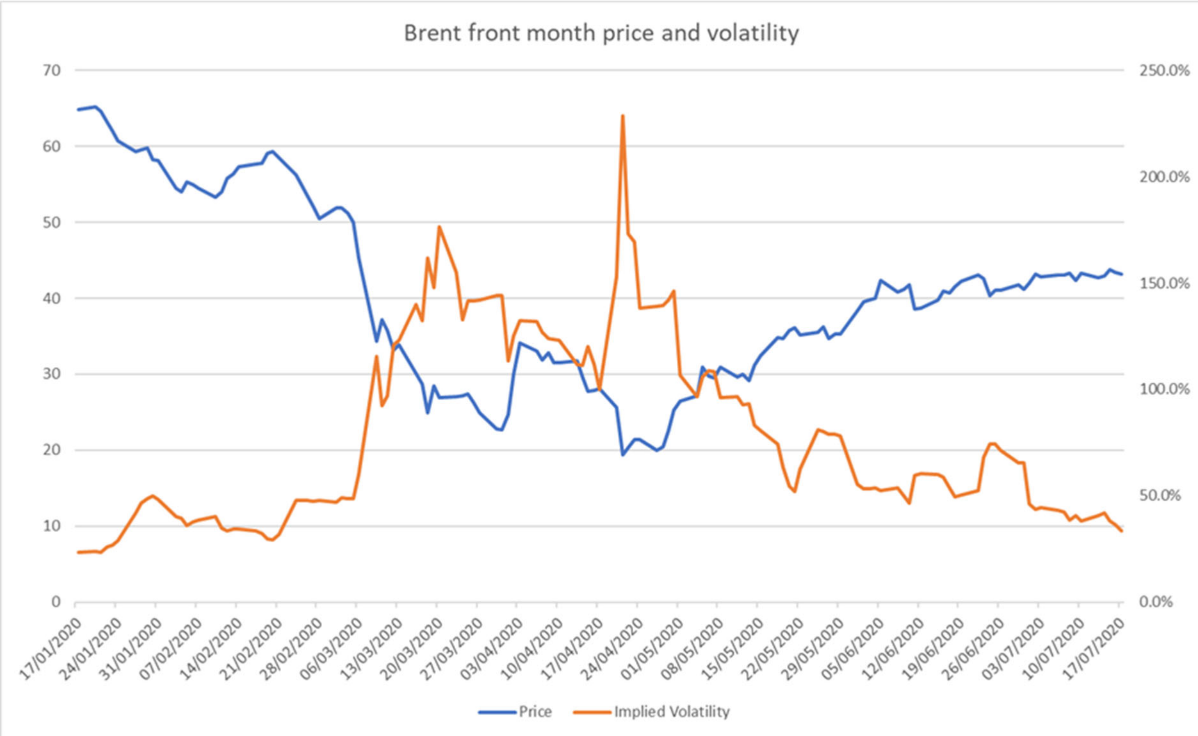

Figure 7: Brent price and its implied volatility

Historical scenarios only replicate historical shocks and therefore give limited information on VM and collateral requirements caused by stress events with shocks of higher magnitude or a more severe breakdown of historical correlations. To overcome this deficiency, the following hypothetical additional scenarios might be constructed[8].

- **Scaled-up hypothetical scenarios:** Scaling-up the shocks of historical scenarios (e.g., x1.25, x1.50 to assess the sensitivity to shocks of increased magnitude, while at the same time preserving the historical stressed correlation),
- **Inverse (Antithetical) hypothetical scenarios:** Switch the sign of historical shocks, to assess the sensitivity to shocks of opposite direction,
- **Sampled hypothetical scenarios:** Randomly select for each risk factor a historical shock from one of the impactful historical scenarios, to explore the impact of changes to the correlation structure, while at the same time preserving the magnitude and direction of historical shocks for individual risk factors.

[8] "ESMA 5th CCP Stress Test Report" European Securities and Market Authority: https://www.esma.europa.eu/document/5th-ccp-stress-test-report.

The margined position can be a good starting point for narrating hypothetical price scenarios. For instance, if an EMP holds a sizeable cleared spread position, it may investigate the impacts of the spread widening or narrowing on its cash liquidity. EMPs can create a set of scenarios, which they can execute according to their chosen stress test frequency. This set of scenarios needs to be curated constantly, to make sure that the scenarios chosen are not only still conservative, but plausible and relevant for the EMPs position.

Once the methods presented in this chapter are in place, EMPs may additionally consider employing reverse stress testing techniques. Similar to the conventional hypothetical stress testing presented above, reverse stress tests rely on hypothetical scenarios. However, the EMP would attempt to find scenarios under which its current available cash and liquid funds would be depleted, rather than investigating how much liquidity would be needed to survive a given market price scenario.

Following the European Securities and Market Authority (ESMA), reverse stress analysis aims to assess the absorption capacity of the EMP's liquidity buffer under more severe assumptions (i.e., allowing these to go beyond what was considered as extreme but plausible scenarios). This can be achieved by scaling the market shocks of a stress scenario by a factor up to the point where the liquidity buffer is no longer sufficient to cover the hypothetical VM and collateral requirements. Reverse stress testing provides another important tool for EMPs to assess their resilience under adverse conditions and determine if the size and composition of their margined position matches their risk bearing capacity.

4 Governance

This chapter explores the organizational set-up and governance of EMPs for effective liquidity risk management under normal and stressed market conditions.

4.1 Stakeholders

An effective governance framework requires a clear definition of the mandate, along with the roles and responsibilities of the stakeholders involved. This includes documentation of the different roles in liquidity risk management. To ensure a high level of independent risk governance, there should always be a functional separation between risk management and commercial operations throughout company hierarchies. As a result, the risk controlling tasks are performed by separate business functions than risk owners (e.g., traders).

The typical stakeholders involved in overall liquidity risk management include:

- **Board of management[9]:** Responsible for setting the liquidity risk tolerance or risk appetite.
- **Risk management divisions:** Dedicated teams tasked with identifying, measuring, and mitigating various risks, including liquidity risk.
- **Treasury departments:** Responsible for cash management, funding, liquidity planning, as well as ensuring sufficient liquidity to meet operational needs.
- **Business units/trading desks:** Engage in buying and selling of energy commodities, requiring access to market data and financial resources. They execute strategies aimed at maximizing profit and also the risk triangle, as advised by risk management.
- **Audit units:** Audit adherence to internal policies related to liquidity risk management.
- **Back office:** Responsible for providing operational support for trading activities, such as validation or reporting and processing margining related tasks.

[9] Board of Management often includes group executives (e.g. Chief Financial Officer (CFO)).

Exchange and information sharing is essential for proper risk management. Typical interactions between the different stakeholders and risk management are:

- **Board of management** shares information on liquidity risk tolerance/risk appetite, often as part of the mid-term-planning update. It regularly receives reports on limit utilization and strategies for optimizing risk management.
- **Exchange with treasury** on liquidity optimization and strategic funding (see Chapter 5) which includes:
  - The development of strategies optimizing liquidity,
  - Cash flow projections and funding requirements, ensuring that sufficient liquidity is maintained for operational needs,
  - Insights into financial market conditions and funding availability.
- **Business units/trading desks** typically receive risk mitigation guidance from their risk management team. For instance, they may execute triangulation arrangements, which involves shifting credit exposure – or, in the case of cash-margined OTC CSAs, also liquidity exposure – between counterparties. They may also engage in Exchange-for-Physical (EFP) trades, which shift exposure between counterparties and an exchange (i.e., shifting between credit and liquidity exposure to manage liquidity risk). Additionally, new products are often discussed as well.
- **Cooperation with back office** on precise margin calculations and settlement.

4.2 Organizational set-ups

EMPs, including utilities, energy producers, and trading companies, have diverse organizational structures tailored to address the unique challenges of the energy market. EMPs generally establish dedicated teams responsible for managing and optimizing the liquidity position of a company, with the aim being to safeguard financial solvency. However, there is no 'one-size-fits-all' organizational and governance setup that suits all EMPs. Various factors such as geographic footprint, business model (producer, seller, trader, or combination thereof) for example, necessitate different organizational setups that need to be considered in line with the proportionality principle.

For EMPs operating across a wide geographical footprint, liquidity management can be decentralized (i.e., based on individual relations between subsidiaries and exchange, or centrally orchestrated to optimize the overall liquidity). The overall liquidity risk tolerance is based on EMP's individual risk appetite, financial condition, and financing availability. This includes, for example, the relationship with their financial institutions (banks, insurance companies) and investors/shareholders. The risk tolerance must be reviewed at least annually, with all relevant stakeholders included. In addition, EMPs adhere to fundamental risk management principles also in terms of transparency: risks are consistently measured, monitored, and reported on.

The energy crisis in 2022 has shown that the strength of EMPs lies in their diverse, tailor-made setups, and their ability to adapt quickly and efficiently to changing market conditions and unexpected external shocks.

Below typical adaptations that were observed in the market are listed:

- Strategically, the formation of decision committees that include members from the liquidity risk, back office, and treasury departments has become vital for steering liquidity risk positions. The organizational setup can be extended by establishing central steering desk to manage and optimize the liquidity risk position of commodity contracts.
- Another example of quick adaptation to changing market conditions is EMP's agile product adjustment capabilities. During the energy crisis the increased usage of triangulations as well as EFP trades allowed to shift exposures between margined and non-margined counterparties (OTC CSA to OTC), and exchange volumes to the OTC market (i.e., to move liquidity risk (margining) to credit risk).
- Additionally, EMPs responded to the extraordinary market situation by hiring additional staff for liquidity management or engaging contract service providers to support with margin calculation and management.
- The overall liquidity governance was further enhanced by updating the risk mandates and setting up dedicated task forces such as liquidity committees, similar to the set-up illustrated on Figure 8.

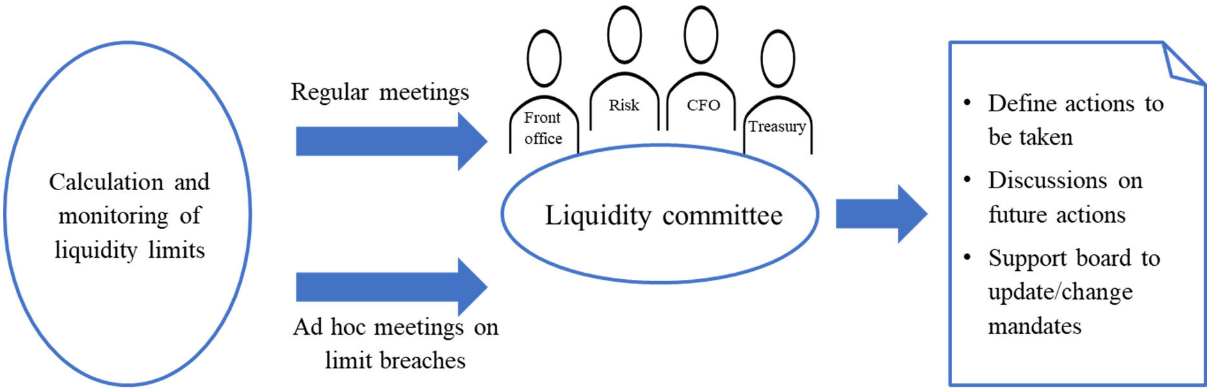

Figure 8: The Liquidity Risk governance

To ensure quick reaction in changing market environment characterized by high volatility, the frequency, composition, and level of detail of such decision committees/fora is mostly dependent on the overall micro and macro environment.

4.3 Risk appetite and limit setting

The risk appetite defines the level of (liquidity) risk an organization is willing to accept. It includes assessing the organization's financial capacity, strategic objectives, and market conditions. The established risk appetite provides guideline for decision-making and forms the basis for developing liquidity policies and procedures.

As part of the planning process, such as mid-term-planning, EMPs also re-size their liquidity limits for margining. These limits may be impacted by Key Performance Indicators' (KPIs), rating classifications, or financial covenants they intend to comply with. The overall limit can then be divided across specific trading activities, business units, or geographical markets, depending on the organization's business type. Following such a limit allocation and its communication to the desks, the respective monitoring is set up or adjusted.

4.4 Reporting

Reporting granularity and KPIs are consistent with the needs of different stakeholders (see Chapter 4.1) and ensure transparency and full visibility in the decision-making process.

There are different reporting dimensions that represent different levels of reporting granularity and enable the detailed analysis and break down of reporting KPIs. The ability to allocate margining requirements to a granular level is critical for the understanding of risk contributors and managing material risk in a portfolio. Possible dimensions include:

- **Time**: Margining requirement over time under the assumption of an aging portfolio and current market conditions.
- **Channel**: Margining requirements per channel (e.g., OTC CSA and exchange). For example, by measuring the channel concentration, the liquidity of the channel, position distribution, and position management.
- **Portfolio hierarchy**: Margining requirements per book, commercial function, or business unit, identify risk contributors' performance adjustment, steering of position and execution or risk reduction measures by the commercial owner.
- **Commodity**: Margining requirements per commodity (e.g., power or gas).

The reports compiled with these dimensions can be based on current or stressed market conditions and may include assumptions about changes to the portfolio. Overall, for complex portfolios, having a greater number of KPIs and dimensions improves the organization's ability to conduct risk management analyses and respond promptly in case of distress scenarios. Table 1 contains several examples of liquidity reports for key stakeholders.

Stakeholder	Reports
Board of Management	Overall performance vs. risk adjusted views, reporting on overall liquidity situation and limit utilization.
Risk Management Divisions	Limit monitoring, utilization, breaches, escalation, incl. recommended actions for risk mitigation/management.
Treasury Departments	Liquidity provision, and monitoring of liquidity, as well as requirement, forecasts, early warning signals, velocity indicators, margin disputes and defaults.
Business Units/Trading Desks	Central and local business units limit availability and limit utilization, cost of liquidity.
Audit Units	Breaches, exceptions, exemptions and mitigations.
Back Office	Margin calculations, reconciliation, day+1 payment requirement, margin disputes and defaults, settlement information.

Table 1: Type of reports per stakeholder

Reporting offers invaluable insights into potential margin requirements and the impact of market fluctuations on financial stability. By establishing minimum reporting requirements, organizations can promote consistency and transparency across departments while fostering a culture of risk awareness and accountability. Standard reporting is based on End of Day (EoD) processes, which provide a snapshot of the company's liquidity position at the end of each business day. This ensures that all short-term obligations can be met and that any potential liquidity shortfalls are identified promptly, allowing them to be considered in the liquidity planning. Since EoD processes are well-established and standardized within the energy industry, they offer a consistent, structured, and reliable approach to monitoring liquidity, ensuring that all necessary data is available and thoroughly analyzed by the end of each day.

Depending on the capability of the infrastructure, (near) real-time reporting could also be established. This more advanced approach involves continuously consuming and processing real-time trade and market data, enabling a more dynamic and responsive liquidity risk management framework. Real-time reporting can provide accurate estimates for an intraday margining requirement and enhance liquidity planning by providing an up-to-date view of liquidity position throughout trading day.

In addition to EoD and real-time reporting, which is based on the current market conditions, it is recommended to regularly perform liquidity stress tests. These are reported at a lower frequency or ad hoc and are designed to assess the resilience of the business under extreme market conditions, beyond the scope of regular reporting. Such reports provide an in-depth analysis of potential liquidity risks under hypothetical adverse market conditions. These stress tests complement the standardized regular reports by ensuring that the EMP is well prepared for a wide range of market scenarios, thereby adding an extra layer of robustness to the overall liquidity risk management framework.

5 Optimization and steering

This chapter provides an overview of the measures taken by the EMPs to ensure the liquidity supply meets the actual and projected margining requirements.

5.1 Funding planning

EMPs set up an internal funding plan to cover for the projected liquidity demand. This plan appropriately reflects the strategies, the risk appetite, and the business model that serves internal management purposes. Since liquidity risk varies in nature and scale, there is no one-size-fits-all funding plan for EMPs; it depends on the nature and extent of liquidity risk.

Long-term and mid-term planning generally leads to a twelve (12) month liquidity and funding plan. In standard market situations, a liquidity plan with monthly granularity might be updated monthly. For the first three (3) months, a liquidity plan with daily granularity is usually updated weekly. During crisis periods, both the frequency and level of detail or granularity of the plan typically increase.

Accurate liquidity forecasting is crucial for funding planning, as it helps prevent suboptimal capital allocation and costs related to accessing lending facilities.

EMPs diversify their funding sources across lenders, markets, timeframes, and products to avoid a clustering of risks through a single channel or the concentration of reliance on a single counterparty. Such diversification reduces EMP's vulnerability in times of funding market stress. It entails obtaining credit lines from multiple financial institutions, including banks, as well as issuing company bonds. In addition, the internal funding plan is assessed for funding robustness by grouping funding sources into stable and unstable. Stable funding sources are instruments that remain unconditionally available even under stressed scenarios, such as liquidity shortages and market dislocations. These may include committed credit lines, cash, and cash equivalents. Unstable sources, on the other hand, are those that many not remain accessible under stressed market conditions (e.g., uncommitted credit lines).

5.2 Contingency planning

Contingency planning is a crucial tool for EMPs seeking to navigate complex and volatile energy markets. By anticipating potential liquidity strains and taking proactive steps to mitigate risk, EMPs can maintain a strong financial position even in the most challenging market conditions. Contingency planning involves developing of preventive measures and response strategies to address identified risks and uncertainties.

Liquidity buffer

The liquidity buffer is a key part of the contingency planning which determines the reserve for short-term liquidity needs of an EMP under stressed market conditions. Liquidity buffers are built using stable funding sources. EMPs set thresholds of liquidity buffer usage to trigger mitigation actions as defined in the contingency plan (see Figure 9).

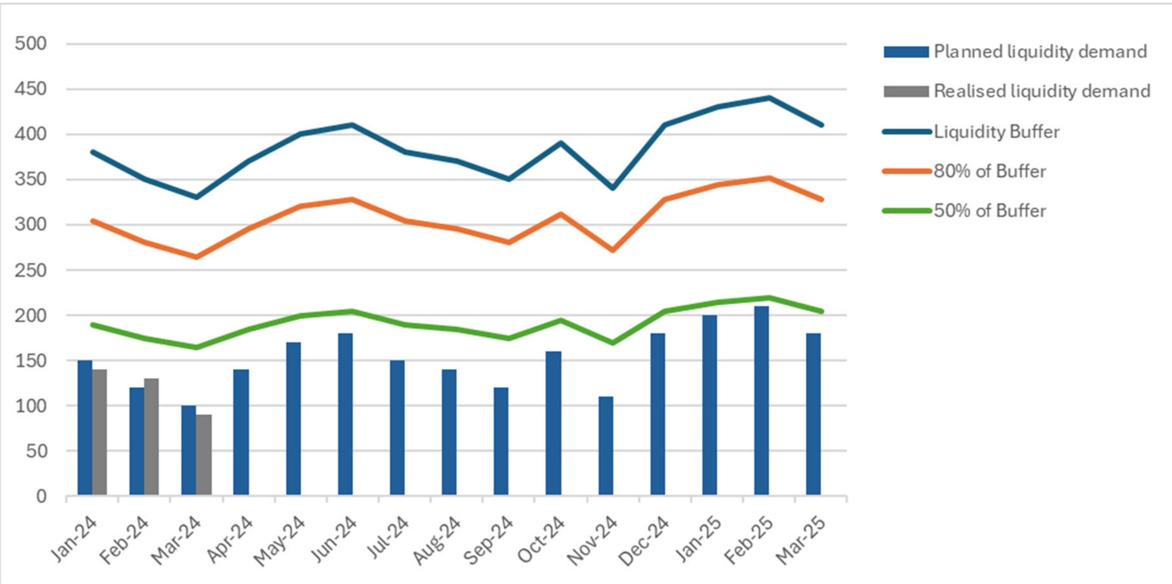

Figure 9: Monitoring of the liquidity demand and available buffer

Scenario analysis

Scenario analysis is a powerful tool used by EMPs to explore potential future events and their impact on market dynamics and liquidity conditions. By systematically evaluating a range of possible market scenarios – including rapid, extreme, and stressed conditions – EMPs can identify potential liquidity stress points and vulnerabilities. It helps identifying the (potential) funding gap that needs to be held as a liquidity buffer.

Reverse stress scenarios are also employed to determine the level of risk an EMP can bear by stressing positions relative to available liquidity sources.

Scenarios must account for potential shocks in both funding supply and liquidity demand. This includes assessing the availability of funding, potential access restrictions, and the cost of funding, all of which must be accounted for in the contingency plan.

A scenario-based approach enables EMPs to identify and assess the likelihood and severity of adverse scenarios, thereby informing strategic decision-making and risk mitigation efforts. By simulating the behavior of energy markets under various scenarios, EMPs can stress test the resilience of liquidity positions and financial resources. Sensitivity analysis and scenario-based stress testing also allow EMPs to quantify potential liquidity shortfalls and assess the adequacy of existing risk mitigation measures.

Action plan

Based on the insights from scenario analysis, EMPs develop robust contingency plans tailored to specific liquidity risk scenarios. These plans prompt actions to reduce risk and optimize margins when liquid resources approach or drop below critical thresholds. They cover a range of liquidity measures, including:

a) Optimization of liquidity supply

- Access to emergency funding facilities, mainly existing funding lines, but also raising liquidity through the market (i.e., bonds etc.).
- Financial instruments for liquidity optimization (i.e., repos, deal prepayments, factoring)
- Partial portfolio, inventory or other assets liquidation.
- Renegotiation of payment terms.

b) Optimization of liquidity usage

- Collateral optimization strategies, for example adjusting CSA thresholds or switching CSA cash collateral to Letters of Credit.
- Minimization of trapped liquidity, for instance avoiding positions in illiquid markets.
- Reduction of liquidity risk bearing positions subject to margin requirements or collateral requirements.
- Setting limits on new cash-intensive business.

- Renegotiation of payment terms.
- Optimization and/or reduction of hedging positions as necessary.

The contingency plan must consider the following aspects:

- The order in which respective measures should take place (hierarchization), depending on the phase of the stress scenario.
- Time necessary for each measure to become effective and help obtain the required cash or release existing restrictions.
- Attainable and target values for liquidity raised after haircut, depending on severity of the stress.
- Where applicable, an assessment of liquidity demand and supply with regards to foreign currencies requirements.
- Other risks associated with the respective liquidity measures, including counterparty and reputational risks.

Contingency plans are only effective if they can be acted upon quickly when the need arise. Therefore, the contingency plan must clearly outline the roles and responsibilities for decision making and execution. Where possible, it should provide guidance with regards to the prioritization of business activities (e.g., prioritizing the continuity of physical operations over hedging of long-term price risks) to facilitate and expedite decision-making.

Proactively developed contingency plans enhance an EMP's ability to withstand liquidity shocks and maintain operational continuity under adverse market conditions. Continuous review, testing, and updating of contingency plans is required to ensure efficiency under evolving market conditions.

5.3 Funding sources and measures

Financing measures must be arranged by treasury to facilitate access to additional cash liquidity when required. Realistic and reasonable assumptions regarding market potential of financial measures must be taken. These assumptions can be derived from historical evidence including market disruptions and stressed conditions.

There are different sources of funding that EMPs may rely on:

Credit Facilities	Debt Instruments	Alternative Funding Measures
Syndicated Credit Facilities	Bonds	Guarantee facilities
Bilateral Credit Facilities	Commercial Papers	Collateral Vs. Guarantee/ SBLC
	Promissory Notes	Factoring
		Secured Borrowing Facilities
		Customer Prepayments
		Agree on longer payment dates
		Repo Structures
		Working Capital Optimization

Table 2: Funding sources and measures

Credit Facilities

- **Syndicated credit facilities:** A syndicated credit facility is a credit structure with more than one financial institution involved in providing the funds (i.e., in contrast to an individual credit facility line, there are several lenders). Particularly in the case of high-volume credit facilities, several banks often join a banking syndicate to provide the funds. This is done for reasons of risk diversification or because of the limited financing capacity of a single bank.
- **Bilateral credit facilities:** Bilateral credit facilities represent a credit agreement between a borrower and lending bank. There are two structures for bilateral credit facilities. They can be either committed or uncommitted. A committed credit facility is a pre-arranged agreement, where the lender agrees to provide a specific amount of credit for a specified period of time. Even if the facility is undrawn during the agreed period of time, the borrower has to pay a commitment fee. An uncommitted credit line is less formal and does not guarantee the availability of funds.

Debt Instruments

- **Bonds:** A bond is a fixed-income investment instrument issued by governments, municipalities, corporations, and other entities to raise capital. As an investor bonds are essentially lending money to the issuer in exchange for periodic interest payments (coupons), and the return of the bond's face value (principal) at maturity.

- **Commercial paper:** Commercial paper is a short-term, unsecured debt instrument, primarily issued by corporations and financial institutions to cover short-term cash flow needs. The terms are usually less than one year and are individually determined by the respective issuer.
- **Promissory notes:** A promissory note is a written, unconditional promise by the issuer to pay a certain sum of money to the lender (known as the payee or holder) at a specified future date. It is a legal instrument used to document a loan or debt transaction between two parties.

Alternative Funding Measures

- **Guarantee facilities:** Guarantee facilities refer to financial arrangements or instruments provided by a lender or financial institution to guarantee the performance of a loan. These facilities are usually offered to borrowers who do not meet the lending criteria or require additional collateral to secure financing. Guarantees can take various forms, such as letters of credit, surety bonds, or collateral, and they serve to mitigate risk for the lender by providing an additional source of funds in the event that the borrower defaults on its obligations.
- **Collateral Vs. Guarantee/Standby Letters of Credit (SBLC):** To strengthen its liquidity position, a company may exchange posted cash collateral for eligible guarantees or provide eligible guarantees/SBLCs instead of cash collateral. However, this is highly dependent on the recipient's acceptance and requires time in advance to align requirements.
- **Factoring:** Factoring or receivable purchase structures refer to financial instruments in which a company sells its outstanding receivables to a factor or finance company in order to obtain immediate liquidity. The factor or finance company pays the company a certain percentage of the value of the receivables in advance and then assumes responsibility for collecting the receivables from the debtors. Once the receivables are collected, the factor or finance company pays the balance to the company minus an agreed fee.

- **Secured borrowing facilities:** Secured borrowing facilities, such as loans secured by liens, are financial instruments where a debtor borrows money from a creditor and provides certain assets as security for the repayment of the loan. These assets, often referred to as collateral or pledges, serve as a guarantee for the lender and provide additional security in the event that the borrower is unable to repay the loan.
- **Customer prepayments:** Customer prepayments against discount is a business transaction in which a customer pays for goods or services in advance and receives a discount in return. This prepayment improves the supplier’s cash flow, while the customer benefits from lower prices and receives delivery of the products or services at a later date. In accounting, the advance payment is recognized as a liability, while the discount reduces the final purchase price.
- **Repo structures:** Repo structures (repurchase agreements) are financial transactions in which a security holder sells securities and at the same time undertakes to repurchase them at a later date at a previously agreed price. These transactions are often referred to as "repo" or "repurchase agreements" and serve as a short-term source of funding or liquidity management.
- **Working capital optimization:** Working capital optimization refers to the management of a company's short-term assets and liabilities. The objective of working capital optimization is to improve a corporate’s liquidity balance and enhance the company’s overall financial health and operational performance. It involves managing the balance between current assets and current liabilities to ensure that the company has enough resources to meet its short-term financial obligations (e.g., sell of gas from gas storages to the bank (summer/winter) and buy back; sell of emission certificates and buy back at a later stage when the certificates are needed). Factoring is possible but limited under EFET agreements as payment terms are too short.

5.4 Liquidity demand optimization

Approaches for the optimization of the liquidity demand side are manyfold. In the following we concentrate on the most effective approaches for cleared and collateralized position under the assumption that the existing (set of) commodity position(s) shall not change.

Optimizing IM across exchanges

Taking optimizing IM as a first step: If an EMP holds positions in the same commodity and delivery periods at two exchanges – for example, TTF M3 at ICE Endex and EEX – it is worth analyzing whether these positions are (partially) offsetting each other and a transfer from one exchange to the other would might reduce the total IM balance across the affected clearing accounts. Such an analysis must consider not only the commodity and delivery period in question but all positions at the affected clearing accounts to avoid losing IM netting benefits between individual positions in the same account.

In case of a sufficient market depth at both exchanges, such an optimization can be performed in the course of standard trading. This approach involves running through bid/offer and carries the risk that markets move between entering into the two new futures positions. Alternatively, the optimization may be done with a suitable market participant who either has an offsetting position or is willing to take these additional positions, typically in exchange for a fee.

Optimization of IM and VM via EFPs

To take optimization a step further, an EMP may want to reduce the length in a futures position via a so-called EFP. In this arrangement, an EMP and its counterparty both agree to close a certain offsetting futures position and simultaneously enter a corresponding bilateral transaction that replicates the commodity position at the exchange. This bilateral transaction can either be a financially settled swap or a physically settled forward. For the typical EMP who hedges its production with futures, a forward is often preferred, so that physical aspect of hedging is also covered.

With an EFP, not only can IM and the associated risk of increases in IM be effectively reduced, but also the risk of increasing VM requirements[10]. However, this comes with a trade-off of increased credit risk.

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[10] With a (partially) closed position, the paid VM is locked-in accordingly. From an EMP's perspective, having hedged its production output (i.e. with having mitigated the risk of a further increase of VM requirement) the opportunity of a flowing-back VM in case of reducing prices had been lost simultaneously. While in a strict sense, given VM is never paid back, it does so economically. For example, consider the standard scenario of an EMP having entered into a short financially settled futures position to secure a fixed price of F for its power production. If the futures underlying price increases to P, the EMP has to provide VM in the amount of the difference between

Once again, the liquidity risk reducing benefits of an EFP can be achieved via standard trading if markets allow. Additionally, as with pure IM optimization, correlation effects across the relevant portfolio must be considered to assess the effectiveness of the EFP in reducing liquidity demand. VM risk is only effectively reduced if the bilateral transaction does not fall under a CSA. If a CSA is in place, and assuming typical CSA parameters (e.g., a very small, if not zero, threshold and daily collateral process), liquidity demand from market price changes would largely remain unchanged, while a T+1 settlement of VM versus a T+2 settlement of collateral complicates the treasury process of managing liquidity. Finally, under a CSA, settlement exposure is also collateralized, which increases liquidity demand for the buyer and reduces it for the seller.

Reducing liquidity demand from cleared positions via EFPs involves three parties: the EMP (counterparty A), the clearing house (which acts as original counterparty B to the EMP, excluding the clearing bank aspect for this discussion), and the other market participant (counterparty C). In this arrangement, the EMP's position towards the clearing house is transferred to counterparty C, which then enters into a market risk-offsetting position with the EMP.

Triangulation

By replacing the clearing house with another EMP in this trilateral process, a process known as 'triangulation' occurs. While triangulation is market risk neutral for all three parties, it changes the net positions between any two parties, thus affecting their bilateral credit risk. If counterparty A and counterparty B trade with each other under a CSA, the triangulation transaction between these parties reduces their bilateral net position. If counterparty C does not have a CSA with the other two parties, counterparty A and counterparty B have effectively reduced their liquidity risk.

Triangulations can be organized between the three parties directly or via a service provider such as brokers or specialized firms.

P and F, P-F. If P remains constant thereafter until the expiry of the contract, no further VM will be exchanged or 'received back'. By selling the power into the physical spot or short-term forward market at the prevailing market price P, the proceeds above F economically nets out with the VM paid and the EMP has secured a price of F for its power production.

5.5 Liquidity charges

A holistic optimization of the risk triangle can be achieved if all risks an EMP faces – market risk, credit risk, and liquidity risk – are assigned a price tag. If an EMP charges for market risk and credit risk, a charging concept for liquidity risk must be established. As a starting point, it is important to recall that a fundamental risk management practice is to limit risk. In the case of liquidity risk, one would want to limit its materialization in the sense of future negative cash balances. This is achieved by setting a limit on the liquidity risk metric that an EMP has chosen as the most practical for their business model.

Setting the limit equal to the liquidity buffer within a strategic planning process involves defining a limit tenor structure. During this process, the EMP must consider the requirements of the business units holding liquidity risk-bearing positions, as well as the relevant constraints that determine the maximum available limit. Typical constraints include affordability, the overall capacity to raise any funds, and, in particular, if the EMP is externally rated, certain financial ratios.

Assigning a price tag to the requested and ultimately granted limit – i.e., charging for it – leads to a more realistic planning and thus avoids unnecessary funding costs in cases where the limits secured via external funding are unlikely to be used.

Paying for the granted limit, similar to paying a commitment fee for a committed credit line, along with charges for the utilization of the liquidity buffer, reflects the true cost of financing out the liquidity buffer. While it is beyond the scope of this manual to suggest the seniority of the liquidity buffer in comparison to funds secured for other purposes such as investments, it is worth noting that the actual price of the liquidity buffer is influenced by its seniority.

Charging for liquidity risk not only helps in the limit allocation process, but also promotes accountability, thereby incentivizing proactive management of this risk type. This is particularly true if, in addition, interest is also charged for negative cash balances – or conversely debited for positive cash balances.

Knowing the price for liquidity risk leads to the challenge of pricing it into individual transactions. In brokered screen trading, the counterparty and related credit terms, including a give-up agreement which would trigger the transaction to be cleared, are only known after the individual transaction with all parameters including the price, has become legally binding. As a result, credit and liquidity risk cannot be priced in pre-deal but must instead be treated as a cost of hedging or earned via the trading strategy. In contrast, while it is theoretically possible to perform a pre-deal calculation of liquidity risk charges for futures traded on the exchange and bilaterally bespoke transactions, it is conceptually and practically difficult to implement.

In principle, one has to consider the following elements in the calculation of funding costs and liquidity risk:

- The expected cash utilization from VM (futures) or MtM (collateralized bilateral transactions).
- The expected cash effect (positive for sells, negative for buys) for settlement exposure of collateralized physically settling transactions (deterministic in case of a fixed price transaction).
- The transaction's marginal contribution to the liquidity buffer (futures and collateralized bilateral transactions).
- The transaction's marginal contribution to the IM (futures).

The marginal contributions to the liquidity buffer and the IM can simply be determined by calculating these quantities with and without the transaction to be priced. The expected funding costs related to the first two categories above are determined by the difference between the gains from the expected VM or collateral to be received ("deposit rate/spread times expected positive cash balance") and the costs to finance expected VM or collateral to be paid ("funding rate/spread times expected negative cash balance"). This Funding Valuation Adjustment (FVA) is given by[11]:

$$FVA = FVA_{benefit} + FVA_{cost},$$

with FVA_{cost} being a negative figure and, for the sake of simplicity, ignoring the EMP's and its counterparty's likelihood of default:

[11] Zeitsch, P.J. (2017) The Economics of XVA Trading. *Journal of Mathematical Finance*, 7.

$$FVA_{benefit} = \int_0^T DR_t EPE_t dt$$

$$FVA_{cost} = \int_0^T BR_t ENE_t dt$$

where

T: maturity of the transaction or portfolio,

DR_t: deposit rate/spread,

EPE_t: expected positive exposure = expected positive VM/ collateral balance,

BR_t: borrowing rate/spread,

ENE_t: expected negative exposure = expected negative VM/ collateral balance.

As under a typical CSA, the collateral-providing party is entitled to receive the respective risk-free rate the true benefit or cost is given by the deposit/borrowing spread only.

However, the practical implementation remains challenging for several reasons. To highlight just three: first, the calculation parameters in CSAs, such as rating-dependent thresholds or the option (if agreed) to provide or receive alternative forms of collateral (typically bank guarantees) instead of cash, make the respective calculations non-linear and non-deterministic. The second challenge is caused by the "known unknows" regarding how the portfolio will evolve over time, and thus how future portfolio effects will impact the marginal contribution of the transaction to be priced, as well as the future set of market prices and associated volatilities and correlations, as well as IM parameters. Therefore, in the simplest form, any calculations would be conditional on the current values of the factors defining the liquidity and funding risk taken.

Finally, it is worth mentioning that a fair allocation of costs/benefits of negative and positive cash balances and liquidity risk incurred must be ensured to support the incentivization of a proactive risk management. However, such details go beyond the scope of this manual.

Annex: Case study

This manual has summarized leading liquidity risk management principles for EMPs. To demonstrate their practical application, the following case study examines a hypothetical EMP owning a gas-fired power plant whose commodity price risk needs to be hedged. Simplified, the plant's hedge relevant technical parameters are as follows:

- nameplate capacity [MW]: 1,000
- average runtime p.a. [hours]: 3,000
- gas efficiency of asset [%]: 50
- EUA efficiency of asset [%]: 40.

The hedge policy defined by the EMP's board can be summarized by:

- hedging of planned forward positions are done at EEX solely[12]
- proxy hedging with German power baseload
- proxy hedging with TTF
- EUA contracts are all December contracts
- hedge profile:
    - 100% of the positions are hedged for the current year, as of January 1st
    - 70% of the positions are hedged for the first year ahead, as of January 1st
    - 30% of the positions are hedged for the second year ahead, as of January 1st
    - positions are entered on the 1st of each month, i.e., each month 1/12 of the positions are entered which are required between January 1st of the current year and January 1st of the next year.

Assuming the hedge policy became effective on January 1, 2018, the hedge profile was in a swung-in state for the first time in 2021. See Figure 10 for exemplary positions.

[12] In reality, besides entering into OTC positions collateralised and uncollateralised, the EMP might not only enter into positions at EEX but also at e.g. ICE – which would increase the total IM as the full netting potential would not be realised.

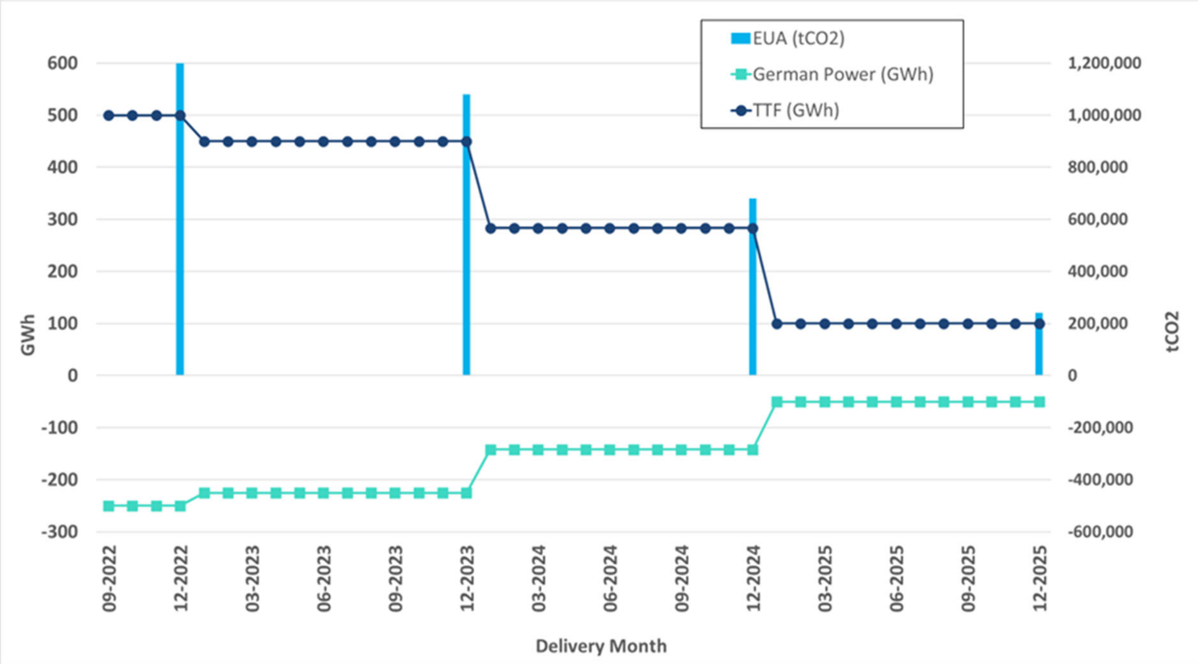

Figure 10: Swung-in hedge positions, as of 26th August 2022 – the date for which the largest VM change over the considered period had been observed.:

For simplicity, we assume that although the liquidity risk profile is affected by changing market prices and volatilities, neither hedge positions are actively managed, nor liquidity risk optimizing activities had been carried out.

To observe the EMP's liquidity risk journey, we begin by analyzing the VM and IM[13] profiles the company had to manage over time (see Figure 11). In this case study, negative figures have the meaning of margins posted.

[13] In this case study, IM has the meaning of Standardized Portfolio Analysis of Risk (SPAN) IM (i.e., additional margins like potential concentration risk margin are not considered).

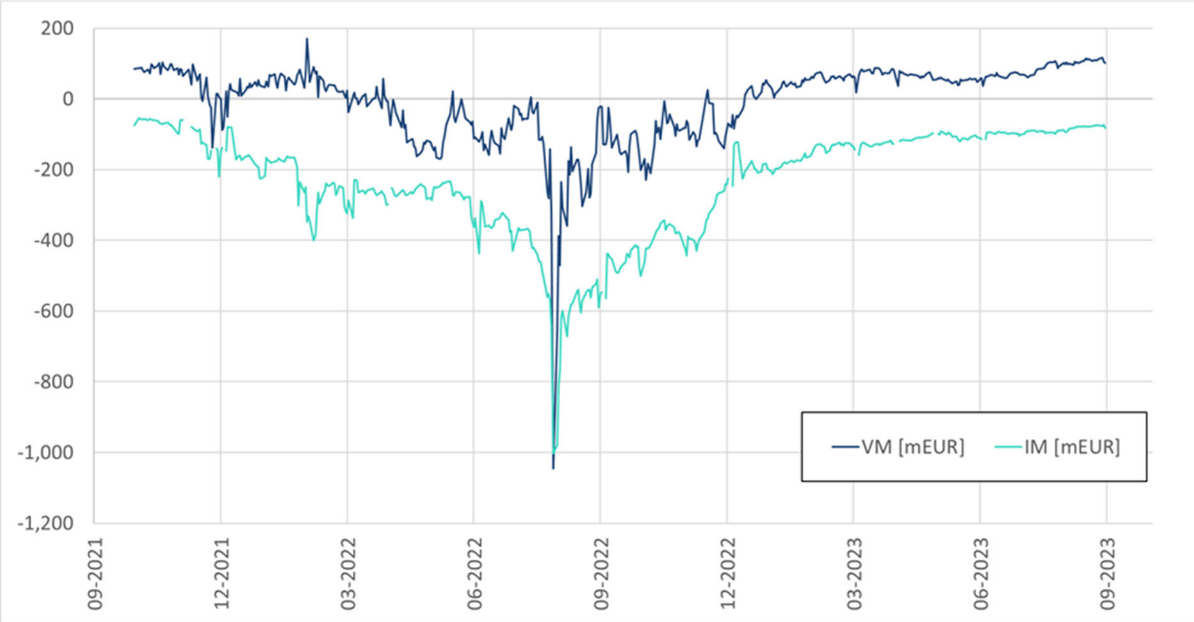

Figure 11: Variation Margin (VM) and Initial Margin (IM) over time.

After experiencing some volatility in VM and IM in late 2021, which stressed funding activities, the EMP improved its quantitative liquidity risk framework by introducing two comprehensive liquidity buffer metrics.

The first metric, the one-day Short Term Buffer (STB), is intended to cover all potential VM calls with 99% certainty. Since the STB accounts for a scenario involving a complete breakdown in cross-commodity correlation, it is first calculated per commodity and subsequently aggregated into a final portfolio figure. In cases of extreme price changes over a short period, the entire forward curve typically shifts in a parallel manner, with prices at the short end moving more significantly than those at the long end. Considering the EMP's hedge policy, this approach enables the aggregation of positions across different tenors into a single absolute net position. The potential value change of this position is modelled as a delta-VaR based on current historical volatilities which are estimated by an Exponentially Weighted Moving Average (EWMA) model with λ=0.97. The forward price and the corresponding volatility are chosen in a way that they correspond to the curve point which holds the position distribution center.

The second metric, the MaR, is calculated with a holding period of ten business days and at 99% confidence level. The calculation begins with the directional STB per commodity with an adjusted holding period. In a next step, the final MaR on portfolio level is determined by taking the direction of the portfolio value change per commodity and the correlations between these commodities into consideration.

The STB shall ensure that the EMP is always able to meet VM calls, thereby avoiding a forced close-out by the clearing house. In contrast, the MaR defines the liquidity needs for meeting VM requirements over a period in which the positions can be orderly managed down and/or additional measures to replenish the liquidity funds can be executed. For the MaR calculation, prevailing correlations are considered, as even after a price shock during market turbulences, standard correlated price dynamics typically hold over the longer time horizon of the MaR.

Both metrics are updated frequently to account for changes in the underlying parameters. Figure 12 and Figure 13 provide a comparison of each metric and the exposure it covers. Ultimately, considering both metrics, the liquid funds required to meet additional VM requirements are determined by the higher of the STB and the MaR.

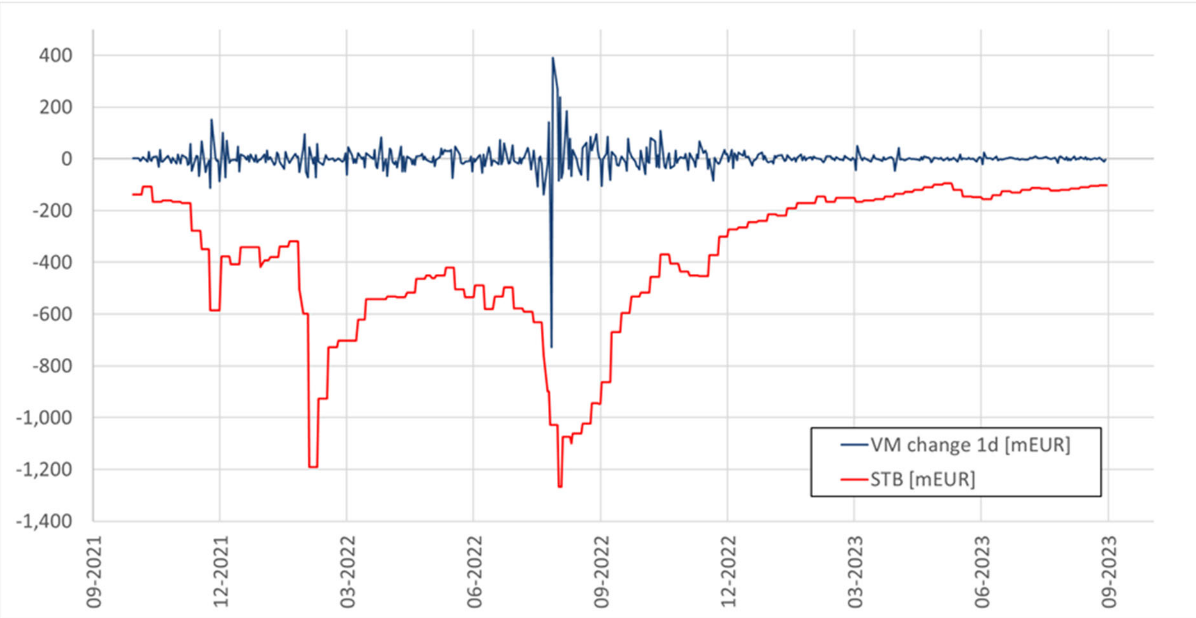

Figure 12: STB vs daily change of VM balance.

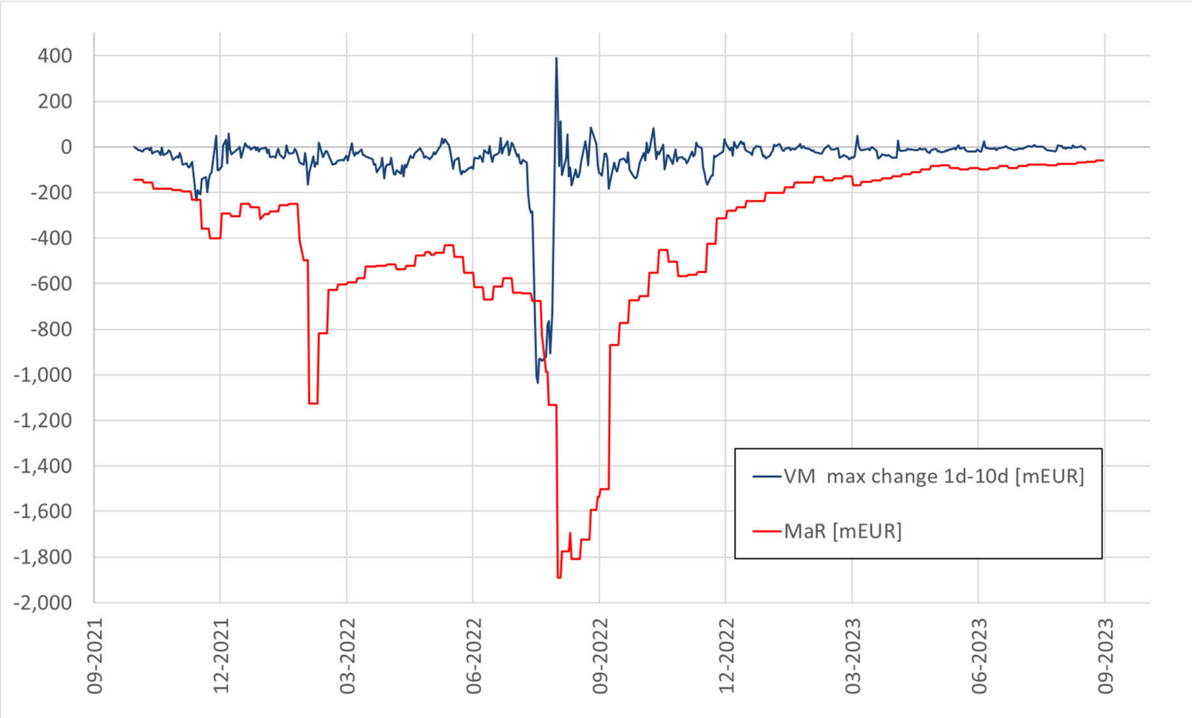

Figure 13: MaR (10d, 99%) vs the maximum cumulative change in the VM balance in the 10-day period covered by the MaR

Please note that the MaR limit breaches are a consequence of the case study's simplified assumption that positions are not actively managed. In reality, this scenario would not materialize, as the EMP would actively manage its positions in accordance with its defined liquidity risk appetite.

As outlined in Chapter 3.3 and indicated in the comparison of the MaR and IM time series (see Figure 14), the EMP's implemented MaR model is well equipped to analyze potential IM changes driven by changes in underlying prices and volatilities. This would allow the EMP to define the liquidity funds required to cover IM.

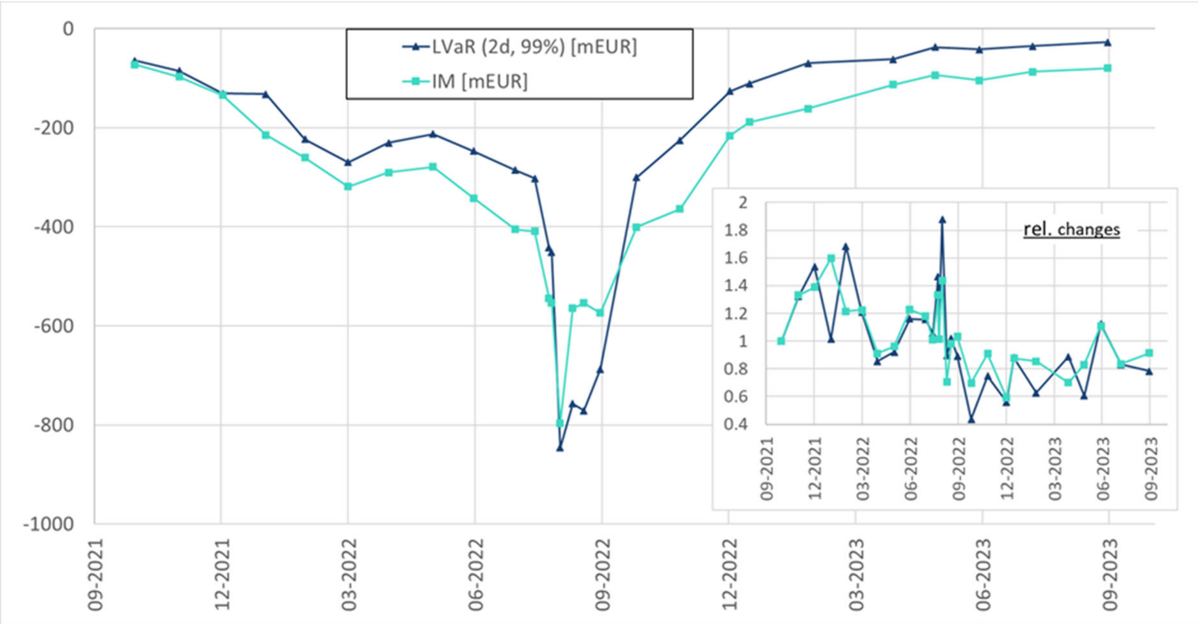

Figure 14: MaR (2d, 99%), calculated by the EMP, vs IM as calculated by the CCP over time (main figure) and their relative change between two calculation dates (inset)

In addition to the statistical metrics to steer liquidity risk, the EMP has implemented a stress testing framework. As a first step, the EMP has defined three different historical scenarios over time, as detailed in Table 3:

- the "low nuclear & hydro output" scenario, observed on 21.12.2021
- the "Russian invasion into the Ukraine" scenario, observed on 24.02.2022
- the "perfect storm scenario"[14], observed on 26.08.2022.

[14] The "perfect storm" scenario refers to August 2022, where a combination of factors on gas and power markets led to unprecedentedly high prices levels. In particular, a massive drop in Russian pipeline gas supplies to Europe coincided with a significant reduction in available power generation capacity (low nuclear, hydro and wind output).

As of Date	Commodity	1-12 months	13-24 months	25-36 months	VM 1d [mEUR]
21.12.2021	German Power	25.9%	10.1%	8.3%	-227.4
21.12.2021	TTF	33.1%	11.8%	1.6%	240.7
21.12.2021	EUA	1.1%	1.1%	1.2%	-66.1
24.02.2022	German Power	39.1%	10.3%	2.4%	-269.5
24.02.2022	TTF	48.4%	17.0%	13.8%	297.2
24.02.2022	EUA	-8.5%	-8.3%	-8.2%	-20.9
26.08.2022	German Power	22.4%	22.9%	11.8%	-921.6
26.08.2022	TTF	6.6%	5.3%	5.6%	189.4
26.08.2022	EUA	1.1%	1.3%	1.3%	3.6

Table 3: Stress tests used by the EMP.

The table above displays the average price shocks observed for the respective commodity and the first, second, and third twelve front months periods. It also shows the observed VM movements. The 'As of Date' indicates the date of the price move. The VM cash flow occurs on the next business day; for example, the changes in settlement prices from the 25th to the 26th (Friday), as shown in the table, determine the VM cash flow on the following Monday (29.08.2022).

Along with updating the STB, the EMP compares the stressed VM from the worst-case historical scenario at that time against the STB (i.e., "point-in-time"). In addition, it tests retrospectively if the STB would cover the overall worst historical scenario. Calculating the ratio of that hypothetical VM and the STB applicable at a certain day defines the reverse stress test result, as suggested by ESMA. The outcome of these calculations is shown in Figure 15.

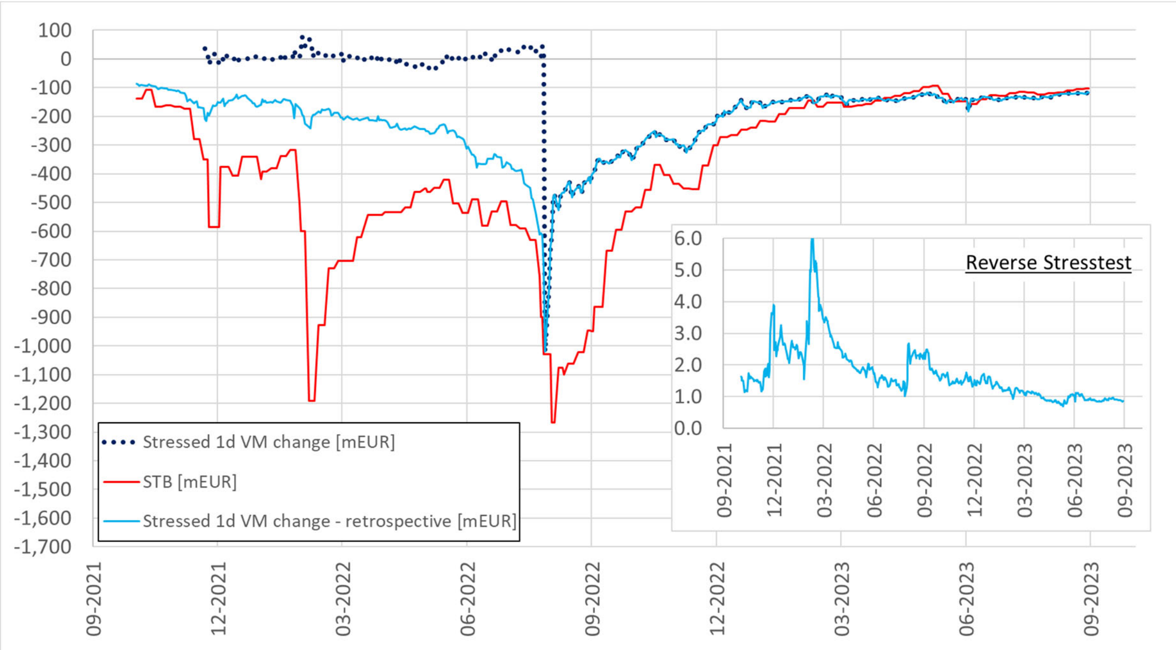

Figure 15: Point-in-time stressed VM change (dotted line) vs STB (red line) and STB vs retrospectively calculated stressed VM change (pale blue line) – the latter defining the inputs for the Reverse Stress test shown in the inset.

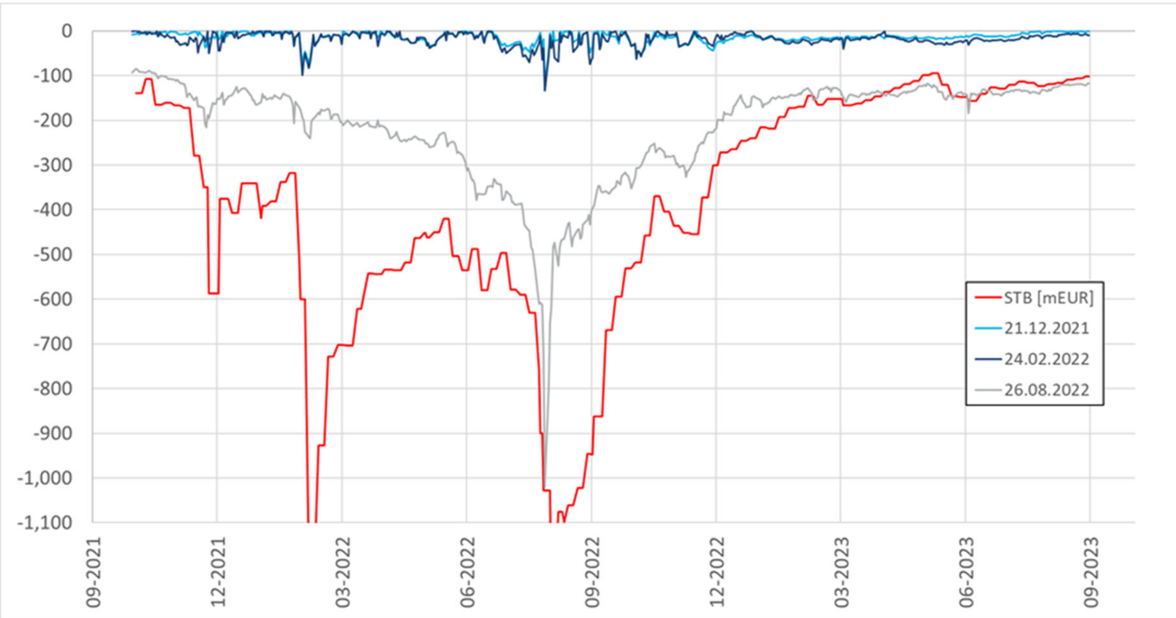

Figure 16: Antithetical hypothetical stress tests with corresponding VM movements [mEUR] vs STB, completing the insights from stress testing

From Figure 15 and Figure 16, it can be inferred that during the high volatility phase of 2022, the STB was sufficiently large to absorb stressed VM changes, as observed in the 'perfect summer storm' scenario – even without an active position management, as assumed in this case study.

However, the reverse stress test results show that without an active position management when volatilities returned to a lower level in 2023, the STB would have been insufficient to cover stressed VM movements. Therefore, in addition to active position management, maintaining a minimum liquidity buffer of sufficient size is recommended.

From a stress testing framework perspective, the most extreme scenario would arise if commodity prices changed independently of each other and the most extreme price movements for individual commodities, usually observed at different points in time, all occurred simultaneously – i.e. under consideration of antithetical scenarios. The outcomes of this doomsday scenario are shown in Table 4.

Commo-dity	Largest VM outflow			Largest VM inflow			Antithetical largest VM movement [mEUR]
	As of Date	Stress Case	VM outflow [mEUR]	As of Date	Stress Case	VM inflow [mEUR]	
German Power	26.08.2022	24.02.2022	-1,233	26.08.2022	25.02.2022	1,024	1,233
TTF	26.08.2022	25.02.2022	-780	26.08.2022	24.02.2022	1,124	1,124
EUA	12.12.2022	01.03.2022	-55	12.12.2022	08.03.2022	58	58
			-2,068			2,207	2,416

Table 4: Largest 1-day VM changes per commodity.

While such a 'sampled historical scenario' would result in a one-day VM outflow of 2.4 bEUR – more than twice the observed maximum outflow during the 'perfect summer storm' – the causality given by the economic reality of the highly interlinked power and gas markets suggests that this hypothetical scenario is unlikely, and therefore can be disregarded by the EMP.

To this point, the case study has demonstrated that the EMP is well-equipped to estimate its liquidity needs, even in extreme circumstances. From a risk analytics point of view, the EMP can manage its futures portfolio under the constraint of its available funds.

While history has proven the EMP was correct in managing its liquidity risk, the company is nevertheless considering whether, under a different hedging approach (or 'other stress scenarios'), their liquidity funds would have been sufficient.

Concentrating on the third stress event, the breakdown of the STB by commodity as of the most recent "as of day" (24.08.2022, calculation performed on the 25th) prior to the stress event is as follows:

- German Power: 519 mEUR
- TTF: 491 mEUR
- EUA: 18 mEUR.

Comparing these figures with the realized VM movements caused by the price movements on the 25th:

- German Power: -922 mEUR
- TTF: 189 mEUR
- EUA: 4 mEUR,

due to the definition of the STB, which assumes a correlation of -1 between commodities having positions in opposite directions, and the positively correlated price movements – in particular of German Power and TTF at the stress event – the STB was sufficiently large to cover the VM call. However, in case of a 'non-balanced portfolio' where, for example, TTF is bought OTC non-collateralized, the STB would have been insufficient.

As the STB is a model that estimates the worst VM move for a given confidence level (here: 99%) and observed volatility for a commodity, it is clear that the STB may be insufficient to meet a VM call if a highly extreme event occurs. For example, the German Power VM movement in the case above corresponds to a 99.9982% event – one that occurs every 222 years.

It is important to emphasize once more that all results presented are compiled under the assumption that the EMP does not actively manage its portfolio in periods of stress under the constraint of its available liquidity funds. In reality, however, such an active management does occur.

In conclusion, this case study, along with real-world history, demonstrates that through active management of the risk triangle, with a proper measurement of the risks taken compared with its risk bearing capacities, EMPs can survive events that occur only once in the lifetime of a Greenland shark.

Addendum: EMP's Liquidity Practices are Aligned with the FSB Liquidity Recommendations

Shortly after the finalization of Energy Traders Europe 'Manual on Liquidity Risk Management', the Financial Stability Board (FSB) published its report, 'Liquidity Preparedness for Margin and Collateral Calls,' on 10 December 2024.[15] The report focuses on improving the ability of non-bank financial intermediation (NBFI) sectors to manage liquidity pressures resulting from spikes in margin and collateral calls during periods of market stress. To achieve its objectives, the report provides eight high-level policy recommendations designed to address liquidity risks and ensure operational resilience. This report forms part of the FSB's broader initiative to enhance the resilience of the NBFI ecosystem. It responds to the findings of the BCBS-CPMI-IOSCO[16] review of 'Margining dynamics in centrally cleared commodities markets in 2022',[17] which identified the need for enhanced liquidity preparedness and data monitoring to mitigate financial stability risks.

<u>This addendum outlines how the eight recommendations from the FSB report on liquidity preparedness for margin and collateral calls are addressed by the practices outlined in the Manual on Liquidity Risk Management for Energy Market Participants (EMPs).</u>

The practices described in the manual align closely with the FSB's guidelines, ensuring robust liquidity preparedness across market conditions. The table below maps each recommendation to the corresponding chapter(s) in the manual.

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[15] Financial Stability Report: https://www.fsb.org/2024/12/liquidity-preparedness-for-margin-and-collateral-calls-final-report/

[16] BCBS-CPMI-IOSCO stands for: Basel Committee on Banking Supervision (BCBS), Committee on Payments and Market Infrastructures (CPMI) and International Organization of Securities Commissions (IOSCO). These organizations collaborate on global financial standards and guidelines, particularly in areas related to banking, payments, securities, and market infrastructure to enhance the stability and resilience of financial systems.

[17] See, e.g., Basel Committee on Banking Supervision: https://www.bis.org/bcbs/publ/d550.htm.

FSB recommendation	Manual on Liquidity Risk
Recommendation 1 Market participants should incorporate the assessment of liquidity risks arising from margin and collateral calls in their liquidity risk management and governance frameworks**.**	**Manual Reference:** Chapters 4 and 5 • Chapter 4 outlines the importance of liquidity risk management in EMP governance structures. Additionally, it details the roles and responsibilities of stakeholders and the integration of liquidity risk within governance frameworks. • Chapter 5 elaborates on funding and contingency planning to meet liquidity demands.
Recommendation 2 Market participants should define their tolerance for liquidity risk arising from margin and collateral calls and establish contingency funding plans to ensure that liquidity needs arising from these calls can be met, including under extreme but plausible stressed conditions.	**Manual Reference:** Chapters 4.4 and 5 • Chapter 4.4 describes the risk appetite framework and limit-setting practices, ensuring clear liquidity risk tolerances. • Chapter 5 provides guidelines for contingency planning, including the establishment of liquidity buffers and emergency funding lines.
Recommendation 3 Market participants should regularly review and update their liquidity risk framework to ensure that liquidity risks arising from margin and collateral calls are robustly managed and mitigated, particularly under extreme but plausible stress scenarios.	**Manual Reference:** Chapters 3.4 and 4.1 • Chapter 3.4 introduces stress testing methodologies to adapt the framework to evolving market conditions. • Chapter 4.1 emphasizes regular governance reviews and updates to risk frameworks.

FSB recommendation	Manual on Liquidity Risk
Recommendation 4 Market participants should conduct liquidity stress tests to identify sources of potential liquidity strains caused by margin and collateral calls, and to ensure a level of resilience consistent with their established liquidity risk tolerance.	**Manual Reference:** Chapter 3.4 • Chapter 3.4 provides detailed methodologies for conducting stress tests, including historical, hypothetical, and reverse stress testing, ensuring resilience under diverse scenarios.
Recommendation 5 Robust stress testing should analyze a range of extreme but plausible liquidity stresses caused by changes in margin and collateral calls, as well as market participants' overall liquidity position.	**Manual Reference:** Chapter 3 • Chapter 3.3 and 3.4 outline advanced liquidity risk metrics and associated stress testing techniques. This includes correlation break assumptions and scaled-hypothetical scenarios, to capture a wide range of stress conditions.
Recommendation 6 Market participants should have resilient and effective operational processes and collateral management practices.	**Manual Reference:** Chapters 3 and 5 • Chapter 3 focuses on the measurement and reporting of liquidity risk, emphasizing transparency and reconciliation processes. • Chapter 5 addresses collateral optimization strategies and operational resilience.
Recommendation 7 Market participants should maintain sufficient levels of cash and readily available as well as diverse liquid assets and establish appropriate collateral arrangements to meet margin and collateral calls.	**Manual Reference:** Chapter 5 • Chapter 5 discusses liquidity management tools, including maintaining cash reserves, diversifying funding sources, and optimizing collateral arrangements.

FSB recommendation	Manual on Liquidity Risk
Recommendation 8 Market participants should have active, transparent, and regular interactions with their counterparties and third-party service providers in collateralized transactions to ensure adequate operational resilience with respect to spikes in margin and collateral calls under stressed conditions.	**Manual Reference:** Chapters 1, 4, and 5 • Chapter 1 highlights the importance of transparent communication with counterparties and third parties (such as rating agencies and banks), particularly during a crisis. • Chapter 4 describes stakeholder interactions, including coordination with trading desks and treasury teams. • Chapter 5 underscores collaboration with financial institutions to ensure access to liquidity during stress periods.