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Reviewing the Market Stability Reserve

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Structural Supply Side Management in the EU ETS

Reviewing the Market Stability Reserve

by

Aleksandar Zaklan
Deutsches Institut für Wirtschaftsforschung, Berlin

Jakob Graichen, Verena Graichen, Hauke Hermann,
Johanna Cludius
Öko-Institut, Berlin

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Publisher
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Wörlitzer Platz 1
06844 Dessau-Roßlau
Tel: +49 340-2103-0
Fax: +49 340-2103-2285
buergerservice@uba.de
Internet: www.umweltbundesamt.de

/umweltbundesamt.de
/umweltbundesamt

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Deutsches Institut für Wirtschaftsforschung (DIW Berlin) Deutsches Institut für Wirtschaftsforschung (DIW Berlin)
Mohrenstr. 58
10117 Berlin
Germany

Öko-Institut e.V.
Postfach 17 71
79017 Freiburg
Germany

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Abstract: Structural Supply Side Management in the EU ETS: Reviewing the Market Stability Reserve

This paper contributes to the review of the Market Stability Reserve (MSR) by assessing the operation of the MSR and by discussing important issues with respect to adapting and complementing the MSR parameters for Phase IV of the EU Emissions Trading System (EU ETS). The analysis focuses on the current cap architecture for Phase IV, while also considering more ambitious cap setting, with an emission reduction of 65% by 2030, compared to 2005, reflecting a potential outcome of revision of the EU ETS cap. We identify and propose reforms to key elements of the MSR. Specifically, we consider several reform options for the MSR feed and release parameters, a change in the definition of the Total Number of Allowances in Circulation (TNAC) thresholds to account for changing liquidity needs during Phase IV, and how to increase the speed of the MSR response within the current MSR architecture. We also discuss the pros and cons of introducing a hybrid system with both price and quantity based MSR triggers. Moreover, we discuss how to account for allowance demand from aviation and introduce invalidation of vintage allowances. We also analyze the interaction between the voluntary cancellation of allowances and the MSR and propose a rule-based cancellation mechanism to account for national initiatives to phase out coal-based power generation.

Kurzbeschreibung: Strukturelles Management des Angebots im EU Emissionshandel: Überprüfung der Marktstabilitätsreserve

Dieses Papier leistet einen Beitrag zur Überprüfung der Marktstabilitätsreserve (MSR), indem es die Funktionsweise der MSR bewertet und wichtige Fragen im Hinblick auf die Anpassung und Ergänzung der MSR-Parameter für Phase IV des EU-Emissionshandelssystems (EU EHS) erörtert. Die Analyse konzentriert sich auf die derzeitige Cap-Architektur für Phase IV, wobei auch eine ehrgeizigere Cap-Setzung mit einer Emissionsreduktion von 65% bis 2030 im Vergleich zu 2005 als mögliches Ergebnis einer Überarbeitung des EU EHS-Caps berücksichtigt wird. Wir schlagen Reformen für Schlüsselelemente der MSR vor. Insbesondere betrachten wir mehrere Reformoptionen für die MSR-Einspeise- und Freigabeparameter, eine Änderung der Definition der Schwellenwerte für die Gesamtzahl der im Umlauf befindlichen Zertifikate (TNAC), um den sich ändernden Liquiditätsbedarf während der Phase IV zu berücksichtigen und wie die Geschwindigkeit der MSR-Reaktion innerhalb der aktuellen MSR-Architektur erhöht werden kann. Wir diskutieren auch die Vor- und Nachteile der Einführung eines hybriden Systems mit sowohl preis- als auch mengenbasierten MSR-Auslösern. Darüber hinaus erörtern wir, ob die Nachfrage nach Zertifikaten aus dem Luftverkehr berücksichtigt werden soll und ein Verfallsdatum für alte Zertifikaten. Wir analysieren auch die Interaktion zwischen der freiwilligen Löschung von Zertifikaten und der MSR und schlagen einen regelbasierten Löschungsmechanismus vor, um nationale Initiativen zum Ausstieg aus der Kohleverstromung zu berücksichtigen.

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BAU	Business as usual
CDM	Clean Development Mechanism
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent (measuring unit for greenhouse gas emissions)
EUAs	European Union allowances
EUAAs	European Union aviation allowances
EU-ETS	EU Emissions Trading Scheme
g/kWh	Gram per kilowatt hour (measuring units for emission intensity)
GHG	Greenhouse gas
GW	Gigawatt
JI	Joint Implementation
LRF	linear reduction factor (annual cap reduction in EU ETS)
MSR	Market stability reserve
Mt	Million tons
NDC	Nationally determined contribution
TNAC	Total number of allowances in circulation
TWh	Terawatt hours (measuring units for energy)
UK	United Kingdom

Summary

This paper contributes to the review of the Market Stability Reserve (MSR) by assessing the operation of the MSR and by discussing important issues with respect to adapting and complementing the MSR parameters for Phase IV of the EU Emissions Trading System (EU ETS). The analysis and discussion in this paper primarily derives from the current architecture of the EU ETS, with a 2.2% linear reduction factor for 2021-2030. We also include a sensitivity analysis that covers an increase in ambition, i.e. a reduction in EU ETS emissions by 65% in 2030, compared to 2005, reflecting a potential outcome of revision of the EU ETS cap. Our main conclusions also hold for the assumed increase in ambition and adjusted assumptions regarding the post-Covid-19 emission path until 2030. However, we suggest to integrate the MSR review with the concrete discussions on updating the EU ETS Directive planned by the EU Commission for mid-2021. Due to the interactions between a reform of the MSR with a reform of other parameters of the EU ETS architecture - such as an update of the linear reduction factor governing the cap or carbon leakage protection rules - an integrated approach is important to ensure that the MSR can effectively contribute to an orderly functioning of the EU ETS during this decade.

In this paper, we first provide some background on the MSR and its current parameters, including the invalidation mechanism. We then introduce the framework used to assess the operation of the MSR and to simulate the impact of changes to its parameters and the MSR Tool developed by Öko-Institute with which the analysis is carried out. In a scenario analysis, we assess the MSR's performance under a range of assumptions regarding the emissions pathway until 2030, including the impact of Covid-19. We find that in its current parametrization the MSR is able to balance the market by containing the surplus and controlling the total number of allowances in circulation (TNAC) in the high emissions / current cap scenario, even when accounting for reduced allowance demand due to the Covid-19 pandemic. However, it will take several years to neutralize the allowance surplus due to the Covid-19-effect. Assuming that emissions from the stationary ETS decline in line with renewable energy targets at EU level and in member states, the MSR is – in its current parametrization - unable to prevent a continuous rise in the TNAC during this decade. In this low emissions / current cap scenario a massive new surplus develops under the current intake rules, even without the Covid-19 crisis.

In a further step we address specific questions regarding the appropriateness of the current definition of MSR parameters for the period 2021-2030. We develop alternative options for the configuration of the parameters and model their impact on the overall surplus for the period 2021-2030.

We first consider the MSR's **feed (intake) and release rates** and show that the MSR intake rate is a key parameter which must be adapted to ensure resilience of the EU ETS to demand-side effects stemming from interacting policies, such as national phase-outs of coal-fired power generation, or from unanticipated shocks like the drop in emissions and concurrent decrease in demand for allowances due to Covid-19. We show that extending the timeframe in which the intake rate is doubled from 12 % to 24 % through 2030 barely prevents an increase in the allowance surplus in the scenario in the high emission scenario, although the allowance surplus would remain well above the upper threshold throughout the decade. A doubled intake rate would thus be insufficient to reduce the surplus in the market. Once the effects of Covid-19 are taken into account, the doubled intake rate becomes entirely inadequate. We therefore develop

three alternative design options for the MSR intake rate. All three are flexible and react to the size of the surplus, generally linking the amount of allowances placed into the MSR to the distance between the surplus and the defined threshold values (of where the surplus should be). While all three of them are more effective than the current rules or the double intake rate in reducing the surplus, only one is able to contain the TNAC surplus in all scenarios.

The definition of the **TNAC threshold corridor** by its upper and lower trigger levels is another area for reform. The corridor was defined to reflect the market's liquidity needs, which, under current rules, are assumed to be constant. This assumption contrasts with a continuously declining cap and emissions, as well as progressing decarbonization of the electricity sector. These factors indicate that liquidity needs and corresponding hedging demand will progressively decline during Phase IV. The corridor as currently defined is too wide and its thresholds are set too high as to be appropriate for Phase IV. We develop two means of automatically adjusting the thresholds to changing liquidity needs. This can be done by defining liquidity needs in terms of a fixed share of (projected) emissions or a fixed share of the cap and setting the thresholds accordingly. We argue that defining the thresholds in relationship to the cap is the preferred option, as cap projections for Phase IV are much more certain than emissions projections. This approach would increase policy certainty for market participants and better align the thresholds with evolving liquidity needs. It also directly translates further cap adjustments during Phase IV to the thresholds.

Our analysis of the **speed of the MSR's response** shows that the MSR is slow in reacting to changes in the market, especially when a shock affects the allowance market early during the calendar year, as is the case with the current Covid-19 demand shock. The speed of the MSR's response can be increased somewhat by compressing the reaction period to July-December of year x, instead of September (year x)-August (year x+1). However, this still leaves a delay in reaction of about 1.5 years to a shock such as caused by Covid-19.

In a qualitative analysis we then analyzed a hybrid MSR configuration which adds an auction floor price as a trigger to transfer unauctioned allowances directly into the MSR in addition to the current quantity-based MSR trigger. We show that a price-based trigger can substantially increase the MSR's reaction speed if the floor price is set at a sufficiently high level. The extreme case of a very high floor price would render the quantity-based trigger largely irrelevant, as the TNAC would rarely exceed its trigger value. Adding a price-based MSR trigger could increase the MSR's response speed. While a floor price may provide a higher level of certainty over future price developments to market participants, a combined price and quantity trigger would also increase the complexity of the MSR's operation.

We then turn to the **aviation sector** as covered by the EU ETS: a net buyer of allowances. Under current rules, its demand is not taken into account when the TNAC is calculated. We conclude that if aviation demand would be taken into account when calculating the TNAC, the TNAC value would decline and thus the ability of the MSR to reduce the surplus would be dampened and its effectiveness would be diminished. The aim of the MSR is to reduce the historic oversupply in the stationary sector and to stabilize the market in case of external shocks. Since a change in the TNAC definition would make it harder to achieve these aims, we recommend to not alter this parameter. In addition to its CO_2-emissions, aviation drives climate change through non-CO_2 impacts not accounted for under the EU ETS. Therefore, one ton saved in the stationary sector is not equal to an additional ton emitted in the aviation sector. Excluding aviation from the TNAC definition somewhat compensates for this false equivalency.

As a final step of our analysis, we investigate the **invalidation of allowances from the MSR**. At present, invalidation of allowances in the MSR happens in relation to the development of the amount of allowances auctioned. As the MSR is intended to react to short-term market imbalances, allowances that are stored in the MSR for an extended period of time are not required for short-term balancing. If allowances remain in the MSR for several years, they should be invalidated to avoid past surpluses being returned to the market and reducing climate ambition in future years. We conclude that the introduction of allowance vintages and their subsequent invalidation is a no-lose option with a safeguard function that can be combined with the current invalidation rule.

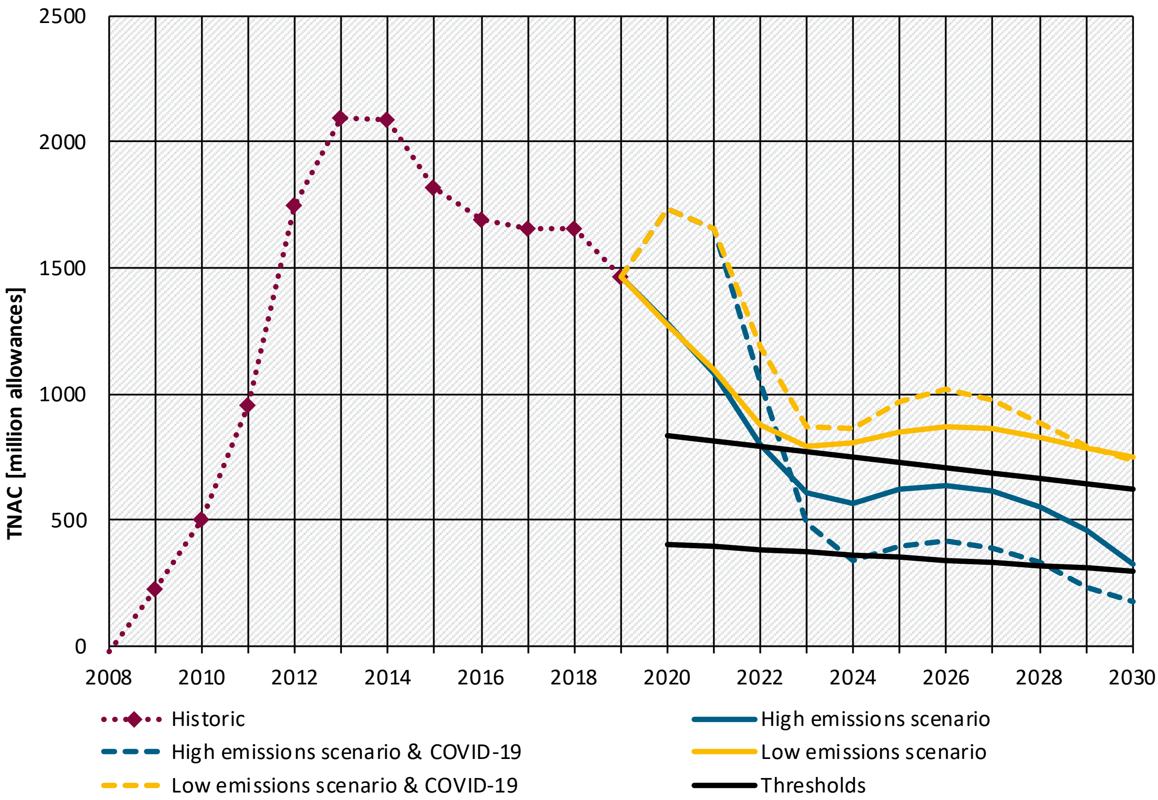
A separate section considers the **interaction of voluntary cancellation**, which is allowed in the case of decommissioning of coal-fired power generation, and the MSR. This case is relevant when national policies are not (fully) reflected in the cap setting. We argue that the MSR is partially effective at puncturing the waterbed for a limited time through the invalidation mechanism. It can and should be supplemented by cancellations e.g. using the voluntary cancellation provision. However, the effectiveness of cancellations would be increased by developing the provision into a simple EU-wide rule-based cancellation policy. We propose a simple approach based on generic average emissions per GW installed capacity and show that its application would lead to cancellations of about 570 million EUAs for coal-fired capacity decommissioned during the period January 2016 – December 2019. A further total of up to 1 480 million EUAs – although some of it after 2030 – could be cancelled for capacity currently in operation but scheduled for decommissioning.

In a final analysis we integrate the preferred options for the different MSR parameters into a new configuration fit for Phase IV. This configuration defines the intake rate as proportional between the TNAC and the threshold values, lowers the thresholds and narrows the corridor in order to reflect changing liquidity needs and compresses the reaction timeframe of the MSR. In this configuration, the MSR is able to keep the TNAC in check during the entire fourth trading period for all emission scenarios. It is the only configuration able to prevent an allowance surplus from building up in the scenario with the lowest projected emissions with the proportional intake rule playing the decisive role.

We also assess the performance of the MSR under current parameters and our proposed changes in a 65% reduction scenario. The 65% reduction scenario is based on an ETS cap in line with an overall ambition of the EU of emission reductions of 55% below 1990 levels. This sensitivity assessment is based on the low emissions scenario and an additional scenario in which emissions decline in line with a 65% reduction in ETS sectors by 2030. We find that the MSR in its current parametrization is not able to effectively reduce the TNAC even in the high ambition ETS with a lower cap. Applying the proposed changes to the MSR ensures that the TNAC decreases to the upper threshold in the emission scenario which achieves the cap. Under a higher emission scenario (where emissions do not reduce in line with the cap) the TNAC would drop to below 100 million allowances presumably at the end of the decade triggering additional emission reductions.

Our recommended configuration of MSR parameters with a proportional intake rate, TNAC limits defined by holding constant their 2019 share of the cap (without including aviation in the calculation of the TNAC), and compressing the auction calendar to the period September of year x to April of year x+1 (Figure 14) delivers a robust performance. In this configuration, the MSR keeps the TNAC in check during the entire fourth trading period in all four scenarios we analyze. Importantly, it is the only configuration able to contain the TNAC surplus in the current cap & low emissions plus Covid-19 scenario, with the proportional intake rate playing the decisive role.

Figure 1: TNAC development under recommended MSR parameters and current ETS cap



Notes: For this graph the proportional intake rate has been applied. The thresholds decline in parallel with the cap (the relationship cap/threshold in 2019 is applied until 2030).
Source: Own calculations.

Zusammenfassung

Diese Studie leistet einen Beitrag zur Überprüfung der Marktstabilitätsreserve (MSR), indem sie die Funktionsweise der MSR bewertet und wichtige Fragen im Hinblick auf die Anpassung und Ergänzung der MSR-Parameter für Phase IV des EU-Emissionshandelssystems (EU EHS) erörtert. Die Analyse und Diskussion in diesem Papier geht in erster Linie von der aktuellen Architektur des EU ETS aus, mit einem linearen Reduktionsfaktor von 2,2% für die Periode von 2021 bis 2030. Wir schließen auch eine Sensitivitätsanalyse ein, die eine Erhöhung der Ambition abdeckt, d.h. eine Reduzierung der EU-ETS-Emissionen um 65 % im Jahr 2030 im Vergleich zu 2005. Dies spiegelt ein mögliches Ergebnis der Revision des Caps des EU-ETS wider. Unsere wichtigsten Schlussfolgerungen gelten auch für die angenommene Erhöhung der Ambition und die angepassten Annahmen bezüglich des Post-Covid-19-Emissionspfads bis 2030. Wir schlagen jedoch vor, die Überprüfung der MSR mit den konkreten Diskussionen über die von der EU-Kommission für Mitte 2021 geplante Aktualisierung der EU-ETS-Richtlinie zu verbinden. Aufgrund der Wechselwirkungen zwischen einer Reform der MSR und einer Reform anderer Parameter der EU-ETS-Architektur - wie einer Aktualisierung des linearen Reduktionsfaktors für die Obergrenze oder der Regeln zum Schutz vor Carbon Leakage - ist ein integrierter Ansatz nötig um sicherzustellen, dass die MSR in diesem Jahrzehnt effektiv zu einem ordnungsgemäßen Funktionieren des EU-ETS beitragen kann.

Als erstes geben wir zunächst einige Hintergrundinformationen zur MSR und ihren aktuellen Parametern, einschließlich des Mechanismus zur Invalidierung bzw. Entwertung von Zertifikaten (Invalidation Mechanism). Anschließend stellen wir die verwendeten Rahmenbedingungen für die Analysen sowie das vom Öko-Institut entwickelte MSR-Tool vor. In einer Szenarioanalyse bewerten wir die Leistung der MSR unter einer Reihe von Annahmen bezüglich des Emissionspfads bis 2030, einschließlich der Auswirkungen von Covid-19. Wir stellen fest, dass die MSR in ihrer aktuellen Parametrisierung in der Lage ist, den Markt auszugleichen, indem sie den Überschuss eindämmt und die Gesamtzahl der im Umlauf befindlichen Zertifikate (TNAC) im Szenario mit hohen Emissionen / aktueller Obergrenze kontrolliert, selbst wenn man die reduzierte Nachfrage nach Zertifikaten aufgrund der Covid-19-Pandemie berücksichtigt. Allerdings wird es mehrere Jahre dauern, den Zertifikatsüberschuss aufgrund des Covid-19-Effekts zu neutralisieren. Unter der Annahme, dass die Emissionen aus dem stationären ETS im Einklang mit den Zielen für erneuerbare Energien auf EU-Ebene und in den Mitgliedsstaaten zurückgehen, ist die MSR - in ihrer aktuellen Parametrisierung - nicht in der Lage, einen kontinuierlichen Anstieg der TNAC in diesem Jahrzehnt zu verhindern. In diesem Szenario mit niedrigen Emissionen / aktuellem Cap entsteht unter den aktuellen Regeln für die Entnahme von Emissionsberechtigungen ein massiver neuer Überschuss, auch ohne die Covid-19-Krise.

In einem weiteren Schritt gehen wir auf spezifische Fragen zur Angemessenheit der aktuellen Definition der MSR-Parameter für den Zeitraum 2021-2030 ein. Wir entwickeln alternative Optionen für die Konfiguration der Parameter und modellieren deren Auswirkungen auf den Gesamtüberschuss für den Zeitraum 2021-2030.

Wir betrachten zunächst die **Entnahme- (Zuführungs-) und Ausschüttungsraten** der MSR und zeigen, dass die MSR-Entnahmerate ein Schlüsselparameter ist, der angepasst werden muss, um die Widerstandsfähigkeit des EU EHS gegenüber nachfrageseitigen Effekten zu gewährleisten. Solche Effekte können sich aus interagierenden Politiken ergeben, wie z. B. dem nationalen

Ausstieg aus der Kohleverstromung, oder aus unvorhergesehenen Schocks wie dem Rückgang der Emissionen und dem gleichzeitigen Rückgang der Nachfrage nach Zertifikaten aufgrund von Covid-19. Wir zeigen, dass selbst eine Verlängerung des Zeitrahmens, in dem die Zuführungsrate von 12% auf 24% verdoppelt wird, bis zum Jahr 2030 einen Anstieg des Zertifikatsüberschusses im Szenario mit hohen Emissionen kaum verhindert, obwohl der Zertifikatsüberschuss während des gesamten Jahrzehnts deutlich über der oberen Schwelle bleiben würde. Eine verdoppelte Zuführungsrate würde also nicht ausreichen, um den Überschuss auf dem Markt effektiv zu reduzieren. Sobald die Auswirkungen von Covid-19 berücksichtigt werden, ist die verdoppelte Zuführungsrate völlig unzureichend. Wir entwickeln daher drei alternative Gestaltungsmöglichkeiten für die MSR-Entnahmerate. Alle drei sind flexibel und reagieren auf die Größe des Überschusses, indem sie die Menge der in die MSR eingebrachten Zertifikate generell an den Abstand zwischen dem Überschuss und den definierten Schwellenwerten (wo der Überschuss liegen sollte) koppeln. Alle drei sind zwar effektiver als die derzeitigen Regeln oder die doppelte Zuführungsrate bei der Reduzierung des Überschusses, aber nur eine ist in der Lage, den TNAC-Überschuss in allen Szenarien einzudämmen.

Die Definition des **TNAC-Schwellenkorridors** durch seine oberen und unteren Auslöseschwellen ist eine weitere Option für die anstehende Reform. Der Korridor wurde so definiert, dass er den Liquiditätsbedarf des Marktes widerspiegelt, der nach den derzeitigen Regeln als konstant angenommen wird. Diese Annahme steht im Gegensatz zu einem kontinuierlich sinkenden Cap und den Emissionen sowie der fortschreitenden Dekarbonisierung des Stromsektors. Diese Faktoren deuten darauf hin, dass der Liquiditätsbedarf und der entsprechende Absicherungsbedarf während der Phase IV schrittweise sinken werden. Der Korridor, wie er derzeit definiert ist, ist zu breit und seine Schwellenwerte sind zu hoch angesetzt, um für die Phase IV geeignet zu sein. Wir entwickeln zwei Möglichkeiten zur automatischen Anpassung der Schwellenwerte an den sich ändernden Liquiditätsbedarf. Dies kann geschehen, indem der Liquiditätsbedarf in Form eines festen Anteils an den (projizierten) Emissionen oder eines festen Anteils an der Obergrenze definiert und die Schwellenwerte entsprechend festgelegt werden. Wir argumentieren, dass die Definition der Schwellenwerte im Verhältnis zum Cap die bevorzugte Option ist, da die Cap-Projektionen für Phase IV viel sicherer sind als die Emissionsprojektionen. Dieser Ansatz würde die Sicherheit für die Marktteilnehmer erhöhen und die Schwellenwerte besser mit den sich entwickelnden Liquiditätsanforderungen in Einklang bringen. Er überträgt auch weitere Cap-Anpassungen während Phase IV direkt auf die Schwellenwerte.

Unsere Analyse der **Reaktionsgeschwindigkeit der MSR** zeigt, dass die MSR nur langsam auf Marktveränderungen reagiert, insbesondere wenn ein Schock den Zertifikatemarkt früh im Kalenderjahr betrifft, wie es beim aktuellen Covid-19-Nachfrageschock der Fall ist. Die Reaktionsgeschwindigkeit der MSR kann etwas erhöht werden, indem der Reaktionszeitraum auf Juli bis Dezember des Jahres x komprimiert wird, anstatt auf September (Jahr x) bis August (Jahr x+1). Dadurch verbleibt jedoch immer noch eine Reaktionsverzögerung von etwa 1,5 Jahren auf einen Schock, wie er durch Covid-19 verursacht wird.

In einer qualitativen Analyse haben wir dann eine hybride MSR-Konfiguration analysiert, die zusätzlich zum derzeitigen mengenbasierten MSR-Auslöser einen Auktions-Mindestpreis als Auslöser für die direkte Übertragung von nicht versteigerten Zertifikaten in die MSR hinzufügt. Wir zeigen, dass ein preisbasierter Auslöser die Reaktionsgeschwindigkeit der MSR deutlich erhöhen kann, wenn der Mindestpreis auf einem ausreichend hohen Niveau festgelegt wird. Der

Extremfall eines sehr hohen Mindestpreises würde den mengenbasierten Trigger weitgehend irrelevant machen, da der TNAC seinen Triggerwert nur selten überschreiten würde. Das Hinzufügen eines preisbasierten MSR-Auslösers könnte die Reaktionsgeschwindigkeit der MSR erhöhen. Während ein Mindestpreis den Marktteilnehmern ein höheres Maß an Sicherheit über künftige Preisentwicklungen bieten kann, würde ein kombinierter Preis- und Mengenauslöser auch die Komplexität des Betriebs der MSR erhöhen.

Anschließend wenden wir uns dem vom EHS erfassten **Luftfahrtsektor** zu, der ein Nettokäufer von Zertifikaten ist. Nach den derzeitigen Regeln wird seine Nachfrage bei der Berechnung des TNAC nicht berücksichtigt. Eine Einbeziehung des Sektors in die TNAC-Berechnung würde die Fähigkeit der MSR, den Überschuss zu reduzieren, und somit ihre Effektivität vermindern. Das Ziel der MSR ist es, das historische Überangebot im stationären Sektor abzubauen und den Markt bei externen Schocks zu stabilisieren. Da eine Änderung der TNAC-Definition das Erreichen dieser Ziele erschweren würde, empfehlen wir, diesen Parameter nicht zu ändern. Zusätzlich zu seinen CO_2-Emissionen treibt der Flugverkehr den Klimawandel durch Nicht-CO_2-Effekte voran, die im EU ETS nicht berücksichtigt werden. Daher ist eine Tonne, die im stationären Sektor eingespart wird, nicht gleichbedeutend mit einer zusätzlichen Tonne, die im Luftfahrtsektor emittiert wird. Der Ausschluss des Flugverkehrs aus der TNAC-Definition gleicht diese falsche Gleichwertigkeit teilweise aus.

In einem letzten Schritt unserer Analyse untersuchen wir den **Mechanismus zur Invalidierung** von Zertifikaten in der MSR. Derzeit geschieht dies in Abhängigkeit von der Entwicklung der versteigerten Menge an Zertifikaten. Da die MSR dazu gedacht ist, auf kurzfristige Marktungleichgewichte zu reagieren, werden Zertifikate, die über einen längeren Zeitraum in der MSR gespeichert sind, nicht zum kurzfristigen Ausgleich benötigt. Wenn Zertifikate über mehrere Jahre in der MSR verbleiben, sollten sie gelöscht werden um zu vermeiden, dass Überschüsse aus der Vergangenheit in den Markt zurückfließen und die Klimaziele in zukünftigen Jahren verwässern. Wir kommen zu dem Schluss, dass die Einführung von Zertifikatsjahrgängen und deren anschließende Löschung eine "No-Lose"-Option mit einer Schutzfunktion ist, die mit der aktuellen Regel zur Ungültigkeit kombiniert werden kann.

Ein separater Abschnitt befasst sich mit dem Zusammenspiel von **freiwilliger Löschung (durch Mitgliedstaaten)**, die im Falle der Stilllegung von Kohlekraftwerken erlaubt ist, und der MSR. Dieser Fall ist dann relevant, wenn sich die nationale Politik nicht (vollständig) in der Festlegung der Obergrenze widerspiegelt. Wir argumentieren, dass die MSR in solchen Fällen teilweise wirksam ist, um den Wasserbetteffekt durch den Invalidierungsmechanismus zu begrenzen. Die freiwillige Löschung kann und sollte diesen Mechanismus ergänzen. Die Wirksamkeit und Anwendung dieser Regelung würde jedoch erhöht, wenn es eine einfachen EU-weite regelbasierte Methodik zur Festlegung der zu löschenden Menge geben würde. Wir schlagen einen einfachen Ansatz vor, der auf den Durchschnittsemissionen pro GW installierter Leistung basiert und zeigen, dass seine Anwendung zu Löschung von etwa 570 Millionen EUAs für kohlebefeuerte Anlagen führen würde, die im Zeitraum Januar 2016 - Dezember 2019 stillgelegt wurden. Eine weitere Gesamtsumme von bis zu 1 480 Millionen EUAs - wenn auch ein Teil davon nach 2030 - könnte für Kapazitäten storniert werden, die derzeit noch in Betrieb sind, aber zur Stilllegung vorgesehen sind.

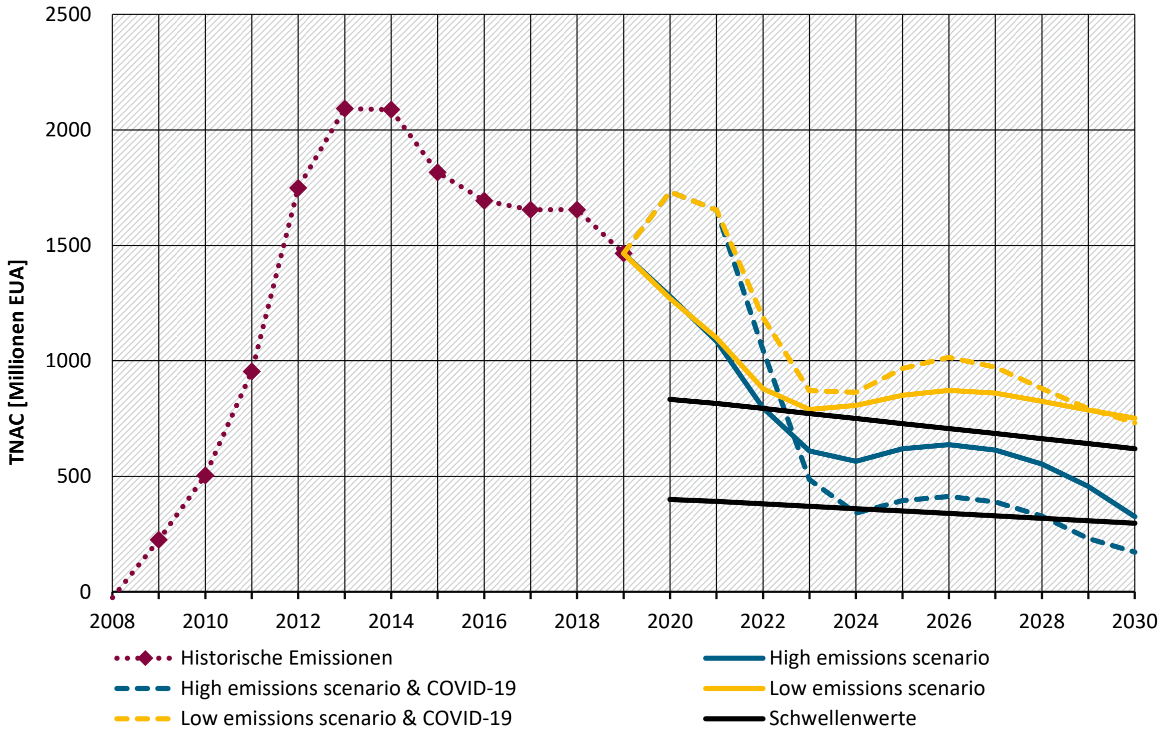
In einer abschließenden Analyse integrieren wir die bevorzugten Optionen für die verschiedenen MSR-Parameter, um die MSR robuster für die Herausforderungen der vierten

Handelsperiode auszugestalten. Diese Konfiguration setzt die Aufnahmerate proportional zwischen der TNAC und den Schwellenwerten, senkt die Schwellenwerte, verengt den Korridor zwischen den Schwellenwerten um den sich ändernden Liquiditätsbedarf widerzuspiegeln und komprimiert die Reaktionsperiode der MSR. In dieser Konfiguration ist die MSR in der Lage, den TNAC während der gesamten vierten Handelsperiode für alle Emissionsszenarien ungefähr in dem Korridor zwischen den Schwellenwerte zu halten. Es ist die einzige Konfiguration, die verhindern kann, dass sich im Szenario mit den niedrigsten prognostizierten Emissionen ein Zertifikatsüberschuss aufbaut, wobei die proportionale Aufnahmeregel die entscheidende Rolle spielt.

Wir bewerten auch die Leistung der MSR unter den aktuellen Parametern und den von uns vorgeschlagenen Änderungen in einem 65%igen Reduktionsszenario. Das 65%-Reduktionsszenario basiert auf einer ETS-Obergrenze, die dem Gesamtziel der EU entspricht, die Emissionen um 55% unter das Niveau von 1990 zu senken. Diese Sensitivitätsbewertung basiert auf dem Szenario mit niedrigen Emissionen und einem zusätzlichen Szenario, in dem die Emissionen im Einklang mit einer 65%igen Reduktion in den ETS-Sektoren bis 2030 zurückgehen. Wir stellen fest, dass die MSR in ihrer derzeitigen Parametrisierung nicht in der Lage ist, die TNAC selbst im ambitionierten ETS mit einer niedrigeren Obergrenze effektiv zu reduzieren. Die vorgeschlagenen Änderungen an der MSR stellen auch im Sensitivitätsszenario sicher, dass die TNAC in dem Emissionsszenario auf den oberen Schwellenwert sinkt. Bei einem höheren Emissionsszenario (bei dem die Emissionen nicht im Einklang mit der Obergrenze sinken) würde die TNAC vermutlich am Ende des Jahrzehnts auf unter 100 Millionen Zertifikate fallen, was zusätzliche Emissionsreduktionen auslösen würde.

Die von uns empfohlene Konfiguration der MSR-Parameter mit einer proportionalen Entnahmerate, Schwellenwerten, die als Anteil an der Obergrenze (Cap) für 2019 definiert sind, keine Einbeziehung des Luftverkehrs in die Berechnung der TNAC und die Komprimierung des Auktionskalenders auf den Zeitraum September des Jahres x bis April des Jahres x+1 (Abbildung 1) liefert unter verschiedenen Szenarien stabile Ergebnisse. In dieser Konfiguration hält die MSR die TNAC während der gesamten vierten Handelsperiode in allen von uns analysierten Szenarien im oder am Zielkorridor. Wichtig ist, dass es die einzige Konfiguration ist, die in der Lage ist, den TNAC-Überschuss im Szenario „aktuelles Cap & niedrige Emissionen plus Covid-19-Schock“ einzudämmen, wobei die proportionale Einnahmequote die entscheidende Rolle spielt.

Abbildung 1: Entwicklung der TNAC unter aktuellen EHS-Bedingungen und den vorgeschlagenen Anpassungen der MSR



Anmerkungen: Für diese Grafik wurde die proportionale Zuführungsrate angewendet. Die Schwellenwerte sinken parallel zur Obergrenze (das Verhältnis Obergrenze/Schwellenwert im Jahr 2019 wird bis 2030 angewendet).
Quelle: Eigene Berechnungen.

1 Background and introduction

The European Union's Emissions Trading System (EU ETS) caps the maximum amount that can be emitted by covered electricity generators, industrial installations and airline operators by defining the maximum amount of EU Allowances (EUAs) and EU Aviation Allowances (EUAAs) supplied to the market each year. This cap is pre-determined several years in advance and declines year-on-year. It is set in line with long-term reduction targets and according to the cost-efficiency of reducing emissions in those sectors covered by the EU ETS and those outside of the EU ETS. The resulting price should ensure a cost-efficient path towards long-term reduction targets. The cap is set prior to the beginning of each trading period and has so far not been adjusted during a trading period.[1]

From the start of the second trading period of the EU ETS (2008-2012) and into the first years of the second trading period (2013-2014), however, on top of the cap there was a significant inflow of credits from the Kyoto-mechanisms[2] to the EU ETS. This resulted in a de-facto increase of the available emissions budget. This expanded supply together with a lower than anticipated demand for allowances led to a large market surplus and a period of low allowance prices for several years. Important drivers on the demand side were developments in interacting European energy and climate policies (e.g. additional abatement through renewable energy and energy efficiency policies) and unforeseen changes in industrial activity, especially the financial and economic crisis that started in 2008 and lowered emissions and thus the demand for allowances. A mechanism we see repeated during the current Covid-19 crisis.

Greater supply-side flexibility was recognized as a necessary safeguard to the long-term effectiveness of the EU ETS at the beginning of the third trading period. As an ad-hoc measure, auctioning amounts were reduced by a total of 900 million allowances in 2014-2016, to be reinserted ('backloaded') by 2020 (European Union (EU) 26.02.2014). Soon thereafter a long-term rule-based instrument of supply-side management was introduced, the Market Stability Reserve (MSR) (European Union (EU) 2015). In keeping with the overall architecture of the EU ETS, the MSR was designed as a quantity-based instrument. During the revision of the EU ETS for the fourth trading period (2021-2030), a number of important changes were made to the original MSR design, including the introduction of an allowance invalidation mechanism. The MSR began operating in January 2019, with a first review scheduled for 2021 (EU 2015).

This paper contributes to the review of the MSR by modelling its performance related to managing the allowance surplus for a number of different emissions scenarios until 2030. We look both at the current configuration and alternative design options for the main parameters of the MSR and also discuss related ETS design elements (e.g. voluntary cancellation of allowances). The remainder of the paper is structured as follows. In Section 2 we present the current configuration of the MSR and its main parameters. Section 3 introduces the assumptions made and the four emission scenarios applied in the remainder of this paper. In Section 4 we model the performance of the MSR related to managing the allowance surplus until 2030 in its

[1] During the current Phase III, which lasts from 2013-2020, the cap declines by 1.74% of the 2010 cap each year, i.e. by approximately 38 million allowances annually. The current framework for the period 2021-2030 foresees an annual cap decline by 2.2% of the 2010 cap, which corresponds to about 48 million allowances annually.

[2] Under the Clean Development Mechanism (CDM) and Joint Implementation (JI) participating countries can generate reduction certificates that could also be used by companies covered by the EU ETS. From 2021, the use of these certificates in the EU ETS is no longer possible.

current configuration. For those design elements especially relevant with respect to the forthcoming review process, we develop a number of alternative options and model their impact on MSR performance during the fourth trading period. Section 5 discusses issues related to the interaction between voluntary cancellations and the operation of the MSR. A sensitivity analysis of the MSR under a 65% ETS target is included in section 6. Section 7presents a final analysis of the MSR using the recommended changes to parameters and concludes. Finally, the Appendix provides additional scenario analysis, as well as technical information on the MSR Tool.

2 Current configuration of the MSR

2.1 MSR inflow and outflow parameters

The MSR is a rule-based mechanism to stabilize the market for EUAs, i.e. emission allowances of the stationary sector,[3] and is activated through quantity-based triggers. The central parameter triggering activation is the total number of allowances in circulation (TNAC). The European Commission publishes the TNAC on May 15 of each year, using December 31 of the prior year as the cutoff date. The TNAC is computed according to the following formula:

$$TNAC = Supply - (Demand + Allowances\ in\ the\ MSR)$$

'Supply' is defined as the supply of allowances to stationary installations since January 1, 2008 (including international credits), while 'Demand' refers to the total number of allowances surrendered by installations or cancelled during the same period. 'Allowances in the MSR' refers to the number of allowances currently held in the MSR; this figure includes allowances that have lost their validity (see Section 2.1).

If the TNAC leaves a pre-defined corridor of between 400 and 833 million allowances in any year, the MSR is triggered during the following year:

- In case the TNAC exceeds 833 million EUAs by December 31 of year x-1, e.g. 2019, the auctioning quantity is reduced by 24% in year x and x+1, in this case September 2020 – August 2021. Auctioning amounts are reduced proportionately for all member states[4] and evenly over time. Those allowances not auctioned are placed in the MSR.
- In case the TNAC drops below 400 million allowances by December 31 of year x-1, then the auctioning quantity is increased by 200 million EUAs during year x.

Both intake and release rates to/from the MSR were doubled for the period 2019-2023, unless the 2021 review determines otherwise (European Union (EU) 2018). After this period the intake rate is set to return to its original value of 12% of the TNAC, while the release rate will be equal to 100 million EUAs.

Note that the placement of allowances into the MSR is defined in relative terms, while the release from the MSR is defined in absolute terms. The amount released from the MSR in case the TNAC falls below 400 million EUAs is much higher in proportional terms than the placement into the MSR when the TNAC is above 833 million EUAs. This means that the MSR reacts relatively more strongly to a tight market than to a saturated one. In case the TNAC falls just short of 400 million allowances, releasing 100 million EUAs corresponds to an increase in the TNAC by almost 25%.

At the time of writing, however, the TNAC is much higher than the upper threshold of 833 million allowances, making the intake rate the most relevant parameter in the short term. On 31 December 2019 the TNAC stood at 1 385 million EUAs (European Commission (EC) 2020b); this

[3] Aviation sector allowances (EUAAs) are not covered by the MSR, but the sector is a net buyer of EUAs (see Section 4.5).
[4] Those auctioning volumes distributed to member states according to the solidarity mechanism of Article 10(1) (10% of overall auctioning amount) are, however, not affected by the MSR.

value was later adjusted to reflect the departure of the United Kingdom (EU 2020); 307.7 million EUAs will be placed in the MSR between September 2020 and August 2021.

2.2 Invalidation mechanism

In contrast to the original design of the MSR (European Union (EU) 2015) a mechanism for the invalidation of allowances held in the MSR was added during the revision of the EU ETS for the fourth trading period (European Union (EU) 2018). Unless determined otherwise during the 2021 MSR Review, from 2023 onwards all allowances held in the MSR exceeding the total amount of EUAs auctioned in the previous year will be invalidated. The available literature estimates that the number of allowances invalidated in 2023 will range between 1.7 billion (Agora Energiewende und Öko-Institut 2018; Perino und Willner 2017) and more than 2.2 billion allowances (Burtraw et al. 2018). Burtraw et al. estimate that the total number of allowances invalidated up until 2030 could reach 3 billion. Lower than anticipated emissions due to Covid-19, and a larger-than-anticipated number of allowances not allocated by 2020 – which will be placed into the MSR - suggest that actual invalidations will likely be in line with the upper end of the estimates from the literature and may even exceed it (cf. Section 3.3).

The invalidation of allowances from the MSR up to 2030 can be understood as an ex-post adjustment of the caps in the second and third trading periods as long as the amount of allowances invalidated is lower or equal to the surplus that has been accumulated by the end of 2020. This structural surplus amounted to 3.8 billion allowances by the end of 2019 and is likely to increase to more than 4 billion by the end of 2020. Thus, the amount invalidated until 2030 will likely not exceed the allowance surplus accumulated until 2020 and – therefore – the MSR invalidation mechanism will not lower the cap of the fourth trading period.

3 Assessing the operation of the MSR under current ETS regulation

We assess the operation of the MSR using the MSR Tool developed by Öko-Institut (Graichen et al. 2019). The Technical Annex (Annex A.2) contains detailed information on the configuration of the MSR Tool. Section 3.1 describes the supply and demand scenarios we consider in this paper, while Sections 3.2 and 3.3 present our estimates of the TNAC, number of EUAs in the MSR, and thus whether the MSR achieves the objective of stabilizing the EUA market.

3.1 Supply and demand of allowances

3.1.1 Supply of allowances: the cap

In this report we assess the operation of the MSR against the current framework including the United Kingdom[5]. This means that a linear reduction factor (LRF) of 1.74% is applied until 2020 and of 2.2% between 2021 and 2030.

In December 2020 the European Council agreed to increase the EU's climate ambition to a reduction of at least 55 % below 1990 levels (European Council (EUCO) 2020). This will require higher contributions by the ETS than in the current legislation which aims at a reduction of 43 % below 2005 levels until 2030. To assess the operation of the MSR in this more ambitious framework an alternate cap path has been developed for the purpose of this paper. It assumes that the cap will remain unchanged until 2025 due to the duration of the necessary legislative process and preparation time required by all actors. From 2025 onwards a LRF of 6.6 % is applied. With this LRF the cap will be 65 % below 2005 levels in 2030; this is the projected emission level in the stationary ETS in the Commission's Impact Assessment which accompanied the proposal to move to an overall reduction target of 55 % (European Commission (EC) 2020c).

3.1.2 Demand for allowances: Emission scenarios used in the assessment

We consider two baseline emission scenarios, a **high emissions scenario** assuming business-as-usual (BAU) development and a **low emissions scenario** which assumes that all current climate and energy policy targets will be achieved individually; in practice this means that the climate targets will be overachieved because the targets for renewable energy expansion and energy efficiency are more stringent (see for example E3M Lab und IIASA (2016)). All scenarios for the stationary installations include UK, Iceland, Norway and Liechtenstein. In a set of crisis scenarios, we amend the emission scenarios to account for emission decreases due to the Covid-19 pandemic (Figure 2).

The baseline emission scenarios for the stationary sector are defined as follows:

- High emissions scenario based on current policies: Emissions follow member states' projections assuming "existing measures" as reported to the European Commission under the Monitoring Mechanism Regulation/Governance Regulation (European Environment Agency (EEA) 2019b). According to this scenario, EU ETS emissions in 2030 will be 36% below 2005 levels. The EU ETS emissions target in 2030 will only be achieved by using

[5] Although UK is no longer part of EU ETS in fourth trading period, UK is included in our analysis for data availability reasons.

banked allowances. The other main energy and climate targets, the target of the Effort Sharing Regulation, the energy efficiency target and the renewables target, will all not be achieved. Member State projections imply that current policies and measures in place are not sufficient to reach those targets and additional actions will have to be taken at EU and/or Member State level.

- Low emissions scenario: The low emission scenario is based on Sandbag (2019). It assumes that all EU-level targets, i.e. the nationally determined contribution (NDC), effort sharing, energy efficiency and renewable energy targets, will be met or overachieved. The scenario further assumes that the phase-out of coal-fired power generation will proceed as planned in member states with existing phase-out plans. For member states without a phase-out plan the scenario assumes that the remaining coal-fired capacity is mothballed by 2040. Based on these assumptions a total GHG reduction of 50% below 1990 levels is achieved by 2030; the ETS would be 52% below 2005.

Both scenarios did not include verified emissions in 2019 which declined strongly. We adapt these two baseline emission scenarios to account for the emission development in the year 2019 and the impacts of the Covid-19 pandemic on emissions, as follows:

- High emissions & -Covid-19: In line with Ferdinand (2020) we assume that emissions will decrease in 2020 by 353 Mt in the stationary sector compared to 2019; 2020 emissions are thus 28% lower than in the baseline projection without the crisis. Ferdinand expects an emission reduction of 265 Mt in industrial sectors and of 88 Mt in the power sector. In relative terms, this corresponds to a 23% reduction compared to 2019 emissions. We assume in this scenario that the emission decrease is temporary, i.e. there is no greening of the economy in the course of Covid-19 or its aftermath, and that by 2023 the non-Covid-19 emission path is reached again.

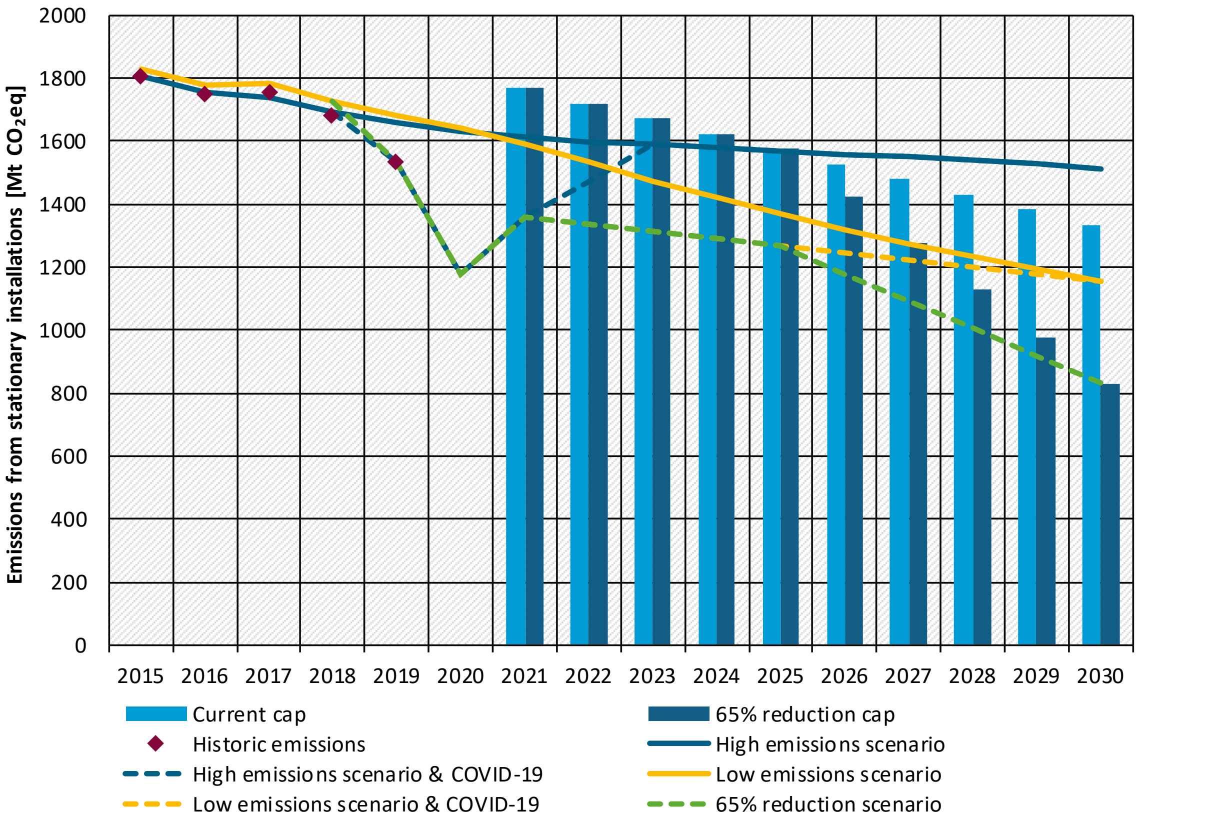
- Low emissions & Covid-19: In this scenario, we assume the same decline in 2020 as in the high emissions & Covid-19 scenario. However, instead of a full recovery in 2021 we assume a partial one, with emissions recovering to one half of the emission reduction from 2019 to 2020. We then assume that emissions are gradually reduced in linear fashion until 2030. In other words, we assume a partial greening of the economy in response to the Covid-19 crisis, where fiscal resources are used to generate green growth. In 2030, this scenario converges to the emission trajectory of the baseline scenario.

In addition to these scenarios we also use one **65% reduction scenario** in line with achieving an overall GHG emission reduction of 55 % compared to 1990. In this scenario emissions follow the low emissions & COVID 19 pathway until 2025, i.e. that there is no short-term emission change due to the higher ambition. We assume that any meaningful measures reducing emissions will only become effective from 2025 onwards. Between 2025 and 2030 emissions decline fast to reach a reduction of 65 % below 2005 levels in line with the Commission's Impact Assessment[6].

[6] According to the Impact Assessment of the Climate Target plan, this is mainly due to the share of renewable energy increasing from 32.5% up to about 36% and increased energy savings (see EC 2020a, table 28 and other measures described in the Impact Assessment).

It has to be noted that the high emissions scenario likely overestimates actual emissions developments (but is still instructive for analysis purposes). In fact, in 2019 already ETS emissions in the stationary sector were 35% below 2005 levels (EEA 2020) whereas the scenario assumes a reduction of 36% in 2030. It is likely that emissions remain below the cap until 2030 for two main reasons: i) the LRF and cap were decided before the EU-wide energy efficiency and renewable energy targets were adopted. These targets are more ambitious than assumed when setting the LRF, i.e. to achieve them emissions will decrease faster than the cap; ii) many member states are in the process of phasing out coal which decreases emissions in the ETS as well. The Commission estimates that ETS emissions will be 55% below 2005 levels in 2030, while the current cap demands a reduction of 43% (European Commission (EC) 2020c).

Figure 2: Emission scenarios for stationary installations until 2030



Source: Own calculations, European Environment Agency (EEA) (2019b), Sandbag (2019).

3.2 Performance of the MSR in the high emissions / current cap scenario

Key findings

- The MSR can tackle the historic surplus in the market if the level of emissions is comparable to the cap level. This is the case in the “high emissions” scenario which very likely overestimates emissions until 2030. Approx. 2 400 million allowances will be invalidated by the MSR mechanism in this scenario.

- The MSR has a time lag of four years to absorb the oversupply of allowances caused by a sudden drop in emissions as may be caused by a crisis such as the Covid-19 pandemic. In the Covid-19 adjusted scenario, the TNAC would drop below the upper threshold in 2027 compared to 2023 in a scenario without the crisis. In this scenario, 3 300 million allowances will be invalidated by the MSR mechanism.

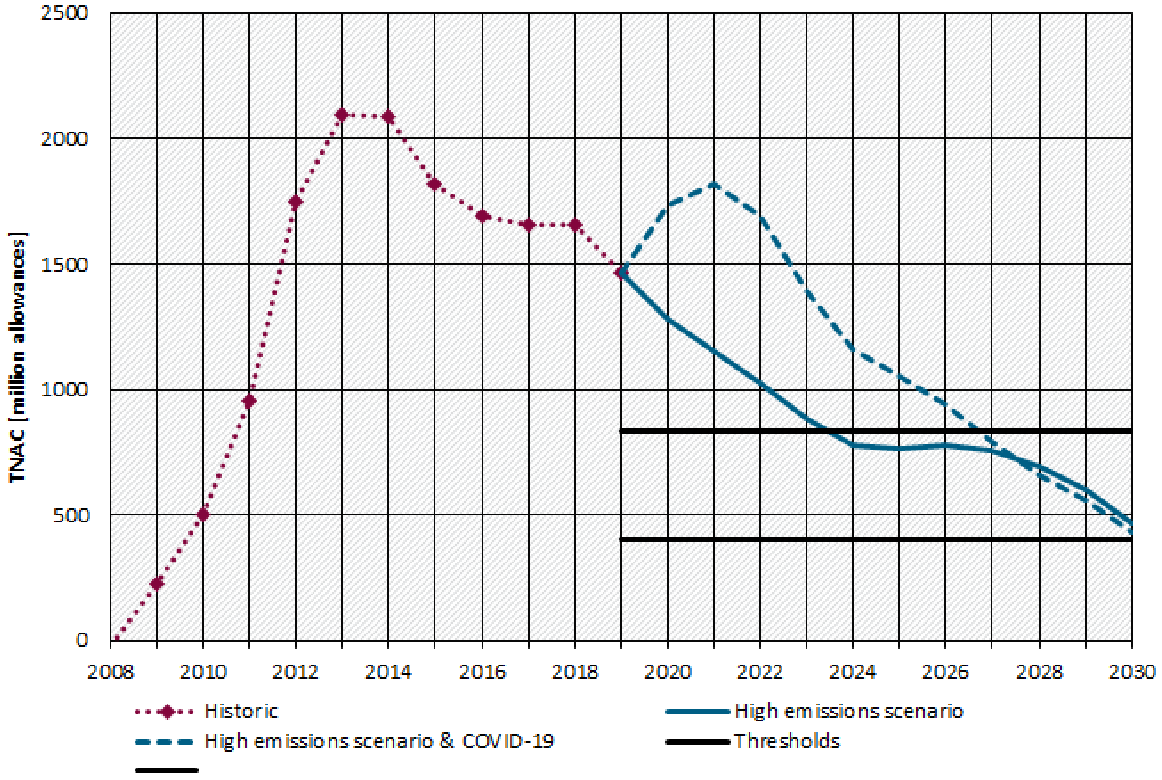
Whether the MSR is activated or not depends on emission levels compared to allowances entering the market. Therefore, the operation of the MSR differs significantly between a world assuming emissions comparable to the cap level (as is the case in the high emissions scenario) from a situation with lower emissions (low emissions scenario). We now provide an overview of the operation of the MSR under the high emissions scenario, with and without accounting for the effects of the Covid-19 pandemic.

Figure 3 shows the development of the TNAC in the current policies scenario with and without the pandemic. Emissions are projected to exceed the amount of new EUAs entering the market through free allocation and auctioning in almost all years of this decade.

In the baseline scenario without Covid-19 the MSR is triggered in each year between 2019 and 2023 decreasing the TNAC during this period. In 2023, 1 969 million allowances contained in the MSR are invalidated. In 2024 and 2025 an additional 422 million allowances are invalidated. Between 2023 and 2030, the TNAC decreases year-on-year, but remains within the thresholds, such that the MSR is not activated again. Due to decreasing auctioning volumnes in line with the annual reduction of the cap, invalidation occurs again in 2030, even if only for 10 million EUAs. In total, 2 401 million allowances are estimated to be invalidated in the baseline scenario.

If the impact of the Covid-19 pandemic is accounted for, the surplus of allowances increases in 2020 and 2021, despite the MSR being operational. The MSR intake rate is insufficient to prevent this crisis-related increase in the TNAC. Allowances held in the MSR reach a maximum of 2 805 million in 2022. In contrast to the baseline scenario, the MSR remains activated until 2027. A total amount of 3 319 million allowances are invalidated between 2023 and 2030. The TNAC remains between the threshold values from 2028 onwards.

Figure 3: TNAC-development in the high emissions scenarios (current cap)



Notes: All figures follow the same basic layout: Each shows the TNAC, amount of EUAs in the MSR, amount of EUAs entering the market, aggregate verified emissions, and indicates the MSR thresholds.
Source: Own calculations.

The MSR is able to fulfil its function, since in the high emission scenarios, emissions exceed the amount of new EUAs entering the market through free allocation or auctioning in almost all years of the coming decade in both the baseline and Covid-19 adjusted scenario. This is not the case in the low emissions / current cap scenarios explored in the next section.

3.3 Performance of the MSR in the low emissions / current cap scenario

Key findings

- In a scenario with lower emissions, the MSR is not able to prevent a new surplus of allowances from building up; with the TNAC remaining significantly above the threshold until 2030.

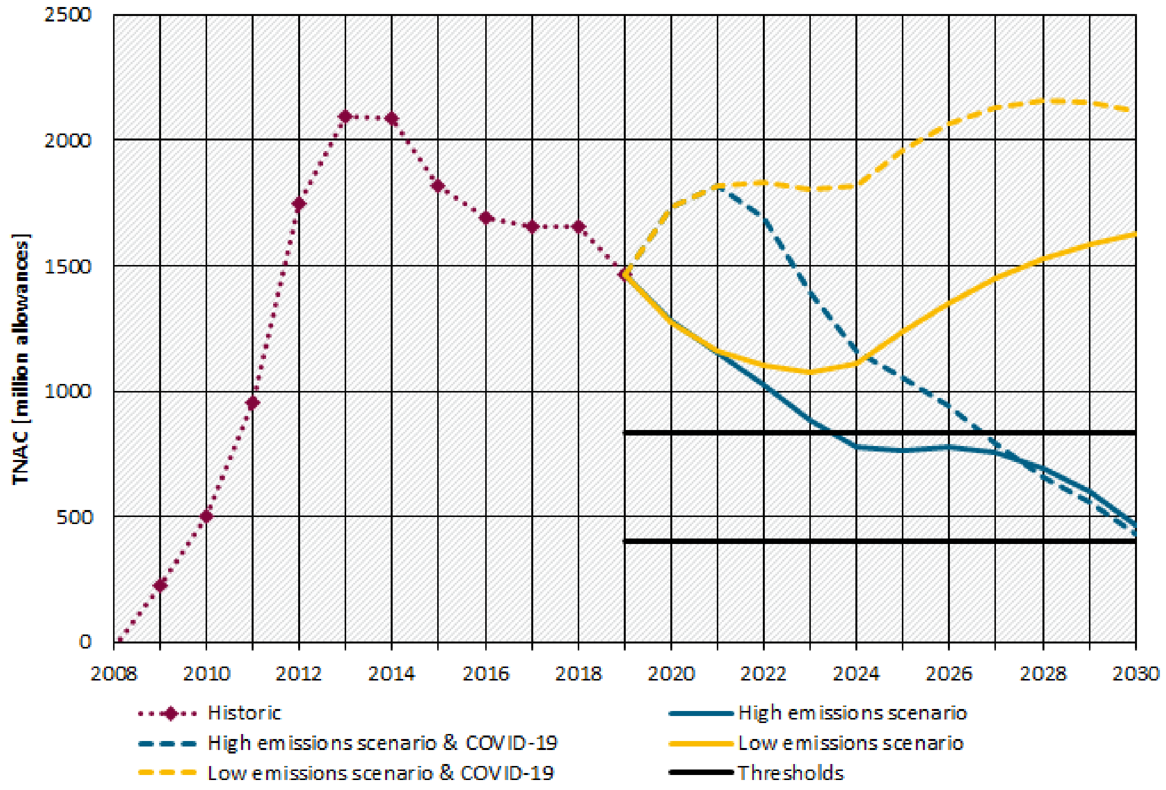
- From 2024 onwards, when the intake rate of the MSR is reduced to 12%, the allowance surplus starts building up, reaching 1.6 billion allowances in 2030. When the impact of the pandemic is taken into account, the surplus increases to over 2.1 billion allowances toward the end of the trading period, surpassing the historic maximum of 2013. In both the baseline and the Covid-19 adjusted scenarios the allowance surplus is so high that there would be no scarcity on the market at all during Phase IV.

- A total of 3.3 billion allowances is invalidated until 2030 in the low emissions baseline scenario. In the Covid-19-scenario, this value increases to 4.3 billion allowances.

In the low emissions scenario (Figure 4) the MSR is not able to balance the allowance market once provisions for doubling the intake rate (24%) end in 2023. The MSR is projected to be in operation throughout the period 2019-2030. It reduces the TNAC between 2019 and 2023, but the reduction is less pronounced compared to the current policies scenario. From 2024 onwards, the amount of EUAs entering the market exceeds projected emissions, leading to a rate of surplus accumulation that is higher than the 12% intake rate in force from 2024 onwards. The surplus accumulates during the second half of the decade and is projected to reach 1 625 million allowances by 2030.

If the impact of the Covid-19 pandemic is accounted for, the MSR is not able to balance the market even during the period until 2023, when a doubled intake rate of 24% is applied. Already from 2020 onwards, the number of new EUAs entering the market exceeds projected emissions. Therefore, the TNAC reaches 1 832 million already in 2022 and climbs to a maximum of 2 155 million in 2028. In 2023, 2 257 million allowances from the MSR are invalidated. Further invalidations follow until the end of the decade, with a projected cumulative invalidation of 4 274 million allowances.

Figure 4: TNAC-development in the high and low emissions scenarios (current cap)



Source: Own calculations.

4 Adapting and Complementing the MSR Parameters for Phase IV

The aim of this section is to investigate the appropriateness of the current MSR parameters for the fourth trading period, thus providing input to the formal review of the MSR scheduled for 2021. The analysis and discussion in this section take the current architecture of the EU ETS as a given. However, we stress that the MSR review should be conducted in an integrated manner together with the discussions around a proposal for updating the EU ETS Directive planned by the EU Commission for mid-2021. This integrated approach is important, because the MSR interacts with other parameters of the EU ETS, such as the linear reduction factor governing the cap, future auction volumes and carbon leakage protection rules.

The MSR review is to assess whether its current parameters ensure delivery of the MSR's twin objectives (Marcu et al. 2019): i) to remove the surplus of allowances that has accumulated in the market since the start of the second trading period; ii) to increase the market's resilience to major external shocks (European Union (EU) 2015). One example of a major external shock is the current drop in emissions due to the Covid-19 crisis.

In each of the following subsections we address specific questions regarding the appropriateness of the current definition of MSR parameters for the period 2021-2030. In Section 4.1 we consider the most influential parameters in the current set-up of the MSR, namely its intake and release rates (Graichen et al. 2019). Section 4.2 investigates whether the current thresholds are likely to reflect the market's need for liquidity during the fourth trading period. Section 4.3 asks if the speed of the MSR's response is appropriate to effectively stabilize the allowance market during the fourth trading period. Section 4.5 addresses the question of how to account for demand for EUAs from the aviation sector. Finally, Section 4.6 discusses further invalidation of allowances in the MSR via the introduction of vintages.

4.1 Are the current MSR intake and release parameters appropriate for Phase IV?

Key findings

- The intake rate is a key parameter to be adapted in order to make the ETS resilient to unforeseen shocks.

- In the high emissions scenario, with and without the effects of the Covid-19-pandemic, the TNAC value in 2030 is very similar for all assessed intake rates as the MSR stops withdrawing allowances from the market in 2023 (2027). In general, this holds true for any scenario with limited or no new surplus. However, differences exist before 2030.

- In the low emissions scenario a massive new surplus develops under the current intake rule, even without Covid-19.

- If a doubled intake rate of 24% is applied until 2030, this is just enough to prevent a new surplus from building up in the low emissions scenario. It is, however, insufficient to reduce the surplus which has already accumulated in the market, let alone cope with the impact of the Covid-19 pandemic.

- Alternative design options of the MSR intake are able to contain the allowance surplus the low emissions scenarios, although only one option is able to bring the TNAC close to the upper threshold level.

In this section we consider whether the current values of the parameters determining the MSR intake and outflow – the feed (or intake) and release rates - appropriately reflect the likely stabilization need of the allowance market during Phase IV. In this context, we analyze whether keeping the intake rate at 24% after 2023 will improve the MSR's ability to balance the allowance market. In addition, we propose three alternative, more flexible intake rules.

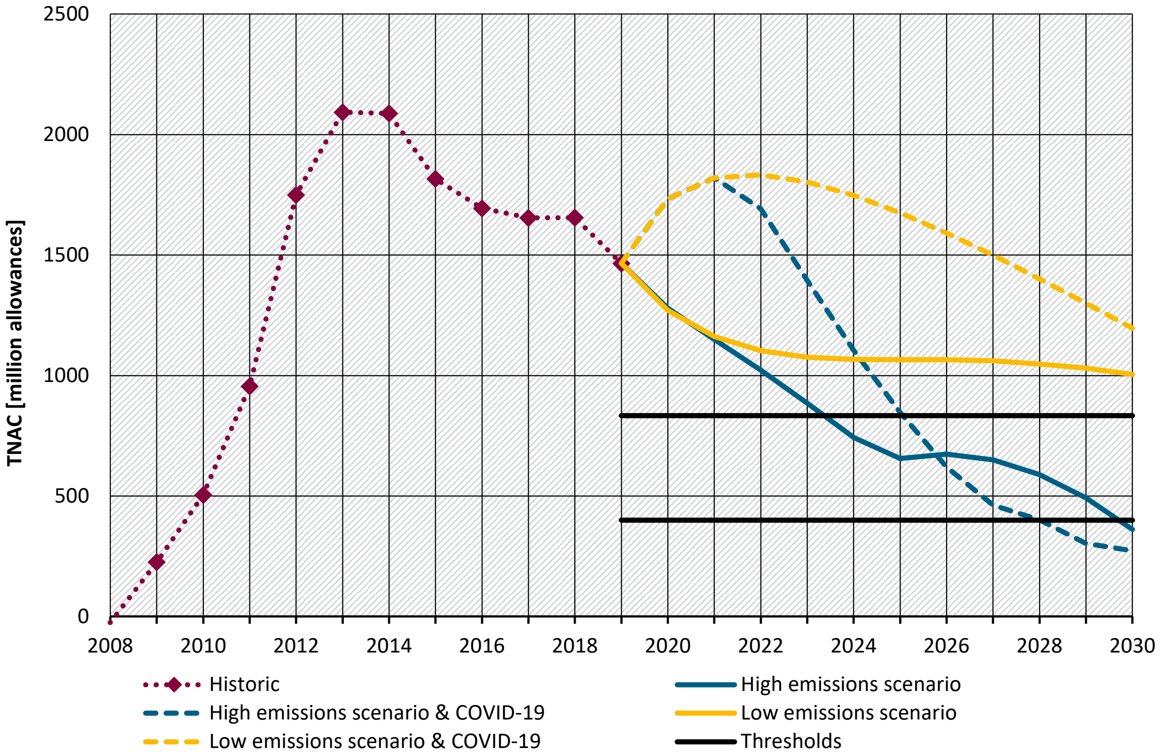
Results from the previous section indicate that the current configuration of the MSR's feed parameters (doubled intake rate of 24% until 2023; 12% for 2024-2030) balance the market in both the high emissions scenario and in the high emissions & Covid-19 scenario. If the impact of the Covid-19 pandemic is accounted for, the surplus of allowances increases in 2020 and 2021, despite the MSR being operational. The MSR intake rate is insufficient to prevent this crisis-related increase in the TNAC. Allowances held in the MSR reach a maximum of 2 805 million in 2022. In contrast to the baseline scenario, the MSR remains activated until 2027. A total amount of 3 319 million allowances are invalidated between 2023 and 2030. The TNAC remains between the threshold values from 2028 onwards. Under the low emissions scenarios, however, an additional allowance surplus accumulates until the end of the decade (Figure 4).

As a first step, we explore the effects of setting the intake rate to 24% throughout Phase IV. If emissions are expected to be relatively high during the fourth trading period (as is the case in the high emissions scenarios), results do not differ greatly from a case where the current configuration is applied (compare Figure 4 with Figure 3).

The picture changes in the low emissions scenarios. By keeping the intake rate at 24% until 2030 the MSR is projected to stabilize the market better than in the case in which the intake rate reverts to 12% in 2024 (compare Figure 5 to Figure 4). The 24% intake rate prevents the TNAC from escalating after 2023, as in the 12% case. The invalidation mechanism is activated in every year during the period 2023-2030, with a projected cumulative invalidation of 3 933 million allowances. However, the TNAC remains above the currently defined upper threshold throughout the decade and stands at 1 005 million allowances in 2030.

In the low emissions & Covid-19 scenario, keeping the intake rate at 24% throughout Phase IV also stabilizes the market better than in the case where the rate reverts back to 12% in 2024. The TNAC reaches a maximum of of 1 832 million EUAs in 2022 and gradually declines afterwards, reaching a projected level of 1 196 million allowances in 2030. However, the TNAC remains significantly above the upper threshold value throughout Phase IV. A total of 5 218 million allowances are invalidated under this scenario in the period until 2030.

Figure 5: Enhanced MSR with 24% intake rate continued until 2030 (current cap)



Source: Own calculations.

This analysis suggests that in a situation where all currently adopted targets are effectively achieved coupled with a negative emission shock even an intake rate of 24% is not sufficient to balance the market. The first best solution to deal with this imbalance of supply and demand is a recalibration of the cap (e.g. through rebasing or increasing the linear reduction factor). The cap is the single most important parameter of each cap-and-trade-system and should be set deliberately. In the absence of a new and strengthened cap the MSR can have a similar effect of reducing the quantity of allowances if designed in a stringent way. Under current cap parameters, either the MSR intake rate must be higher than 24% or tied to the amount of the surplus in order to effectively balance the market.

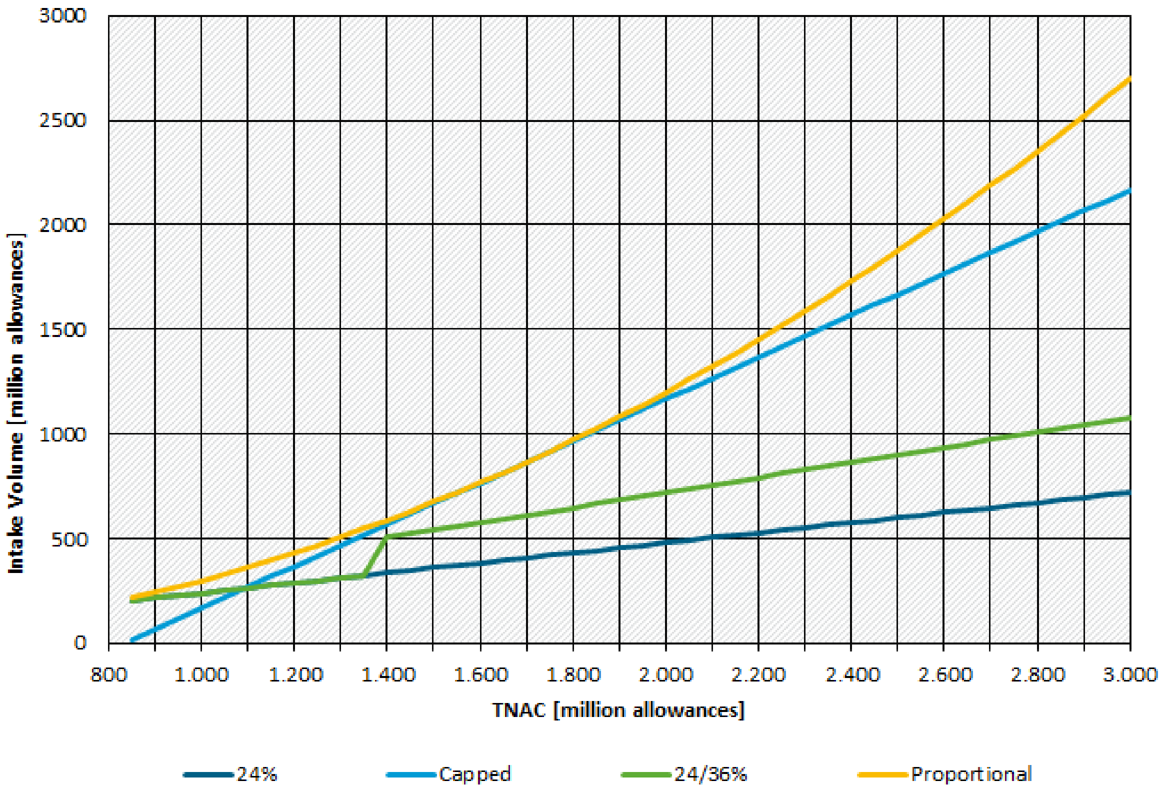
Under current cap parameters, two options exists to effectively balance the market via the MSR feed parameters: i) by increasing the MSR intake rate to above 24% or ii) by tying the intake rate to the level of the surplus, represented by the TNAC. Simply increasing a fixed intake rate, however, has the drawback that threshold effects are exacerbated. Close to the upper TNAC threshold, a fixed intake rate would adjust the allowance supply discontinuously, as the MSR responds in the same way irrespective of how close the TNAC is to the threshold when the MSR is triggered. If the upper TNAC limit is exceeded marginally, the MSR reduces the supply of EUAs by 12%/24% of the TNAC. If the TNAC is slightly below the upper limit, the EUA supply does not change at all. Such a behaviour is difficult to predict for market participants and could lead to gaming by large market actors to ensure a certain outcome. With a higher intake rate, the threshold effect would become even more pronounced. To avoid potentially destabilising threshold effects the design of the intake rate could ensure that such threshold effects are minimised. Instead of using TNAC as reference for the intake rate, the intake rate could be based on the difference between TNAC and the upper threshold, as for example, German Emissions Trading Authority at the German Environment Agency (DEHSt) (2014) has suggested, or all allowances exceeding the upper threshold could be moved to MSR. This would lead to much higher intake volumes in situations with a high surplus; if the TNAC is close to the threshold, the intake would be minimal.

In the following, we explore three alternative definitions of the MSR intake rate, which increase its potential to respond more flexibly to different levels of allowance surplus.

- 24%/36% steps: The first variant is based on keeping the 24% intake rate until 2030 adding a "crisis release valve": In years where the TNAC exceeds emissions from the stationary sector, the intake rate switches from 24% to 36%.
- Proportional: The second variant takes into account the ratio between TNAC and the lower threshold by multiplying the 12% original intake rate with the scalar obtained when the TNAC is divided by the lower threshold value (TNAC/lower threshold).
- Capped by upper threshold: The third variant takes into account the difference between the TNAC and the upper threshold. All allowances above the upper threshold are moved into the MSR.

Figure 6 compares the intake volumes of the four different options to increase the intake rate for different TNACs. The values along the lines represent the quantity of allowances that would be placed into the MSR for the corresponding TNAC in a given year. Except for the capped approach all options start with a minimum intake of 200 million allowances if the TNAC surpasses the threshold of 833 million. The capped approach leads to small amounts of intake for TNAC values close to the upper threshold but ramps up intake volumes much faster than the 24% and the 24%/36% variants as the TNAC increases. While the 24%, 24%/36% and capped options show a linear relationship between the TNAC and intake volumes, the proportional option follows a quadratic function for very high TNAC values. It represents the most powerful option for scenarios with low ETS emissions (cf. the low emissions & Covid-19 scenario).

Figure 6: Comparison of intake volumes by intake rate definition and TNAC



Note: For the step from 24% to 36% an emission level of 1 350 million t CO_2eq was used; this is the average emission value in the low emissions scenario.
Source: Own calculations.

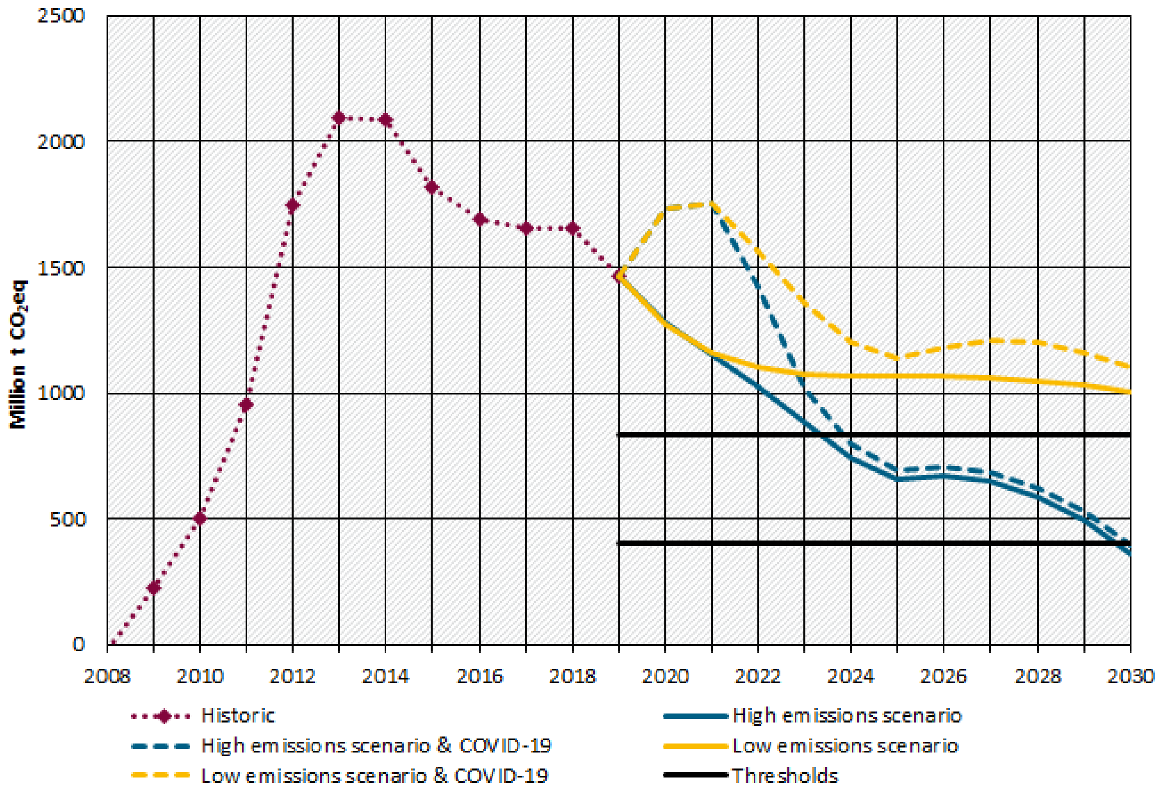
As shown in Figure 7 to Figure 9, the three more flexible approaches succeed in containing the allowance surplus as represented by the TNAC throughout Phase IV even in the scenario with lowest projected emissions (low emissions & Covid-19).

In the baseline low emissions scenario (without adjusting for the crisis), the 24%/36% rule leads to exactly the same outcome as the constant 24% intake rule. The reason for this is that the TNAC never exceeds the annual emissions of the same year. In this scenario, both the 24%/36% rule and the capped approach do not reduce the TNAC below the upper threshold because TNAC increases as fast as it is reduced by the MSR. Under both approaches, the TNAC remains above 1 billion allowances for almost the entire trading period.

The proportional approach is the only one capable of bringing the TNAC down to the upper threshold level in the low emissions scenarios, as it has the highest intake volumes at all TNAC values (cf. Figure 6). While the capped approach leads to large intake amounts if the TNAC is high, it is very weak close to the threshold. It does avoid potentially disruptive threshold effects, but is ineffective when the TNAC is below 1 billion allowances.

As shown in Figure 7 to Figure 9, all three approaches succeed in containing the TNAC surplus throughout Phase IV even in the low emission scenario with the Covid-19 crisis. In the low emission scenario without crisis the 24%/36% rule leads to exactly the same development as the constant 24% intake rule. The reason for this is that the TNAC never exceeds the annual emissions of the same year. Both the 24%/36% rule and the capped approach do not bring the TNAC down to the upper threshold; TNAC remains above 1 billion allowances for almost the entire trading period in both approaches. The proportional approach is the only one capable of bringing TNAC down to the threshold in the current targets scenarios. It has the highest intake volumes at all TNAC values. The capped approach leads to strong intake at high TNAC but is very weak close to the threshold. While it avoids the points of discontinuity/threshold effects, it is ineffective when TNAC is below 1 billion allowances in a low emission scenario.

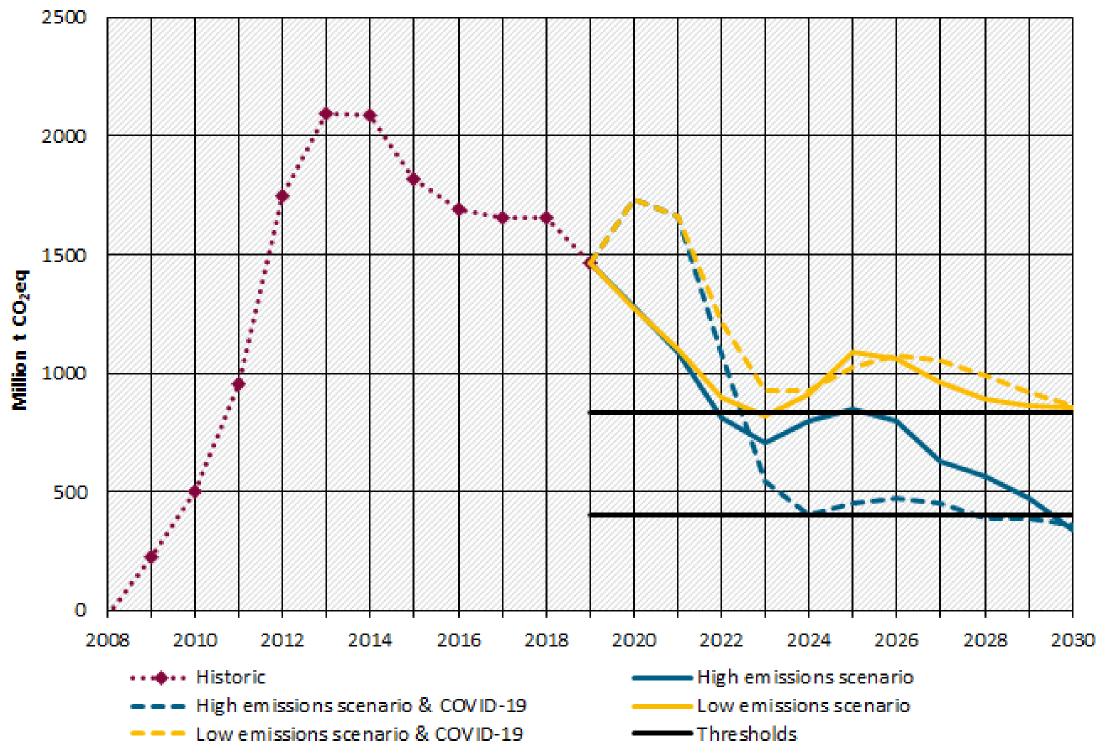
Figure 7: Enhanced MSR with 24%/36% intake rate (current cap)



Source: Own calculations.

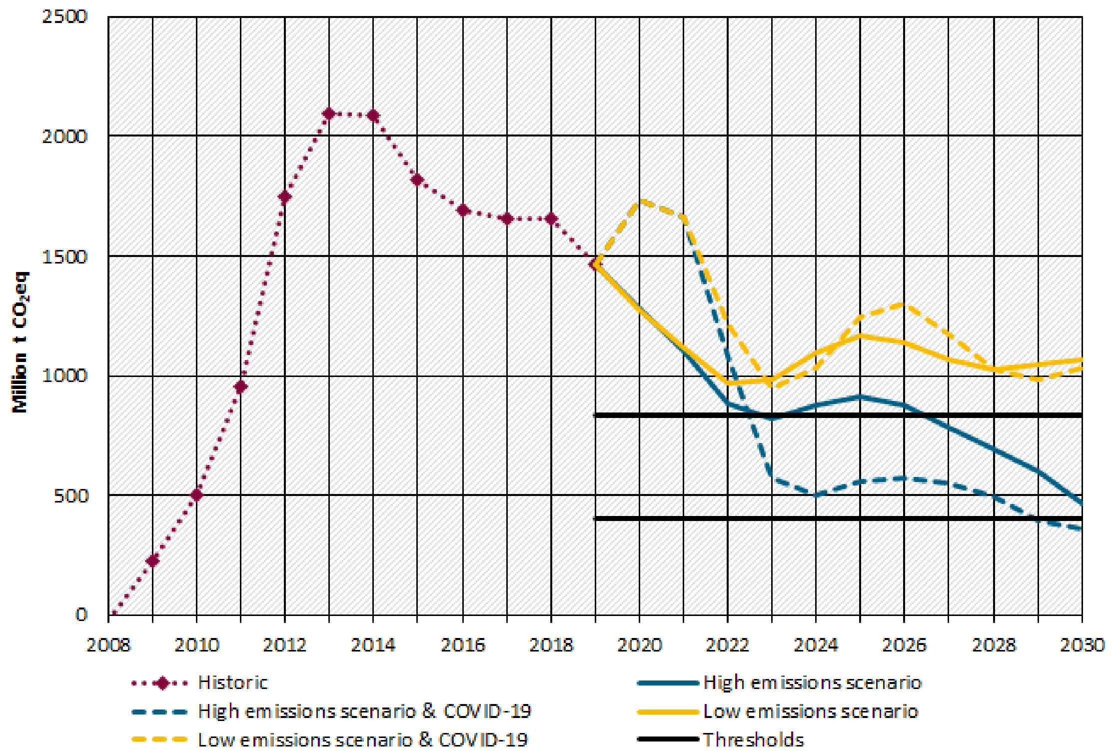
Figure 8 and Figure 9 show a very steep decline of the TNAC in the years following the COVID-19 crisis. The reason for this is that the intake rates used for these two graphs – proportional and capped – show such a strong relationship to the TNAC value. Intake rates of about 50 % in 2021 and 2022 have a very strong impact with a delay of about two years (see section 4.3 for a discussion of the speed of the MSR reply).

Figure 8: Enhanced MSR with proportional intake rate (current cap)



Source: Own calculations.

Figure 9: Enhanced MSR with capped TNAC (current cap)



Source: Own calculations.

A comparison of the intake rates between the current configuration, an extension of the doubled 24% intake rate and the three alternative approaches is shown in Table 1. In the high emissions scenarios, the MSR is completely or nearly inactive during the second half of the decade in all definitions of the intake rate. Applying the 24%/36% approach the higher intake rate is only triggered in the crisis scenarios[7]. In the proportional and the capped approaches, the initial intake rate in 2021 reaches and exceeds 50% in the scenarios which take the effect of the COVID-19 pandemic into account. In the high emission scenarios, the intake rate quickly drops to zero whereas in the low emissions scenarios the intake rate remains at around 30% until the end of the trading period for the proportional approach. Under the capped approach, lower intake rates are observed during the second half of the decade than under the proportional approach. Even in the scenario with lowest emissions (e.g. the Covid-19 adjusted low emissions scenario), it remains below 20% towards the end of the trading period and the TNAC is not brought down to the upper threshold by the capped approach. The reason for this is that the cap does not decline as fast as emissions in this scenario and the annual surplus is as high as the intake by the MSR. The table also shows that threshold effects remain under the proportional approach, e.g. in 2024 of the low emissions scenario and in 2026 of the high emissions scenario.

The parameters for the three flexible intake rates used in this assessment could be set differently of course. For example, a lower trigger for the stepped approach would reduce TNAC more effectively than the one used here. The capped approach could be modified in a way that only a certain percentage of the difference between the upper threshold and the TNAC is moved into the MSR or could be based on a different TNAC level (e.g. the middle between the upper and lower threshold instead of the upper one). While these parameters need to be studied in more detail this analysis shows that the intake rate should depend on the TNAC and not be a fixed value. Such a coupling of TNAC and intake rate reduces threshold effects and ensures that even under very low emission scenarios the MSR is able to effectively reduce the TNAC.

[7] This depends on the trigger used for the step towards 36%. For this analysis the higher rate applies if the TNAC exceeds the emissions from the stationary installations in the same year.

Table 1: Intake rate per year (in percentage of TNAC) under different intake rules and emission scenarios

	Scenario	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Current rules	High emissions	24%	24%	24%	24%	12%	12%	12%	12%	12%	12%	12%
	High emissions & Covid-19	24%	24%	24%	24%	12%	12%	12%	12%	12%	12%	12%
	Low emissions	24%	24%	24%	24%	12%	12%	12%	12%	12%	12%	12%
	Low emissions & Covid-19	24%	24%	24%	24%	12%	12%	12%	12%	12%	12%	12%
24% until 2030	High emissions	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%
	High emissions & Covid-19	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%
	Low emissions	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%
	Low emissions & Covid-19	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%
Steps 24% - 36%	High emissions	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%
	High emissions & Covid-19	24%	36%	36%	24%	24%	24%	24%	24%	24%	24%	24%
	Low emissions	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%	24%
	Low emissions & Covid-19	24%	36%	36%	36%	36%	24%	24%	24%	24%	36%	24%
Proportional to TNAC	High emissions	24%	37%	32%	24%	21%	24%	26%	24%	19%	17%	14%
	High emissions & Covid-19	24%	51%	49%	33%	17%	12%	14%	15%	14%	12%	9%
	Low emissions	24%	37%	32%	27%	25%	28%	33%	32%	29%	27%	26%
	Low emissions & Covid-19	24%	51%	49%	37%	28%	28%	31%	32%	32%	30%	28%
Capped at upper threshold	High emissions	24%	33%	23%	7%	0%	6%	9%	5%	0%	0%	0%
	High emissions & Covid-19	24%	51%	49%	24%	0%	0%	0%	0%	0%	0%	0%
	Low emissions	24%	33%	24%	15%	17%	24%	28%	26%	22%	19%	21%
	Low emissions & Covid-19	24%	51%	49%	32%	14%	20%	33%	36%	29%	19%	16%

Notes: Years in which the MSR is triggered are shown in blue; in the other years TNAC is below 833 million allowances.

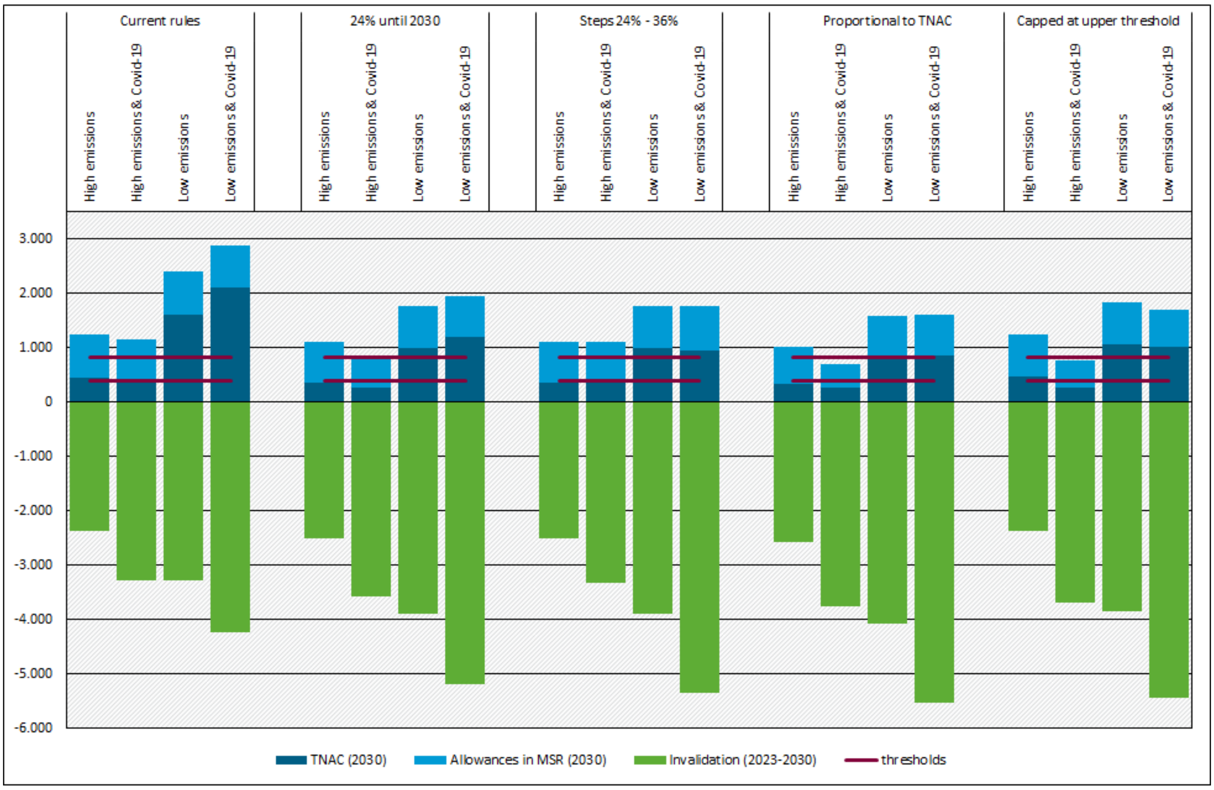
Source: Own calculations

Figure 10 and Annex A.1 show a comparison of key MSR parameters in 2030 across all emission scenarios and the five different intake rates discussed in this paper. For a scenario with high emissions and not accounting for the impacts of the Covid-19 pandemic, the differences across the five intake rates are relatively minor in 2030. This is because the MSR is only triggered during the first few years of the trading period.

Even taking into account the impacts of the pandemic on emissions, the differences across the options remain limited. Interestingly, in the 24%/36% approach more units remain in the MSR than in the constant 24% intake rate approach. The reason for this is that in the stepped approach the TNAC is reduced quickly and the MSR is not triggered anymore after 2024. In the constant 24% case the MSR is triggered for two additional years which leads to higher quantities being invalidated.

For the two low-emission scenarios, larger differences are observed across the different approaches. Under current rules TNAC remains very high. Only under the proportional approach is the TNAC reduced to the upper threshold by 2030. The other three approaches to determine the intake rate lead to a TNAC of around 1 000 million allowances. Valid allowances in the MSR are somewhat lower in the proportional and capped approach. With the very high intake rates in single years the maximum number of allowances in the MSR is lower.

Figure 10: Comparison of key MSR parameters in 2030 across the different scenarios and intake rates



Note: Annex A.1 contains a table with the data behind the graph.
Source: Own calculations.

4.2 Do the current thresholds reflect the needs for liquidity in Phase IV?

Key findings

- Liquidity needs in the allowance market are currently assumed to be constant, despite the continuously declining cap and emissions. Given that the share of fossil electricity generation has decreased substantially in the past years and the power sector will continue to decarbonize, the threshold corridor as currently defined seems to be too wide and thresholds too high for application in Phase IV.

- Holding constant the share of the cap represented by the TNAC thresholds could better align them with evolving liquidity needs.

- TNAC threshold values would need to decrease further if the cap is adjusted during Phase IV.

The TNAC thresholds are currently static: Allowances are placed in the MSR if the TNAC exceeds 833 million EUAs and they are released from the MSR if the TNAC falls below 400 million. The upper limit was defined as the level of market surplus required to yield an absolute MSR intake of at least 100 million allowances at an intake rate of 12% (European Union (EU) 2015). The thresholds were defined based on estimates of the hedging demand for EUAs from the power sector and demand for allowances to satisfy banking needs from industrial installations. The resulting need for liquidity is difficult to pinpoint, not least due to a lack of data on banking patterns by installations in industrial sectors and continuously changing hedging and banking strategies.

Changes in the hedging demand are to be expected during Phase IV. The UK leaving the EU ETS after 2020 may lead to one-off decrease in the hedging and banking demand. The lower liquidity demand of the EU 27+3 may be taken into account by adjusting the threshold levels downwards. The adjustment could be based on a range of different factors, e.g. on the UK's share in verified 2005 emissions (approx. 11.6%) or the UK's share of the MSR (11.2% (European Commission (EC) 2020a)), the share of the cap (approx. 11.1% (Gores und Graichen 2016))[8] or the share of UK's power emissions in total EU's power emissions from the TNAC levels.

Moreover, the pace of decarbonization in the power sector exceeded the decline in the cap during Phase III. During the period 2013-2018 power sector emissions decreased by about 18.8%, while the cap declined by about 9.2% during the same period (European Commission (EC) 2020a) . The more rapid decrease in power sector emissions is likely to continue or even accelerate during this decade, with more ambitious renewable energy and energy efficiency targets at EU level and with a large-scale decommissioning of coal-fired power generation capacity planned in the period up until 2030. While a full assessment of the hedging trends in the power sector between 2021 and 2030 is beyond the scope of this paper, we expect that the hedging demand from the power sector is likely to decrease in excess of the decline in the cap during Phase IV.[9] This decrease in the hedging demand from the power sector may be counteracted by an increase in banking demand from industry to some extent.

[8] According to article 9 of the ETS Directive, the cap is calculated as average cap of TP2 plus a correction for the activities and gases covered from TP3 on. Following the approach from Gores und Graichen 2016, we calculate a share of 11.1% for UK.

[9] Further research should systematically assess data on recent hedging trends in the power sector to better quantify the hedging demand from power producers.

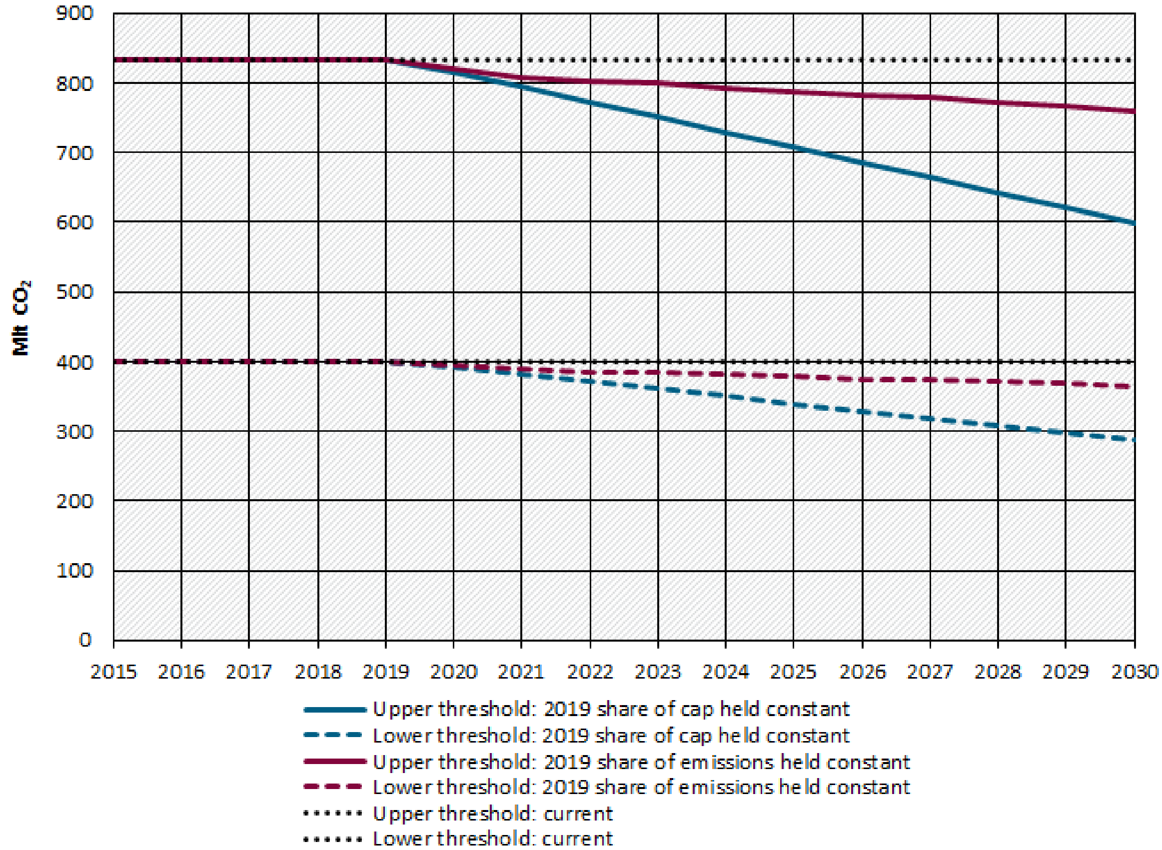
Any estimation of the development of the combined hedging and banking demand will be subject to uncertainty, not least due to a lack of data availability. If the TNAC trigger levels are set too high the MSR may not be effective at stabilizing prices. Defining the corridor too narrowly may lead to price volatility (Neuhoff et al. 2015) or a loss in cost-effectiveness as some firms may reduce their emissions beyond the cost-effective point to stick to their banking strategy (Gilbert et al. 2014). However, possible destabilizing effects from defining the TNAC trigger values too narrowly are mitigated by two mechanisms: First, the entire free allocation is placed into the market before installations must surrender allowances for the previous year. Second, one quarter of the annual auctioning amount is also available to the market prior to the surrender deadline. These mechanisms provide additional liquidity in case the market needs more liquidity to satisfy hedging and banking needs.

We illustrate two pragmatic ways of adjusting the TNAC trigger levels using EU-31 data, i.e. not adjusting for Brexit, to better reflect a declining need for liquidity during Phase IV. One possibility is to apply constant shares of (projected) emissions to define the TNAC triggers. As Figure 11 shows, using the ratio between the original trigger levels of 400 and 833 million and 2019 emissions, the year when the MSR began operating, decreases the upper trigger level to 759 million allowances and the lower trigger value to 365 million allowances in 2030. Applying the ratio between the trigger levels and emissions from an earlier year, e.g. in 2015, when the MSR was formally devised, will decrease the trigger levels to 698 and 335 million allowances in 2030, respectively.

An alternative calculation applies constant shares of the cap to define MSR trigger values. In our example shown in Figure 11 we again use 2019 as the base year, when the upper TNAC threshold represented 44.9% of the cap, while the lower threshold represented 21.6%. Applying this method leads to lower values of both the upper and lower thresholds and to a narrower corridor than using shares of emissions. The upper limit is then equal to 606 allowances in 2030, while the lower limit is equal to 291 million allowances. Again, using an earlier base year for calculating the adjustment in the trigger values results in lower thresholds and a narrower TNAC. Using the cap as reference point to calculate the TNAC thresholds holds several advantages over using (projected) emissions, mainly related to the fact that information on annual caps is available in advance, while emissions may change in the short term, as illustrated by the Covid-19 crisis. Therefore, pegging the threshold values to the overall cap increases predictability compared to when emissions are used and reduces policy uncertainty for market participants. Moreover, the TNAC thresholds would be updated automatically when changes to the cap are made, e.g. to account for Brexit or in case of changes to the linear reduction factor.

The calculations for adapting the TNAC trigger levels presented here assume that the current 2030 target for the EU ETS of a 43% reduction by 2030, compared to 2005, will remain unchanged. However, in December 2020 the European Council agreed on increasing the EU's climate target from 40% below 1990 levels to at least 55% (European Council (EUCO) 2020). Once the target is adapted, the TNAC thresholds will need to be adapted accordingly, to account for a further decrease in the liquidity need due to a lower cap.

Figure 11: TNAC trigger levels using constant emission or cap shares



Source: Own calculations.

4.3 How to speed up the MSR response?

Key findings

- The MSR is slow in reacting to changes in market outcomes.

- The speed of the MSR's response can be increased by compressing the reaction period, instead of keeping it at September (year x)-August (year x+1).

In its current configuration the MSR responds to the TNAC being above or below the trigger values with a delay. Auctioning quantities are adjusted between September of year x and August of year x+1 in response to the TNAC for December 31 of year x-1. That is, the response is spread over a timeframe of between nine and 20 months after the occurrence of the relevant TNAC. Moreover, the MSR's reaction is spread evenly over this timeframe. Currently, the feed into the MSR and the release from it occurs by decreasing/increasing auctioning amounts by the same share in every month from September of year x to August of year x+1.

This delayed response may dampen the stabilising effect of the MSR and is especially pronounced when a shock to the allowance market occurs during the early part of a year, as is the case with the decline in emissions caused by the Covid-19 pandemic. In our Covid-19 scenarios we assume that emissions decrease by 353 Mt in 2020 in the stationary sector, i.e. by

23% compared to 2019 levels (Ferdinand 2020), leading to a prolonged increase in the allowance surplus as represented by the TNAC, only slowly diminishes under current MSR parameters (cf. Sections 3.2 and 3.3).

In its current configuration, the MSR will only start reacting to the initial Covid-19 shock in September 2021, with the reaction spread out until August 2022. The re-alignment of the allowance market could be accelerated if the MSR were to react more quickly. One possibility to increase the MSR's reaction speed would be to compress the feed/release schedule to a duration of less than twelve months. The operational phase of the MSR could, for example, be shortened to eight months between September (year x) and April (year x+1) which would mean that 50% of the intake takes place in year x (instead of 33% as under current rules). However, such a compressed reaction schedule would not be able to address the delayed start of the MSR's reaction, only speed up the intake/release.

4.4 What are the pros and cons of a hybrid system with price and quantity-based triggers?

Key findings

- A hybrid price-based and quantity based MSR trigger could further increase the MSR's response speed while increasing its complexity

- A very high floor price would lead to a systemic change for the MSR, from a quantity-based mechanism to a predominantly price-based one.

- The relative relevance of price-based and quantity-based triggers in a hybrid system could change over time depending on the development of both.

An alternative option would be to introduce a floor price at EUA auctions and link the price mechanism to the MSR. Allowances not auctioned at the floor price could either be immediately placed in the MSR or be offered at a pre-defined number of subsequent auctions before being placed in the MSR. Offering allowances at subsequent auctions would delay the speed of the MSR's reaction time, depending on the number of times unsold allowances are re-offered. However, either option will likely lead to a similar number of allowances ultimately transferred to the MSR, except in the case of very short-lived demand shocks or many re-offerings. An immediate placement of unauctioned allowances in the MSR would thus simplify the mechanism for all market participants.

As auctions take place frequently, a floor price would ensure that an excess supply of EUAs would be transferred into the MSR quickly, considerably increasing the speed of the MSR's reaction. In the case of a demand shock occurring during the early part of the calendar year, such as the current Covid-19 shock, this would cut the time until the MSR begins reacting to the initial shock from about 1.5 years to a few months or even weeks or days, assuming that the shock is strong enough to trigger the price-based reaction of the MSR and depending on the number of times allowances are re-offered at subsequent auctions.

The auction floor price would also ensure rapid convergence of the price in the secondary allowance market to the floor price through arbitrage: As an alternative to participating in auctions, market participants may purchase allowances on the secondary market while the price in the secondary market is below the floor price. This would ensure that unauctioned EUAs continue being transferred into the MSR until the EUA price in the secondary market converges to the floor price. The EUA price would then remain at the floor price until further scarcity in the allowance market raises the EUA price above the floor price.

Assuming that the remaining MSR parameters remain unchanged, the relevance of adding a price-based trigger for transferring allowances into the MSR compared to the current quantity-triggers, is determined by the level of the floor price. A floor price set far below average EUA prices in recent years would ensure that a minimum allowance price is maintained in the event of a substantial decline in the demand for allowances. This relatively low floor price would cause the MSR's price mechanism to be triggered infrequently, only when large drops in the demand for allowances cause strong price reactions. Thus, the quantity-based mechanism would remain the primary instrument of market stabilization and the reaction speed of the MSR would remain mostly delayed, as is currently the case. As an example, due to the Covid-19-related drop in allowance demand in early 2020 the allowance price fell from about 25 Euro per allowance in mid-February 2020 to about 15 Euro per allowance in mid-March 2020. A price-based MSR trigger would have had to be set at about 15 Euro or above, combined with no or relatively few re-offerings of unauctioned allowances, to effectively transfer allowances into the MSR using a price trigger.

A higher floor price, defined to ensure that economic incentives for market participants to reduce emissions stay intact even in the event of a drop in demand, e.g. incentivizing a fuel switch from coal to gas fired power generation, would trigger the floor price mechanism more frequently. A larger price-based transfer of allowances into the MSR would decrease the TNAC more strongly compared to a purely quantity-based trigger, leaving fewer surplus allowances for the quantity-based mechanism. This would also increase the speed of MSR's reaction. In the extreme case, a very high price floor would immediately remove so many allowances from the market that the TNAC would never exceed its trigger value to activate the quantity-based mechanism. Overall, a sufficiently high floor price would therefore dramatically increase the speed of the MSR's reaction. However, it would also lead to a systemic change for the MSR, from a predominantly quantity-based mechanism to a predominantly price-based one. Furthermore, setting an adequate price level would be a challenge.

Another factor determining how frequently the price-based mechanism is activated is whether the floor price remains constant or increases over time. Assuming that abatement in EU ETS sectors progresses toward options with higher abatement costs over time, the average EUA price will continue to increase. If the floor price remains constant, its distance from the average price range will increase and progressively render it less relevant. A floor price increasing over time would counter such an effect.

The total number of allowances placed into the MSR is ambiguous, as shown in a stylized example (Table 2). We consider two very similar cases, but with different outcomes in terms of the total number of allowances transferred to the MSR. In both cases we assume that the initial TNAC is at 1 400 million allowances, approximately the level at the end of 2019, and that no further allowances are added to it in the subsequent years (e.g. that emissions are equal to the supply in the same year). We also assume that a one-time shock occurs that triggers the price-based mechanism. In Case 1, the floor price is chosen such that the price-based mechanism immediately transfers 20% of the TNAC into the MSR. In Case 2, we assume that the floor price is higher, so that 22% percent of the TNAC is immediately moved to the MSR. In both cases, the purely quantity-based MSR is triggered twice, placing a total of 591 million EUA into the MSR.

In contrast, in Case 1 the MSR with both a price-based and a quantity-based trigger immediately transfers 280 million EUAs into the MSR due to the price-based trigger. The quantity-based trigger is activated in two consecutive years, removing an additional 473 million allowances from the market, for a total transfer of 753 million allowances due to the combined price-based and quantity-based mechanisms. Thus, in Case 1 the hybrid price / quantity-based MSR removes more allowances from the market than the quantity-based MSR alone.

In Case 2, the price-based mechanism leads to an immediate transfer of 308 million allowances to the MSR, with an additional 262 million EUAs removed through the quantity-based mechanism in the first year. However, in the second year the TNAC falls to 830 million, below the trigger value to activate the quantity-based mechanism. In Case 2, the hybrid price/quantity-based mechanism places a total of 570 million allowances into the MSR, thus removing fewer allowances from the market than the purely quantity-based version of the MSR. Lower removals in the second year might lead to lower prices in the future and a higher chance of triggering future transfers into the MSR due to the floor price being hit.

Thus, while it is clear that introducing a price-based mechanism for triggering the MSR would increase its reaction speed, it is not clear whether it would lead to a greater or smaller aggregate transfer of allowances into the MSR, compared to the purely quantity-based version.

Table 2: Illustrative comparison of quantity-based MSR trigger with hybrid price/quantity-based MSR trigger

		Base case (only quantity based)		Price/quantity-based MSR triggers			
	Period	TNAC	MSR intake	TNAC	Price-based MSR intake	Quantity-based MSR intake	Total MSR intake
Case 1	1	1 400	336	1 400	280	269	549
	2	1 064	255	851	-	204	204
	3	809	-	647	-	-	-
Total			**591**				**753**
Case 2	1	1 400	336	1 400	308	262	570
	2	1 064	255	830	-	-	-
	3	809	-	830	-	-	-
Total			**591**				**570**

Note: All numbers in million EUAs. For the price trigger in case 1 it is assumed that 20% of the allowances will not be auctioned but transferred to the MSR due to a lack of demand; in case 2 22% would not be sold and instead transferred to the MSR due to the price trigger. The MSR-intake is based on a 12% intake rate.

Source: own calculation

4.5 How to account for demand for EUAs from aviation?

Key findings

- The aviation sector is a net buyer of EU allowances. Its demand is currently not taken into account when the TNAC is calculated.

- If aviation demand was taken into account, the ability of the MSR to reduce the surplus would be dampened and the environmental effectiveness of the scheme would decrease.

- The aim of the MSR is to reduce the historic oversupply in the stationary sector and to stabilize the market in case of external shocks. Since a change in the TNAC definition would make it harder to achieve these aims, we recommend to not alter this parameter.

- In addition to its CO_2 emissions aviation has a non-CO_2 climate impact. Therefore, from a climate perspective one ton saved in the stationary sector is not equal to an additional ton emitted in the aviation sector. Excluding aviation from the TNAC definition somewhat compensates for this false equivalency.

The stationary ETS and the aviation sector covered by the EU ETS are governed by separate caps and used to be linked by one-way trade. Aircraft operators were allowed to use EUAs from the stationary sector for compliance whereas operators in the stationary ETS could not use aviation allowances (EUAAs) to cover their emissions. From Phase IV onwards the two types of allowances are fully fungible.

Since its inclusion into the EU ETS the aviation sector has emitted more CO_2 than it could cover using EUAAs and has covered the difference mainly by purchasing EUAs. Whereas the aviation emissions included in the EU ETS are only 4% relative to those of the stationary sector (European Environment Agency (EEA) 2019a), they are expected to increase further in the future even in the Covid-19 scenario (albeit less than anticipated before travel bans were imposed in 2020, see Section 3.1). As abatement measures in the aviation sector are relatively costly and the impact of current carbon prices on demand is minimal, buying allowances from the stationary sector is a more economical way to ensure compliance than reducing emissions in the aviation sector itself.

Currently the demand for EUAs from the aviation sector is not taken into account in the calculation of the TNAC. As the sector is a net buyer, including aviation demand into the TNAC calculation would decrease the amount of allowances transferred to the MSR as well as the amount of allowances invalidated and would therefore reduce the overall environmental effectiveness of the EU ETS.

It has been argued that the TNAC-calculation should be adapted to reflect the number of allowances de-facto available to the market, also taking into account the demand from aviation (Ferdinand et al. 2017). This argumentation neglects that the MSR was introduced to serve two aims: 1) address the surplus of allowances built up in the stationary sector and 2) improve the system's resilience to major shocks.[10] The historic surplus in the stationary sector was largely caused by the unanticipated emission reductions following the financial and economic crisis in 2008/2009 and high imports of international credits – neither of those developments are

[10] Refer to https://ec.europa.eu/clima/policies/ets/reform_en, accessed 9/2/2021.

related to the aviation sector. Including aviation demand in the TNAC definition would reduce the ability of the MSR to reduce the historic surplus and thus counteract the first aim cited. At the time the MSR was introduced, policy makers had not expected a pandemic such as Covid-19, but they did consider the possibility of major shocks. Again, emission reductions due to the pandemic are independent of developments in the aviation sector. If aviation demand was taken into account in the TNAC calculation, the ability of the MSR to react to the current external shock would be reduced thus counteracting also the second aim referred to above. The surplus built up or building up in the stationary sector should be tackled within the stationary sector, inter alia through the MSR.

Independently of the purpose of the MSR there is a further fundamental reason why aviation should be treated differently. Aviation contributes to global warming not only through CO_2 emissions. Non-CO_2 climate impacts are caused by emissions of oxides of nitrogen (NO_x), soot particles, oxidised sulphur species, and water vapour. Based on latest scientific evidence the warming impact of aviation on the climate is three times the rate of CO_2 alone (Lee et al. 2020); the EU Commission states that the impact of the sector's non-CO_2 emissions is at least in the order of magnitude of CO_2 (European Commission (EC) 2020d).This difference in the climate impacts contravenes a central pillar of any ETS: the interchangeability of emission sources. In theory, it should not matter which entity covered by an ETS emits a unit of GHG. In practice, there is a significant difference between the stationary and the aviation sectors: one avoided ton of CO_2 in the stationary sector has a much lower climate impact than one additional ton of CO_2 and its accompanying non-CO_2 impacts in the aviation sector. To reflect this, aviation operators could be obligated to purchase more than one EUA to cover one ton of CO_2-emissions (Graichen und Graichen 2020). However, as long as non-CO_2 effects are not included in the EU ETS, the different treatment of aviation in the MSR somewhat compensates for the false equivalency of emissions from the stationary sector with emissions by the aviation sector.

4.6 Invalidation of vintage allowances from the MSR

Key findings

- The intention of the MSR is to react to short term imbalances. Allowances therefore should not be stored in the MSR for a long period of time.

- An introduction of vintages for allowances can help avoid that past surplus reduces climate ambition in future years.

- Invalidation of vintage allowances is a no-lose option that can be combined with the current invalidation rule. As it will only be activated in case emissions equal the cap over several years it has a safeguard function but might well not be triggered at all.

From 2023 onwards, allowances in the MSR are invalidated if the number of allowances in the MSR exceeds the auctioning amount of the previous year. This could lead to a constant number of allowances in the MSR if the TNAC remains between the threshold values and neither absorbs nor releases allowances. This is the case if emissions are similar to the cap level. Allowances that were not needed to fulfil demand for several years may then be released into the market in, for example, the target year 2030 and thus endanger fulfilling the target or stretch into the next trading period. In this case, the MSR would not react to short time imbalances but a historic surplus would reduce climate ambition in future years. The issue is of more relevance if the auctioning share is higher (e.g. due to a reduction of the share of free allocation in the overall emissions budget) and more allowances remain in the MSR.

One option is to limit the number of years allowances may remain in the MSR, e.g. to three or five years. This rule could come on top of the current invalidation rule - oldest allowances would be first in line if allowances are released to the market or if allowances are invalidated. If nevertheless allowances remain in the MSR that are older than the defined time span, they would be deleted. This mechanism would have a back-stop function for a specific case as it is only triggered when emissions decline at the same speed as the cap in order to avoid past surplus allowances from coming into the market at a much later date. It is a no-lose option as it would neither be triggered if emissions are substantially above or below the cap.

5 Interaction of voluntary cancellation and the MSR

Key findings

- The MSR is partially effective at puncturing the waterbed for a limited time through its invalidation mechanism.

- Voluntary cancellation of allowances supplements the MSR and member states should make use of it. Voluntary cancellations cannot, however, replace the MSR.

- The effectiveness of voluntary cancellation is diminished in the presence of the MSR, because voluntary cancellations reduce the TNAC and, hence, cancellations by the MSR.

- It is suggested to further develop the option of voluntarily cancelling allowances and base the cancellation of allowances related to the closure of power plants on common rules that can be used by all member states.

Many member states are implementing or planning national climate policies additional to the EU ETS, which will become relevant during Phase IV. These policies, many of them related to phasing out coal-fired power generation, were not considered when the cap was set. While the EU climate target will be stepped up (European Council (EUCO) 2020) likely resulting in a strengthened EU ETS, it is unclear from what year onwards this increased ambition will come into effect and by how much the cap will be adjusted downwards. It is likely that the yet-to-be defined cap does not (fully) reflect the national coal phase policies before the end of the trading period and that new and additional policies will be introduced during the trading period.

Most national policies previously not taken into account in the definition of the EU ETS cap are related to the decommissioning of coal-based power generation capacity. If decommissioning takes place as currently planned in the respective ETS countries, a total of about 316 TW of capacity will be phased out by 2030, leading to a cumulative reduction in EU ETS emissions due to national policies in the order of 1 Gt CO_2e for the period 2021-2030 (Zaklan et al. 2020). Without taking any additional measures, such unilateral policies can lead to a “waterbed effect”, where emissions reductions in one sector, country or region are compensated by an increase in another sector country or region. The reason is either a spatial or intertemporal shift in emissions (Burtraw et al. 2018; Agora Energiewende und Öko-Institut 2018; Perino 2018).

The MSR as planned originally (European Union (EU) 2015) – i.e. without an invalidation mechanism – did not solve the waterbed effect. By absorbing allowances in the short term and releasing them in the future it exchanged more scarcity in the allowance market in the present for less scarcity in the future while leaving the aggregate cap unchanged (Perino 2018). Including an invalidation mechanism makes the MSR partially effective at reducing the waterbed effect (Perino 2018; Flachsland et al. 2018): The decrease in allowance demand from phased-out power plants decreases the aggregate demand for allowances, possibly leading to an increase in the TNAC. If the TNAC increases above its trigger value, the number of allowances fed in the MSR increases and so does the number of allowances invalidated under the current invalidation rule. The earlier the unilateral phase-out occurs, the longer the MSR can remove allowances from the market and more allowances will be cancelled under the invalidation rule, increasing the effectiveness of the MSR with respect to puncturing the waterbed.

The current invalidation mechanism reduces the number of allowances available, but does not compensate for 100% of emissions avoided due to the closure of power plants. Perino (2018) calculates that with early unilateral action, e.g. in 2020, in combination with the MSR absorbing allowances for several years, at least until 2023, for each ton of CO_2 abated unilaterally aggregate long-term emissions will decrease by at almost 0.6 tons. In contrast, in years where the MSR is not active, e.g. from 2024 onwards, each ton of CO_2 abated by national policies only yields a long-term abatement of 0.47 tons. The effectiveness of unilateral action with respect to long-term aggregate abatement therefore increases, the longer the MSR withdraws allowance from the market. Thus, lowering the upper TNAC threshold to account for a lower cap in the future would increase effectiveness of the MSR.

However, a decrease in demand induced by national policies does not necessarily increase the TNAC. It may also lead to a lower EUA price thus incentivizing, for example, more emission-intensive electricity production in another country or region. In this case, where the TNAC is unchanged, the MSR cannot counteract the waterbed effect.

Therefore, an additional option to reduce the waterbed effect has been introduced in Phase IV: **voluntary cancellation**. It allows member states to compensate for the effect of national policies leading to power plant closures by cancelling allowances, thus decreasing aggregate emissions (European Union (EU) 2018). As voluntary cancellations decrease the TNAC, they generally reduce the number of allowances transferred into the MSR. Therefore, invalidation from the MSR is smaller than it would have otherwise been. Voluntary cancellations are therefore less effective in the presence of the MSR.

Several authors estimate that voluntary cancellations related by Member States will be up to 2/3 effective when the MSR is active (Doda et al. 2021; Graichen et al. unpublished). However, the timing of cancellations matters. In a stylized theoretical contribution, Gerlagh und Heijmans (2019) show that if allowances are cancelled while the MSR is still active, i.e. while the TNAC is above the upper trigger threshold, cancellation is less effective than if allowances are withdrawn and banked initially and then cancelled after the MSR has stopped removing allowances from the market. The initial banking leads to a greater MSR feed and thus higher aggregate cancellations.[11] Another way of increasing the effectiveness of voluntary cancellations would be to exclude cancellations from the calculation of the TNAC. This would make them fully additional. However, the TNAC would then reflect less accurately the supply of allowances.

In addition to interacting with the MSR, unilateral allowance cancellations in their current form do not make use of the full potential of the instrument. Cancellations are voluntary and restricted to cases in which the entire installation is closed. Further, allowances may only be cancelled up to average emissions of the past five years prior to the closure (European Union (EU) 2018). Moreover, each member state is fully responsible for the cost of the cancellation policy, as the cancelled allowances are removed from the country's auctioning quantity. It is currently unclear to what extent voluntary cancellations will take place, which increases policy uncertainty for market participants.

It is therefore suggested to develop the instrument further. **Rule-based allowance cancellations** to account for the effects of unilateral policies applied uniformly across the EU

[11] There might even be the effect that voluntary cancellations lead the TNAC to drop below the lower threshold of 400 M EUAs and thus trigger allowances to be released from the MSR.

ETS would establish policy certainty for market participants and decrease the political burden in member states. One way would be to adjust the MSR intake for decommissioning of coal-fired power plants. This could be implemented by transferring allowances corresponding to the amount of abated emissions due to decommissioned power plants into the MSR.

The amount of allowances to be cancelled could be calculated in different ways.

1. Based on average emissions of the five years prior to the closure of a power plant.
2. Based on average emissions of the five years prior to the closure of a power plant block.
3. Based on generic average emissions per GW installed capacity.
4. Based on modelled net emission reductions.

The first option follows the same approach as currently set out in the directive. Member states would be required to notify the European Commission a decommissioning and the installation's emissions during the five years prior to decommissioning. However, this manner of computing the amount of cancelled allowances would increase the administrative burden for operators of installations and for government bodies, while still facing the restriction that only fully decommissioned installations would enter this calculation. In addition, power plants typically have lower load hours in their last years leading to lower quantities which could be cancelled.

Often power plants which are no longer economical close block by block rather than all blocks at one time. A modified approach could base the amount to be cancelled or transferred to the MSR on the average emissions of the decommissioned block. While emissions are reported only for the entire installation, often including several blocks, operators should be able to separate the amount of fuel that was used to fire the decommissioned block. Alternatively, the share of installed capacity decommissioned in total installed capacity could be used to attribute a share of emissions to the decommissioned block.

A simpler approach, also suitable to partial decommissioning, would be to apply standard factors to calculate emission savings and thus the number of cancelled allowances for each GW of decommissioned capacity. The method could be based on average capacity utilization factors and emission intensity depending on the coal type used. Those average annual emissions are then multiplied by a number of years: either 5 years similarly to the rule currently included in the directive or e.g. the number of years the power plant would have operated till its technical lifetime. This amount would then be cancelled or transferred into the MSR either entirely in one year or spread over several years (e.g. 5). The advantage over the previous approaches is that it is both simpler to administrate and more representative of a typical power plant whereas the approach using average emissions can be influenced by reduced operation prior to the closure. Another advantage is that this calculation does not depend on the emission reports to be surrendered by April of the following year and thus can be implemented quicker, e.g. within 3 months after closure auctioning amounts could already be adapted.

The fourth approach would model the emission reduction in the electricity sector attributable to the closure of a specific plant. This approach is not recommended, because of its complexity and because modelling would need to rely on a set of assumptions that can easily be put into question.

A rough estimate of the amount of allowances that can be cancelled or transferred into the MSR applying a rule-based cancellation policy was carried out for this paper. In the 2015-2019 period the average gross emissions of lignite fired power plants were 5.2 Mt CO_2 / GW and the emissions of hard coal fired power plants were 3.1 Mt CO_2 / GW (based on EUTL data). The difference between the emission factor for lignite and hard coal fired power plants is mainly due to three factors: the emission intensity of the fuel, the efficiency of the plants and the assumed capacity utilization (which is on average higher for lignite fired power plants because of their low operational costs).

Coal fired power plants are currently operated in 19 EU member states (figures based on 'Europe Beyond Coal: European Coal Plant Database, 21 Apr 2020', see Table 3). Emissions from coal fired power plants in the EU 28 amounted to about 600 Mt CO_2 in the year 2018 and 450 Mt CO_2 in the year 2019. In total, 51 GW lignite fired power plants and 89 GW hard coal are still open in January 2020. In the last years substantial closures have happened already: from January 2016 to December 2019 especially hard coal capacities have declined substantially (-24 GW). About half of the retired or fuel switched capacity is located in the UK, but other countries have seen substantial reductions both in absolute and relative terms also. Lignite fired capacities have declined by 7 GW.

Table 3: Installed capacity of coal-fired power plants

	Retired power plant capacity (2016 – 2019)		Operational power plant capacity (Jan. 2020)	
	Lignite [GW]	Hard Coal [GW]	Lignite [GW]	Hard Coal [GW]
Total	7	24	51	89
Austria	0	1	0	0
Belgium	0	1	0	0
Bulgaria	0	0	4	1
Croatia	0	0	0	0
Czech Republic	0	0	9	1
Denmark	0	1	0	2
Finland	0	1	0	2
France	0	0	0	3
Germany	3	6	19	24
Greece	1	0	4	0
Hungary	0	0	1	0
Ireland	0	0	0	1
Italy	0	1	0	9
Netherlands	0	2	0	4
Poland	1	0	8	22
Portugal	0	0	0	2
Romania	1	0	4	1
Slovakia	0	0	0	0
Slovenia	0	0	1	0
Spain	0	1	1	9
Sweden	0	0	0	0
United Kingdom	0	11	0	7

Note: Retired capacities also include fuel switch (e.g. to biomass).

Source: 'Europe Beyond Coal: European Coal Plant Database, 21 Apr 2020'

If capacities retired in the last five years would trigger the rule-based cancellation mechanism, this would add up to about 114 million EUAs per year (lignite and hard coal together) or 570 million EUAs when average yearly emissions are deleted corresponding to a period of five years (see Table 4).

Table 4: Annual amount of allowances available for cancellation in case of closure of coal fired power plants

	Cancellation amount for retired power plant capacity		Cancellation amount for open capacity in countries with national phase out		National phase out date
Fuel	**Lignite**	**Hard Coal**	**Lignite**	**Hard Coal**	**-**
Total	39	75	126	170	
Austria		2			2020
Belgium		2			
Bulgaria					
Croatia		0,4			
Czech Republic	2	0,7			
Denmark		4		7	2030
Finland		2		6	2029
France				10	2022
Germany	17	19	99	76	2038
Greece	6		20		2028
Hungary			5	0,8	2030
Ireland				3	2025
Italy		3		27	2025
Netherlands		6		14	2029
Poland	6	0,7			
Portugal				6	2030
Romania	5				
Slovakia		0,2	2	1	2023
Slovenia	2				
Spain		3			
Sweden					
United Kingdom		34		21	2024

Note: The following emission factors based on average 2015-2019 averages were used: 5.2 M t CO_2- / GW for lignite power plants and 3.1 M t CO_2 / GW for hard coal power plants.

Source: 'Europe Beyond Coal: European Coal Plant Database, 21 Apr 2020', own calculation.

For countries with coal phase-out policies we have adapted the same approach for capacities currently still in operation. Total lignite capacities add up to 39 GW emitting 126 Mt CO_2 per year based on average emissions of lignite fired power plants in the years 2015-2019. Hard coal capacities add up to 75 GW, representing 170 Mt CO_2. If allowances corresponding to five years of emissions were cancelled this would add up to 1 480 million EUAs. The amount that could be cancelled within the trading period up to 2030 is lower, as only part of those installations are expected to close before 2025 and therefore part of this cancellation is expected to reach into the following ETS trading period.

6 Sensitivity analysis of the MSR under a 65% ETS target

Key findings

- When the cap is tightened to reflect stepped up EU climate ambition, MSR reform is still necessary. Current MSR rules are not able to substantially reduce the TNAC before 2030 even in an ETS with a 65% reduction target. This is because we assume the cap to be adjusted in the second half of the trading period without rebasing; this adjustment of the supply is too small to create scarcity by itself in a scenario where emissions decline in line with the Commission's Climate Target Plan. A more stringent cap reduction with rebasing and / or starting earlier would reduce the role of the MSR in eliminating structural imbalances.

- With the proportional intake rate and an emission scenario that reaches a 65% reduction in 2030 in line with the cap, the TNAC remains around the thresholds both if the thresholds are kept constant or decline in line with the cap.

- In an emission scenario which does not meet the 65% reduction target, the TNAC declines to below 100 million allowances. This would trigger higher emission reductions or operators would be unable to comply with their obligations.

The assessments and recommendations above were all based on the current ETS framework, both for the MSR but also for the cap until 2030. With the political agreement to increase the EU's ambition to at least 55% below 1990 levels, emissions in the ETS will need to decrease much faster as well: in its Impact Assessment, the Commission modeled a 65% reduction of emissions from stationary sources in the ETS by 2030 (European Commission (EC) 2020c). This section analyses the performance of the MSR against the backdrop of a substantially lower supply of allowances. Under such conditions the MSR should contribute to removing the historic surplus, ensure that no new structural surplus builds up, but not restrict the market unduly if it is tight.

For this sensitivity assessment we use a cap in line with a 65% reduction in the ETS by 2030 and analyse the effects for two scenarios:

- a 65% emission reduction scenario where emissions decrease in line with the cap and
- the low emissions scenario plus Covid-19 in which emissions do not meet the 65% reduction target in 2030.

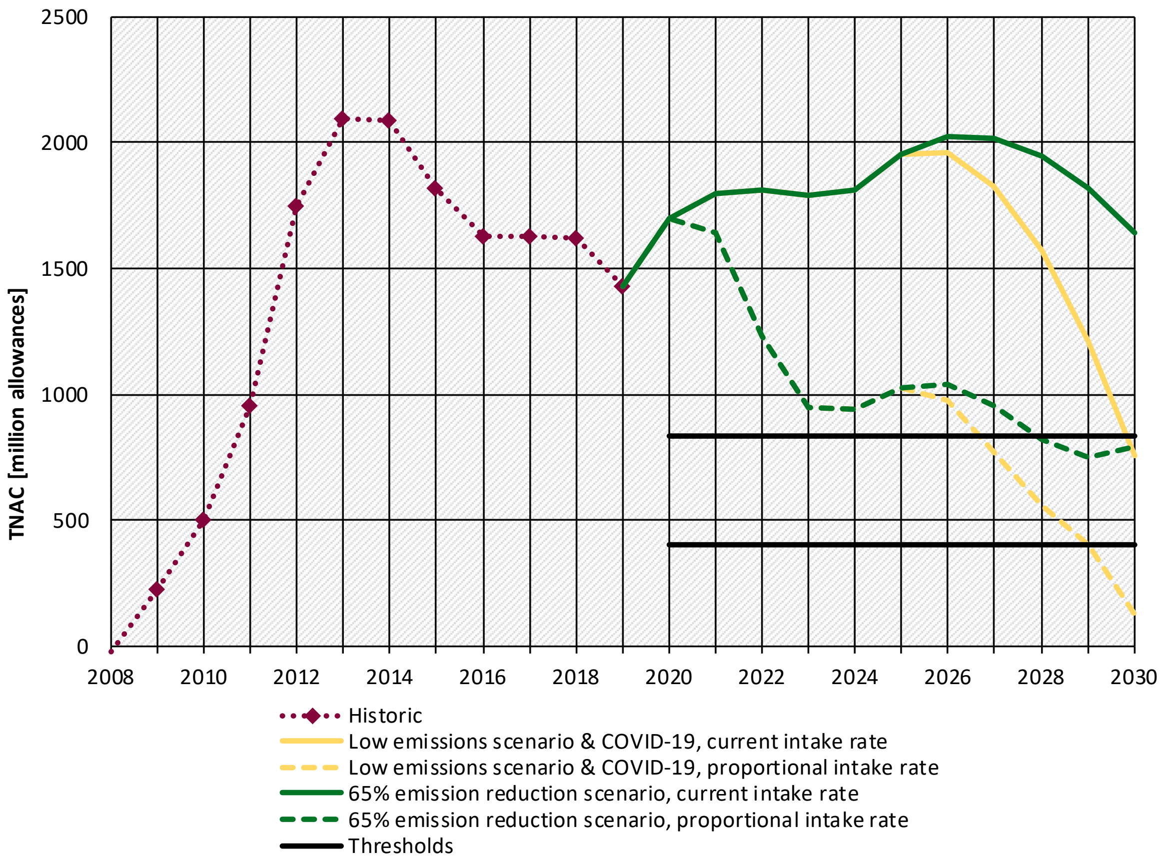
The underlying emission trajectories are discussed in Section 3 (Figure 2). Note that emissions in the 65% emission reduction scenario are lower from 2025 onwards than in the low emissions scenario plus Covid-19. Furthermore, in the latter scenario emissions are higher than the 65% cap in the last years of the decade.

Even under the 65% reduction cap there is a significant increase in the TNAC under the current rules for the MSR (Figure 12). The reason for this is that the cap is assumed to remain unchanged until 2025 due to the necessary time to agree on the ETS reform and implement the changes.

In a scenario where emissions do not decrease as fast as the cap (the low emissions plus Covid-19 scenario), the relatively high emission level (compared to the 65% reduction scenario) together with the MSR intake reduces the TNAC sharply towards the end of the trading period. This sharp decline starts earlier if the proportional intake rate is used. In fact, if the proportional intake rate is applied, the TNAC declines continuously after 2025 and would reach zero shortly after 2030.[12] This reflects the fact that the assumed emission pathway is not compatible with the cap.

In the scenario where emissions reduce in line with the cap (65% reduction until 2030), the TNAC remains above 1 600 million allowances in all years if the current intake rule is applied. If the proportional intake rate is applied, the TNAC drops already shortly after the Covid-19 impact on emissions begins to cease, i.e. from 2021/22 onwards. It then remains at around 1 000 million allowances from 2023 until 2027 and then drops just below the upper threshold.

Figure 12: TNAC development under current and proportional intake rates (enhanced cap)

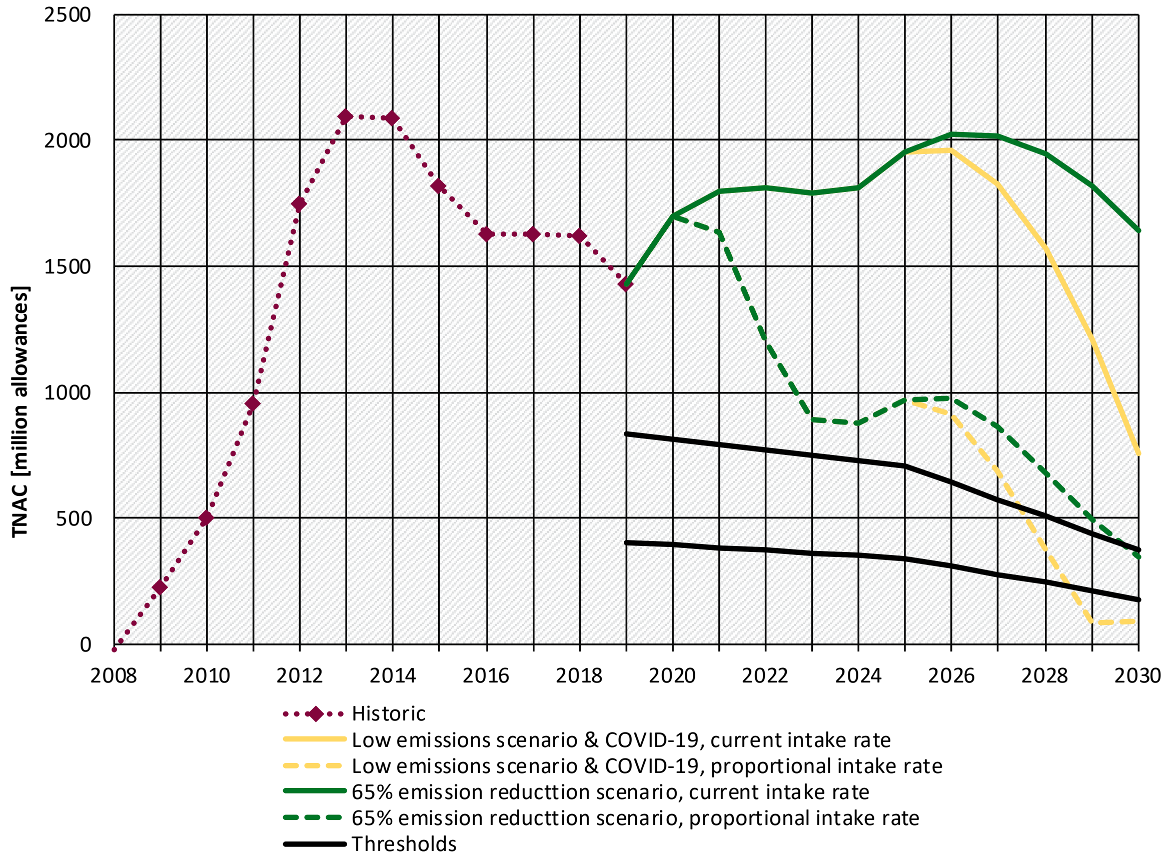


Source: Own calculations.

In Figure 13 the thresholds are changed to decrease in line with the cap. Similar to the situation with unchanged thresholds depicted in Figure 12 the current parametrization of the intake rate is not able to contain the TNAC, while the proportional intake rate achieves the containment. In the low emissions scenario, the TNAC increases again in 2030. This is because the MSR releases allowances into the market for the first time in that year, i.e. stabilizing the market in the case of insufficient liquidity.

[12] The MSR calculator is a static model with no feedback between TNAC and demand for allowances. In practice, allowance prices would increase in such a case which would lead to higher mitigation. As a result, TNAC would not decrease as much as depicted here.

Figure 13: TNAC development under current and recommended parameters incl. threshold adjustments (enhanced cap)



Source: Own calculations.

7 Conclusions

7.1 Recommendations for the MSR

The analysis in this paper shows that MSR reform should be a priority on the policy agenda, as the MSR as currently constructed is not able to fulfil its intended role of stabilizing the allowance market in this decade. This remains true also if the cap is adjusted to reflect higher EU climate ambition. As the current Covid-19 crisis shows, the MSR is – in its current configuration - not robust to unanticipated crises: The strong decrease in emissions due to Covid-19 is projected to lead to a structural surplus in the allowances market for several years. Under current MSR parameters and in a policy environment leading to emissions lower than anticipated when setting the cap for fourth trading period, the MSR is unable to absorb the allowance surplus and balance the market. In this paper, we therefore discuss and analyse the parameters with the greatest impact on the functioning of the MSR, taking the current configuration of the overall EU ETS as a given. However, as MSR parameters interact with other features of the EU ETS, discussions on MSR reform should be coordinated with discussions on structural reform of other areas of the EU ETS, especially adjusting the cap to align the EU ETS with a higher 2030 GHG emission reduction target. We also stress that the MSR is not designed to enhance the cap and should therefore not be viewed as a substitute for raising ambition through cap adjustment. Instead, the MSR should be viewed as a no-lose option focused on market stabilization which is ideally never triggered.

Our analysis shows that the MSR intake rate is the key parameter in terms of MSR performance as measured by the size of the surplus. Changing the intake rule has the greatest impact on the functioning of the MSR. **We propose a proportional intake rule multiplying the original intake rate of 12% while putting the current TNAC in relation to the lower TNAC threshold**. I.e., the further away the TNAC is from the lower threshold, the larger is the MSR intake, and vice versa. The proportional intake rate is effective at keeping the TNAC in check during Phase IV under all scenarios we consider, including a low emissions scenario with 2030 emissions below the current 2030 ETS cap level but closer to the current emission path, combined with the demand shock due to Covid-19.

We propose combining the proportional MSR intake rule with a redefinition of the TNAC thresholds, defining them as fixed shares of the cap. Defining TNAC thresholds in terms of the cap better reflects evolving liquidity needs by market participants over time. It also automatically accounts for changes in the cap due to changes in ETS scope (cf. Brexit) or ambition. We further propose to keep the definition of the TNAC limited to stationary sectors and not include net demand from aviation in its calculation, as this would decrease the environmental effectiveness.

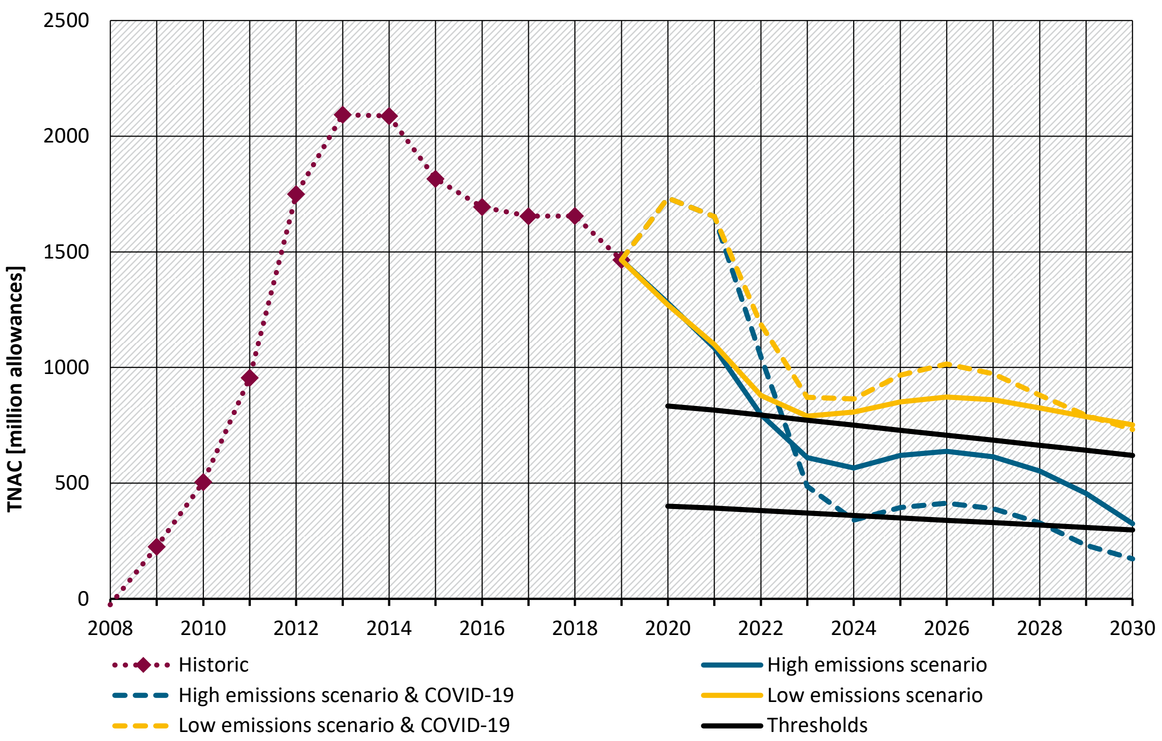
The relative importance of changing the thresholds and the intake rate depends on the market situation: in conditions of oversupply the intake rate has the strongest impact on the functioning of the MSR, in conditions of scarcity the thresholds become more important.

We identify the reaction speed of the MSR as another reform dimension. We conclude that the reaction speed can be increased by compressing the auction calendar. However, speed gains from changes to the auction calendar are limited. The most direct option to increase the MSR's reaction speed is to introduce a floor price for allowance auctions, with unauctioned allowances being transferred to the MSR immediately. A price floor, if set at a sufficiently high level, would have the advantage of increasing the MSR's reaction speed and of increasing policy certainty and therefore providing stable investment incentives for market participants. To avoid a progressive loss in relevance the price floor should increase over time. However, a price floor introduced in addition to the MSR's quantity triggers would also further increase the complexity of the EU ETS and potentially make it more difficult to predict MSR behavior and the development of TNAC. It is also unclear on what metric the derivation of an adequate floor price should be based. Without a detailed impact assessment of different price options, this paper cannot make a clear recommendation regarding the introduction of an additional price trigger to the MSR. We therefore view the introduction of a price trigger as a possible topic of consideration for future revisions of the MSR, as opposed to an immediate reform option.

We also note that the definition of invalidation rules should be considered in discussions about MSR reform. Automatic invalidation, e.g. based on vintages, can be a good option to account for structural changes in allowance demand and avoid past allowance surpluses from being rolled over to future trading periods. As this mechanism would only operate if the TNAC remains within its corridor for several years, it is unlikely to have a great impact on the total number of invalidated allowances.

Figure 14 shows the development of the TNAC during Phase IV under our recommended configuration of MSR parameters: the proportional intake rate, defining TNAC limits by holding constant their 2019 share of the cap (without including aviation in the calculation of the TNAC), and compressing the auction calendar to the period September of year x to April of year x+1. In this configuration the MSR is able to keep the TNAC in check during the entire fourth trading period in all four scenarios we analyze. Importantly, it is the only configuration able to contain the TNAC surplus in the current cap & low emissions plus Covid-19 scenario, with the proportional intake rate playing the decisive role.

Figure 14: TNAC development under recommended MSR parameters and current ETS cap



Notes: For this graph the proportional intake rate has been applied. The thresholds decline in parallel with the cap (the relationship cap/threshold in 2019 is applied until 2030).
Source: Own calculations.

As shown in Section 6, these proposed changes can also be applied in a scenario with a 65% reduction target for EU ETS, where the cap decreases sharply after 2025. The initial build-up of the TNAC until 2025 is so large that only a proportional intake rate is able to bring the number of allowances in circulation close to the threshold. Adjusting the supply of allowances through rebasing or an earlier cap adjustment could reduce the role of the MSR in eliminating structural imbalances.

We assess the interactions with the **aviation sector** as covered by the EU ETS: a net buyer of allowances. Under current rules, its demand is not taken into account when the TNAC is calculated. We conclude that if aviation demand would be taken into account when calculating the TNAC, the TNAC value would decline and thus the ability of the MSR to reduce the surplus would be dampened and its effectiveness would be diminished. The aim of the MSR is to reduce the historic oversupply in the stationary sector and to stabilize the market in case of external shocks. Since a change in the TNAC definition would make it harder to achieve these aims, we recommend to not alter this parameter. In addition to its CO_2-emissions, aviation drives climate change through non-CO_2 impacts not accounted for under the EU ETS. Therefore, one ton saved in the stationary sector is not equal to an additional ton emitted in the aviation sector. Excluding aviation from the TNAC definition somewhat compensates for this false equivalency.

7.2 Rule-based voluntary cancellation

Our analysis shows that voluntary cancellations are an option to complement the MSR and should be developed further to increase their effectiveness. We recommend introducing a simple EU-wide rule-based cancellation policy. Cancellations would be based on generic average emissions per GW of installed capacity by applying standard factors to calculate emission savings and thus the number of cancelled allowances for each GW of decommissioned capacity. Those average annual emissions are then multiplied by a number of years: either 5 similarly to the rule currently included in article 12 of the ETS Directive or, e.g., the number of years the power plant would have operated until the end of its technical lifetime. Allowances could either be cancelled directly or transferred into the MSR.

While there are a number of options for cancellation rules that would be preferable compared to the current situation, we recommend focusing on simple rules that can be applied uniformly throughout the EU in order to limit administrative burden and uncertainty for market participants.

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A Annex

A.1 Key MSR parameters

Table 5: Key MSR parameters under different options to enhance the effectiveness of the MSR in all emission scenarios (current ETS regulation)

		Different intake rates					Different intake rates & faster intake					Different intake rates & scaling of thresholds				
		Current rules	24% until 2030	Steps 24% - 36%	Proportional to TNAC	Capped at upper threshold	Current rules	24% until 2030	Steps 24% - 36%	Proportional to TNAC	Capped at upper threshold	Current rules	24% until 2030	Steps 24% - 36%	Proportional to TNAC	Capped at upper threshold
High emissions	TNAC (2030)	459	355	355	344	463	492	389	389	392	483	287	183	183	325	298
	MSR (2030)	777	748	748	684	777	777	777	777	752	777	774	741	741	764	755
	Invalidation (2023-2030)	-2.372	-2.507	-2.507	-2.581	-2.369	-2.376	-2.480	-2.480	-2.502	-2.386	-2.585	-2.722	-2.722	-2.556	-2.593
High emissions & Covid-19	TNAC (2030)	425	270	394	276	275	463	320	457	344	476	260	173	205	173	180
	MSR (2030)	730	598	726	422	489	748	630	755	601	605	739	697	732	416	463
	Invalidation (2023-2030)	-3.287	-3.574	-3.322	-3.744	-3.678	-3.268	-3.529	-3.267	-3.533	-3.398	-3.480	-3.609	-3.541	-3.889	-3.835
Low emissions	TNAC (2030)	1.621	1.004	1.004	853	1.068	1.619	1.004	1.004	874	1.061	1.625	1.005	1.005	752	854
	MSR (2030)	786	774	774	745	762	785	774	774	769	780	786	774	774	763	756
	Invalidation (2023-2030)	-3.267	-3.897	-3.897	-4.076	-3.845	-3.307	-3.933	-3.933	-4.068	-3.871	-3.300	-3.933	-3.933	-4.197	-4.102
Low emissions & Covid-19	TNAC (2030)	2.111	1.195	961	864	1.029	2.111	1.205	997	878	1.053	2.115	1.196	1.101	732	815
	MSR (2030)	779	754	817	738	667	778	755	679	747	750	779	753	773	725	660
	Invalidation (2023-2030)	-4.241	-5.182	-5.354	-5.529	-5.436	-4.278	-5.209	-5.492	-5.543	-5.365	-4.274	-5.218	-5.294	-5.712	-5.693

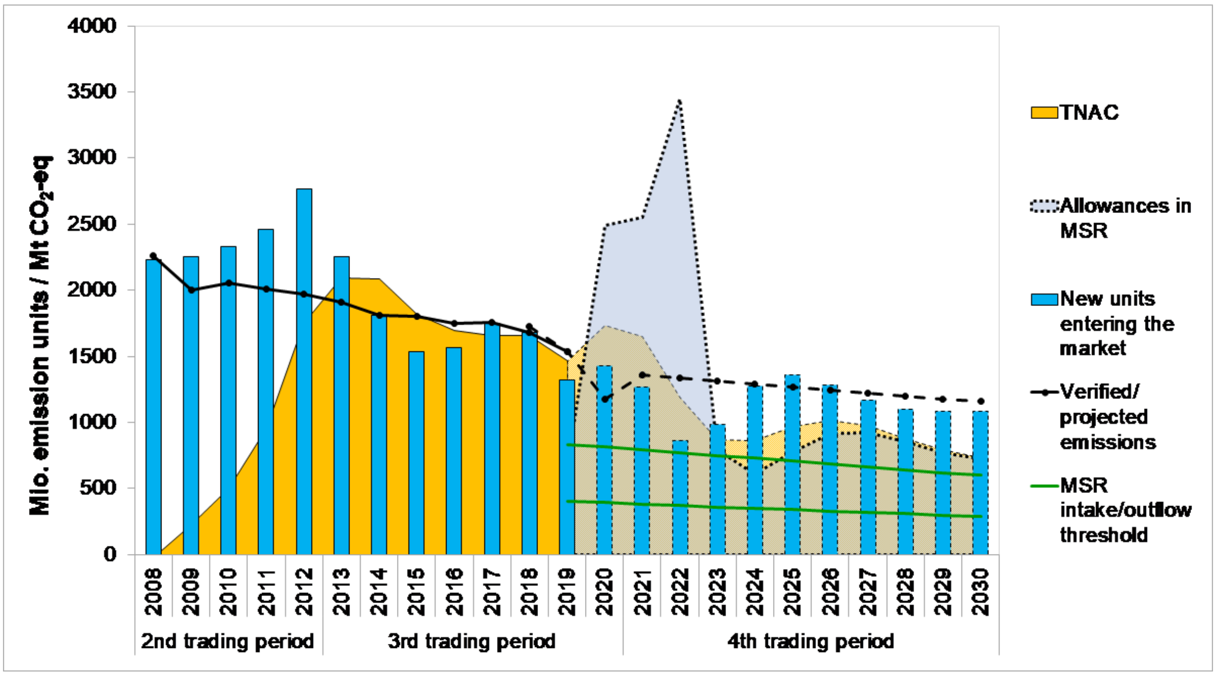
Source: Own calculations

A.2 Configuration of the MSR Tool

The reaction of the MSR is modelled throughout the paper based on the MSR tool developed by Öko-Institut. It is based on historic data up to 2019, from 2020 onwards results are modelled (see Figure 15). Historic emissions (shown as black line) as well as units entering the market (blue bars) are based on information from the EEA EU ETS data viewer and include an estimate for the change in scope to make time series comparable. Units entering the market are the sum of allowances allocated for free, auctioned or sold and international credits used/exchanged.

In the years 2009 to 2013 the number of allowances entering the market surpasses the verified emissions and thus the TNAC shown in orange increases as the surplus in the market builds up. In the following years of the third trading period new allowances entering the market are equal or below verified emissions leading to a decrease of the TNAC.

Figure 15: MSR tool – example graph



Source: Original graph from MSR-tool by Öko-Institut.

The projected results in forthcoming years depend on a number of variables that can be altered in the tool. These include:

- the cap and projected emissions,
- MSR parameters such as the intake and outflow rates, thresholds, the definition of the TNAC, invalidation rules and amounts, the reaction speed of the MSR and voluntarily cancelled amounts.

Based on these inputs, the MSR tool can calculate the expected number of allowances in the MSR, the development of the TNAC and the amount of invalidated allowances. In the scenario shown above, the number of allowances in the MSR increases steeply in 2020 when the MSR is filled with backloaded amounts and unallocated allowances. It increases further till 2023 when for the first time any allowances in the MSR surpassing the auctioning amounts of the previous year are invalidated. This development is mirrored by the TNAC development: after an increase towards the end of trading period III and beginning of trading period IV which are caused inter alia by the dip in emissions due to Covid-19 and additional allowances entering the market towards end of the period (such as unallocated allowances reserved for measures under Article 10c) the MSR shows its effect and reduces the TNAC substantially. From 2024 onwards, emissions and verified emissions are of comparable magnitude in the shown scenario. In some years, the new supply surpasses the emissions, in other years emissions are higher than the amount of new allowances entering the market. Both TNAC and the number of allowances in the MSR are therefore following a curvy slope between 500 and 1000 M EUAs.