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To:	Mr Jeppe TRANHOLM-MIKKELSEN, Secretary-General of the Council of the European Union
No. Cion doc.:	SWD(2021) 601 final - part 3
Subject:	COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT REPORT Accompanying the document DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757

Delegations will find attached document SWD(2021) 601 final - part 3.

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EUROPEAN
COMMISSION

Brussels, 14.7.2021
SWD(2021) 601 final

PART 3/4

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Accompanying the document

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757

{COM(2021) 551 final} - {SEC(2021) 551 final} - {SWD(2021) 557 final} - {SWD(2021) 602 final}

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19 REQUIREMENTS OF THE LEGAL REVIEW CLAUSE

When the European co-legislators introduced the MSR into the EU ETS in 2015, they introduced an obligation into Article 3 of the MSR Decision for the Commission to conduct a review of the reserve within three years of its start of operation (i.e. by the end of 2021)[1] and at five-year intervals thereafter, on the basis of an analysis of the orderly functioning of the European carbon market: paying particular attention to the percentage figure for the MSR feed, the numerical value of the threshold, and the number of allowances to be released from the reserve; looking also into the impact of the reserve on growth, jobs, the Union's industrial competitiveness and on the risk of carbon leakage.

Another aspect to be considered in the review was introduced in 2018, namely concerning the invalidation mechanism set out in Article 1(5a) of the MSR Decision[2].

Article 3 of the MSR Decision requires the Commission to submit, where appropriate, a legislative proposal to the EP and Council.

In what follows, the results of this review are presented, in two sections: (i) an analysis of whether the MSR has reduced the historical surplus, and (ii) an analysis of whether the MSR has improved market resilience. The results are based on a study conducted by Vivid Economics to support the European Commission in the review of the Market Stability Reserve (MSR) of the EU ETS ("the Vivid study")[3].

The study concluded that taking into account all sources of net demand in the calculation of the TNAC and in the threshold-setting would improve the impact of the measure on market resilience. Future changes to the MSR should try to minimise regulatory complexity to the extent possible while maintaining market balance.

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[1] Article 3: "*The Commission shall monitor the functioning of the reserve in the context of the report provided for in Article 10(5) of Directive 2003/87/EC. That report should consider relevant effects on competitiveness, in particular in the industrial sector, including in relation to GDP, employment and investment indicators. Within three years of the start of the operation of the reserve and at five-year intervals thereafter, the Commission shall, on the basis of an analysis of the orderly functioning of the European carbon market, review the reserve and submit a proposal, where appropriate, to the European Parliament and to the Council. Each review shall pay particular attention to the percentage figure for the determination of the number of allowances to be placed in the reserve pursuant to Article 1(5) of this Decision, as well as the numerical value of the threshold for the total number of allowances in circulation and the number of allowances to be released from the reserve pursuant to Article 1(6) or (7) of this Decision. In its review, the Commission shall also look into the impact of the reserve on growth, jobs, the Union's industrial competitiveness and on the risk of carbon leakage*."

[2] See in this regard Article 2 of Directive (EU) 2018/410 amending article 1 of the MSR decision, by adding a new paragraph 5a: "*Unless otherwise decided in the first review carried out in accordance with Article 3, from*

[3] Vivid Economics (2021) – « The Review of the EU ETS Market Stability Reserve », unpublished.

20 MSR AND THE HISTORICAL SURPLUS

20.1 The Total Number of Allowances in Circulation (TNAC)

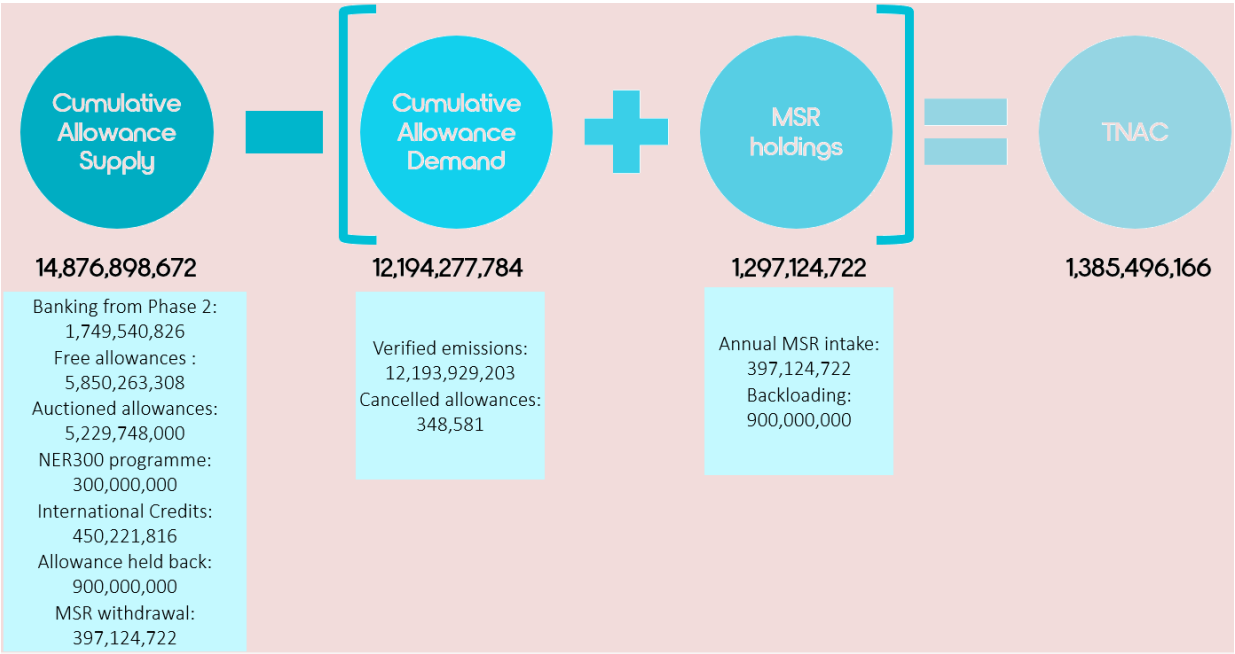
The EU ETS cap defines the number of allowances that are made available to market participants, where allowances that are not used can be banked for future use. Regulated entities as well as non-compliance market participants may bank allowances between years and trading periods without constraint. Therefore, allowances accumulate in holding accounts when they are not needed for compliance.

Credits from international projects are incremental to those distributed under the cap. Certified Emission Reductions (CERs) from the Clean Development Mechanism (CDM) and Emission Reduction Units (ERUs) from Joint Implementation (JI) that are issued under the Kyoto Protocol can be used for compliance up to a predefined limit. In Phase 2, these could be used directly for compliance, whereas in Phase 3 these credits had to be exchanged for EU allowances. These allowances cannot be used for compliance under Phase 4 of the EU ETS.

The Total Number of Allowances in Circulation (TNAC) estimates the cumulative amount of banking by market participants. The TNAC captures the total supply of allowances issued in accordance with the cap that have not been used for compliance, voluntarily cancelled, or otherwise made unavailable to market participants. The TNAC also includes allowance supply from international credits. Since 2017, the TNAC is calculated and published each year by the European Commission.

Each May, the TNAC from the previous calendar year is calculated and published by the EU Commission. The TNAC publications include data on underlying supply and demand components as recorded on 1 April. As an example, Figure 26 depicts an example of the 2019 TNAC, published in May 2020.

Figure 26: 2019 TNAC Calculations



MSR adjustments are based on 24% of the TNAC (12% post-2023) when it exceeds the pre-defined thresholds of 833 million allowances. When the TNAC is shown to exceed the upper threshold, auction volumes are reduced from 1 September of the current year to 31 August of the following year. These allowances are placed in the MSR. When the TNAC falls short of a 400 million allowance threshold, auction volumes are increased by 100 million in the same year of the TNAC publication by injecting allowances held in the MSR.

The TNAC is an important indicator of a surplus or deficit of allowances in the market, and therefore provides an indication of market balance and allowance prices. The TNAC is a quantity-based indicator to of allowance scarcity. A large or growing TNAC is an indicator of a lack of scarcity in the short-term, which may be associated with low market prices and therefore insufficient incentives to abate emissions. Likewise, a very low TNAC is an indicator that there is not sufficient supply in the market, including enough available allowances to optimise low-carbon investment strategies across time periods. This may be associated with high allowance prices and volatility.

The historical build-up of the TNAC led to market imbalances and very low prices in Phase 2 and Phase 3 of the EU ETS, motivating the introduction of measures to address this imbalance, including the MSR. The historical evolution of the TNAC is described in the following section, along with a description of how the market imbalance was addressed through policy interventions and the introduction of the MSR.

20.2 The historical surplus

The TNAC is an indicator of a surplus or deficit of allowances in the market, and therefore provides an indication of market balance and allowance scarcity. A large or growing TNAC is an indicator of a lack of scarcity in the short-term, which may be associated with low market prices and therefore insufficient incentives to abate emissions. Likewise, a very low TNAC is an indicator that there may not sufficient supply in the market, including enough available allowances to optimise low-carbon investment strategies across time periods.

There was a historical build-up of the TNAC, that led to market imbalances in Phase 2 and Phase 3 of the EU ETS, motivating the introduction of measures to address this imbalance, including the MSR.

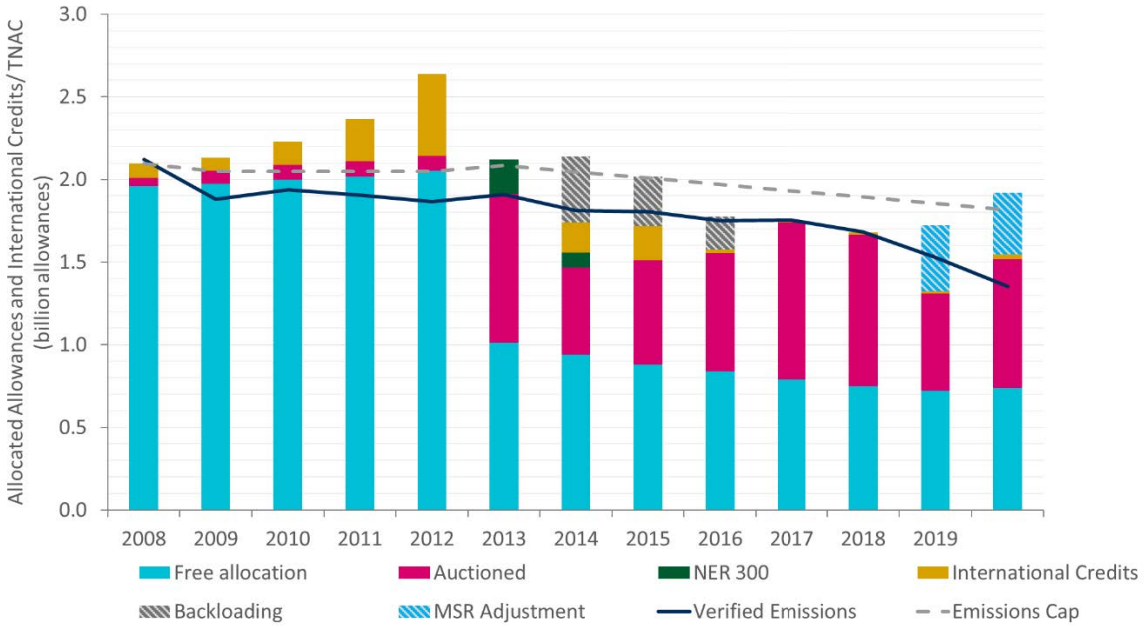
In Phase 2 of the EU ETS (2008 to 2012) the number of allowances that were put into circulation exceeded demand, leading to a buildup of 1.75 billion unused allowances in the system. Total supply of allowances exceeded demand in every year except 2008. The volume of allowances allocated for free or auctioned exceeded verified GHG emissions each year post 2008. This supply-demand imbalance resulted in the initial build-up of the TNAC over the period.

Market participants were able to carryover these unused allowances into Phase 3, adding supply equivalent to 11% of the cumulative cap over Phase 3.

In Phase 3, actual GHG emissions were lower than anticipated when the cap was set. This low underlying demand would likely have resulted in the continued growth of the TNAC in the absence of market intervention. The allowance surplus was further exacerbated by delivery of allowances under the NER300 program and continued use of international credits.

The growing TNAC at the beginning of Phase 3 also lead to the price of EU allowances fell to lows of €4.46/t and €6.00/t in 2013 and 2014 respectively.[4] These low prices would have provided very little incentive to regulated entities to reduce emissions or invest in low-carbon technologies. Given these structural market imbalances could not be dealt with by the market itself within a reasonable timeframe, the European Commission approved the backloading of 900 million allowances and subsequently the introduction of the MSR as a long-term solution[5].

Figure 27: TNAC composition Phase 2 and 3



Source: Vivid Economics based on European Union Transaction Log

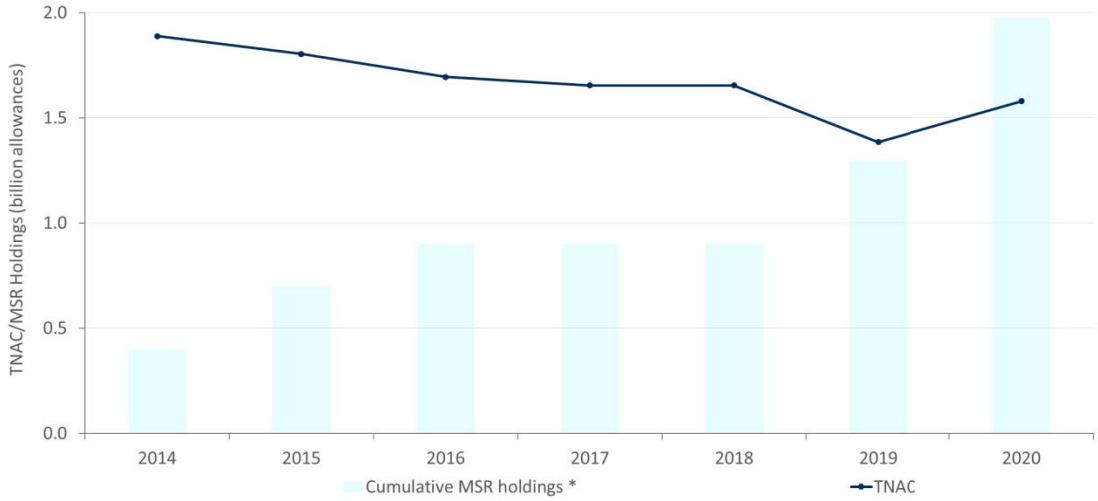
Other policy changes helped reduce the TNAC over Phase 3. These included the removal of unallocated allowances from the New Entrants Reserve and allowance adjustments from installations that had closed or reduced their production or production capacity (compared to the ones initially used to calculate Phase 3 allowance distribution). Estimates put these unallocated allowances at 550 to 700 million allowances through 2020[6]. Restrictions on international credit entitlements also significantly constrained allowance supply. The TNAC was further reduced by voluntary cancellation of allowances, totalling 441 393 allowances from 2013 to 2020.

[4] https://ember-climate.org/data/carbon-price-viewer/
[5] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0018&from=EN
[6] https://ec.europa.eu/clima/policies/ets/reform_en

20.3 The introduction of the Market Stability Reserve (MSR)

The MSR was introduced as a permanent rules-based approach to addressing market imbalances. The MSR was introduced in 2015, amended in 2018 and became operational in 2019[7]. The MSR was chosen over other policy options since it could both resolve the historical allowance surplus as well as automatically respond in the event of future supply-demand imbalances.

Figure 28: Recent evolution of the TNAC



Note: the 2020 MSR holdings include the unallocated allowances from Article 10a(7) of the ETS Directive. The unallocated allowances from Articles 10a(19) and 10a(20) of the ETS Directive were not available at the time of the publication of this document.[8]

Source: Vivid Economics based on European Union Transaction Log

20.4 The impact of the MSR on the historical surplus

The MSR has begun to address historical imbalances with its first two years of operation leading to intakes of nearly 700 million allowances. This includes an adjustment of 397 million allowances withdrawn from auction volumes over 2019-20, and over 300 million allowances to be withdrawn from auction volumes over 2020-21, representing 24% of the previous year's published TNAC in each case. These adjustments alongside others such as backloading reduced the 2019 TNAC to 1 385 million allowances, or 29% below its high in 2013. In 2020, reduced emissions due

[7] Decision (EU) 2015/1814 of the European Parliament and of the Council of 6 October 2015 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC, OJ L 264, 9.10.2015, p. 1. See: https://eur-lex.europa.eu/legal-content/EN/TXT/?toc=OJ:L:2015:264:TOC&uri=uriserv:OJ.L_.2015.264.01.0001.01.ENG

[8] See C(2021) 3266 final - Communication from the Commission - Publication of the total number of allowances in circulation in 2020 for the purposes of the Market Stability Reserve under the EU Emissions Trading System established by Directive 2003/87/EC.

to COVID 19 resulted in an increase of the TNAC to 1 579 million allowances. This will result in a higher MSR intake over the period 2021-2022 of 379 million allowances.

Intakes to the MSR are expected to continue reducing auction supply in coming years, with the TNAC remaining well above the upper threshold, and the COVID-19 pandemic reducing demand. With a depressed demand for allowances, the TNAC would grow in the absence of MSR adjustments. As such, the MSR will continue to address the historical surplus built up over Phase 2 and 3 while simultaneously responding to the impact of the demand shock stemming from the COVID-19 pandemic. According to the Vivid study, **in a scenario where GHG emissions fall by 155 $MtCO_2e$ in 2020, but then rebound to market balance by 2023, the TNAC would be expected to fall below the upper MSR threshold of 833 million allowances in 2023**.[9] **In the absence of the COVID-19 pandemic, the TNAC may have reached this outcome in 2022.** With a counterfactual intake rate of 12% addressing this imbalance is likely to have taken a substantially longer period of time.

According to the Vivid study, the MSR and backloading measures may also have played an indirect role in relation to EU allowance prices and helped restore historical prices from all-time lows. However, the increase in the allowance price from historical lows cannot be fully attributed to the MSR and may also be due to the broader strengthening of the EU ETS in 2018, and expectations for future ETS adjustments[10] [11].

[9] The 155 $MtCO_2e$ drop in emissions is based on analysis using the PRIMES energy system model, estimating the impact of COVID on GHG emissions. Emissions pathways are fictional and static in the sense that they do not incorporate price effects in this analysis. The PRIMES model has also been used in the 2030 EC Impact Assessment https://eur-lex.europa.eu/resource.html?uri=cellar:749e04bb-f8c5-11ea-991b-01aa75ed71a1.0001.02/DOC_2&format=PDF

[10] https://ercst.org/background-note-the-eu-ets-market-stability-reserve-coping-with-covid-19-and-preparing-for-the-review/

[11] https://www.eionet.europa.eu/etcs/etc-cme/products/etc-cme-reports/etc-cme-report-3-2019-trends-and-projections-in-the-eu-ets-in-2019

Figure 29: Allowance price evolution compared to the TNAC

Note: EUA Prices (€) (LHS); TNAC (billion allowances) (RHS)

Source: Vivid Economics based on European Union Transaction Log, EEX/ICAP

20.5 Net demand from other sources

The TNAC as currently defined does not include aviation demand or supply, nor net demand from linked Emission Trading Systems.

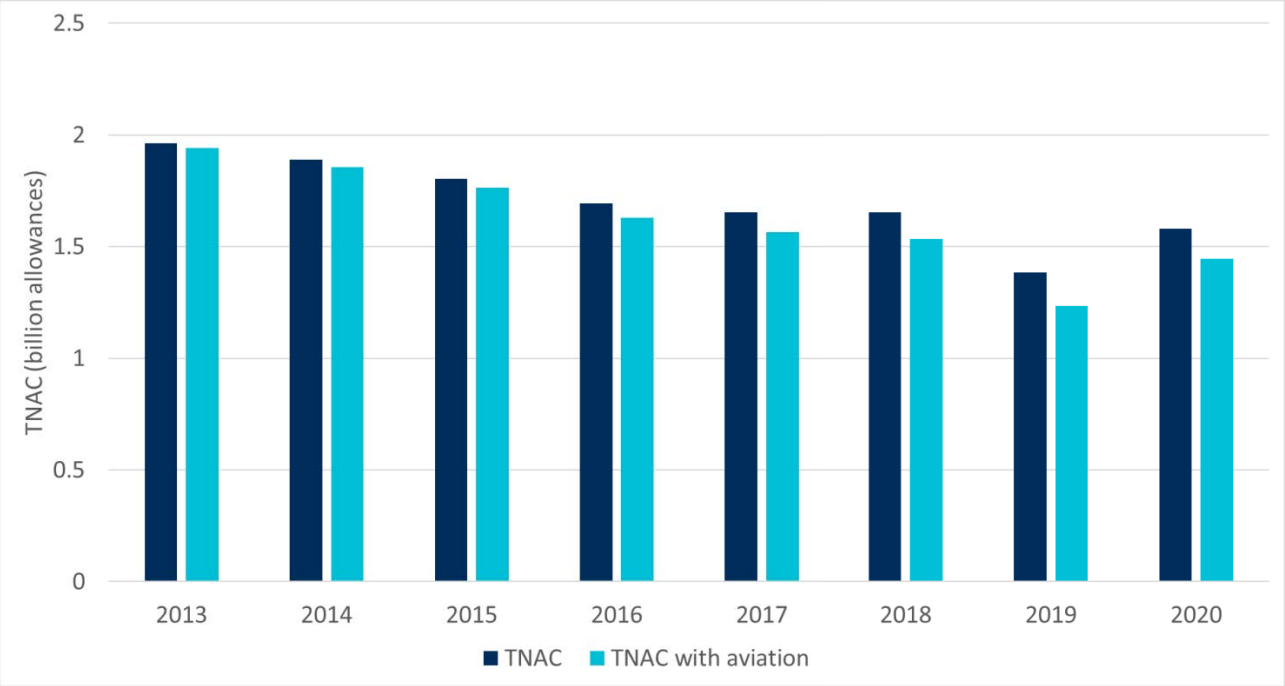
20.5.1 Aviation

According to the Vivid Economics study, the inclusion of aviation would have reduced the TNAC in each year of Phase 3, impacting MSR adjustments (Error! Reference source not found.**).** When included in calculations, net aviation demand reduces the TNAC, resulting in lower total allowances in circulation than recorded at present. Thus far, this impact has been limited with the largest difference occurring in 2019 when net aviation demand was the highest at approximately 151 million cumulative allowances. The corrected MSR adjustment would result in an intake of 303 million allowances in 2020 which is 8.8% lower than the MSR adjustment made without aviation.

With the forecasted growth in aviation emissions, there is a strong case for the inclusion of net demand from aviation in TNAC calculations going forward. Aviation emissions in 2020 were

significantly lower due to COVID-19, which may limit aviation's demand for EU allowances, but demand is projected to grow thereafter[12].

Figure 30: The TNAC with and without net aviation demand



Source: Vivid Economics based on European Union Transaction Log

20.5.2 The Swiss ETS

The Swiss ETS linked with the EU ETS on January 1st, 2020 after a 10-year process of negotiations. The Swiss ETS covered about 10% of the country's total GHG emissions in 2019, or 4.72 $MtCO_2e$ (2017 data)[13]. EU and Swiss operators can surrender allowances from either system to meet their emissions liabilities[14].

Allowances allocated under the Switzerland's ETS are available for market participants and will form part of the TNAC publication starting in May 2020[15]. Since allowances are fully fungible between the two systems, allowances auctioned or allocated for free under the Switzerland system will need to be treated the same as EUAs for the purpose of calculating the TNAC. These figures should be included in subsequent TNAC calculations.

Likewise, verified emissions from Switzerland's covered entities will represent demand for allowances and may need to be included in future TNAC calculations.

[12] https://www.eurocontrol.int/sites/default/files/2020-04/eurocontrol-aviation-recovery-factsheet-27042020.pdf
[13] https://icapcarbonaction.com/en/?option=com_etsmap&task=export&format=pdf&layout=list&systems%5B%5D=64
[14] https://ec.europa.eu/clima/sites/clima/files/ets/markets/docs/faq_linking_agreement_part2_en.pdf
[15] https://ec.europa.eu/clima/sites/clima/files/ets/markets/docs/faq_linking_agreement_part2_en.pdf

20.5.3 Market behaviour

The Vivid study also looked at changes in market behaviours related to the introduction of the MSR, and whether the evolution of market behaviours would have an impact on the levels of the MSR thresholds. The MSR's upper and lower thresholds (currently 400 and 833 million allowances respectively) represent a range of estimates of the required efficient level of hedging demand, however emerging sources of additional demand other than utility hedging could require changes to threshold levels, especially if those changes result in higher overall holdings.

- **Utilities have actively managed their carbon exposure in some markets by hedging.** There is some evidence that larger industrials, especially in the oil and gas industry, also hedge to some extent, but it is less common overall compared to utilities. Many large utilities companies have increased their hedging timeframes in recent years due to concern over rising carbon prices, such as RWE, who have hedged some proportion of their liabilities as far out as 2030[16].
- **The Vivid Economics study found that hedging demand from utilities is likely to fall due to high EU allowance prices triggering increased abatement and the coal phase-out.** Below a price of €30, EU allowance pricing did not have a significant impact on business decisions by utilities. However, if price increases are sustained, utility companies may look at changing investment or abatement decisions. Increased investment in abatement reduces the volume of hedging demand because of reduced EU allowance compliance requirements in the future. Sustained higher prices could also reduce the profitability of some higher emissions power plants. Therefore, as prices remain high and as MS proceed with planned coal phase-outs, utility hedging demand is likely to fall with the sector's carbon exposure.
- **Industrials have historically not undertaken significant hedging given the large number of banked allowances they hold. The Vivid Economics study found that industrial demand is increasing in volume and frequency.** There are still many small industrials which have no active EU allowance exposure management. However, an increasing number of industrials which did not buy much volume historically (for example, large chemical firms) now undertake hedging over multi-year timeframes. Most small to mid-size industrials trade via intermediaries such as banks, traders, or other financial institutions rather than using in-house trading teams. As free allowances decrease, banked allowances are used, and prices increase, industrials are expected to increase strategic behaviour, including hedging.

Short-term speculative trading in the market was relatively low in the mid-2010s following the downturn in carbon prices. Prior to 2014, a significant number of participants traded speculatively in the market in relatively large size, with a focus on short-term trades (less than 1 year holding periods). However oversupply in the EU allowance market and depressed prices reduced the number of short-term speculators. Drivers of oversupply included the global financial crisis and the

[16] https://carbon-pulse.com/94238/

EU credit crisis, with carbon trading desks shrinking substantially. Some of the remaining players still held large positions, though most predominately participated in the carry trade[17].

- **Short-term speculation increased in volume over 2018 and 2019, driven by price expectations.** By the end of 2017, the implementation of the MSR and other policy announcements contributed to increased market confidence. There were signs of increasing EU ambition and several research houses published "buy" recommendations for the EU allowance market. This led to an increase in speculative trading, although increased volatility meant that trading sizes were significantly smaller compared to earlier speculative activity. Short-term speculative trading is less impactful on the overall holdings compared to other types of activity because holding periods are less than 1 year.
- **Short-term trading volumes fell over 2020, with increasing speculation from long-term investors.** Volatility reduces the amount of allowances most short-term traders can hold because of capital requirements. The cost of holding positions became increasingly more expensive as the market saw significant volatility from COVID-19. At the same time, awareness of the EU's climate ambition increased among investors with the announcement of the EU's net zero commitment and a strengthened 2030 carbon target. Volume shifted to long term investors and hedge funds seeking to generate returns from price increases over several years. These long-term positions have a direct effect on TNAC holdings by removing EU allowances from circulation, similar to the effect of banking and hedging.
- **The size of long-term speculative holdings in the market is estimated to range between 50 $MtCO_2e$ to 100 $MtCO_2e$.** This includes over-hedging by utility firms and the long-term positions held by investors. Utility desk maximum positions are estimated to range from between 1 to 10 $MtCO_2e$. For long term investors, fund positions are estimated to range between 1 to 5$MtCO_2e$. Overall, the total size of this market is estimated to be less than 100 $MtCO_2e$. An increase in total speculative holdings in the market from 50-100 to 200+ could affect market balance, but this scenario is considered extremely unlikely by market participants.
- **Most recently, there have been some very small volumes from participants in the market who buy EU allowances voluntarily for non-speculative reasons.** Corporates who are looking to hedge against climate change fall into this group. There are also socially motivated buyers who voluntarily cancel EU allowances without associated emissions (for example, CarbonKiller or World Carbon Fund) or offer a decarbonisation service for investment funds (Cap2). It is not expected that this segment of the market will be large enough to affect the TNAC.

[17] The carry trade seeks to exploit differences in the relative prices of spot and future EUA contracts relative to other risk-free assets. Simultaneously buying spot EUA contracts vs selling EUA futures contracts creates a risk flat position, which held over time can generate a risk-free return. Over Phase III this rate of return was around 4-5%.. This is sometimes referred to as "optimising cost of cash" or a "contango trade" and does not reflect an outright investment or holding in the underlying EUA instrument.

To sum up, the Vivid Economics study found that there is no evidence that increases in industrial hedging or speculative behaviour have substantially offset decreases in utilities hedging. Market participants interviewed as part of this analysis considered it unlikely that either industrial hedging or speculative behaviour would become significant enough in the next few years to pose a problem for market balance.

21 MSR AND EU ETS RESILIENCE

The Vivid Economics study also looked at the impact of the newly-introduced MSR on the resilience of the EU ETS.

The study began by the simplest indicator of market balance, the TNAC in relation to the MSR thresholds. The TNAC thresholds for MSR intakes and releases are set in a manner that aims to reflect the range of secondary market holdings that would be consistent with the efficient functioning of the allowances market. The study indicated that the TNAC definition is a more accurate measure of market balance when it accounts for all relevant sources of supply and demand, such as aviation operators and the link with the Swiss ETS. Further, demand stemming from other regulated compliance options might need to be considered going forward. Moreover, the appropriate level of the TNAC thresholds are subject to change with market developments, policy design and participants' hedging needs.

The study also proposed other indicators for assessing whether a market is "resilient", being able to function well under a range of plausible circumstances and returning the market to balance in a reasonable timeframe following a shock. Aside from supply-demand balance, an assessment of market stability should include characteristics such as allowance price levels and price volatility, market liquidity, and how the market interacts with other climate and energy policies. The study then looked at the types of events and market shocks that could impact market stability in the EU ETS, and whether the MSR's response is sufficient to restore market stability in a timely fashion:

- **Exogenous events or shocks** - changes to the environment where the ETS operates, without changes to the ETS design or market characteristics themselves. Exogenous events could include changes to the economy that increase or decrease emissions below/above ex-ante expectations, in a temporary or definitive manner; changes in relative prices (particularly for energy); breakthroughs in low-carbon technologies; and anticipated and unanticipated policy changes.

- **Market-related shocks** - changes to market design and in market participants' behaviour. Changes to market design could include changes to the linear reduction factor (LRF), linking to other ETS systems, and new legislated sources of allowance demand. Changes in market participants' behaviour include changes in hedging demand or speculative holdings, or changes in behaviour related to the voluntary cancellations of allowances.

The study found that the time to return the TNAC to acceptable levels after a demand shock is significantly faster under a 24% MSR intake rate as compared to a 12% intake rate, and specifically that only the 24% rate can reduce the TNAC to below the upper threshold in the event of a lasting negative demand shock. The MSR's response to

negative and positive demand shocks was tested with a constant MSR intake rate of 12% or 24% in all years. It takes two additional years to return to TNAC thresholds after a temporary negative demand shock under a 12% intake rate as compared to a 24% intake rate. Similarly, it takes one additional year in the case of the temporary positive demand shock to reach TNAC thresholds under a 12% intake rate as compared to a 24% intake rate, as there is a need to continue correcting for the historical imbalance for a longer period of time. All these scenarios fall within 'reasonable' timeframe definitions of commentators (see ERCST, 2019)[18]. However the MSR does not return the TNAC to within the acceptable level in the case of a lasting negative demand shock given a 12% intake rate.

The study suggested that the market price for allowances is determined by allowance supply and demand levels both today and perceived future conditions. Allowance prices are determined by allowance demand relative to allowance supply as is primarily determined by the cap. Since market participants have the ability to bank allowances, the relative level of market supply to demand, both today as well as in the future, will impact allowance prices. Given that firms have imperfect foresight (i.e., market-related and exogenous future events are unknown), allowance prices will also reflect expectations about an unknown future, which may prove to be inaccurate. For example, if market participants believe the stringency of the system will increase in the future, economic growth accelerate, or low-carbon technologies will fail, this will inflate market prices today. As such the MSR's adjustments to auctioning volumes are expected to have only a partial impact on the allowance price.

The impact of the MSR on price formation in case of shocks depended on whether the shock was expected, or anticipated.

If the demand shock is unexpected, the MSR would cushions the price effect from a negative temporary demand shock, supporting additional GHG mitigation. The MSR immediately helps support short-term prices in response to negative demand shocks by buoying expectations about future prices, regardless of the delay in its actual impacts on supply. Although the MSR's mechanistic effect on the TNAC has more than a year-long delay and takes place gradually over time, it has the ability to shape price expectations immediately as market participants anticipate a reduction in the future supply of allowances. The MSR's role in increasing short term prices after demand shocks can help firms invest in low-carbon technologies today, benefiting from innovation while avoiding market outcomes such as stranded assets. The MSR's restrictions to auctioning volumes increase short-term allowance scarcity and drives up prices. Academic modelling shows that this should incentivise firms to adopt low-carbon technologies and invest in other

[18] https://ercst.org/wp-content/uploads/2019/07/20191008-MSR-review-draft-paper-presentation-v.1-1.pdf

abatement solutions[19]. This could stimulate early innovation and help avoid higher-carbon lock in of capital assets.

However, if the drop in demand is known ahead of time, then the MSR could have a counterproductive impact on allowance prices[20]. The MSR's adjustment to supply could be counterproductive when the TNAC is high due to future expectations about allowance scarcity. This could occur, for example, through a policy announcement that the LRF were to be increased. In this case, compliance-based actors might abate more GHG emissions today in order to save their allowances for future use. As such, emissions would fall and the TNAC would rise in the current period, triggering the MSR. In this case, the MSR would reduce auctioning volumes further, introducing even more scarcity in the market where it is not needed. The TNAC in this case could be an inaccurate indicator of overall market stringency over the lifespan of the program, and the MSR adjustment could work in a counterproductive direction.

Recent empirical analysis suggests that the MSR may have had a stabilising effect on prices, indicating many of the theoretical channels that could drive price volatility may not materialise in practice. Gerlagh et al. (2020) and Azarova and Mier (2020) cite the COVID-19 induced demand shock as evidence that the MSR works well in stabilising EUA prices for short term demand shocks[21,22]. EUA prices did not fall below 15 EUR, despite the EU's GDP declining by an estimated 7% and industry production in the EU-27 declining by nearly 20% in April[23]. Interviews with financial market participants suggest that without the MSR, prices would have dropped substantially more than what was observed over the COVID-19 induced demand shock. However, there is not yet literature on the degree to which the MSR has impacted price volatility in the ordinary operation of the market.

The study also found that **the MSR introduces additional market complexity to the operation of the EU ETS through the addition of rules which influence market supply, interactions with other policies and ultimately prices.** The MSR's rules-based approach provides transparency and a degree of predictability, however complexities regarding changes to auction schedules and updates to data impacting TNAC calculations could make it hard for market participants to understand or predict the MSR's future. As a quantity-based mechanism, the MSR's indirect impact on price needs to be estimated by market participants adding a level of complexity to allowance price projections.

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[19] https://www.pik-potsdam.de/members/pahle/mauer-et-al-2019.pdf/at_download/file
[20] Marcu et al. (2020), Gerlagh et al. (2020), Healy et al (2019)
[21] https://link.springer.com/article/10.1007/s10640-020-00441-0
[22] https://www.ifo.de/en/publikationen/2020/working-paper/msr-under-exogenous-shock-case-covid-19-pandemic
[23] https://ec.europa.eu/eurostat/statistics-explained/index.php/Impact_of_Covid-19_crisis_on_industrial_production#Development_of_industrial_production_in_2020

Market participants may struggle to form rational expectations on EUA prices given both the MSR's response to allowance demand and supply, and the subsequent feedback effects from the MSR's actions. Flues and van Dender (2020) argue that the MSR increases price uncertainty in the market as the quantity of emission allowances in circulation does not provide any focal point about future price levels[24]. **The addition of the invalidation mechanism adds uncertainty regarding the absolute quantity of allowances that will be available in the future.**

Moreover, in the future, the MSR could be prone to threshold effects. Threshold effects are small deviations in the TNAC around the threshold can result in significant supply shocks if the deviations trigger the MSR. This can lead to oscillatory price behaviour around the threshold. This could be exacerbated by speculation to take advantage of the TNAC being near the threshold where speculators change their banking behaviour to trigger the MSR, increasing volatility further. So far, the TNAC has remained far above the upper threshold so such behaviour has not been observed.

21.1 The MSR and competitiveness impacts

As shown earlier, the MSR is designed to ensure market balance and thereby both directly and indirectly affects competitiveness through several channels. These can include impacts via market prices, price volatility, market liquidity, strategic behaviour, market sentiment, predictability, complexity and transparency.

According to the Vivid study, the MSR's impact on competitiveness is yet to be directly discussed in the broader academic literature, given its recent introduction and limited evidence of carbon leakage from the initial phases of the EU ETS. MSR adjustments to auctioning volumes restrict short-term supply, and therefore put upward pressure on allowance prices. However, many other factors, such as the perception of increasing ambition in the future and developments in mitigation technologies will also impact allowance prices. Disentangling the level of price rise that is attributable to the MSR relative to other events occurring concurrently is challenging, but it is broadly agreed that the MSR contributed, in part, to the price rise. Given free allocations throughout Phase 3 and Phase 4 for EITE sectors, these firms only experience a proportion of any MSR induced price rises. Interviews with market participants indicate that the most important aspects with respect to competitiveness considerations are the LRF and decisions on free allocation and CBAMs for EITE sectors.

Price stability and predictability are important for investment decisions and therefore a firm's longer-term competitiveness position. Investment in mitigation and

[24] https://www.oecd-ilibrary.org/taxation/carbon-pricing-design-effectiveness-efficiency-and-feasibility_91ad6a1e-en

low-carbon technology is fundamental to a smooth progression to period of higher carbon prices. The MSR plays a supporting role in increasing certainty on the EUA price path, but the MSR also adds to regulatory complexity. To the extent that the MSR helps ensure price stability it will also support competitiveness. However, this is unlikely to significantly impact competitiveness as excessive volatility has not been observed since the introduction of the MSR.

Modelling performed in the context of the Vivid study suggests that over the longer term, the impact of the MSR on market prices is small relative to the potential impact of other policies, such as a strengthened LRF. Given the relatively small difference in these price levels the effect of the MSR on competitiveness is likely to be minor. This alongside the ongoing high level of allocations to free allocations suggests that the MSR is unlikely to have had any significant effect on competitiveness over the period of its operation.

For EITE firms who are able to abate at low cost, EUA price increases may increase competitiveness. If EITE sectors receiving free allocation are able to mitigate at a lower price than the EUA price they would be able to sell excess free allowances. EUA price rises could support competitiveness for these firms. An increase in EUA prices will increase the net value of the firms who hold allowances in excess of their current liabilities. In this sense, any MSR induced allowance price rises will benefit them in the short term.

Annex 8: Design options for the Market Stability Reserve

22 SENSITIVITY ANALYSIS FOR THE MSR

22.1 Performance of each MSR design option given future shocks

This section provides stress tests to assess how different MSR designs interact with changes in external market conditions. The modelled performance of the MSR under different market and policy outcomes can be used to assess the resilience of the MSR. The results of these stress tests will inform the extent to which negative outcomes may be mitigated or accentuated by the MSR.

We consider two types of stress test:

- **Shocks**, such as a reduction in economic demand or an increase in complementary policy ambition due to coal phase outs. These can largely be incorporated into the model based on reasonable estimates of magnitude to assess the outcome, with some complementary qualitative analysis as required.

- **Induced imbalances,** such as strategic speculative behaviour aiming to destabilise the ETS by purchasing large quantities of allowances. These imbalances have been designed by identifying areas of potential risk in the current MSR design and constructing scenarios which could lead to destabilising outcomes based on these risks. Given the nature of these risks, we will complement modelled results with a discussion of the potential risks and outcomes. We identify two potential induced imbalances below.

Shocks may operate through different impact channels, but ultimately have the same effect on market outcomes. For example, increased speculation and increased hedging demand both provide a temporary increase in demand for allowances. On the other hand, a reduction in economic activity (and associated emissions) or a coal phase out both permanently reduce demand for allowances. These shocks have different root causes, but ultimately pose the same implications for the functioning of the MSR.

We therefore classify the stress tests based on their ultimate impact channel. They are:

- **An anticipated increase or decrease in EU allowance demand.** These shocks include announcements of complementary policies such as coal phase outs, and technological breakthroughs for low-emissions technologies. Their effect on future emissions can be anticipated before the effects start to materialise. These shocks can be modelled as an exogenous change in market participants' expectations for future emissions. While shocks can also result in an unanticipated increase in EUA demand, this less likely than a decrease in demand for allowances due to sustained decarbonization efforts across the economy. This analysis therefore focuses on the impact of an anticipated reduction in allowance

demand, modelling the announcements of further coal phase outs beyond what is confirmed by 2020.

- **An unanticipated increase or decrease in EU allowance demand**. Temporary shocks of this type include a change in long-term speculation or hedging demand from compliance entities, while permanent shocks include a change in abatement costs or economic activity relative to expectations. To estimate the impact of an unanticipated reduction in EUA demand, we analyse a shock similar in size to the 2020 COVID-19 shock, but occurring in 2025. COVID-19 represents a large shock by historic standards, illustrating the impact of a tail risk to EUA demand materialising. We also assess the impact of a similar magnitude of shock but in the opposite direction (i.e. an unanticipated increase in EUA demand). This could happen for example due to a sudden nuclear incident causing nuclear energy to be replaced with natural gas or coal.

- **Induced holdings to stimulate tightening.** This could occur where market actors deliberately hold allowances in order to induce additional tightening from the MSR, inflating the prices. For instance, speculators or actors seeking to enhance the overall ambition of the EU ETS could buy and hold enough allowances to corner a large share of the TNAC, triggering the MSR repeatedly and creating a price spiral. To assess the impact of induced holdings, we analyse the prospect of non-compliance entities holding a significant number of allowances from 2025.

The plausible magnitude of shocks used in stress tests is informed by numerous sources, including literature review, interviews and surveys with market participants and quantitative analysis. For stress tests based on external factors such as coal phase out in MS, a literature review and internal analysis has provided sensible estimates of magnitude. To analyse factors with less publicly available data, such as hedging and speculative demand, we have complemented our understanding with input from interviews and surveys with market participants.

As indicated in annex 4, Section 9.1.4, the modelling outputs are not intended to be used as forecasts for prices and emissions. In particular the modelling focuses on carbon prices as adjustment variable and does not well cover the overall policy mix. However, when combined with qualitative and quantitative insights, the model can provide useful indications of the direction and size of impact.

The stress tests implemented here are summarised below

Table 23: Stress tests analysed in the model

Type of stress test	Specification of stress test implemented	Other causes of similar stress	Key issue for current MSR design
Anticipated decrease in EU allowance demand	Communicated policy measures, specifically coal phase out.	• Technological breakthrough with deployment delay.	Anticipated reductions in EU allowance demand can lead to an increase in cumulative emissions under current ETS policy. A reduction in future demand means firms need to bank less. They then have more liquidity in the current period, reducing prices.
Unanticipated decrease in EU allowance demand	Economic activity (and emissions) below expectations.	• Reduced demand for hedging. • Reduction in abatement costs. • Additional complementary policy measures e.g., larger coal phase out.	MSR has a partial and delayed response to negative demand shocks and price drops. Its effectiveness depends on timing of shock
Unanticipated increase in EU allowance demand	Economic activity (and emissions) exceeds expectations	• Increased long-term speculation. • Increasing hedging demand from industrials. • Increase in current abatement costs. • NGOs or governments buy and bank allowances permanently. • Complementary policies underperform, e.g., energy efficiency and renewable targets.	Sudden increases in demand for EU allowances can lead to an increase in EU allowance prices. The MSR is not suited to positive demand shocks, as it was designed to remove a surplus.
Induced holdings to stimulate tightening	Non-compliance entities hold a large number	• Speculators seek to corner market to induce price increases.	The MSR removes allowances from future auctions if the TNAC is above the threshold,

Type of stress test	Specification of stress test implemented	Other causes of similar stress	Key issue for current MSR design
	of allowances for long-term investment	• Actors seek to hold allowances to induce tightening and increased emissions reductions from ETS sectors.	regardless of the price level. Actors without compliance obligations could use this to multiply their impact on the emissions market by holding a large share of the TNAC over multiple years to drive price rises and additional mitigation.

Source: Vivid Economics

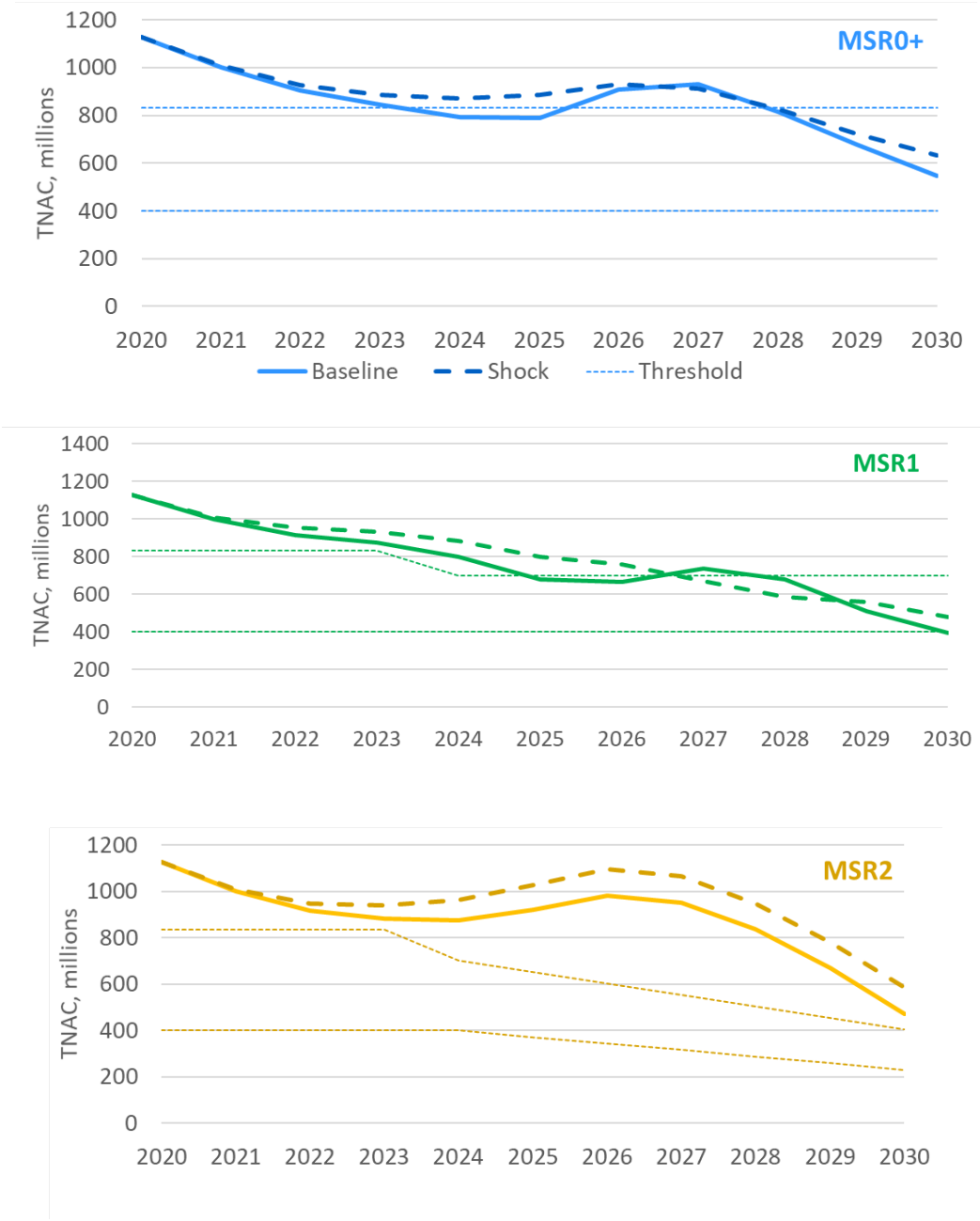
22.2 Anticipated decrease in EUA demand: coal phase out

The regulated phase out of coal power has the potential for a significant permanent reduction in EUA demand. The coal phase out is expected to reduce EUA demand by up to 277 million allowances by 2030. Half of this reduction is built into baseline emissions. The shock here simulates a scenario where the other half of emissions reductions are also realised, reducing EUA demand by 27 million allowances in 2021 and up to 138.5 million allowances by 2030. This shock is expected to be larger than other likely sources of anticipated demand reduction such as complementary policy measures or significant progress in industrial abatement technologies. It therefore represents the upper limits of a realistic shock.

An anticipated reduction in EUA demand leads market participants to anticipate lower future prices, leading to a reduction in abatement. If prices fall, compliance entities would rather pay for emissions than invest in abatement. However, this only partially offsets the reduction in emissions from the closure of coal plants, such that total emissions are still lower in the coal phase out scenarios. In other words, the reduction in emissions pushes up TNAC (as there is an excess supply of allowances) while the *expectation* of future emissions reductions reduces TNAC.

Intakes increase under all MSR designs when faced with an anticipated reduction in EUA demand, but MSR1 and MSR2 generate a stronger response than MSR0+ due to higher intake rates. Under MSR0+, the shock results in cumulative intakes from 2021-2030 increasing by 0.22 billion (from 1.24 billion EUAs to 1.146 billion). Under MSR1, there is an increase of 0.24 billion allowances (from 1.50 billion to 1.74 billion), reflecting the higher intake rate and lower thresholds for activation of the MSR. MSR2 results in an increased cumulative intake of 0.0.22billion, the same as MSR0+ but lower than MSR1.

Figure 31: TNAC under an anticipated reduction in EUA demand

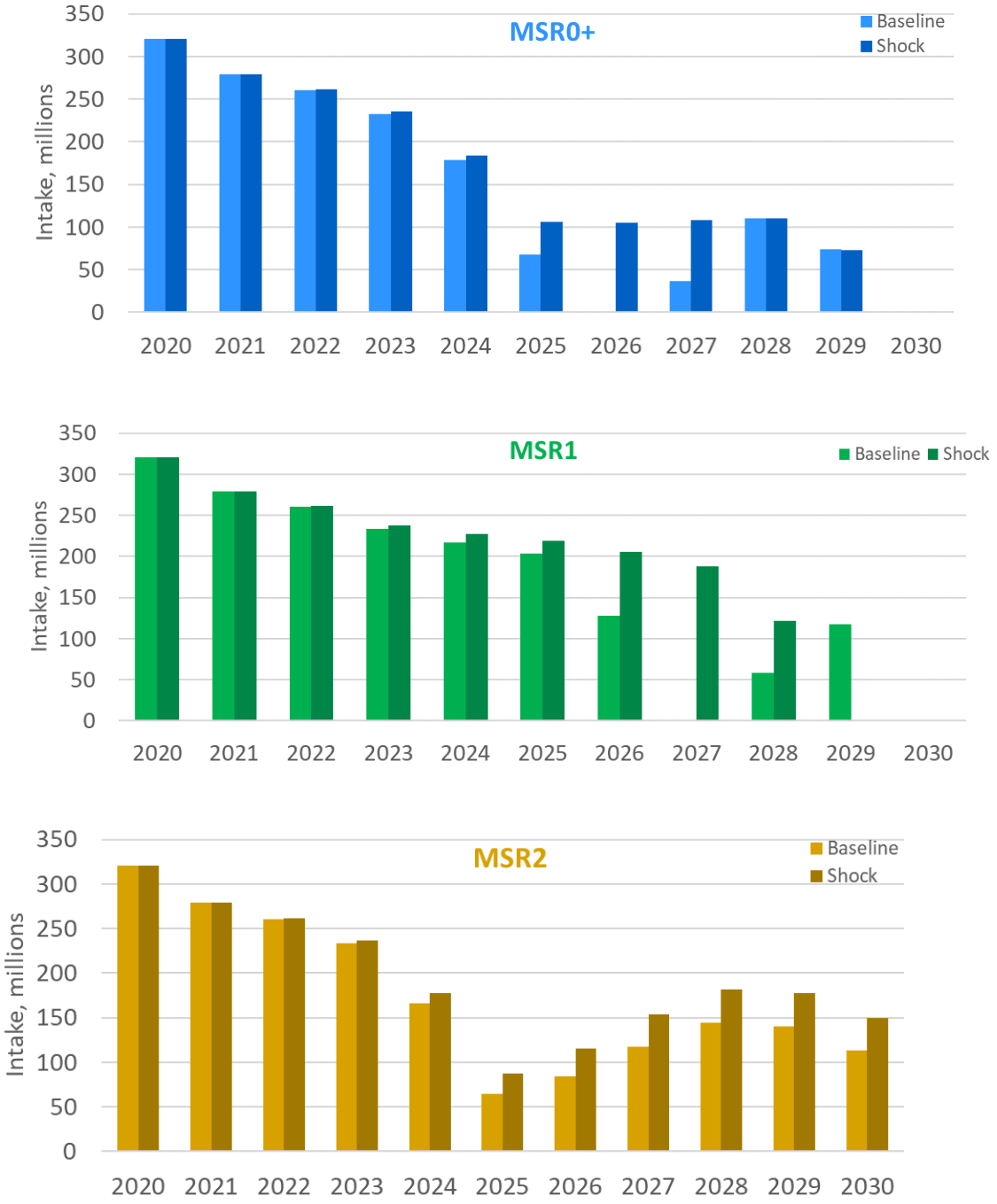


Source: Vivid Economics

The shock bumps TNAC up further, resulting in prolonged intakes into the MSR throughout the 2020s for MSR0+ and MSR2, and till 2028 for MSR1. While MSR1 intakes more allowances than MSR0+ and MSR2, the intakes are large and concentrated between 2021-2028. MSR0+ and MSR2 have a more long drawn out response, taking longer to neutralise the shock as intakes continue till 2030. This is due to the relatively low intake rates compared to MSR1. MSR2 gradually ramps up intakes as the impact of the shock gets bigger.

The 2030 TNAC is therefore lowest under MSR1, followed by MSR2 and finally MSR0+. Under MSR1, TNAC in 2030 is 47 million higher with coal phase out. This compares to 1110 million under MSR2 and 45 million under MSR0+.

Figure 32: MSR intakes under an anticipated reduction in EUA demand

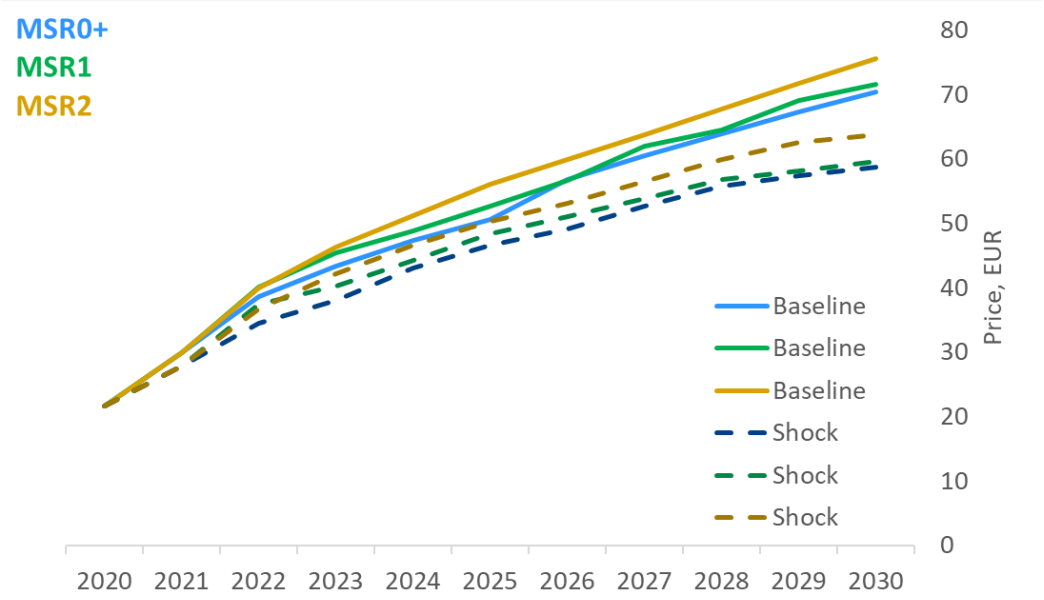


Source: Vivid Economics

A long-term reduction in EUA demand leads to a consistent decrease in price across MSR designs. As the reduction in emissions is assumed to be permanent, firms have a lower demand for allowances. Prices therefore remain lower to 2030, despite the higher cumulative intakes across all design options. The reduction in prices cause by the shock (measured against the respective reference case) is fairly consistent, at around 10 EUR in

all MSR designs. This indicates that the MSR is not well suited to maintaining a particular price level in the event of an anticipated long term shock, which permanently alters the available allowances and firm behaviour.

Figure 33: EUA prices under an anticipated reduction in EUA demand

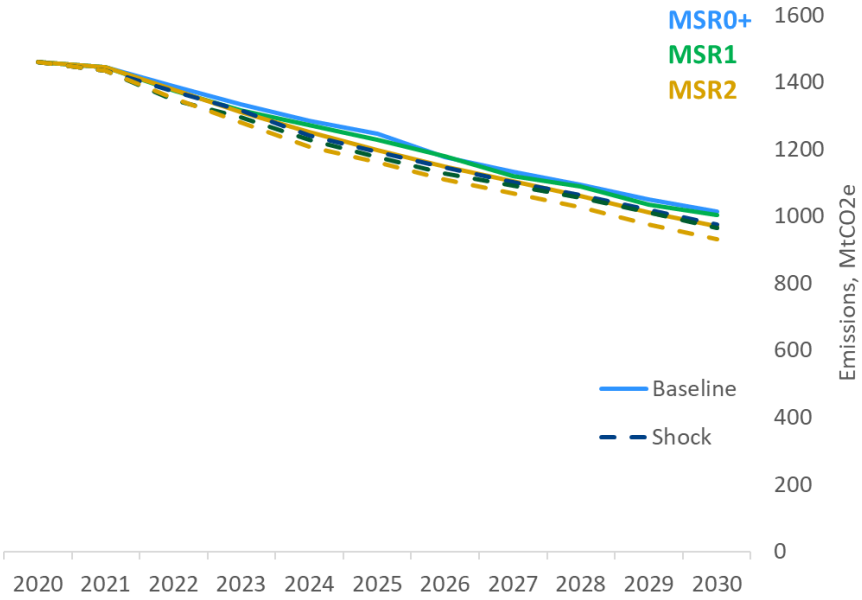


Note: *Prices are shown in constant 2015 Euros.*

Source: *Vivid Economics*

Emissions reductions from the coal phase out persist across all MSR designs. These results do not support the 'green paradox' theory, whereby anticipated emissions reductions lead to entities reducing abatement behaviour. This is due to the fact that the impact of the coal phase out on emissions is realised gradually, with additional reductions occurring each year from 2021-30. The emissions reductions realised from 2021 offset the reduction in abatement due to lower anticipated emissions levels in future years, leading to a consistent reduction in emissions relative to the baseline.

Figure 34: Emissions under an anticipated reduction in EUA demand



Note: Prices are shown in constant 2015 Euros.

Source: Vivid Economics

22.3 Unanticipated change in EUA demand: economic shock

A sudden economic downturn can result in reduced emissions and an unanticipated decrease in EUA demand. Conversely, an economic boom could result in higher demand for EUAs. In this section we explore four different variations of an economic shock:

- **A temporary economic recession**. This tests the impact of a 155 Mt shock occurs in 2025, lasting for one period before economic production and baseline emissions bounce back to previous levels. The magnitude of the shock is based on the 2020 emissions impact of COVID-19, which represents an unprecedented reduction in emissions.

- **A temporary economic recession with a shorter anticipation horizon for the firm**. This scenario tests the impact of a temporary shock (as outlined above) when firms have a shorter time horizon (3 years instead of 10 years).

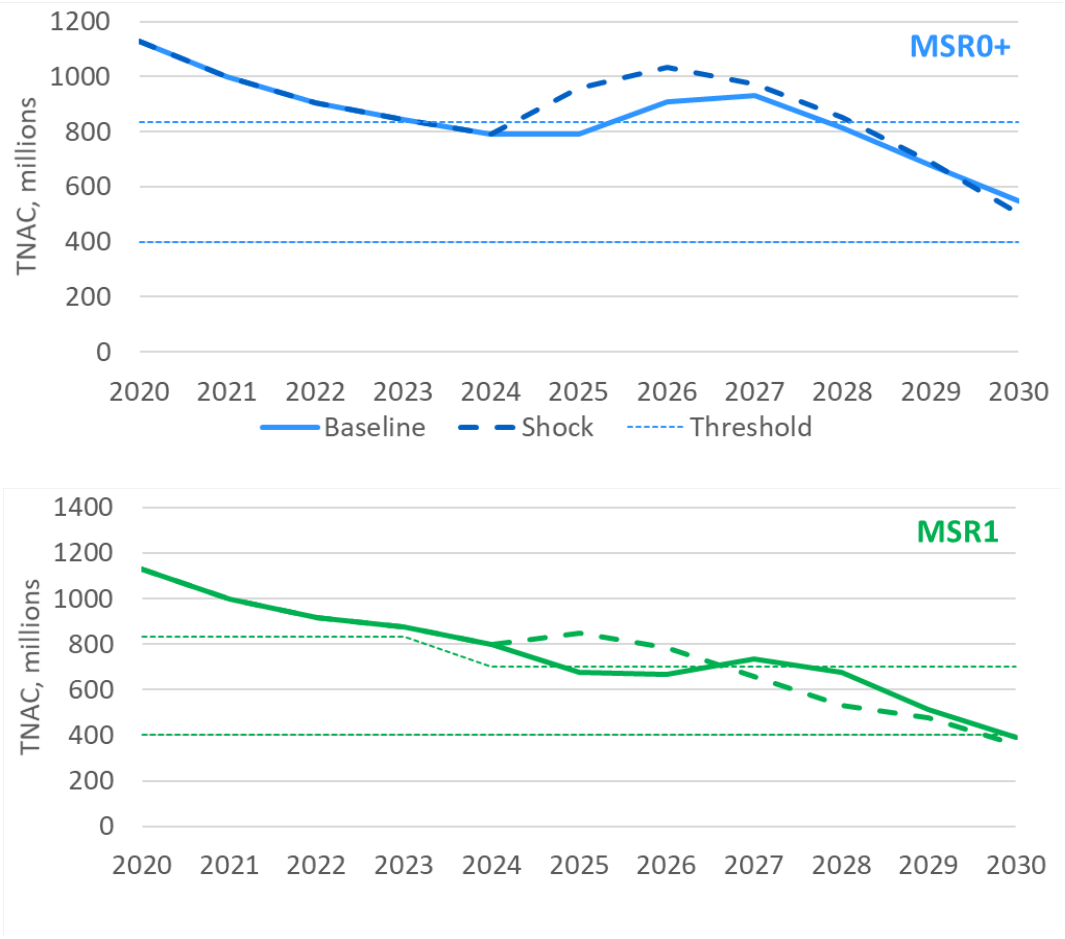
- **A persistent economic recession**. This tests the impact of a 155 Mt shock in 2025, which halves in 2026 (78 Mt), and halves again in 2027 (39 Mt). The 39 Mt reduction is considered structural and remains persistent to the end of 2050.

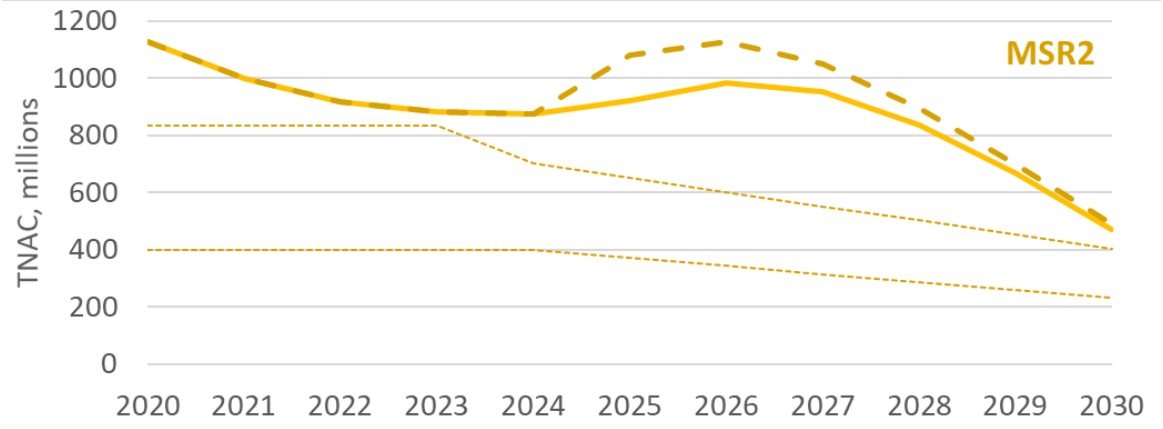
- **A persistent economic boom**. Finally, we consider a scenario where there is an unanticipated increase in EUA demand rather than a decrease.

(1) Temporary reduction in EUA demand

An unanticipated reduction in EUA demand leads to an increase in TNAC across MSR designs as firms bank excess allowances, but different intake rules lead to varied reactions. The initial change in TNAC is fairly similar across different MSR designs, with TNAC increasing in 2025 in response to a negative economic shock. However, subsequent reaction to the shock is dependent on the MSR design. MSR0+ is just able to bring the TNAC back in line with the baseline by 2030, five years after the shock occurs. MSR1 reduces the surplus quicker due to the higher intake rate. The larger intakes as a result of the shock even result in TNAC dipping below what it would have been without a shock. This result is due to threshold effects. MSR2 is able to reduce the surplus by 2030. Under MSR0+ and MSR1 intakes stop by the end of the decade. However, declining thresholds mean that intakes continue under MSR2.

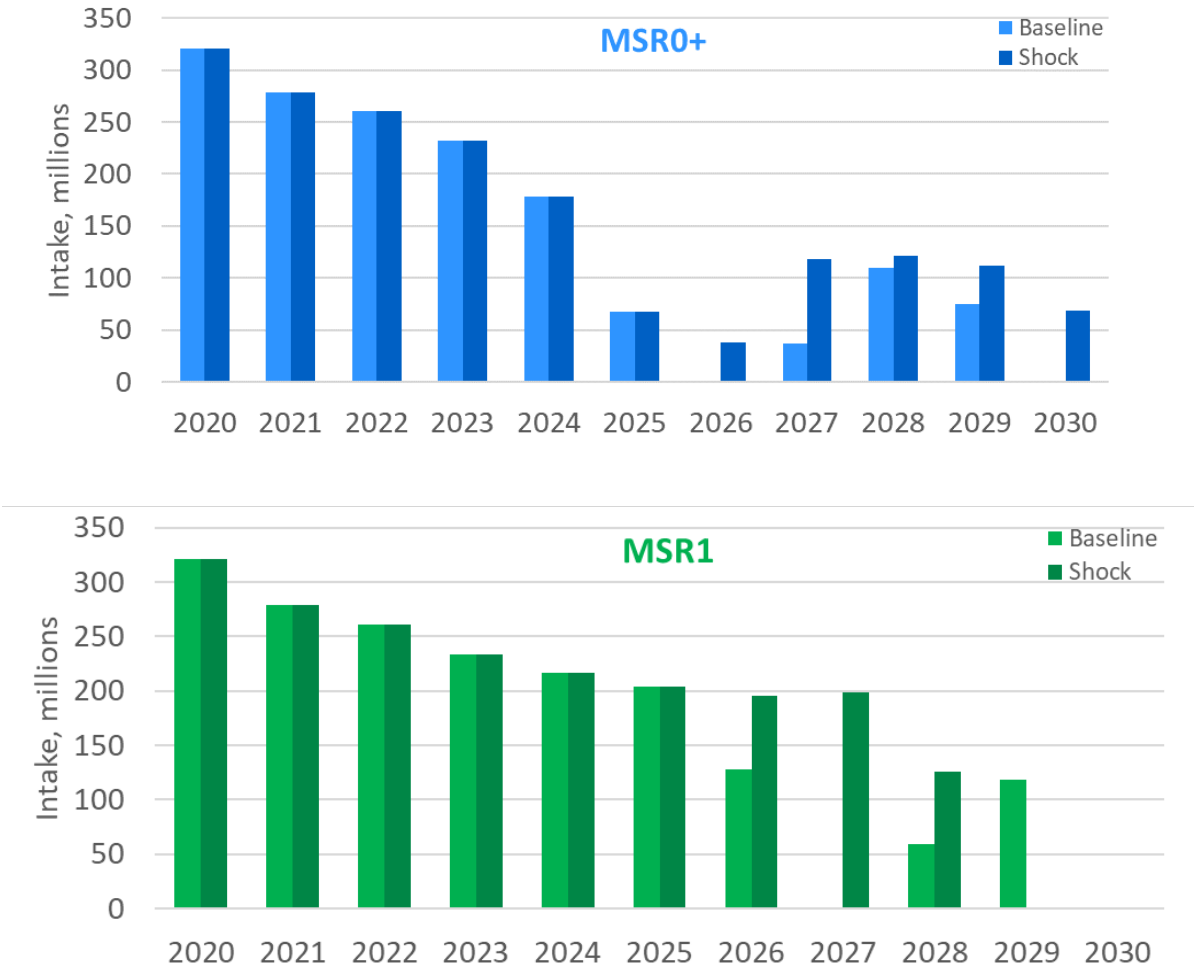
Figure 35: TNAC under a temporary reduction in EUA demand

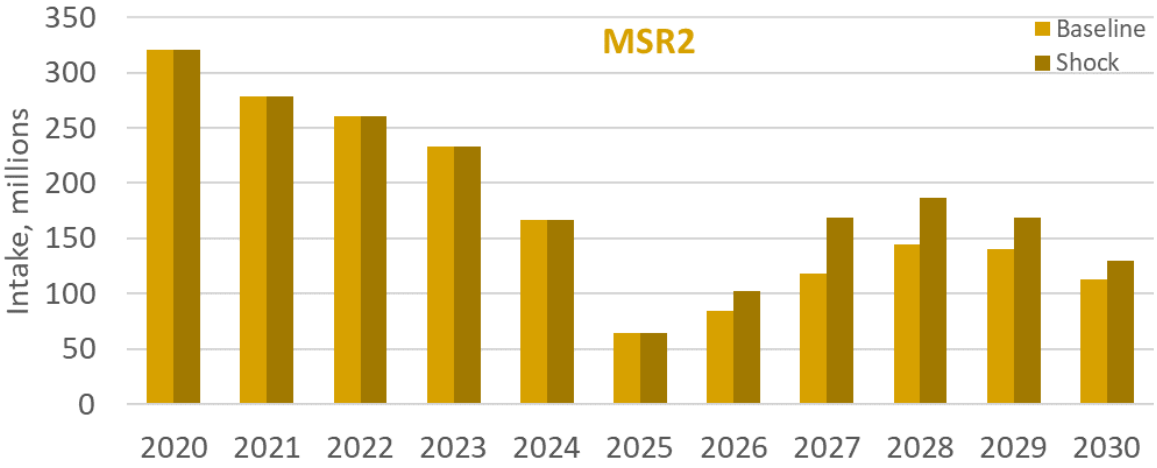




Source: Vivid Economics

Figure 36: MSR intakes with a temporary reduction in EUA demand

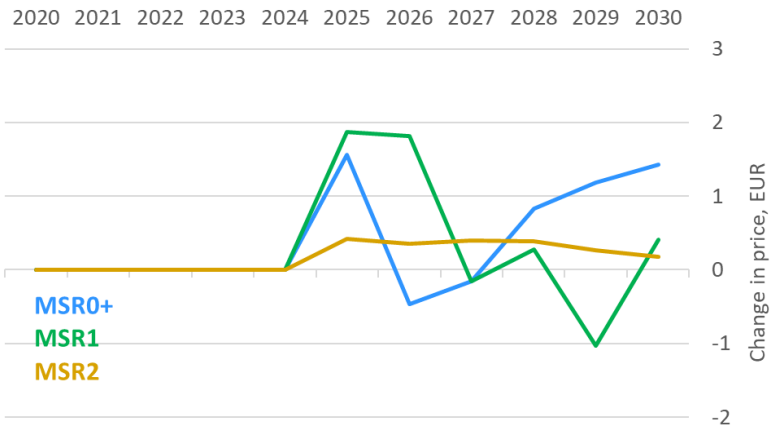




Source: Vivid Economics

The price response to an unanticipated shock is limited and equivalent across MSR designs, in part due to an assumption on 10 year foresight for firms. In the years following the initial demand shock, prices relative to the reference case without the shock are broadly the same, with some small deviations for MSR0+ and MSR1 due to threshold effects. The variation between designs is in the range of 1.5 euros. This is due to the temporary nature of the shock and the MSR's delayed time scale of action. By the time the intakes kick in, economic activity has returned to normal. The price trajectory is unstable for MSR0+ and MSR1 due to changing expectations of the size of intakes in future periods. This contrasts with a relatively stable price path under MSR2. This is also due to modelling assumptions, as firms anticipate that the long-term emissions trajectory is relatively unaffected.

Figure 37: EUA prices relative to baseline under a one period unanticipated reduction in EUA demand



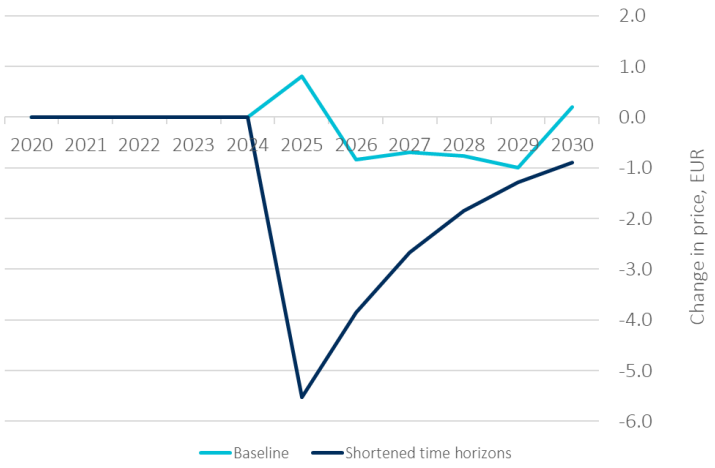
Note: Prices are shown in constant 2015 Euros.

Source: Vivid Economics

(2) Temporary unanticipated reduction in EUA demand with shortened time horizons

The relatively muted price response in the previous section is partially a result of the modelling assumption that firms have a 10 year forward looking horizon. While this horizon is likely appropriate for the medium term without any economic disturbances, firms typically behave in a more short-sighted fashion in times of crises. We therefore tested this reduction in EUA demand with a 3 year time horizon. Results show that there is a more dramatic decrease in price when firms have a shorter time horizon.

Figure 38: EUA prices relative to baseline (for MSR0+)



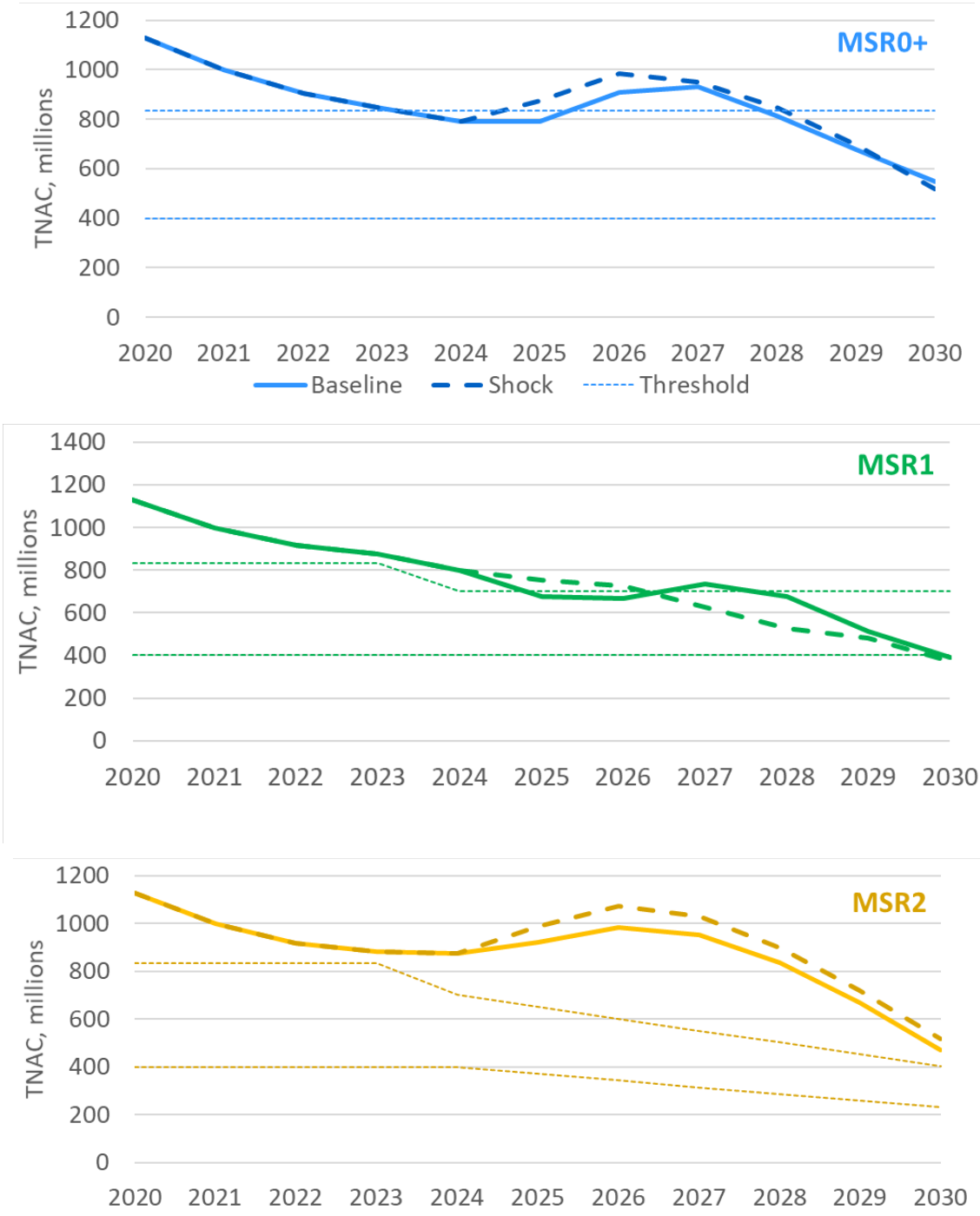
Note: Prices are shown in constant 2015 Euros.

Source: Vivid Economics

(3) Persistent and unanticipated reduction in EUA demand

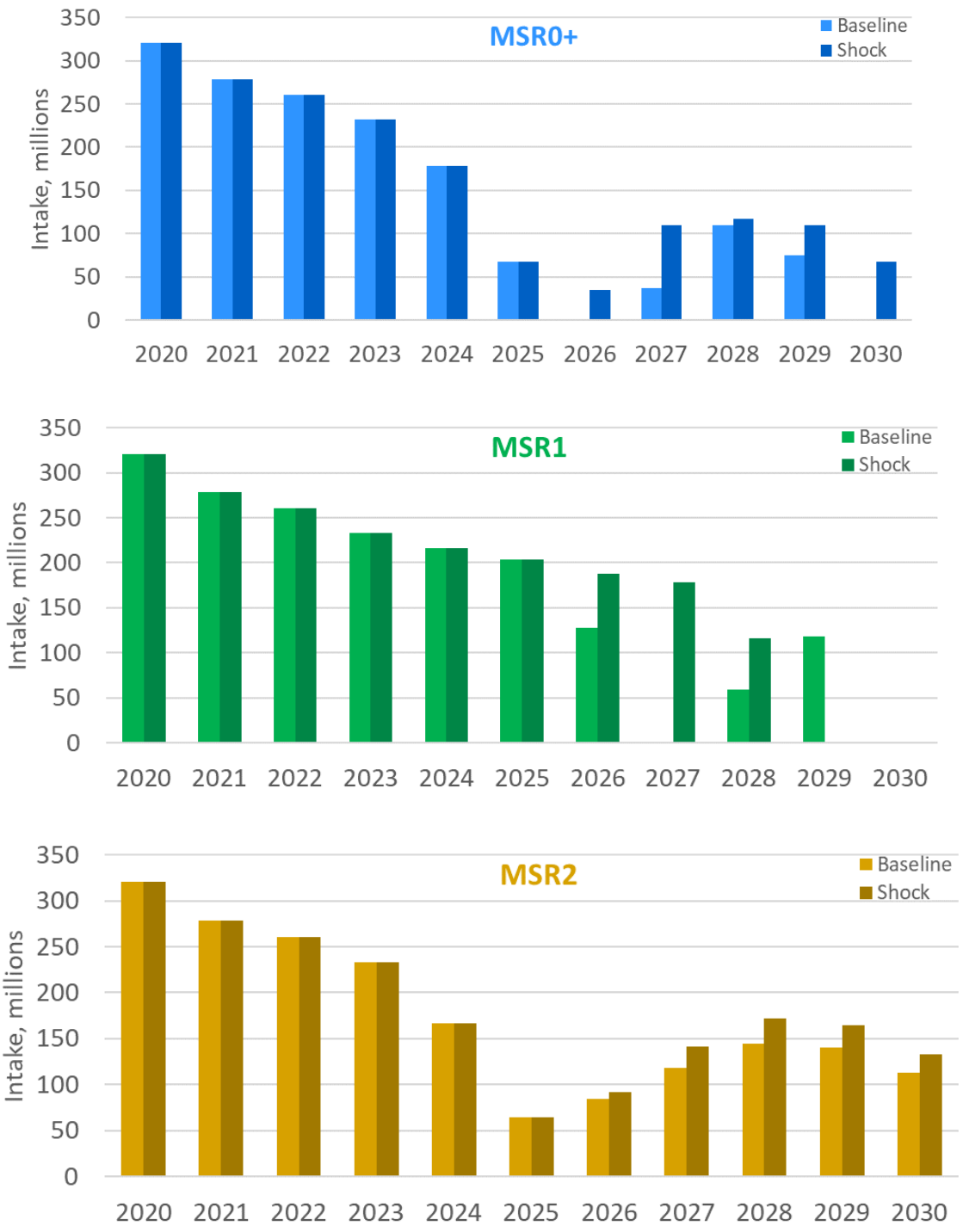
The key difference between a temporary and persistent reduction in EUA demand is the effect on prices, which fall more significantly and remain slightly lower than the baseline through to 2030. Prices fall by around 10 EUR in 2025 when the shock occurs and remain about 4 EUR lower than the counterfactual without the shock across all MSR designs in 2027. This price impact persists to 2030 due to the long-term persistence assumed in this case. The price impacts vary slightly by MSR design, with MSR1 making the quickest recovery due to the higher intake rate. However, differences of this small size (approx. 2 EUR) should be interpreted with caution.

Figure 39: TNAC under a persistent unanticipated reduction in EUA demand



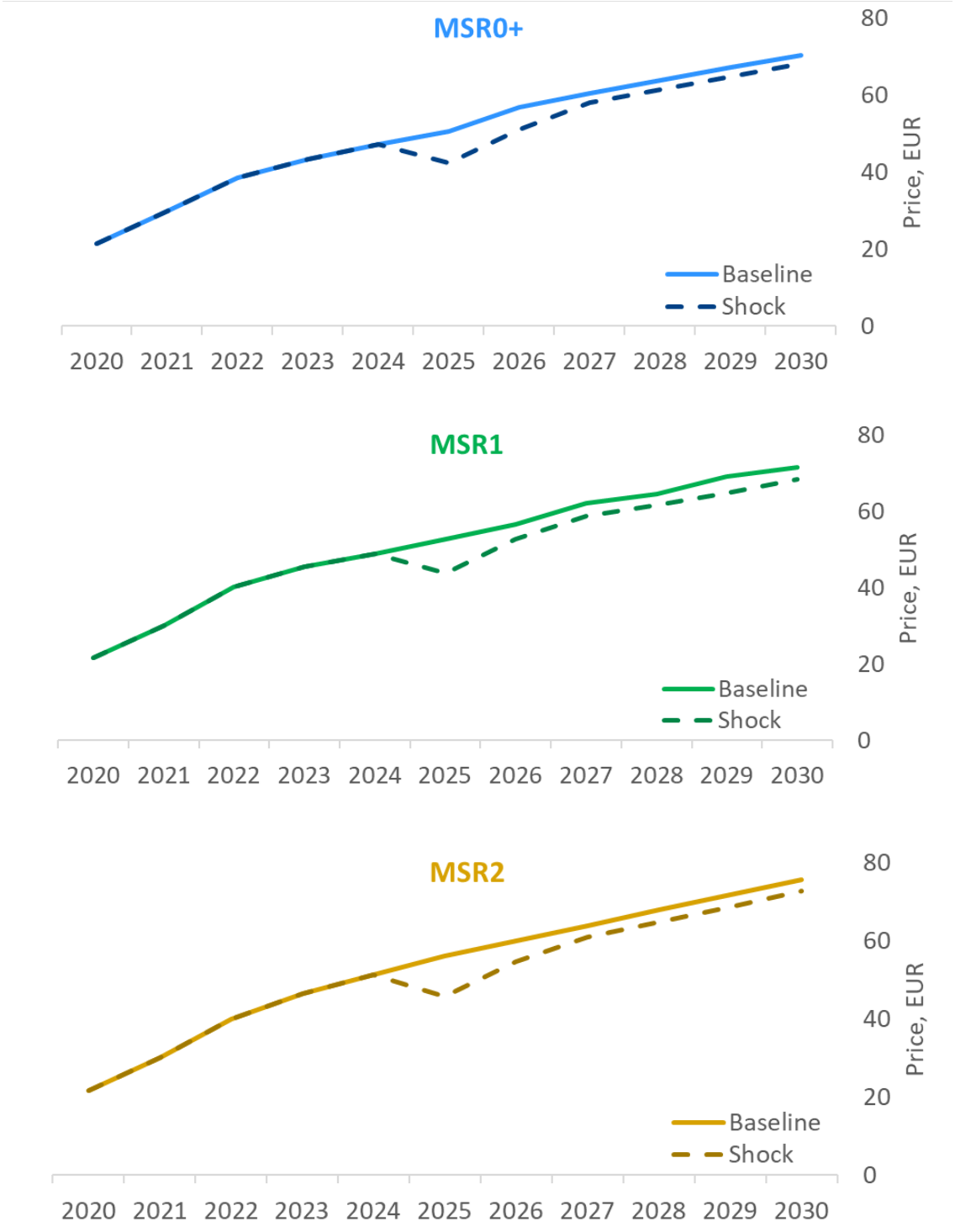
Source: Vivid Economics

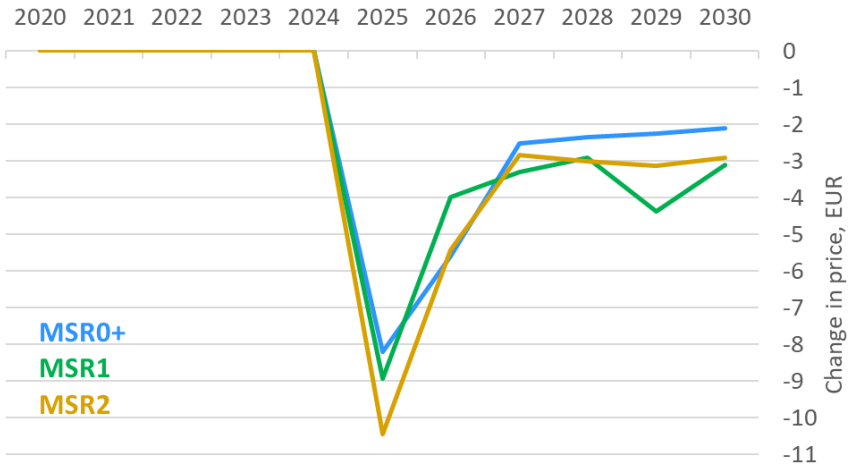
Figure 40: MSR intakes with a persistent unanticipated reduction in EUA demand



Source: Vivid Economics

Figure 41 EUA prices under a persistent unanticipated reduction in EUA demand





Note: Prices are shown in constant 2015 Euros.

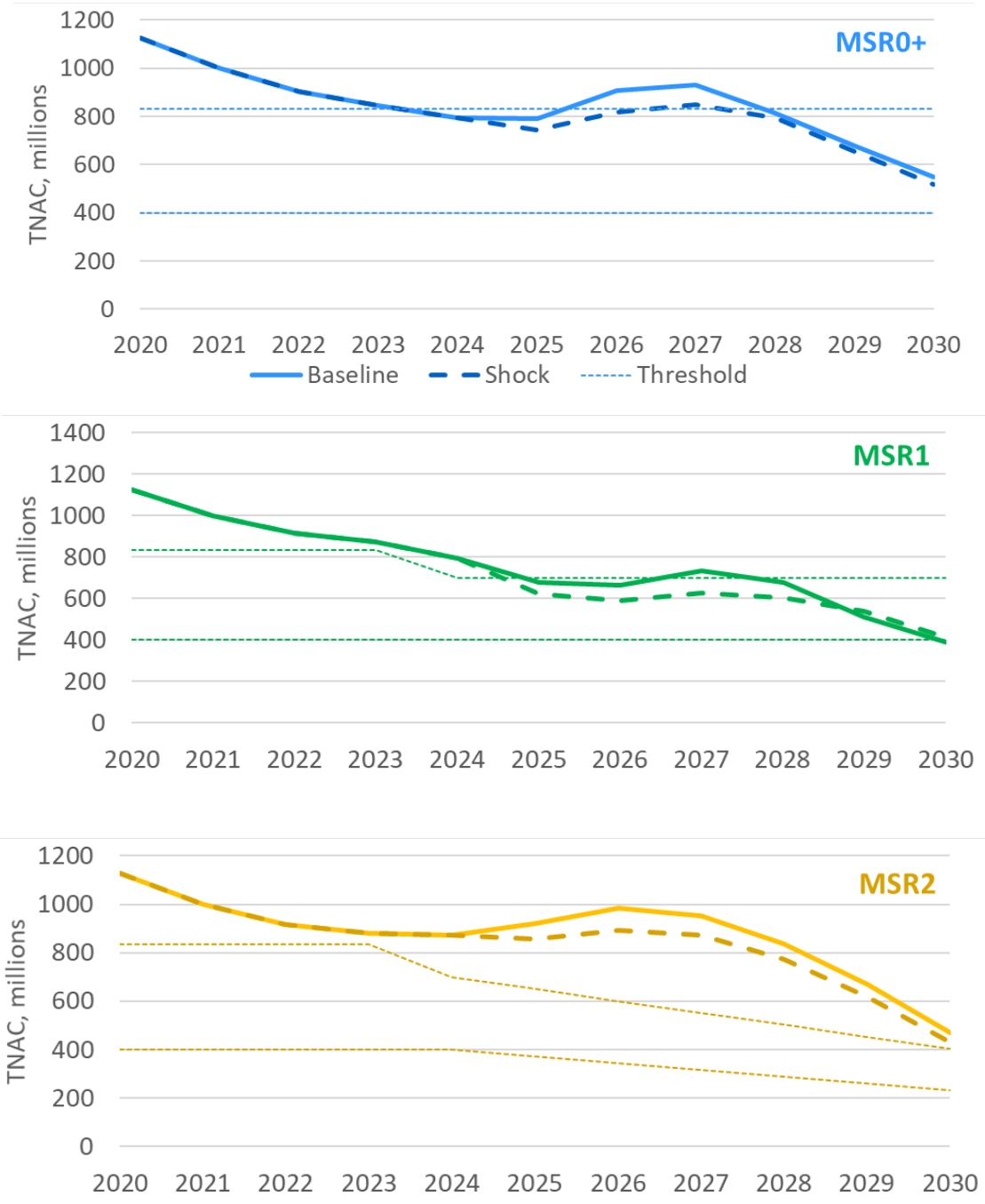
Source: Vivid Economics

An auction reserve price, which is part of MSR3, could provide a faster and more effective response to negative demand shocks. The MSR3 design outlines an auction reserve price that starts at €25 in 2025 and increases by a real rate of 3% each year, reaching €29 in 2030 if unadjusted. While this price floor does not bind in the scenarios tested, it could serve to bolster market participants' confidence in the system in case of a larger demand shock. A minimum price also unlocks investment in abatement options below the price floor by removing uncertainty around future prices and market evolution. Alternative projections of price impacts should also be considered, as these results reflect outputs of one model and do not constitute a definitive forecast of prices.

(4) Persistent unanticipated increase in EUA demand

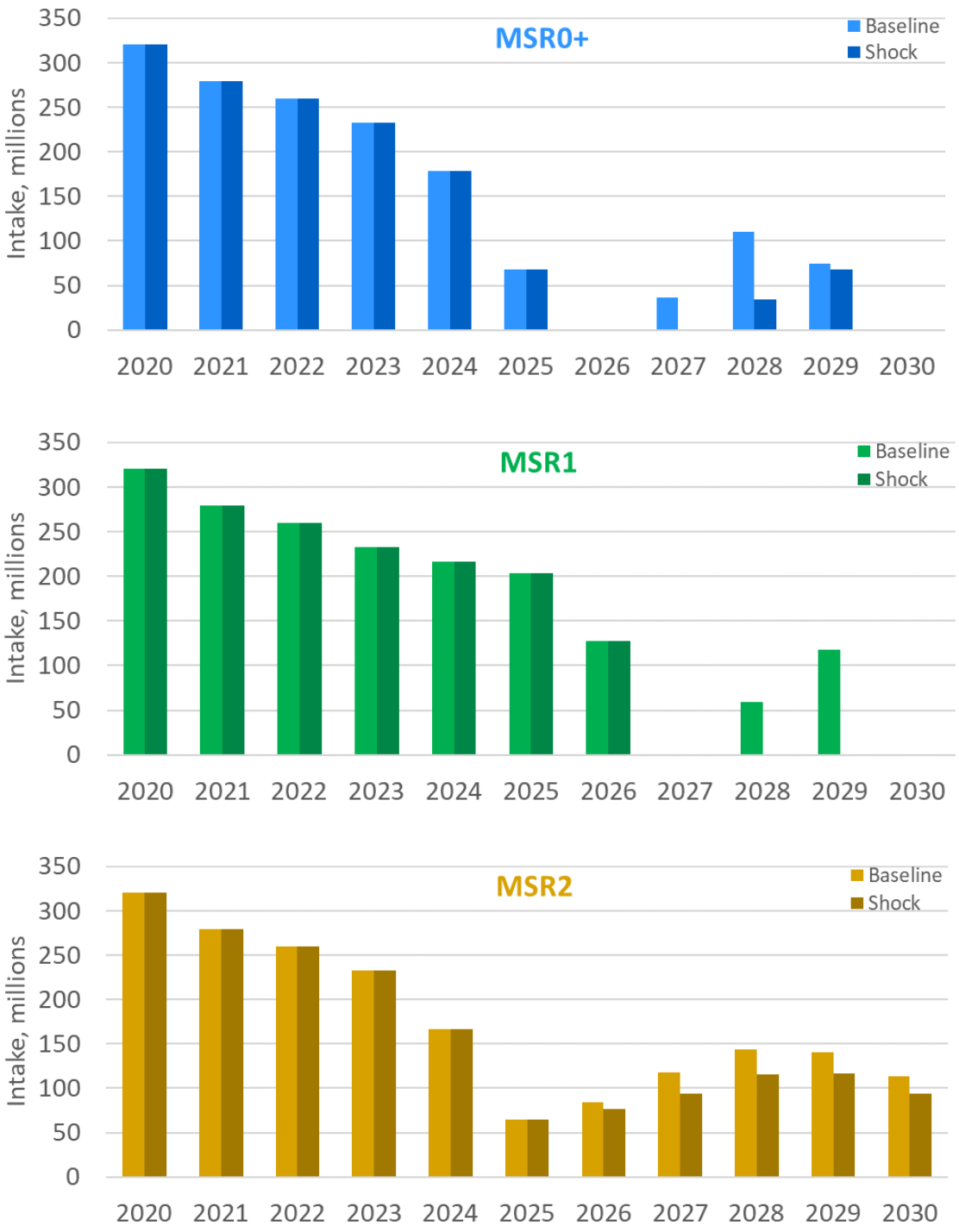
A persistent increase in EUA demand mirrors the results presented for a persistent decrease in demand, and has been included for completeness. Prices increase by around 12 EUR in the initial period of the shock, with this differential reduced to around 4 EUR across all MSR designs by 2027. This price impact continues to 2030 due to the long-term persistence assumed in this case.

Figure 42: TNAC under a persistent unanticipated increase in demand for EUAs



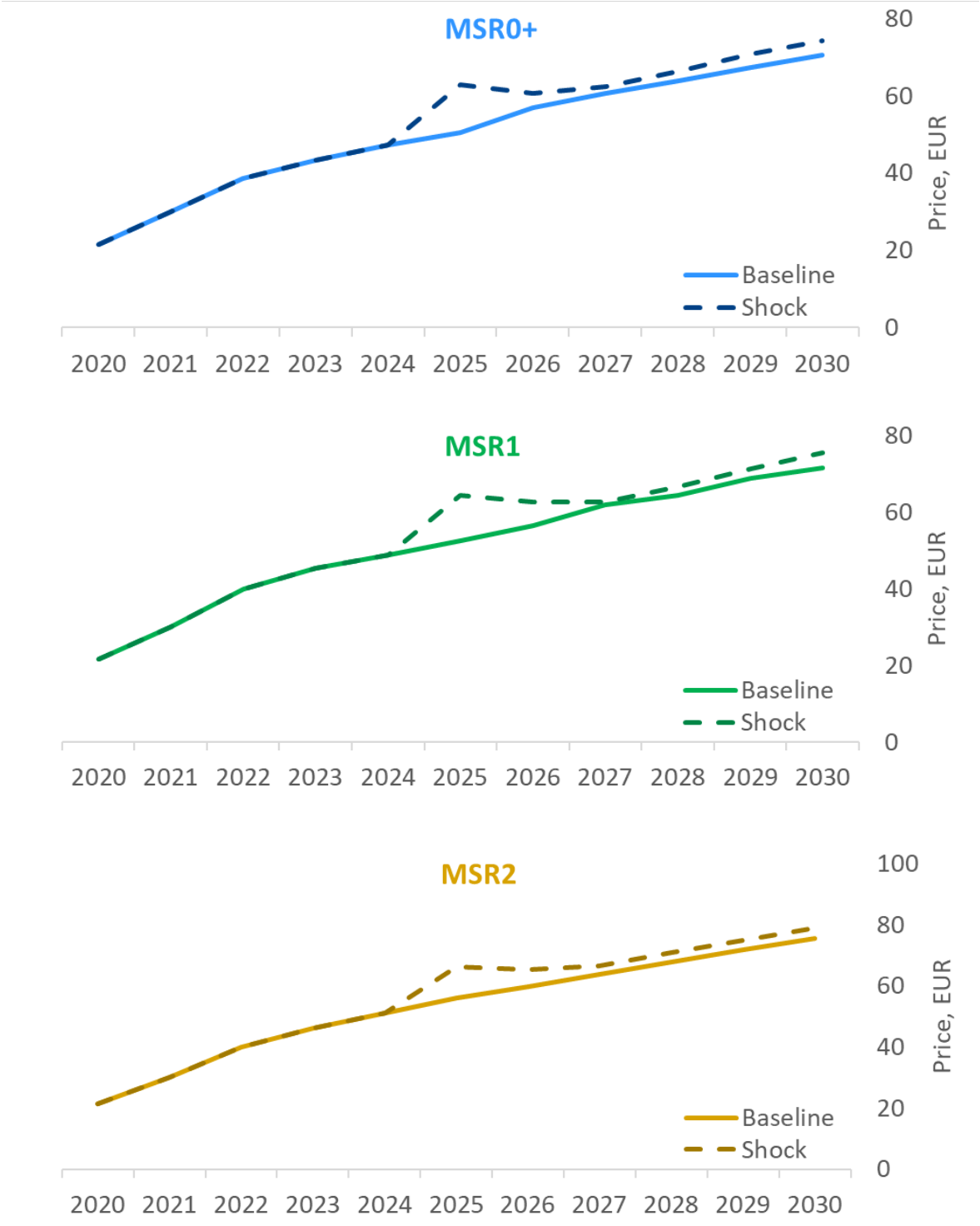
Source: Vivid Economics

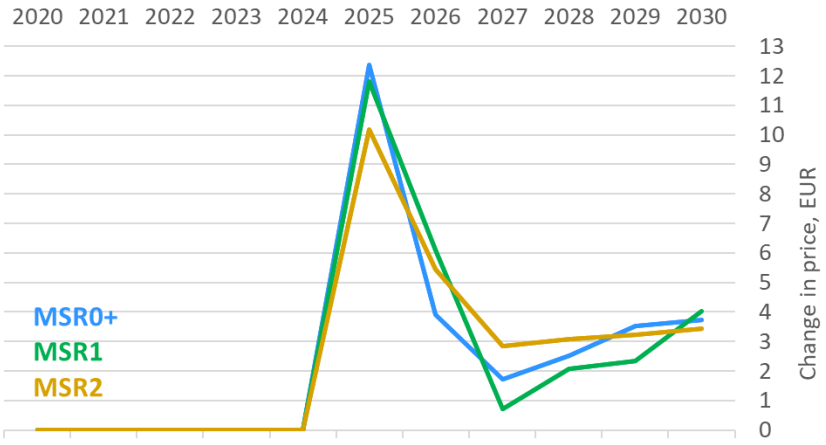
Figure 43: MSR intake under a persistent unanticipated increase in demand for EUAs



Source: Vivid Economics

Figure 44: EUA prices under a persistent unanticipated increase in EUA demand





Note: Prices are shown in constant 2015 Euros.

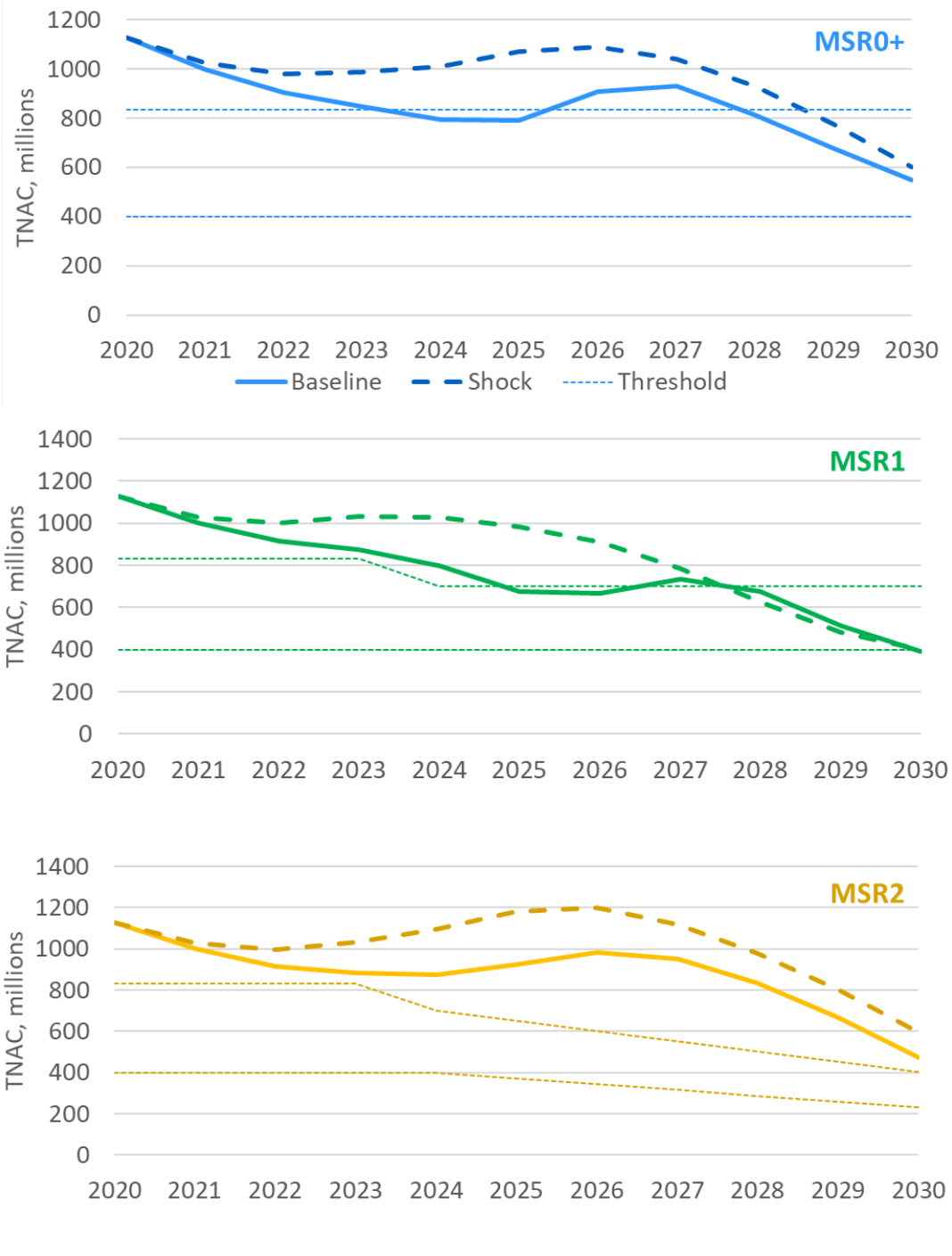
Source: Vivid Economics

22.4 Induced holdings to stimulate tightening

In some cases, actors may seek to leverage the MSR's design to deliberately drive prices up. An artificially high TNAC means the MSR is triggered more often, causing intakes and rising prices. For instance, long term investors may hold a large share of allowances to increase prices and return on investment, and environmental NGOs may hold allowances to drive increased climate action through higher prices. The shock modelled assumes that allowances being held by non-compliance entities from 2025, are driving up TNAC by 240 million, as well as increasing prices in the ETS.

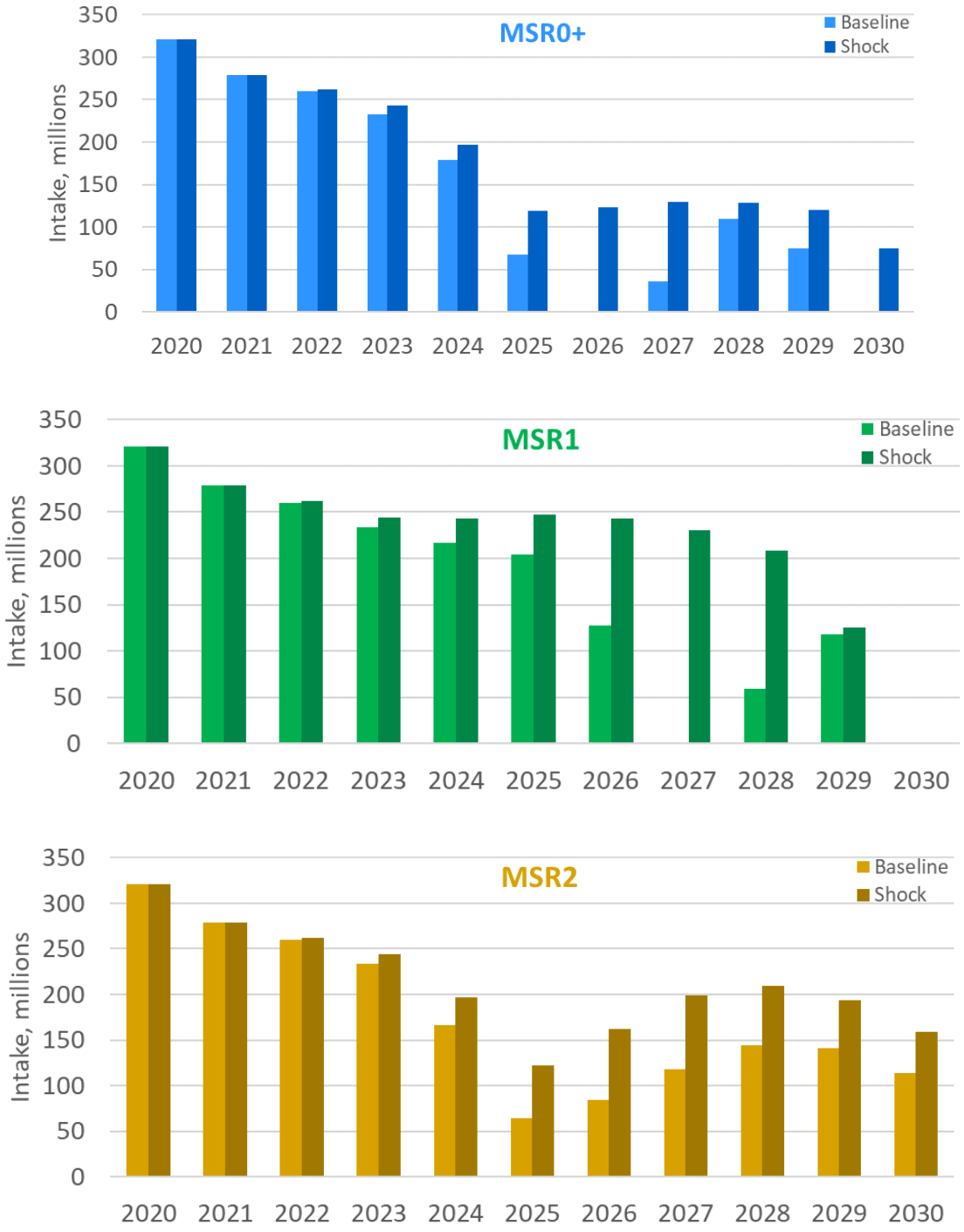
MSR1 results in the largest intakes due to induced holdings. An induced holdings shock increases EUA demand, ultimately leading to an increase in TNAC and intakes across all designs. Due to the way the intakes are structured, MSR2 intakes allowances more slowly and avoids sharp threshold effects. Note that if these induced holdings remain inaccessible to market participants, the higher intake rates will also have negative impacts on liquidity for compliance entities.

Figure 45: TNAC under an induced holdings shock



Source: Vivid Economics

Figure 46: MSR intakes under an induced holdings shock



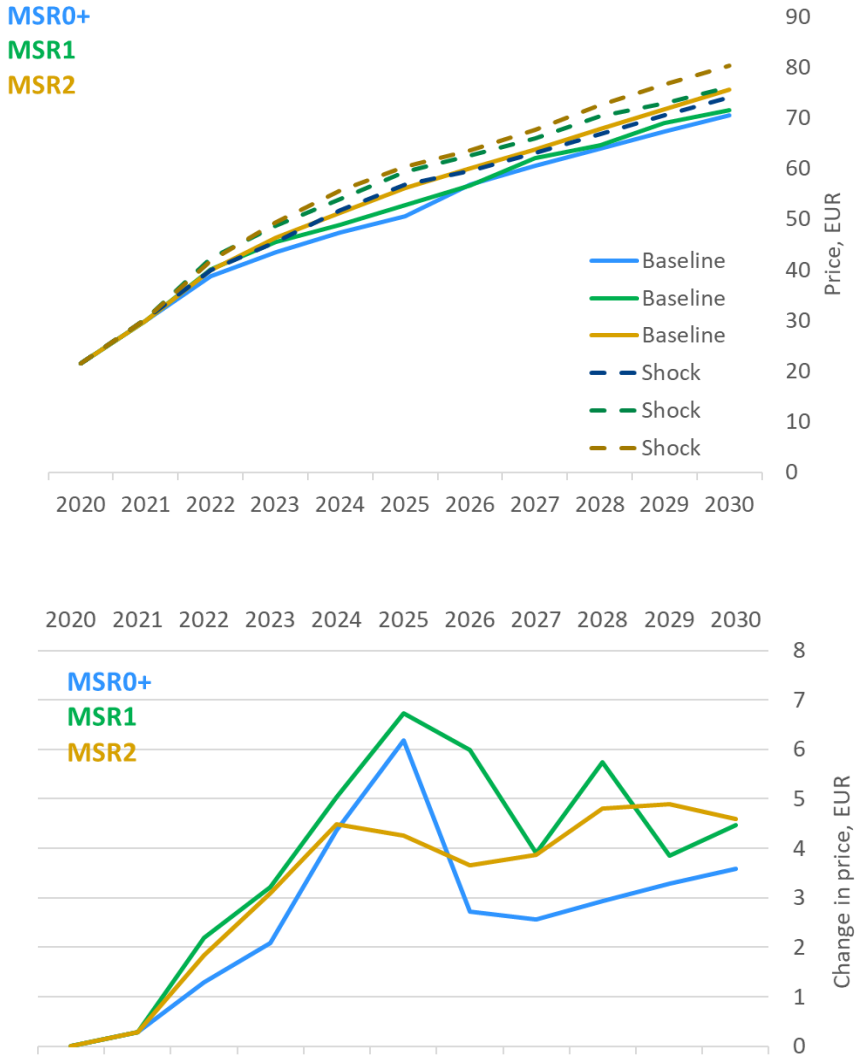
Source: Vivid Economics

An induced holdings shock increases prices in all MSR designs, but is exacerbated by higher intake rates and lower thresholds. As expected, the holding shock instigates prices increases as supply of allowances falls short of demand. Prices are driven up by further reductions in auctioned allowances, as the higher TNAC leads to increased intakes to the MSR. In the interim period, prices are stabilised, as firms benefit from the early abatement activity undertaken when allowance supply was tighter. However, prices increase again relative to the case without induced holdings as TNAC approaches zero,

as firms have been unable to bank as many allowances as desired, and the MSR continues to reduce supply relative to the case without the shock. Prices are increased most under MSR1 followed by MSR2, where higher intake rates cause the induced shock to reduce cumulative allowance supply most.

MSR1 results in sharper price increases than MSR2 due to threshold effects. The graph below shows the change in price between the 'shock' scenario and the respective baseline case for each MSR design. MSR1 results in the highest increase in prices, but also the most volatile ones because of the large intakes when the threshold is crossed. In practice, this volatility may be more pronounced than modelling shows. This is because the model is only able to represent an annual time period (which abstracts away from within-year volatility), and assumes firms have a 10 year anticipation horizon (which may not hold in practice, resulting in more myopic and erratic behaviour of short term prices).

Figure 47: EUA prices under induced holdings



Note: Prices are shown in constant 2015 Euros.

Source: Vivid Economics

Insights from interviews and discussions with market participants suggest that the likelihood of speculation triggering a price spiral is low. The primary reason that the likelihood is small is because of the relatively small size of the speculative market. Short-term speculators do not tend to hold large positions and would be more likely to sell in the event of a larger-than-expected price increase. Long-term investors represent a small part of the market (less than 100 million allowances) so would not be a significant driver of a price spiral. Speculative activity may also serve to reduce prices as investors may be incentivised to sell off a portion of holdings if the EUA price exceeds internal price targets. However, this market is changing rapidly and high-profile investment in EUAs may cause the size of the market to expand suddenly and dramatically.

23 POLICY VARIATION SENSITIVITIES

23.1 MSR results for the extreme cap scenarios

In this impact assessment, we consider three cap scenarios, a central one (AMB2a), and two extremes (AMB1 and AMB2b), which represents differing levels of stringency over the 2021-2030 period. All cap variations lead to an equal level of allowance supply in 2030, with variations in the annual allowance supply from 2024-2030.

23.1.1 Market balance

Detailed modelling results for each MSR option under the different cap variations are presented below. The figures present the modelled level of the TNAC, the intakes into the MSR and the effective cap level – the cap as it would be affected by MSR intakes or releases. The qualitative insights regarding the MSR designs discussed in Section **Error! Reference source not found.** remain unchanged in these cap variations, although there are some important differences in the numerical results driven by the adjusted cap trajectories. The key observations are summarised below:

- **A tighter Phase IV cap (e.g. AMB2b) results in a lower TNAC between 2024 and 2030.** This is a direct result of a reduced supply of allowances available to market participants. The resulting differences in the level of TNAC across the cap variations is more pronounced between 2025 to 2027, after which the impact of MSR intakes become observable from the narrowing differences across the cap variations. By 2030, the difference in TNAC between AMB1 and AMB2a typically lies within 100 million. The same is true when comparing 2030 TNAC between AMB2a and AMB2b under the different MSR options.

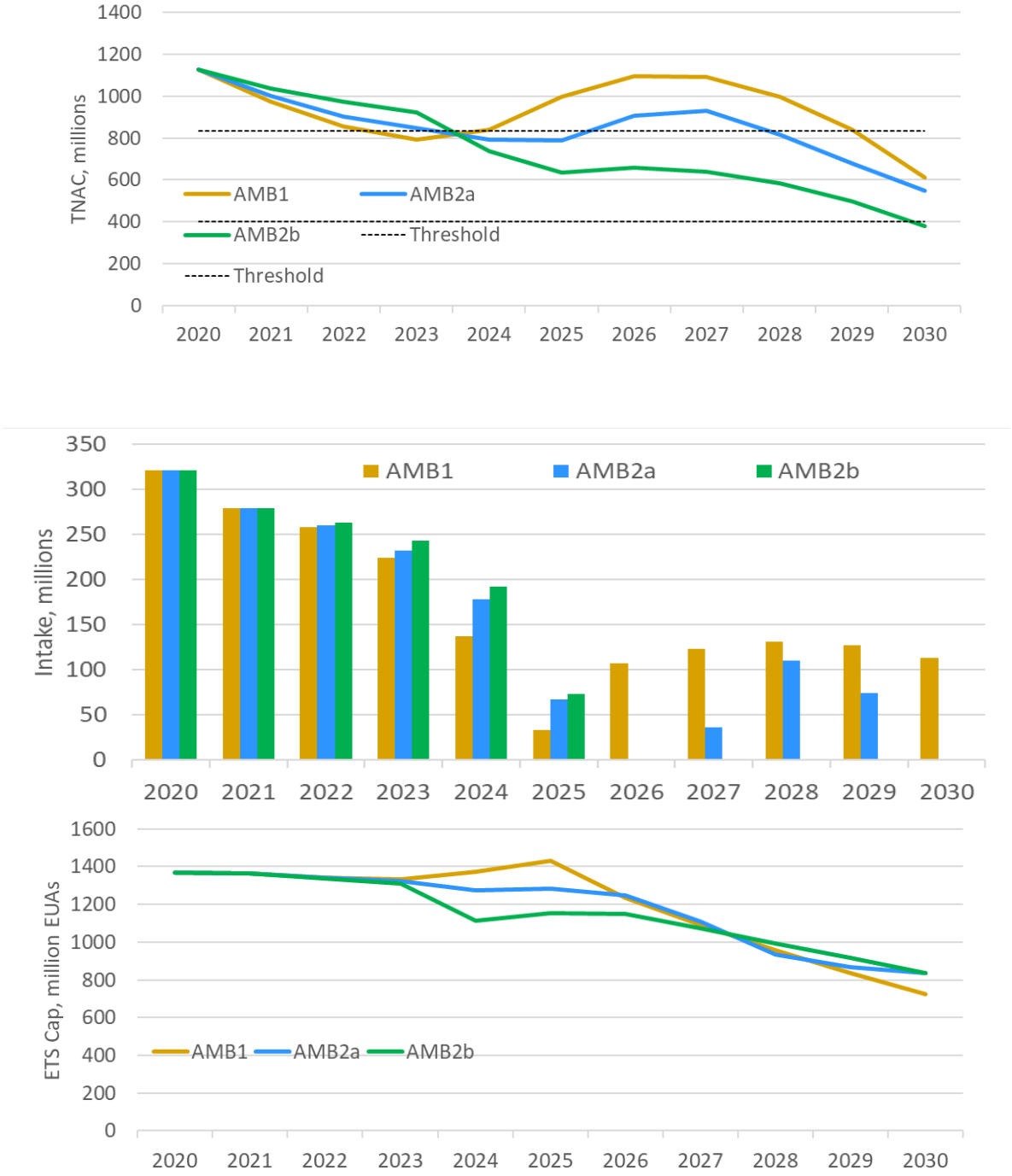
- **A tighter Phase IV cap has two immediate implications for the MSR: (a) fewer MSR intakes, and (b) shorter intake period and potentially earlier releases.** For instance, under MSR1, the MSR intakes become zero by 2027 under AMB2b with MSR1, three years earlier compared to AMB1. In this particular example of AMB2b with MSR1, TNAC in 2027 goes just below the lower threshold of 400 million,

resulting in releases from the MSR by 2029. The extent to which (b) occurs, and by how much, is sensitive to model parameters. This creates some uncertainty for market participants facing MSR0+ and MSR1, because intakes are discontinuous at the upper threshold, swinging from over 100 million in a particular year to zero in the next year. Depending on whether market expectations are met, this 'threshold effect' can produce kinks in the price path. Meanwhile, this is not the case for MSR2, as intakes continue throughout the period.

- **Across all MSR options, the main analytical statistics under AMB2a are nested between AMB1 and AMB2b.** For this reason, the impact discussion in the main text, which is based on AMB2a, can be interpreted as the midpoint of policy ambitions in the EU ETS cap.

With MSR0+, the lower intake rate is unable to limit the increase of the surplus as of 2025, across cap scenarios.

Figure 48: TNAC, intake and cap post-MSR adjustments under cap scenarios under the baseline design MSR0+

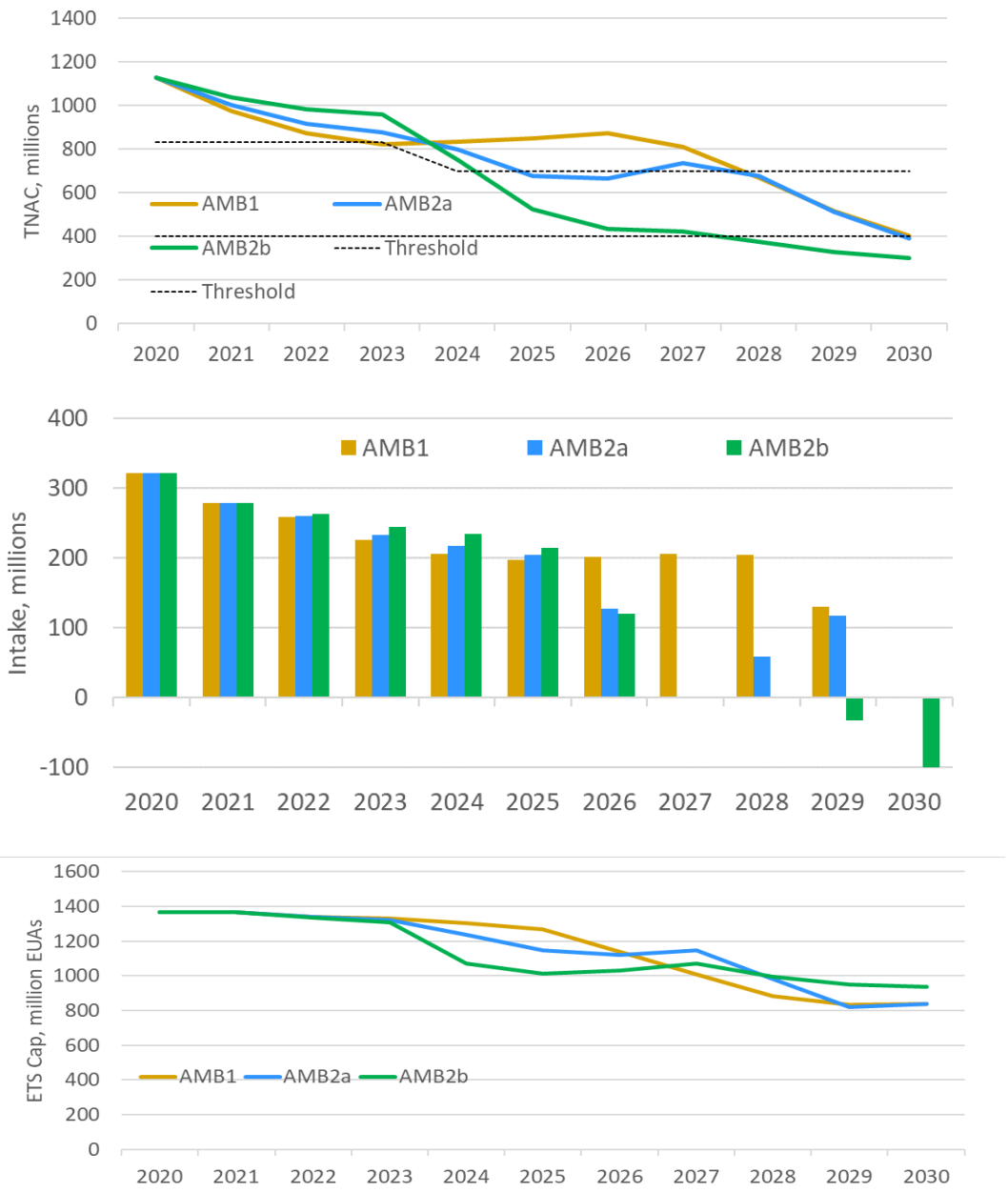


Source: Vivid Economics

The higher intake rate under MSR1 leads to a larger volume of intakes into the MSR, more quickly offsetting the relative slack in AMB1 and AMB2a. Cumulative intakes are 1 billion higher under AMB1 than under AMB2b. The relatively high supply of allowances in the short term under AMB1 leads to more banking, a higher TNAC and therefore larger intakes to the MSR. Under AMB1, there are intakes to the MSR until 2030, whereas the final year of intakes under AMB2b is 2027. This leads AMB1, the least stringent cap, to have a lower effective supply than AMB2b during the period 2026-

2030 (see the bottom graph in Figure 49). The post-MSR cumulative supply of allowances under AMB1 is 10.6 billion, compared with 10.7 billion under AMB2b.

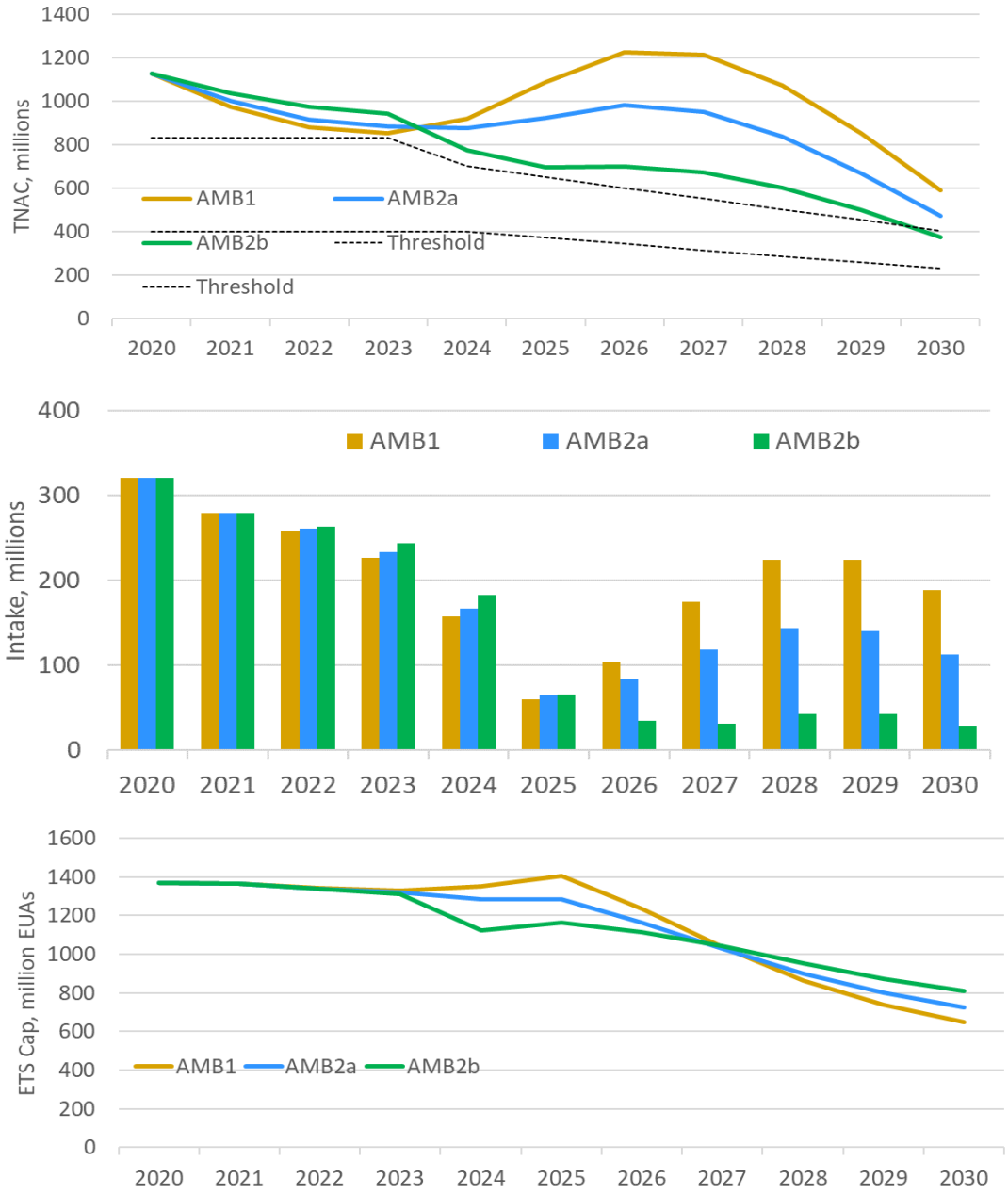
Figure 49 TNAC, intake and cap post-MSR adjustments under cap scenarios under MSR1



Source: Vivid Economics

A similar outcome is seen under MSR2, where the higher availability of allowances under AMB1 results in larger intakes into the MSR, lowering the effective cap. Unlike MSR0+ and MSR1, there is no threshold effect to account for in MSR2, as the TNAC remains above the (declining) upper threshold to 2030 in all cap variations. However, the higher intake rate of 33% leads to consistently higher intakes under the looser cap scenarios, which brings cumulative supply down substantially in these scenarios.

Figure 50: TNAC, intake and cap post-MSR adjustments under cap scenarios under MSR2

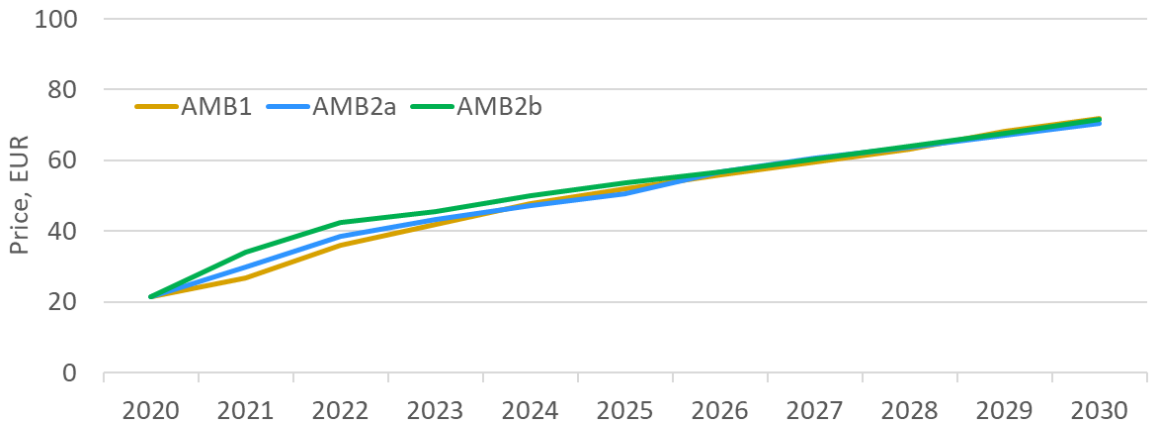


Source: Vivid Economics

23.1.2 Stylised carbon prices

Differences in prices across different cap scenarios are smaller because supply under a less stringent cap would be tightened by larger intakes to the MSR (see Figure 51 below). Caps which are initially less stringent, such as AMB1, have a higher surplus of allowances in earlier periods due to greater annual supply. This increases the TNAC during 2021-2030, which subsequently increases intakes into the MSR, reducing auctioned allowances and the effective cap. This leads to similar price outcomes across the different caps.

Figure 51: Carbon price with MSR0+, for the cap scenarios AMB1, AMB2a, AMB2b



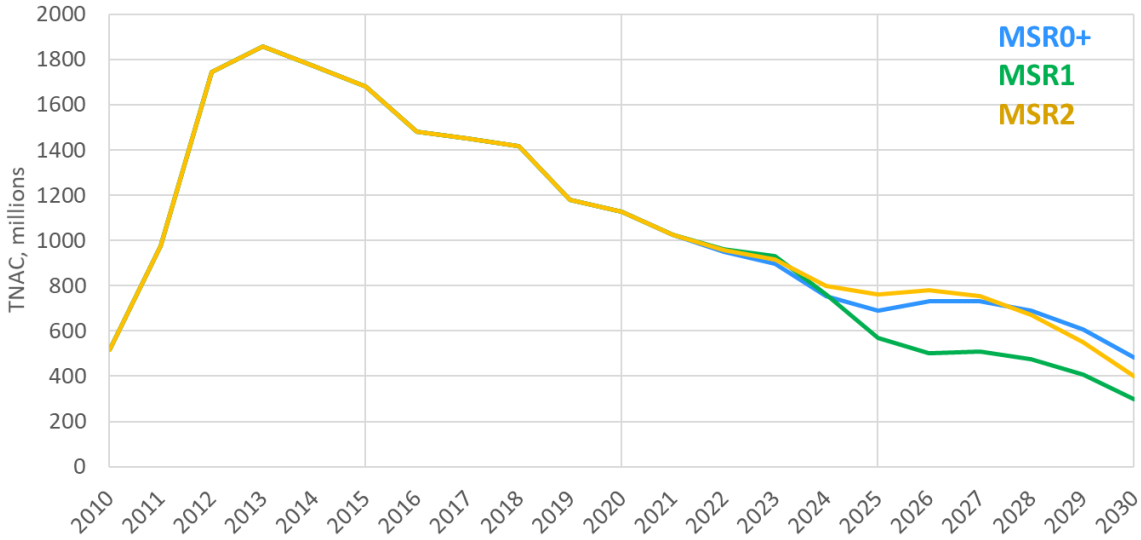
Source: Vivid Economics

23.2 MSR results for AMB2c

In what follows, the modelling results for cap scenario AMB2c are also presented. The key observations are summarised below:

- **The higher intake rate of MSR1 reduces the TNAC the highest with this cap option, possibly leading to releases in 2030.** The outcomes with MSR0+ and MSR2 have similar trajectories, although the TNAC with MSR2 is nearly 100 million lower at the end of the period, possibly leading to releases from the MSR.

Figure 52: TNAC for MSR0+, MSR1 and MSR2, for cap scenario AMB2c

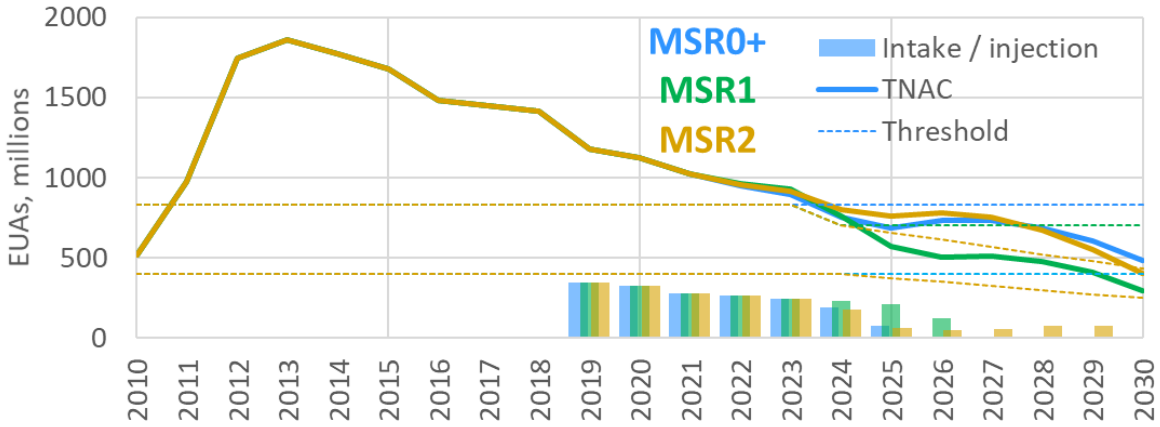


Source: Vivid Economics

- **Intakes**

The behaviour in terms of intakes is consistent with the other cap scenarios. Intakes with MSR0+ and MSR1 last until the middle of the period, while with MSR2, due to the decreasing cap, they continue up to 2029.

Figure 53: TNAC and intakes for MSR0+, MSR1 and MSR2, with cap scenario AMB2c

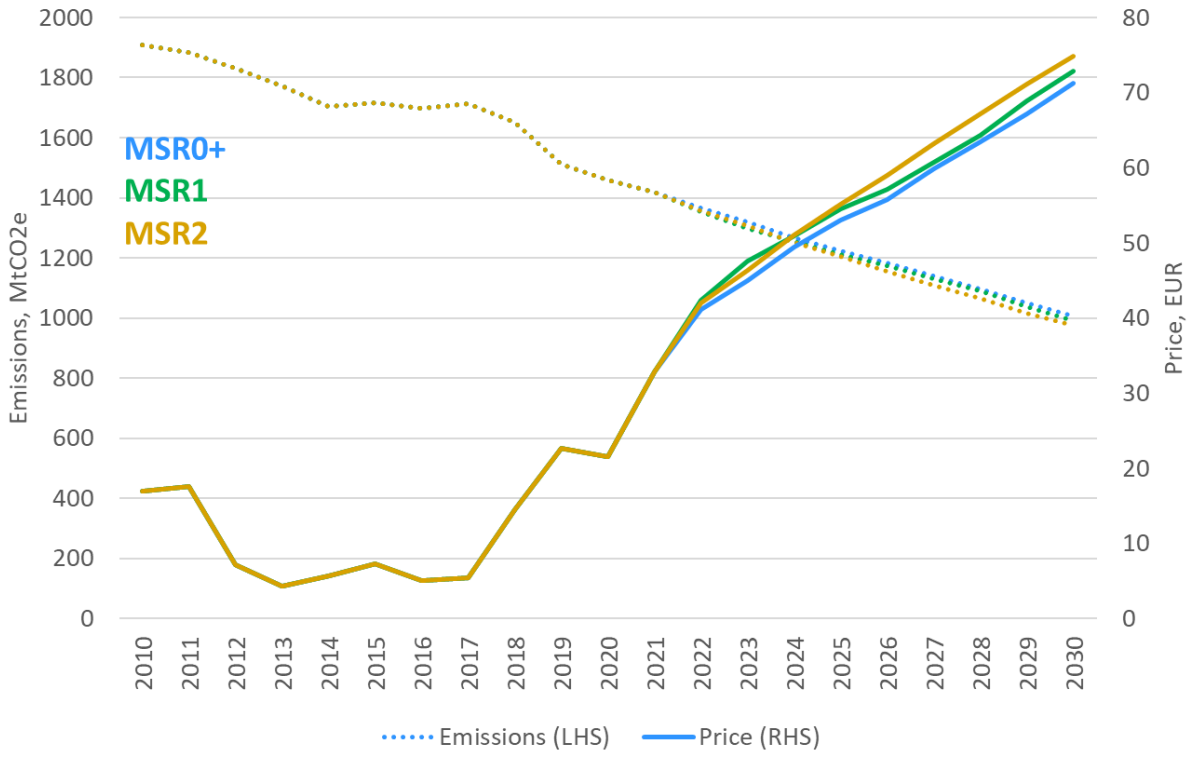


Source: Vivid Economics

- **Prices and price volatility**

The price results are comparable to the other price scenarios, in particular with AMB2a and AMB2b.

Figure 54: Stylised presentation of carbon price and emissions for MSR0+, MSR1 and MSR2, for the cap scenario AMB2c



Note: Prices are presented in constant 2015 prices.

Source: Vivid Economics

23.3 MSR results for a hybrid MSR option

This section analyses the outcomes of an MSR option that combines elements from the various MSR options presented in Section **Error! Reference source not found.** above.

Table 24: Parameters of a hybrid MSR option

	Hybrid MSR option
Intake[25]	If the TNAC is above 1096 million

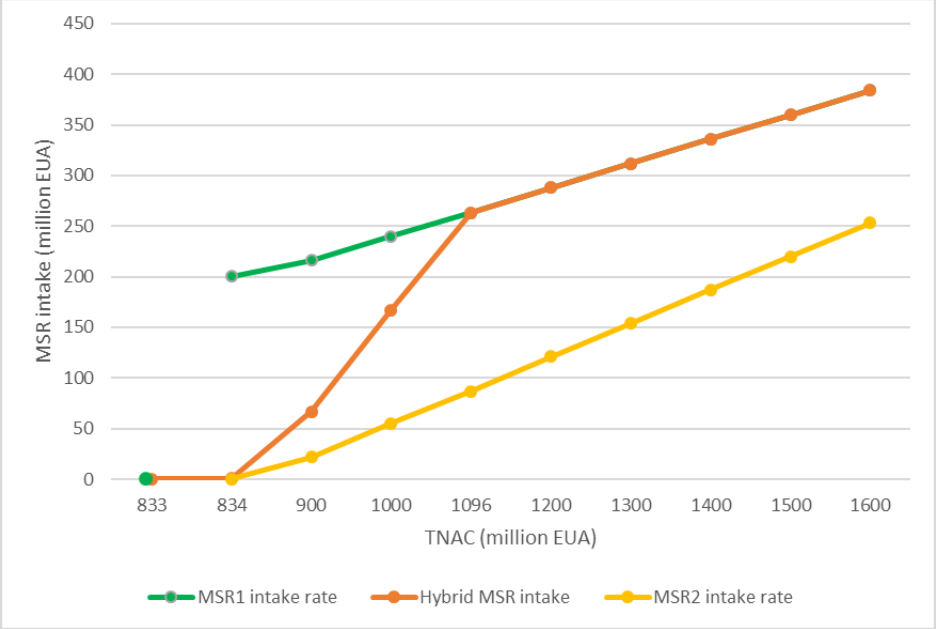
[25] For a TNAC of 833 million, the intake is 0. For a TNAC of 834 million, the intake is 834-833 million = 1 million allowances. For a TNAC of 900 million, the intake is 900-833 = 67 million allowances. For a TNAC of 1096 million, the intake is 1096-833 = 263 million allowances. For a TNAC of 1100 million allowances, the intake is 24%*1100 = 264 million allowances.

	Hybrid MSR option
	allowances, 24% of the TNAC If the TNAC is below 1096 million allowances but above the upper threshold, the difference between the TNAC and the upper threshold
Injections	100m
Upper threshold	833m
Lower threshold	400m
Invalidation mechanism	Invalidate excess above lower threshold
Auction reserve price	-
MSR review	Every three years

This option keeps the current MSR threshold of 833 million, in order to guarantee a sufficient level of liquidity in light of uncertainties about future liquidity needs, including hedging volumes, and introduces more frequent reviews of the MSR. This option introduces a gradual approach to the intake, depending on the level of the TNAC If the TNAC is between the upper threshold and 1096 million allowances, the difference between the TNAC and the upper threshold is put in the MSR. If the TNAC is above 1096 million allowances, then 24% of the TNAC is put in the MSR. At 1096 million allowances, the two options would result in approximately the same intake. Using a gradual approach for the intake rate allows at the same time to avoid the threshold effect (since the intake near 833 million allowances is very low), while keeping the efficient intake of the 24% rate for higher levels of the TNAC.

Figure 55 below shows the intakes that would result at various TNAC levels, for the hybrid MSR option, compared to MSR1 (24% of the TNAC) and MSR2 (33% of the difference between the TNAC and the upper threshold).

Figure 55: Intake profile for the MSR hybrid option, MSR1 and MSR2 at various TNAC levels



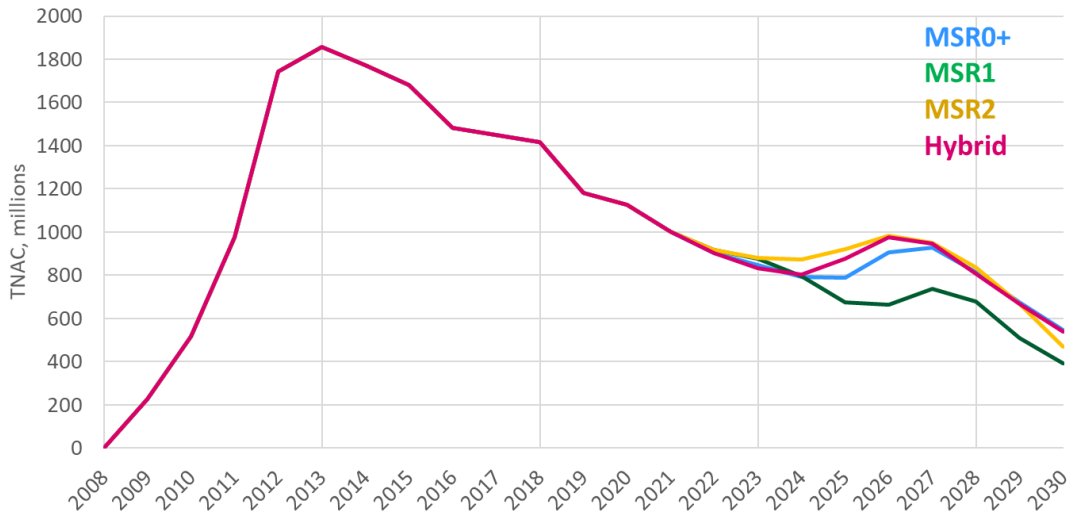
Source: European Commission

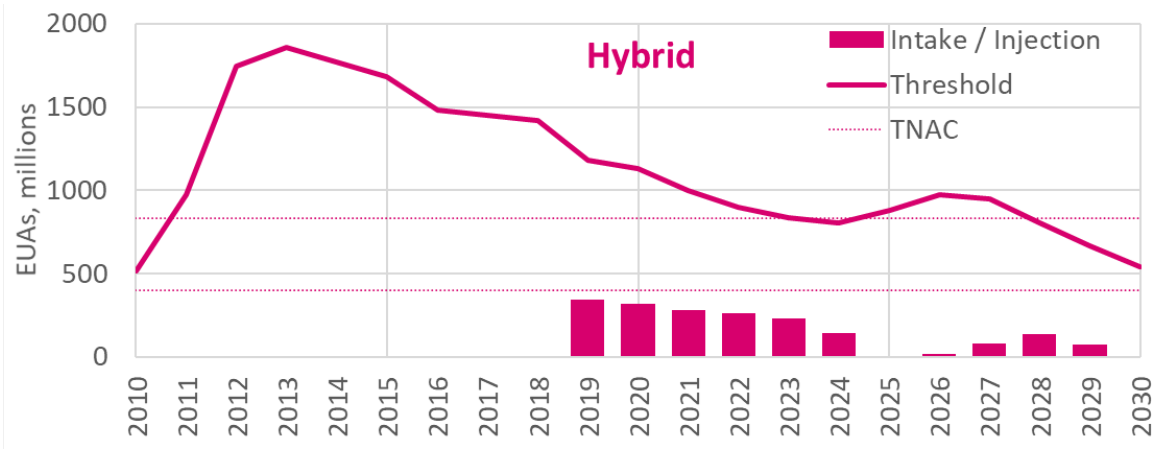
The main results for this option are summarized below:

For the central cap scenario AMB2a, **the hybrid MSR option results in a TNAC similar to MSR0+ and MSR2**. The TNAC briefly jumps back above the upper threshold of 833 million allowances in 2026 and 2027, before returning between the two thresholds. The modelling shows that this MSR option avoids the threshold effect in 2024, when the TNAC is very close to the upper threshold of 833.

In terms of intakes, this option results in intakes similar to MSR0+, 20 % lower than MSR1, and 24% lower than MSR2.

Figure 56: TNAC and intakes for MSR0+, MSR1, MSR2 and the hybrid MSR option, for central cap scenario AMB2a



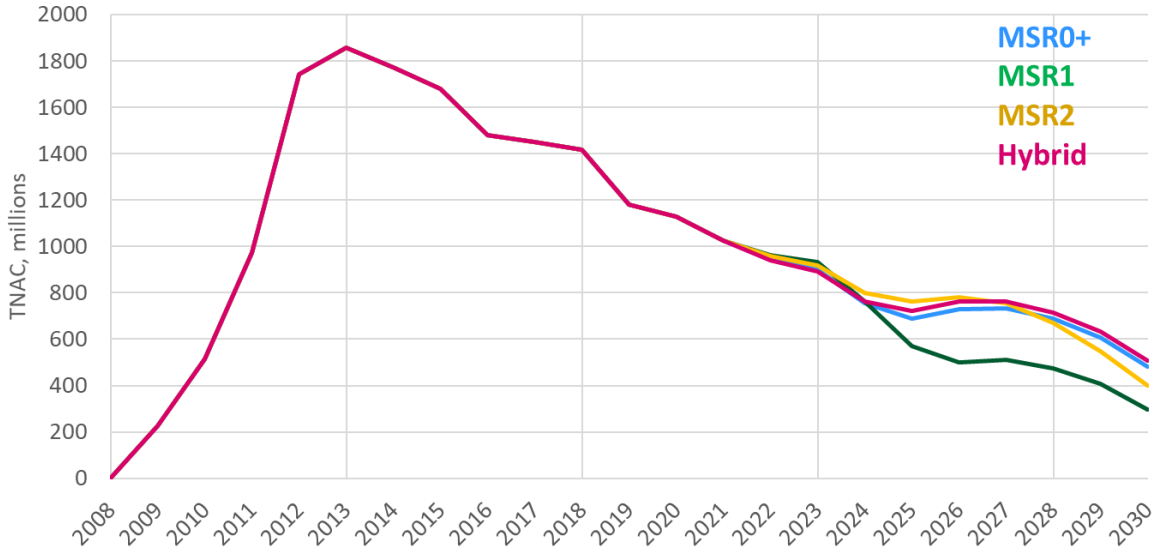


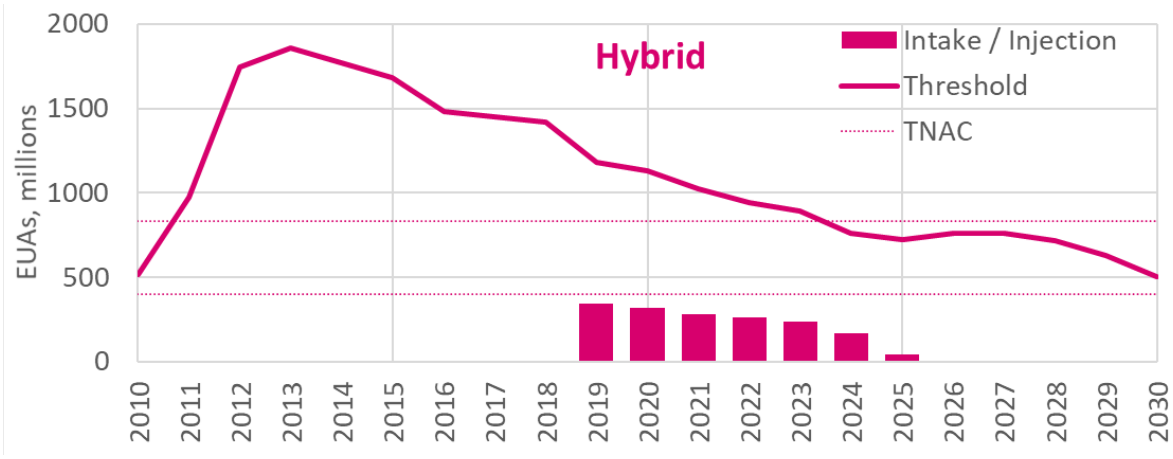
Source: Vivid Economics

For tighter cap scenario AMB2c, the hybrid MSR option reduces the TNAC in a similar manner to MSR0+, all the while avoiding the threshold effect. The TNAC stays between the two thresholds constantly after 2023.

In terms of intakes, this option results in intakes 26% lower than MSR1, and 25% lower than MSR2.

Figure 57: TNAC and intakes for MSR1, MSR2 and the hybrid MSR option, for cap scenario AMB2c

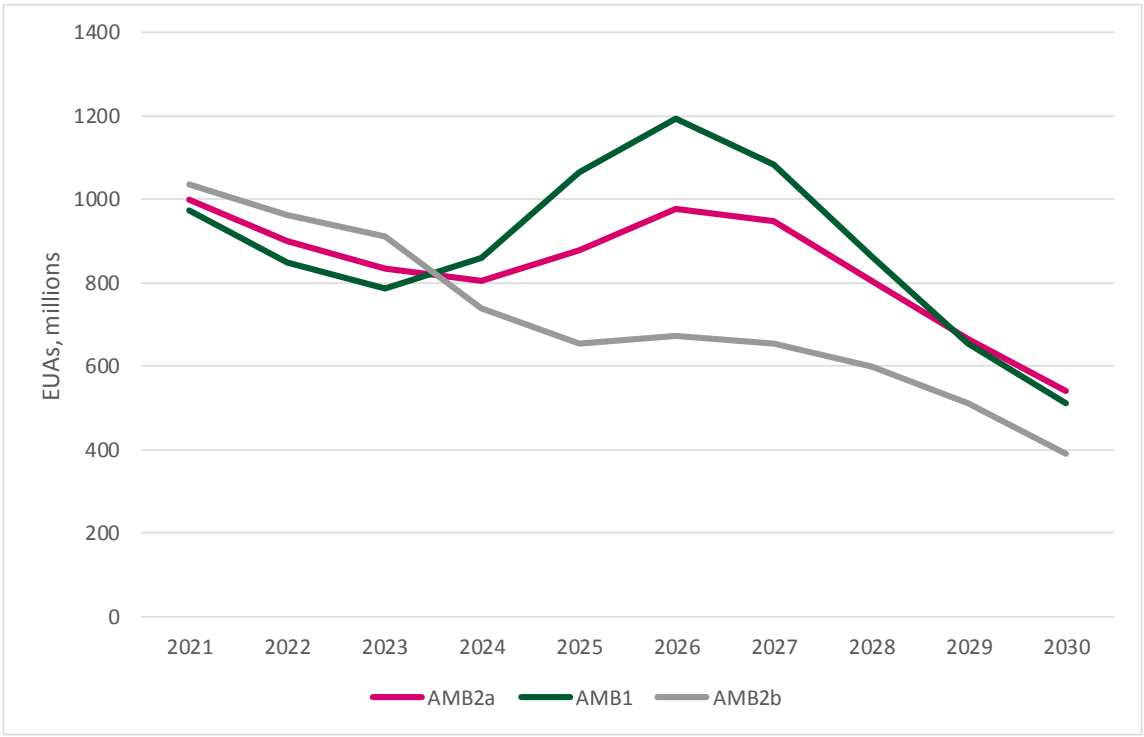




Source: Vivid Economics

A comparison of this hybrid MSR option across for the extreme cap scenarios AMB1 and AMB2b shows that the outcomes of this MSR option depend on the cap scenario chosen. For the less stringent AMB1 cap, the TNAC would be above the upper threshold from 2024 until 2028. With the tightest cap option AMB2b, the TNAC would stay between the thresholds as of 2023.

Figure 58: Evolution of the TNAC with the hybrid MSR option, for the cap scenarios AMB1, AMB2a, AMB2b

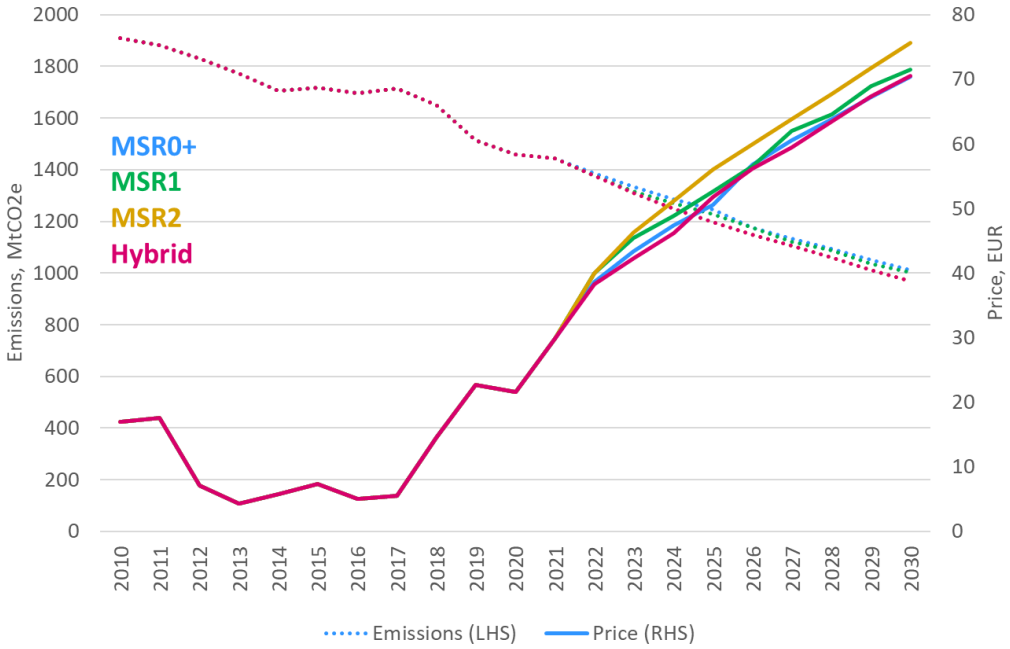


Source: Vivid Economics

In terms of impact on carbon prices and emissions, this option results in similar outcomes to MSR0+. **Since this option also eliminates the threshold effect, this option does not induce price volatility when the TNAC is close to the upper threshold.** Even if the intake rates are different above and below the level of 1 096 million allowances, the

difference in MSR intake around this level is too insignificant[26] to create market volatility.

Figure 59: Evolution of the stylised carbon price and emission level for the MSR options, for cap scenario AMB2a



Note: Prices are presented in constant 2015 prices.

Source: Vivid Economics

Due to the lower intake levels, this option results in the highest auction volumes and therefore highest auction revenues, despite the lower price. The auction volumes are similar with, or slightly higher than MSR0+.

23.4 Introduction of a Carbon Border Adjustment Mechanism

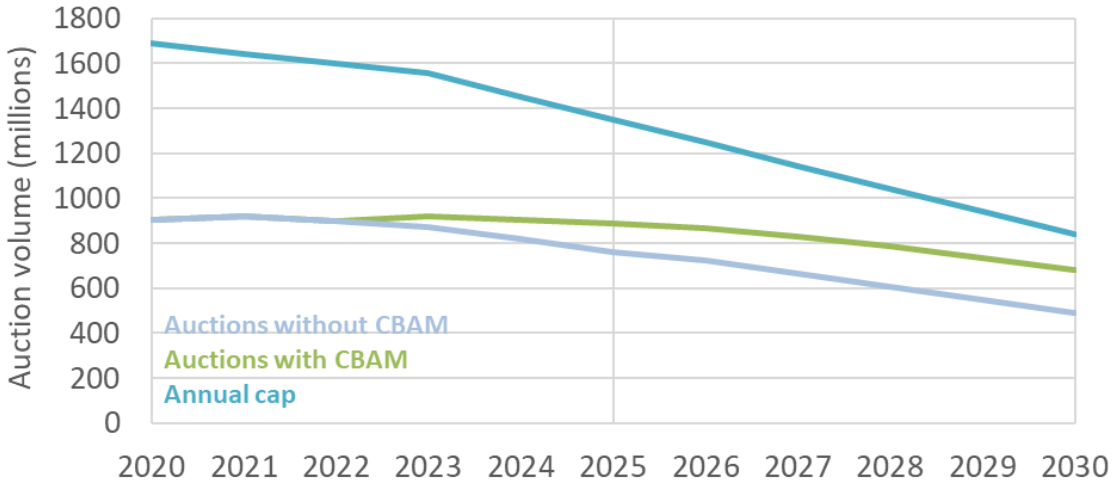
The introduction of a CBAM is being considered as an alternative to free allocations to prevent carbon leakage. A CBAM prevents carbon leakage and safeguards competitiveness by imposing a tariff-like adjustment to emissions-intensive imports and/or exports to account for differences in carbon prices between the EU and its trading partners. Free allocations could be phased out for some sectors if a CBAM is introduced,

[26] If the TNAC is 1 096 million allowances, the intake would be 1096 – 833 = 263 million allowances. With a TNAC of 1097 million allowances, the intake would be 1097 * 24% = 263.28 million allowances, or 280 thousand allowances more. The difference in intake between the two levels is only 0.1%, too low to be significant.

forcing them to participate in the market. This is likely to increase the number of allowances required for banking and hedging, resulting in a higher TNAC.

The analysis in this section investigates the impact of different MSR designs with a hypothetical CBAM. Since the precise design and scope of a CBAM is not yet available, the analysis makes the simplifying assumption that firms in the steel and cement sectors will be subject to a CBAM in 2023, and see their free allocations phased out gradually between 2023 and 2030. In this scenario, free allocations within the EU ETS each year drop from 43% of the cap towards 21% of the cap in 2030, remaining constant post-2030. The share of auctions under the cap increases correspondingly, as shown in Figure 60 below.

Figure 60: Auction volumes with and without a CBAM (prior to MSR adjustment), under cap AMB2a

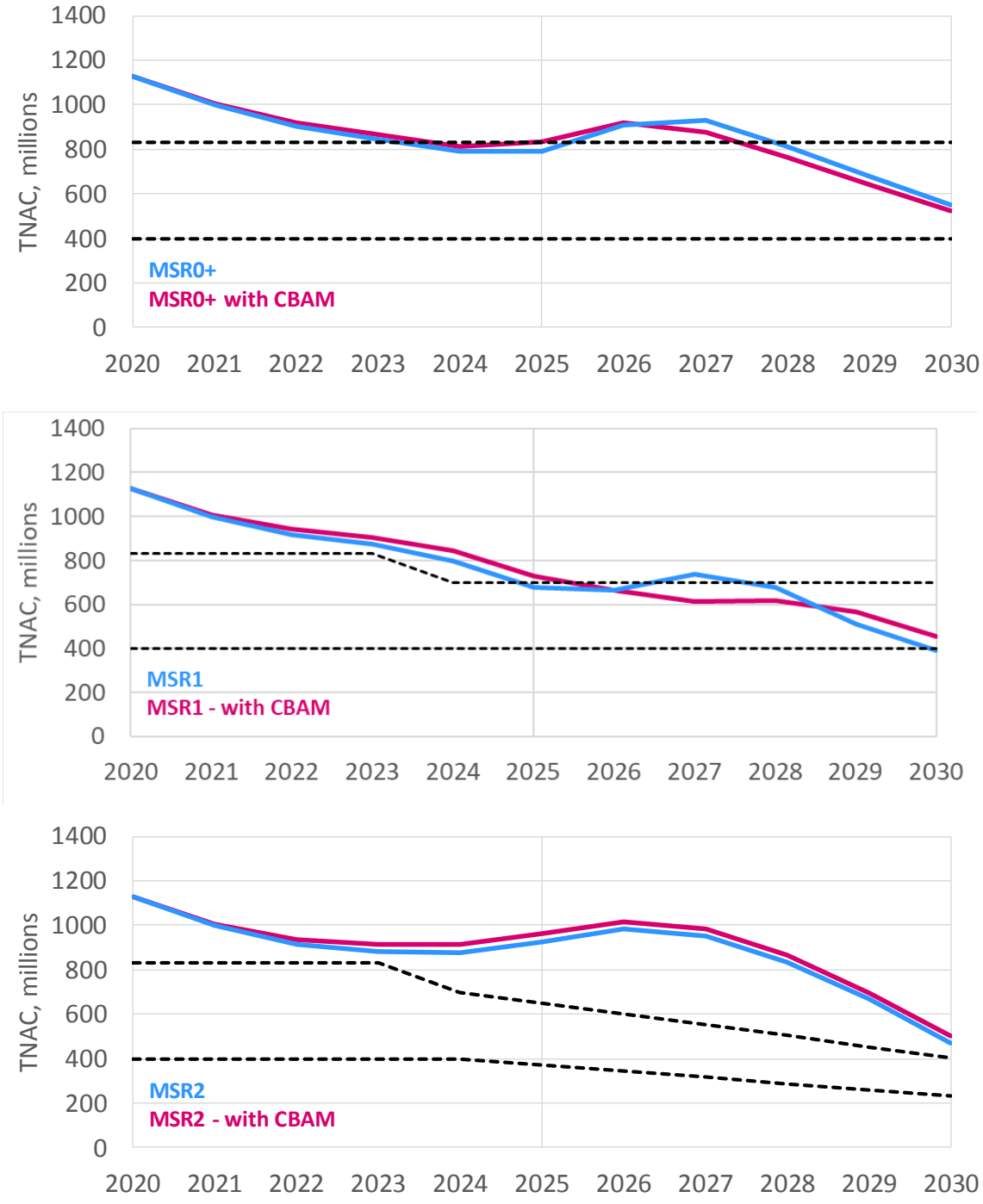


Note: Auction volumes shown include the 3% flexibility buffer.

Source: Vivid Economics

The inclusion of a CBAM increases TNAC (and MSR intakes), but do not change the conclusions made in previous sections comparing the different MSR options. Across all the MSR options, the introduction of the hypothetical CBAM specified above results in a level increase in TNAC by 50 to 100 million for most of the 2020s. In some cases, such as MSR1, the inclusion of a CBAM shifts the point in which TNAC goes below the upper threshold back by a year. This has the direct consequence of prolonging intakes for an extra year. However, whether this 1-year shift occurs is sensitive to the particular cap and model parameters, regardless of the MSR design.

Figure 61: TNAC with and without a CBAM under the three MSR options (with cap setting of AMB2a)



Source: Vivid Economics

The introduction of a CBAM reduces the rate at which allowances are invalidated within the MSR. Under MSR0+ and MSR1, allowances within the MSR that exceed the auction volume in the previous year is invalidated. As there are more auctioned allowances under the CBAM scenario, the MSR stock declines slower. By contrast, there is no such distinction under MSR2, under which allowances that exceed the lower

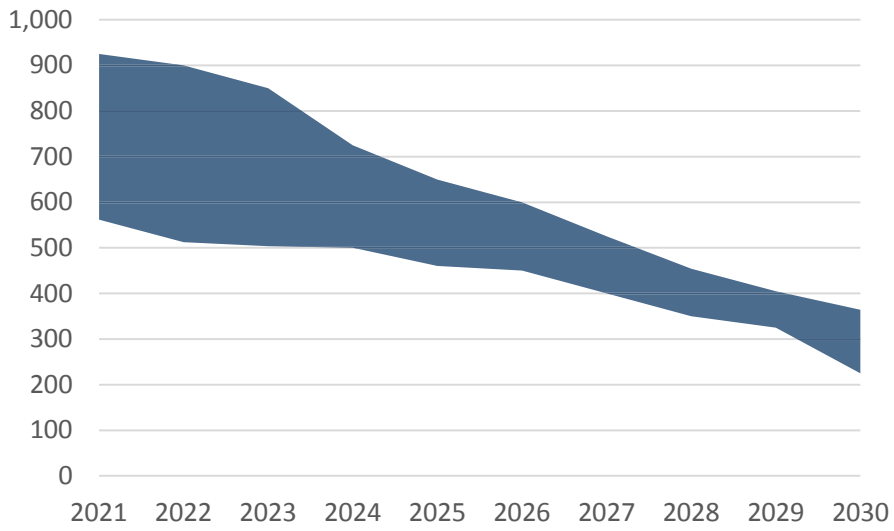
threshold are invalidated. It should be noted that the MSR stock is influenced by both the invalidation threshold (e.g. prior year auction for MSR0+ and MSR1, upper threshold for MSR2) and the size of MSR intakes. This directly affects the number of allowances in the MSR available for release beyond 2030 but lies outside of the scope of this impact assessment.

Moreover, as explained above, the level of the cap in 2030 influences the most the evolution of the carbon price. As such, the introduction of the CBAM would not have a significant influence on the carbon price in the results of the model.

24 ESTIMATES OF FUTURE HEDGING NEEDS AND POTENTIAL IMPLICATIONS FOR THE MSR THRESHOLDS

The Vivid study also performed an analysis of hedging needs and expectations on their evolution. The study pointed to significant uncertainties in this estimate, in terms of the total number of banked allowances, as well as which sectors or companies are likely to engage in hedging activities in the future. **The study found that utility hedging is expected to decrease significantly by 2030 as emissions decrease, which will be partially offset by increases in industrial hedging.**

Figure 62: Range of estimates for hedging demand from utilities to 2030



Source: Vivid Economics, drawing from ICIS and BNEF estimates

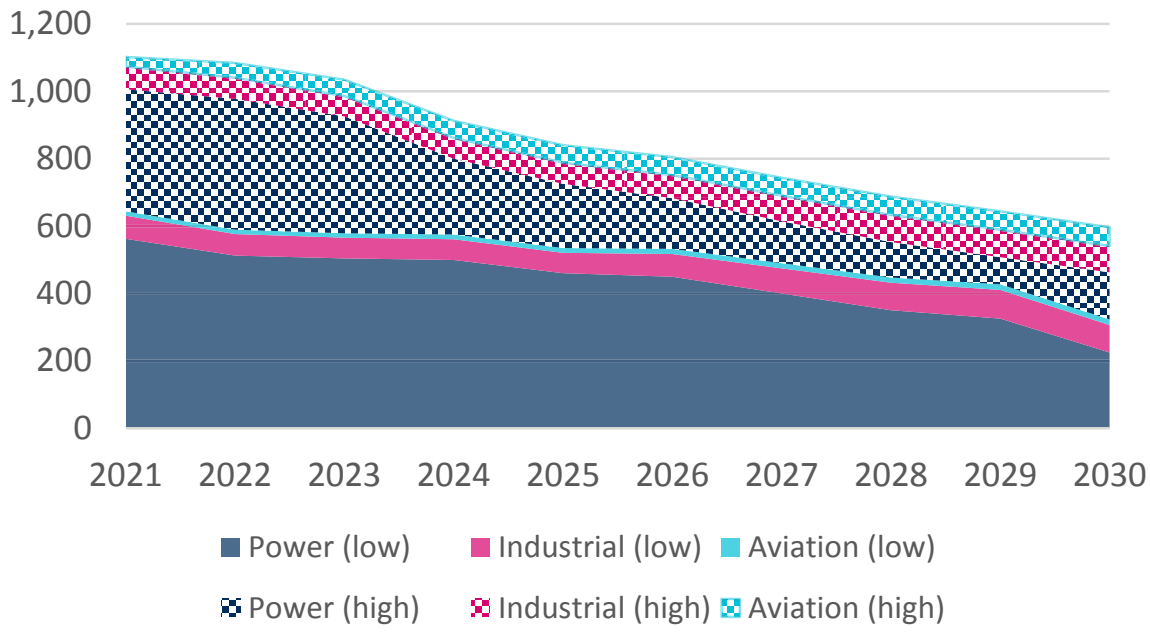
The study estimated increased demand due to industrial hedging ranges from 75 to 300 million allowances in 2030.

- Industrial hedging is generally expected to increase, although the potential size of the market and growth trajectory is extremely uncertain. Projections for industrial hedging demand are not readily available. This necessitated a scenario-based approach to estimate the potential size of this demand. Estimates range from 50 to 150 million allowances in 2021, increasing to 75 to 175 million allowances by 2030.

- **Hedging demand from airlines currently covered by the ETS is expected to increase up to 2030, but its pathway is highly dependent on the airline industry's recovery from COVID-19.** Airline hedging is estimated to be less than 25 million allowances in 2021, partially driven by projected decreases in emissions due to COVID. 2030 estimates range from 20 to 75 million allowances.
- The study estimates excluding the impact of a possible Carbon Border Adjustment Mechanism (CBAM), leading to additional demand in 2025 of approximately 50 million allowances, increasing to over 100 million in 2030

The estimates for total hedging demand to 2030 are between 300 and 600 million allowances, assuming no changes in other aspects of ETS design (especially free allocations).

Figure 63: Makeup of total hedging demand for EU allowances to 2030



In view of these uncertainties, the Vivid study found that upper and lower threshold recommendations of 700 and 400 million allowances respectively fall within a reasonable range of hedging expectations. In general, hedging demand is expected to decrease overall as emissions decrease, implying that a mechanism to reduce thresholds over time, like in MSR2, may be appropriate.